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PROPOSED BUFFER REQUIREMENTS FOR PENNSYLVANIA

The Need for Buffers

Everyone pays the price for pollution and flooding in our streams—the high cost of treating and purifying water for drinking; loss of recreational opportunities (fishing, swimming and canoeing) and associated economic windfalls; community desolation; and the staggering cost of flood damage and property loss. Watersheds do not respect political boundaries. As such, streams flow from one jurisdiction to the next; thus protection and restoration of our watersheds must be a concerted effort among all our local governments within a watershed. One of the best ways to stabilize a stream and protect water quality is to preserve the stream's surrounding ecosystem, or corridor.

A stream corridor is composed of several essential elements including the stream channel itself, associated wetlands and vernal ponds, floodplains and forests. The body of scientific research indicates that stream buffers, particularly those dominated by woody vegetation, are instrumental in providing numerous ecological and socioeconomic benefits. Simply put, riparian corridors protect and restore the functionality and integrity of streams. Some of the benefits often cited in the literature are summarized below.

Increased property values by adding to the natural character and providing viewsheds within the community
One study noted a 32% increase in properties adjacent to a greenbelt and another reported that 82% of communities with buffers viewed them positively (n=39). In the Pennypack Park area of Philadelphia, the stream buffer network was found to increase adjacent property values by an average of 33%, with a net increase of more than $3.3 million in real estate. Another such system in Boulder, CO was found to increase property values as well, resulting in and additional $500,000 in tax revenue per year (CWP, 1998).

Prevention of flood-related damage by storing flood waters
Tourbier (1994) noted that buffer systems in conjunction with LID practices work by utilizing natural processes to provide significant detention through depression storage and infiltration. As a result, peak rate and volume of post-construction runoff can often be reduced dramatically.

Decreased need for stormwater infrastructure
Building upon the work of Tourbier and others, research has consistently concluded that because of the hydrological impacts of buffers, those areas which preserve and restore such systems may require less or smaller sized stormwater infrastructure, such as detention basis. (Miller and Sutherland, 1999) This fact is widely recognized and many state and local stormwater management programs, including Pennsylvania's, allow for the "crediting" of stormwater that is discharged to intact buffer systems.

Trapping and filtering sediment, nutrients, and other pollutants from runoff
Numerous studies have concluded that buffers, particularly forested varieties, provide significant removal of aquatic contaminants, including toxics. While site specific conditions dictate the effectiveness of such

systems, many researchers have concluded that buffers can remove upwards of 80 to 90% of such contaminants when equal or greater to 100 feet in width. See summary table below.

For instance, Lowrance (2001) found that for nitrogen, the smallest buffer (15 ft) provided a 5% reduction, while the widest buffer (170 ft) exceeded a 95% reduction. Nitrogen content from the narrow buffers (15 ft to 100 ft) was mostly nitrate; the wider buffers had an even division of nitrate and ammonium. As the buffer width increased, the amount of organic nitrogen as a percentage of the total runoff also increased. A switch from inorganic to organic nitrogen is likely to be beneficial to the aquatic system because organic nitrogen is not as easily utilized by harmful algal blooms. For phosphorus, the smallest buffer (15 ft) was effective, reducing 62% of the load; however, the widest buffer (170 ft) removed 90% of the total phosphorus load. Sediment reductions were also dependent on buffer width. Sediment reductions increased as buffer width increased, up to a 90% reduction for a buffer width of 55 ft. It is notable, however, that Lowrance described the sediment load from the adjacent land as "low" and not of "a level of input that would stress the sediment load reduction capacity of the buffer." One would expect that land with a greater susceptibility for erosion would necessitate a wider buffer.

A 2003 study by Vellidis et al. examined a restored forested riparian wetland (average width of 125 feet) that was buffering an area of manure application and a heavily fertilized pasture. This three zone buffer removed 66% of total nitrogen and 59% of total phosphorus. Significantly, this research indicates that "within the first eight years following restoration, restored areas can retain large masses and high percentages of the nutrients entering."

Summary of Select Studies Reporting Percentage of Pollutant Reductions Based on Buffer Size

		% Reduction based on Buffer Size:											
		~15 ft (4.6 m)			**~35 ft (10.7 m)**			**~100 ft (30.5 m)**			**> 100 ft (> 30.5 m)**		
Study	**Year**	**N**	**P**	**S**	**N**	**P**	**S**	**N**	**P**	**S**	**N**	**P**	**S**
Vellidis *et al.*	2003										66%	59%	
Lowrance *et al.*	2001	5%	62%	60%	50%	65%	80%	80%	80%	90%	95%	90%	90%
Lowrance *et al.*	1995	4%	29%	61%	23%	24%	75%	80%	77%	97%			
Schwer & Clausen	1989							76%	78%	89%			
Magette *et al.*	1987	17%	41%	72%	51%	53%	86%						
Barker & Young	1984										99%		
Young *et al.*	1980							87%	88%				

Enhanced in-stream uptake and sequestration of nutrients and other pollutants
Research by the Stroud Water Research Center has concluded that forested buffer systems, as opposed to grassed systems, provide enhanced *in situ* (instream) contaminant sequestration and degradation primarily due to increased biological activity. The researchers noted that increased nitrogen attenuation and pesticide degradation were particularly associated with forested stream buffers (Sweeney et al., 2004).

Reduced stream bank erosion
The root systems associated with vegetated buffers protect and support the banks and other critical parts of a stream's morphology, allowing it to resist erosive forces and remain stable. The vegetation's roots hold the riparian lands in place, maintaining the hydraulic roughness of the bank, slowing flow velocities in the stream near the bank. Root systems of woody shrubs and trees do a better job of anchoring soils—a function turf grass cannot do effectively (NRC, 2002).

Enhanced habitat for fish and other aquatic organisms by moderating water temperatures Buffers also regulate stream temperature through shading, important for healthy habitat. Studies have concluded that removal of streamside vegetation can result in a temperature increase of 6 to 9 degrees Centigrade (Leavitt, 1998). A Pennsylvania study found increases from 4 to 9 degrees Fahrenheit which is the equivalent of moving the stream over 400 miles south (Klapproth, and Johnson, 2000). Also, riparian vegetation moderates stream temperature reducing the daily and seasonal fluctuations in stream temperature. The heating up of a stream reduces the oxygen carrying capacity of the waterway, harming stream life that is temperature-sensitive. Klapproth and Johnson also noted water temperatures are important in regulating phosphorus concentrations when water reaches above 60 °F, phosphorus is more readily released from its sediment hosts and dissolved into the stream as a pollutant. Increased water temperatures also produce heavy growth of filamentous algae (from increases of 9 °F), encourage the growth of parasitic bacteria, and can adversely affect benthic organisms.

Meyer et al. (2005) noted that not only the presence but also the size of forested stream buffers have a profound impact on a streams ability to support trout populations. Researchers found that when forested buffer widths were reduced from 100 feet to 50 feet, stream temperatures increased 2.9 °F to 4.2 °F while fine sediments increased 11%. Although these changes may appear small numerically, they resulted in an 81-88% reduction in young trout populations.

Enhanced habitat for fish and other aquatic organisms by providing woody debris
The rich habitat adds to the organic food base and increases biological diversity and productivity of stream communities (Sweeney et al., 2004). In small upland streams as much as 75% of the organic food base may be supplied by dissolved organic compounds or detritus such as fruit, limbs, leaves, and insects that fall from the forest canopy (Welsch, 1991). Benthic organisms feed on the detritus, forming the basis of the food chain (Sweeney et al., 2004).

Clearly, protecting existing and restoring lost forested stream buffers will have profound impact on the health and integrity of waters of the Commonwealth. We believe that the science supports an expanded set of requirements to assure ecological integrity and restoration while sustaining, and even enhancing, economical activity. To that end, we have devised the following set of technically-based recommendations for stream buffer protection and restoration as part of the Commonwealth's Chapter 102 revision process.

<u>Recommendations</u>

In order to achieve the goals set forth in the federal Clean Water Act and Pennsylvania's Clean Streams Law, we recommend all streams be afforded <u>a minimum 100 horizontal foot forested buffer</u> extending from the top of the stream bank on either side of the stream (unless the flood-plain exceeds this distance, in which case, the floodplain area is used), with additional areas as outlined below:

- First and Second order streams: An additional 50 feet from the top of the bank would be required to more fully protect these vulnerable but very valuable waterways.
- Special Protection Waters: An additional 200 feet from the top of the bank would be required to ensure greater protection for the best streams in the Commonwealth. Additional protection beyond that ordinarily required should also be provided to streams that are tributaries to Special Protection streams (if the tributary is not already classified EV or HQ) in order to ensure protection of the downstream Special Protection water quality.
- Steep Slope: Additional distances would be added based on the following formula: add 10 feet if slope is 10-15%; 20 feet if slope 16-17%; 30 feet if slope is 18-20%; 50 feet if slope is 21-23%; 60 feet if slope is 24-25%; and 70 feet if slope exceeds 25%.
- In areas where development is proposed and a forested buffer does not exist, Chapter 102 would require full restoration using native plant species.
- In areas where there are Threatened & Endangered Species concerns, irrespective of the size and vegetation type requirements for buffers, the Department shall ensure that buffers are of a size and vegetation type necessary to protect state or federal threatened or endangered species and their

habitat. To meet this requirement, buffers may be wider than the minimum widths or be maintained in a vegetation type other than woody vegetation.

- Language establishing a mechanism in which buffers are afforded some form of permanent protection.
- Areas containing Impaired Waters: Developers in impaired waters would have the option of either choosing to extend the buffer an additional 50 feet from the top of the bank beyond the other requirements **or** to implement the following improvements in the buffer area **and** in the developed area adjacent to it:
    - Improvements to the buffer area:
        - 50% or more of trees planted in the buffer must be of two inch caliper or greater, and tree species composition should consist of a diverse mix of native tree species planted in the proper hydrologic zone as listed in Appendix B of the Pennsylvania Stormwater BMP Manual.
        - Applicants must develop and implement an operation and maintenance plan for the buffer to be approved by DEP. The O&M plan must require maintenance activities for a minimum of 5 years, include measures to control invasive species, deer and rodent damage, and require replacement of all deceased trees for a minimum of the first 3 years.
        - Applicants must provide permanent protection of riparian buffer area by placing a conservation easement on the property.
    - Improvements to adjacent area:
        - Achieve no net increase in pre-development to post-development volume, rate and concentration of pollutants in water quality using alternative site design, low impact development principles such as limiting disturbance, infiltration BMPs and other environmentally sound stormwater BMPs.
        - Through deed restriction for all lots sold and as a condition of any final land development plan approval, ban the use of fertilizers, pesticides, herbicides or other chemicals on lawns and other portions of the property, except that herbicides may be used for invasive species control in riparian buffers if part of an O&M plan approved by DEP.
        - Developments must replace any trees removed during the development process with the caliper of removed trees approximately matched by the sum of the caliper of replacement trees (ie four 3 inch trees replace one 12 inch tree).

We also believe that a forested buffer be defined as: An area of diverse species of native woody vegetation (trees and shrubs) that is adjacent to a body of water which is managed to maintain the integrity of stream channels and shorelines, to reduce the impact of upland sources of pollution by trapping, filtering, and converting sediments, nutrients, and other chemicals, and to supply food, cover, and thermal protection to fish and other wildlife. A riparian buffer area is considered forested if the existing vegetation consists of at least 66% woody vegetation.

Chapter 102 should also explicitly state that the buffer zone is a non-disturbance area where disturbance of vegetation or soil is limited to restoration activities or other activities that minimally disrupt existing tree cover and vegetation and soil mantle. No new structures shall be allowed in the buffer zone. Any minimal impact uses proposed for the buffer zone must be permitted by DEP and must be offset by buffer improvements or extension of the buffer zone.

The Campaign for Clean Water has also separately proposed buffer protection requirements for areas including nontidal wetlands, vernal pools, lakes and ponds. For more information on these recommendations, contact bwendelgass@cleanwater.org.

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