# Appendix VII – Integrated Approaches to "Slow the Flow" While Promoting Economic Opportunity

"Slowing the flow" is an intuitive approach to reducing flood risk (as well as droughts) by utilizing the natural water storage capacity of watersheds and ecosystems[1]. It means slowing the rate that water (precipitation) runs across the landscape and to larger order streams by increasing upstream water storage in soil, vegetation, and groundwater. Approaches to slow the flow of water on the landscape can occur in upland areas in the form of permanent/year-round vegetation, on hillsides where reforestation activities are highly effective, and in valleys and floodplains which often serve as water catchment areas for the landscape.

Conserving or restoring floodplain ecosystems through reforestation, riparian buffers and wetlands/forested wetlands is a common example of a nature-based approach to slowing the flow that can be integrated into working landscapes. Vegetated buffers along streams and rivers (i.e. riparian areas) are excellent examples of nature-based actions that can greatly increase the resilience of a system. Riparian buffers can provide a number of ecosystem services, including water quality protection, erosion and flood control, carbon sequestration, and wildlife habitat[2,3,4].

Riparian buffers can be designed in a number of ways, depending on the function they are intended to provide. The width of the buffer (distance from the stream edge) varies, depending on which of these services a land manager or landowner desires to achieve. For example, streambank stability can generally be achieved with a 30-foot buffer, however near-total nutrient removal cannot be achieved until buffer widths are greater than 120 feet. Corridors for wildlife travel and habitat can generally be achieved in a 150-300 foot buffer, however riparian buffers aimed at providing habitat for threatened, endangered, and sensitive species is generally not achieved in under 600 feet (Figure 1).

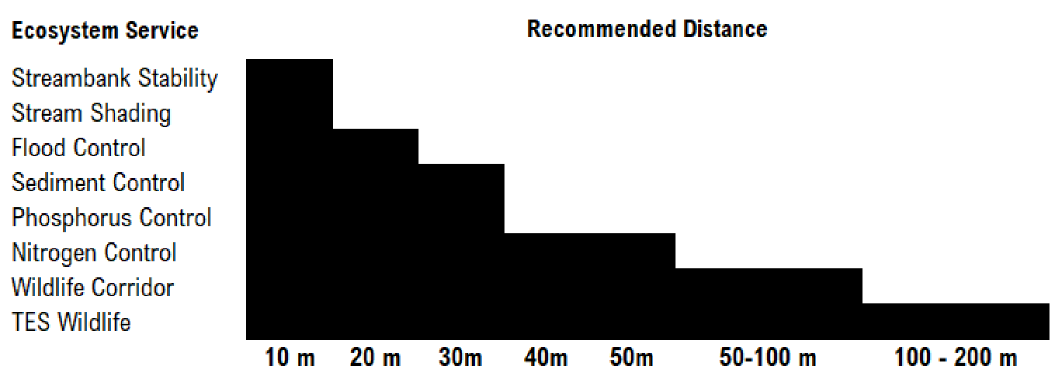


**Figure 1.** Recommended riparian buffer widths (distance from stream) from research literature for various ecosystem service goals (references listed below).

It is important to note that while these are generalized recommendations, various circumstances can change effective distances. For example, the Southeastern Wisconsin Regional Planning Commission recommends a 50-foot buffer to achieve 75% sediment removal during small, low intensity storms, but found that buffers more than

150 feet wide are necessary to achieve the same sediment reduction during more severe storms. Nearby slope gradients will also have an impact on the effectiveness of buffers of varying widths. It will be important for landowners to work with local land and water conservationists (for example, from Monroe County Land Conservation Dept or local NRCS conservationists) to determine the most effective buffer distance for their goals on their land.

Because there is great flexibility in the way that streamside buffers can be designed and still accomplish intended ecological function, this flexibility can also be used to generate innovated agricultural products and diversify income on farmland. Riparian buffers can be thought of as having 3 distinct zones with distinct functions as well as a potential for diversifying income on farmlands[5]. Zone 1 is the narrow area closest to the stream bank and can include a mixture of native trees, shrubs, and/or forbs that are adapted to wet conditions. The principal goal of this zone is to stabilize the bank and provide shade for aquatic habitat. Zone 2 is a much wider area, consisting of fast-growing trees and shrubs that can tolerate periodic flooding. The primary function of this zone is nutrient uptake and storage and slowing floodwater. This zone can be managed or additional income from nuts or wood products. Lastly, Zone 3 is the area adjacent to crop fields or grazing lands that provides high infiltration, sediment filtering, nutrient uptake and can help disperse concentrated runoff. Native grasses and wildflowers are often preferred for providing wildlife and pollinator habitat, but dense, stiff-stemmed grasses can also be established and occasionally harvested for biofuels as an additional source of income.

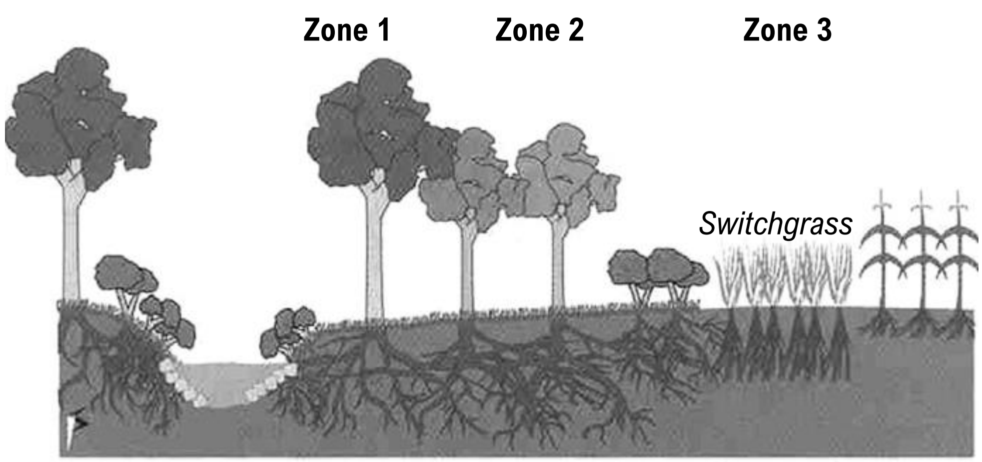


**Figure 2.** Conceptual design of a 3-zone riparian (streamside) buffer in which Zones 2 and 3 can be managed for harvestable crops such as wood products and switchgrass for biofuels.

## Biofuels as a Conservation Practice

Increasing landscape resilience in the face of climate change is an important goal for many land managers and landowners, however, such actions can, at times, be in competition with other land uses such as food and fuel production. Use of native perennials is a potential solution to this tension, with native grasses such as switchgrass (*Panicum virgatum*) showing high potential for biofuel production. Switchgrass is a warm-season, native perennial grass adapted to Wisconsin's climate, and can be used for livestock grazing, riparian herbaceous buffer, wildlife cover, and as a biofuel crop. Furthermore, harvests occur once a year; if harvesting occurs 2-3 weeks after the first frost, the plant will recycle nutrients and likely reduce future fertilization as well as drying costs[6].

The benefits of switchgrass can be especially prominent on “marginal lands”, which are often defined as lands that have are frequently flooded, shaded, or otherwise characterized by low productivity and reduced economic return for agricultural use. Oftentimes in Wisconsin, marginal lands occur on hydric soils – defined by USDA NRCS as those soils that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part. Other marginal lands can include lands on steep slopes, those that are subject to high levels or erosion, or other attributes (such as shade) that causes low rates of returns on annual crop production. The establishment of native perennial biofuel plantations on marginal soils has been frequently promoted as having the ability to restore degraded soils, sequester SOC, improve soil quality, and benefit the environment[7,8].

Biofuels have been promoted for their many benefits; for growers, some biofuels can be planted in marginal lands and as an extra source of income; for wildlife, biofuels make a better habitat alternative to annual crops; and for ecosystem services, biofuels sustain soils and reduce runoff[9]. Following the 3 Zone model above, riparian buffers could provide numerous ecosystem services while also providing additional income in the form of woody biomass fuel stocks (Zone 2) and herbaceous biomass fuel stocks (Zone 3). Within Zone 2, fast-growing woody species such as willow and poplar, which are also adapted to hydric conditions, can be grown as a source of woody biofuel stock. Within Zone 3, native perennial grasses can be established as a “transition zone” between the woody riparian buffer and traditional row crops. Switchgrass crops need little to no maintenance or input once established; nutrients trapped in riparian buffers can largely meet the needs of switchgrass.

Economically, the establishment of switchgrass plantings and riparian buffers can come at a cost to landowners, both in the form of the initial establishment as well as lost income during subsequent years that the land is taken out of production. Despite this, the establishment of native, perennial biofuel stock can not only offset the costs of establishing a buffer, but also provide positive net income for landowners in subsequent years. Native perennials may cost less in the long term to maintain than annual crops, as they only need to be planted once, can be grown on marginal land, and annual inputs such as pesticides will be minimal[9]. Xu et al. (2019) found that harvesting switchgrass as a biomass feedstock can offset the costs of riparian buffer installation, at a biomass price >$20 per dry ton. Once the biomass market matures and prices reach $40 per d/t, switchgrass harvesting would not only offset the cost of riparian buffer implementation but also generate significant positive revenues for farmers and landowners[10].

Other biofuels, such as roundwood, logging residues, and other cellulosic feedstocks may become a viable income source on agricultural lands, providing an opportunity to integrate conservation and restoration into working lands. Demand for biofuels already outpaces supply[9] and the Energy Information Administration anticipates that production of biofuels within the US will increase substantially through 2050. Political/economic incentives seem to be on the rise: In the US, 36 billion gallons of renewable fuels will be required with the Energy Independence and Security Act by 2022[11]. The US Department of Energy has developed iterative versions of The Billion Ton Report (BTR) which aims to assess the US ability to develop a billion tons of renewable energy annually. BTR data estimated in 2016 that Monroe County could be producing as much as 16,000 dry tons of whole-tree biomass from approximately 1,465 acres by the year 2030. They also report the potential for up to 28,000 annual dry tons being produced in the county from farmed willow and poplar feedstocks (Medium housing, medium energy demand, $60 d/t market; see the BTR interactive data download site here). Ultimately, the use of marginal lands for bioenergy production, combined with comprehensive management practices, could potentially increase soil carbon sequestration, enhance soil and water quality and support ecosystem services[11], while providing an economically feasible income source for landowners.

### *Appendix VII References*


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