NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

RIPARIAN FOREST BUFFER

(Acre)

CODE 391

DEFINITION

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

PURPOSES

- Create shade to lower water temperatures to improve habitat for aquatic organisms.
- Provide a source of detritus and large woody debris for aquatic and terrestrial organisms.
- Create wildlife habitat and establish wildlife corridors.
- 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.
- Provide a harvestable crop of timber, fiber, forage, fruit, or other crops consistent with other intended purposes.
- Provide protection against scour erosion within the floodplain.
- Restore natural riparian plant communities.
- Moderate winter temperatures to reduce freezing of aquatic over-wintering habitats.
- To increase carbon storage.

CONDITIONS WHERE PRACTICE APPLIES

On areas adjacent to permanent or intermittent streams, lakes, ponds, wetlands and areas with ground water recharge that are capable of supporting woody vegetation.

CRITERIA

General Criteria Applicable To All Purposes

The location, layout and density of the riparian forest buffer will accomplish the intended purpose and function

Dominant vegetation on riparian areas (bottom land sites) will consist of existing, naturally regenerated, or planted broadleaf trees and shrubs suited to the site and the intended purpose. Conifers such as Ponderosa pine and Rocky Mountain juniper can be utilized, to a limited degree, as appropriate on riparian areas (bottom land sites) in MLRA's 64 and 67 where they are adapted and meet the intended purpose.

All buffers will consist of a Zone 1 that begins at the top of the bank, and extends a minimum distance of 15 feet, measured horizontally on a line perpendicular to the water body. Zone 1 will contain at least one row of trees and/or shrubs.

Occasional removal of some tree and shrub products such as high value trees is permitted in zone 1 provided the intended purpose is not compromised by the loss of vegetation or harvesting disturbance.

Necessary site preparation and planting shall be done at a time and manner to insure survival and growth of selected species.

Only viable, high-quality and adapted planting stock will be used.

Site preparation shall be sufficient for establishment and growth of selected species and is done in a manner that does not compromise the intended purpose.

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resource Conservation Service.

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

Harmful pests present on the site will be controlled or eliminated as necessary to achieve and maintain the intended purpose.

Comply with applicable federal, state and local laws and regulations during the installation, operation (including harvesting activities) and maintenance of this practice.

Additional Criteria To Create Shade to Lower Water Temperatures to Improve Habitat For Aquatic Organisms

When moderating water temperature for the targeted aquatic organism(s) especially cold water fisheries, tree species in zone 1 will be selected to provide adequate shading during the summer months. When necessary to provide adequate shade trees will also be a component of zone 2. Effective tree heights will account for summer shadow lengths and the distance to the surface of the water body for moderating water temperatures. To effectively moderate water temperature a significant reach of the stream will need to be shaded starting at its source.

When selecting tree species the effective height will be the mature height of trees in zone 1 plus the height from the edge of the bank to the normal flow line. Refer to Tables 1-10 "Conservation Tree & Shrub Suitability Groups" in Section II Windbreak Interpretations of the FOTG to determine mature tree height. Shadow lengths will vary depending which side the buffer is located, and the time of the day and the month. Trees on the north side of a stream will not provide shading benefits needed for this purpose.

For purposes of selecting appropriate tree species (on the south, east and west sides) to provide shading during the most critical periods, use 50% of the effective height to determine shadow length. For example; a mature tree 50 feet tall that is 10 feet from the top-edge of the stream bank to the normal flow line would have an effective tree height of 60 feet, providing an average shadow length of 30 feet.

Additional Criteria To Provide Habitat For Terrestrial Wildlife

Width of Zone 1 and/or Zone 2 will be expanded to meet the minimum requirements of the wildlife or aquatic species and associated communities of concern.

Establish riparian plant communities that address the target wildlife needs and existing resources in the watershed. Upland game birds and grassland songbirds that utilize woody cover are best suited to shrub only plantings that minimize detrimental impacts from raptors and provide optimum habitat. Refer to Table 1 for detailed width preferences for selected wildlife.

Widths on Table 1 include the sum of buffer zones on one or both sides of a stream (widths on each side should usually be the same) and may extend beyond riparian boundaries as long as they are contiguous.

Additional Criteria To 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

An additional strip or area of land, Zone 2, will begin at the edge and up-gradient of Zone 1 and extend a minimum distance of 20 feet, measured horizontally on a line perpendicular to the water body. The minimum combined width of Zones 1 and 2 will be 100 feet or 30 percent of the flood plain whichever is less, but never less than 35 feet. Refer Figures 1-4 for example calculations and Figure 5 for a typical riparian forest buffer design.

The active floodplain is defined as the flow width including out of channel flow that occurs after a 2-year 24-hour storm event. Streams that are deeply incised will contain a 2-year 24-hour storm event and the active floodplain is contained within their banks.

Criteria for Zone 1 shall apply to Zone 2 except that removal of products such as timber, fiber, nuts, fruit and forbs is permitted and encouraged on a periodic and regular basis provided the intended purpose is not compromised by loss of vegetation or harvesting disturbance.

Zone 2 will be expanded in high nutrient, sediment, and animal waste application areas,

where the contributing area is not adequately treated or where an additional level of protection is desired.

A Zone 3 shall be added to the riparian buffer when adjacent to cropland or other sparsely vegetated or highly erosive areas to filter sediment, address concentrated flow erosion, and maintain sheet flow. The Filter Strip standard (practice code 393) shall be used to design Zone 3.

Table 1 - Riparian Forest Buffer Width Preferences of Selected Wildlife Species

Species:	Desired Width in Feet
American Avocet	*
American Bittern	*
Black-tailed Prairie Dog	*
Black Tern	*
Burrowing owl	*
Canada Goose	*
Ferruginous Hawk	*
Lark Bunting	*
Long-billed Curlew	*
Plains Topminnow	*
Pronghorn Antelope	*
Sandhill Crane	*
Swift Fox	*
Trumpeter Swan	*
Upland Sandpiper	*
Whooping Crane	*
Western Meadowlark	* - N
Mink	* - N
Blue Winged Teal	N
Eastern Bluebird	N
Greater Prairie Chicken	N
Mule Deer	N
Pheasant	N
Sharptail Grouse	N
Short-eared Owl	N
Red Headed Woodpecker	N
Beaver	N – VW
Coyote	N – VW
Great Horned Owl	N - VW
Raccoon	N - VW
Red-tailed Hawk	N - VW
Virginia Opossum	N - VW
White-tailed Deer	N - VW
Mourning Dove	N - W
Red Fox	N - W
American Elk	VW
Bald Eagle	VW
Bobcat	VW
Eastern Woodrat	VW
Gray Fox	VW
Southern Flying Squirrel	VW
Woodcock	VW
Bobwhite Quail	W
Cooper's Hawk	W
Mocking Bird	W
Swainson's Hawk	W
Eastern Fox Squirrel	W -VW
Great Blue Heron	W - VW
Hairy Woodpecker	W - VW
Red Bat	W - VW
Turkey Vulture	W - VW
Wild Turkey	W - VW
Wood Duck	W - VW

* = Avoids Woody Cover
N = Narrow - 35'
W - Wide - 35 - 100'
VW = Very Wide = > 100'

FIGURE 1. ACTIVE FLOODPLAINS GREATER THAN 333 FEET (102 M) IN WIDTH.

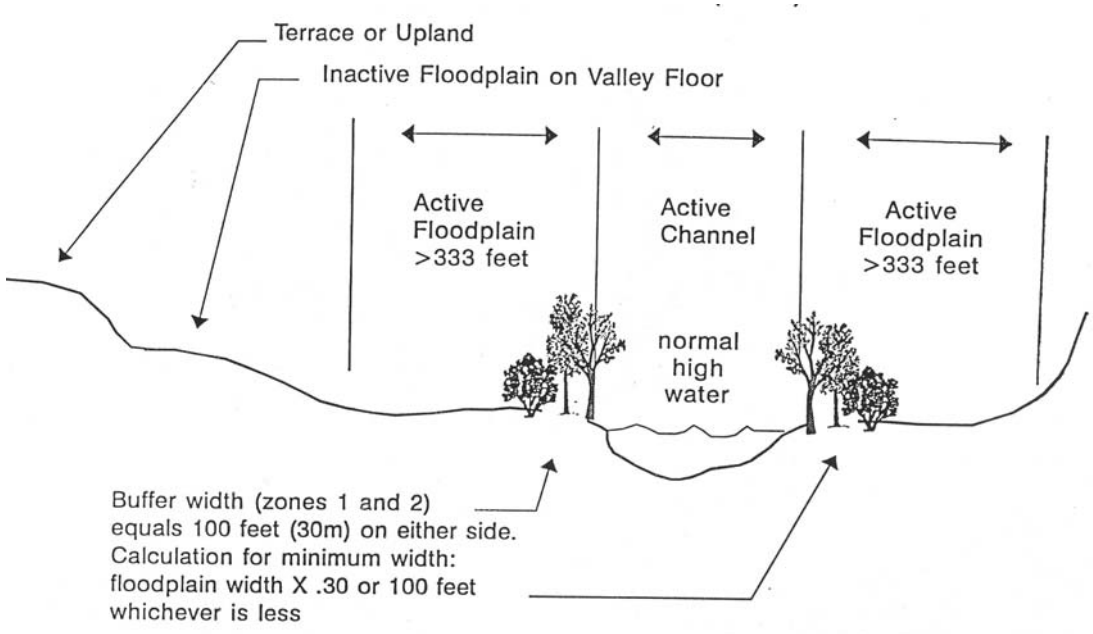

FIGURE 2. ACTIVE FLOODPLAINS LESS THAN 333 FEET (102M).

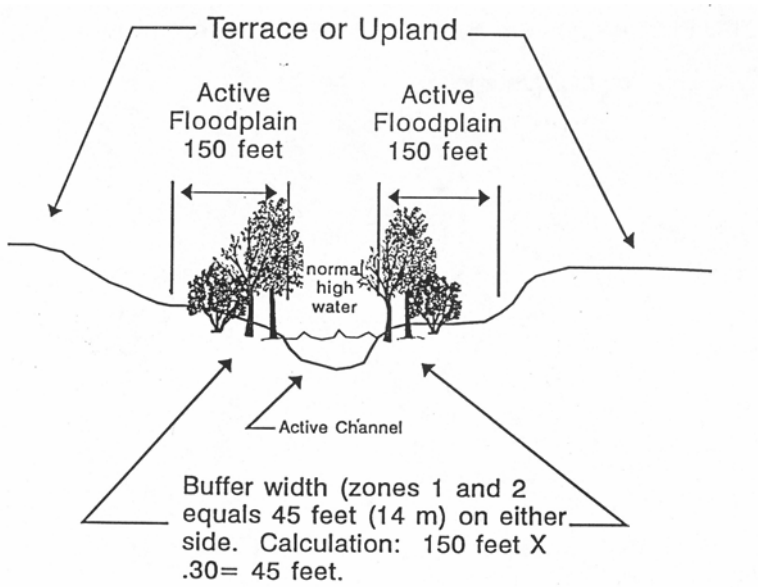

FIGURE 3. INCISED CHANNEL WITH ACTIVE FLOODPLAIN (2-YR 24 HOUR STORM) CONTAINED WITHIN ITS BANKS AND OTHER WATER BODIES SUCH AS LAKES.

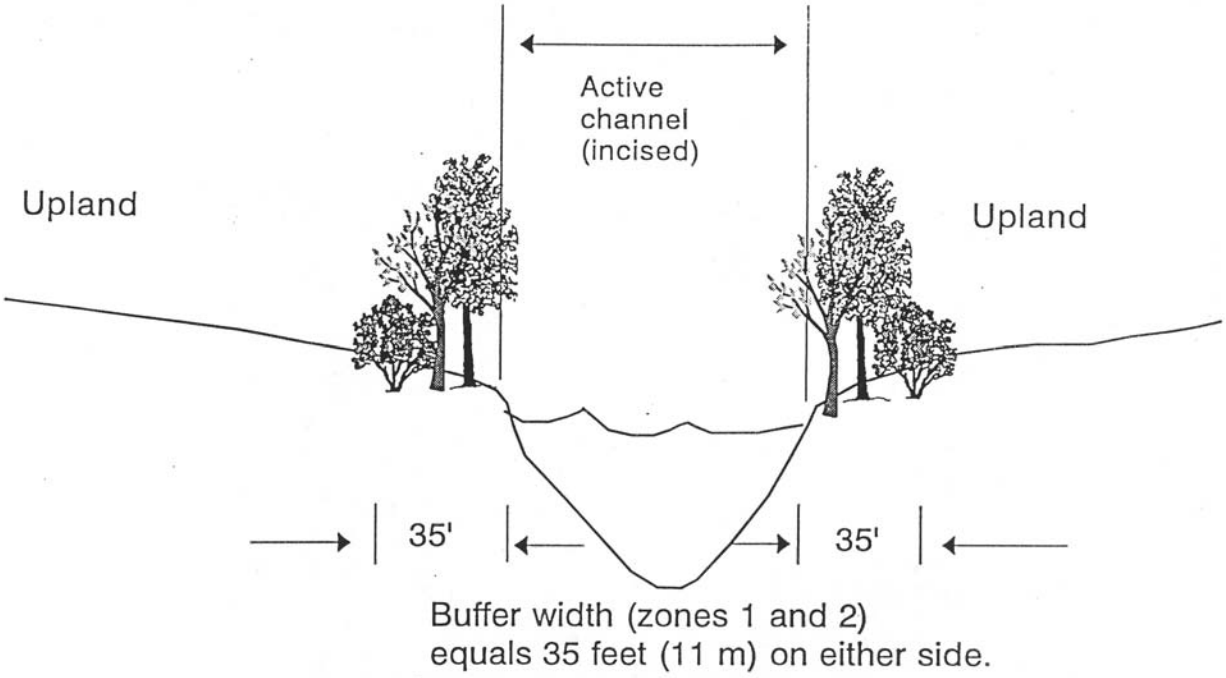

FIGURE 4. ACTIVE FLOODPLAIN ON ONLY ONE SIDE OF THE CHANNEL.

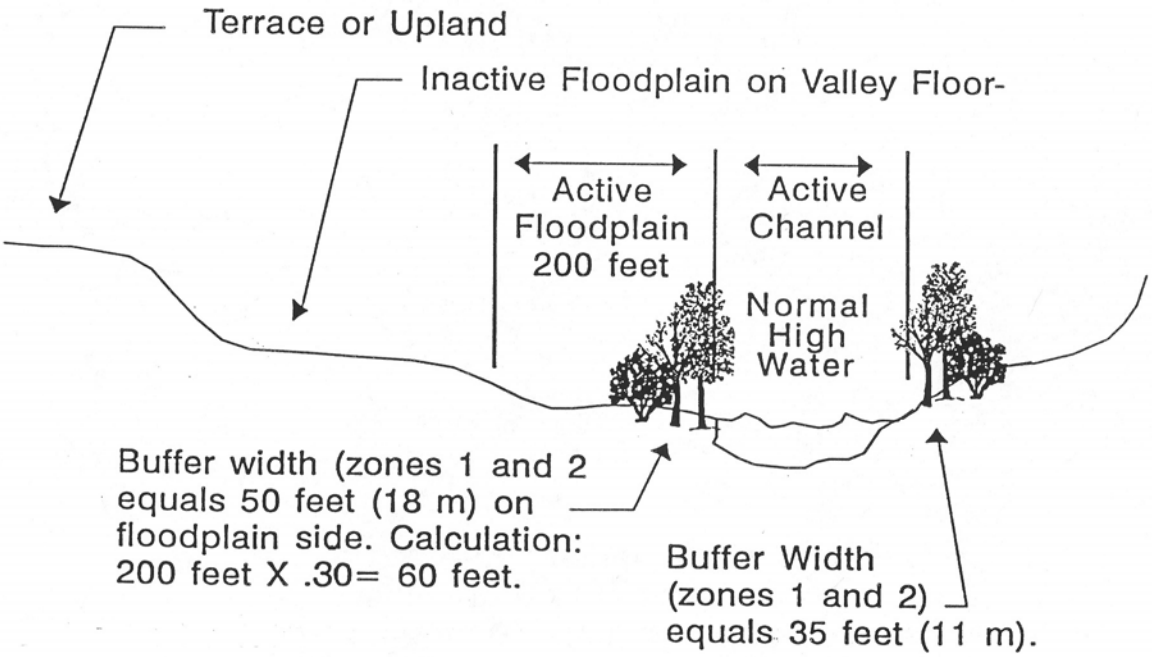

Figure 5 Typical Riparian Forest Buffer

	←Min 20'→ (if required)	←Min 20'→	←Min 15'→		←Min 15'→	←Min 20'→	←Min 20'→ (if required)	
CROPLAND	ZONE 3 RUNOFF CONTROL	ZONE 2 MANAGED FOREST	ZONE 1 UNDISTURBED FOREST	STREAMBOTTOM	ZONE 1 UNDISTURBED FOREST	ZONE 2 MANAGED FOREST	ZONE 3 RUNOFF CONTROL	PASTURE
Sediment, fertilizer and pesticides are carefully managed.	Concentrated flows are converted to dispersed flows by water bars or spreaders, facilitating ground contact and infiltration.	Filtration, deposition, plant uptake, anaerobic denitrification and other natural processes remove sediment and nutrients from runoff and subsurface flow.	Maturing trees provide detritus to the stream and help maintain lower water temperature vital to fish habitat.	Debris dams hold detritus for processing by aquatic fauna and provide cover and cooling shade for fish and other stream dwellers.	Tree removal is generally not permitted in this zone.	Periodic harvesting is necessary in Zone 2 to remove nutrients sequestered in tree stems and branches and to maintain nutrient uptake through vigorous tree growth.	Controlled grazing or haying can be permitted in Zone 3 under certain conditions.	Watering facilities and livestock are kept out of the Riparian Zone insofar as practicable.

CONSIDERATIONS

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

Consider establishing trees/shrubs through natural regeneration when seed or current tree/shrub reproduction is adequate to establish an acceptable stand in the timeframe desired. Existing or expected regeneration needs to be protected from domestic and/or wild animals, fire, logging, herbicide damage, etc. Natural regeneration coupled with appropriate management techniques can be successful with some tree/shrub species. Trees/shrubs must be desirable and meet the objectives of the customer. They must also meet the appropriate criteria and considerations in this standard. Contact your local forester for assistance.

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

Favor tree and shrub species that are native**,** non-invasive, or have multiple values such as those suited for timber, biomass, nuts, fruit, browse, nesting, aesthetics and tolerance to locally used herbicides.

Tree and shrub species, which may be alternate hosts to undesirable pests, should be avoided. Species diversity should be considered to avoid loss of function due to species-specific pests.

Plants that deplete ground water should be used with caution in water-deficit areas.

Allelopathic impacts of plants such as Black Walnuts should be considered.

Generally, sites that are/were naturally wooded with native tree species should be developed/managed to maintain and enhance those qualities and characteristics. (See Appendix A for recommendations.)

Sites which are suited for predominantly herbaceous vegetation and occasional, intermixed shrub patches should be developed/managed using the Riparian Herbaceous Cover (390) standard. This includes sites where native prairie located in close proximity will be negatively impacted by woody encroachment. (See Appendix A for recommendations.)

Nebraska Biology Technical Note #65 – Terrestrial Natural Communities of Nebraska, Steinauer and Rolfsmeier 2003 – should be used as a reference to determine sites which are suited for riparian forest buffer.

The following natural communities are critical habitat types that frequently occur adjacent to rivers and streams throughout Nebraska and should be developed or managed as riparian forest buffers:

- Eastern Riparian Forest
- Western Riparian Woodland
- Eastern Cottonwood-Dogwood Riparian Woodland
- Eastern Cottonwood-Willow Riparian Woodland
- Paper Birch Springbranch Canyon Forest
- Lowland Bur Oak Forest
- Lowland Hackberry-Walnut Forest
- Green Ash-Elm Canyon Bottom Woodland

The following natural communities are critical habitat types that frequently occur adjacent to rivers and streams throughout Nebraska and should be developed or managed as riparian herbaceous cover:

- Western Alkaline March
- Eastern Saline Marsh
- Eastern Cordgrass Wet Prairie
- Eastern Saline Meadow
- Eastern Sedge Wet Meadow
- Northern Sedge Wet Meadow
- Northern Cordgrass Wet Prairie
- Western Streamside Wet Meadow
- Western Alkaline Meadow
- Wet-mesic Tallgrass Prairie
- Missouri River Floodplain Terrace Grassland
- Western Floodplain Terrace Grassland

Each natural community description for these sites also contains detailed information related to herbaceous plant species composition which can be used to develop planting recommendations or management options.

The location, layout and density of the buffer should complement natural features, and mimic natural riparian forests. This includes providing

for small open meadows or prairie areas within the riparian forest buffer as appropriate to provide for a specific purpose (e.g. habitat diversity for terrestrial wildlife).

PLANS AND SPECIFICATIONS

Specifications for applying this practice shall 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. Refer to Statement of Work documentation requirements and 391SOW for guidance on deliverables for design, installation, and checkout of this practice. Plans and specifications will address all of the appropriate criteria within this standard. In addition the following guidelines will be utilized when developing plans and specifications:

Tree/Shrub Planting Procedures. Refer to Tree/Shrub Planting Procedures (380TPP) for planting procedures and requirements for tree/shrub plantings including: site preparation; planting stock requirements; planting dates; planting operations; control of competitive vegetation after planting; cover between rows; care and maintenance (including replanting); direct seeding methods; drip watering systems and fabric mulch installation.

Initial Planting Density. Initial tree/shrub planting density for trees and shrubs will depend on their average height at 20 years of age (Refer to Table 2 for requirements). Heights may be estimated based on:

1) Performance of the individual species (or comparable species) in nearby areas on similar sites, or
2) Predetermined and documented heights using Conservation Tree/Shrub Suitability Groups, Section II, Windbreak Interpretations in the Field Office Technical Guide.

Plant List. The following is a partial list of potential species that are generally favored for riparian forest buffers with moist soils or flooding conditions. On bottomland sites adapted broadleaf trees and shrubs shall be favored over conifers. For a complete list of species for all sites, refer to FOTG Section II, Windbreak Interpretations - Conservation Tree and Shrub Interpretations, Conservation Tree and Shrub Suitability Groups, Tables I-10 for guidance on adapted species for a specific site and Table 11 for species attributes.

Conifers
Bald Cypress

Deciduous Trees
Green Ash
American Basswood (well drained soils)
Boxelder
Black Cherry (well drained soils)
Cottonwood
Hackberry (well drained soils)
Honeylocust (well drained soils)
Silver Maple
Mulberry
Pecan
Pin Oak
Swamp White Oak
American Sycamore
Black Walnut (well drained soils)
White Willow
Black Willow (Salix nigra)
Golden Willow

Shrubs
Redosier dogwood
Gooseberry
Gray Dogwood
Elderberry
Silky Dogwood
False indigo

Table 2 Initial Tree/Shrub Planting Density

Plant Types/Heights: (20 year Height in ft.)	[2/] Plant-to-Plant Spacing in feet	No. of Plants/Stems (Per Acre) Min.	Max.
[1/] Small shrubs (< 10')	3-6'	1210	4840
[1/] Large shrubs and small trees including columnar trees (10' to 20')	6-10'	440	1210
Large trees (> 20')	10-15'	200	440

[1/] Small shrubs and small trees planted as understory of large trees do not need to meet minimum planting density requirements.

[2/] It is preferable that plant-to-plant spacing is equal between and within rows when possible. If necessary for maintenance a wider between row spacing is allowed as long as the minimum number of saplings/plants/stems per acre are planted.

OPERATION AND MAINTENANCE

The following actions shall be carried out to insure that this practice functions as intended throughout its expected life.

The riparian forest buffer will be inspected periodically and maintained to protect from adverse impacts such as excessive vehicular and pedestrian traffic, pest infestations, pesticides, livestock or wildlife damage and fire.

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Replacement of dead trees or shrubs and control of undesirable vegetative competition will be continued until the buffer is, or will progress to, a fully functional condition. Refer to Tree Planting Procedures TPP 380 for detailed Care and Maintenance guidelines and control of competitive vegetation. Refer to Nebraska Forestry Technical Note No. 63 for detailed replanting requirements.

As applicable, control of concentrated flow erosion and sediment deposition shall be controlled by an adjacent filter strip (zone 3).

Any use of fertilizers, pesticides and other chemicals to assure buffer function shall not compromise the intended purpose. Refer to the Current Guide for Weed Management in Nebraska for herbicide use guidelines.

Management is needed on certain sites to maintain vegetation, including the control of unwanted vegetation (e.g. undesirable, volunteer tree species such as Siberian elm, Russian olive, red cedar, etc.).

A riparian functional assessment can monitor the change in riparian health and direct future management needs.