Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

WINDBREAK-SHELTERBELT ESTABLISHMENT AND RENOVATION

CODE 380

(ft)

DEFINITION

Establishing, enhancing, or renovating windbreaks, also known as shelterbelts, which are single or multiple rows of trees and/or shrubs in linear or curvilinear configurations.

PURPOSE

Use this practice to accomplish one or more of the following purposes:

- Reduce soil erosion from wind
- Enhance plant health and productivity by protecting plants from wind-related damage
- Manage snow distribution to improve moisture utilization by plants
- Manage snow distribution to reduce obstacles, ponding, and flooding that impacts other resources, animals, structures, and humans
- Improve moisture management by reducing transpiration and evaporation losses and improving irrigation efficiency
- Provide shelter from wind, snow, and excessive heat, to protect animals, structures, and humans
- Improve air quality by intercepting airborne particulate matter, chemicals, and odors, and/or by reducing airflow across contaminant or dust sources
- Reduce energy use in heating and cooling buildings, and in relocating snow
- Increase carbon storage in biomass and soils

CONDITIONS WHERE PRACTICE APPLIES

On all lands except forest land, apply this practice to establish, enhance, or renovate windbreaks where rows of woody plants are desired and suited for the intended purposes.

Apply this practice to any existing windbreaks that are no longer functioning properly for the intended purpose, or where renovation can extend the functional life of a windbreak.

CRITERIA

General Criteria Applicable to All Purposes

Plan, design, install, enhance, and renovate windbreaks to comply with applicable Federal, State, and local laws and regulations. Locate and design windbreak plantings to achieve functionality for their intended purposes within 20 years from the time of establishment.

Design windbreak dimensions and configurations to address site conditions. The protected zone on the leeward side of a windbreak is 10 times the maximum design height (H) of the tallest row of trees or shrubs at age 20. Adjust H estimates based on site productivity. Use species and setback distances that allow for the expected mature windbreak size to mitigate potential negative impacts of shading, visibility along travel routes, snow deposition, or concerns for visual quality. Windbreak length must be adequate to protect the site and allow for "end effect" (turbulence effects at the end of a windbreak) and minor changes in predominant wind direction.

Select tree and/or shrub species that are adapted to soils, climate, and other site conditions. Do not use species that are on Federal or State invasive species or noxious weed lists. Space individual plants based on the growing area needed by each species, with accommodation for maintenance equipment and for the desired configuration of the stems, branches, and canopy to achieve windbreak purposes. Do not plant trees or shrubs where they will interfere with above or belowground structures, utilities, irrigation or moisture management systems, or desired drains. Permit the periodic removal of some products, such as high value trees, medicinal herbs, nuts, fruits, etc., provided the loss of vegetation or harvesting disturbance does not compromise the conservation purpose.

Use the following NRCS Conservation Practice Standards (CPSs) as needed to establish windbreaks:

- Tree/Shrub Site Preparation (Code 490) for preparing the site prior to plant establishment
- Tree/Shrub Establishment (Code 612) when establishing trees and/or shrubs
- Irrigation System, Microirrigation (Code 441) for supplemental water

Additional Criteria to Reduce Wind Erosion and Protect Growing Plants

Determine the appropriate interval between windbreaks using current soil erosion prediction technology to minimize wind erosion. Interval widths must not exceed that permitted by the soil loss tolerance (T) or other planned soil loss objective. Account for the effects of other practices used in the conservation management system when calculating interval widths. Design windbreaks with adequate height to protect the desired area. The protected zone is 10H on the leeward side and 2H on the windward side. Orient a windbreak perpendicular to the wind direction(s) that causes the resource concern or as nearly perpendicular as practical. Select species for planting that are taller than the height of the crop.

Additional Criteria to Manage Snow Deposition

Orient the windbreak as close to perpendicular to the predominant snow-bearing wind as practical. Locate windbreaks so that snow deposition will not pose a health or safety problem, management constraint, or obstruct human, animal, or vehicular traffic. Windbreak density during expected snow-producing months must be at least 50 percent.

Where it is desirable for wind to blow snow off road surfaces and limit ice formation, design windbreaks using greater setback distances and allow for maximum mature windbreak height as well as 20-year height.

Where soil erosion and/or runoff from melting snow can be a hazard, control it by adjusting the siting of new windbreaks prior to establishment or by using appropriate supporting practices.

Additional Criteria for Managing Snow Distribution

For managing snow distribution across a field, windbreak density during expected snow-producing months should be 25 to 50 percent. The interval between windbreaks should not exceed 20H.

Additional Criteria to Provide Shelter for Animals, Structures, and Humans

Use windbreaks as needed to provide shade and reduce wind or snow impacts to animals, structures, and humans, or to reduce energy use. Where feasible, plant native species that benefit wildlife, including pollinators and natural enemies of crop pests.

The density for windbreaks that protect animals from cold and wind must be at least 65 percent during the months when the wind is most responsible for the resource concern. Design and maintain shade-producing windbreaks at a low density as needed to allow for air movement.

Prevent snowmelt drainage from a windbreak from flowing across an area of animal confinement. Prevent drainage of animal waste into a windbreak.

Additional Criteria to Improve Air Quality by Reducing and Intercepting Airborne Particulate Matter, Chemicals, and Odors

Design windbreak intervals to be less than or equal to 10H depending on site conditions and related supporting conservation practices. Design windbreak density on the windward side of the problem source (i.e., particulate, chemical, or odor) to be greater than 50 percent to reduce airflow into the source area.

Locate odor-protecting windbreaks of 50 to 65 percent density on the leeward side of the problem source, and windward side of the area that needs protection, to both decrease wind speed and encourage odor particle deposition and create wind turbulence that disperses and dilutes odor particles.

Use tree and shrub species with foliar and structural characteristics that optimize interception, adsorption, and absorption of airborne particles, chemicals, or odors. Coniferous evergreen trees and/or shrubs are generally preferred. Select windbreak species that are tolerant of identified spray drift and other pollutants to the extent that these impacts are predictable.

Windbreaks can help USDA certified-organic and transitioning-to-organic producers meet National Organic Program requirements for suitable buffers or barriers between certified organic production areas and nonorganic production areas on the same farm or neighboring farms that utilize National Organic Program prohibited substances.

Additional Criteria to Reduce Energy Use in Structures

Design windbreaks to address heating and cooling needs of structures as needed for the local climate. Use plants with a potential height growth taller than the structure or facility that needs protection and with a plant density that meets energy reduction needs. To reduce heat loss in structures, design windbreak intervals to be no more than 5H and with density greater than 50 percent on the windward side.

In areas where snow drifting is a common problem, ensure that windbreak setbacks are adequate to limit snow deposition in areas near structures to limit energy used to mechanically move snow.

Ensure that summer windbreak densities are low enough that they do not stifle cooling breezes. Note the direction of seasonal winds and design accordingly.

Additional Criteria for Carbon Capture and Storage

Plant windbreaks with a larger footprint to increase carbon capture and storage in biomass and soils. Where practical, while meeting the primary objective of the windbreak, adjust plant spacing and species selection to increase above and belowground productivity for increased carbon capture and storage.

Maintain site fertility. Minimize soil disturbance during windbreak establishment, maintenance, and renovation. Manage without tillage, where possible, to reduce impacts on soil organic matter. Limit the use of petroleum-based herbicides and fertilizers.

Models that predict carbon storage in biomass over time are useful when selecting trees and shrubs for greenhouse gas mitigation.

Additional Criteria for Windbreak Renovation

Renovate windbreaks by planning and implementing treatments to adjust the design, width, length, species composition, and density to achieve functionality for the intended purposes within 20 years from the time of establishment. Protect desirable vegetation as well as soil and site conditions during renovation. Control erosion, runoff, compaction, and displacement.

Thin trees and/or shrubs as needed to reduce plant competition, alter windbreak density, remove dead, injured or diseased vegetation, or provide access for maintenance. Use NRCS CPS Tree/Shrub Pruning

(Code 660) for branch or root pruning. Remove entire or partial rows of trees and/or shrubs to release trees in adjacent rows. Cut trees and/or shrubs that regrow from their base (i.e., coppicing) close to the ground when vigorous regrowth is desired.

Retain vegetative residues onsite except where fire hazard or threats from diseases and insect pests are of concern or where prescribed burning will take place to meet other management objectives. Use NRCS CPS Woody Residue Treatment (Code 384) to treat woody debris as necessary to assure that it does not present an unacceptable fire, safety, environmental, or pest hazard. Place remaining woody material so that it does not interfere with the intended purpose or other management activities. When woody residue or other debris requires onsite burning, use NRCS CPS Prescribed Burning (Code 338).

Add rows of trees and/or shrubs adjacent to or within an existing windbreak to increase windbreak density as needed to achieve the purpose. Plant individual trees and/or shrubs to fill gaps or replace declining plants. Before adding trees or shrubs, evaluate existing growing space, shade level, and root competition to determine that conditions are acceptable for the growth of new plantings.

Where herbicide application will occur, evaluate and interpret risks using the Windows Pesticide Screening Tool (WIN-PST) or other approved tools or guides, or use NRCS CPS Pest Management Conservation System (Code 595).

CONSIDERATIONS

Considerations for Species Selection

Plan and design windbreaks to be visually pleasing while meeting the purposes for the planned area. Design plantings to complement natural landscape features. Consider including trees and shrubs that produce edible fruits and nuts, provided that windbreak function is not impacted. Visual quality can be enhanced by using evergreen species or species with features such as showy flowers, brilliant fall foliage, or persistent colorful fruits. Avoid using potentially invasive species.

In cropping systems, select windbreak species that minimize adverse effects on crop growth (e.g., shade, allelopathy, competing root systems, or root sprouts). Avoid using plants that may be alternate hosts to undesirable pests. Consider species diversity (ideally, genus-level diversity), including the use of native species, to avoid loss of function due to species-specific pests.

Use deciduous trees on south and west sides of structures to reduce summer energy use. Use conifer windbreaks to reduce impacts of prevailing winter winds and reduce energy use.

Considerations for Windbreak Design

Windbreaks are not usually fully functional immediately after installation. Plan other practices as appropriate to control wind erosion in adjacent fields until a windbreak is fully functional.

Use one or more “legs” (i.e., windbreak extensions oriented at right angles to the main windbreak), where practical, to provide protection from changing winds and to increase the area of the protected zone.

Windbreaks established for odor and chemical drift reduction are more effective as the amount of foliage surface area increases. Wide, multiple-row plantings offer greater interception potential than smaller plantings.

Windbreaks may sometimes delineate field boundaries.

Considerations for Managing Snow

Consider additional actions for situations where a windbreak alone does not provide enough snow storage. Add windbreak rows or obtain supplementary storage with temporary or herbaceous wind barriers, constructed or living snow fences, or by retaining standing crop residues within the fetch (storage) area. Retain standing crop residues to enhance the effectiveness of windbreaks in uniformly distributing snow across a field.

To control end drifts, extend the length of the windbreak beyond the protected area, add supplemental windbreak legs, use greater setback distances, and/or use temporary or herbaceous wind barriers.

Secondary windbreaks made up of shorter tree species can be used to address snow control when winds come from directions different than the prevailing wind.

Considerations for Wildlife Habitat

When compatible with the purposes and criteria for application of this practice, modify windbreak design to better address identified wildlife needs. Windbreak dimensions, density, and species composition can be designed to provide food and/or shelter for desired wildlife species, and windbreaks can be located as wildlife travel corridors to connect existing patches of habitat. Consider windbreak proximity to roads and potential conflicts between wildlife and vehicles.

Address pollinator and beneficial organism needs when selecting or siting tree or shrub species and when planning windbreak management. Ground-dwelling pollinators may find habitat in an untilled area within the windbreak. Windbreaks may provide habitat for species that pollinate or consume pests in nearby crops. Early-blooming trees can provide nectar sources for pollinators and pest predators in the spring before herbaceous sources are available. Consider adding plantings of suitable, noncompetitive forbs and legumes that bloom at times when trees are not flowering; this action may favor a greater diversity of native pollinators and natural enemies of crop pests by providing additional nectar and pollen sources.

Considerations for Noise Screens

Noise screens should be designed for a density of at least 65 percent during the time of the year when noise is a problem. They should be as tall as the noise source and as close to the source as is practicable. Noise screen windbreaks should be two times as long as the distance from the noise source to the area needing protection.

For limiting noise from high-speed traffic, the windbreak width should be at least 65 feet. For moderate-speed traffic the windbreak width should be at least 20 feet wide. Select species tolerant of impacts including automobile emissions, sand and gravel deposition, and salt spray or runoff.

Considerations for Visual Screens

Visual screens should be located as close to the observer as possible with a density, height, and width that sufficiently blocks the view between the area of concern and the sensitive area.

Considerations for Windbreak Renovation

Windbreak renovations may require a period of years.

Where insect pests and plant diseases are not of concern, treat woody debris by mulching or chipping to increase soil organic matter and reduce herbaceous weed competition. Debris and other vegetation requiring removal during renovation could become biofuel for energy generation. Consider performing a life cycle analysis to determine whether there is a net energy gain after transport and processing.

PLANS AND SPECIFICATIONS

Prepare specifications for windbreak establishment and/or restoration in accordance with this standard for each site and purpose in the implementation requirements document. At a minimum, include—

- Maps, drawings, and/or narratives identifying and describing areas planned for windbreak establishment, including location and distances to adjacent features, structures, and known utilities.
- A planting plan, including—
  - Dimensions and configuration of plantings, including the number of rows of trees and/or shrubs and their spacing;
  - Species to use;

    - Type and size of plant material;
    - Planting or seeding rates;
    - Required survival density;
    - Site preparation, if any;
    - Season of planting;
    - Sequence of planting, if applicable;
    - Fertilizer and weed control, if needed;
    - Type of plant protection, if needed; and,
    - Moisture management during establishment, if needed.
- Contingency plans to achieve project goals in case of drought, insect/disease impacts, undesired plant invasions, animal pressure, or other occurrences that may limit vegetation establishment.
- The landowner is responsible for notifications and for obtaining all necessary permits for the project prior to installation.

OPERATION AND MAINTENANCE

Prepare an operation and maintenance (O&M) plan and review it with the landowner or operator prior to practice installation. The O&M plan ensures the practice will function as intended throughout its expected life. The plan will include normal repetitive activities that occur during use of the practice (operation), and repair and upkeep (maintenance). At a minimum, include—

- Inspecting the planting at least annually and after major storm events or other disturbances to identify needs for repair and maintenance.
- Maintaining protection for trees and/or shrubs during establishment, and removing protective structures (e.g., tube shelters, cages) when plants are large enough to withstand environmental stressors.
- Protecting trees and shrubs from adverse impacts including insects, diseases, competing vegetation, fire damage, spray drift, animals, etc.
- Applying maintenance practices and activities at times that minimize wildlife disturbance during the reproductive period for desired species, where wildlife habitat is a consideration.
- Monitoring tree or shrub establishment or renovation and replacing dead trees or shrubs as needed until the windbreak is functional.
- Providing supplemental water if needed during the establishment period.
- Managing competing vegetation during establishment.
- Thinning or pruning the windbreak to remove dead, injured, or diseased wood and to maintain windbreak function.
- Applying nutrients periodically to maintain plant vigor following approved fertilizer recommendations.

Renovate a windbreak that has lost its functionality due to impacts of storms, disease, insects, or other natural events, or because trees have reached their life expectancy and are deteriorating.

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