Edge of Field Practices

Riparian Forest Buffers and Vegetative Filter Strips: Riparian buffers and filter strips are strategically located vegetated areas adjacent to water resources that protect water from nonpoint source pollution, provide bank stabilization and aquatic and wildlife habitat (figure 1). These buffers utilize a mix of trees, shrubs and or grasses. Regionally, research has demonstrated that riparian buffers and filter strips are very effective in reducing excess sediment, organic material, nutrients (N & P), and pesticides in surface runoff by: reducing the rate of run off, decreasing suspended solids, reducing edge of field sheet and rill erosion, and increasing infiltration, microbial activity, evapotranspiration, and overall water storage capacity (see LCSA, 2000). Based on the science summary produced by the Iowa Nutrient Reduction Strategy (Lawrence 2013), cereal rye cover crops result in an average 91% reduction in nitrate (N) and about 58% reduction in phosphate (P) (though it should be noted that the standard deviations are quite high indicating highly variable results). The lifespan of buffer practices are indefinite; as with all Best Management Practices based on perennial vegetation, there is an idealized expectation that these practices are effectively permanent (though it is technically possible to return the land base to agricultural production).

Saturated buffers: A "saturated buffer" is a riparian buffer in which the water table is artificially raised by diverting a substantial portion (up to 60%) of subsurface drainage parallel to an existing riparian buffer. This is accomplished by installing a water control structure in the main drainage outlet at the buffer interface. In Iowa, this practice is being investigated as a way to reduce nitrate and phosphate loading to surface waters (see Isenhart and Jaynes 2015). Table 1 below summarizes the general use characteristics of these practices and overviews their basic cost aspects.

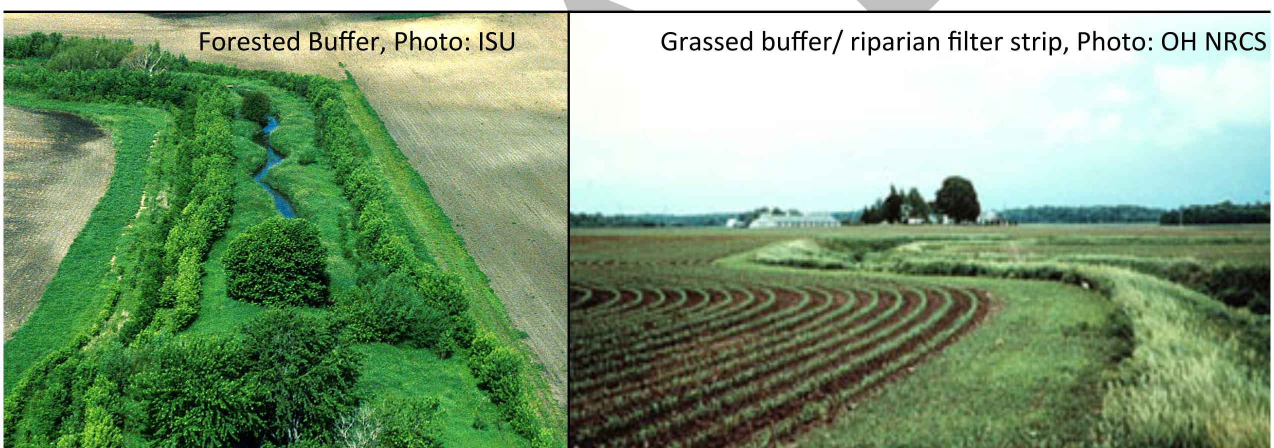

Figure 1. Riparian forest buffer (left) and vegetative filter strip (right).

Table 1. General use characteristics of Riparian Forest Buffers (Practice Code 391), Vegetative Filter Strip (Practice Code 393), Saturated buffers (practice standard in development for Iowa) and basic cost parameters.

Best Management Practice (NRCS practice standard code)	General use of the BMP: For the most part this information comes directly from NRCS practice standard information.	Basic Cost Parameters: Varies considerably from site to site and depends on initial conditions, hydrology, soil, crop, practice design, and management characteristics.
Riparian Forest Buffer (Practice Code 391)[1]	Restore riparian plant communities. Reduce excess sediment, organic material, nutrients (N & P), and pesticides in surface runoff. Increase carbon storage.	Site preparation; seed mix (high diversity; multi-species: woody, grasses); planting; mowing and/or periodic burning. Opportunity costs in the form of foregone land rent or crop revenue.

Vegetative Filter Strip (Practice Code 393)[2]	Reduce suspended solids & associated contaminants in runoff. Reduce dissolved contaminant loadings in runoff. Reduce suspended solids and associated contaminants in irrigation tailwater	Site preparation; seed mix (usually 1-2 different species); planting; mowing. Opportunity costs in the form of foregone land rent or crop revenue.
Saturated buffers (Practice Code 604; Draft)[3]	Reduce suspended solids and associated contaminants in runoff. Reduce dissolved contaminant loadings in runoff. Reduce nitrogen loading from redirected tile drainage	Site preparation; seed mix (e.g., similar to vegetative or riparian buffer strips); planting; mowing. Excavation for tile drainage pipes; control structure purchase & installation; connection tile pipe; control gate yearly maintenance. Opportunity costs (e.g., foregone land rent or crop revenue).

1. Riparian Forest Buffer (Practice Code 391): http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_026098.pdf.

2. Vegetative Filter Strip (Practice Code 393): https://efotg.sc.egov.usda.gov/references/public/IA/Filter_Strip_393_STD_2010_02.pdf.

3. Saturated buffers (Practice Code 604; Draft): http://www.saturatedbufferstrips.com/images/ncrs.pdf

Cost Overview for Riparian Forest Buffers, Vegetative Filter Strip and Saturated buffers:
With regard to riparian forest buffers and vegetative filter strips the primary upfront costs are associated with site preparation, planting stock and establishment. The primary management costs are associated with annual maintenance activities (e.g., mowing, replanting/seeding if needed). The significant long-term cost of these practices is the annual opportunity cost of foregone rent or revenue associated with any crop-land that is effectively retired. The annualized costs for a 66-foot-wide riparian forest buffer comes to about $460 per acre per year, for a vegetative filter strip annualized costs come to ~ $300 per acre per year (the main difference in cost between these buffer types is the woody planting stock and increased management needs required for the riparian forest buffer). For saturated buffers the primary costs are associated with control structures and tile extensions. Saturated buffers are in addition to the buffers themselves, so in practicality, the buffer costs apply as well.

There are conservation programs that will offset some of the cost to landowners. Both Riparian Forest Buffer (Practice Code 391; CP 22) and Vegetative Filter Strip (Practice Code 393; CP 21) qualify for continuous CRP (10-15 year initial contract lengths), 90% cost share on establishment, a $10 per acre/year practice incentive, and a 20% rental payment bump on top of weighted average rental payment (based on soils); for Riparian forest buffers there is also a one-time bonus of at least $100/ acre for planting trees. Note that program payments may vary somewhat from county to county and year to year;

Average annual 2016 costs (per acre per year) of using either a 66-foot wide riparian forest buffer or a riparian vegetative filter strip (e.g., planted to a CP21 compliant mix)

Practice	Average annualized cost per acre [1]
Riparian Forest Buffer	$330
Vegetative Filter Strip	$233
Saturated Buffer [2]	$360[2]

1. Calculated using standard discounted cash-flow procedures using a 4% discount rate and 20-year management horizon. Assumes land rent cost of $100/acre; 2. Assumes a 20 acre drainage area.

Important caveat: Please note that the direct and indirect cost of any Best Management Practice can vary considerably from site to site and are largely contingent on: initial conditions, hydrology, soils, crop, practice design, management characteristics and experienced opportunity costs (which can be highly variable). As with all of these types of financial assessments, the costs presented here are simply baseline numbers and are meant to be informative rather than prescriptive.

References

Isenhart, T. and D. Jaynes (2015) Cleaning Iowa's Waters with Saturated Buffers in Iowa Watersheds. Iowa State University Extension and Outreach. WQ 0005, October 2015. Available at: https://store.extension.iastate.edu/Product/14441

Jaynes, D.B. and T. Isenhart (2011) Re-saturating Riparian Buffers in Tile Drained Landscapes. A Presentation of the 2011 IA-MN-SD Drainage Research Forum. November 22, 2011. Okoboji, IA

LCSA - Leopold Center for Sustainable Agriculture (2000) Frequently asked questions about riparian buffer management systems. Available at: http://www.buffer.forestry.iastate.edu/Assets/FAQ.pdf

Plastina and Johanns (2016) 2016 Iowa farm custom rate survey. Iowa State University Extension and Outreach, Ag Decision Maker File A3-10; FM 1698 (Revised, March 2016).

Plastina, Johanns and Welter (2016) Cash Rental Rates for Iowa. 2016 Survey. Iowa State University Extension and Outreach, Ag Decision Maker File C2-10. FM 1851 Revised May 2016.

Schultz, R.C., Colletti, J.C., Isenhart, T., Marquez, C.O., Simpkins, W.W., and C.J. Ball (2000) Riparian buffer practices. Chapter in North American Agroforestry: An integrated Science and practice. American Society of Agronomy, Madison WI.

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Table 3. Custom rate costs associated with multi-species, vegetative and saturated buffers installed in Iowa; primary goal is nitrogen reduction from agricultural runoff. Costs presented in 2016 dollars. Data updated from Christianson et al. 2013.

Cost Activities [1]/ items	Year cost incurred	Range of costs (units)	Mean price (ac)	Notes	Data Source
Buffer Site design	0	$0 - $300/ design	$0	Typically, buffer designs will be *gratis* from NRCS, but more complex buffers may need outside assistance	Cost data: Plastina, A., and A., Johanns 2016
Site preparation	0	$133.80 - $219.30/ acre	$174.40	Includes disking, harrowing, site clearing, herbicide (various) and fertilizer application (lime, K, P). In some cases it might be recommended that in the fall prior to buffer establishment, the site is disked and planted to a winter cover (e.g., winter rye or timothy). This would add ~$40 per acre to site prep costs.	Cost data: Plastina, A., and A., Johanns 2016; Site preparation data: Schultz et al. 2000
Multi-species Buffer (Trees, shrubs, grass)					
Planting stock (bare root seedlings)	0	$38.50 to $53.50 per 100 seedlings	Variable	Species choice is a matter of soil conditions, landowner goals, and expected/emerging pest and pathogen concerns. Total costs of planting stock depends upon buffer design (e.g., total number of tree/shrub rows, spacing between trees/shrubs).	Iowa DNR State Nursery 2016: http://www.iowadnr.gov/Portals/idnr/uploads/forestry/nursery/seedlingcatalog.pdf
Trees and shrubs planting cost (machine planting)	0	$80 to $400 per acre.	~$240.00		Edwards 2009 (inflated to 2016$)
Replanting (trees)	0-5	$38.50 to $53.50 per 100 seedlings; $1 per tree hand planting	Variable	Natural mortality of at least 10% is common in the first several years of buffer establishment. Replanting may be required to fill significant gaps in the buffer.	Tyndall and Grala 2009
Drilling grass seed	0	$46 to $121.50/ acre	$70.35	Includes seeds and seed drilling. A basic seed selection is a CP21 compliant mix (wet to mesic soil mixes are available). There are a number of companies that sell regional genotypic prairie grass and forb seed.	Cost data: Plastina, A., and A., Johanns 2016
Pre-emergent Herbicide	1	$40 to $80/gal	$30	A mix of oxyfloufen and oryzalin should control both grasses and broadleaves.; 0.5 gallons per acre.	Management information: Schultz et al. 2003
Herbicide narrow-band application	0	$11 to $45/ acre	$25		Cost data: Plastina, A., and A., Johanns 2016; Edwards 2009 (inflated to 2016$)
Buffer mowing cost	0-5	$20 - $60/ acre	$36.70	Vegetative buffers should be mown twice yearly	Cost data: Plastina, A., and A., Johanns 2016
Vegetative buffer only (grasses)					

Drilling grass seed	0	$46 to $121.50/ acre	$70.35	Includes seeds and seed drilling. A basic seed selection is a CP21 compliant mix (wet to mesic soil mixes are available). There are a number of companies that sell regional genotypic prairie grass and forb seed.	Cost data: Plastina, A., and A., Johanns 2016; Christiansen et al. 2013.
Buffer mowing (management option 1)	0-lifespan	$20 - $60/ acre	$36.70	Mow 2 x in yr 1 during stand establishment phase; annually after. Material does not necessarily need to be baled.	Cost data: Plastina, A., and A., Johanns 2016; Christiansen et al. 2013.
Mow, rake/row, bale & move (management option 2)	Variable	$28 to $61/ acre	$44.00	Mow 2 x in yr 1 during stand establishment phase; annually after	Cost data: Plastina and Johanns (2016)
Burning	Variable	Mow & bale ~ $23/ acre. Burning $60 to $200/acre	---	Burning the grass is an alternative to mowing and baling; assumption is land manager would either mow/bale or burn. Mow 2 x in yr 1 -2 during stand establishment phase; burn every 3 yrs after	SNR Foundation 2007 & Edwards 2009; inflated to 2016 $ rounded to nearest dollar.
General operating costs	Annual	1-3% of upfront costs	—	This would involve general monitoring of the buffer and record keeping.	
Opportunity Cost of Land					
Land rent	Annual	Variable	$120 - $400	Varies considerably throughout Iowa and changes year by year. Average rental rates in Iowa have dropped 15% since 2013. In 2016, the statewide average for cropland was $230/acre, for improved pasture land it was $80/acre.	Plastina, Johanns and Welter, (2016):
Impacts on adjacent upland crop yield	Annual	Variable	--	The impact of vegetative buffers on corn and bean yields is assumed to be negligible.	
Saturated buffer component					
Saturated buffer structures	0	$2290 to $5890/ drainage area (20 ac.)	$4120.00	Includes 2 control structures, contracting costs to install structures (backhoe @ 8 hrs), and 1000' of connecting tile to route drainage from 20 acres	Christiansen et al. 2013; Design data: Jaynes and Isenhart 2011.
Saturated buffer maintenance – adjust control gates	Annual	$20.00 to $40.00/ drainage area (20 ac.)	$28.40	Control structures must be adjusted seasonally to account for crop growth and field operations	Cost data: Christiansen et al. 2013; Design data: Jaynes and Isenhart 2011.
Saturated buffer maintenance – replace control gates	Every 8 years	$141.70 to 153.20/ drainage area (20 ac.)	$147.50	Control structure gates must be replaced every 8 years to maintain correct operation	Cost data: Christiansen et al. 2013; Design data: Jaynes and Isenhart 2011.

This cost information may be cited as:
Tyndall, J., and T. Bowman (2016) Iowa Nutrient Reduction Strategy Best Management Practice cost overview series: Riparian buffers, vegetated filter strips, saturated buffers. Department of Ecology & Natural Resource management, Iowa State University.