Riparian Buffers for Western Washington Agriculture

Tilth Producers Farm Walk Series

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What are buffers and why should I care?

*"Riparian buffers are vegetated zones adjacent to streams and wetlands that represent a best management practice (BMP) for controlling nitrogen entering water bodie*s." US EPA, EPA/600/R-05/118

"Buffers are vegetated zones located between natural resources and adjacent areas subject to human alteration". Castelle et al., 1994. Journal of Environmental Quality 23: 878-

These broad definitions characterize the two fundamental attributes of buffers: They are a *physical barrier* between natural resources and landscapes that have been disturbed by human activity, and they are *functional biological systems* that remove or break down pollutants as they transit through that system. Buffers provide many ancillary services such as protecting soil, enhancing water quality, and providing habitat for wildlife.

A buffer can be a protected natural *no-touch zone* or an engineered landscape feature designed to solve a specific problem. The type of vegetative cover and width depend on land use, topography, and classification of surface water. For example, tree plantings along farm field borders can protect the soil from wind erosion, function as a living snow fence, and serve as habitat and migration corridor for wildlife. Natural riparian forest buffers on rangeland and pasture, from which livestock are excluded, provide stream shading, erosion control, and capture animal waste in runoff. Riparian buffers in steep upland forested areas have highly regulated no-touch zones where width is determined by site-potential tree height. These buffers provide large woody debris to the stream bed which modulate flow velocity and therefore erosion, and provide shading and habitat for terrestrial and aquatic organisms. Agricultural cropland buffers can take many forms, from simple contour grass strips and grassed waterways to capture sediment, to more complex grass filter plus riparian forest buffers along streams and ditches that provide an intercept zone for sediment, applied

pesticide, and broadcast soil nutrient amendments. Forested buffers on agricultural land also can provide stream shading and habitat for wildlife, and function to extract applied nutrients leached into shallow groundwater before it converges with surface water.

Large segments of many salmon-bearing rivers and streams in the Puget Sound basin are bordered by agricultural land. Historically, floodplain areas in western Washington, where a significant portion of agricultural land is located, contained connected wetlands, braided channels and oxbow lakes that performed a variety of valuable functions for fish and wildlife as well as indigenous peoples. While the building of dikes, drainage ditches and levees to expose arable land and control flooding along the lower river reaches have facilitated enormous advancement of agricultural productivity, important habitats for nourishing juvenile salmon in the estuaries have become lost or disconnected from the rivers or degraded by catastrophic flooding events. Several species of salmon and trout are presently listed as threatened or endangered. Currently, Puget Sound Chinook salmon are running at about 10% of their historic levels. Farming practices can have significant impacts on the fate of salmon in these rivers. Buffers on agricultural lands can help mitigate a number of these impacts.

Public health has also become increasingly threatened when pesticides, chemicals, animal waste, soil fertility amendments, and stormwater from urban areas enter waterways directly and contribute to degraded water quality, leading to health impacts and higher treatment costs. The implementation of BMPs along streams and ditches and restoration of wetlands in critical areas are positive steps toward regaining sustained health of these ecological systems we all depend on.

What services do buffers provide?

- Buffers provide an intercept zone, preventing air borne pesticide applications or broadcast soil nutrient amendments from directly entering surface water bodies. Grass filter strips are effective at intercepting sediments and sediment-bound pollutants in run-off in run-off by increasing surface roughness and water infiltration.
- Forested riparian buffers modulate the temperature of surface water through shading. Low stream and river temperatures are critical for maintaining adequate dissolved oxygen for fish and aquatic organisms.
- Forested riparian buffers are a source of large woody debris, which regulate stream flows and provide habitat and nutrients for fish and aquatic organisms.
- Buffers prevent erosion by holding soil in place, and capturing waterborne sediment.
- Buffers provide stormwater storage by allowing rain to infiltrate into the soil instead of running directly in to the stream, thereby helping to reduce the impacts of winter flood events.
- Forested buffers provide stream channel containment during flooding events.
- Forested riparian buffers provide habitat for wildlife.

How do buffers remove leached nutrients and toxic chemicals in groundwater?

Buffers remove soluble nitrate and phosphate from shallow groundwater primarily through three processes: *Assimilation*, where buffer vegetation extracts and utilizes these nutrients for biomass growth; *immobilization*, where soil micro-organisms (bacteria, fungi) absorb nutrients, thus preventing their being accessible to plants; and *denitrificatio*n, where various soil bacteria in anoxic or hypoxic soil

conditions utilize nitrate for metabolic reactions. Organic matter is oxidized in the process. The reduction of nitrate ultimately produces gaseous molecular nitrogen which is unavailable for plants and leaves the system, reducing the amount that arrives in surface waters).

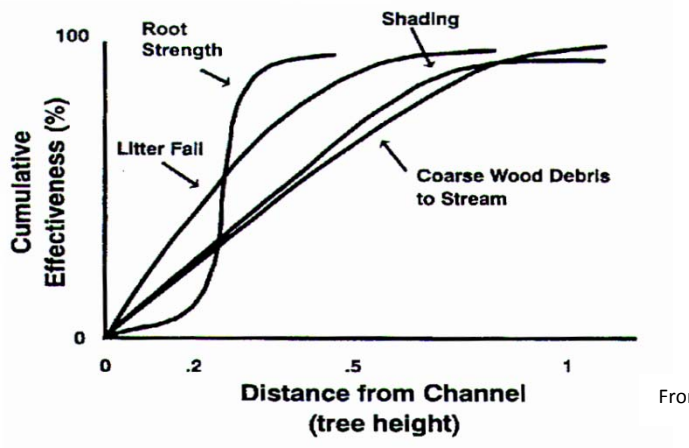
Some toxic organic molecules, such as some pesticides and petroleum-based molecules can be filtered, broken down or neutralized by vigorous populations of soil bacteria that are supported by the above-ground buffer vegetation.

How wide should a buffer be?

Buffer width and recommended vegetation vary by site characteristics, land use, and water body attributes. In western Washington, counties have identified critical areas along waterways as part of their plan to comply with the Shoreline Management Act. County Conservation Districts have recommendations and guidelines for what to plant and how wide a buffer should be for these areas.

A recent EPA literature review of riparian buffer research on nitrate removal effectiveness indicates that the most effective forested buffers are at least 100 feet wide [EPA/600/R-05/118]. Narrower buffers can still reduce groundwater nitrate up to ~80%, but extensive experimental support for narrow buffer zones less than 30 feet wide on agricultural land is lacking. Other common findings are that nitrate removal efficiency does not necessarily have a linear relationship with buffer width. In many cases the additional width required to increase effectiveness from 75 to 100% was disproportionately larger than the width to remove the first 50%. Effectiveness also diminishes with increasing nitrate influx loading, suggesting that there is a threshold of effectiveness. Narrow buffers may therefore be inadequate in situations where nitrate inputs are large, such as adjacent to agricultural cropland.

Additional studies have shown that buffer widths required to achieve other functions have distance relationships based on vegetation height. For example, bank stabilization by tree roots could attain 90% effectiveness in a buffer width equal to 25% of tree height, whereas shading and deposition of course woody debris into the stream would be 90% effective in a buffer width equal to 1 tree height.



From FEMAT 1993

The width of buffers along salmon-bearing streams should be based on its ability to provide habitat-based biological and physical requirements for spawning, incubation, rearing, feeding, sheltering, and migration.

What should I plant?

A number of native trees, shrubs, and herbs are appropriate for planting in western Washington riparian buffers. Conifers such as Sitka spruce and western red-cedar ultimately produce the most shade and the largest woody debris (a valuable structural element in aquatic habitats), but require long periods of time to grow. Broadleaf trees such as red alder grow quickly, and do well in already disturbed sites. One need not plant the whole buffer to trees, either: planting a few open areas with shrubs like salmonberry creates habitat diversity and alternate food sources for wildlife.

- Streamside
  - Trees & shrubs
    - *Salix scouleriana* Scouler's willow
    - *Salix sitchensis* Sitka willow
    - *Salix lasiandra* Pacific willow
    - *Cornus cerulea* Red-osier dogwood
    - *Alnus rubra* Red alder
    - *Thuja plicata* Western red-cedar
    - *Picea sitchensis* Sitka spruce
    - *Rubus spectabilis* Salmonberry
    - *Ribes lacustre* Prickly currant
    - *Spirea douglasii* Spirea (hardhack)

  - Understory
    - *Oxalis oregano* Wood sorrel
    - *Polystichum munitum* Sword fern
    - *Athyrium filix-femina* Lady fern

- Upslope
  - Trees & shrubs
    - *Pseudotsuga menziesii* Douglas-fir
    - *Tsuga heterophylla* Western hemlock
    - *Populus trichocarpa* Black cottonwood
    - *Acer macrophyllum* Bigleaf maple
    - *Fraxinus latifolia* Oregon ash
    - *Acer douglasii* Douglas maple
    - *Symphoricarpos albus* Snowberry
    - *Rosa spp.* Wild rose

How much will it cost to install and maintain?

Clearly, a major consideration is the loss of income from areas dedicated to buffers. Area in a buffer cannot be utilized in the same way that an open, tilled field can. Additionally, there are a number of costs associated with establishing and maintaining a hardwood riparian buffer. However, there are a number of ways in which a farmer can realize economic value from buffers.

Maintenance costs and establishment costs are the primary direct costs of protecting resources with riparian buffers. Example establishment costs per acre of a buffer system using hybrid poplars are given in the following table (taken from Henri and Johnson 2005, *Journal of Soil and Water Conservation* 60: 159-163).

Activity	Cost/acre
Site preparation	$20
Purchase of poplar cuttings (whips)	$218
Planting labor	$91
Spot spray of herbicide (year 2)	$45

Maintenance comprised 16-50% of costs in a number of case studies conducted by Carolyn Henri and Jon D. Johnson, researchers at WSU Puyallup. Maintenance may include control of competing vegetation (e.g., Himalayan blackberry, *Rubus armenaicus*) or thinning dense portions of the buffer.

Depending on pulp and small sawlog prices, thinning operations in the buffers may partially offset the costs associated with buffers while contributing to the goal of large, vigorous trees. Smaller trees should be removed so that the larger, faster-growing trees can accumulate wood at an even faster rate. These smaller trees will have less taper and few branches than larger trees, enhancing their value. Also, hardwood trees (especially red alder) have maintained their market values very well through the economic downturn, and may be expected to do so into the future. Evidence suggests that buffer management should aim for at least some sawlog production (at least as much volume in sawlogs as in pulpwood) and fairly heavy extraction levels (>50% of stand) if profitability is desired.

There may be additional opportunities for cost recovery, such as the cultivation of secondary crops within the buffer, including berries, medicinal herbs, and true firs (*Abies* spp.) for the lucrative Christmas tree and holiday bough markets. This is a developing field that may be addressed in trials at WSU Puyallup.

Some of the economic benefits of buffers to farmers are indirect. Riparian buffers may hold enhanced populations of arthropod predators, which can help control populations of insect pests in the farm field itself. Buffers may also help reduce damage to agricultural lands from flood events. Leaf litter from healthy buffers may also enrich soils in the adjacent farm field, especially if the litter is from a tree species that accumulate a given nutrient (e.g., nitrogen in red alders and calcium in bigleaf maple).

In many cases, cost-sharing programs can relieve the farmer of some or all of the costs of establishing and maintaining a buffer. In the future, farmers may be able to sell credits for protecting water, soil, and habitat to industries that cannot cost-effectively reduce their own impact (a "cap-and-trade" system). Municipal, county, and federal "cost-share" programs are available to help farmers establish and maintain buffers. Some of the best known of these programs are operated by the Natural Resources Conservation Service, and include the Conservation Reserve Enhancement Program (CREP). The CREP program pays the costs of buffer establishment as well as rental rates for the land held in the buffer for a lease period of 10-15 years.

While a significant commitment of resources, a riparian buffer on agricultural land need not be an unmitigated cost to agricultural producers. There are both direct and indirect benefits to the producer which may be realized with planning and proper management.

Can I harvest trees, vegetation, or forest products from a buffer?

If you are installing the buffer because you desire to contribute to aquatic and ecosystem health, and not as an action complying with local regulations, then you may manage the buffer as you wish. This may include thinning or harvesting trees; growing and harvesting berries, forbs, and other products; and other activites. However, if you are establishing the buffer in compliance with regulation or as part of a program such as CREP (Conservation Reserve Enhancement Program), then you will need to check with the buffer specialist at the regulatory or conservation agency responsible to see what activities are allowed within the buffer. For example, CREP does not allow management within the buffer following an initial 5-year establishment period.

What are the regulations and permit requirements for buffers?

The state Growth Management Act (1990) was written to help Washington reduce impact to environmental and aesthetic resources as its population grows. Each county is charged with adopting regulations to comply with the provisions of this act, including regulations to protect wetlands, rivers, creeks, and lakes. Current agricultural use of land is largely exempt from mandatory buffer regulations; we highly recommend that you check with your county government and county conservation district for the current status on regulations protecting water bodies from adjacent uses.

Certain rules may apply to the buffers established as part of mitigation for another activity or impact. For example, they may require that only native plants be used, or that the planting mix be comprised of perennials, shrubs, or trees.

If any of your land is classified as forest land, then you must comply with Washington State's Forest Practices Act (see 'Helpful Websites' section at the end of this document). We recommend contacting the state Department of Natural Resources to find out about mandatory riparian buffer regulations as well as exemptions for small landowners.

Helpful websites

Natural Resources Conservation Services and Washington Conservation Commission

- *Agroforestry for Farms and Ranches*

An introduction to using tree and shrub practices in sustained agricultural systems
http://www.nrcs.usda.gov/technical/ECS/forest/technote.html#riparian

- *Buffers, common-sense conservation*

http://www.nrcs.usda.gov/feature/buffers/BufrsPub.html#EligibleBuff_4Anchor

- Case study: conservation benefits versus lost agricultural profits.
  http://www.wa.nrcs.usda.gov/news/Showcases/Showcase24.html

- *Washington State Conservation Commission*, *Overview of the Conservation Reserve Enhancement Program* http://www.scc.wa.gov/index.php/Conservation-Reserve-Enhancement-Program/Overview-of-the-Conservation-Reserve-Enhancement-Program.html

Washington State University Cooperative Extension

- *Resources for Farming with Buffers*

Agriculture and Natural Resources Fact Sheet #529
http://king.wsu.edu/foodandfarms/documents/buffer.pdf

- *Riparian Buffers: Function, Management and Economic Implications for Agriculture*

http://www.puyallup.wsu.edu/agbuffers/

Washington State Agencies

- Department of Natural Resources- regulates buffers on forest lands.
  http://www.dnr.wa.gov/
- Department of Ecology- regulates certain types of impact to surface waters.
  http://www.ecy.wa.gov/

Shoreline Management Act

- http://www.mrsc.org/subjects/environment/shorelin.aspx

Western Washington Protected or Critical Areas (Shoreline Master Programs)

- *Shoreline Master Program Guidelines* (Department of Ecology)
  Links to local planning offices; lakes, rivers and streams under shoreline jurisdiction for western Washington counties

http://www.ecy.wa.gov/programs/sea/SMA/guidelines/index.html

- *Introduction to Washington's Shoreline Management Act. Where does the Shoreline Management Act apply?* http://www.co.jefferson.wa.us/commdevelopment/PDFS/SMPupdate/FormalReviewProcess/ECY%20-%20SMA%20factsheet.pdf