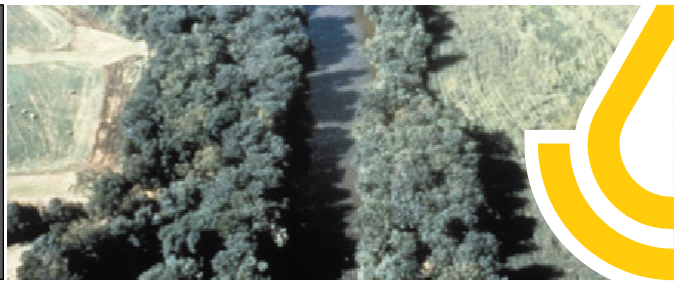
Riparian Forest Buffer

Wisconsin Guidance Document 391



DEFINITION

An area that consists predominately of combinations of trees and shrubs designed to mitigate the impacts of land use on a water feature. These areas are connections between aquatic and upland habitats for wildlife and can also serve as connections to other habitat areas along the water feature.

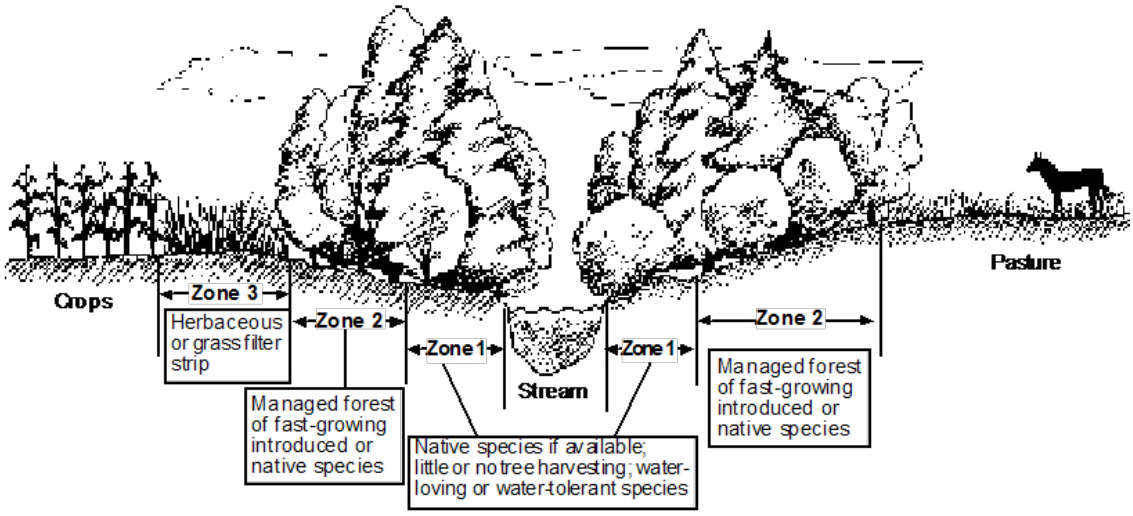
PURPOSE

- Provide shade to lower water temperatures and facilitate higher stream dissolved oxygen concentrationsto improve habitat for aquatic organisms.
- Provide a source of detritus and large woody cover for aquatic organisms.
- Improve water quality by establishing permanent tree and herbaceous cover in floodplain areas subject to out-of-bank flow and/or scour erosion.
- Provide habitat and corridors for aquatic and terrestrial flora and fauna.
- Increase transpiration and infiltration, resulting in slower groundwater discharge to streams and reduced flood flows and to mitigate flood damage.
- Restore riparian plant communities.
- Improve water quality by reducing amounts of sediment, organic matter, nutrients, pesticides, and other pollutants in surface runoff and reducing the amounts of nutrients and other chemicals in shallow groundwater.
- Reduce pesticide drift entering the water body.
- Increase carbon storage in plant biomass and soils.

WHERE USED

Buffers are located along or around permanent or intermittent streams, lakes, ponds, wetlands, or seeps. Many of these areas feature year-round or seasonal moisture, which allows woody species to establish quickly. A new riparian forest buffer can rapidly benefit a variety of settings, such as cropland, rangeland, forest land, and urban areas.

Figure 1. Zones of Riparian Forest Buffer



A riparian forest buffer includes a zone 1, the area closest to the stream or waterbody, and a zone 2, the area adjacent to and up gradient of zone 1. Trees and shrubs in zone 1 provide important wildlife habitat, litter fall for aquatic organisms, large wood that can fall into the stream or waterbody and shading to lower water temperature. This zone helps stabilize streambanks and shorelines. It is important for trees and shrubs in this zone to be adapted to periodic flooding and/or seasonally wet soil. Trees and shrubs in zone 2 (along with zone 1) intercept sediment, nutrients, pesticides, and other pollutants in surface and subsurface water flows. Zone 2 can be managed to provide timber, wood fiber, and horticultural products. A third zone, zone 3, is established if periodic and excessive water flows, erosion, and sediment from upslope fields or tracts are anticipated. Zone 3 generally consists of herbaceous plants or grass and a diversion or terrace. This zone provides a "first line of defense" to assure proper functioning of zones 1 and 2.

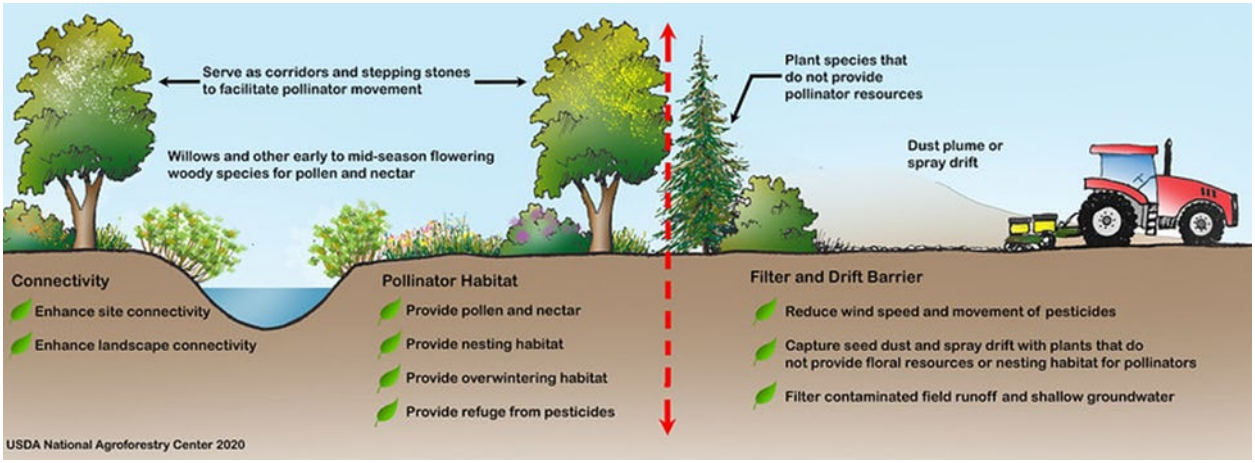
RESOURCE MANAGEMENT SYSTEM

Riparian forest buffers are normally established concurrently with other practices as part of a resource management system. For example, adjoining streambanks or shorelines must be stabilized before or in conjunction with the establishment of the buffer (streambank and shoreline protection). To maintain proper functioning of a planting, excessive water flows and erosion must be controlled upslope of the riparian forest buffer (filter strip, critical area planting, residue management). New plantings must be protected from grazing during establishment.

WILDLIFE

Connecting a riparian forest buffer with existing perennial vegetation, such as woodlots and woody draws or other woody habitat (windbreak/shelterbelt), benefits wildlife, including fish and other aquatic organisms. Select tree and shrub species and a planting pattern that benefit the wildlife species of interest and enhance local landscape aesthetics. See Figure 2 for a layout that benefits pollinators.

Figure 2. Buffer Layout to Benefit Pollinators



PLANNING CONSIDERATIONS

See 612-Tree/Shrub Establishment-Planting Guide guidance document for general reference on planning a planting. 612-Tree/Shrub Establishment also has guidance documents for planting protection and ash replacement plantings. What follows is guidance specific to Riparian Forest Buffer plantings, including agroforestry considerations.

Zone 1: This zone is required to be at least 15 feet in width. Management should be limited to removal of invasive species or hazard trees. Economic activities should be limited in this zone, as the primary function is ecological. For this reason, only native species should be planted.

Soils in this area can often be waterlogged or seasonally flooded. This can be a difficult area to establish trees and shrubs. Areas that are waterlogged throughout the year should not be planted as the planting is likely to fail. Work around the edges of waterlogged areas or on mounds or other elevated areas within them. Mounds can also be created with site preparation using an excavator. Often cuttings of flooding tolerant species will work well in these situations. Willow species, eastern cottonwood, and balsam poplar are particularly well suited to the cutting planting method.

Tamarack is a good conifer choice around waterlogged soil. Black spruce (on acidic soils) and northern white-cedar (on calcareous soils) are good conifer choices around waterlogged soils as well and are best suited climatically to the northern parts of Wisconsin.

Areas that flood periodically with periods of drying in between have a wider range of planting options. In addition to the species already listed, swamp white oak, silver maple, bur oak, hackberry, red maple, northern red oak, and basswood may be appropriate depending on site and climate conditions. River birch and sycamore are also potential options and are best suited climatically to the southern part of Wisconsin.

American elm is suited to floodplains; however, it is susceptible to Dutch elm disease. Cultivars resistant to Dutch elm disease have been developed and include Jefferson (Hardiness Zone 4), New Harmony (Zone 4b), Valley Forge (Zone 4), JFS-Prince II Colonial Spirit® (Zone 4), Lewis and Clark Prairie Expedition® (Zone 3), Princeton (Zone 4), and St. Croix First Editions® St. Croix™ (Zone 3). These cultivars are typically available from commercial nurseries in more expensive sapling size trees. Note that

resistance is not a guarantee a tree will survive the targeted disease; however, it should perform better than natural trees. These trees will be susceptible to other diseases of elm, such as elm yellows.

Several ash species are also well suited to floodplains; however, these species should not be planted due to likely infestation by emerald ash borer. This recommendation will be revisited if a control option for emerald ash borer is found or resistant cultivars become available.

Stocking should be established at a minimum of 300 stems/acre, of which at least 200 stems/acre should be established as trees. Up to 100 stems/acre may be established as shrubs. It is advisable to plant more than the minimum to account for expected mortality. Plan for at least 25-30% mortality, and up to 50% mortality on difficult sites. Larger stock types (potted or ball-n-burlap) can establish faster and have better survival, although expense is also greater.

Zone 2: This zone is required to be at least 20 feet in width. Forest management and agroforestry are encouraged in this zone. This zone can be used to meet a blend of economic and ecological objectives.

Soils in this area can range from waterlogged to drier upland soils. Matching vegetation species to soil conditions is a key consideration in this zone.

This zone is where management for economic benefit is encouraged. Native species to consider for nut production include shagbark hickory and black walnut. Native species to consider for the floral industry include dogwoods and willows. Oak, black walnut, and sugar maple are native species generally valuable for timber production. Sugar maple can also be used for maple syrup production, although this will reduce timber value. Acceptable cultivars of non-native, non-invasive species developed for fruit, nut, or other economic production are available in the Agroforestry Species List on the Field Office Technical Guide in Section III>Planning Tools>Forestry. When planning an agroforestry planting in riparian areas, carefully consider species/cultivars to plant and their need for fertilizer and pesticide inputs. Species/cultivars that require fewer or no inputs are desirable to reduce potential leaching into the nearby water body. If inputs are required, choose formulations designed for use near water if available.

Make sure that species/cultivars selected for planting are suited to the site and climate rather than focusing solely on economic considerations. Future climate conditions should be considered as well. Stocking will be dependent upon the objectives of the landowner for the zone. Finally, it is important to confirm that markets are available for planned economic production.

Zone 3: If required to buffer forested area from a crop field with an herbaceous/grass buffer, Conservation Practice Standard 393-Filter Strip should be used for planning.

Conservation Reserve Program (CRP) and Conservation Reserve Enhancement Program (CREP) Considerations: The maximum width for CRP riparian forest buffers is 180 feet. The maximum width for most CREP riparian forest buffers is 150 feet. The Lake Superior CREP area has a maximum width of 200 feet for slopes that are 3% or less and a maximum width of 300 feet for slopes greater than 3%.

It is important to note that only native species can be planted for CRP and CREP. Non-native agroforestry species are not appropriate for CRP and CREP plantings.

Site Preparation: Most sites will require some form of site preparation prior to planting to provide growing conditions suitable for tree survival and growth. The amount of site preparation needed will vary depending on existing condition of the planting site. Previously tilled cropland may not require much site preparation. In this situation it is recommended to plant a cover crop (Conservation Practice Standard 340) to reduce soil erosion while trees and shrubs are establishing. Good cover crops for tree planting will not create sod competition. Winter wheat and clover are recommended. An area that currently is established with aggressive grasses or invasive species will require intensive site preparation. Herbicide that is formulated for use in or near water is recommended to control aggressive species efficiently and effectively. On pasture sites, compaction may be an issue and require ripping or sub-soil site preparation to break up the compacted layer and allow better root growth and tree stability.

In wet areas, mounding site preparation may increase planting success. This can be done with an excavator (backhoe), or by hand for small plantings. Mounds are typically 1-3 feet in diameter and 6-12 inches in height. When using mechanical equipment in wetland/riparian settings, it is important to work only when soil conditions are dry to avoid rutting and compaction (generally late summer). The mounds provide a better-drained and warmer planting spot which is beneficial for seedling establishment. Mound's mimic natural processes in wetland forests where trees are tipped over by wind, partially pulling the roots out and above the ground surface and resulting in a depression where the roots used to be. As the roots decompose and attached soil sloughs off, mounds are formed next to the depressions. These natural mounds should also preferentially be used as planting spots.

Conservation Practice Standard 490-Tree/Shrub Site Preparation should be used where significant site preparation is required.

Planting Protection: Areas with a high density of deer will require protection of planted species that deer find palatable. Rabbits and other rodents may also girdle trees in winter by eating the inner bark on the lower part of planted trees/shrubs. Tree shelters, individual tree cages, and perimeter fencing can be used to address deer and/or rodent damage. Shelters (and the trees within) may be susceptible to damage during flood events due to having a high resistance to flowing water. Flood risk must be weighed carefully with browse risk in these situations. Well-staked wire cages or perimeter fencing may be better options in flood-prone areas. More information can be found in Conservation Practice Standard 612-Tree/Shrub Establishment-Protection Guidance Document.

Competition Control During Establishment: To have a successful planting, competition from other vegetation must be controlled until the trees and shrubs have established and outgrown the competitive species. This is commonly done either by herbicide application or mulching/weed fabric. Herbicide application should be planned carefully to avoid impacts to water quality in the nearby water feature. Herbicides specifically formulated for use near or in water are recommended.
Reed canarygrass may be an issue in riparian areas. Research in Wisconsin bottomland hardwoods has shown that, if timed carefully, reed canarygrass can be controlled with herbicide without damaging seedlings. Timing is crucial, with the window in the fall after the seedlings have gone dormant for winter

and before the reed canarygrass has died back. If the seedlings are not dormant the herbicide may damage or kill them. This window typically occurs sometime in October.

Mowing between rows of planted trees is also recommended to reduce habitat for rodents that may damage tree boles by feeding on the inner bark in winter. Mowing late in the growing season will reduce winter habitat for rodents.

CONSIDERATIONS FOR AREAS OF EXISTING TREE/SHRUB COVER

Areas within the buffer that have established tree/shrub cover may already be functioning as riparian forest buffer. These areas should be excluded from the treatment area if they meet stocking guidelines for the forest type. To determine this, sample plots should be done. Install at least three sample plots and collect species, trees/acre, and DBH (Diameter at Breast Height - 4.5' above ground level) measurements. Use fixed area plots at a size that results in an average of 4 – 10 trees per plot (typical is a 1/20th acre fixed plot with a plot radius of 26.3' or 1/30th acre fixed plot with a plot radius of 21.5'). Average the plot data (DBH and trees/acre) and compare to the table below for bottomland hardwood forest type (if the existing forest type is not bottomland hardwoods, consult with NRCS state forester for recommendations).

- If the result falls within the stocking recommendations, no further action is required (although 314-Brush Management or 315-Herbaceous Weed Treatment may be needed for invasive plants). However, species composition should also be considered. Areas with significant stocking of ash species will fall below recommended stocking levels due to emerald ash borer. A treatment to salvage ash and regenerate other species may be appropriate in this case.
- If stocking is higher than the maximum recommended, use 666-Forest Stand Improvement to implement a thinning.
- If stocking is below the minimum recommended, include in the Riparian Forest Buffer treatment and underplant the area to increase stocking. Carefully consider tree species' tolerance of shade in this case, and only choose trees that can thrive in the current light conditions.

Table 1. Minimum and Maximum Stocking Levels by Average Diameter at Breast Height (DBH) for Bottomland Hardwood Forest Type

Average DBH (inches)	Range of Full Stocking (Trees/Acre)
6	202-475
10	112-202
14	71-112
18	49-71
22	36-49
26	27-36

Source: Meyers, C.C. 1989. Estimating bottomland hardwood growth and yield. In. Clark, F.B. tech. ed.; Hutchinson, J.G. ed. Central Hardwoods Notes. St. Paul, MN: USDA, Forest Service, North Central Forest Experiment Station. Note 5.05., accessed from the website North Central

Region Bottomland Hardwood Management Guide: *A cooperative project of the USDA Forest Service and University of Minnesota.* https://www.nrs.fs.fed.us/fmg/nfmg/bl_hardwood/silv/communities/intermediate.html#stockingchart. Accessed 4-19-2021.

The NRCS Stream Visual Assessment Protocol Version 2 may be used in combination with the above information to determine existing vegetation's suitability as a riparian forest buffer. Elements 4 and 5 of the protocol address riparian area quantity and quality. Scores for these elements greater than 5 indicate a functional riparian forest buffer. These elements are attached as an appendix.

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(d) Elements 4 and 5—Riparian area quantity and quality

Description and rationale for assessing riparian area conditions

Riparian areas are the vegetated areas adjacent to stream channels that function as transitional areas between the stream and uplands. Riparian vegetation thrives on the moisture provided by streamflow and ground water associated with the stream corridor. Riparian areas may or may not include flood plains and associated wetlands, depending on the valley form of the stream corridor. For example, steep mountainous streams in narrow V-shaped valleys often do not have obvious flood plains. Riparian areas are among the most biologically diverse habitats of landscapes and are sources of wood, leaves, and organic matter for the stream. These areas provide important habitat and travel corridors for numerous plants, insects, amphibians, birds, and mammals.

Ecological processes that occur in the stream corridor are linked to those in uplands via intact riparian areas and flood plains, if present. Riparian areas themselves also provide valuable functions that maintain or improve stream and flood plain conditions. The capacity for riparian areas to sustain these functions depends in part on the quality and quantity of the riparian vegetation and how it interacts with the stream ecosystem. The quality of the riparian area increases with the width, complexity, and linear extent of its vegetation along a stream. A complex riparian community consists of diverse plant species native to the site or functioning similarly to native species, with multiple age-classes providing vertical structural diversity suitable for the site. As explained previously, the quality of riparian areas is influenced by the hydrological features of the stream, as well as upland and bank conditions. Well-established and connected riparian areas perform critical functions for maintaining healthy, resilient stream ecosystems by providing:

- a vegetative filter for surface runoff, reducing pollutants and sediment entering streams, and no concentrated flow from upland areas
- roughness that slows water and the erosive effects of floodwater
- root systems that bind soil, protect streambank integrity, and build flood plain surfaces
- moisture, soil conditions, surface macrotopography and microtopography, and microclimates for a diversity of riparian plants, animals, and microorganisms
- structurally diverse habitat for migratory songbirds, as well as resident species of wildlife that are especially dependent on woody riparian vegetation for reproduction and feeding
- shade or overhanging vegetation to maintain cooler water temperatures for aquatic species
- large wood to forested stream channels, which offers instream cover, creates pools, traps sediments, and provides habitat for stream biota
- organic material (leaves, twigs, grass) and insects for stream and riparian food chains
- undercut banks important to fish for hiding and resting
- diverse, complex off-channel habitats, such as backwaters, wetlands, and side channels formed by the interaction of streamflow, riparian vegetation, and often large wood. These areas of slower water provide critical refuge during floods for a variety of aquatic species and serve as rearing areas for juvenile fish
- a diversity of plant species of multiple age classes, adapted to the site and providing critical habitat for both resident and migratory birds and other riparian wildlife species

Well-established riparian areas are critical for stream health and fish and wildlife habitat. For this reason, it is important to evaluate both the quantity (Element 4) and the quality (Element 5) of the riparian area, and score the riparian conditions of the entire stream within a property boundary. Visually score the entire stream, if possible. If the stream is too extensive to score using SVAP2, score only the assessment reach visually, and use recent aerial photos (less than 2 years old) to score those riparian areas of the stream outside of the assessment reach.

Element 4 Riparian area quantity

	Natural plant community extends at least two bankfull widths or more than the entire active flood plain and is generally contiguous throughout property		Natural plant community extends at least one bankfull width or more than 1/2 to 2/3 of active flood plain and is generally contiguous throughout property Vegetation gaps do not exceed 10% of the estimated length of the stream on the property		Natural plant community extends at least 1/2 of the bankfull width or more than at least 1/2 of active flood plain Vegetation gaps do not exceed 30% of the estimated length of the stream on the property		Natural plant community extends at least 1/3 of the bankfull width or more than 1/4 of active flood plain Vegetation gaps exceed 30% of the estimated length of the stream on the property			Natural plant community extends less than 1/3 of the bankfull width or less than 1/4 of active flood plain Vegetation gaps exceed 30% of the estimated length of the stream on the property	
Right bank	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Left bank	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**

Note: Score each bank separately. Scores should represent the entire stream riparian area within the property. Score for this element = left bank score plus right bank score divided by 2. If the score of one bank is 7 or greater and the score of the other bank is 4 or less, subtract 2 points from final score.

Riparian area quantity: what to look for

- This element rates the extent of the riparian area on the property (length × width). Estimate the width of the vegetation area from the edge of the active channel outward to where natural riparian vegetation ends and other land use/land cover begins.
- Vegetation gaps are lengths of streamside with no natural vegetation ecologically suitable for the site and at a density and spacing uncharacteristic of the plant community being assessed. Estimate gap percentage by dividing the total length of gaps by the total length of the stream within the property boundary multiplied by 100.
- For this element, natural plant community means one with species native to the site or introduced species that have become naturalized and function similarly to native species of designated reference sites, growing at densities characteristic of the site. Regional plant guidebooks are useful to have in the field for scoring this element.
- Compare the width of the riparian area to the bankfull channel width. In steep, V-shaped valley forms, there may not be enough room for a flood plain riparian area to extend as far as one or two active channel widths. In this case, a score may be adjusted to a higher value based on reference site conditions.

Element 5 Riparian area quality

Natural and diverse riparian vegetation with composition, density and age structure appropriate for the site No invasive species or concentrated flows through area			Natural and diverse riparian vegetation with composition, density and age structure appropriate for the site: Little or no evidence of concentrated flows through area Invasive species present in small numbers (20% cover or less)			Natural vegetation compromised Evidence of concentrated flows running through the riparian area Invasive species common (>20% <50% cover)			Little or no natural vegetation Evidence of concentrated flows running through the riparian area Invasive species widespread (>50% cover)		
Right bank	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Left bank	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**

Notes: Score should represent the entire stream riparian area within the property.
Score for this element = left bank score plus right bank score divided by 2.

Riparian area quality: what to look for

- Plant species should be native or naturalized and consist of multiple structural layers (grasses and forbs, shrubs, and/or trees if suitable for the site). Forested sites should also have a diverse mix of shrubs, understory trees, and new shrub and tree regeneration. Early successional sites (recently disturbed by fire, tree harvesting, grazing, land clearing) should have representative native species (typically herbaceous, woody, and tree seedlings). Continually disturbed sites usually have only a few species, and often these include nonnative invasive species. As early vegetation matures, the structure of the plant community becomes more diverse with a multilayer canopy. Finally, the plant community reaches a mature stage with regeneration, growth, and mortality occurring in all layers. In forested streams, mature trees with potential for falling into the stream are present. Regional plant guidebooks are useful for scoring this element.
- Vigorously growing vegetation in the riparian area on both sides of the stream is important for healthy stream and riparian conditions. In doing the assessment, examine both sides of the stream, and note on the site diagram which side of the stream has problems. For the highest ratings, there should be no evidence of concentrated flows through the riparian area that are not adequately buffered or intended to short-circuit the riparian area or buffer and no nonnative invasive species.
- The type, timing, intensity, and extent of activities in riparian areas are critical in determining the impact on these areas. Note these in the Summary Sheet. Riparian areas that have roads, agricultural activities, residential or commercial structures, excessive animal use, or significant areas of bare soils have reduced functional value for the stream and its watershed.