Riparian and Wetland Management

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Ensuring the health of riparian corridors and wetlands is an important consideration for site selection and ongoing management of outdoor hog operations in San Francisco's Bay Area. Though riparian areas comprise a small portion of the overall landscape in California, they are vital to the health of our ecosystems. Wetlands and riparian areas not only act as filters for surrounding uplands, but the waterways within them provide critical habitat and food sources for many species, as well as recreation opportunities and other functions to human users.

Many riparian areas in Northern California contain intermittent or ephemeral water bodies, and are often the only green spots on the landscape, particularly in late spring and summer. For this reason, livestock may spend a disproportionate amount of time in these areas looking for shade and green forage. Unlike cattle or sheep, which can provide significant benefits to riparian area if properly managed, hogs can be particularly damaging to these sensitive zones. In particular, rooting, trampling, wallowing and dunging in these areas has the potential to jeopardize some of their critical ecological functions. Just how far hogs should be kept away from the riparian area is related to many factors such as how wet the area is, configuration of the farm operation and the adjacent waterway including slope and soil type, what vegetative species are present, as well as fencing and how the riparian area is managed. All of these factors should be taken into account in an outdoor hog operation with proximity to a riparian area or waterbody.

Pasture riparian area, Sonoma, CA. Photo courtesy of Lynn Betts, NRCS.

Management Approaches

Listed below are some of the different management tools and approaches to help minimize the impact of hogs on adjacent waterways. Contact your local

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Natural Resource Conservation Service, (NRCS), Resource Conservation District (RCD) or University of California Cooperative Extension (UCCE) Advisor for assistance in designing these tools so they are of maximum benefit.

Filter Strips

Vegetative filter strips are a critical tool for protecting riparian areas and waterways from the potential impacts of outdoor hog production. A filter strip is an area of herbaceous (non-woody) vegetation located between an agricultural production zone and sensitive areas to provide protection from overland flow of sediments, nutrients, or pathogens.

The appropriate width of a filter strip depends on several factors including slope, density of vegetation and expected sediment and nutrient flow; steeper slopes with less vegetation require wider filter strips. Vegetative filter strips should be wide enough to filter sediment, nutrients and fecal pathogens. Atwill et al. (2002 and 2006) demonstrated California annual rangelands are able to reduce movement of the pathogen *Cryptosporidium spp.* within one yard under different slopes (up to 35%) and different amounts of vegetation (as low as 250 lbs/acre) over the period of two years of actual rainfall events, while Tate et al. (2006) found the same results for *E. coli* under the same conditions. On irrigated pastures with slope, Tate et al. (2000) found that a 10 yard filter strip was effective at reducing sediment for both flood irrigation and sprinkler irrigation and effective for reducing phosphorous under sprinkler irrigation, but not nitrogen for either irrigation types. Follow up research by Bedard-Haughn et al. (2004) found that

	Plant Characteristics	Lbs/Acre	Filter Strip	Grassed Waterway	Critical Area	Pasture
1. Berber orchardgrass[1]	Perennial grass	16	X	X		
2. **Creeping wildrye**[1,2]	Perennial grass	30[3]	X	X		
3. 'Blando' brome 'Zorro' annual fescue Rose clover[4] **California poppy**[5] **Arroyo lupine**[5,6,7] Crimson clover[4]	Annual grass Annual grass Annual legume Annual wildflower Annual wildflower Annual legume	18 10 9 1 1 1	X	X	X	
4. **California brome**[1] **Blue wildrye**[1] **California poppy**[5] **Arroyo lupine**[5,6,7]	Perennial grass Perennial grass Annual wildflower Annual wildflower	25 18 1 1	X		X	
5. Blando brome Annual ryegrass	Annual grass Annual grass	25 24			X	
6. 'Berber' orchardgrass[1] Tetraploid perennial ryegrass[1] Subclover[4,7] Rose clover[4]	Perennial grass Perennial grass Annual legume Annual legume	4 6 6 4				X
7. 'Blando' brome Rose clover[4] Subclover[4,8]	Annual grass Annual legume Annual legume	6 6 6				X

Table 1: Seeding Recommendations for Horse Facilities in the San Francisco Bay Area. The following table from "Seeding Recommendations for Horse Facilities in the San Francisco Bay Area" (2001) can be used as a reference. Note: Species in bold are native to California.

[1] Mulch must be used to provide initial erosion control when establishing perennials
[2] Also known as beardless wildrye
[3] Or use plugs at 1' x 1' spacing
[4] Also see "legume inoculation" section below
[5] Optional, use for color
[6] *Lupinus succulentus*, also known as hollowleaf annual lupine
[7] Lupine may be toxic to horses. Only use where horses will not graze.
[8] Use locally adapted varieties recommended by UC Cooperative Extension

managing the vegetation in the filter strips with grazing was necessary for the filter to remove nitrogen under both irrigation types. Research in other areas suggests anywhere from 5 yards to retain the majority of sediment (Collins, et. al, 2004, Dabney, et. al, 2006, Dorioz, et. al, 2006) to 30 yards (McNeill, 1992) to decrease pathogens. Based on research done in California, the recommendation would be to create a riparian pasture that can be managed by other species (cattle, sheep, goats, horses, etc.) as appropriate to maintain a functioning filter strip to remove nutrients. A riparian pasture should be wider than 10 yards in order for it to be an effectively managed pasture, thus exceeding the research findings. If it is not possible to create a riparian pasture, a minimum filter width of 10 yards should be implemented following California research and it should be managed by mowing. See table 1 and contact your local NRCS, RCD, or UCCE for assistance in designing your filter strip and selecting appropriate vegetative species.

Vegetative filter strip. Photo courtesy of Lynn Betts, NRCS.

Fencing and Infrastructure

While in some cases filter strips may benefit from managed grazing by cattle or other ruminants to avoid the build-up of excess vegetation (Bedard-Haughn et. al, 2004 and 2005), hogs will be less effective at managing this vegetation and will cause damage to wet areas. This will likely require hog-proof fencing, either permanent or electric between the livestock area and the filter strip with gates as needed. The establishment of this exclusion zone may necessitate modifications of farm infrastructure,

Alleyways between paddocks are heavy use areas and should be managed to minimize erosion into waterways. Photo courtesy of Riverdog Farm.

such as the establishment of off-stream or portable watering systems, as well as the creation of reinforced bank areas, river crossings or bridges. In some cases, farm roads may need to be relocated if they have the potential to act as channels for run off to water courses during heavy rains.

Planning Heavy Use Areas

Particular care should be taken when locating heavy use areas, such as feeding or watering facilities, or farrowing or shade structures. Such high use areas tend to decrease vegetation, increase manure deposition and lead to soil compaction and increased erosion risks. The combination of these impacts may result in the transport of sediments, pathogens or excess nutrients into the riparian area or waterbody, resulting in water quality impairments locally or further downstream. Heavy use areas should follow the same general rule of thumb and be located at least 10 yards away from riparian areas and wetlands, ideally separated by a vegetative filter strip and should be sloped away from drainages to prevent direct run-off.

Ensuring Vegetative Cover

Within a functioning filter strip, herbaceous vegetation is the primary tool for slowing, capturing and filtering run-off. Ensuring sufficient coverage and density of vegetation is critical, particularly in

advance of the rainy winter months.

In some cases, a riparian forest buffer, which consists of predominantly woody trees or shrubs, may also be appropriate with the goal of enhancing riparian habitat, creating shade and increasing carbon storage. Mature buffers will also reduce sediment and organic materials. In either the case of a filter strip or forest buffer, avoid invasives and consider the use of appropriate natives to maintain diversity.

Riparian Buffer Species for the Bay Area	
Shrubs	
mule fat	For riparian areas
Coyote brush	Can be weedy and invasive
California rose	
common snowberry	Common understory species
California blackberry	Prefers shade
coffeeberry	
blue elderberry	
red elderberry	Prefers wetter areas
Trees	
willow	Species vary by location
Fremont cotton	
Pacific dogwood	Prefers wetter areas

Table 2: Riparian Buffer Species for the Bay Area

In addition to filter strips and riparian buffers, working to maintain vegetative cover in pastures, paddocks and high use areas is ultimately the most effective means of protecting sensitive riparian areas and waterways. This generally requires a careful rotation of animals, as well as feed, water and shelter, throughout different pastures or paddocks, allowing for adequate rest after use - see factsheet on Rangeland and Pasture Management for more information. When multiple pastures or paddocks are available, hogs should be moved to those as far away from riparian areas as possible when there is a high possibility of runoff.

Additional Tools to Minimize Run-off

Straw wattles and berm and swale systems can also be used to help prevent overland flow and erosion from entering sensitive areas. A straw wattle is a biodegradable tube often made of compressed straw wrapped in jute, roughly 20-25 feet in length. Wattles are generally installed in a shallow trench along a contour to intercept runoff from up-slope. A berm and swale system consists of a narrow trench or depression (swale) dug on a contour, with a ridge on the downslope side (berm) often constructed from the soil removed to create the swale. Runoff is trapped in the swale, thereby preventing sediments or other contaminants from leaving the site and allowing water to percolate back into the ground. In cases where significant runoff is expected and slopes are such that a filter strip or buffer will not sufficiently slow and filter contaminants, a pond or sediment basin can also be installed to capture and store overland flow. Your local NRCS or RCD office may be able to assist in determining what structures are needed to safeguard resources.

To function successfully, riparian areas need to be properly managed and periodically inspected to identify excessive vegetation growing in the bank. Native deep rooted vegetation, such as willows, can be used to protect or reinforce banks, improving their stabilization. Do not dispose of waste in riparian areas and remove debris from the banks of watercourses or ditches, streams and rivers. Consult with your local UCCE, NRCS or RCD before removing fallen trees as these can serve as valuable habitat niches

A well managed rotation may be required to maintain vegetation adjacent to riparian areas. Photo courtesy of Magruder Ranch.

Literature Cited

Atwill, E.R., L. Hou, B.M. Karle, T. Harter, K.W. Tate, and R.A. Dahlgren. 2002. Transport of *Cryptosporidium parvum* Oocysts through Vegetated Buffer Strips and Estimated Filtration Efficiency. *Applied and Environmental Microbiology*. 68:5517-5527.

Atwill, E.R., K.W. Tate, M. Das Gracas C. Pereira, J.W. Bartolome, and G.A. Nader. 2006. Efficacy of Natural Grass Buffers for Removal of *Cryptosporidium parvum* in Rangeland Runoff. *J. Food Protection*. 69:177-184.

Bedard-Haughn, A., K.W. Tate, and C. van Kessel. 2004. Using 15N to Quantify Vegetative Buffer Effectiveness for Sequestering N in Runoff. *J. Environmental Quality*. 33:2252-2262.

Bedard-Haughn, A., K.W. Tate, and C. van Kessel. 2005. Quantifying the Impact of Regular Cutting on Vegetative Buffer Efficacy for 15N sequestration. *J. Environmental Quality*. 34:1651-1664.

Collins, R., Donnison, A., Ross, C., and McLeod, M. 2004. Attenuation of effluent-derived faecal microbes in grass buffer strips. New Zealand Journal of Agricultural Research. 47:565-574.

Council of Bay Area Resource Conservation Districts. 2001. Seeding Recommendations for Horse Facilities in the San Francisco Bay Area.

Dabney, S.M., Moore, M.T., and Locke, M.A. 2006. Integrated management of in-field, edge-of-field, and after-field buffers. Journal of the American Water Resources Association 42:15-24.

Dorioz, J.M, Wang, D., Poulenard, J., and Trevisan, D. 2006. The effect of grass buffer strips on phosphorus dynamics – A critical review and synthesis as a basis for application in agricultural landscapes in France. Agriculture, Ecosystem and Environment 114:4-21.

McNeill, A. 1992. The ecological roles of riparian vegetation: The role of buffer strips in the management of waterway pollution: Aspects relating to pathogens and bacteria. In J. Woodfull et al. (eds). Proceedings of the Role of Buffer Strips in the Management of Waterway Pollution from Diffuse Urban and Rural Sources. International House, University of Melbourne, October 9, 1992.

Land and Water Resources Research and Development Corporation and Centre for Environmental Applied Hydrology, University of Melbourne, Victoria, Australia. P 83-91.

Tate, K.W., G.A. Nader, D.J. Lewis, E.R. Atwill, and J.M. Connor. 2000. Evaluation of Buffers to Improve the Quality of Runoff from Irrigated Pastures. Journal of Soil and Water Conservation, 55(4):473-478.

Tate, K.W., E.R. Atwill, J.W. Bartolome, G.A. Nader. 2006. Significant Escherichia coli Attenuation by Vegetative Buffers on Annual Grasslands. Journal of Environmental Quality 35:795-805.

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