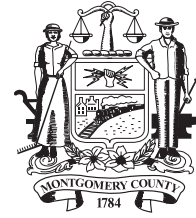


# Guidebook for Riparian Corridor Conservation

Montgomery County, Pennsylvania



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# Guidebook for Riparian Corridor Conservation

Montgomery County Planning Commission



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# Forward

In the 1990s many state, county, and local government agencies began incorporating a watershed-based approach to water resource protection. A key element to this approach was the use of best management practices for runoff control. In particular, the protection of riparian corridors, which consist of forested or vegetated lands along both sides of a stream, was identified as an effective best management practice for water resource protection. In addition, the County's 1993 Open Space Initiative increased attention to the importance of greenway protection. In response to this, the Montgomery County Planning Commission developed the Guidebook for Riparian Corridor Protection in 1996 to assist municipalities with the development of a riparian corridor conservation strategy.

Since the initial release of the Guidebook, seven communities have adopted a version of the model zoning overlay district, protecting over 430 miles of streams, and numerous communities have adopted a variety of other stream corridor protection standards. Working with these communities has shed new light on the issues and practicalities associated with implementing riparian corridor protection strategies. In addition, the science and techniques associated with riparian corridor protection have evolved. Therefore, we have revised the Guidebook for Riparian Corridor Conservation and are re-releasing it for continued use.

The revised Guidebook is divided into four sections. The first section is intended to educate municipal officials and the general public about the various ecological functions and

benefits of riparian corridors. Understanding the benefits of riparian corridors establishes the foundation for all future conservation activities. The remaining sections focus upon our three-pronged approach to riparian corridor conservation, including acquisition, land use controls, and stewardship.

The first element of the conservation strategy discusses the role of both fee-simple and easement acquisition. Acquisition is essential to preserving the highest value riparian areas as well as riparian lands that add value to other properties of municipal interest, such as parks and trail corridors.

It is not possible, or necessary, to acquire all riparian corridors in order to provide some minimum level of protection. Therefore, the second key conservation strategy involves the implementation of land use controls. A variety of beneficial land use controls, ranging from zoning ordinance provisions to subdivision and land development standards, are discussed as options. In some cases, several of the land use controls can be used to complement each other.

The guidebook does, however, provide a model zoning overlay district and recommends its use as the most universal method of preserving riparian corridors. The model ordinance is not intended to be adopted exactly as it appears. It should be considered in the context of past municipal comprehensive planning and zoning, including the advice of the municipal solicitor. Each section of the model ordinance is accompanied by a commentary that relates the specific ordinance requirements to the func-



tion and benefit of riparian corridors. The commentary also indicates how the model ordinance requirements may be tailored to each municipality's goals.

The final component of the three-pronged conservation strategy is stewardship. In addition to discussing the importance and fundamental elements of stewardship, various stewardship practices are discussed for four types of basic ownership scenarios: municipal, corporate, homeowner, and agricultural. Guidelines for various forms of stewardship are also provided.



# Benefits of Riparian Corridor Conservation

## Introduction

Prior to the settlement of Pennsylvania, the majority of the state's land area was forested. For centuries riparian forests provided streams with shade, protected streambanks from excessive erosion, and promoted a beneficial streamside and instream ecosystem. The plants, animals, and insects living in the riparian woodland evolved based upon these wooded conditions and were well adapted to this setting. Moreover, the organisms developed interdependencies with the surrounding environment, and the entire ecosystem consisted of balanced relationships making it a sustainable landscape.

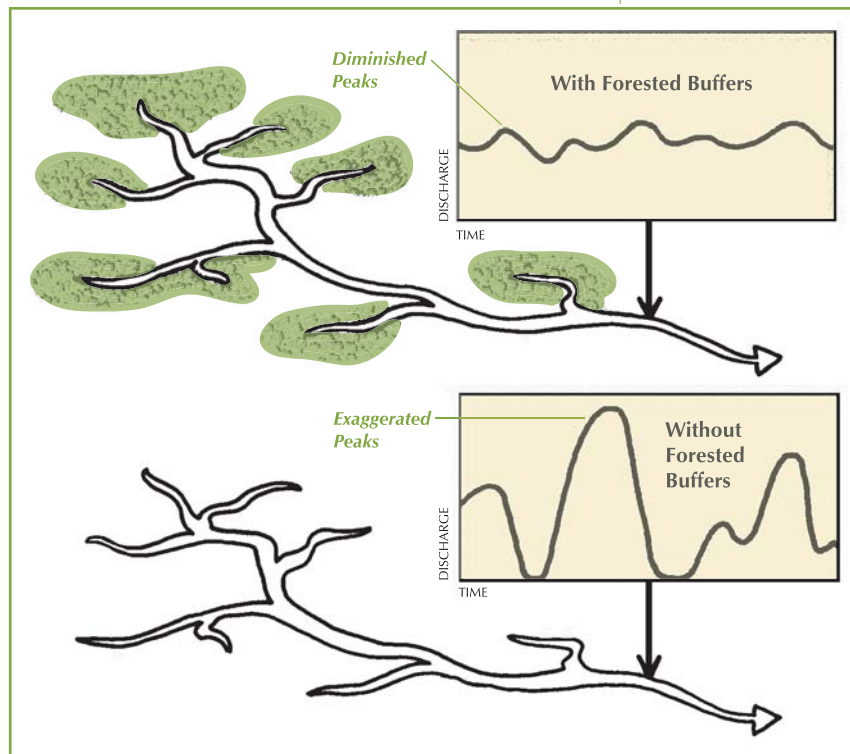
Land clearing and development has drastically changed the streamside environment. Without riparian forests, streams erode downward and develop a narrow, steeply sloped bed.

This reduces available habitat, so the stream lacks diversity. What habitat does exist tends to have warmer temperatures, increased sunlight, drastic changes in stream flow and stormwater runoff, and invasive species. The balance of the ecosystem, established over a long period of time, has been disturbed. The ability of the disturbed landscape to sustain a balanced ecosystem is doubtful unless an effort is made to preserve these critical areas.

## Benefits of Forested Riparian Corridors

In order to fully reap the benefits of riparian corridors, it is essential to retain corridors in a vegetated state, preferably as forests. When lands are not forested, management efforts should be undertaken to assist the growth of woody vegetation and the reestablishment of woodlands. As discussed in the following sections, the benefits of vegetated riparian corridors relate to how the corridors function to protect air, land, water quality, and animal habitat. While the benefits of riparian corridors have been grouped into several broad categories, many interrelationships exist between them.

**NATURAL FLOODPLAINS** Vegetated riparian corridors with undeveloped floodplains slow the concentration of runoff and flood flows, reducing the height and velocity of floodwaters downstream. As part of a municipality's floodzone management strategy, riparian corridors set development back from the banks of waterways and out of most floodways. Lastly, the riparian corridor serves as a natural reservoir by storing runoff and then releasing it over time into the stream, helping to maintain baseflow.



*Riparian forest buffers slow runoff, increasing infiltration and reducing flood peaks.*

**CONTROL OF EROSION** Riparian corridors can significantly reduce erosion of streambanks and adjoining floodplain, helping to prevent sedimentation of the stream. The riparian corridor reduces the velocity of runoff, allowing much of the sediment and attached phosphorus (roughly 85 percent of available phosphorus is bound to sediment) to be filtered out before reaching the stream. Also, the floor of a forested buffer acts as a natural sponge, due to the large soil pore spaces created by the root system of the trees and plants. This allows increased infiltration around the stream, helping to maintain stream baseflow, and enables the phosphorus to be utilized and transformed by the corridor's vegetation.

The root system of trees within the riparian corridor also helps to hold the surrounding soil in place during storms, and minimizes the slumping of streambanks over time. This is important for maintaining the width and overall health of a stream since the surface area of the stream bottom is where most biological activity occurs. Sedimentation of a stream can also increase potential for flooding, since the size and carrying capacity of the stream channel are reduced. In addition, eroded soil entering the stream is initially suspended in the water, decreasing the amount of sunlight reaching aquatic plants, inhibiting their growth and reproduction. Suspended sediment also harms a stream's fish life by clogging fish gills, reducing water circulation and aeration of the blood.

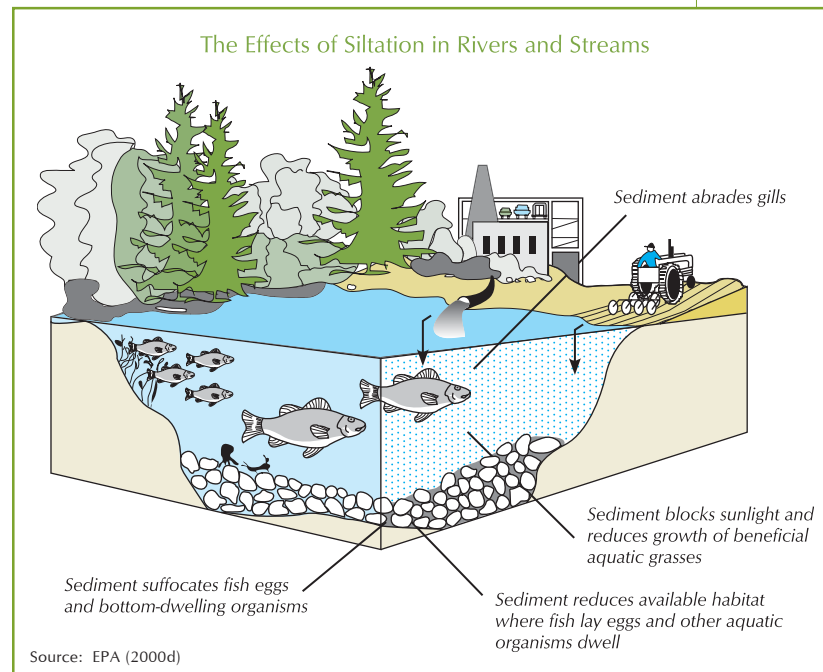
**WATER QUALITY/STREAM HEALTH** There are several ways the riparian corridor enhances water quality. As mentioned

earlier, the vegetated corridor operates as a filter to reduce the flow of sediment and phosphorus into streams. The reduction of phosphorus is especially important to water quality: phosphorus is typically the nutrient that controls the growth and activity of aquatic organisms in freshwater. Excessive phosphorus loading on the stream leads to proliferation of algae and other aquatic plants and is often referred to as eutrophication.

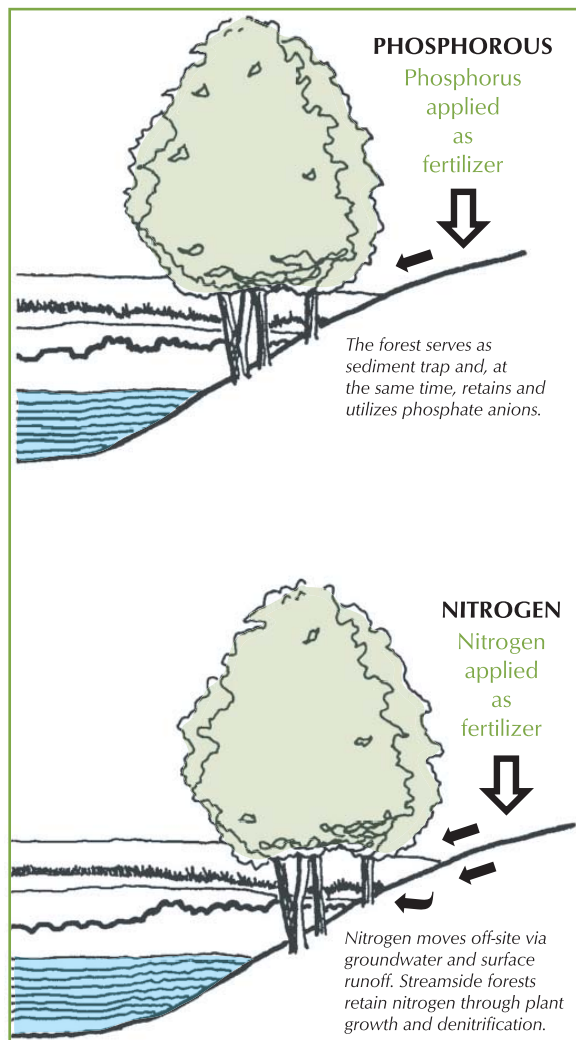
**Eutrophication** adversely affects water quality, particularly in the smaller slow-moving streams, when algal blooms and other aquatic plant growth interfere with the amount of sunlight reaching submerged aquatic plants. The lack or absence of sunlight impedes photosynthesis in the submerged aquatic plants,

A study of White Clay Creek in Chester County showed that forested streams are likely to be 2.5 times wider than meadow streams.

**eu-troph-ic** *adjective. Ecology.*  
Having waters rich in mineral and organic nutrients that promote a proliferation of plant life, especially algae, which reduces the dissolved oxygen content and often causes the extinction of other organisms.



*Siltation is one of the leading pollution problems in the nation's rivers and streams. Over the long term, unchecked siltation can alter habitat with profound adverse effects on aquatic life. In the short term, silt can kill fish directly, destroy spawning beds, and increase water turbidity resulting in depressed photosynthetic rates.*



causing them to die. Since the bacteria that decompose the dying plants maintain a high oxygen demand, the dissolved oxygen levels in the stream drop abruptly, causing fish and other aquatic life to die.

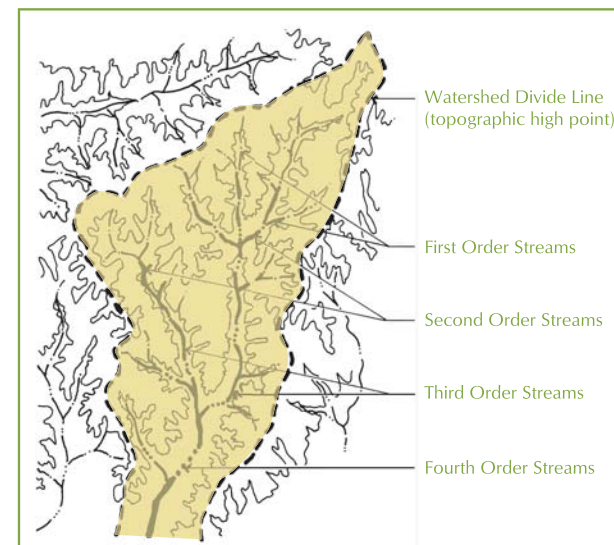
Another factor affecting the amount of dissolved oxygen in a stream is water temperature. Cold water is able to hold more dissolved oxygen. Therefore, increases in water temperature are a form of thermal pollution due to the direct effect on aquatic life. Shading of the stream by a forested riparian corridor will help to keep the stream cool, increasing the potential level of dissolved oxygen and lowering stress on fish (especially trout) and aquatic macroinvertebrates. The impact of forest buffers on water temperature is also supported by a Study of the White Clay Creek, which found that the amount of heat reaching a forested stream is only 17 percent of that received by a meadow stream.

Riparian corridors also reduce the amount of nitrogen entering the stream directly or via shallow groundwater flow. Nitrogen applied to farmland or lawns as fertilizer or found in animal waste is water-soluble and transforms to nitrate in runoff. Since nitrate does not attach to soil particles (as phosphorus does), it can leach into groundwater and streams. Excessive nitrates in a stream can also contribute to eutrophication. As a contaminant nitrates can increase water treatment costs. A riparian corridor will impede and intercept runoff from rain events and shallow groundwater flow. Once the runoff or shallow groundwater flow enters the riparian corridor, the nitrates are transformed by bacteria in the soil for consumption by the corridor's vegetation.

Finally, the trees and plants that constitute the riparian corridor also contribute to the

health of the stream by providing food to aquatic organisms. The organic debris deposited from streamside vegetation is a food source that supports various forms of algae (i.e. diatoms) that are preferred by fish and other plant-eating stream organisms. As leaves accumulate on the surface, they form leaf packs that provide habitat for small stream organisms that are food for larger organisms.

Recent studies by the Stroud Water Research Center and the University of Idaho have found that loss of headwater streams can adversely affect downstream conditions. The small, first and second order streams appear to be conduits for organic material to enter the stream system. The insects and other organisms that are dominant in these streams begin the nutrient cycles that support downstream organisms. When first and second order streams are culverted or otherwise lost through devel-



Roughly 73% of a watershed's total stream length consists of first and second order streams.

opment, much less organic material enters the stream, and downstream populations of fish suffer. This underscores the importance of protecting the small streams in the headwaters area of the watershed.

**HABITAT PROTECTION** The disappearance of habitat for a variety of species is one of the problems caused by suburban development. Riparian corridors, and greenways in general, offer wide swaths of land, allowing various animals to move more safely among developed portions of a municipality and between larger open space habitats (i.e., parks and land preserves). In addition, the riparian corridor serves as a critical interface for many animal species that live and breed along streams. Plants also have specific needs that are dependent upon the larger areas of natural surroundings often found along streams. For example, various spring ephemeral flowers and understory shrubs depend upon shade and filtered light caused by larger trees within forested riparian corridors. To meet these needs, forested areas must be wide enough to contain a broad tree canopy that fully shades the ground.

Also, when riparian corridors are forested they add variety to the instream habitat of the waterway via the shedding of large stable debris from adjacent trees. This debris tends to accumulate, forming small dams, which beneficially affects the depth, flow, and texture of the stream. This debris also increases the physical surface area of the stream, which

helps to support aquatic life. Finally, the natural dams help the stream channel resist degradation and downcutting by retaining organic matter and inorganic sediments.

The streamside forest is home to a variety of mammals, birds, amphibians and reptiles. The forested edge between land and water is prime habitat; berries, buds, fruits and nuts offer a varied menu and there are plentiful places for nesting. The riparian corridor offers a continuous transportation corridor for the migration of plant (via seeds) and animal species.

**CLIMATE MODERATION** The trees within forested riparian corridors add moisture to the air and create shade, significantly reducing air temperatures in the summer. This will benefit nearby residents as well as the stream. Scientific studies have also shown that groups of trees can reduce wind speeds by sixty to eighty percent, depending upon the planting density. Trees also help to purify the air by filtering dust and pollutants as well as absorbing carbon dioxide and releasing oxygen.

Native brook trout require water temperatures below 68 degrees to survive, and forested streams are as much as 10 degrees cooler than streams that flow through meadows.



# The Role of Acquisition

## Introduction

There are numerous ways to secure protection of riparian corridors and their natural feature components. The two primary methods of acquisition include fee simple acquisition, where all rights to the property are acquired, and conservation easements that preserve only specific rights and/or features within the corridor. Fee simple acquisition provides a municipality with the highest level of protection, including physical access. On the other hand, conservation easements protect a site's important natural features but don't typically involve physical access. Therefore, a municipality must balance its environmental protection goals with its available resources, desired level of control and requirements for access.

## The Need for Acquisition

The value of protecting riparian corridors often times coincides with other municipal conservation and recreation goals and can create the need for acquisition. This is especially the case where multiple resources converge or highly sensitive resources are present. For example, stream corridors often traverse areas of prime farmland or are found adjacent to steep slopes. In these cases, the combined value of protecting multiple resources may justify the

costs of acquisition. Full ownership may also be necessary when the resources contained on the land are highly sensitive and require careful management that only the municipality (or a land trust) has the capacity to provide.

In some instances there may be a need to secure physical access to a property that can only be accomplished via acquisition. This can occur when the riparian corridor parallels a potential trail link or traverses a larger site useful for active recreation.

While land use controls can have a major influence on conservation as a property becomes developed or changes use, they provide less protection for riparian corridors on land that is part of a larger existing development. Lastly, acquisition may be the last chance to secure a key parcel necessary to complete an interconnected greenway or riparian corridor.

## Primary Acquisition Strategies

**FEE SIMPLE ACQUISITION** The purchase of full ownership rights for the riparian corridor is the most direct way to protect the riparian corridor. In addition, municipal ownership also guarantees that some form of public access will be permitted and the riparian corridor will be properly maintained. The main obstacle to fee simple acquisition is the expense of purchasing the full rights to all the land needed. In addition, the riparian corridor may involve many different landowners, making identification and negotiation difficult. If a municipality chooses acquisition, there are

several alternative methods of purchase, such as installment buying, lease with option to buy, purchase and leaseback, and life estates that could be considered.

**EASEMENTS** If a municipality does not want to pursue fee simple acquisition, easements are a sound way to limit public expense while receiving open space protection and recreation benefits. Since easements provide a limited right over land, which can be negotiated to include the specific rights desired (i.e. trail easement), the costs can be considerably less than fee simple acquisition. Once again, difficulty may arise due to the large number of landowners that may have to be contacted. Easements may also be donated to a municipality. The grantor of the easement receives tax benefits. However, municipalities should investigate the legality of purchasing easements that do not provide for public access.

# Land Use Control Strategies

## Introduction

Although acquisition is effective for ensuring public access and protecting key riparian lands, resources may not be available to protect every mile of riparian corridor. Significant protection can be afforded riparian corridors by limiting encroachment within the corridor and/or controlling the removal of critical vegetation. Therefore, it is essential to integrate land use controls into any riparian corridor protection strategy. These controls can apply to lands that are developed, proposed for development, or remain undeveloped without any acquisition costs incurred by the municipality.

## Zoning Controls

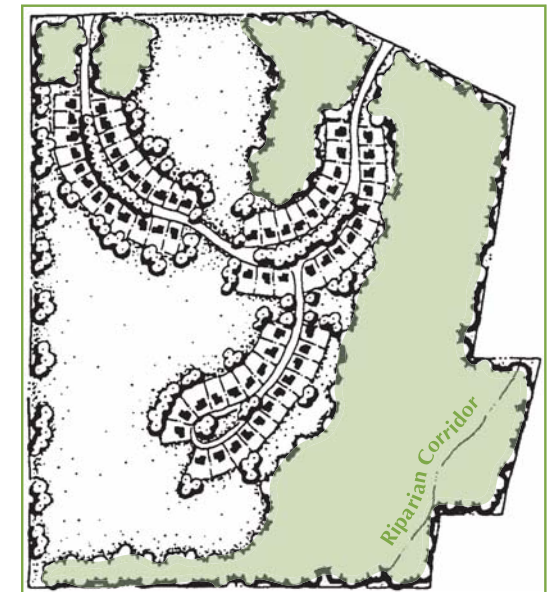
**OVERLAY ZONING** Overlay zoning is the basic approach many municipalities have used to regulate floodplains to comply with the Federal Flood Insurance Program. When applied to riparian corridors, the applicability of the overlay district is either defined within the zoning language or delineated on an officially adopted map. Various riparian corridor protection standards are added to the zoning ordinance to regulate the use and intensity of activities within the corridor. If a municipality's goal is to protect riparian corridors and the essential benefits they provide, this method pro-

vides a high level of legally permitted control, without municipal ownership.

*This method may be most suited for Montgomery County municipalities due to the varied type and function of streams. In addition, there may be numerous types of land uses adjacent to a riparian corridor within one municipality. By instituting an overlay zoning district, specific/critical riparian corridors can be targeted for protection, while considering all potential land uses. The next section of the Guidebook contains model zoning language.*

### TRANSFER OF DEVELOPMENT RIGHTS

A transfer of development rights (TDR) program allows municipalities to preserve, among other things, vulnerable or important natural resources (i.e., riparian corridors). This form of overlay zoning would apply only to designated



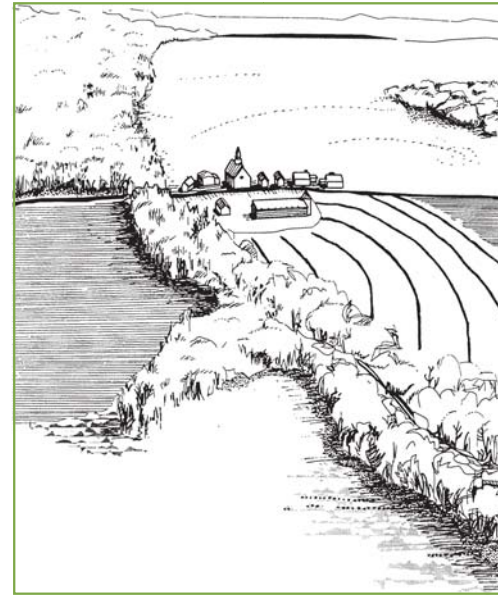
*By clustering development in the upland areas, riparian corridors and vegetation can be preserved.*



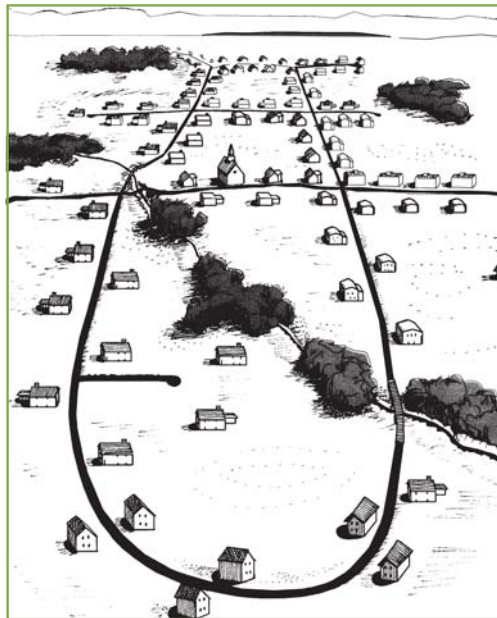
riparian corridors, requiring the land be preserved in its natural state. To protect property values, landowners are permitted to transfer their right to develop, based on the underlying zoning district, to a portion of the municipality designated for more intensive development. This allows the riparian corridors to be permanently deed-restricted from development, while maintaining the value of the land.

**CONSERVATION SUBDIVISION/CLUSTERING** Conservation subdivisions, or clustering, is usually permitted as an option, or encouraged through density incentives, in some zoning districts and may be mandatory in others. The concept allows dwellings to be clustered on smaller lots on a portion of a tract, allowing the remainder to be set aside as open space. By allowing cluster developments, a municipality can identify certain site amenities, such as riparian corridors, to satisfy the open space requirements. In this way, the riparian corridor is protected as open space, and the landowner retains full development potential of the land under current zoning. If density incentives are used, the landowner may be permitted more development than is allowed under current zoning.

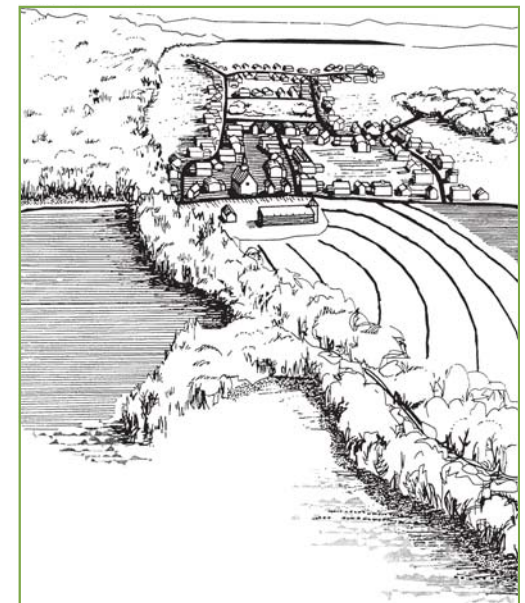
**PERFORMANCE ZONING** Performance zoning expands upon the overlay concept by linking the permitted density of a development to the amount of developable land on a site. For example, in a performance subdivision, the applicant might be required to subtract all or a percentage of land in floodplain, riparian corridor, road rights-of-way, or steep slopes before calculating the permitted density. Performance zoning also includes



*An existing hamlet traversed by riparian corridor*



*Under conventional zoning the riparian corridor is partially cleared and extensively developed.*



*Under TDR zoning the riparian corridor is preserved by transferring development into designated growth areas.*

extensive requirements for landscaped buffers between different land uses that could be expanded to include the riparian corridor.

## Subdivision and Land Development Standards

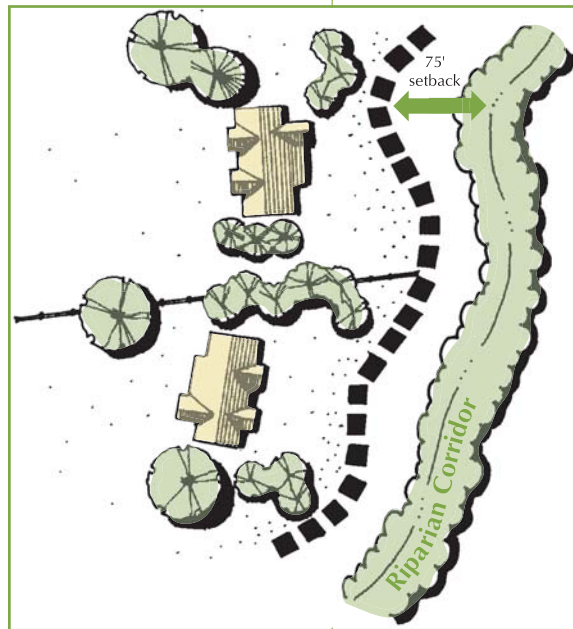
**STREAMBANK SETBACK** Similar to rights-of-way applied to roads or other utility corridors, streams within a community could be protected through an established buffer strip. In the simplest form, the buffer strip would be uniform for all streams. Stream setback requirements may be established within the subdivision and land development ordinance or as a separate municipal code. This method, how-

ever, does not provide the authority to control use of the corridor and may have less certainty than an overlay zoning district.

**LANDSCAPE REGULATIONS** Generally, landscaping has been used to maintain or enhance views of development from roads, to buffer uses, and to improve the appearance of streets and parking lots. Landscaping regulations, found within a municipality's subdivision and land development ordinance, can also work to preserve and enhance riparian corridors

by protecting existing trees and plants and requiring use of native trees and plants that are tolerant of wet soil conditions. Landscape regulations could work in conjunction with one or more of the other protection methods described in this section.

**STORMWATER MANAGEMENT REGULATIONS** Stormwater management regulations are designed mainly to detain runoff during rain events, decreasing the potential and level of downstream flooding. While these regulations effectively maintain and lower the peak flow of streams during storms, the outlets of detention structures still discharge directly into local streams. This direct discharge has the potential to carry numerous pollutants and sediments. Therefore, the outlets should be designed to drain into the riparian corridor, following conversion to sheet flow.



*Stream setbacks can be used to prevent construction within the riparian corridor.*



# Model Overlay District

## Introduction

Given the importance of integrating land use controls into a comprehensive riparian corridor protection strategy, a model zoning overlay district has been provided for municipal use. The model ordinance is not intended to be adopted “as is,” but should be modified as necessary to meet the unique needs of a given municipality. The model ordinance is accompanied by sidebar commentary that can help guide the modification process and concludes with model subdivision ordinance language to complement the zoning overlay district. Lastly, we have included an outline of riparian corridor conservation principles on which the ordinance was based and a brief discussion on the legal basis for riparian corridor conservation.

## Principles of Riparian Corridor Conservation

To obtain the many benefits that a riparian corridor can provide, certain minimum principles must be adhered to:

- Riparian corridors should extend at least 75 feet from the edge of the stream to perform properly. The 75 feet should include several distinct zones that perform specific functions. Ideally, the first zone should con-

sist of undisturbed forest to provide food and shade for the stream. The second zone should consist of managed woodland that allows for infiltration of runoff, filtration of sediment and nutrients, and nutrient uptake by plants. Finally, flow into the buffer should be transformed from concentrated flow into sheet flow to maximize ground contact with the runoff.

- Development within the riparian corridor should be limited only to structural facilities that are necessary for public health and safety. Agricultural activities would be permitted within the outer zone of the riparian corridor provided they were conducted in conformance with recognized soil conservation practices. When construction activities occur within the riparian corridor, such as stream crossings, specific mitigation measures should be taken.
- The riparian corridor should be uninterrupted. This will help reduce concentrated flow from entering the stream and “short-circuiting” the filtration and infiltration benefits of riparian corridors. Uninterrupted corridors also provide continuous habitat for the passage of wildlife.
- Forested riparian corridors should be maintained, and reforestation should be encouraged where no wooded buffer exists. Trees are the single most important element of the riparian corridor for removing nutrients from the soil, stabilizing the soil, modifying water temperature, and providing food for aquatic organisms.
- Recreation within the riparian corridor should be balanced with the effect it may

have upon existing features. For example, physical invasion of a riparian corridor may be limited when it contains plant or animal species of concern or steep slopes or significantly impacts adjacent landowners.

# Legal Basis for Municipal Riparian Corridor Protection

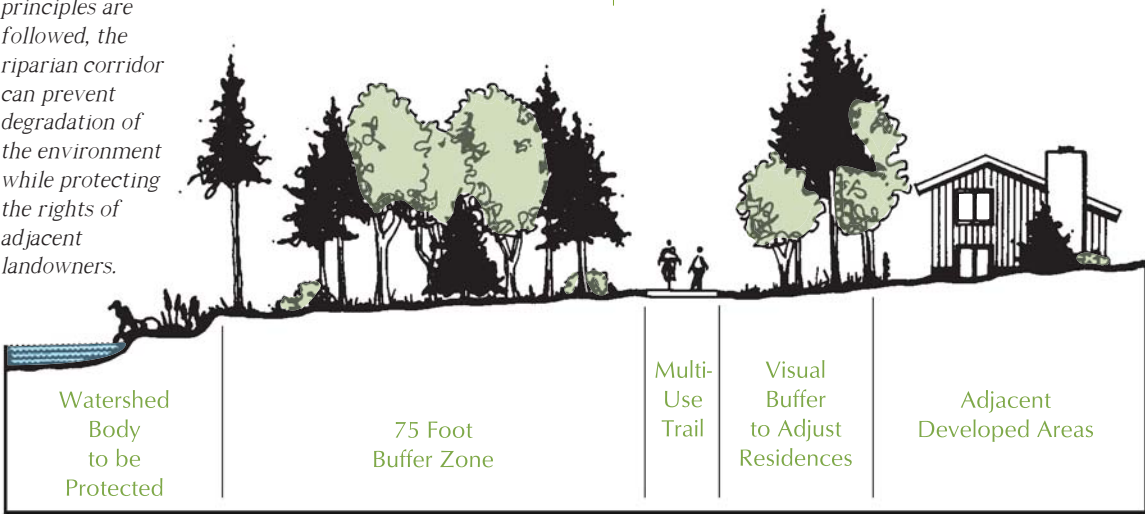
Power to protect streams and regulate the use of adjoining lands can be found within the Pennsylvania Municipalities Planning Code. Specific authority for creating riparian corridors can be found in the zoning provisions authorizing municipalities the power to protect many riparian corridor features including woodlands, historic resources, wildlife habitat, wooded areas, and scenic vistas. See in particular Sections 603(b)(5), 604(1) and 605(2)(ii & vii). Additional authority to plan for and to protect water supply, found in Sections 301(b) and 603(d), further empowers municipalities to enact riparian corridor protection.

Riparian corridor ordinances that regulate land within private ownership are similar to floodplain and steep slope ordinances which have typically been upheld due to the compelling health, safety and welfare benefits of such a land use control. Furthermore, it is generally accepted that land use controls that provide flexibility and offer a “release valve” for unique situations are less likely to take away all economic use of a property. Flexibility within riparian buffer ordinances that protect property owners’ rights include buffer averaging, density compensation, and variances. Our model overlay district uses both buffer averaging and the variance (a standard “release valve” for all Pennsyl-

vania zoning requirements) to provide flexibility and reflect extraordinary circumstances. As with the adoption of any zoning language, municipalities should consult with their solicitor during the development of any riparian corridor conservation ordinance.

To date, no specific challenges to the concept of riparian corridor preservation have been found. It is interesting to note that the few related legal challenges involve cases where the municipality has gone beyond reasonable requirements. For example, a challenge was made to an ordinance in New Jersey that required 300 feet on either side of a waterway be preserved. Any property owner wishing to build an impervious surface or structure within the buffer zone would need a use variance in order to do so. This is well beyond the 75-foot science has identified as necessary to protect water quality and stream health.

*When certain minimum principles are followed, the riparian corridor can prevent degradation of the environment while protecting the rights of adjacent landowners.*





## MODEL ORDINANCE

# Riparian Corridor Conservation District

### Section 1 Legislative Intent

In expansion of the Declaration of Legislative Intent and Statement of Community Development Objectives found in Sections 101 and 102 of Article I of this ordinance, it is the intent of this article to provide reasonable controls governing the conservation, management, disturbance, and restoration, of riparian corridors under authority of Article I, Section 27 of the Pennsylvania Constitution, Act 247 the Municipalities Planning Code as amended, and other Commonwealth and Federal statutes, in conformance with the goals of the Comprehensive Plan, Open Space and Environmental Resource Protection Plan, and the following objectives:

- 1.1** Improve surface water quality by reducing the amount of nutrients, sediment, organic matter, pesticides, and other harmful substances that reach watercourses, wetlands, subsurface, and surface water bodies by using scientifically-proven processes including filtration, deposition, absorption, adsorption, plant uptake, and denitrification, and by improving infiltration, encouraging sheet flow, and stabilizing concentrated flows.
- 1.2** Improve and maintain the safety, reliability, and adequacy of the water supply for domestic, agricultural, commercial, industrial, and recreational uses along with sustaining diverse populations of aquatic flora and fauna.

*The legislative intent section provides the rationale for the regulation, including the applicable power to do so. This will demonstrate that the regulation is reasonable and related to a defensible public purpose. The authority to protect riparian corridors is contained within the Pennsylvania Constitution and the MPC (Secs 301b, 603b5, 603d, 604(1), and 605(2)).*

*The intent section also recognizes the scientifically proven and published benefits of riparian corridors.*

*The Commonwealth of Pennsylvania has invested over a billion dollars in water quality protection over the last two decades. Protection of riparian corridors helps to advance this large public investment.*

*The majority of land within a watershed is drained by the smaller 1st and 2nd order streams. Therefore, regulation of riparian corridors must focus upon all streams within a watershed and not just the larger more apparent creeks and rivers.*

*There are other laws of the Commonwealth that this ordinance complements which should be referenced.*

*Depending on a municipality's goals for corridor preservation, recreational opportunities may exist and should be mentioned as part of the regulation's intent.*

*The ordinance should reference other existing municipal regulations regarding natural resource preservation.*

- 1.3** Preserve and protect areas that intercept surface water runoff, wastewater, subsurface flow, and/or deep groundwater flows from upland sources and function to remove or buffer the effects of associated nutrients, sediment, organic matter, pesticides, or other pollutants prior to entry into surface waters, as well as provide wildlife habitat, moderate water temperature in surface waters, attenuate flood flow, and provide opportunities for passive recreation.
- 1.4** Regulate the land use, siting, and engineering of all development to be consistent with the intent and objectives of this ordinance and the best-accepted conservation practices, and to work within the carrying capacity of existing natural resources.
- 1.5** Assist in the implementation of pertinent state laws concerning erosion and sediment control practices, specifically Erosion Control, of the Pennsylvania Clean Streams Law, Act 394, P.L. 1987, Chapter 102 of the Administrative Code (as amended October 10, 1980 Act 157 P.L.), Title 25, and any subsequent amendments thereto, as administered by the Pennsylvania Department of Environmental Protection and the Montgomery County Conservation District.
- 1.6** Conserve natural features important to land or water resources such as headwater areas, groundwater recharge zones, floodway, floodplain, springs, streams, wetlands, woodlands, prime wildlife habitats, and other features that provide recreational value or contain natural amenities whether on developed or undeveloped land.
- 1.7** Work with floodplain, steep slope, and other requirements that regulate environmentally sensitive areas to minimize hazards to life, property, and riparian features.



- 1.8** Recognize that natural features contribute to the welfare and quality of life of the [Municipal] residents.
- 1.9** Conserve natural, scenic, and recreation areas within and adjacent to riparian areas for the community's benefit.

## Section 2

### Application and Width Determination of the District

- 2.1** *Application.* The Riparian Corridor Conservation District is an overlay district that applies to the streams, wetlands, and waterbodies, and the land adjacent to them, as specified in the following table:

*Scientific research has demonstrated that the benefits of riparian corridors are maximized when they extend at least 75 feet from the streambank.*

SURFACE WATER FEATURE	MINIMUM CORRIDOR WIDTH
A. <b>Perennial Streams:</b> All perennial streams identified in the Soil Survey <sup>1</sup> . (Perennial streams are shown as solid lines on the Soil Survey maps.)	<p><b>Zone 1:</b> Minimum width of 25 feet from each defined edge of the watercourse at bank full flow, measured perpendicular to the edge of the watercourse.</p> <p><b>Zone 2:</b> Minimum width of 50 feet from the outer edge of Zone 1, measured perpendicular to the edge of Zone 1, or equal to the extent of the 100-year floodplain<sup>3</sup>, or 25 feet beyond the outer edge of a wetland along the stream, whichever is greater. (Total minimum width of Zones 1 &amp; 2 = 150 feet plus the width of the stream.)</p>
B. <b>Intermittent Streams:</b> Intermittent streams identified in the Soil Survey <sup>1</sup> or any stream otherwise identified on the applicant's plan that have an upstream drainage area of 75 acres or more <sup>2</sup> . (Intermittent streams are shown as dotted and dashed lines on the Soil Survey maps.)	<p><b>Zone 1:</b> Minimum width of 25 feet from each defined edge of the watercourse at bank full flow, measured perpendicular to the edge of the watercourse.</p> <p><b>Zone 2:</b> Minimum width of 50 feet from the outer edge of Zone 1, measured perpendicular to the edge of Zone 1, or equal to the extent of the 100-year floodplain<sup>3</sup>, or 25 feet beyond the outer edge of a wetland along the stream,</p>

*Zone One should be a minimum of 25 feet from the streambank and consist of undisturbed forest and vegetation in order to stabilize the streambank, shade the stream, and provide food for aquatic organisms.*

*Zone Two is the "outer edge" of the corridor and allows for infiltration of runoff, filtration of sediment and nutrients, and nutrient uptake by plants.*

The following notes should accompany the chart:

<sup>1</sup>Soil Survey shall mean the most recent edition of the Soil Survey of Montgomery County.

<sup>2</sup>Upstream drainage area shall be measured from where the stream exits the applicant's site.

<sup>3</sup>100-year floodplain is identified on the Flood Insurance rate Map (FIRM) prepared by FEMA, or as calculated by the applicant where FEMA data does not apply.

SURFACE WATER FEATURE	MINIMUM CORRIDOR WIDTH
	whichever is greater. (Total minimum width of Zones 1 & 2 = 150 feet plus the width of the stream.)
C. <b>Other Streams:</b> All other streams with an upstream drainage area of less than 75 acres <sup>2</sup> , including intermittent streams identified in the Soil Survey <sup>1</sup> .	<p><b>Zone 1:</b> Minimum width of 25 feet from the centerline of the watercourse, measured perpendicular to the centerline of the watercourse, or equal to the extent of the 100-year floodplain<sup>3</sup>, or 25 feet beyond the outer edge of a wetland along the stream, whichever is greater. (Total minimum width of 50 feet).</p> <p><b>Zone 2:</b> Does not apply.</p>
D. <b>Wetlands and Waterbodies:</b> Wetlands not located along a stream, and waterbodies, where the wetland and/or waterbody is greater than 10,000 square feet in area.	<p><b>Zone 1:</b> Minimum width of 25 feet from the outer edge of the wetland or waterbody, measured perpendicular to the edge. For wetlands located at the edge of a waterbody, the measurement shall be made from the outer edge of the wetland.</p> <p><b>Zone 2:</b> Does not apply.</p>

Steep slopes are often found adjacent to waterways and may reduce the infiltration and filtering benefits of the buffer.

Providing a Zone 1 designation to the steeply sloped areas will afford greater protection for existing vegetation. Maintaining vegetation on steep slopes is especially critical for reducing erosion and sedimentation.

**2.2 Zone Designation Adjustments for Steep Slopes.** Where steep slopes in excess of 25 percent are located within 75 feet of a stream identified in 2.1, A or B, above, the area of steep slopes shall be designated as Zone One consistent with the following:

- A. If the extent of the steeply sloped area is more than 75 feet, the Zone 1 designation shall extend to 75-feet or to the full extent of the steeply sloped area within the corridor. If Zone 1 extends greater than 75 feet, as may be required in Section 2.1.C., Zone 2 shall not be required except as may be required in 2.1, A or B for floodplains.
- B. If the extent of the steeply sloped area is less than 75 feet, the Zone 1 designation shall extend to the limit of the steeply

sloped area, and the width of Zone Two shall be adjusted so that the total corridor width (Zone 1 plus Zone 2) will be that required in 2.1 A, B, or C.

- 2.3 Identification and Width Determination.** The applicant shall be responsible for the following:
- A. Identifying the watercourses, wetlands, and/or waterbodies on and abutting the applicant's site, and locating these features accurately on the applicant's plans.
  - B. Initial width determination of the riparian corridor(s) in compliance with Section 2.1, herein, and for identifying these areas on any plan that is submitted for subdivision, land development, or other improvements that require plan submissions or permits. The initial determination(s) shall be subject to review and approval by the [Municipal] Planning Commission, with the advice of the [Municipal] Engineer.

*This ordinance requires the applicant to designate the riparian corridor on the subdivision or land development plan. This requirement is similar to the way wetlands and floodplains are designated.*

### Section 3 Uses Permitted in the Riparian Corridor Conservation District

The following uses are permitted by right in the Riparian Corridor Conservation District in compliance with the requirements of this Article:

- 3.1 Zones One and Two:** At least half of any required yard setback area, for any individual lot, must be entirely outside of the Riparian Corridor Conservation District.
- 3.2 Zone One:**
- A. Open space uses that are primarily passive in character shall be permitted to extend into the area defined as Zone One, including:

*The uses permitted within each zone are directly related to the specific benefits the zone provides and should be tailored to the community's goals.*

*To ensure usable yard area is provided, at least half of all yard setbacks shall be outside the riparian corridor.*

*For Zone One to function properly it should remain relatively undisturbed. Therefore, the by-right uses are generally*

*passive and allow for the implementation of streambank stabilization techniques to minimize erosion.*

*To sustain and encourage agricultural operations, crossings for farm vehicles and livestock are permitted by-right.*

*Invariably, driveways, roads, and other types of corridor crossings will be required and are permitted by-right provided specific mitigation and design standards are satisfied.*

*The main purpose of Zone Two is to impede the flow of runoff, allowing increased infiltration to filter out nutrients for uptake by plants.*

*Existing agricultural uses should be allowed to continue, as long as best-management practices are implemented.*

1. Wildlife sanctuaries, nature preserves, forest preserves, fishing areas, passive areas of public and private parklands, and reforestation.
2. Streambank stabilization.
- B. Forestry operations approved by the Montgomery County Conservation District.
- C. Corridor Crossings:
  1. Agricultural crossings by farm vehicles and livestock.
  2. Driveways serving one or two single-family detached dwelling units, provided the mitigation requirements of Section 8.2 are satisfied. The corridor crossing standards of Section 9 should be considered during design of the driveway.
  3. Driveways serving more than two single-family detached dwelling units, or roadways, recreational trails, railroads, and utilities, provided the mitigation requirements of Section 8.2 and the corridor crossing design standards of Section 9 are satisfied.

### **3.2 Zone Two:**

- A. Open space uses including wildlife sanctuaries, nature preserves, forest preserves, passive areas of public and private parklands, recreational trails, and reforestation.
- B. Agricultural uses conducted in compliance with methods prescribed in the Department of Environmental Protection's *Erosion and Sediment Pollution Control Manual*, March 2000, as amended.

C. Corridor Crossings:

1. Agricultural crossings by farm vehicles and livestock.
2. Driveways serving one or two single-family detached dwelling units, provided the mitigation requirements of Section 8.2 are satisfied. The corridor crossing standards of Section 9 should be considered during design of the driveway.
3. Driveways serving more than two single-family detached dwelling units, or roadways, recreational trails, railroads, and utilities, provided the mitigation requirements of Section 8.2 and the corridor crossing design standards of Section 9 are satisfied.

D. Residential accessory structures having an area equal to or less than 225 square feet.

*The standards for accessory structures should be tailored to be consistent with existing municipal regulation.*

E. Forestry operations approved by the Montgomery County Conservation District.

F. Passive use areas such as camps, campgrounds, picnic areas, and golf courses. Active recreation areas such as ballfields, playgrounds, and courts provided these uses are designed in a manner that will not permit concentrated flow of stormwater runoff.

*The main purpose of Zone Two is to slow runoff. Therefore, concentrated runoff flow should be prevented. This may be particularly important if impervious surface is introduced into Zone Two.*

G. Centralized sewer and/or water lines and public utility transmission lines running along the corridor. When proposed as part of a subdivision or land development, the mitigation requirements of Section 8.2 shall be satisfied. In all cases, these lines shall be located as far from Zone One as practical.

*Denudation of the buffer area is prohibited unless it is done to allow for construction of a permitted use, such as a utility crossing, provided the uses are constructed and revegetated according to ordinance specifications.*

*The ordinance should specifically prohibit uses that may inevitably lead to erosion, sedimentation, pollution, and general disturbance of the corridor, which may not be reasonably mitigated. Once again, this section should be modified to meet the goals of the municipality*

*Structures and uses that legally exist prior to adoption of this ordinance, which will no longer be permitted, are considered nonconforming. It is important to recognize these instances, regulate their expansion, and determine abandonment.*

## Section 4

### Uses Specifically Prohibited in the Riparian Corridor District

Any use or activity not authorized within Section 3, herein, shall be prohibited within the Riparian Corridor Conservation District and the following activities and facilities are specifically prohibited:

- 4.1** Clearing of all existing vegetation, except where such clearing is necessary to prepare land for a use permitted under Section 3.1, herein, and where the effects of these actions are mitigated by re-establishment of vegetation, as specified under Section 8.1, herein.
- 4.2** Storage of any hazardous or noxious materials.
- 4.3** Use of fertilizers, pesticides, herbicides, and/or other chemicals in excess of prescribed industry standards or the recommendations of the Montgomery County Conservation District.
- 4.4** Roads or driveways, except where permitted as corridor crossings in compliance with Section 3, herein.
- 4.5** Motor or wheeled vehicle traffic in any area not designed to accommodate adequately the type and volume.
- 4.6** Parking lots.
- 4.7** Any type of permanent structure, including fences, except structures needed for a use permitted in Section 3, herein.
- 4.8** Subsurface sewage disposal areas.
- 4.9** Sod farming.
- 4.10** Stormwater basins, including necessary berms and outfall facilities.

## Section 5

### Nonconforming Structures and Uses in the Riparian Forest Corridor District

Nonconforming structures and uses of land within the Riparian Corridor Conservation Overlay District shall be regulated under the provisions of Article VII, Nonconforming Status, herein, except that the one-year time frame for discontinuance shall not apply to agricultural uses which are following prescribed Best Management Practices for crop rotation.

*There may be disputes about the extent of the corridor on specific properties. This section provides the applicant with the opportunity to justify a change in the boundary location.*

## Section 6

### Boundary Interpretation and Appeals Procedure

- 6.1** When an applicant disputes the Zone 1 and/or 2 boundaries of the Riparian Corridor or the defined edge of a watercourse, surface water body, or wetland, the applicant shall submit evidence to the [Municipality] that shows the applicant's proposed boundary, and provides justification for the proposed boundary change.
- 6.2** The [Municipal] Engineer, and/or other advisors selected by the [Governing Body] shall evaluate all material submitted and provide a written determination within 45 days to the [Governing Body], [Municipal] Planning Commission, and landowner or applicant.
- 6.3** Any party aggrieved by any such determination or other decision or determination under this section may appeal to the Zoning Hearing Board under the provisions of [existing Zoning Hearing Board Article] of this ordinance. The party contesting the location of the district boundary shall have the burden of proof in case of any such appeal.

*Similar to other zoning appeals, further disputes should be handled by the zoning hearing board.*



*Once lands start being preserved, and a contiguous system of lands begin to form, some degree of regular inspection will be necessary. The inspection will determine landowner compliance with the ordinance provisions.*

## Section 7 Inspection of Riparian Corridor Conservation District

- 7.1** Lands within or adjacent to an identified Riparian Corridor Conservation Overlay District will be inspected by the [Municipal] Code Enforcement Officer when:
- A. A subdivision or land development plan is submitted.
  - B. A building permit is requested.
  - C. A change or resumption of nonconforming use is proposed.
- 7.2** The district may also be inspected periodically by the Code Enforcement Officer and/or other representatives designated by the [Governing Body] for compliance with an approved restoration plan, excessive or potentially problematic erosion, hazardous trees, or at any time when the presence of, or possibility of, an unauthorized activity or structure is brought to the attention of [Municipal] officials.

## Section 8 Management of the Riparian Corridor District

*Vegetation is one of the key ingredients to a healthy and useful corridor. Therefore, to encourage and aid in the establishment of the riparian corridor, specific riparian plantings should be required as part of the site's general landscaping.*

- 8.1** *Riparian Corridor Planting.* Re-establishment of forest cover and woodland habitat shall be required consistent with the requirements of the landscape regulation within the [Municipal] Subdivision and Land Development Ordinance.
- 8.2** *Mitigation Measures.* Uses permitted in Section 3 involving corridor crossings or other encroachment within the riparian corridor shall be mitigated by increasing the width of the corridor

as replacement for the area lost due to the encroachment or disturbance, so that the total corridor area (land area within Zone One and Zone Two) for each applicable side of the stream or watercourse is equal to that required by Section 2.1.

Corridor area is the product of the corridor width required by Section 2.1 and the total length for each applicable side of the stream or watercourse for which a riparian corridor is being established. Perimeter shall be used in place of length for determining wetland buffer area. The increased width shall be spread throughout the corridor to the maximum extent possible. For streams and watercourses, the increased width shall be applied along the length of the stream in blocks of 1,000 feet or more, or the full length of the corridor on the affected property, whichever is less.

*When development encroaches upon the riparian corridor, the function of the corridor is compromised and mitigation will be required.*

*A “buffer averaging” approach adds width to portions of the buffer to offset reductions in width due to corridor crossings or other types of disturbance.*

## Section 9

### Corridor Crossing Standards

**9.1** *Corridor Crossing Criteria.* All corridor crossings permitted under Sections 3.1 or 3.2, herein, shall incorporate, as required, the following design standards.

- A. The width of the right-of way should not be greater than the minimum right-of-way width required by the [Municipal] Subdivision and Land Development Ordinance.
- B. Crossings should be designed to cross the riparian corridor at direct right angles to the greatest extent possible in order to minimize disturbance of the corridor.
- C. Corridor crossings should be separated by a minimum of 1,000 feet of buffer length.

*While the need for corridor crossings is inevitable, the number and design of these crossings should be controlled in order to protect the integrity and functionality of the riparian corridor to the greatest extent possible.*

D. Bridges should be used in place of culverts when crossings would require a 72-inch or greater diameter pipe. When culverts are installed they should consist of slab, arch, or box culverts and not corrugated metal pipe. Culverts should also be designed to retain the natural channel bottom to ensure the passage of water during low flow or dry weather periods.

## Section 10

### Use of Technical Terminology

Technical terminology used in this article shall be interpreted to have the meanings used by recognized sources and experts in the fields of forestry, woodland or meadow management, streambank protection, wetlands management, erosion and sedimentation control, or other relevant fields.

## Model Landscape Standards for Subdivision and Land Development Ordinance

### A. Purpose & Application

In areas within the Riparian Corridor Conservation District as defined in Section ### of the [Municipal] Zoning Ordinance, the edge of water features and stream corridors should be in forest cover to further the ecological and environmental benefits, as stated in the Riparian Corridor Conservation Overlay District (RCC). To promote re-establishment of forest cover and woodland habitat, new tree plantings shall be implemented in Zone One wherever existing trees do not meet the minimum tree planting requirements.

*Integration of the Riparian Corridor Conservation Overlay District into the municipal zoning ordinance should be complemented by the adoption of specific landscape standards within the municipal subdivision and land development ordinance.*

### B. Planting Requirements

1. New trees shall be planted at a minimum rate of 15 feet on center or one tree per 225 square feet in staggered rows or an equivalent informal arrangement within the area defined as Zone One by the RCC.
2. New trees shall be a variety of sizes ranging from a minimum 4 to 5 foot branched whip to an approximate 1 1/2 " balled and burlapped planting stock.
3. New tree plantings shall be composed of native tree species.
4. Tree plantings shall be located along the streambank to provide shade for the stream, soil erosion control and stormwater benefits, according to accepted streambank restoration practices.
5. Existing trees within Zone One shall be preserved and retained. Existing tree cover should be surveyed and inventoried to assess the need for any new plantings. Existing tree species included on the noxious/invasive plant species list, Appendix C, may be removed where conditions warrant.

*The required plantings will help to enhance or re-establish a vegetated riparian buffer, maximizing water quality benefits.*

*Plantings installed as part of the subdivision and land development process will provide visual cues to future property owners by providing a distinction between the riparian corridor and the remaining lot area.*

*If the riparian corridor is to be ultimately managed by numerous private owners, the municipality should provide or arrange for continued education of property owners regarding the benefits of riparian corridors and proper management and stewardship.*

# Model Ordinance

## Implementation Guidance

### Mitigation Measures

While preservation is the goal of the riparian corridor conservation district, there will be cases where disturbance to a portion of the corridor is unavoidable. These disturbances may include corridor crossings by farm vehicles and livestock, roads, recreational trails, railroads, centralized sewer and water lines, and electric, gas and oil transmission lines. However, the scientifically proven benefits of riparian corridors can be significantly reduced when the corridor is interrupted by crossings or vegetation removal. Therefore, the ordinance only permits disturbances when followed by mitigation. In general, mitigation works by increasing the efficiency and effectiveness of one part of the buffer to compensate for a decrease in effectiveness caused by disturbance. While there are several methods to offset corridor disturbance, the model ordinance only offers one option for mitigation: buffer averaging. This is the most basic mitigation measure and one of the easiest to apply. This method and two other options are discussed below:

#### Buffer Averaging

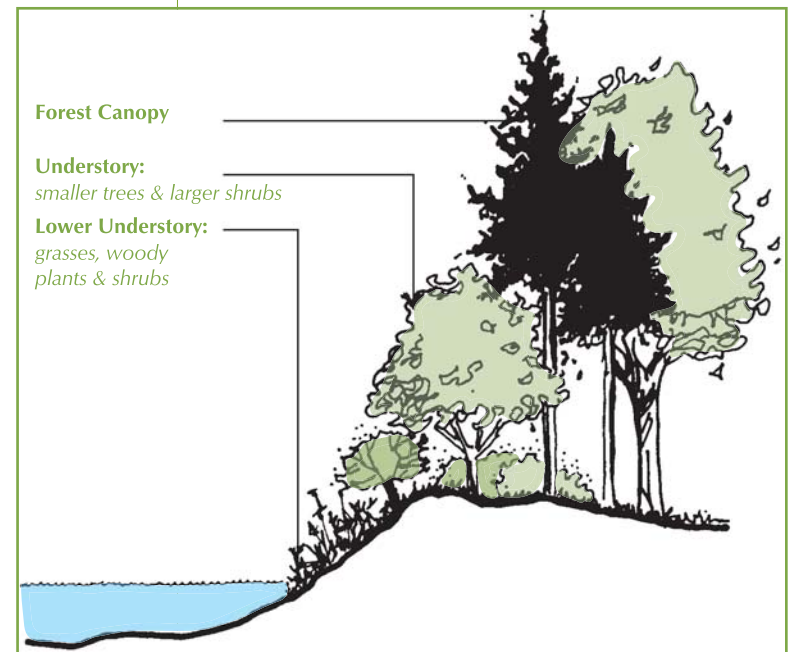
Within the model ordinance, the riparian corridor district is defined as 75 feet from each defined edge of an identified watercourse or surface water body at normal flow or level, or the extent of the 100 year floodplain, whichever is greater. This area is considered to be the minimum necessary to be effective in preserving water quality and maintaining the general viability of the

stream. However, disturbances to the corridor, including corridor crossings, will effectively reduce the 75 foot width necessary to secure the benefits of corridor conservation. To offset this reduction in corridor width in the area of the disturbance, the buffer should be increased in width in other areas so that the area of the buffer is the same as it was prior to the disturbance. While increasing the width in other areas of the corridor may not fully mitigate the impacts of disturbance, wider buffers do marginally improve water quality and provide additional benefits.

#### Add Layers of Vegetation

In addition to wider corridors, the addition vegetative layers will improve the effectiveness of the riparian area. For maximum effectiveness, the riparian area should have three distinct layers of vegetation, similar to those present in mature woodlands: (1) trees that form an overhead canopy, (2) shrubs that provide an immediate layer of cover, and (3) herbaceous plants that serve as ground cover. These layers work together to provide a roughness and diversity that increases filtration efficiency and creates habitat for a wider range of wildlife.

**Overhead Canopy** – The overhead canopy is comprised of deciduous or evergreen trees with heights ranging between



*A mature riparian habitat will contain three distinct layers of vegetation.*

thirty and one hundred feet. Typical species include oak, hickory, maple gum, beech, sycamore, spruce, hemlock, pine, and fir. Major benefits of this vegetation includes:

- *Improved Water Quality* - The root systems of trees stabilize the soil, preventing sediments and pollutants from entering the water body. Twigs and leaves from trees slow and trap sediments in stormwater runoff, allowing the nutrients they carry to infiltrate into the ground where they may be stored or removed through natural processes. Nutrients are stored in leaves, limbs and roots instead of polluting the waterway.
- *Reduced Erosion* - The root systems of trees and shrubs stabilize streambanks and can substantially reduce erosion. Erosion is a progressive problem that is more easily corrected in its early stages.
- *Temperature Moderation* - Tree canopy shades and cools the riparian area along the stream, benefiting nearby residents as well as cooling water temperature in the stream, critical for many aquatic species. Shading moderates water temperatures and protects against rapid fluctuations in temperature that can reduce fish spawning and survival.
- *Enhanced Wildlife Habitat Protection* - Leaves, branches, and fruit that fall from streamside vegetation accumulate on the bottom of the stream and provide food for

bacteria, fungi, and macro invertebrates which form the basis of the aquatic food chain. This benefit that riparian corridors provide becomes increasingly important for the survival of various animal and plant species in the wake of continued development.

**Understory** - The evergreen and deciduous shrubs (such as elderberry, viburnum, azalea, rhododendron, holly, laurel, and alders) provide habitat and food for wildlife and are key to stabilizing the forest floor. The small trees and understory vegetation reduce the velocity of stormwater runoff, while at the same time filtering out pollutants before reaching the stream. Reduced runoff volume from trees upstream can reduce downstream flood flows that erode the channel. Roots and fallen logs slow stream flow, reducing erosion along the bank. The layers of under story vegetation also provide habitat in the form of food supply, breeding areas, and migratory corridors, making these areas critical to the survival of many ecologically important species that use the riparian corridor.

**Groundcover** - The ground cover vegetation such as ferns, sorrel, trillium, violet, Virginia creeper, nettle, phlox, and aster mixes with decomposing leaves, organic litter, and debris from other layers and water to create a rich, moist forest floor essential to the sustenance of the other



layers. Ground cover can also help distribute the flow of runoff from adjacent land uses which might otherwise cut channels in the forest buffer. Lastly, ground cover can filter out non-point source pollutants (discharged over a wide land area, not from one specific location), such as nutrients, pesticides and sediments which impair water quality.

### Convert to a More Effective Landscape

Landscapes ranging from woodlands to meadows could exist within the riparian buffer zones. However, the various landscape types are not equal in their ability to filter sediment and enhance water quality. For example, woodlands are more effective than meadows in achieving the goals of the riparian zones. However, meadows are much more effective than lawns or degraded pastures. The following landscape types are listed in order of effectiveness: woodland, meadow, shrub, old field, and pasture. Landowners and developers can improve the effectiveness of their riparian buffer zones by converting the existing landscape to one that is more effective.

## Stormwater Management

Stormwater management is a changing field and no longer is stormwater merely a nuisance to be conveyed off site as quickly as possible. Stormwater is a resource; part of the hydrologic cycle that provides people with drinking water and sustains our landscape and wildlife.

A healthy, wooded riparian corridor can

be an integral part of a comprehensive stormwater management strategy by helping to restore hydrologic conditions and purify runoff before it reaches the stream. In fact, riparian corridors are recognized as a stormwater best management practice (BMP) in the *Pennsylvania Stormwater Best Management Practices Manual*. As a best management practice, the manual rates riparian corridors “very high” for water quality benefits, and “medium” for volume reduction and recharge.

Site constraints will influence stormwater management practices, but in general, stormwater should be managed close to where it is generated. For example, roof drains should be connected to rain gardens, or discharged as sheet flow across grassed areas. Parking areas should contain bioswales or be bordered by infiltration trenches. Where stormwater needs to be transported across the site, the conveyance should be by vegetated swale. Basins should be curvilinear and landscaped with native trees, shrubs, and grasses, often referred to as “naturalized.” These practices will reduce the volume and velocity of stormwater draining through riparian corridors. If managed properly, stormwater runoff that flows through vegetated management structures and then passes through the wooded riparian corridor will have minimal adverse impact on the receiving stream.

Particular attention should be paid to the upland edge of the riparian corridor when developing the stormwater management controls for a site. The benefits of the riparian buffer can be bypassed if stormwater runoff is allowed to concentrate and form a channel through the corridor. Concentrated flow in such a channel can also lead to erosion within the buffer, adding sediment to the stream and undermining

trees and vegetation within the buffer. Piping stormwater directly to the stream bypasses the benefits of a wooded riparian corridor entirely. To avoid this, stormwater runoff entering the corridor should be diffused to sheet flow. One of the most effective measures for achieving this is the level spreader. Level spreaders are structures that are designed to uniformly distribute concentrated flow over a large area. Level spreaders come in many forms, depending on the peak rate of inflow and the site conditions. A common form employs a shallow detention basin whose down slope berm is graded to the same elevation along its entire length. Stormwater flows over this berm at a uniform rate. Regardless of type, the level spreader should operate in the following sequence:

- Concentrated stormwater enters the level spreader through a pipe, ditch or swale.
- The flow is slowed and energy is dissipated.
- The flow is distributed throughout a long linear shallow trench that is typically parallel to the stream.
- Water flows over the lip of the trench uniformly along the entire length.

### Best Management Practices (BMPs) for Agriculture

The model ordinance permits agricultural crossings within Zone 1 of the riparian corridor and all other agricultural uses, provided they are conducted in accordance with best management practices, within Zone 2. Below is a summary of BMPs for agriculture. While not an all-inclusive list, it does include those most commonly used for agricultural operations. Technical assistance regarding site-specific BMPs and

design of conservation systems can be obtained at a local USDA Service Center.

**Stream Crossing** - A stabilized area or structure constructed across a stream to provide a travel way for people, livestock, equipment, or vehicles.

- Protects/improves water quality
- Reduces streambank and streambed erosion
- Improves water quality by reducing sediment, nutrient, organic and inorganic loading of the stream.

**Crop Rotation** – Crops grown in rotation to maintain or increase soil productivity and fertility.

- Reduces soil erosion
- Helps control weeds, disease and insects
- Improves or maintains health soil condition

**Conservation Tillage** – Any tillage or planting system that maintains a minimum of 30 percent of the soil surface covered by plant residue.

- Reduces soil erosion
- Reduces volume and velocity of surface runoff
- Reduces fuel and time
- Improves soil moisture
- Improves wildlife habitat

**Contour Plowing** – Conducting field activities such as tilling, planting, cultivating and harvesting around a hill or slope as

near to the contour as is practical to reduce erosion.

- Reduces soil erosion
- Reduces water runoff
- Improves water quality
- Increases moisture absorption into the soil
- Most effective when used with conservation tillage or strip cropping on moderate slopes of 3-8%

**Grassed Waterway** - A natural or constructed channel or swale where water usually concentrates as it runs off a field.

- Improves field conditions
- Reduces gully erosion
- Protects/improves water quality

**Terrace** – An embankment, channel or combination ridge and channel constructed across the slope to catch and store water runoff.

- Reduces soil erosion
- Permits more intensive use of cropland
- Improves soil moisture
- Works well with contour farming
- Not suited to steep land

**Prescribed Grazing** – Managing grazing or browsing animals to harvest vegetation while protecting the environment.

- Minimizes soil erosion
- Improves water quality through increased plant nutrient uptake and ground cover

- Increased profits through reduced costs and improved animal health
- Can be used on lands not suited for cropland (i.e. steep, stony or wet land)

# Stewardship Strategies

## Introduction

When maintained in a natural state, riparian corridors have demonstrated their ability to improve water quality, drain flood waters, control erosion and sedimentation, provide recreational benefits, and contribute to wildlife habitat. Stewardship of riparian corridors can be defined as the careful and responsible management of the land immediately surrounding the river or stream in a way that is beneficial to it and the wildlife that depend on it. Proper stewardship of riparian corridors, including maintenance and re-vegetation of native plants when necessary, must take place in order to continue to realize the full benefits they provide. This burden falls on municipalities, institutions, corporations, farmers and residential homeowners – everyone who owns land with a river or stream passing through it.

## Stewardship Through the Development Process

When development does take place, it is important to have a tool like a riparian overlay district to protect riparian buffers, and assure the development that does take place near them does not impair them. The following design principles should be followed for development along riparian corridors:

- Preserve the riparian corridor as open space

or regulate activities within the corridor.

- Avoid placing roads next to streambanks. Pollutants picked up from roads in stormwater runoff are a cause of non-point source pollution which will impair water quality.
- Limit road crossings. Crossings should be designed to cross the riparian corridor at direct right angles to the greatest extent possible in order to minimize disturbance of the corridor.
- The width of the corridor crossing right-of-way should not be greater than the minimum right-of-way width required by the municipality's Subdivision and Land Development Ordinance.
- Choose residential building sites wisely; protect property and streams by not building within the floodplain. Delineate an adequate yard area at least partially outside of the buffer. It is recommended that the yard encroach no more than 25 feet into Zone 2 of the riparian buffer.
- If agricultural activities are conducted along the corridor, they should only be permitted if they conform to recognized soil conservation practices.
- When construction activities occur within the riparian corridor, specific mitigation measures should be taken in the form of improvements to the riparian corridor, such as landscape restoration, that would help mitigate the impacts of the development.
- Limit intensive recreation within the riparian corridor. Multiuse trails can be placed adjacent to the corridor without impairing

it, but play fields, parks, parking areas and lawns should not encroach upon the riparian corridor.

- Access points for boat launching, trails or scenic vistas should be sited on the more stable bank areas (not on stream curves), be limited in size, and should be stabilized immediately after construction to avoid erosion.
- Avoid channel narrowing and straightening of the streambank. This will make the water flow more quickly, inducing erosion and making the streambank more susceptible to flooding. If the streambank must be altered, be sure to contact the Pennsylvania Department of Environmental Protection first, as permits are likely required.
- Leave most logjams in place to slow river flow, reducing velocity and flood impacts, decreasing erosion, and preserving habitat.
- Contact the local DEP office or county conservation district if soil laden runoff is observed leaving a construction site.

## Stewardship and Existing Land Uses

Forested riparian corridors should be uninterrupted. This is important for achieving soil stabilization, water quality, moderating water temperature to lower stress on fish, and providing food and habitat for animals and aquatic organisms. In areas where no wooded buffer exists, reforestation with native vegetation should be done and maintained. Native species will not require significant chemical maintenance

by fertilizers, herbicides, and pesticides, all of which will harm the stream.

### Good Stewardship Practices

Avoid planting a lawn to the water's edge. Lawns have little or no habitat value, put property at risk for erosion, and deliver lawn chemicals directly to the stream. Gradually replace lawns with native trees, shrubs and ground covers. A lawn closer to the house can work as part of the riparian buffer by catching sediment from driveways and bare ground. Do not mow within 15 feet of the streambank. An un-mowed, naturally vegetated streambank buffer helps prevent erosion and filters out lawn chemicals which are damaging to stream life. Set mower blades between 4 and 6 inches high for lawns to slow runoff and reduce the need for fertilizer. Check local weed ordinances and local homeowner's association policy, if applicable, for rules about allowable height, especially if this area is in public view.

Most people overfertilize their lawns. These chemicals easily find their way into the stream and can kill stream life, including vegetation, insects, fish and birds. Soil should be tested by the local cooperative extension branch to determine if it needs fertilizing. Base fertilizer use on soil conditions. Don't fertilize plants near streams. Limit overall use of pesticides and herbicides and fertilizers to only once per year, if at all and extreme caution should be used when using them near streams. The Environmental Protection Agency estimates that homeowners apply 10 times as much chemical pesticide to their lawns as farmers apply to cropland. Excess chemicals run off with rainfall into

local waterways. Native plants need fewer or no fertilizer and pesticide applications and also filter out pollutants, absorb runoff and replenish groundwater supplies better than turf grass. Only use pesticides on calm, dry days when no rain is forecast for at least 24 hours. Never apply pesticides near wells or waterways. Compost yard waste. Don't bag lawn trimmings; leave them in place for effective recycling of nutrients.

Manure, garden waste or grass clippings should not be stored or dumped near streams. Grass clippings in the stream will cause water-quality problems and will suffocate fish and other aquatic organisms. Never dump materials, including trash, chemicals or other pollutants into streams, storm drains or sewers. Never store loose soil near a stream. Soil particles, or sediment, can reduce the stream width and increase the potential for flooding near the stream.

Do not remove stable, naturally occurring, in-stream debris, such as fallen logs unless they pose a safety threat. Fallen debris traps leaves, twigs, fruits, and seeds, providing food and habitat for fish and other stream dwellers. Don't remove native vegetation growing adjacent to the streams. Trees and shrubs shade the stream (trout require cool waters for survival) and provide leaf litter which forms the base of the aquatic food web. Do plant native trees and shrubs along unvegetated areas of the streambank. The root systems of woody vegetation stabilize streambanks and prevent erosion. Native trees and shrubs are especially important along steep slopes because they help hold the soil with their deep root systems.

## Stewardship and the Role of Municipalities

It is important for municipalities to foster riparian corridor protection and stewardship in the long term by providing citizens with riparian management information and educating them on the benefits and importance of buffers. Community outreach and education, both for acting public officials as well as community residents, is a necessary component in establishing and preserving riparian corridors. Community outreach about how to be good riparian stewards can be done in conjunction with conservation organizations (such as the Nature Conservancy or the Natural Lands Trust) and may take the form of radio and television advertisements, brochures, workshops, public conferences, information on the municipality's website with supporting links, demonstration projects, or presentations to school groups. If many residents speak English as a second language, outreach materials should be produced in other languages. Consider pooling resources with other municipalities or non-profit organizations in the region to stretch the dollar and create a stronger, more effective message.

Brochures with information for what homeowners can do to supplement existing buffers that give them various options, least expensive to most expensive, can be helpful. However, it is best not to rely on one medium alone. Studies indicate that the most influential mediums for delivering environmental messages to the average citizen are advertisements in TV, radio, and the newspaper. Public Service An-



nouncements on commercial television or targeted messages on cable network channels have shown to have a much wider audience than local community access cable channels.

Intensive training done in workshops and seminars can send more complex messages to smaller and more interested audiences. Many organizations, including the Montgomery County Lands Trust, Natural Lands Trust, Stroud Water Research Center, and local watershed organizations typically offer a variety of educational programs describing the benefits of land preservation and managed growth which may be tailored to specific audiences, such as high school groups, farmers or municipal officials. They can work with municipalities to show them the merits of good riparian corridor planning, and the benefits of riparian buffers and controlling stormwater. Several also teach developers about conservation design, a way of developing land that protects important natural features and open space.

Creating or supporting citizen action groups that focus on tree planting and preservation can raise the awareness of the benefits of trees and be an effective form of public stewardship as well. These action groups are often non-profit organizations that may focus specifically on tree planting or have a larger range such as a particular watershed. Members for these groups might include garden clubs, environmental groups, or school groups. Citizen tree groups can provide assistance to private landowners on planting trees particularly when the community does not have an arborist or forester on staff.

While encouraging others to be good stewards, it is important to show good examples of riparian corridor stewardship on publicly owned lands.

## Process for Establishing a Buffer

**DETERMINE BUFFER SIZE** Walk along the stream to see what may be growing in the buffer area and if the banks are eroded (exposed soil). If the banks are actively eroding, then professional assistance will be necessary for streambank stabilization prior to planting. After the walk, outline the proposed buffer area on the property with rope, flagging or spray paint. Consider the following questions: Will there be enough room outside of the buffer area for recreation? Will the proposed area be manageable to maintain (both financially and physically) in the next three years until it is established? Begin small, and in time add on.

**PLANNING THE BUFFER** Hand draw the proposed buffer area including waterway and existing plants, onto graph paper. Research the native plants that should be planted within the buffer. Visit a local natural area or state park to see what is growing in similar buffer conditions (sun/shade, wet/dry) etc.

Make a list of the plants and determine where they should go using the drawing. Use different sizes of circles to show trees, shrubs, grasses, and flowers by using various coins as templates. A soil test done by the cooperative extension (listed in the blue pages of the phone book) will help in appropriate plant selection. The proposed buffer area may have

different soils in different locations because of imported fill, so it is best to take samples from 2 or 3 areas. Check the property map for public utility rights-of-way (sewer, electric, natural gas, etc.) in the proposed buffer zone. If this map is not available, utilize PA One Call at 1-800-242-1776 for more information. If utilities are present, plant wildflowers in that area, rather than shrubs or trees.

**SITE PREPARATION** Identify and remove all invasive, non-native vegetation from the site. Currently, 11 plant species are on Pennsylvania's control list: Canada thistle (*Cirsium arvense*), multiflora rose (*Rosa multiflora*), Johnson grass (*Sorghum halepense*), marijuana (*Cannabis sativa*), mile-a-minute vine (*Polygonum perfoliatum*), kudzu vine (*Pueraria lobata*), bull thistle (*Cirsium vulgare*), musk thistle (*Carduus nutans*), shattercane (*Sorghum bicolor* ssp. *Drummondii*), jimsonweed (*Datura stramonium*), and purple loosestrife (*Lythrum salicaria*). If a large expanse of soil is exposed after removing the weeds, plant a cover crop such as annual rye to help prevent growth of new weeds or use weed mats or landscape fabric.

**GENERAL MAINTENANCE GUIDELINES** In general, it is ideal to maintain or create forested areas in Zone 1 (within 25 feet of the streambank), to have a managed woodland in Zone 2, and to have a thick layer of ground cover (such as a managed meadow) adjacent to Zone 2 in order to maximize ground contact with runoff, and more effectively filter pollutants. No landscape is maintenance free, but once riparian corridors are established, (roughly 3 years) they require very little maintenance. The first year is the most critical. Water is the key to

ensuring plant establishment and ensuring long-term survival. Weeding and keeping tall grass away from new plants is also important. An application of composted mulch four inches deep will help the soil retain moisture and hamper weed growth. Keep the mulch from touching the base of the plant. Eventually, the trees and shrubs will grow tall enough to form a canopy that will shade out most of the grass and weeds underneath. Avoid working in the buffer zone between mid-April to mid-August if wildlife is using the buffer to mate and raise young. Disturbance at the time can be detrimental.

Replanting and reseeding are important maintenance practices during the first few years after the buffer is established in order to assure the benefits of a contiguous buffer, as well as a combination of large trees, under story trees, shrubs and groundcover, necessary for wildlife. An annual inspection should be made to identify areas in need of replanting/reseeding. If more than 4 consecutive woody plant seedlings in a row died, replant them. Replanting is best done in the spring or fall. Pruning and thinning during the lifespan of the riparian buffer will best assure an optimal growth rate. Consider harvesting every second or third tree after 8 to 9 years, to increase water and growth space for the remaining trees. These trees can then be chipped and used for mulch around other trees within the buffer.

**PRUNING AND THINNING GUIDELINES** Trees should be pruned during late fall, winter, or early spring while the plants are dormant. Only minimal pruning is required to decrease competition between trees. Overpruning can stunt trees and suspend optimum growth rates. When pruning, never cut out more than

25% of the crown of a tree, and retain at least 2/3 of the tree height in live branches to protect tree health. Trees grow most efficiently when there are enough canopy to provide plenty of food for the tree. Entire trees can be harvested and removed at any time throughout the year.

Late spring is the ideal time to thin vegetation. Thinning may be done by removing every other row, or every other tree within rows. Thinning can also be done by selecting the trees to remain and removing the surrounding competing trees.

**RESTORATION GUIDELINES** Restoring woodland to a healthy state depends on the amount of and type of degradation. If the woodland is healthy, the best management approach is to minimize disturbance. The site should be monitored on a regular basis for the presence of invasive vegetation, reduced levels of regeneration due to excessive browsing of deer and other herbivores, or increases in air or water pollution that harm existing vegetation. If these conditions are found, the woodlands should be treated as degraded. If the riparian corridor is degraded, follow these guidelines for the best results:

- Identify the source of degradation (vines, deer, soil, etc.) as soon as possible so that restoration costs can be minimized.
- Eliminate the larger invasive vines on canopy trees first. Then, smaller invasive plants, such as tree seedlings and shrubs, should be removed.
- Gaps in the woodlands should be replanted with native trees for low maintenance. Layers of vegetation should be planted – overhead canopy trees, shrubs, and herbaceous

plants for ground cover. Fencing, tree shelters or flexible deer guards should be placed around trees for the first six months or until they are established to protect them. Contact the cooperative extension office or the Pennsylvania Department of Conservation and Natural Resources Service Forester for a list of appropriate vegetation.

- Remove invasive trees last as they help provide shade and keep invasive vines to a minimum. Replace them with native tree species.
- Correct soil erosion by rerouting trails along the contour and/or by controlling the water source. Fill gullies and plant with an annual rye and/or oats (in spring or early fall) and native trees and shrubs. Avoid the use of standard conservation seed mixes as they may introduce exotic species.
- Minimize the area to be cleared, establishing a buffer between the streambank and areas of construction or use of heavy equipment. This will reduce the amount of soil exposed by construction that could wash into the waterway.
- Inspect the riparian corridor annually (spring is a good time) to address further degradation as it occurs.

If more than 75% of the canopy of trees has been killed or deformed by vines or Norway Maple is the dominant species, it may be preferable to convert part or all of the woodland to a meadow. If the degraded woodland is in Zone 1 (next to the streambank), it is best to manage the area with as little landscape disturbance as possible. Otherwise, follow these steps for best results:

- First, eliminate all existing vegetation. Remove trees and shrubs and use herbicides and cultivation several times at two week intervals to eliminate existing grasses and herbaceous plants. Avoid spraying herbicides within 50 feet of the stream.
- Plant native grass and wildflower species appropriate for site conditions. Adding annual rye or oat to the seed, (planted in spring or early fall) to create a quick growth cover that will aid in controlling erosion.
- Mow the young meadow twice a year. The first mowing should be done as early as possible in the spring (mid April is a good estimate). The second mowing should be done between late May and mid June. This second mowing will act to control thistle and other weeds and will allow the warm season grasses and wildflowers to grow. No mowing should occur after that time and the grasses need time to grow and go to seed.

Monitor the condition of the stream periodically throughout the year. Healthy streams are cool, clean, oxygenated, and full of aquatic life. Streams under stress may exhibit the following warning signs:

- Gully erosion in the streambanks and floodplain. Gully erosion is severe erosion in which trenches are cut to a depth greater than a foot.
- Severely undercut banks.
- Extensive bare soil on streambanks or in the flood plain (the normally dry land along the river or stream that is covered by water during a flood).

- Increased turbidity, or persistently muddy, cloudy or opaque water.
- Loss of fish and other aquatic life.

*A list of state noxious weeds is available from the Pennsylvania Department of Agriculture and a list of invasive plants in Pennsylvania is available from the Pennsylvania Department of Conservation and Natural Resources.*

*The Pennsylvania Bureau of Forestry offers information and technical assistance to woodland owners. Upon request, the Bureau will examine woodlots; prepare management plans for riparian restoration and tree planting; mark timber for improvement cutting and firewood harvesting; and provide advice on erosion and sedimentation control, wildlife habitat improvement, and urban community forestry. There is no charge for the service, but it is limited to four days per ownership per year. For more information, call (717) 787-2106.*



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8. The Stream Corridor Restoration Guidebook, Montgomery County Planning Commission
9. Urban Watershed Forestry Manual, Center for Watershed Protection  
[www.cwp.org/watershed\\_planning.htm](http://www.cwp.org/watershed_planning.htm)
10. *25 Ways to Protect Your Streamside Property*, (brochure) Morris Arboretum of the University of Pennsylvania in conjunction with River Keeper
11. *Pennsylvania Department of Environmental Protection, Stream Releaf Program*



## Resources

Bureau of Forestry 610-469-6217

Center for Watershed Protection, *Urban Watershed Forestry Manual*, February 2005

Montgomery County Conservation District 610-489-4506

Natural Resources Conservation Service 610-489-6071

[www.nrcs.usda.gov/programs](http://www.nrcs.usda.gov/programs)

Penn State Cooperative Extension 610-489-4315

Consolidated Farm Service Agency 610-489-4158

Conservancy of Montgomery County 215-283-0383

Natural Lands Trust – [www.natlands.org](http://www.natlands.org)

Penn State Cooperative Extension Gardening Section [www.extension.psu.edu/Hort.html](http://www.extension.psu.edu/Hort.html)







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