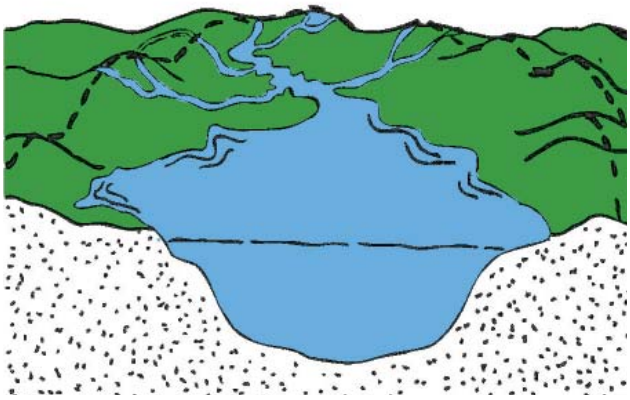
Community Watershed Protection

WHAT IS A WATERSHED?

A watershed is an area of land within which water from rain or snow drains into a body of water, such as a stream, river, lake, or ocean. Your home's watershed is an area of land around the home within which its water drains to the nearest stream, swale, or stormwater drain. We typically describe watersheds based on the land area that drains to a specific stream, river, or waterbody because they are nature's natural drainage areas.



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Community Watershed Protection

INTRODUCTION

Long before your community was built, the sun evaporated water, which condensed in the sky and later fell as rain. This rain fell on forests or deep-rooted grasses. Water that wasn't used by plants or infiltrated to become groundwater slowly made its way to streams, lakes, and rivers.

This same process still happens today, but impervious surfaces such as parking lots and roofs do not allow water to infiltrate into the ground. Instead large amounts of water more quickly to streams, lakes, and rivers. Increased flows can cause erosion and flooding. Along the way, rainwater also picks up pollutants such as oils, fertilizers and pesticides that can harm the water resources that are needed by plants, animals, and people.

PROMOTING A HEALTHY WATERSHED

There are several steps a community can take to promote the health of its watershed. Understanding regulations and considering alternatives to traditional land-use planning and community development are key components to improving your watershed health. Additionally, your community should incorporate a number of policies and ordinances that, along with everyday practices, can have a significant impact. Finally, the implementation of Best Management Practices (BMPs) can enhance your community's understanding of watershed health, improve your watershed, and demonstrate to others healthy watershed procedure.

POLICY & WATERSHED HEALTH

As a public official or citizen, it is important to understand the regulatory context in which your community has to abide and the tools available for protecting and improving watershed health. This booklet explains regulations involved with water quality and watershed health, explores changes in community development and its potential impacts, and examines policies related to these topics. All of the policies discussed in this booklet can have a significant impact on watershed protection and, therefore, the health of your overall community. Good luck, we're all counting on you!

MOVING FORWARD

In moving forward with the improvement of your watershed, you should first assess what you have as a community and determine how to enhance the positive aspects and eliminate the negative ones. Making a plan to move forward involves learning from other communities' experiences, some of the best examples in your area, and using the human resources you have in your community. By engaging people in the community and in the watershed, you can profit from their knowledge, abilities, and interest in the health of your watershed. It is important to recognize that planning, research, and diverse feedback are vital to advancing practices in your area.

LEADING BY EXAMPLE

You can lead by example by implementing BMPs and educational kiosks on public facilities to demonstrate the importance of stormwater management and how it works to improve water quality and reduce excess water quantity.

Regulatory

CONTEXT

The Clean Water Act was designed to protect our nation's waters and is enforced by the Environmental Protection Agency. Under the Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) regulates point-source pollution by issuing permits that ensure water quality standards are met. These permits are typically distributed through the Mississippi Department of Environmental Quality (MDEQ). The National Pollutant Discharge Elimination System's Phase II requires certain minimum control measures be met. Usually, the local municipality or developer is responsible for ensuring that these requirements are met. Your community may or may not fall under Phase II. Either way, the standards set can create a starting point for your efforts. (Note: this page was adapted from the Environmental Protection Agency's web site)

THE CLEAN WATER ACT

The Federal Water Pollution Control Act was enacted in 1948 and was reorganized and expanded in 1972. In 1972, it included several amendments and became commonly known as the Clean Water Act. The Clean Water Act (CWA) forms the basis for regulating surface water quality standards along with discharge regulation of pollutants into the United States' waters. Major amendments were added in 1977 and 1987.

Under the CWA, the Environmental Protection Agency (EPA) has implemented pollution control programs by setting wastewater standards and has created water quality standards for surface waters. By the CWA, it is unlawful to discharge any pollutant from a point source (a discrete conveyance such as pipes or man-made ditches) into navigable waters without a permit. EPA formed the National Pollutant Discharge Elimination System (NPDES) for handling these permits to control discharges.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

NPDES was introduced in 1972 and is a permit system designed to regulate point source pollution. This applies to industrial facilities, municipal governments, other governments, and some agricultural facilities. Permits are written to ensure water quality standards are met in order to protect receiving waters. In most states, EPA has authorized state agencies to issue permits directly, usually through the state's Department of Environmental Quality (DEQ) or similar agencies. However, EPA still issues permits for a handful of states.

The 1987 amendments to the CWA required EPA to address stormwater runoff in two phases. Phase I began in 1990 and applied to medium and large municipal separate storm sewer systems, known as MS4's and certain industrial categories including construction sites disturbing more than five acres. Phase II began in 1999 and applies to small MS4's not covered by Phase I and construction sites disturbing one to five acres. It also applies to cities and towns or counties with a population exceeding 10,000 people and/or areas with population densities exceeding 1,000 people per square mile, called urbanized areas.

PHASE II REQUIREMENTS

Under NPDES Phase II regulations, MS4's have to create a stormwater management plan to address the following areas, known as minimum control measures. The local government or developer is responsible for meeting the minimum control measures if their municipality falls under Phase II requirements. This is done differently in each municipality, but it is typically completed using a variety of related ordinances and programs. Many municipalities opt to follow some or all of these measures even if it is not required of them in order to be more proactive about their stormwater management programs.

- **Public Education and Outreach** - distributing educational materials and performing outreach to citizens
- **Public Participation and Involvement** - providing participation opportunities to citizens for program development and implementation
- **Illicit Discharge Detection and Elimination** - implementing a plan to detect and eliminate illicit discharges to the storm sewer system
- **Construction Site Runoff Control** - developing and enforcing erosion and sedimentation control programs on applicable construction sites
- **Post-Construction Runoff Control** - addressing discharges of post-construction stormwater runoff from developments
- **Pollution Prevention and Good Housekeeping** - preventing or reducing pollutant runoff from municipal operations

My Clean Water Act

Community

DEVELOPMENT

Plan community development to accommodate growth in efficient development patterns, minimize impervious cover, and conserve land. Concentrated density in development means less impervious cover is needed, and there is a smaller impact per person. This can be achieved through comprehensive planning to cluster development and preserve open space. Additional improvements can be addressed by handling residential streets and parking lots, lot development, and conservation of natural areas in a better way.

BETTER SITE DESIGN

Better site design focuses on protecting natural areas, reducing impervious surfaces, and integrating stormwater treatment in development projects. These principles can be applied to both single sites and to sites within a larger community. Open space development, clustered development, and resource preservation and enhancement can be employed within better site design along with the following principles for residential streets and parking lots, lot development, and conservation of natural areas.

RESIDENTIAL STREETS AND PARKING LOTS

- Use minimum street pavement widths needed for travel lanes, on-street parking, and access for emergency, maintenance, and service vehicles
- Examine alternative street layouts to reduce the total length of residential streets so as to increase the number of homes per unit length
- Reflect the minimum required residential street right-of-way widths to accommodate the travel-way, sidewalk, and vegetated open channels
- Minimize the number and size of residential street cul-de-sacs and incorporate landscaped areas to reduce their impervious cover.
- Use vegetated open channels in the street right-of-way to convey and treat stormwater runoff where possible
- Enforce both a maximum and a minimum parking standard in order to curb excess parking space construction; also review existing parking ratios
- Revise parking codes to lower parking space requirements where there is mass transit or enforceable shared parking arrangements
- Provide compact car spaces, minimize stall dimensions, incorporate efficient parking lanes, and use pervious materials in parking areas where possible
- Provide meaningful incentives to encourage structured and shared parking to make it more economically viable
- Provide stormwater treatment for parking lot runoff using bioretention areas, filter strips, and/or other practices that can be integrated into required landscaping areas and traffic islands

(List from Jacksonville State University)

RESIDENTIAL LOT DEVELOPMENT

- Incorporate smaller lot sizes, reduce total construction costs, conserve natural areas, provide community recreational space, and promote watershed protection
- Relax side and front yard setbacks and allow narrower frontages
- Consider locating sidewalks on only one side of the street and provide common walkways linking pedestrian areas
- Promote alternative driveway surfaces and shared driveways that connect two or more homes together
- Clearly specify how community open space will be managed and designate a sustainable legal entity responsible for managing both natural and recreational open space
- Direct rooftop runoff to pervious areas and avoid routing rooftop runoff to the roadway and the stormwater conveyance system

CONSERVATION OF NATURAL AREAS

- Create naturally vegetated buffer systems along all perennial streams that also encompass critical environmental features
- Preserve or restore the riparian stream buffer with native vegetation and maintain the buffer through all stages
- Limit clearing and grading to the minimum amount needed to build lots, allow access, and provide fire protection at a site and protect community open space as green space in a consolidated manner
- Conserve trees and other vegetation by planting additional vegetation, clustering tree areas, and promoting native plant use
- Encourage conservation of stream buffers, forests, meadows, and other areas of environmental value through incentives and flexibility
- Do not allow unmanaged stormwater discharge into jurisdictional wetlands, sole source aquifers, or sensitive areas

REFERENCES
Jacksonville State University | jsu.edu
New York State Department of Environmental Conservation | dec.ny.gov

Tree Protection

ORDINANCE

Tree protection ordinances are used to maintain a desirable number of trees. Tree protection ordinances apply to actions taken on trees in public rights-of-way and on private land. They protect native trees or those with historic importance, and assist in solving disputes between property owners about a tree that blocks a view or access to sunlight.

WATERSHED BENEFITS

- Mitigates stormwater run-off by intercepting rain and through the transpiration process (2380 gallons of rainfall per year by medium-sized tree).
- Shades impervious areas, which cause heated runoff and increases nearby stream temperatures.
- Reduces erosion by protecting streams with deep-seated roots.
- Helps to create stream buffers, which are important for stream health.

OTHER BENEFITS

- Reduces air and noise pollution.
- Shades homes, which reduces energy demands.
- Increases of property values.
- Provides canopy for wildlife habitat.
- Improves community image and quality of life.

CONSIDERATIONS

In order to adopt a tree protection ordinance, there are some key decisions to make such as:

- How is a tree determined to be covered under the ordinance? Age? Type? Historic Significance? Location?
- Who will have to comply? Public Land? Residential? Commercial?
- What is the penalty for breaking the ordinance?
- What is the process for requesting a variance?
- Who will manage the program?

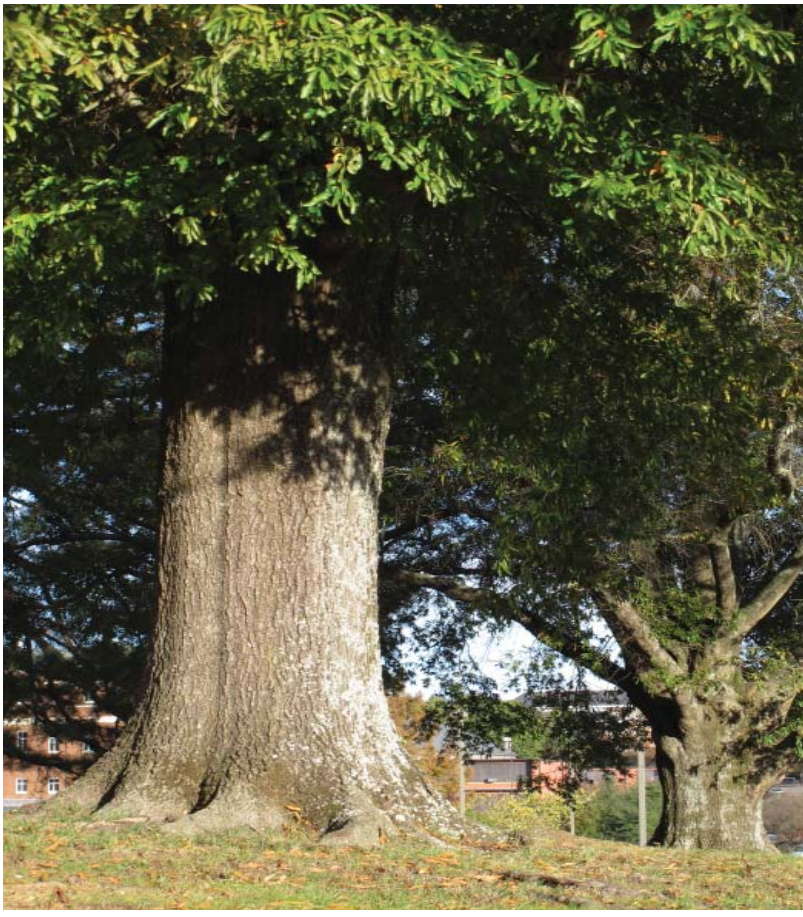
EXAMPLES

Atlanta, GA | atlantatreecommission.com
Austin, TX | austintexas.gov/faq/tree-regulations
San Antonio, TX | sanantonio.gov/dsd/environmental

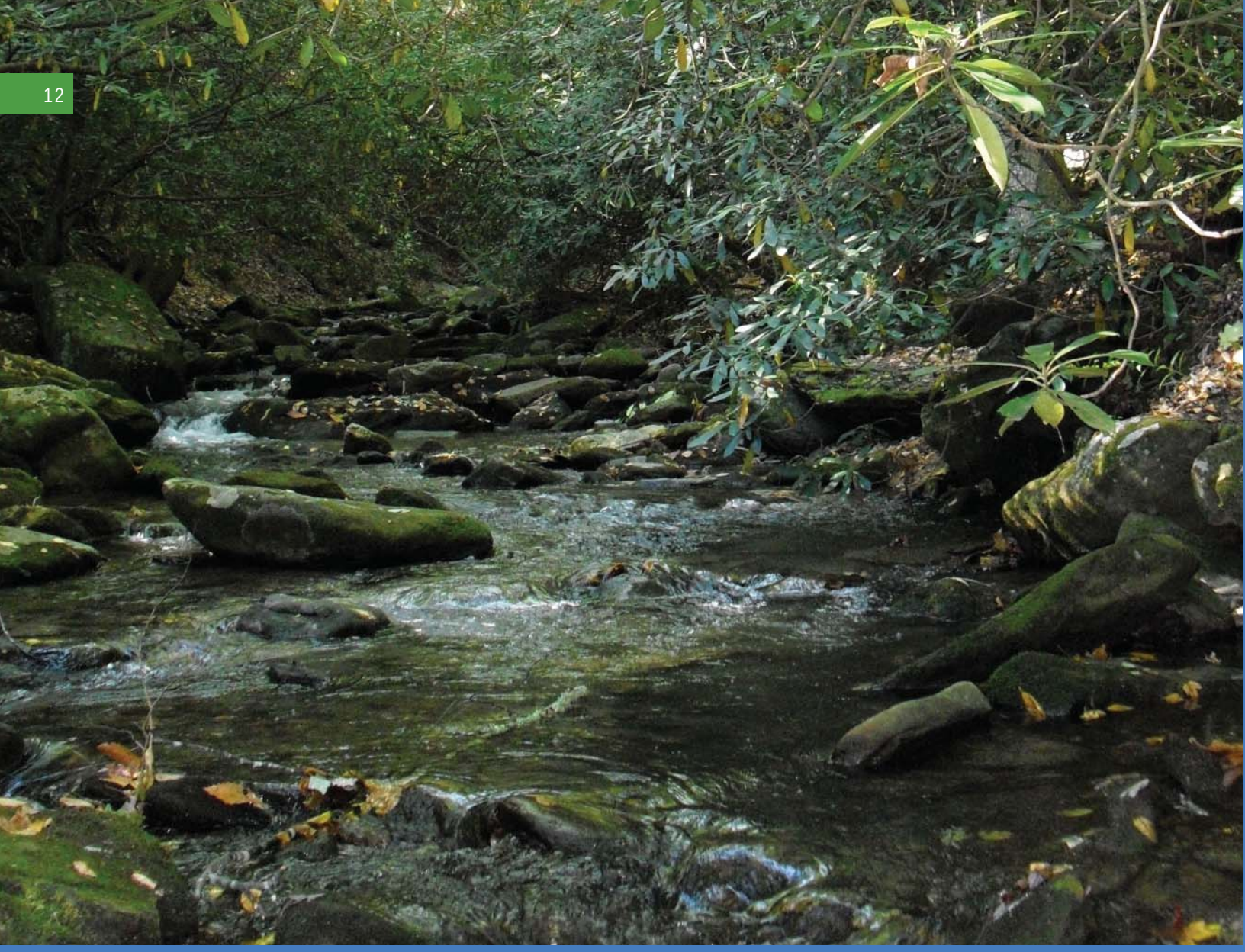
HOW IT WORKS

The first step toward a good tree ordinance is defining goals which identify the most important issues and concerns of the community. Depending on the community, included goals may be to preserve tree canopy, maintain a diverse age of trees, and encourage a range of tree species. Additional goals may include cultivating community support for the urban forest and providing education to help citizens properly manage trees, and to mollify tree-related conflicts between property owners.

For new construction, ordinances can require a percentage of trees to remain during development or the density of trees of a certain size that must be present after construction is completed. Management of the program should be centralized and under someone with appropriate expertise. Appropriate tools and management strategies should be selected to ensure that the chosen goals are implemented, met, and periodically reevaluated and revised if necessary.



REFERENCES
International Society of Arborculture | isa-arbor.com Tree Conservation Commission | atlantatreecommission.com



Stream Buffer

ORDINANCE

Streams shape the landscape through deposition and erosion. This process is directly influenced by changes in the watershed, which “feeds” the stream. The more the watershed is changed through development, the more the stream changes through additional erosion and deposition. To limit the negative impacts of urban development, a stream buffer is used to create a “right-of-way” to slow down, reduce, and clean runoff before it enters the stream. In other words, a stream buffer provides a boundary between development and a waterway.

WATERSHED BENEFITS

- Filters nutrients, sediments, and pollutants.
- Provides greater streambank stability due to a slowing of the natural erosion process.
- Helps to control and preserve the natural geometry and shape of streams, thus, promoting better flood control.
- Provides for deep root penetration of trees and shrubs that slow bank erosion of streams.
- Shades streams, thus, promoting cooler and better habitat for aquatic organisms and better water quality.

OTHER BENEFITS

- Creates opportunities for trails.
- Complements public parks and open spaces.

CONSIDERATIONS

In order to adopt a stream buffer ordinance, there are some key decisions to make such as:

- What will be the distance for various water pollution hazards from the stream?
- What are allowable uses for each zone?
- What will be the buffer size and geometry adjustments by slope and stream type?
- How will this affect future developments and community growth?

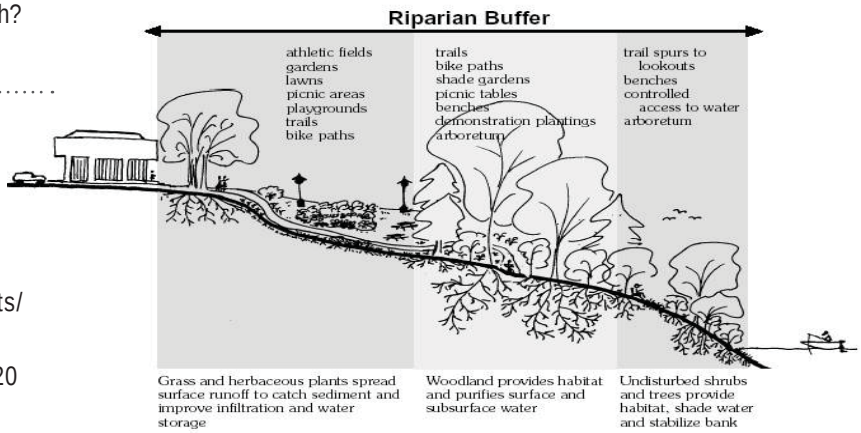
EXAMPLES

Westchester County, NY | planning.westchestergov.com/aquatic-restore
Cherokee County, GA | http://cherokeega.com/departments/engineering/uploads/File/ordinance_streambuffer.pdf
Auburn. AL | auburnalabama.org/planningDocs/Zoning%20Ordinance/April%202012/2012%20April%20ZO.pdf

HOW IT WORKS

Certain criteria must be met for an effective stream buffer system. Stream buffers in the United States range from 20 to 200 feet in width; this depends on resource characteristics and sensitivity. A base width is determined and additional width is required for certain goals such as water quality, recreational uses, and sensitive stream habitats. These goals contribute to the varying width requirements in different communities. The ordinance should limit flow into the stream from pipes and excessive amounts of impervious pavement. Additionally, runoff should come into the buffer as overland sheet flow, and there should not be extra management besides routine debris removal in the buffer.

A three-zone buffer system provides an effective design. The streamside zone functions to protect the integrity of the local ecosystem and requires a minimum width of 25 feet on either side of the stream bank. It should consist of undisturbed natural vegetation with limited vegetative management. Directly flanking the streamside zone is the middle zone, which varies in width according to the stream order, the 100-year floodplain, protected wetland areas, and adjacent slopes. This area is ideally a mature forest with limited tree clearing, and the minimum width is about 50 feet plus any additional required buffer width. The final zone is the outer zone, which functions as a safeguard for the buffer and needs a minimum width of 25 feet.



http://www.darbywatershed.com/urban_stream_buffers.htm

REFERENCES
Environmental Protection Agency | water.epa.gov Center for Watershed Protection | chesapeakestormwater.net
Westchester County | westchester.gov Atlanta Regional Commission | atlantaregional.com
The Architecture of Urban Stream Buffers | http://marc.org/environment/Water/pdfs/Setback_Ordinances/ArchitectureUrbanStreamBuffers.pdf

http://stevensonintermountainseed.com/devsiseed/?page_id=2295

Erosion and Sedimentation

ORDINANCE

Erosion is the separation and movement of soil by the forces of nature, including wind and water. It may also be described as the wearing away of natural material by these forces. In streams, erosion typically consists of the removal of clay, silts, and sands from streambanks. One product of erosion in streams is sedimentation. This occurs when dislodged particles are carried from their original location to elsewhere in a water body or land. Most commonly, erosion and sedimentation take place during construction when areas are cleared and graded. By removing the topsoil and natural landscape, the drainage area is changed, making it more susceptible to erosion. Typical erosion and sedimentation controls include settling basins, sediment traps, perimeter controls, and vegetated buffer strips.

WATERSHED BENEFITS

- Prevents need to dredge lakes and ponds.
- Thwarts vegetation loss by stabilizing banks.
- Avoids disorder to aquatic habitats.
- Evades increased turbidity associated with sedimentation.
- Lessens downstream flooding.
- Hinders transport of metal ions and pesticides that attach to sediment.

OTHER BENEFITS

- Protects property.
- Guards environment.

CONSIDERATIONS

In order to adopt an erosion and sedimentation ordinance, there are some key decisions to make such as:

- What area of land disturbance will require erosion and sedimentation controls?
- What types of controls are acceptable?
- Who will enforce these requirements?

EXAMPLES

Maryland | mde.state.md.us/programs/Water/StormwaterManagementProgram/SoilErosionandSedimentControl/Pages/Programs/WaterPrograms/SedimentandStormwater/erosionsedimentcontrol/index.aspx
Georgia | gaepd.org/Documents/esc_manual
South Carolina | scdhec.gov/environment/ocrm/docs/bmp_handbook/erosion_prevention.pdf

HOW IT WORKS

Erosion and sedimentation control ordinances regulate design, construction, and maintenance of land disturbances. A map to identify items such as soils, natural resources, and forest cover is needed. The ordinance should also have a construction sequence, maintenance requirements, and control measures needed to meet goals. The plan should also state the desired vegetation requirements, e.g. trees, shrubs, and grasses.

Furthermore, design requirements have been established by the Environmental Protection Agency. For example, natural resources should be protected from clearing and grading, and any clearing should not begin until sediment control devices are in place. Certain levels of stabilization or erosion controls must be in place throughout the project. Within a specified time period, soil and stockpiles should be stabilized, and seeding or other vegetative erosion controls should be established. At the close of the construction season, the whole site should be stabilized.

REFERENCES
Erosion and Sedimentation | waterencyclopedia.com/En-Ge/Erosion-and-Sedimentation
Environmental Protection Agency | water.epa.gov/polwaste/nps/erosion.cfm

Open Space Development

ORDINANCE

As an alternative to traditional site planning, open space development locates dwellings in a compact space. This forms “cluster developments” in order to preserve undeveloped space. Open space development can involve minimizing lot size, frontage distance, and setback for a dwelling. This form of development is commonly used for neighborhood recreation, resource conservation, and stormwater management.

WATERSHED BENEFITS

- Lessens runoff because there is less imperviousness; clearing and grading is reduced by 35 to 60 percent.
- Can sometime treat stormwater with natural buffers.
- Reduces pressure to enter buffer areas.
- Preserves green space.
- Provides potential sites for Best Management Practices.

OTHER BENEFITS

- Require less maintenance.
- Form a sense of community and promote pedestrian movement.
- Generate urban wildlife habitat.
- Reduce future public service costs.

CONSIDERATIONS

In order to adopt an open space development ordinance, there are some key decisions to make such as:

- Which calculation for determining density will best suit the community?
- What will be considered to be open space?
- Who will own open spaces?

EXAMPLES

Rowley, MA | mass.gov/envir/smart_growth_toolkit/pages/CS-osrd-rowley.html
Hamburg Township, MI | hamburg.mi.us/lawroom/PDFS/ZONING ORDINANCE/Art-14-Open space community.pdf
West Chester, PA | landscapes2.org/ToolsElement/Pages/Cluster.cfm

HOW IT WORKS

An open space development ordinance aims to ensure that a certain amount of undeveloped space will remain after development. This is done by limiting the number of residential units to what was previously allowed under previous zoning. Then a calculation is used to determine how many units may actually be built. Reduced setbacks, shared driveways, limited parking, shared septic systems, and irregular lot shapes may be utilized in open space development.

At least half of the existing open spaces should remain as natural, green space. These should be located adjacent to each other if possible and have limited access. Open spaces may be considered community spaces and used for recreation or used for stormwater facilities. Plans and parcel plats must clearly outline open space boundaries. Also, signs should be placed in the field to indicate designated open spaces. The owner must ensure that development does not occur in the open space, designate allowable uses and activities, and oversee maintenance.

REFERENCES
Erosion and Sedimentation | waterencyclopedia.com/En-Ge/Erosion-and-Sedimentation
Environmental Protection Agency | water.epa.gov/polwaste/nps/erosion.cfm

Landscape

ORDINANCE

Landscape ordinances are designed to improve current and future landscapes. Screening views, buffering different land uses, landscaping to street edges, and improving parking lots are common methods for improving landscapes. Landscape ordinances typically also include standards for land clearing, types of plantings, building density, and parking lot shading.

WATERSHED BENEFITS

- Improves quality of stormwater with increase of naturally filtering plants.
- Reduces runoff by having more infiltration and transpiration.

OTHER BENEFITS

- Cools parking lots, reduces glare, and maintains air quality with shade trees.
- Improves aesthetic qualities in landscaped areas.

CONSIDERATIONS

In order to adopt a landscape ordinance, there are some key decisions to make such as:

- What plants are suitable for the environment?
- What system will be used to ensure a proper number of plants are present?

EXAMPLES

Prince William County, VA | greenlaws.lsu.edu/Annotation Codes/code annotations S05/Prince Wm.County, VA.htm
El Paso, TX | planelpaso.org/2011/06/city-of-el-paso-requires-street-trees-and-landscaping-for-pedestrians/

HOW IT WORKS

To improve public areas, a landscape ordinance addresses trees and other plants in streets and parks. Technical requirements for the type, size, and spacing of plants and trees should be included in a landscape ordinance. Additionally, planting guidelines should be in place to promote correct planting and transplanting methods. Regulations for maintenance and pruning should be established to ensure the success of the landscape. Also, a landscape ordinance should list which species are desired and which are best to avoid.

To reach the desired landscape covering, a certain number of planting units can be required. For instance, a tree would be worth more units than a shrub or other small plants. Similar to this system, an ordinance could have point requirements. The points would be based on the size and quantity of trees and shrubs planted and could be determined by the size of the container. This could apply to landscaped areas and public rights-of-way and require a certain number of points per square foot of landscaped areas.

REFERENCES
City of El Paso | planelpaso.org/2011/06/city-of-el-paso-requires-street-trees-and-landscaping-for-pedestrians
Prince William Country, VA | greenlaws.lsu.edu/Annotation Codes/code annotations S05/Prince Wm.County, VA.htm
Green Laws | greenlaws.lsu.edu/greenlaws.htm

Post-Construction

ORDINANCE

A post-construction stormwater ordinance provides guidance for minimizing stormwater runoff to reduce flooding, erosion, sedimentation, and increased stream temperatures. It also aims to lower runoff rates and total runoff volume to pre-development conditions. This requires well-designed stormwater management controls and proper maintenance. If nonpoint source pollution is involved, a post-construction ordinance attempts to improve the water quality.

WATERSHED BENEFITS

- Controls runoff volume through structural and non-structural designs.
- Addresses stormwater quality requirements.
- Prevents erosion by limiting outfall velocities.

OTHER BENEFITS

- Protect habitats from degradation

CONSIDERATIONS

In order to adopt a post-construction ordinance, there are some key decisions to make such as:

- What activities will be excluded from this ordinance?
- What are the requirements of a development that falls under this ordinance?
- What will be the minimum water quality standards for stormwater treatment and how will they be met?

EXAMPLES

Charlotte, NC | charmeck.org/stormwater/regulations/documents/pcco documents/pcco2011.pdf
Florida | dep.state.fl.us/water/stormwater/npdes/docs/Post_Construction_Storm_Water_Management_in_New_Development.pdf

HOW IT WORKS

A post-construction stormwater ordinance must state which developments must comply with the ordinance. The area of the site or collection of sites is typically used to determine this. To ensure that a site complies, landowners should not be given any building, grading or land development permits until the requirements of this ordinance are fulfilled.

Sites should reduce the creation of stormwater and control peak flow rates for designated design storms. Designs should capture the given water volume, be properly constructed and maintained, and meet the local design manual's criteria. Effective practices maximize flow paths, protect inlet and outfall structures, provide necessary underdrains, and eliminate erosive flow velocities. Non-structural designs are preferred so that there is less dependency on structural practices. Additionally, a landscaping plan with vegetation and corresponding maintenance is required.

REFERENCES
Environmental Protection Agency | water.epa.gov/polwaste/nps/mol6.cfm

Post-Construction

BEST MANAGEMENT PRACTICES

Stormwater pollution involves an increased amount of pollutants in stormwater runoff and an increase in the amount and rate of runoff due to the presence of impervious surfaces, such as roads and parking lots. Best Management Practices (BMPs) are incorporated in designs to manage and improve stormwater runoff, both in quantity and quality. A combination of BMPs can be used to manage stormwater and provide aesthetic value to the community.

BEST MANAGEMENT PRACTICES

Best Management Practices (BMPs) are structural or non-structural techniques, measures, or controls designed to help manage the quantity and improve the quality of stormwater runoff, preferably at the source. Ideally, natural and vegetated stormwater controls should be used so that there is less reliance on structural controls. It is vital to the health of the watershed that the BMPs be maintained so that they may work properly. BMPs can be incorporated in the initial stages of a project or implemented in restoration projects.

EXAMPLES

Below are common examples of stormwater BMPs that can be implemented in your community for stormwater management.

Vegetated Buffers

- Most frequently used and highly effective structures to reduce runoff from development sites
- Riparian buffers are intended to reduce erosion and sedimentation along streams, creeks, and rivers.
- Natural vegetation buffers are especially critical in urban areas

Cisterns

- Above or below ground, these storage structures are used to offset building or landscape potable water demands.

Tree Canopy

- One of the simplest and most effective BMPs; a single tree with a 30-foot crown transpires approximately 40 gallons of water per day and can intercept up to 1" of rainfall during a rain event.

Green Roofs

- Thin, vegetated roofs can typically mitigate over 50% of the average annual rainfall and provide many other benefits for a building and its occupants.

Infiltration Basins/Rain Gardens

- Rain gardens are specially designed to absorb rainwater, which will eventually infiltrate into the surrounding soil where it stays clean and cool.
- A rain garden designed to hold the first 2" of all rain events will reduce run-off by over 90%.

Bioswales

- Bioswales are similar to rain gardens, but they also convey excess run-off like a traditional swale.

Flow-Through Planters

- Flow-through planters are similar to rain gardens, but they are designed to fit into a dense, urban context where they work as concentrated green roofs, cleaning and absorbing water.

Green Streets

- The public right-of-way comprises roughly 25% of cities and is the greatest source of pollutants. Basins and other BMPs in street rights-of-way are considered green street solutions.

Porous Pavement

- Porous pavements come in a variety of materials such as concrete, asphalt and pavers. They store stormwater in gravel layers below the pavement and can easily manage very large events.

PRODUCTION NOTES

This document was produced by the Mississippi Water Resources Research Institute at Mississippi State University for the Mississippi Department of Environmental Quality in November 2013.

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