



**Natural Resources Conservation Service**  
**CONSERVATION PRACTICE STANDARD**  
**WINDBREAK/SHELTERBELT ESTABLISHMENT**

(Acres)

**CODE 380**

**DEFINITION**

Windbreaks or shelterbelts are single or multiple rows of trees or shrubs in linear configurations.

**PURPOSES**

- Reduce soil erosion from wind.
- Protect plants from wind related damage.
- Alter the microenvironment for enhancing plant growth.
- Manage snow deposition.
- Provide shelter for structures, animals, and people.
- Enhance wildlife habitat.
- Provide noise screens.
- Provide visual screens.
- Improve air quality by reducing and intercepting air borne particulate matter, chemicals and odors.
- Delineate property and field boundaries.
- Improve irrigation efficiency.
- Increase carbon storage in biomass and soils.
- Reduce energy use.

**CONDITIONS WHERE PRACTICE APPLIES**

Apply this practice on any areas where linear plantings of woody plants are desired and suited for controlling wind, noise, and visual resources. Use other tree/shrub practices when wind, noise and visual problems are not concerns.

**CRITERIA**

**General Criteria Applicable to All Purposes**

Use of this standard requires compliance with all applicable federal, state, and local laws and regulations.

The species, type of plant material, location, layout and density of the windbreak will accomplish the purpose and intended function within a 20-year period. (Refer to Table 1).

Woody plants will be established without compromising the integrity of:

**Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service State Office, or download it from the Field Office Technical Guide for your State.**

1. Property Lines
2. Fences
3. Utilities
4. Roads
5. Legal Drains
6. Other Easement Areas or Right of Ways

Where a right-of-way easement exists, written permission from the appropriate entity will be needed.

Where subsurface drains (tile lines) cross through a windbreak/shelterbelt planting, and where these drains will remain functional, solid conduit will be installed through the planting and extend a minimum of 50 feet on either side of the planting or trees/shrubs will not be planted within 50 feet on either side of the tile line.

The first outside row to adjacent property lines or contrasting land use areas will be planted at ½ the maximum "Within Row" spacing.

**Table. 1** Plant Spacing

| Within Rows                                   | Spacing (ft.) <sup>1</sup> |
|---|----------------------------|
| Shrubs < 10 feet tall                         | 3-8                        |
| Shrubs and trees 10-25 ft. tall               | 5-16                       |
| Columnar Trees<br>(Cedar and Arborvitae)      | 6-10                       |
| Trees > 25 ft. tall                           | 8-16                       |
| Large Conifers                                | 14 - 24                    |
| Between Rows                                  | Spacing (ft.) <sup>2</sup> |
| Between shrubs < 10 ft. tall                  | 10                         |
| Between shrubs and small trees 10-25 ft. tall | 12                         |
| Between small trees <25 ft. tall              | 12                         |
| Between small and tall trees >25 ft. tall     | 16                         |
| Between two tall trees >25 ft. tall           | 18                         |
| Between shrub and conifer                     | 16                         |
| Between any tree and conifer                  | 20                         |
| Between two columnar trees                    | 14                         |
| Between two large conifers                    | 25                         |
| Twin Row High Density                         | 8                          |
| Twin High Density wide crowned                | 12                         |

<sup>1</sup> Use smaller spacing for narrow crowned species or when there is a need to obtain benefits sooner (such as wind erosion exceeding tolerable limits, odor issues, visual screens, etc.). Use larger spacing when extending the longevity or for normal crowned and large conifers.

<sup>2</sup>If space is limited or there is a need to obtain benefits sooner; rows between tall trees, and rows between any tree and conifer can be spaced no closer than 14 feet, and 12 feet for between rows of shrubs and conifer or rows of two columnar trees.

Planting dates, and care in handling and planting of the seed, cuttings or seedlings will ensure that planted materials have an acceptable rate of survival.

The maximum design height (H), for the windbreak or shelterbelt will be the expected height of the tallest row of trees or shrubs at 20 years of age for the given site.

All plantings will follow applicable criteria found in the Indiana (IN) Field Office Technical Guide (FOTG) Forestry Technical Note: Tree & Shrub Establishment.

Species will be adapted to the soils, climate and site conditions. Adapted species can be found at the NRCS Soil Data Mart or Web Soil Survey by generating the Windbreak and Environmental Plantings reports. This report will also show 20 year average height by species.

Native plant species will be used whenever possible. Known invasive species will not be used.

Multiple species will not be used within a windbreak row unless heights and growth forms are similar.

Windbreaks containing two or more rows of plants will be stagger-planted so the plants in one row will be planted opposite of the opening in the other row.

All windbreaks will have sufficient setback distances from roadways, rights of way, and structures to prevent unwanted snowdrift and accumulation. For setback distance from snowfall refer to Table 2. If available, use local WETS Station snowfall data.

**Table 2.** Set Back Distances from Snowfall (min)

| Snowdrift and Snow Accumulation       |                                     |  |   |
|---------------------------------------|-------------------------------------|--|---|
| Region                                | Average Snowfall <sup>1</sup> (in.) | Setback Distance <sup>2</sup> Windward Row (ft.) | Setback Distance <sup>3</sup> Leeward Row (ft.) |
| North                                 | >30                                 | 75   | 1.5 times the plant height <sup>4</sup>         |
| Central                               | 15-30                               | 50   |   |
| South                                 | <15                                 | N/A  | N/A   |
| Ice Formation From Shade <sup>5</sup> |                                     |  |   |
| Region                                | Setback Distance (ft.)              |  |   |
| North & Central                       | 1.5 times the mature plant height   |  |   |
| South                                 | N/A                                 |  |   |

<sup>1</sup> Refer to FOTG Section II Climate Data

<sup>2</sup> Windbreaks west or north of roads or structures

<sup>3</sup> Windbreaks east and south of roads

<sup>4</sup> Use the mature plant height of the row closest to the road

<sup>5</sup> Windbreaks on the south of roads

“Windward” = side of the windbreak closest to the prevailing wind

“Leeward” = side of the windbreak furthest from the prevailing wind

Set back distances from snowdrift and accumulation include potential snowfall, direction of potential winter winds, location and the density of the windbreak. Existing fence rows and woodlands with trees or shrubs of suitable size, shape, and density will be considered as a row of a planned windbreak if they are in desirable locations and meet design requirements.

**Additional Criteria to reduce soil erosion from wind and to protect plants from wind related damage, e.g. field windbreak**

Establish a windbreak with a plant density (air porosity) >40%, using one of the 3 following options:

1. A one row windbreak using a dense non-deciduous conifer of Spruce, Cedar, and/or Arborvitae.
2. A three row windbreak consisting of at least one shrub row, and one deciduous tree row. The third row will consist of a conifer tree row or a deciduous hardwood tree row.
3. A Twin-Row High Density Windbreak consisting of two closely spaced rows of trees or shrubs having the same growth rates, row characteristics, and life span.

Establish windbreaks as nearly perpendicular to the prevailing wind and/or the most damaging winds as possible.

If more than one windbreak is planned in a field, the distance between windbreaks will be based upon crop tolerance to wind and/or wind-blown soil. Use one of the following spacing alternatives:

1. For moderate to tolerant crops (e.g. barley, oats, wheat, rye, corn, and soybeans), windbreaks will be spaced at a distance of 10-15H.
2. For low tolerance crops (e.g. fruit trees, and vegetable crops), windbreaks will be spaced at a distance of 6-8H.

**Additional Criteria to manage snow deposition e.g. living snow fence**

When designing a windbreak to be a “living snow fence,” plan the density to determine the snow deposition. Very dense (60 percent plus air porosity) barriers will cause most snow to drift within 50 feet of the leading edge of the barrier. Less-dense barriers (50 percent to 40 percent) will spread drifting snow further.

Locate living snow fences so that they intercept blowing snow. The windward row will not be closer than 75 feet nor more than 150 feet from the windward edge of the road or other features where drifting snow is undesirable.

Living snow fences will contain a minimum of 3 rows of plants with at least 2 of the rows in conifers or designed using a twin-row high-density configuration.

**Additional Criteria to provide shelter for structures, livestock, and recreational areas**

Establish windbreaks as nearly perpendicular to the prevailing wind and/or the most damaging wind as possible.

The windward row of the windbreak will not be closer than 75 feet to the windward side of any building, road, feedlot, or area where snowdrifts cannot be tolerated.

Where the landowner has made a decision that drifting snow can be tolerated, plans will contain written documentation of potential snow drifting and icing hazards.

Minimum for windbreak: one leg as perpendicular to the prevailing wind and/or the most damaging wind as possible.

Minimum length of windbreak (leg) is 100 feet long.

Minimum requirements will be 3 rows of plants of which at least one tree row must be an evergreen conifer and at least two rows must be trees; or an exception would be in cases of severe space limitation where a twin-row high-density design will meet minimum requirements.

**Additional Criteria to enhance wildlife habitat**

When providing a travel corridor, minimum width for a wildlife travel corridor is 50 feet. The corridor will include at least three rows of shrubs, one row of a soft mast tree species, and one row of a hard mast tree species.

If pollinator habitat is an objective, select shrubs from the IN FOTG Standard (645) Upland Wildlife Habitat Management.

**Additional Criteria for living screens**

Minimum requirement will be 1 row of woody plants.

Evergreen trees and shrubs are most effective for year-round protection.

Living screens for noise abatement will be planted with the edge of the planting from the center of the nearest traffic lane as follows:

- High speed traffic, 100-150 feet
- Moderate speed traffic, 50-80 feet

Screens to reduce noise will be at least 65 percent density, as tall as and as close to the noise source as practical and legal.

Plantings will be twice as long as the distance from the noise source to the receiver, extending equal distances on each side of the receiver.

High speed traffic: The tallest tree row will be capable of attaining a mature height of at least 45 feet. The screen will not be less than 65 feet wide.

Moderate speed traffic: The tallest tree row should be capable of attaining a mature height of at least 30 feet. The screen will not be less than 20 feet wide.

Visual screens will be located as close to the observer as possible. Use plants that will add color, texture, and diversity to the site.

**Additional Criteria to improve air quality by reducing and intercepting airborne particulate matter, chemicals, and odors.**

Direct odor away from an odor-producing source to a sensitive area. Tree varieties and placement for the windbreak will be managed to maximize odor interception and dilution of air, and reduce odor leaving the source.

Where site conditions allow, place plantings around the entire perimeter of the odor source.

Select species based on high leaf surface roughness (plants with leaf hairs, leaf veins, and small leaf size), complex leaf shapes, and large leaf circumference to area ratios and medium to rapid growth rates.

Adjust windbreak porosities/densities to meet air movement needs for naturally ventilated livestock confinement systems.

Keep the inner row of windbreak plantings from all buildings and waste storage areas at least 10 times the exhaust fan diameter or 50 feet, whichever is farther. Use wide “between row spacing” to increase particle surface area contact and foliage light levels.

**Additional Criteria to delineate property and field boundaries**

Plant a minimum of one row of a tree or shrub species to delineate field or property boundaries.

**Additional Criteria to improve irrigation efficiency**

For sprinkler irrigation systems, the windbreak will be no taller than the sprinkler heads. The barrier will not interfere with the operation of the irrigation system.

**Additional Criteria to increase carbon storage**

Select plants that are adapted to the site to assure strong health and vigor and plant the full stocking rate for the site.

Use fast growing species in a mix with long-lived species.

Maintain optimal water and nutrient needs for the planting.

**Additional Criteria to Reduce Energy Use**

Orient the windbreak as close to perpendicular to the troublesome wind as possible.

Use proper plant density to meet energy reduction needs.

Use plants with a potential height growth that will be taller than the structure or facility being protected.

**CONSIDERATIONS**

The considerations section contains information that is optional to the planner.

Consider planting a mixture of species adapted to the site to improve plant diversity.

Consider leaving a maintenance strip (greater than 8 feet) on the leeward side of the windbreak, e.g. the row adjacent to the cropped area. This will allow room for the plants to grow out between the windbreak and the crop field. Consider planting the maintenance strip to non-competitive cool season grasses.

To enable long-term maintenance, leave a 5 foot maintenance strip to ½ the Within Row spacing of the outside row to adjacent property lines or contrasting land use areas.

If planting are to be cultivated, between row spacing should be wide enough for equipment to operate freely between rows. Usually this requires about 4 feet wider than the equipment.

No single recommendation on row and tree spacing will satisfy all situations. Wide spacing will reduce competition between rows, and result in windbreaks that retain lower foliage longer. In addition, wide spacing will allow more snow storage inside the windbreak.

Narrow spacing between trees within a row will result in short-term increase in density of the windbreak; the increased competition will result in self-pruning and competition, thus creating a less dense windbreak in the long term. The optimal way to increase windbreak density throughout its life is by adding additional rows.

On droughty soils it is desirable to have the ground on both sides of the tree row sloped slightly toward the trees to allow water to gravitate toward the plants.

Planting stock should be locally adapted and come from no more than 200 miles north or south of the planting site.

When protecting structures and/or animals from the elements, consider using a 4-row windbreak consisting of 1 row of shrubs on both sides of the windbreak with one row of deciduous trees and one row of evergreen trees in the middle. The evergreen trees should be on the windward side.

Consider a two leg windbreak, L-shaped or curved as viewed from above with one leg as perpendicular to the prevailing wind as possible. Consider one or more additional legs, oriented as needed to provide protection from winds and blowing snow from directions other than prevailing winds.

For living snow fences and twin row high density windbreaks, consider planting trees and shrubs at or near the minimum spacing requirements listed under General Criteria, Plant Spacing. Close spacing is needed to compensate for trees that die, to create a barrier in a short period of time, and to reduce the time for weed control.

Living snow fences should normally be located north of east-west roads and west of north-south roads. Living snow fences should, where possible, extend at least 50 feet beyond the snow drift problem area.

Consider ordering 20 percent more trees than needed for the windbreak for replacement stock since some mortality is normal with bare rooted stock.

- If a drip irrigation system is installed, place on top of the weed barrier for ease of maintenance.

If bedding (raised beds) is necessary to provide surface drainage to the windbreak it should be completed in the fall prior to spring planting.

Consider the effects of snowdrift and distribution adjacent to windbreaks, which will cause a local increase in surface or groundwater.

Consider using plant species tolerant of salt spray near roads and highways that are deiced in the winter with salt. See NRCS Plant Data Center web site for appropriate species.

Consider using a support stake when planting container trees and balled and burlapped stock.

To provide habitat for nesting songbirds consider establishment of a shelterbelt >1.5 acres in size and >115 feet wide

## **PLANS AND SPECIFICATIONS**

Plans and specifications for planting field windbreaks will be prepared for each site in accordance with the criteria for this practice. The plan will include, at a minimum, the number of plants needed for the windbreak by species, location, row spacing, in row plant spacing, and applicable set back distances from road, structures, etc.

## **OPERATION AND MAINTENANCE**

When using smaller spacing provide a detailed O&M plan to restore or enhance the longevity or the original planned function. See IN FOTG standard (650) Windbreak Renovation.

Water seedlings, as needed, during first growing season.

Replace trees and shrubs as needed.

Use fence, if necessary, to protect the windbreak from excessive livestock browsing and trampling damage. Refer to IN FOTG Standards (472) Access Control and (382) Fence.

Protect woody plants from disease, rodents, deer, and insects using approved pesticides, repellents, tree shelters, hunting, fencing, or other appropriate methods.

Control weed competition during establishment (3 years). Competing weeds, brush, and vines can adversely affect survival, form and rate of tree growth. Additional years of weed control may be needed in some instances e.g. to control johnsongrass, quackgrass, or other hard to control weed species.

Use the following or combination of methods as needed to control weed competition:

- shallow cultivation
- spraying approved herbicides
- cutting woody plants and applying approved pesticides
- mowing can damage trees and result in increased grass vigor, and is therefore not an acceptable method for weed control to improve tree growth, but may be suitable for controlling un-wanted weeds within the planting.

Windbreak trees and shrubs must be protected from barnyard and feedlot runoff water.

Protect trees and shrubs from pesticide drift and from fire.

**REFERENCES**

*Silvics of North America, Volume 1, Conifers.* USDA, Forest Service, Agriculture Handbook 654, December 1990.

*Silvics of North America, Volume 2, Hardwoods.* USDA, Forest Service, Agriculture Handbook 654, December 1990.

*Benefits Associated with Feedlots and Livestock Windbreaks.* MNTC Technical Note Series No. 190-LI-1. June 1983, USDA-NRCS.

*Enhancing the Wildlife Values Associated with Windbreaks.* MNTC Technical Note: Series No. 190-LI-4 arch 1984, USDA-NRCS.

*American Standard for Nursery Stock.* ANSI Z60.1-1973, American Association of Nurserymen,

*Right Tree-Right Place, White Pine and Salt Tolerance,* Purdue University, Forestry and Natural Resources, FNR-FAQ-10-W

*Roadside De-Icing Salts and Ornamental Plants,* Purdue University, Department of Horticulture, HO-142-W

*Urban and Community Forestry, A Guide for the Northeast and Midwest United States,* U.S. Forest Service, Northeastern Area, State and Private Forestry

*Forestry Handbook,* Society of American Foresters, 2<sup>nd</sup> Edition, 1984

*How Windbreaks Work,* University of Nebraska, Extension 91-1763-B, 1991.