



United States Department of Agriculture

CORE 4 Conservation Practices



The Common Sense Approach to Natural Resource Conservation

- Conservation Tillage
- Nutrient Management
- Pest Management
- **CONSERVATION BUFFERS**



Helping People Help the Land

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Caribbean Area

Core 4 Conservation Practices

OBJECTIVES

- Know what conservation buffers are.
- Identify, define and describe the benefits of 10 conservation buffers and their components in the Caribbean Area.



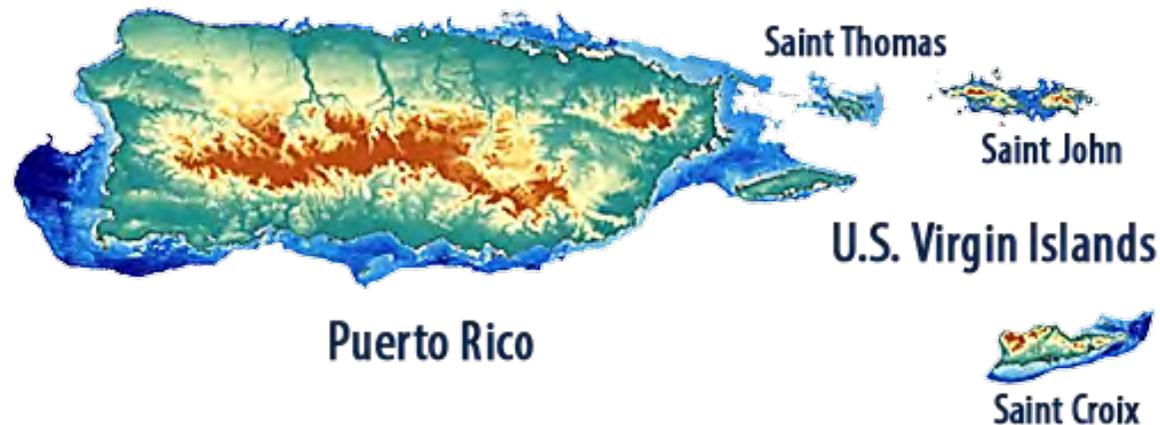


Natural Resources

- Soil
- Water
- Animals
- Plants
- Air
- Energy
- Humans

CARIBBEAN AREA FACTS

- Vulnerable coastal and marine resources.
- Land near the ocean, coastal areas, hillsides and mountains are subject to intense development pressures and a long history of deforestation. (For 2015 the Population Density: PR 1,046 mi², USVI 799 mi²), 3rd and 7th position respectively after DC 11,011 mi²).
- High-intensity storms (hurricanes) that are more likely to deliver water faster than it can be absorbed by the soil, resulting in widespread runoff and erosion.
- Land is scarce in the Caribbean, particularly flat and gently sloping land for all uses including agriculture.



Sources:
. gsa.gov

https://en.wikipedia.org/wiki/List_of_states_and_territories_of_the_United_States_by_population_density



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What are conservation buffers?

Vegetated strips of land strategically designed and applied in a field or adjacent to stream channels, coastal waters, or other areas.

Intent of conservation buffers. What do they do?

Decrease the velocity and erosive potential of wind and runoff water and to filter out sediments. Buffer strips provide additional environmental benefits including stream temperature maintenance and the protection of biologically valuable habitat.



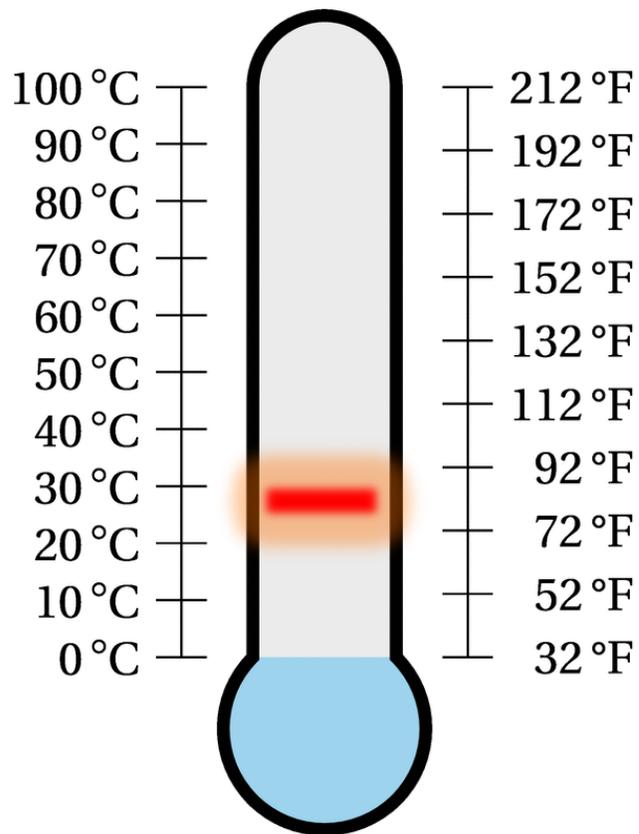
How conservation buffers help soil health?

Summary: Principles of soil health

- Always keep the soil covered
- Maximize the living roots in the soil profile all year round
- Minimize soil disturbance
- Energize the system with biodiversity



How conservation buffers help soil health?



When the soil temperature rises to:

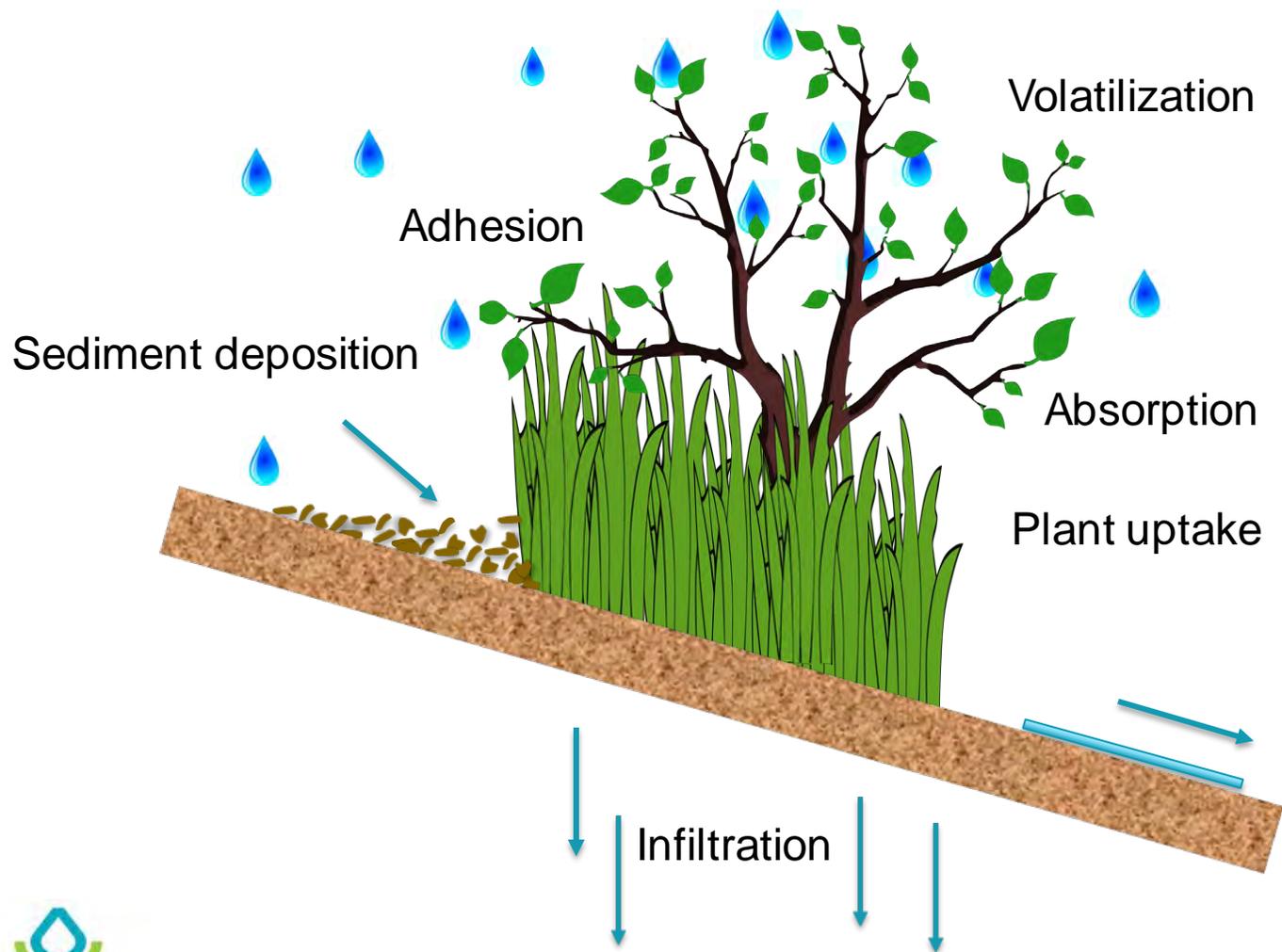
- ✓ 140 °F, soil bacteria die.
- ✓ 130 °F, 100% of moisture is lost by evaporation and transpiration.
- ✓ 100 °F, 15% of the humidity is used for growth and 85% is lost by evaporation and transpiration.
- ✓ 70 °F, 100% of the humidity is used by plants for growth.

PR data: 17.5 °F difference between bare soil and covered soil. (Cotto Soil Series, Isabela)



Sources: USDA NRCS, Samuel Ríos, Manuel Matos: personal communication USDA NRCS. Oagles K. & Ramson, 2011. Economics of poor grazing management.

Trapping Mechanism of Conservation Buffers



Adhesion: action of adhering or bonding to a surface.

Absorption: incorporation of a substance in one state into another substance.

Infiltration: process by which water on the ground surface enters the soil.

Sediment deposition: conglomerate of materials, organic and inorganic, that can be carried away by water, and when suspended particles settle down to the bottom of a body of water.

Volatilization: The conversion of a solid or liquid into a gas.



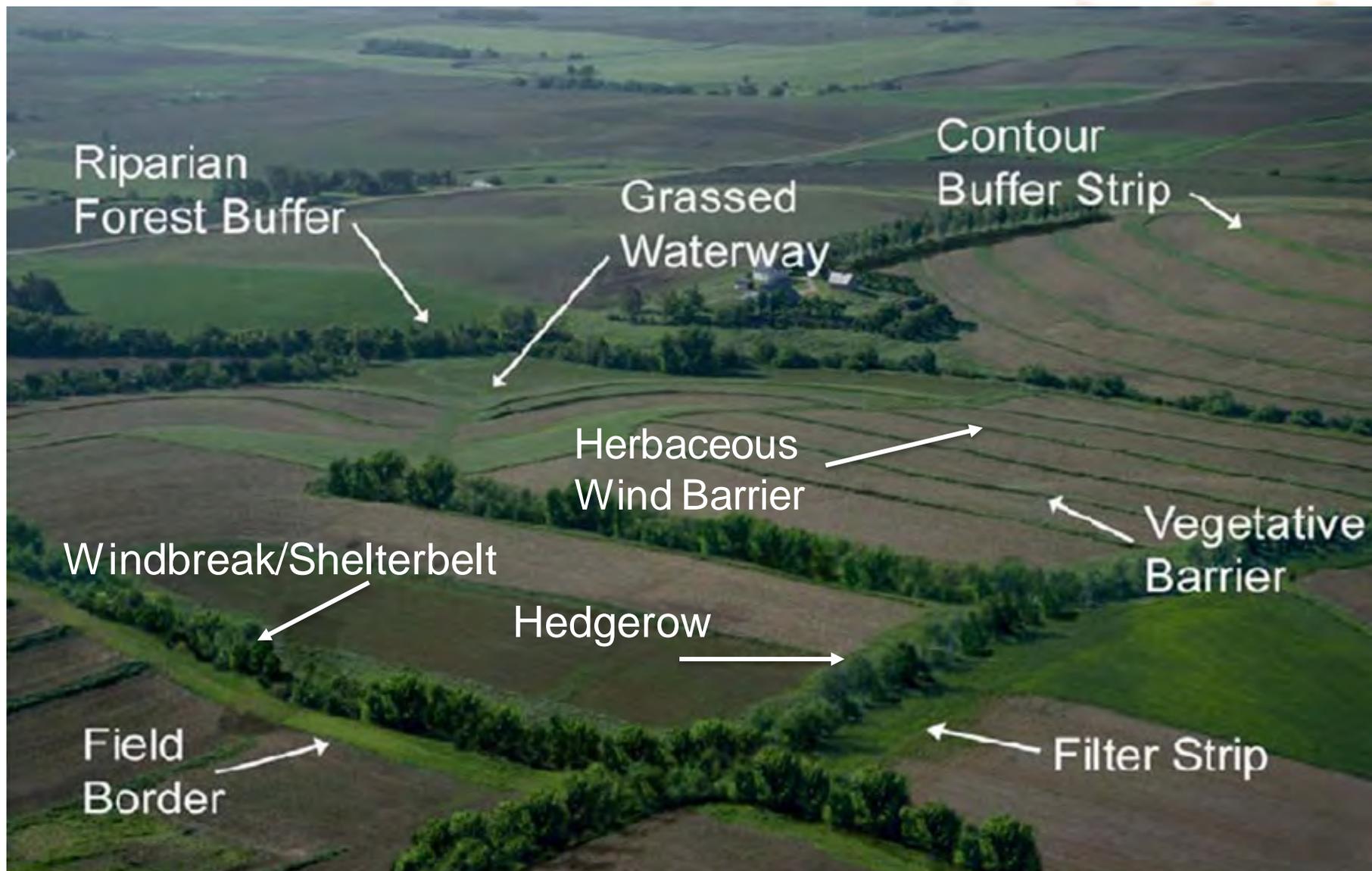


10 Conservation practices commonly thought of as buffers:

- Alley Cropping
- Contour Buffer Strip
- Field Border
- Filter Strip
- Grassed Waterway & Vegetative Filter

- Hedgerow Planting
- Herbaceous Wind Barrier
- Riparian Forest Buffer
- Vegetative Barrier
- Windbreak/Shelterbelt





When trees and shrubs are the dominant vegetative elements, the **conservation buffers** are called:

**Agroforestry
Practices**



Agroforestry is the [intentional combination of agriculture and forestry](#) to create integrated and sustainable land-use systems.



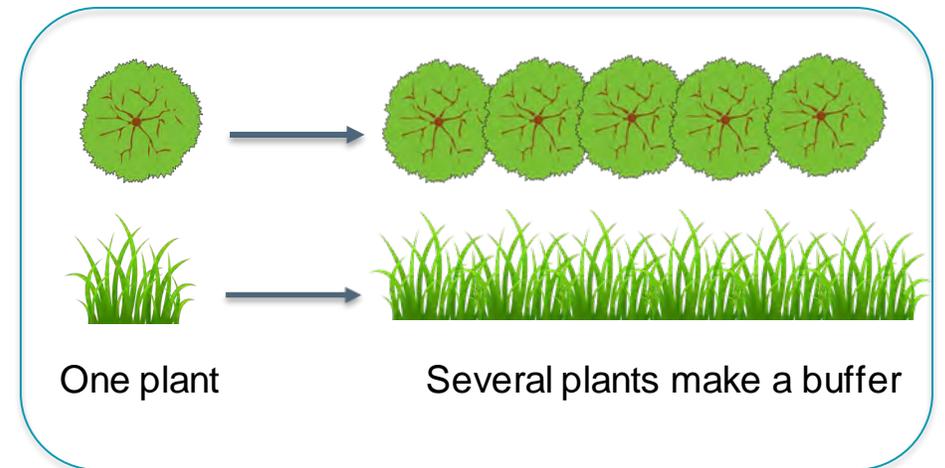
Agroforestry practices include:

- Alley Cropping
- Hedgerow Planting
- Multistory Cropping
- Riparian Forest Buffers
- Silvopasture
- Windbreak/Shelterbelt Establishment

Conservation Buffers Supporting Practices:

Are conservation practices that may help to **create vegetated strips** on land.

- Tree and Shrub Establishment (Code 612)
- Forage and Biomass Planting (512)
- Tree/Shrub Site Preparation (Code 490)
- Tree/Shrub Pruning (Code 660)
- Mulching (Code 484)
- Contour Farming (Code 330)
- Contour Orchard and Other Perennial Crops (Code 331)





Functions of conservation buffers

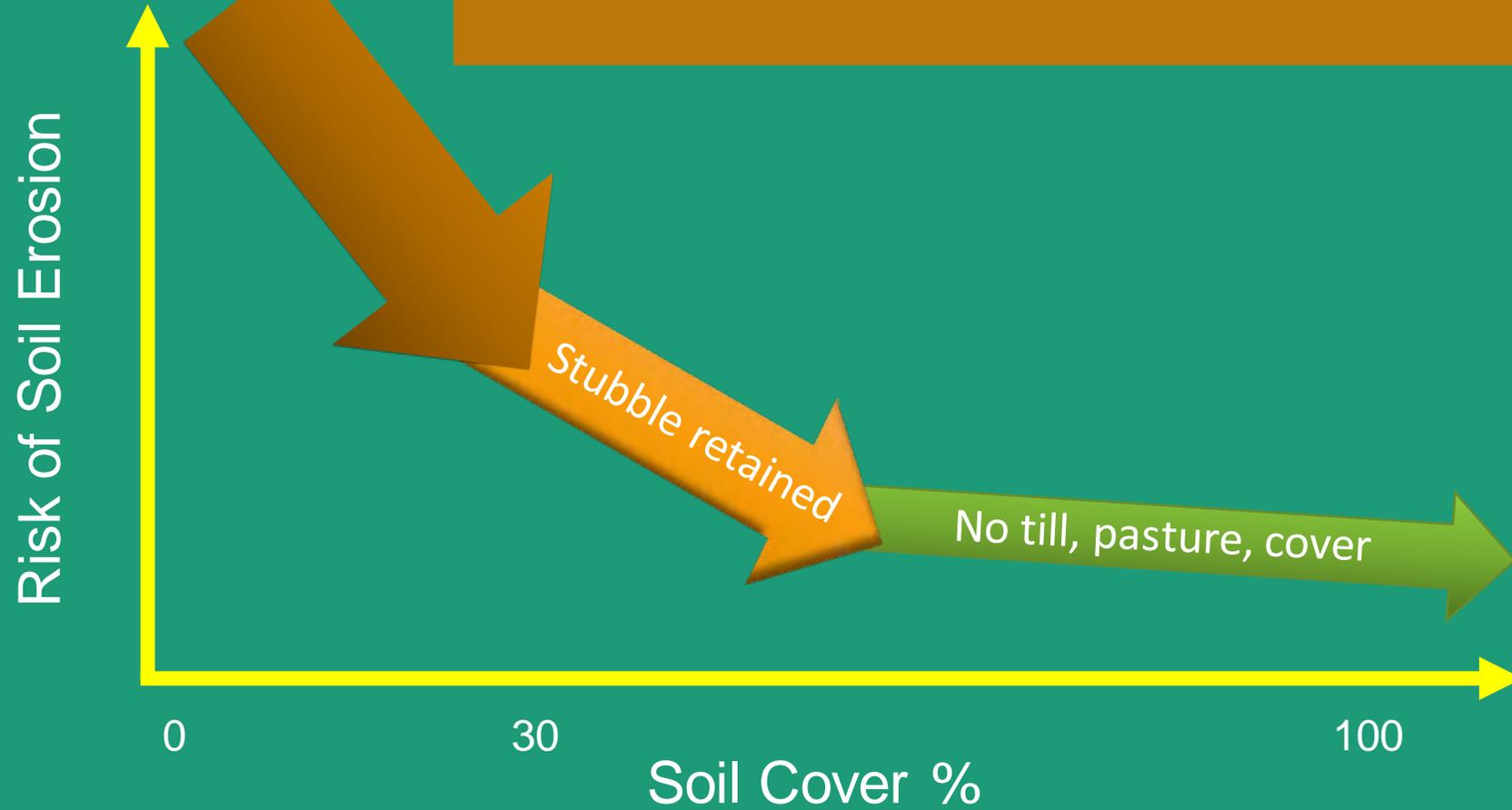
A Common Sense Approach

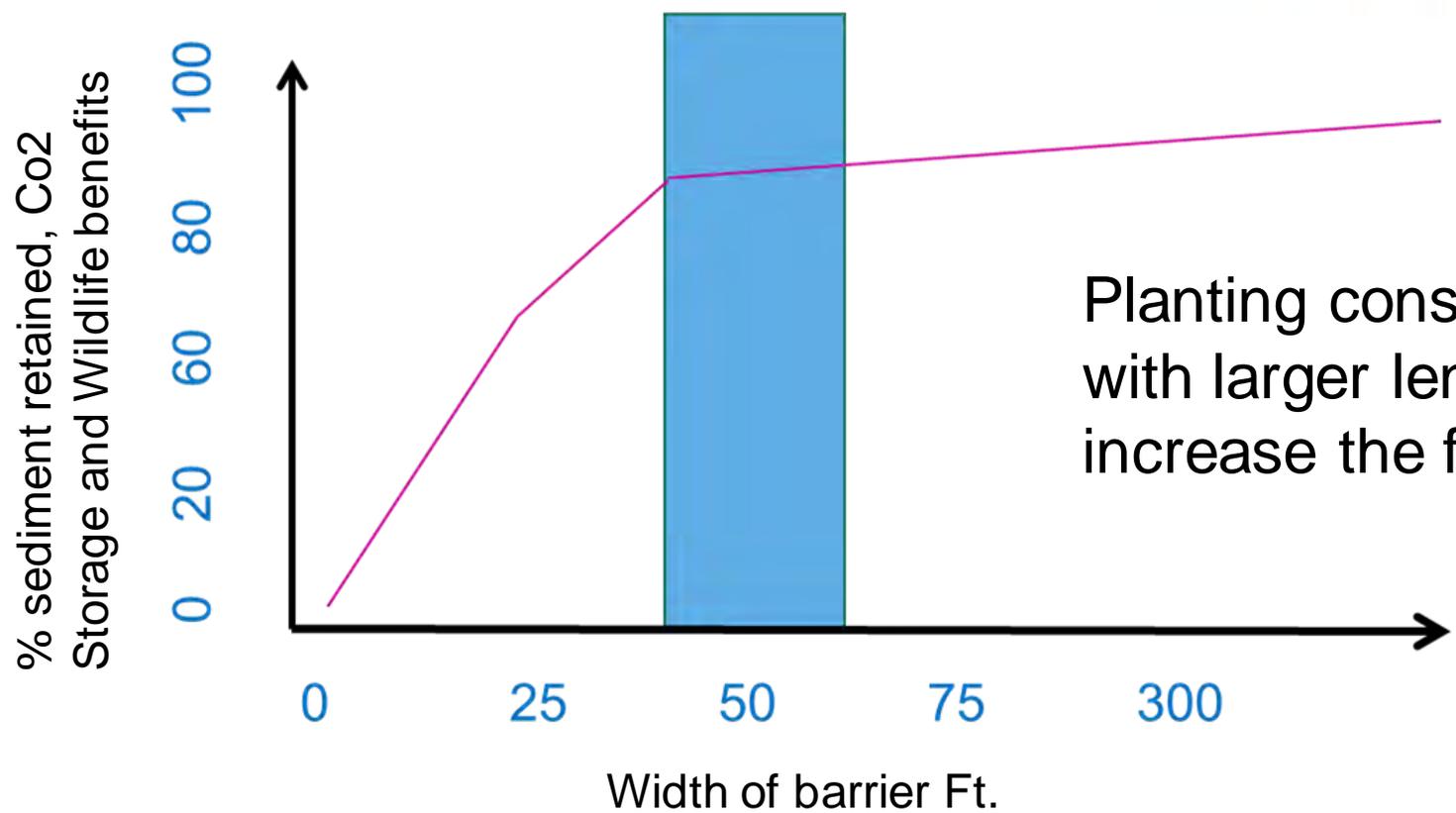
Natural Resources Conservation Service

nrcs.usda.gov/



Cover vs. soil erosion





Planting conservation buffers with larger length and width will increase the filtering capacity.

Sources:

- . Conservation Buffers. USDA. NEDC. 2015
- . ITCF (Institut Technique des Céréales et des Fourrages) France. 1993-1995.
- . Ramírez-Avila, John J. , Sotomayor-Ramírez, David R. , Martínez-Rodríguez, Gustavo A. , Más, Edwin G. , Ortega-Achury, Sandra L. , 2009. American Society of Agricultural and Biological Engineers. Meeting. Grass filter strips evaluation for reducing sediment and nutrient exportation from grasslands under manure applications in Puerto Rico.

Water erosion equation (RUSLE):

$$A = R * K * LS * C * P$$

P = P is the support practice factor. Accounts for the effect of conservation support practices, such as buffer strips on soil erosion.

Wind Erosion Equation (WEQ):

$$E = f(I * K * C * L * V)$$

V = V is the vegetative cover factor. It accounts for the kind, amount, and orientation of growing plants or plant residue on the soil surface.

<https://www.law.cornell.edu/cfr/text/7/610.12> § 610.12 Equations for predicting soil loss due to water erosion.
<https://www.law.cornell.edu/cfr/text/7/610.13> § 610.13 Equations for predicting soil loss due to wind erosion.



Examples: (RUSLE) Bare ground vs Vetiver grass barriers added

Profile: default*

STEP 1: Choose location to set climate: Location

STEP 2: Choose soil type: Soil

STEP 3: Set slope topography: Slope length (along slope), ft Avg. slope steepness, % Rock cover, %

STEP 4a: Select base management: Base management

STEP 4c: adjust management inputs if desired: Adjust yields open Adjust ext. res. addition open Contouring a. rows up-and-down hill
General yield level

Soil loss for cons. plan, t/ac/yr Avg. ann. total biomass removal, lb/
Soil loss for cons. plan DK? Sediment delivery, t/ac/yr Surf. res. cov. values open
T value, t/ac/yr Avg. forage age, days Soil conditioning index open
SCI value OK?

Crop year results open Total shortfall, lb/ac

Net event runoff, in/yr

Nitrogen leaching index open

Harvest Period Outputs								
Num.	Start date, m/d/yr	Length removal, days	Length rest, days	Harvest, lb/ac	Avg. harv. rate, lb/ac/day	Live portion, fraction	Age, days	Shortfall, lb/ac
1								

Profile: default*

STEP 1: Choose location to set climate: Location

STEP 2: Choose soil type: Soil

STEP 3: Set slope topography: Slope length (along slope), ft Avg. slope steepness, % Rock cover, %

STEP 4a: Select base management: Base management

STEP 4c: adjust management inputs if desired: Adjust yields open Adjust ext. res. addition open Contouring c. perfect contouring no row grade
General yield level

Soil loss for cons. plan, t/ac/yr Avg. ann. total biomass removal, lb/
Soil loss for cons. plan DK? Sediment delivery, t/ac/yr Surf. res. cov. values open
T value, t/ac/yr Avg. forage age, days Soil conditioning index open
SCI value OK?

Crop year results open Total shortfall, lb/ac

Net event runoff, in/yr

Nitrogen leaching index open

Harvest Period Outputs								
Num.	Start date, m/d/yr	Length removal, days	Length rest, days	Harvest, lb/ac	Avg. harv. rate, lb/ac/day	Live portion, fraction	Age, days	Shortfall, lb/ac
1								



FOR ALL CONSERVATION BUFFERS GENERAL WILDLIFE CONSIDERATIONS

- Consider species that provide fodder and shelter for most wildlife.
- Select species that enhance habitat for beneficial insects including pollinators.
- Generally, wider corridors accommodate more wildlife use and linking fragmented habitats may increase wildlife use of an area.
- Buffer management must be conducted to avoid mating and nesting seasons.
- Buffers containing a mixture of native vegetation and multiple structural levels provide greatest environmental benefits to wildlife.
- Reducing incidence of solar radiation on watercourses through shading.



FOR ALL CONSERVATION BUFFERS GENERAL CONSIDERATIONS



- Select according to and applicable to a resource concern and client objectives.
- Permanent vegetation (not necessarily perennial but permanent).
- Adapted to soil, climate, management system.
- Higher vegetative density better performance.



FOR ALL CONSERVATION BUFFERS GENERAL CONSIDERATIONS

- Preserve and protect on site desirable vegetation.
- Minimize soil disturbance through use of no-till/reduce till methods.
- Reestablish or replace plant materials as needed.
- Select for foliage and color of flowers.



FOR ALL CONSERVATION BUFFERS GENERAL CONSIDERATIONS



- Species shall be selected that do not host pests or diseases that could pose a risk to nearby crops/people.
- Choose appropriate planting dates, handling and planting methods to increase rates of survival.
- Consider allelopathic impacts of plants.



FOR ALL CONSERVATION BUFFERS GENERAL CONSIDERATIONS



- Establish plant species with morphological characteristics that optimize interception and adhesion of water and/or airborne particulates.
- Avoid planting trees or shrubs where they will interfere with structures and above or below ground utilities.
- Ability to recover from flooding and sediment deposition.

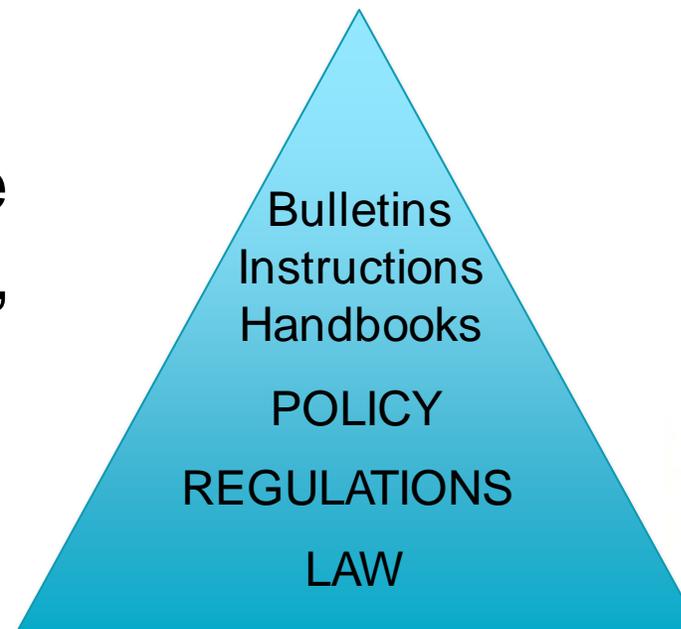


FOR ALL CONSERVATION BUFFERS GENERAL CONSIDERATIONS

- Follow cultural resource protection law before designs and applications.
- No plant listed federally or by the state as a noxious weed shall be established.



Laws are the base
for the regulations,
upon which the
policy is built.



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AUTHORITIES: NOXIOUS PLANTS

- National Environmental Policy Act of 1969.
- Federal Noxious Weed Act of 1974 ("FNWA", Pub. L. 93–629, 88 Stat. 2148)
- Executive Order 11987 - Exotic Organisms. May 24, 1977.
- Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990.
- Plant Protection Act of 2000 (7 U.S.C. 7701). Plant protection and noxious weed control and eradication.
- Executive Order 13751 - February 3, 1999. Safeguarding the Nation from the Impacts of Invasive Species.
- Executive Order 13112 - December 5, 2016.





Acts provide that: *“the detection, control, eradication, suppression, prevention, or retardation of the spread of plant pests or noxious weeds is necessary for the protection of the agriculture, environment, and economy of the United States”.*

- A noxious weed, harmful weed or injurious weed is a weed that has been designated by an agricultural authority as one that is injurious to agricultural or horticultural crops, natural habitats or ecosystems, or humans or livestock. Most noxious weeds have been introduced into an ecosystem by ignorance, mismanagement, or accident. Some noxious weeds are native.



Policy/Procedures (GM 190, Part 414)

- **NRCS employees are to incorporate identification and control of invasive species into the agency planning process.**
- **Additional roles of NRCS:**
 - Supportive of, and consistent with National Invasive Species Management Plan (NISMP)
<http://www.invasivespeciesinfo.gov/council/nmp.shtml>.
 - Consistent with laws.
 - Mindful of impacts of mitigation.
 - Early detection and rapid response.
 - Preference for native species but not exclusively.
 - Preparation of appropriate plans, technical notes, and guides.
- Importance of partnerships with all institutions, agencies, etc.



National Planning Handbook
National Environmental Compliance Handbook
<http://directives.sc.egov.usda.gov/>

When evaluating and planning, include at a minimum:

- Inventory (identification of species, amount, growth stage, etc.).
- Map of affected areas.
- Control and restoration (know the life cycle, alternative control techniques, implementation of safe and sustainable methods to prevent, evade, monitor and suppress noxious plants (i.e. Land Grant Universities, ARS, CIG, Plant Materials Centers, Industry).
- Environmental Evaluation CPA-52. (***Special Environmental Concerns***).



Introduced, Invasive, and Noxious Plants

<https://plants.usda.gov/java/noxious?rptType=Federal>



You are here: Home / Introduced, Invasive and Noxious Plants / Introduced, Invasive, and Noxious Plants Results

Introduced, Invasive, and Noxious Plants

NRCS Invasive Species Policy
Invasive Species Executive Order 13112

Federal Noxious Weeds

112 records returned

Click on an accepted name below to view its PLANTS Profile with more information, and web links if available. Noxious weeds that are synonyms retain their noxious status, and are indented beneath the current PLANTS accepted name.

USDA, Animal and Plant Health Inspection Service (APHIS), Plant Protection and Quarantine (PPQ). *State Plant Regulatory Officials letters* (). National Plant Board.

USDA, Animal and Plant Health Inspection Service (APHIS), Plant Protection and Quarantine (PPQ), 2012. *Federal noxious weed list* (1 February 2012). USDA, APHIS, PPQ.

Symbol	Scientific Name	Noxious Common Name	Federal Noxious Status†	Native Status*
AEGIN	<i>Aeginetia</i> L.		NW	
AGAD2	<i>Ageratina adenophora</i> (Spreng.) R.M. King & H. Rob.	crofton weed	NW	L48 (I), HI (I)
ALECT2	<i>Alectra</i> Thunb.		NW	(I)
ALSE4	<i>Alternanthera sessilis</i> (L.) R. Br. ex DC.	sessile joyweed	NW	(I), L48 (I), HI (I), PR (N), VI (N)
ASF12	<i>Asphodelus fistulosus</i> L.	onionweed	NW	L48 (I)
AVST	<i>Avena sterilis</i> L.	animated oat	NW	L48 (I), CAN (W)
AZPI	<i>Azolla pinnata</i> R. Br.	mosquito fern	NW	L48 (I)
CAOX6	<i>Carthamus oxyacanthus</i> M. Bieb.			L48 (I)
CAOX2	<i>Carthamus oxyacantha</i> M. Bieb., orth. var.	wild safflower	NW	
CATA5	<i>Caulerpa taxifolia</i> (Vahl) C. Agardh ¹		NW	L48 (I)
CHAC	<i>Chrysopogon aciculatus</i> (Retz.) Trin.	pilipiliula	NW	(N), L48 (I), HI (I)
COBE2	<i>Commelina benghalensis</i> L.	Benghal dayflower	NW	(I), L48 (I), HI (I), PR (I)
CRVU2	<i>Crupina vulgaris</i> Cass.	common crupina	NW	L48 (I)
CUSCU	<i>Cuscuta</i> L. ²	odder	NW	(I,N), L48 (I,N)
DIAB	<i>Digitaria abyssinica</i> (Hochst. ex A. Rich.) Stapf			HI (I)
DISC5	<i>Digitaria scalarum</i> (Schweinf.) Chiov.	African couch grass	NW	
DIVE2	<i>Digitaria velutina</i> (Forssk.) P. Beauv.	velvet fingergrass	NW	L48 (I)
DRAR7	<i>Drymaria arenarioides</i> Humb. & Bonpl. ex Schult. [excluded]	alfombrilla	NW	
EIAZ2	<i>Eichhornia azurea</i> (Sw.) Kunth	anchored waterhyacinth	NW	L48 (I), PR (I)
EMAU	<i>Emex australis</i> Steinh.	three-cornered jack	NW	L48 (I)
EMSP	<i>Emex spinosa</i> (L.) Campd.	devil's thorn	NW	L48 (I), HI (I)
GAOF	<i>Galega officinalis</i> L.	goatsrue	NW	L48 (I), CAN (I)

Search
Name Search

Scientific Name

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PLANTS Topics

- Alternative Crops
- Characteristics
- Classification
- Cover Crops
- Culturally Significant
- Distribution Update
- Documentation
- Fact Sheets & Plant Guides
- Introduced, Invasive, and Noxious Plants**
- Threatened & Endangered
- Wetland Indicator Status

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Related Tools

- Crop Nutrient Tool
- Ecological Site Information

Introduced, Invasive, and Noxious Plants



Scientific Name

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Related Tools

- Crop Nutrient Tool
- Ecological Site Information System
- PLANTS Identification Keys
- Plant Materials Web Site
- Plant Materials Publications
- USDA Plant Hardiness Map

Saccharum spontaneum L.
wild sugarcane

General Information	
Symbol:	SASP
Group:	Monocot
Family:	Poaceae
Duration:	Perennial
Growth Habit:	Graminoid
Native Status:	HI I PB N PR I

Data Source and Documentation

About our new maps

Symbol: SASP

USDA-NRCS-NGCE

Native Introduced Both Absent/Unreported
 Native, No County Data Introduced, No County Data Both, No County Data

Native Status:

L48 AK HI PR VI NAV CAN GL SPM NA



Saccharum spontaneum

Examples of Noxious Plants CB



1. Tropical apple soda
2. Neem
3. Catclaw mimosa
4. Sweet lime
5. Dumbcane
6. Venezuela grass
7. Twisted grass
8. Jaragua/giant thatching grass
9. Stink casha
10. Datura/prickly burr
11. Rubber vine
12. Day Cestrum/Jessamine
13. Asclepsias/red milkweed



Introduced, Invasive, and Noxious Plants

Cenchrus ciliaris
Buffel grass





AUTHORITIES: Threatened and Endangered Species

- Endangered Species Preservation Act of 1966
- Endangered Species Conservation Act 1969
- Endangered Species Act of 1973
- The Endangered Species Act of 1982
- 21st Century Endangered Species Transparency Act



Threatened & Endangered Plant Species



Threatened & Endangered

About PLANTS Threatened & Endangered

Protected Plants for All Scientific Names

US Virgin Islands

Symbol	Scientific Name	Common Name	Federal Protected Status*	State Protected Status*
BVVA	<i>Bursera vahlii</i> Baill.	Vahl's box	E	
CAAM14	<i>Callicarpa amplia</i> Schauer	caparosa	E	
CATH1	<i>Calyptranthes thomasi</i> Berg	Thomas' lidflower	E	
CAME19	<i>Catesbaea melanocarpa</i> Krug & Urb.	tropical lilythorn	E	
LEDR6	<i>Leptocarpus grandifolius</i> Britton	reburan	E	
PEVW2	<i>Piperomia whelanii</i> Britton	Whelan's peperomia	E	
STHO	<i>Stahliella monozeyma</i> (Tul.) Urb.	cobana negra	T	
ZATH	<i>Zanthoxylum thomasi</i> (Krug & Urb.) ex P. Wilson	St. Thomas pricklyash	E	

US Virgin Islands

Threatened & Endangered

About PLANTS Threatened & Endangered

Protected Plants for All Scientific Names

Puerto Rico

Symbol	Scientific Name	Common Name	Federal Protected Status*	State Protected Status*
ADVA1	<i>Adiantum viviparum</i> Presler	Puerto Rico maidenhair	E	PR (E)
ALAM5	<i>Alephila amara</i> Conant	forest alozaha	E	
CYDR2	<i>Cyathea dryopteroides</i> Maxon		E	PR (E)
ARCR4	<i>Arundinella olivacea</i> Hitchc.	Chaco's threesawn	E	PR (E)
ASPO3	<i>Anolis portoricensis</i> Steg.	patos del diablo	E	PR (E)
AUR42	<i>Asterandrium pauciflorum</i> Alain	turtletail	E	PR (E)
BAVA2	<i>Banana vanderbiltii</i> Urb.	Vanderbilt's palm de ramon	E	
BVVA	<i>Bursera vahlii</i> Baill.	Vahl's box	E	PR (E)
CAAM14	<i>Callicarpa amplia</i> Schauer	caparosa	E	PR (E)
CATH1	<i>Calyptranthes thomasi</i> Berg	Thomas' lidflower	E	PR (E)
CAE19	<i>Catesbaea melanocarpa</i> Krug & Urb.	Puerto Rico manna	T	
CAME19	<i>Catesbaea melanocarpa</i> Krug & Urb.	tropical lilythorn	E	
CHGLM2	<i>Chamaecrista glaniflora</i> (L.) Greene var. <i>mirabilis</i> (Pelland) Irwin & Barnaby	Jamaican broom	E	PR (E)
COBR3	<i>Conium maculatum</i> L.	serpentine monkshood	E	
COOB4	<i>Conium maculatum</i> L.	roque	E	PR (E)
CRS24	<i>Crucifera ricardii</i> Ackerman	Puerto Rico helmet orchid	E	PR (E)
CRPO6	<i>Crematosia aurantiocarpa</i> Britton	figueroa de vierte	E	PR (E)
DAHE2	<i>Daphnopsis helleriana</i> Urb.	Heller's cinnaquillo	E	PR (E)
ELSD2	<i>Elysiptrochium serjense</i> Maxon & Noel Holmgren	sereno de punta Jeyrick	E	PR (E)
ELJN4	<i>Euponia hawaiiensis</i> Alain	Louisville Mountain stopper	E	
EUW02	<i>Euponia woodburyana</i> Alain	Woodbury's stopper	E	
GERF3	<i>Generea pauciflora</i> Urb.	yerba manaca de cueva	T	
SOEL	<i>Guetzia elegans</i> Wylder	mata buya	E	PR (E)
WAP02	<i>Hemelia portoricensis</i> Britton	Puerto Rico applecress	T	

Puerto Rico

<https://plants.sc.egov.usda.gov/java/threat>



What are conservation buffers made of?

Tree, Shrub, Vine, Forb, Grass and Grass-like

Woody Plants

Herbaceous (non-woody) Plants



Tree

Large woody with secondary branches supported on a main stem.



Shrub/Bush

Smaller than tree, woody with multiple stems.



Vine

Herbaceous or woody, with climbing or twining stem.



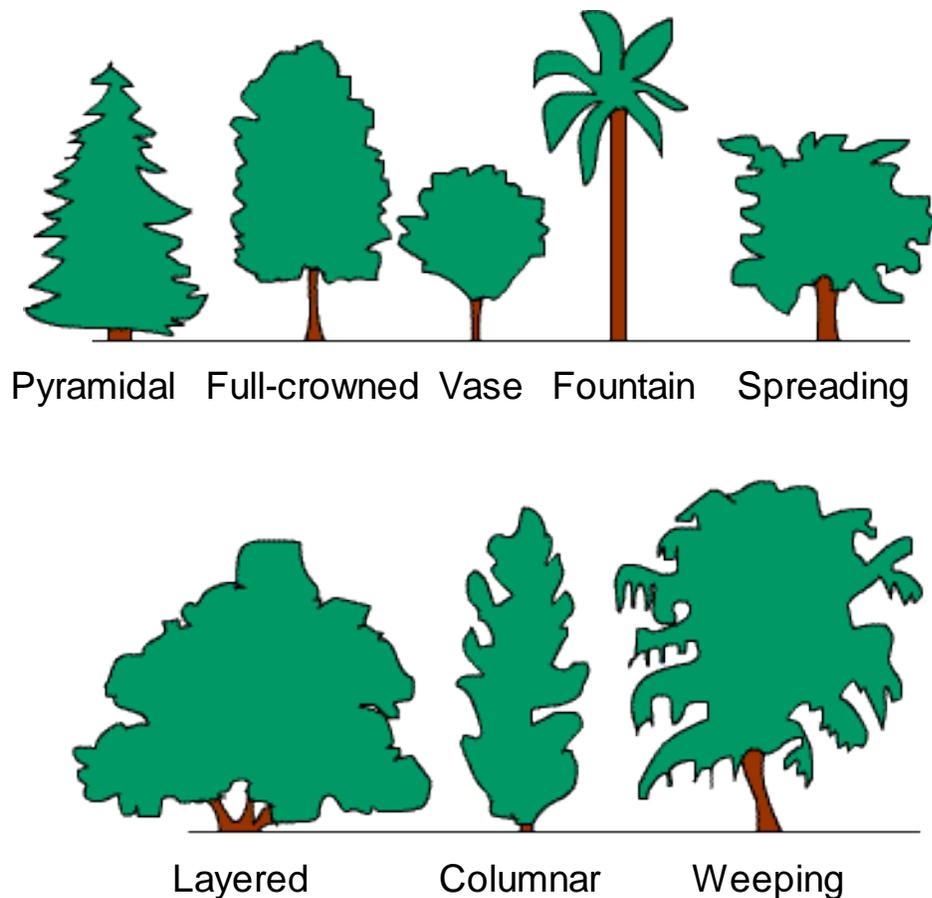
Forb

Herbaceous, broad-leaf often with showy flowers.



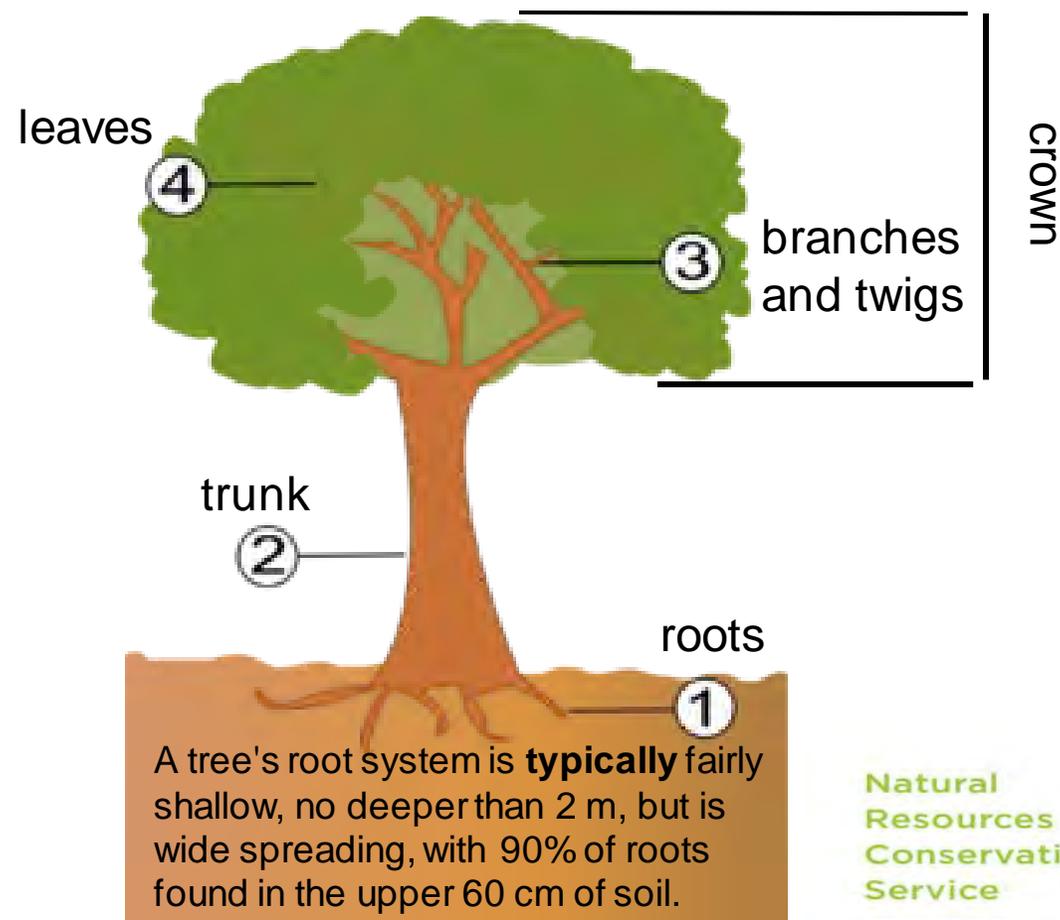
Grass and Grass-like

Herbaceous with slender leaves and inconspicuous flowers.



Tree: Large woody with secondary branches supported on a main stem.

Tree canopy and its attributes on species selection for buffers.

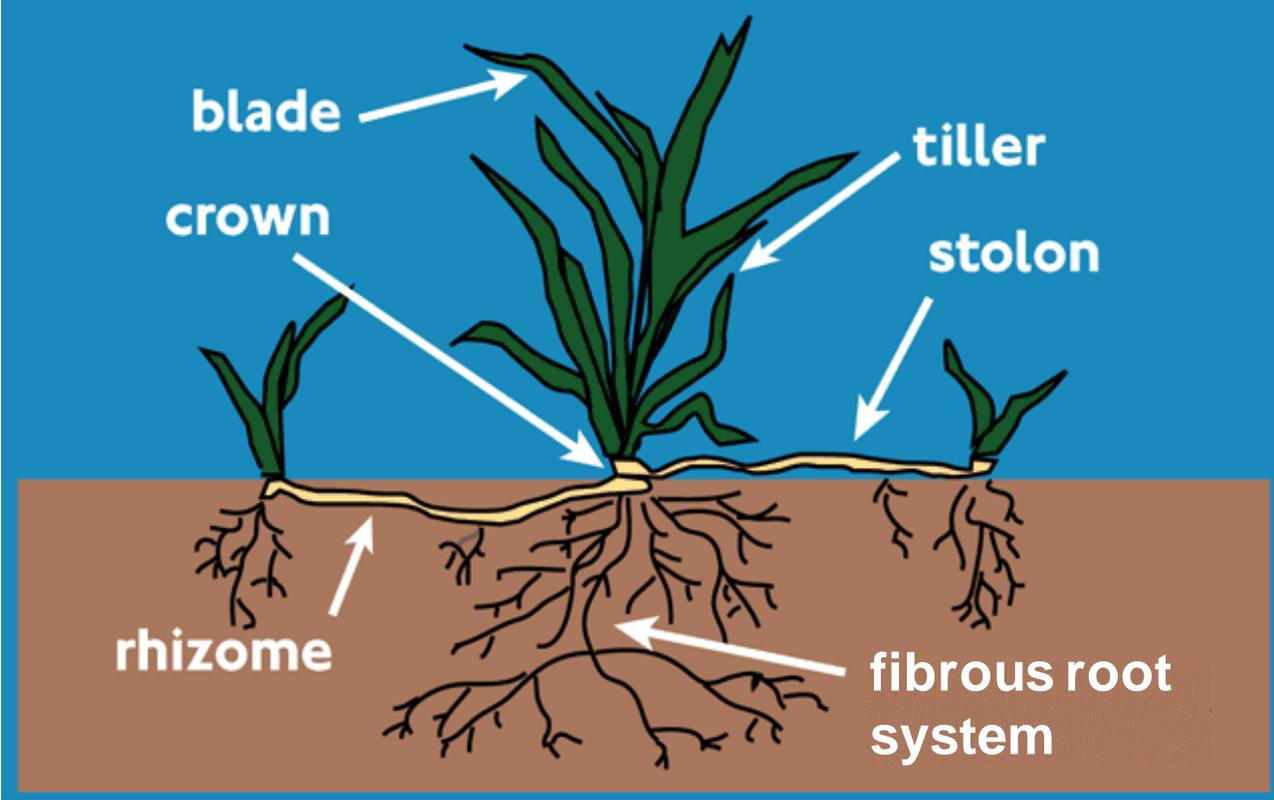


Structure of a Grass Plant



How grasses grow?

- Bunch
- Stoloniferous
- Rhizomatous





Some Recommended Species for Conservation Buffers in the Caribbean Area

Grasses	Technical name
Carpet grass	<i>Axonopus compressus</i>
Pangola grass	<i>Digitaria eriantha</i>
Kleberg/Pajón	<i>Dichanthium annuatum</i>
Carib grass/Malojilla	<i>Eriochloa polystachya</i>
Star grass	<i>Cynodon nlemfuensis</i>
Hurricane grass	<i>Bothriochloa pertusa</i>
Vetiver grass	<i>Chrysopogon zizanioides</i>

Tree/Shrub	Technical name
Black olive/Ucar	<i>Bucida buceras</i>
Fustic/Tachuelo	<i>Pictetia aculeata</i>
White oak/Roble nativo	<i>Tabebuia heterophylla</i>
María	<i>Calophyllum calaba</i>
Guazima	<i>Guazuma ulmifolia</i>
Emajaguilla	<i>Tespesia populnea</i>
Uva playera	<i>Cocoloba uvifera</i>
Palma real	<i>Roystonea borinquena</i>
Quick stick	<i>Gliricidia sepium</i>





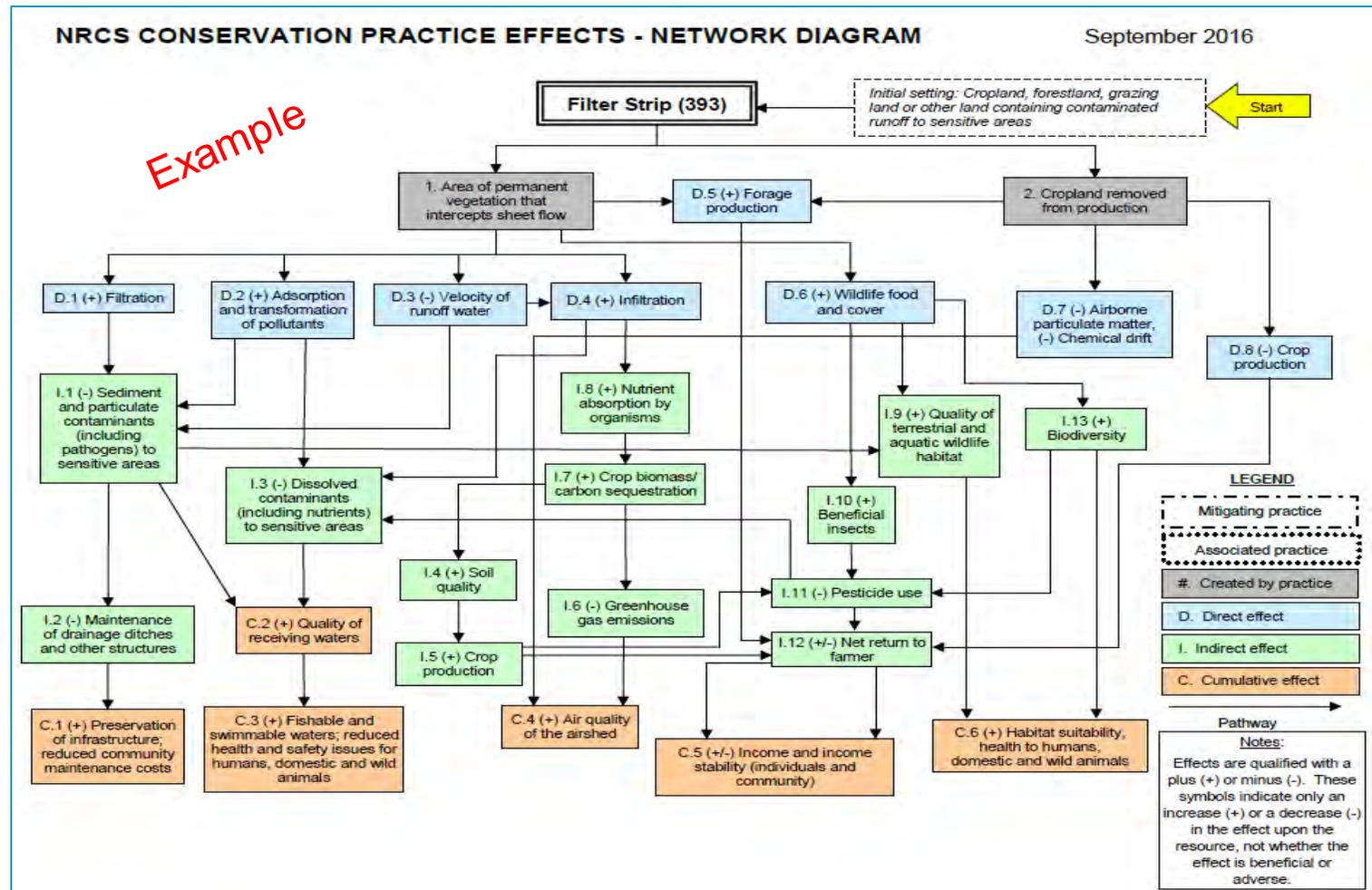
Conservation Buffers may be made of **same plant species** but the **name** may change depending on:

- **Land use:** Cropland, Grassland, Forestland,
All lands
- **Resource Concern/Purpose** - SWAPAEH
- **Plant species:** Growth habit
- **Orientation in the landscape:**
(Parallel, Perpendicular, Diagonal to the steep or resource)

CONSERVATION BUFFERS

eFOTG's

- Standards
- Specifications
- Conservation practice information sheets.
- Conservation Practice Physical Effects (CPPE) worksheets.
- Conservation practice job sheets.
- National templates for statements of work associated with each conservation practice.
- Network effects diagrams.



Alley Cropping

Code 311 (Cultivo en callejones)

DEFINITION

Trees or shrubs are planted in sets of single or multiple rows with agronomic, horticultural crops or forages produced in the alleys between the sets of woody plants that produce additional products.



St. Croix, USVI



Alley Cropping

PURPOSE

- Enhance microclimatic conditions to improve crop or forage quality and quantity.
- Reduce surface water runoff and erosion.
- Improve soil health by increasing utilization and cycling of nutrients.
- Alter subsurface water quantity or water table depths.
- Enhance wildlife and beneficial insect habitat.
- Increase crop diversity.
- Decrease offsite movement of nutrients or chemicals.
- Increase carbon storage in plant biomass and soils.
- Develop renewable energy systems.
- Improve air quality.





- Tree or shrub rows will be oriented on or near the contour to reduce water erosion.
- To reduce surface water runoff and erosion, herbaceous ground cover will be established.
- To reduce wind erosion, tree or shrub rows will be oriented as close as possible perpendicular to erosive winds.





The distance between the sets of trees or shrubs will be determined by:

- Tree or shrub management objectives.
- Light requirements and growth period of the crops or forages in the alleys.
- Erosion control needs.
- Machinery widths and turning areas.

Refer to:

- Tree/Shrub Site Preparation ()
- Tree/Shrub Establishment (Code 612)
- Conservation cover ()



Contour buffer strips

Code 332

(Franjas de amortiguamiento al contorno)

DEFINITION

Narrow strips of permanent, herbaceous vegetative cover established around the hill slope, and alternated down the slope with wider cropped strips that are farmed on the contour.





PURPOSE

This practice is applied to support one or more of the following purposes:

- Reduce sheet and rill erosion.
- Reduce water quality degradation from the transport of sediment and other water-borne contaminants downslope.
- Improve soil moisture management through increased water infiltration.
- Reduce water quality degradation from the transport of nutrients downslope.



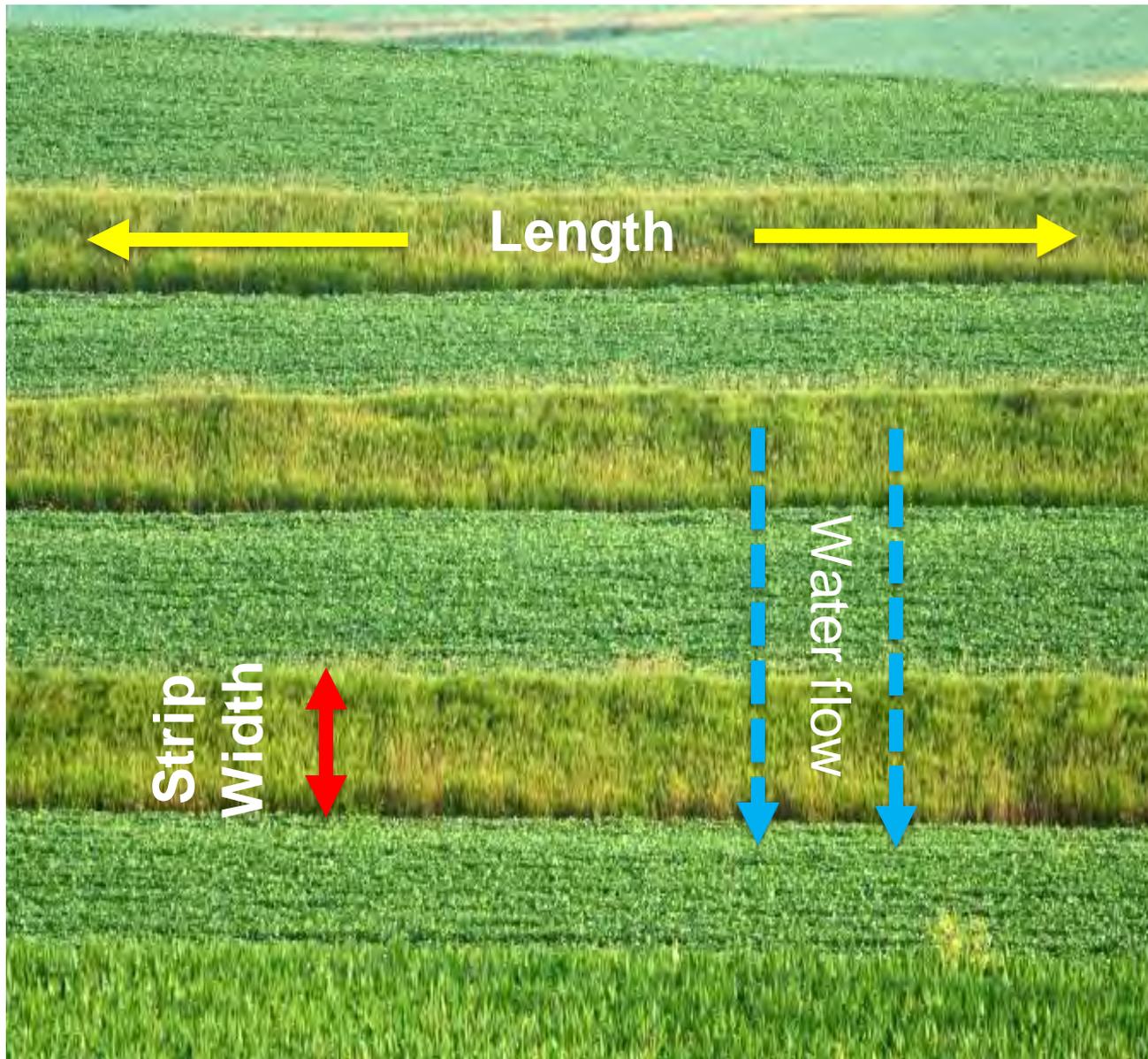


CONDITIONS WHERE PRACTICE APPLIES

This practice applies on all sloping cropland, including orchards, vineyards and nut crops.

- The buffer strips will have at least 95% ground cover.
- This practice will be less effective in achieving the stated purpose(s) on slopes exceeding 10 percent and in areas with 10-year, 24-hour rainfall over 6.5 inches.
- This practice is most effective on slopes lengths between 100 and 400 feet.





Width of Strips

The minimum **width** (water flow length) will be:

- At least 15 feet wide for strips planted to grasses or grass-legume/forbs mixtures with at least 50% grass and,
- At least 30 feet wide when legumes/forbs are used alone or legumes make up more than 50% of the stand.



Reference practices:

- Contour farming (330)
- Forage and Biomass Establishment (512)



Field border

Code 386 (Franja periferal)

DEFINITION

A strip of permanent vegetation established at the edge or around the perimeter of a field.





Field border Code 386

PURPOSE

- Reduce erosion from wind and water and reduce excessive sediment to surface waters (soil erosion).
- Reduce sedimentation offsite and protect water quality and nutrients in surface and ground waters (water quality degradation).
- Provide food and cover for wildlife and pollinators or other beneficial organisms (inadequate habitat for fish and wildlife).
- Reduce greenhouse gases and increase carbon storage (air quality impact).
- Reduce emissions of particulate matter (air quality impact).





CONDITIONS WHERE PRACTICE APPLIES

This practice is applied around the inside perimeter of fields. Its use can support or connect other buffer practices within and between fields. This practice applies to cropland and pasture fields.

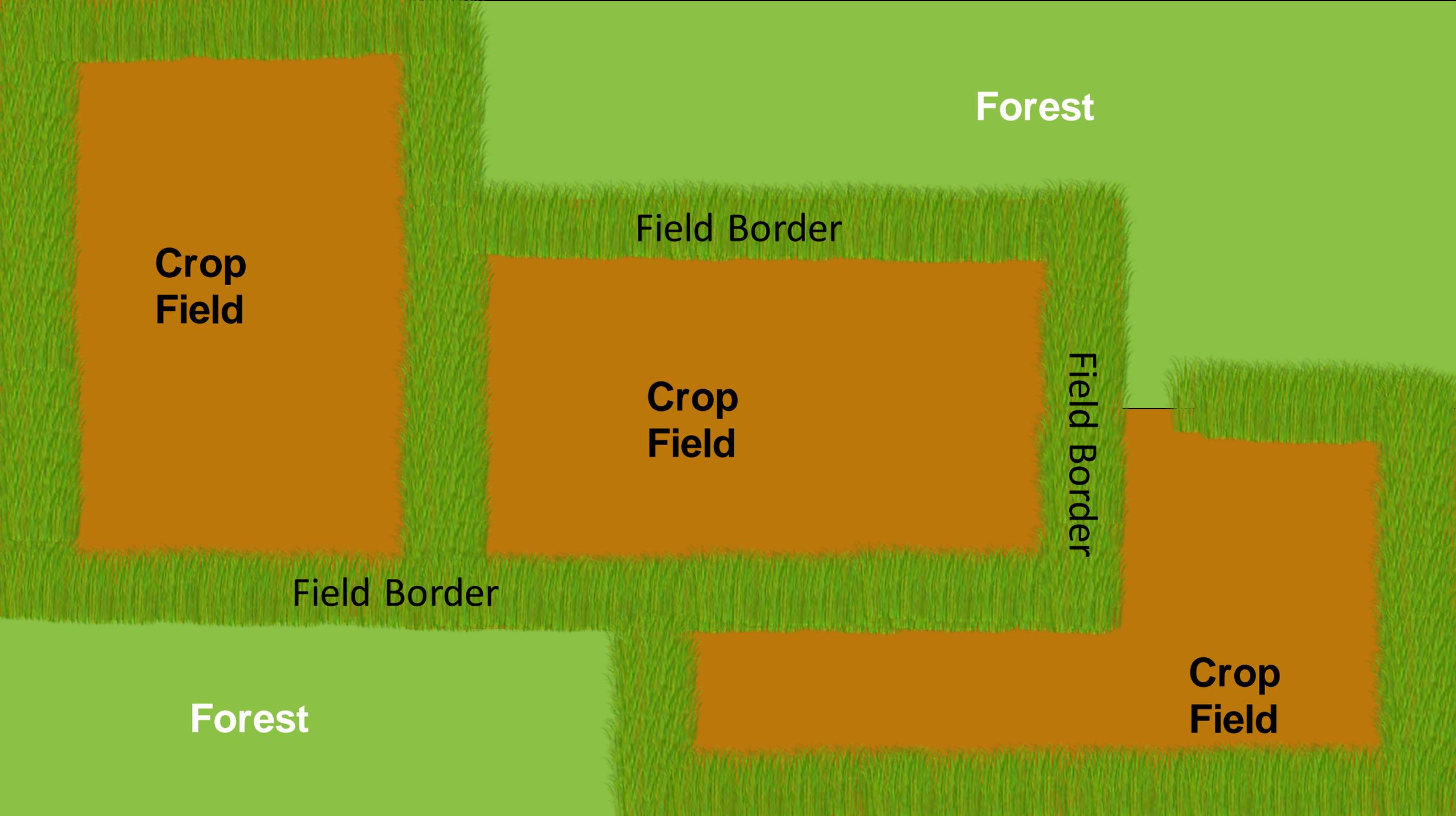
- Minimum field border widths shall be based on local design criteria specific to the purpose or purposes for installing the practice.
- Minimum height of grass or forbs shall be one foot during the critical wind erosion period.
- Plant field borders around the entire field, not just on the field edges where water enters or leaves the field, to maximize resource conservation benefits.





- Criteria to **Reduce Sedimentation Offsite and Protect Water Quality and Excess Nutrients in Surface and Ground Waters**: As a minimum, locate field borders along the edge(s) of the field where runoff enters or leaves the field. The minimum width for this purpose shall be **30 feet** and have a dense vegetative stand (similar to a dense sod).
- Criteria to **Provide Wildlife Food and Cover and Pollinator or Other Beneficial Organisms**: The minimum width for this purpose shall be **30 feet**.





Forest

**Crop
Field**

Field Border

**Crop
Field**

Field Border

Field Border

Forest

**Crop
Field**



Some recommended
species for Field Border
and Filter Strips CB.

Filter strips

Code 393 (Franja filtrante)

DEFINITION

A strip or area of herbaceous vegetation that removes contaminants from overland flow.



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Filter strips

PURPOSE

- Reduce suspended solids and associated contaminants in runoff and excessive sediment in surface waters.
- Reduce dissolved contaminant loadings in runoff.
- Reduce suspended solids and associated contaminants in irrigation tailwater and excessive sediment in surface waters.

CONDITIONS WHERE PRACTICE APPLIES

Filter strips are established where environmentally sensitive areas need to be protected from sediment, other suspended solids, and dissolved contaminants in runoff.



Filter strips work better in slopes greater than 1% but less than 10%.

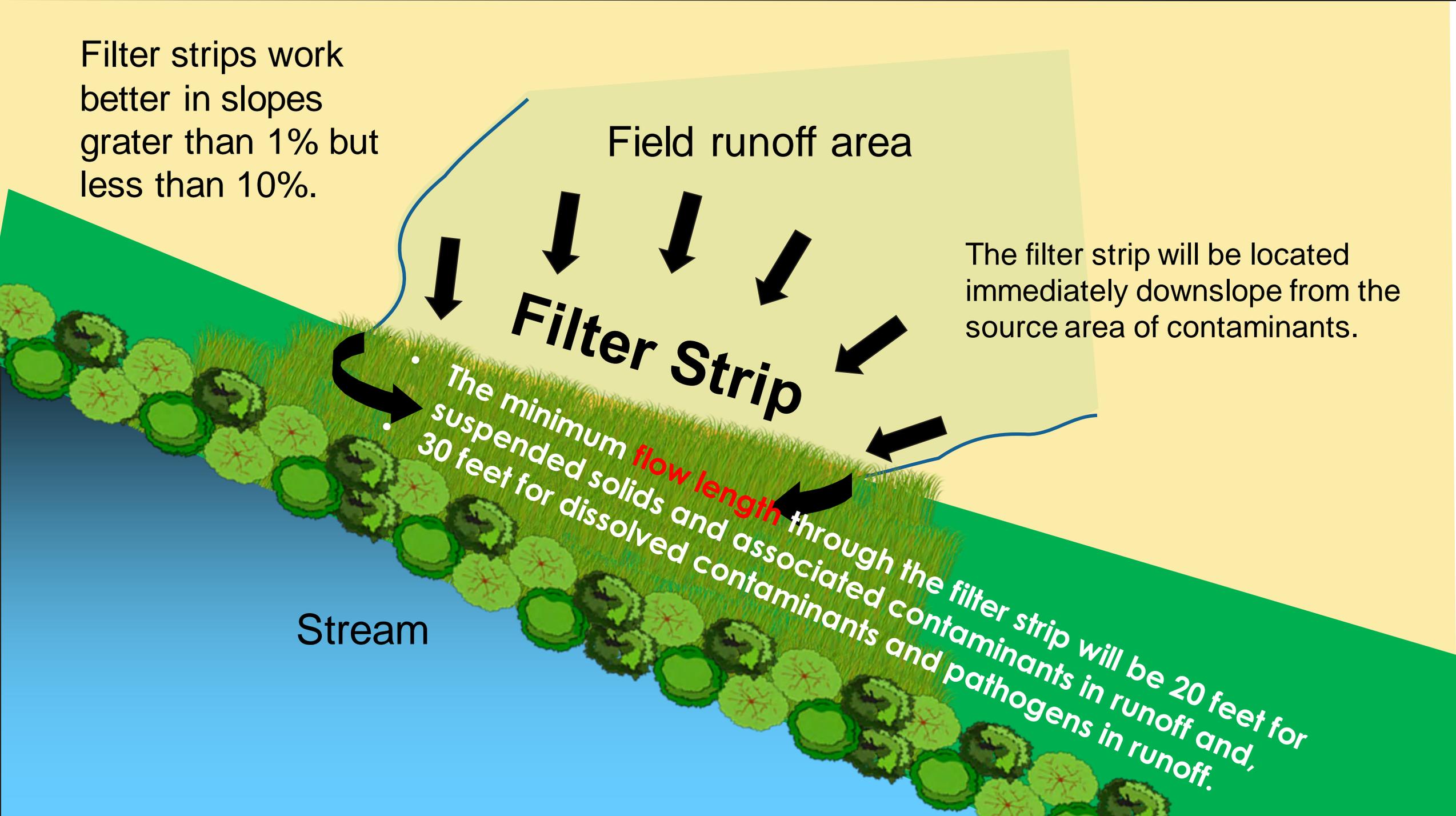
Field runoff area

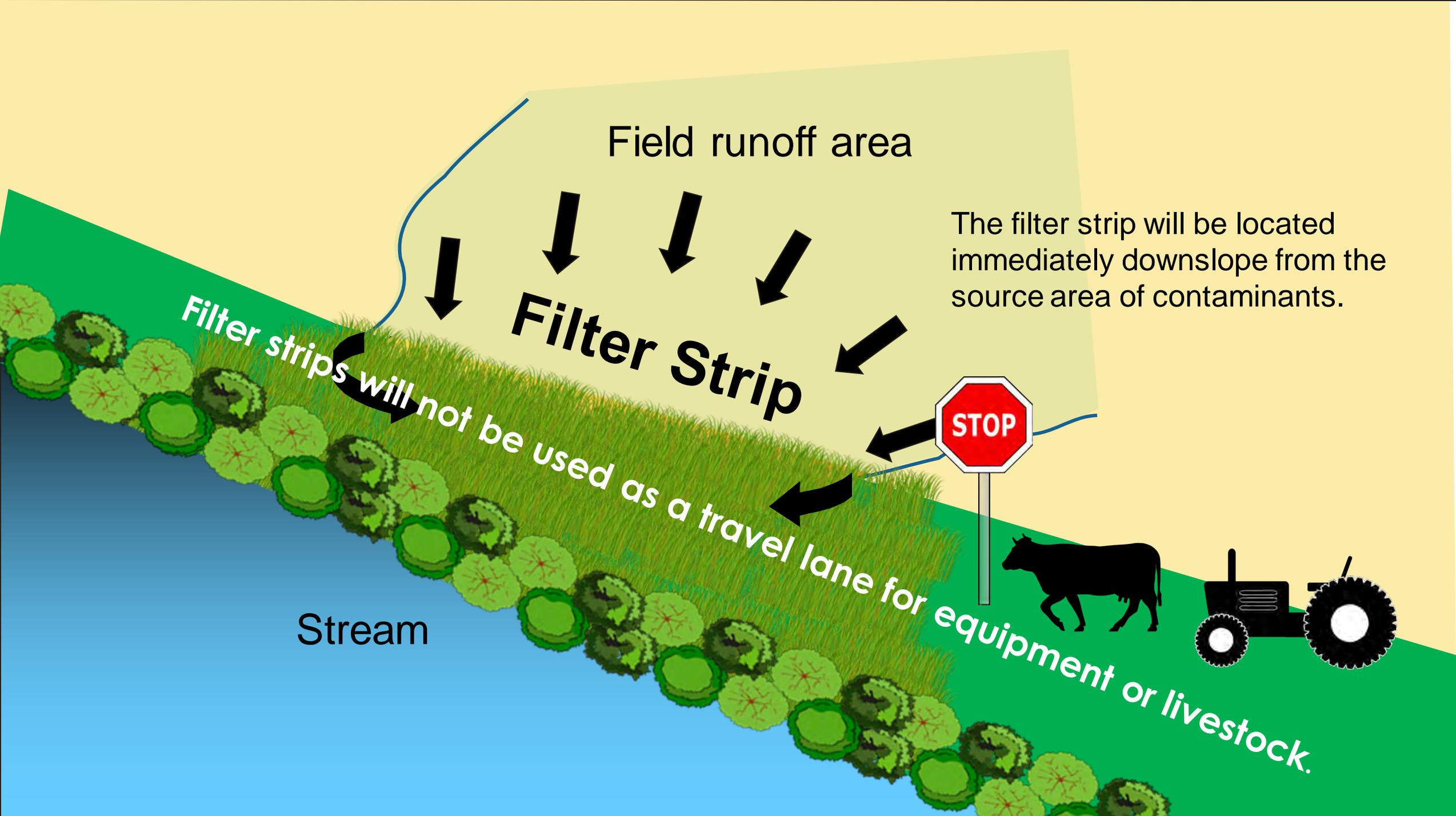
The filter strip will be located immediately downslope from the source area of contaminants.

Filter Strip

The minimum **flow length** through the filter strip will be 20 feet for suspended solids and associated contaminants in runoff and, 30 feet for dissolved contaminants and pathogens in runoff.

Stream





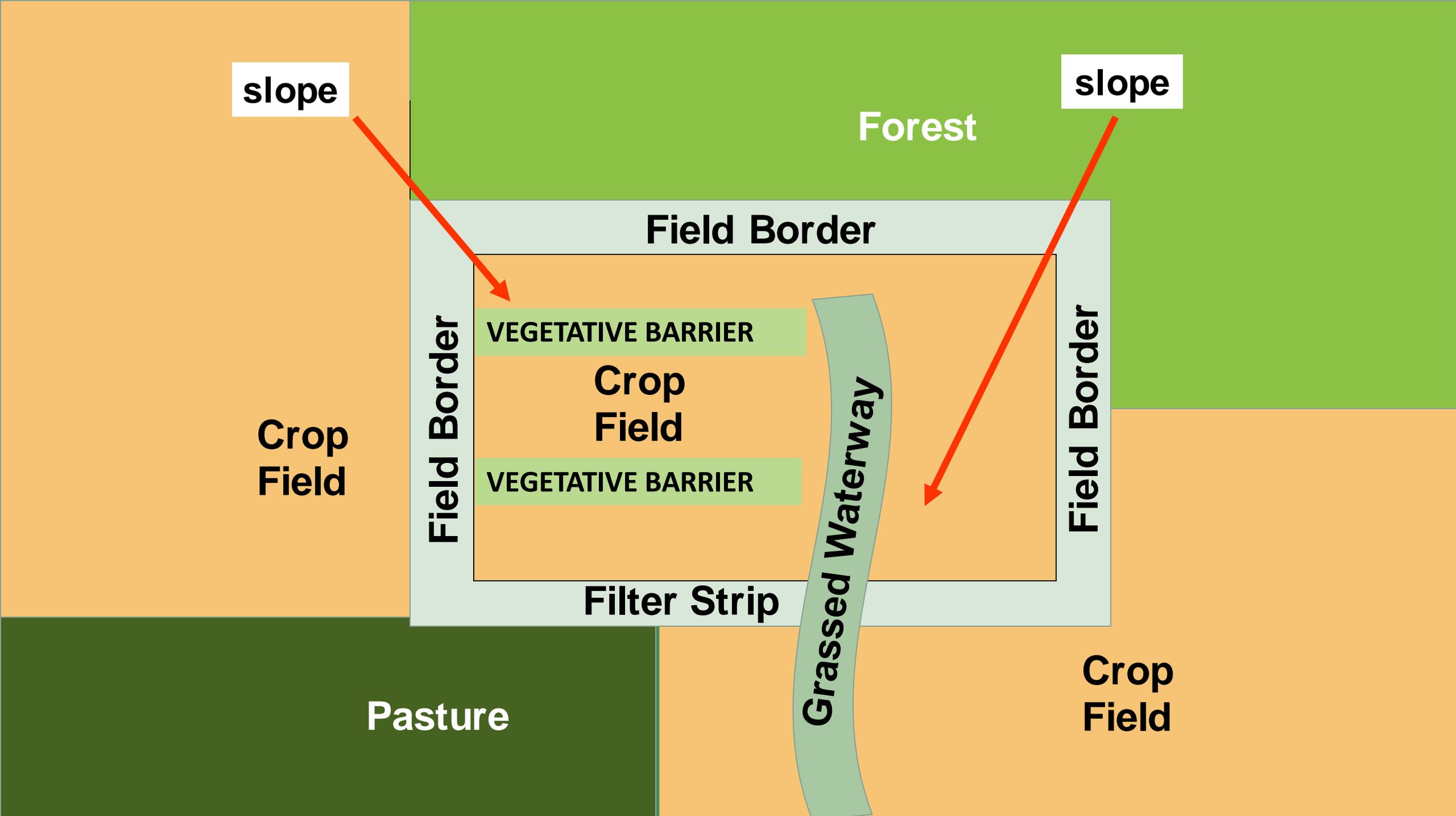
Field runoff area

The filter strip will be located immediately downslope from the source area of contaminants.

Filter Strip

Filter strips will not be used as a travel lane for equipment or livestock.

Stream



slope

slope

Forest

Field Border

Field Border

VEGETATIVE BARRIER

Crop Field

VEGETATIVE BARRIER

Field Border

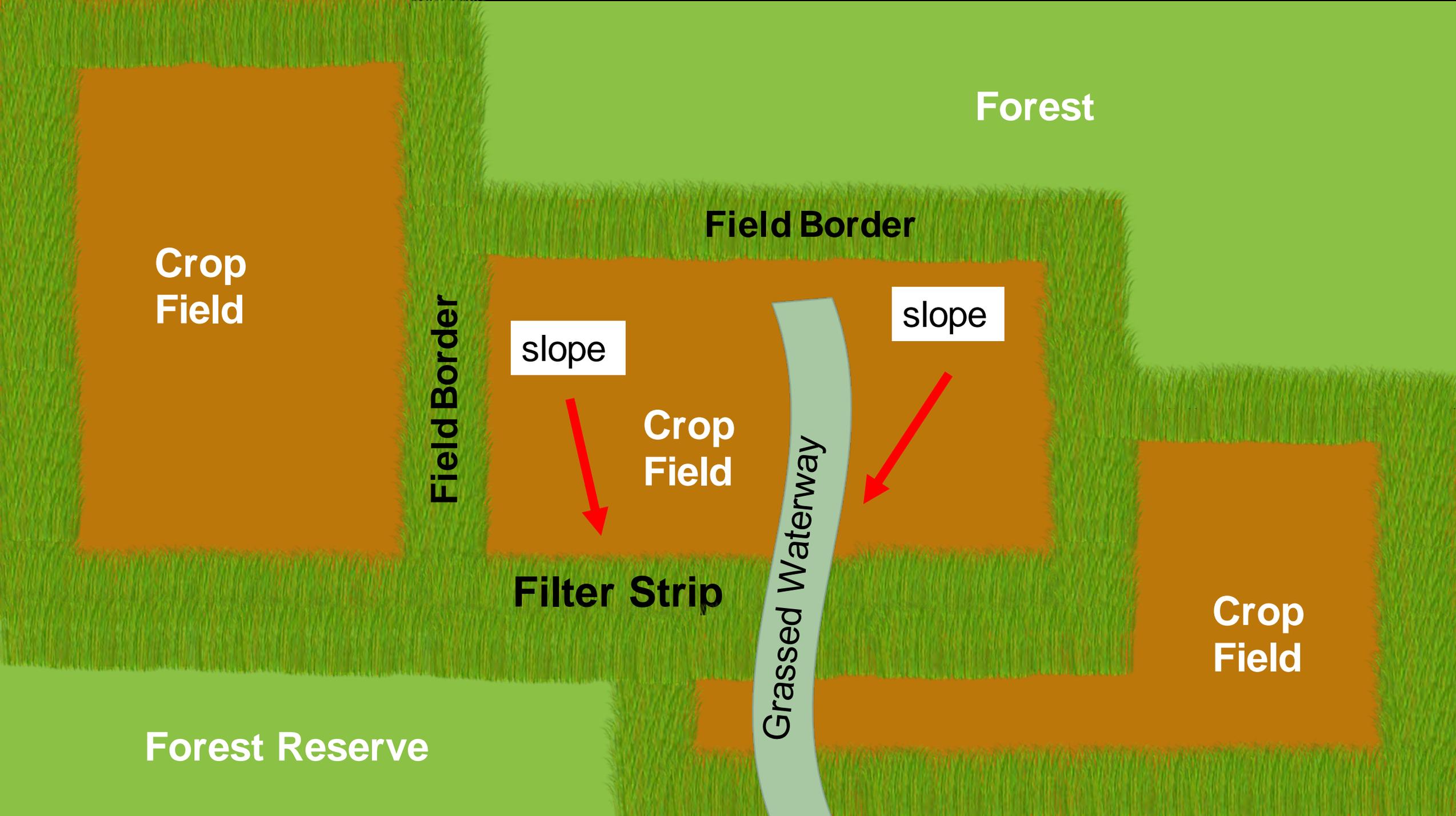
Filter Strip

Grassed Waterway

Crop Field

Crop Field

Pasture



Forest

Field Border

Crop Field

Field Border

slope

Crop Field

slope

Filter Strip

Grassed Waterway

Crop Field

Forest Reserve

Recommended Plants for Establishing Filter Strip

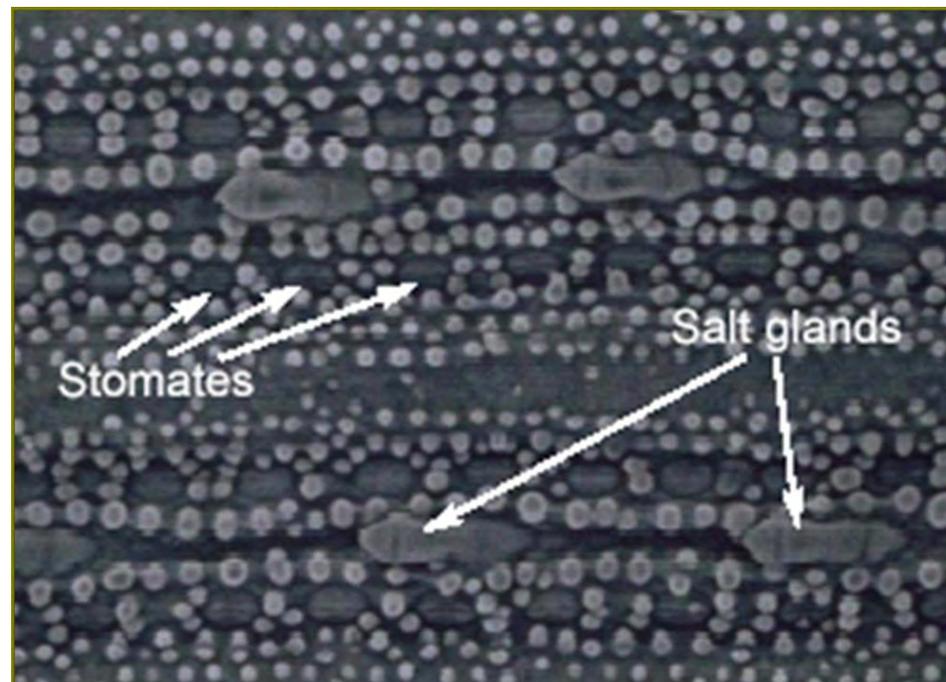


Name		Soil Permeability			Tolerant		Planting method minimum rate		
Spanish/English	Scientific	Well	Mod	Poor	Acid	Salinity	Stolon (lbs/ac)	Seeds (lbs/ac)	Seeds (lbs/1000 p ₂)
Grama colorada/ Carpet grass (a)	<i>Axonopus compressus</i>		x	x	Yes	No	1,500	40	1
Malojilla/Carib grass	<i>Eriochloa polystachya</i>		x	x	Yes	No	1,500	--	--
Malojillo/Para grass	<i>Urochloa mutica</i>		x	x	Yes	Fair	1,500	5	0.12
Matojo de playa/Saltgrass	<i>Sporobolus virginicus</i>	x			No	Yes	1,500	--	--
Pajón/Railroad-track grass	<i>Dichanthium annulatum</i>	x	x		No	Fair	--	20	0.5
Rhodes grass	<i>Chloris gayana</i>	x	x		No	Fair	1,500	9	0.2
Signal/Signal grass	<i>Urochloa brizantha</i>	x	x		Yes	No	1,500	6	0.14
Táner/Tanner grass	<i>Urochloa arrecta</i>		x	x	Fair	No	1,500	--	--
Yerba Bahía/Bahia Grass (a)	<i>Paspalum notatum</i>	x	x		Yes	Fair	1,500	40	1
Yerba Bermuda/Common Bermuda (a)	<i>Cynodon dactylon</i>	x	x		Yes	Yes	1,500	60	1.5
Yerba Dalis/Dallis grass	<i>Paspalum dilatatum</i>	x	x		Yes	No	1,500	20	0.5
Yerba Estrella/Star grass	<i>Cynodon nlemfuensis</i>	x	x		Fair	Fair	1,500	--	--
Yerba Huracán/Hurricane grass (b)	<i>Bothriochloa pertusa</i>	x	x		Fair	Fair	--	6	0.14
Yerba Pangola/Pangola grass	<i>Digitaria eriantha</i>	x	x		Yes	No	1500	--	--



Halophytes: Salt Tolerant Species

Recommended for Filter Strips and Field Borders



Halophytes: plants that are tolerant to salinity



Paspalum vaginatum



Sesuvium portulacastrum



Batis maritima

Source: Detrés, Y. & Silva, W. 2012. Halophytes for coastal erosion control.



Halophytes



Spartina patens



Zoysia sp.





Considerations

Ideally, filter strips function best on slopes 15% or less. However, on slopes 1% or less, vegetation used should be tolerant of saturated soil conditions.



Grassed waterway with vegetative filter

CODE 412 (Desagüe protegido)

DEFINITION

A shaped or graded channel that is established with suitable vegetation to convey surface water at a non-erosive velocity using a broad and shallow cross section to a stable outlet.





Grassed waterway with vegetative filter

PURPOSE

- To convey runoff from terraces, diversions, or other water concentrations without causing erosion or flooding.
- To prevent gully formation.
- To protect/improve water quality.

CONDITIONS WHERE PRACTICE APPLIES

This practice is applied in areas where added water conveyance capacity and vegetative protection are needed to prevent erosion and improve runoff water quality resulting from concentrated surface flow.





Vegetative Establishment. Establish vegetation as soon as possible using the criteria listed under “Establishment of Vegetation” in the conservation practice standard **Critical Area Planting (342)** and/or the state planting guide.



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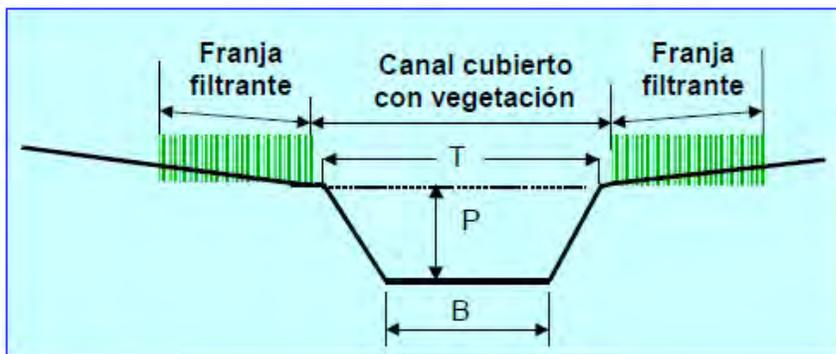


Name		Degree of Retardance	Percent of cover (%)			Averag height (inc)
Spanish/English	Scientific		100-95	94-86	85-80	
Ciempíes/Centipede grass	<i>Eremochloa ophiuroides</i>	C		x		6
		D		x		2-6
		E			x	2
Grama colorada/Carpet grass	<i>Axonopus compressus</i>	D		x		2-6
		E		x		2
Mallojilla/Carib grass	<i>Eriochloa polystachya</i>	C		x		>20
Malojillo/Para grass	<i>Urochloa mutica</i>	C		x		11-24
Pajón/Railroad-track grass	<i>Dichanthium annulatum</i>	B		x		>20
		C			x	>20
Rhodes grass	<i>Chloris gayana</i>	B			x	>20
San Agustín/San Agustin grass	<i>Stenotaphrum secundatum</i>	C		x		6-10
		D			x	6-10
Signal/Signal grass	<i>Urochloa brizantha</i>	C			x	>20
Yerba Bahía/Bahia Grass	<i>Paspalum notatum</i>	B		x		>10
		C		x		6-10
		D			x	6-10
Yerba Bermuda/Common Bermuda	<i>Cynodon dactylon</i>	C		x		6-10
		D			x	2-6
		E			x	2
Yerba Buffel/Buffel grass	<i>Pennisetum ciliare</i>	B		x		11-24
		C		x		10-12
Yerba Dalis/Dallis grass	<i>Paspalum dilatatum</i>	C		x		6-12
Yerba Estrella/Star grass	<i>Cynodon nlemfuensis</i>	A	x			>30
		B		x		>30
		C			x	30
Yerba Huracán/Hurricane grass	<i>Bothriochloa pertusa</i>	B		x		>20
		C			x	>20
Yerba Pangola/Pangola grass	<i>Digitaria eriantha</i>	A	x			>30
		B		x		>30
		C			x	>30
Zoysia	<i>Zoysia spp</i>	C		x		6
		E		x		2

Degree of retardance for grasses in the Caribbean Area



Usuario: _____ Asistido por: _____ Fecha: _____



Definición

Un sistema de desagüe protegido surge cuando mejoramos un canal natural o cuando construimos uno nuevo con la forma, pendiente y vegetación requerida para transportar adecuadamente la escorrentía. Una franja filtrante es un área cubierta con vegetación la cual sirve para retener los sedimentos, materia orgánica, nutrientes u otros contaminantes potenciales que fluyan junto con la escorrentía.

Propósito

- Concentrar la escorrentía que provenga de terrazas, predios u otras áreas y proveer un cauce protegido para reducir problemas de erosión.
- Reducir el potencial de inundaciones.
- Filtrar contaminantes.

Las franjas filtrantes se diseñan para atrapar sedimentos y aumentar la infiltración de manera que la cantidad de sustancias contaminantes como plaguicidas y nutrientes en la escorrentía se reduzcan.

Estos sistemas ofrecen además otros beneficios tales como:

- Hábitat para la vida silvestre.
- Conexión de áreas verdes (corredores).
- Proveen diversidad de especies.
- Mejoran la estética.

Q. What supporting Practices are applicable to Grass Waterway with Vegetated Filter?:

- Critical Area Planting (342)
- Forage and Biomass (512)
- Filter Strip (393)
- Field Border (386)



Hedgerow Planting

CODE 422 (Seto vivo)

DEFINITION

Establishment of dense vegetation in a linear design to achieve a natural resource conservation purpose.



Hedgerow Planting

PURPOSE

Providing at least one of the following conservation functions:

- Habitat, including food, cover, and corridors for terrestrial wildlife.
- To enhance pollen, nectar, and nesting habitat for pollinators.
- Food, cover, and shade for aquatic organisms that live in adjacent streams or watercourses.
- To provide substrate for predaceous and beneficial invertebrates as a component of integrated pest management.
- To intercept airborne particulate matter.



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- To reduce chemical drift and odor movement.
- Screens and barriers to noise and dust.
- To increase carbon storage in biomass and soils.
- Living fences
- Boundary delineation and contour guidelines



CONDITIONS WHERE PRACTICE APPLIES:

- This practice applies wherever it will accomplish at least one of the purposes stated in 422.
- In, across, or around fields.



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General Criteria Applicable to All Purposes

- Hedgerows shall be established using woody plants or perennial bunch grasses producing erect stems attaining average heights of at least 3 feet.
- The practice shall be protected from livestock grazing and trampling to the extent necessary to ensure that it will perform the intended purpose(s).
- No minimum width beyond a single row is required except where wildlife food and cover is an objective.





Additional Criteria for Wildlife Food, Cover and Corridors

- Establish at least two compatible species of native vegetation.
- Minimum hedgerow width, at maturity, shall be 15 feet. This may necessitate the establishment of more than one row of plants.

Additional Criteria for Pollinator Habitat

- Hedgerow plants must provide abundant pollen and nectar resources.

Additional Criteria for Living Fences

- Plants shall not be poisonous or hazardous to the animals.





Additional Criteria for Screens and Noise Barriers

- Screening hedgerows provide privacy, hide unsightly areas from view or reduce noise.

Additional Criteria for Reducing Particulate Matter Movement

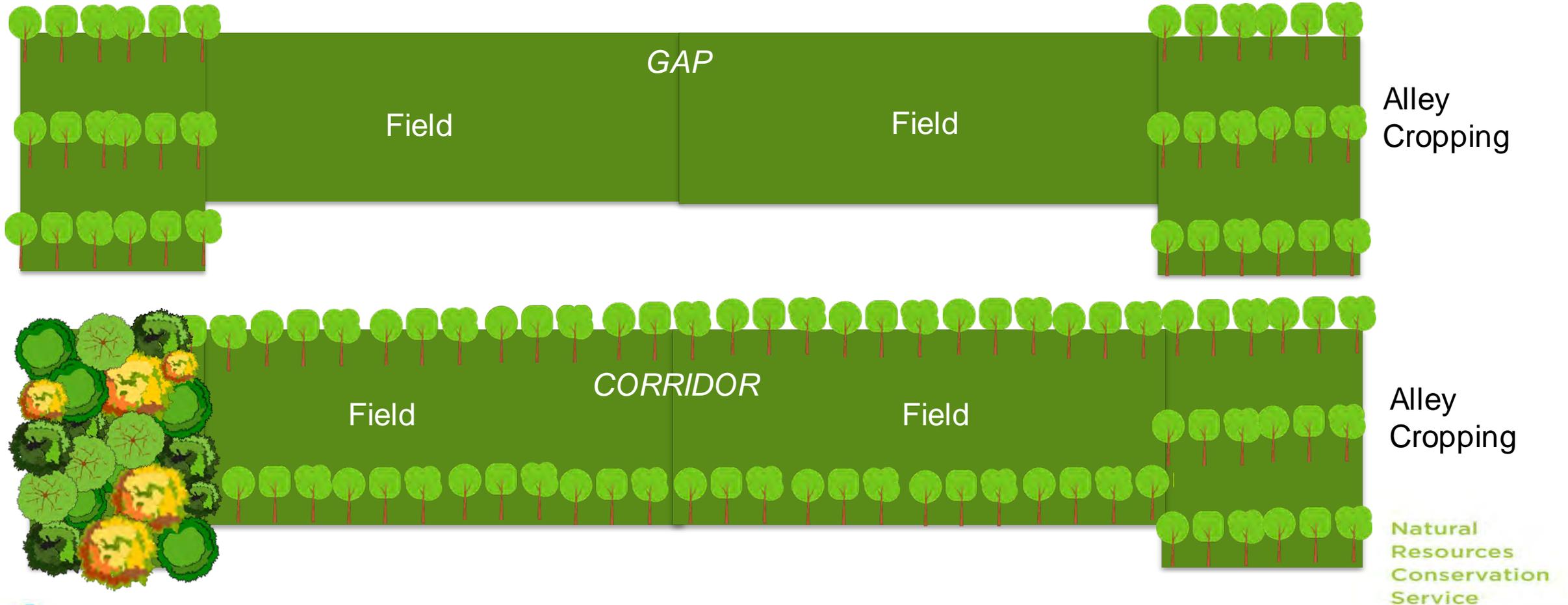
- The hedgerow will be oriented as close to perpendicular to the prevailing wind direction as possible.

Additional Criteria to Reduce Odor Movement and/or Chemical Drift

- As close to perpendicular to the prevailing wind direction during the period of concern as possible, and between the source of the odor or chemical drift and the sensitive areas.



Connectivity: Hedgerows as ecological corridors



NATURAL RESOURCES CONSERVATION SERVICE CONSERVATION PRACTICE STANDARD

Specification Guide

HEDGEROW PLANTING

(Ft)
Code 422

A hedgerow is a linear planting of vegetation. Plantings usually consist of trees and shrubs but may include grasses. Hedgerows can perform many biological functions and purposes on your farm and landscape.

This practice applies wherever it will accomplish at least one of the following purposes

- Habitat, including food, cover, and corridors for terrestrial wildlife.
- To enhance pollen, nectar, and nesting habitat for pollinators.
- Food, cover, and shade for aquatic organisms that live in adjacent streams or watercourses.
- To provide substrate for predaceous and beneficial invertebrates as a component of integrated pest management.
- To intercept airborne particulate matter.
- To reduce chemical drift and odor movement.
- Screens and barriers to noise and dust.
- To increase carbon storage in biomass and soils.
- Living fences
- Boundary delineation

Specifications

Practice specifications will be developed individually for each site with the landowner. Specifications will comply with Standard 422, and the decisions concerning location, plant materials and other specific technical decisions will be documented.

Use woody plants or perennial bunch grasses producing erect stems attaining average heights of at least 3 feet.

No plant listed by the state as a noxious weed shall be established.

Species shall not host pests or diseases that could pose a risk to nearby crops.

Plantings consisting of two or more species, especially locally native plant species, shall be encouraged

No minimum width beyond a single row is required except where wildlife food and cover is an objective.

Type		Common Name	Technical Name
T		Tachuelo	Fustic <i>Pictetia aculeata</i>
T		Ucar	Black Olive <i>Bucida buceras</i>
		Uva playera	seagrape <i>Coccoloba uvifera</i>
		Vomitel	<i>Cordia spp.</i>
G		Caña de azúcar	Sugarcane <i>Saccharum spontaneum</i>
G		Pacholí	Vetiver, khus-khus <i>Vetiveria zizanioides</i>

S_Shrub
T_Tree
G_Grass





Hedgerow Planting

- One row is the minimum to define a field boundary or serve as a screen planting.
- For wildlife purposes, plant 3 or more rows of trees/shrubs.

Q. What supporting practices are applied to Hedgerow Planting?

- Access Control (472)
- Fence (382)
- Tree/Shrub Establishment (612)
- Tree/Shrub Site Preparation (490)



Herbaceous Wind Barrier

Code 603 (Rompevientos herbáceo)

DEFINITION

Herbaceous vegetation established in narrow strips within the field to reduce wind speed and wind erosion.



UPRM, AES Isabela

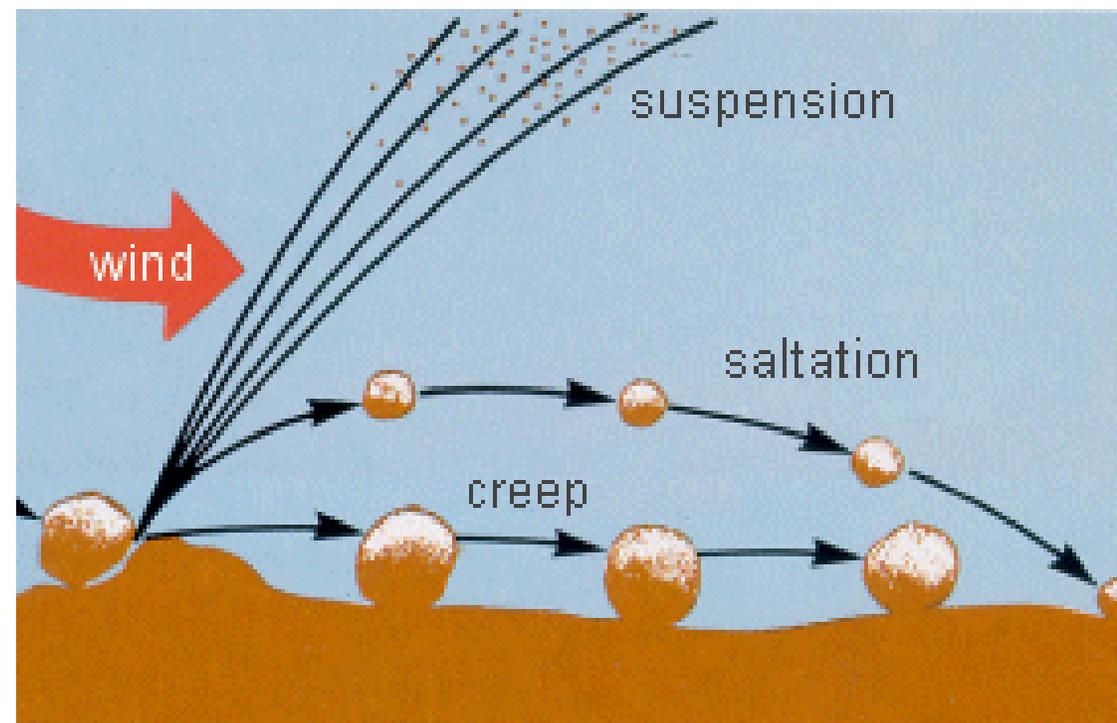
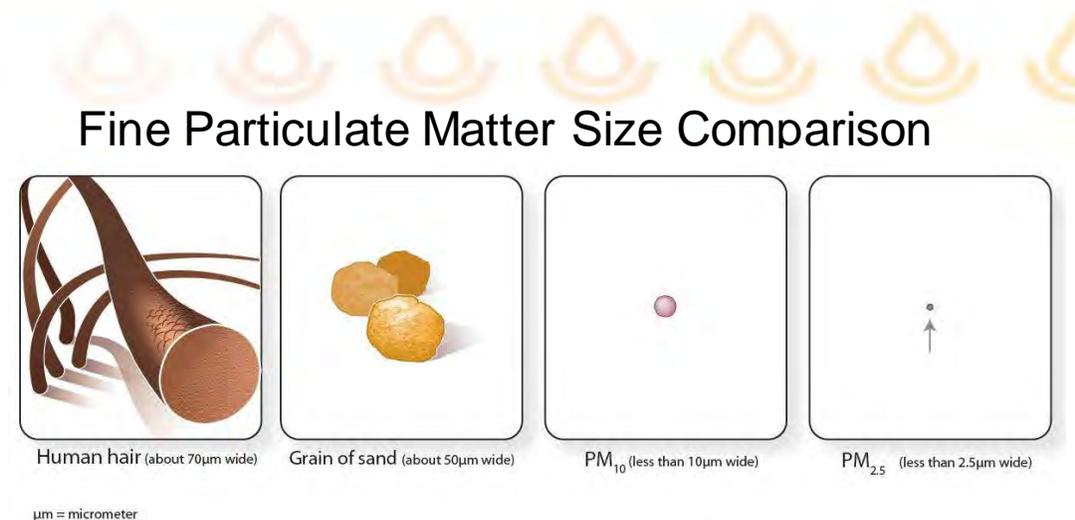


PURPOSE

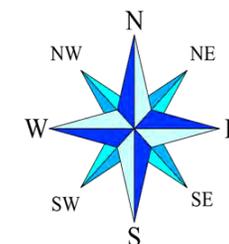
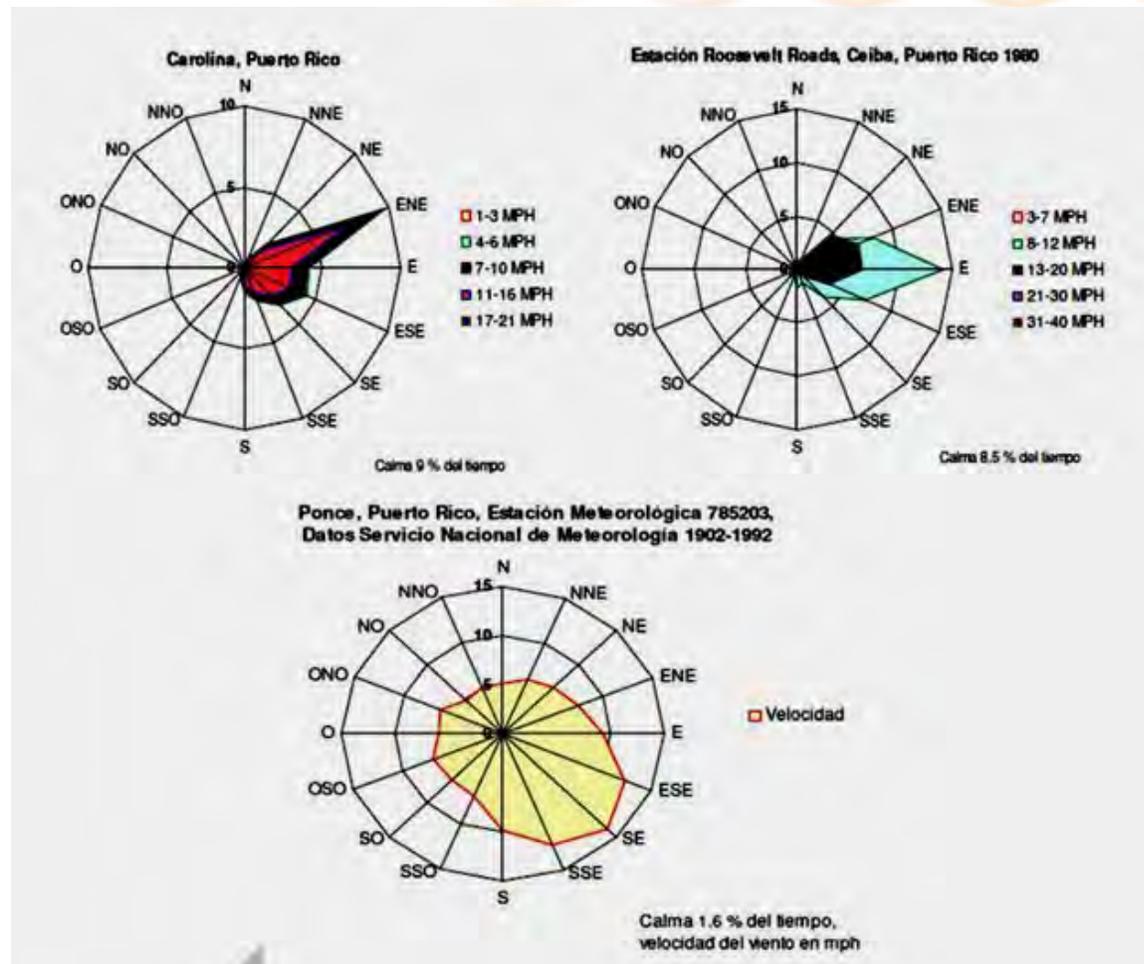
- Reduce soil erosion (wind erosion: saltation, creep, and suspension)
- Reduce soil particulate emissions to improve air quality.
- Improve plant health by reducing crop damage by wind or wind-borne soil particles.

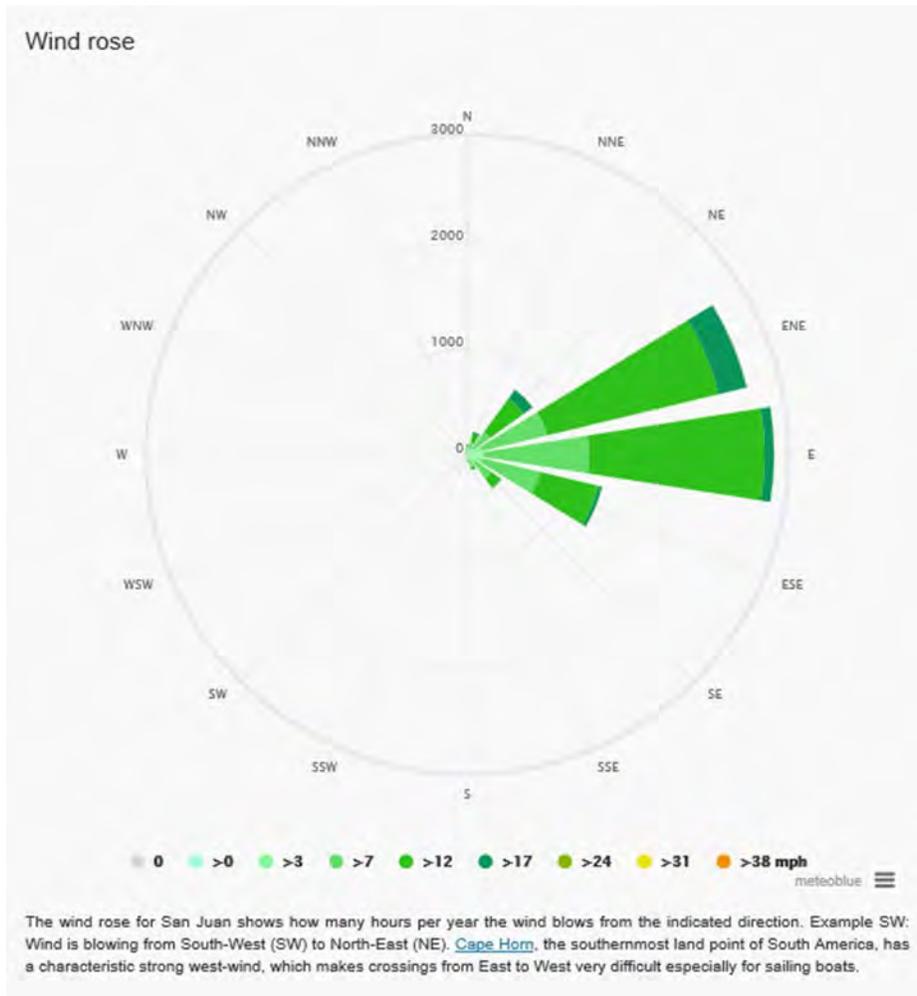
CONDITIONS WHERE PRACTICE APPLIES

Cropland where wind erosion is a resource concern.



- Wind barriers are installed across the prevailing wind erosion direction.
- Wind barriers consist of one or more rows.
- Row spacing within the wind barrier width is no greater than 36 inches.





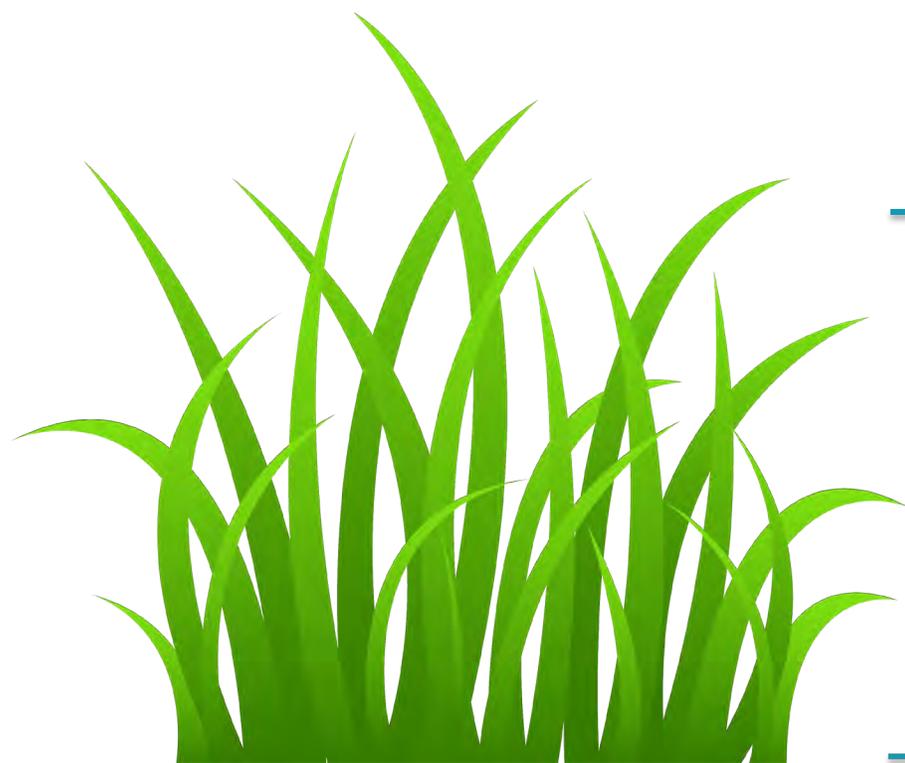
Average reduction of:
30% dust
18% ammonia

https://www.meteoblue.com/en/weather/forecast/modelclimate/san-juan_puerto-rico_4566880





- Wind barriers have a minimum expected height of 1.5 feet and porosity of 40 to 50 percent during the wind erosion periods for which the barriers are designed.



1.5 ft minimum

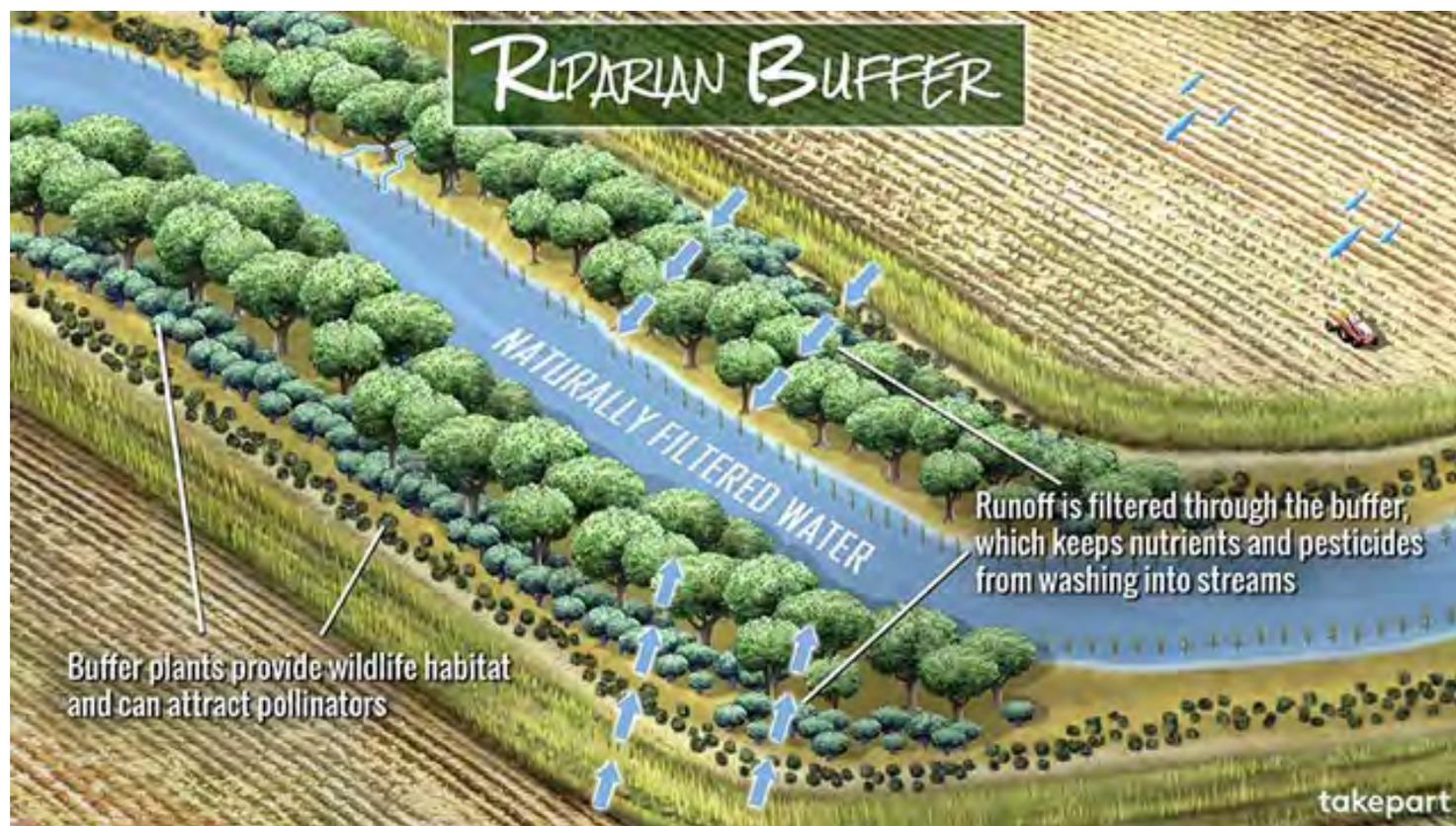


Riparian forest buffer

CODE 391 (Bosque ribereño de amortiguación)

DEFINITION

An area predominantly trees and/or shrubs located adjacent to and up-gradient from watercourses or water bodies.





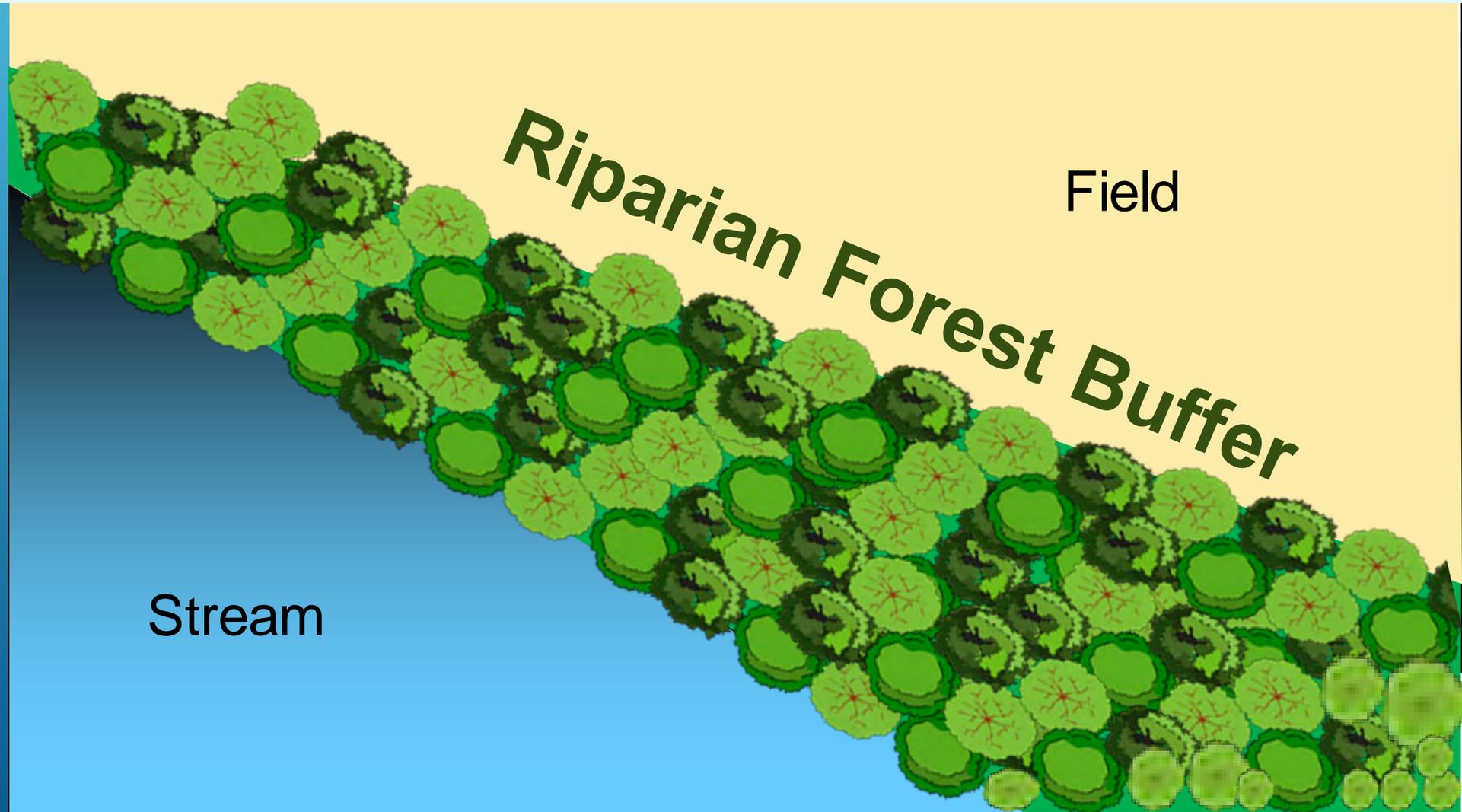
PURPOSE

- Create shade to lower or maintain water temperatures to improve habitat for aquatic organisms.
- Create or improve riparian habitat and provide a source of detritus and large woody debris.
- Reduce excess amounts of sediment, organic material, nutrients and pesticides in surface runoff and reduce excess nutrients and other chemicals in shallow ground water flow.
- Reduce pesticide drift entering the water body.
- Restore riparian plant communities.
- Increase carbon storage in plant biomass and soils.

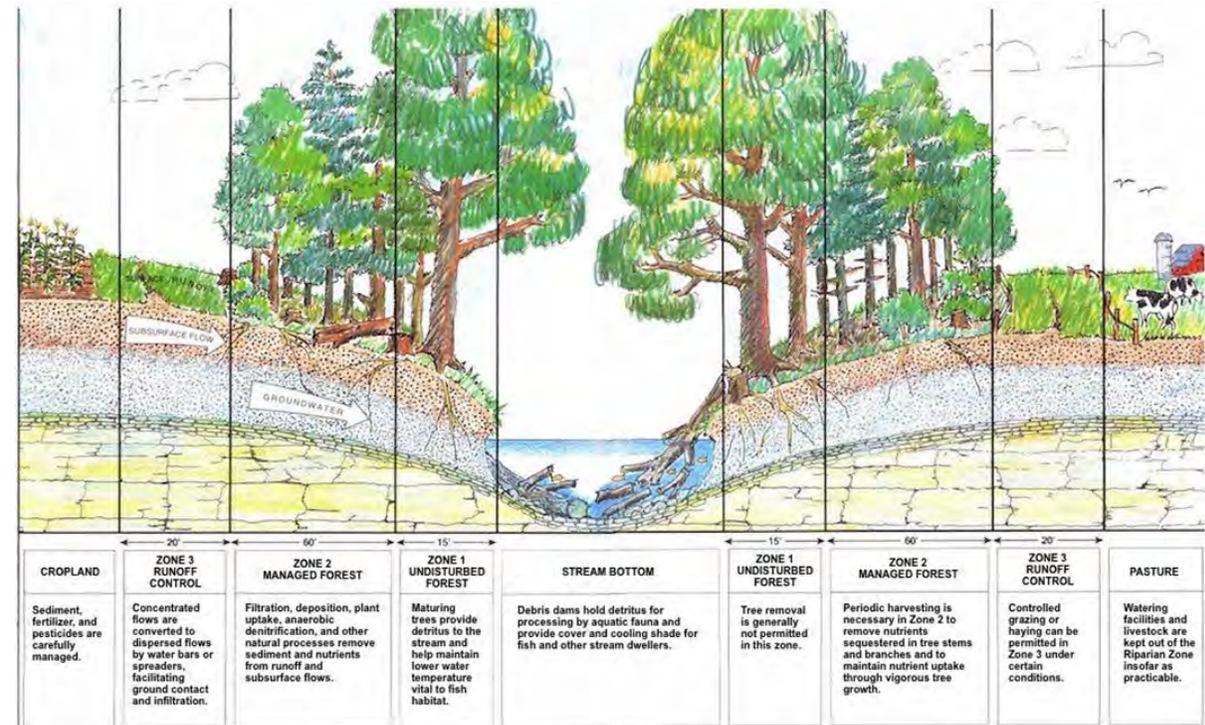


CONDITIONS WHERE PRACTICE APPLIES

Riparian forest buffers are applied on areas adjacent to permanent or intermittent streams, lakes, ponds, and wetlands. They are not applied to stabilize stream banks or shorelines.



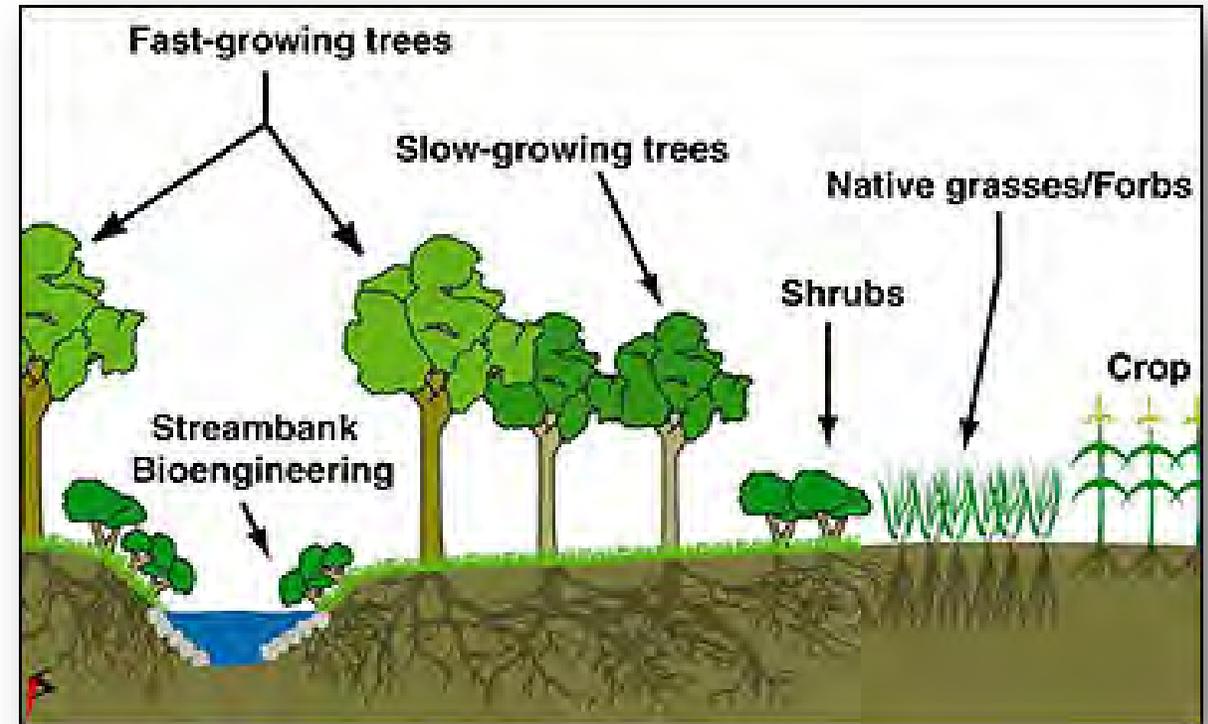
- The riparian forest buffer shall be positioned appropriately and designed to achieve sufficient width, length, vertical structure/density and connectivity to accomplish the intended purpose(s).



- Livestock shall be controlled or excluded as necessary to achieve the intended purpose. Refer to the standards Prescribed Grazing, 528, and/or Access Control, 472, as applicable.

Q. What supporting practices:

Forest Stand Improvement, 666. Prescribed Grazing, 528, and/or Access Control, 472. Tree/Shrub Establishment (612). Tree/Shrub Site Preparation (). Pest Management, 595.



Vegetative barrier

Code 601 (Barrera vegetativa)

DEFINITION

Permanent strips of stiff, dense vegetation established along the general contour of slopes or across concentrated flow areas.

PURPOSE

- Reduce sheet and rill erosion.
- Improve water quality by trapping sediment.

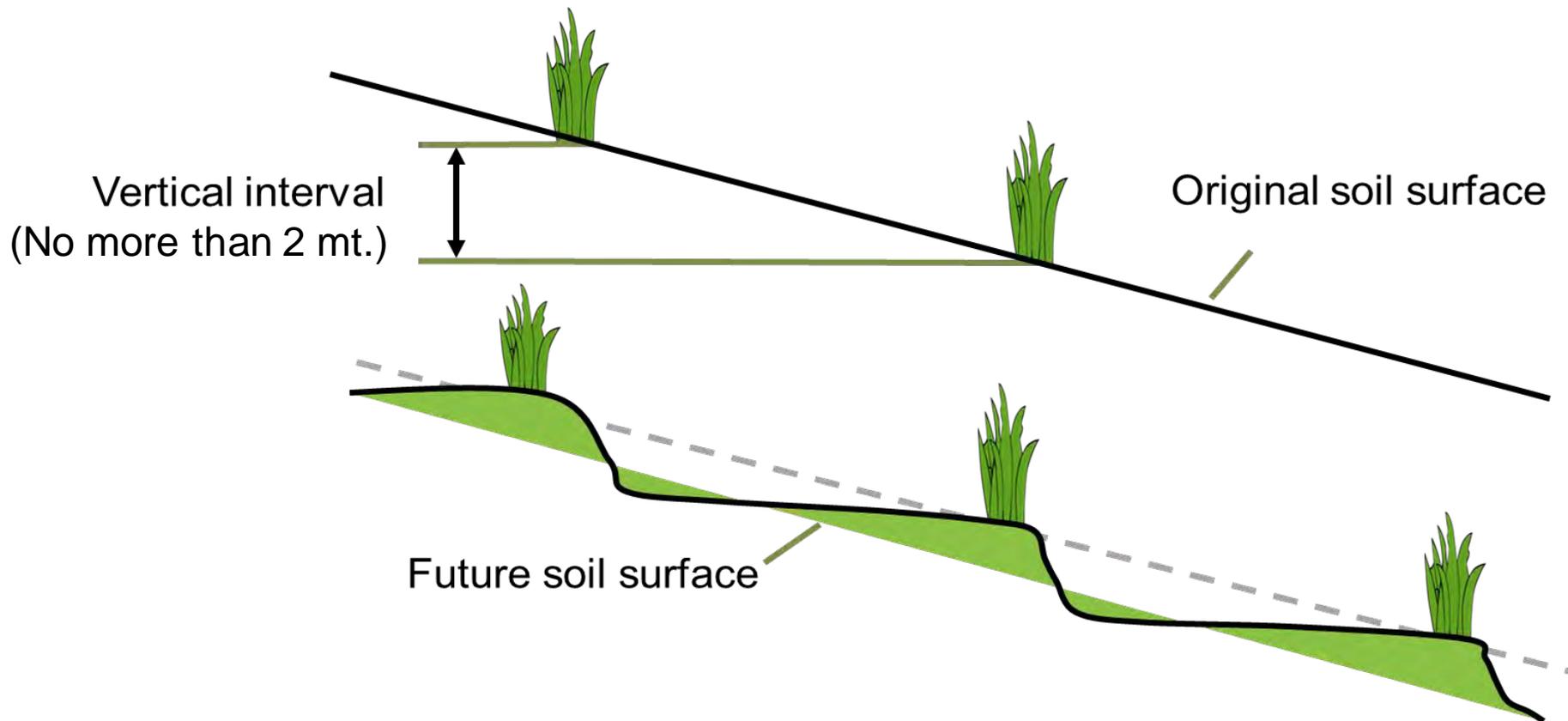


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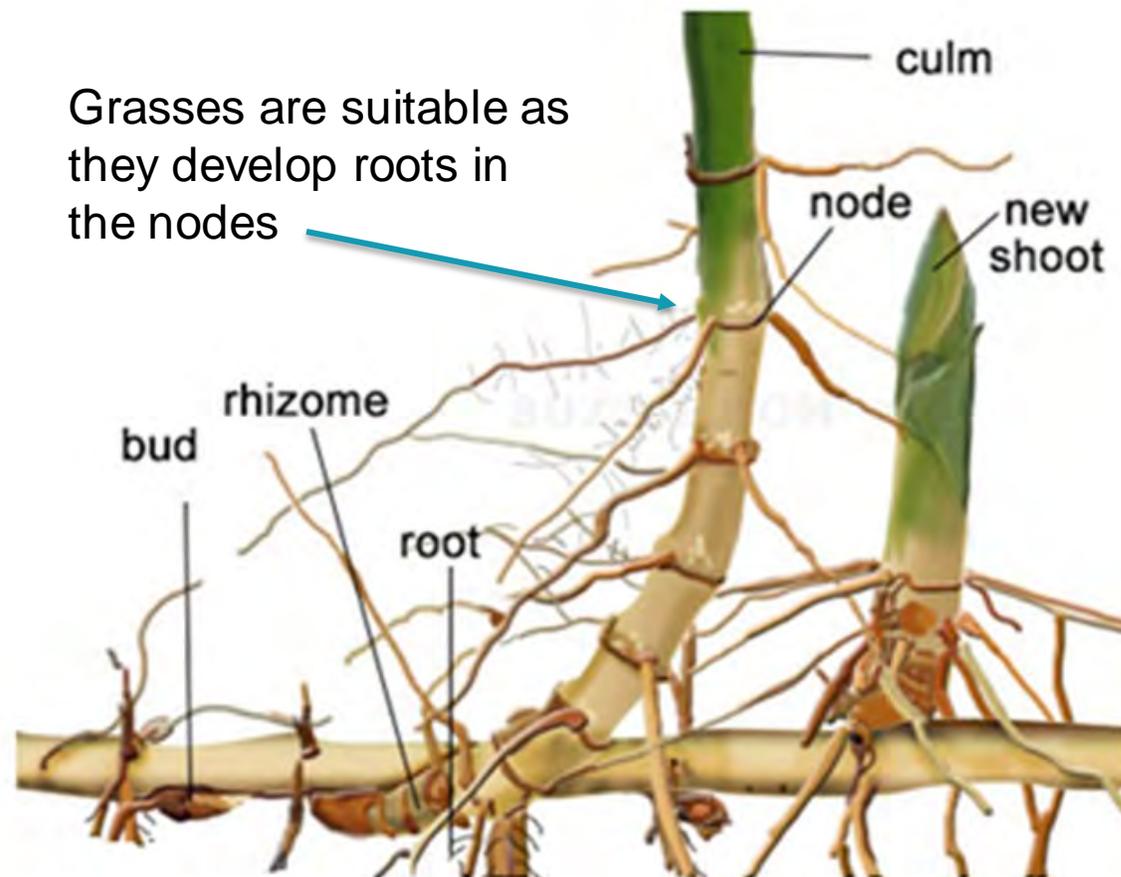
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CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all land uses where sheet and rill erosion are resource concerns.

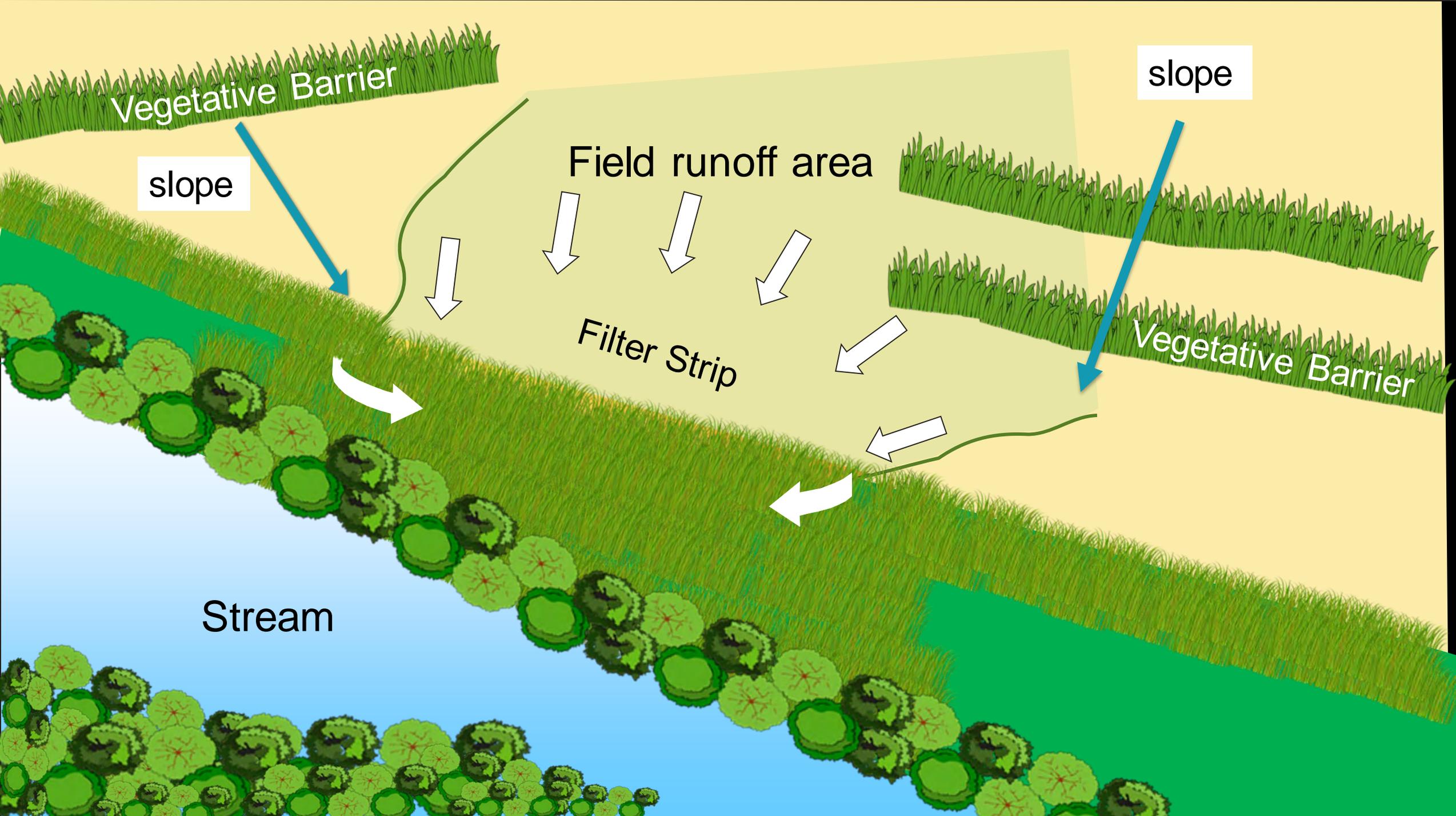


Vegetative Barrier Pond Water & Release it Slowly



Grasses are suitable as they develop roots in the nodes







Vetiver grass



Vegetative Barrier



- All tillage and equipment operations in the interval between barriers will be parallel to the vegetative barrier.
- The vertical interval between vegetative barriers will not exceed 2 mt (6 feet) in cropland. In bioengineering projects the vertical interval can be substantially reduced.
- Mowing of herbaceous barriers may be used as a management practice to encourage the development of a dense stand and prevent shading of crops in adjacent fields.
- Consider double rows of barriers in areas of water flow concentrations.



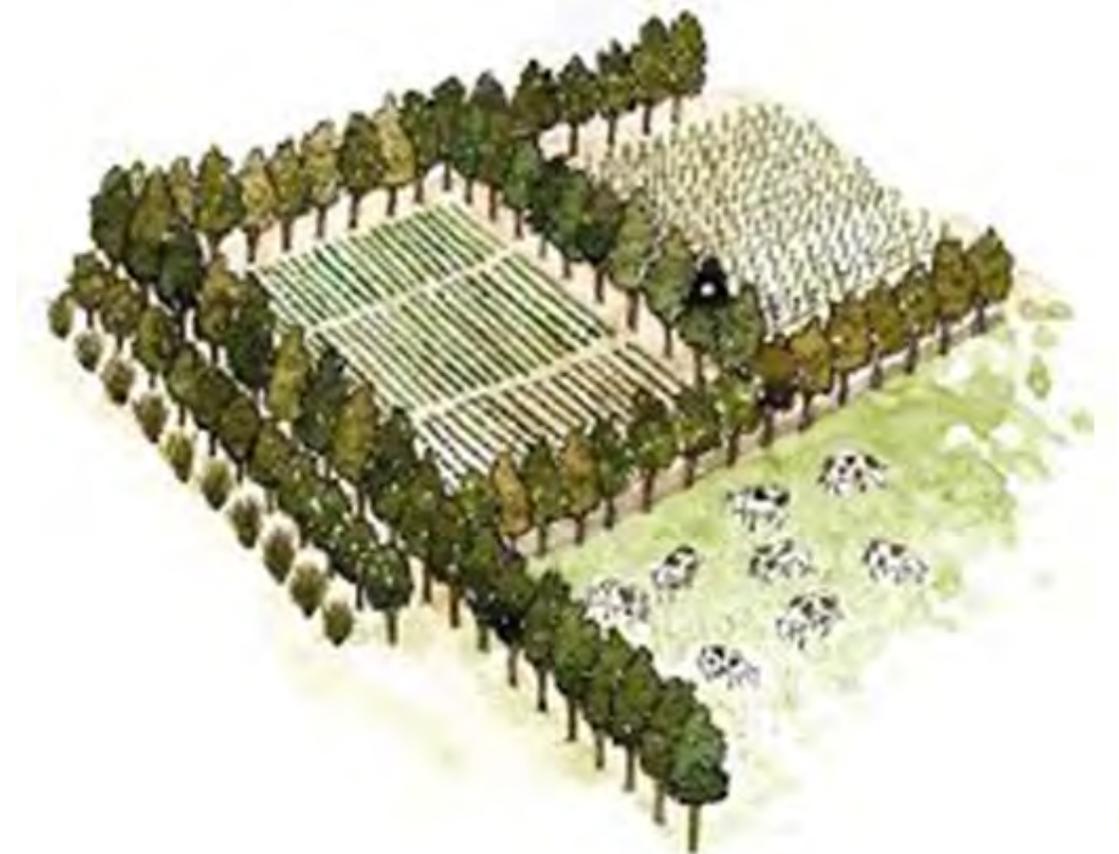
Windbreak/Shelterbelt Establishment

Code 380 (Rompevientos/Refugios)



DEFINITION

- Windbreaks or shelterbelts are single or multiple rows of trees or shrubs in linear configurations.
- The windbreak will be oriented as close to perpendicular to the troublesome wind as possible.
Prevailing winds.



PURPOSE

- 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.





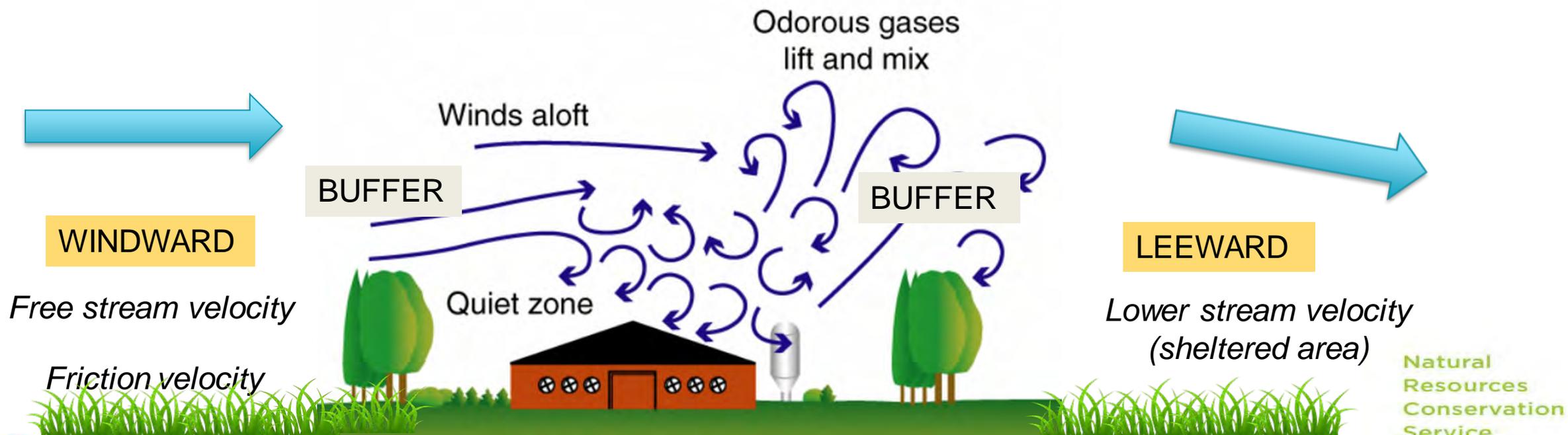
PURPOSE

- 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.

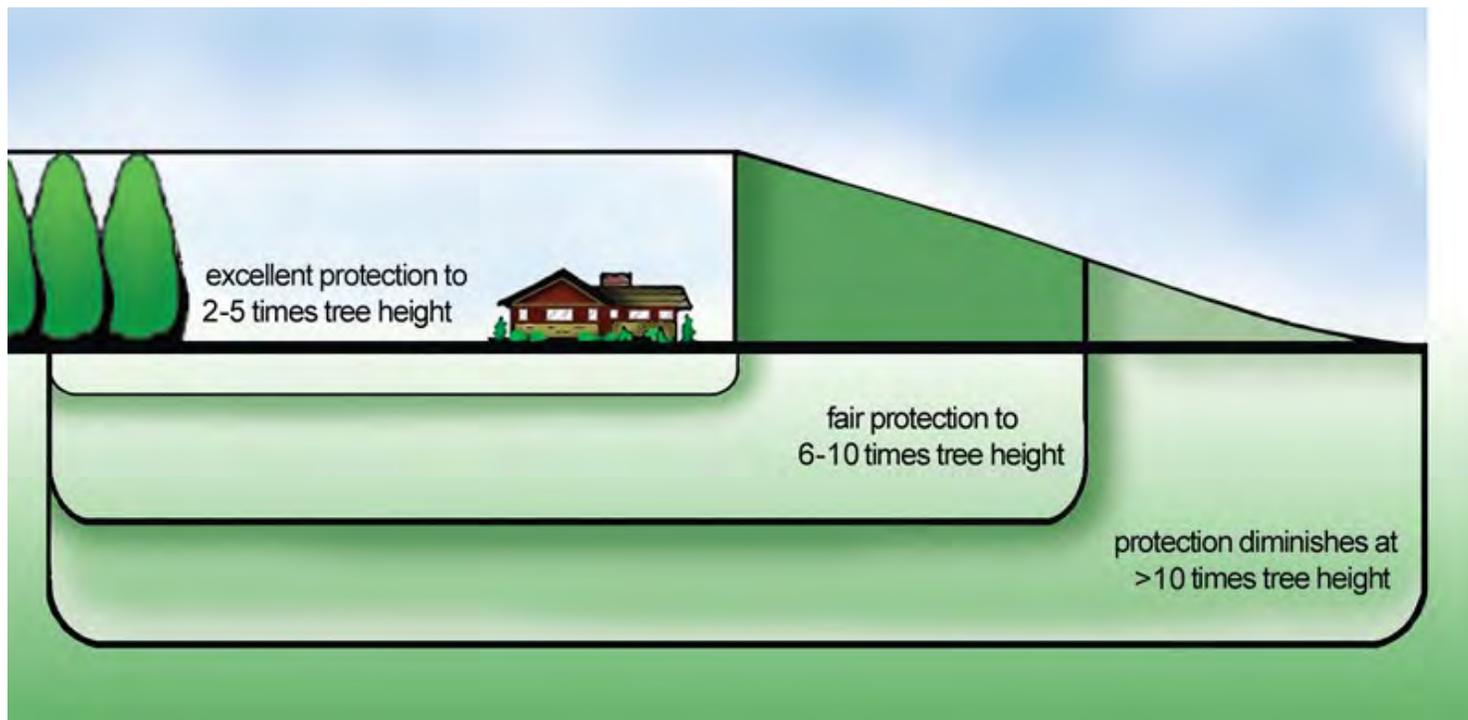


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Adapted from: Air Quality and Shelterbelts: Odor Mitigation and Livestock Production, A Literature Review. USDA National Agroforestry Center.

nrcs.usda.gov/



Tree height	Protection
2 to 5 H	Excellent
6 to 10 H	Fair
>10 H	Low

Height and length are important. Extend the length to the entire area to account for changing wind directions. Doubling the length will generally increase the area protected by 4 times.

Different zones of protection from a windbreak. The level of protection depends on the height of the trees and distance (downwind) from the windbreak. This formula applies to flatland. The maximum design height (H) for the windbreak or shelterbelt shall be the expected height of the tallest row of trees or shrubs at **age 20** for the given site.

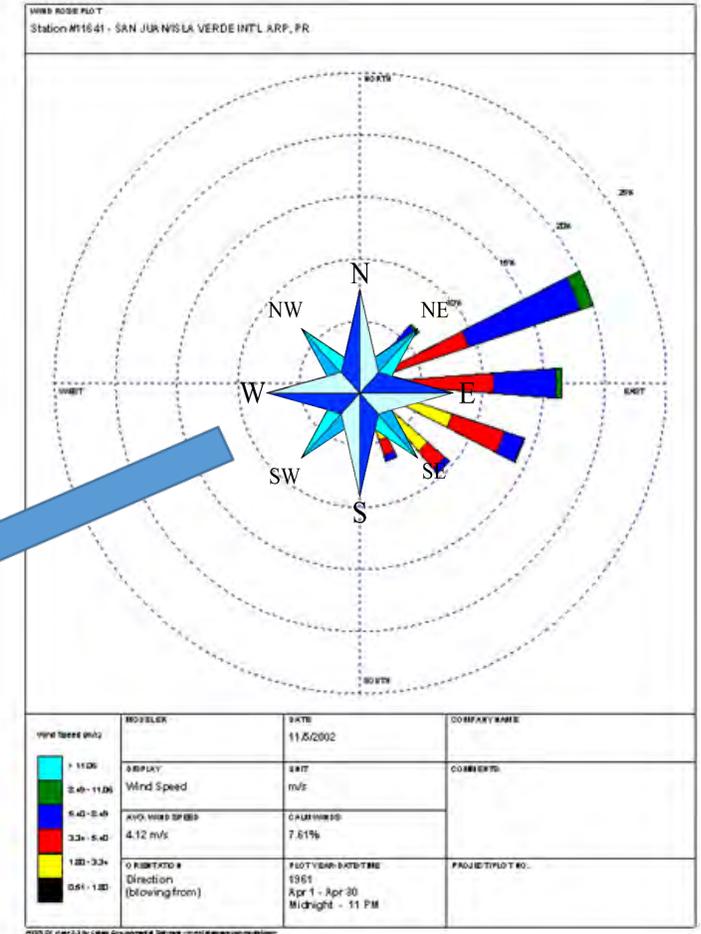
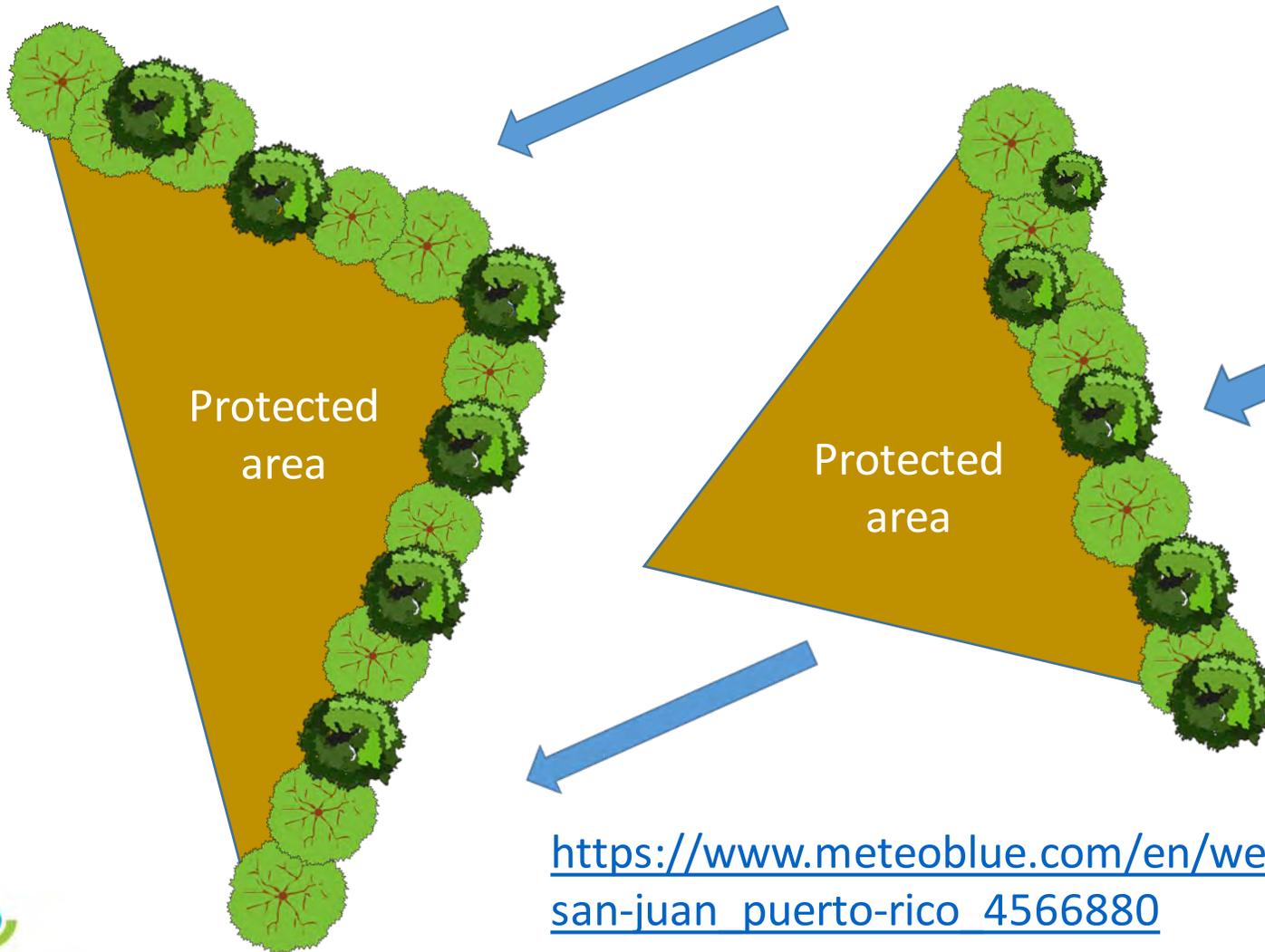
For wind protection, the minimum barrier **density** will be 65 percent during the months of most troublesome wind.

Density: solid part of the barrier. 50% to 65% is acceptable for most of the uses.

Porosity: open spaces in the barrier.



Windbreak/Shelterbelt



https://www.meteoblue.com/en/weather/forecast/modelclimate/san-juan_puerto-rico_4566880





- Windbreaks designed primarily for wildlife can have more plant diversity for a natural look.
- For traffic noise, the barrier width shall not be less than 20 feet wide.
- **Points to remember:**
 - Windbreaks modify: air flow, sound waves, odor plumes, microclimate dynamics and,
 - Trap/filter: sediment, nutrients, pesticides, pathogens and VOC's
 - There are 6 key features upon windbreak depends:
 - Height
 - Density
 - Orientation
 - Length
 - Width
 - Continuity





Q. What Supporting Practices for Windbreak/Shelterbelt Establishment?

- Tree/Shrub Site Preparation (Code 490)
- Tree/Shrub Establishment (Code 612)
- Tree/Shrub Pruning (Code 660)



For all conservation practices:

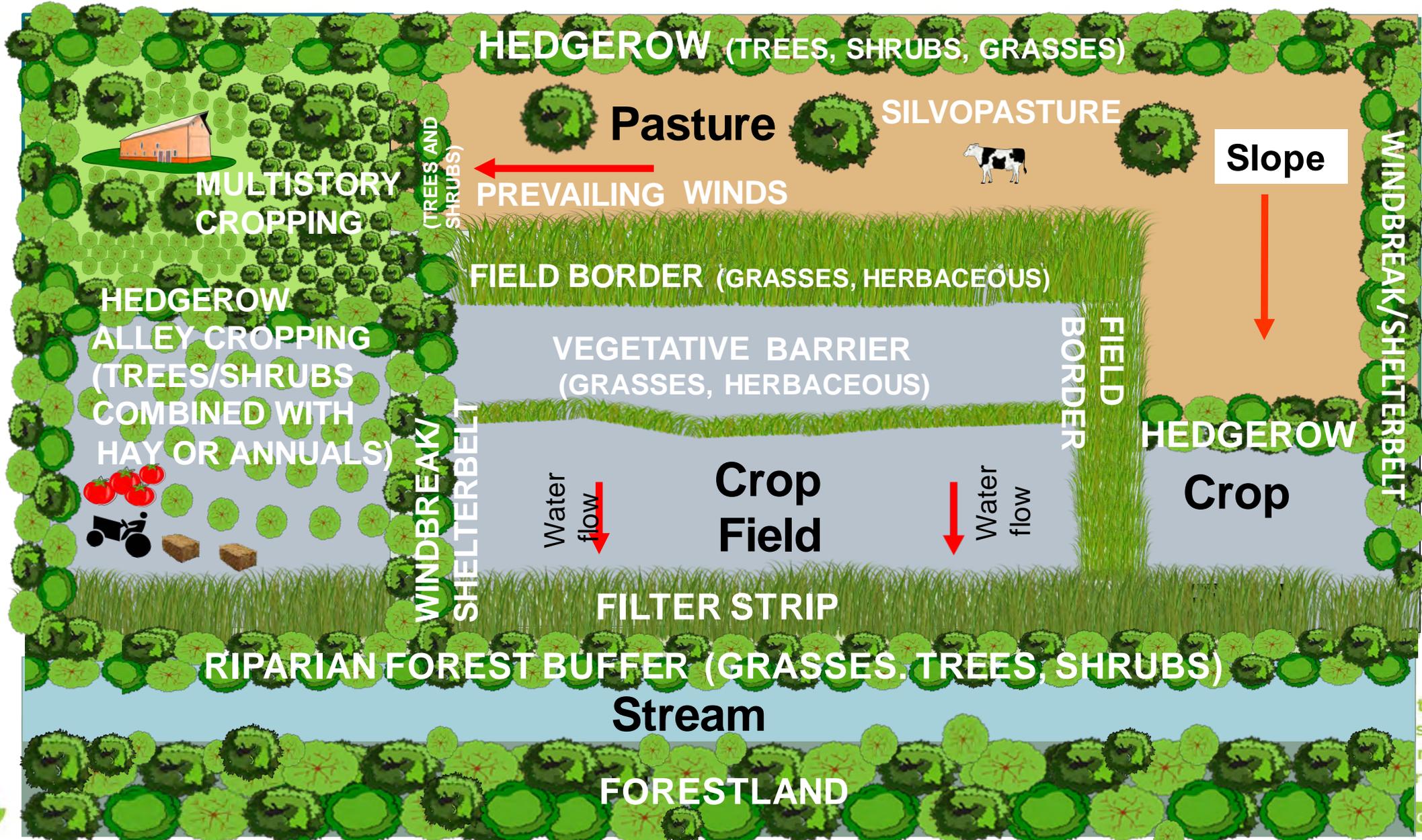
PLANS AND SPECIFICATIONS

Plans and specifications for applying practices must be prepared for each site and recorded using approved specification sheets, job sheets, technical notes and narrative statements in the conservation plan, or other acceptable documentation.

OPERATION AND MAINTENANCE: COMMIT TO LONG-TERM MAINTENANCE.

According to conservation practice standard and specifications: a maintenance program including frequency of inspection, provisions for repair, and routine on site visits.







References:

1. *Use of Vegetation in Civil Engineering*. N. J. Coppin (Author), I. G. Richards (Editor). 1990
2. *CORE4. Conservation Practices Training Guide. The Common Sense Approach to Natural Resource Conservation. 1999, Rev. 2015. USDANRCS*
3. *eFOTG USDANRCS Caribbean Area (Dec. 2018)*
4. Equations for predicting soil loss due to water and air erosion. Legal Information Institute. Cornell Law School. (Dec 2018)
5. *PUERTORICO EROSION AND SEDIMENT CONTROL HANDBOOK FOR DEVELOPING AREAS*. March 2005. Puerto Rico Environmental Quality Board and USDA – Natural Resources Conservation Service.
6. USDANRCS PLANTS (Dec 2018)
7. *USVI Coastal Zone, Management Program, Section 309, Assessment and Strategy 2018-2021*. 2018. USVI DPNR.





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- (2) fax: (202) 690-7442; or
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