Average Width of Stream Buffers Downstream from Agriculture

This EnviroAtlas national map estimates the average agricultural riparian buffer width in meters within each 12-digit hydrological unit (HUC) in the conterminous U.S. The map layer uses the 2006 National Land Cover Database (NLCD) and the 2010 USDA Cropland Data Layer (CDL) to combine agriculture, forests, grasslands, and wetlands with stream networks and elevation datasets in flow path models to estimate the buffer widths associated with flows that originate in agriculture. Only those buffers adjacent to streams were included in the calculations.

Why is agricultural buffer width important?

Areas of forest, grasslands, or wetlands adjacent to streams or rivers are called riparian buffers. Riparian buffers located between streams and agricultural fields provide many benefits that contribute to clean and plentiful water, recreational opportunities, and increased biodiversity.

Riparian buffers adjacent to agricultural lands can act as natural water filters by removing or entrapping excess nutrients, pesticides, and eroded topsoil. Research studies at field edges have shown that vegetated riparian buffers can remove excess nitrogen from ponded surface water and shallow groundwater through denitrification, a microbial process where nitrogen is released back to the atmosphere in the form of nitrogen gas.[1] Trees and grasses also serve as a physical barrier to eroded topsoil leaving agriculture fields that would otherwise carry phosphorus and silts to streams.[2] The width of buffers can influence filtration effectiveness, which can ultimately influence water quality in downstream rivers, bays, and estuaries.[3] The relationships among varying buffer widths and water quality concerns are reviewed in the literature cited below.

The presence of trees and natural vegetation and the width of riparian buffers along streams and rivers are important indicators of suitable habitat for birds, reptiles, amphibians, and mammals. Riparian buffers increase biodiversity, especially in areas that are dominated by agriculture. A table in the data fact sheet for the metric, Percent Forest Land in Stream Buffer, shows estimated minimum widths for various wildlife. The presence of green spaces and associated wildlife near streams also has recreational and aesthetic benefits.

Streamside vegetation has large impacts on the stream itself; vegetation stabilizes stream banks to reduce instream erosion and loss of property. Wider buffers provide greater stability


Photo: Iowa stream, L. Betts, NRCS

as they are less vulnerable to wind and flood damage. Trees provide shade that lowers water temperatures and creates instream habitat in the form of large woody debris, snags, and roots. The creation of more hospitable conditions for fish species increases local fish diversity and recreational opportunities. Near-stream vegetation also influences instream habitat and food sources for aquatic insects that form the base of the aquatic food chain.

Though riparian buffers clearly provide beneficial services, their effectiveness to deliver specific benefits (e.g., nutrient filtering) depends on the width of the buffer as well as other factors like climate, slope, and soil permeability. See the selected publications below to learn more about the conditions and efficiencies of various riparian buffers.

How can I use this information?

This map layer, Average Width of Stream Buffers Downstream from Agriculture, indicates the average buffer width of 12-digit HUCs across the U.S. that contain agriculture. It is important to recognize that this average buffer width does not include any riparian areas that do not also contain agriculture upslope. For estimates of buffers across all land cover types, see the EnviroAtlas layer, Percent Forest and Woody Wetlands in Stream Buffer.

This map layer can assist in identifying areas that may benefit from restoration and preservation of riparian buffers within agricultural landscapes. Hydrologic units with low average buffer widths can be selected for further exploration and analysis to address water quality and habitat concerns. While

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other layers within EnviroAtlas (e.g., Percent Forest and Woody Wetlands in Stream Buffer) indicate how much forested buffer is within 30 meters of the stream, this map layer incorporates the potential area of agriculture upslope of buffers, specifically focusing on the watershed patterns and buffering capacity within agricultural watersheds. This map layer is one of three map layers that connect agricultural fields, buffers, and streams by tracing flows from upslope agriculture to the riparian buffers and streams. The other two metrics address 1) the percentage of agricultural lands in each HUC with flow paths that would intersect natural land cover before reaching a stream, and 2) the percentage of each 12-digit HUC that contains unbuffered agricultural land.

How were the data for this map created?

This map layer was created using a flow-path model originally created for the Chesapeake Bay that has been used in subsequent research where the methods are outlined in detail.[4,5] The model connects agriculture from the 2006 National Land Cover Database (NLCD) and the 2010 Cropland Data Layer (CDL) to the existing stream network (National Hydrography Dataset – high resolution 1:24,000+ resolution, NHDPlus HR) via flow-paths generated using a 30 meter elevation grid (DEM). If the agriculture flow path intersects natural buffers on its way to a stream, the buffer width of that natural area contiguous with the stream is counted and assigned to the connected agricultural fields. A value of 0-meter buffer width is given to agricultural fields that do not intersect contiguous natural buffers greater than 30 meters wide prior to reaching the stream. Buffers that overlapped the stream on the 30-meter grid were given a value of 15 meters. Agricultural areas included all crop types excluding pasture (see metadata for specific crop types). Natural areas included forest, grassland, and wetland land covers from the 2006 NLCD. Urban classes were ignored in these flow-path calculations. The buffer widths assigned to agriculture were tallied within each 12-digit HUC and divided by the total number of agricultural cells within the HUC to find the average agricultural buffer width in meters.

What are the limitations of these data?

Though EnviroAtlas uses the best data available, there are limitations associated with the data. The landcover classes found in national datasets are created through the classification of satellite imagery, and areas in different landcover classes with a similar spectral signature can result in classification errors. As a result, NLCD/CDL is a best estimate of actual landcover.

Specific care needs to be given when considering the exclusion of narrow buffers in this map layer. Because of its 30m pixel size, the NLCD/CDL product may miss riparian buffers that are less than 30m wide. Such narrow buffers would be given a value of 0 meters in this analysis to lower the average width. The use of DEM-derived flow paths necessarily relies on the assumption that both surface and shallow subsurface flows follow the topographical gradient represented in this national map layer by the 30-meter elevation grid.

How can I access these data?

EnviroAtlas data can be viewed in the interactive map, accessed through web services, or downloaded. The NLCD, CDL, and NHD high resolution product are accessible through their respective websites.

Where can I get more information?

A selection of resources related to riparian buffers is listed below. For more details on metric creation, see the metadata. To ask specific questions about this data layer, please contact the EnviroAtlas Team.

Acknowledgments

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Selected Publications

1. Mayer, P.M., S.K. Reynolds, M.D. McCutchen, and T.J. Canfield. 2006. Riparian buffer width, vegetative cover, and nitrogen removal effectiveness: A review of current science and regulations. EPA/600/R-05/118. U.S. Environmental Protection Agency, Cincinnati, Ohio.

2. Yuan, Y, R.L. Binger, and M.A. Locke. 2009. A review of effectiveness of vegetative buffers on sediment trapping in agricultural areas. *Ecohydrology* 2(3):321–336.

3. Sweeney, B.W., and J.D. Newbold. 2014. Streamside forest buffer width needed to protect stream water quality, habitat, and organisms: A literature review. *Journal of the American Water Resources Association* 50(3):560–584.

4. Baker, M.E., D.E. Weller, and T.E. Jordan. 2006. Improved methods for quantifying potential nutrient interception by riparian buffers. *Landscape Ecology* 21(8):1327–1345.

5. Christensen, J. R., M.S. Nash, and A. Neale. 2013. Identifying riparian buffer effects on stream nitrogen in southeastern coastal plain watersheds. *Environmental Management* 52(5):1161–1176.

Weller, D.E., M.E. Baker, and T.E. Jordan, 2011. Effects of riparian buffers on nitrate concentrations in watershed discharges: New models and management implications. *Ecological Applications* 21:1679–1695.