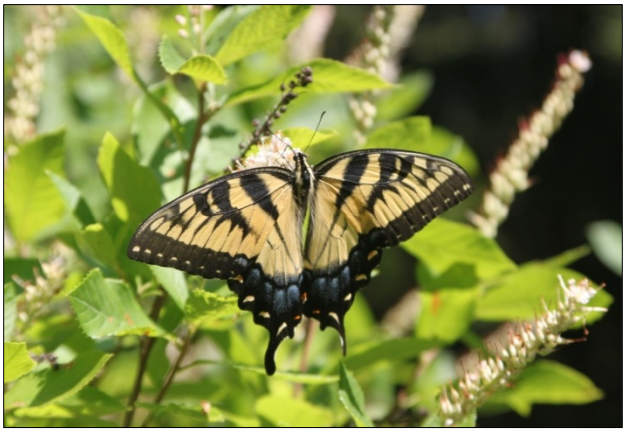
United States Department of Agriculture

DELAWARE CONSERVATION PLANTING GUIDE



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Natural Resources Conservation Service (NRCS) – Delaware

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Table of Contents

List of Tables

Introduction

The information contained in the Delaware Conservation Planting Guide is an official part of the Field Office Technical Guide (FOTG), and is incorporated by reference into many conservation practice standards contained in Section IV of the FOTG. This Planting Guide provides additional information, recommendations, and specifications for most planting, seeding, or revegetation operations performed as stand-alone cover practices, or as components of other conservation practices.

This Planting Guide is organized as follows:

Section 1 - General Requirements and Reference Tables Applicable to All Plantings - contains guidelines for planting seeds of different sizes and types in a grass/forb mixture. This section also contains a table that cross-references Delaware conservation practices with recommended planting types, the USDA Plant Hardiness Zone Map for Delaware, and a table of recommended planting dates for permanent cover.

Section 2 - Upland Herbaceous Conservation Plantings: Conservation Cover Plantings - contains recommended seed mixes for permanent herbaceous cover with low to medium plant density. Depending on the species, these conservation cover mixes may need a year or more to become fully established, and may eventually become dense with maturity, especially without periodic disturbance. These mixes are generally used for wildlife habitat and water quality purposes, and can provide protection from erosion when site conditions are not severe. Some mixes are also suitable for areas that receive light to moderate human use, such as for paths, walkways, and travel lanes. Plantings are generally not harvested, hayed, or grazed for agricultural production.

Section 3 - Upland Herbaceous Conservation Plantings: Critical Area Plantings - contains recommended seed mixes for temporary and permanent herbaceous cover with high plant density. These critical area planting mixes are designed to provide cover that establishes relatively quickly and is very durable. These mixes are typically used on sites that have, or are expected to have, high erosion rates, as well as on sites with limiting factors that make plants especially difficult to establish (e.g., on construction sites) and/or maintain (e.g., on heavily used areas). Plantings are generally not harvested, hayed, or grazed for agricultural production.

Section 4 - Tree and Shrub Plantings - contains recommended trees and shrubs (and sevaral woody vines) that can be planted for native cover, hedgerows, windbreaks/shelterbelts, forest production, wetland restoration, and other purposes.

Section 5 - Streambank and Shoreline Plantings - contains recommended woody and herbaceous plantings for streambank and shoreline stabilization and protection.

Section 6 - Wetland Plantings - contains recommended plantings for wetlands and shallow water areas.

Section 7 - Forage and Biomass Plantings - contains recommendations for establishing adapted and/or native species, varieties, or cultivars of herbaceous plants suitable for pasture, hay, or biomass production.

Section 8 - Cover Crop Plantings - contains recommendations for establishing grasses, legumes, and forbs for seasonal vegetative cover.

Using this Planting Guide

1. Start with Section 1. The general information at the beginning of this section is applicable to all plantings in the Guide.

2. Using Table 1.1, select the appropriate conservation practice and type of planting. Most practices have an option for more than one planting type, depending on site conditions and/or how the planting will be used.

3. Use Figure 1.1 to identify the Plant Hardiness Zone where the planting will be established.

4. Go to the Planting Guide section (as directed in Table 1.1) for additional information and tables of recommended species/mixes for planting. Select vegetative cover to accomplish the intended purpose of the practice and the objectives of the client. Select plant types and species based on their compatibility in growth rates, moisture requirements, and other characteristics.

5. Return to Section 1, and use Table 1.2 to determine the appropriate planting dates for the type of plant materials (e.g., warm-season grasses, cool-season grasses, trees, etc.) selected for permanent cover. Planting dates for temporary cover, when applicable, are included in separate tables elsewhere in this Guide.

SECTION 1 - GENERAL REQUIREMENTS AND REFERENCE TABLES APPLICABLE TO ALL PLANTINGS

Use Table 1.1 to find the location in this Planting Guide of recommended plantings for each listed conservation practice and type of planting.

Use Figure 1.1 and Table 1.2 to determine the appropriate planting dates for the different types of plant materials for permanent cover. Planting dates for temporary cover, when applicable, are included in separate tables elsewhere in this Guide.

Guidelines for Planting Seeds of Different Sizes and Types in a Grass/Forb Mixture

Seeds of grasses, legumes, and wildflowers have a wide variety of seed sizes. Some of the native grasses and wildflowers are also “chaffy” -- that is, they have awns (stiff or fluffy bristles) attached to the seeds that prevent them from flowing smoothly through a traditional drill or broadcast seeder. Grasses with chaffy seeds include big bluestem, little bluestem, broomsedge, Indiangrass, Canada wild rye, and Virginia wild rye. Smooth-seeded native grass species include deertongue, beaked panicgrass, coastal panicgrass, redtop panicgrass, purpletop, and switchgrass. Although the seeds of native legume and wildflower species are often smooth, some such as goldenrods and asters are chaffy. Native wildflower and legume seeds also vary greatly in size.

Mixes with seeds of different types and sizes require special equipment and/or methods for planting. Native seed drills (i.e., drills with a chaffy seed box) can be used to plant mixes with chaffy seed. For mixes with different size seeds, a drill with a small seed box is required to provide proper seed distribution. Traditional drills, drop seeders, and broadcast seeders require the use of a carrier (e.g., pelletized lime, fertilizer with no nitrogen or a low nitrogen content, sand, sawdust, a nurse crop such as oats, etc.) when planting variable seed mixes. A drop seeder is usually a better choice than a broadcast seeder because seed variability can affect the distribution of the seed and result in a non-uniform stand. Broadcast and drop seeders also require additional seedbed cultivation to promote good seed-to-soil contact, which can be accomplished using a cultipacker (preferred), rake, harrow, or drag. When using a broadcast seeder, use a high ratio of carrier to seed and calibrate the seeder to put down only half the amount in one pass. Then apply the seed in two passes -- one horizontal and one vertical -- to enhance seed distribution.

If the seed is mixed with a carrier, select the type of the carrier with the type of seeding equipment in mind, and calibrate the equipment to deliver a specific amount of carrier and seed per acre. Many seeders and spreaders will not deliver less than a certain amount of material, so the type of equipment may dictate the carrier weight to seed weight ratio. For example, a fertilizer spreader may be designed to deliver no less than 100 pounds per acre, which is significantly higher than most seeding rates. A minimum ratio of 1:1 carrier weight to seed weight should be used, but the ratio should be high enough to make the seed flow through the seeder/spreader and mix the different kinds of seed.

For seed mixes with smooth seeds of different sizes, a minimum 5:1 ratio (carrier weight to seed weight) is recommended to bulk up the mix, especially for small seeds that tend to separate in the hopper of the seeder. For chaffy seeds, use a 15:1 to 20:1 ratio. A 40:1 ratio is recommended for seeds with very stiff awns, such as the wild ryes.

For carriers, pelletized lime is readily available and is seldom applied in high enough amounts to alter the pH. For example, a 20:1 ratio with a 5-pound per acre seed mix only adds 100 pounds of lime per acre. Oats as a carrier may be especially useful on sites with steeper slopes, where the oats will also serve as a nurse crop.

TABLE 1.1: Location of Recommended Plantings for Vegetative Cover Practices							
Conservation Practice	**Planting Guide Section for Recommended Plantings**						
	2	**3**	**4**	**5**	**6**	**7**	**8**
Conservation Cover (327)	■						
Cover Crop (340)							■
Critical Area Planting (342) Herbaceous cover Trees/shrubs		■	■				
Fence (382) Herbaceous cover - conservation cover Herbaceous cover - critical areas Forage/biomass	■	■				■	
Field Border (386) Herbaceous cover - conservation cover Herbaceous cover - critical areas Shrubs	■	■	■				
Filter Strip (393)		■					
Forage and Biomass Planting (512)						■	
Hedgerow Planting (422) Stiff-stemmed grasses Trees/shrubs	■		■				
High Tunnel System (325)		■					
Riparian Forest Buffer (391)			■				
Riparian Herbaceous Cover (390) Herbaceous cover - conservation cover Forage/biomass	■					■	
Shallow Water Development and Management (646) Herbaceous cover in the buffer - conservation cover Herbaceous cover in the buffer - critical areas Trees/shrubs in the buffer Herbaceous vegetation in the pool area	■	■	■		■		
Streambank and Shoreline Protection (580) Bioengineering, tidal marsh, and dune plantings Herbaceous cover - critical areas (other than listed above)		■		■			
Tree/Shrub Establishment (612)			■				
Wetland Restoration (657) Herbaceous cover in the buffer - conservation cover Herbaceous cover in the buffer - critical areas Trees/shrubs in the buffer and pool area Herbaceous vegetation in the pool area	■	■	■		■ ■		
Windbreak/Shelterbelt Establishment (380)			■				
Other - Vegetative Stabilization for Engineering Practices		■	Or as specified in the engineering practice.				

FIGURE 1.1: USDA Plant Hardiness Zones for Delaware

http://planthardiness.ars.usda.gov/PHZMWeb/

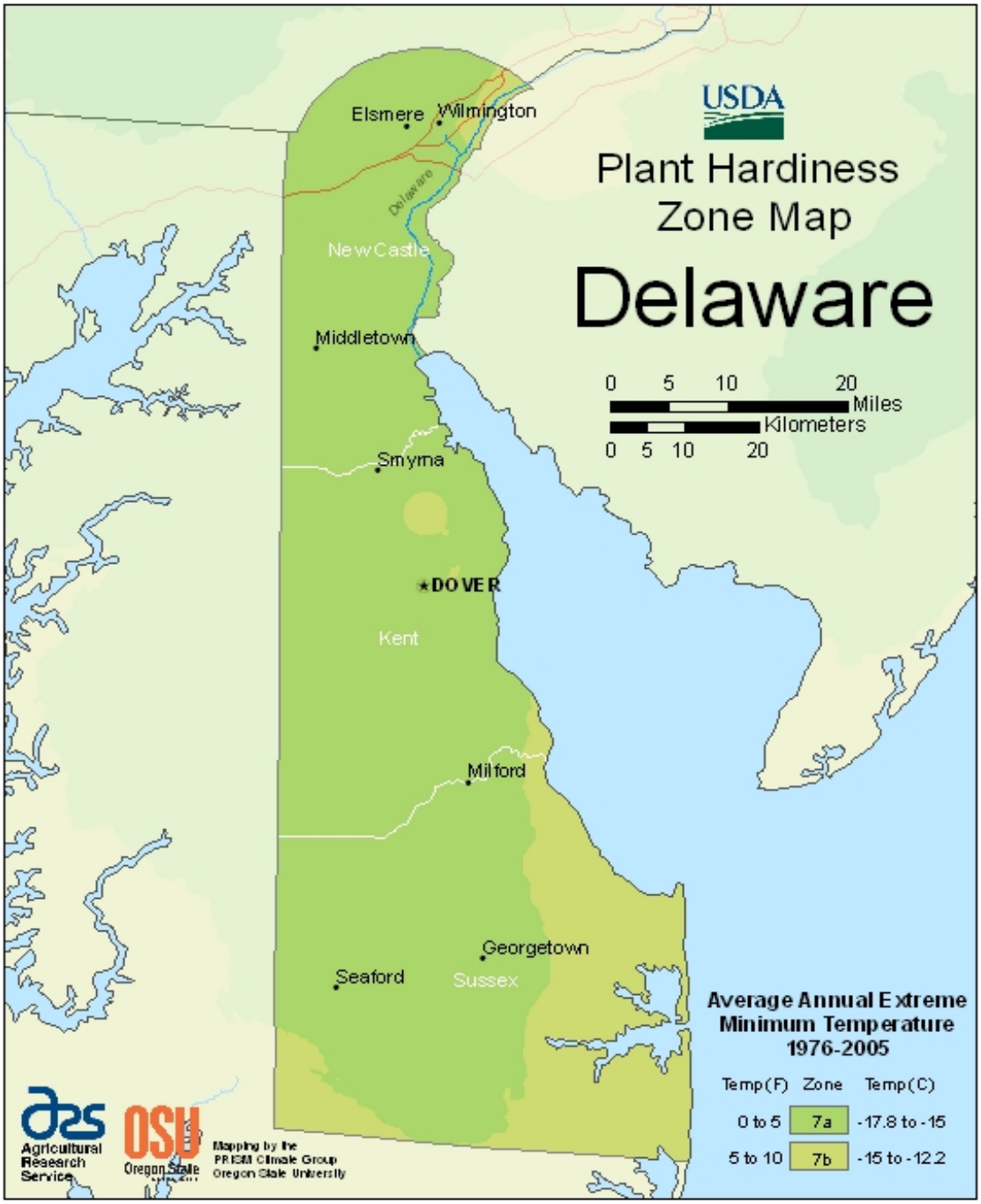

FIGURE 1.1 NOTE: This map is intended for general guidance. For more specific county-level Plant Hardiness Zone information, refer to local GIS data.

TABLE 1.2: Recommended Planting Dates for Permanent Cover in Delaware [1/]	
Type of Plant Material	**Plant Hardiness Zones 7a and 7b**
Seeds - Cool-Season Grasses (includes mixes with forbs and/or legumes)	Feb 15 to Apr 30 Aug 15 to Oct 31 Nov 1 to Nov 30♦
Seeds - Warm-Season/Cool-Season Grass Mixes (includes mixes with forbs and/or legumes)	Feb 15 to Apr 30♦♦ *May 1 to May 31**
Seeds - Warm-Season Grasses (includes mixes with forbs and/or legumes)	Apr 15 to May 31♦♦ *Jun 1 to Jun 30** *Dec 1 to Dec 31***
Sprigs – Warm-Season Grasses; Plugs – Perennial Forbs	April 1 to May 15
Sod - Cool-Season	Feb 15 to Apr 30 *May 1 to Sep 30** *Oct 1 to Dec 1*✦*
Dormant Cuttings [2/]	Feb 15 to Feb 28 *Mar 1 to Jun 30* Nov 15 to Nov 30
Bare-Root Plants; Bulbs, Rhizomes, Corms, and Tubers [3/]	Feb 15 to Apr 30 *May 1 to Jun 30**
Container Plants, Balled-and-Burlapped Stock	Feb 15 to Apr 30 *May 1 to Jun 30** *Oct 1 to Dec 15*✦*

TABLE 1.2 NOTES:

1. The planting dates listed are averages. These dates may require adjustment to reflect local conditions. When seeding toward the end of the listed planting dates, or when conditions are expected to be less than optimal, add an appropriate nurse crop to permanent seeding mixes. Certain legumes such as white/ladino and red clover can be seeded into cool-season grass stands using a frost seeding from January 15 to March 1. Success is dependent on receiving freeze-thaw cycles and adequate rainfall to germinate the legume seed.

2. Early spring and late fall planting dates are approximate for locally harvested dormant cuttings that will be planted immediately. *Additional spring - early summer planting dates in italics* are for dormant cuttings that are harvested and properly stored by commercial vendors.

3. When planted during the growing season, most of these materials must be purchased and kept in a dormant condition until planting. Bare-root grasses are the exception—they may be supplied as growing (non-dormant) plants.

♦ Additional planting dates for the lower Coastal Plain, dependent on annual rainfall and temperature trends. Recommend adding a nurse crop, as noted above, if planting during this period.

♦♦ In general, planting during the latter portion of this period allows more time for weed emergence and weed control prior to planting. When selecting a planting date, consider the need for weed control vs. the likelihood of having sufficient moisture for later plantings, especially on droughty sites.

* Additional planting dates during which supplemental watering may be needed to ensure plant establishment.

** Fall dormant season plantings of warm-season grasses – starting approximately 2 weeks after the first hard freeze (average date based on air temperature reading of 28 degrees F or lower, 50% probability of occurrence). Warm-season grasses need a soil temperature of at least 50 degrees F in order to germinate. If soil temperatures are colder than 50 degrees, or moisture is not adequate, the seeds will remain dormant until conditions are favorable.

✦ Frequent freezing and thawing of wet soils may result in frost-heaving of materials planted in late fall, if plants have not sufficiently rooted in place.

SECTION 2 - UPLAND HERBACEOUS CONSERVATION PLANTINGS: CONSERVATION COVER PLANTINGS

This section contains recommended seed mixes for permanent herbaceous cover with low to medium plant density. Depending on the species, these conservation cover mixes may need a year or more to become fully established, and may eventually become dense with maturity, especially without periodic disturbance. These mixes are generally used for wildlife habitat and water quality purposes, and can provide protection from erosion when site conditions are not severe. Some mixes are also suitable for areas that receive light to moderate human use, such as for paths, walkways, and travel lanes. Plantings in this section are generally not harvested, hayed, or grazed for agricultural production.

Selecting Mixes and Establishing Plantings

Tables in this section supplement the applicable conservation practice standards (see Section 1, Table 1.1), and contain additional requirements for species selection, planting rates, and methods of establishment.

Plantings shall consist of two or more species to provide vegetative diversity.

Refer to Table 2.1 to select appropriate mixes for specific purposes.

Refer to Table 2.2 for recommended herbaceous cover mixes and seeding rates. Other herbaceous species that are native to Delaware, or are introduced and are non-invasive, may also be suitable.

For optimum wildlife and pollinator habitat, Mixes 15 and 16 are designed to establish highly diverse herbaceous stands containing native grasses and wildflowers. Delaware native grasses are matched with native wildflowers for dry-mesic and mesic-wet soil moisture conditions.

The grasses are generally 3 feet in height or shorter, and tend to be less competitive than non-native grasses and tall-statured native grasses. This makes them more compatible with native wildflowers. All of the grasses tend to have a bunch-type growth form and are suitable for sites with low fertility.

Table 2.3 provides a list of native grasses, grass-like plants, and their characteristics.

Table 2.4 provides a list of native wildflowers and legumes, and their characteristics. Information in these tables may be used to select alternative species to substitute for species that are not currently available, or when desired by the client or planner. They may also be used to develop custom mixes.

Warm-Season Grass Plantings. Refer to the Delaware NRCS Fact Sheet *Warm-Season Grasses for Erosion Control, Water Quality, and Wildlife Habitat* for establishment, maintenance, and management recommendations.

Cool-Season Grass Plantings. Refer to the Delaware NRCS Fact Sheet *Cool-Season Grasses for Erosion Control, Water Quality, and Wildlife Habitat* for establishment, maintenance, and management recommendations.

Pollinator Habitat Plantings. Refer to the Delaware NRCS Fact Sheet *Native Plantings for Pollinators* for establishment, maintenance, and management recommendations.

TABLE 2.1: Recommended Upland Herbaceous Seeding Mixes for Conservation Cover by Purpose or Primary Use of the Planting

Purpose or Primary Use of the Planting	Recommended Mix* (see Table 2.2)													
	1	2	3	4	5	8	9	10	11	12	13	14	15	16
Reduce sheet, rill, and wind erosion (provide perennial cover)	✓	✓	✓	✓	✓	◆	✓	✓	✓	✓	✓	✓	◆	◆
Improve surface water quality (by nutrient uptake and reduced sedimentation)	✓	✓	✓	✓	✓	◆	✓	✓	✓	✓	✓	✓	◆	◆
Improve groundwater quality (by nutrient uptake)	✓	✓												
Reduce dust (provide vegetated travel lanes for light to moderate use in perennial crop systems, such as orchards and vineyards)							◆	◆		◆				
Enhance wildlife, pollinator, and beneficial organism habitat (provide diverse mixes of grasses and forbs)			◆	◆	◆	✓	◆	◆	◆	◆		◆	✓	✓
Improve soil health (provide high volumes of organic matter)	✓	✓	◆	◆	✓	◆	◆	◆	◆	◆		◆	◆	◆
Firebreak (cool-season grass strips adjacent to flammable vegetation, such as warm-season grasses, woodland, etc.)							✓	✓	✓	✓	✓			
Paths/Walkways (low-growing, low-maintenance grasses for light to moderate use)										✓				
Companion planting (low-growing, non-competitive grasses to control erosion in conjunction with tree/shrub plantings)										✓				

TABLE 2.1 NOTES:

✓ Recommended mix for this purpose.

◆ Alternative mix, depending on site conditions and preferences of the client.

* Mixes 6 & 7 (Reserved) are omitted from this table.

TABLE 2.2: Permanent Upland Herbaceous Cover Mixes: Conservation Cover

Mix [1]	Recommended Cultivar	Seeding Rate (lbs/ac) [2]	Plant Hardiness Zones [3]	Soil Drainage Class [4]	Max. Height (feet)	All Native Species [5]	Type of Grass in Mix	Remarks
1. SELECT THREE GRASSES:								**This mix is suitable for dry to mesic sites.**
Big Bluestem *Andropogon gerardii*	**Niagara, Rountree**	**2 - 4**						**Grasses in bold are typically used.**
Little Bluestem *Schizachyrium scoparium*	**Aldous, Blaze**	**3 - 5**						All of these grasses, except Little Bluestem, are tall-statured, and can be aggressive, especially on W - MW drained sites.
Switchgrass *Panicum virgatum*	**Shelter**	**2 - 4**	All					
Coastal Panicgrass *Panicum amarum*	Atlantic	2 - 4	(See Remarks)	E - MW	6 - 8	Y	Warm season grasses	Coastal Panicgrass is primarily a coastal species.
Indiangrass *Sorghastrum nutans*	Rumsey	2 - 4						Big Bluestem, Indiangrass, and Little Bluestem have fluffy seeds, which require a native seed drill.
OPTIONAL, SELECT ONE:								
Partridge Pea *Chamaecrista fasciculata*		1						Because the grasses tend to dominate a stand, wildflowers may not persist. Wildflowers may be more persistent on very dry sites.
Round-head Bush-Clover *Lespedeza capitata*		0.4						
Mix 8		Varies						
2. SELECT THREE GRASSES:								**This mix is suitable for mesic sites.**
Coastal Panicgrass *Panicum amarum*	**Atlantic**	**1 - 2**						**Grasses in bold are typically used.**
Florida Paspalum *Paspalum floridanum*	**Common**	**1 ½ - 3**						All of these grasses, except Little Bluestem and Red Fescue, are tall-statured grasses, and can be aggressive on sites with good moisture.
Switchgrass *Panicum virgatum*	**Kanlow**	**1 ½ - 3**						
Indiangrass *Sorghastrum nutans*	Rumsey, Suther	2 - 4						Little Bluestem prefers drier sites. Red Fescue is a cool-season grass, and can be used on wetter sites.
Little Bluestem *Schizachyrium scoparium*	Aldous, Blaze	3 - 5	All				Warm and cool season grasses	
Red Fescue *Festuca rubra*	Common	1 - 2	(See Remarks)	W - SP	6 - 8	Y		Coastal Panicgrass and Florida Paspalum are primarily coastal species.
OPTIONAL, SELECT ONE:								
Partridge Pea *Chamaecrista fasciculate*		1						Can add Eastern Gamagrass 'Meadowcrest' as a 4th species at 5 - 10 lb/ac. Eastern Gamagrass has large seed that must be planted separately from the other species.
Round-head Bush-Clover *Lespedeza capitata*		0.4						
Mix 8		Varies						Indiangrass and Little Bluestem have a fluffy seed that requires a native seed drill.

TABLE 2.2: Permanent Upland Herbaceous Cover Mixes: Conservation Cover

Mix [1]	Recommended Cultivar	Seeding Rate (lbs/ac) [2]	Plant Hardiness Zones [3]	Soil Drainage Class [4]	Max. Height (feet)	All Native Species [5]	Type of Grass in Mix	Remarks
3. SELECT TWO WARM-SEASON GRASSES:								**This mix is suitable for dry to mesic sites.**
Little Bluestem *Schizachyrium scoparium*	**Aldous, Blaze**	**4 - 6**						**Grasses in bold are typically used.**
Purpletop *Tridens flavus*	**Common**	**1 ½ - 3**						All of these species are short-statured, native grasses.
Broomsedge *Andropogon virginicus*	Common	1 - 2						Canada Wildrye and Virginia Wildrye are CSGs.
Splitbeard Bluestem *Andropogon ternarius*	Common	3 - 4						Canada Wildrye prefers dry sites; Virginia Wildrye prefers mesic sites. Canada Wildrye is not currently listed as native in DE, but occurs naturally in adjacent states.
Purple Lovegrass *Eragrostis spectabilis*	Common	½ - 1	All (See Remarks)	E - MW	3 - 4	Y	Warm and cool season grasses	Splitbeard Bluestem is a Coastal Plain species.
AND ONE COOL-SEASON GRASS:								
Canada Wildrye *Elymus canadensis*	Common	4 - 6						
Virginia Wildrye *Elymus virginicus*	**Common**	**5 - 8**						
AND ONE OF THE FOLLOWING:								
Partridge Pea *Chamaecrista fasciculata*		1						
Mix 8		Varies						
4. SELECT TWO WARM-SEASON GRASSES:								**This mix is suitable for mesic sites.**
Broomsedge *Andropogon virginicus*	**Common**	**½ - 1**						**Grasses in bold are typically used.**
Little Bluestem *Schizachyrium scoparium*	**Aldous, Blaze**	**3 - 5**						All of these species are short-statured, native grasses, except Florida Paspalum, the seedheads of which can reach 5 feet.
Splitbeard Bluestem *Andropogon ternarius*	Common	2 - 3						Little Bluestem prefers drier sites.
Purple Lovegrass *Eragrostis spectabilis*	Common	½ - 1						Splitbeard Bluestem is a Coastal Plain species.
Purpletop *Tridens flavus*	Common	1 - 2						Use River Oats in the Piedmont, and Slender Woodoats on the Coastal Plain.
Florida Paspalum *Paspalum floridanum*	Common	1 ½ - 3	All (See Remarks)	W - SP	3 - 4	Y	Warm and cool season grasses	
AND ONE COOL-SEASON GRASS:								
Virginia Wildrye *Elymus virginicus*	**Common**	**4 - 8**						
River Oats *Chasmanthium latifolium*	Common	4 - 8						
Riverbank Wildrye *Elymus riparius*	Common	4 - 8						
Slender Woodoats *Chasmanthium laxum*	Common	4 - 8						
AND ONE OF THE FOLLOWING:								
Partridge Pea *Chamaecrista fasciculata*		1						
Mix 8		Varies						

TABLE 2.2: Permanent Upland Herbaceous Cover Mixes: Conservation Cover

Mix [1]	Recommended Cultivar	Seeding Rate (lbs/ac) [2]	Plant Hardiness Zones [3]	Soil Drainage Class [4]	Max. Height (feet)	All Native Species [5]	Type of Grass in Mix	Remarks
5. SELECT ONE WARM-SEASON GRASS:								**This mix is suitable for wet sites.**
Redtop Panicgrass *Panicum rigidulum*	**Common**	**0.5 - 1**						**Grasses/sedges in bold are typically used.**
Bushy Broomsedge *Andropogon glomeratus*	Common	0.5 - 1						All but Florida Paspalum and Riverbank Wildrye are short-statured grasses.
Beaked Panicgrass *Panicum anceps*	Common	1 - 2						Florida Paspalum is a Coastal Plain species.
Florida Paspalum *Paspalum floridanum*	Common	2 - 4						Use River Oats in the Piedmont, and Slender Woodoats on the Coastal Plain.
AND ONE COOL-SEASON GRASS:								
Virginia Wildrye *Elymus virginicus*	**Common**	**4 - 8**						Rattlesnake Grass occurs in the Piedmont region.
River Oats *Chasmanthium latifolium*	Common	5 - 7					Warm and cool season grasses, and sedges	
Riverbank Wildrye *Elymus riparius*	Common	5 - 7	All					
Slender Woodoats *Chasmanthium laxum*	Common	5 - 7	(See Remarks)	P - VP	3 - 5	Y		
AND ONE OF THE FOLLOWING:								
Fox Sedge *Carex vulpinoidea*	**Common**	**0.25 - 0.5**						
Hop Sedge *Carex lupulina*	Common	4 - 6						
Lurid Sedge *Carex lurida*	Common	1 ½ - 3						
Fowl Mannagrass *Glyceria striata*	Common	0.25 - 0.5						
Rattlesnake Grass *Glyceria canadensis*	Common	0.25 - 0.5						
AND ADD:								
Mix 8		Varies						
6. - 7. (Reserved)								

TABLE 2.2: Permanent Upland Herbaceous Cover Mixes: Conservation Cover

8. Delaware Native Wildflowers and Legumes
Select **at least 4 wildflowers** and **one legume**. It is preferable to include species that will bloom at different times during the growing season. Add this mix to all-grass Mixes 1 - 5, 11, and 12 for added wildlife and aesthetic value. For the highest diversity grass/wildflower mixes that have a predominant wildflower component (i.e., "pollinator mixes"), use Mix 15 or 16, as appropriate for site conditions.

Common Name	Scientific Name	Moisture [1]			Seeding Rate (lbs/ac) [2]	Life Cycle [3]	Legume	Flowering Period and Flower Color								
		D	M	W				M	A	M	J	J	A	S	O	N
Tall White Beardtongue	*Penstemon digitalis*	■	■		0.2	P										
Butterfly Milkweed	*Asclepias tuberosa*	■	■		0.4	P										
Common Milkweed	*Asclepias syriaca*	■	■		0.4	P										
Swamp Milkweed	*Asclepias incarnata*			■	0.4	P										
Wild Bergamot	*Monarda fistulosa*		■		0.05	P										
Virginia Mountain Mint	*Pycnanthemum virginianum*	■	■		0.02	P										
Dense Blazing Star	*Liatris spicata*	■	■		0.25	P										
Common Boneset	*Eupatorium perfoliatum*			■	0.02	P										
Orange Coneflower	*Rudbeckia fulgida*	■	■		0.1	P										
Joe-Pye Weed	*Eutrochium fistulosum*		■	■	0.03	P										
New York Aster	*Symphyotrichum novi-belgii*			■	0.07	P										
Rough-leaf Goldenrod	*Solidago patula*			■	0.15	P										
Wrinkle-leaf Goldenrod	*Solidago rugosa*	■	■		0.1	P										
Narrowleaf Sunflower	*Helianthus angustifolius*		■	■	0.15	P										
New York Ironweed	*Vernonia noveboracensis*		■	■	0.15	P										
Showy Tickseed	*Bidens aristosa*			■	0.5	A										
Yellow False Indigo	*Baptisia tinctoria*	■	■		0.15	P	■									
Partridge Pea	*Chamaecrista fasciculata*	■	■		0.5	A	■									
American Senna	*Senna hebecarpa*		■	■	0.5	P	■									
Round Head Bush-Clover	*Lespedeza capitata*	■	■		0.2	P	■									
Hairy Bush-Clover	*Lespedeza hirta*	■	■		0.2	P	■									

Mix 8 Notes:

1. **Moisture:** The amount of moisture the species needs or tolerates, as part of a mix. D - Dry (excessively drained to well-drained soil); M - Mesic (moderately well to somewhat poorly drained soil); W – Wet (poorly to very poorly drained soil).
2. **Seeding Rate:** The value listed is the seeding rate in pure live seed (PLS). It is calculated based on the number of seeds per pound, at a seeding rate ranging from 0.5 to 2 seeds/SF for each species.
3. **Life Cycle:** P – Perennial; A – Annual.

TABLE 2.2: Permanent Upland Herbaceous Cover Mixes: Conservation Cover

Mix [1]	Recommended Cultivar	Seeding Rate (lbs/ac) [2]	Plant Hardiness Zones [3]	Soil Drainage Class [4]	Max. Height (feet)	All Native Species [5]	Type of Grass in Mix	Remarks
9. Orchardgrass *Dactylis glomerata*	Any	3 - 4	All	W - MW	2 - 3	N	Cool season grasses	Once well-established, orchardgrass may tend to dominate the stand.
Red Fescue *Festuca rubra*	Common	3 - 4						Alsike clover can be toxic to horses.
Alsike Clover *Trifolium hybridum*	Common	1 - 2						
White Clover *Trifolium repens*	Common	1 - 2						
10. Orchardgrass *Dactylis glomerata*	Any	2 - 4	All	W - MW	2 - 3	N	Cool season grasses	Timothy generally does not perform well in PHZs 7a and 7b, but may be suitable where local conditions are cool and soil moisture is adequate.
Bluegrass *Poa pratensis* **AND/OR**	Not a turf type	1 - 2						Once well-established, orchardgrass may tend to dominate the stand.
Timothy *Phleum pratense*	Climax	2 - 4						
AND ONE OF THE FOLLOWING:								
White Clover *Trifolium repens*	Common	1 - 2	(See remarks)					
Red Clover *Trifolium pratense*	Any	1 - 2						
Common Lespedeza *Lespedeza striata*	Kobe	3 - 5						
Korean Lespedeza *Lespedeza stipulacea*	Climax or Rowan	3 - 5						
11. Riverbank Wildrye *Elymus riparius*	Common	4 - 6	All	MW - P	3 - 4	Y	Cool season grasses	All native, shade-tolerant CSG grass mix for mesic to wet sites.
Virginia Wildrye *Elymus virginicus*	Common	4 - 6						Use River Oats in the Piedmont and Slender Woodoats on the Coastal Plain.
River Oats *Chasmanthium latifolium*	Common	5 - 10						
OR								Add Mix 8c to provide a grass-forb mix for wildlife habitat.
Slender Woodoats *Chasmanthium laxum*	Common	5 - 10						
OPTIONAL ADDITION:								
Mix 8		Varies						

TABLE 2.2: Permanent Upland Herbaceous Cover Mixes: Conservation Cover

Mix [1]	Recommended Cultivar	Seeding Rate (lbs/ac) [2]	Plant Hardiness Zones [3]	Soil Drainage Class [4]	Max. Height (feet)	All Native Species [5]	Type of Grass in Mix	Remarks
12. Chewings Fescue *Festuca rubra ssp. fallax*	Common	1 - 2	All	W - MW	2 - 3	N	Cool season grasses	Attractive, low-growing grass and wildflower (or clover) mix. Select the clover option when using this mix for travel lanes and companion plantings. Clover may be omitted when using this mix for paths/walkways.
Hard Fescue *Festuca brevipila*	Beacon, Gotham, Spartan II, Sword	1 - 2						
Sheep fescue *Festuca ovina*	Common or Bighorn	1 - 2						
AND ADD WILDFLOWER MIX:								
Mix 8		Varies						
OR ADD CLOVER MIX:								
White Clover *Trifolium repens*	Common	1 - 2						
Red Clover *Trifolium pratense*	Any	1 - 2						
13. Rough Bluegrass *Poa trivialis*	Common	1 - 2	All	SP - P	4 - 5	N	Cool season grasses	Use Red Fescue on drier soils and Fowl Meadowgrass on wetter soils.
Virginia Wildrye *Elymus virginicus* **OR**	Common	5 - 8						
Riverbank Wildrye *Elymus riparius*		4 - 6						
Fowl Meadowgrass *Poa palustris* **OR**	Common	1 - 2						
Red Fescue *Festuca rubra*	Common	1 - 2						
14. Fowl Meadowgrass *Poa palustris*	Common	1 - 2	All	SP - P	2 - 3	Y (See Remarks)	Cool season grasses	Low-growing mix of native grasses for wet sites. Use Partridge Pea if an all-native mix is desired. (Alsike and White Clover are not native to Delaware.) Alsike Clover can be toxic to horses.
Virginia Wildrye *Elymus virginicus*	Common	4 - 6						
Red Fescue *Festuca rubra*	Common	1 - 2						
AND ADD:								
Partridge Pea *Chamaecrista fasciculata*	Common	1 - 2						
OR ADD CLOVER MIX:								
Alsike Clover *Trifolium hybridum*	Common	1 - 2						
White Clover *Trifolium repens*	Common	1 - 2						

TABLE 2.2: Permanent Upland Herbaceous Cover Mixes: Conservation Cover

15. Delaware Native Grass-Forb Mix for Pollinators: Dry - Mesic Sites

The species composition of this mix is appropriate for a range of soil moisture conditions from **excessively-drained to well-drained**.
Alternative native species may be substituted for a listed species due to desirability or lack of availability. When possible, select an alternative that has flowering period that is similar to the species for which it is being substituted. Omit the grasses when using this mix to interseed existing native grass stands.

Common Name	Scientific Name	% by Seed [1/]	Seeding Rate (lbs/ac) [2/]	Life Cycle [3/]	Legume	Flowering Period and Flower Color								
						M	A	M	J	J	A	S	O	N
Tall White Beardtongue	*Penstemon digitalis*	10.0%	0.65	P										
Virginia Spiderwort	*Tradescantia virginiana*	1.0%	0.15	P										
Butterfly Milkweed	*Asclepias tuberosa*	1.0%	0.37	P										
Common Milkweed	*Asclepias syriaca*	1.0%	0.37	P										
Dotted Mint	*Monarda punctata*	10.0%	0.18	P										
Lanceleaf Coreopsis	*Coreopsis lanceolata*	8.0%	0.95	P										
Perennial Blanketflower	*Gaillardia aristata*	5.0%	0.59	P										
Blackeyed Susan	*Rudbeckia hirta*	7.0%	0.12	B										
Purple Coneflower	*Echinacea purpurea*	5.0%	1.13	P										
Partridge Pea	*Chamaecrista fasciculata*	1.0%	0.40	A	■									
Wild Bergamot	*Monarda fistulosa*	10.0%	0.21	P										
Virginia Mountain Mint	*Pycnanthemum virginianum*	8.0%	0.05	P										
New England Aster	*Symphyotrichum novae-angliae*	8.0%	0.19	P										
Wrinkleleaf Goldenrod	*Solidago rugosa*	4.0%	0.10	P										
Purpletop	*Tridens flavus*	5.0%	0.28	P										
Broomsedge	*Andropogon virginicus*	2.0%	0.07	P										
Little Bluestem	*Schizachyrium scoparium*	14.0%	2.54	P										
Totals		**100%**	**8.34**	Total seeding rate is approximately **60 seeds/SF**.										

Mix 15 Notes:

1. Composition of this seed mix is calculated based on seeds per square foot, not percent by weight.
2. Seeding rate per acre for each species varies significantly because of the desired composition of the mix (seeds per square foot) and variation in seed size.
3. Life cycle categories include: P – Perennial; B – Biennial; A – Annual.

To create a custom mix, use the Xerces Society Seed Mix Calculator, available at http://www.xerces.org/wp-content/uploads/2009/11/XERCES-SEED-MIX-CALCULATOR.xls

TABLE 2.2: Permanent Upland Herbaceous Cover Mixes: Conservation Cover

16. Delaware Native Grass-Forb Mix for Pollinators: Mesic - Wet Sites

The species composition of this mix is appropriate for a range of soil moisture conditions from **well-drained to somewhat poorly drained**.
Alternative native species may be substituted for a listed species due to desirability or lack of availability. When possible, select an alternative that has flowering period that is similar to the species for which it is being substituted. Omit the grasses/sedge when using this mix to interseed existing native grass stands.

Common Name	Scientific Name	% by Seed [1]	Seeding Rate (lbs/ac) [2]	Life Cycle [3]	Legume	Flowering Period and Flower Color								
						M	A	M	J	J	A	S	O	N
Golden Alexanders	*Zizia aurea*	1.0%	0.15	P										
Tall White Beardtongue	*Penstemon digitalis*	7.0%	0.46	P										
Virginia Spiderwort	*Tradescantia virginiana*	1.0%	0.15	P										
Bigleaf Mountain Mint	*Pycnanthemum muticum*	8.0%	0.04	P										
Common Boneset	*Eupatorium perfoliatum*	7.0%	0.06	P										
Common Milkweed	*Asclepias syriaca*	1.0%	0.37	P										
Culver's Root	*Veronicastrum virginicum*	5.0%	0.02	P										
Dense Blazing Star	*Liatris spicata*	1.0%	0.26	P										
Great Blue Lobelia	*Lobelia siphilitica*	9.0%	0.03	P										
Partridge Pea	*Chamaecrista fasciculata*	1.0%	0.40	A	■									
Swamp Milkweed	*Asclepias incarnata*	2.0%	0.75	P										
Wild Bergamot	*Monarda fistulosa*	7.0%	0.14	P										
Narrowleaf Sunflower	*Helianthus angustifolius*	3.0%	0.16	P										
New England Aster	*Symphyotrichum novae-angliae*	4.0%	0.10	P										
New York Ironweed	*Vernonia noveboracensis*	2.0%	0.17	P										
Showy Tickseed	*Bidens aristosa*	5.0%	1.01	A										
Sneezeweed	*Helenium autumnale*	5.0%	0.09	P										
Wrinkleleaf Goldenrod	*Solidago rugosa*	3.0%	0.08	P										
Blue Vervain	*Verbena hastata*	10.0%	0.18	P										
Broomsedge	*Andropogon virginicus*	3.0%	0.10	P										
Deertongue	*Panicum clandestinum*	5.0%	0.47	P										
Fox Sedge	*Carex vulpinoidea*	5.0%	0.10	P										
Purpletop	*Tridens flavus*	5.0%	0.28	P										
Totals		**100%**	**5.56**	Total seeding rate is approximately **60 seeds/SF**.										

Mix 16 Notes:

1. Composition of this seed mix is calculated based on seeds per square foot, not percent by weight.
2. Seeding rate per acre for each species varies significantly because of the desired composition of the mix (seeds per square foot) and variation in seed size.
3. Life cycle categories include: P – Perennial; A – Annual.

TABLE 2.2 NOTES:

1. **Mix:** Where “OR” is shown, select from one of the two species or mixes separated by “OR” based on site conditions and desirability.

2. **Seeding Rate:** Seeding rates listed are for planting methods that incorporate seed into the soil. These methods include drilling (conventional or no-till), and broadcast seeding on a prepared seedbed, followed by light soil incorporation with a cultipacker.

   Seeding rates for the native grasses, sedges, legumes, and other wildflowers are in pounds of Pure Live Seed (PLS). Order seed from the supplier based on the PLS rate; the seed supplier will adjust the bulk amount to be planted based on percent seed germination and purity, as tested.

   Adjustments are not usually needed for the introduced grasses and legumes. However, be aware that some seed may be polymer-coated. This coating can double the weight of the seed, so that a bag of seed may contain only 50% seed by weight (e.g., a 10-pound bag of grass seed may contain only 5 pounds of seed, with the other 5 pounds consisting of the polymer coating). Be sure to read the seed analysis label when purchasing seed, and adjust the per acre weight to be planted accordingly.

   Legume seeds shall be inoculated before planting with the appropriate *Rhizobium* bacteria. When feasible, hard-seeded legumes should be scarified to improve germination.

   When a seeding rate is expressed as a range (i.e., 4 - 6), the lower rate should be used if erosion is not a concern. Where erosion is a concern, use the higher seeding rate and add one of the following nurse crops with the selected mix: 20 - 40 lbs/ac of oats or barley. This can be planted with the selected mix at the time of seeding. If using a conservation tillage method, plant the small grain as a cover crop in the fall, mow in early spring, and drill the permanent planting into the remaining stubble. Do not use cereal rye as a nurse crop. It has allelopathic properties that inhibit the germination and growth of other plants.

   Oats are the recommended nurse crop for warm-season grasses.

3. The **Plant Hardiness Zones** designate where a species can be successfully planted in Delaware, while the geographic distribution describes where the species usually occurs under natural conditions.

4. **Soil Drainage Class** (refer to the county soil survey for further information):
   E - Excessively Drained; W - Well Drained; MW - Moderately Well Drained; SP - Somewhat Poorly Drained; P - Poorly Drained; VP - Very Poorly Drained.

5. **Native Species:** The term "native" refers to species that occur naturally in one or more geographic regions of Delaware. Native mixes may include non-native nurse crops (which are short-lived) for site stabilization during establishment of the permanent planting.

TABLE 2.3: Selected Characteristics of Native Grasses and Grass-like Plants

Scientific Name	Region [1]		Soil Drainage Class [2]	Moisture [3]			Wetland AGCP EMP [4]	Est. Seeds/lb	PLS Lbs/Ac [5]		Height	Drought Tolerant	Shade Tolerant	Remarks
	P	CP		D	M	W			Grass Mix	Forb Mix				
WARM-SEASON GRASSES														
Andropogon gerardii Big Bluestem	■	■	E - SP	■	■		FAC FAC	144,000	2.5	0.3	5 - 8	■		One of the taller species. Can be aggressive.
Andropogon glomeratus Bushy Broomsedge	■	■	SP - P			■	FACW FACW	800,000	0.4	0.05	1½ - 3			Often volunteers in wet, idle crop fields in association with *Andropogon virginicus*.
Andropogon ternarius Splitbeard Bluestem		■	E - SP	■	■		FACU FACU	216,000	1.5	0.2	1½ - 3	■		Blooms earlier than other bluestem species. Highly drought tolerant.
Andropogon virginicus Broomsedge	■	■	E - SP	■	■		FAC FACU	800,000	0.4	0.05	1½ - 3	■		Often volunteers in idle crop fields with low fertility and low pH.
Dichanthelium clandestinum Deertongue	■	■	E - SP	■	■		FACW FAC	350,000	1	0.1	1½ - 3	■		Tolerates a wide range of site conditions. Tendency to fall over.
Eragrostis spectabilis Purple Lovegrass	■	■	MW - SP	■	■		FACU UPL	1,059,100	0.3	0.04	1 - 3	■		Prefers sandy sites. Seed is extremely small.
Panicum amarum Coastal Panicgrass		■	E - SP	■	■		FAC FACU	325,000	1	0.15	3 - 6	■		Similar to *Panicum virgatum*, but with a closed panicle. Found naturally on dunes and sandy, droughty sites. Can be aggressive.
Panicum anceps Beaked Panicgrass	■	■	SP - P			■	FAC FAC	570,000	0.6	0.08	2 - 4			Spreads from short rhizomes to form dense clumps. Prefers some shade. Use Delaware ecotype.
Panicum rigidulum Redtop Panicgrass	■	■	SP - VP			■	FACW FACW	800,000	0.4	0.05	2 - 3			Prefers wet sites. Seed is extremely small, so seeding rate should be proportionally smaller in a mix.
Panicum virgatum Switchgrass	■	■	E - VP	■	■	■	FAC FAC	259,000	1.5	0.15	4 - 6	■		Common native species that has been cultivated for wildlife, biomass, and erosion control. Can be aggressive. Site adaptability varies with cultivar.
Panicum virgatum Switchgrass 'Cave-in-Rock'	■	■	W - P		■	■		259,000	1.5	0.15		■		Midwestern variety with high biomass production.
Panicum virgatum Switchgrass 'Kanlow'	■	■	SP - VP			■		259,000	1.5	0.15				Midwestern plains variety. Adapted to wet soils.
Panicum virgatum Switchgrass 'Shelter'	■	■	E - SP	■	■			259,000	1.5	0.15		■		Northeast variety selected for its stiff stems, which allow it to remain standing under snow loads and provide winter cover.
Paspalum floridanum Florida paspalum		■	W - P	■	■	■	FACW FACW	259,000	1.5	0.15	3 - 5			Tolerates a wide range of soils. Relatively large seeds are used by wildlife. Deteriorates rapidly after maturity

TABLE 2.3: Selected Characteristics of Native Grasses and Grass-like Plants

Scientific Name	Region [1]		Soil Drainage Class [2]	Moisture [3]			Wetland AGCP EMP [4]	Est. Seeds/lb	PLS Lbs/Ac [5]		Height	Drought Tolerant	Shade Tolerant	Remarks
	P	CP		D	M	W			Grass Mix	Forb Mix				
WARM-SEASON GRASSES (cont'd)														
Schizachyrium scoparium Little Bluestem	■	■	E - W	■			FACU FACU	144,000	2.5	0.3	2 - 3	■		Prefers dry sites. Similar in appearance to *Andropogon virginicus*.
Sorghastrum nutans Indiangrass	■	■	E - SP	■	■		FACU FACU	175,000	2	0.25	4 - 6	■		May be somewhat aggressive on sites with normal moisture or fertility. Golden flower panicle is very attractive.
Tridens flavus Purpletop	■	■	E - SP	■	■		FACU FACU	465,000	0.7	0.09	3 - 4	■		Best suited for dry, sandy areas or sites with shallow soils.
Tripsacum dactyloides Eastern Gamagrass	■	■	W - P		■	■	FAC FACW	7,000	10	1	3 - 5			Can be found on roadsides in both dry and wet locations. A distant relative to corn, it has large seeds that can be planted with a conventional drill. Planted as a forage crop.
COOL-SEASON GRASSES														
Agrostis scabra Rough Bentgrass	■	■	W - P		■	■	FAC FAC	5,000,000	0.07	0.009	2 - 3			Short-lived, perennial bunchgrass. Can be used for quick cover on disturbed areas.
Chasmanthium latifolium River Oats	■		W - SP		■	■	FAC FACU	85,000	4	0.5	2 - 4		■	Can be used for soil erosion control in shaded areas and along streams. Flood tolerant. Attractive seed heads.
Chasmanthium laxum Slender Woodoats		■	MW - SP		■	■	FACW FAC	85,000	4	0.5	2 - 3	■	■	Shade tolerant. Can be used in riparian areas and floodplains.
Cinna arundinacea Wood Reedgrass	■	■	MW - P		■	■	FACW FACW	1,300,000	0.25	0.03	3 - 5		■	Found in shaded riparian areas and forested wetlands.
Elymus canadensis Canada Wildrye	■	■	E - MW	■			FAC FACU	114,000	3	0.4	3 - 4	■	■	Prefers partial shade. Seedlings establish quickly, but are not highly competitive with other grasses. Not compatible with prescribed burning.
Elymus histrix Bottlebrush Grass	■	■	W - SP		■		UPL UPL	75,000	4.5	0.6	2 - 4		■	A woodland grass with a conspicuous panicle.
Elymus riparius Riverbank Wildrye	■	■	MW - P		■	■	FACW FACW	125,000	2.5	0.35	3 - 5		■	Shade tolerant. Occurs on stream banks and in forested wetlands. Used for soil stabilization.
Elymus virginicus Virginia Wildrye	■	■	MW - P		■	■	FAC FACW	100,000	3.5	0.45	3 - 4		■	See remarks for *Elymus canadensis*. Prefers moist sites.
Poa palustris Fowl Meadowgrass	■	■	SP - P			■	FAC FACW	1,900,000	0.15	0.02	2 - 4			A native bluegrass of wet meadows.

TABLE 2.3: Selected Characteristics of Native Grasses and Grass-like Plants

Scientific Name	Region [1]		Soil Drainage Class [2]	Moisture [3]			Wetland AGCP EMP [4]	Est. Seeds/lb	PLS Lbs/Ac [5]		Height	Drought Tolerant	Shade Tolerant	Remarks
	P	CP		D	M	W			Grass Mix	Forb Mix				
GRASS-LIKE WETLAND OBLIGATE PLANTS														
Carex lupulina Hop Sedge	■	■	P - VP			■	OBL OBL	94,700	3.5	0.45	1½ - 3		■	Obligate wetland sedge. Provides food and cover for wildlife. MD ecotype available.
Carex lurida Lurid Sedge	■	■	P - VP			■	OBL OBL	250,000	1.5	0.15	1 - 3			Obligate wetland sedge. Provides food and cover for wildlife.
Carex vulpinoidea Fox Sedge	■	■	P - VP			■	FACW OBL	1,300,000	0.25	0.03	1½ - 3			Provides food and cover for wildlife. Can be aggressive. Seed is extremely small.
Glyceria canadensis *Rattlesnake Grass*	■		SP - VP			■	OBL OBL	1,184,000	0.3	0.04	2 - 3			Obligate wetland bunchgrass found in marshes and swamps.
Glyceria striata *Fowl Mannagrass*	■	■	SP - VP			■	OBL OBL	1,540,000	0.2	0.03	3 - 5		■	Obligate wetland bunchgrass found in forests and marshes.
Schoenoplectus tabernaemontani Softstem Bulrush	■	■	P - VP			■	OBL OBL	496,000	0.65	0.09	5 - 10			Provides food and cover for wildlife. Found in and around the edges of waterbodies, including flooded wetlands.
Scirpus cyperinus Woolgrass	■	■	P - VP			■	OBL OBL	36,000,000	0.009	0.001	4 - 5			A tall, bunch type sedge of wet meadows and marshes.
Sparganium americanum Eastern Bur Reed	■	■	P - VP			■	OBL OBL	50,000	6.5	0.85	2½ - 3			An herbaceous emergent aquatic plant with distinct ball-like seed heads.

TABLE 2.3 NOTES:

1. **Region:** The physiographic region where the species usually occurs in Delaware, under natural conditions. P - Piedmont; CP - Coastal Plain.

2. **Soil Drainage Class** (refer to the county soil survey for further information):
   E - Excessively Drained; W - Well Drained; MW - Moderately Well Drained; SP - Somewhat Poorly Drained; P - Poorly Drained; VP - Very Poorly Drained.

3. **Moisture:** The amount of moisture the species needs or tolerates, as part of a mix. D - Dry (excessively drained to well-drained soil); M - Mesic (moderately well to somewhat poorly drained soil); W – Wet (poorly to very poorly drained soil).

4. **Wetland:** Wetland indicator status for the Atlantic and Gulf Coastal Plain (AGCP) and Eastern Mountains and Piedmont (EMP).

5. **PLS Lbs/Ac:** The value listed is the seeding rate in pure live seed (PLS) for the individual species within a Grasses with Wildflowers mix (a predominantly grass planting; column header “Grass Mix”) and a Wildflower Meadow mix (a predominantly wildflower planting; column header “Forb Mix”). Rates are based 30 PLS/SF with 3 spp grass and 5 spp forbs at a 75:25 ratio in the Grass Mix, and 30 PLS/SF with 3 spp grass and 10 spp forbs at 10:90 in the Forb Mix.

TABLE 2.4: Selected Characteristics of Native Wildflowers and Legumes

Scientific Name	Common Name	Region [1]		Duration [2]	Moisture [3]			Wetland [4]		Est. Seeds/Lb	PLS Lbs/Ac [5]		Traits [6]	Flowering Period and Flower Color								
		P	CP		D	M	W	AGCP	EMP		Grass Mix	Forb Mix		M	A	M	J	J	A	S	O	N
Asclepias incarnata	Swamp Milkweed	■	■	P			■	OBL	OBL	70,000	0.45	1.5	T									
Asclepias syriaca	Common Milkweed	■	■	P	■	■		UPL	FACU	70,000	0.45	1.5	T									
Asclepias tuberosa	Butterfly Milkweed	■	■	P	■	■		NI	NI	70,000	0.45	1.5	D,T									
Baptisia tinctoria	Yellow False Indigo	■	■	P	■	■		NI	NI	300,000	0.1	0.4	D,T									
Bidens aristosa	Bur Marigold		■	A			■	FACW	FACW	130,000	0.25	0.9										
Bidens cernua	Nodding Bur Marigold	■	■	A			■	OBL	OBL	130,000	0.25	0.9										
Bidens frondosa	Beggar Ticks	■	■	A			■	FACW	FACW	80,000	0.4	1.5										
Caltha palustris	Marsh Marigold	■	■	P			■	OBL	OBL	554,000	0.06	0.2										
Chamaecrista fasciculata	Partridge Pea	■	■	A	■	■		FACU	FACU	65,000	0.25	1	T									
Chelone glabra	White Turtlehead	■	■	P			■	OBL	OBL	1,472,000	0.02	0.08	S									
Conoclinium coelestinum	Mistflower	■	■	P		■	■	FAC	FAC	1,500,000	0.02	0.08	A									
Coreopsis lanceolata	Lanceleaf Tickseed			P		■		UPL	FACU	221,000	0.15	0.55										
Coreopsis tinctoria	Golden Tickseed	■	■	A		■		FAC	FAC	3,222,222	0.01	0.04										
Coreopsis verticillata	Whorled Tickseed	■	■	P	■	■		NI	NI	200,000	0.15	0.6	D									
Desmodium canadense	Showy Tick-Trefoil	■		P		■		FAC	FAC	72,500	0.45	1.5	T									
Desmodium paniculatum	Panicled Tick-Trefoil	■	■	P	■	■		FACU	FACU	200,000	0.15	0.6	D,T									
Doellingeria umbellata var. *umbellata*	Flat-topped White Aster	■	■	P		■	■	FACW	FACW	800,000	0.04	0.15										
Echinacea purpurea	Purple Coneflower			P		■		NI	NI	116,000	0.3	1										
Eupatorium perfoliatum	Boneset	■	■	P			■	FACW	FACW	2,800,000	0.01	0.04	S									
Euthamia graminifolia	Grass-leaved Goldenrod	■	■	P	■	■	■	FAC	FAC	5,600,000	0.006	0.02	A,D									
Eutrochium dubium	Coastal Plain Joe-Pye Weed	■	■	P		■	■	FACW	FACW	2,000,000	0.02	0.06										
Eutrochium fistulosum	Joe-Pye Weed	■	■	P		■	■	FACW	FACW	2,000,000	0.02	0.06	S									
Eutrochium purpureum	Sweet-scented Joe-Pye Weed	■	■	P		■	■	FAC	FAC	672,000	0.05	0.2										
Helenium autumnale	Yellow Sneezeweed	■	■	P		■	■	FACW	FACW	1,464,000	0.02	0.08	T									
Helenium flexuosum	Purple Sneezeweed	■	■	P		■		FACW	FAC	2,000,000	0.02	0.06	T									
Helianthus angustifolius	Swamp Sunflower		■	P		■	■	FACW	FACW	500,000	0.07	0.25										

TABLE 2.4: Selected Characteristics of Native Wildflowers and Legumes

Scientific Name	Common Name	Region [1]		Duration [2]	Moisture [3]			Wetland [4]		Est. Seeds/Lb	PLS Lbs/Ac [5]		Traits [6]	Flowering Period and Flower Color								
		P	CP		D	M	W	AGCP	EMP		Grass Mix	Forb Mix		M	A	M	J	J	A	S	O	N
Heliopsis helianthoides	Smooth Oxeye	■	■	P	■	■		UPL	FACU	116,410	0.3	1										
Lespedeza capitata	Round-head Bush-Clover	■	■	P	■	■		FACU	FACU	174,000	0.2	0.7	D,T									
Lespedeza hirta	Hairy Bush-Clover	■	■	P	■	■		NI	NI	175,000	0.2	0.65	D,T									
Liatris pilosa	Grass-leaf Blazing Star	■	■	P	■	■		NI	NI	290,000	0.1	0.4	D									
Liatris scariosa	Large Blazing Star	■	■	P		■		UPL	FACU	100,000	0.35	1										
Lobelia cardinalis	Cardinal Flower	■	■	P			■	FACW	FACW	11,292,758	0.003	0.01	S									
Lobelia siphilitica	Blue Lobelia	■		P			■	OBL	FACW	8,000,000	0.004	0.01	S									
Mimulus ringens	Square-stemmed Monkeyflower	■	■	P			■	OBL	OBL	22,900,000	0.001	0.005										
Monarda didyma	Scarlet Bee-balm			P		■	■	FAC	FAC	1,272,500	0.03	0.09	S									
Monarda fistulosa	Wild Bergamot	■	■	P		■		FACU	UPL	1,272,500	0.03	0.09	S									
Monarda punctata	Spotted Bee-balm	■	■	P	■	■		FACU	UPL	1,440,000	0.02	0.08										
Penstemon canescens	Gray Beard-tongue	■		P	■			NI	NI	400,000	0.08	0.3										
Penstemon digitalis	Tall White Beard-tongue	■	■	P	■	■		FAC	FAC	400,000	0.08	0.3	D,S									
Pycnanthemum incanum	Hoary Mountain Mint	■	■	P	■	■		NI	NI	4,500,000	0.007	0.03	S									
Pycnanthemum muticum	Big-leaf Mountain Mint		■	P	■	■	■	FAC	FAC	4,500,000	0.007	0.03	S									
Pycnanthemum tenuifolium	Narrow-leaf Mountain Mint	■	■	P	■	■	■	FACW	FACW	4,500,000	0.007	0.03	A,S									
Rudbeckia fulgida var. *fulgida*	Orange Coneflower	■	■	P		■		FAC	FAC	500,000	0.07	0.25										
Rudbeckia hirta	Black-eyed Susan	■	■	B	■	■		FACU	FACU	1,575,760	0.02	0.07	D									
Rudbeckia triloba	Brown-eyed Susan	■	■	P		■		FACU	FACU	536,000	0.06	0.2										
Senna hebecarpa	American Senna	■	■	P		■	■	FAC	FAC	20,500	0.25	1	T									
Senna marilandica	Maryland Senna	■	■	P	■	■		FAC	FAC	20,500	0.25	1	D,T									
Silphium perfoliatum	Cup Plant	■		P		■		FAC	FAC	100,000	0.35	1	A									
Solidago juncea	Early Goldenrod	■	■	P	■	■		NI	NI	2,500,000	0.01	0.05	D									
Solidago nemoralis	Gray Goldenrod	■	■	P	■	■		NI	NI	1,008,000	0.03	0.1	D									
Solidago patula	Rough-leaved Goldenrod	■		P			■	OBL	OBL	700,000	0.05	0.15										
Solidago rugosa	Wrinkle-leaf Goldenrod	■	■	P	■	■		FAC	FAC	1,000,000	0.03	0.1	A,D									
Symphyotrichum ericoides	White Heath Aster	■		P	■	■		UPL	FACU	700,000	0.05	0.15										

TABLE 2.4: Selected Characteristics of Native Wildflowers and Legumes

Scientific Name	Common Name	Region [1]		Duration [2]	Moisture [3]			Wetland [4]		Est. Seeds/Lb	PLS Lbs/Ac [5]		Traits [6]	Flowering Period and Flower Color								
		P	CP		D	M	W	AGCP	EMP		Grass Mix	Forb Mix		M	A	M	J	J	A	S	O	N
Symphyotrichum laeve var. *laeve*	Smooth Blue Aster	■	■	P	■	■		UPL	FACU	1,014,000	0.03	0.1	D									
Symphyotrichum lateriflorum var. *lateriflorum*	Calico Aster	■	■	P		■	■	FAC	FACW	750,000	0.04	0.15	D									
Symphyotrichum novae-angliae	New England Aster	■	■	P		■	■	FACW	FACW	1,100,000	0.03	0.1										
Symphyotrichum novi-belgii	New York Aster	■	■	P			■	OBL	FACW	700,000	0.05	0.15										
Symphyotrichum oblongifolium	Aromatic Aster	■		P	■	■		NI	NI	700,000	0.05	0.15										
Symphyotrichum pilosum	White Oldfield Aster	■	■	P	■	■		FAC	FAC	700,000	0.05	0.15	D									
Symphyotrichum prenanthoides	Zigzag Aster	■		P		■		FAC	FAC	700,000	0.05	0.15	D									
Symphyotrichum puniceum	Purple-stemmed Aster	■	■	P			■	OBL	OBL	700,000	0.05	0.15										
Symphyotrichum urophyllum	White Arrowleaf Aster	■	■	P	■	■		NI	NI	700,000	0.05	0.15										
Thalictrum pubescens	Tall Meadow Rue	■	■	P		■	■	FACW	FACW	192,000	0.15	0.6	S									
Tradescantia ohiensis	Ohio Spiderwort	■	■	P		■		FAC	FAC	1,750,000	0.02	0.07	S									
Tradescantia virginiana	Virginia Spiderwort	■	■	P	■	■	■	FAC	FACU	1,750,000	0.02	0.07	D,S									
Verbena hastata	Blue (Swamp) Vervain	■	■	P			■	FAC	FACW	1,500,000	0.02	0.08										
Vernonia noveboracensis	New York Ironweed	■	■	P		■	■	FACW	FACW	300,000	0.1	0.4	S									
Veronicastrum virginicum	Culver's Root	■		P		■	■	FACW	FACU	7,800,000	0.004	0.02										
Zizia aurea	Golden Alexanders	■	■	P		■		FAC	FAC	168,400	0.2	0.7	S									

TABLE 2.4 NOTES:

1. **Region:** The physiographic region where the species usually occurs in Delaware, under natural conditions. P - Piedmont; CP - Coastal Plain.
2. **Dur (Duration):** A – Annual; B – Biennial; P – Perennial.
3. **Moisture:** The amount of moisture the species needs or tolerates, as part of a mix. D - Dry (excessively drained to well-drained soil); M - Mesic (moderately well to somewhat poorly drained soil); W – Wet (poorly to very poorly drained soil).
4. **Wetland:** Wetland indicator status for the Atlantic and Gulf Coastal Plain (AGCP) and Eastern Mountains and Piedmont (EMP).
5. **PLS Lbs/Ac:** The value listed is the seeding rate in pure live seed (PLS) for the individual species within a Grasses with Wildflowers mix (a predominantly grass planting; column header “Grass Mix”) and a Wildflower Meadow mix (a predominantly wildflower planting; column header “Forb Mix”). Rates are based 30 PLS/SF with 3 spp grass and 5 spp forbs at a 75:25 ratio in the Grass Mix, and 30 PLS/SF with 3 spp grass and 10 spp forbs at 10:90 in the Forb Mix.
6. **Traits:** A - Can be aggressive; D - Drought tolerant; S - Shade tolerant; T - Potential toxicity to livestock.

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SECTION 3 - UPLAND HERBACEOUS CONSERVATION PLANTINGS: CRITICAL AREA PLANTINGS

This section contains recommended seed mixes for temporary and permanent herbaceous cover with high plant density. These critical area planting mixes are designed to provide cover that establishes relatively quickly and is very durable. These mixes are typically used on sites that have, or are expected to have, high erosion rates, and on sites with limiting factors that make plants especially difficult to establish (e.g., on construction sites) and/or maintain (e.g., on heavily used areas). Plantings are generally not harvested, hayed, or grazed for agricultural production.

The following tables supplement the applicable conservation practice standards (see Section 1, Table 1.1), and contain additional requirements for species selection, planting rates, and establishment methods, and care in handling and planting of the seed or planting stock.

Selecting Mixes and Establishing Plantings

Refer to Table 3.1 for recommended annual species, seeding rates, and planting dates for temporary cover.

Refer to Table 3.2 to select appropriate permanent herbaceous cover mixes for specific purposes.

Refer to Table 3.3 for recommended permanent herbaceous cover mixes and seeding rates. Other herbaceous species that are native to Delaware, or are introduced and are non-invasive, may also be suitable.

TABLE 3.1: Temporary Seeding for Site Stabilization					
Plant Species	**Seeding Rate [1]**		**Seeding Depth (inches) [2]**	**Recommended Seeding Dates by Plant Hardiness Zone [3]**	**Remarks**
	lbs./ac.	**lbs./ 1,000 sq.ft.**		**7a and 7b**	
Cool-Season Grasses					
Barley *Hordeum vulgare*	96	2.2	0.5 - 1.0	Feb 15 to Apr 30 Aug 15 to Nov 30	
Oats *Avena sativa*	96	2.2	0.5 - 1.0	Feb 15 to Apr 30 Aug 15 to Nov 30	Oats are the recommended nurse crop for warm-season grasses.
Wheat *Triticum aestivum*	120	2.8	0.5 - 1.0	Feb 15 to Apr 30 Aug 15 to Nov 30	
Cereal Rye *Secale cereale*	112	2.8	0.5 - 1.0	Feb 15 to Apr 30 Aug 15 to Dec 15	Cereal rye generally should not be used as a nurse crop, unless planting will occur in very late fall beyond the seeding dates for other temporary seedings. Cereal rye has allelopathic properties that inhibit the germination and growth of other plants. If it must be used as a nurse crop, seed at 1/3 of the listed rate.
Warm-Season Grasses					
Foxtail Millet *Setaria italica*	30	0.7	0.25 - 0.5	May 1 to Aug 14	
Pearl Millet *Pennisetum glaucum*	20	0.5	0.25 - 0.5	May 1 to Aug 14	

TABLE 3.1 NOTES:

1. Seeding rates for the warm-season grasses are in pounds of Pure Live Seed (PLS). Actual planting rates shall be adjusted to reflect percent seed germination and purity, as tested. Adjustments are usually not needed for the cool-season grasses.

   Seeding rates listed above are for temporary seedings, when planted alone. When planted as a nurse crop with permanent seed mixes, use 1/3 of the seeding rate listed above for barley, oats, and wheat. For smaller-seeded grasses (pearl millet, foxtail millet), do not exceed more than 5% (by weight) of the overall permanent seeding mix.

2. For sandy soils, plant seeds at twice the depth listed above.

3. The planting dates listed are averages for each Zone, and may require adjustment to reflect local conditions, especially near the boundaries of the zone.

TABLE 3.2: Recommended Permanent Upland Herbaceous Seeding Mixes for Critical Areas by Site Condition or Purpose

Site Condition or Purpose of the Planting	Recommended Mix (see Table 3.3)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Steep Slopes, Roadsides	✓	✓	✓	◆	✓	◆					◆	✓	✓		
Sand and Gravel Pits, Sanitary Landfills	✓	✓	✓	◆	✓	◆					◆	✓			
Salt-Damaged Areas	◆												✓		
Mine Spoil, Dredged Material, and Spoil Banks	◆		✓	◆	◆										
Utility Rights-of-Way	✓	✓	✓	✓	✓	✓	◆			✓	✓	✓			
Dikes and Dams	◆	◆	✓	◆		✓	✓	◆			✓	✓			
Berms, Low Embankments (<u>not</u> on Ponds)	✓	✓	✓	✓	✓	✓	◆	◆		✓	✓	✓	◆		◆
Pond and Channel Banks, Streambanks, Ditch Plugs	✓	✓	✓	✓	◆	◆	◆			✓	◆		◆		✓
Grassed Waterways, Diversions, Terraces, Spillways	◆				◆	✓	◆		✓		◆				
Bottom of Dry Detention Basins and Swales				◆		◆	◆			◆	✓		✓		✓
Field Borders, Filter Strips	✓	✓	✓	◆	◆	✓	◆	✓	✓	✓	✓	✓	◆		
Vegetated Treatment Areas (for Wastewater Treatment)								✓	◆	◆					
Heavy Use Areas (Grass Loafing Paddocks for Livestock)								✓						✓	
Athletic Fields, Residential and Commercial Lawns							◆	✓	✓		✓				
Recreation Areas (Low to Moderate Maintenance)							✓	✓	✓		✓				

TABLE 3.2 NOTES:

✓ Recommended mix for this site condition or purpose.

◆ Alternative mix, depending on site conditions.

TABLE 3.3: Permanent Upland Herbaceous Cover Mixes: Critical Area Plantings

Mix	Recommended Cultivar	Seeding Rate [1] lbs./ac.	Seeding Rate [1] lbs./ 1,000 SF	Soil Drainage Class [2]	Max. Height (feet)	Maint. Level [3]	Remarks
WARM-SEASON/COOL-SEASON GRASS MIXES							
1. SELECT ONE WARM-SEASON GRASS:							
Switchgrass *Panicum virgatum* **OR**	Blackwell, Carthage, Cave-in-Rock, or Shelter	10	0.23				All species are native to Delaware. Plant this mix with a regular grass drill.
Coastal Panicgrass *Panicum amarum*	Atlantic	10	0.23				
AND ADD:							
Creeping Red Fescue *Festuca rubra*	Dawson, Jasper, Navigator II	15	0.34	E – P	4 - 7	C - D	Creeping Red Fescue is a cool-season grass that will provide erosion protection while the warm-season grass is becoming established.
PLUS ONE OF THE FOLLOWING LEGUMES:							
Partridge Pea *Chamaecrista fasciculata*	Common	1	0.02				Switchgrass, Coastal Panicgrass, the 'Dawson' variety of Creeping Red Fescue, and Partridge Pea are moderately salt-tolerant. Bush Clover and Wild Indigo do not tolerate wet sites.
Round Bush Clover *Lespedeza capitata*	Common	2	0.05				
Wild Indigo *Baptisia tinctoria*	Common	2	0.05				
2. Big Bluestem *Andropogon gerardii*	Niagara or Rountree	6	0.14				All species are native to Delaware.
Indiangrass *Sorghastrum nutans*	Rumsey	6	0.14				The Indiangrass and Bluestems have fluffy seeds. Plant with a specialized native seed drill.
Little Bluestem *Andropogon gerardii*	Aldous or Blaze	4	0.09				
Creeping Red Fescue *Festuca rubra*	Dawson, Jasper, Navigator II	15	0.34	E – MW	6 - 8	C - D	Creeping Red Fescue is a cool-season grass that will provide erosion protection while the warm-season grasses are becoming established.
PLUS ONE OF THE FOLLOWING LEGUMES:							
Partridge Pea *Chamaecrista fasciculata*	Common	1	0.02				
Round Bush Clover *Lespedeza capitata*	Common	2	0.05				
Wild Indigo *Baptisia tinctoria*	Common	2	0.05				
Showy Tick-Trefoil *Desmodium canadense*	Common	1	0.02				

TABLE 3.3: Permanent Upland Herbaceous Cover Mixes: Critical Area Plantings

Mix	Recommended Cultivar	Seeding Rate [1] lbs./ac.	Seeding Rate [1] lbs./ 1,000 SF	Soil Drainage Class [2]	Max. Height (feet)	Maint. Level [3]	Remarks
WARM-SEASON/COOL-SEASON GRASS MIXES							
3. SELECT THREE GRASSES:							
Deertongue *Dichanthelium clandestinum*	Tioga	20	0.46				Excellent for excessively droughty, low pH (acidic) soils.
Sheep Fescue *Festuca ovina* **OR**	Bighorn	20	0.46				Sheep Fescue, Canada Wildrye, and Redtop are cool-season grasses that will provide erosion protection while the warm-season grass (Deertongue) is becoming established.
Canada Wildrye *Elymus canadensis*	Common	5	0.11				
Rough Bentrgrass *Agrostis scabra* **OR**	Common	1	0.02				
Redtop *Agrostis gigantea*	Streaker	1	0.02	E - MW	4 - 6	C - D	Rough Bentrgrass and Redtop are quick to establish. Rough Bentgrass is native; Redtop is introduced.
PLUS ONE OF THE FOLLOWING LEGUMES:							
Maryland Senna *Senna marilandica*	Common	0.25	0.006				
Round Bush Clover *Lespedeza capitata*	Common	2	0.05				
Wild Indigo *Baptisia tinctoria*	Common	2	0.05				
4. Deertongue *Dichanthelium clandestinum*	Tioga	15	0.34				
Creeping Red Fescue *Festuca rubra*	Dawson, Jasper, Navigator II	20	0.46				Use Virginia Wildrye on moist, shady sites.
Virginia Wildrye *Elymus virginicus* **OR**	Common	5	0.11				
Canada Wildrye *Elymus canadensis*	Common	5	0.11	W - P	2 - 3	C - D	Use Canada Wildrye on droughty sites.
PLUS ONE OF THE FOLLOWING LEGUMES:							
American Senna *Senna hebecarpa*	Common	0.25	0.006				
Panicled Tick-trefoil *Desmodium paniculatum*	Common	2	0.05				
Round Bush Clover *Lespedeza capitata*	Common	2	0.05				

TABLE 3.3: Permanent Upland Herbaceous Cover Mixes: Critical Area Plantings

Mix	Recommended Cultivar	Seeding Rate [1] lbs./ac.	Seeding Rate [1] lbs./ 1,000 SF	Soil Drainage Class [2]	Max. Height (feet)	Maint. Level [3]	Remarks
COOL-SEASON GRASS MIXES							
5. SELECT ONE GRASS:							Either Creeping Red Fescue or Hard Fescue can be used in heavy shade. Use Hard Fescue for sites in full sun and/or with droughty soils.
Creeping Red Fescue *Festuca rubra* **OR**	Dawson, Jasper, Navigator II	20	0.46				
Hard Fescue *Festuca brevipila* (formerly *Festuca trachyphylla)*	Beacon, Gotham Spartan II, Sword	20	0.46				Perennial Ryegrass, Rough Bentgrass, and Redtop will establish more rapidly than either fescue. Rough Bentgrass and Redtop tolerate wet sites better than Ryegrass.
PLUS ONE OTHER GRASS:							
Perennial Ryegrass *Lolium perenne*	Recommended DE turf-types [4]	10	0.23	E - SP	2 - 3	C - D	Rough Bentgrass is native; Redtop is introduced.
Rough Bentgrass *Agrostis scabra*	Common	2	0.05				Flatpea will suppress woody vegetation. It should be planted in the spring or as a dormant seeding in late fall or winter. It may not be winter-hardy if planted late summer - fall. Caution: Flatpea can spread aggressively, and can be toxic to livestock.
Redtop *Agrostis gigantea*	Streaker	2	0.05				
OPTIONAL ADDITION:							
Flatpea *Lathyrus sylvestris*	Lathco	15	0.34				
6. Tall Fescue *Schedonorus arundinaceus* (formerly *Festuca arundinacea)*	Refer to Note 4 at the end of this table.	65	1.49				Tall Fescue produces a dense turf if frequently mowed, but tends to be clumpy if mowed only occasionally.
PLUS ONE OTHER GRASS:							
Perennial Ryegrass *Lolium perenne* **OR**	Recommended DE turf-types [4]	5	0.11	W - SP	2 - 3	C - D	Redtop tolerates moist sites better than Perennial Ryegrass. Either one will grow rapidly and provide erosion control while Tall Fescue becomes established.
Redtop *Agrostis gigantea*	Streaker	2	0.05				
PLUS ONE OF THE FOLLOWING LEGUMES:							
Showy Tick Trefoil *Desmodium canadense*	Common	1	0.02				Showy Tick-Trefoil is a native legume; White Clover is introduced.
White Clover *Trifolium repens*	Common	5	0.11				
7. Creeping Red Fescue *Festuca rubra*	Dawson, Jasper, Navigator II	30	0.69				Good mix for cool, shady sites. Can be frequently mowed.
Kentucky Bluegrass *Poa pratensis*	Recommended DE turf-types [4]	15	0.34	W - MW	1 - 2	A - D	Where erosion is a concern during stand establishment, add Perennial Ryegrass or Redtop at the rate shown for Mix 6. If desired, a legume may also be added as per Mix 6.

TABLE 3.3: Permanent Upland Herbaceous Cover Mixes: Critical Area Plantings

Mix	Recommended Cultivar	Seeding Rate [1] lbs./ac.	Seeding Rate [1] lbs./ 1,000 SF	Soil Drainage Class [2]	Max. Height (feet)	Maint. Level [3]	Remarks
COOL-SEASON GRASS MIXES							
8. Tall Fescue *Schedonorus arundinaceus* (formerly *Festuca arundinacea)*	Refer to Note 4 at the end of this table.	100	2.29	E - SP	2 - 3	A - C	Suitable for highly managed turf areas when planted as a single species at this seeding rate. Higher rates may be specified for athletic fields and lawns. For best results, recommend using a blend of 3 turf-type cultivars. Use endophyte-friendly cultivars in areas where livestock may graze.
9. Tall Fescue *Schedonorus arundinaceus*	Refer to Note 4 at the end of this table.	60	1.38				Suitable for highly managed turf areas and for low maintenance sites. Higher seeding rates may be specified for athletic fields and lawns.
AND ADD ONE OF THE FOLLOWING:							
Creeping Red Fescue *Festuca rubra* **OR**	Dawson, Jasper, Navigator II	20	0.46				Tall Fescue produces a dense turf if frequently mowed, but tends to be clumpy if mowed only occasionally. Kentucky Bluegrass does not perform well on hot, dry sites without frequent watering. For best results, use a blend of 3 cultivars each for Tall Fescue and Kentucky Bluegrass.
Kentucky Bluegrass *Poa pratensis*	Recommended DE turf-types [4]	5	0.11				
PLUS ONE OTHER GRASS:				W - SP	2 - 3	A - D	
Perennial Ryegrass *Lolium perenne* **OR**	Recommended DE turf-types [4]	5	0.11				
Redtop *Agrostis gigantea*	Streaker	2	0.05				Perennial Ryegrass is generally not recommended for inclusion in highly managed turf where it is more susceptible to fungal diseases. However, its use may be justified for erosion control during stand establishment.
10. Orchardgrass *Dactylis glomerata*	Any	25	0.57				Orchardgrass may not persist on sites that lack sufficient soil moisture and/or nutrients.
Creeping Red Fescue *Festuca rubra*	Dawson, Jasper, Navigator II	10	0.23				
Redtop *Agrostis gigantea*	Streaker	2	0.05	W - SP	2 - 3	C - D	
Alsike Clover *Trifolium hybridum*	Common	3	0.07				
White Clover *Trifolium repens*	Common	3	0.07				Omit the clovers if using this mix for vegetated treatment areas.

TABLE 3.3: Permanent Upland Herbaceous Cover Mixes: Critical Area Plantings

Mix	Recommended Cultivar	Seeding Rate [1] lbs./ac.	Seeding Rate [1] lbs./ 1,000 SF	Soil Drainage Class [2]	Max. Height (feet)	Maint. Level [3]	Remarks
COOL-SEASON GRASS MIXES							
11. Creeping Red Fescue *Festuca rubra*	Dawson, Jasper, Navigator II	15	0.34				Suitable mix for shady turf area. Higher seeding rates may be specified for athletic fields and lawns.
Chewings Fescue *Festuca rubra* ssp.*fallax*	Fairmont, Intrigue 2, Longfellow 3, Radar, Treazure II, Wrigley 2, Zodiac	15	0.34				Add Rough Bluegrass in moist, shady conditions only.
Kentucky Bluegrass *Poa pratensis*	Recommended DE turf-types [4]	10	0.23	E - MW	2 - 3	B - D	Where erosion is a concern during stand establishment, add Perennial Ryegrass or Redtop at the rate shown for Mix 9. Perennial Ryegrass is generally not recommended for inclusion in highly managed turf where it is more susceptible to fungal diseases. However, its use may be justified when needed for erosion control.
OPTIONAL ADDITION:							
Rough Bluegrass *Poa trivialis*	Laser, Saber	15	0.34				
12. Creeping Red Fescue *Festuca rubra*	Dawson, Jasper, Navigator II	15	0.34				Attractive mix of fine fescues and wildflowers for low maintenance conditions. Once well established, the grasses may tend to outcompete the wildflowers. On sites where erosion is not a concern and wildlfowers will be planted, grasses may be seeded at 1/3 of the listed rate.
Hard Fescue *Festuca brevipila* (formerly *Festuca trachyphylla)*	Beacon, Gotham Spartan II, Sword	15	0.34				
Sheep Fescue *Festuca ovina*	Bighorn	15	0.34				
Perennial Ryegrass *Lolium perenne*	Recommended DE turf-types [4]	5	0.11				
AND ADD WILDFLOWER MIX:							Wildflowers are best established by broadcasting and cultipacking on a prepared seedbed. Drilling can be also used, but care must be taken so that seeds are not drilled too deep. Hydroseeding is not recommended for this mix if wildflowers are used because their seeds are very small.
Black-eyed Susan *Rudbeckia hirta*	Common	2	0.05	E - MW	2 - 3	C - D	
Golden Tickseed *Coreopsis tinctoria*	Common	2	0.05				
Wild Bergamot *Monarda fistulosa*	Common	2	0.05				
Partridge Pea *Chamaecrista fasciculata*	Common	1	0.02				
OR ADD CLOVER MIX:							
White Clover *Trifolium repens*	Common	3	0.07				
Red Clover *Trifolium pratense*	Any	3	0.07				

TABLE 3.3: Permanent Upland Herbaceous Cover Mixes: Critical Area Plantings							
Mix	**Recommended Cultivar**	**Seeding Rate [1]**		**Soil Drainage Class [2]**	**Max. Height (feet)**	**Maint. Level [3]**	**Remarks**
		lbs./ac.	**lbs./ 1,000 SF**				
COOL-SEASON GRASS MIXES							
13. Alkali Saltgrass *Puccinellia distans*	Fults or Salty	20	0.46	W - P	2 - 3	B - D	This is the recommended mix for saline sites. Saltgrass will persist only under saline conditions.
Creeping Red Fescue *Festuca rubra*	Dawson	15	0.34				For best results, use only the 'Dawson' variety of Creeping Red Fescue. It is a salt-tolerant variety.
Fowl Meadowgrass *Poa palustris*	Common	2	0.05				
OPTIONAL ADDITION:							
Creeping Bentgrass *Agrostis stolonifera*	Seaside	2	0.05				Add Bentgrass for wetter conditions.
WARM-SEASON GRASS							
14. Bermudagrass *Cynodon dactylon*	Quickstand, Patriot, Tufcote	Plant sprigs at 25 - 40 bu./ac.	Plant sprigs at 0.57 – 0.92 bu./1000 SF	W - SP	1 - 2	B - D	Suitable for summer heavy use areas for livestock. Caution: Can spread rapidly into adjacent cool-season plantings. Broadcast sprigs on a prepared seedbed. Lightly disk (1-2 inches) to incorporate, and follow with a field roller or cultipacker to firm the soil. One bushel (1.25 cu. ft.) contains approx. 1,000 plants.

TABLE 3.3: Permanent Upland Herbaceous Cover Mixes: Critical Area Plantings							
Mix	**Recommended Cultivar**	**Seeding Rate [1]**		**Soil Drainage Class [2]**	**Max. Height (feet)**	**Maint. Level [3]**	**Remarks**
		lbs./ac.	**lbs./ 1,000 SF**				
NATIVE GRASS-SEDGE-FORB MIX							
15. Riverbank Wildrye *Elymus riparius*	Common	10	0.23	MW - P	4 - 5	D	This mix is recommended for soil stabilization of earthen structures, such as ditch plugs, and disturbed areas within and adjacent to floodplains and wetlands. Primarily a native cool-season grass mix with wildflowers and legumes. Redtop Panicgrass is a native warm-season grass. Most species in this mix are tolerant of partial shade, but are also suitable for full sun. On the Coastal Plain, substitute Slender Woodoats for River Oats. Beaked Panicgrass can be substituted for Redtop Panicgrass on the Coastal Plain. If a wildflower is not available, double the rate of one of the other wildflowers in the mix (not Partridge Pea). For example, if Joe-Pye Weed is not available, Boneset could be substituted at a rate of 0.2 lb/ac.
Virginia Wildrye *Elymus virginicus*	Common	10	0.23				
Redtop Panicgrass *Panicum rigidulum*	Common	2	0.05				
River Oats *Chasmanthium latifolium*	Common	2	0.05				
Rough Bentgrass *Agrostis scabra*	Common	1	0.02				
Fox Sedge *Carex vulpinoidea*	Common	2	0.05				
Blue (Swamp) Vervain *Verbena hastata*	Common	0.2	0.005				
Boneset *Eupatorium perfoliatum*	Common	0.1	0.002				
Bur Marigold *Bidens aristosa*	Common	1.4	0.03				
Joe-Pye Weed *Eutrochium fistulosum*	Common	0.1	0.002				
Narrow-leaf Mountain Mint *Pycnanthemum tenuifolium*	Common	0.1	0.002				
Partridge Pea *Chamaecrista fasciculata*	Common	1	0.02				
Wild Bergamot *Monarda fistulosa*	Common	0.1	0.002				

TABLE 3.3 NOTES:

1. Seeding rates for native grasses, sedges, legumes, and other wildflowers are in pounds of Pure Live Seed (PLS). Order seed from the supplier based on the PLS rate; the seed supplier will adjust the bulk amount to be planted based on percent seed germination and purity, as tested.

Adjustments are not usually needed for the introduced grasses and legumes. However, be aware that some seed may be polymer-coated. This coating can double the weight of the seed, so that a bag of seed may contain only 50% seed by weight (e.g., a 10-pound bag of grass seed may contain only 5 pounds of seed, with the other 5 pounds consisting of the polymer coating). Be sure to read the seed analysis label when purchasing seed, and adjust the per acre weight to be planted accordingly.

Legume seeds shall be inoculated before planting with the appropriate *Rhizobium* bacteria. When feasible, hard-seeded legumes should be scarified to improve germination.

2. Soil Drainage Class (refer to the county soil survey for further information):
E - Excessively Drained; W - Well Drained; MW - Moderately Well Drained; SP - Somewhat Poorly Drained; P - Poorly Drained.

3. Maintenance Level:

A - Intensive mowing (every 2 - 4 days), fertilization, lime, insect and weed control, and watering (examples: high maintenance lawns and athletic fields);
B - Frequent mowing (every 4 - 7 days), occasional fertilization, lime, pest control, and watering (examples: residential, school, and commercial lawns);
C - Periodic mowing (every 7 - 14 days), occasional fertilization and lime (examples: residential lawns, parks);
D - Infrequent or no mowing, fertilization, or lime after the first year of establishment (examples: wildlife areas, roadsides, steep banks).

4. Select turf-type cultivars of Tall Fescue, Kentucky Bluegrass, Perennial Ryegrass, and Fine-leaf Fescues based on recommendations from the University of Delaware Extension. http://extension.udel.edu/factsheets/turfgrass-selections-for-delaware/ The use of recommended cultivars usually results in a grass stand of higher quality and density, greater drought tolerance, lower nutrient requirements, and fewer pest problems. Cultivars developed for other regions of the country or for forage may be also used, but they may not perform as well as the recommended turf-types in a critical area planting.

Tall Fescue: Where livestock may be allowed to graze (e.g., heavy use grass loafing paddocks), use tall fescue varieties that are are novel endophyte-infected or endophyte-free to avoid livestock health problems due to endophyte toxicity. Tall fescue with the novel endophyte is not toxic to livestock, and has the adaptive advantages of being more resistant to drought, disease, and insects than endophyte-free varieties. Please note that endophyte levels in plantings can vary between varieties, between fields of the same variety, and with the time of year.

For areas where livestock will not have access, tall fescue varieties with higher endophyte levels are preferable because they tend to be more drought tolerant and more resistant to disease and insect damage. Most turf-type tall fescue varieties have high endophyte levels, as does 'Kentucky 31' tall fescue (originally selected as a forage variety).

Certified varieties of endophyte-infected tall fescue may be used for stockpile grazing (i.e., winter grazing) when the risk of endophyte toxicity is much reduced.

TABLE 3.4: Quality of Seed					
Species	**Minimum Seed Purity (%)**	**Minimum Seed Germination (%)**	**Species**	**Minimum Seed Purity (%)**	**Minimum Seed Germination (%)**
COOL-SEASON GRASSES			***WARM-SEASON GRASSES***		
Barley	98	85	Bluestem, Big	60	60
Bentgrass, Creeping	95	85	Bluestem, Little	55	60
Bluegrass, Canada	90	80	Deertongue	95	75
Bluegrass, Kentucky	90	80	Indiangrass	60	60
Bluegrass, Rough	90	80	Millet, Foxtail or Pearl	98	80
Fescue, Chewings	95	85	Panicgrass, Coastal	95	70
Fescue, Creeping Red	95	85	Switchgrass	95	75
Fescue, Hard	95	85	Other native WSGs	--	--
Fescue, Sheep	95	85	***LEGUMES/FORBS***		
Fescue, Tall	95	85	Clover, Alsike	99	85
Oats	98	85	Clover, Red	99	85
Orchardgrass	90	80	Clover, White	98	90
Redtop	92	80	Flatpea	98	75
Rye, Cereal	98	85	Pea, Partridge	98	70
Ryegrass, Annual or Perennial	95	85	Other native legumes	--	--
Saltgrass, Alkali	85	80	Trefoil, Birdsfoot	98	85
Wheat	98	85	Wildflowers	--	--
Wild Rye, Canada	85	70			
Other native CSGs	--	--			

TABLE 3.4 NOTE:

1. All seed shall comply with the Delaware State Seed Law. Seed shall be free of prohibited or restricted noxious weeds, as currently listed by the Delaware Department of Agriculture, Plant Industries Section.

SECTION 4 - TREE AND SHRUB PLANTINGS

This section contains recommended trees and shrubs (and several woody vines) that can be planted for native cover, hedgerows, windbreaks/shelterbelts, forest production, wetland restoration, and other purposes.

Selecting Species and Establishing Plantings

The following tables supplement the applicable conservation practice standards (see Section 1, Table 1.1), and contain additional requirements for species selection, planting rates, and establishment methods.

Plant materials shall comply with minimum standards, such as those as established by the American Nursery and Landscape Association or U.S. Forest Service.

The following tables provide recommended planting rates and/or spacing for specific uses:

- Table 4.1 - Planting rates for trees, shrubs, and tree/shrub mixes for wildlife habitat and water quality purposes.

- Table 4.2 - Spacing for hedgerow plantings, except around poultry houses. For hedgerows around poultry houses, especially in fan impact areas, refer to the appropriate Delaware NRCS 422 Hedgerow Planting Fact Sheets (*Warm-Season Grasses for Poultry Houses* and *Trees and Shrubs for Poultry Houses)* for spacing requirements.

- Table 4.3 - Spacing for windbreak/shelterbelt plantings.

- Table 4.4 - Number of rows and type of plants needed to meet windbreak/shelterbelt density requirements.

Refer to the following tables to select appropriate species of deciduous trees, evergreen trees, shrubs (mostly multi-stemmed plants, ≤15 feet tall at 20 years of age), and woody vines:

- Table 4.5 - Provides a quick reference for selecting species based on site conditions, specific uses, and other factors.

- Table 4.6 - Provides more detailed information about each species.

Other woody species that are native to Delaware, or are introduced and are non-invasive, may also be suitable.

Refer to the Delaware NRCS Fact Sheets *Trees and Shrubs: Establishing and Maintaining Bare-root Seedlings* and *Trees and Shrubs: Establishing and Maintaining Containerized and Balled and Burlapped Plants* for planting, establishment, and maintenance recommendations.

For hedgerows around poultry houses, refer to the appropriate Delaware NRCS 422 Hedgerow Planting Fact Sheets (*Warm-Season Grasses for Poultry Houses* and *Trees and Shrubs for Poultry Houses*) for recommended species, planting, establishment, and maintenance recommendations.

TABLE 4.1: Planting Rates for Trees, Shrubs, and Tree & Shrub Mixes for Native Cover Plantings (Wildlife Habitat and Water Quality)

Step 1: Identify the primary purpose of the planting and its associated establishment goal. The establishment goal is the number of trees and/or shrubs expected to survive two years after planting.

Step 2: Determine the planting rate based on the type of planting stock used and the expected survival rate. (For more details, refer to the Note at the end of this table.) Use the information listed below as a guide to determine the number of plants needed per acre.

Primary Purpose	Establishment Goal (number of trees and/or shrubs per acre after two years)	Type of Planting Stock	Planting Rate [1/] (per acre)	Number of Plants Needed (per acre) for Standard Spacing (in feet)	Remarks
Create or Enhance Wildlife Habitat	200 - 300	Bare-root seedlings	308 - 462	363 plants at 10 x 12 436 plants at 10 x 10	Where trees and/or shrubs will be used to provide wildlife cover within or adjacent to herbaceous areas, they should be planted in groups so that the woody cover area is at least 20 feet wide and at least 400 sq. ft. in size.
		Containerized (1 gallon or larger)	211 - 316	302 plants at 12 x 12	
Reduce Soil Erosion and/or Improve Water Quality	300 - 400	Bare-root seedlings	462 - 615	544 plants at 8 x 10	Recommend using Mix 12 from Table 2.2 as a ground cover on highly erodible land and on other land where erosion is a concern.
		Containerized (1 gallon or larger)	316 - 421	363 plants at 10 x 12	

TABLE 4.1 NOTE:

1. The planting rate is determined by dividing the establishment goal by the expected survival rate. For example, if the establishment goal is 300 - 400, and the expected survival rate is 65% (0.65), then the planting rate is 462 - 615. The planting rates in this table are based on estimated survival rates of 65% for bare-root seedlings and 95% for containerized stock. It may be necessary to adjust planting rates if survival is expected to be significantly different than the 65% or 95% rates.

After a planting is established, the long-term density goal for trees is often determined by basal area (i.e., the cross-sectional area of trees measured at 4.5 feet above the ground). Consult with a licensed professional forester to determine the appropriate basal area (typically, in square feet per acre) or stand density (trees per acre) for a specific site.

TABLE 4.2: Hedgerows - Recommended Spacing [1/]		
Plant Type	**Spacing (in feet) Within and Between Rows for:**	
	Visual Screens and Physical Barriers	**Wildlife Habitat, Landscaping, and Other Uses**
Perennial Bunch Grasses	1 - 2	2 - 4
Perennial Forbs (as plugs - optional companion plantings with bunch grasses, trees, and/or shrubs)	N/A	2
Shrubs [2/]	2 - 4	4 - 8
Deciduous Trees	6 - 12	8 - 14
Evergreen Trees	6 - 10	8 - 14

TABLE 4.2 NOTES:

1. Within a row, use only one species, or select a mix of species that have similar growth forms and growth rates. Use staggered spacing in multiple row plantings. Plant taller-growing trees or shrubs in center rows, and medium or lower growing species in outer rows. Or, for a more "natural appearing" effect, intersperse trees, shrubs, grasses, and forbs in the hedgerow. **For hedgerows around poultry houses, especially in fan impact areas, refer to the Delaware NRCS 422 Hedgerow Planting Fact Sheets *Warm-Season Grasses for Poultry Houses* and *Trees and Shrubs for Poultry Houses* for spacing requirements**.

2. Use a spacing of 2 feet between rows if drilling seeds of leguminous shrubs.

TABLE 4.3: Windbreaks/Shelterbelts - Recommended Spacing [1/]			
Plant Type	**Spacing (feet) Within Rows**		**Spacing (feet) Between Rows**
	Single Row	*Multiple Rows*	
Small Shrubs (4 – 12 feet tall)	3 - 5	4 - 6	10 - 15
Large Shrubs and Small Deciduous Trees (12 – 30 feet tall)	6 - 8	8 - 10	10 - 20
Large Deciduous Trees (more than 30 feet tall)	10 - 12	12 - 14	15 - 20
Evergreen Trees (columnar form)	6 - 8	8 - 10	10 - 20
Evergreen Trees (conical and broad forms)	8 - 10	10 - 14	15 - 20

TABLE 4.3 NOTE:

1. Use spacings at or near the lower end of the range to create a dense barrier in a shorter period of time. Spacing between rows shall be at least four feet wider than the mechanized maintenance equipment used, and may be increased beyond what is shown in this table to accommodate the equipment. Where space (width) is limited and a two-row planting is needed to meet density requirements, the same spacing within and between rows may be used with staggered plantings.

TABLE 4.4: Windbreaks/Shelterbelts - Number of Rows and Type of Plants to Meet Density Requirements		
Purpose	**Required Density and Location of Planting [1/]**	**Minimum Number of Rows and Type of Plants [2/]**
Provide shelter for structures, animals, and people	At least 65%; upwind and within 10H of area to be protected	Plant two rows of medium and/or high density species. If year-round protection is needed, use at least one row of evergreens.
Improve air quality (reduce airborne particulates, chemicals, odors)	At least 50%; upwind and within 10H of the source area	Plant one row of medium and/or high density species, or two rows of low density species. If year-round protection is needed, use at least one row of evergreens.
	At least 65%; downwind and within 10H of the source area	Plant two rows of medium and/or high density species. If year-round protection is needed, use at least one row of evergreens.
Noise screens	At least 65%; downwind as close to the noise source as feasible	Plant two rows of medium and/or high density species. Select species with a mature height that is as tall as the noise source as feasible. If year-round protection is needed, use at least one row of evergreens. Plant as close together as practical to form a tight barrier.
Visual screens	Dense enough to block the view; located as close to the observer as possible	For year-round screening, plant one row of evergreens. Alternatively, one row of densely branched deciduous species may be sufficient to provide the desired amount of screening.
Reduce energy use; reduce wind erosion; improve irrigation efficiency; increase carbon storage	Density and location as appropriate for the purpose	Minimum one row. Select plants with a mature height that will be taller than the structures or crops to be protected. For carbon sequestration, design the windbreak to maximize above and below ground biomass production. Refer to Additional Criteria in the Windbreak Shelterbelt Establishment (380) standard for specific requirements.
Manage snow	25 to 50%; within 20H upwind of an area for snow distribution	Plant one row of low, medium, or high density species to distribute snow across a field or other area. To achieve the overall specified density, use a closer spacing for low density species, and wider spacing for high density species.
	At least 50%; within 20H upwind of an area for snow accumulation	Plant one row of medium and/or high density species, or two rows of low density species to reduce wind velocities sufficiently for snow to accumulate within 100-200 feet on the downwind side of the windbreak.
Enhance wildlife and/or pollinator habitat	Density and location as appropriate for the primary purpose	Minimum two rows for wildlife; one row can be used for pollinators. Select trees and/or shrubs that will provide food, nesting cover, and/or protective cover for the desired wildlife species or pollinators. Refer to Additional Criteria in the Windbreak Shelterbelt Establishment (380) standard for specific requirements.

TABLE 4.4 NOTES:

1. The maximum design height (H) for the windbreak is the expected height of the tallest row of trees or shrubs in 20 years. Select species with an appropriate mature height to provide protection.

2. For higher levels of protection (at a density $\geq$50%), use at least three rows of trees and shrubs, with at least one row being evergreen trees. Refer to Table 4.6 for the summer and winter densities of each species.

TABLE 4.5: Recommended Trees, Shrubs, and Woody Vines for Selected Uses (see Table 4.6 for detailed species information)

Plant Names	Region [1/]		Moisture [2/]			Native to Delaware	Habitat Use Characteristics [3/]								Hedgerows and Windbreaks [4/]			Wetlands (surface saturation/ infrequent inundation)	Wetlands (surface saturation/ frequent or prolonged inundation)
							Cover		Fruit/Seed Consumption			Pollinator Food							
	Piedmont	Coastal Plain	Dry Sites	Mesic Sites	Wet Sites		Nesting/ Resting	Protection	Wildlife (H)	Wildlife (M)	Humans	Nectar/ Pollen	Foliage	Toxic to Livestock	Wildlife Habitat	Screens/ Barriers	Poultry		
DECIDUOUS TREES																			
ASH, GREEN *Fraxinus pennsylvanica*	■	■		■	■	■	■			■			■			■		■	
ASH, WHITE *Fraxinus americana*	■	■	■	■		■	■			■			■			■			
ASPEN, LARGE-TOOTHED *Populus grandidentata*	■	■	■	■		■	■						■						
BASSWOOD, AMERICAN *Tilia americana*	■	■	■	■		■	■					■				■			
BEECH *Fagus grandifolia*	■	■	■	■		■	■		■		■		■			■			
BIRCH, RIVER *Betula nigra*	■	■	■	■	■	■	■			■			■					■	
BLACKGUM *Nyssa sylvatica*	■	■	■	■	■	■	■			■		■				■		■	
BOX-ELDER *Acer negundo*	■	■		■	■	■	■			■						■		■	
BUTTERNUT *Juglans cinerea*	■			■		■	■			■	■		■	■		■			
CHERRY, BLACK *Prunus serotina*	■	■	■	■		■	■		■		■	■	■	■		■			
CHESTNUT, AMERICAN *Castanea dentata*	■	■	■	■		■	■		■		■		■						
CHINQUAPIN *Castanea pumila*		■	■	■		■	■			■	■		■		■	■			
CHOKECHERRY *Prunus virginiana*	■		■	■		■	■		■		■	■	■	■	■	■			
COTTONWOOD, EASTERN *Populus deltoides*	■	■	■	■	■	■	■									■		■	
CRABAPPLE, SOUTHERN *Malus angustifolia*		■	■	■		■	■		■		■	■	■		■	■			

TABLE 4.5: Recommended Trees, Shrubs, and Woody Vines for Selected Uses (see Table 4.6 for detailed species information)

Plant Names	Region [1/]		Moisture [2/]			Native to Delaware	Habitat Use Characteristics [3/]								Hedgerows and Windbreaks [4/]			Wetlands (surface saturation/ infrequent inundation)	Wetlands (surface saturation/ frequent or prolonged inundation)
							Cover		Fruit/Seed Consumption			Pollinator Food							
	Piedmont	Coastal Plain	Dry Sites	Mesic Sites	Wet Sites		Nesting/ Resting	Protection	Wildlife (H)	Wildlife (M)	Humans	Nectar/ Pollen	Foliage	Toxic to Livestock	Wildlife Habitat	Screens/ Barriers	Poultry		
DECIDUOUS TREES																			
CRABAPPLE, SWEET *Malus coronaria*	■	■	■	■		■	■		■		■	■	■		■	■			
CYPRESS, BALD *Taxodium distichum*		■		■	■	■	■									■	■		■
DOGWOOD, FLOWERING *Cornus florida*	■	■	■	■		■	■		■			■			■				
DOGWOOD, PAGODA *Cornus alternifolia*	■	■	■	■		■	■		■			■			■				
ELM, AMERICAN *Ulmus americana*	■	■	■	■	■	■	■						■			■	■	■	
ELM, SLIPPERY *Ulmus rubra*	■	■	■	■	■	■	■						■			■		■	
HACKBERRY *Celtis occidentalis*	■	■	■	■		■	■		■		■	■	■		■	■	■		
HACKBERRY, SMALL'S *Celtis laevigata* var. *smallii*		■	■	■	■		■		■		■	■	■		■	■	■		
HAWTHORN, COCKSPUR *Crataegus crus-galli*	■	■	■	■		■	■			■	■	■			■	■			
HAWTHORN, GREEN *Crataegus viridis*		■		■	■	■	■			■	■	■			■	■		■	
HICKORY, BITTERNUT *Carya cordiformis*	■	■		■	■	■	■						■			■		■	
HICKORY, MOCKERNUT *Carya tomentosa*	■	■	■	■		■	■		■		■		■			■			
HICKORY, PIGNUT *Carya glabra*	■	■	■	■		■	■			■			■			■			
HICKORY, SHAGBARK *Carya ovata*	■	■	■	■		■	■		■		■		■			■			
HONEYLOCUST *Gleditsia triacanthos*	■	■	■	■			■					■	■			■	■		

TABLE 4.5: Recommended Trees, Shrubs, and Woody Vines for Selected Uses (see Table 4.6 for detailed species information)

Plant Names	Region [1/]		Moisture [2/]			Native to Delaware	Habitat Use Characteristics [3/]								Hedgerows and Windbreaks [4/]			Wetlands (surface saturation/ infrequent inundation)	Wetlands (surface saturation/ frequent or prolonged inundation)
							Cover		Fruit/Seed Consumption			Pollinator Food							
	Piedmont	Coastal Plain	Dry Sites	Mesic Sites	Wet Sites		Nesting/ Resting	Protection	Wildlife (H)	Wildlife (M)	Humans	Nectar/ Pollen	Foliage	Toxic to Livestock	Wildlife Habitat	Screens/ Barriers	Poultry		
DECIDUOUS TREES																			
HOP-HORNBEAM *Ostrya virginiana*	■		■	■		■	■			■						■			
HORNBEAM, AMERICAN *Carpinus caroliniana*	■	■		■	■	■	■			■						■		■	
LOCUST, BLACK *Robinia pseudoacacia*	■	■	■				■					■		■		■	■		
MAGNOLIA, SWEETBAY *Magnolia virginiana*		■		■	■	■	■			■		■			■	■		■	
MAPLE, RED *Acer rubrum*	■	■	■	■	■	■	■			■		■	■	■		■	■		■
MAPLE, SILVER *Acer saccharinum*	■			■	■	■	■			■		■	■			■			■
MULBERRY, RED *Morus rubra*	■	■	■	■		■	■		■		■					■			
OAK, BLACK *Quercus velutina*	■	■	■	■		■	■		■				■	■		■			
OAK, BLACKJACK *Quercus marilandica*	■	■	■			■	■		■				■	■		■			
OAK, CHERRYBARK *Quercus pagoda*		■			■	■	■		■				■	■		■		■	
OAK, CHESTNUT *Quercus montana* (*Q. prinus)*	■	■	■			■	■		■		■		■	■		■			
OAK, CHINQUAPIN *Quercus muehlenbergii*	■		■			■	■		■		■		■	■		■			
OAK, NORTHERN RED *Quercus rubra*	■	■	■	■		■	■		■				■	■		■			
OAK, OVERCUP *Quercus lyrata*		■		■	■	■	■		■		■		■	■		■			■
OAK, PIN *Quercus palustris*	■	■		■	■	■	■		■				■	■		■		■	

TABLE 4.5: Recommended Trees, Shrubs, and Woody Vines for Selected Uses (see Table 4.6 for detailed species information)

Plant Names	Region [1/]		Moisture [2/]			Native to Delaware	Habitat Use Characteristics [3/]								Hedgerows and Windbreaks [4/]			Wetlands (surface saturation/ infrequent inundation)	Wetlands (surface saturation/ frequent or prolonged inundation)
							Cover		Fruit/Seed Consumption			Pollinator Food							
	Piedmont	Coastal Plain	Dry Sites	Mesic Sites	Wet Sites		Nesting/ Resting	Protection	Wildlife (H)	Wildlife (M)	Humans	Nectar/ Pollen	Foliage	Toxic to Livestock	Wildlife Habitat	Screens/ Barriers	Poultry		
DECIDUOUS TREES																			
OAK, POST *Quercus stellata*	■	■	■	■		■	■		■		■		■	■		■			
OAK, SOUTHERN RED *Quercus falcata*	■	■	■	■		■	■		■				■	■		■			
OAK, SWAMP CHESTNUT *Quercus michauxii*		■		■	■	■	■		■		■		■	■		■		■	
OAK, SWAMP WHITE *Quercus bicolor*		■		■	■	■	■		■		■		■	■		■		■	
OAK, WATER *Quercus nigra*		■		■	■	■	■		■				■	■		■		■	
OAK, WHITE *Quercus alba*	■	■	■	■		■	■		■		■		■	■		■			
OAK, WILLOW *Quercus phellos*		■		■	■	■	■		■				■	■		■		■	
OSAGE-ORANGE *Maclura pomifera*	■	■	■	■			■									■	■		
PAWPAW *Asimina triloba*	■	■		■	■	■	■		■		■		■		■			■	
PECAN *Carya illinoinensis*	■	■	■	■			■		■		■					■			
PERSIMMON, COMMON *Diospyros virginiana*	■	■	■	■	■	■	■		■		■	■			■			■	
PLUM, AMERICAN *Prunus americana*	■	■	■	■		■	■		■		■	■		■	■	■			
POPLAR, HYBRID *Populus deltoides x nigra* 'Spike'	■	■		■			■								■	■			
POPLAR, TULIP *Liriodendron tulipifera*	■	■	■	■		■	■					■	■		■	■			
REDBUD *Cercis canadensis*	■			■		■	■					■			■				

TABLE 4.5: Recommended Trees, Shrubs, and Woody Vines for Selected Uses (see Table 4.6 for detailed species information)

Plant Names	Region [1/]		Moisture [2/]			Native to Delaware	Habitat Use Characteristics [3/]								Hedgerows and Windbreaks [4/]			Wetlands (surface saturation/ infrequent inundation)	Wetlands (surface saturation/ frequent or prolonged inundation)
							Cover		Fruit/Seed Consumption			Pollinator Food							
	Piedmont	Coastal Plain	Dry Sites	Mesic Sites	Wet Sites		Nesting/ Resting	Protection	Wildlife (H)	Wildlife (M)	Humans	Nectar/ Pollen	Foliage	Toxic to Livestock	Wildlife Habitat	Screens/ Barriers	Poultry		
DECIDUOUS TREES																			
REDWOOD, DAWN *Metasequoia glyptostroboides*	■	■		■	■		■									■	■		
SASSAFRAS *Sassafras albidum*	■	■	■			■	■			■	■	■	■		■	■			
SERVICEBERRY, CANADIAN *Amelanchier canadensis*	■	■		■	■	■	■		■		■	■	■		■	■		■	
SERVICEBERRY, COMMON *Amelanchier arborea*	■	■	■	■	■	■	■		■		■	■	■		■	■		■	
SWEETGUM *Liquidambar styraciflua*	■	■		■	■	■	■									■		■	
SYCAMORE *Platanus occidentalis*	■	■		■	■	■	■									■		■	
TUPELO, SWAMP (SWAMP BLACK GUM) *Nyssa biflora*		■		■	■	■	■			■		■				■			■
WALNUT, BLACK *Juglans nigra*	■	■		■		■	■			■	■		■	■					
WILLOW, BLACK *Salix nigra*	■	■		■	■	■	■					■	■			■			■
WILLOW, HYBRID *Salix matsudana x alba* ‘Austree’	■	■	■	■	■		■	■								■	■		
WILLOW, PURPLEOSIER *Salix purpurea* ‘Streamco’	■	■		■	■		■	■								■	■		

TABLE 4.5: Recommended Trees, Shrubs, and Woody Vines for Selected Uses (see Table 4.6 for detailed species information)

Plant Names	Region [1/]		Moisture [2/]			Native to Delaware	Habitat Use Characteristics [3/]								Hedgerows and Windbreaks [4/]			Wetlands (surface saturation/ infrequent inundation)	Wetlands (surface saturation/ frequent or prolonged inundation)
							Cover		Fruit/Seed Consumption			Pollinator Food							
	Piedmont	Coastal Plain	Dry Sites	Mesic Sites	Wet Sites		Nesting/ Resting	Protection	Wildlife (H)	Wildlife (M)	Humans	Nectar/ Pollen	Foliage	Toxic to Livestock	Wildlife Habitat	Screens/ Barriers	Poultry		
EVERGREEN TREES																			
ARBORVITAE *Thuja occidentalis*	■		■	■	■		■	■								■	■		
ARBORVITAE *Thuja plicata x standishii* 'Green Giant'	■	■	■	■			■	■								■	■		
CEDAR, ATLANTIC WHITE *Chamaecyparis thyoides*		■		■	■	■	■	■		■						■	■		■
CEDAR, EASTERN RED *Juniperus virginiana*	■	■	■	■		■	■	■							■	■	■		
CYPRESS, LEYLAND *x Cupressocyparis leylandii*	■	■	■	■			■	■								■			
HEMLOCK, EASTERN *Tsuga canadensis*	■	■	■	■		■	■	■		■						■		■	
HOLLY, AMERICAN *Ilex opaca*	■	■	■	■	■	■	■	■		■					■	■	■	■	
PINE, AUSTRIAN *Pinus nigra*	■	■	■	■	■		■	■								■			
PINE, LOBLOLLY *Pinus taeda*		■		■	■	■	■	■		■			■			■		■	
PINE, PITCH *Pinus rigida*	■	■	■	■		■	■	■		■			■			■			
PINE, VIRGINIA *Pinus virginiana*	■	■	■	■		■	■	■		■			■			■			
PINE, WHITE *Pinus strobus*	■	■	■	■			■	■		■			■			■			
SPRUCE, NORWAY *Picea abies*	■	■	■	■			■	■								■	■		

TABLE 4.5: Recommended Trees, Shrubs, and Woody Vines for Selected Uses (see Table 4.6 for detailed species information)

Plant Names	Region [1/]		Moisture [2/]			Native to Delaware	Habitat Use Characteristics [3/]								Hedgerows and Windbreaks [4/]			Wetlands (surface saturation/ infrequent inundation)	Wetlands (surface saturation/ frequent or prolonged inundation)
							Cover		Fruit/Seed Consumption			Pollinator Food							
	Piedmont	Coastal Plain	Dry Sites	Mesic Sites	Wet Sites		Nesting/ Resting	Protection	Wildlife (H)	Wildlife (M)	Humans	Nectar/ Pollen	Foliage	Toxic to Livestock	Wildlife Habitat	Screens/ Barriers	Poultry		
SHRUBS AND WOODY VINES																			
ABELIA, GLOSSY *Abelia x grandiflora*	■	■	■	■			■	■				■				■			
ALDER, SMOOTH *Alnus serrulata*	■	■		■	■	■	■	■	■						■	■			■
ARROWWOOD *Viburnum dentatum*	■	■	■	■	■	■	■	■	■						■	■		■	
AZALEA, SWAMP *Rhododendron viscosum*		■		■	■	■	■					■		■	■			■	
BAYBERRY, NORTHERN *Morella pensylvanica* *(Myrica pensylvanica)*	■	■	■	■	■	■	■	■	■						■	■	■	■	
BEAUTYBERRY, AMERICAN *Callicarpa americana*		■	■	■			■	■	■			■			■	■			
BLACKBERRY, ALLEGHENY *Rubus allegheniensis*	■		■	■		■	■	■	■		■	■			■	■			
BLACKBERRY, SAND *Rubus cuneifolius*		■	■	■		■	■	■	■		■	■			■				
BLACK-HAW *Viburnum prunifolium*	■	■	■	■		■	■	■	■		■				■	■			
BLUEBERRY, HIGHBUSH *Vaccinium corymbosum*	■	■		■	■	■	■	■	■		■	■	■		■	■		■	
BLUEBERRY, LOWBUSH *Vaccinium angustifolium*	■		■	■		■	■	■	■		■	■	■		■				
BUSH, HIGH TIDE (GROUNDSEL) *Baccharis halimifolia*		■		■	■	■	■	■								■		■	
BUSH, HIGH TIDE (MARSH-ELDER) *Iva frutescens*		■		■	■	■	■	■								■		■	
BUTTONBUSH *Cephalanthus occidentalis*	■	■		■	■	■	■	■				■			■	■			■

TABLE 4.5: Recommended Trees, Shrubs, and Woody Vines for Selected Uses (see Table 4.6 for detailed species information)

Plant Names	Region [1/]		Moisture [2/]			Native to Delaware	Habitat Use Characteristics [3/]								Hedgerows and Windbreaks [4/]			Wetlands (surface saturation/ infrequent inundation)	Wetlands (surface saturation/ frequent or prolonged inundation)
							Cover		Fruit/Seed Consumption			Pollinator Food							
	Piedmont	Coastal Plain	Dry Sites	Mesic Sites	Wet Sites		Nesting/ Resting	Protection	Wildlife (H)	Wildlife (M)	Humans	Nectar/ Pollen	Foliage	Toxic to Livestock	Wildlife Habitat	Screens/ Barriers	Poultry		
SHRUBS AND WOODY VINES																			
CHOKEBERRY, BLACK *Aronia melanocarpa*	■		■	■	■	■	■	■		■	■	■			■	■		■	
CHOKEBERRY, RED *Aronia arbutifolia*	■	■	■	■	■	■	■	■		■	■	■			■	■		■	
DEWBERRY, BRISTLY *Rubus hispidus*		■			■	■	■			■	■		■		■			■	
DEWBERRY, COMMON *Rubus flagellaris*	■	■	■	■		■	■			■	■	■							
DOGWOOD, GRAY *Cornus racemosa*	■		■	■		■	■	■	■			■			■	■			
DOGWOOD, REDOSIER *Cornus sericea*	■			■	■	■	■	■	■			■			■	■			■
DOGWOOD, SILKY *Cornus amomum*	■	■		■	■	■	■	■	■			■			■	■		■	
DOGWOOD, STIFF *Cornus foemina*		■		■	■	■	■	■	■			■			■	■		■	
ELDERBERRY *Sambucus nigra* ssp. *canadensis* (*Sambucus canadensis)*	■	■		■	■	■	■	■	■		■	■		■	■	■		■	
EUONYMUS, SPREADING *Euonymus kiautschovicus* 'Manhattan'	■	■	■	■			■	■				■				■	■		
FETTERBUSH *Eubotrys racemosa* *(Leucothoe racemosa)*		■		■	■	■	■	■						■		■		■	
GRAPE, FOX *Vitis labrusca*	■	■	■	■		■	■	■	■		■				■				
GRAPE, MUSCADINE *Vitis rotundifolia*		■		■	■	■	■	■	■		■				■			■	

TABLE 4.5: Recommended Trees, Shrubs, and Woody Vines for Selected Uses (see Table 4.6 for detailed species information)

Plant Names	Region [1/]		Moisture [2/]			Native to Delaware	Habitat Use Characteristics [3/]								Hedgerows and Windbreaks [4/]			Wetlands (surface saturation/ infrequent inundation)	Wetlands (surface saturation/ frequent or prolonged inundation)
							Cover		Fruit/Seed Consumption			Pollinator Food							
	Piedmont	Coastal Plain	Dry Sites	Mesic Sites	Wet Sites		Nesting/ Resting	Protection	Wildlife (H)	Wildlife (M)	Humans	Nectar/ Pollen	Foliage	Toxic to Livestock	Wildlife Habitat	Screens/ Barriers	Poultry		
SHRUBS AND WOODY VINES																			
GRAPE, RIVERBANK *Vitis riparia*	■	■			■		■	■	■		■				■			■	
HACKBERRY, DWARF *Celtis pumila*	■	■	■	■			■		■		■	■	■		■	■	■		
HAZELNUT (AMERICAN FILBERT) *Corylus americana*	■	■	■	■		■	■	■	■		■				■	■			
HAZELNUT, BEAKED *Corylus cornuta*	■		■	■		■	■	■	■		■				■	■			
HUCKLEBERRY, BLACK *Gaylussacia baccata*	■	■	■	■	■	■	■	■	■		■	■	■		■			■	
HUCKLEBERRY, BLUE *Gaylussacia frondosa*	■	■	■	■	■	■	■	■	■		■	■	■		■			■	
HOLLY, JAPANESE *Ilex crenata* 'Steeds'	■	■		■			■	■								■	■		
HOLLY, NELLIE STEVENS *Ilex cornuta x aquifolium* 'Nellie Stevens'	■	■		■			■	■								■	■		
INDIGO, FALSE (INDIGO BUSH) *Amorpha fruticosa*	■	■	■	■	■	■	■	■		■		■			■	■		■	
INKBERRY *Ilex glabra*		■		■	■	■	■	■	■						■	■			■
LESPEDEZA, SHRUB *Lespedeza bicolor*		■	■	■			■	■								■			
MEADOWSWEET, WHITE *Spiraea alba*	■			■	■	■	■	■		■		■	■		■	■		■	
NINEBARK, COMMON *Physocarpus opulifolius*	■		■	■	■	■	■	■		■		■			■	■		■	
PEPPERBUSH, SWEET *Clethra alnifolia*	■	■		■	■	■	■	■				■			■	■		■	

TABLE 4.5: Recommended Trees, Shrubs, and Woody Vines for Selected Uses (see Table 4.6 for detailed species information)

Plant Names	Region [1/]		Moisture [2/]			Native to Delaware	Habitat Use Characteristics [3/]								Hedgerows and Windbreaks [4/]			Wetlands (surface saturation/ infrequent inundation)	Wetlands (surface saturation/ frequent or prolonged inundation)
							Cover		Fruit/Seed Consumption			Pollinator Food							
	Piedmont	Coastal Plain	Dry Sites	Mesic Sites	Wet Sites		Nesting/ Resting	Protection	Wildlife (H)	Wildlife (M)	Humans	Nectar/ Pollen	Foliage	Toxic to Livestock	Wildlife Habitat	Screens/ Barriers	Poultry		
SHRUBS AND WOODY VINES																			
POSSUM-HAW *Viburnum nudum*	■	■		■	■	■	■	■		■	■				■	■		■	
RAISIN, WILD *Viburnum nudum* var. *cassinoides*				■	■	■	■	■		■	■				■	■		■	
RASPBERRY, BLACK *Rubus occidentalis*	■		■	■		■	■	■	■		■	■			■	■			
ROSE, CAROLINA *Rosa carolina*	■	■	■	■		■	■	■	■		■	■			■	■			
ROSE, SWAMP *Rosa palustris*	■	■		■	■	■	■	■	■		■	■			■	■			■
ROSE, VIRGINIA *Rosa virginiana*	■	■	■	■		■	■	■	■		■	■			■	■			
SPICEBUSH *Lindera benzoin*	■	■		■	■	■	■	■	■		■		■		■	■		■	
STEEPLEBUSH *Spiraea tomentosa*	■	■		■	■	■	■	■				■	■		■	■		■	
SWEETSPIRE, VIRGINIA *Itea virginica*		■		■	■	■	■	■				■			■	■		■	
WAXMYRTLE, SOUTHERN *Morella cerifera (Myrica cerifera)*		■	■	■	■	■	■	■	■						■	■		■	
WINTERBERRY *Ilex verticillata*	■	■		■	■	■	■	■	■						■	■		■	
WITCH-HAZEL *Hamamelis virginiana*	■	■	■	■		■	■	■				■			■	■			

TABLE 4.5 NOTES:

1. **Region:** The physiographic region where the species usually occurs in Delaware, under natural conditions. For introduced species, this is the region where the species can be planted. Native species may also be planted in other locations, based on Plant Hardiness Zones (PHZ). Refer to Table 4.6 for PHZ and other information for each species.
2. **Moisture:** The amount of moisture the species needs or tolerates. Dry - excessively drained to well-drained soil; Mesic - moderately well to somewhat poorly drained soil; Wet - poorly to very poorly drained soil.

TABLE 4.5 NOTES: (continued)

3. Habitat Use Characteristics:

Cover - All plants provide some type of cover for wildlife, depending on the time of year and the wildlife species of interest. These columns describe the cover use primarily for birds and small mammals, as follows:

- Nesting/Resting - Provides nesting and/or resting cover.
- Protection - Provides protective habitat, typically characterized by high stem density near ground level and/or dense, persistent foliage (usually evergreens, but also some deciduous species that retain leaves well into the winter).

Fruit/Seed Consumption - These columns note whether a fruit or seed is a good food source for wildlife, or may be eaten by humans:

- Wildlife - (H) Highly preferred food for many birds and mammals, or (M) Medium value, and is utilized by fewer species or is produced in smaller quantities than similar foods. Plant species not noted as having High or Medium value have Low or unknown value. Refer to Table 4.6 for detailed wildlife food value information.
- Humans - May be consumed by people. Caution: This list should not solely be relied upon for knowledge of human edibility. Many plants with palatable parts also contain parts that are to a certain degree toxic to humans. Toxicity effects can vary with people and environment, and not all human toxicity effects are known for wild plants. People who intend to consume parts of wild plants should ensure their own safety and health by consulting experts and/or trusted plant references.

Pollinator Food - These columns note whether a species provides a food source for adult and larval-stage pollinators:

- Nectar/Pollen - Species produces nectar and/or pollen that are consumed by adults or larvae of various pollinator species.
- Foliage - Species has vegetative plant parts (foliage, stems, etc.) that are consumed by various insect pollinators, especially while in the larval stage.

Toxic to Livestock - Reported to be slightly to highly toxic if consumed by livestock. Toxicity may include flowers, fruits/nuts, foliage, and other plant parts, and can vary with species of livestock, age of the animal, and growth stage of the plant.

4. Hedgerows and Windbreaks:

Wildlife Habitat - Species is a recommended planting for wildlife habitat. Recommended species are native to Delaware, and are shrubs and small trees that have moderate to high value as food for birds, mammals, and/or pollinators.

Screens/Barriers - Species is a recommended planting for visual screens and/or barriers to noise, dust, and odors. Recommended species are expected to grow to at least 6 feet in height at 20 years, and have a medium or high foliar density for at least part of the year. For year-round protection, most screens/barriers will need one or more rows of evergreens. Shorter or less dense species may be selected for planting in additional rows, provided there are sufficient rows of recommended species to meet the objectives of the planting.

Poultry - For hedgerows around poultry houses, especially in fan impact areas, refer to the Delaware NRCS 422 Hedgerow Planting Fact Sheet *Trees and Shrubs for Poultry Houses* for additional information concerning recommended woody species that are tolerant of harsh conditions.

TABLE 4.6: Selected Characteristics of Trees, Shrubs, and Woody Vines

Plant Names	Plant Hardiness Zones [1]	Natural Distribution in Delaware [1]	Soil Drainage Class [2]	Height at 20 Years	Growth Rate [3]	Density [4] -Summer	Density - Winter	Wildlife Food Value for Birds and Mammals	Remarks
DECIDUOUS TREES									
ASH, GREEN *Fraxinus pennsylvanica*	All	Statewide	SP -P	35 ft.	Mod.	Medium	Low	Medium: seeds eaten by ducks, gamebirds, songbirds, squirrels; browsed by deer.	Naturally occurring on streambanks and floodplains. Abundant seed produced in late summer. Susceptible to emerald ash borer.
ASH, WHITE *Fraxinus americana*	All	Statewide	W - SP	35 ft.	Mod.	Medium	Low	Medium: seeds eaten by ducks, gamebirds, songbirds, squirrels; browsed by deer.	Attractive fall color (yellow to maroon). Abundant seed produced in late summer. Susceptible to emerald ash borer.
ASPEN, LARGE-TOOTHED *Populus grandidentata*	All	Statewide	W - SP	40 ft.	Fast	Low	Very Low	Medium: browsed by deer and rabbits; bark and buds eaten by beaver.	Beneficial to cavity-nesting species when trees get older. Very fast-growing; relatively short-lived tree. In hedgrerows and windbreaks, can be planted in one row, and add one or more other rows of species with higher density foliage. Has aggressive roots—keep away from structures, sewers, and tile lines.
BASSWOOD, AMERICAN *Tilia americana*	All	Mostly Piedmont	W - SP	40 ft.	Fast	Medium to High	Low	Low: seeds eaten by quail and squirrels; browsed by deer and rabbits.	Prefers rich, moist, well-drained soils; tolerates some drought. Good den tree when mature. Fragrant white flowers attract bees and other pollinators.
BEECH, AMERICAN *Betula lenta*	All	Statewide	W - SP	20 ft.	Slow	Medium	Low	High: fruits eaten by squirrels, quail, turkey, songbirds, deer.	Prefers rich, moist, well-drained soils; can tolerate drier or wetter conditions. Suckers and forms colonies. Shade tolerant.
BIRCH, RIVER *Betula nigra*	All	Mostly Coastal Plain	W - P	30 ft.	Fast	Low	Very Low	Medium: seeds eaten by ducks and songbirds.	Naturally occurring on streambanks and floodplains. Unique peeling reddish bark. Attractive for landscaping.
BLACKGUM *Nyssa sylvatica*	All	Statewide	W - P	30 ft.	Mod.	Medium	Low	Medium: fruits eaten by squirrels, quail, turkey, and songbirds; browsed by deer.	Foliage turns bright red in early fall.

TABLE 4.6: Selected Characteristics of Trees, Shrubs, and Woody Vines

Plant Names	Plant Hardiness Zones [1]	Natural Distribution in Delaware [1]	Soil Drainage Class [2]	Height at 20 Years	Growth Rate [3]	Density [4] -Summer	Density - Winter	Wildlife Food Value for Birds and Mammals	Remarks
DECIDUOUS TREES									
BOX-ELDER *Acer negundo*	All	Statewide	MW - P	40 ft.	Fast	Medium to High	Low	Medium: seeds eaten by gamebirds, songbirds, squirrels; browsed by deer.	Naturally occurring on streambanks and floodplains. Soft wood may split in ice storms. Abundant seed produced in late summer. Attracts box-elder bugs.
BUTTERNUT *Juglans cinerea*	All	Piedmont	MW - SP	40 ft.	Fast	Medium	Low	Medium: nuts eaten by squirrels.	Fast-growing but relatively short-lived tree. Nuts are similar to black walnut, with thick, hard shells that are not easily accessible as food for most wildlife (except squirrels). Butternut can be allelopathic to other plants. Susceptible to butternut canker, an introduced fungal disease.
CHERRY, BLACK *Prunus serotina*	All	Statewide	W - SP	40 ft.	Fast	Medium	Low	High: fruits eaten by songbirds, turkey, quail; browsed by rabbits and deer.	Clusters of white flowers attract bees and other pollinators. Leaves and branches are poisonous if eaten by livestock.
CHESTNUT, AMERICAN *Castanea dentata*	All	Statewide	W - MW	20 ft.	Slow	Medium	Low	High: nuts eaten by turkey, squirrels, and deer; browsed by deer.	Native trees are susceptible to the Asian chestnut blight fungus. Stump sprouts occur, but rarely grow mature enough to produce seeds. Blight-resistant strains are being tested but are not readily available. Host plant for butterfly larvae.
CHINQUAPIN *Castanea pumila*	All	Coastal Plain; uncommon	W - MW	15 ft.	Slow	Medium	Low	Medium: nuts eaten by turkey, squirrels, and deer; browsed by deer.	Small tree or shrub. Moderately resistant to the Asian chestnut blight fungus that kills the related American chestnut (*C. dentata*). Nuts preferred by wildlife, but amount produced is low. Host plant for butterfly larvae.
CHOKECHERRY *Prunus virginiana*	All	Piedmont	W - SP	15 ft.	Fast	High	Low	High: fruits eaten by songbirds, turkey, quail; browsed by rabbits and deer.	Small tree or shrub; tends to spread by root suckering. Clusters of white flowers attract bees and other pollinators. Leaves and branches are poisonous if eaten by livestock.

TABLE 4.6: Selected Characteristics of Trees, Shrubs, and Woody Vines

Plant Names	Plant Hardiness Zones [1]	Natural Distribution in Delaware [1]	Soil Drainage Class [2]	Height at 20 Years	Growth Rate [3]	Density [4] -Summer	Density - Winter	Wildlife Food Value for Birds and Mammals	Remarks
DECIDUOUS TREES									
COTTONWOOD, EASTERN *Populus deltoides*	All	Statewide	W - P	80 ft.	Fast	Medium to High	Low	Medium: browsed by deer and rabbits; buds and catkins eaten by squirrels and quail.	Naturally occurring on streambanks and floodplains. Tolerates dry soils. Grows rapidly, can be used to quickly establish cover for wildlife. Is weak-wooded, tends to be messy. Has aggressive roots; keep away from structures, sewers, and tile lines.
CRABAPPLE, SOUTHERN *Malus angustifolia*	All	Coastal Plain	W - SP	20 ft.	Slow	Medium to High	Medium	High: fruits eaten by songbirds, turkey, quail, and various mammals; browsed by rabbits and deer.	Small tree or shrub; can spread by root suckering. Pink-white flowers attract bees and other pollinators. Plant at least 500 ft. away from red cedar *(Juniperus virginiana)* to avoid spread of cedar-apple rust.
CRABAPPLE, SWEET *Malus coronaria*	All	Statewide; common	W - SP	20 ft.	Slow	Medium to High	Medium	High: same as above.	Same as above.
CYPRESS, BALD *Taxodium distichum*	All	Coastal Plain	MW - P	45 ft.	Fast	High	Medium	Low: seeds eaten by ducks and marsh birds.	Naturally occurring on streambanks and in swamps.
DOGWOOD, FLOWERING *Cornus florida*	All	Statewide	W - SP	20 ft.	Slow	Low	Low	High: berries eaten by songbirds, turkey, quail, squirrels; browsed by deer, rabbits.	White flowers and red fruit. Widely planted as an ornamental. Susceptible to dogwood anthracnose disease.
DOGWOOD, PAGODA *Cornus alternifolia*	All	Mostly Piedmont	W - SP	25 ft.	Slow	Low	Low	High: berries eaten by songbirds, turkey, quail, squirrels; browsed by deer, rabbits.	Small tree or shrub; may be multi-stemmed. Usually found on dry, rocky sites, but will tolerate some moisture. White flowers and bluish-black fruit. Attracts pollinators.
ELM, AMERICAN *Ulmus americana* 'New Harmony' and 'Valley Forge'	All	Statewide	W - P	35 ft.	Mod.	Medium	Low	Low: seeds eaten by songbirds, turkey, quail; browsed by rabbits and deer.	Prefers moist soil but will tolerate drier sites. Species is susceptible to Dutch elm disease. The New Harmony and Valley Forge cultivars are disease-resistant.
ELM, SLIPPERY *Ulmus rubra*	All	Statewide	W - P	45 ft.	Fast	Medium	Low	Low: seeds eaten by songbirds, turkey, quail; browsed by rabbits and deer.	Naturally occurring on streambanks, floodplains, and uplands. Shade tolerant.

TABLE 4.6: Selected Characteristics of Trees, Shrubs, and Woody Vines

Plant Names	Plant Hardiness Zones [1]	Natural Distribution in Delaware [1]	Soil Drainage Class [2]	Height at 20 Years	Growth Rate [3]	Density [4] -Summer	Density - Winter	Wildlife Food Value for Birds and Mammals	Remarks
DECIDUOUS TREES									
HACKBERRY *Celtis occidentalis*	All	Statewide	W - SP	25 ft.	Mod.	Medium to High	Low	High: fruits eaten by quail, turkey, and songbirds.	Small tree. Adaptable to a wide range of conditions. Flowers attractive to butterflies and other pollinators. Host plant for several species of butterfly larvae.
HACKBERRY, SMALL'S *Celtis laevigata* var. *smallii*	All	Introduced to Delaware; native to Southeastern U.S.	W - P	25 ft.	Mod.	High	Low	High: fruits eaten by quail, turkey, and songbirds.	Small tree. Very hardy; adapted to a wide range of soil and site conditions. Flowers attractive to butterflies and other pollinators. Host plant for several species of butterfly larvae.
HAWTHORN, COCKSPUR *Crataegus crus-galli*	All	Statewide	W - SP	25 ft.	Slow	High	Medium	Medium: fruits eaten by songbirds, gamebirds, squirrels; browsed by deer.	Small tree or shrub. Attractive white flowers produce bright orange-red fruits that may persist into winter. Thorny stems. Flowers attract bees and other pollinators.
HAWTHORN, GREEN *Crataegus viridis*	All	Coastal Plain	MW - P	25 ft.	Slow	High	Medium	Medium: fruits eaten by songbirds, gamebirds, squirrels; browsed by deer.	Same as above.
HICKORY, BITTERNUT *Carya cordiformis*	All	Statewide	MW - P	25 ft.	Slow	Medium	Low	Low: nuts are very bitter and are not a preferred food; may be eaten by squirrels.	Naturally occurring on floodplains and in wetlands; occasionally on dry sites. Wood used for furniture, tool handles, charcoal, firewood.
HICKORY, MOCKERNUT *Carya tomentosa*	All	Statewide	W - SP	20 ft.	Slow	Medium	Low	High: nuts eaten by squirrels, turkey, quail, deer.	Usually found on well-drained sites; tolerates some moisture. Wood used for furniture, tool handles, charcoal, firewood.
HICKORY, PIGNUT *Carya glabra*	All	Statewide	W - SP	20 ft.	Slow	Medium	Low	Medium: nuts are usually bitter and are not a preferred food; may be eaten by squirrels and other mammals.	Same as above.
HICKORY, SHAGBARK *Carya ovata*	All	Mostly Piedmont	W - SP	20 ft.	Slow	Medium	Low	High: nuts eaten by squirrels, turkey, quail, deer.	Same as above.

TABLE 4.6: Selected Characteristics of Trees, Shrubs, and Woody Vines

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DECIDUOUS TREES									
HONEYLOCUST *Gleditsia triacanthos*	All	Introduced to Delaware; native to Eastern and Central U.S.	W - SP	40 ft.	Fast	Low to Medium	Very Low	Low: seeds eaten by songbirds and squirrels.	Prefers well-drained sites, but will tolerate brief inundation. Drought-resistant and somewhat tolerant of salinity. Fragrant white flowers attract bees and other pollinators.
HOP-HORNBEAM *Ostrya virginiana*	All	Piedmont; uncommon	W - SP	20 ft.	Slow	Medium	Low	Medium: seeds eaten by songbirds, turkey, squirrels; browsed by deer, rabbits.	Occurs as an understory tree in moist woods and on rocky slopes. Produces hop-like, papery seed clusters.
HORNBEAM, AMERICAN *Carpinus caroliniana*	All	Statewide	MW - P	20 ft.	Slow	Medium	Low	Medium: seeds eaten by songbirds, turkey, squirrels; browsed by deer, rabbits, beaver.	Understory tree in woodlands; may be multi-stemmed. Prefers moist soil and partial shade.
LOCUST, BLACK *Robinia pseudoacacia*	All	Introduced to Delaware; native to Eastern and Central U.S.	W - MW	40 ft.	Fast	Low to Medium	Very Low	Low: seeds eaten by songbirds and squirrels.	Spreads readily; seeds freely and suckers. Nitrogen fixing. Fragrant white flowers attract bees and other pollinators. Flowers are poisonous if eaten by livestock.
MAGNOLIA, SWEETBAY *Magnolia virginiana*	All	Coastal Plain	SP - P	30 ft.	Mod.	Medium	Low to Medium	Medium: seeds eaten by songbirds and squirrels; browsed by deer.	Considered a small tree or shrub. May be evergreen in mild winters. Creamy white flowers up to 3" diameter. Host plant for three species of swallowtail butterfly larvae.
MAPLE, RED *Acer rubrum*	All	Statewide	W - P	40 ft.	Fast	Medium to High	Low	Medium: seeds eaten by ducks, gamebirds, songbirds, squirrels; browsed by deer.	Abundant seed produced in the spring. Red fall color and blooms. May provide an early source of pollen for bees.
MAPLE, SILVER *Acer saccharinum*	All	Mostly Piedmont	SP - P	45 ft.	Fast	Medium to High	Low	Medium: seeds eaten by ducks, gamebirds, songbirds, squirrels; browsed by deer.	Naturally occurring on streambanks and floodplains. Good source of woody debris for riparian systems. Roots can be aggressive. Abundant seed produced in the spring. May provide an early source of pollen for bees.

TABLE 4.6: Selected Characteristics of Trees, Shrubs, and Woody Vines

Plant Names	Plant Hardiness Zones [1]	Natural Distribution in Delaware [1]	Soil Drainage Class [2]	Height at 20 Years	Growth Rate [3]	Density [4] -Summer	Density - Winter	Wildlife Food Value for Birds and Mammals	Remarks
DECIDUOUS TREES									
MULBERRY, RED *Morus rubra*	All	Statewide	W - SP	35 ft.	Mod.	Medium	Low	High: fruits eaten by songbirds, squirrels, and other mammals.	Occurs in rich, moist woods and along field edges. Produces numerous, large, reddish-purple fruits that can be messy when fallen.
OAK, BLACK *Quercus velutina*	All	Statewide; more common in Piedmont	W - MW	35 ft.	Mod.	Medium to High	Low	High: acorns eaten by quail, turkey, squirrels, and deer.	Prefers moist, well-drained sites, but tolerates drier conditions.
OAK, BLACKJACK *Quercus marilandica*	All	Coastal Plain; uncommon	W - MW	30 ft.	Mod.	Medium to High	Low	High: same as above.	Occurs on dry, sandy or shaly soils, including serpentine barrens and back dunes.
OAK, CHERRYBARK *Quercus pagoda*	All	Coastal Plain	SP - P	35 ft.	Mod.	Medium to High	Low	High: same as above.	Occurs in moist, wooded floodplains and wetlands.
OAK, CHESTNUT *Quercus montana (Quercus prinus)*	All	Statewide	W - MW	35 ft.	Mod.	Medium to High	Low	High: same as above.	Grows well on dry, rocky, or gravelly soils.
OAK, CHINQUAPIN *Quercus muehlenbergii*	All	Piedmont; uncommon	W - MW	35 ft.	Mod.	Medium to High	Low	High: same as above.	Under-used, native tree. Usually found on dry, limestone outcrops.
OAK, NORTHERN RED *Quercus rubra*	All	Statewide	W - SP	35 ft.	Mod.	Medium to High	Low	High: same as above.	Excellent red fall color. Tolerates urban conditions.
OAK, OVERCUP *Quercus lyrata*	All	Coastal Plain; uncommon	SP - P	30 ft.	Mod.	Medium to High	Low	High: same as above.	Important lumber tree. Withstands flooding and prolonged inundation.
OAK, PIN *Quercus palustris*	All	Statewide	MW - P	40 ft.	Fast	High	Medium	High: same as above.	Bronze or red fall foliage. Widely planted as an ornamental. Produces small acorns.
OAK, POST *Quercus stellata*	All	Statewide	W - SP	30 ft.	Mod.	Medium to High	Low	High: same as above.	Often occurs in thin-canopy woods and on field edges, usually on dry sites.
OAK, SOUTHERN RED *Quercus falcata*	All	Statewide	W - SP	35 ft.	Mod.	Medium to High	Low	High: same as above.	Excellent red fall color. Tolerates poor, dry soil.

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DECIDUOUS TREES									
OAK, SWAMP CHESTNUT (BASKET OAK) *Quercus michauxii*	All	Mostly Coastal Plain	SP - P	35 ft.	Mod.	Medium to High	Low	High: acorns eaten by quail, turkey, squirrels, and deer.	Naturally occurring on floodplains and other wet areas. Important lumber tree.
OAK, SWAMP WHITE *Quercus bicolor*	All	Mostly Coastal Plain	SP - P	30 ft.	Mod.	Medium to High	Low	High: same as above.	Good choice for wet sites. Important lumber tree. Requires acid soils.
OAK, WATER *Quercus nigra*	All	Mostly Sussex Co.	SP - P	30 ft.	Mod.	Medium to High	Low	High: same as above.	Naturally occurring on floodplains and other wet areas, but can tolerate a wide range of conditions, including well-drained uplands. Produces small acorns.
OAK, WHITE *Quercus alba*	All	Statewide	W - SP	25 ft.	Slow	Medium to High	Low	High: same as above.	Variable fall color, stately tree. Important lumber tree.
OAK, WILLOW *Quercus phellos*	All	Mostly Coastal Plain	MW - P	60 ft.	Fast	Medium to High	Low	High: same as above.	Frequently used as an ornamental planting. Produces small acorns. Red fall color.
OSAGE-ORANGE *Maclura pomifera*	All	Introduced: native to Midwestern U.S.	W - SP	20 ft.	Slow	High	Low	Low: seeds eaten quail and squirrels.	Adapted to a wide range of soil and site conditions. Trunk is usually short and divides into several prominent limbs. Fruits are messy, so select male plants. 'White Shield' may be the most thorn-free cultivar.
PAWPAW *Asimina triloba*	All	Statewide; infrequent	MW - P	25 ft.	Slow	Medium	Low	High: important food for fox, raccoon, opossum; also turkey, songbirds, deer, and other mammals.	Suckers and forms colonies. Purple flowers; large yellow fruits. Host plant for zebra swallowtail larvae.
PECAN *Carya illinoinensis*	All	Introduced; native to south-central U.S.	W - SP	35 ft.	Mod.	High	Low	High: nuts eaten by squirrels, turkey, quail, deer; browsed by deer.	Prefers moist, well-drained sites. Numerous cultivars are available for nut production.
PERSIMMON, COMMON *Diospyros virginiana*	All	Statewide	E - P	25 ft.	Slow	Medium	Low	High: important food for fox, raccoon, opossum; also turkey, songbirds, deer, and other mammals.	Slow growing tree. Adaptable to a wide range of conditions. Attracts pollinators. Produces edible fruit.

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DECIDUOUS TREES									
PLUM, AMERICAN *Prunus americana*	All	Statewide	W - SP	20 ft.	Slow	High	Medium	High: fruits eaten by songbirds, turkey, quail; browsed by rabbits and deer.	Small tree or shrub, with thorny stems. Prefers full sun and mesic moisture conditions. Can sucker and form thickets. Provides cover for wildlife and attracts pollinators.
POPLAR, HYBRID *Populus deltoides x nigra* 'Spike'	All	Introduced; hybrid of U.S. and European species	MW -SP	40 ft.	Fast	Medium	Low	Unknown. Presumably similar to other species of *Populus*.	Sterile hybrid.
POPLAR, TULIP *Liriodendron tulipifera*	All	Statewide	W - SP	40 ft.	Fast	Medium	Low	Low: seeds eaten by squirrels and songbirds; seedlings browsed by deer.	Flowers produce abundant nectar, much used by bees. Dropped flowers and fruits can be messy. Tends to be weak-wooded; not recommended near buildings. Important lumber tree.
REDBUD *Cercis canadensis*	All	Mostly Piedmont	MW -SP	20 ft.	Slow	Medium	Low	Low: seeds eaten by quail, pheasants, and deer.	Nitrogen-fixing. Bright pink flowers, appearing in early spring before the leaves, provide an early source of nectar/pollen for bees and other insects. Useful as an ornamental.
REDWOOD, DAWN *Metasequoia glyptostroboides*	All	Introduced; native to China	MW - P	35 ft.	Mod.	High	Medium	Low. Presumably similar to bald cypress.	Prefers moist soil but will tolerate drier sites. Needle-leaved deciduous tree; similar in appearance to bald cypress. Sometimes planted as an ornamental.
SASSAFRAS *Sassafras albidum*	All	Statewide	W - MW	20 ft.	Slow	Medium	Low	Medium: fruits eaten by songbirds, quail, turkey, and squirrels. Browsed by deer and rabbits.	Small tree; forms dense thickets by suckering. Greenish-yellow flowers are pollinated by small bees and other insects. Host plant for spicebush and tiger swallowtail larvae, as well as several species of moths.

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DECIDUOUS TREES									
SERVICEBERRY, CANADIAN *Amelanchier canadensis*	All	Statewide	MW - P	20 ft.	Slow	High	Low	High: fruits eaten by turkey, songbirds, squirrels; browsed by rabbits, deer.	Small tree or shrub; usually multi-stemmed. Showy white flowers provide an early spring food source for bees, butterflies, and other pollinators. Also a food source for several species of butterfly and moth larvae. Produces purple-black fruits.
SERVICEBERRY, COMMON *Amelanchier arborea*	All	Statewide	W - P	20 ft.	Slow	High	Low	High: fruits eaten by turkey, songbirds, squirrels; browsed by rabbits, deer.	Small tree or shrub; single or multi-stemmed. Tolerates a wide range of moisture conditions. Other characteristics similar to Canadian serviceberry.
SWEETGUM *Liquidambar styraciflua*	All	Statewide	MW - P	40 ft.	Fast	Medium	Low	Low: seeds eaten by songbirds, squirrels, and chipmunks.	Excellent yellow-red fall color. Widely planted as an ornamental. Fallen seed heads are a nuisance on lawns. Fruitless types are available.
SYCAMORE *Platanus occidentalis*	All	Statewide	MW - P	65 ft.	Fast	Medium to High	Low	Low: seeds eaten by songbirds and squirrels.	Naturally occurring on streambanks and floodplains. Unique peeling bark, fast growth rate. Susceptible to anthracnose; mix with other species for disease control. Constantly drops leaves, twigs, and fruits. Good den tree.
TUPELO, SWAMP (SWAMP BLACK GUM) *Nyssa biflora*	All	Sussex and Southern Kent Co.	SP - P	35 ft.	Mod.	Medium to High	Low	Medium: fruits eaten by squirrels, quail, turkey, and songbirds. Browsed by deer.	Naturally occurring on streambanks, floodplains, and bottomland swamps. Foliage turns bright red in early fall.
WALNUT, BLACK *Juglans nigra*	All	Statewide	MW -SP	40 ft.	Fast	Low	Low	Medium: nuts eaten by squirrels.	Very important lumber tree. Valuable for furniture and nut production. Nuts are large and sweet, with thick, hard shells; nuts are not easily accessible as food for most wildlife (except squirrels). Black walnut can be allelopathic to other plants.

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DECIDUOUS TREES									
WILLOW, BLACK *Salix nigra*	All	Statewide	SP -P	50 ft.	Fast	Medium	Low	Medium: browsed by beaver, and deer.	Naturally occurring on streambanks and floodplains. Can be aggressive and weedy. Flowers provide an early source of nectar/pollen in the spring for bees.
WILLOW, HYBRID *Salix matsudana x alba* 'Austree'	All	Introduced; hybrid of Chinese and European species	W - P	60 ft.	Very Fast	Medium to High	Medium	Unknown. Presumably similar to other willows.	Sterile hybrid. Due to its extremely fast growth (>3 ft/yr), can provide visual screen in 1 – 2 years. Dense branch structure.
WILLOW, PURPLEOSIER *Salix purpurea* 'Streamco'	All	Introduced from Europe	MW - P	20 ft.	Fast	Medium to High	Medium	Low: browsed by deer, beaver, and rabbits.	Non-invasive small tree or shrub; usually multi-stemmed. Streamco is a male clone, does not root sucker, and does not spread readily beyond the planting site.
EVERGREEN TREES									
ARBORVITAE *Thuja occidentalis*	All	Introduced; native to Appalachian Mountains and north	W - P	25 ft.	Slow	Very High	Very High	Low: browsed by deer.	Frequently planted statewide as an ornamental. Prefers moist, well-drained soil, but tolerates a wide range of conditions. Prone to bagworms.
ARBORVITAE *Thuja plicata x standishii* 'Green Giant'	All	Introduced; hybrid of Western U.S. and Japanese species	W - MW	40 ft.	Fast	Very High	Very High	Low: browsed by deer.	Prefers well-drained soil, but tolerates a wide range of conditions. Bagworms are potential pests.
CEDAR, ATLANTIC WHITE *Chamaecyparis thyoides*	All	Coastal Plain; uncommon	SP - P	20 ft.	Slow	Very High	Very High	Low: seeds eaten by songbirds; browsed by deer.	Cannot compete with hardwoods; best planted in solid stands.
CEDAR, EASTERN RED *Juniperus virginiana*	All	Statewide	W - SP	20 ft.	Slow	Very High	Very High	Medium: seeds eaten by songbirds, quail, turkey; browsed by deer and rabbits.	Should not be planted near apple orchards; alternate host of cedar-apple rust.

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EVERGREEN TREES									
CYPRESS, LEYLAND *x Cupressocyparis leylandii*	All	Introduced; not native to U.S.	W - SP	40 ft.	Very Fast	Very High	Very High	Low: browsed by deer.	This is a hybrid of Cupressus macrocarpa and Chamaecyparis nootkatensis. Adaptable to adverse sites; growth is best on good sites. Prone to bagworms, canker, and windthrow. Use in multiple-row plantings to minimize windthrow. Green Giant arborvitae is a preferred alternative to Leyland cypress.
HEMLOCK, EASTERN *Tsuga canadensis*	All	Mostly Piedmont	W - SP	20 ft.	Slow	Very High	Very High	Medium: seeds eaten by songbirds and squirrels; browsed by deer.	Often planted as an ornamental. Can become infested with hemlock woolly adelgid, a serious insect pest.
HOLLY, AMERICAN *Ilex opaca*	All	Statewide	W - P	20 ft.	Slow	High	High	Medium: fruits eaten by songbirds, quail, and squirrels.	Need male and female plants for fruit production. Shade tolerant. In hedgerows and windbreaks, can be planted in one row, and add one or more other rows of faster-growing species.
PINE, AUSTRIAN *Pinus nigra*	All	Introduced; not native to U.S.	E - P	35 ft.	Mod.	Low to Medium	Low to Medium	Unknown. Presumably similar to other pines.	Frequently planted statewide as an ornamental. Prefers moist, well-drained soil, but tolerates a wide range of conditions. Withstands dryness better than other pines. Fairly salt tolerant.
PINE, LOBLOLLY *Pinus taeda*	All	Mostly Coastal Plain	MW - P	45 ft.	Fast	Low to Medium	Low to Medium	Medium: seeds eaten by songbirds, quail, turkey; browsed by deer and rabbits.	Self-prunes lower limbs, so best suited in a multiple-row planting.
PINE, PITCH *Pinus rigida*	All	Mostly Coastal Plain; uncommon	W - SP	30 ft.	Mod.	Low to Medium	Low to Medium	Medium: seeds eaten by songbirds, quail, turkey; browsed by deer and rabbits.	Tolerant of dry, sandy soils. Mature trees are resistant to fire. Will reproduce from stump sprouts.
PINE, VIRGINIA *Pinus virginiana*	All	Statewide	W - MW	30 ft.	Mod.	Low to Medium	Low to Medium	Medium: same as above.	Can be used for pulpwood. Tolerant of adverse site conditions.

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EVERGREEN TREES									
PINE, WHITE *Pinus strobus*	All	Introduced; native to Appalachian Mountains and north	W - MW	40 ft.	Fast	Low to Medium	Low to Medium	Medium: same as above.	Frequently planted statewide as an ornamental.
SPRUCE, NORWAY *Picea abies*	All	Introduced; not native to U.S.	W - MW	35 ft.	Mod.	High	High	Unknown. Presumably similar to white spruce.	Fast growth rate when young, slows down with age. Prefers moderately moist, well-drained soil. Often planted as an ornamental.
SHRUBS AND WOODY VINES									
ABELIA, GLOSSY *Abelia x grandiflora*	All	Introduced; not native to U.S.	W - SP	6 ft.	Fast	High	Medium	Low: generally not browsed by wildlife.	Semi-evergreen foliage. Stems may be killed to the ground in cold winters. No serious pests or diseases. Many cultivars are available with different height and width characteristics. Rosy-white flowers attract pollinators.
ALDER, SMOOTH *Alnus serrulata*	All	Statewide; less common on Coastal Plain	SP - P	10 ft.	Fast	Medium	Low	High: seeds eaten by ducks, quail, doves; browsed by deer, beaver.	Nitrogen-fixing. Attractive catkins. Provides good cover for woodcock.
ARROWWOOD *Viburnum dentatum*	All	Statewide	W - P	10 ft.	Fast	Medium	Low	High: fruits eaten by turkey, songbirds, squirrels; browsed by rabbits, deer.	Suckers freely; wood used to make arrows. White flowers, bluish-black berries. Attracts pollinators.
AZALEA, SWAMP *Rhododendron viscosum*	All	Coastal Plain	SP - P	8 ft.	Slow	Low	Low	Low: nectar attractive to hummingbirds; plants browsed by deer.	Naturally occurring in shrub swamps, forested wetlands, and on streambanks. Showy pink-white tubular flowers attract pollinators.
BAYBERRY, NORTHERN *Morella pensylvanica* *(Myrica pensylvanica)*	All	Statewide	W - P	10 ft.	Mod.	Medium	Low	High: fruits eaten by quail, songbirds. Browsed by deer.	Need male and female plants for fruit production. Waxy berries may persist through winter. Salt tolerant (0-20 ppt.) Suckers to form colonies.

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SHRUBS AND WOODY VINES									
BEAUTYBERRY, AMERICAN *Callicarpa americana*	All	Introduced to Delaware; native to Southeastern U.S.	W - SP	6 ft.	Mod.	High	Medium	High: fruits eaten by quail, songbirds, squirrels. Browsed by deer.	Occurs on woodland edges and in openings, thickets, and fence rows; intolerant of deep shade. Adapted to a wide range of upland sites. Attracts pollinators. Produces clusters of attractive, pink-purple berries along the stems.
BLACKBERRY, ALLEGHENY *Rubus allegheniensis*	All	Piedmont	W - SP	6 ft.	Fast	High	Medium	High: fruits eaten by turkey, songbirds, squirrels; browsed by rabbits, deer.	Arching stems (canes) can develop into dense, thorny thickets. White flowers attract pollinators, and produce purplish black berries.
BLACKBERRY, SAND *Rubus cuneifolius*	All	Mostly Coastal Plain	W - SP	3 ft.	Fast	High	Medium	High: fruits eaten by turkey, songbirds, squirrels; browsed by rabbits, deer.	Same as above.
BLACK-HAW *Viburnum prunifolium*	All	Statewide	W - SP	12 ft.	Fast	Medium	Low	High: fruits eaten by turkey, songbirds, squirrels; browsed by rabbits, deer.	White flower clusters, blue berries, red fall color. Fruits may remain on shrubs for much of the winter.
BLUEBERRY, HIGHBUSH *Vaccinium corymbosum*	All	Statewide	MW - P	12 ft.	Mod.	Medium to High	Low to Medium	High: fruits eaten by songbirds, turkey, squirrel; browsed by deer, rabbits.	Prefers acid soils. Small white flowers attract bees.
BLUEBERRY, LOWBUSH *Vaccinium angustifolium*	All	Piedmont	W - SP	2 ft.	Mod.	Medium to High	Low to Medium	High: fruits eaten by songbirds, turkey, squirrel; browsed by deer, rabbits.	Same as above.
BUSH, HIGH TIDE (GROUNDSEL) *Baccharis halimifolia*	All	Coastal Plain	MW - P	10 ft.	Mod.	Medium	Low	Low: minimal value for food; occasionally browsed by deer.	Usually in brackish and coastal marshes, above MHW. Salinity 0-15 ppt. Has fluffy white seeds. Male flowers & female flowers on separate plants. Prefers full sun.
BUSH, HIGH TIDE (MARSH-ELDER) *Iva frutescens*	All	Coastal Plain	MW - P	10 ft.	Mod.	Medium	Low	Low: minimal value for food; occasionally browsed by deer.	Usually in brackish and coastal marshes, above MHW. Salinity 0-15 ppt. Prefers full sun.

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SHRUBS AND WOODY VINES									
BUTTONBUSH *Cephalanthus occidentalis*	All	Statewide	SP - P	10 ft.	Mod.	Medium	Low	Low: seeds eaten by ducks and rails; browsed by deer.	Unusual, round white flowers. Tolerates extended periods of flooding and ponding. Prefers permanent saturation. Attracts butterflies and other insects.
CHOKEBERRY, BLACK *Aronia melanocarpa*	All	Piedmont	W – P	6 ft.	Mod.	Medium	Low	Medium: fruits eaten by songbirds, squirrel; browsed by deer, rabbits.	White flowers in spring. Lush summer foliage. Black berries in late summer persist into winter. Colorful red foliage in fall. Suckers and forms thickets. Tolerant of a wide range of soil and moisture conditions. Attracts small bees.
CHOKEBERRY, RED *Aronia arbutifolia*	All	Statewide	W – P	10 ft.	Mod.	Medium	Low	Medium: fruits eaten by songbirds, squirrel; browsed by deer, rabbits.	Similar to black chokeberry, but with red berries, and slightly taller and more upright growth habit. Attracts small bees.
DEWBERRY, BRISTLY *Rubus hispidus*	All	Coastal Plain	SP – P	1 ft.	Fast	Medium	Low	High: berries eaten by turkey, songbirds, squirrels; browsed by rabbits, deer.	More like a vine than a shrub. Very low-growing, with long, trailing stems; in moist woods and wetlands. White flowers attract pollinators, and produce small, reddish-purple berries.
DEWBERRY, COMMON *Rubus flagellaris*	All	Statewide	W – MW	2 ft.	Fast	Medium	Low	High: fruits eaten by turkey, songbirds, squirrels; browsed by rabbits, deer.	More like a vine than a shrub. Mostly low, trailing stems (less than 1 foot tall), but flowering stems can be taller. White flowers attract pollinators, and produce small, reddish-purple berries.
DOGWOOD, GRAY *Cornus racemosa*	All	Piedmont	W – SP	6 ft.	Mod.	High	Medium	High: fruits eaten by songbirds, turkey, quail, squirrels; browsed by deer, rabbits.	Low growing, thickly branched shrub. Suckers and forms thickets. Not well adapted to the Coastal Plain. Beneficial for wildlife and pollinators.
DOGWOOD, REDOSIER *Cornus sericea*	All	Piedmont	MW - P	12 ft.	Mod.	Medium	Low	High: fruits eaten by songbirds, turkey, quail, squirrels; browsed by deer, rabbits.	Attractive red stem color. White flowers and fruit. Attracts pollinators.

TABLE 4.6: Selected Characteristics of Trees, Shrubs, and Woody Vines

Plant Names	Plant Hardiness Zones [1]	Natural Distribution in Delaware [1]	Soil Drainage Class [2]	Height at 20 Years	Growth Rate [3]	Density [4] -Summer	Density - Winter	Wildlife Food Value for Birds and Mammals	Remarks
SHRUBS AND WOODY VINES									
DOGWOOD, SILKY *Cornus amomum*	All	Statewide	MW - P	10 ft.	Mod.	Medium to High	Low to Medium	High: fruits eaten by songbirds, turkey, quail, squirrels; browsed by deer, rabbits.	Produces fruit at 3-5 years of age. White flowers with blue berries. Prefers some shade. Attracts pollinators.
DOGWOOD, STIFF *Cornus foemina*	All	Mostly Coastal Plain; uncommon	MW - P	15 ft.	Mod.	Medium	Low	High: fruits eaten by songbirds, turkey, quail, squirrels; browsed by deer, rabbits.	Usually occurs in wetlands and on streambanks. Suckers and forms thickets. Moderately salt-tolerant. White flowers produce blue berries. Attracts pollinators.
ELDERBERRY *Sambucus nigra* ssp. *canadensis* (*Sambucus canadensis)*	All	Statewide	MW - P	8 ft.	Fast	Medium	Low	High: fruits eaten by songbirds, turkey, squirrels; browsed by deer, rabbits.	Large clusters of white flowers followed by purple berries; fast growth rate. Suckers freely. Attracts bees.
EUONYMUS, SPREADING *Euonymus kiautschovicus* 'Manhattan'	All	Introduced; not native to U.S.	W - SP	10 ft.	Mod.	High	High	Low: fruits eaten by songbirds; browsed by deer.	Semi-evergreen foliage that may be damaged in cold winters. Not as susceptible to scale as other euonymus. Attracts pollinators.
FETTERBUSH *Eubotrys racemosa (Leucothoe racemosa)*	All	Mostly Coastal Plain; common	SP - P	12 ft.	Mod.	Medium to High	Low to Medium	Low: seeds eaten by songbirds; browsed by deer.	Small white flowers in drooping racemes. Tends to sucker and form thickets. Prefers permanent saturation.
GRAPE, FOX *Vitis labrusca*	All	Statewide	W – SP	20 ft. (in trees)	Fast	Medium	Low	High: fruits eaten by songbirds, turkey, squirrels; browsed by deer, rabbits.	Vine that climbs up tree trunks and sprawls over shrubs. Commonly found in thickets and fence rows, and along woodland edges.
GRAPE, MUSCADINE *Vitis rotundifolia*	All	Coastal Plain	MW – P	20 ft. (in trees)	Fast	Medium	Low	High: fruits eaten by songbirds, turkey, squirrels; browsed by deer, rabbits.	Similar to above, but prefers moist to wet sites.
GRAPE, RIVERBANK *Vitis riparia*	All	Introduced; native to Northern U.S.	SP – P	20 ft. (in trees)	Fast	Medium	Low	High: fruits eaten by songbirds, turkey, squirrels; browsed by deer, rabbits.	Vine that climbs up tree trunks and sprawls over shrubs. Commonly found in thickets and fence rows, and along woodland edges.

TABLE 4.6: Selected Characteristics of Trees, Shrubs, and Woody Vines

Plant Names	Plant Hardiness Zones [1]	Natural Distribution in Delaware [1]	Soil Drainage Class [2]	Height at 20 Years	Growth Rate [3]	Density [4] -Summer	Density - Winter	Wildlife Food Value for Birds and Mammals	Remarks
SHRUBS AND WOODY VINES									
HACKBERRY, DWARF *Celtis pumila*	All	Introduced; native to Southeastern U.S.	W - SP	15 ft.	Mod.	High	Low	High: fruits eaten by quail, turkey, and songbirds.	Adapted to a wide range of soil and site conditions. Flowers attractive to butterflies and other pollinators. Host plant for several species of butterfly larvae.
HAZELNUT (AMERICAN FILBERT) *Corylus americana*	All	Statewide	W - SP	10 ft.	Mod.	Medium	Low	Medium: seeds eaten by turkey, squirrels; browsed by deer, rabbits.	Thicket-forming. Good ornamental; not many diseases/pests. Monecious flowers (needs both male and female plants to produce nuts).
HAZELNUT, BEAKED *Corylus cornuta*	All	Piedmont; uncommon	W - SP	15 ft.	Mod.	High	Medium	Medium: seeds eaten by turkey, squirrels; browsed by deer, rabbits.	Same as above.
HOLLY, JAPANESE *Ilex crenata* 'Steeds'	All	Introduced; not native to U.S.	MW -SP	8 ft.	Fast	High	High	Low: fruits eaten by songbirds.	Evergreen. Need male and female plants for fruit production.
HOLLY, NELLIE STEVENS *Ilex cornuta x aquifolium* 'Nellie Stevens'	All	Introduced; not native to U.S.	MW -SP	15 ft.	Fast	High	High	Low: fruits eaten by songbirds.	Evergreen. Need male and female plants for fruit production.
HUCKLEBERRY, BLACK *Gaylussacia baccata*	All	Statewide	W - P	3 ft.	Mod.	High	Medium	High: fruits eaten by songbirds, quail, turkey, squirrels; browsed by deer.	Overall appearance is very similar to highbush blueberry. Forms thickets. Berries are edible but seedier than blueberries. Small flowers attract bees and other pollinators.
HUCKLEBERRY, BLUE (DANGLEBERRY) *Gaylussacia frondosa*	All	Mostly Coastal Plain	W - P	4 ft.	Mod.	High	Medium	High: fruits eaten by songbirds, quail, turkey, squirrels; browsed by deer.	Same as above.
INDIGO, FALSE (INDIGO BUSH) *Amorpha fruticosa*	All	Statewide; uncommon	W - P	6 ft.	Slow	Medium to High	Low	Medium: seeds eaten by quail, turkey, and doves; browsed by deer.	Nitrogen-fixing multi-stemmed shrub. Flowers in purple spikes during late spring; attracts pollinators. Tolerates a wide range of moisture conditions, from seasonal saturation to drought. Individual plants may have a limited life span (5-10 years), but naturally regenerate from seed.

TABLE 4.6: Selected Characteristics of Trees, Shrubs, and Woody Vines									
Plant Names	**Plant Hardiness Zones [1]**	**Natural Distribution in Delaware [1]**	**Soil Drainage Class [2]**	**Height at 20 Years**	**Growth Rate [3]**	**Density [4] -Summer**	**Density - Winter**	**Wildlife Food Value for Birds and Mammals**	**Remarks**
SHRUBS AND WOODY VINES									
INKBERRY *Ilex glabra*	All	Coastal Plain	SP - P	6 ft.	Slow	Medium	Low	High: fruits eaten by songbirds, quail, and squirrels.	Black fruits persist during the winter. Extensive rhizomes, often forms colonies. Prefers permanent saturation.
LESPEDEZA, SHRUB *Lespedeza bicolor*	All	Introduced; not native to U.S.	E - SP	8 ft.	Fast	Medium	Low	Low: seeds eaten by songbirds.	Perennial semi-woody legume. Cut back periodically to maintain dense, shrubby growth. May become weedy in some habitats and may displace desirable vegetation if not properly managed. Does not tolerate shade or wet soils.
MEADOWSWEET, WHITE *Spiraea alba*	All	Piedmont; uncommon	SP - P	6 ft.	Mod.	High	Medium	Low: seeds eaten by songbirds; browsed by deer and rabbits.	Deciduous upright shrub. Prefers moist to wet sites. Clusters of white flowers in summer attract pollinators. Host plant for butterfly and moth larvae.
NINEBARK, COMMON *Physocarpus opulifolius*	All	Piedmont; uncommon	W - P	10 ft.	Slow	High	Medium	Medium: fruits eaten by songbirds.	Deciduous upright, spreading shrub. Adaptable to a wide range of soil and moisture conditions. Cultivars commonly used in landscape plantings. White flowers in spring attract pollinators.
PEPPERBUSH, SWEET *Clethra alnifolia*	All	Statewide	MW - P	10 ft.	Mod.	Medium	Low	Low: seeds eaten by songbirds; browsed by deer.	Showy, fragrant white flower spikes in mid-summer, often when other flowers and nectar are less abundant. Many cultivars available. Attracts pollinators.
POSSUM-HAW *Viburnum nudum*	All	Statewide	SP - P	12 ft.	Mod.	Medium	Low	Medium: fruits eaten by turkey, songbirds, squirrels; browsed by rabbits, deer.	White flower clusters, red berries, red fall color. Fruits may remain on shrubs for much of the winter.
RAISIN, WILD *Viburnum nudum* var. *cassinoides*	All	Piedmont	SP - P	8 ft.	Mod.	Medium	Low	Medium: fruits eaten by turkey, songbirds, squirrels; browsed by rabbits, deer.	White flower clusters, black berries. Fruits may remain on shrubs for much of the winter. Reddish-purple foliage in fall.

TABLE 4.6: Selected Characteristics of Trees, Shrubs, and Woody Vines									
Plant Names	**Plant Hardiness Zones [1]**	**Natural Distribution in Delaware [1]**	**Soil Drainage Class [2]**	**Height at 20 Years**	**Growth Rate [3]**	**Density [4] -Summer**	**Density - Winter**	**Wildlife Food Value for Birds and Mammals**	**Remarks**
SHRUBS AND WOODY VINES									
RASPBERRY, BLACK *Rubus occidentalis*	All	Mostly Piedmont	W - SP	6 ft.	Fast	High	Medium	High: fruits eaten by turkey, songbirds, squirrels; browsed by rabbits, deer.	Arching stems (canes) can develop into dense, thorny thickets. White flowers attract pollinators, and produce black berries.
ROSE, CAROLINA *Rosa carolina*	All	Statewide	W - MW	3 ft.	Mod.	High	Medium	High: fruits eaten by songbirds; browsed by deer.	Occurs on field edges and in pastures; forms thorny thickets. Pink flowers attract bees and other pollinators. Red fruits may remain for much of the winter.
ROSE, SWAMP *Rosa palustris*	All	Statewide	SP - P	6 ft.	Mod.	Medium	Low	High: fruits eaten by songbirds; browsed by deer.	Prefers wetlands with permanent saturation and full sun; forms thorny thickets. Pink flowers attract bees and other pollinators. Red fruits may remain for much of the winter.
ROSE, VIRGINIA *Rosa virginiana*	All	Statewide	W - SP	6 ft.	Mod.	High	Medium	High: fruits eaten by songbirds; browsed by deer.	Occurs on field edges and in pastures; forms thorny thickets. Pink flowers attract bees and other pollinators. Red fruits may remain for much of the winter.
SPICEBUSH *Lindera benzoin*	All	Statewide	MW - P	12 ft.	Slow	Medium	Low	High: fruits eaten by songbirds (especially thrushes) and small mammals; browsed by rabbits, deer.	Fragrant leaves and twigs; yellow fall color. Bright red berries. Leaves are a main food source for larvae of spicebush and eastern tiger swallowtail butterflies, and prometheus moths.
STEEPLEBUSH *Spiraea tomentosa*	All	Mostly Coastal Plain	SP -P	6 ft.	Mod.	High	Medium	Low: seeds eaten by songbirds; browsed by deer and rabbits.	Deciduous upright shrub. Spreads by root suckering. Prefers moist to wet sites; acidic soils. Terminal clusters of pink flowers in summer attract pollinators. Host plant for butterfly and moth larvae.
SWEETSPIRE, VIRGINIA *Itea virginica*	All	Coastal Plain	SP - P	8 ft.	Mod.	Medium	Low	Low: seeds eaten by songbirds; foliage and twigs not generally browsed by wildlife.	Small white flowers in elongated clusters up to 6 inches long. Prefers permanent saturation. Attracts pollinators.

TABLE 4.6: Selected Characteristics of Trees, Shrubs, and Woody Vines									
Plant Names	**Plant Hardiness Zones [1]**	**Natural Distribution in Delaware [1]**	**Soil Drainage Class [2]**	**Height at 20 Years**	**Growth Rate [3]**	**Density [4] -Summer**	**Density - Winter**	**Wildlife Food Value for Birds and Mammals**	**Remarks**
SHRUBS AND WOODY VINES									
WAXMYRTLE, SOUTHERN *Morella cerifera (Myrica cerifera)*	All	Coastal Plain	W - P	10 ft.	Mod.	Medium	Medium	Medium: fruits eaten by quail, songbirds; browsed by deer.	Evergreen. Need male and female plants for fruit production. Salt tolerant (0-10 ppt).
WINTERBERRY *Ilex verticillata*	All	Statewide	SP - P	10 ft.	Mod.	Medium to High	Low to Medium	Medium: fruits eaten by songbirds, quail, and squirrels.	Need male and female plants for fruit production. Bright red berries persist after leaves drop.
WITCH-HAZEL *Hamamelis virginiana*	All	Statewide	W - SP	15 ft.	Slow	Medium	Low	Low: seeds eaten by squirrels; browsed by deer.	Bark is used for making witch-hazel lotion. Blooms in the fall; fragrant yellow flowers attract bees and other pollinators. .

TABLE 4.6 NOTES:

1. The Plant Hardiness Zones designate where a species can be successfully planted in Delaware, while the Geographic Distribution describes where the species usually occurs under natural conditions.

2. Soil Drainage Class (refer to the county soil survey for further information):
E - Excessively Drained; W - Well Drained; MW - Moderately Well Drained; SP - Somewhat Poorly Drained; P - Poorly Drained.

3. Growth Rate: Slow = usually 1 ft/year or less; Moderate = 1–2 ft/year; Fast = 2-3 ft/year; Very Fast = more than 3 ft/year.

4. Density: For an individual plant species, defined as the amount of space that is occupied by foliage, twigs, and branches, and can be estimated by the amount of light that can be seen through the plant. Low density – 25-35% of space occupied by plant material (with 65-75% open space through which air can travel); Medium density – 40-60% of space occupied by plant material; High density - 60-80% of space occupied by plant material; Very High – more than 80% of space occupied by plant material. The overall density of a windbreak is affected by the species selected, number of rows, and spacing between plants.

SECTION 5 - STREAMBANK AND SHORELINE PLANTINGS

This section contains recommended woody and herbaceous plantings for streambank and shoreline stabilization and protection.

Selecting Species and Establishing Plantings

Select bioengineering plant materials and tidal marsh plantings from Tables 5.1 to 5.3. For additional lists of suitable bioengineering plants, and details concerning site preparation and use of these plants, refer to the NRCS Engineering Field Handbook, Chapter 16, *Streambank and Shoreline Protection* and East Region Supplement No. 1. (See the References section of the 580 standard.)

When using unrooted woody plant materials (e.g., whips, fascines, and live stakes), select species that have a rooting ability of "Good" or better. (See Table 5.1) Species rated as "Fair" can be mixed with better rooting species. For species rated "Poor," use only bare-root or containerized materials.

Select and establish dune plantings based on recommendations in the publication *The Utility and Beauty of Coastal Dunes*. (See the References section of the 580 standard.)

TABLE 5.1: Selected Characteristics of Woody Plants for Streambank and Shoreline Stabilization

Plant Names	Plant Hardiness Zones [1]	Geographic Distribution in Delaware [1]	Native to DE	Planting Zone [2]	Sun/ Shade [3]	Growth Rate	Height at 20 Years	Rooting Ability from Cuttings [4]	Type of Plant Material Available	Natural Habitat and Other Characteristics
ARROWWOOD *Viburnum dentatum*	All	Statewide	■	Mid to Upper Bank	O - ◗	Fast	10 ft.	Fair	Bare-root, Containerized	Shrub swamps and forested wetlands. Suckers freely. White flowers, bluish-black berries.
BLACK-HAW *Viburnum prunifolium*	All	Statewide	■	Upper Bank	O - ◗	Slow	12 ft.	Poor	Bare-root, Containerized	Upland forests and hedgerows. White flower clusters, blue berries, red fall color. Fruits may remain on shrubs for much of the winter.
BUSH, HIGH-TIDE (GROUNDSEL) *Baccharis halimifolia*	All	Coastal Plain	■	Mid to Upper Bank	O	Moderate	10 ft.	Fair	Whips, Fascines, Bare-root, Containerized	Brackish and coastal marshes, usually above MHW. Salinity 0-15 ppt. Has fluffy white seeds. Male flowers & female flowers on separate plants.
BUSH, HIGH-TIDE (MARSH-ELDER) *Iva frutescens*	All	Coastal Plain	■	Lower to Mid Bank	O	Moderate	10 ft.	Fair	Whips, Fascines, Bare-root, Containerized	Brackish and coastal marshes, usually above MHW. Salinity 0-15 ppt.
BUTTONBUSH *Cephalanthus occidentalis*	All	Statewide	■	Toe	O - ◗	Slow	8 ft.	Fair - Good	Bare-root, Containerized	Shrub swamps and streambanks. Unusual, round white flowers. Tolerates long periods of inundation.
DOGWOOD, GRAY *Cornus racemosa*	All	Mostly Piedmont	■	Mid to Upper Bank	O - ◗	Fast	10 ft.	Poor	Bare-root, Containerized	Forested wetlands and streambanks. Produces fruit at 3-5 years of age. White flowers with white berries on reddish stalks. Prefers some shade.
DOGWOOD, REDOSIER *Cornus sericea* 'Ruby'	All	Piedmont; uncommon	■	Toe to Mid Bank	O - ◗	Fast	8 ft.	Good	Whips, Fascines, Live Stakes, Bare-root, Containerized	Forested wetlands and streambanks. Attractive red stem color. White flowers and fruit.

TABLE 5.1: Selected Characteristics of Woody Plants for Streambank and Shoreline Stabilization

Plant Names	Plant Hardiness Zones [1]	Geographic Distribution in Delaware [1]	Native to DE	Planting Zone [2]	Sun/ Shade [3]	Growth Rate	Height at 20 Years	Rooting Ability from Cuttings [4]	Type of Plant Material Available	Natural Habitat and Other Characteristics
DOGWOOD, SILKY *Cornus amomum*	All	Statewide	■	Lower to Mid Bank	O - ◗	Fast	10 ft.	Fair	Whips, Fascines, Live Stakes, Bare-root, Containerized	Forested wetlands and streambanks. Produces fruit at 3-5 years of age. White flowers with blue berries. Prefers some shade.
ELDERBERRY *Sambucus nigra ssp. canadensis*	All	Statewide	■	Toe to Upper Bank	O - ◗	Fast	12 ft.	Fair	Whips, Fascines, Live Stakes, Bare-root, Containerized	Open, forested wetlands and streambanks. Suitable for use as a secondary component of plantings with willows and dogwoods. Suckers freely.
VIBURNUM, MAPLE-LEAF *Viburnum acerifolium*	All	New Castle and Kent Cos; common	■	Lower to Mid Bank	O - ◗	Moderate	12 ft.	Poor	Bare-root, Containerized	Moist or dry forests; streambanks. Yellow to red fall color; white flower clusters. Bright red berries.
WILLOW, DWARF *Salix X cottetii* 'Bankers'	All	Introduced; not native to U.S.		Toe to Mid Bank	O - ◗	Fast	5 ft.	Good	Whips, Fascines, Live Stakes, Bare-root, Containerized	Male hybrid (sterile), non-invasive. Semi-prostrate shrub, sends up many branches from the roots to form dense surface cover in 2-3 years.
WILLOW, PURPLEOSIER *Salix purpurea* 'Streamco'	All	Introduced; not native to U.S.		Toe to Upper Bank	O - ◗	Fast	20 ft.	Excellent	Whips, Fascines, Live Stakes, Poles, Bare-root, Containerized	Non-invasive shrub. 'Streamco' is a male clone, does not root sucker, and does not spread readily beyond the planting site.
WILLOW, PUSSY *Salix discolor*	All	Piedmont	■	Toe to Mid Bank	O - ◗	Fast	20 ft.	Very Good	Whips, Fascines, Live Stakes, Poles, Bare-root, Containerized	Forested wetlands and streambanks. Fuzzy flower catkins appear in early spring. Grows rapidly, but does not spread readily beyond the planting site.

TABLE 5.1: Selected Characteristics of Woody Plants for Streambank and Shoreline Stabilization										
Plant Names	**Plant Hardiness Zones [1]**	**Geographic Distribution in Delaware [1]**	**Native to DE**	**Planting Zone [2]**	**Sun/ Shade [3]**	**Growth Rate**	**Height at 20 Years**	**Rooting Ability from Cuttings [4]**	**Type of Plant Material Available**	**Natural Habitat and Other Characteristics**
WILLOW, SANDBAR *Salix exigua* *(S. interior)* 'Greenbank'	All	Coastal Plain (historical)	■	Toe	○	Fast	15 ft.	Good	Whips, Fascines, Live Stakes, Poles, Bare-root, Containerized	Streambanks and sandbars. **Caution:** This is a native species that may aggressively spread by root suckering into adjacent areas.
WILLOW, SILKY *Salix sericea*	All	Statewide; uncommon	■	Toe to Mid Bank	○ - ◗	Fast	20 ft.	Good	Whips, Fascines, Live Stakes, Poles, Bare-root, Containerized	Forested wetlands and streambanks. Fuzzy flower catkins appear in early spring. Grows rapidly, but does not spread readily beyond the planting site.

TABLE 5.1 NOTES:

1. The **Plant Hardiness Zones** designate where a species can be successfully planted in Delaware, while the **Geographic Distribution** describes where the species usually occurs under natural conditions.

2. Planting Zone: Recommended area for planting each species, based on tolerance of flooding, long periods of saturation, and drought.
Toe - at base flow elevation;
Lower to Mid Bank - just above the baseflow elevation to the two-year flood elevation;
Upper Bank - above the two-year flood elevation and onto the floodplain.

3. Sun - Shade: Sunlight and shade tolerance for each species.
○ Full Sun - 6 or more hours of light per day or 4 hours of midday sun;
◗ Part Shade - 3 to 6 hours of light per day;
● Shade - less than 3 hours of light per day.

4. Rooting Ability from Cuttings: Subjective rating of the ability of cut stems of woody plants to root in soil without any special measures (e.g., without the use of a rooting hormone or greenhouse conditions). When using unrooted woody plant materials such as whips, fascines, live stakes, or poles, select species that have a rooting ability of "Good" or better. Species rated as "Fair" can be mixed with better rooting species. For species rated "Poor," use only bare-root or containerized materials.

Generally, no special site preparation or soil amendments are required at the time of planting. Sites with low fertility, based on results from a soil test, may benefit from top-dressing with fertilizer after leaf-out.

TABLE 5.2: Selected Characteristics of Companion Grasses [1] for Woody Bioengineering Plantings

Plant Names	Recommended Cultivar	Plant Hardiness Zones [2]	Native to DE	Planting Zone [3]	Sun/ Shade [4]	Growth Rate	Max. Height	Planting Rate [5]	Natural Habitat and Other Characteristics
BLUEGRASS, ROUGH *Poa trivialis*	Colt, Cypress, Sabre	All		Lower to Mid Bank	O - ●	Moderate	2 ft.	Plant seed at the rate of 10 lbs./acre (0.23 lbs./1,000 SF).	Cool-season, sod-forming grass. Medium textured, non-competitive. Prefers moist, shady sites; moderately well drained to somewhat poorly drained soils. More shade tolerant than *Poa palustris*. May be short-lived on the Coastal Plain, especially on drier sites in full sun.
FESCUE, CREEPING RED *Festuca rubra*	Dawson, Jasper, Navigator II	All	■	Mid to Upper Bank	O - ●	Moderate	2 ft.	Plant seed at the rate of 20 lbs./acre (0.45 lbs./1,000 SF).	Found in shady, upland areas. Cool-season, sod-forming grass. Fine textured, non-competitive. Use on upland sites, especially in shady conditions. Prefers well drained to somewhat poorly drained soils. The 'Dawson' variety is salt-tolerant.
MEADOWGRASS, FOWL *Poa palustris*	Common	All		Lower to Mid Bank	O - ◗	Moderate	3 ft.	Plant seed at the rate of 10 lbs./acre (0.23 lbs./1,000 SF).	Native to N. US; introduced in DE. Found in moist, shady sites. Cool-season, sod-forming grass. Fine textured, non-competitive. Prefers moderately well drained to somewhat poorly drained soils. May be short-lived on the Coastal Plain, especially on drier sites in full sun.
RYEGRASS, PERENNIAL *Lolium perenne*	Recommended DE turf-types	All		Mid to Upper Bank	O - ◗	Fast	2 ft.	Plant seed at the rate of 10 lbs./acre (0.23 lbs./1,000 SF).	Cool-season, bunch grass with medium longevity. Seedlings establish quickly. Prefers moist sites; moderately well drained to somewhat poorly drained soils.
WILDRYE, RIVERBANK *Elymus riparius*	Common	All	■	Lower to Mid Bank	O - ●	Moderate	5 ft.	Plant seed at the rate of 10 lbs/ac (0.23 lbs/1,000 SF) This seeding rate is for Pure Live Seed. (Seed is usually sold with awns still attached.)	Found along rivers and streams on moist, shady sites. Cool-season, coarse-textured bunch grass. Short-lived perennial. Seedlings establish quickly, but are not highly competitive with other plantings.

TABLE 5.2: Selected Characteristics of Companion Grasses [1] for Woody Bioengineering Plantings									
Plant Names	**Recommended Cultivar**	**Plant Hardiness Zones [2]**	**Native to DE**	**Planting Zone [3]**	**Sun/ Shade [4]**	**Growth Rate**	**Max. Height**	**Planting Rate [5]**	**Natural Habitat and Other Characteristics**
WILDRYE, VIRGINIA *Elymus virginicus*	Common	All	■	Lower to Mid Bank	○ - ●	Moderate	3 ft.	Plant seed at the rate of 10 lbs./acre (0.23 lbs./1,000 SF). This seeding rate is for Pure Live Seed. (Seed is usually sold with awns still attached.)	Found along rivers and streams on moist, shady sites. Cool-season, coarse-textured bunch grass. Short-lived perennial. Seedlings establish quickly, but are not highly competitive with other plantings. Prefers moderately well drained to poorly drained soils. *Elymus virginicus* var. *halophilus* is a naturally occurring salt-tolerant variety, but is not readily available from commercial sources.

TABLE 5.2 NOTES:

1. **Companion Grasses** can be used in combination with woody species to provide ground cover and reduce erosion, especially while woody plantings are becoming established.
2. The **Plant Hardiness Zones** designate where a species can be successfully planted in Delaware.
3. **Planting Zone:** Recommended area for planting each species, based on tolerance of flooding, long periods of saturation, and drought.
   Toe - at base flow elevation;
   Lower to Mid Bank - just above the baseflow elevation to the two-year flood elevation;
   Upper Bank - above the two-year flood elevation and onto the floodplain.
4. **Sun - Shade:** Sunlight and shade tolerance for each species.
   ○ Full Sun - 6 or more hours of light per day or 4 hours of midday sun;
   ◗ Part Shade - 3 to 6 hours of light per day;
   ● Shade - less than 3 hours of light per day.
5. **Planting Rate:** Generally, no special site preparation or soil amendments are required at the time of planting. Sites with very low fertility, based on results of a soil test, may benefit from top-dressing when plants are actively growing.

TABLE 5.3: Selected Characteristics of Grasses and Grass-like Plants for Tidal Shoreline Stabilization

Plant Names	Plant Hardiness Zones [1]	Geographic Distribution in Delaware [1]	Native to DE [2]	Planting Zone [3]	Sun/ Shade [4]	Growth Rate	Max. Height	Planting Rate [3]	Natural Habitat and Other Characteristics
BEACHGRASS, AMERICAN *Ammophila breviligulata* 'Cape'	All	Coastal Plain	■	Above MHT	O	Fast	3 ft.	Plant containerized plants and bare-root plants 18 to 24 inches apart, in staggered rows. If the site is exposed to severe wind erosion, spacing needs to be reduced to 12 inches.	Upland sites with sandy or other coarse textured soils. Cool-season grass. Strongly rhizomatous. Highly salt tolerant and drought tolerant. Does not tolerate much soil moisture. Use on coastlines for initial stabilization of frontal sand dunes.
BULRUSH, THREE-SQUARE *Schoenoplectus pungens*	All	Coastal Plain	■	Mid-tide to MHT	O	Fast	3 ft.	Plant containerized plants and bare-root plants 12 to 24 inches apart, in staggered rows.	Shallow fresh to brackish marshes and open water fringes. Salinity 0–15 ppt.
CORDGRASS, GIANT *Spartina cynosuroides*	All	Coastal Plain	■	Near MHT to above MHT	O	Moderate	10 ft.	Plant containerized plants and bare-root plants 18 to 36 inches apart, in staggered rows.	Upper intertidal zone of tidal marshes, and saturated soils above MHT. Warm-season grass. Up to 0.5 feet of lateral spread can be expected annually. Salinity 0 – 10 ppt.
CORDGRASS, PRAIRIE *Spartina pectinata*	All	Coastal Plain; uncommon (only in New Castle Co.)	■	Mid-tide to above MHT	O	Fast	6 ft.	Plant containerized plants and bare-root plants in staggered rows 24 to 36 inches apart, with plants 24 inches apart in each row.	Occurs in wet ditches and on upper margins of tidal fresh areas, and in saturated nontidal wetlands. Warm-season grass. Strongly rhizomatous; 5 – 10 feet of lateral spread can be expected annually. Tolerates seasonal dryness once established. Low tolerance to prolonged flooding or ponding. Salinity 0-3 ppt.

TABLE 5.3: Selected Characteristics of Grasses and Grass-like Plants for Tidal Shoreline Stabilization

Plant Names	Plant Hardiness Zones [1]	Geographic Distribution in Delaware [1]	Native to DE [2]	Planting Zone [3]	Sun/ Shade [4]	Growth Rate	Max. Height	Planting Rate [3]	Natural Habitat and Other Characteristics
CORDGRASS, SALTMEADOW *Spartina patens* 'Avalon'	All	Coastal Plain	■	Above MHT	O	Fast	3 ft.	Plant containerized plants and bare-root plants 18 to 36 inches apart, in staggered rows.	Tidal marshes between MHT and the 15-foot elevation above MHT. Warm-season grass. Strongly rhizomatous; up to 2 feet of lateral spread can be expected annually. Salinity 0 – 35 ppt.
CORDGRASS, SMOOTH *Spartina alterniflora* 'Bayshore'	All	Coastal Plain	■	Mid-tide to MHT	O	Fast	6 ft.	Plant containerized plants and bare-root plants 18 to 36 inches apart, in staggered rows.	Intertidal zone of tidal marshes. Warm-season grass. Up to 2 feet of lateral spread can be expected annually. Salinity 0 – 35 ppt.
PANICGRASS, COASTAL *Panicum amarum* var. *amarulum* 'Atlantic'	All	Coastal Plain	■	Above MHT	O	Moderate	6 ft.	Plant containerized plants and bare-root plants in staggered rows 2 to 3 feet apart, with plants 2 feet apart in each row. Plant seed at the rate of 20 lbs./acre (0.45 lbs./1,000 SF).	Naturally found on dry upland sites. Warm-season grass. Drought tolerant. Moderately salt tolerant. Used extensively for secondary dune stabilization. May be interseeded between rows of American Beachgrass.
RUSH, SOFT *Juncus effusus*	All	Statewide	■	Near MHT to above MHT	O	Moderate	3 ft.	Plant containerized plants and bare-root plants 6 to 12 inches apart, in staggered rows.	Upper intertidal zone of tidal fresh marshes, saturated soils above MHT, and in saturated nontidal wetlands. Moderately drought tolerant once established. Salinity to 0.5 ppt (fresh water).

TABLE 5.3: Selected Characteristics of Grasses and Grass-like Plants for Tidal Shoreline Stabilization

Plant Names	Plant Hardiness Zones [1]	Geographic Distribution in Delaware [1]	Native to DE [2]	Planting Zone [3]	Sun/ Shade [4]	Growth Rate	Max. Height	Planting Rate [3]	Natural Habitat and Other Characteristics
SWITCHGRASS *Panicum virgatum* 'Blackwell' 'Carthage' 'Cave-in-Rock' 'High Tide' 'Shelter'	All	Coastal Plain	■	Above MHT	○	Moderate	6 ft.	Plant containerized plants and bare-root plants in staggered rows 2 to 3 feet apart, with plants 2 feet apart in each row. Plant seed at the rate of 20 lbs./acre (0.45 lbs./1,000 SF).	Occurs on upper margins of fresh and brackish tidal marshes. Native, warm-season bunchgrass. Wide range of adaptation from dry uplands to poorly drained sites. Moderately salt tolerant. Salinity 0 – 10 ppt. 'Blackwell,' 'Carthage,' and 'Shelter' varieties are better suited for well-drained to somewhat poorly drained sites. 'Cave-in-Rock' is a lowland type that tolerates droughty soils, but is better suited to wet sites and frequent flooding. 'High Tide' is a Mid-Atlantic ecotype specifically selected for tidal shorelines and streambank stabilization.

TABLE 5.3 NOTES:

1. The **Plant Hardiness Zones** designate where a species can be successfully planted in Delaware, while the **Geographic Distribution** describes where the species usually occurs under natural conditions.
2. **Native to Delaware:** The term "native" refers to species that occur naturally in one or more geographic regions of Delaware Due to page limitations, this list is not all-inclusive. There are many other species that may be suitable, depending on site conditions.
3. **Planting Zone:** Recommended area for planting each species, based on tolerance of flooding, long periods of saturation, and drought.
   Mid-tide – elevation midway between mean low tide (MLT) and mean high tide (MHT); MHT – elevation at mean high tide; Above MHT - above the mean high tide elevation.
4. **Sun - Shade:** Sunlight and shade tolerance for each species.
   ○ Full Sun - 6 or more hours of light per day or 4 hours of midday sun; ◗ Part Shade - 3 to 6 hours of light per day; ● Shade - less than 3 hours of light per day.
5. **Planting Rate:** Generally, no special site preparation or soil amendments are required at the time of planting. Sites with low fertility, based on results of a soil test, may benefit from top-dressing with fertilizer when plants are actively growing.

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SECTION 6 - WETLAND PLANTINGS

This section contains recommended plantings for wetlands and shallow water areas. Other wetland plantings that are native to Delaware may also be suitable.

Selecting Species and Establishing Plantings

Planting can be used as appropriate to hasten establishment of desired species or to supplement the natural regeneration process. The use of species native to Delaware is required for all permanent plantings (not including temporary seedings or nurse crops) in a wetland or shallow water area.

Where needed, use an appropriate seed mix for wetlands to provide short-term herbaceous cover to control erosion and to help build the organic components of the soil. Temporary or non-competitive permanent mixes may be needed in areas where natural regeneration is planned, woody species will be planted, or other permanent plantings will be delayed. Plantings for short-term cover shall be non-competitive to the introduction and establishment of the desired species.

Table 6.1 contains a quick reference to recommended trees, shrubs, and woody vines for wetlands. (Refer to Section 4, Table 4.6 for more detailed information concerning each species.)

Refer to Table 6.2 for mixes that can be used for temporary site stabilization, companion plantings with trees and shrubs, and early successional plantings.

Table 6.3 provides additional information for herbaceous wetland species.

TABLE 6.1: Recommended Trees, Shrubs, and Woody Vines for Wetlands (see Section 4, Table 4.6 for detailed species information)

Plant Names	Region [1/]		Moisture [2/]			Native to Delaware	Habitat Use Characteristics [3/]								Water Regime (surface saturation/ infrequent inundation)	Water Regime (surface saturation/ frequent or prolonged inundation)
							Cover		Fruit/Seed Consumption			Pollinator Food				
	Piedmont	Coastal Plain	Dry Sites	Mesic Sites	Wet Sites		Nesting/ Resting	Protection	Wildlife (H)	Wildlife (M)	Humans	Nectar/ Pollen	Foliage	Toxic to Livestock		
DECIDUOUS TREES																
ASH, GREEN *Fraxinus pennsylvanica*	■	■		■	■	■	■			■			■		■	
BIRCH, RIVER *Betula nigra*	■	■	■	■	■	■	■			■			■		■	
BLACKGUM *Nyssa sylvatica*	■	■	■	■	■	■	■			■		■			■	
BOX-ELDER *Acer negundo*	■	■		■	■	■	■			■					■	
COTTONWOOD, EASTERN *Populus deltoides*	■	■	■	■	■	■	■								■	
CYPRESS, BALD *Taxodium distichum*		■		■	■	■	■									■
ELM, AMERICAN *Ulmus americana*	■	■	■	■	■	■	■						■		■	
ELM, SLIPPERY *Ulmus rubra*	■	■	■	■	■	■	■						■		■	
HAWTHORN, GREEN *Crataegus viridis*		■		■	■	■	■			■	■	■			■	
HICKORY, BITTERNUT *Carya cordiformis*	■	■		■	■	■	■						■		■	
HORNBEAM, AMERICAN *Carpinus caroliniana*	■	■		■	■	■	■			■					■	
MAGNOLIA, SWEETBAY *Magnolia virginiana*		■		■	■	■	■			■		■			■	
MAPLE, RED *Acer rubrum*	■	■	■	■	■	■	■			■		■	■	■		■
MAPLE, SILVER *Acer saccharinum*	■			■	■	■	■			■		■	■			■
OAK, CHERRYBARK *Quercus pagoda*		■			■	■	■		■				■	■	■	

TABLE 6.1: Recommended Trees, Shrubs, and Woody Vines for Wetlands (see Section 4, Table 4.6 for detailed species information)

Plant Names	Region [1/]		Moisture [2/]			Native to Delaware	Habitat Use Characteristics [3/]								Water Regime (surface saturation/ infrequent inundation)	Water Regime (surface saturation/ frequent or prolonged inundation)
							Cover		Fruit/Seed Consumption			Pollinator Food				
	Piedmont	Coastal Plain	Dry Sites	Mesic Sites	Wet Sites		Nesting/ Resting	Protection	Wildlife (H)	Wildlife (M)	Humans	Nectar/ Pollen	Foliage	Toxic to Livestock		
DECIDUOUS TREES																
OAK, OVERCUP *Quercus lyrata*		■		■	■	■	■		■		■		■	■		■
OAK, PIN *Quercus palustris*	■	■		■	■	■	■		■				■	■	■	
OAK, SWAMP CHESTNUT *Quercus michauxii*		■		■	■	■	■		■		■		■	■	■	
OAK, SWAMP WHITE *Quercus bicolor*		■		■	■	■	■		■		■		■	■	■	
OAK, WATER *Quercus nigra*		■		■	■	■	■		■				■	■	■	
OAK, WILLOW *Quercus phellos*		■		■	■	■	■		■				■	■	■	
PAWPAW *Asimina triloba*	■	■		■	■	■	■		■		■		■		■	
PERSIMMON, COMMON *Diospyros virginiana*	■	■	■	■	■	■	■		■		■	■			■	
SERVICEBERRY, CANADIAN *Amelanchier canadensis*	■	■		■	■	■	■		■		■	■	■		■	
SERVICEBERRY, COMMON *Amelanchier arborea*	■	■	■	■	■	■	■		■		■	■	■		■	
SWEETGUM *Liquidambar styraciflua*	■	■		■	■	■	■								■	
SYCAMORE *Platanus occidentalis*	■	■		■	■	■	■								■	
TUPELO, SWAMP (SWAMP BLACK GUM) *Nyssa biflora*		■		■	■	■	■			■		■				■
WILLOW, BLACK *Salix nigra*	■	■		■	■	■	■					■	■			■

TABLE 6.1: Recommended Trees, Shrubs, and Woody Vines for Wetlands (see Section 4, Table 4.6 for detailed species information)

Plant Names	Region [1/]		Moisture [2/]			Native to Delaware	Habitat Use Characteristics [3/]								Water Regime (surface saturation/ infrequent inundation)	Water Regime (surface saturation/ frequent or prolonged inundation)
							Cover		Fruit/Seed Consumption			Pollinator Food				
	Piedmont	Coastal Plain	Dry Sites	Mesic Sites	Wet Sites		Nesting/ Resting	Protection	Wildlife (H)	Wildlife (M)	Humans	Nectar/ Pollen	Foliage	Toxic to Livestock		
EVERGREEN TREES																
CEDAR, ATLANTIC WHITE *Chamaecyparis thyoides*		■		■	■	■	■	■		■						■
HEMLOCK, EASTERN *Tsuga canadensis*	■	■	■	■		■	■	■		■					■	
HOLLY, AMERICAN *Ilex opaca*	■	■	■	■	■	■	■	■		■					■	
PINE, LOBLOLLY *Pinus taeda*		■		■	■	■	■	■		■			■		■	
SHRUBS AND WOODY VINES																
ALDER, SMOOTH *Alnus serrulata*	■	■		■	■	■	■	■	■							■
ARROWWOOD *Viburnum dentatum*	■	■	■	■	■	■	■	■	■						■	
AZALEA, SWAMP *Rhododendron viscosum*		■		■	■	■	■					■		■	■	
BAYBERRY, NORTHERN *Morella pensylvanica (Myrica pensylvanica)*	■	■	■	■	■	■	■	■	■						■	
BLUEBERRY, HIGHBUSH *Vaccinium corymbosum*	■	■		■	■	■	■	■	■		■	■	■		■	
BUSH, HIGH TIDE (GROUNDSEL) *Baccharis halimifolia*		■		■	■	■	■	■							■	
BUSH, HIGH TIDE (MARSH-ELDER) *Iva frutescens*		■		■	■	■	■	■							■	
BUTTONBUSH *Cephalanthus occidentalis*	■	■		■	■	■	■	■				■				■
CHOKEBERRY, BLACK *Aronia melanocarpa*	■		■	■	■	■	■	■		■	■	■			■	

TABLE 6.1: Recommended Trees, Shrubs, and Woody Vines for Wetlands (see Section 4, Table 4.6 for detailed species information)

Plant Names	Region [1/]		Moisture [2/]			Native to Delaware	Habitat Use Characteristics [3/]								Water Regime (surface saturation/ infrequent inundation)	Water Regime (surface saturation/ frequent or prolonged inundation)
							Cover		Fruit/Seed Consumption			Pollinator Food				
	Piedmont	Coastal Plain	Dry Sites	Mesic Sites	Wet Sites		Nesting/ Resting	Protection	Wildlife (H)	Wildlife (M)	Humans	Nectar/ Pollen	Foliage	Toxic to Livestock		
SHRUBS AND WOODY VINES																
CHOKEBERRY, RED *Aronia arbutifolia*	■	■	■	■	■	■	■	■		■	■	■			■	
DEWBERRY, BRISTLY *Rubus hispidus*		■			■	■	■			■	■		■		■	
DOGWOOD, REDOSIER *Cornus sericea*	■			■	■	■	■	■	■			■				■
DOGWOOD, SILKY *Cornus amomum*	■	■		■	■	■	■	■	■			■			■	
DOGWOOD, STIFF *Cornus foemina*		■		■	■	■	■	■	■			■			■	
ELDERBERRY *Sambucus nigra* ssp. *canadensis* (*Sambucus canadensis)*	■	■		■	■	■	■	■	■		■	■		■	■	
FETTERBUSH *Eubotrys racemosa* *(Leucothoe racemosa)*		■		■	■	■	■	■						■	■	
GRAPE, MUSCADINE *Vitis rotundifolia*		■		■	■	■	■	■	■		■				■	
GRAPE, RIVERBANK *Vitis riparia*	■	■			■		■	■	■		■				■	
HUCKLEBERRY, BLACK *Gaylussacia baccata*	■	■	■	■	■	■	■	■	■		■	■	■		■	
HUCKLEBERRY, BLUE *Gaylussacia frondosa*	■	■	■	■	■	■	■	■	■		■	■	■		■	
INDIGO, FALSE (INDIGO BUSH) *Amorpha fruticosa*	■	■	■	■	■	■	■	■		■		■			■	
INKBERRY *Ilex glabra*		■		■	■	■	■	■	■							■
MEADOWSWEET, WHITE *Spiraea alba*	■			■	■	■	■	■		■		■	■		■	

TABLE 6.1: Recommended Trees, Shrubs, and Woody Vines for Wetlands (see Section 4, Table 4.6 for detailed species information)

Plant Names	Region [1/]		Moisture [2/]			Native to Delaware	Habitat Use Characteristics [3/]								Water Regime (surface saturation/ infrequent inundation)	Water Regime (surface saturation/ frequent or prolonged inundation)
							Cover		Fruit/Seed Consumption			Pollinator Food				
	Piedmont	Coastal Plain	Dry Sites	Mesic Sites	Wet Sites		Nesting/ Resting	Protection	Wildlife (H)	Wildlife (M)	Humans	Nectar/ Pollen	Foliage	Toxic to Livestock		
SHRUBS AND WOODY VINES																
NINEBARK, COMMON *Physocarpus opulifolius*	■		■	■	■	■	■	■		■		■			■	
PEPPERBUSH, SWEET *Clethra alnifolia*	■	■		■	■	■	■	■				■			■	
POSSUM-HAW *Viburnum nudum*	■	■		■	■	■	■	■		■	■				■	
RAISIN, WILD *Viburnum nudum* var. *cassinoides*				■	■	■	■	■		■	■				■	
ROSE, SWAMP *Rosa palustris*	■	■		■	■	■	■	■	■		■	■				■
SPICEBUSH *Lindera benzoin*	■	■		■	■	■	■	■	■		■		■		■	
STEEPLEBUSH *Spiraea tomentosa*	■	■		■	■	■	■	■				■	■		■	
SWEETSPIRE, VIRGINIA *Itea virginica*		■		■	■	■	■	■				■			■	
WAXMYRTLE, SOUTHERN *Morella cerifera (Myrica cerifera)*		■	■	■	■	■	■	■	■						■	
WINTERBERRY *Ilex verticillata*	■	■		■	■	■	■	■	■						■	

TABLE 6.1 NOTES:

1. **Region:** The physiographic region where the species usually occurs in Delaware, under natural conditions. For introduced species, this is the region where the species can be planted. Native species may also be planted in other locations, based on Plant Hardiness Zones (PHZ). Refer to Section 4, Table 4.6 for PHZ and other information for each species.

2. **Moisture:** The amount of moisture the species needs or tolerates. Dry - excessively drained to well-drained soil; Mesic - moderately well to somewhat poorly drained soil; Wet - poorly to very poorly drained soil.

TABLE 6.1 NOTES: (continued)

3. Habitat Use Characteristics:

Cover - All plants provide some type of cover for wildlife, depending on the time of year and the wildlife species of interest. These columns describe the cover use primarily for birds and small mammals, as follows:

- Nesting/Resting - Provides nesting and/or resting cover.
- Protection - Provides protective habitat, typically characterized by high stem density near ground level and/or dense, persistent foliage (usually evergreens, but also some deciduous species that retain leaves well into the winter).

Fruit/Seed Consumption - These columns note whether a fruit or seed is a good food source for wildlife, or may be eaten by humans:

- Wildlife - (H) Highly preferred food for many birds and mammals, or (M) Medium value, and is utilized by fewer species or is produced in smaller quantities than similar foods. Plant species not noted as having High or Medium value have Low or unknown value. Refer to Section 4, Table 4.6, for detailed wildlife food value information.
- Humans - May be consumed by people. Caution: This list should not solely be relied upon for knowledge of human edibility. Many plants with palatable parts also contain parts that are to a certain degree toxic to humans. Toxicity effects can vary with people and environment, and not all human toxicity effects are known for wild plants. People who intend to consume parts of wild plants should ensure their own safety and health by consulting experts and/or trusted plant references.

Pollinator Food - These columns note whether a species provides a food source for adult and larval-stage pollinators:

- Nectar/Pollen - Species produces nectar and/or pollen that are consumed by adults or larvae of various pollinator species.
- Foliage - Species has vegetative plant parts (foliage, stems, etc.) that are consumed by various insect pollinators, especially while in the larval stage.

Toxic to Livestock - Reported to be slightly to highly toxic if consumed by livestock. Toxicity may include flowers, fruits/nuts, foliage, and other plant parts, and can vary with species of livestock, age of the animal, and growth stage of the plant.

TABLE 6.2: Recommended Herbaceous Mixes for Wetlands [1/]

Mix	Recommended Cultivar	Seeding Rate (lbs/ac) [2/]	Plant Hardiness Zones [3/]	Max. Height (feet)	Type of Grass in Mix	Remarks
1. Rough Barnyard Grass *Echinochloa muricata*	Common	5 - 10	All	3 - 4	Warm & cool season grasses	Mix for temporary site stabilization. Native, short-lived grasses. Can be used when permanent plantings will be delayed. (For example, use this mix to stabilize the site in late fall, then plant permanent vegetation the following spring.)
Riverbank Wildrye *Elymus riparius*	Common	4 - 6				
Virginia Wildrye *Elymus virginicus*	Common	4 - 6				Suitable for seasonally saturated wetlands and adjacent somewhat poorly drained areas. Tolerates dry conditions and brief periods of inundation after establishment.
2. Rough Bentgrass *Agrostis scabra*	Common	4 - 6	All	1 - 2	Cool season grasses	Companion planting for trees and shrubs. Low-growing, native perennial grasses. Mix provides semi-permanent grass cover that helps to suppress weeds and control erosion. May be planted at the same time as woody plantings. Suitable for seasonally saturated wetlands and adjacent somewhat poorly drained areas. Tolerates dry conditions and brief periods of inundation after establishment.
Fowl Meadowgrass *Poa palustris*	Common	4 - 8				
3. Virginia Wildrye *Elymus virginicus*	Common	2 - 3	All	2 - 3	Warm & cool season grasses	Early successional mix. Low-growing all-native species. Use this as a basic "starter mix" to provide cover in areas where natural regeneration is planned. Suitable for seasonally saturated wetlands and adjacent somewhat poorly drained areas. Tolerates dry conditions and brief periods of inundation after establishment.
Red Fescue *Festuca rubra*	Common	3 - 4				
Fowl Meadowgrass *Poa palustris* **OR**	Common	2 - 4				
Deertongue *Dichanthelium clandestinum*	Tioga	2 - 4				Fowl Meadowgrass may be short-lived on the Coastal Plain, especially on drier sites in full sun.
AND ADD:						
Partridge Pea *Chamaecrista fasciculata*	Common	1				
4. Rough Barnyard Grass *Echinochloa muricata*	Common	2 - 4	All	3 - 4	Warm & cool season grasses	Early successional mix. All native species. The Barnyard Grass is an annual warm-season grass that provides temporary cover and wildlife food. Use this mix as a basic "starter mix" to provide cover in areas where natural regeneration is planned.
Fowl Meadowgrass *Poa palustris*	Common	2 - 4				
Virginia Wildrye *Elymus virginicus*	Common	2 - 4				Diverse mix that is suitable for seasonally saturated wetlands and adjacent somewhat poorly drained areas. Tolerates dry conditions and brief periods of inundation after establishment.
AND ADD THE FOLLOWING WILDFLOWERS:						
Partridge Pea *Chamaecrista fasciculata*	Common	1				Fowl Meadowgrass may be short-lived on the Coastal Plain, especially on drier sites in full sun.
Beggar Ticks *Bidens frondosa*	Common	1				
Smartweed *Polygonum pensylvanicum*	Common	0.5 - 1				
Swamp Milkweed *Asclepias incarnata*	Common	2				

TABLE 6.2: Recommended Herbaceous Mixes for Wetlands [1/]

Mix	Recommended Cultivar	Seeding Rate (lbs/ac) [2/]	Plant Hardiness Zones [3/]	Max. Height (feet)	Type of Grass in Mix	Remarks
5. Eastern Bur Reed *Sparganium americanum*	Common	0.5				This is a diverse, all-native species for emergent wetlands and shallow water areas that will provide food and cover for waterfowl and other wetland wildlife.
Fox Sedge *Carex vulpinoidea*	Common	0.2				Substitutions:
Lurid Sedge *Carex lurida*	Common	0.5				Can substitute Hop Sedge (*Carex lupulina*) for Fox Sedge or Lurid Sedge at a rate of 1.5 lb/ac.
Redtop Panicgrass *Panicum rigidulum*	Common	0.3				Can substitute Fowl Mannagrass (*Glyceria striata*) for Redtop Panicgrass at a rate of 0.1 lb/ac, or can substitute Woolgrass (*Scirpus cyperinus*) for Redtop Panicgrass at a rate of 0.01 lb/ac.
Riverbank Wildrye *Elymus riparius*	Common	2				
Rough Barnyard Grass *Echinochloa muricata*	Common	1				
Softstem Bulrush *Schoenoplectus tabernaemontani*	Common	0.1				
AND ADD THE FOLLOWING WILDFLOWERS:			All	5 - 8	Warm & cool season grasses	If a wildflower in the mix is not available, double the rate of one of the other wildflower species. For example, if Swamp Milkweed is not available, Joe-Pye Weed can be increased to 0.2 lb/ac.
Beggar Ticks *Bidens frondosa*	Common	1				
Blue (Swamp) Vervain *Verbena hastata*	Common	0.1				
Joe-Pye Weed *Eutrochium fistulosum*	Common	0.1				
Nodding Bur Marigold *Bidens cernua*	Common	0.5				
Pennsylvania Smartweed *Polygonum pensylvanicum*	Common	1				
Swamp Milkweed *Asclepias incarnata*	Common	1				
Yellow Sneezeweed *Helenium autumnale*	Common	0.1				

TABLE 6.2 NOTES:

1. **Herbaceous Mixes for Wetlands:** This is a list of mixes that can be used for temporary site stabilization, companion plantings for trees and shrubs, and as basic "starter mixes" to provide initial cover and food for wildlife. See the "Remarks" column of this table for recommended uses. Due to page limitations, this list is not all-inclusive. There are many other mixes that may be suitable, depending on site conditions and the purpose of the planting.

2. **Seeding Rate:** Seeding rates for native grasses, sedges, legumes, and other wildflowers are in pounds of Pure Live Seed (PLS). Order seed from the supplier based on the PLS rate; the seed supplier will adjust the bulk amount to be planted based on percent seed germination and purity, as tested. Legume seeds shall be inoculated before planting with the appropriate *Rhizobium* bacteria. When feasible, hard-seeded legumes should be scarified to improve germination.

   When a seeding rate is expressed as a range (i.e., 4 - 6), the lower rate should be used if site conditions are generally good and erosion is not a concern.

3. The **Plant Hardiness Zones** designate where a species can be successfully planted in Delaware.

TABLE 6.3: Selected Characteristics of Herbaceous Wetland Plants

Plant Names	Plant Hardiness Zones [1]	Geographic Distribution in Delaware [1]	Native to DE [2]	Sun/ Shade [3]	Height at Maturity	Rate of Spread [4]	Wildlife Value for Food	Natural Habitat and Other Characteristics
Water Regime: Surface Saturation to Infrequent Inundation								
ASTER, NEW ENGLAND *Symphyotrichum novae-angliae*	All	Statewide; common	■	❍ - ◗	3-6 ft.	Slow	Flowers attractive to butterflies. Seeds eaten by songbirds.	Wet meadows. Prefers full sun. Attractive clusters of purple flowers.
ASTER, NEW YORK *Symphyotrichum novi-belgii*	All	Mostly Coastal Plain; common	■	❍ - ◗	3-6 ft.	Slow	Flowers attractive to butterflies. Seeds eaten by songbirds.	Wet meadows. Prefers full sun. Attractive clusters of violet flowers.
ASTER, PURPLE-STEMMED *Symphyotrichum puniceum*	All	Statewide; common	■	❍ - ◗	3-6 ft.	Slow	Flowers attractive to butterflies. Seeds eaten by songbirds.	Wet meadows. Prefers full sun. Attractive clusters of violet flowers.
BENTGRASS, CREEPING *Agrostis stolonifera*	All	Statewide; common		❍	<3 ft.	Slow	Seeds eaten by songbirds.	Wet meadows. Cool-season grass with creeping habit. Widely naturalized, but not native to US.
BLUESTEM, BUSHY *Andropogon glomeratus*	All	Coastal Plain	■	❍	<3 ft.	Fast	Seeds eaten by songbirds.	Wet meadows. Warm-season grass with stiff stems.
BONESET *Eupatorium perfoliatum*	All	Statewide; common	■	❍ - ◗	3-6 ft.	Slow	Flowers attractive to butterflies.	Wet meadows. Small white flower clusters.
CARDINAL FLOWER *Lobelia cardinalis*	All	Statewide; common	■	◗	<3 ft.	Slow	Flowers attractive to hummingbirds & butterflies.	Wet meadows and open forested wetlands. Spike of attractive bright red flowers.
CORDGRASS, SALTMEADOW *Spartina patens*	All	Coastal Plain; common	■	❍	<3 ft.	Fast	Seeds eaten by waterfowl & songbirds. Roots eaten by waterfowl and muskrats.	Tidal marshes above MHT. Warm-season grass. Salinity 0 – 35 ppt.
DEERTONGUE *Dichanthelium clandestinum*	All	Statewide; common	■	❍ - ◗	<3 ft.	Slow	Seeds eaten by songbirds.	Wet meadows. Warm-season grass. Tolerates seasonal wetness and drought.
FESCUE, RED *Festuca rubra*	All	Statewide; common	■	❍ - ●	<3 ft.	Slow	Seeds eaten by songbirds.	Shady uplands and moist sites. Cool-season, sod-forming grass. Very fine leaves. Tolerates drought once established.
FERN, MARSH *Thelypteris palustris*	All	Statewide; common	■	❍ - ◗	<3 ft.	Fast	Minimal value for food. Occasionally browsed by deer.	Open forested wetlands and wet meadows.
IRONWEED *Vernonia noveboracensis*	All	Statewide; common	■	❍	3-6 ft.	Slow	Flowers attractive to butterflies.	Wet meadows. Deep purple flower clusters.

TABLE 6.3: Selected Characteristics of Herbaceous Wetland Plants								
Plant Names	**Plant Hardiness Zones [1]**	**Geographic Distribution in Delaware [1]**	**Native to DE [2]**	**Sun/ Shade [3]**	**Height at Maturity**	**Rate of Spread [4]**	**Wildlife Value for Food**	**Natural Habitat and Other Characteristics**
Water Regime: Surface Saturation to Infrequent Inundation (continued)								
JOE-PYE WEED *Eutrochium fistulosum*	All	Statewide	■	❍ - ◗	3-6 ft.	Slow	Flowers attractive to butterflies.	Wet meadows. Pink-purple flower clusters.
LOBELIA, BLUE *Lobelia siphilitica*	All	Piedmont; common	■	◗	<3 ft.	Slow	Flowers attractive to butterflies. Leaves and stems eaten by deer.	Wet meadows (often in shade) and saturated forested wetlands. Attractive blue flower spike.
MEADOWGRASS, FOWL *Poa palustris*	All	Statewide		❍ - ◗	<3 ft.	Slow	Seeds eaten by songbirds.	Wet meadows. Cool-season grass. May be short-lived, especially on drier sites in full sun. Native to northern US.
MILKWEED, SWAMP *Asclepias incarnata*	All	Statewide; common	■	❍	3-6 ft.	Slow	Flowers attractive to butterflies. Important plant for Monarchs.	Wet meadows. Small pink flowers in clusters.
MONKEY FLOWER, WINGED *Mimulus alatus*	All	Statewide; common	■	❍	<3 ft.	Slow	Flowers attractive to butterflies.	Wet meadows. Pink-purple flowers similar to snapdragons.
MONKEY FLOWER, ALLEGHANY *Mimulus ringens*	All	Statewide; common	■	❍ - ◗	<3 ft.	Slow	Flowers attractive to butterflies.	Openings in saturated forested wetlands. Pink-purple flowers similar to snapdragons.
PASPALUM, FLORIDA *Paspalum floridanum*	All	Coastal Plain; common	■	❍	3-5 ft.	Moderate	Large seeds eaten by quail, dove, turkeys, and other birds. Wildlife browse the foliage.	Native warm-season bunch grass. Readily grows on moist, disturbed areas and roadside ditches. Foliage deteriorates rapidly after maturity.
PEA, PARTRIDGE *Chamaecrista fasciculata*	All	Statewide; common	■	❍ - ◗	<3 ft.	Fast	Seeds eaten by quail, turkeys, songbirds.	Mostly in upland fields. Tolerates moist sites. Reseeding annual legume. Feathery foliage; yellow flowers.
REEDGRASS, WOOD *Cinna arundinacea*	All	Statewide; common	■	❍ - ◗	3-6 ft.	Slow	Seeds eaten by songbirds. Foliage eaten by deer.	Saturated forested wetlands. Cool-season grass.
TICKSEED *Coreopsis tinctoria*	All	Statewide		❍ - ◗	<3 ft.	Fast	Seeds eaten by songbirds.	River banks and floodplains. Prefers moist soils; tolerates dry sites. Re-seeding annual with yellow flowers. Native to central and western US.

TABLE 6.3: Selected Characteristics of Herbaceous Wetland Plants

Plant Names	Plant Hardiness Zones [1]	Geographic Distribution in Delaware [1]	Native to DE [2]	Sun/ Shade [3]	Height at Maturity	Rate of Spread [4]	Wildlife Value for Food	Natural Habitat and Other Characteristics
Water Regime: Surface Saturation to Infrequent Inundation (continued)								
VERVAIN, BLUE *Verbena hastata*	All	Statewide; common	■	❍	3-6 ft.	Slow	Seeds eaten by songbirds.	Wet meadows. Small blue flowers in spikes.
WILD RYE, RIVERBANK *Elymus riparius*	All	Statewide; common	■	❍ - ◗	3-5 ft.	Fast	Foliage eaten by wildlife in early spring.	Wet meadows and river banks. Cool-season grass.
WILDRYE, VIRGINIA *Elymus virginicus*	All	Statewide; common	■	❍ - ◗	<3 ft.	Fast	Foliage eaten by wildlife in early spring.	Wet meadows and river banks. Cool-season grass.
WOODOATS, SLENDER *Chasmanthium laxum*	All	Coastal Plain; common	■	❍ - ◗	2-3 ft.	Moderate	Occasionally browsed by wildlife. Seeds eaten by birds.	Stream banks, floodplains, moist meadows.
Water Regime: Surface Saturation to +3 inches of Surface Water								
CUTGRASS, RICE *Leersia oryzoides*	All	Statewide; common	■	❍	<3 ft.	Fast	Seeds eaten by waterfowl, songbirds. Roots eaten by waterfowl.	Shallow fresh marshes & wet meadows. Cool-season grass. Leaves have sawtoothed edges.
FERN, SENSITIVE *Onoclea sensibilis*	All	Statewide; common	■	❍ - ●	<3 ft.	Fast	Minimal value for food. Occasionally browsed by deer.	Wet meadows and saturated forested wetlands.
FERN, CINNAMON *Osmunda cinnamomea*	All	Statewide; common	■	●	3-6 ft.	Slow	Minimal value for food. Occasionally browsed by deer.	Saturated forested wetlands.
FERN, ROYAL *Osmunda regalis*	All	Statewide; common	■	◗ - ●	3-6 ft.	Slow	Minimal value for food. Occasionally browsed by deer.	Wooded swamps and saturated forested wetlands.
IRIS, BLUE *Iris versicolor*	All	Statewide; common	■	❍	<3 ft.	Slow	Plants eaten by muskrats.	Shallow fresh marshes. Attractive blue flower.
MALLOW, MARSH *Kosteletzkya virginica*	All	Coastal Plain; common	■	❍	3-6 ft.	Slow	Flowers attractive to hummingbirds.	Brackish & fresh tidal marshes; saturated soils above MHT. Salinity 0 - 10 ppt. Large, showy pink flowers.
MALLOW, ROSE *Hibiscus moscheutos*	All	Coastal Plain; common	■	❍	3-6 ft.	Slow	Flowers attractive to hummingbirds.	Brackish & fresh tidal marshes; saturated soils above MHT. Salinity 0 - 15 ppt. Large, showy white flowers.
MANNA GRASS *Glyceria canadensis*	All	Statewide; uncommon	■	❍ - ◗	3-6 ft.	Fast	Seeds eaten by songbirds, waterfowl. Plants eaten by deer, muskrats.	Shallow fresh marshes, wet meadows, open forested wetlands. Cool-season grass.

TABLE 6.3: Selected Characteristics of Herbaceous Wetland Plants								
Plant Names	**Plant Hardiness Zones [1]**	**Geographic Distribution in Delaware [1]**	**Native to DE [2]**	**Sun/ Shade [3]**	**Height at Maturity**	**Rate of Spread [4]**	**Wildlife Value for Food**	**Natural Habitat and Other Characteristics**
Water Regime: Surface Saturation to +3 inches of Surface Water (continued)								
MANNA GRASS, EASTERN *Glyceria septentrionalis*	All	Statewide; common	■	❍	3-6 ft.	Fast	Seeds eaten by songbirds, waterfowl. Plants eaten by deer, muskrats.	Shallow fresh marshes and wet meadows. Cool-season grass.
MANNA GRASS, FOWL *Glyceria striata*	All	Statewide; common	■	❍ - ◗	<3 ft.	Slow	Seeds eaten by songbirds, waterfowl. Plants eaten by deer, muskrats.	Wet meadows. Cool-season grass. Contains prussic acid; can be poisonous to livestock.
MILLET, WALTER'S *Echinochloa walteri*	All	Coastal Plain; common	■	❍	<3 ft.	Slow	Seeds eaten by songbirds, waterfowl.	Shallow fresh marshes and wet meadows. Annual, warm-season grass.
REEDGRASS, BLUE-JOINT *Calamagrostis canadensis*	All	Coastal Plain; uncommon	■	❍ - ◗	3-6 ft.	Slow	Stems, leaves, & rootstocks eaten by muskrats, deer.	Shallow fresh marshes, wet meadows, open forested wetlands. Cool-season grass.
RUSH, SOFT *Juncus effusus*	All	Statewide; common	■	❍	<3 ft.	Slow	Seeds eaten by songbirds, waterfowl.	Shallow fresh marshes and wet meadows.
SMARTWEED, PENNSYLVANIA *Polygonum pensylvanicum*	All	Statewide; common	■	❍	3-6 ft.	Fast	Seeds eaten by waterfowl, songbirds.	Shallow marshes and wet meadows. Small pink flowers.
SMARTWEED, SWAMP *Polygonum hydropiperoides*	All	Coastal Plain; uncommon	■	❍	<3 ft.	Fast	Seeds eaten by waterfowl, songbirds.	Shallow fresh marshes and wet meadows. Small white flowers.
SWITCHGRASS *Panicum virgatum*	All	Coastal Plain; common	■	❍	3-6 ft.	Slow	Seeds eaten by songbirds. Foliage eaten by rabbits, deer.	Wet meadows; shallow edges of fresh & brackish marshes. Warm-season grass. Salinity 0 - 10 ppt.
TEARTHUMB *Polygonum arifolium* *Polygonum sagittatum*	All	Statewide; common	■	❍	Vine	Fast	Seeds eaten by waterfowl, songbirds.	Shallow fresh marshes and wet meadows. Small white-pink flowers. Many small prickles on stems.
WOOL-GRASS *Scirpus cyperinus*	All	Statewide; common	■	❍	3-6 ft.	Fast	Seeds eaten by songbirds, waterfowl. Rootstocks & foliage eaten by muskrats.	Shallow fresh marshes and wet meadows. A bulrush, not a grass.
WILD RICE *Zizania aquatica*	All	Mostly Coastal Plain	■	❍	6-9 ft.	Slow	Seeds eaten by songbirds, waterfowl.	Mostly in tidal fresh marshes. Annual, cool-season grass.

TABLE 6.3: Selected Characteristics of Herbaceous Wetland Plants

Plant Names	Plant Hardiness Zones [1]	Geographic Distribution in Delaware [1]	Native to DE [2]	Sun/ Shade [3]	Height at Maturity	Rate of Spread [4]	Wildlife Value for Food	Natural Habitat and Other Characteristics
Water Regime: Surface Saturation to +6 inches of Surface Water								
ARROW-ARUM *Peltandra virginica*	All	Coastal Plain; common	■	❍ - ◗	<3 ft.	Slow	Seeds eaten by waterfowl, rails, muskrats.	Shallow marshes and stream edges. Salinity 0 - 2 ppt. Plant also known as "Duck Corn." Inconspicuous green flowers.
BURREED, AMERICAN *Sparganium americanum*	All	Statewide; common	■	❍ - ◗	<3 ft.	Fast	Seeds eaten by waterfowl and rails. Stems and leaves eaten by muskrats.	Shallow fresh marshes, especially along rivers & streams. White flowers.
BURREED, GIANT *Sparganium eurycarpum*	All	Statewide; common	■	❍	3-6 ft.	Fast	Seeds eaten by waterfowl and rails. Stems and leaves eaten by muskrats.	Shallow fresh marshes. White flowers.
BULRUSH, GREEN *Scirpus atrovirens*	All	Piedmont; uncommon	■	❍	3-6 ft.	Fast	Seeds eaten by waterfowl, songbirds. Rootstocks & stems eaten by muskrats.	Shallow fresh marshes and wet meadows.
BULRUSH, RIVER *Schoenoplectus fluviatilis*	All	Coastal Plain; common	■	❍ - ◗	3-6 ft.	Fast	Seeds eaten by waterfowl, songbirds. Rootstocks & stems eaten by muskrats.	Shallow fresh marshes.
BULRUSH, SOFT-STEM *Schoenoplectus tabernaemontani*	All	Statewide; common	■	❍	6-9 ft.	Fast	Seeds eaten by waterfowl, songbirds. Rootstocks & stems eaten by muskrats.	Shallow fresh to slightly brackish marshes. Salinity 0 - 5 ppt.
BULRUSH, THREE-SQUARE *Schoenoplectus pungens*	All	Coastal Plain; common	■	❍	<3 ft.	Fast	Seeds eaten by waterfowl, songbirds. Rootstocks & stems eaten by muskrats.	Shallow fresh to brackish marshes and open water fringes. Salinity 0 - 15 ppt.
CORDGRASS, SALTMARSH *Spartina alterniflora*	All	Coastal Plain; common	■	❍	3-6 ft.	Fast	Seeds eaten by waterfowl & songbirds. Roots eaten by waterfowl and muskrats.	Tidal marshes between mid tide and MHT. Warm-season grass. Salinity 0 - 35 ppt.
SEDGE, FOX *Carex vulpinoidea*	All	Statewide; common	■	❍	<3 ft.	Slow	Seeds eaten by waterfowl, songbirds, rails. Foliage eaten by deer.	Shallow fresh marshes.
SEDGE, FRINGED *Carex crinita*	All	Statewide; common	■	❍ - ◗	<3 ft.	Slow	Seeds eaten by waterfowl, songbirds, rails. Foliage eaten by deer.	Forested wetlands and thickets.

TABLE 6.3: Selected Characteristics of Herbaceous Wetland Plants

Plant Names	Plant Hardiness Zones [1]	Geographic Distribution in Delaware [1]	Native to DE [2]	Sun/ Shade [3]	Height at Maturity	Rate of Spread [4]	Wildlife Value for Food	Natural Habitat and Other Characteristics
Water Regime: Surface Saturation to +6 inches of Surface Water (continued)								
SEDGE, SHALLOW *Carex lurida*	All	Statewide; common	■	❍ - ◗	<3 ft.	Slow	Seeds eaten by waterfowl, songbirds, rails. Foliage eaten by deer.	Forested wetlands with shallow water and/or saturated soil.
SEDGE, THREE-WAY *Dulichium arundinaceum*	All	Statewide; common	■	❍	<3 ft.	Slow	Foliage eaten by deer.	Shallow fresh marshes and openings in forested wetlands.
SEDGE, TUSSOCK *Carex stricta*	All	Statewide; common	■	❍	<3 ft.	Slow	Seeds eaten by waterfowl, songbirds, rails. Foliage eaten by deer.	Shallow fresh marshes and wet meadows.
SPIKERUSH, BLUNT *Eleocharis obtusa*	All	Statewide; common	■	❍ - ◗	<3 ft.	Slow	Seeds and plants eaten by waterfowl, muskrats.	Shallow fresh marshes and open water fringes.
SWEETFLAG *Acorus calamus*	All	Statewide; more common on Coastal Plain		❍ - ◗	<3 ft.	Fast	Roots eaten by waterfowl, muskrats.	Shallow fresh to brackish marshes, stream edges, wet meadows. Widely naturalized, but not native to US. Salinity 0 - 10 ppt.
Water Regime: Surface Saturation to +12 inches of Surface Water								
ARROWHEAD, BROADLEAF *Sagittaria latifolia*	All	Statewide; common	■	❍ - ◗	<3 ft.	Fast	Seeds and tubers eaten by waterfowl, wading birds, muskrats.	Shallow fresh marshes. White flowers.
ARROWHEAD, RIGID *Sagittaria rigida*	All	Formerly Coastal Plain; extirpated	■	❍ - ◗	<3 ft.	Fast	Seeds and tubers eaten by waterfowl, wading birds, muskrats.	Shallow fresh marshes. White flowers.
CATTAIL, NARROW-LEAF *Typha angustifolia*	All	Statewide		❍	3-6 ft.	Fast	Rootstocks eaten by geese and muskrats. Stems also eaten by muskrats.	Shallow fresh and brackish marshes. Salinity 0 - 15 ppt. **Aggressive species.** Tends to dominate wetlands, to the exclusion of other plants. Should not be planted if a mix of plant species is desired.
CATTAIL, BROAD-LEAF *Typha latifolia*	All	Statewide; common	■	❍	3-6 ft.	Fast	Rootstocks eaten by geese and muskrats. Stems also eaten by muskrats.	Shallow fresh marshes. **Aggressive species.** Tends to dominate wetlands, to the exclusion of other plants. Should not be planted if a mix of plant species is desired.

TABLE 6.3: Selected Characteristics of Herbaceous Wetland Plants								
Plant Names	**Plant Hardiness Zones [1]**	**Geographic Distribution in Delaware [1]**	**Native to DE [2]**	**Sun/ Shade [3]**	**Height at Maturity**	**Rate of Spread [4]**	**Wildlife Value for Food**	**Natural Habitat and Other Characteristics**
Water Regime: Surface Saturation to +12 inches of Surface Water (continued)								
CLUB, GOLDEN *Orontium aquaticum*	All	Coastal Plain; common		❍	<3 ft.	Fast	Seeds eaten by waterfowl, muskrats.	Tidal fresh marshes, shallow ponds, slow streams. Small yellow flowers on a spathe.
LIZARD'S-TAIL *Saururus cernuus*	All	Statewide; common		❍ - ◗	<3 ft.	Fast	Occasionally eaten by wood ducks.	Shallow fresh marshes and openings in forested wetlands. Nodding spike of small white flowers.
PICKEREL-WEED *Pontederia cordata*	All	Coastal Plain; common		❍ - ◗	<3 ft.	Fast	Seeds and roots eaten by waterfowl. Flowers attractive to butterflies.	Shallow fresh to slightly brackish marshes and slow streams. Salinity 0-3 ppt. Showy, small blue flowers on spikes up to 6" long.
POND-LILY, YELLOW (SPATTERDOCK) *Nuphar lutea*	All	Statewide; common		❍ - ◗	<3 ft.	Fast	Seeds eaten by waterfowl, muskrats. Stems also eaten by muskrats.	Tidal fresh marshes, shallow ponds, slow streams. Tolerates tidal inundation up to 3 feet. Large, heart-shaped leaves. Bright yellow flowers.
Water Regime: +12 inches to +36 inches of Surface Water, and Deeper								
LOTUS, AMERICAN *Nelumbo lutea*	All	Coastal Plain; uncommon		❍	3-6 ft.	Fast	Seeds eaten by waterfowl, muskrats. Stems also eaten by muskrats.	Shallow ponds, slow streams. Large, round leaves, floating or raised above the water. Can grow in water up to 6 feet deep. Pale yellow flowers on stalks extending up to 3 feet above the water.
WATER-LILY, WHITE *Nymphaea odorata*	All	Statewide; common		❍ - ◗	3-6 ft.	Fast	Seeds eaten by waterfowl, muskrats. Stems also eaten by muskrats.	Tidal fresh marshes, shallow ponds and bogs. Can grow in water up to 4 feet deep. Leaves and flowers float on the water surface. Attractive white flowers.

TABLE 6.3 NOTES:

1. The **Plant Hardiness Zones** designate where a species can be successfully planted in Delaware, while the **Geographic Distribution** describes where the species usually occurs under natural conditions.

2. **Native to Delaware:** The term "native" refers to species that occur naturally in one or more geographic regions of Delaware. Due to page limitations, this listing of native species is not all-inclusive. There are many more native plants that occur in Delaware and may be suitable for planting in and around wetlands.

3. **Sun - Shade:** Sunlight and shade tolerance for each species.

   ❍ Full Sun - 6 or more hours of light per day or 4 hours of midday sun;
   ◗ Part Shade - 3 to 6 hours of light per day;
   ● Shade - less than 3 hours of light per day.

4. **Rate of Spread:** Relative rate of spreading under ideal conditions.

   Slow: spreading at a rate of < 0.5 ft. per year.
   Fast: spreading at a rate of ≥0.5 ft. per year.

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SECTION 7 - FORAGE AND BIOMASS PLANTINGS

This section contains recommendations for establishing adapted and/or native species, varieties, or cultivars of herbaceous plants suitable for pasture, hay, or biomass production.

Selecting Species and Establishing Plantings

Refer to the following tables to select the appropriate plant species and seeding rates to meet the client's needs:

- Table 7.1 - Recommended Mixes for Cool-Season Forage and Biomass Plantings;
- Table 7.2 - Cool-Season Forage and Biomass Plantings—Establishment, Management, and Use Characteristics;
- Table 7.3 - Cool -Season Forage and Biomass Plantings—Plant Suitability for Site Conditions;
- Table 7.4 - Cool -Season Forage and Biomass Plantings—Seeding Recommendations;
- Table 7.5 - Warm-Season Forage and Biomass Plantings—Establishment, Management, and Use Characteristics;
- Table 7.6 - Warm-Season Forage and Biomass Plantings—Plant Suitability for Site Conditions;
- Table 7.7 - Warm-Season Forage and Biomass Plantings—Seeding Recommendations;
- Table 7.8 - Forage and Biomass Plantings—Annual Plantings for an Extended Grazing Season or Emergency Forage Production.

Other species that are native to Delaware, or are introduced and are non-invasive, may also be suitable.

Refer to the Delaware NRCS Fact Sheet *Forage and Biomass Plantings* for additional recommendations concerning species selection, establishment, and maintenance.

TABLE 7.1: Recommended Mixes for Cool-Season Forage and Biomass Plantings [1/]

Mix	Seeding Rate [2/] (lbs/ac)		Plant Hardiness Zones [3/]	Soil Drainage Class [4/]	Remarks
	Pasture	***Hay***			
GRASS-ALFALFA MIXES					
1. SELECT ONE GRASS: Orchardgrass *Dactylis glomerata* Tall Fescue *Schedonorus arundinaceus* **AND ADD:** Alfalfa *Medicago sativa*	 8 - 10 10 - 15 8 - 10	 2 - 6 5 - 10 8 - 12	All	W - MW	Use an endophyte-free or novel endophyte-infected variety of Tall Fescue.
2. SELECT ONE GRASS: Perennial Ryegrass *Lolium perenne* Smooth Bromegrass *Bromus inermis* Timothy *Phleum pretense* **AND ADD:** Alfalfa *Medicago sativa*	 10 - 15 8 - 15 N/A 8 - 10	 4 - 8 6 - 10 2 - 6 8 - 12	7a (Piedmont only)	W - MW	Perennial Ryegrass is useful for quick reseeding – high quality pasture, but is short lived. Smooth Bromegrass and Timothy are suitable for one-cut hay. Timothy is not recommended for pasture. Smooth Bromegrass can be used for less intensive pasturing, as compared to Mix 1.
GRASS-BIRDSFOOT TREFOIL MIXES					
3. SELECT ONE GRASS: Orchardgrass *Dactylis glomerata* Smooth Bromegrass *Bromus inermis* Timothy *Phleum pretense* **AND ADD:** Birdsfoot Trefoil *Lotus corniculatus*	 8 - 10 8 - 15 N/A 6 - 10	 2 - 4 6 - 8 4 - 6 5 - 8	7a (Piedmont only)	W - P	Good for wet sites. "No bloat" mix.
4. USE TWO GRASSES: Kentucky Bluegrass *Poa pratensis* Timothy *Phleum pretense* **AND ADD:** Birdsfoot Trefoil *Lotus corniculatus*	 5 - 15 5 - 10 6 - 10	N/A	7a (Piedmont only)	W - SP	"No bloat" mix.

TABLE 7.1: Recommended Mixes for Cool-Season Forage and Biomass Plantings [1/]					
Mix	**Seeding Rate [2/] (lbs/ac)**		**Plant Hardiness Zones [3/]**	**Soil Drainage Class [4/]**	**Remarks**
	Pasture	***Hay***			
GRASS-CLOVER MIXES					
5. SELECT ONE GRASS: Perennial Ryegrass *Lolium perenne* Smooth Bromegrass *Bromus inermis* Timothy *Phleum pretense* **AND ADD:** Ladino (White) Clover *Trifolium repens* Red Clover *Trifolium pratense*	 10 - 15 8 - 15 5 - 10 1 - 2 2 - 4	N/A	7a (Piedmont only)	W - SP	Perennial Ryegrass is sensitive to drought. Timothy is sensitive to high temperatures. Ladino (White) Clover is intolerant of droughty soils. Red Clover is short-lived and has low winter hardiness. A fungus associated with Red Clover can cause livestock (especially horses) to slobber or drool excessively. When used in horse pastures, plant the Red Clover at 50% of the specified rate if "slobbers" is a concern, or use an all grass mix (e.g., Mix 9 or 10) instead.
6. USE ALL THREE GRASSES: Kentucky Bluegrass *Poa pratensis* Perennial Ryegrass *Lolium perenne* Timothy *Phleum pretense* **AND ADD:** Ladino (White) Clover *Trifolium repens* Red Clover *Trifolium pratense*	 5 - 15 5 - 10 5 - 10 1 - 2 2 - 4	N/A	7a (Piedmont only)	W - SP	Tall Fescue (endophyte-free or novel endophyte-infected variety) can be substituted for Perennial Ryegrass or Timothy. Perennial Ryegrass is sensitive to drought. Timothy is sensitive to high temperatures. Red Clover is short-lived and has low winter hardiness. For Red Clover in horse pastures, see Remarks for Mix 5.
7. SELECT ONE GRASS: Orchardgrass *Dactylis glomerata* Tall Fescue *Schedonorus arundinaceus* **AND ADD:** Ladino (White) Clover *Trifolium repens* Red Clover *Trifolium pretense*	 8 - 10 10 - 15 1 - 2 6 - 8	 2 - 6 5 - 10 N/A 6 - 8	All	W - SP	Use an endophyte-free or novel endophyte-infected variety of Tall Fescue. For Red Clover in horse pastures, see Remarks for Mix 5.
8. SELECT ONE GRASS: Orchardgrass *Dactylis glomerata* Tall Fescue *Schedonorus arundinaceus* **AND ADD:** Korean Lespedeza *K. stipulacea* Red Clover *Trifolium pratense*	 8 - 10 10 - 15 10 - 15 4 - 6	 2 - 6 5 - 10 10 - 15 N/A	All	W - SP	Use an endophyte-free or novel endophyte-infected variety of Tall Fescue. For Red Clover in horse pastures, see Remarks for Mix 5. The Lespedeza component makes this an especially good mix because lespedeza is more heat-tolerant than most of the other legumes.

TABLE 7.1: Recommended Mixes for Cool-Season Forage and Biomass Plantings [1/]					
Mix	**Seeding Rate [2/] (lbs/ac)**		**Plant Hardiness Zones [3/]**	**Soil Drainage Class [4/]**	**Remarks**
	Pasture	***Hay***			
GRASS MIXES WITHOUT LEGUMES					
9. USE ALL THREE GRASSES: Kentucky Bluegrass *Poa pratensis* Smooth Bromegrass *Bromus inermis* Timothy *Phleum pretense*	5 - 15 4 - 8 4 - 8	N/A	7a (Piedmont only)	W - SP	Good grass base for pastures; especially suited for horse pastures.
10. USE TWO GRASSES: Kentucky Bluegrass *Poa pratensis* Tall Fescue *Schedonorus arundinaceus*	5 - 10 15 - 20	N/A	All	W - SP	For heavily grazed horse pastures or other loafing lots, use this mix with a **novel endophyte** variety of Tall Fescue. It will withstand abuse better than the endophyte-free varieties. Follow the Tall Fescue manufacturer's guidelines for establishment.

TABLE 7.1 NOTES:

1. Selected Mixes: These mixes have been selected based primarily on recommendations in the *Penn State Agronomy Guide* and in *Forage Production for Pasture Based Livestock Production, Establishing Forage Stands (Chapter 7)*. Due to page limitations, this list of mixes is not all-inclusive. There are many other combinations of grasses and/or legumes that may be suitable for pasture or hay, depending on site conditions and the producer's needs. All legume seeds shall be inoculated before planting with the appropriate *Rhizobium* bacteria.
2. Seeding Rates: Seeding rates listed are for planting methods that incorporate seed into the soil. Whenever possible, optimize seed distribution by using a brillion or cultipacker-seeder. If drilling, it is recommended to split rates and apply seed twice, with the second pass going perpendicular across the first drill rows. If broadcast planting, increase the seeding rate by 50%.
3. The Plant Hardiness Zones designate where a species can be successfully grown in Delaware, as shown on the Plant Hardiness Zone map (Figure 1.1).
4. Soil Drainage Class (refer to the county soil survey for further information):E - Excessively Drained; W - Well Drained; MW - Moderately Well Drained; SP - Somewhat Poorly Drained; P - Poorly Drained.

TABLE 7.2: Cool-Season Forage and Biomass Plantings—Establishment, Management, and Use Characteristics

Species	Seedling Growth Rate [1]	Plant Growth Habit	Stand Persistence [2]	Forage Quality [3]		Relative Maturity [4]	Suitability for Grazing Management [5]		Suitability for Mechanical Harvest [6]		Compatible Species for Mixtures [7]
				Palatability	*Digestibility*		*Rotational Grazing*	*Continuous Grazing*	*Hay*	*Silage*	
GRASSES											
Kentucky Bluegrass *Poa pratensis*	Moderate	Sod	Long	High	Moderate	Early	Excellent	Excellent	Poor	Poor	Timothy Birdsfoot Trefoil Ladino Clover
Orchardgrass *Dactylis glomerata*	Fast	Bunch	Moderate	Moderate	Moderate	Early	Excellent	Good	Excellent	Excellent	Alfalfa Birdsfoot Trefoil Ladino Clover Red Clover
Perennial Ryegrass [8] *Lolium perenne* (Diploid and Tetraploid types)	Very Fast	Bunch	Short	High	High	Early	Excellent	Poor	Good	Excellent	Alfalfa Birdsfoot Trefoil Ladino Clover Red Clover
Prairiegrass [8] *Bromus catharticus*	Fast	Bunch	Short	High	High	Late	Good	Poor	Excellent	Excellent	Alfalfa
Smooth Bromegrass [8] *Bromus inermis*	Moderate	Sod	Short	High	Moderate	Late	Good	Poor	Excellent	Excellent	Alfalfa Birdsfoot Trefoil Ladino Clover
Tall Fescue [9] (endophyte-free or novel endophyte) *Schedonorus arundinaceus* *(*formerly *Festuca arundinacea)*	Moderate	Bunch	Moderate	Moderate	Moderate	Medium	Excellent	Poor	Good	Excellent	Alfalfa Ladino Clover Red Clover
Timothy *Phleum pratense*	Slow	Bunch	Short	Moderate	Moderate	Late	Good	Poor	Excellent	Excellent	Ky. Bluegrass Alfalfa Birdsfoot Trefoil Ladino Clover Red Clover

TABLE 7.2: Cool-Season Forage and Biomass Plantings—Establishment, Management, and Use Characteristics

Species	Seedling Growth Rate [1]	Plant Growth Habit	Stand Persistence [2]	Forage Quality [3]		Relative Maturity [4]	Suitability for Grazing Management [5]		Suitability for Mechanical Harvest [6]		Compatible Species for Mixtures [7]
				Palatability	*Digestibility*		*Rotational Grazing*	*Continuous Grazing*	*Hay*	*Silage*	
LEGUMES											
Alfalfa [10] *Medicago sativa*	Fast	Bunch	Long	High	High	Early	Excellent	Poor	Excellent	Excellent	Orchardgrass, Perennial Ryegrass, Smooth Bromegrass, Tall Fescue, Timothy.
Annual Lespedeza: Korean *Kummerowia stipulacea* or Common *K. striata* (both species formerly in genus *Lespedeza)*	Moderate	Spreading	Moderate	Moderate	High	Medium	Excellent	Poor	Good	Poor	Orchardgrass, Tall Fescue, Timothy, Red Clover.
Birdsfoot Trefoil *Lotus corniculatus*	Slow	Bunch	Long	High	High	Late	Good	Good	Good	Good	Ky. Bluegrass, Orchardgrass, Perennial Ryegrass, Smooth Bromegrass, Tall Fescue, Timothy.
Ladino (White) Clover [10] *Trifolium repens*	Moderate	Spreading	Moderate	High	High	Early	Excellent	Good	Good	Good	Ky. Bluegrass, Orchardgrass, Perennial Ryegrass, Smooth Bromegrass, Tall Fescue, Timothy, Red Clover.
Red Clover [10] *Trifolium pratense*	Fast	Bunch	Short	Moderate	High	Medium	Good	Poor	Good	Good	Orchardgrass, Perennial Ryegrass, Tall Fescue, Timothy, Ladino Clover.

TABLE 7.2 NOTES:

1. Seedling Growth Rate (Slow, Moderate, Fast): Vigor and competitiveness of the species, as compared to other grasses or legumes. Slow-growing seedlings tend to have more problems with weed competition than faster growing species.

2. Stand Persistence (Short, Moderate, Long): Persistence of the species (without replanting) as compared to other grasses or legumes. This is an indication of how soon the planting will need to be renovated or overseeded. Long - Generally 5 years or more; Moderate - 3 to 5 years; Short - 1 or 2 years.

3. Forage Quality (Low, Moderate, High): Values of each species for palatability and digestibility, as compared to other forages. When developing pasture mixes, select species that have similar palatability to minimize selective grazing.

4. Relative Maturity (Early, Medium, Late, Very Late): Relative time of maturity for each species during the growing season. When developing pasture or hay mixes, select species and varieties that are expected to mature at approximately the same time.

5. Suitability for Grazing Management (Poor, Fair, Good, Excellent): Describes the suitability of each species for grazing, depending on the type of grazing system used. Rotational Grazing – A system that provides a rest and regrowth period for pastures. Continuous Grazing – A system that allows livestock to have continuous access to pastures.

6. Suitability for Mechanical Harvest (Poor, Fair, Good, Excellent): Describes the suitability of each species as a mechanically harvested forage crop, depending on whether the forage will be harvested and stored as hay or as silage.

7. Compatible Species for Mixtures: If desired, one or more of these species may be combined with the primary species to make a mixture. When making mixtures, select species that are suited for the geographic location (plant hardiness zone) and local site characteristics and have the desired plant characteristics for establishment, maintenance, and use of the forage. Simple mixtures, such as one species of grass and one or two legumes are generally recommended versus a mix with many species.

8. Perennial Ryegrass, Prairiegrass, and Smooth Bromegrass: In Delaware, stand persistence is significantly reduced for these species due to disease and climate factors.

9. Tall Fescue Varieties: To avoid fescue toxicosis, use certified varieties that are endophyte-free or are novel endophyte-infected. Fescue with the novel endophyte is not toxic to livestock, and has the adaptive advantages of being more resistant to drought, disease, and insects than endophyte-free varieties.

10. Animal Health Issues Associated with Legumes: **Caution**--Livestock consumption of some legume species may result in adverse health effects. To minimize health risks to livestock, use careful management with these species, and know when to expect potential problems and how to avoid them. The following health concerns have been associated with specific legumes:

    Bloat - Associated with consumption of alfalfa, various clovers, cowpeas, and other legumes (but not birdsfoot trefoil);

    Alsike Clover Poisoning - Associated with consumption of alsike clover. This type of poisoning is known to occur in horses and occasionally in cattle, resulting in photodermatitis and long-term liver damage. Alsike clover should not be planted where pastures and hay will be used by horses;

    "Slobbers" (Excessive Salivation) - Associated with consumption of fungal-infected red clover (and sometimes white clover and other legumes) by horses and cattle.

TABLE 7.3: Cool-Season Forage and Biomass Plantings—Plant Suitability for Site Conditions

Plant Species	Plant Hardiness Zones [1/]	Soil Drainage Class [2/]	Soil pH [3/]	Fertility Requirements [4/]	Flooding or Ponding Tolerance [5/]	Drought Tolerance [6/]	Salinity Tolerance [7/]	Winter Hardiness [8/]
GRASSES								
Kentucky Bluegrass *Poa pratensis*	All	W - SP	5.5 - 7.0	Moderate	Low	Low	Low	Good
Orchardgrass *Dactylis glomerata*	All	E - SP	5.5 - 7.0	Moderate	None	Moderate	Low	Good
Perennial Ryegrass *Lolium perenne*	7a (Piedmont only)	W - P	5.0 - 8.0	Moderate-High	Low	Low	Low	Poor
Prairiegrass *Bromus catharticus*	7a (Piedmont only)	E - MW	5.5 - 8.0	Moderate-High	None	Low	Moderate	Fair
Smooth Bromegrass *Bromus inermis*	7a (Piedmont only)	E - P	5.5 - 8.0	High	Low	Moderate	Low	Fair
Tall Fescue (endophyte-free or novel endophyte) *Schedonorus arundinaceus (*formerly *Festuca arundinacea)*	All	E - P	4.5 - 9.0	Moderate	Low	Moderate	Moderate	Good
Timothy *Phleum pratense*	7a (Piedmont only)	W - SP	5.0 - 7.5	Moderate	Low	Low	Low	Good
LEGUMES								
Alfalfa *Medicago sativa*	All	E - W	6.5 - 7.0	High	None	High	Low	Excellent
Annual Lespedeza: Korean *Kummerowia stipulacea* or Common *K. striata*	All	E - P	4.5 - 7.0	Low - Moderate	Low	High	Low	None (Annual)
Birdsfoot Trefoil *Lotus corniculatus*	7a (Piedmont only)	W - P	5.0 - 7.5	Moderate	Moderate	Moderate	Moderate	Excellent
Ladino (White) Clover *Trifolium repens*	All	W - P	5.5 - 7.5	Moderate-High	Moderate	Low	Low	Good
Red Clover *Trifolium pratense*	All	W - SP	6.0 - 7.5	Moderate	None	Low	Low	Good

TABLE 7.3 NOTES:

1. The Plant Hardiness Zones designate where a species can be successfully grown in Delaware, as shown on the Plant Hardiness Zone map (Figure 1.1).
2. Soil Drainage Class (refer to the county soil survey for further information):E - Excessively Drained; W - Well Drained; MW - Moderately Well Drained; SP - Somewhat Poorly Drained; P - Poorly Drained.
3. Soil pH: Preferred soil pH range for fair to excellent forage production.
4. Fertility Requirements (Low, Moderate, High): Indicates the relative need of each species for nutrients to support plant growth. Species with relatively high fertility requirements will require more frequent nutrient applications.
5. Flooding or Ponding Tolerance (None, Low, Moderate, High): Describes the ability of each species to tolerate anaerobic conditions associated with extended ponding or flooding (generally more than 24 hours, continuously).
6. Drought Tolerance (Low, Moderate, High): Describes the ability of each species to withstand long periods of hot, dry weather. For each plant species, some varieties may be more (or less) tolerant than others.
7. Salinity Tolerance (None, Low, Moderate, High): Describes the ability of each species to withstand and flourish in saline soils (i.e., soils that contain water-soluble salts. For each plant species, some varieties may be more (or less) tolerant than others.
8. Winter Hardiness (Poor, Fair, Good, Excellent): Describes the ability of each species to survive typical winters in Delaware. For each plant species, some varieties may be more (or less) winter hardy than others.

TABLE 7.4: Cool-Season Forage and Biomass Plantings—Seeding Recommendations

Plant Species	Recommended Cultivar(s)	Seeding Rate (lbs/ac)			Seeding Depth (inches)	Suitability for Frost Seeding [1/]
		Alone	***Pasture Mix***	***Hay Mix***		
GRASSES						
Kentucky Bluegrass *Poa pratensis*	Ginger, Ken Blue, Park, Slezanka, Troy	15	5 - 15	----	0.25	Poor
Orchardgrass *Dactylis glomerata*	Numerous cultivars available	10 - 15	5 - 15	2 - 6	0.25 - 0.5	Poor
Perennial Ryegrass *Lolium perenne*	Numerous cultivars available	30	10 - 15	4 - 8	0.25 - 0.5	Good
Prairiegrass *Bromus catharticus*	Matua	25 - 40	----	20 - 30	0.25 - 0.5	Poor
Smooth Bromegrass *Bromus inermis*	Baylor, Saratoga	15	4 - 15	6 - 10	0.25 - 0.5	Poor
Tall Fescue (endophyte-free or novel endophyte) *Schedonorus arundinaceus*	Endophyte-free: Numerous cultivars available Novel endophyte: Jesup MaxQ, BarOptima PLUS E34 Endophyte-infected: Not recommended for forage purposes	15 - 35	10 - 15	5 - 10	0.25	Poor
Timothy *Phleum pratense*	Numerous cultivars available	10 - 15	4 - 10	2 - 6	0.25 - 0.5	Poor
LEGUMES						
Alfalfa *Medicago sativa*	Numerous cultivars available	15 - 20	10 - 15	10 - 15	0.25 - 0.5	Poor
Annual Lespedeza: Korean *Kummerowia stipulacea* or Common *K. striata* (both species formerly in genus *Lespedeza)*	Korean: Climax or Rowan Common: Kobe	15 - 25	10 - 15	10 - 15	0.25 - 0.5	Good
Birdsfoot Trefoil *Lotus corniculatus*	Pasture: Dawn, Empire Hay: Fergus, Norcen, Tretana, Viking	10	6 - 10	2 - 6	0.25	Good
Ladino (White) Clover *Trifolium repens*	Alice (a tall variety), Durana	----	1 - 3	1 - 3	0.25	Excellent
Red Clover *Trifolium pratense*	Cultivars resistant to both northern and southern strains of anthracnose	10 - 15	4 - 8	4 - 8	0.25	Excellent

TABLE 7.4 NOTE:

1. Suitability for Frost Seeding (Poor, Fair, Good, Excellent): Describes the suitability of each species for broadcast-overseeding during late winter to reestablish it in an established stand.

TABLE 7.5: Warm-Season Forage and Biomass Plantings—Establishment, Management, and Use Characteristics

Species	Seedling Growth Rate [1]	Plant Growth Habit	Stand Persistence [2]	Forage Quality [3]		Relative Maturity [4]	Suitability for Grazing Management [5]		Suitability for Mechanical Harvest [6]	
				Palatability	*Digestibility*		*Rotational Grazing*	*Continuous Grazing*	*Hay*	*Silage*
Bermudagrass[7] *Cynodon dactylon*	Moderate	Sod	Moderate - Long	High	Moderate	Late	Good	Good	Good	Good
Big Bluestem *Andropogon gerardii*	Slow	Bunch	Long	High	High	Very Late	Good	Poor	Good	Poor
Caucasian Bluestem *Bothriochloa bladhii (B. caucasica)*	Slow	Bunch	Long	High	High	Late	Good	Poor	Good	Poor
Eastern Gamagrass *Tripsacum dactyloides*	Slow	Bunch	Long	Very High	High	Very Late	Good	Poor	Good	Good
Indiangrass *Sorghastrum nutans*	Slow	Bunch	Long	High	Moderate	Very Late	Good	Poor	Good	Poor
Little Bluestem *Schizachyrium scoparium*	Slow	Bunch	Long	Moderate	Moderate	Very Late	Fair	Poor	Poor	Poor
Switchgrass *Panicum virgatum*	Slow	Bunch	Long	Moderate	High	Very Late	Good	Poor	Good	Poor

TABLE 7.5 NOTES:

1. Seedling Growth Rate (Slow, Moderate, Fast): Vigor and competitiveness of the species, as compared to other grasses or legumes. Slow-growing seedlings tend to have more problems with weed competition than faster growing species.
2. Stand Persistence (Short, Moderate, Long): Persistence of the species (without replanting) as compared to other grasses or legumes. This is an indication of how soon the planting will need to be renovated or overseeded. Long - Generally 5 years or more; Moderate - 3 to 5 years; Short - 1 or 2 years.
3. Forage Quality (Low, Moderate, High): Values of each species for palatability and digestibility, as compared to other forages. When developing pasture mixes, select species that have similar palatability to minimize selective grazing.
4. Relative Maturity (Early, Medium, Late, Very Late): Relative time of maturity for each species during the growing season. When developing pasture or hay mixes, select species and varieties that are expected to mature at approximately the same time.
5. Suitability for Grazing Management (Poor, Fair, Good, Excellent): Describes the suitability of each species for grazing, depending on the type of grazing system used. Rotational Grazing – A system that provides a rest and regrowth period for pastures. Continuous Grazing – A system that allows livestock to have continuous access to pastures.
6. Suitability for Mechanical Harvest (Poor, Fair, Good, Excellent): Describes the suitability of each species as a mechanically harvested forage crop, depending on whether the forage will be harvested and stored as hay or as silage.
7. Bermudagrass: **Caution**—This species can spread into other pasture plantings, lawns, and cropland fields. **Do not plant unless containment of the planting is feasible, as determined and approved by NRCS.**

TABLE 7.6: Warm-Season Forage and Biomass Plantings—Plant Suitability for Site Conditions								
Plant Species	**Plant Hardiness Zones [1]**	**Soil Drainage Class [2]**	**Soil pH [3]**	**Fertility Requirements [4]**	**Flooding or Ponding Tolerance [5]**	**Drought Tolerance [6]**	**Salinity Tolerance [7]**	**Winter Hardiness [8]**
Bermudagrass [9] *Cynodon dactylon*	All	E - SP	5.0 - 7.5	Moderate - High	Moderate	High	Moderate	Depends on the variety
Big Bluestem *Andropogon gerardii*	All	E - MW	5.0 - 7.5	Low - Moderate	Low	Very High	Low	Good
Caucasian Bluestem *Bothriochloa bladhii (B. caucasica)*	All	E - MW	5.0 - 8.0	Moderate	None	High	Low	Good
Eastern Gamagrass *Tripsacum dactyloides*	All	W - P	5.0 - 7.5	Moderate - High	Moderate	High	None	Good
Indiangrass *Sorghastrum nutans*	All	E - MW	5.0 - 7.5	Low - Moderate	None	Very High	Moderate	Good
Little Bluestem *Schizachyrium scoparium*	All	E - MW	5.5 - 8.5	Low - Moderate	None	Very High	None	Good
Switchgrass *Panicum virgatum*	All	E - P	4.5 - 7.5	Low - Moderate	Low - High (depends on the variety)	Low - Very High (depends on the variety)	Moderate	Good

TABLE 7.6 NOTES:

1. The Plant Hardiness Zones designate where a species can be successfully grown in Delaware, as shown on the Plant Hardiness Zone map (Figure 1.1).
2. Soil Drainage Class (refer to the county soil survey for further information):E - Excessively Drained; W - Well Drained; MW - Moderately Well Drained; SP - Somewhat Poorly Drained; P - Poorly Drained.
3. Soil pH: Preferred soil pH range for fair to excellent forage production.
4. Fertility Requirements (Low, Moderate, High): Indicates the relative need of each species for nutrients to support plant growth. Species with relatively high fertility requirements will require more frequent nutrient applications.
5. Flooding or Ponding Tolerance (None, Low, Moderate, High): Describes the ability of each species to tolerate anaerobic conditions associated with extended ponding or flooding (generally more than 24 hours, continuously).
6. Drought Tolerance (Low, Moderate, High): Describes the ability of each species to withstand long periods of hot, dry weather. For each plant species, some varieties may be more (or less) tolerant than others.
7. Salinity Tolerance (None, Low, Moderate, High): Describes the ability of each species to withstand and flourish in saline soils. For each plant species, some varieties may be more (or less) tolerant than others.
8. Winter Hardiness (Poor, Fair, Good, Excellent): Describes the ability of each species to survive typical winters in Delaware. For each plant species, some varieties may be more (or less) winter hardy than others.
9. Bermudagrass: **Caution**—This species can spread into other pasture plantings, lawns, and cropland fields. **Do not plant unless containment of the planting is feasible, as determined and approved by NRCS**.

TABLE 7.7: Warm-Season Forage and Biomass Plantings—Seeding Recommendations				
Plant Species	**Recommended Cultivar(s)**	**Seeding Rate (PLS lbs/ac) 1/**	**Seeding Depth (inches)**	**Planting Implement**
Bermudagrass 2/ *Cynodon dactylon*	Quickstand, Ozark, Tifton 44	20 bushels/acre, sprigged	N/A	Sprigger
Big Bluestem *Andropogon gerardii*	Niagara	8 - 10	0.25 - 0.5	Warm-Season Grass Drill
Caucasian Bluestem *Bothriochloa bladhii (B. caucasica)*	Common	6 - 8	0.25 - 0.5	Warm-Season Grass Drill
Eastern Gamagrass 3/ *Tripsacum dactyloides*	Iuka, Pete, PMK-24	10	0.75 - 1.0	Corn Planter
Indiangrass *Sorghastrum nutans*	Rumsey	8 - 10	0.25 - 0.5	Warm-Season Grass Drill
Little Bluestem *Schizachyrium scoparium*	Blaze, Camper	7	0.25 - 0.5	Warm-Season Grass Drill
Switchgrass *Panicum virgatum*	Lowland Ecotypes: Cave-in-Rock, Kanlow Upland Ecotypes: Blackwell, Carthage	8 - 10	0.25 - 0.5	Conventional Grass Drill or Broadcast and Cultipack

TABLE 7.7 NOTES:

1. Seeding Rate: Seeding rates for the warm-season grasses are in pounds of Pure Live Seed (PLS). Actual planting rates shall be adjusted to reflect percent seed germination and purity, as tested. Adjustments are usually not needed for the cool-season grasses or legumes. Whenever possible, optimize seed distribution by using a brillion or cultipacker-seeder. If drilling, it is recommended to split rates and apply seed twice, with the second pass going perpendicular across the first drill rows. Chaffy, warm season seeds require a specialized seed drill or native grass drill.
2. Bermudagrass: **Caution**—This species can spread into other pasture plantings, lawns, and cropland fields. **Do not plant unless containment of the planting is feasible, as determined and approved by NRCS.**
3. For Eastern Gamagrass, recommend using dry, stable seed that is pre-treated to break dormancy.

TABLE 7.8: Forage and Biomass Plantings—Annual Plantings for an Extended Grazing Season or Emergency Forage Production [1/]

Plant Species	Seeding Rate [2/] (lbs/ac)	Seeding Depth (inches)	Seeding Dates	Harvest Season	Time to First Harvest	Growth Stage at First Harvest		Regrowth After Grazing	Yield Range (Dry Matter)
						If Grazed	*If Mechanically Harvested*		
GRASSES									
Annual Ryegrass *Lolium perenne* spp. *multiflorum*	30 - 45	0.25 - 0.5	8/15 - 10/15	Fall, spring, early summer	30 - 45 days	At 6 inches	At 15 - 20 inches	Yes	2 - 5 tons
Barley *Hordeum vulgare*	100 - 150	1.0 - 1.5	9/1 - 10/1	Fall, spring	40 - 60 days	Vegetative stage, at 3 - 5 inches	Late boot – early head	Yes	1 - 2 tons
Cereal Rye *Secale cereale*	120 - 180	1.0 - 1.5	8/15 - 11/15	Fall, spring	40 - 60 days	Vegetative stage, at 3 - 5 inches	Late boot – early head	Yes	2 - 3 tons
Corn *Zea mays*	25,000 - 45,000 seeds/acre	1.0 - 2.0	4/15 - 6/1	Summer	40 - 100 days	Above 20 inches	Milk line 1/3 - 1/2 down kernel	No	3 - 8 tons
Oats *Avena sativa*	100 - 150	1.0 - 1.5	3/1 - 4/15, 8/1 - 8/30	Spring, early summer, fall	35 - 50 days	Vegetative stage, at 3 - 5 inches	Late boot - head	Yes	2 - 4 tons
Pearl Millet *Pennisetum glaucum*	25 - 30	0.5 - 1.0	5/1 - 8/1	Summer	30 - 45 days	At 18 inches	Above 18 inches, early head - early bloom	Yes	3 - 5 tons
Sudangrass Sudan x Sorghum *Sorghum bicolor*	20 - 30	1.0 - 1.5	5/1 - 7/15	Summer	30 - 45 days	Minimum of 18 inches, wait 7 days after frost	At 36 - 48 inches, early head - early bloom	Yes	3 - 8 tons
Triticale *Triticale hexaploide*	120 - 180	1.0 - 1.5	8/15 - 11/15	Fall, spring	40 - 60 days	Vegetative stage, at 3 - 5 inches	Late boot - head	Yes	1 - 3 tons
Wheat *Triticum aestivum*	120 - 180	1.0 - 1.5	10/1 - 10/15	Fall, spring	40 - 60 days	Vegetative stage, at 3 - 5 inches	Late boot - head	Yes	1 - 2 tons
BRASSICAS									
Kale *Brassica oleracea*	3 - 4	0.25 - 0.5	5/1 - 6/15	Late summer, fall	120 - 180 days	150 days after seeding	----	No	1 - 5 tons
Rape *Brassica napus*	3 - 4	0.25 - 0.5	5/1 - 8/15	Summer, fall	80 - 90 days	80 - 90 days after establishment	----	Yes	1 - 5 tons
Swede *Brassica napus*	1 - 2	0.25 - 0.5	5/1 - 6/15	Fall	150 - 180 days	150 days after seeding	----	No	1 - 5 tons
Turnips *Brassica rapa*	2	0.25 - 0.5	5/1 - 8/15	Summer, fall	60 - 90 days	70 - 90 days after establishment	----	Yes	1 - 5 tons

TABLE 7.8 NOTES:

1. Animal Health Concerns: Caution--Livestock consumption of sorghum, sudangrass, and sudan-sorghum hybrids (and to some extent, other plants) can result in nitrate poisoning and prussic acid (hydrogen cyanide) poisoning. Plant growth stage, plus environmental and management factors, affect nitrate and prussic acid concentrations in foliage. To minimize health risks to livestock, use careful management when feeding with emergency and late-season forages, and know when to expect potential problems and how to avoid them. Before feeding any suspect forage, have representative samples tested for nitrate and prussic acid content.
2. Seeding rate shall be calculated on a pure live seed (PLS) basis.

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SECTION 8 - COVER CROP PLANTINGS

This section contains recommendations for establishing grasses, legumes, and forbs for seasonal vegetative cover.

Refer to Tables 8.1 and 8.2 for a listing of cover crops, seeding rates, seeding depths, planting dates, kill dates, and suitable uses. Select species based upon time of year, availability and cost of seed, and geographic location. Adjust the seeding rate as appropriate based on the method of planting.

Refer to the Delaware NRCS Fact Sheet *Cover Crop* for information about the benefits of cover crops and recommendations concerning selection of cover crops for specific purposes.

Plant cover crops as early as possible and terminate as late as feasible to maximize plant biomass and nutrient uptake, considering crop insurance criteria, the time needed to prepare the field for the following crop, and soil moisture depletion.

TABLE 8.1: Recommended Cover Crops

Species	Seeding Rate (lbs/ac) [1]	Seeding Depth (inches) [2]	Suitable Uses [3]							Planting dates based on PHZ [4]	Kill /Suppression Dates [5]
			E	R	N	O	B	S	W	7a - 7b	
WINTER ANNUAL GRASSES											
Annual Ryegrass *Lolium multiflorum* Lam.	15	0.25 - 0.5	●	●		●		●	●	9/1 - 11/15	For optimum benefits as a green manure crop, terminate no later than 2 to 4 weeks before planting the next crop. Spring oats may winter kill. To meet crop insurance requirements for a following crop on non-irrigated cropland, cover crops must be terminated at, or within 5 days after, planting the following crop, but before crop emergence. Earlier termination is acceptable. ***NOTE*** – Planting before the Hessian Fly Free Dates (Oct 3 – New Castle County; Oct 8 – Kent County; Oct 10 – Sussex County) could result in damage from this pest in wheat, barley, triticale and rye. Oats are not attacked by Hessian Fly.
Spring Oats *Avena sativa*	90	1.0 - 1.5	●	●		●		●	●	9/1 - 10/15	
Winter Barley *Hordeum vulgare*	100	1.0 - 1.5	●	●		●		●	●	9/1 - 11/1	
Winter (Cereal) Rye *Secale cereale*	100	1.0 - 1.5	●	●		●		●	●	9/1 - 11/15	
Winter Wheat *Triticum aestivum*	100	1.0 - 1.5	●	●		●		●	●	9/1 - 11/15	
Triticale *Triticum X Secale*	100	1.0 - 1.5	●	●		●		●	●	9/1 - 11/15	
WINTER ANNUAL LEGUMES											
Austrian Winter Pea *Pisum sativum*	50	1.0 - 1.5	●		●	●	●	●		9/1 - 10/15	For optimum benefits as a green manure crop, terminate no later than 2 to 4 weeks before planting the next crop. To meet crop insurance requirements for a following crop on non-irrigated cropland, cover crops must be terminated at, or within 5 days after, planting the following crop, but before crop emergence. Earlier termination is acceptable. Seeding rates for pre-inoculated and/or lime-coated seeds are PLS. [7]
Common Vetch *Vicia sativa*	60	0.5 - 1.0	●		●	●	●	●		9/1 - 10/15	
Hairy Vetch *Vicia villosa*	20	0.5 - 1.0	●		●	●	●	●	●	9/1 - 10/15	
Crimson Clover *Trifolium incarnatum*	15	0.25 - 0.5	●		●	●	●	●		9/1 - 10/15	

TABLE 8.1: Recommended Cover Crops

Species	Seeding Rate (lbs/ac) [1]	Seeding Depth (inches) [2]	Suitable Uses [3]							Planting Dates by PHZ [4]	Kill/Suppression Dates [5] and Other Notes
			E	R	N	O	B	S	W	7a - 7b	
WINTER ANNUAL BRASSICAS [6]											
Kale *Brassica oleracea*	8	0.25 - 0.5	●	●		●		●	●	9/1 - 10/15	If grown on sandy soils, extra sulfate sulfur may be needed for improved growth. Kill prior to seed heads maturing.
Winter Rape (Canola) *Brassica napus*	8	0.25 - 0.5	●	●		●		●	●	9/1 - 10/15 See Other Notes	If grown on sandy soils, extra sulfate sulfur may be needed for improved growth. If the purpose is nematicide, plant before Sept. 20th. Kill prior to seed heads maturing.
Forage/Oilseed Radishes *Raphanus sativus* var. *niger*, var. *oleiferus*, and var. *longipinnatus*	8	0.25 -0.5	●	●		●		●	●	9/1 - 10/15	Seeding rates for these species are PLS. [7] May be planted up to an inch deep during dry conditions. The varieties 'niger' and 'longipinnatus' have very long, thick tap roots. These varieties are sometimes referred to as "tillage" radishes because they can be used to break up hard pans. The variety 'oleiferus' (usually grown for oilseed) has shorter roots but is somewhat more winter hardy.
Forage Turnip *Brassica rapa*	5	0.5	●	●		●		●	●	9/1 - 10/15	Seeding rates for these species are PLS. [7] If grown on sandy soils, extra sulfate sulfur may be needed for improved growth.
SUMMER ANNUAL GRASSES											
Sudangrass *Sorghum bicolor var. sudanese*	25	0.5 - 1.0	●			●		●	●	5/1 - 6/15	
Sorghum - Sudangrass Hybrids *Sorghum bicolor X S. bicolor var. sudanese*	25	0.5 - 1.0	●			●		●	●	5/1 - 6/15	
Pearl Millet *Pennisetum glaucum*	20	0.5 - 1.0	●			●		●	●	5/15 - 7/1	
Foxtail (German) Millet *Setaria italica*	20	0.5 - 1.0	●			●		●	●	5/15 -7/1	
Teff *Eragrostis tef*	5	0.125 - 0.25	●			●		●	●	5/15 -7/1	Seeding rates for these species are PLS. [7]

TABLE 8.1: Recommended Cover Crops

Species	Seeding Rate (lbs/ac) [1]	Seeding Depth (inches) [2]	Suitable Uses [3]							Planting Dates by PHZ [4]	Kill/Suppression Dates [5] and Other Notes
			E	R	N	O	B	S	W	7a - 7b	
SUMMER ANNUAL FORAGES & LEGUMES											
Buckwheat *Fagopyrum esculentum*	60	0.5 - 1.0	●	●		●		●	●	5/15–8/1	For optimum benefits as a green manure crop, terminate no later than 1 to 2 weeks before planting the next crop. To meet crop insurance requirements for a following crop on non-irrigated cropland, cover crops must be terminated by the time of planting or within 5 days after planting the following crop, but before crop emergence. Earlier termination is acceptable.
Annual Lespedeza: **Korean** *Kummerowia stipulacea* or **Common** *K. striata*	15	0.25 - 0.5	●		●	●				3/20–4/15	
Soybeans *Glycine max*	100	1.0 - 1.5			●	●			●	5/15–7/1	

Additional Notes for this table are located on Page 124.

TABLE 8.2: Recommended Cover Crop Mixes

WINTER ANNUAL GRASS/LEGUME/BRASSICA MIXTURES

Select one GRASS, one LEGUME, and one BRASSICA; or one GRASS and one LEGUME; or one GRASS and one BRASSICA; or one BRASSICA and one LEGUME (total seeding rate is the sum of the individual species)

Species	Seeding Rate (lbs/ac) [1]	Seeding Depth (inches) [2]	Suitable Uses [3]							Planting dates based on PHZ [4]	Kill /Suppression Dates [5] and Other Notes
			E	R	N	O	B	S	W	7a - 7b	
Select one GRASS (if using more than one Grass, divide the rate by the number of species)											
Rye, Wheat, Barley Triticale *Secale cereale, Triticum aestivum, Hordeum vulgare, Triticum x Secale,* respectively	40	0.25 – 0.5	●	●		●	●	●	●	9/1 - 10/15	For optimum benefits as a green manure crop, terminate no later than 1 to 2 weeks before planting the next crop. To meet crop insurance requirements for a following crop on non-irrigated cropland, cover crops must be terminated by the time of planting or within 5 days after planting the following crop, but before crop emergence. Earlier termination is acceptable. These cover crops may entirely winter kill, depending on geographic location and/or the severity of the winter. When using Annual Ryegrass in the mixture, plant to a depth of 0.5 inches. Research suggests Hairy Vetch is a better phosphorus scavenger than other legumes. Legumes seeding rates are based on PLS. [7] Brassicas: lower rates work well if planted early (mid-Aug. to early Sept.). Higher rates may be needed if planted later (mid-Sept. – Oct.). Tillage radish (*Raphanus sativus* var. *niger,* or var. *longipinnatus*) is an excellent choice for reduction of soil compaction. *Brassica/Raphanus* seeding rates are based on PLS. [7]
Spring Oats *Avena sativa*	50		●	●		●	●	●	●		
Annual Ryegrass *Lolium perenne* ssp. *multiflorum*	15		●	●		●	●	●	●		
Select one LEGUME (if using more than one LEGUME, divide the rate by the number of species)											
Hairy Vetch *Vicia villosa*	20		●		●	●	●	●	●		
Crimson Clover *Trifolium incarnatum*	10		●		●	●	●	●	●		
Select one BRASSICA (if using more than one BRASSICA, divide the rate by the number of species)											
Forage/Oilseed Radishes *Raphanus sativus* var. *niger*, var. *oleiferus*, and var. *longipinnatus*	2		●	●		●	●	●	●		
Winter Rape (Canola), Kale, Turnips *Brassica napus, B. rapa, B. oleracea*	2		●				●	●	●		

Additional Notes for this table are located on Page 124.

TABLES 8.1 AND 8.2 NOTES:

1. **Seeding Rate:** Seeding rates listed are for planting methods that incorporate seed into the soil. These methods include drilling (conventional or no-till) and broadcast seeding followed by light soil incorporation with a cultipacker, vertical tillage, rolling basket, or light disking. **A minimum germination rate of 80% is required unless using PLS**.

   If broadcast seeding (without incorporation) or aerial seeding, increase the seeding rate by at least 30%. When calculating a 30% increase, use 1.3 x the primary seeding rate per individual species.

2. **Seeding Depth:** Provides the recommended depth to plant seed to obtain the best germination. Plant deeper in sandy soil, and less deep in clayey soil.

3. **Suitable Uses:** Lists the benefits obtained from each species or mix:

   E - Erosion control and surface water protection; R - Recycle excess nutrients; N - Nitrogen fixation; O - Organic matter added; B - Biodiversity; S - Soil structure improved; W - Weed suppression.

4. **Planting Dates:** Preferred planting dates are listed based on Plant Hardiness Zones (see Figure 1). Successful establishment of the planting will vary with environmental conditions, but is more likely to occur if the crop is planted near the beginning of the planting period. Planting before the earliest date is permissible when weather conditions are favorable. To allow sufficient time for growth, the latest planting date should rarely be exceeded.

5. **Kill/Suppression Dates:** The preferred timing for killing the cover crop or suppressing growth of the crop. Harvesting or herbicide treatment may be used, or the crop may be rolled/crimped or plowed under, depending on the purpose and desired use of the cover crop.

6. **"Brassica" cover crops** (family Brassicaceae) include rape, kale, mustard, turnips, etc. Canola is a term for rape cultivars that are used to produce oil and other products for human and livestock consumption. Oil from other rape varieties is less palatable and is used for industrial purposes. All rape varieties are suitable for use as cover crops.

   Brassicas can be especially useful for planting after early vegetable crops. Brassica cover crops are well-suited for uptake of residual nitrogen in the fall because they grow rapidly during periods of cool weather. They may also provide other benefits such as suppression of detrimental nematodes, plant diseases, weeds, and reduce soil compaction.

   There are a few drawbacks to using Brassica cover crops: (1) Brassicas have low tolerance for poorly drained or frequently flooded soils; (2) Plants are susceptible to below freezing temperatures, and may winter-kill. It is important that they be well-established (6 to 8 leaf stage) before a hard freeze in order to provide the benefits of a cover crop; (3) If allowed to set seed, these plants may become "weedy" in crop fields.

7. **Pure Live Seed (PLS):** Percent (%) Purity x Percent (%) Total Germination /100 = % PLS