ESTABLISHING AND MANAGING BUFFER STRIPS

Buffer strips come in all shapes and sizes, and for good reason. Wider buffers are needed for wildlife habitats. Narrow buffers are perfectly adequate for simple setbacks from cropland. Local site conditions also affect buffer strip design. On steeply sloping land, for example, buffers need to be wider to be effective in reducing cropland runoff to water.

In this chapter, we'll look at:

- function – what do you want your buffer strip to do?
- design – what are the site features and considerations that will make the most effective design for your property?
- plants – what grasses, trees and shrubs would work best in your buffer strip?
- establishment – what steps should you take to get your buffer strip in place?

Choose the design that best suits your goals, and the type and condition of your riparian area.

Tree and shrub roots will provide more bank stability. A minimum buffer width of 5 metres (over 15 ft.) is recommended.

A treed buffer strip will protect the watercourse and link natural areas.

Grass buffers provide range habitat, while planted tree buffers provide more diverse "edge" habitat for mammals, beneficial birds and insects. ("Edge" is the transitional area between two habitats, and generally offers greater overall diversity of plants and animals.) For wildlife, wider is better. Buffers make ideal wildlife corridors, which are important for survival. Shaded buffers are particularly important to cool and cold water fisheries.

Before we get started, please remember: buffer strips are not stand-alones. In agriculture, buffer strips should be considered as part of a cropland conservation plan. To repeat, **buffers are intended as the last (not the only!) line of defence against erosion and runoff.** For more on this, please see the next chapter, starting on page 93.

Well-managed grassed buffers effectively filter cropland runoff.

Here is a before-and-after example of a treed buffer planted on the south and west side of a drainage ditch. The buffer's design was practical and focused on improving fish habitat.

FUNCTION

Have a clear idea of what key functions (or benefits) you're seeking. The functions will affect width, cover types, and special features or concerns.

For example, if you want a buffer strip to act as a setback and offer some sediment control on flat, clayey, intensive cropland, your buffer strip will probably be narrow and grassed.

In a watercourse riparian area through moderately sloping cropland, erodible soils and concentrated flow, the buffer will have to be wider – perhaps with woody plants and some streambank and in-field erosion control measures.

RELATIVE EFFECTIVENESS OF RIPARIAN TYPES BY FUNCTION

	VEGETATION TYPE		
FUNCTION	**GRASS AND FORBS**	**SHRUBS**	**TREES**
BANK/SHORE STABILITY	Low/Medium	Medium/High	High
FILTRATION OF SEDIMENT	High	Medium	High
FILTRATION OF SOIL-BOUND NUTRIENTS, PESTICIDES, BACTERIA	High	Medium	High
RETENTION OF SOLUBLE NUTRIENTS, BACTERIA, PESTICIDES	Low	Low	Medium
WATER STORAGE	Low	Medium	High
FLOOD PROTECTION	Low	Medium	High
FISH HABITAT	Low	Medium	High
WILDLIFE HABITAT	Medium	Medium	Medium
FORESTLAND HABITAT	Low	Medium	High
GREENHOUSE GAS – CARBON SEQUESTRATION	Low	Medium	High
NITRATE UPTAKE	Low	Low	Medium/High
PHOSPHORUS	High	Low/Medium	High
ECONOMIC PRODUCTS	Low	Low	High
VISUAL DIVERSITY	Low	Medium	High

(adapted from Tjaden and Weber, *Riparian Buffer Systems*, MCU Extension Fact Sheet 733, 1998)

Natural riparian areas offer diverse habitats for fish and wildlife.

Soils in treed buffers have the porosity and structure to store floodwaters.

DESIGN

One of the most important steps in planning an effective buffer strip is your design choice. Consider the following criteria to help you identify the best one for you.

SITE CONDITIONS AND FEATURES

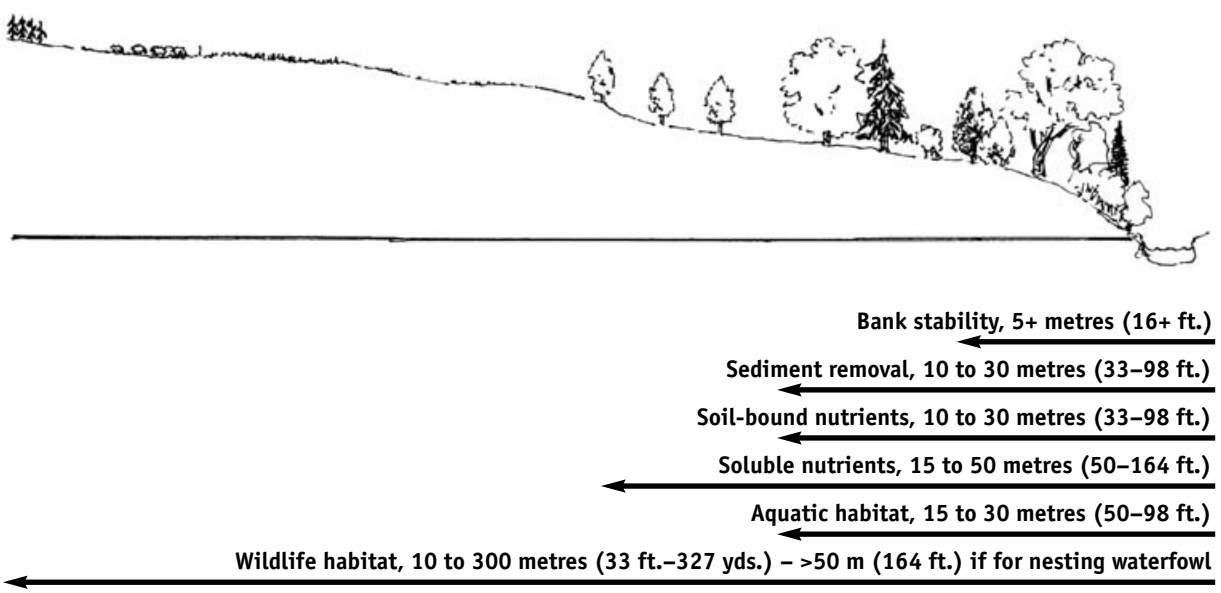
A site assessment should help determine features such as soil types, slope, surrounding land use, and riparian type (e.g., stream vs. river). These features affect design in the ways summarized in the next chart.

FEATURE	EFFECT ON DESIGN
SOIL TYPE (SAND, LOAM, CLAY)	• runoff is greatest on clayey soils ○ the design should prevent or manage this (e.g., drop structures, grassed waterways) • loamy soils are most erodible ○ special features may be needed for sediment control in the design and during construction (e.g., silt fences) • soil drainage will affect species suitability (e.g., flood tolerance)
SLOPE	• the steeper the slope, the greater the potential rates of erosion and runoff ○ buffer type and width plus in-field BMPs must be designed to address this • slope length and slope segments will affect the cover type and the species selected (e.g., if the riparian slope is too steep, it may be unsuitable for hay cropping but not for trees and shrubs)
SHAPE	• in some riparian areas, the banks follow a straight path (drains, shores) and the floodplain width is uniform ○ the same design should work throughout the length of the proposed buffer strip (here, overall length is important) • in other areas, the watercourse meanders, the floodplain width varies, and the slopes of the ravine are deeply cut ○ this causes irregularly shaped field borders for the cropland or pasture adjacent to the riparian area – buffer strip type and planted species should adjust to these influences on shape
LAND USE	• adjacent land uses could be residential, agricultural, natural, etc. ○ the nature of impacts from cottages (e.g., removal of shoreline wetlands) differs from farm operation impacts on croplands in lakeshore areas – designs should recognize this ○ within agriculture, a buffer strip beside an orchard differs from one beside steeply sloping cropland
RIPARIAN TYPE	• lakeshore buffer strips differ from small stream buffers, in terms of plantings and additional erosion control needs • similarly, a simple, narrow, grassed buffer strip may work for a municipal drain, but may not suffice for a deeply cut, meandering stream through hilly cropland

WIDTH

Width is a key design factor. Wider buffers are more effective at filtering contaminants, encouraging infiltration and providing diversity of habitat.

Effective width varies with soil type, slope, adjacent watershed size, function and cover type. The following illustration is an attempt to specify the range of widths by function. Please note that it assumes bare soil conditions in the adjacent land upslope from the buffer area and less than 10 percent slope conditions.



Once again, width alone will rarely replace the benefit of upland soil and water conservation BMPs.

How to measure buffer strips

Buffer strip width is the distance from the top of a bank to the edge of a field. Where streams meander, take the average of three measurements.

Assuming land function is the same on both sides of a watercourse, buffers on both sides should be approximately the same width. Wider buffers perform a greater number of functions more effectively.

CONCENTRATED FLOW

Buffer strips are intended to manage sheet flow from adjacent land use. They are not meant to manage concentrated or channel flow of runoff to riparian areas, as seen with draws, rills, and gullies that "short-circuit" buffer strips. Concentrated flow is faster and will cut a deeper channel if unmanaged.

Soil and water conservation BMPs and structures should prevent this flow from entering riparian areas unchecked. But in some cases, more effort is required. This should be part of the overall design of the buffer strip.

In most cases, you have four options for managing concentrated flow:

- disperse the energy with soil cover – forages, cover crops and crop residues
- divert the flow with embankments, berms, terraces or sediment control basins
- re-channel the water with grassed waterways and drop structures to adequate outlets or subsurface drainage systems
- convey the flowing water safely at the bank or shore using rock chute spillways and drop pipe structures.

For more information on managing concentrated flow, please see page 104.

Buffers strips are intended to manage sheet flow – not concentrated flow – from cropland.

Here is a graphic example of how grass buffer strips can intercept and hold sediment carried with surface runoff. A suite of erosion control measures is often required to control sheet and rill erosion.

BANK AND SHORELINE EROSION

Buffer strip designs should provide for any necessary bank or shoreline stabilization work. The nature and extent of the problems (including seepage) should be determined in the site assessment. See page 102 for further details.

Please note that in some cases, the stabilization work should proceed before any site preparation for planting.

PLANTS FOR BUFFER STRIP ESTABLISHMENT

Buffer strips can be planted to grass, wildflowers, shrubs and trees. Select plants according to the desired buffer function and also the plants' suitability to local site conditions, including climate, soil, soil drainage, soil pH and risk of flooding. Avoid invasive, non-native species, wherever possible.

Plants can be established in many arrangements and mixtures to suit design needs. The following charts describe species suitable for buffer strip plantings.

Grasses

Grasses for buffer strips should have as many of the following features as possible:

- dense branching
- upright stems that remain erect in winter to trap sediment in runoff and offer superior waterfowl nesting
- strong rooting systems
- appropriateness for local soil and site conditions
- usefulness for grazing or harvesting forage.

COOL-SEASON GRASSES	
REED CANARY GRASS	Tall, coarse, sod-forming, perennial with aggressive rhizomes. Tolerates very poor drainage. Will survive long periods of flooding. Has very good acid tolerance; moderate saline and alkaline tolerance. Can be used for streambank and gully stabilization where woody plants are not suitable. Introduced. Can be invasive. Grows 1–2 metres (3–6 ft.) tall.
PERENNIAL RYE GRASS	Introduced, rapid developing, short-lived perennial bunchgrass. Prefers imperfectly drained soils. Moderately alkaline tolerant. Requires over 50 cm (20 in.) annual precipitation. Grows 0.3–0.6 metres (1–2 ft.) tall.
ORCHARD GRASS	Introduced, drought-tolerant bunchgrass. Exhibits some shade tolerance. Prefers imperfect drainage conditions.
TIMOTHY	Perennial bunchgrass that forms more open sod. It should be seeded in a mixture with a legume or other grasses. Tolerates imperfect drainage but prefers well-drained sites.

WARM-SEASON GRASSES	
	 **Native grasses can provide dense cover to meet nesting-bird habitat requirements.**
BIG BLUESTEM	Robust, native bunchgrass (with short rhizomes). Prefers imperfectly drained soils, but is more drought tolerant than other warm-season grasses. Good acid tolerance. Grows 2–2.5 metres (6–8 ft.) tall.
LITTLE BLUESTEM	Warm-season, native bunchgrass. Fair to excellent acid tolerance. Drought tolerant. Grows 1 metre (3 ft.) tall. Usually sown in mixtures with other native grasses. Seeds are light and fluffy.
EASTERN GAMA GRASS	Large, native, colony-forming bunchgrass. Useful in lowland or irrigated sites. Not alkaline tolerant. Do not include in seeding mixture with other warm-season grasses.
INDIAN GRASS	Native perennial. Acid and drought tolerant. Difficult to establish in pure stands; best used in mixtures. Seed light and fluffy.
SWITCH GRASS	Native, perennial, tall grass. Drought resistant, but grows under a wide range of conditions. Salt and acid tolerant. Used as a sand stabilizer and for erosion control. Earliest maturing warm-season grass. Grows 1–3 metres (1–10 ft.) tall.

LEGUMES	
ALFALFA	Well-suited to a wide range of soil conditions but not acidic. Has a high nutrient value and is high yielding on neutral-to-high pH, well-drained soils. Alfalfa should be used in a mixture with sod grasses for erosion control.
ALSIKE	Short-lived perennial adapted to a cool climate and wet soils; it can even tolerate periodic flooded conditions and acid soils. Should be seeded in a mixture with sod grasses for erosion control.
BIRDSFOOT TREFOIL	Has a well-developed root system and generally is adapted to a moderate climate. Because of its nonbloating nature, birdsfoot trefoil can be used without grass in a pasture situation. Has excellent feed quality and should be seeded in a mixture with sod grasses for erosion control. Will tolerate low pH levels.
RED CLOVER	Relatively short-lived perennial that's best suited to moderate temperatures and adequate moisture. Good for hay and pasture and for improving soil tilth. Red clover is easy to establish with no-till methods, and should be seeded in a mixture with sod grasses for erosion control.
WHITE OR LADINO CLOVER	These clovers adapt to fertile soils with sufficient soil moisture. High moisture levels make it difficult to harvest as a hay crop. To reduce the possibility of bloat in grazing cattle, this clover should be grown in a mixture with grasses. Its fibrous root system makes it well suited for erosion control.

SUITABILITY OF FORAGE SPECIES FOR DIFFERENT USES

FORAGE SPECIES	INTENSIVE GRAZING	ROTATIONAL GRAZING	STORED FEED
ALFALFA	Not recommended	Suitable	Highly suitable
TREFOIL	Not recommended	Highly suitable	Highly suitable
RED CLOVER	Not recommended	Suitable	Highly suitable
WHITE CLOVER	Highly suitable	Highly suitable	Suitable
ALSIKE CLOVER	Not recommended	Suitable	Suitable
SWEET CLOVER	Not recommended	Suitable	Suitable
BROME GRASS	Not recommended	Suitable	Highly suitable
TIMOTHY	Not recommended	Suitable	Highly suitable
REED CANARY GRASS	Not recommended	Highly suitable	Highly suitable
ORCHARDGRASS	Highly suitable	Highly suitable	Highly suitable
PERENNIAL RYE GRASS	Highly suitable	Highly suitable	Highly suitable
ANNUAL RYE GRASS	Highly suitable	Highly suitable	Highly suitable
TALL FESCUE	Not recommended	Suitable	Highly suitable
MEADOW FESCUE	Not recommended	Suitable	Highly suitable
CREEPING RED FESCUE	Highly suitable	Highly suitable	Not recommended
MEADOW FOXTAIL	Not recommended	Suitable	Not recommended
KENTUCKY BLUE GRASS	Highly suitable	Highly suitable	Not recommended

TREES AND SHRUBS FOR RIPARIAN AREAS

Plant trees. Wide, treed buffers are the most functional cropland buffer strips.

On productive riparian sites, fast-growing hardwoods can fully shade narrow channels within 10 years. Shown here is green ash, silver maple, red oak and poplar along Washington Creek in Oxford County.

Base your selection of trees and shrubs for buffer strip plantings on the following criteria:

- **climate** – think globally and plant locally by using plants suited to the region
- **soil drainage** – promote survival and growth by matching trees to site conditions
- **flood tolerance** – ensure any trees in floodplains are flood tolerant
- **shade tolerance** – ensure slower growing trees and shrubs, or ones that are likely to be in the shade for most of their existence, are shade tolerant
- **growth rate** – plant fast-growing trees if you need to create shade as soon as possible
- **wildlife value** – determine which trees are best suited to providing cover, shelter and food
- **economic value** – be aware that some of our most valuable trees grow very well in riparian areas.

Stream bottomlands are ideal sites for valuable hardwoods like black walnut.

FEATURES	SUGGESTED HARDWOOD TREES FOR BUFFER STRIP PLANTINGS						
SPECIES	**SILVER MAPLE**	**GREEN ASH**	**BLACK WILLOW**	**COTTON-WOOD**	**BLACK WALNUT**	**WHITE ASH**	**RED OAK**
FROST ZONE	4–9	3–9	5–9	7–9	7–9	3–9	3–9
SOIL TYPE	All	All	All	Loamy to sandy	Loam to clay loam	All	All sandy to loamy
DRAINAGE	Imperfect to very poor	Imperfect to very poor	Poor to very poor	Poor to very poor	Well to imperfect	Well to imperfect	Well to imperfect
FLOOD TOLERANCE	High	High	High	High	Medium	Medium	Medium
ROOTING	Shallow	Shallow	Shallow	Shallow	Taproot	Moderate lateral	Deep lateral
GROWTH RATE	Medium	Very fast	Very fast	Very fast	Medium	Fast	Fast
HEIGHT	Medium	Tall	Medium	Tall	Tall	Tall	Tall
SHADE TOLERANCE	Medium	Low to medium	Low	Low	Low to medium	Low to medium	Low to medium
WILDLIFE VALUE	Low to medium	Low to medium	High	Low	Medium	Low	High
ECONOMIC VALUE	Low to medium	Moderately high	Very low	Very low	Very high	High	Very high

Introducing evergreens like white cedar in row plantings along the buffer strip edge creates an ideal travel corridor.

FEATURES	SUGGESTED CONIFER TREES FOR BUFFER STRIP PLANTINGS						
SPECIES	**WHITE CEDAR**	**TAMARACK**	**WHITE SPRUCE**	**WHITE PINE**	**RED PINE**	**HEMLOCK**	**RED CEDAR**
FROST ZONE	1–8	0–9	1–5	2–9	2–5	3–9	4–9
SOIL TYPE	All	Sandy to loamy	All	Sandy to clay loams	Sandy to sandy loams	Loamy	All
DRAINAGE	Well to very poor	Imperfect to very poor	Rapid to poor	Rapid to imperfect	Rapid to imperfect	Well to imperfect	Well to imperfect
FLOOD TOLERANCE	High	High	Medium to high	Low to medium	Low	Low to medium	Low to medium
ROOTING	Shallow	Shallow	Shallow	Deep lateral	Deep lateral	Shallow	Shallow
GROWTH RATE	Slow	Fast	Medium to slow	Fast	Fast	Slow	Slow
HEIGHT	Short	Medium	Medium to tall	Tall	Tall	Tall	Short
SHADE TOLERANCE	Medium	Low to medium	High	Medium to high	Low to medium	Very high	Low
WILDLIFE VALUE	Very high	Low	Medium	Medium	Low	High	Medium
ECONOMIC VALUE	Medium	Medium	Medium	High	Medium	Medium	Low

Group or block plantings create excellent tree-growing environments and wildlife cover.

Mature cedar creates ideal wintering sites for a wide range of wildlife.

FEATURES	SUGGESTED SHRUBS FOR BUFFER STRIP PLANTINGS						
SPECIES	**NINEBARK**	**ELDER-BERRY**	**RED OSIER DOGWOOD**	**STAGHORN SUMAC**	**ALTERNATE LEAVED DOGWOOD**	**NANNY–BERRY**	**HIGHBUSH CRANBERRY**
FROST ZONE	3–9	2–9	2–8	2–9	3–9	3–9	3–9
SOIL TYPE	Wide range	Loams to sandy loam	Wide range	Sandy and gravelly	Most soils	Most soils	Fertile soils
DRAINAGE	Imperfect to very poor	Imperfect to very poor	Poor to very poor	Rapid to imperfect	Well to imperfect	Well to poor	Well to imperfect
FLOOD TOLERANCE	High	High	High	Low	Low	Moderate	Moderate to low
ROOTING	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
GROWTH RATE	Fast	Fast	Fast	Fast	Medium	Medium	Medium
HEIGHT	2–4 m (6.5–13 ft.)	1–5 m (3–16 ft.)	<2 m (<6.5 ft.)	1–5 m (3–16 ft.)	2–4 m (6.5–13 ft.)	5–10 m (16–33 ft.)	2–4 m (6.5–13 ft.)
SHADE TOLERANCE	Low	Moderate	Moderate	Low	Moderate	Moderate	Low
WILDLIFE VALUE	High	Very high	High	High	Very high	High	High

HOW TO ESTABLISH A BUFFER STRIP PROJECT

The most effective buffer strip projects are planned. Keeping in mind the principles we've covered, you're ready to undertake your own project. Here are some planning considerations.

- **Step 1. Assess existing conditions in your riparian area(s), e.g., instream conditions, water quality, and vegetation quality.** Draw a map showing soil types, slopes, existing vegetation, adjacent croplands, and other riparian and natural areas. Complete a grazing management plan if appropriate.

- **Step 2. Predict the benefits of a well-maintained, planted buffer strip.** Put your list of desired benefits together with other related management goals and objectives. Contact your Conservation Authority to discuss risk assessment and identify opportunities. Select functions for the buffer strips. Talk to neighbours.

- **Step 3. Assess upslope conditions on the farm.** Ask yourself whether additional soil and water conservation BMPs would enhance the effectiveness of your buffer strip(s).

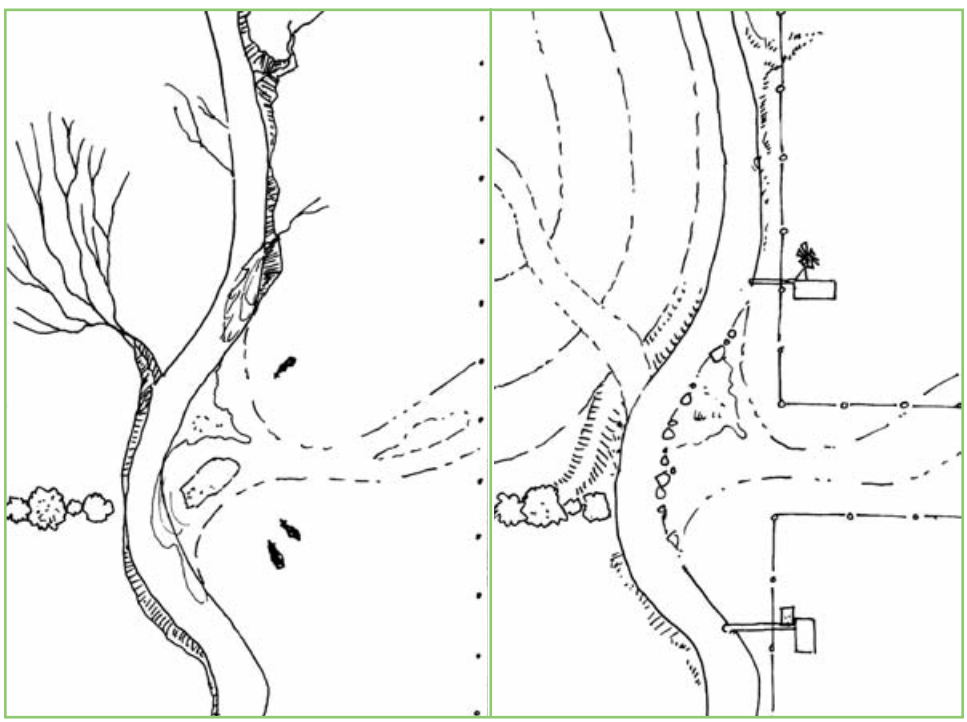
- **Step 4. Examine and select options.** Which BMPs will do the job? Do the advantages outweigh the disadvantages? Which options require approvals, permits and technical assistance? Which agencies offer financial assistance?

- **Step 5. Design and implement.** Refer to the designs in this book and other references. Seek technical advice from a Conservation Authority and other agencies and from experienced landowners. Obtain permits and approvals where necessary. Create an action plan – outline your resources, your time, and a schedule of activities. Remember that the project can be phased in over several years.

- **Step 6. Maintain, monitor and evaluate.** Maintain planted vegetation by watering at critical periods, sampling the soil, fertilizing, pruning or clipping, replacement and weed control. Confirm survival rates of planted grasses, shrubs and trees. Look for washouts and rills cutting across the buffer strip. Determine if the project is fulfilling its intended benefits. Assess whether additional BMPs would improve its effectiveness.

Consult with your local Conservation Authority to discuss risk assessment and identify opportunities.

Inspect your project routinely to ensure that it's doing its job. Note any improvements needed.



This is the "before" situation. You can see cropland erosion from the sloping field on the left of the stream. Bank degradation from intensive livestock access is also evident on the right side of the stream.

Above we can see planned projects for an on-farm riparian area. Soil and water conservation measures, including a cropland buffer strip, are planned for the sloping field. Intensive grazing management, fencing and alternative water sources are planned for the streamside grazing area.

DESIGN 1

NARROW BUFFERS FOR DRAINS AND LIVESTOCK EXCLUSION

Description

- narrow grassed buffers established along drains

Functions

- setback of farm operations or grazing from top of bank
- ditchbank stabilization
- some sediment and nutrient filtering

Suitable For

- municipal and other open drains in flat, intensively cropped areas (e.g., clay plains)
- intensively grazed areas where livestock have been excluded and tree plantings are not suitable (e.g., tiles are invaded by tree roots)
- low-order, shallow and deep-channel streams
- lakeshores and ponds

Narrow buffer strip designs are most suitable along drains.

Narrow buffers can be used as turning areas for cropping equipment.

Unsuitable For

- slopes greater than 10%
- slopes greater than 5% with no BMPs for soil and water conservation
- natural riparian areas
- cold-water fisheries
- deep ravines with broad floodplains
- wildlife habitat (very low quality)

Design Considerations

- width: minimum of 5 metres (16 ft.) for most situations
- should be 10 metres (33 ft.) if used as a pesticide application setback – check pesticide label
- severe bank and shore erosion should be managed (see page 102)
- concentrated flow needs to be diverted and controlled with erosion control structures (see page 104)
- can be used as turning area for cropping equipment

Narrow buffers are also suitable for riparian areas fenced out from intensively grazed pastures.

Wide, shallow and channelized streams will narrow after buffer strips are established.

DESIGN 2

ONE-ZONE BUFFERS FOR FORAGE AND DELAYED GRAZING

Description

- wide grassed buffers (5–50 metres or 16–164 ft.) established along around natural areas
- established for forage harvest or grazing

Functions

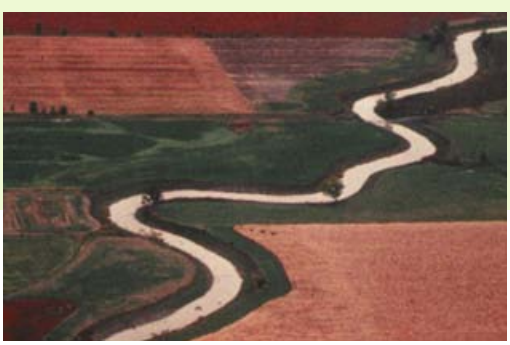
- setback of cropland management from bank or shore
- setback of livestock grazing from most of the riparian area
- forage management – cropland not lost to production
- livestock grazing – delayed grazing until late summer or fall as part of a grazing management plan
- sediment, pesticide and nutrient filtering
- wildlife habitat for mammals, grassland bird species, amphibians and insects

Suitable For

- most riparian areas and site conditions
- most suited to waterfowl nesting areas (wetlands, lakes, ponds, large rivers)
- livestock operations that use forages or graze

Wide buffers adjacent to streams make suitable headlands and forage crop strips.

A single row of red osier dogwood planted along the outer edge of this grass buffer strip, right alongside the crop edge, will be enough to keep field equipment back and provide some wildlife habitat. The shrubs will present only minimal obstruction to future drain maintenance, and bounce back quickly after disruptions.



This is an aerial shot of a buffer strip that provides a forage crop and a source for delayed grazing. It spans many properties and several kilometres along the south branch of the South Nation River municipal drain in Dundas County.

Having the buffer included in the engineer's report and accepted through bylaw helps ensure the buffer's integrity indefinitely.

Unsuitable For

- very steeply sloping, narrow ravines
- intensively managed cropland – horticulture and field crops
- cropland in areas with no local market for forages

Design Considerations

- should be 5–50 metres (16–164 ft.) wide – buffer width should be compatible with forage harvest equipment
- greater widths are most suited to managed grazing areas
- species mixtures should be for forage, grazing or dual purpose
- later maturing warm-season species would be best for wildlife habitat
- severe bank and shore erosion plus concentrated flow should be managed (see page 102)
- use the zone to accommodate alternative water storage site (e.g., off-line pond)

If you want to promote wildlife habitat, don't clip the grass. Another reason to leave the grass long is that short, lush grass can attract nuisance Canada geese to the buffer.

Cropland converted to forages is not lost farmland.

3 DESIGN

TREED BUFFERS – THREE-ZONE DESIGN

Description

- a wide buffer design that consists of three zones (minimum total width 10 metres or 33 ft.)
- Zone 1 consists of trees closest to the bank or shore
- Zone 2 consists of shrubs (or trees or a mixture) and is placed between Zone 1 and Zone 3
- Zone 3 is planted to grasses and/or legumes

Functions

- ZONE 1
  - roots from mature trees provide bank and shore stability plus stability for the streambed
  - trees filter runoff, taking sediment, nutrients and pesticides out of runoff and promoting infiltration
  - addition of leaves and woody debris helps the watercourse maintain its sediment load and provides nutrients for aquatic life
  - as trees mature, adjacent waters are cooled by the shade provided
  - trees remove nitrogen from groundwater and fix carbon from the atmosphere
  - trees provide wildlife habitat
  - wood products, nut crops, sugar maple, alternative forest products, Christmas trees, etc. offer revenue opportunities

Treed buffer strips can produce high-value timber products.

- ZONE 2
  - shrubs (or trees) and grasses (or natural cover) help water infiltrate
  - Zone 1 and Zone 2 help store floodwaters
  - woody tissue offers long-term storage of nutrients and carbon
- ZONE 3
  - erosion control: sheet erosion is controlled in this zone
  - infiltration is increased in sod cover, which can boost water storage capacity
  - nutrients, pesticides and sediment in sheet flow are filtered by standing forage vegetation

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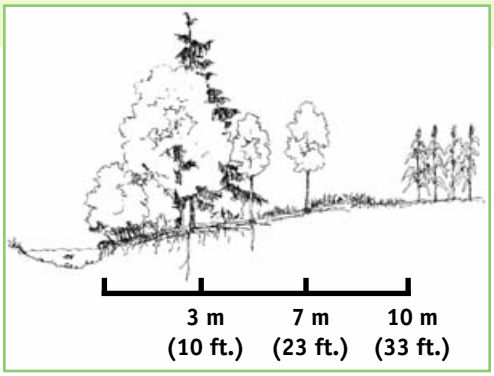
Suitable For

- most suited for wide-channel streams
- also suitable for narrow watercourses with a small floodplain, steep but short banks and erodible soil on table lands (see illustration below)
- highly erodible or fragile lands that are also of marginal economic importance for crop production or grazing, such as ravines
- gently sloping shorelines and river banks
- previously pastured ravine lands



In the three-zone treed buffer design, each zone has its distinct place and function. The trees in Zone 1 shade the water and stabilize the banks. Zone 2 soils and vegetation help to filter sediments, and promote infiltration and floodwater storage. Zone 3 filters cropland runoff and serves as a field buffer.

With its narrow channel and small floodplain, Washington Creek in Oxford County was an ideal setting for a demonstration of the three-zone treed buffer design.

Unsuitable For

- intensively cropped prime farmland
- wetlands (unless geese are troublesome)

Design Considerations

SPECIES TO PLANT

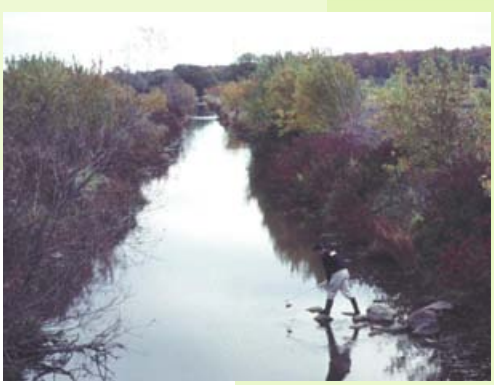
- ZONE 1
  - use the chart on pages 75-76 to select suitable trees
  - use water-tolerant trees if floodplain floods frequently; if drier, use higher-value trees
  - select fast-growing trees if you plan to leave Zone 1 as a no-management zone
  - space trees within and between rows to maximize height growth (2–3 metres or 6.5-10 ft.)
  - try to plant all of floodplain to trees for maximum functionality
- ZONE 2
  - use high-value hardwoods (or mix with conifers for habitat effect) that are best suited to the local soil and site conditions
  - also consider fast-growing, high-value and long-living trees to reduce greenhouse gas emissions
  - use the shrub chart on page 77 to select suitable shrub species – avoid usage during wet conditions

- ZONE 3
  - based on what your purpose is (habitat vs. erosion control), select suitable mixtures of cool-season, warm-season grasses and other plants from the chart on pages 71-72
  - could be used as turning area for cropping equipment

Other Considerations

- for bank or shore stability,
  - apply bioengineering techniques to control severe erosion problems (see page 105)
- for areas of concentrated flow,
  - use suitable BMPs for soil and water conservation or drop structures to convey water safely through buffer strip planting
- for riparian areas that were previously grazed or cropped and have been since abandoned,
  - consider planting the entire area to trees and shrubs for timber production, wildlife habitat, water quality improvement, greenhouse gas abatement and aesthetics

When suitable habitat is provided, wildlife will move in. In time, that could mean beavers moving into treed buffer strips.



Trees can provide shade to moderate water temperatures, and attract insects that will be a food source for aquatic creatures.

LAYOUT

Grassed Buffer Strips

- ▸ sketch buffer strip plan on map or aerial photograph
- ▸ stake out buffer width in fall or early spring – use widths that are multiples of the widest piece of equipment to be used to establish planting
- ▸ soil test to ensure phosphorus and potassium levels are suitable for early growth – don't apply nitrogen
- ▸ tie in fencerows and natural areas where possible

When fencing to exclude livestock, work with existing vegetation as a buffer strip.

- ▸ consider setting aside odd-shaped areas where site features or land use changes
- ▸ if buffer strip is part of a livestock exclusion project,
  - ▹ consider just working with the existing vegetation OR
  - ▹ time the buffer planting with existing plan for pasture improvement or pasture-crop rotation
- ▸ for rotational grazing systems,
  - ▹ this is a good time to reconfigure paddocks
- ▸ if alternative watering or electric fencing is being considered,
  - ▹ this is the time to bury water and electrical lines if desired
  - ▹ establish planted buffer strip before fencing
- ▸ use forward-grazing to get the vegetation down to ground level. Grazing this way will deplete forage root reserves. This will weaken the sod so that tillage or site preparation operations will more effectively kill the sod.

Trees

- ▸ determine whether you want the buffer width to be uniform and straighten the edge of the field, or vary with stream meandering
- ▸ if, prior to establishing Zone 2, trees are to be planted in old sod, be sure to clearly distinguish Zone 1 from Zone 2 (or Zones 1 and 2 from Zone 3 if using a three-zone design)
- ▸ use stakes to mark desired location of shade trees

SITE PREPARATION

Grassed Buffer Strips

- ▸ monitor soil fertility more closely in established forage stands
- ▸ remember recommended separation distances from riparian areas if manure is to be applied prior to stand establishment
- ▸ for tillage,
  - ▹ if herbicides are not being used, ensure that all perennial weeds (e.g., quackgrass) are killed by fallowing, since many warm-season grasses can't compete with them
  - ▹ as with any forages, a level, firm seedbed is required for establishment
- ▸ for no-till method,
  - ▹ apply glyphosate or similar herbicide in mid-fall or early spring – remember to stay back from the water's edge
  - ▹ use BMPs for pesticide application to reduce the risk of drift and runoff – ensure a complete kill before drilling grass mixture

If the area is already sod and is not to be used for grazing or forage, leave it.

Trees and Shrubs

- ▸ if site is to be tilled,
  - ▹ reconsider and use spot herbicide treatment in Zone 1 and Zone 2 in exact spots where trees are to be planted – tree and shrub plantings are easier into killed sod
- ▸ if it's already tilled,
  - ▹ consider using a spring cereal cover crop to reduce over-winter erosion and suppress weed growth
- ▸ begin site preparation in the fall before planting (ideally)
- ▸ if planting trees in riparian areas, check with the local municipality first – some require significant setbacks to accommodate future drain maintenance

PLANTING

- ▸ broadcast (only for tillage method); use hand-held, tractor- or ATV-mounted broadcast seeders (follow guidelines in OMAF *Agronomy Guide* for seeding rate)
- ▸ harrow or cultivate lightly to increase soil-seed contact
- ▸ for no-till, calibrate drill to ensure proper depth, penetration, residue control and slot closure
- ▸ broadcast straw mulch on erodible areas during establishment period – under-seeding or direct seeding is more feasible in wider buffer designs
- ▸ for tree establishment,
  - ▹ ensure all weeds are controlled prior to planting
  - ▹ use saplings where affordable and available – survival and growth rates are better than with seedling stock
  - ▹ handle trees with care – avoid exposure of roots to sun and wind
  - ▹ order about 10–20% more seedlings than are needed to plant – heel in the extra seedlings in a temporary "nursery" for replanting after assessing first-year survival
  - ▹ trample all soil around planted trees to reduce air spaces in disturbed soil
  - ▹ mulch the trees to conserve moisture and control competing vegetation
  - ▹ consider tree protection systems to get them off to a good start

Handle trees with care. Don't expose roots to sun and wind.

Trample all soil around planted trees to reduce air spaces left by disturbed soil.

MAINTENANCE

Weed Control

- control weeds around trees during the first year of establishment – mulching is the best method
- if you choose to clip, do so before weeds reach 30 cm (12 in.)
- use selective herbicides according to recommendations from OMAF Publication 75, *Guide to Chemical Control*
- for some species mixtures, regular mowing and the maintenance of fertility levels will help ensure stand composition.

As with all natural or non-crop areas, buffer strips can be sources of weeds and other pests. Addressing pest pressures from these areas will become part of a pest-monitoring program.

Mulching and tree shelters are an excellent combination to protect valuable shade trees from weeds and rodents.

Monitoring

- during the first year, check strip for rills and washouts after snowmelt and rain events
- repair and replant damaged areas – check tree and shrub survival
- prevent future problems by adopting BMPs for soil and water conservation (such as drop structures) OR
  - create temporary shallow diversion trenches or small berms to divert small runs of concentrated flow
  - delay haying, ideally until July 15, to promote wildlife habitat (e.g., waterfowl and songbird nesting)
  - manage delayed access by livestock to reduce impact – try forward, delayed grazing within the riparian area to improve efficiency and reduce the access time, and restrict access if you've planted trees or shrubs
  - water trees regularly for the first year after planting unless conditions are wetter than normal
  - prune crop trees and thin out poor quality trees as buffer matures (usually about 10–25 years after planting)

Use signs to protect new plantings from field operations.

Where feasible, use large tree stock and saplings rather than tree nursery seedlings in riparian plantings. Survival and growth rates are better in these densely weeded environments.

Some vegetated buffers are designed to invite existing seed to take hold with an absolute minimum of planned maintenance. Within a few years, this "free-to-grow" buffer, designed for the James Berry Municipal Drain in Norfolk County, experienced a significant shift away from troublesome weed populations towards a sustainable and desirable mix of grasses and wildflowers.