Vegetated Riparian Buffers And Buffer Ordinances

Table Of Contents

Recommendations for Vegetated Buffers and Buffer Ordinances in South Carolina

I. Minimum average width 50 feet. The inner (streamside) zone of 25 feet (approximately two mature trees deep) needs to be left pristine and forested. A width of 50 feet plus 25 feet of turf (residential backyard) before reaching the first pavement or structure is preferable, while a width of 100 feet (75 feet plus 25 feet of turf) is optimum and should be attempted where possible.

- **A.** Attempt to make two-thirds of the vegetated buffer at least 75 feet wide. Consider incentives to developers (e.g. density bonuses elsewhere or property tax exemptions) for providing buffers of 75 or 100 feet. *See Figure 1 for the recommended three-zone riparian buffer design.*
- **B.** Do not allow the buffer to become too fragmented. Continuity is as important as buffer width. Do not allow more than 10% of the buffer to be less than 33 feet (10 meters) wide.

II. Establish specific water quality and habitat goals for the outer, middle, and streamside zones of the buffer. Adopt a vegetative target for the buffer based on the native, predevelopment plant community. Allow property owners to prune some vegetation in a portion of the buffer on their property so that they may establish a view of the water from their home.

III. Make the buffer ordinance flexible. The use of buffer averaging, density compensation, conservation easements, and/or variances can ensure the rights of the property owner are protected.

IV. Actively manage buffers with annual buffer walks to ensure no improper encroachment by residents. Inform developers, builders, and residents on the location of and reason for the buffers. Make the boundaries of buffers visible before, during, and after construction with posted signs that describe allowable uses.

V. Print buffer boundaries on all development and construction plans, plats, and official maps.

VI. Limit the number and conditions for stream buffer crossings (e.g. roads, bridges, and underground utilities). All footbpaths running through the buffer to the water (perpendicular to the buffer) should be covered by nonelevated wooden boardwalks to prevent the channelization of stormwater runoff caused by dirt footpaths.

VII. Do not rely on vegetated buffers as the sole stormwater management tool.

RIPARIAN AREAS. The term "riparian" refers to the area of land along a stream, river, marsh, or shoreline.

The purpose of this pamphlet is to provide basic information on riparian buffers. It is also intended as a general resource for local policy makers who are considering the creation of buffers or greenways in their communities. It includes an annotated reference list for those interested in pursuing the topic in more detail.

PURPOSES OF A RIPARIAN BUFFER:

- reduce erosion and stabilize stream banks.
- encourage infiltration of stormwater runoff
- control sedimentation.
- reduce the effects of flood and drought.
- provide forest areas to shade streams and encourage desirable aquatic species.
- provide and protect wildlife habitat
- offer scenic value and recreational opportunity.
- restore and maintain the chemical, physical, and biological integrity of water resources.
- minimize public investment in waterway restoration, stormwater management, and other public water resource endeavors.

Schueler, WPT Summer 1995

Nonpoint source (NPS) pollution from stormwater runoff is a growing problem in South Carolina's coastal areas. The water quality of rivers and streams frequently becomes impaired in urbanized watersheds or where riparian corridors are altered by such human activities as development or agriculture (WPT June 1997, pp. 490-491). The movement of rainfall over urban and agricultural landscapes flushes pollutants such as oil, gasoline, sediment, metals, and fertilizer into rivers, creeks, and estuaries. These pollutants:

- degrade water quality;
- alter natural habitats for fish and other wildlife;
- lead to excessive algae growth, which depletes the oxygen needed by fish;
- allow chemicals to accumulate in fish and shellfish, which ultimately affects consumers.

I. Facts About Riparian Buffers

Riparian buffers or buffer zones are corridors of vegetation along rivers, streams, and tidal wetlands which help to protect water quality by providing a transition between upland development and adjoining surface waters. Vegetated riparian buffers filter urban stormwater runoff from impervious areas before it reaches the waterbody (U.S. EPA, 1993, pp. 4-47). Buffers also provide important wildlife habitat, reduce flood and drought conditions, and create recreational opportunities.

THE ADVANTAGES OF BUFFERS

☑ Water Quality and Aquatic Habitat Improvement

Many chemicals easily adsorb, or attach, to individual sediment particles, so the sediment particles frequently carry pollutants and nutrients, such as nitrogen and phosphorus, into streams. An overabundance of nutrients in a waterbody causes algae blooms; as the excess algae dies and decomposes, oxygen is consumed, which kills plants, fish, and other aquatic life (Horton and Eichbaum, 1991). In addition, the sediment itself can be a pollutant, since it can impair the feeding and reproduction of many forms of aquatic life (Anderson and Masters, 1993) Buffers act as a filter by reducing the amount of sediment reaching the water. By slowing the movement of stormwater runoff, buffer vegetation allows more time for sediment contained in the stormwater to settle out (Castelle *et al.*, 1994).

When rainwater collects on roofed and paved areas, it is heated by sunlight. This heated runoff raises the temperature of the receiving waterbody, which can limit fish spawning and also cause excessive algal growth. The tree canopy of a riparian buffer shades the land below it and the receiving waterbody

to limit heating. One researcher found that shading of small streams was adequate with a 50-foot wide forested buffer (Baltimore Buffer Subcommittee Recommendations).

☑ Prevent Flooding, Drought, and Erosion

Vegetated buffers reduce downstream flooding by slowing stormwater velocity, storing some water in soils, and allowing more water to percolate to the water table. Riparian buffers are useful also for flood zone management, keeping development back from the immediate banks of waterways and out of most floodways.

Riparian buffers reduce channelized flow erosion from stormwater runoff and stabilize streambanks. The slow release of stored groundwater from saturated soils in riparian areas helps maintain streamflow between storms and reduce drought conditions (Anderson and Masters, 1993). Leaves and grass on the ground act like a sponge by absorbing water and then releasing it over time. Such organic debris also covers the soil, preventing splash erosion, and maintains infiltration capacity.

☑ Wildlife Habitat Protection

Streams and the surrounding riparian areas provide habitat for a diverse group of wildlife. These animals either live in the riparian area or use the buffer as a travel corridor. For example, colonial waterbirds need buffers along the marsh-upland shoreline to protect roosting and foraging sites (Dodd, 1998). Wildlife diversity within a buffer is linked to a buffer's size; i.e., wider buffers support a greater variety and number of species. A continuous buffer is of particular value in protecting amphibians, waterfowl, and coastal fish spawning and nursery areas (WPT June 1997, pp. 471-472).

☑ Financial Benefits

1. **Minimizing Property Damages**

   Buffers mitigate property destruction by maintaining some undeveloped land along waterways and keeping developing areas away from floodwaters, storm surges, and extreme high tides (VBCZ, p. 29).

2. **Decreased Public Investment Needs**

   By reducing flooding, erosion, and sedimentation, vegetated buffers minimize public investment in stormwater management and waterway protection and restoration (Baltimore Buffer Subcommittee). Buffers can also reduce the number of drainage complaints received by local publicworks departments.

3. **Increased Property Values**

   In a national study of ten programs that diverted development away from flood-prone areas, researchers discovered that land next to protected floodplains had increased in value by an average of $10,427 per acre (Burby, 1988). In another national study, buffers were thought to have a positive or neutral impact on adjacent property values in 32 out of 39 communities surveyed (Schueler, 1995). Homes located near seven California stream restoration projects had a 3 to 13% higher property value than similar homes located on unrestored streams (Streiner and Loomis, 1996).

"When managed as a 'greenway,' stream buffers can expand recreational opportunities and increase the value of adjacent parcels (Flink and Searns, 1993). Several studies have shown that greenway parks increase the value of homes adjacent to them..." (WPT, June 1997 pp. 471-472).

4. Reduced Maintenance Costs

"Corporate landowners can save between $270 to $640 per acre in annual mowing and maintenance costs when open lands are managed as a natural buffer area rather than turf," (Wildlife Habitat Enhancement Council, 1992 - as cited in WPT June 1997, pp. 471-472).

☑ Recreational Opportunities and Improved Aesthetics

Many urban areas are combining the habitat and water quality benefits of buffers with the recreational and transportation advantages of greenways. Trail systems provide an alternate means for people to travel and can be a principle place for recreation. Greenways serve to make communities more attractive places to live and tend to boost local economies. Quality of life can be an important factor in many corporate relocation decisions.

CONDITIONS AFFECTING BUFFER PERFORMANCE

The effectiveness of a buffer in achieving water quality benefits depends on several conditions, including:

- buffer slope
- vegetation
- soil type
- buffer width
- buffer design
- buffer management

☑ Buffer Slope

Several researchers have concluded that the slope of a buffer should not exceed fifteen percent (Schueler *et al.*, 1992). Above fifteen percent, the velocity of runoff becomes too fast, and sediment particles will not have time to settle out. Runoff is likely to become concentrated and channelized, rendering the buffer much less effective (Baltimore Buffer Subcommittee). Shallower slopes allow for longer residence time, slower flow, and are more effective at removing sediment and pollutants from the runoff.

"Use near construction sites and agricultural fields that yield heavy sediment loads requires a buffer slope greater than 1% or the sediment deposits may need to be removed or spread after each heavy rainfall. A temporary silt fence could also be installed and the deposits removed at the end of construction or the farming season. After construction and where sediment loads from existing urban developments are moderate, buffer slopes may be as low as 0.5% and still only require normal annual maintenance... [L]and slopes average 0.2% in the Cooper, Wando, and Ashley river basins, and near the wetland margins tend to steepen to 0.5% to 1%, (McCutcheon *et al.*, 1999). If sediment buildup is not expected, the shallower slopes (<0.5%) can be even better for removing nutrients and fine sediment. Longer residence and greater infiltration will remove more of the pollutants" (McCutcheon fax to Debra Hernandez).

☑ Vegetation

Native vegetation capable of withstanding local water, climate, soil, and pest conditions is preferred. For the creation of new buffer areas, or for supplemental planting in natural areas, native plants that establish rapidly and are suitable for flood zone conditions (where relevant) should be used. Native plants that have an extensive root system work best to stabilize the soil and take up nutrients.

If runoff is allowed to "short circuit" a buffer by concentrating and forming channels or rivulets, the chance for filtration of runoff is greatly reduced. The more dense the vegetation is in a buffer, the better it will filter runoff.

If the intended use of a buffer is solely for stormwater filtration, grasses work best, because trees and shrubs allow more channelization of runoff (McCutcheon *et al.*, 1999). However, grasses do not provide the habitat of forested buffers. In addition, removing trees and shrubs along a streambank to create a grassed buffer can erode the streambank. Grassed buffers also require mowing two or three times annually to prevent the natural succession of bushes and trees (McCutcheon *et al.*, 1999), and they provide no shade for the land or the waterbodies.

☑ Soil Type

Medium-fine textured soils, such as loams and silt loams, work best to establish plants, filter pollutants, retain surface water, and increase groundwater discharge to streams. Highly permeable soils, such as coarse-textured sandy soils, may percolate water so rapidly that little uptake of excess nitrogen occurs. Well-drained soils are only half as effective at removing nitrogen as poorly drained soils. The saturated, organically rich soils typically found in salt marshes, wetlands, and wet forests are useful in the removal of both soluble and sediment-bound pollutants. Sandy soils may be most effective in removing sediments and sediment-bound pollutants, but only marginally effective at removing soluble forms of pollutants.

☑ Buffer Width

The ability of a buffer to provide multiple benefits is closely linked to width. A national survey of 36 local buffer programs found a range in width from 20 to 200 feet on each side of the stream, with a median of 100 feet. The buffer programs surveyed generally incorporated the 100-year floodplain and some included adjacent wetlands, steep slopes or critical habitat areas. In most regions of the country, 100 feet translates to three to five mature trees deep on each side of the stream (WPT Summer 1995, p. 157). The only types of development allowed in these areas are usually limited to those structures needed to allow reasonable use of the property, such as docks (U.S. EPA, 1993, pp. 4-47).

Table 1 lists several methods suggested for determining appropriate buffer widths. The methods listed have been used by many municipalities.

Table 1. Example buffer width formulas.

- **50 ft. + 4-5 ft. for every 1% increase in slope** (Trimble and Schwartz, 1957; Aucella, 1989).
- **75 ft. for slopes less than 10%. Additional width may be added for steeper slopes** (Carter, 1988).
- **3 times the maximum height of the tree canopy** (Palfrey and Bradley, 1982).

The Environmental Protection Agency recommends a 100-foot minimum buffer of native vegetation landward from the mean high tide line in coastal areas to help remove or reduce sediment, excess nutrients, and toxic substances entering surface waters (MWCOG, 1991). A main difference between tidal creeks and freshwater streams is that researchers recommend bigger buffers for bigger freshwater streams, but the opposite is true for tidal creeks. Since small tidal creeks are critically important spawning and nursery areas, bigger buffers are recommended for small tidal creeks. Tributaries of non-tidally influenced freshwater streams have not been shown to be as important to freshwater stream ecosystems.

In a University of Washington study, "twenty-two small-stream watersheds [were] chosen to represent a range of development levels from relatively undeveloped (reference) to highly urbanized. In this study, the streambank stability [was found to be directly related] to the width of the riparian buffer and inversely related to the number of breaks in the riparian corridor," (WPT June 1997, pp. 488-489). This study found that "wide, continuous, and mature-forested riparian corridors appear to be effective in mitigating at least some of the cumulative effects of adjacent basin development." Results of the study suggest that"enhancement and mitigation efforts should be focused on watersheds where ecological function is impaired but not entirely lost..." (WPT June 1997, pp. 490- 491). The study made several recommendations to maintain existing natural stream quality:

1. Ensure that at least 70% of the riparian corridor has a minimum buffer width of 30 m [approx. 100 ft.] and utilize wider (100m) buffers around more sensitive or valuable resource areas [A buffer width of less than ten meters (approximately thirty-three feet) is generally considered functionally ineffective (Castelle *et al.*, 1994)].
2. Limit encroachment of the riparian buffer zone through education and enforcement (<10% of the riparian corridor should be allowed to have a buffer width <10m [approx. 33 ft.])
3. Actively manage the riparian zone to ensure a long-range goal of at least 60% of the corridor as mature, native ... forest," (WPT June 1997, p. 492).

The size of a buffer also depends significantly upon the desired function of the site. One buffer width may be effective for improving water quality but may not be significant enough to provide functional wildlife habitat. Wildlife requirements range according to the desired type and quantity of species. A Charleston Harbor Project researcher recommends a buffer zone of 100 feet along the marsh-upland shoreline to protect roosting and foraging sites for colonial wading birds (Dodd, 1998).

Table 2 presents a generalized overview of pollutant removal effectiveness and wildlife value associated with various buffer widths.

☑ Buffer Design

The riparian buffer design favored by the journal *Watershed Protection Techniques* involves the creation of three management zones within a buffer (Figure 1). Each zone has preferred target vegetation and allowed uses. The inner (streamside) zone contains the most natural vegetation target and most restricted uses (WPT 2/94, p. 19).

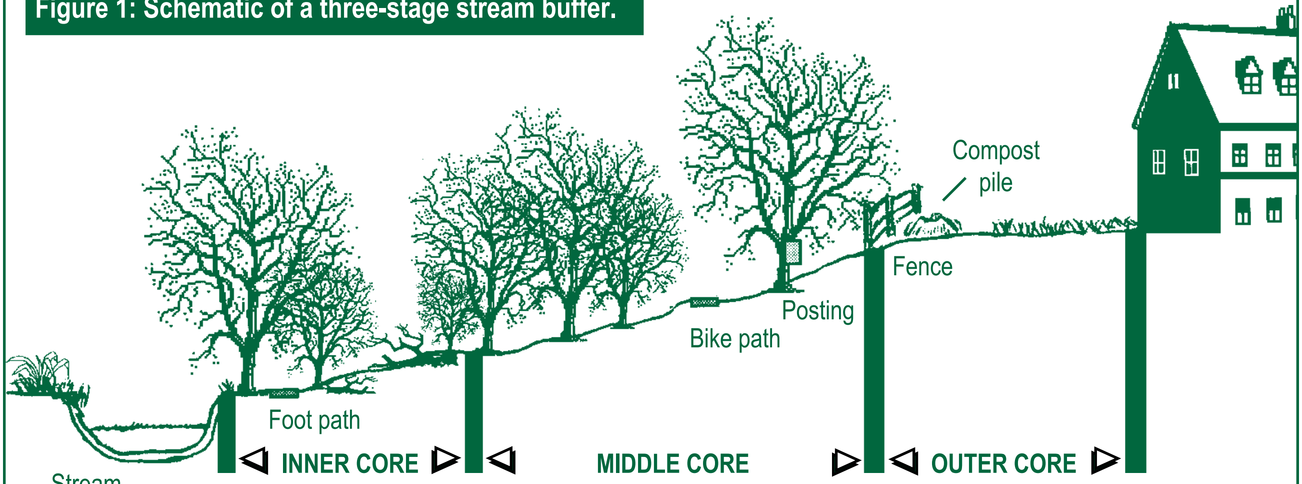
The ***streamside buffer zone*** extends a minimum of 25 feet from the stream bank (about the distance of one or two mature trees) and serves to protect the physical and ecological integrity of the stream ecosystem. A mature riparian forest is the desired vegetation because it provides shade, leaf litter and woody debris, and erosion protection. Reforest it if it is now grass. Only allow very restricted uses such as foot paths and utility rights of way.

The ***middle buffer zone***: 50 feet wide minimum (size depends on the stream order, the extent of the 100-year floodplain, adjacent steep slopes, and protected wetland areas), composed of managed forest with some clearing allowed. Allow some recreational uses, stormwater BMPs, bike paths, and tree removal. (WPT Summer 1995, p. 157) Sediment and nutrients are also removed by this multi-purpose land use.

Table 2: A summary of pollutant removal effectiveness and wildlife habitat value of vegetated buffers according to buffer width (1 meter=3.28 feet) (Source: Desbonnet et al. 1994).

Buffer Width	Pollutant Removal	Effectiveness Wildlife Habitat Value
5 meters (approx 16.5 ft.)	Approximately 50% or greater sediment and pollutant removal.	Poor habitat value; useful for temporarty activities of wildlife.
10 meters (approx 33 ft.)	Approximately 60% or greater sediment and pollutant removal.	Minimally protects stream habitat; poor habitat value; useful for temporary activities of wildlife.
15 meters (approx 50 ft.)	Greater than 60% sediment and pollutant removal.	Miinimal general wildlife and avian habitat value.
20 meters (approx 66 ft.)	Approximately 70% or greater sediment and pollutant removal.	Minimal wildlife habitat value; some value as avian habitat.
30 meters (approx 100 ft.)	Approximately 70% or greater sediment and pollutant removal.	May have use as a wildlife travel corridor as well as general avian habitat.
50 meters (approx 165 ft.)	Approximately 75% or greater sediment and pollutant removal.	Minimal general wildlife habitat value
75 meters (approx 248 ft.)	Approximately 80% or greater sediment and pollutant removal.	Fair-to-good general wildlife and avian habitat value
100 meters (approx 330 ft.)	Apporximately 80% or greater sediment and pollutant removal.	Good general wildlife value; may protect significant wildlife habitat.
200 meters (approx 660 ft.)	Approximately 90% or greater sediment and pollutant removal.	Excellent wildlife value; likely to support a diverse community.

Figure 1: Schematic of a three-stage stream buffer.



WATER SOURCE
water quality & aquatic habitat enhanced.

STREAMSIDE ZONE
25 ft. wide; mature forest; very restricted uses.

MIDDLE ZONE
50+ ft. wide; managed forest; restricted uses.

OUTER ZONE
25+ ft. wide; forest or turf; few restrictions.

Source: *Schueler, WPT 2/94, p.19 (Graphic Courtesy of the Center for Watershed Protection)*

The ***outer buffer zone***: 25 feet wide minimum, composed of forest or turf. It is the buffer's buffer, an additional 25-foot setback from the outward edge of the middle zone to the nearest permanent structure. It is usually a residential backyard. The only major restrictions are no septic systems, no new impervious surfaces, and no new permanent structures (WPT Summer 1995, p. 157).

☑ Buffer System Management

Buffer management is covered in depth in the following section.

II. Problems and Solutions for Buffers and Buffer Ordinances

PROTECTING THE RIGHTS OF THE PROPERTY OWNER: MAKE THE BUFFER ORDINANCE FLEXIBLE

Since in most watersheds a 100-foot buffer ordinance will take about 5% of the total land area out of development consideration, many communities are concerned that stream buffer requirements could represent an uncompensated taking of private property. This situation can be mitigated by making a buffer ordinance more flexible (WPT Summer 1995, p. 162).

To address the concern that stream buffer requirements could represent an uncompensated taking of private property, a community can incorporate several simple measures to ensure fairness and flexibility when administering its buffer program (WPT Summer 1995, p. 162).

"Buffer ordinances that retain property in private ownership generally are considered by the courts to avoid the takings issue, as buffers provide compelling public safety, welfare, and the environmental benefits to the community that justify partial restrictions on land use. Most buffer programs meet the 'rough proportionality' test recently advanced by the Supreme Court for local land use regulation (Hornbach, 1993) ... [S]tream buffers are generally perceived to have a neutral or positive impact on adjacent property value. The key point is that the reservation of the buffer cannot take away all economically beneficial use for the property." Six techniques described below can ensure that the interests of the property owners are protected (WPT Summer 1995, p. 162).

1. Buffer Averaging

Buffer averaging permits the buffer to become narrower at some points along the stream, as long as the average width of the buffer meets the minimum requirement. However, buffer narrowing must be limited, so that the streamside zone is not disturbed and no new construction is allowed within the 100-year floodplain. Since continuity in the buffer is as important as width, do not allow more than 10% of the buffer to be less than 33 feet (10m) wide (WPT Summer 1995, p. 162).

2. Density Compensation

"This scheme grants a developer a credit for additional density elsewhere on the site, in compensation for developable land that has been lost due to the buffer requirement... Credits are granted when more than 5% of developable land is consumed. The density credit is accommodated at the development site by allowing greater flexibility in setbacks, frontage distances or minimum lot sizes to squeeze in 'lost lots.' Cluster development also allows the developer to recover lots that are taken out of production due to buffers and other requirements. The intent of stream buffers is to modify the location but not the intensity of development," (WPT Summer 1995, pp. 162-163).

3. Conservation Easements

"[An] easement conditions the use of the buffer, and can be donated to a land trust as a charitable contribution that can reduce an owner's income tax burden. Alternatively, the conservation easement can be donated to a local government, in exchange for a reduction or elimination of property tax on the parcel," (WPT Summer 1995, pp. 162-163).

4. Purchase of Development Rights

"Purchase of development rights could be considered by local governments if a proposed buffer would encompass all or nearly all of a property owner's developable land. It is "a tool that achieves some of the same goals as conservation easements, in that another landowner may purchase the rights to develop a property from the owner. When the land is sold or inherited, it retains the prohibition against development," (WPT June 1997, p. 479).

5. Variances

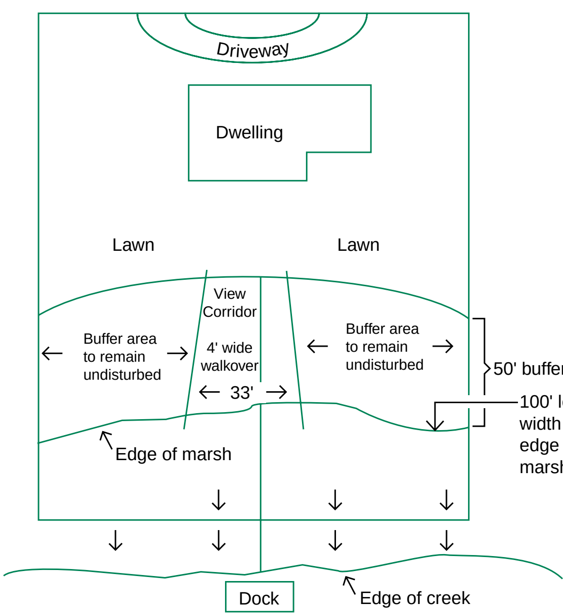
"The buffer ordinance should have provisions that enable an existing property owner to be granted a variance or waiver, if the owner can demonstrate severe economic hardship or unique circumstances make it impossible to meet some or all of the buffer requirements. The owner should also have access to a defined appeals process should the request… be denied," (WPT Summer 1995, p. 163).

6. Allow Selective Pruning and Clearing to Provide a View Corridor

Allow property owners to prune vegetation in a portion of the buffer on their property to afford them a view of the water a "view corridor." Keep such corridors either 75 feet wide or one-third the width of each lot, whichever is less. A landowner should also have the option to submit a selective clearing and landscaping plan for the view corridor. Such a plan must leave or replace enough vegetation in the corridor to maintain the value of the buffer. To prevent conversion of the area to turf, do not allow pruning below a height of three feet.

Figure 2: Example of a Selective Clearing and Landscape Plan

- **View corridor to be maintained by pruning brush to a height of 3'**
- **View corridor at shore = 33'/100' of buffer length at coastal feature = 33%**



PRINT BUFFER BOUNDARIES ON ALL DEVELOPMENT PLANS

Buffer boundaries are often invisible to property owners, developers, and even local government officials. Without defined boundaries, urban buffers are subject to encroachment and incompatible uses. Landowners are more often unaware of buffers than deliberately violating buffer boundaries.

Over 60 percent of the local governments surveyed in a national survey of 36 local buffer programs (Heraty, 1993) indicated that most individual property owners were unaware of either the boundary or the purpose of a buffer. One-time legal disclosures, such as notes on the deed of sale were usually the only notification given to property owners about buffer limits. Local governments need to record the buffer boundaries on their own official maps. Such buffer maps are necessary so local governments can inspect and manage their network of buffers and evaluate the potential impact of new development at specific sites in the buffer network (WPT 2/94, pp. 19-20).

In a study of 21 buffers in Seattle ranging from two to eight years old, ninety-five percent had been visibly altered, including tree removal, conversion into lawns, and erosion by stormwater runoff. In one hundred percent of the residential lots located within narrow buffer networks, natural vegetation had been cleared and replaced by lawns. Encroachment into riparian buffer zones is extremely difficult to control. (WPT 2/94, pp. 20-21). Boundaries for vegetated buffers printed on all development plans delineate the limits of disturbance during construction, decreasing the likelihood that contractors will encroach or disturb the buffer (WPT February 1994, p. 19).

ACTIVELY MANAGE BUFFERS

Due to staff constraints, in almost every jurisdiction surveyed in the Seattle study, only one inspection of property within buffer zones is performed, usually at the end of construction. Subsequent post-construction "bufferwalks" are rare or nonexistent (WPT 2/94, p. 20). However, after requiring buffers during development review, local governments must also make the effort to manage buffers after they become established. Render them visible to contractors, users, and property owners before, during, and after construction. Install silt fencing outside the limit of the buffer to keep silt out of the buffer. Buffer education and enforcement are also needed to protect buffer integrity (WPT 2/94, p. 21; WPT Summer 1995, p. 157).

Additional recommendations for buffer management:

- "Verify the stream delineation in the field;
- Mark buffer limits on all plans used during construction (i.e., clearing and grading plans, and erosion and sediment control plans), plats, and other official maps;
- Conduct a preconstruction stakeout of buffers to define limits of disturbance;
- Mark the limits of disturbance with silt or snow fence barriers, and signs to prevent the entry of construction equipment and stockpiling;
- Mark the buffer boundaries with permanent signs that describe allowable uses;
- Conduct annual bufferwalks to check on encroachment;" (WPT Summer 1995, pp. 160-162)
- Inform buffer owners using pamphlets, interpretive buffer-walks, and meetings with homeowners associations;
- Ensure new property owners are made aware of the buffer limits/uses when property is sold or transferred;
- "[S]ome kind of limited enforcement program may be necessary. This usually involves a series of correction notices and site visits, with civil fines used as a last resort... Some buffer ordinances have a further enforcement option, whereby the full cost of buffer restoration is charged as a property lien," (WPT Summer 1995, p. 162).

MINIMIZE BUFFER CROSSINGS AND DISRUPTIONS TO THE STREAM NETWORK

"Fragmentation of the riparian corridor in urban watersheds can come from a variety of human impacts; the most common and potentially damaging being road crossings. [In a University of Washington study], the number of stream crossings (roads, trails, and utilities) increased in proportion to development intensity... In general, the more fragmented and asymmetrical the buffer, the wider it needs to be to perform the desired functions (Barton *et al.*, 1985)," (WPT June 1997, p. 486).

1. Develop performance criteria to specifically describe the conditions under which the stream or its buffers can be crossed with linear forms of development, such as roads, bridges, and underground utilities.

- *"Crossing width:* Minimum width to allow for maintenance access.

- *Crossing angle:* Use direct right angles to cross streams since they require less clearing in the buffer than oblique crossing angles.
- *Crossing frequency:* Allow only one road crossing within each subdivision
- *Crossing elevation:* All roadway crossings and culverts should be capable of passing the ultimate 100-year flood event, and, where feasible, lower one culvert below stream invert to ensure water during low-flow periods...” (WPT Summer 1995, pp. 158-159).

2. Reduce road right-of-way in buffer zone, with utilities under pavement.

3. Avoid crossing stream with mainline sewer.

4. Site sewers out of buffers (WPT Summer 1995, p. 159).

5. Use buffers to minimize the impact of golf courses on streams:

   a. Construct all fairway crossings perpendicular to the stream.
   b. Allow no more than one golf fairway crossing for every 1,000 feet of buffer.
   c. Protect all wetlands with an extra buffer.
   d. Treat outflow with a combination of vegetative BMPs (filter, swale, wetland). (adapted from Powell and Jolley, 1992) WPT Summer 1994, p. 74; WPT Summer 1995, p. 158)

DO NOT RELY UPON THE BUFFER AS THE SOLE STORMWATER MANAGEMENT TOOL

The capacity of vegetated buffers to remove pollutants in urban stormwater is fairly limited. In urban watersheds rainfall is rapidly converted into concentrated flow. If flow is allowed to concentrate, it forms a channel that effectively bypasses a buffer. As much as 90% of urban runoff concentrates before it reaches a buffer, ultimately crossing it in a channel or stormwater drain pipe. Therefore additional structural BMPs are usually needed to remove pollutants from runoff before they reach a stream (WPT Summer 1995, p. 155).

Only use the stream buffer as a stormwater filtering system “if basic maintenance can be assured, such as routine mowing of the grass filter and annual removal of accumulated sediments at the edge of the impervious areas and the grass filter,” (WPT Summer 1995, p. 160).

Constructing stormwater ponds on or near the stream provides treatment of the greatest possible drainage area, making construction easier and cheaper. In some areas, ponds and wetlands “require the dry weather flow of a stream to maintain water levels and prevent nuisance conditions. Lastly, ponds and

wetlands add a greater diversity of habitat types and structure and can add to the total buffer width in some cases. On the other hand, placing a pond or wetland in the buffer can create environmental problems, including the localized clearing of trees and stream warming..." Therefore it is useful to consider possible performance criteria that restrict the use of ponds or wetlands:

1. A maximum contributing area (e.g. 100 acres)
2. Clearing of the streamside buffer zone only for the outflow channel (if the pond is discharging from the middle zone into the stream),
3. Use ponds only to manage stormwater quantity within the buffer,**"** (WPT Summer 1995, p. 160).

Buffer Design in Relation to Pavement:

"When the buffer receives flow directly from an impervious area, design curb cuts or spacers to spread runoff evenly over the buffer strip. Locate the buffer 3 to 6 inches below the pavement surface to prevent sediment deposits from blocking inflow to the buffer. A narrow stone layer at the pavement edge can serve this purpose," (WPT Summer 1995, p 160).

III. Examples of Existing Buffer Ordinances

Numerous states and communities have implemented requirements for various types and sizes of buffers. Some examples are given below (contact the state or individual community for more detailed information).

Brunswick, Maine

The city adopted 125-300 foot buffers from mean high water within the Coastal Protection Zone. The exact width is determined by the slope of the buffer, as designated on the town's land use map (USEPA, 1993, pp. 4-48).

Chesapeake Bay

The states of Maryland and Virginia have buffer programs in effect to protect the Chesapeake Bay. Both states require a 100-foot vegetated buffer along the shoreline of the Bay and its tributaries. In Maryland, the buffer requirement is only applicable to new development; however, the requirement may be waived if "good conservation practices" are utilized at the shoreline. Virginia's Chesapeake Bay Preservation Act does provide for limited use within the buffer, generally allows for marinas and docks within the buffer, and can grant variances for utilizing land within the buffer area; however, no variance will result in a vegetated buffer of less than 50 feet (except for agricultural uses) (Desbonnet *et al.*, 1994).

Alexandria, Virginia

The city of requires buffers in all designated Resource Protection Areas (RPAs). Buffer must reduce 75% of sediments and 40% of nutrients. Buffers of 100 feet are considered adequate to achieve this standard, and smaller widths may be allowed if they can be proven to meet sediment and nutrient removal requirements. "Indigenous vegetation removal is limited to that necessary to provide reasonable sight lines, access paths, general woodlot management, and BMP implementation," (USEPA, 1993, pp. 4-48).

Queen Annes County, Maryland

The county has a standard shoreline buffer of 300 feet from the edge of tidal waters or wetlands, with at least 50 percent forested (USEPA, 1993, p. 4-48).

Illinois

The state has adopted a five-sixths property tax exemption for vegetated buffers managed in accordance with a plan approved by the county conservation district. The protected zone must be at least 66 feet wide and "contain vegetation that 'has a dense top growth, forms a uniform ground cover, [and] has a heavy fibrous root system,'" (NPSN 4/5 1998, p. 11).

Massachusetts

The state's new Rivers Protection Act establishes a 200-foot wide buffer zone along the state's perennial rivers and streams (NPSN 4/5 1998, p. 11).

North Carolina

The state has adopted a 50-foot protected, vegetated zone on each side of the Neuse river (NPSN 4/5 1998, p. 11). In North Carolina's coastal zone management program, the portion of the coastal zone that lies within 75 feet of the water's edge is subject to permit approval for development purposes.

Beaufort, South Carolina

To protect water quality and habitat, "a buffer strip of 50 feet from the OCRM critical line was established in 1995 on all waterfront property. The buffer strip must be maintained as an undeveloped landscape or undisturbed natural area with some restricted uses allowed in the area. The River Protection District also establishes development setbacks of 50, 100, and 150 feet from the OCRM critical line, depending on the intended development," (NPSN 4/5 1998, p. 11).

Beaufort's Buffer Regulations:

"[A] buffer strip of existing or planted vegetation is established within the District, extending fifty feet perpendicular to and in a horizontal plane from the OCRM Critical Line. The purpose of this buffer strip is to:

1. provide a natural filtration system for runoff from adjoining development that may enter the waters;
2. minimize erosion and help stabilize the streambank;
3. provide a natural habitat for the flora and fauna that exist in this important transition area between wetland and upland areas... The entire buffer must be maintained as an undeveloped landscaped area."

"No development is permitted in the buffer with the exception of the following six uses:

1. Pedestrian and/or vehicular access ways leading to docks, fishing piers, boat landings... provided that only permeable... or semi-permeable materials ... are used for vehicular access ways…
2. [the structures that the vehicular access ways lead up to]
3. Use of grassed swales rather than drainage pipes is required...
4. Approved flood control and erosion control devices...
5. Utility lines serving approved water/marsh uses or crossing the water/marsh...
6. Installation of playground equipment or benches, picnic tables or other similar outdoor furniture."

"Roads leading to bridges that cross the waterway [are allowed] provided the roads are placed approximately perpendicular to the line of the buffer and provided all shoulders are grassed."

"The following uses within the River Protection Overlay District shall be set back a minimum of fifty feet from the OCRM Critical Line: agricultural uses... regulation golf courses... recreational parks and playgrounds...drainage systems and retention ponds."

"The following require a one hundred-foot set-back: detached single family residential units, multi-family and attached residential units, parking areas and driveways, garages, [civic buildings] not larger than four thousand square feet, parking lots with no more than [6 spaces or 1000 square feet], ... and ROW of two-lane road." Any uses not specified in the River Protection District must be set back a minimum of one hundred fifty feet (Beaufort County River Protection Overlay District Ordinance, pp. 3-6).

CONCLUSION

Vegetated riparian buffers along urban waterbodies have proven to be effective against polluted runoff, flooding, and erosion while protecting aquatic and terrestrial habitats. However, scientific research often encourages the use of buffers that are wider than what many communities are willing to accept. After informing citizens on the need for buffers and receiving public input, community leaders must decide on buffer widths that both afford a measure of protection for riparian zones and are acceptable within the community (politically feasible). Use the information presented in this document as a guide for establishing appropriate buffers and for resolving any conflicts that may arise from a proposed buffer ordinance.

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