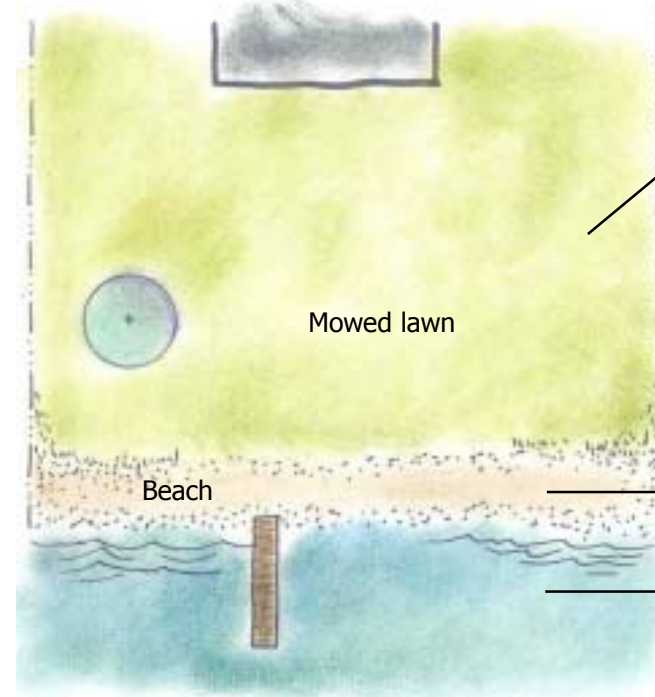


TYPICAL
LAKESHORE
PLAN
WITHOUT
BUFFER

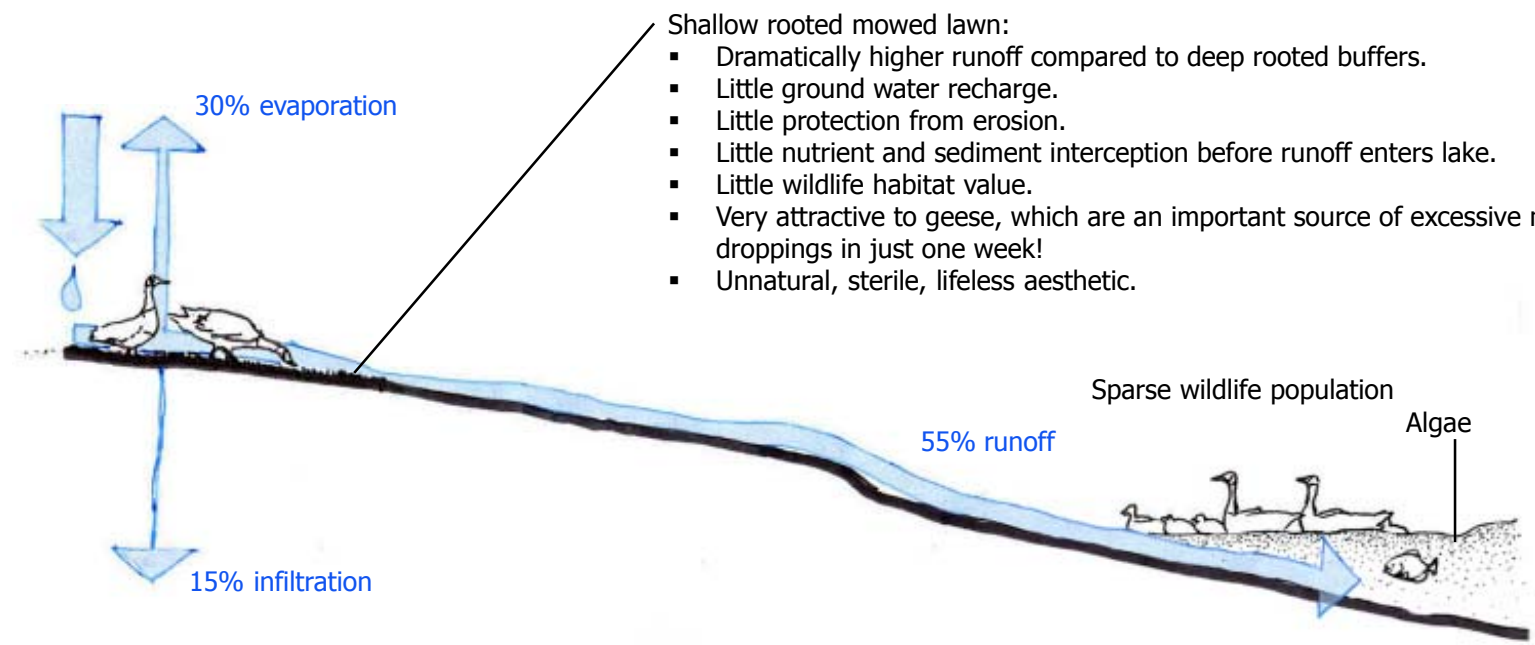


Rain from mowed lawn carries nutrients from improperly applied fertilizer, pet waste and lawn clippings into the lake, which fuels algae blooms, turning the lake green, creating unpleasant smells, and making swimming less enjoyable.

Beach sand covers underwater gravel or silt needed by fish, mayflies, and frogs.

Water thick with algae and depleted of oxygen needed by fish.

TYPICAL
LAKESHORE
SECTION
WITHOUT
BUFFER



Shallow rooted mowed lawn:

- Dramatically higher runoff compared to deep rooted buffers.
- Little ground water recharge.
- Little protection from erosion.
- Little nutrient and sediment interception before runoff enters lake.
- Little wildlife habitat value.
- Very attractive to geese, which are an important source of excessive nutrients; one adult goose can produce 15 lbs. of droppings in just one week!
- Unnatural, sterile, lifeless aesthetic.

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LAKE BUFFER TEMPLATE

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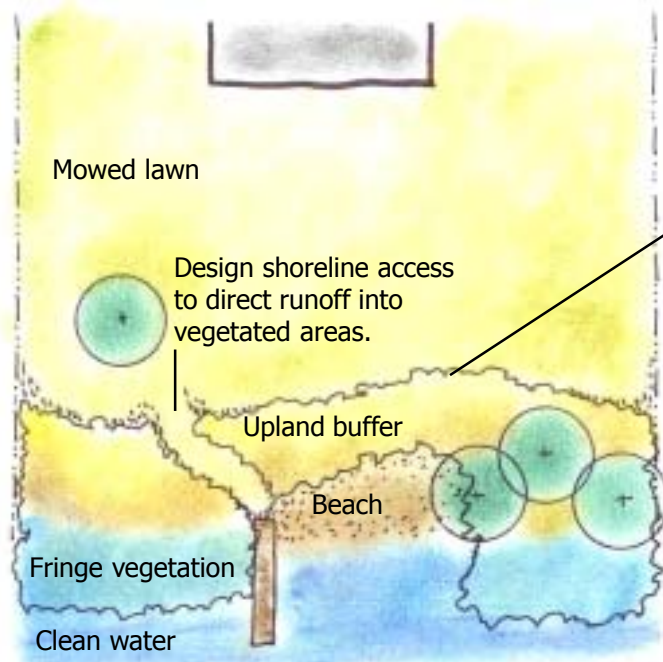
Prepared for:
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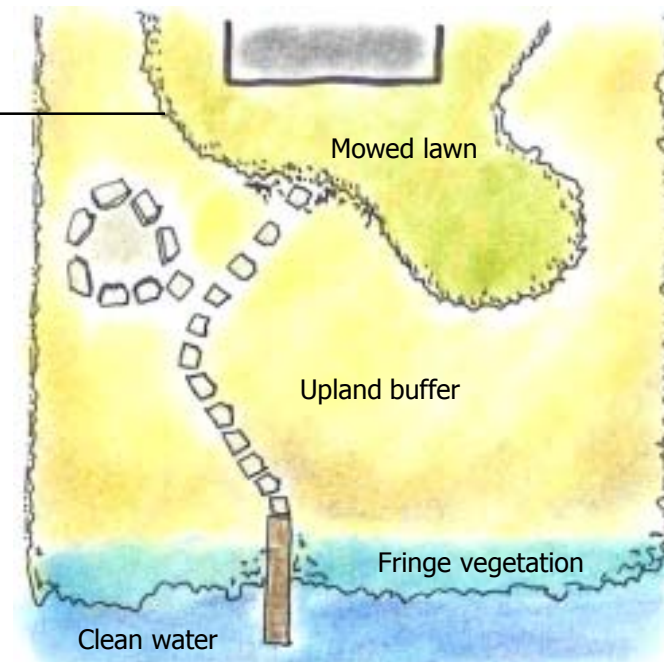


TYPICAL LAKESHORE PLAN WITH BUFFER



Nutrients in runoff from mowed lawn intercepted by buffer vegetation.

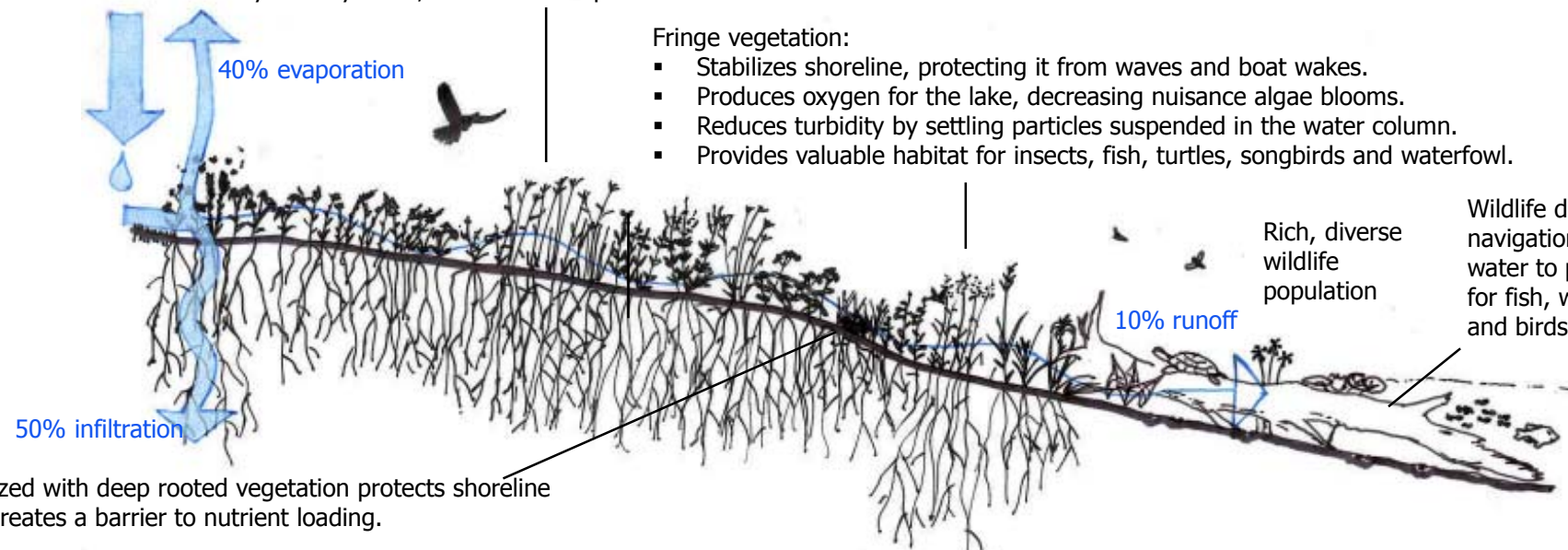
- Recommended buffer width varies depending on many factors, such as, for example,
- desired buffer functions
 - shoreline slope and soil erodibility
 - functions and values of the receiving water, e.g. sensitivity to disturbance
 - watershed characteristics
 - context in watershed.



TYPICAL LAKESHORE SECTION WITH BUFFER

Deep-rooted buffer:

- Intercepts and filters nutrients, increases groundwater recharge, and reduces runoff, erosion and sedimentation.
- Provides places for wildlife to eat, sleep, hide and nest.
- Increases shoreline's natural beauty with dynamic, colorful native plants.



Fringe vegetation:

- Stabilizes shoreline, protecting it from waves and boat wakes.
- Produces oxygen for the lake, decreasing nuisance algae blooms.
- Reduces turbidity by settling particles suspended in the water column.
- Provides valuable habitat for insects, fish, turtles, songbirds and waterfowl.

Ice ridge stabilized with deep rooted vegetation protects shoreline from lake and creates a barrier to nutrient loading.

Rich, diverse wildlife population

Wildlife docks – Unless they are a hazard to navigation or swimming, leave fallen trees in the water to provide hiding, feeding and sunning places for fish, watchable wildlife and mosquito eating insects and birds, such as dragonflies and purple martins.

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COMMON LAKE BUFFER PLANTS

NATIVE BUFFER PLANTS - HERBACEOUS

Scientific Name	Common Name	Sun or Shade	Height (ft.)	Moisture Regime
<i>Andropogon gerardii</i>	Big Bluestem	Sun, partial shade	2-6	um, ud
<i>Arisaema triphyllum</i>	Jack in the Pulpit	Partial shade, shade	1-2	w, um
<i>Asarum canadense</i>	Wild Ginger	Partial shade, shade	0.5	um
<i>Aster macrophyllus</i>	Large Leaved Aster	Sun, partial shade, shade	1-2	um, ud
<i>Aster novae-angliae</i>	New England Aster	Sun, partial shade, shade	3-5	w, um
<i>Aster umbellatus</i>	Flat-Topped Aster	Sun, partial shade	3-4	w, um
<i>Carex bebbii</i>	Bebb's Sedge	Sun, partial shade	2	w, um
<i>Carex comosa</i>	Bottlebrush Sedge	Sun, partial shade	3	f, w
<i>Carex crinita</i>	Fringed Sedge	Sun, partial shade	3	f, w
<i>Carex vulpinoidea</i>	Fox Sedge	Sun, partial shade	1-3	w, um
<i>Elymus hystrix</i>	Bottlebrush Grass	Partial shade, shade	2-4	w, um, ud
<i>Eupatorium maculatum</i>	Joe Pye Weed	Sun, partial shade	3-6	w, um
<i>Eupatorium perfoliatum</i>	Boneset	Sun, partial shade	2-4	w, um
<i>Helenium autumnale</i>	Sneezeweed	Sun, partial shade	2-5	w, um
<i>Hydrophyllum virginianum</i>	Virginia Waterleaf	Partial shade, shade	1	um
<i>Liatris ligulistylus</i>	Meadow Blazing Star	Sun, partial shade, shade	2-3	w, um
<i>Lobelia siphilitica</i>	Blue Lobelia	Sun, partial shade	1-3	w, um
<i>Matteuccia struthiopteris</i>	Ostrich Fern	Shade	2-4	w, um
<i>Onoclea sensibilis</i>	Sensitive Fern	Sun, partial shade	2	w, um
<i>Osmunda claytoniana</i>	Interrupted Fern	Partial shade, shade	3-4	w, um
<i>Physostegia virginiana</i>	Obedient Plant	Sun, partial shade, shade	2-4	f, w, um
<i>Podophyllum peltatum</i>	May Apple	Partial shade, shade	1-2	um
<i>Silphium perfoliatum</i>	Cup Plant	Sun, partial shade	4-7	w, um
<i>Smilacina racemosa</i>	False Solomon's Seal	Partial shade, shade	2	um
<i>Solidago flexicaulis</i>	Zig-Zag Goldenrod	Partial shade, shade	1-2	um, ud
<i>Solidago rigida</i>	Rigid Goldenrod	Sun, partial shade	1-5	um, ud
<i>Spartina pectinata</i>	Prairie Cord Grass	Sun	4-6	w, um
<i>Thalictrum dioicum</i>	Early Meadow Rue	Partial shade, shade	1-2	um
<i>Verbena hastata</i>	Blue Vervain	Sun, partial shade	2-5	w, um

NATIVE FRINGE PLANTS

Scientific Name	Common Name	Sun or Shade	Height (ft.)	Moisture Regime
<i>Acorus calamus</i>	Sweet Flag	Sun	2-3.5	f, w
<i>Carex lacustris</i>	Lake Sedge	Sun, partial shade	2-4	f, w
<i>Iris versicolor</i>	Blue Flag Iris	Sun, partial shade	2-3.5	f, w
<i>Mimulus ringens</i>	Monkey Flower	Sun, partial shade	1-3	f, w
<i>Pontedaria cordata</i>	Pickerel Weed	Sun, partial shade	2-3	f
<i>Sagittaria latifolia</i>	Arrowhead	Sun, partial shade	2-3.5	f
<i>Scirpus acutus</i>	Hardstem Bulrush	Sun	3-9	d, f
<i>Scirpus pungens</i>	Three-square bulrush	Sun	2-4	f, w
<i>Scirpus validus</i>	Hardstem Bulrush	Sun	3-9	d, f
<i>Sparganium eurycarpum</i>	Bur Reed	Sun	2-3.5	f
<i>Zizania aquatica</i>	Wild Rice	Sun	6-10	d, f

NATIVE BUFFER PLANTS - TREES AND SHRUBS

Scientific Name	Common Name	Sun or Shade	Height (ft.)	Moisture Regime
<i>Acer rubrum</i>	Red Maple	Sun, partial shade	40-60	w, um
<i>Alnus incana</i> spp. <i>rugosa</i>	Speckled Alder	Sun, partial shade	15-30	w
<i>Aronia melanocarpa</i>	Black Chokeberry	Sun, partial shade, shade	3-6	w, um, ud
<i>Betula nigra</i>	River Birch	Sun	50-70	w, um, ud
<i>Celtis occidentalis</i>	Hackberry	Sun, partial shade	60-100	um
<i>Cephalanthus occidentalis</i>	Button Bush	Sun, partial shade	6-12	f, w
<i>Cornus sericea</i>	Red Osier Dogwood	Sun, partial shade, shade	6-12	w, um, ud
<i>Populus deltoides</i>	Eastern Cottonwood	Sun, partial shade	90	w, um, ud
<i>Quercus bicolor</i>	Swamp White Oak	Sun, partial shade	75-100	w, um
<i>Salix exigua</i>	Sandbar Willow	Sun	5-9	f, w
<i>Salix humilis</i>	Prairie Willow	Sun	3-9	w, um, ud
<i>Sambucus canadensis</i>	Common Elderberry	Sun, partial shade, shade	3-12	w, um
<i>Sambucus pubens</i>	Red Elderberry	Partial shade, shade	8-10	um
<i>Spiraea alba</i>	Meadowsweet	Sun, partial shade	2-5	f, w
<i>Thuja occidentalis</i>	Northern White Cedar	Sun, partial shade	40-60	w, um

INTRODUCED PLANTS AND CULTIVARS

Scientific Name	Common Name	Sun or Shade	Height (ft.)	Moisture Regime
<i>Anemone</i> spp.	Anemones	Sun, partial shade	1-3	um
<i>Astilbe</i> spp.	Astilbe	Sun, partial shade	1.5-3	um
<i>Brunnera macrophylla</i>	Brunnera	Partial shade, shade	1-1.5	w, um, ud
<i>Calamagrostis x acutiflora</i>	'Karl Foerster'	Partial shade, shade	4-5	um, ud
<i>Hemerocallis</i> spp.	Daylilies	Sun, partial shade	1-5	um
<i>Hosta sieboldiana</i>	Hosta	Partial shade, shade	2-3	um
<i>Iris sibirica</i> varieties	Siberian Irises	Sun, partial shade	1.5-3.5	um, w
<i>Ligularia dentata</i>	Bigleaf Goldenray	Partial shade, shade	2.5-5	um
<i>Paeonia</i> spp.	Peonies	Sun, partial shade	1-4	um
<i>Pennisetum alopecuroides</i>	Fountain Grass	Sun	3-4	um, ud
<i>Rudbeckia fulgida</i>	Goldsturm Black Eyed Susan	Sun	1.5	um

COVER CROPS

Cover crops are fast growing annual plants, typically oats (*Avena sativa*) or annual rye (*Lolium multiflorum*) that are often added to seeded buffers to reduce weed growth and prevent soil erosion until the seeded buffer is established.

GUIDE TO ABBREVIATIONS

d: Deep water plants, typically in water 14 inches to 5 feet deep
 f: Fringe plants; grow in shallow water less than 14 inches deep
 w: Wet soil lakeshore plants; moist year-round
 um: Upland moist; upland soils that are moist but not saturated
 ud: Upland dry; upland soils that are dry and well-drained

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GUIDELINES FOR DEVELOPING A PLANT PALETTE

- Trees, shrubs, and/or herbaceous plants suitable to the site's growing conditions can be included in the buffer plant palette. Leaving deadfalls and duff in place will also enhance the ecological functions of the buffer.
- Criteria considered in selecting buffer plants include growing conditions (sunlight exposure, soil type, hydrology, etc.), cold hardiness, rooting characteristics, maintenance requirements, plant availability, wildlife value, project goals, aesthetics and personal taste.
- Planting design style can range from naturalistic to formal.
- Maximizing plant diversity maximizes the buffer benefits listed on page 1 by maximizing root and above ground structural diversity. Natural lake buffers often have 20-100 species!
- So long as soils have not been extensively disturbed, native plants are adapted to local conditions and hence do not require artificial inputs and minimal maintenance. They also give a site a strong sense of regional identity.
- If you want to use native plants, use an analogous natural reference site to select the plant palette best suited to your site.
- Avoid planting invasive species at all costs!

The plant lists shown in this publication do not represent the complete spectrum of potential buffer plants. Consult with a landscape professional, plant supplier, or the references listed below for additional plant recommendations:

- Henderson, Carrol, Carolyn Dindorf, and Fred Rozumalski. Lakescaping for Wildlife and Water Quality. 1999. Minnesota Department of Natural Resources, St. Paul, Minnesota.
- MNDNR. Restore Your Shore CD. Includes interactive Plant Selection Guide. For sale from Minnesota's Bookstore in St. Paul, (651) 297-3000.
- Shaw, Daniel and Rusty Schmidt. Plants for Stormwater Design. 2003. Minnesota Pollution Control Agency, St. Paul, MN. Available for free by calling (651) 297-8679.
- Shaw, Daniel B. Native Vegetation in Restored and Created Wetlands. 2000. Minnesota Water and Soil Resources, St. Paul, Minnesota.
- Wovcha, D.S., B.C. Delaney and G.E. Nordquist. 1995. Minnesota's St. Croix River Valley and Anoka Sandplain: A Guide to Native Habitats. Minnesota Department of Natural Resources. University of Minnesota Press.
- Many native plant supplier catalogs are also very informative.

POTENTIAL PLANT SUPPLIERS

Listing does not constitute endorsement.

Listing below is not an exhaustive list of suppliers.

- Bailey's Nursery, Newport, MN, (612) 459-9744
- Critical Connections Ecological Services, Inc. Nursery, Marine on St. Croix, MN, 651 433-4410
- Dragonfly Gardens, Amery, WI, (715) 268-7660, www.dragonflygardens.net
- Hild and Associates, River Falls, WI, (715) 426-5131
- Ion Exchange, Harpers Ferry, IA, (800) 291-2143, www.ionxchange.com
- Landscape Alternatives, Inc., Roseville, MN, (651) 488-3142
- Prairie Moon Nursery, Winona, MN, (507) 452-1362
- Prairie Restorations, Inc., Princeton, MN, (612) 389-4342
- Natural Shore Technologies, Champlin MN, (612) 703-7581, www.naturalshore.com
- North American Prairies, Annandale, MN, (320) 274-5316, northamericanprairies.com.
- Shooting Star Native Seed, Spring Grove, MN, (507) 498-3944, ssns@means.net.
- Woodland Plant Salvage Company, White Bear Township, MN, 651-426-8174

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OTHER BUFFER COMPONENTS

- Hardwood shredded mulch: used only when planting live plants, not with seeded buffers; beneficial in controlling weeds and getting young plants established.
- Straw mulch: beneficial when seeding buffer vegetation; controls erosion and enhances seed germination.
- Mycorrhizae: sometimes beneficial in poor soils.
- Biodegradable erosion control blanket: often beneficial on eroding or steep slopes.
- Edging: edging minimum 6" wide or 6" deep, such as heavy duty black plastic edging, helps keep lawn grasses from invading the buffer.
- Vegetation protection fence: sometimes used to protect plants from intruders, dogs, and herbivores until plants are established (typically 2 years).
- Tree shelters: sometimes used to protect woody plants from herbivores until established (typically 2-3 years).
- Plant labels can be helpful to distinguish buffer plants from weeds.
- Wildlife habitat enhancements (tree snags, turtle logs, bird boxes, butterfly boxes).
- Soil bioengineering methods can also be used to address erosion problems but are not covered in this publication.

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- Hardwood shredded mulch and compost: NRG Processing, St. Paul, (612) 331-4610
- Mycorrhizae: Mycorrhizal Applications, Inc., Grants Pass, OR, (541) 476-3985, www.mycorrhizae.com
- Erosion control blanket: Brock White Company, St. Paul MN, (800) 880-3210, www.brockwhite.com
- Tree shelters: Treessentials Co., St. Paul, MN, (800) 248-8239; Oasis Tree Shelters, Salinas, CA, (800) 784-4769

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MAINTENANCE

- In the first year, when plant roots are not yet fully established, water thoroughly once a week every week that it does not rain at least one inch. In the second year, water only during severe drought. After the second year, no watering will be required if using native plants adapted to local conditions.
- Invasive species should be closely monitored and removed immediately, especially in the first 3-5 years. If not promptly removed, invasive species will rapidly spread and displace desired buffer vegetation. Eradication will be very difficult, time-consuming, and costly!
- Lists of worst invasive plants are shown to the right.
- Native plants that evolved under a periodic fire regime will benefit from periodic controlled burns. Mow with a mulching mower set on the highest setting where controlled burns are not feasible.
- Ensure that runoff is spread across vegetated areas and not allowed to bypass or flow into concentrated channels.
- Avoid mowing, raking, or removing leaf litter and deadfall.
- Do not dispose of yard waste in buffer zone.
- Do not use fertilizers and pesticides in buffer zones and use in other areas only when needed.
- Limit trails and structures within 25' of lake. Where lake access is needed, use narrow pervious trails only.
- To further reduce mowing maintenance on your property, consider replacing your lawn with a no-mow turf, such as a no-mow fescue mix (not native), blue gramma (native, sandy or loamy soil).
- Use low impact development techniques throughout the watershed to minimize the negative effects of impervious surfaces on surface water bodies (e.g. collect runoff from hard surfaces in raingardens, use pervious paving on driveways and paths, disconnect downspouts from storm sewer systems, install rain barrels on downspouts).

LAKE BUFFER EXAMPLES

Nelson Park Shoreline, Long Lake, MN; East on Lake St. from Highway 12 (Installed 1999) - Funded by Minnehaha Creek Watershed District and MNDNR



Photo: The Kestrel Design Group, Inc.



Photo: The Kestrel Design Group, Inc.

Trillium Bay Shoreline Buffer, Minnetrista, MN; adjacent Trillium Lane E (Installed 2003) - Funded in part by Minnehaha Creek Watershed District



Photo: The Kestrel Design Group, Inc.

Lake Nokomis Lakeshore Restoration, Minneapolis, MN; Northeast Shoreline of Lake Nokomis (Installed 2001)



Photo: The Kestrel Design Group, Inc.

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INVASIVE SPECIES

HERBACEOUS PLANTS

Scientific Name

Alliaria officinalis
Ambrosia trifida
Botumus unbellatus
Bromus inermis
Centaurea maculosa
Cirsium arvense
Coronilla varia
Euphorbia esula
Iris pseudacorus
Lotus corniculatus
Lythrum salicaria
Melilotus alba
Melilotus officinalis
Myriophyllum spicatum
Phalaris arundinacea L.
Plantago major
Poa pratensis
Polygonum cuspidatum
Rumex crispus
Typha spp.

Common Name

Garlic Mustard
 Giant Ragweed (native)
 Flowering Rush
 Hungarian Brome
 Spotted Knapweed
 Canada Thistle
 Crown Vetch
 Leafy Spurge
 Yellow Iris
 Bird's Foot Trefoil
 Purple Loosestrife
 White Sweet Clover
 Yellow Sweet Clover
 Eurasian Water Milfoil
 Reed Canary Grass (native)
 Plantain
 Kentucky Bluegrass
 Japanese Knotweed
 Curly Dock
 Hybrid Cattails

WOODY PLANTS

Scientific Name

Celastrus orbiculata
Lonicera tatarica
Morus alba
Philadelphus spp.
Rhamnus spp.
Robinia pseudoaccacia

Common Name

Oriental Bittersweet
 Asian Honeysuckle
 Asian Mulberry
 Mockorange
 Buckthorn
 Black Locust

The following websites provide images and information about potential removal techniques for the species listed above:
http://www.dnr.state.mn.us/ecological_services/exotics/index.html
<http://tncweeds.ucdavis.edu/>
<http://www.dnr.state.wi.us/org/land/er/invasive/>

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