A REVIEW OF THE SCIENTIFIC LITERATURE ON RIPARIAN BUFFER WIDTH, EXTENT AND VEGETATION

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for the

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EXECUTIVE SUMMARY

Many local governments in Georgia are developing riparian buffer protection plans and ordinances without the benefit of scientifically-based guidelines. To address this problem, over 140 articles and books were reviewed to establish a legally-defensible basis for determining riparian buffer width, extent and vegetation. This document presents the results of this review and proposes several simple formulae for buffer delineation that can be applied on a municipal or county-wide scale.

Sediment is the worst pollutant in many streams and rivers. Scientific research has shown that vegetative buffers are effective at trapping sediment from runoff and at reducing channel erosion. Studies have yielded a range of recommendations for buffer widths; buffers as narrow as 4.6 m (15 ft) have proven fairly effective in the short term, although wider buffers provide greater sediment control, especially on steeper slopes. Long-term studies suggest the need for much wider buffers. It appears that a 30 m (100 ft) buffer is sufficiently wide to trap sediments under most circumstances, although buffers should be extended for steeper slopes. An absolute minimum width would be 9 m (30 ft). To be most effective, buffers must extend along all streams, including intermittent and ephemeral channels. Buffers must be augmented by limits on impervious surfaces and strictly enforced on-site sediment controls. Both grassed and forested buffers are effective at trapping sediment, although forested buffers provide other benefits as well.

Buffers are short-term sinks for phosphorus, but over the long term their effectiveness is limited. In many cases phosphorus is attached to sediment or organic matter, so buffers sufficiently wide to control sediment should also provide adequate short-term phosphorus control. However, long-term management of phosphorus requires effective on-site management of its sources. Buffers can provide very good control of nitrogen, include nitrate. The widths necessary for reducing nitrate concentrations vary based on local hydrology, soil factors, slope and other variables. In most cases 30 m (100 ft) buffers should provide good control, and 15 m (50 ft) buffers should be sufficient under many conditions. It is especially important to preserve wetlands, which are sites of high denitrification activity.

To maintain aquatic habitat, the literature indicates that 10-30 m (35-100 ft) native forested riparian buffers should be preserved or restored along all streams. This will provide stream temperature control and inputs of large woody debris and other organic matter necessary for aquatic organisms. While narrow buffers offer considerable habitat benefits to many species, protecting diverse terrestrial riparian wildlife communities requires some buffers of at least 100 meters (300 feet). To provide optimal habitat, native forest vegetation should be maintained or restored in all buffers.

A review of existing models for buffer width and effectiveness showed that none are appropriate for county-level buffer protection. Models were found to be either too data-intensive to be practical or else lacked verification and calibration. Potential variables for use in a buffer width formula were considered. Buffer slope and the presence of wetlands were determined to be the most important and useful factors in determining buffer width.

Three options for buffer guidelines were proposed. All are defensible given the scientific literature. The first provides the greatest level of protection for stream corridors, including good control of sediment and other contaminants, maintenance of quality aquatic habitat, and some minimal terrestrial wildlife habitat. The second option should also provide good protection under most circumstances, although severe storms, floods, or poor management of contaminant sources could more easily overwhelm the buffer.

Option One:

- Base width: 100 ft (30.5 m) plus 2 ft (0.61 m) per 1% of slope.
- Extend to edge of floodplain.
- Include adjacent wetlands. The buffer width is extended by the width of the wetlands, which guarantees that the entire wetland and an additional buffer are protected.

- Existing impervious surfaces in the riparian zone do not count toward buffer width (i.e., the width is extended by the width of the impervious surface, just as for wetlands).
- Slopes over 25% do not count toward the width.
- The buffer applies to all perennial and intermittent streams. These may

Option Two:

The same as Option One, except:

- Base width is 50 ft (15.2 m) plus 2 ft (0.61 m) per 1% of slope.
- Entire floodplain is not necessarily included in buffer, although potential sources of severe contamination should be excluded from the floodplain.
- Ephemeral streams are not included; affected streams are those that appear on US Geological Survey 1:24,000 topographic quadrangles. Alternatively, buffer can be applied to all perennial streams plus all intermittent streams of second order or larger

Option Three:

- Fixed buffer width of 100 ft.
- The buffer applies to all streams that appear on US Geological Survey 1:24,000 topographic quadrangles or, alternatively, all perennial streams plus all intermittent streams of second order or larger (as for Option Two).

For all options, buffer vegetation should consist of native forest. Restoration should be conducted when necessary and possible.

All major sources of contamination should be excluded from the buffer. These include construction resulting in major land disturbance, impervious surfaces, logging roads, mining activities, septic tank drain fields, agricultural fields, waste disposal sites, livestock, and clear cutting of forests. Application of pesticides and fertilizer should also be prohibited, except as may be needed for buffer restoration.

All of the buffer options described above will provide some habitat for many terrestrial wildlife species. To provide habitat for forest interior species, at least some riparian tracts of at least 300 ft width should also be preserved. Identification of these areas should be part of an overall, county-wide wildlife protection plan.

For riparian buffers to be most effective, some related issues must also be addressed. These include reducing impervious surfaces, managing pollutants on-site, and minimizing buffer gaps.

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I. Background and Introduction

Riparian buffers have gained wide acceptance as tools for protecting water quality, maintaining wildlife habitat and providing other benefits to people and the environment (Lowrance 1998, USEPA 1998). Today in Georgia, as in many other states, local governments are developing programs to protect riparian buffers. Laws such as the Georgia Planning Act and the Mountain and River Corridor Protection Act give counties and municipalities strong incentives to incorporate aquatic resource protection into their plans and ordinances. However, scientifically-based guidelines for local riparian buffer ordinances are not readily available. The minimum standards issued by the Department of Natural Resources' Environmental Protection Division (EPD) are not based on current scientific research and do not provide a strong level of resource protection. Many local governments are interested in developing effective, comprehensive riparian buffer regulations, but fear that without solid scientific support, such ordinances would not be legally defensible.

The purpose of this document is to provide a scientific foundation for riparian buffer ordinances established by local governments in Georgia. To achieve this goal more than 140 articles and books were reviewed with an eye toward determining the optimal width, extent (i.e., which streams are protected) and vegetation (e.g., forest or grass) of riparian buffers. This task is challenging due to the lack of research in certain geographic regions. Although a large number of riparian buffer studies have been conducted in the Georgia Coastal Plain (see Figure 1), there has been very little research specific to the physiographic provinces of North Georgia (Piedmont, Blue Ridge, Valley and Ridge) or to urban and suburban areas. Nevertheless, it is apparent in reviewing the literature that there are general trends which cut across geographic boundaries. Based on current research, it is possible to develop defensible guidelines for determining riparian buffer width, extent and vegetation that are applicable to much of Georgia and beyond. Naturally, these recommendations will not be as accurate as those supplied by data-intensive models applied on a site-by-site basis (such as the REMM model developed by Richard Lowrance and colleagues). However, these guidelines have the virtue of being simple enough to be incorporated into a county or municipal ordinance.

The guidelines proposed in this document should be viewed as a reasonable interpretation of the best available scientific research. If additional riparian buffer studies are conducted in North Georgia, urban areas, and other neglected regions, it may be possible to refine the recommendations. However, this in no way means that the current state of our knowledge is insufficient to develop good policy guidelines and implement effective buffer ordinances. As Lowrance et al noted in 1997:

> *"Research is sometimes applied to broad-scale environmental issues with inadequate knowledge or incomplete understanding. Public policies to encourage or require landscape management techniques such as riparian (streamside) management will often need to proceed with best professional judgment decisions based on incomplete understanding."*

Local officials and natural resource managers are making decisions on riparian buffers today. The scientific community would be remiss if it failed to provide these decision makers with the best available information.

To ensure that this review has covered the most relevant research and has made reasonable conclusions, other members of the scientific community were asked to review its findings. These reviewers included:

- Richard Lowrance, Ph.D., USDA-Agricultural Research Service
- David Correll, Ph.D., Smithsonian Environmental Research Center
- Cathy Pringle, Ph.D., University of Georgia
- Laurie Fowler, J.D., L.L.M., University of Georgia
- Judy Meyer, Ph.D., University of Georgia
- Ronald Bjorkland, University of Georgia
- Michael Paul, University of Georgia