

**NATURAL RESOURCES CONSERVATION SERVICE  
CONSERVATION PRACTICE STANDARD**

**RIPARIAN FOREST BUFFER  
(Acre)  
CODE 391**

**DEFINITION**

An area of trees, shrubs and other vegetation located in areas adjacent to and upgradient from water bodies.

**PURPOSE**

The purpose of this practice is to:

- \* Reduce excess amounts of sediment, organic material, nutrients and pesticides and other pollutants in surface runoff and reduce excess nutrients and other chemicals in shallow ground water flow
- \* Create shade to lower water temperatures to improve habitat for fish and other aquatic organisms
- \* Provide a source of detritus and large woody debris for fish and other aquatic organisms and riparian habitat and corridors for wildlife
- \* Provide room for water courses to establish geomorphic stability.
- \* Create riparian habitat and corridors for wildlife.

The riparian buffer strip will be most effective when used as a component of a total resource management system including nutrient management, pest management, and erosion, runoff and sediment control practices.

**CONDITIONS WHERE PRACTICE APPLIES**

This practice applies to stable areas, which are adjacent to or immediately upgradient of: perennial or intermittent streams; rivers; lakes; ponds; sinkholes; wetlands types 1 (bottomland hardwood sites only) and types 6, 7, 8.

Where existing perennial vegetation is already established, directly adjacent to the water body, the forest riparian buffer will apply to the area directly upslope of the existing vegetation within the maximum buffer width allowable.

**CRITERIA**

**General Criteria Applicable To All Purposes Listed Above:**

The location, width, layout and woody plant density of the riparian forest buffer will accomplish the intended purpose and function. The design width shown for each criteria includes any existing natural woody vegetation. The buffer will consist of the following distinct zones:

Zone 1

Zone 1 will begin at the normal water line or at the upper edge of the active channel and extend a minimum distance of 35 feet, measured horizontally on a line perpendicular to the watercourse or water body.

Where equipment access corridors are necessary adjacent to stream channels, a strip no more than 40 feet in length adjacent to the stream may be maintained in low shrubs or herbaceous plants. If possible restrict access to one side only preferably the north or east bank. Wider channels may require access on both sides.

Zone 2

When appropriate or as desired by the landowner an additional strip or area of land (Zone 2) can be added to Zone 1, extending the buffer to meet the needs of the site and to accomplish the intended purpose of the buffer. Zone 2 will begin at the upslope edge of Zone 1 and extend a minimum distance to provide the designed function of the buffer.

**ADDITIONAL CRITERIA TO REDUCE EXCESS AMOUNTS OF SEDIMENT, ORGANIC MATERIAL, NUTRIENTS, PESTICIDES, AND OTHER POLLUTANTS IN SURFACE RUNOFF AND REDUCE EXCESS NUTRIENTS AND OTHER CHEMICALS IN SHALLOW GROUND WATER FLOW.**

An additional strip or area of land, zone 2, will begin at the edge and up-gradient of zone 1 and extend a minimum distance of 65 feet, measured horizontally on a line perpendicular to the water course or water body. The minimum combined width of zones 1 and 2 will be

100 feet or 30 percent of the geomorphic floodplain whichever is less, but not less than 35 feet. Figure 1 illustrates examples of zone 1 and zone 2 widths for water courses and water bodies designed for this criteria.

**ADDITIONAL CRITERIA TO IMPROVE AND ENHANCE SELECTED WILDLIFE SPECIES AND THEIR HABITATS**

Widths below are considered the minimum desired width (zones 1 and 2 combined) to adequately provide resource protection including habitat enhancement for the listed species. The widths listed pertain to one or both sides of water courses or water bodies but shall not exceed to 100 year floodplain.

Species:	Width in Feet
Bald eagle, cavity nesting ducks, heron rookery, sandhill crane	600
Common Loon, Pileated woodpecker	450
Beaver, dabbling ducks, mink	300
Deer	200
Frog, salamander	100

**ADDITIONAL CRITERIA TO PROVIDE MULTIPLE RESOURCE PROTECTION**

To achieve multiple resource protection objectives, including potential flood damage reduction, water and air quality enhancement, watershed protection, bottomland hardwood forest restoration, and water course geomorphic stability riparian forest buffers located upslope and adjacent to rivers or perennial and intermittent streams can be expanded beyond the width requirements for wildlife. Natural resource planners can set the minimum combined width of zones 1 and 2 to include the entire riparian area, not to exceed the 100 year floodplain. The entire riparian area can be approximated by multiplying the width of the river or stream at the ordinary high water mark by 10 and adding 50 feet. The buffer width associated with this calculation will be adjusted downward not to exceed the

100 year floodplain. The width determination of this definition pertains to one side of the water course. To obtain the total riparian width associated with both sides of a water course multiply the area determined above by 2.

**ADDITIONAL CRITERIA TO CREATE SHADE TO LOWER WATER TEMPERATURES TO IMPROVE HABITAT FOR FISH AND OTHER AQUATIC ORGANISMS.**

A buffer for lowering warm-season water temperatures shall consist of at least zone 1 for: 1) water course reaches or water bodies less than or equal to 30 feet in width or; 2) water bodies greater than 30 feet in width but less than 1 acre.

Buffers shall be established or maintained on the south and west sides of the water courses to the greatest extent practical. The buffer canopy shall be established to achieve at least 50 percent crown cover with average canopy heights equal to or greater than the width of the water course or 30 feet for water bodies. See figure 2.

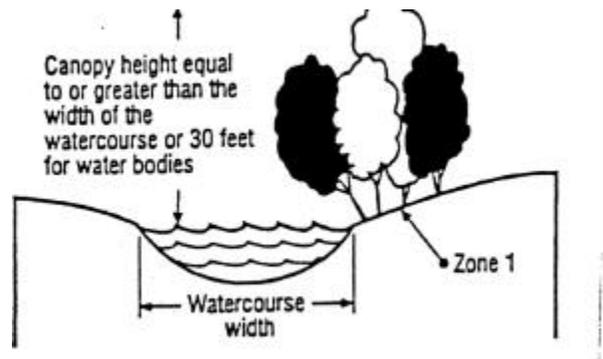
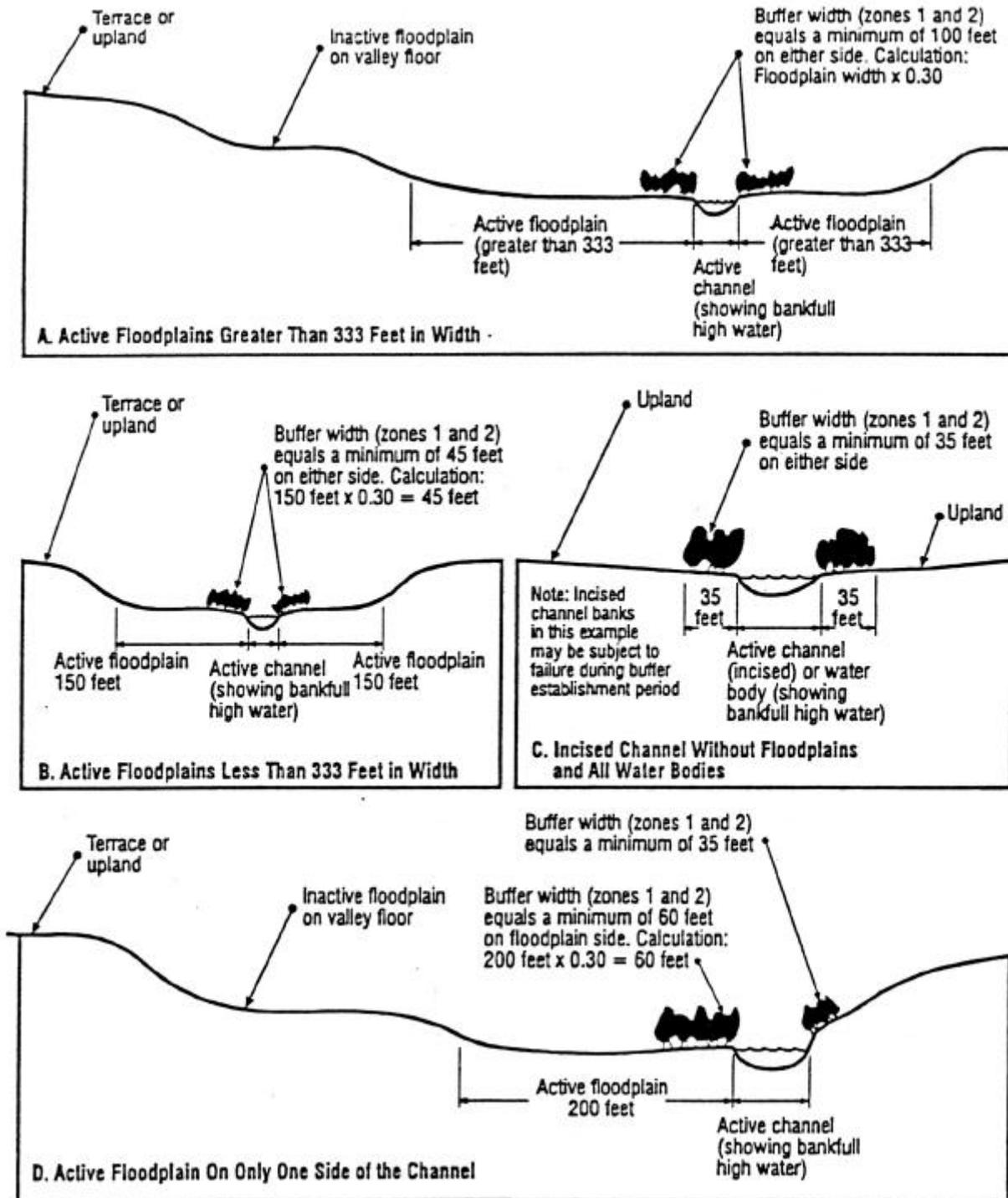


Figure 2 Canopy height for water temperature control.

Buffer species shall include those listed in Table 1 or other appropriate native species. Place drooping or wide-crowned trees and shrubs nearest the water course or body. Shoreline or channel relief and topographic shading will be taken into account in selecting species.

Figure 1: Examples of riparian buffer widths designed using the water quality criteria. The minimum width of zones 1 and 2 will be 100 feet or 30% of the geomorphic floodplain, whichever is less but not less than 35 feet.



**ADDITIONAL CRITERIA TO PROVIDE A SOURCE OF DETRITUS AND LARGE WOODY DEBRIS FOR FISH AND OTHER AQUATIC ORGANISMS.**

Within zone 1 as a minimum, establish, favor or manage species capable of producing stems and limbs of sufficient size to provide an eventual source of large woody debris for in-stream habitat for fish and other aquatic organisms.

Overland Flow

Runoff to be buffered or filtered by Zone 2 will be limited to shallow, overland sheet flow only. Shaping and grading of the area immediately upslope from the buffer and the buffer strip itself may be necessary to insure shallow, overland sheet flow. Concentrated flows must be converted to sheet flow prior to entering Zone 2. This includes converting water carried by waterways and ditches into sheet flow conditions.

Buffer Establishment

Dominant vegetation will consist of existing or planted trees and shrubs suited to the site and the intended purpose. Planted woody perennial vegetation will be composed of riparian trees and shrubs suitable to the site and soil. Emphasis will be placed on the use of locally native species. Plantings will consist of two or more species with individual plants suited to the seasonal variation of soil moisture at specific planting sites. Nitrogen fixing species should be discouraged where nitrogen removal or buffering is desired.

**Natural Revegetation**

Where frequent flooding makes tree planting impractical, revegetation can be accomplished by enhancing or allowing natural succession to occur. Where natural revegetation is allowed, an adequate stand will require at least 300 well spaced, trees and/or shrubs per acre at the end of the third growing season. If 300 stems per acre are not present a technical determination will be made to determine if additional planting is recommended based on the original stocking level of the site. If the existing stocking rate is less than 40% of the original stocking rate supplemental planting will be recommended. If the existing stocking rate is between 40% and 70% of the original stocking the recommendation to plant additional trees will be made on a site specific basis.

**Planting**

Planting densities for trees and shrubs will depend on the species and their potential height at 20 years of age. Heights may be estimated based on: 1) performance of the individual species (or comparable species) in nearby areas on similar sites, or 2) predetermined and documented heights using Section II-N of the FOTG, Windbreak Suitability Groups. Planting density recommendations are:

Plant Types/Heights	Plant-to-Plant Spacing in feet
* Shrubs less than 10 feet in height	3 to 6
* Shrubs and trees from 10 to 25 feet in height	5 to 10
* Trees greater than 25 feet in height	8 to 14

Refer to Table 1 for woody species commonly associated with and suited to riparian areas.

Refer to Standard 612, Tree Planting for additional information on the age, size, handling, storage and quality of planting stock.

Bared root stock plantings shall be completed as soon as practical in the spring when soil, site, and weather conditions are suitable. Containerized or potted stock plantings may be completed in the fall provided soil moisture is adequate.

Planting Site Preparation

Necessary site preparation shall be done at a time and manner to insure survival and growth of planted species. Only viable, high quality and adapted planting stock will be used. Planting sites shall be properly prepared based on the soil type and vegetative conditions listed below. For sites to be tilled leave a minimum 3 foot untreated strip at the edge of the bank or shoreline. Avoid sites that have had recent applications of pesticides harmful to woody species. If pesticides are used, apply only when needed and handle and dispose of properly and within federal, state, and local regulations. Follow label directions and precautions listed on containers.

Geo-textile fabric mulch and other appropriate mulch materials may be used for weed control and moisture conservation for new plantings on all sites.

Appropriate mulch materials must allow for water infiltration and air exchange.

Based on the site conditions and soils procedures to prepare sites include:

### **Sod and Alfalfa**

Till (moldboard plow, disk plow, rototiller or similar equipment) in the fall before planting. Fall seeded temporary cover may be used where needed to control erosion.

Sod may be killed by non-selective herbicides. These herbicides are most effective when used in the year prior to planting with stock planted into the residue. On heavy soils, tillage is usually necessary to achieve a satisfactory planting when a tree planting machine is used.

### **Small Grain or Row Crop Sites**

If the site is in row crop, till (moldboard plow, disk plow, rototiller or similar equipment) in the fall or in the spring prior to planting. If the site has a plow pan or hard pan in the subsoil perform a deep disking or ripping operation in the fall. Fall seeded cover crops may be used where needed to control erosion.

If the site is in small grain stubble, planting can be done in the spring without further preparation. If fabric mulch or other mulch materials are to be installed till in the spring before planting.

Tillage on steep slopes must be done on the contour or cross-slope. Cover crops between the rows may be established, where needed, to control erosion and sediment deposition on planted stock.

**On sites where it is not practical or possible to operate equipment, where tillage of the site will cause excessive erosion or where tillage of the site is impractical the methods listed below may be used.**

- \* Machine or hand scalp an area at least 36 inches in diameter and place planted stock in the center of the scalped area.
- \* Rototill a strip at least 36 inches wide the year prior to planting and plant stock in the center of the tilled area.
- \* Kill the vegetation in a 36 inch diameter or larger area with a non-selective herbicide. This is most effective when done the year prior to planting. Plant the stock in the center of the treated area.

Sites with undesirable brush will need initial treatments that physically removes and kills the brush species to facilitate planting of desired stock and prevents re-encroachment of the brush. Suitable methods include hand-cutting and removal, brush hogging, brush blading, or other equivalent procedure with repeated treatment or use of herbicides to control resprouting.

Temporary plantings or cover may be needed for streambank stabilization during the establishment period.

Livestock shall be controlled or excluded as necessary to achieve and maintain the intended purpose.

Harmful pests present on the site shall be controlled or eliminated as necessary.

## **CONSIDERATIONS**

The severity of bank erosion and its influence on existing or potential riparian trees and shrubs should be assessed. Watershed-level treatment or bank stability activities may be needed before establishing a riparian forest buffer.

Complex ownership patterns of riparian areas may require group planning for proper buffer design, function and management.

Where ephemeral, concentrated flow erosion and sedimentation is a concern within zone 2 or in the area upslope of zone 2 consider the application of a vegetated strip consisting of grasses and forbes. Stiff stemmed grasses at the up-gradient edge of zone 2 will accelerate deposition of sediment (see figure 3). Criteria from standard 393, Filter Strip, will be used in designing this grass strip.

Favor tree and shrub species that are native and that have multiple values such as those suited for timber, biomass, nuts, fruit, nesting, and aesthetics. Also consider used of species that have a tolerance to locally used herbicides.

Consider the use of species that resprout or can be propagated by layering when establishing new rows nearest to water courses or bodies.

Joining of existing and new buffers increases the continuity of cover and will further moderate water temperatures. A mix of species with growth forms that are tall and wide-crowned or drooping will increase

moderation effects. For water courses, buffers established on both sides will enhance multiple values.

When concentrated flow erosion and sedimentation cannot be controlled vegetatively consider structural or mechanical treatments.

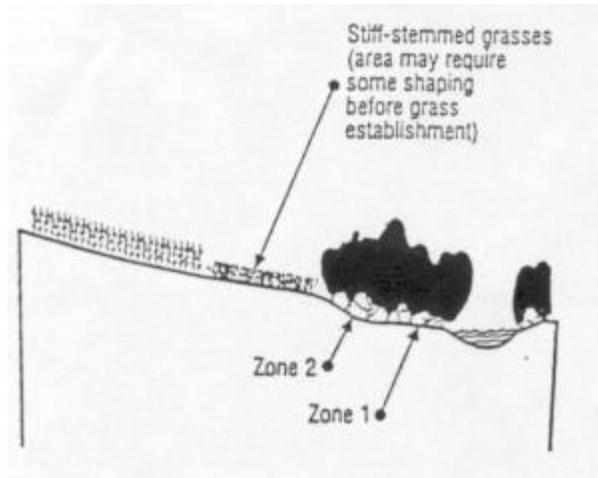


Figure 3. Control of concentrated flow erosion

Avoid tree and shrub species which may be alternate hosts to undesirable pests or that may be considered noxious or undesirable. Species diversity should be considered to avoid loss of function due to species specific pests.

The location, layout and density of the buffer should complement natural features. Avoid designs or locations that would concentrate flood flows or return flows. Flexible-stemmed shrubs will minimize obstruction of local flood flows. Avoid establishing buffers in windthrow prone locations.

Woody species which obtain water by the penetration of their roots into the water table (phreatophytes) and hydrophytes that can potentially deplete ground water should be used with caution in water-deficit areas.

Consider the positive and negative impacts beaver, muskrat, deer, rabbits and other wildlife species may have on establishment of woody plants. Temporary and local population control methods of these kinds of wildlife should only be used within state and local regulations.

Consider the type of human use and the aesthetic, social and safety aspects of the area when determining the vegetation selection, arrangement and management. For example, avoiding shrubs that block views near

recreation trails. Species selection to improve aesthetics include seasonal foliage color, showy flowers, and fruit, foliage texture, form and branching habit.

Consider the additional benefits and values of expanding the buffer beyond the minimum width. In cases where the expanded buffer exceeds the 100 year flood plain refer to Standard 612, Tree Planting for information on tree establishment.

## PLANS AND SPECIFICATIONS

Plans and specifications for establishment and maintenance of this practice shall be prepared for each site. Plans and specifications shall be recorded using approved specification sheets, job sheets, narrative statements in the conservation plan or other acceptable documents. These documents are to specify the requirements for installing the practice, such as the kind, amount or quality of materials to be used, or the timing or sequence of installation activities. Requirements for operation and maintenance of the practice shall be incorporated into site specifications.

## OPERATION AND MAINTENANCE

The following actions shall be carried out to insure that this practice functions as intended throughout its expected life. These actions include normal repetitive activities in the application and use of the practice and repair and upkeep of the practice.

The riparian forest buffers will be inspected periodically, protected and restored as needed from adverse impacts such as excessive traffic, pest infestations, pesticide use on adjacent lands, livestock use and fire.

As applicable control of concentrated flow erosion shall be continued in the area up-gradient of zone 2 to maintain buffer function. Following severe storms check for evidence of sediment deposit, erosion or concentrated flow channels. Prompt corrective action needs to be taken to stop erosion and restore sheet flow.

Replacement of dead trees or shrubs and control of undesirable vegetative competition will be continued until the buffer is in a fully functional condition.

The following should be avoided within the buffer strips: excess use of fertilizers, pesticides, or other chemicals and removal or disturbance of vegetation and

litter inconsistent with erosion control and buffering objectives.

Zone 1 vegetation should remain undisturbed except for removal of individual trees that could present an usual hazard, such as potentially blocking culverts or creating dangerous hydraulic obstructions.

As Zone 1 approaches 40 years of age, it will begin to produce large stable debris. Large debris, such as logs, create small dams which trap and hold detritus for processing by aquatic insects thus adding energy to the stream ecosystem, strengthening for food chain and improving aquatic habitat. Wherever possible, stable debris should be conserved.

Where debris dams must be removed, try to retain useful, stable portions which provide detritus storage. Remove unstable and smaller debris which will contribute to unwanted debris jams. Deposit removed material a sufficient distance from the stream so that it will not be refloated by high water.

Management of Zone 1 will be limited to bank stabilization and removal of problem vegetation. Zone 2 vegetation, undergrowth, forest floor, duff layer and leaf litter shall remain undisturbed except for: the periodic cutting of trees to remove sequestered nutrients; or for spot site preparation for regeneration purposes. Logging and other overland equipment traffic shall be excluded except for streamcrossing and stream stabilization work.

Additional operation and maintenance requirements shall be developed on a site-specific basis to assure performance of the practice as intended.

## REFERENCES

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US-Environmental Protection Agency, 1991. Water Quality Functions of Riparian Forest Buffer Systems in the Chesapeake Bay Watershed. EPA 903-R-95-004. Prepared by the Nutrient Subcommittee of the Chesapeake Bay Program. Annapolis, MD.

**TABLE 1: Woody Species Recommendations for Establishing Forest Riparian Buffers**

Species:		Flooding Tolerance	Large Debris	Shade Value	Wildlife Merit	Potential Height
American cranberry	<i>Viburnum trilbum</i>	H-M	L	L	H	16
American plum	<i>Prunus americana</i>	L-M	L	L	H	10
Arrowwood	<i>Viburnum dentatum</i>	H	L	L	H	8
Ash, green	<i>Fraxinus pennsylvanica</i>	M	M	H	M	60
white	<i>Fraxinus americana</i>	M	M	H	M	80
black	<i>Fraxinus nigra</i>	H-M	M	M	M	70
Birch, white	<i>Betula papyrifera</i>	M-H	M	M	H	70
river	<i>Betula nigra</i>	M-H	M	M	M	70
yellow	<i>Betula alleghaniensis</i>	M-H	H	M	H	60
Basswood	<i>Tilia americana</i>	L-M	H	H	L	100
Cedar, Red	<i>Juniperus virginiana</i>	M	M	H	H	40
White	<i>Thuja occidentalis</i>	H-M	M	H	H	50
Chokecherry	<i>Prunus virginiana</i>	L-M	L	L	H	30
Cottonwood	<i>Populus deltoides</i>	H-V	H	H-V	M	100
Dogwood, red-osier	<i>Cornus stolonifera</i>	H	L	L	M	10
silky	<i>Cornus stolonifera</i>	H	L	L	M	10
gray	<i>Cornus racemosa</i>	M	L	L	M	10
Fir, Balsam	<i>Abies balsamea</i>	M-H	M	M	H	60
Hackberry	<i>Celtis occidentalis</i>	M	M-H	H	H	100
Hawthorne	<i>Crataegus crusgalli</i>	M	L	L	H	25
Hazelnut	<i>Corylus americana</i>	M	L	L	H	25
Honeylocust	<i>Gleditsia triacanthoa</i>	L	L	L	L	75
Maple, silver	<i>Acer saccharinum</i>	H	H	H	M	95
red	<i>Acer rubrum</i>	M-H	H	H	M-H	70
Nannyberry	<i>Viburnum lentago</i>	M	L	L	H	14
Ninebark	<i>Physocarpus opulifolius</i>	L	L	L	H-M	10
Oak, bur	<i>Quercus macrocarpa</i>	H-M	H	H	H	80
pin	<i>Quercus ellipsoidalis</i>	M-L	H	H	H	75
red	<i>Quercus rubrum</i>	L	H	H	H	80
swamp white	<i>Quercus bicolor</i>	H	M	H	H	70
Pine, jack	<i>Pinus banksiana</i>	L	L	M	L	80
red	<i>Pinus rubrum</i>	M	H	M	M	80
white	<i>Pinus strobus</i>	M	H	H	H	100
Spruce, black	<i>Picea mariana</i>	H-V	M	M	M-H	70
white	<i>Picea abies</i>	M-L	H	M-H	H	80
Serviceberry	<i>Amelanchier alnifolia</i>	M-L	L	L	H	12
Tamarack	<i>Larix laricina</i>	H-M	H	M	M	75
Walnut, black	<i>Juglans nigra</i>	L	M	M	H	60
white	<i>Juglans cinerea</i>	L	M	M	H	60
Willow, black	<i>Salix nigra</i>	H	M	H	M	60
sandbar	<i>Salix exigua</i>	H-V	L	L	L	8
peachleaf	<i>Salix amygdaloides</i>	H	L	L	L	25

\* - This is not an all inclusive list of species to plant or a list of only those species eligible for establishment with cost share. All native species which are locally adapted may be recommended for establishment. Additional references you may want to consult for species recommendations include: "Trees and Large Shrubs: Species Native to Minnesota's Ecological Regions" by MN/DNR Division of Forestry and "Minnesota Tree Handbook" by MASWCD

\* - Refer to Windbreak Suitability groups in Section II of the FOTG for additional information on suitability of trees and shrubs for specific soils

Relative ranking values: V = Very high; H = High; M = Medium; L = Low

**Flooding Tolerance** describes the relative capacity of the species to survive standing water or anaerobic soil conditions. Species shown with a "V" ranking have the ability to survive deep, prolonged flooding; "H" the ability to survive flooding for one growing season, with significant mortality occurring if flooding is repeated the following year; "M" the ability to survive flooding or saturated soils for 30 consecutive days during the growing season; "L" relatively unable to survive more than a few days of flooding during the growing season without significant mortality.

**Large Debris** describes the relative potential for the species to produce woody debris larger than ten inches in diameter before senescence. "H" indicates that large debris is likely within the species life span; "M" indicates that large debris is possible within the species life span; "L" indicates that large debris is unlikely.

**Shade Value** describes the density or degree of shade provided by the species' crown canopy in leaf out condition. "H" indicates that the species has a large crown canopy capable of providing full shade; "M" indicates that the species has a medium or narrower crown and/or an open grown canopy that provides partial shade; "L" indicates that the species is open grown, has a small canopy, or is too short to provide anything except minimal shade.

**Wildlife Merit** describes the relative potential for the species to be valuable for wildlife including providing useful cavity sites, quality nesting cover, or quality fruit and food production. "H" indicates excellent large cavity potential, nesting cover or fruit production; "M" indicates moderate cavity potential, nesting cover or fruit production; "L" indicates low cavity potential, nesting cover, or fruit production.

**Potential Height** indicates the species' potential height at maturity.