THE CASE FOR RIPARIAN CORRIDOR PROTECTIONS

Zoning Strategies to Reduce Pollution of Inland Waters
and Resultant Hypoxia of Long Island Sound

August 10, 2021
Western Connecticut Council of Governments
1 Riverside Road, Sandy Hook, CT 06482
http://westcog.org

WESTCOG

This Report was created under the leadership of:

WestCOG members:

Rudolph Marconi, Chair, First Selectman, Ridgefield
Jayme Stevenson, Vice Chair, First Selectman, Darien
Lynne Vanderslice, Treasurer, First Selectman, Wilton
Julia Pemberton, Secretary, First Selectman, Redding
Matt Knickerbocker, First Selectman, Bethel
Curtis Read, First Selectman, Bridgewater
Stephen Dunn, First Selectman, Brookfield
Joseph M. Cavo, Mayor, Danbury
Fred Camillo, First Selectman, Greenwich
Kevin Moynihan, First Selectman, New Canaan
Pat Del Monaco, First Selectman, New Fairfield
Peter Bass, Mayor, New Milford
Daniel Rosenthal, First Selectman, Newtown
Harry Rilling, Mayor, Norwalk
Don Lowe, First Selectman, Sherman
David Martin, Mayor, Stamford
Samantha Nestor, First Selectman, Weston
Jim Marpe, First Selectman, Westport

WestCOG Staff:

Francis R. Pickering, Executive Director
Michael Towle, Deputy Director
Victoria Ricks, Finance Manager
Cricket Carpenter, Office Manager
Kevin Mahoney, Senior Project Manager
Kristin Hadjstylianos, Principal Planner
Todd Fontanella, Senior Planner
Kristin Floberg, Planner
Nicole Sullivan, Planner
Charles Vidich, Senior Project Manager
Paula Burton, Project Manager
Nicholas Trabka, Data Scientist
Tucker Beckett, Assoc. Data Scientist

Contents

Executive Summary

Land use policies have an important role to play in protecting rivers and streams and in achieving federal and state clean water act objectives. As a result of an explosion in scientific evidence pointing to the importance of riparian buffers to reduce nonpoint source pollutants, planning and zoning commissions have begun to recognize the values of limiting development along major rivers and their tributaries leading into Long Island Sound. Recent Connecticut legislation – Public Act 21-29 – enacted in 2021 has re- emphasized the important responsibility of local governments in protecting water quality. One leading strategy to fulfill that responsibility is the adoption of riparian buffers, also sometimes referred to as riparian corridors – as a means to protect coastal and inland waters and address the hypoxic conditions found in Long Island Sound.

Public Act 21-29 provides new regulatory authority and responsibility over pollutant discharges into navigable waters feeding into Long Island Sound thereby requiring the development of zoning strategies to control the discharge of a wide range of pollutants – including phosphorus. The new law declares (note: Underlined text represents the expansion of zoning authority to navigable waters) zoning regulations adopted pursuant to Section 8-2 of the Connecticut General Statutes <u>shall</u>:

"In any municipality that is contiguous to <u>or on a navigable waterway draining to</u> Long Island Sound, (A) be made with reasonable consideration for the restoration and protection of the ecosystem and habitat of Long Island Sound; (B) be designed to reduce hypoxia, pathogens, toxic contaminants and floatable debris on Long Island Sound; and (C) provide that such municipality's zoning commission consider the environmental impact on Long Island Sound coastal resources, as defined in section 22a-93, of any proposal for development."

The law strengthens the case for developing water quality-based riparian zoning in Connecticut. To address phosphorus discharges and the factors that contribute to that discharge, municipalities contiguous to a navigable waterway draining to Long Island Sound now have additional legal responsibility to regulate 1) setbacks from streams and rivers to create riparian corridors such as vegetative buffers and/or non-development buffers, 2) setbacks from phosphorus producing activities (e.g., fertilizers, leaking septic systems, wastewater treatment plant discharges and lawn runoff), 3) density in areas where water quality issues are of greatest concern and 4) to create comprehensive low impact development standards that address water quality, flood mitigation, climate change, stormwater management and green chemistry initiatives for business, industry and agriculture.

Despite any explicit provisions for riparian corridors within Section 8-2 of the Connecticut General Statutes governing municipal zoning, thirty-eight municipalities in the state have adopted buffer zones for watercourses within their jurisdiction. Riparian buffer zone protections go beyond the limited review authorities granted to inland wetland agencies by the Inland Wetlands and Watercourses Act. Inland wetland agencies consider, on an application-by-application basis, the impact to wetlands caused by activities occurring in wetland review areas – ranging from 100 to 250 feet depending upon local practices. In contrast, municipalities that govern riparian corridors establish specific restrictions on activities and land uses in buffer zones thereby reducing the case-by-case analysis associated with the inland wetland review process and minimize opportunities for compromises and negotiations that often occur when a developer comes before an inland wetland agency seeking development within the upland review area. Some riparian corridor zoning strategies rely on setback standards – such as a 100-foot setback for buildings from rivers – while others have established overlay zones, often referred to as

floating zones that identify setback standards on the municipal zoning map. Riparian corridor protections have been firmly established by hundreds of scientific studies as critical components of any strategy designed to reduce the pollution of the state's rivers and streams and Long Island Sound. The width of riparian corridors varies with the purpose for which it is created. However, for purposes of Public Act 21-29, water quality protection is a paramount purpose and this study has found a minimum a 100 foot buffer as the most accepted zoning approach used in Connecticut and in New England.

A key provision of Public Act 21-29 is its reference to navigable waters as the litmus test of whether and how a municipality has a responsibility to address the restoration and protection of the ecosystem and habitat of Long Island Sound. Historically, Connecticut statutes defined navigable waters as those that are influenced by the tides. However, in 2012, the state legislature expanded the definition of navigable waters to include all upstream water that can be navigated upstream until the first obstruction to navigation for watercraft. This revision appears to bring Connecticut's definition of navigable water in alignment with Connecticut case law which affords recreational users of watercraft the right of passage over navigable waters beyond tidally influenced zones of rivers and streams. Yet the concept of navigability also requires an understanding of the federal Clean Water Act. Recent Supreme Court decisions have narrowly strengthened Clean Water Act authority over tributaries of navigable waters when it can be shown that they are hydrologically connected to downstream river systems and are the cause of pollution of the waters of the United States. In this context, under the Clean Water Act, municipalities can arguably establish land use controls that are intended to reduce the discharge of surface water pollutants into the tributaries of Connecticut's navigable waters. Taking an expansive definition of navigable waters – as suggested by recent U.S. Supreme Court rulings – all of the region's major river systems discharging into Long Island Sound, and their hydrologically connected tributaries, must be addressed by zoning commissions to determine how discharges of nitrogen, phosphorus and total suspended solids can be reduced.

This report identifies and provides model regulations for three zoning techniques that can reduce the quantity of nutrients and other pollutants entering rivers that discharge into Long Island Sound. The most comprehensive approach relies on restricting impervious development at a watershed level consistent with the notion that all rainfall – regardless of where it falls – will finds its way to a tributary or a major river and be a source of polluted stormwater. While this approach has its merits, it doesn't focus on areas within the watershed posing the greatest risk to water quality. The most popular and widely adopted strategy in New England is the use of Riparian Corridor Protection zones that function either as overlay districts or as standalone river setbacks over designated rivers, streams, brooks and intermittent streams. While Public Act 21-29 focuses on water quality protections of Long Island Sound, there is sufficient zoning enabling legislation to support the development of multi-purpose riparian corridor protection zones. From an ecological perspective, river systems and their adjoining shores serve a wide range of functions and for this reason, multi-purpose strategies are not only appropriate but critical to improving the ecosystem services offered by the state's rivers and tributaries. The third strategy relies on the implementation of low impact development techniques to reduce impervious cover, minimize stormwater runoff, and recharge groundwater supplies. Low impact development represents a complementary zoning strategy to traditional stormwater management. It includes a range of green techniques and technologies such as green roofs, requiring pervious pavements, vegetative swales, and protecting riparian corridors along both riverbanks. These three strategies are not mutually exclusive – they are complementary strategies for the protection of Long Island Sound and its contributing watersheds.

Introduction

Land use policies have an important role to play in the protection of rivers and streams in Connecticut. As a result of an explosion in scientific evidence pointing to the importance of riparian buffers as a means to reduce nonpoint source pollutants, planning and zoning commissions have begun to recognize the values of limiting development along major tributaries leading into Long Island Sound. Recent state legislation enacted in 2021 has re-emphasized the importance responsibility of local government in protecting water quality. One leading strategy to fulfill that responsibility is the adoption of riparian buffers, also sometimes referred to as riparian corridors – as a means to protect coastal and inland waters and address the hypoxic conditions found in Long Island Sound.

This report identifies current Connecticut zoning practices that address water quality protection, reviews federal, state and municipal laws and regulations that influence how land use regulations can facilitate improved nonpoint source reduction strategies and recommends riparian protection strategies for planning and zoning commissions.

The regulatory structure of water quality protection at the federal and state levels has historically emphasized the importance of using a permit process to control point sources of pollution. The National Pollutant Discharge Elimination System (NPDES) permit program focuses on major point sources of pollution such as wastewater treatment plants, construction activities, water intensive industrial facilities including vehicle repair and maintenance and many others. However, the NPDES program has been less effective at addressing nonpoint sources of pollutants associated with agricultural activities, roadway discharges, municipal stormwater systems and residential uses of fertilizers and pesticides. As a result of concerns with municipal stormwater discharges, the U.S. Environmental Protection Agency and the Connecticut Department of Energy and Environmental Protection are now focused on municipal strategies to control stormwater pollutants through the NPDES program known as MS4 – Municipal Separate Storm Sewer Systems. Yet the MS4 program does not address a variety of water quality issues associated with piecemeal development of land adjoining streams and rivers including failing septic systems and the overuse of fertilizers and chemicals homeowners apply to their lawns and gardens. This report addresses land use control under the jurisdiction of planning and zoning commissions that can improve the protection of riparian corridors.

Development within Riparian Corridors

The rivers and streams of Western Connecticut represent one of the Region's most important natural resources. Yet this resource is under increasing development pressure caused by building near rivers and streams and by excessive impervious groundcover caused by driveways, parking lots, road development and other manmade alterations of natural groundcover. The Western Connecticut Regional Plan of Conservation and Development determined that 46% of the land within the Region's drainage basins (representing 163,758 downgradient at speeds that increase with the degree of impermeability and slope of the ground surface. acres) has impervious cover levels of 11% or more. When an entire watershed exceeds the 11% impervious threshold, the net result is increased stormwater runoff, reduced onsite groundwater storage, reduced water quality for streams and rivers and increased flood hazards for all development in the lower reaches of the watershed (Figure 1).

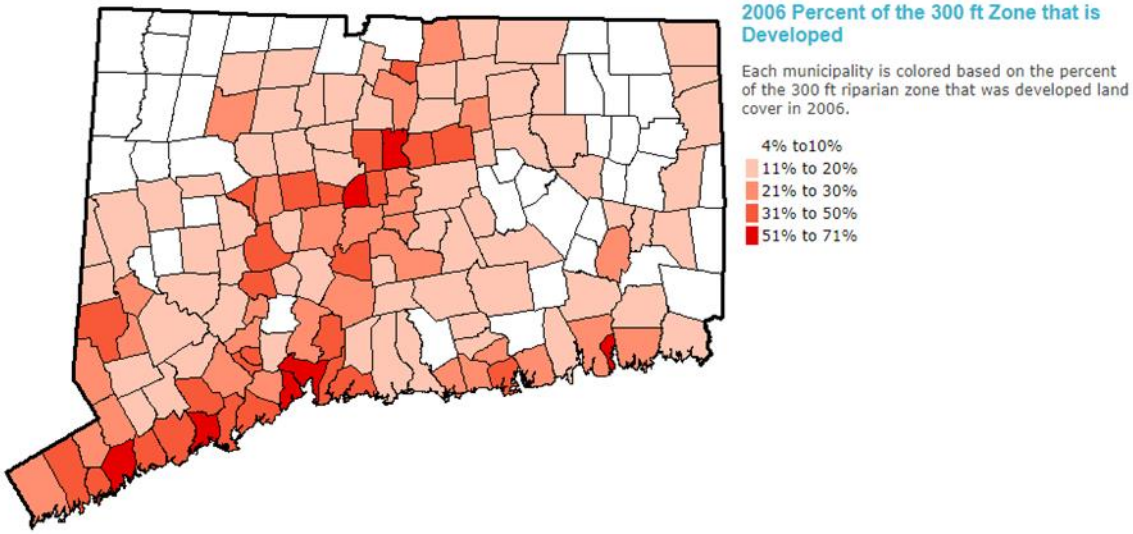


Figure 1. Development in Connecticut's Riparian Zones: 2006. UCONN Center for Land Use Education and Research.

Another factor that influences the ability of a riparian corridor to attenuate pollutants is the presence of tree canopies along a river's buffer zones. Stormwater discharges increase with the loss of tree canopy coverage across the region in general and along major rivers and streams in particular. The combination of tree canopy coverage of bare earth coupled with the erosion limiting value of leaf litter on the forest floor help reduce runoff containing a wide range of pollutants – both natural and manmade. At a regional scale 61.5% of the land has tree cover canopies, ranging from a municipal low of 39.2% in Norwalk to a high of 74.7% in Weston. While the higher tree canopy coverage found in Weston may appear protective of riparian corridors, a tree canopy coverage approaching 80 to 90% would further reduce stormwater discharges.

The most critical area to maintain tree canopies is along major rivers and streams – including perennial, intermittent and seasonal streams – since these areas have the greatest value in reducing the release of sediment and other contaminants. A 2019 LIDAR study conducted by WestCOG identified the prevalence of tree canopies within 50 feet of either side of thirty-one major rivers or streams. That analysis found that rivers and streams in the city of Norwalk only had 49% tree canopy coverage, whereas the rural municipality of Bridgewater had 82% coverage and Weston had 84% coverage.[1]

Ideally, the scientific literature recommends buffer zones of at least 100 feet on either side of a watercourse to have the greatest benefit in reducing erosion and sedimentation issues.[2] Riparian buffer zones of 100 feet maintain high levels of surface water quality and substantially reduce erosion and sedimentation of watercourses. Studies conducted by the Connecticut Department of Energy and Environmental Protection and other scientific studies have confirmed that a significant degradation of water

[1] Ibid, p. 99.
[2] Massachusetts requires a 200-foot riparian buffer by law; Vermont recommends 50 foot riparian buffers for watersheds less than 2 square miles and 100 foot buffers for larger watersheds. The Chesapeake Bay Program recommends riparian buffers of 100 to 150 feet. In Connecticut, twelve municipalities have established riparian corridor setbacks of 100 feet, and eleven additional municipalities have setbacks that exceed 100 feet.

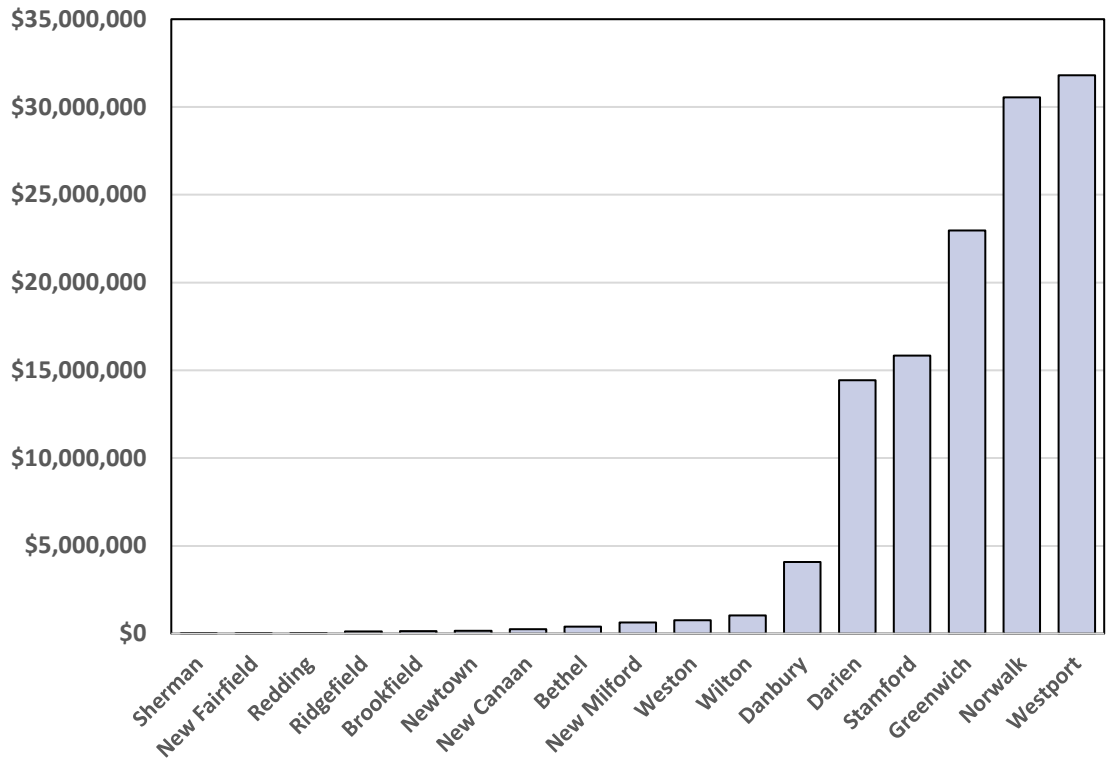


Figure 2. Flood Insurance Losses in Municipalities of Western Connecticut: 1984 to 2019

quality occurs when more than 11% of any given land area is impervious (e.g., buildings, paving, compacted soils, etc.).[3] The University of Connecticut Center for Land Use Education and Research completed a landmark study of riparian corridors that determined 19,000 acres of land within 300 feet of the state's riparian corridors had been developed between 1985 and 2006.[4]

Loss of tree canopy and increased impervious surfaces within riparian corridors are two of the leading factors contributing to increased stormwater runoff and downstream flooding in Western Connecticut municipalities. The region's groundwater supplies are also adversely impacted by loss of tree canopies and impervious soils since aquifers are unable to fully capture precipitation to recharge public drinking water supplies. Over the last thirty-five years, Western Connecticut municipalities along the coastline have had inordinately high property losses – with the most significant impacts attributable to Hurricane Sandy in 2012. It is not a coincidence that the greatest losses have been along the coastline – these municipalities have taken the brunt of hurricanes as well as the flood losses caused by swollen river systems along over-developed riparian corridors. The region had $147 million in flood losses over this 35-year period when adjusted for inflation (Figure 2).

[3] Elizabeth Brabec Stacey Schulte Paul L. Richards, Impervious Surfaces and Water Quality: A Review of Current Literature and Its Implications for Watershed Planning, Journal of Planning Literature, Vol. 16, No. 4, May 2002
[4] Center for Land Use Education and Research, The Status of Connecticut's Riparian Corridors, 2011

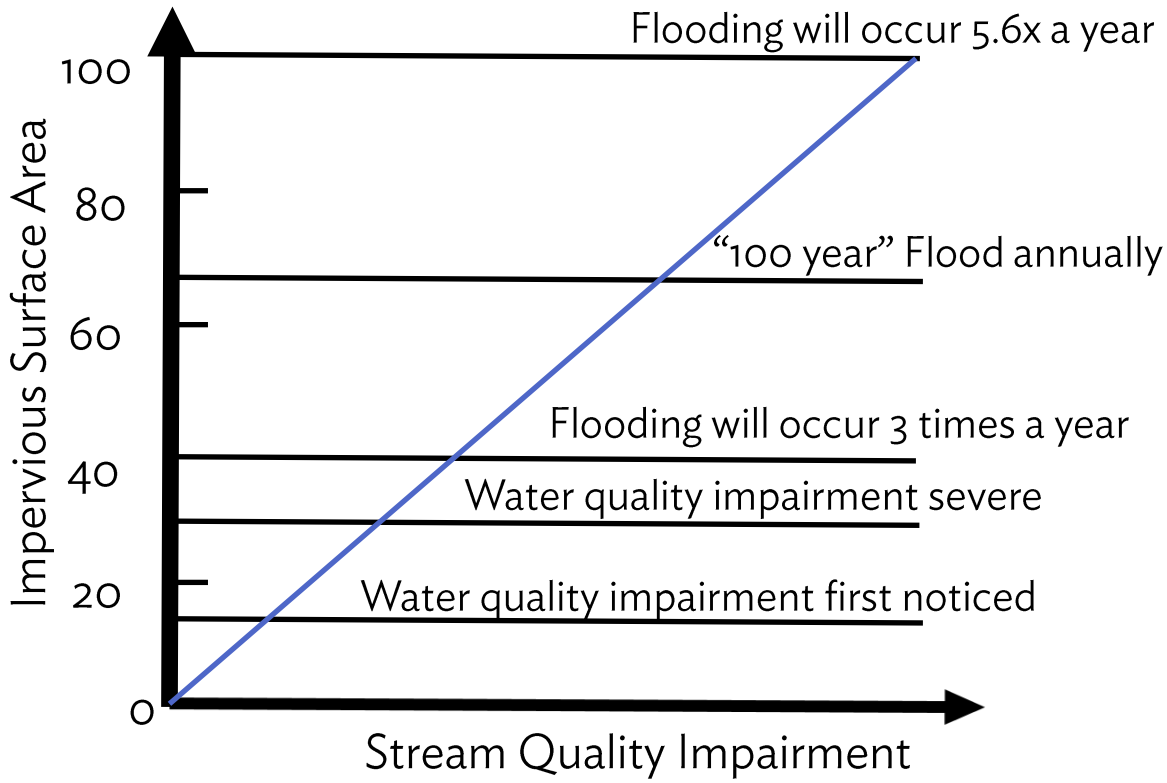
The U.S. Geological Survey and other researchers have identified a direct relationship between the level of impervious cover within a watershed and the frequency with which bank full flows – that is flows that top riverbanks – occur. When impervious surface areas cover 65% of a watershed, Klein and Leopold have demonstrated 100-year flood volumes, compared to the same watershed in a forested condition, will occur annually (Figure 3).[5] Flooding is not merely a function of rainfall intensity and frequency but is strongly influenced by the rate of water runoff caused by compacted soils, deforestation, and urban pavements. Efforts to reduce the flood hazards created by increasing development will need to address non-structural best management practices such as natural vegetation to treat stormwater runoff as well as structural solutions based on engineered detention and retention systems to control the rate of water runoff.

In urbanized areas, engineered solutions will be an inevitable component of any comprehensive strategy to reduce the rate and quality of stormwater runoff. However, in rural and suburban municipalities, the protection and maintenance of riparian corridors can play a significant role in reducing flood hazards when they remain relatively un-fragmented over their length and width. They are often far cheaper than building and maintaining manmade stormwater infrastructure. The key is to establish an effective impervious cover strategy at the regional scale – after structural and non-structural stormwater management strategies have been implemented – to keep impervious cover at 15% or less for the region's final build-out. Since 90% of Western Connecticut's land is zoned for single family residential development and most of that land is allocated for lots of two acres or more – with lot cover standards ranging from 5 to 30% – this should not be difficult to accomplish in municipalities further away from the coast. In contrast, in the urbanized portions of the region, it may not be possible to reduce impervious cover but it may be possible to develop engineered solutions that retain or detain stormwater to create an effective impervious coverage area that achieves the same goals. The trick is to create a total impervious surface calculated for post development conditions –for a given neighborhood or municipality – that is reduced by the amount of impervious surface that is subject to robust Stormwater Management Plans. Such plans must rely on Low Impact Development as described later in this report and other techniques that capture, treat, and reduce the negative impacts of storm water. Assuming the region's build-out development is set at 75% and protected open space accounts for the remaining 25% of the land, it still will be a challenge to achieve a net effective impervious cover of 15% at the regional level.

Fortunately, not all impervious cover is created equally. The greatest threat to flooding and water quality occurs along riparian corridors and for this reason the need to limit region-wide development is less important than steering it away from critical river management zones in the region.

In response to the development pressures on critical watershed within Western Connecticut, CTDEEP has identified five river systems and their associated watersheds for priority protection and restorations – the Norwalk, Saugatuck, Silvermine and Still Rivers and Limekiln Brook.

[5] Richard D. Klein, Urbanization and Stream Quality Impairment, Water Resource Bulletin, American Water & Resource Association, Vol. 15, No. 4, August 1979; L.B. Leopold, Hydrology for Urban Planning, A Guidebook on the Hydrologic Effects of Urban Land Use. U.S. Geological Survey, 554, Washington D.C.



Source: Richard D. Klein, Urbanization and Stream Quality Impairment, Water Resources Bulletin, American Water Resources Association, Vol. 15, No. 4, August 1979.

Figure 3. Watershed Development – Impacts to Stream Quality and Flooding

Figure 4 reveals Western Connecticut's watersheds are viewed as top priorities for immediate action given the pollutant loadings discharged into the region's rivers and streams. The CTDEEP Nonpoint Source Management Program Plan emphasizes the importance of protecting riparian corridors to reduce hypoxic conditions in Long Island Sound:

"Degradation of existing wetlands and riparian areas can cause the wetlands or riparian areas themselves to become sources of nonpoint pollution in coastal waters. Such degradation can result in the inability of existing wetlands and riparian areas to treat nonpoint pollution."[6]

One of the unintended effects of increased urban development and inadequate riparian corridor protections is that Western Connecticut's coastal communities are far more threatened by flooding than any other region in Connecticut. This reflects the greater degree of urban development in Western Connecticut than in most of the state, influenced by development pressures due to its proximity to New York City, and the availability of public sewers that have increased density and therefore impervious surfaces. Public sewers serve 68% of the region's population even though sewers only reach 13.9% of the region's land area.[7] Without specific policy and regulatory guidance concerning the appropriate siting of sewer lines,

[6] Connecticut Department of Energy and Environmental Protection, Connecticut Nonpoint Source Management Program Plan, Hartford, CT, 2019, p. 68.
[7] Western Connecticut Council of Governments, 2020-2030 Regional Plan of Conservation and Development, 2021, p. 45.

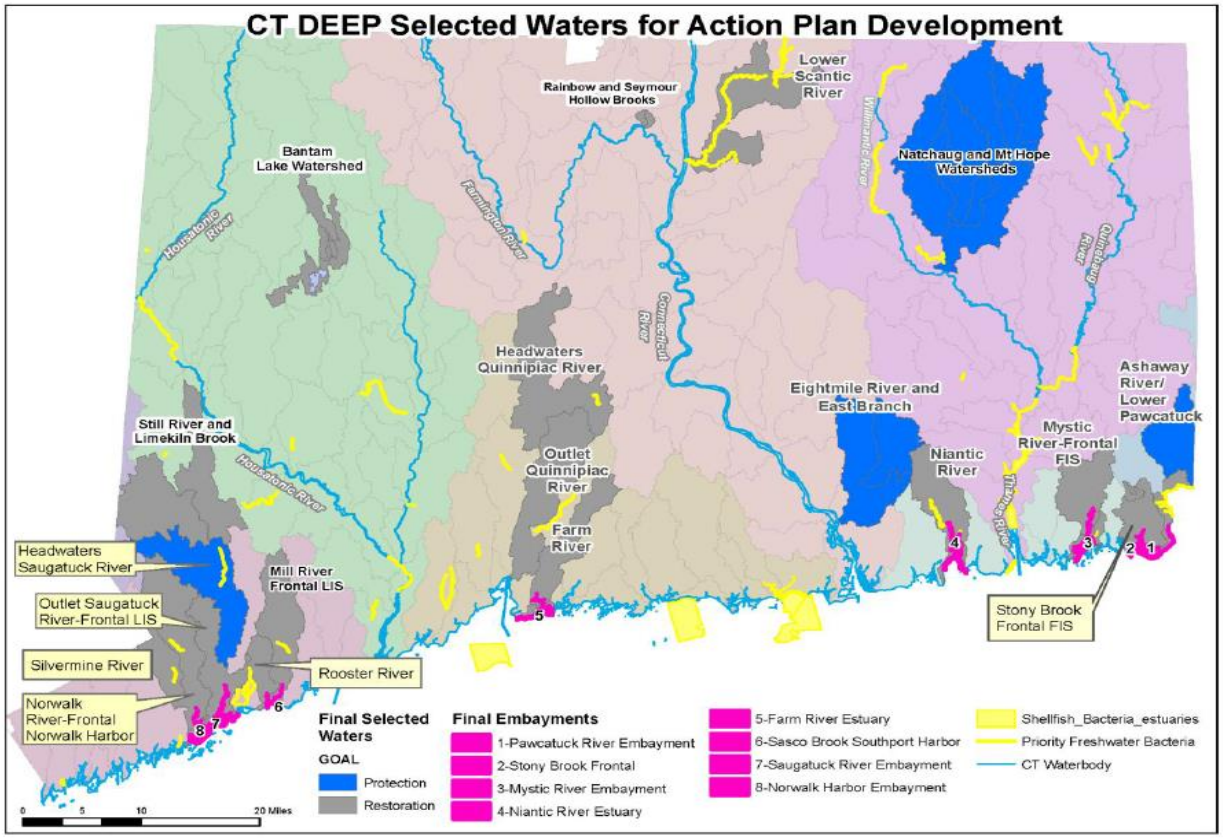


Figure 4. CTDEEP Selected Waters for Restoration and Protection

these trends may continue resulting in deterioration of the Regi on's surface water resources.

Past Legislative Support for Riparian Corridors

The state of Connecticut has historically approached the protection of riparian corridors on a case-by-case basis. In contrast, other New England states – including Maine, Massachusetts, New Hampshire, Rhode Island and Vermont – have developed comprehensive statewide riparian protection programs with strong land use planning considerations.[8] The first riparian corridor in Connecticut dates back to 1971 when the state legislature established the Five Mile River Commission to enable Nor-

[8] For example, in 2016, New Hampshire enacted the River Management Protection Program that establishes eighteen broad criteria for developing river management programs based on local applications that meet the stated criteria. Similarly, in 2017 Vermont enabled local governments to develop free-standing local laws to regulate development along river shorelines and enable zoning commissions to develop river protection programs. Maine has established mandatory shoreline protection programs to be implemented by local zoning commissions. In 1996, Massachusetts promulgated "An Act Providing Protection for the Rivers of the Commonwealth" that established 200 foot riparian buffers along the commonwealth's rivers with some exclusions for urban areas where such buffer widths would not be feasible. Massachusetts towns can create stricter riparian buffers but cannot opt out or reduce local standards below those of the Commonwealth. In 2015 Rhode Island prohibited local zoning commissions from regulating riparian buffers and has recently adopted implementing regulations that provide expansive new controls over the state's riparian zones based on their degree of urbanization and the ecological significance of the riparian zones. Appendix 3 summarizes state level riparian setback standards that have been adopted throughout New England.

walk and Darien to "concern itself with the navigation, pollution and conservation of said river and its drainage basin."[9] In 1973, the state legislature enabled municipalities in the lower Connecticut River basin to establish riparian corridor regulations with much more expansive controls over development than set forth for the Five Mile River Commission. Public Act 73-349 declared:

"It is found that the lower Connecticut River and the towns abutting the river possess unique scenic, ecological, scientific and historic value contributing to public enjoyment, inspiration and scientific study, that it is in the public interest that the provisions of this act be adopted to preserve such values and to prevent deterioration of the natural and traditional river way scene for the enjoyment of present and future generations of Connecticut citizens...."[10]

This law created an explicit conservation zone boundary affecting eight municipalities under the authority of a quasi-zoning entity known as the Gateway Conservation Committee. The committee consists of the commissioner of environmental protection or his designee, and a representative from each of the towns of Old Saybrook, Essex, Deep River, Chester, Haddam, East Haddam, Lyme and Old Lyme. Public Act 73-349 gave broad authority to recommend zoning standards for municipalities to adopt based on the Gateway Committee's final recommendations. It also had the authority to approve the proposed zoning regulations of each municipality under specific due process procedures. The committee was charged to:

"...prepare minimum standards for the regulation of the usage of property within the conservation zone consistent with the purposes of this act and for the protection and development, for purposes of this act, of such property by means of land coverage, frontage, setback, design and building height and the regulation of the cutting of timber, burning of undergrowth, removal of soil or other earth materials and the dumping or storing of refuse to prevent deterioration of the natural or traditional river way scene, provided such standards shall not discourage constructive development and uses of such property, which are consistent with the purposes of this act..."[11]

Six years after the creation of the Gateway Conservation zones on the lower Connecticut River, the legislature saw fit to expand the protection of its upper reaches – from Middletown to the Massachusetts border – by enacting Special Act 79-77, An Act Creating the Connecticut River Assembly. Unlike the earlier legislation this one was not exclusively focused on conservation issues – it also called for a study to address a wide range of competing interests in land uses along the Connecticut River.[12] The legislature called for a report to address the range of conservation and economic development issues by no later than January 1, 1981. Based on the study findings, in 1982 the state legislature enacted Public Act 82-296, An Act Concerning the Preservation of the Upper Connecticut River Area. Like the Gateway Conservation initiative, the Connecticut River Assembly delineated the boundaries of the conservation zone for the full length of the river from Middletown to the Massachusetts border. It also identified fifteen municipalities that must participate; Middletown, East Hampton, Portland, Cromwell, Glastonbury, Rocky Hill, Wethersfield, Hartford, East Hartford, Windsor, South Windsor, Windsor Locks, East Windsor,

[9] Public Act No. 805, An Act Concerning the Establishment of a Five Mile River Commission, enacted July 8, 1971.
[10] Public Act 73-349, An Act Concerning the Preservation of the Lower Connecticut River Area, enacted May 3, 1973
[11] Ibid.
[12] Special Act 79-77, An Act Creating the Connecticut River Assembly. June 18, 1979.

Protected Greenway along the Housatonic River

Suffield.[13] Unlike the Gateway Conservation Committee, the Connecticut River Assembly – representing the member municipalities –was created with responsibility to review twelve specific development proposals of greatest concern that fall within the boundaries of the conservation zone. Zoning commissions of member municipalities were required to revise their regulations to address the requirements of PA 79-77 and subsequent revisions to this legislation.

Protected River Corridors

In 1984, recognizing the increasing interest in riparian corridor conservation zones, the state legislature enacted Public Act 84-522, An Act Concerning River Protection Commissions. Unlike previous case by case approaches, this law enabled any two or more municipalities to develop a "protected river corridor" as defined in the law. A protected river corridor means; "...any river, river segment and adjacent lands deemed worthy of permanent protection, preservation and resource management because of environmental, historic, hydrologic, ecologic, agricultural or recreational qualities."[14]

Recognizing the need for flexibility and knowing the herculean challenges of coordinating a large number of municipalities under one pol-

[13] Public Act 82-296, An Act Concerning the Preservation of the Upper Connecticut River Area, effective October 1, 1982.
[14] Public Act 84-522, An Act Concerning River Protection Commissions, June 13, 1984.

Table 1: Federal or State Enabled Riparian Corridors in Connecticut: 1971 to 1993

Name of River Commission	Towns involved	River Segments Included	Towns in Western Connecticut	Date Authorized by State/Federal Law
Five Mile River Commission	2	Five Mile River	Norwalk, Darien	1971
Connecticut River Gateway Commis-	8	Lower Connecticut River		1973
Connecticut River Assembly	15	Upper Connecticut River		1979
Housatonic River Commission	5	Upper Housatonic River	New Milford	1979
Shepaug Bantam River Protection Commission	5	Shepaug/Bantam Rivers		1984
Niantic River Gateway Commission	2	Niantic River		1987
Housatonic Estuary Commission	6	Housatonic River		1990
Bi-State Pawcatuck River Commis-	2	Pawcatuck River		1990
Bi-State Farmington River Commis-	5	Farmington River		1990
Farmington River Coordinating Committee	5	Farmington River (Wild and Scenic Designation)		1993 (PL 103-313) 2016 (PL 116-9)
Total 9 Commissions	50	10	3	

icy and program framework, the river protection law enabled any two or more municipalities:

"...1) establish a river protection commission to protect any river flowing through or forming the common boundary of such municipalities; or (2) designate an existing river advisory board to act as a river protection commission. Any municipality may become a member of a commission by adoption by its legislative body of the agreement which created the commission and any amendments thereto."[15]

Unlike past riparian corridor initiatives, Public Act 84-522 made the Connecticut Department of Environmental Protection (DEP) responsible for determining statewide river policy, identifying rivers that should be protected, designating protected river corridors and approving or denying any municipal applications for such designations. With this authority and additional procedural guidance provided in subsequent legislation (Public Acts 91-394, 94-150 and 95-333), DEP was given statewide responsibility for identifying all potential areas that might be considered worthy of river corridor protections with specific review and public participation procedures to ensure any designations addressed issues of consistency with state land use, environmental and water quality plans, the state plan of conservation and development and numerous other state plans that might impact the creation of a protected river.

Evolution of Environmentally-Based Land Use Regulations

The revisions to the original law also placed DEP in charge of developing river corridor management plans to address the entire con-

[15] Public Act 84-522, An Act Concerning River Protection Commissions, June 13, 1984.

tributing watershed for each of the state's watercourses – not just land along their immediate banks. In effect, the series of amendments to river corridor protection enacted between 1984 and 1995 transformed riparian corridor issues into watershed management strategies based on a top-down approach where the opportunities for local involvement in land use planning were driven by broad DEP policy perspectives – including the need to consider interstate cooperation in the management of watersheds that cross state boundaries. Rather than giving planning and zoning commissions a lead role in the process, these legislative measures required local land use boards to revise their regulations to be consistent with policy and program objectives developed under the guidance of DEP.

As will be seen in this report, only a limited number of zoning commissions have incorporated river protection concepts into their regulations. In part, this reflects two broad developments prevalent in the pre-1990 era; 1) a relatively limited amount of scientific evidence accessible to zoning commissions that supported such concepts as riparian buffer zones, impervious coverage standards, stormwater management, and erosion and sedimentation control measures and; 2) the relatively slow pace at which the Connecticut state legislature required zoning commissions to consider environmental factors in their land use decision-making process. For example, even though Connecticut's zoning statute has been in place since 1925 it was only in 1977 with the passage of Public Act 77-509 that zoning commissions were allowed to consider historic factors, sedimentation control and erosion in zoning regulations; effective July 1, 1985, erosion and sedimentation control measures were required in zoning regulations (PA 83-388); In 1985 it also became mandatory for zoning commissions to consider the protection of surface and groundwater (PA 85-279); in 1991 those municipalities contiguous to Long Island Sound were required to address land use practices that affected pollutant loadings into the Sound (PA 91-170) and in 2004 zoning commissions were authorized to regulate floodplains and to establish more restrictive standards for development in floodplains not subject to tides (PA 04-444).

As will become clear in later sections of this report, planning and zoning commissions have not been involved in river protection programs unless municipalities have chosen to undertake the burdensome tasks of developing river management plans. The result has been that only a handful of municipal planning and zoning commissions have taken a comprehensive review and reassessment of their regulations to support the state's water management goals.[16] Only fifty municipalities in Connecticut have participated in multi-town river commissions to address riparian corridor protections (Table 1). Perhaps more importantly, many of the municipalities participating in the state's earliest river commissions did so without addressing riparian buffer concepts as a zoning measure. Many merely focused their efforts on quasi-floodplain management concepts in an era prior to the promulgation of FEMA's flood insurance rate program. While these early efforts were important, they no longer align with many recent environmental studies that emphasize the critical role of reducing impervious cover in

[16] For details concerning the extremely complex procedures for involving local government land use commissions in the development of river corridor management plans, see Public Act 91-394, An Act Concerning River Management and Protection, enacted in 1991; Public Act 94-150, An Act Concerning Protected Rivers, enacted in 1994; and Public Act 95-333, An Act Concerning Multiple Use Rivers, enacted in 1995.

Table 2: Municipalities with Self-Initiated Riparian Corridors in Their Zoning Regulations

Municipality	Name of Primary Watercourse	Minimum Building Setbacks from Watercourse (in feet)	Require Maintenance of a Vegetative Buffer along Watercourse?	Date of Latest Revisions to Regulations
Sherman	Housatonic River	Off Flood Soils	No	NS
Willington	Fenton, Willimantic Rivers	150	No	2012
North Haven	Quinnipiac River	50	Yes (50 feet)	NS
North Branford	Eight Mile River	150	No	NS
Killingly	Five Mile River	NS	No	2000
Wallingford	Quinnipiac River	50	Yes (50 feet)	NS
East Hampton	Salmon River	150	No	2004
Salem	E. Branch Eight Mile River	50	Yes (50 feet)	2007
Woodstock	Little River	100 (SRA)	Yes	NS
Stonington	Pawcatuck River	100	NS	NS

NS= Not Specified; SRA = Special Review Area for watercourses in critical watershed lands

watersheds in general and within riparian buffer zones in particular.

Self-Initiated River Protection

In addition, to the multi-town river commissions formed as a result of state legislation enacted in the period 1970 to 1993, ten municipalities have independently chosen to develop various types of riparian corridor protection initiatives through amendments to their zoning regulations. Some of the initiatives expand local zoning commission's authority beyond the FEMA floodplain model ordinance by restricting development in the 100-year floodplain without an option for compensatory storage. The stream belt provisions in the Sherman zoning regulations are an example of this approach. In contrast, nine municipalities have established riparian corridor setbacks for rivers of special concern such as those found in Willington (Fenton River), Killingly (Five Mile River), North Haven (Quinnipiac River), North Branford (Eight Mile Brook, Farm River and Branford River), Wallingford (Quinnipiac River), East Hampton (Salmon River), Salem (The East Branch of the Eight Mile River), Woodstock (Little River) and Stonington (Pawcatuck River).The advantage of riparian corridor regulations under the exclusive jurisdiction of one municipality is that it become much easier to develop appropriate local regulations without the burdensome and complex requirements imposed by the DEEP protected river corridor regulations and their administrative procedures.

With the enactment of the national flood insurance program in 1968 and the Connecticut legislature's enactment of inland wetland regulations in 1972, many of the most pressing flood related and wetland disturbing impacts of development have been brought under local land use controls. However, inland wetland regulations do not prohibit development within upland areas adjacent to riparian corridors and the Federal Management Agency's flood insurance program does not prohibit development

within the 100-year floodplain. Even with upland review areas that extend as much as 200 feet from wetland or watercourse boundaries in Western Connecticut, Inland Wetland Agencies may not prohibit development along Connecticut's watercourses as long as the proposed activity can be shown not to influence water quality or the physical characteristics of the wetlands (see Appendix 2 for locally defined upland review areas in Western Connecticut). The flaw in this process is that once, dwellings or other structures are placed within 100 feet of a watercourse – based on the presumption that they will not alter the physical characteristics of the wetland – there is little to control a homeowner's later use of fertilizers and pesticides nor their removal of trees and shrubs for a well-manicured lawn. Upland review areas do provide a measure of control over inappropriate development within riparian corridors but this case-by-case review process enables development to nibble away at the integrity of the water quality values associated with undeveloped riparian forest buffers.

Protecting riparian corridors based on FEMA's model floodplain regulations also creates similar challenges to those found with Inland Wetland regulations. For example, FEMA's regulations permit development in the 100-year floodplain as long as compensatory storage of flood waters can be achieved and any construction within the flood zone is built to be above the designated 100-year flood level. The intent of this federal program was to avoid regulations that could deny a landowner a use of their property. FEMA attempted to balance the public benefits of reducing flood hazards with the liabilities of uncompensated takings of private land. However, this paradigm is inconsistent with the dramatic changes in flood hazards associated with rising temperatures, increased precipitation and more intense storms that have emerged in New England over the last thirty years. It should come as no surprise that in 2004 the Connecticut State Legislature authorized zoning commissions to adopt stricter flood hazard regulations than those offered by FEMA's flood insurance program. When the 50-year flood occurs every 8.5 years, it is clear something is wrong with the Flood Insurance Rate Maps (FIRM) and the outdated hydrologic data upon which they were based.[17] Yet, even if a municipality were to adopt flood hazard regulations that prohibit development in the 100 year floodplain, this is not equivalent to developing a robust riparian buffer zone regulation. A strict "no build" standard for development in the 100-year floodplain would only be the first step in the right direction. Subsequent steps would need to focus on maintaining or restoring riparian zone vegetation to reduce stormwater discharges and ensuring these buffers absorb peak stormwater discharges. The objectives of flood hazard mitigation programs only achieve a limited number of the portfolio of benefits associates with the ecosystem services offered by riparian corridor protections.

Since their inception, the federal flood insurance program and Connecticut's inland wetland regulations have achieved substantial environmental benefits. Yet, the weaknesses of these two programs and the continuing failure of the state to meets its water quality goals for nitrogen and phosphorus, explains why the scientific literature has focused on more effective strategies – in particular riparian corridor regulations – to address hypoxic conditions in Long Island Sound. Connecticut's Inland Wetland

[17] L. Slater, et al., Global Changes in 20 Year, 50-Year and 100-Year River Floods, Geophysical Research letters, February 2021; accessed July 12, 2021, p.3.

regulations are far less sophisticated than those developed by other New England states and this by itself has made it far more difficult to develop uniform and science based standards for protecting water quality.

Rise of Pollutant Loadings on State Watercourses

The widespread use of fertilizers, pesticides, and hazardous chemicals in the home and workplace has played an outsize role in creating a new wave of zoning regulations that focus on specific land uses that pose a threat to surface and groundwater supplies. In particular, phosphorus levels in most municipalities in Western Connecticut - and across the state – are high or very high (Figure 1). Because of these high phosphorus levels, in 2012 the state legislature ordered DEEP to develop a phosphorus reduction strategy. Connecticut DEEP must address nutrient pollutant loadings in the state in order to bring the state into compliance with Section 303(d) of the Clean Water Act. Responding to this concern, in 2017 DEEP submitted its report to the legislature indicating significant reductions will be required to achieve Clean Water Act standards. The primary sources of manmade phosphorus include non-point sources, agricultural runoff, and discharges from wastewater treatment plants located throughout the state. In Western Connecticut, wastewater treatment plants account for a significant share of the manmade phosphorus discharges, but impervious land coverage and limited stormwater management programs in developed urban areas of the region also contribute to low dissolved oxygen levels – a condition known as hypoxia – in Long Island Sound (see Glossary).

However, it is important to recognize that phosphorus and other nutrients such as nitrogen are interstate water pollution control issues that cannot be solved by states operating independently of each other. In 2013, the U.S. Geological Survey estimated nitrogen loads for rivers that cross the Connecticut border with Massachusetts – excluding the Farmington River – represent 52 to 54% of the loads that reach the Long Island Sound.[18] Nevertheless, despite the host of players involved in reducing nitrogen and phosphorus levels in New England's rivers and streams, planning and zoning commissions and inland wetland agencies play a pivotal role – especially for controlling non-point sources of pollution and those associated with new construction. Efforts to reduce nitrogen and phosphorus levels in Long Island Sound, must do more than rely on the unwieldy process of interstate cooperation; there is an urgent need for inter-municipal cooperation – for those sharing common riverine boundaries and occupying the same watershed basins – to develop minimum riparian buffer standards consistent with statewide efforts to "Save the Sound" and address water quality violations identified by the Connecticut Department of Energy and Environmental Protection.[19]

Inland Wetland Based Watercourse Upland Review Area Practices

Before undertaking any zoning initiatives to protect riparian corridors, it is important to rec-

[18] Mullaney, John R., and Gregory E. Schwarz. "Estimated Nitrogen Loads from Selected Tributaries in Connecticut Draining to Long Island Sound, 1999-2009." 65. Reston, Virginia: U.S. Geological Survey, 2013, p. 27.
[19] Connecticut Department of Energy and Environmental Protection, Recommendations for Phosphorus Strategy Pursuant to PA 12-155, February 16, 2017

ognize the role municipal inland wetland agencies play in protecting the state's rivers and streams. As a result of a 1997 policy document developed by the Connecticut Department of Environmental Protection, inland wetland agencies were encouraged to establish upland review areas outside of the jurisdictional limits of the state's wetlands and watercourses. Indirect water quality effects created by excavation, land clearing, timber cutting, and septic system installation outside the jurisdictional limits of wetlands and watercourses made it apparent that reviews of development proposals needed to consider the interconnected and expansive nature of riparian corridors. While there is no state law requiring an upland review area or that specifies the distance from a watercourse that might impact the state's rivers and streams, 114 of 169 municipalities (67%) have adopted a 100-foot standard. In contrast, twenty-nine municipalities (17%) have adopted more restrictive standards and twenty-six (15%) have either established no standard or one less restrictive than 100 feet (Figure 6).

Not all rivers should be treated equally since some serve as tributaries to public water supply reservoirs, others fall within watersheds designated by the state's highest surface water quality ratings and still others are significantly impaired and require a greater level of land use controls to restore them to swimmable condition. In this context, thirty-seven municipalities have more expansive upland review areas for rivers of special concern with standards ranging from ninety feet to 500 feet – reflecting local practices in Connecticut. A total of 31 of these 37 municipalities (84%) have adopted more stringent review standards for rivers of concern – primarily those serving public water supply reservoirs, tributaries to aquifer protection zones or within the watershed of a public water supply. The most common practice found among 21 of these 37 municipalities (57%) is to set the upland review area at 200 feet. Similarly, nineteen municipalities have identified streams and brooks of special concern, particularly those within public water supply watersheds. The most common practice is to require an upland review area of 150 feet – an approach taken by 7 of the 19 municipalities (37%) with designated stream and brook standards.

While upland review areas for wetlands and watercourses are almost universal across Connecticut, there are eighteen other less frequently used criteria developed to protect special rivers, wetlands, drinking water supplies and other lands of concern (Figure 5). None of these municipal standards are explicitly authorized by state law or regulation but are supported by policy documents developed by the former Connecticut Department of Environmental Protection.[20] The important point to bear in mind is that these upland review areas do not prohibit development outside of wetlands or watercourses – they merely ensure that appropriate reviews are conducted to minimize the adverse impacts of these developments. Minimizing impacts, of course, is not the same as eliminating impacts and for this reason inland wetland regulations are only one of many land use tools that should be considered as part of statewide efforts to protect riparian corridors.

[20] Murphy, Brian D. "Utilization of 100 Foot Buffer Zones to Protect Riparian Areas in Connecticut." 6. 1991: Connecticut Department of Environmental Protection, 1991; Bureau of Water Management, Wetlands Management Section, "Guidelines; Upland Review Area Regulations – Connecticut's Inland Wetland & Watercourses Act." Hartford, Connecticut: Connecticut Department of Environmental Protection 1997.

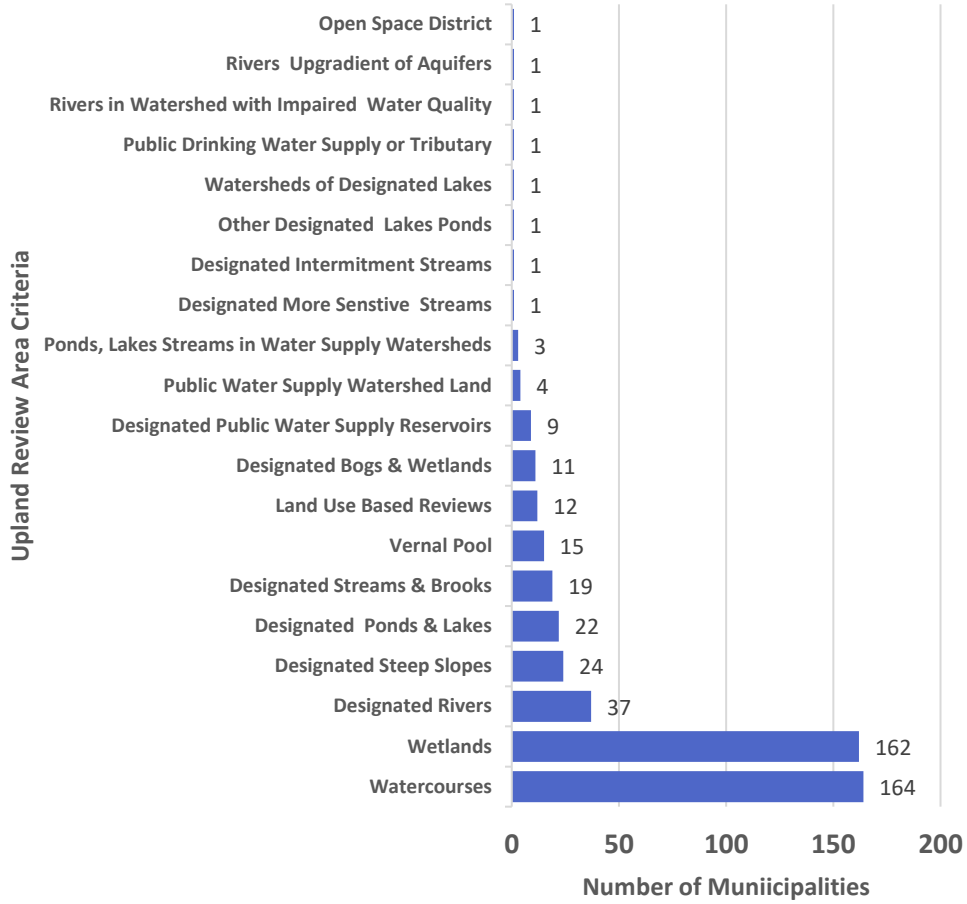


Figure 6. Connecticut Municipalities with Specific Upland Review Area Criteria in Wetland Regulations

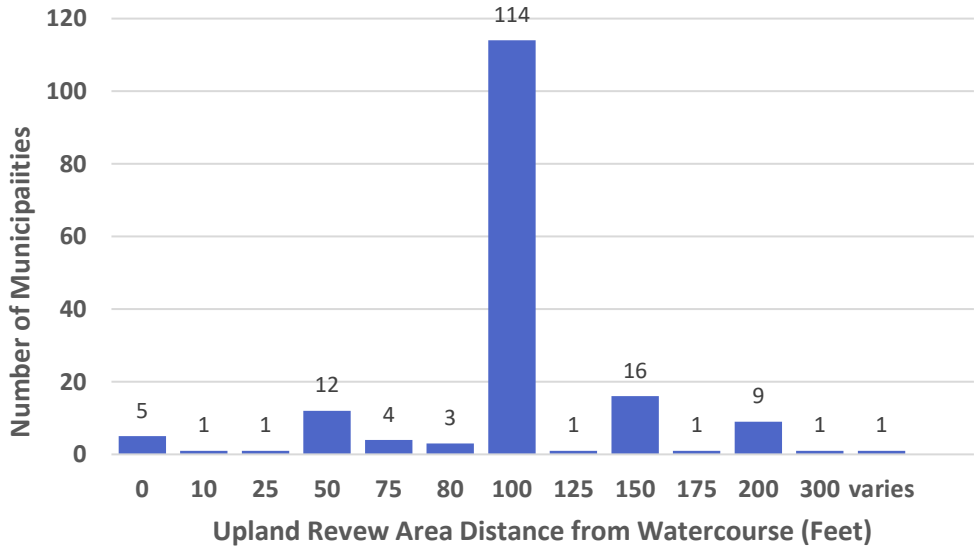


Figure 5. Inland Wetland and Watercourse Regulations for Watercourse Upland Review Areas

A Forested Riparian Corridor on the Housatonic River

Zoning Based Watercourse Setback Practices in Connecticut

Connecticut's shoreline communities have very high levels of phosphorus (Figure 7). These high levels are not the sole responsibility of any given downstream municipality that receives these phosphorus discharges but the collective responsibility of all upstream municipalities that contribute to these impaired stream classifications. While DEEP has identified a range of engineering solutions to reduce manmade discharges into the state's waterways, its 2017 phosphorus study did not focus on strategies that fall within the purview of planning and zoning commissions. This oversight has prompted WestCOG to review the 167 municipalities with zoning regulations to identify best practices. Zoning initiatives aimed to protect water quality through setback restrictions fall into five basic strategies; 1) setbacks for land uses that generate pollutants; 2) setbacks for construction related activities; 3) setbacks from water resources regardless of land use; 4) setbacks from floodplains for flood storage benefits and, 5) setbacks based on ecological planning principles tied to large parcel development.

The first setback category includes efforts to reduce pollutant loadings to streams and rivers that take the form of stream setbacks for such activities as compost operations, manure piles, hazardous materials storage facilities, septic leaching fields, excavation, animal barns and

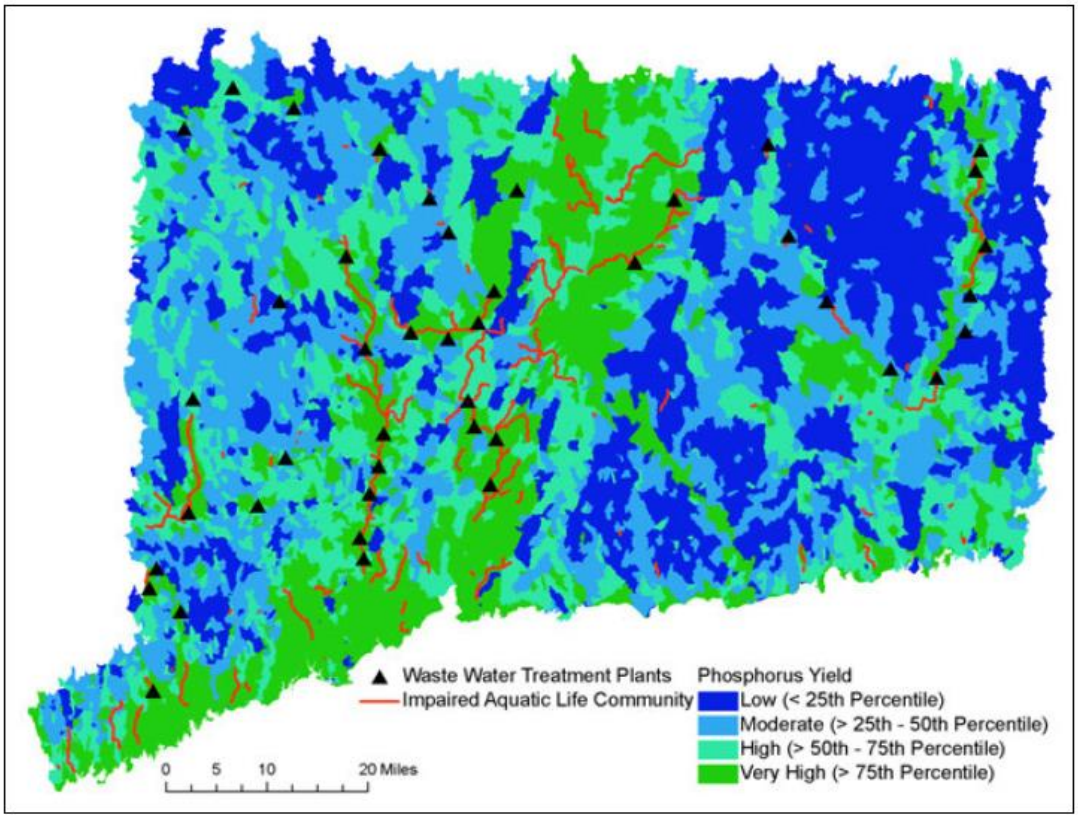


Figure 7. Statewide Phosphorus Yields based on using Sparrow (Moore, et.al. 2011). Aquatic life impairment based on assessment for the 2012 impaired waters list. Source: Connecticut DEEP, Recommendations for Phosphorus Strategy Pursuant to PA 12-155, February 16

stables, salt storage facilities, and junk yards.[21] Twenty-nine municipalities have adopted setbacks for activities deemed potential threats to surface waters (Table 3).

The second category of setbacks focuses on land disturbing activities such as the construction of parking lots, buildings, telecommunication towers, timber cutting, subdivision related work, cemetery plots and other land disturbing activities associated with construction and long-term impacts from increased impervious surface coverage of the land. Thirty-seven Connecticut municipalities have adopted setback regulations that focus on limiting the water runoff concerns caused by construction activities.

The third category of zoning regulation focuses on the protection of water resources and land conservation – regardless of the type of potential offending land uses that might be proposed – by establishing universal setbacks for development activities within designated riparian corridors. Stormwater runoff is a known conveyer of phosphorus to waterways and development close to watercourses increases the

[21] While the average septic system setback found in Connecticut zoning regulations is 88 feet, the Connecticut Public Health Code only requires a 50 foot setback from open watercourses. See, Connecticut Department of Public Health. "Connecticut Public Health Code: On-Site Sewage Disposal Regulations and Technical Standards for Subsurface Sewage Disposal Systems." Hartford, CT: Connecticut Department of Public Health, 2018, p. 14.

rate of runoff.[22] Thirty-four Connecticut municipalities have taken this approach.

The fourth category of zoning regulation focuses on maintaining the flood storage capacity of the state's river systems by prohibiting development on either flood prone soils or in areas designated as subject to a one percent chance of receiving the 100 year flood in any given year.[23] Nine Connecticut municipalities have adopted regulations that emphasize the importance of maintaining a river's flood storage capacity without regard to FEMA's more permissive compensatory storage approach (Table 3). Because of possible concerns with taking land without compensation, few municipalities in Connecticut have chosen to go beyond FEMA's model floodplain regulations. Those model regulations allow for flood mitigation measures (e.g., raising building elevations above the flood level) and techniques to increase flood storage to compensate for buildings located in the floodplain. One of the reasons these nine municipalities have chosen a more restrictive approach is that their efforts, in large part, preceded those of FEMA's flood insurance program. However, in 2004 the Connecticut state legislature expressly authorized zoning commissions to create more restrictive non-tidally influenced floodplain management regulations to address the increasing flood hazards associated with climate change and inappropriate levels of development in areas designated for flood storage.[24]

Finally, the fifth category of zoning regulation focuses on ecological planning where setbacks from streams and other sensitive lands are evaluated within the context of proposals to create conservation zones. Where conservation zones exist, natural resource protection is the primary driver for new development. Only a handful of municipalities have adopted this approach reflecting the greater development costs associated with comprehensive ecological planning concepts.

While not all the 119 zoning strategies for protecting streams and rivers identified through the WestCOG investigation targeted phosphorus as the primary pollutant of concern, many of the land uses and activities they target (e.g., manure piles, animal barns, timber cutting, etc.) clearly align with the state's phosphorus reduction goals. Yet there is much more that will be required to protect the region's water quality including a greater emphasis on reduced lot cover standards and/or limits on the amount of impermeable land cover allowed within any given watershed basin. As mentioned earlier, numerous scientific studies have found when watersheds exceed an impervious land cover of 11% surface water quality pollutant discharges tend to increase. Only 26% of Connecticut's municipalities have adopted impervious cover standards for all new development, and most that have done so are already in areas with high phosphorus levels in their streams and rivers (Appendix 4 provides a detailed assessment of current zoning practice with respect to impervious cover standards). Perhaps more importantly, it appears that few, if any, of the municipalities with impervious cover standards have considered the long-term build-out impacts of the adopted standards.[25]

---

[22] Connecticut Department of Energy and Environmental Protection, Recommendations for Phosphorus Strategy Pursuant to PA 12-155, February 16, 2017, p. 18.
[23] The 100-year floodplain is normally defined by FEMA flood insurance rate maps for each municipality.
[24] Public Act 04-444, An Act Concerning Floodplain Management and hazard Mitigation, approved May 21, 2004.
[25] This data is based on a WestCOG staff analysis of the state's 167 municipalities with zoning regulations pertaining to impervious cover standards for new development, July 2021.

Table 3: Water Resource Setback Zoning Practices in Connecticut Municipalities

Setback Practice	Number of Municipalities	Average Setback
Ecological Planning		
Conservation Setbacks	5	300
Maintain Flood Storage		
Riparian Setbacks	9	199
Flood Storage Zone Materials Setbacks	1	25
Minimize Land Disturbance		
Cemetery Plot Setbacks	1	75
Parking Facility Setbacks	3	28
Land Disturbing Activity Setbacks	3	33
Subdivision Setbacks	3	25
Excavation Setbacks	6	53
Timber Cutting Setbacks	3	75
Tower Setbacks	2	50
Building Setbacks	17	61
Protect Water Resource		
Waterbody Setbacks	2	38
Riparian Setbacks	30	109
Watershed Setbacks	3	117
Reduce Pollutant Loading		
Manure Setback	11	127
Compost Pile Setbacks	1	200
Hazmat Discharge Setbacks	1	150
Hazmat Storage Setbacks	1	50
Septic Setbacks	6	88
Animal Barns Setbacks	7	86
Leaf Composting Setbacks	1	100
Junk Yard Setbacks	1	200
Salt Storage Setbacks	1	250
Fertilizer Setbacks	1	150
Grand Total	**119**	**100**

Note: Because East Hampton has two riparian zoning regulations (one riparian based and the other to protect water resources), there are only 38 municipalities with riparian setbacks.

Another zoning tool that might also be used to minimize development within riparian corridors is the buildable lot concept. A total of 103 of the state's 167 municipalities with zoning regulations have adopted town-wide buildable lot standards that exclude wetlands, watercourses, land within the 100-year floodplain and land exceeding a specified steep slope from being considered a buildable lot. Another 48 municipalities have established buildable lot standards but have varied those standards based on the zone or the type of land development allowed within the municipality. Only sixteen municipalities are without a definition for a buildable lot with most of those municipalities located in the most rural or most urban areas of the state. Expanding the concept of buildable lot to exclude riparian buffers areas from the lot size calculation would be another means of protecting Connecticut's rivers. With the general acceptance of buildable lot concepts as an environmental protection tool, zoning commissions should consider adding a 25-to-50-foot riparian buffers on designated streams as an additional sensitive buildable lot exclusion factor.

Public Act 21-29 – A Renewed Focus on Hypoxia in Long Island Sound

Recognizing that zoning commissions play a central role in controlling development along the region's streams and rivers, in 2021 the Connecticut legislature expanded their authority to address phosphorus issues up-gradient of Long Island Sound. Public Act 21-29 provides zoning commissions with new regulatory authority and responsibility over pollutant discharges into navigable waters feeding into Long Island Sound thereby requiring the development of zoning strategies to control the discharge of a wide range of pollutants – including phosphorus. The new law declares (note: Underlined text represents the expansion of zoning authority to navigable waters) zoning regulations adopted pursuant to Section 8-2 of the Connecticut General Statutes shall:

"In any municipality that is contiguous to or on a navigable waterway draining to Long Island Sound, (A) be made with reasonable consideration for the restoration and protection of the ecosystem and habitat of Long Island Sound; (B) be designed to reduce hypoxia, pathogens, toxic contaminants and floatable debris on Long Island Sound; and (C) provide that such municipality's zoning commission consider the environmental impact on Long Island Sound coastal resources, as defined in section 22a-93, of any proposal for development."

The law also strengthens the case for developing water quality-based riparian zoning in Connecticut. To address phosphorus discharges and the factors that contribute to that discharge, municipalities contiguous to a navigable waterway draining to Long Island Sound now have additional legal responsibility to regulate 1) setbacks from streams and rivers to create riparian corridors such as vegetative buffers and/or non-development buffers, 2) setbacks from phosphorus producing activities, 3) density in areas where water quality issues are of greatest concern and 4) to create comprehensive low impact development standards that address water quality, flood mitigation, climate change, stormwater management and green chemistry initiative for business, industry and agriculture.

Riparian Corridor Practices in Connecticut

Despite any explicit provisions for the development of riparian corridors within Section 8-2 of the Connecticut General Statutes governing municipal zoning, thirty-eight municipalities have adopted controls over the activities that occur within buffer zones of watercourses

within their jurisdiction.[26] Riparian buffer zone protections go beyond the limited review authorities granted to inland wetland agencies by the Inland Wetlands and Watercourses Act. As discussed earlier, inland wetland agencies consider, on an application-by-application basis, the impact to wetlands caused by activities occurring in wetland review areas – ranging from 100 to 250 feet depending upon local practices. In contrast, municipalities that govern riparian corridors – also called streambelt zoning – establish specific restrictions on activities and land uses that may be allowed in buffer zones thereby reducing the case-by-case analysis associated with the current inland wetland review process and minimize opportunities for compromises and negotiations that often occur when a developer comes before an inland wetland agency seeking development within the 100 foot upland review area.[27] Some streambelt zoning strategies rely on simple setback standards – for example a 100 foot setback for buildings from streams and rivers – while others have established overlay zones, often referred to as floating zones that identify specific setback standards on the municipal zoning map.

There is no agreement within the scientific literature or within current municipal or state level practice as to what is the most appropriate width of a riparian corridor. The reasons for this are manifold reflecting the wide range of ecological values and services that are provided by riparian corridors.

The Regional Plan of Conservation and Development outlined some of these key ecological values as follows:

"Streambelt zoning supports more than a dozen ecological principles including; 1) promoting land uses that are not likely to adversely impacts streams; 2) to promote the public health, safety and general welfare of residents living near streams to avoid flooding; 3) to maintain natural drainage to ensure natural flow of floodwaters in periods of heavy precipitation; 4) to ensure public access to high quality natural riparian corridors in proximity to population centers; 5) to stabilize stream flow; 6) to protect water quality including through protection of tree canopies; 7) to retain corridors beneficial for water supply, wildlife habitat and recreation; 8) to protect areas of significant ecological importance; 9) to improve recreational opportunities that are valued for their aesthetic, scenic and natural values; 10) to preserve unique areas of historic scientific and sacred importance for conservation, nature education, scientific study and personal enjoyment; 11) to establish buffer zones between incompatible land uses and riparian corridors to ensure the "edge effect" flexibility for the dynamics of fluvial morphology including fluvial erosion hazards; 12) to protect and improve fish and wildlife habitats; and 13) to

---

[26] Despite any explicit reference to riparian buffer concepts, section 8-2 of the Connecticut General Statutes does provide legal authority for zoning commissions to address 1) the percentage of the area of the lot that may be occupied; 2) the size of yards, courts and other open spaces; 3) the density of population and the location and use of buildings, structures and land for trade, industry, residence or other purposes, including water-dependent uses, as defined in section 22a-93; 4) Provide that proper provisions be made for soil erosion and sediment control pursuant to section 22a-329; 5) Be made with reasonable consideration for the protection of existing and potential public surface and ground drinking water supplies; and 6) In any municipality that is contiguous to or on a navigable waterway draining to Long Island Sound, (A) be made with reasonable consideration for the restoration and protection of the ecosystem and habitat of Long Island Sound; (B) be designed to reduce hypoxia, pathogens, toxic contaminants and floatable debris on Long Island Sound; and (C) provide that such municipality's zoning commission consider the environmental impact on Long Island Sound coastal resources, as defined in section 22a-93, of any proposal for development; and 6)under section 8-2l a municipality may adopt more stringent restrictions for flood storage and conveyance of water for floodplains that are not tidally influenced.

[27] Emily Wilson, et al., Land Cover Change in the Riparian Corridors of Connecticut, Watershed Science Bulletin, Fall 2001, pp. 3-31

help protect groundwater supplies that are hydraulically connected to the state's watercourses."[28]

Based on the multiplicity of water protection objectives adopted by Connecticut's municipalities, riparian corridor buffer zones range in width from 50 to 750 feet depending upon the specific land use issue of concern and the type of land impacted by the buffer zone standards (Appendix 5). For example, municipalities that have adopted riparian buffer zones based on floodplain delineations often have much greater buffer standards than those that have focused on the use of buffers as a means to reduce water quality degradation issues. The riparian corridors developed in the 1970s and 1980s had a decided focus on floodplain management concerns (e.g., the 15 municipalities in the Connecticut River Assembly contiguous to the upper Connecticut River). In contrast, the riparian corridors established in East Hampton (Salmon River) and Killingly (Five Mile River) are focused on protecting watercourses from stormwater and septic system discharges into pristine streams and rivers. Those zoning regulations that have focused on water quality protection have riparian buffers that on average are about 100 feet in width. In some instances, these buffers exclude virtually all land disturbing activities within the 100-foot buffer. In other instances, where a two tier or three tier buffer system exists, it is common to find prohibitions on development within the first 50 feet from the river's edge and a more permissive outer buffer zone that may allow such uses as agriculture or recreation activities.

Vegetative and Forest Buffer Zones as Pollutant Reduction Technologies

In the last thirty years there have been an enormous number of studies that have identified the benefits of maintaining or creating vegetative and forest buffer systems to reduce surface runoff and its attendant discharge of pollutants. The Chesapeake Bay watershed has been at the epicenter of many important riparian buffer zone studies since that watershed has been impacted by a significant amount of development over the last fifty years and is a test bed for evaluating new water quality protection concepts in the backyard of the U.S. Environmental Protection Agency (EPA). Studies funded by the EPA and Chesapeake Bay Program demonstrate the benefits of forest buffer systems for pollutant reduction. One 1995 study authored by Richard Lowrance and twelve other co-authors builds on the Riparian Forest Buffer System developed by the U.S. Department of Agriculture and for this reason its findings are particularly important for municipalities with a substantial representation of agricultural and forest lands within their land inventory.

Based on the findings of the 1995 Lowrance study, forest buffer systems or a combination of forest and grass buffer systems can reduce phosphorus levels by as much as 70 to 78.5% depending upon the width of the grass and forest buffers (Table 4). Similarly forest and meadow buffer systems can reduce nitrogen levels anywhere from 74.3 to 80.1% over nitrogen input levels identified in the Lowrance study. Similar findings have been made by dozens of other scientists even though there

[28] Ibid, pp. 28-29.

Table 4: Effect of Different Size Buffer Zones on Sediment & Nutrient Reduction from Surface Runoff

Item	Buffer Zone			Reduction: 100 x (input-output)/input		
#	Width (meters)	Width (Feet)	Plant Cover	Sediment %	Nitrogen %	Phosphorus %
1	4.6	15	Grass	61.0	4.0	28.5
2	9.2	30	Grass	74.6	22.7	24.2
3	19.0	62	Forest	89.8	74.3	70.0
4	23.6	77	Grass/Forest	96.0	75.3	78.5
5	28.2	93	Grass/Forest	97.4	80.1	77.2

Item 4: Width comprises 4.6 meter grass buffer plus 19 meter of trees
Item 5: Width comprises 9.2 meters of grass buffer plus 19 meters of trees

Source: Richard Lowrance, et. al., Water Quality Functions of Riparian Forest Buffer Systems in the Chesapeake Bay Watershed, August 1995, p. 30

are differences in the appropriate width of a riparian buffer due to a wide range of site-specific factors including soil types, slopes, hydrology, underground root systems, vegetation type, and the presence of woody debris (e.g., carbon sources). To achieve at least a 70% phosphorus and nitrogen reduction level, Lowrance determined grass and forest buffers need to be at least 62 feet wide. However, larger buffers approaching 100 feet enable greater reductions of these two pollutants.

A subsequent 2003 assessment of riparian buffers conducted by the Forest Workgroup for the Chesapeake Bay Program recommended even greater buffers than suggested by the 1995 Lowrance study. Ideally a forest buffer should be as much as 150 feet to achieve higher water quality standards. Three key findings of that study are as follows:[29]

1. For maximum ecosystem resiliency, forest buffers should exist on at least 70% of all shorelines and streambanks in the watershed;
2. We need stronger emphasis on urban buffers and tree canopy
3. We need stronger support for conserving and maintaining existing forest buffers

In addressing these findings the Chesapeake program developed several goals that are relevant to municipalities in Western Connecticut including adopting a buffer of least 75 to 150 feet to "achieve and sustain a full array of water quality benefits."[30] Wider buffers may offer additional benefits beyond water quality – such as protecting migratory pathways and wildlife habitat – but such considerations must also be mindful of landowner's property interests and the importance of public education and tax incentives to maintain wider riparian buffers as viable land use concepts. The Chesapeake Bay program, like numerous other studies, has emphasized the fluidity of the riparian buffer zone since it varies by site and is best determined by assessing several factors including:

1. The value of the resource being protected;
2. Site buffer, and watershed characteristics;
3. The intensity of adjacent land uses;
4. The desired buffer functions; and
5. Landowner objectives and constraints.

[29] Michael Foreman, Chair, Chesapeake Bay Program Forest Workgroup, Recommendations for the 2003 Directive on Expanded Riparian Forest Buffer Goals in the Chesapeake Watershed, December 2003, pp. 3-12.
[30] Ibid p. 9.

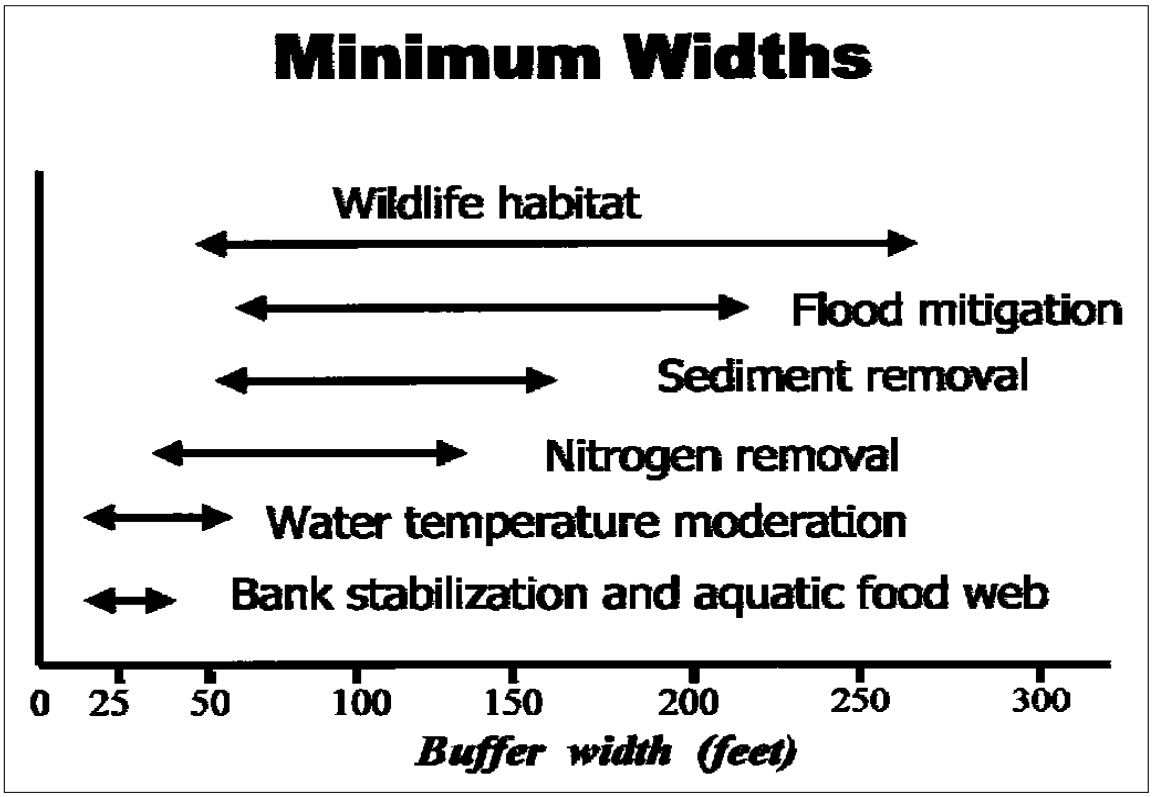
In contrast to the labor intensive approach of evaluating each river system to determine the optimum width of the riparian corridor, a 1991 report completed by the staff of the Connecticut Department of Environmental Protection recommended, for administrative efficiency, that the optimum riparian buffer be set to 100 feet based on the wide number of scientific studies that have found that comparable widths have been clearly linked to reduced nitrogen, phosphorus and total suspended solids in streams and rivers.[31] It was more than a coincidence that this report was instrumental in the later development of the 100-foot upland review area that now constitutes the legal foundation for Inland Wetland Agency review of land outside regulated wetlands.

Development of riparian buffers, while a valuable tool to protect streams and rivers in Western Connecticut, must be done with reasonable consideration of where such buffers would have the most benefit in reducing phosphorus and nitrogen levels. Planning and zoning commissions should consider targeting streams and rivers where buffers will have the maximum value in restoring water quality – not necessarily all rivers and streams within their jurisdiction. Ideally, to the extent feasible, efforts should be made to develop contiguously forested stream corridors, protect headwater steams, and target high nitrogen and phosphorus source areas within the region.[32] While wastewater treatment plants are responsible for a significant amount of phosphorus discharge, these sources are already under the control of Connecticut DEEP and do not fall within the regulatory authority of planning and zoning commissions. In contrast, agricultural activities, residential uses of fertilizers and pesticides and construction activities adversely impact water quality and are a land use issue. CTDEEP has recently identified the following non-point sources of nitrogen and phosphorus associated with nutrient enrichment of lakes. These sources are also the leading causes of the enrichment of the state's river systems and many of these issues fall directly under the purview of local land use regulations.[33]

- Street and parking lot drains which discharge to or near surface waters;
- Unmanaged runoff from urban and agricultural lands;
- Erosion sites (including unpaved roads, streams, construction, etc.);
- Expansive pavement or lawns leading to the lake's edge;
- Over-fertilized lawns, especially adjacent to lake or tributary streams;
- Sites where dog waste is regularly abandoned;
- Suspected sewer and septic system leaks;
- Manure management needs; and
- Other stormwater or pollutant hotspots.

Much effort has been made to include stormwater management guidance in zoning regulations but much less effort on the use of fertilizers and pesticides in new development. Planning and zoning commission could play a more active role by including explicit references to approved application procedures for fertilizer

[31] Brian D. Murphy, Technical Assistance Biologist, Connecticut Inland Fisheries Divisions, Position Statement: Utilization of 100 Foot Buffer Zones to Protect Riparian Areas on Connecticut, 1991
[32] *Connecticut DEEP, Recommendations for Phosphorus Strategy Pursuant to PA 12-155, February 16, 2017, Appendix B.*
[33] Connecticut Department of Energy and Environmental Protection, Connecticut Statewide Lake Nutrient Total Maximum Daily Load Core Document (Draft), July 2021, p. 33.



Source: Palone, Roxane, S, and Albert H. Todd, eds. Chesapeake Bay Riparian Handbook: A Guide for Establishing and Maintaining Riparian Forest Buffers, pp. 6-8.

Figure 8. Minimum Riparian Buffer Widths Vary with Desired Ecosystem Services

and pesticides in their regulations as required by Public Act 12-155.[34]

Benefits of Forested Riparian Corridors

While water quality is clearly a major ecosystem service provided by forested riparian corridors , it is far from the only benefit. Appendix 1 provides a summary of the groundwater protection, flood hazard management, streambank stability, streamflow regulation, active and passive recreation, wildlife and migratory pathways and micro-climate benefits identified in the scientific literature on riparian buffer systems. Depending upon the purpose of a riparian buffer system, the minimum width of the buffer may need to be increased beyond the 100-foot setback standard commonly used in Connecticut municipalities and other states along the eastern seaboard. For example, riparian corridors that focus on creating un-fragmented migratory pathways for wildlife and bird sanctuaries need to be much wider (Figure 8).

[34] Public Act 12-155 established controls on fertilizer use on lawns including a formula limit of 0.67% phosphorus for use on established lawns as well as seasonal prohibition on lawn fertilizer applications from December 1 – March 15. Lawn fertilizer may not be applied within 20 feet of a watercourse or on impervious surfaces. These requirements should be incorporated into land development regulations. For an excellent summary guidance document on the proper use of fertilizers and pesticides, refer to the New England Interstate Water Pollution Control Commission NEIWPCC), Regional Clean Water Guidelines for Fertilization of Urban Turf, 2014.

The Chesapeake Bay forest buffer research represents an important reference point for Connecticut municipalities interested in reducing nitrogen and phosphorus levels that contribute to hypoxic conditions in Long Island Sound. With the enactment of Public Act 21-29 Connecticut municipalities are required to address hypoxic conditions in Long Island Sound as long as they are on a navigable river draining into the Sound. Because the term "navigable waters" determines the scope of a municipal authority over various creeks, streams, rivers and intermittent streams a review of federal and state definitions of this term is necessary to determine the geographic limits of any riparian buffer concepts that might be developed under Public Act 21-29.

Navigable Waters of Connecticut

Historically, Connecticut statutes defined navigable waters as those that are influenced by the tides. However, in 2012, the state legislature expanded the definition of navigable waters to include all upstream water that can be navigated upstream until the first obstruction to navigation for watercraft.[35] This revision appears to bring Connecticut's definition of navigable water in alignment with Connecticut case law which affords recreational users of watercraft the right of passage over navigable waters beyond tidally influenced zones of rivers and streams.[36]

Federal definitions of navigable waters have varied over the years depending upon the context of federal judicial rulings concerning the ever-evolving concern with water pollution created in upstream tributaries that directly impacts the traditional commerce clause definition of navigable waters (i.e., waters that are subject to tidal influence or are used for commerce). Recent Supreme Court decisions and 2020 EPA rule have narrowly strengthened Clean Water Act authority over tributaries of navigable waters when it can be shown that they are hydrologically connected to downstream river systems and are the cause of pollution of the waters of the United States.[37] In this context, under the Clean Water Act, municipalities can arguably establish land use controls that are intended to reduce the discharge of surface water pollutants into the tributaries of Connecticut's navigable waters.[38] Taking an expansive definition of navigable waters – as suggested by recent U.S. Supreme Court rulings – all of the region's major river systems discharging into Long Island Sound, and their hydrologically connected tributaries, must be addressed by zoning commissions to determine how discharges of nitrogen, phosphorus and total suspended solids can be reduced (Figure 9).

---

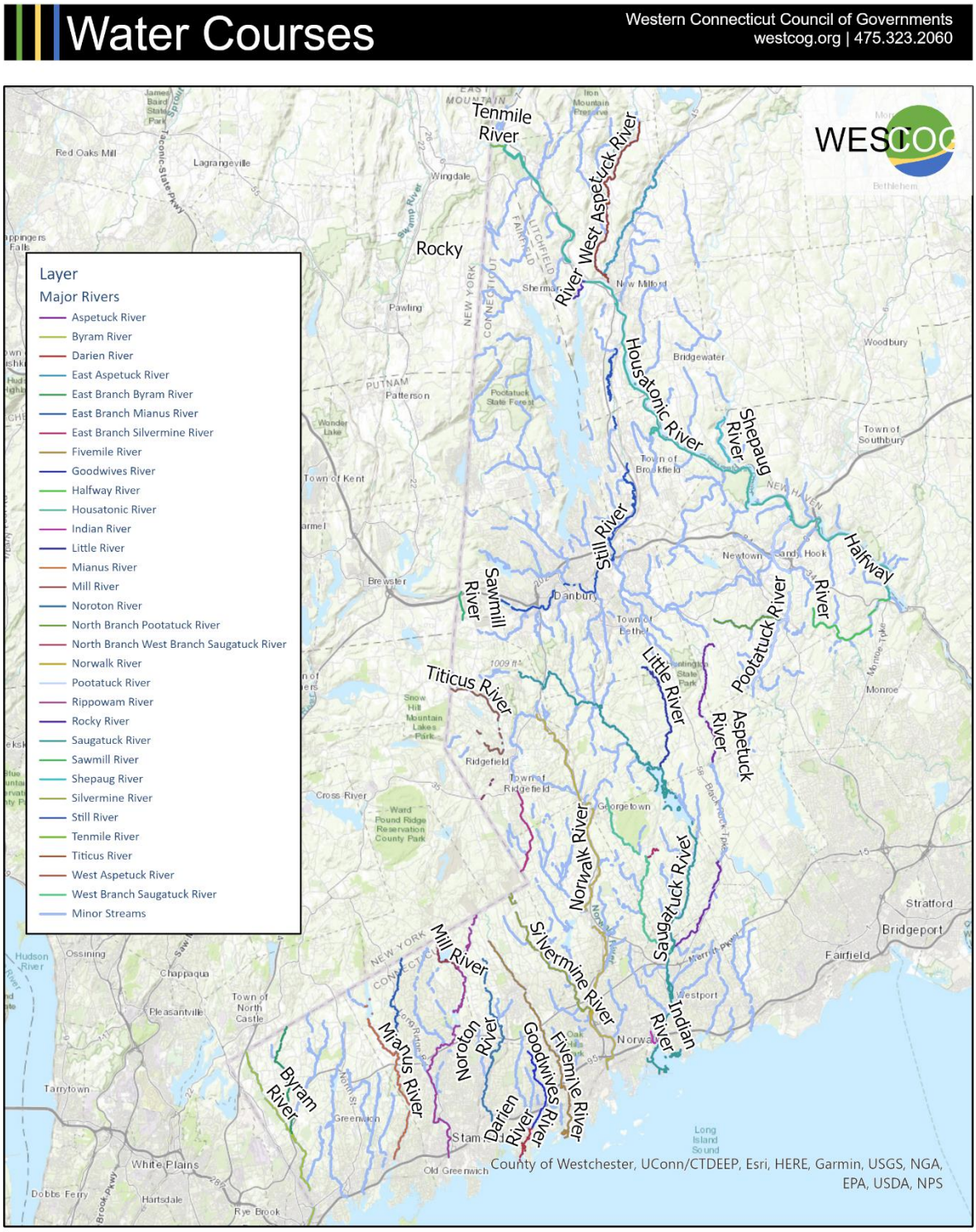
[35] In 2012, the definition of navigable waters was revised by Pubic Act 12-101. That law states: "As used in this section and sections 22a-360 to 22a-363a, inclusive, 'navigable waters' means Long Island Sound, any cove, bay or inlet of Long Island Sound, and that portion of any tributary, river or stream that empties into Long Island Sound upstream to the first permanent obstruction to navigation for watercraft from Long Island Sound."

[36] Thomas Zeilman, Connecticut by Canoe: Navigability in the Nutmeg State, Connecticut Bar Journal, 2010, Vol. 84, pp. 305-324

[37] James Murphy, Muddying the Waters of the Clean Water Act: Rapanos v. United States and the Future of America's Water Resources, Vermont Law Review, Vol. 31, 2007, 355-379; Department of the Army, Corps of Engineers, Department of Defense; and Environmental Protection Agency (EPA), The Navigable Waters Protection Rule: Definition of "Waters of the United States", 85 FR 22250, April 21, 2020.

[38] Jeffrey G. Miller, Plain Meaning, Precedent, and Metaphysics: Interpreting the "Navigable Waters" Element of the Clean Water Act Offense, Environmental Law Reporter, 45, pp. 10548-10588

Figure 9 : Major Watercourses in Western Connecticut



Alternative Zoning Approaches to Protecting Long Island Sound

There are a wide range of zoning techniques that can be applied to reduce the quantity of nutrients and other pollutants that are entering the rivers that discharge into Long Island Sound. The most comprehensive approach relies on restricting impervious development at a watershed level consistent with the notion that all rainfall – regardless of where it falls – will finds its way to a tributary or a major river and be a source of polluted stormwater. While this approach has its merits, it might not necessarily focus on priority areas within the watershed that pose the greatest risk to the water quality of Connecticut's rivers and streams.

One of the most popular and widely adopted strategies in New England is the use of Riparian Corridor Protection zones that function either as overlay districts or as standalone river setbacks over designated rivers, streams, brooks, and intermittent streams (Appendix 5 reviews all New England riparian protection strategies). The zoning approaches that have been adopted depend upon the specific objectives set forth in establishing such districts. A review of the purposes for which riparian corridors have been established by zoning commissions in Connecticut reveals most planning and zoning commissions have sought to achieve multiple purposes (Table 5). Water quality protection, reduction of toxins and contaminants, reduction of erosion and sedimentation and the need for improved stormwater controls account for one third of all the enumerated reasons for developing riparian corridor zones in Connecticut. While Public Act 21-29 has mandated that planning and zoning commissions focus on water quality protections of Long Island Sound, there is sufficient zoning enabling legislation to support the development of multi-purpose riparian corridor protection zones. Indeed, this is an important consideration since protecting riparian corridors is not a one-dimensional planning process. From an ecological perspective, river systems and their adjoining shores serve a wide range of functions and for this reason, multi-purpose strategies are not only appropriate but critical to improving the ecosystem services offered by the state's rivers and tributaries.

A third strategy relies on the implementation of low impact development techniques that can reduce impervious cover, minimize stormwater runoff and recharge groundwater supplies. Low impact development represents a complementary zoning strategy to traditional stormwater management that focus on structural best management practices such as detention and retention ponds. Examples of low impact development include green roofs (e.g., impermeable roof membranes where vegetation is grown to capture rainfall and reduce roof heat gain), storing roof runoff in rain barrels, requiring pervious pavements for driveway and sidewalks, installing vegetative swales, and protecting riparian corridors by maintaining tree canopies along both riverbanks.

These three strategies are not mutually exclusive. It is appropriate to consider the three options – protecting vulnerable watersheds, river corridor protection overlay zones and low impact development – as complementary strategies that can be integrated into a comprehensive management plan for the protection of Long Island Sound and its contributing watersheds. Appendix 6 provides six model regulations that address the mandates of Public Act 21-29. Each of the six approaches has been developed based on existing best practices for watershed management zones, riparian protection zones and low impact development regulations found in Connecticut and New Hampshire municipalities. Based on an exhaustive review of the strategies adopted by municipalities in Connecticut and throughout New England,

Table 5: Primary Purposes for Connecticut Riparian Corridors

Purpose	Number of municipalities
Aesthetics	38
Reduce Toxins, contaminants and bio-contaminants	28
Protect Habitat for Marine and Terrestrial Species	19
Water Quality Protections	17
Reduce Flooding	16
Sediment reduction	14
Maintain Flow of River	8
Groundwater Table Protection	7
Limit Erosion	7
Vegetative Cover along shorelines	7
Protect Environmentally Sensitive Lands	7
Timber Management	6
Protect Recreational Resource	5
Stormwater controls	4
River Protection Measures	3
Protect Agriculture	2
Archeological Resources	1
Grand Total	189

Source: WestCOG analysis of 34 Connecticut Riparian Zoning Regulations, July 2021

these six model regulations offer a range of approaches that should appeal to planning and zoning commissions with varying levels of professional staff support and varying levels of development pressures. The most appropriate approach may vary depending upon the development patterns that currently exist within any given municipality. However, the Model Riparian Corridor Protection District – Option 4 (Based on Exeter, NH) is the most appropriate starting point for most Connecticut municipalities since it provides a range of checks and balances on the needs of landowners who are likely to be affected by a riparian corridor regulation.

Consistency with the Regional Plan of Development

The Western Connecticut Council of Governments unanimously endorsed the infrastructure goals and policies of the 2020-2030 Regional Plan of Development that included three

riparian corridor policies.[39] The three policies listed below are intended to assist municipal governments with development of riparian corridor regulations that achieve the goals of reducing stormwater discharges, decreasing thermal pollution of watercourses through improved vegetative buffer and impervious cover standards along the region's major waterways. Specific strategies consistent with the Western Connecticut Regional Plan of Development, and that support the findings of this report, are presented below.

2020-2030 Riparian Corridor Goals and Policies

1. Encourage the adoption of streambelt zoning as a means to protect ecology and riparian values provided by the major watercourses in Western Connecticut.
2. Develop model streambelt zoning regulations for adoption by municipalities in Western Connecticut.
3. Increase the protection of tree canopies and maintain core forests along major riparian corridors in Western Connecticut.

Strategies and Next Steps

To respond effectively to the directive of Public Act 21-29 – to reduce hypoxia and other pollutants in Long Island Sound that are discharged by nonpoint sources throughout the region – municipalities should consider the following strategies within the context of the Region's adopted riparian goals and policies:

Goal 1: Encourage the adoption of streambelt zoning as a means to protect ecology and riparian values provided by the major watercourses in Western Connecticut.

Strategy 1: Develop zoning strategies to minimize development along navigable waters and their tributaries including strategies to address appropriate setback and review standards.

Strategy 2: Determine if revisions to subdivision regulations can be a means to improve stormwater management and erosion and sedimentation controls procedures for developments near navigable waters, tributaries, intermittent streams and headwater streams.

Strategy 3: Revise Inland Wetland Agency regulations to expand upland review areas near navigable rivers and their tributaries that contribute hypoxic conditions in Long Island Sound.

Strategy 4: Consider incentives for the protection of riparian corridors and public water supply watersheds including allowing low impact development driveway and road standards in new subdivisions and offering flexible lot setback standards on lots abutting rivers, streams and their tributaries.

Goal 2: Develop model streambelt zoning regulations for adoption by municipalities in Western Connecticut.

Strategy 1: Review and evaluate the model riparian corridor zoning regulations contained in Appendix 6 for possible adoption in Western Connecticut.

Strategy 2: Develop setback standards applicable to farms, animal barns and stables, and manure storage operations to minimize

[39] Western Connecticut Council of Governments, 2020-2030 Regional Plan of Conservation and Development, 2021, p. 58.

stormwater discharges into the streams and rivers of Western Connecticut.

Strategy 3: Review and revise traditional lot cover standards used in zoning regulations and move toward the use of impervious cover standards as a means to reduce stormwater discharges.

Strategy 4: Revise current buildable lot standards to address proximity to stream and rivers feeding into Long Island Sound as an additional consideration in what is considered a buildable lot.

Goal 3: Increase the protection of tree canopies and maintain core forests along major riparian corridors in Western Connecticut.

Strategy 1: Investigate the feasibility of obtaining federal and state grants to fund efforts to install trees along riparian corridors in the more urbanized portions of the region.

Strategy 2: Identify the location and extent of core forests in Western Connecticut – especially those forests that fall within public water supply watersheds – to enable land conservation programs to target this important resource consistent with the water quality objectives of Public Act 21-29.

Strategy 3: Develop education and outreach programs to increase public awareness of the value of tree canopies in urban centers and along riparian corridors as tools to reduce water pollution and address the impacts of climate change.

Strategy 4: Consider the adoption of minimum zoning and subdivision standards governing the cutting of trees, including those within 100 feet of a watercourse.

Appendices

Appendix 1: Benefits of Forested Riparian Corridors

Groundwater Quantity Benefits
Increases groundwater recharge of aquifers adjoining and underlying stream channels.
Reduces the threat of drought for groundwater dependent community water supplies.
Water Quality Benefits
Traps nutrients from surface and subsurface runoff.
Reduces total suspended solids in rivers thereby improving water quality.
Reduces hypoxic conditions in Long Island Sound.
Increases uptake of nutrients though tree root system and associated commensal bacteria.
Provides carbon source for nutrient breakdown from woody debris.
Reduces siltation of sensitive aquatic habitats used for fish spawning.
Reduces light penetration of river (tree canopy), in turn reducing algal and macrophyte growth.
Improved Flood Hazard Management
Reduces downstream flooding from reduced speed of stormwater discharges.
Attenuates peak flooding through surface water drawdown from mature tree root biomes.
Riparian vegetation delays input of water into the floodplain and delays backwater drainage.
Increases floodplain capacity by reducing saturated surface soils from deep rooted trees.
Streambank Stability
Enables root structure along river banks to maintain slope and bank stability
Reduces bank erosion from tree canopy and leaf litter detritus absorption of rainfall impacts
Plant roots provide cohesion to riparian soils reducing soil collapse.
Improves bank stability on steep slopes from large tree deep root systems.
Reduces pesticide use which improves effectiveness of riparian vegetation in stabilizing soils.
Stream Flow Benefits
Improves stream flow from groundwater recharge in periods of low precipitation.
Active and Passive Recreation
Improves active river based recreation activities with improved water quality.
Improves the scenic beauty and passive recreational benefits of surrounding area.
Reduces fragmentation of forest systems along river corridors improving wildlife habitat.
Provides important mental and physical refreshment,
Creates tourist attractions that support local economies.
Wildlife Benefits and Migratory Pathways
Enables migratory pathways for many species of wildlife.
Controls pests in adjoining agricultural lands, by presence of mammals, birds & invertebrates.
Provides natural windscreens for agricultural crops and livestock from extreme heat & cold.
Supports wildlife habitats at ground level from moderated temperatures in forested corridor.
Increases leaf litter discharge to rivers that, once decomposed, serves as food for invertebrates which in turn
Bank erosion has benefits, some erosion keeps major channels open and replenishes stream substrate essen-
Improves biological diversity which is a reservoir for genetic variability critical to species.
Riverbank tree canopy supports temperature sensitive fish habitats from thermal pollution.
Micro-Climate Benefits
Moderates summertime temperatures from riparian vegetation evapotranspiration.
Positively influences two key climate change concerns; temperature and water availability.

Appendix 2: Upland Review Areas in the Inland Wetland Regulations of Western Connecticut

Municipality	Watercourse	Wetland	Designated Rivers*	Designated Lakes*	Designated Public Water Supply reservoirs	Public Drinking Water Supply or Tributary	Lands in Public Water Supply Watersheds	Ponds, Lakes Streams in Water Supply Watersheds	Designated Steep Slopes	Vernal Pool	Land Use Based Reviews
Bethel	100	100	None	None							
Bridgewater	100	100	200	None					Yes		
Brookfield	100	75	200	200					Yes		
Danbury	100	100	200	200	200						
Darien	50	50	100	100							
Greenwich	100	100	None	None	200				Yes		
New Canaan	50	50	None	None		100			Yes		
New Fairfield	150	150	200	200	200				Yes		
New Milford	100	100	200	200							
Newtown	100	100	None	200							
Norwalk	100	50	None	None					Yes		
Redding	150	100	200	200						500	
Ridgefield	100	100	150	150						150	
Sherman	100	100	150	200							
Stamford	25	25	None	None			50	100			
Weston	100	100	None	None							
Westport	20/75	20/75	None	None					Yes	100	Yes
Wilton	100	100	None	None					Yes		

*Designated Lakes and Rivers

Bridgewater regulates within 200 ft. of high waterline of Lake Lillinonah, Housatonic or Shepaug Rivers.

Brookfield regulates within 200 ft. of the mean waterline of Candlewood Lake, Still River, or Lake Lillinonah.

Danbury regulates within 200 ft. of mean high waterline of Candlewood Lake, Lake Kenosia, Still River, water supply reservoirs.

Darien regulates within 100 ft. of Holly Pond or Gorham's Pond, or mean high water line of the Noroton, Five Mile, or Goodwives Rivers, or Tokeneke, or Stony Brook.

New Fairfield regulates within 200 ft. from mean water line of Lake Candlewood, Squantz Pond, Ball Pond, Marjorie Lake Reservoir, and mean water line of Ball Pond Brook.

New Milford regulates within 200 ft. of ordinary high waterline of Candlewood Lake, Aspetuck (east & west branch), Still and Housatonic Rivers or watercourses within West Aspetuck River watershed.

Newtown regulates within 200 ft. from ordinary high water mark of Taunton Pond, Lake Zoar, or Lake Lillinonah.

Redding regulates within 200 ft. of mean water line of Norwalk, Saugatuck, Aspetuck, and Little Rivers; of Great, Umpawaug, Steichen's, Factory, Sterritt's South Falls, and Hedmond's Ponds; Mirror Lake and Saugatuck Reservoir

Ridgefield regulates 150 ft. from spring high water mark of Norwalk, Saugatuck; Silvermine & Titicus Rivers & Mamanasco Lake.

Sherman regulates within 200 feet of mean high waterline of Candlewood Lake, including Squantz Pond; within 150 feet of Lake Mauweehoo, Timber, Valley & Spring Lakes; Deer, Pepper, Green, & Haviland Mill Ponds; and Quaker Pond North and South; within 150 of Ten Mile and Housatonic Rivers; within 150 feet of Saw Mill, Tollgate, Greenwoods, Glen, Wimisink, Quaker, and Naromiyocknowhusunkatankshunk Brooks, and their tributaries.

Appendix 3: Riparian Setback Standards Adopted by New England States: 2021

State	State Law Establishing Buffer Zone	State Law Establishing Minimum Setbacks
Connecticut (1995)		
Regulate activities adjacent to wetlands**	No	No
Regulate activities Adjacent to Rivers and Streams**	No	No
Maine (2002)		
Regulate activities Adjacent to Wetlands		75
Regulate Shore lands of Rivers		250
Regulate activities Adjacent to Streams		75
Principal Structure Setback 12 Significant River Segments		125
Shore & Protection Sub-Dist. Rivers draining 50 sq. miles+		250
Massachusetts (1996)		
River Front protection corridor for perennial streams	200	
River Front protection in 14 designated Urban Areas	25	
New Hampshire (1988, 1990)		
State established buffer zone	250	
Setbacks for 4th order streams and Higher		150
Setbacks for Primary Structures on 1st to 3rd order Streams		50
Setbacks for Accessory Structures		20
Setback for Woodland Buffer*		50
Setback for controlled release fertilizers		25
Setback for all other fertilizers		50
Setbacks for New Auto Junk Yards***		50/250
Setbacks for applicator license applied Pesticides		50
Rhode Island (2015)****		
Buffer zones for Swamps of 3 acres or more	100	
Buffer zones for Marshes of 1 acre or more	100	
Buffer for Rivers, Streams & Intermittent streams < 10 ft. wide	100	
Buffer for Rivers, Streams & intermittent streams > 10 ft. wide	200	
20 Designated Drinking Water Supply Reservoirs	200	
Rivers in watershed of public drinking water supply reservoirs	200	
76 Designated Rivers in Regions 1&2	200	
33 Designated rivers in Regions 1&2	150	
All Streams in River Protection Zones 1&2	100	
Swamps & Marshes of any size in Urban region	100	
3 Designated rivers in Urban region	150	
14 designated rivers in Urban region	100	
Ponds contiguous to river in public drinking water watershed	100	
15 designated Ponds greater than 10 acres	50	
Vermont (2015)		
Setback from streams less than 2 square mile watershed		50
Setback from stream s more than 2 sq. mi. watershed		100

*25% of woodland buffer between 50 & 150 feet remains unaltered (RSA 483-B:(V(b))

**Buffer zone recommendations established by CTDEP policy in 1997.

***Auto Junk yards on streams (1st to 3rd order) designated before 2015 are setback 50 ft. On streams designated after 2015, auto junk yards are setback 250 ft.

**** Rhode Island's wetland regulations implement a 2015 law. Table reflects the final rule.

Appendix 4: Impervious Cover – The Wild West of Connecticut Zoning Regulations

During the last twenty-five years, there has been an upsurge of interest in controlling stormwater run-off through revisions to traditional lot cover standards. Lot cover standards restrict the amount of a lot that can be developed based on the footprint of buildings and accessory structures. In the late 1980s, as greater emphasis was being placed on stormwater management concerns, many of Connecticut's planning and zoning commissions modified lot cover standards to include pavement and sidewalks within the traditional lot cover definition.

What is Impervious?

More recently, municipalities have established separate impervious cover standards that addresses building footprints, impervious pavement such a driveways and sidewalks and other structures such as Astro turf, semi-pervious pavers, swimming pools, decks, patios, stone walls and other items that interfere with natural recharge of groundwater. Today, 111 Connecticut municipalities have developed lot cover, building cover or impervious cover standards to address the broader concerns caused by manmade materials that interfere with groundwater recharge. Because there is not statewide model zoning regulation nor a statewide dictionary for commonly used zoning terms, there is a relatively wide disparity in the application of three terms building cover, lot cover, and impervious cover. As can be seen in Table C, within the eighteen western Connecticut municipalities, there is virtually no agreement on what constitutes impervious cover. For example, should pervious pavement be included in the definition of impervious cover and, if so, what level of imperviousness should be applied to such materials? Similar challenges also apply to outdoor decks and ground mounted solar panels that cover the ground but leave most of the earth beneath these structures undisturbed. Should these structures be exempted or should there be a focus on only that part of these structures that penetrates and/or is immediately on top of the surface of the earth?

Resolving the practice and principles of imperviousness is not a problem unique to Western Connecticut. The WestCOG analysis of the state's 167 municipalities with zoning regulations found a similar level of inconsistent application of the three terms. Rather than having each municipality reinvent the appropriate definition for impervious cover, the Office of Policy and Management should take responsibility to development a dictionary of zoning terms. This is not a new idea. Other New England states have already taken this approach (e.g., Vermont and Maine) and Connecticut could benefit from adopting a similar strategy.

How are Impervious Cover Standards Applied?

It is not simply that zoning commissions lack a standard zoning dictionary, they also have widely different understandings of the purpose for impervious cover standards. Amongst 44 zoning commissions that have adopted comprehensive town-wide standards, 20 have adopted one size fits all standards for impervious cover regardless of lot size, 20 have adopted impervious cover standards that decline in inverse proportion to the lot size; three had no impervious cover standards for residential development and one municipality assigned a higher percentage of allowable impervious cover to larger lots than smaller ones (Table A). There appears to be little substantive ecosystem based evidence behind these zoning standards other than to mimic the traditional application of lot cover standards with a buffer factor reflecting the increased percentage of lot cover anticipated by the use of an impervious cover standard versus a traditional lot cover standard. The growing body of scientific evidence points to the water quality concerns when impervious cover exceeds 11% at a watershed level of analysis. The issue at hand is weighing the rights of property owners to make reasonable use of their land versus the public

interest of limiting the unintended consequences of development that adversely affects surface water quality, erosion and sedimentation of rivers and streams and increased flood hazard from diminished groundwater recharge.

	Impervious Cover (IC) Applications in Connecticut Zoning Regulations	Number of Municipalities
Definitions for IC	Define Lot or Building Cover to Include Impervious cover	28
	Define Impervious Cover as a New Zoning Concept	83
	Total Municipalities that Define Impervious cover	111
	Total Municipalities that Do NOT Define Impervious cover	56
	Total Connecticut Municipalities with Zoning Regulations	167
IC Applies to	Do not Regulate Impervious Cover as a Zoning tool	43
	Regulate Impervious Cover as a Zoning tool without Defining IC	13
	Regulate Impervious Cover as a Zoning Tool with Definitions for IC	111
	Total Connecticut Municipalities with Zoning Regulations	167
IC Applies to Zones*	Regulate Impervious Cover in only one zone	18
	Regulate Impervious Cover in Commercial and Industrial Zones	10
	Regulate Impervious Cover in some but not all Zones	35
	Regulate Impervious Cover in all Zones	44
	Do not regulate impervious Cover in any Zone and are without IC Definition	56
	Total Connecticut Municipalities with Zoning Regulations	167

Note:* This portion of the analysis of IC standards applied to zoning district was limited to municipalities with explicit impervious cover definitions.

Source: WestCOG staff analysis of the regulations for the 167 municipalities with zoning.

Impervious Cover Standards in Western Connecticut

Half of the municipalities in Western Connecticut (9) have adopted impervious cover standards for residential single-family zones and eight have adopted standards for commercial and industrial zones. However, of the 381 zoning districts that exist in Western Connecticut only 112 of these districts have impervious cover standards (Table B). Impervious cover standards are a relatively new zoning concept and it is apparent that the appropriate district level thresholds will need to be refined in the years ahead. The value of establishing impervious cover standards should be based on specific environmental protection parameters such as the value of; 1) groundwater recharge, 2) riparian corridor protection, 3) water quality protection, 4) reduction in thermal pollution (e.g., the urban heat island effect) and 5) reduction in flood hazards.

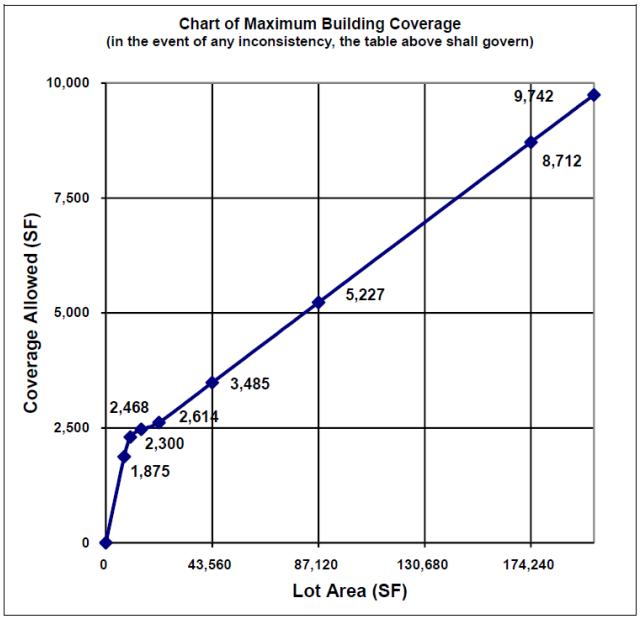
It is important to recognize that while most Western Connecticut municipalities have adopted impervious cover standards that are fixed regardless of the size of the lot in any given zone, several have established lot cover or building cover standards that vary by the size of the lot regardless of the zone in which they are located. Specifically, Ridgefield and New Canaan vary lot cover and building cover respectively by the size of the lot – not by the zone in which the property is located. To accomplish this "property specific" regulatory approach, these two municipalities use nomographs that enable a landowner to determine the maximum lot cover or building cover allowed based on the size of the lot in square feet (see New Canaan nomograph below). While the Ridgefield and New Canaan approaches

do not offer a nomograph for impervious cover standards, it could be useful develop a comparable tailor made approach for impervious cover standards to address the wide range of lot sizes that exist in any given zoning district.

A third approach is that used in Greenwich based on a "green area" standard that functions as the inverse of an impervious cover standard. For example, rather than limiting impervious cover to 28% in the town's RA-1 district, the Green Area standard requires that 72% of the lot meet "green area" standards that emphasize vegetation as the goal rather than minimizing pavement. The Greenwich approach is the most innovative approach to regulating impervious cover in the state of Connecticut and should be an important model for other municipalities concerned with the loss of vegetation, tree cover and diminished groundwater recharge due to excessive paving or overly compacted soils.

New Canaan Connecticut Nomo graph to Determine Maximum Building Cover

(Note: Building Cover Does Not include impervious surface cover in New Canaan)



A Strategic Perspective on Build-Out Conditions

The wild-west approach to regulating impervious cover at the municipal level merits statewide guidance concerning the appropriate standards given the need to 1) provide a variety of land use activities to support the needs of the marketplace, 2) assure reasonable protection of property rights and 3) to protect water quality and reduce flood hazards in the state. With the possible exception of Guilford, there is no evidence that municipal impervious cover standards have considered the long-term consequences of the varied standards that have been adopted on the ecosystem in general and riparian corridors in particular. To accomplish such a task would require each municipality to undertake a build out analysis of their community based on current development standards and to determine the measures that may be needed to mitigate overly liberal impervious cover standards applied to commercial, industrial and residential zones in Connecticut. The municipal impervious cover standards that exist today, with few exceptions, appear inconsistent with long term environmental planning strategies to retain

rainfall onsite. The uncertainty lies in the unknown mitigating benefits provided by the future development of riparian corridors, revised impervious cover standards for the most problematic land uses (i.e., commercial and industrial development) and the adoption of stormwater control measures that compensate for the lack of pervious ground cover in the urbanized portions of the region and the state. Since most of the land in Connecticut is zoned for two acre or larger size lots, the challenge for most municipalities is not overdevelopment but the adoption of more energy efficient patterns of development that reduce the overall miles of roads and driveways needed to serve any future build-out scenario. Since roads, driveways and sidewalks are a significant component of the impervious land cover, cluster development, more compact development and low impact development strategies need to be made mandatory and not discretionary zoning strategies. The marketplace, in the form of real estate practice in Connecticut, needs to be directed toward the new paradigm. Excessive reliance on traditional paving solutions to create vehicular, biking and walking routes need to be replaced with more ecosystem friendly low impact development alternatives.

Table A. Impervious Lot Cover Standards in Connecticut Municipalities with Town-wide Standards

Municipality	Industrial Zones	Commercial and Business Zones	Impervious Cover (IC) Standards for Single Family Zones				
			Residential Under 20K Lot Size	Residential 20K-39K Lot size	Residential 40K-79K Lot Size	Residential 80K-173K Lot Size	Residential Higher than 173K Lot Size
Andover	50	50		10	10	10	
Bethany	75	75			15	15	
Bethel	35-50	None	30	20	10	7.5	
Bolton	65	50-65		20	20		
Bridgeport*	50-100	85	80				
Brookfield*	75	75	25		10	10	
Canton	50	50	50	50	40	30	20
Clinton	75	60-90	20	15	10	10	
Coventry	None	60			20	15	
Darien	None	None	20	20	20	20	
Deep River	40	50-70		20	15	15	
Durham	25-40	40		20		12	
East Haddam	50	60		20	20	10	10
East Hampton	50	50-75		20	10	10	
East Windsor	75	60-65		25	25	25	
Goshen	None	25		20	25	25	10
Haddam	25-30	40			15	10	
Hamden*	60	80	35	25	20	20	
Harwinton	50	50				15	
Killingly	70	60-65	30	20		15	
Killingworth	50	40				20	
Ledyard	80	12		30	25		
Lyme	None	50			10	10	12
Marlborough	60	60			20	20	
New Fairfield	65	50			25	25	
North Branford	30-80	60-80			30	30	
North Stonington	70	60		20	20	15	
Old Lyme	40	55-60	30	30	30	30	
Orange	40	25			30		
Pomfret	None	60				35	30
Prospect	70	70			30	30	
Salem	50	50			None	None	None
Somers	60	60		25	25		
Stamford*	80	30-80	25	15	25	10	
Stratford	70-80	70-80	None	None	None		
Thompson	60	60		20	20	20	
Torrington	75	75	None	None	None	None	None
Warren	10 to 20	10 to 20			20	15	
Washington	None	25			15	12.5	10
West haven	30-40	55-100	15	10			
Weston	None	15				15	
Willington	25	15				15	
Wilton	None	20-30					
Winchester	None	75				15	
Windham	70-80	25-70	20			15	
Average	**60**	**51**	**32**	**22**	**20**	**17**	**15**

Note: Coventry has a 10% IC standard for its Lake Residence zone & East Hampton has 15% IC in the 1 acre Lake Dist.
Note: Torrington has IC standard for non-residential uses in Residential Zones – Not for residences.
Note: Washington has IC standard of 10% for 2 acres lots: Warren has 10% IC standard for lots 10 acre lots
Note: Ledyard has 20% IC standard in R60 zone.
*These towns have 2 or more IC standards for lots under 20K. The most liberal standard is presented.

Table B. Impervious Lot Cover Standards in Zoning Regulations of Western Connecticut: 2021

Municipality	Zones Governed by Impervious Cover Standards	Total Municipal Zones	Exclusive Single Family Residential Zones with Impervious Cover Standards	Total Exclusive Single Family Residential Zones in each Municipality	Are Single Family Residential Zones Governed by Impervious Cover Standards?	Do Commercial and Industrial Zones Have Impervious Cover Standards?
Bethel	8	19	6	6	Yes	No
Bridgewater	6	6	2	2	Yes	Yes
Brookfield	9	21	6	6	Yes	Yes
Danbury	6	28	3	4	Yes	No
Darien	17	29	0	10	No	Yes
Greenwich	7	33	7	11	Yes	No
New Milford	1	28	1	6	No	No
New Canaan	2	21	0	8	No	No
New Fairfield	7	10	4	4	No	Yes
Newtown	13	24	0	4	No	Yes
Norwalk	0	31	0	9	No	No
Redding	10	12	4	4	Yes	Yes
Ridgefield	4	22	0	9	No	No
Sherman	0	4	0	2	No	No
Stamford	9	40	6	6	Yes	No
Weston	2	2	1	1	Yes	Yes
Westport	1	36	1	9	No	No
Wilton	10	15	3	3	Yes	Yes
Total	**112**	**381**	**44**	**104**	**9 Yes**	**8 YES**

Note 1: HOD = Housing Opportunity Development; CBD = Central Business District; NB= Neighborhood Business; B-1 = Business 1 District; MH = Milliport Housing Zone; CPH = Canaan Parrish Housing; MRCCS = Mill River Cluster Conservation Subdivision District; WP = Water Protection Zone which is an overlay zone over six sectors of single-family development in Danbury.
Note 2: Single Family zones are considered exclusive if they do not permit two-family or multi-family residences.

Table C. Zoning Criteria for Lot Coverage and Impermeable Surface Cover in Western Connecticut

Criteria	Municipalities																		
	Bethel	Bridgewater	Brookfield	Danbury	Darien	Greenwich	New Milford	New Canaan	New Fairfield	Newtown	Norwalk	Redding	Ridgefield	Sherman	Stamford	Weston	Westport	Wilton	Total
Outside Storage Areas					1					1									2
Roofed Buildings	1	1			1	1			1	1	0	1	1	0	1	1	0	1	11
Roofs			1												1				2
Structures						1			1						1	1		1	5
Driveways			1		1	1				1			1		1			1	7
Driveways Paved									1			1							2
Driveways Unpaved									1										1
Parking Areas/Lots		1	1		1	1				1			1					1	7
Pavement or Paved Areas	1		1						1			1				1		1	6
Roadways									1			1			1				3
Covered Decks						1													1
Handicapped Areas															1				1
Loading & Unloading Areas										1									1
Patios & Other Impenetrable Material													1						1
Patios -Covered					1	1													2
Porches						1													1
Sidewalks			1		1				1	1		1			1				6
Terraces					1							1							2
Walkways					1														1
Artificial Soil Coverings (Astro Turf)															1				1
Courts - Similar Recreation to Tennis									1										1
Courts -Tennis						1			1				1						3
Courts-Basketball									1				1						2
D139 Plastic Turf reinforcing grids						1													1
Hard Surface Recreation Areas												1	1						2
Impervious Surface Treatment																		1	1
Impervious Surfaces - Other	1		1						1	1									4
Man-Made Surface Inhibiting Water				1		1			1										3
Surface Structure		1																	1
Asphalt													1						1
Asphalt - Porous						1													1
Brick													1						1
Concrete	1												1						2
Concrete - Porous						1													1
Concrete grid Pavers						1													1
Masonry walls												1							1
Pavers													1						1
Pavers-Permeable, Interlocking Concrete						1							1		1				3
Stone													1						1
Pool Coping						1													1
Swimming Pools			1			1			1			1							4
Total	**4**	**3**	**7**	**1**	**8**	**16**	**0**	**0**	**13**	**7**	**0**	**9**	**13**	**0**	**9**	**3**	**0**	**6**	**99**

Appendix 5: An Analysis of Riparian Buffer Protections in New England States

With the exception of Connecticut, the other New England states have adopted state legislation that establishes explicit riparian setback standards for rivers and streams. In the case of Connecticut, in 1997 the Connecticut Department of Environmental Protection issued policy recommending a 100 foot upland review area. However, this policy does not require local governments to adhere to it nor is it supported by state regulations requiring riparian buffer zones. In contrast, the other five New England states have established statewide laws and regulations with explicit riparian buffer zone dimensions applicable to all municipalities. With the exception of Rhode Island, that prohibits municipal regulation of riparian buffer zones, Massachusetts, New Hampshire and Vermont have regulations that authorize municipalities to establish local riparian buffer zones as long as they are as stringent, or more stringent, than those established by the state. Connecticut is the only New England state without explicit riparian buffer dimensions authorized by legislation or regulation.

Regulatory Approaches Vary but State Oversight of Riparian Corridors is a Common Theme

Maine mandates local governments to implement its Shoreland Protection Act requirements in strict compliance with the model regulation developed by the Maine Department of Environmental Protection or one that is just as stringent. Massachusetts also requires local conservation commissions to develop riparian buffer regulations that are as strict, or stricter, than those administered by the Massachusetts DEP. However, unlike Maine, municipalities in Massachusetts are not required to administer the commonwealth's River Front Area regulations if they are not so inclined. Similarly, Vermont does not require local governments to implement its River Corridor Protection Program but if they do so, it must be in compliance with the minimum standards established by the Vermont Agency for Natural Resources (ANR). Vermont also has a complementary initiative referred as the Flood Protection Program that provides financial incentives to those municipalities that develop floodplain regulations that exceed – and are more protective than – those established by FEMA. Vermont also implements its River Corridor Protection Program through its Public Act 250 land use review process giving a level of redundancy and increased oversight over development that might impact riparian corridors. New Hampshire encourages local government participation in its Rivers Management and Protection Program. According to the New Hampshire Department Environmental Services (NHDES), if a municipality wishes to regulate riparian buffer zones it must first obtain approval from NHDES. According to NHDES, "A river designation gives a river an extra level of state protection for significant instream river resources, particularly water quality and instream flows."

Because of the relatively small size of the state of Rhode Island, in 2015 the Rhode Island legislature removed municipal control over riparian buffers and assigned full responsibility for its Freshwater Wetland program to the Department of Environmental Management (RIDEM). With only 39 municipalities in the state, this legislation established uniform riparian buffer zones statewide for each class of river, stream and wetland according to ecosystem zones established by RIDEM.

A Review of Riparian Corridor Protection in Connecticut

As can be seen in Tables D, E, and Appendix 3 Connecticut has the least stringent riparian buffer standards of any New England state. The CT DEEP does not require minimum riparian buffer setbacks since its legislative mandate only authorizes an upland review area – not a fixed setback standard. Similarly, Connecticut's zoning enabling legislation makes no mention of riparian buffer zones or setbacks although it is clear that this statute permits such regulations to be enacted under the broad authority to

make "reasonable consideration for the protection of existing and potential public surface and groundwater drinking supplies" and now *mandates* municipalities contiguous to or on a navigable waterway draining to Long Island Sound to make "reasonable consideration for the restoration and protection of the ecosystem and habitat of Long Sound." Yet despite any explicit reference to riparian corridor protections in the zoning enabling statute, thirty eight municipalities have adopted home grown standards (table G).

Despite the limited role played by zoning commissions in the protection of Connecticut's watercourses, fifty three of the state's 169 municipalities have established inland wetland and watercourse regulations that exceed the CTDEEP's recommended 100 foot upland review area (see table F). It noteworthy that fifteen of these more progressive municipalities are also ones that have established riparian buffer zones in their zoning regulations. There are three disadvantages created by Connecticut's discretionary upland review area procedure compared to fixed width riparian buffer setbacks; 1) negotiations over development proposals in upland review areas tend to create a bias toward accommodation rather than disapproval; 2) arguably the overwhelming scientific evidence supporting the critical value of riparian buffer zones eliminates the need for case by case analysis of development proposals - especially when explicit exemption procedures can be adopted to deal with concerns about land takings or de-minimis riparian impact situations; and 3) without objective standards for what land uses and activities are allowed in a riparian buffer zone applicants are uncertain how to comply thereby increasing transaction costs. The other New England states have largely overcome these three shortcomings through 1) explicit statewide standards, 2) explicit procedures for addressing non-conforming uses and 3) explicit procedures for uses that may be allowed in the buffer zones. The success of the riparian buffer zone standards adopted in the other five New England states provide useful examples for how Connecticut can update its riparian corridor protection program – whether managed by inland wetland agencies, planning and zoning commissions or both.

However, to create an effective riparian buffer zone system, using zoning as the preferred instrument for implementing a river protection program, will require a significant investment in training and education of town planners, town attorneys and the lay commission members who volunteer their time and expertise to managing Connecticut's zoning regulations. The path forward is best achieved by duplicating the success stories found in Massachusetts, Maine, New Hampshire and Vermont where significant state resources have been made available to create more uniform statewide riparian buffer zone regulations coupled with education and outreach programs to local governments.

With the exception of Connecticut, the other New England states require riparian buffer zones either by state mandate implemented locally (Maine) by state regulation with an option for more stringent local regulations (Massachusetts, New Hampshire and Vermont) or by exclusive state management of the program (Rhode Island). These five states have explicit state defined riparian buffer setback standards based on the ecological significance and functional classification of the rivers and streams in each state.

Table D. Riparian Buffer Zones in New England States at the State and Local Levels: 2021

State	Municipalities with Riparian Buffer Setback Regulations	Municipalities Governed by State Administered Riparian Buffers	Municipalities in State	Percent with Local Riparian Buffer Regulations	Percent with State Riparian Buffer Regulations
Connecticut	38	0	169	22%	0
Maine	488	488	488	100%	100%
New Hampshire	147	234	234	63%	100%
Massachusetts*	31	351	351	9%	100%
Vermont	97	246	246	39%	100%
Rhode Island	0	39	39	0%	100%
Total	**801**	**1358**	**1527**	**52%**	**89%**

Note:* Massachusetts municipalities regulate riparian buffer setbacks through Conservation Commissions – not municipal zoning.

Table E: Authority and Administration of Riparian Buffer Zones in New England States: 2021

State	River Protection Program	Who Sets Minimum Buffer Standards	State Allows More Stringent Local Riparian Buffer Regulations?	State Mandates Local Govt. Buffer Regulations?
Connecticut	Inland Wetlands/Watercourses	IWA/ZC	Yes	No
Maine	Natural Resource Protection	MEDEP	Yes	Yes
New Hampshire	Protected Shore Land	NHDES	Yes	No
Massachusetts	River Front Area	MADEP	Yes	No
Vermont	River Corridor Protection	VTANR	Yes	No
Rhode Island	Freshwater Wetlands Act	RIDEM	No	Prohibited

IWA = Inland Wetland Agency; CC = Conservation Commission; ZC = Zoning Commission
RIDEM = Rhode Island Dept. of Environmental Management; NHDES = New Hampshire Dept. of Environmental Services;
MADEP = Massachusetts Dept. of Environmental Protection;
VTANR = Vermont Agency for Natural Resources; MEDEP= Maine Dept. of Environmental Protection.

Table F: Inland Wetland and Watercourse Regulations for Riparian Upland Review Areas Exceeding Connecticut DEEP Minimum Standards

Connecticut Municipality	Watercourse	Wetland	Designated Rivers	Streams & Brooks	Sensitive Streams	Intermittent Streams
Andover	100	100	200	200		
Ashford	100	100	200	150		
Bethany	150	150				
Bridgewater	100	100	200			
Brookfield	100	75	200			
Brooklyn	175	125				
Chaplin	100	100	200			
Cornwall	150	150				
Coventry	75	75	150			
Cromwell	100	100	200			
Danbury	100	100	200			
Darien	50	50	100			
East Hampton	100	100	150			
East Lyme	300	300				
East Windsor	150	150				
Easton	100	100	200			
Enfield	100	100	200	200		
Fairfield	varies	0	90	106		
Farmington	150	150				
Glastonbury	150	150	150	150		
Greenwich	150	150				
Groton	100	100		150	200	
Hamden	200	200				
Hartland	100	100	100			
Hebron	100	100	200			
Killingly	200	200				
Lyme	100	100	150	150		
Mansfield	150	150				
Marlborough	150	150	200	200		
Middlebury	100	100		150		
Monroe	100	100	150	150		
New Fairfield	150	150				
New London	100	100		200		
New Milford	100	100	200			
North Branford	100	100	200			
Pomfret	150	150	500	300		
Putnam	100	100	200			
Redding	150	100	200			
Ridgefield	100	100	150			
Roxbury	100	100	200			
Scotland	100	100	200			
Shelton	50	25	100	75		
Sherman	100	100	150	150		
Southbury	50	50	100	100		
Southington	100	50	100	100		50
Sterling	100	0	200			
Stratford	100	100	350	250		
Vernon	100	100	200	200		
Wallingford	150	50	200			
West Hartford	150	150				
Willington	100	100	150			
Windham	100	100	200	100		
Windsor	150	150				
Total	**53**	**51**	**37**	**19**	**1**	**1**

These 15 towns also have riparian setbacks in their zoning regulations.

Table G: Connecticut Municipalities with Riparian Setbacks in Zoning Regulations

Municipality	Designated Rivers	Purpose for the Riparian Regulation			
		Maintain Flood Storage		Protect Water Resources	
		Minimum Setback (feet)	Maximum Setback (feet)	Minimum Setback (feet)	Maximum Setback (feet)
Barkhamsted	Farmington			100	100
Canaan	Housatonic	125	3500		
Canton	Farmington			100	100
Chester	Connecticut			100	100
Cornwall	Housatonic			75	75
Cromwell	Connecticut & Mattabesset	50	5000		
Deep River	Connecticut			100	100
East Haddam	Eightmile			50	100
East Hampton	Connecticut & Salmon			150	500
East Lyme	All			100	100
Enfield	Connecticut			100	325
Haddam	Connecticut			100	100
Hartford	Connecticut			75	75
Hartland	Farmington			100	100
Hebron	Jeremy			100	100
Kent	Housatonic	300	1000		
Killingly	Five Mile			750	2900
Lyme	Eightmile			50	100
New Hartford	Farmington			100	100
New Milford	Housatonic	320	1700		
North Branford	Farm, Branford & 2 brooks	150	1500		
North Canaan	Housatonic			75	75
North Haven	Quinnipiac & Muddy			50	50
Old Lyme	Connecticut			100	100
Old Saybrook	Connecticut			100	100
Roxbury	Shepaug			100	200
Salem	Eightmile			50	100
Salisbury	Housatonic	75	1770		
Sharon	Housatonic			100	950
Sherman	Housatonic & Ten Mile			50	250
Stonington	Pawcatuck			100	100
Stratford	All			50	50
Suffield	Connecticut	125	1500		
Wallingford	Quinnipiac & Muddy			50	100
Wethersfield	Connecticut	500	5000		
Willington	Fenton			150	150
Windsor Locks	Connecticut	150	1200		
Woodstock	All			100	100

Note: The riparian setback distances for the nine municipalities with flood storage based setbacks and those for Enfield, Killingly, Sharon and Sherman, reflect the measured widths of FEMA floodplains for the narrowest and widest widths from the designated rivers.

Example Regulations

Appendix 6: Model Watershed and Riparian Corridor Regulations

1. Simple Model Riparian Zoning – Option 1 (Based on Stonington, CT)
2. Model River Setback Zoning – Option 2 (Based on Wallingford, CT)
3. Model Riparian Corridor Protection Zone – Option 3 (Based on Salem, CT)
4. Model Riparian Corridor Protection District – Option 4 (Based on Exeter, NH)
5. Model Watershed Protection Overlay - Option 5: (Based on Guilford & New Milford, CT)
6. Low Impact Development Model – Option 6 (Based on Waterford, CT)

Simple Model Riparian Zoning – Option 1 (Based on Stonington, CT)

Where development abuts the (insert name of rivers), a 100 foot non-infringement area shall be provided. Such non-infringement area shall remain undisturbed with the exception of any public trails, stormwater detention/retention ponds and/or wetland plantings required to renovate stormwater before entering the river. The use of pesticides and fertilizers within the non-infringement zone are prohibited except where an applicant can demonstrate that such applications are for existing agriculture following best management practices. In no case shall pesticides or fertilizers be applied within 25 feet of any designated non-infringement area.

Model River Setback Zoning – Option 2 (Based on Wallingford, CT)

Section 1: SETBACKS FROM BODIES OF WATER

1.1 Purpose - To provide erosion control, reduce flooding, improve water quality, benefit wildlife and reduce hypoxic conditions in Long Island Sound as mandated by Public Act 21-29. The Connecticut Department of Energy and Environmental Protection has declared that loss of riparian habitat and vegetation occurs when natural areas along rivers and streams are converted to developed land uses. Riparian, or streamside, corridors are environmentally important areas critical to stream stability, pollutant removal, and both aquatic and terrestrial wildlife habitat.

A. No building shall be constructed within the Stream Encroachment Lines as set by the Connecticut Department of Environmental Protection.

B. Along the entire length of the following rives and tributaries (insert names of rivers and tributaries here) there shall be established a 100-foot greenbelt in single-family residential districts, and a 100-foot greenbelt in all commercial and industrial districts. The greenbelt area shall contain natural vegetation and where the Commission deems necessary additional plantings. The measurements of the greenbelt shall begin at the river's edge and move outward either 100 feet. Land disturbance shall be kept to a minimum within the greenbelt zone.

C. There shall be established a 50 foot buffer along the entire length of every lake, stream, brook, and other body of water within the Town that directly discharges through higher rivers into Long Island Sound.

D. There shall be established a 200 foot buffer along the entire length of every lake, stream, brook, and other body of water within the Town that falls within a public drinking water supply watershed, discharges into a public water supply reservoir or functions to recharge groundwater for public water supply aquifers.

E. Public multi-use trails which prohibit motorized vehicles and are less than 10 feet in width shall be permitted in the greenbelt.

F. It is prohibited to apply fertilizers and pesticides within 50 feet of any river, stream, brook or other body of water. Agricultural applications of fertilizers must comply with best management practices established by the New England Interstate Water Pollution Control Commission.

G. This section shall not apply to road, driveway or utility crossings.

Model Riparian Corridor Protection Zone – Option 3 (Based on Salem, CT)

Riparian Corridor Overlay Zone (RCOZ)

1. Purpose and Intent

The purpose of the Riparian Corridor Overlay Zone is to protect and enhance the functions and values of the riparian features of the following (Insert River Names) Rivers and their tributaries to minimize stormwater pollutants discharged into Long Island Sound. High levels of phosphorus and nitrogen from fertilizers, septic systems, agricultural practices and other nonpoint sources of pollution have resulted in hypoxic conditions in Long Island Sound. Undisturbed vegetative buffers along streams and rivers serve to reduce stormwater runoff and minimize pollutants entering the surface waters within the town of (insert town name). Public Act 21-29 requires municipalities contiguous to or on a navigable river draining to Long Island Sound to adopt zoning regulations that shall be made with reasonable consideration for the restoration and protection of the ecosystem and habitat of Long Island Sound; (B) be designed to reduce hypoxia, pathogens, toxic contaminants and floatable debris on Long Island Sound; and (C) provide that such municipality's zoning commission consider the environmental impact on Long Island Sound coastal resources, as defined in section 22a-93, of any proposal for development. The features of rivers and their tributaries are a key component of the largely intact watersheds and natural character of (insert municipality). In order to preserve a fully functioning aquatic system in the (Insert River Name) River Watershed and to prevent damage to the critical buffer area around its water bodies, the Riparian Corridor Overlay Zone is hereby established. Any use not specifically listed as permitted shall be considered prohibited.

Within the Riparian Corridor Overlay Zone, it is intended that there shall be a continuous buffer of native forest and shrubs around all watercourses consisting of a mix of trees, shrubs and herbaceous plants native to the region and appropriate to the environment in which they are to be planted or retained. Protection of a vegetated buffer around watercourses is crucial for public health, safety, and welfare because the buffer regulates water flow, preserves diversity and abundance of wildlife species and habitat, protects water quality and maintains important cultural and historic features of the Town. Specific functions include:

Regulation of water flow:

a. Promotes water infiltration and groundwater discharge.
b. Reduces flooding.
c. Reduces streambed scour.

Preservation of wildlife habitat:

a. Provides a unique habitat that supports a diverse species assemblage.
b. Shades, filters, and moderates stream flow, improving habitat for fish and other aquatic organisms.
c. Provides an effective travel corridor for terrestrial wildlife.

Protection of water quality:

a. Reduces sedimentation.
b. Filters out pesticides, heavy metals, and bio-contaminants.
c. Removes excess nutrients that lead to the deterioration of water quality, including nitrogen and phosphorus, which leads to eutrophication and hypoxic conditions in Long Island Sound.

d. Prevents erosion through bank stabilization by vegetation.

Preservation of views:

a. Provides a screen that protects privacy of riverfront landowners.
b. Enhances landscape diversity resulting in improved aesthetics.

2. RCOZ Defined

The RCOZ includes all perennial rivers or streams in the (Insert watershed names) and the area landward and horizontal from the stream edge, for a distance of fifty (50) feet on either side of stream for smaller headwater streams and one hundred (100) feet on either side for larger streams and rivers as defined by the map described below. The Watershed is the land surfaces that drain into the following (Insert river names) Rivers. A stream edge is the ordinary high water mark, typically defined by vegetation or soil types that are distinct from the upland area. The proposed overlay zone does not apply to wetlands or vernal pools, which are not connected by surface flow to streams. The watershed and those streams to which this setback requirement applies are shown on a map entitled "Town of _____ Riparian Corridor Overlay Map, dated ____, effective _____" and filed in the Office of the Town Clerk.

3. Significant Activities within the RCOZ

No land-disturbing activity within the RCOZ established in Section 2 shall be permitted by the Planning and Zoning Commission, except in conformance with these Regulations. The Planning and Zoning Commission shall presume that such activity will have a significant adverse impact on the functions of the required RCOZ unless the Commission finds that there is no reasonably available alternative with less adverse impact on RCOZ functions, and that the project as proposed will not have a significant adverse impact on those functions.

4. Standards and Permitted Activities within the RCOZ

4.1 Vegetation Coverage: Within the RCOZ, wherever possible, not less than ninety (90%) percent of the total surface area shall be covered with live vegetation. Diversity of vegetation and forest stages is encouraged, including a mix of trees, shrubs and herbaceous vegetation not having invasive characteristics (as defined by the most recent version of the Connecticut Invasive Plant List [as authorized by Connecticut Public Act 03-136]). The list can be obtained from the Town Planner's Office. A variety of plant types is more effective at capturing a wide range of pollutants than a single vegetation type. Vegetation Management: In general, where suitable vegetation existed within the RCOZ before the effective date of this amendment, vegetation is to be left in a natural state.

4.2 The following activities are permitted as-of-right within the RCOZ:

(a) Mowing and maintenance of lawns, gardens, meadows, fields, and agricultural plantings that legally pre-existed prior to this regulation; continuation, but not expansion of, pre-existing farm practices.

(b) Removal or pruning of dead, dying, diseased, or invasive plants. Leaving some downed woody debris is also preferable to provide a greater variety of wildlife habitat unless the spread of plant diseases is a concern. If removal of healthy trees four (4) inches in diameter or greater at four (4) feet above the ground is proposed, there shall be a plan by a qualified forester which is subject to approval by the Commission.

(c) Construction and maintenance of one (1) unpaved meandering footpath per property not more than four (4) feet in width to provide non-motorized access to the water body.

(d) Fire prevention activities and emergency operations necessary for public safety and protection of property.

(e) Surveying and boundary posting, including fences, for the purpose of marking boundary lines, subject to any other applicable regulations.

(f) State and municipal utility improvements and operations for which activity within the RCOZ is unavoidable and necessary. This includes activities such as the replacement, rehabilitation or creation of infrastructure such as sewer, water, power lines, bridges, highway maintenance, and drainage facilities. Any activity within the Zone may be undertaken only if there is no practical and feasible alternative for provision of these services, and only if all measures will be taken to minimize any adverse impacts to natural features and the functions of the watershed. These activities are subject to all other applicable regulations.

(g) In areas where a diverse natural setback does not exist, landowners are encouraged to create, enhance or restore native vegetation and soil grades appropriate to the water resource being buffered. Replanting with native trees or shrubs is encouraged if natural regeneration is not sufficient to restore vegetative cover. A list of suggested native plants for riparian setbacks can be obtained from the Town Planner's Office.

(h) Removal of non-native invasive species and replacement by native vegetation. Invasive plants are those listed on the most recent version of the Connecticut Invasive Plant List (as authorized by Connecticut Public Act 03-136). The list can be obtained from the Town Planner's Office.

(i) Existing Activities: Existing structures or continuing activities that were legally and actively in existence before the effective date of this regulation, such as agriculture.

(j) Granted Permits: The building of new structures, modification of existing structures or commencement of activities that were granted all applicable permits before the effective date of this regulation.

(k) Septic System Maintenance: If a system has failed, repair/replacement must minimize encroachment on the RCOZ.

5. Activities Requiring Commission-Issued Zoning Permit

5.1 Activities listed below are allowed only by a Zoning Permit issued by the Planning and Zoning Commission as described in this regulation:

(a) Forest Management and Conservation Activities:

(1) Commercial activities must be carried out under the supervision of a licensed professional forester, forest ecologist, or wildlife biologist in accordance with a written forest and/or wildlife management plan that addresses such issues as the location and construction of logging roads, wetland crossings, equipment use, forest regeneration and wildlife habitat. The forest management plan should provide for maintaining a healthy forest understory and succession to a natural wooded or other permitted state in the RCOZ. Forest harvest practices must leave a full and natural tree canopy over the watercourse. They shall follow DEP "best management forestry practices" as detailed in Best Management

Practices Connecticut Field Guide, as may be revised from time to time, for all forestry practices including stream crossings.

(2) Clearing or maintenance of existing or abandoned woods roads for the purposes of habitat management, firewood cutting, agricultural or timber access or other access needs under the following conditions: follow current best management practices for erosion control.

(3) Forest harvest practices must allow for and enhance regeneration of a predominantly woody state. All activities must account for restoration and enhancement of natural ecosystems and wildlife habitat.

(4) Leave full and natural tree canopy over the watercourse.

(5) There shall be no removal of more than twenty-five (25%) percent tree canopy within the RCOZ at any given time, and there shall be no removal of more than twenty-five (25%) percent of standing trees within any given size category within any one (1) acre area with the exception of wildlife clearings described in #(1) and #(2) above.

(6) There shall be no activity within twenty-five (25) feet of the high water mark of any watercourse, and there shall be maintained a seventy-five (75%) percent canopy cover for the RCOZ at all times.

(7) DEP's Best Management Practices Connecticut Field Guide, shall be followed for all forestry practices including stream crossings.

(8) All activities shall follow a written plan approved by the Commission.

(b) New or expansion of existing agricultural activities under the following conditions: following current best management practices for erosion control, fertilizer application and run-off prevention, not exceeding in size ten (10%) percent of the total area of the portion of the lot that falls within the RCOZ, providing not less than twenty-five (25) feet of natural and/or undisturbed vegetative buffer between the agricultural activity and the stream edge.

(c) Clearing of vegetation from recently abandoned agricultural fields for the purpose of agriculture or non-commercial activities under the following conditions:

(1) No less than twenty-five (25) foot buffer of live native or undisturbed vegetation remains between the clearing and the watercourse, and

(2) Clearing does not require the cutting of saplings over one (1) in dbh (diameter at 4.5 feet from ground).

(d) Clearing or maintenance of existing or abandoned woods roads for the purposes of habitat management, non-commercial firewood cutting, agricultural or timber access or other access needs provided that current best management practices for erosion control are followed.

(e) Building of fences outside a twenty-five (25) foot buffer of a stream. Fences must not block or impair the movement of wildlife or water within the RCOZ.

(f) Other land-disturbing activities occurring outside of a twenty-five (25) foot buffer of a stream and resulting in less than one hundred (100) square feet of land-disturbing activity in total and having an insignificant impact on the purposes of the RCOZ.

(g) Construction and maintenance of more than one (1) unpaved footpath per property not more than four (4) feet in width to provide non- motorized access to the water body. The construction or maintenance of footpaths must be done in such a manner that it does not result in erosion or the creation of a channel of surface runoff.

(h) Stream crossings not requiring structures or excavation of any kind, for the purposes of footpaths and equestrian trails for the purposes of recreation and non-motorized property access. In general, stream crossings at grade are discouraged. Within reason, crossings must be implemented at a point in the stream with a relatively narrow streambed and flat approach from the bank. Reinforcement of the bank and streamside with areas is encouraged and may be required if conditions warrant. Loose stone and other materials may not be placed in the stream without a plan from an engineer, hydrologist or other approved expert. Stream crossings may not block natural connectivity of aquatic or terrestrial life including, but not limited to, fish passage and may not alter, or cause to be altered, the stream width or flow type.

5.2 Planning and Zoning Commission Permit Process

(a) Application for Permit: The applicant shall include, at a minimum, a written description of the site, including slope, current vegetation coverage, current use, and proposed activity, and erosion and sedimentation control measures, as well as any other relevant features and such additional documentation as deemed necessary by the Commission.

(b) Application Fee: Each application for a Zoning Permit to be considered by the Commission shall be in accompanied by a fee payable to the Town of (Insert name of town) in accordance with the schedule adopted by the Commission.

(c) Approval of Permit: Application for a Zoning Permit under the RCOZ shall be granted only by the Planning and Zoning Commission.

5.3 Specific Standards for Zoning Permit in the RCOZ

The Commission shall issue a Zoning Permit only for activities as described above in Section 5.1 which shall have an insignificant impact on the purpose of the RCOZ. The Commission shall instead require a Special Permit as described in Section 6 if the application proposes excavation, the building of structures or the installation of any impervious service.

The Commission may require a Special Permit for any of the activities above in Section5.1 if the Commission finds that the circumstances of the application (such as soil type or slope, past disturbance in the area, other recent permits or activities within the same area of the RCOZ or any other circumstance) warrant a Special Permit application.

6. Activities Permitted by Special Permit

6.1 Activities listed below are allowed only by Special Permit. When the Special Permit results in disturbing or removal of the vegetative RCOZ, the Commission may require an expansion of the RCOZ in an alternate location to compensate for the loss of setback area due to the disruption.

(a) Building of new and/or accessory structures, modification of existing structures associated with lawfully existing single family, multi-family houses or commercial/industrial buildings where the Planning and Zoning Commission finds that alternatives outside the setback area are not available, provided that the size and impacts of the proposed structure or use have been minimized, and that the structure/use is located as far from the resource as possible. As mitigation, the Commission may require that the applicant plant or maintain a naturally vegetated buffer of the maximum feasible width given the size, topography and configuration of the lot.

(b) Structures used for shoreline access, including, but not limited to, docks, boathouses, stairs, may be built after granting a Special Permit. The Special Permit application must demonstrate that the construction and installation of the proposed structure does not contribute to significant flow alteration, channel modification, alteration of water quality or create any other deleterious effects on the watercourse.

(c) Alteration of an existing activity located within a specific portion of the RCOZ that is already altered such that the RCOZ cannot be provided without the removal of pre-existing structures and/or pavement, provided that the proposed alteration will not increase adverse impacts on the specific portion of the overlay area and the applicant can demonstrate to the satisfaction of the Commission that there exists no feasible construction alternative.

(d) Stream crossings requiring structures or excavation of any kind for the purposes of recreation, property access, forestry operations, agriculture or other uses. Permanent crossings must follow the "Massachusetts River and Stream Crossing Standards: Technical Guidelines." Temporary crossings must follow the CT DEP publication "Best Management Practices for water quality while harvesting forest products 2007 Connecticut Field Guide" Chapter 5 – Stream Crossings. The Commission may use its discretion as to the requirement of "General" versus "Optimum" standards as defined by the "Massachusetts River and Stream Crossing Standards" document as a general guide. Stream crossings may not block natural connectivity of aquatic or terrestrial life including, but not limited to, fish passage.

6.2 Special Permit Process

(a) Application for permit: The applicant shall submit a site plan, prepared in accordance with Section (insert site plan reference) of these Regulations, and provide documentation demonstrating the need for a Special Permit, the efforts made to minimize disturbance to the functions of the RCOZ and water resources, or other documentation that may be reasonably requested by the Commission.

Model Riparian Corridor Protection District – Option 4 (Based on Exeter, NH)

1.1 Authority and Purpose: Pursuant to Connecticut Public Act 21-29 the Town of (insert name) hereby adopts the Riparian Corridor Protection District and accompanying regulations in order to protect and promote public health, safety and general welfare and to:

A. Protect, maintain and enhance the water quality of the (name of rivers), their tributaries within the watersheds in the Town, and to ensure the continued availability of a safe public water supply;

B. Protect, maintain and enhance the water quality of the Long Island Sound by reducing the use of phosphorus and nitrogen.

C. Protect, maintain and enhance the water quality of the in the Town through the use of low impact development.

D. Conserve and protect aquatic and terrestrial habitat associated with river areas as well as intertidal and riparian areas;

E. Preserve and enhance those recreational and aesthetic values associated with the natural shoreline and river environment;

F. Encourage those uses that can be appropriately located adjacent to shorelines.

1.2 Definitions:

A. Bulk Storage: Storage of materials intended for wholesale distribution or used in a manufacturing facility.

B. Contiguous Wetland: A wetland which extends landward from its adjacent waterbody to a point where a natural or manmade discontinuity exists. Contiguous wetlands include bordering wetlands as well as wetlands that are situated immediately above the ordinary high water mark and above the normal hydrologic influence of their adjacent waterbody. Such wetlands that fall within the Riparian Corridor Protection District shall be considered the inner edge of the riparian corridor. Man-made discontinuities in contiguous wetlands that fall within the riparian corridor protection district include dikes and barriers such as roads, etc. Natural discontinuities may be river berms, beach dunes, abrupt slope changes or abrupt changes in the soil material.

C. Fertilizer: Any substance containing one or more recognized plant nutrients which are designed for use in promoting plant growth such as nitrogen, phosphorus or potassium. Fertilizer as defined shall not include nitrogen- free soil-building products such as molasses, humic acid, kelp, soil biological stimulants, secondary macronutrients, micronutrients, and biological inoculums.

D. Hazardous and Toxic Materials: Includes but is not limited to volatile organic chemicals, petroleum products, heavy metals, radioactive or infectious wastes, acids and alkalis, pesticides, herbicides, solvents, and thinners, and such other substances in code of Federal Regulations 40 CFR 261.

E. Perennial Brooks, Streams, and Creeks: Brooks, streams and creeks that appear on U.S. Geological Survey quadrangle maps revised (7.5", scale 1": 24,000") covering the Town of (Name of town).

F. Residential Accessory Structure: A subordinate structure located on the same lot as the principal building, the use of which is incidental to the principal building, and discharges no sewage or other wastes.

G. Seasonal High Water Level (fresh): The average annual high water elevation of a stream, brook, or river, including contiguous wetlands and floodplains.

H. Shoreline (fresh): The water's edge at seasonal high water level.

1.3 District Boundaries: The Riparian Corridor Protection District is defined to include the following:

A. (Insert Name of River):

1. The area of land within 300 feet horizontal distance of the seasonal high water level of the River and its major tributaries. Major tributaries are defined to be the following: (insert names).

2. In addition, the area of land within 150 feet horizontal distance of the seasonal high water level of all perennial brooks and streams within the (insert name of River) Watershed and all other perennial brooks and streams.

1.4 Use Regulations:

A. Minimum Lot Size: The minimum lot size within the Riparian Corridor Protection District shall be the same as required in the underlying Zoning District and by applicable subdivision regulations for the Town.

B. Maximum Lot Coverage: Impervious surfaces, shall not cover more than ten percent (10%) of any lot or portion thereof within the Riparian Corridor Protection District as defined in 1.3. unless a Conditional Use Permit is granted by the Planning and Zoning Commission under the terms of Article 1.4.G.2 Riparian Corridor Protection District – Conditional Use.

C. Building Setbacks: No building (except a structure permitted as a Conditional Use, under Article 1.4.G. Riparian Corridor Protection District – Conditional Use or a permitted use under Article 1.4.I Permitted Uses) septic system or septic system leaching field, (except a repair or reconstruction) shall be constructed on or moved to a site within 300 feet from the shoreline of the (insert name of rivers); within 150 feet from the shoreline of the (insert name of rivers) or their major tributaries as herein defined, or within 100 feet of the shoreline of perennial brooks and streams located within the Riparian Corridor Protection District.

1. Exemptions: Prior to the date of adoption of this regulation, the following uses are exempt from the provisions of Article 1.4-C.

a. Septic Systems: septic systems or septic systems leaching field designs applied for with the State Water Supply and Pollution Control Boards as well as principal buildings associated with such uses.

D. Surface Alterations: Alteration of the surface configuration of land by the addition of fill or by dredging shall be permitted within 150 feet of the shoreline of the (insert names of rivers) or their major tributaries only to the extent necessitated by a permitted or conditionally permitted use.

E. Vegetative Buffer: Alteration of natural vegetation or managed woodland within 75 feet of the shoreline of the (insert names of the rivers) or their major tributaries shall be permitted only to the extent necessitated by a permitted or conditionally permitted use.

F. Prohibited Uses: The following uses shall not be permitted within the Riparian Corridor Protection District:

1. Disposal of solid waste (as defined by the Connecticut General Statutes other than brush.

2. On-site handling, disposal, bulk storage, processing or recycling of hazardous or toxic materials.

3. Disposal of liquid or leachable wastes, except from residential subsurface disposal systems, and approved commercial or industrial systems that are otherwise permitted by this article.

4. Buried storage of petroleum fuel and other refined petroleum products except as regulated by the CT Department of Energy and Environmental Protection). Storage tanks for petroleum products, if contained within basements, are permitted.

5. Outdoor unenclosed or uncovered storage of road salt and other de-icing chemicals.

6. Dumping of snow containing road salt or other de- icing chemicals.

7. Commercial animal feedlots.

8. Automotive service and repair shops; junk and salvage yards.

9. Dry cleaning establishments.

10. Laundry and car wash establishments not served by a central municipal sewer systems.

11. Earth excavation within 150 feet of (insert name of rivers) or their major tributaries. It is prohibited to conduct said excavation within four feet of the Seasonal High Water Table.

12. The use of fertilizer is restricted to the following conditions:

a. Fertilizer may not be applied within 100 feet of the shoreline of all regulated waterbodies in the Riparian Corridor Protection District.

b. Between 100 feet from the shoreline of all regulated waterbodies, fertilizer application must meet the following criteria:

i. Application follows best management practices limiting the potential for nutrient runoff or groundwater infiltration.

ii. Fertilizer must contain a minimum of 50% slow release nitrogen.

iii. Fertilizer must be phosphorus-free unless a recent (within 12 months) soil test indicates a deficiency. In those situations, fertilizer is limited to ≤ 2% phosphorus.

iv. Application rates may not exceed 0.5 lb. total nitrogen/1,000 ft^2, with an annual maximum application of 1.5 lb. of nitrogen/1,000 ft^2.

c. Fertilizer restrictions may be waived by the Commission or its designee for circumstances indicated, provided the following conditions are met:

i. Heavy-Use Turf (i.e. athletic fields or high priority areas of golf courses such as greens): Upon submission of a turf management plan adhering to all other criteria above, the Commission or their designee may increase application rate limits to a maximum rate of 1 lb. total nitrogen/1,000 ft^2, with an

annual maximum application of 3.0 lb. of nitrogen/1,000 ft^2. Waivers granted shall provide for temporary allowance, not to exceed 3 years.

ii. Restoration or Establishment of New Landscaping: With the exception of the above fertilizer application requirements, the Commission may waive certain requirements upon submission of written justification addressing the need and the specific location(s) within the property where the request applies. Waivers granted will provide for temporary allowance, not to exceed one year.

G. Conditional Uses:

1. The following uses, if allowed in the underlying zoning district, are permitted only after a Conditional Use Permit is granted by the Planning and Zoning Commission.

a. Industrial and commercial uses not otherwise prohibited in Article 1.4.F of the Riparian Corridor Protection District – Use Regulations of these regulations.

b. Multi-family residential development.

c. Transmission lines, access ways, including driveways and parking lots or roadways, paved or unpaved, within 150 feet of the (insert name of rivers) or their major tributaries, or within 100 feet of perennial brooks, streams and creeks located within the Riparian Corridor Protection District.

d. Detention ponds, treatment swales, and other drainage structures as required by State or local regulations.

2. The Planning and Zoning Commission may grant a Conditional Use Permit for those uses listed above only after written findings of fact are made which have been reviewed by technical experts if required by the Commission, at the cost of the developer, provided that all of the following are true:

a. The proposed use will not detrimentally affect the surface water quality of the adjacent river or tributary, or otherwise result in unhealthful conditions.

b. The proposed use will discharge no waste water on site other than that normally discharged by domestic waste water disposal systems and will not involve on-site storage or disposal of hazardous or toxic wastes as herein defined.

c. The proposed use will not result in undue damage to spawning grounds and other wildlife habitat.

d. The proposed use complies with the use regulations identified in Article 1.4 Riparian Corridor Protection District – Use Regulations and all other applicable sections of this article.

e. The design and construction of the proposed use will be consistent with the intent of the purposes set forth in Article 1.3.1 Riparian Corridor Protection District authority and Purpose.

H. Lots of Record: (See I.5 below)

I. Permitted Uses: The following uses are permitted within the Riparian Corridor Protection District provided they are conducted in accordance with the purpose and intent of this regulation.

1. Agriculture, including grazing, hay production, Christmas tree growing and harvesting, aquiculture, truck gardening and silage production, provided that such use will not cause increases in surface

or groundwater contamination by pesticides, fertilizers, or other hazardous or toxic substances and that such use will not cause or contribute to substantial soil erosion and stream sedimentation. However, no clearing of natural vegetation within the vegetated buffer (as defined in 1.4.E) shall be permitted for the purpose of establishing new tilled and cultivated farmland without a conditional use permit. All pesticide applications shall be conducted in strict accordance with the requirements set forth in the Connecticut General Statutes.

2. Forest Management, including the construction of access ways for said purpose and all harvests of woody vegetation for conversion of land to non- forest management or agricultural purposes. Partial cutting of trees is limited to twenty five percent (25%) of the pre-harvest basal area for all live trees measuring six inches (6") diameter, breast height (4 ½ feet above ground level), or greater. Partial cutting shall be done in such a way that a well distributed stand of healthy growing trees remains. Clear cuts to develop improved wildlife habitat and promote forest regeneration are restricted to one-quarter (¼) acre openings dispersed throughout the Riparian Corridor Protection District. Harvesting of trees in the Riparian Corridor Protection District is limited to one cut per ten years and must not occur within the first twenty five (25) feet from the river or stream's edge. Salvage necessitated by acts of God shall exempt property owners from the conditions set forth in this paragraph.

3. Residential accessory structures, of less than 400 square feet in first floor area, within 150 feet of the (insert name of rivers) or their major tributaries, or within 100 feet of perennial brooks, streams and creeks located within the Riparian Corridor Protection District, providing that the Building Inspector has determined that the conditions set forth above have been met.

4. The clearing of natural vegetation for the creation of new agricultural land not closer than twenty five (25) feet from a shoreline, provided that any agricultural activities are carried out according to best management practices as prescribed by the Connecticut Department of Agriculture.

5. The erection of a single family residence or permitted duplex on an official lot of record, prior to the date on which this amendment was posted and published in the Town, provided the Building Inspector determines the following to be true.

a. The use for which the exception is sought cannot feasibly be carried out on a portion or portions of the lot that are outside the Riparian Corridor Protection District.

b. The design and construction of the proposed use will, to the extent practical, be consistent with the purpose and intent of this article.

6. Uses permitted in the underlying zoning district, except for those listed as conditional uses in this Article under G, Conditional Uses and those prohibited in F, Use Regulations.

J. Non applicability to the downtown and village Districts: The following provisions within this Article shall not apply to the downtown village Districts: 1.4: B, C, D, E, and F (8-11).

K. Validity: The invalidity of any provisions of this regulation shall not affect the validity of any other provisions.

1.5 Administration:

A. General: The provisions of the Riparian Corridor Protection District regulation shall be administered by the following:

1. Building Inspector for building permits;

2. Planning & Zoning Commission for subdivision, site plan review, and conditional use approval; and

3. Zoning Board of Appeals for special exception approval of existing lots.

B. Enforcement: The Zoning Enforcement Officer shall be responsible for the enforcement of the provisions and conditions of the Riparian Corridor Protection District Ordinance.

1.6 Effective Date: This Article shall become effective upon the date of passage.

Model Watershed Protection Overlay - Option 5: (Based on Guilford & New Milford, CT)

Watershed Protection

§1-1 Impervious Surfaces

A. Purpose – The purpose of this section is to provide limits on the development of impervious surface (see definition below) within the Town of (insert name of town) in order to protect the surface and groundwater resources of the Town.

B. Vulnerable Local Watersheds (VLW) – There is herewith established a zoning overlay area known as a Vulnerable Local Watershed and identified on the Zoning Map as such. A Vulnerable Local Watershed is the designated watershed area, which at projected build out, will be at a density of development in terms of impervious surface which is considered harmful to the waters of the Town of (insert town name) and Long Island Sound. {Current science indicates that density of development above 10% impervious surface in any given watershed is potentially harmful to the proper functioning of natural systems.} Within the VLW area, Low Impact Development (LID) techniques shall be employed in the development of land as recommended by the Town Engineer. LID techniques and standards are described in The Practice of Low Impact Development. Prepared for: U.S. Department of Housing and Urban Development, Office of Policy Development and Research, Washington, D.C. By: NAHB Research Center, Inc., Upper Marlboro, MD, 2003.

C. Commercial and Industrial Zones – The following impervious surface limits are established for lots within commercial and industrial zones as follows;

- (Insert Commercial and Industrial Zone designations here) – No lot within these zones shall have a maximum impervious surface of greater than 50%.

- (Insert Commercial and Professional Office Zones here) – No lot within these zones shall have a maximum impervious surface of greater than 40%.

- (Insert Village District Zones here) – No lot within these zones shall have a maximum impervious surface of greater than 30%.

D. Residential Zones – The following impervious surface limits are established for lots within residential zones as follows;

- (Insert residential Zones here) – No lot with this zone shall have a maximum impervious surface of greater than 10%.

- (Insert residential Zones here) – No lot with this zone shall have a maximum impervious surface of greater than 15%.

D. Low Impact Development - considerations that apply to low impact development are set forth in a Checklist to Guide Low Impact Development – Best Management Practices (attachment 1).

E. Modification of Standards – These standards may be waived by Special Permit with the submission of a Stormwater Management Plan. The Special Permit may be approved when the Commission finds

that the purpose of this section will be better served by allowing a greater percentage of impervious surface when structural best management practices and/or riparian corridor protections can establish an effective impervious cover standard of 10% or less.

F. Definitions – the following definitions apply to the Vulnerable Local Watershed overlay zone:

IMPERVIOUS SURFACES – A surface composed of any material that impedes or prevents natural infiltration of water into the soil. Impervious surfaces shall include but are not limited to eaves, roofs, (including overhangs), solid decks, driveways, patios, sidewalks, parking areas, tennis courts, concrete or asphalt streets, or compacted gravel surfaces. Slatted decks, porous paving with runoff coefficients of less than 25%, ponds, streams and other water surfaces, including the water area of swimming pools shall be considered to be pervious. Calculation of impervious surfaces for streets shall include the area compacted for pavement or gravel base.

IMPERVIOUS COVERAGE, EFFECTIVE: The total actual Impervious Surface calculated for post-development conditions on a lot or parcel reduced by the amount of Impervious Surface that is subject to implementation of a Stormwater Management Plan. The Stormwater Management Plan must employ Low Impact Development as described in Section G (below) and other techniques that capture, treat, and reduce the negative impact of storm water up to and including a twenty-five (25)-year storm event.

G. The Storm Water Management Plan – the plan shall be designed to meet the following general standards:

1. Prevent flooding on-or off the site;

2. Minimize pollutant loads in storm water runoff into inland wetlands, surface and subsurface water;

3. Maintain the hydrology of existing sub-watersheds including wetlands and water courses;

4. Low Impact Development (LID) on-site storage and treatment of storm water methods shall be employed to the maximum extent feasible. Direct channeling (via pipe or paved culvert or the like) of untreated surface water runoff into adjacent ground and surface water shall be avoided; and,

5. Pollutants shall be controlled at their source to the maximum extent feasible using best available control technologies to contain and treat pollutants prior to surface discharge or infiltration into the ground. Methods include, but are not limited to, sweeping of streets and parking lots (especially in the early spring), use of oil and water separators and traps, vegetated and manufactured sediment basin systems and the use of overland (sheet flow) runoff to vegetated filter strips and swales.

Attachment 1

A Checklist to Guide Low Impact Development – Best Management Practices

Date: _____ Assessor Map No._____ _____Lot No._____

Location of Property:

_____

Applicant: _____

Items listed below should be considered by developers in the creation of site plans. Due to individual site constraints not all items will apply to each individual property. CHECK ALL ITEMS THAT HAVE BEEN ADDRESSED IN THE SITE PLAN APPLICATION. Applicants should indicate by writing Yes, No, or N/A (not applicable). Attach additional comments on a separate sheet of paper with project name and address.

SITE PLAN CONSIDERATIONS		
1. Site Assessment of Natural Resources	**Applicant**	**Staff Com-**
a. Natural Resources and constraints have been indicated and are identified on the plans (wetlands, rivers, streams, flood hazard zones, meadows, agricultural land, tree lines, slopes [2 foot contours], soil types, exposed ledge & stone walls).		
b. Is the property shown on CT DEP State and Federal Listed Species and Significant Natural Communities Map as property listed in the Natural Diversity Data Base (NDDB)? If yes, provide copy of CT-DEP NDDB request form & CT-DEP reply letter.		
c. Development is designed to avoid critical coastal resources, water courses, wetlands and steep slopes.		
d. Soils Suitable for septic & stormwater infiltration have been identified.		
e. Natural existing drainage patterns have been delineated on the plan and are proposed to be preserved or impacts minimized.		
f. Significant trees/tree clusters in proposed development areas have been identified. Removal avoided and or protection in conservation easement.		
g. View sheds have been recognized/ maximized		
h. A copy of the latest USGS Quad map along with an aerial photograph showing the site and adjacent properties is attached.		
2. Preservation of Open Space	**Applicant**	**Staff Com-**
a. Considered open space subdivision or planned residential development (PRD).		
b. Open space/ common areas are delineated.		
c. Open space is retained in a natural condition.		
d. Located proposed open space adjacent to existing open space or wild life corridors.		
e. Evaluate properties with non-water-dependent uses on waterfront sites.		
f. Minimize street line setbacks to reduce impervious surface & optimize open space.		
3. Minimization of Land Disturbance	**Applicant**	**Staff Com-**
a. Proposed building is located where least environmental impact can occur.		
b. Buildings designed for maximum solar gain. (Window exposure, are oriented to the sun for maximum energy efficiency).		
c. Clustered development has been considered.		
d. Disturbance areas are delineated to avoid unnecessary clearing or grading,		
e. Sanitary systems setback from water bodies to maximum extent possible.		
f. Native Vegetation outside construction area is undisturbed or will be restored.		

g. Storage of heating oil provided in double wall tanks aboveground.		
4. Street and Driveway Sizes	**Applicant**	**Staff Com-**
a. The design provides an efficient layout minimizing length and width of streets.		
b. Roadways and driveways conform to natural land formations.		
c. Design features to reduce impervious surfaces such as shared parking & driveways have been considered.		
d. Proposed drainage systems utilize existing topography.		
A. EROSION AND SEDIMENT CONTROL	**Applicant**	**Staff Com-**
a. Erosion and Sedimentation control plan complies with regulations.		
b. Permanent erosion control measures are to be utilized.		
c. Development does not create steep slopes subject to erosion.		
d. Permanent vegetated buffers provided for riparian protection corridors.		
e. Cleared areas will be replanted and/ or heavily mulched.		
B. MANAGING STORMWATER		
a. Efforts have been made to retain or infiltrate water on site.		
b. Outfalls are stabilized and receiving streams are protected from sediment scour potential velocity.		
c. Use level spreaders or dispersed flow methods if natural dispersal is not possible.		
d. Maximum use is made of vegetated ditches/ swales, especially along driveways, parking areas and roads.		
e. Cul-de-sacs include a landscape island for bio-retention.		
f. Sheet flow is used to the maximum extent possible to avoid concentrating runoff.		
g. Rooftop drainage is discharged into bio-retention areas or rain gardens.		
h. Rainwater collection, green roofs, and porous pavement were considered.		
i. Grass swales are used beside roads instead of curbs and gutters.		
j. Parking medians are designed for bio-retention to allow infiltration.		
k. Infiltration structures have been included –e.g. drywells and infiltration trenches.		
l. Best Management Practices to provide water quality treatment to remove existing and expected pollutants generated to be the proposed use.		
m. Impervious surfaces are disconnected and stormwater is treated locally.		
n. Proposed construction of the storm water management system is designed in compliance with the Connecticut Stormwater Manual.		
o. Onsite soil infiltration/ permeability has been measured.		
p. Onsite soils are suitable for stormwater detention/ infiltration.		
q. Sufficient infiltration areas are utilized to maximize onsite water retention.		
C. LANDSCAPE PLAN	**Applicant**	**Staff Com-**
a. Clearing and grading have been minimized.		
b. Irrigation with automatic sensors have been considered.		
c. Landscaped areas retain water such as in water gardens, vegetated swales, etc.		
d. Habitat-enhancing native plant species are used.		
e. Species appropriate to soil and microclimate conditions have been considered.		
f. Includes indigenous plants suited for vegetated buffers, riparian corridors & wetlands		
g. Invasive Plants (2004 DEEP List) are not included in the landscape design plan.		
h. Invasive species removal and maintenance control plan has been considered.		
i. Underground utilities have been considered.		
j. Use of fertilizers only specified & applied per CTDEEP recommendations.		
k. Integrated Pest Management Plan incorporated into land development plan.		

Low Impact Development Model – Option 6 (Based on Waterford, CT)

STORMWATER MANAGEMENT AND LOW IMPACT DEVELOPMENT STANDARDS

1.1 Purpose

To reduce impacts of stormwater run-off volume and stormwater run-off quality on receiving surface waters, wetlands, and groundwater of the Town of _____ and to protect the aquatic habitat of Long Island Sound -to which these surface waters ultimately discharge. The Commission makes the following findings which supports the necessity to require these regulations:

1. The Town of _____ waterways and wetlands are valuable natural, recreational, cultural, aesthetic and economic resources.

2. The protection and preservation of these resources is in the public interest and is essential to the health, welfare and safety of the citizens of _____.

3. Town waterways and the near-shore aquatic environment of Long Island Sound have been identified by the State of Connecticut as impaired water resources, not meeting designated uses due to water quality.

4. Stormwater is recognized as a leading source of non-point pollution to waterways.

5. To protect and preserve surface waters and groundwater from non-point sources of pollution, management of stormwater generated from site construction and property development is required to minimize increases in stormwater flows, suspended solids, pathogens, toxic contaminants, heavy metals, petroleum hydrocarbons, nutrients and floatable debris transported by stormwater to water resources including Long Island Sound. Stormwater discharged from rivers and tributaries in the town adversely impact hypoxic conditions in Long Island Sound and low impact development strategies – both structural and non-structural can reduce non-point sources of pollution.

The Town supports the incorporation of Low Impact Development (LID) strategies and structural designs into site plans and developments to address stormwater run-off and pollutant loading at its source, to minimize potential adverse impacts to water quality, habitat and ecological integrity, and to preserve or enhance existing water quality of surface waters and wetlands. Low Impact Development is a site design strategy intended to maintain or replicate pre-development hydrology through the use of design techniques and small-scale controls integrated throughout the site to manage run-off as close to its source as possible.

1.2 Principles & Objectives

The following goals of Low Impact Development and Stormwater Management Practices are intended to emulate the guidance and objectives outlined in the State of Connecticut Department of Energy & Environmental Protection's 2004 Connecticut Stormwater Quality Manual, as amended:

1. Preserve pre-development site hydrology (including runoff, infiltration, interception, evapotranspiration, groundwater recharge, and stream base flow) to the extent possible.

2. Preserve and protect environmentally sensitive resources such as wetlands, riparian buffers, floodplains, natural drainage systems, and other natural features that provide water quality and quantity benefits.

3. Minimize sediment, nutrient and pollutant loading to stormwater run-off and adverse impacts to water quality of receiving waterways and wetlands;

4. Minimize changes in peak rates and volumes of site stormwater discharge for the construction and post-construction period to prevent downstream flooding impacts and erosion;

5. Prevent pollutants from entering receiving waters and wetlands in amounts that exceed the systems' natural ability to assimilate the pollutants and provide the desired functions.

6. Incorporate pollution prevention and pollution best management practices for source control and maintenance protocols.

7. After construction has been completed and the site is permanently stabilized, reduce the average annual pollutant loadings in the post-development runoff to pre-development levels to the maximum extent practicable.

8. For designated high quality receiving waters and sites with the highest potential for significant pollutant loadings, reduce post-development pollutant loadings so that average annual post-development loadings do not exceed pre-development loadings (i.e. no net increase).

9. Seek multi-objective benefits from stormwater control measures (i.e. flood control, stream protection, water quality improvement, habitat, aesthetics, and recreation).

1.3 Definitions

Definitions applicable to this section are set forth below.

BEST MANAGEMENT PRACTICE (BMP) - A BMP is a technique, process, activity or structure used to reduce the pollutant content of a storm water discharge. BMPs include simple non-structural methods such as good housekeeping and preventative maintenance. BMPs may also include structural modification, such as the installation of bio-retention measures. BMPs are most effective when used in combination with each other, and customized to meet the specific needs (drainage, materials, activities, etc.) of a given operation.

BIORETENTION - A practice to manage and treat stormwater runoff by using a specially designed planting soil bed and planting materials to filter runoff stored in a shallow depression. Bio-retention areas consist of a mix of elements each designed to perform different functions in the removal of pollutants and attenuation of stormwater runoff.

BUFFER STRIP - A parcel of land unoccupied by buildings, structures, or pavements and maintained as a grass area and/or planted with trees or shrubs.

CATCH BASIN - A structure placed at or below grade to conduct water from a street or other paved surface to the storm sewer.

CATCH BASIN INSERTS - A structure, such as a tray, basket, or bag that typically contains a pollutant removal medium (i.e., filter media) and a method for suspending the structure in the catch basin. They are placed directly inside of the existing catch basins where stormwater flows into the catch basin and is treated as it passes through the structure

DISTURBANCE – Any clearing, grubbing, filling, grading, excavating, constructing, depositing or removing material that could leave the ground surface subject to the potential for accelerated erosion or an increase in the rate of runoff.

DISTURBED AREA – An area where the ground cover is destroyed or removed leaving the land subject to accelerated erosion.

DRY DETENTION POND – Stormwater basin designed to capture, temporarily hold and gradually release a volume of stormwater runoff to attenuate and delay stormwater runoff peaks. Dry detention ponds provide water quantity control (peak flow control and stream channel protection) as opposed to water quality control. Also known as "dry ponds" or "detention basins."

FILLING – Deposition of material to raise the surface elevation of land.

GRADING – Action that vertically alters the ground surface by excavation, filling or a combination thereof. Grading includes any excavating, grubbing, filling (including hydraulic fill), or stockpiling of earth materials or any combination thereof, including the land in its excavated or filled condition.

GRASS DRAINAGE CHANNELS – Traditional vegetated open channels, typically trapezoidal, triangular or parabolic in shape, whose primary function is to provide non-erosive conveyance, typically up to the 10-year frequency design flow. They provide limited pollutant removal through filtration by grass or other vegetation, sedimentation, biological activity in the grass/soil media, as well as limited infiltration if underlying soils are pervious.

GRAVEL –Rock fragments between 2mm and 75mm in diameter, generally rounded individual grains.

GROUNDWATER RECHARGE – The process by which water seeps into the ground, eventually replenishing groundwater aquifers and surface water such as lakes, streams and the oceans. This process helps maintain water flow in streams and wetlands and preserves water table levels that support drinking water supplies.

GROUNDWATER RECHARGE VOLUME (GRV) – The post-development design recharge volume (on a storm-event basis) required to minimize the loss of annual pre-development groundwater recharge. The GRV is determined as a function of annual pre-development recharge for site specific soils or surficial materials, average annual rainfall volume, and amount of impervious cover on a site.

HYDRODYNAMIC SEPARATORS – A group of stormwater treatment technologies designed to remove large particle total suspended solids and large oil droplets, consisting primarily of cylindrical-shaped devices that are designed to fit in or adjacent to existing stormwater drainage systems. The most common mechanism used in these devices is a vortex-enhanced sedimentation, where stormwater enters as tangential inlet flow into the side of the cylindrical structures. As the stormwater spirals through the chamber, the swirling motion causes the sediments to settle by gravity, removing them from the stormwater.

INFILTRATION PRACTICES – Stormwater treatment practices designed to capture stormwater runoff and infiltrate it into the ground over a period of days, including infiltration trenches and infiltration basins.

NONPOINT SOURCE POLLUTION – Pollution caused by diffuse sources that are not regulated as point sources and are normally associated with precipitation and runoff from the land.

NON-ROUTINE MAINTENANCE - Corrective measures taken to repair or rehabilitate stormwater controls to proper working condition. Non-routine maintenance is performed as needed, typically in response to problems detected during routine maintenance and inspections.

OIL/PARTICLE SEPARATORS - Consist of a subsurface structure with one or more chambers designed to remove trash and debris and to promote sedimentation of coarse materials and separation of free oil (as opposed to emulsified or dissolved oil) from stormwater runoff. Oil/particle separators are typically designed as off-line systems for pretreatment of runoff from small impervious area, and therefore provided minimal attenuation of flow. Also called oil/grit separators, water quality inlets, and oil/water separators.

PERMEABLE PAVING MATERIALS - Materials that are alternatives to conventional pavement surfaces and that are designed to increase infiltration and reduce stormwater runoff and pollutant loads. Alternative materials include modular concrete paving blocks, modular concrete or plastic lattice, cast-in-place concrete grids, and soil enhancement technologies. Stone, gravel, and other low-tech materials can also be used as alternative for low traffic application such as driveways, haul roads and access road.

QUARRYING - Excavating and maintaining an open or surface area for purposes of extraction of stone, rock, aggregate or other mineral materials

RAIN BARRELS - Barrels designed to retain small volumes of runoff for reuse in gardening and landscaping. They are applicable to residential, commercial, and industrial sites and can be incorporated into a site's landscaping plan. The size of the rain barrel is a function of the rooftop surface area and the design storm to be stored. Rain barrels capture runoff that would otherwise be lost to storm drains, divert water to the landscape, and conserve tap water. For large rain barrels see "Cistern".

RAIN GARDEN - Functional landscape elements that combine plantings and a specially designed planting soil bed in depressions that allow water to pool for only a few days after a rainfall then be filtered by and slowly absorbed by the soil and plantings. Rain gardens improve water quality by reducing the sediment, nutrients, bacteria and chemicals from flowing into water bodies.

STORMWATER- Water consisting of precipitation runoff or snowmelt.

STORMWATER FACILITY -Any device, structure, system, or practice used to improve stormwater quality, promote infiltration, provide peak flow control, or to provide peak runoff attenuation.

STORMWATER MANAGEMENT PLAN - A Plan describing the potential water quality and quantity impacts associated with a development project both during and after construction. The plan identifies selected source controls and treatment practices to address those potential impacts, the engineering design of the treatment practices, and maintenance requirements for proper performance of the selected practices.

STORMWATER PONDS - Vegetated ponds that retain a permanent pool of water and are constructed to provide both treatment and attenuation of stormwater flows.

STORMWATER RUNOFF - Above ground water flow resulting from precipitation or snow melt

STORMWATER TREATMENT PRACTICES - Devices constructed for primary treatment, pretreatment or secondary treatment of stormwater.

Primary – Stormwater treatment practices that are capable of providing high levels of water quality treatment as stand-alone devices: can be grouped into five major categories – stormwater ponds, stormwater wetlands, infiltration practices, filtering practices, and water quality swales.

Secondary - Stormwater treatment practices that may not be suitable as stand-alone treatment because they are either not capable of meeting the water quality treatment performance criteria or have not yet received the thorough evaluation needed to demonstrate the capabilities for meeting the performance criteria.

STORMWATER TREATMENT TRAIN -Stormwater treatment practices, as well as site planning techniques and source controls, combined in series to enhance pollutant removal or achieve multiple stormwater objectives.

STORMWATER WETLANDS - Shallow, constructed pools that capture stormwater and allow for the growth of characteristic wetland vegetation. These facilities provide enhanced treatment of stormwater and peak flow attenuation.

STREAM ORDER - Stream order indicates the relative size of a stream based on Strahler's (1957) method. Streams with no tributaries are first order streams, represented as the start of a solid line on a 1:24,000 USGS Quadrangle Sheet. A second order stream is formed at the confluence of two first order streams, and so on.

UNDERGROUND DETENTION FACILITIES - Vaults, pipes, tanks, and other subsurface structures designed to temporarily store stormwater runoff for water quantity control and to drain completely between runoff events. They are intended to control peak flows, limit downstream flooding and provide some channel protection.

UNDERGROUND INFILTRATION SYSTEMS - Structures designed to capture, temporarily store, and infiltrate the water quality volume over several days, including pre-manufactured pipes, vaults and modular structures. These are used as alternatives to infiltration trenches and basins for space limited sites and stormwater retrofit applications.

VEGETATED BUFFER - An area or strip of land in permanent undisturbed vegetation adjacent to a water body or other resource that is designed to protect resources from adjacent development during construction and after development by filtering pollutants from runoff, protecting water quality and temperature, providing wildlife habitat, screening structures and enhancing aesthetics, and providing access for recreation.

VEGETATED FILTER STRIPS - A strip or area of vegetation for removing sediment, organic material, nutrients and chemicals from runoff or wastewater. They are typically located down gradient of stormwater outfalls and level spreaders to reduce flow velocities and promote infiltration and filtration.

VEGETATED LEVEL SPREADERS - Uniformly graded vegetated surfaces (i.e. grass or close growing native vegetation) located between pollutant source areas and downstream receiving waters or wetlands. A level spreader is usually located at the top of the slope to distribute overland flow or concentrated runoff evenly across the entire length of the filter strip.

VEGETATED ROOF COVERS – Multilayered, constructed roof systems consisting of a vegetative layer, media, a geotextile layer, and a synthetic drain layer installed on building rooftops. Rain water is either

intercepted by vegetation and evaporated to the atmosphere or retained in the substrate before being returned to the atmosphere through transpiration and evaporation. Also referred to as green roofs.

WATER QUALITY FLOW (WQF) - The peak flow associated with the water quality volume calculated using the NRCS Graphical Peak Discharge Method, as defined in the 2004 CT Stormwater Quality Manual, as amended.

WATER QUALITY SWALES - Vegetated open channels designed to treat and attenuate the water quality volume and convey excess stormwater runoff. Dry swales are primarily designed to receive drainage from small impervious areas and rural roads. Wet swales are primarily used for highway runoff, small parking lots, rooftops and pervious areas.

WATER QUALITY VOLUME (WQV) - The peak flow associated with the water quality volume calculated using the NRCS Graphical Peak Discharge Method, as defined in the 2004 CT Stormwater Quality Manual, as amended.

1.4 Exempted Activities

The following activities are exempt from these standards:

Construction on an existing single family residential lot and /or accessory uses on a lot of record providing there is not more than 10,000 square feet of disturbance on the lot. A lot of record is a lot that is existing as of the effective date of these standards. Submittal of a stormwater management plan is not required. Implementation of LID techniques as outlined in this section are encouraged.

1.5 Site Design

At a minimum, all site development plans shall comply with the design criteria and objectives identified in the most recent version of Connecticut Stormwater Quality Manual, as well as the General Criteria below. Where there may be a perceived conflict between the standards provided in these regulations and the Connecticut Stormwater Quality Manual, the standards in these regulations shall govern. The applicant may propose other tested and documented stormwater treatment facilities provided the technical design criteria and supporting scientific studies of the facility performance are provided for the Town's review and approval.

No Untreated Discharges. All stormwater runoff generated from subdivision activities shall not discharge untreated stormwater runoff directly to a wetland, local water body, municipal drainage system, or abutting property, without adequate treatment.

1.5.1 Site Design Criteria

1. The use of Low Impact Development (LID) measures is required to the maximum extent practicable for new development in order to promote recharge, reduce runoff volumes, and minimize reliance on structural stormwater management measures. The Site Design Criteria require that the site planning process shall be documented and shall follow the objectives listed in the Low Impact Development Appendix to the Connecticut Stormwater Quality Manual. The applicant must document project conformance with these design criteria and the technical infeasibility in cases where site conditions prevent implementation of LID techniques and any proposed mitigation measures.

2. The following LID techniques shall be incorporated into the planning and design of development plans to preserve pre-development hydrologic conditions and minimize stormwater run-off:

a. Avoiding installation of roof drains that discharge to impervious surfaces.

b. Directing flows to vegetated areas.

c. Directing flows from paved areas to stabilized vegetated areas.

d. Breaking up flow directions from large paved surfaces.

e. Encouraging sheet flow through vegetated areas.

f. Locating impervious areas so that they drain to permeable areas.

g. Maximizing overland sheet flow.

h. Lengthening flow paths and increase the number of flow paths.

i. Maximizing use of open swale systems.

j. Increasing (or augmenting) the amount of vegetation on the site.

k. Restricting ground disturbance to the smallest possible area.

l. Reducing pavement and impervious surface areas.

m. Avoiding compaction or disturbance of highly permeable soils.

n. Avoiding removal of existing trees.

o. Reducing the use of turf and using more natural land cover.

p. Maintaining existing topography and drainage divides.

q. Locating structures, roadways on Type C soils where feasible.

r. Provide source controls to prevent or minimize the use of and potential introduction of pollutants into stormwater run-off.

3. Groundwater Recharge Volume (Re)

a. Annual groundwater recharge rates shall be maintained by promoting infiltration through the use of structural and non-structural methods. At a minimum, annual groundwater recharge from the post-development site shall approximate the annual recharge from pre-development site conditions.

b. The Re should be determined using the methods prescribed in the latest version of the Connecticut Stormwater Quality Manual. The recharge requirements shall apply to all activities within the jurisdiction of these Regulations except as noted, and unless specifically modified by the Commission. The Commission may relax or eliminate the recharge requirement at its discretion, if the site is situated on unsuitable soils or is in a redevelopment area with documentation of prior contaminated soils.

c. Soil testing shall be performed in locations that can substantiate the ability of subsurface conditions to recharge stormwater in accordance with the proposed stormwater management facilities. Depth to

seasonal high groundwater, restrictive layers, and infiltration rates as determined through an appropriate field permeability test shall be verified by a qualified professional registered in the State of Connecticut.

4. Water Quality Volume (WQv) – the amount of stormwater run-off from any given storm that should be captured and treated in order to remove a majority of stormwater pollutants on an average annual basis, equivalent to run-off associated with the first one inch of rainfall.

The prescribed water quality volume required in the sizing of a structural stormwater practice shall be determined using the methods prescribed in the latest version of the Connecticut Stormwater Quality Manual

1.5.2 Structural Practices for Water Quality

1. All structural stormwater management facilities shall be selected and designed using the appropriate criteria from the most recent version of the Connecticut Stormwater Quality Manual.

2. Structural stormwater management facilities must be designed to, at a minimum, capture and treat the water quality volume (WQv) from the development area, and to reduce post-development stormwater pollutant discharge to the maximum extent practicable. Stormwater treatment practices may be implemented in series to attain increased attenuation of stormwater pollutants. It is presumed the stormwater management facility functions and achieves documented pollutant removal rates if it is:

a. Accurately sized to capture the prescribed water quality volume;

b. Designed according to the specific design and siting criteria outlined in the Connecticut Stormwater Quality Manual;

c. Constructed properly; and

d. Maintained regularly.

The Commission may require a stormwater treatment design to attenuate specific stormwater pollutants of concern where the receiving waters are identified as impaired or susceptible to water quality impairment, or are in areas where Total Maximum Daily Loads (TMDLs) have been completed. Applicants may be required to submit documentation to demonstrate the performance of the facility in removal of pollutants based on available scientific literature /studies documenting pollutant removal efficiencies.

All stormwater control and conveyance facilities shall be constructed on property owned by the applicant or within suitable easements. All stormwater facilities shall be designed with suitable access for inspection and maintenance.

25.6.5.3 Runoff Reduction – Designers shall use Low Impact Development (LID) strategies and site design techniques to reduce the generation of stormwater runoff to the maximum extent practicable such that there is no discharge from the 1-year, 24 hour Type III design storm (i.e., the entire runoff volume is reused, infiltrated, evaporated, and/or otherwise retained on site). Proposed projects meeting this standard automatically meet the Water Quality Standard. Projects that do not retain the 1-year, 24 hour Type III design storm on site are required to retain the stormwater runoff volume generated by the first inch of rainfall on site, and must meet the requirements for Water Quality. If full compliance is

not provided, the application must document why key steps in the process could not be met and what is proposed as mitigation. The objective of this standard is to provide a process by which LID is considered at an early stage in the planning process such that stormwater impacts are prevented rather than mitigated.

1.5.4 Stream Channel Protection – Consistent with the Connecticut Stormwater Quality Manual and CT Erosion and Sedimentation Guidelines, protection of channels from bank and bed erosion and degradation shall be provided by:

1. Controlling the 2-year; 24-hour post-development peak flow rate to 50 percent of the 2-year; 24-hour pre-development level; or

2. Controlling the 2-year; 24-hour post-development peak flow rate to the 1-year; 24-hour pre-development level.

1.5.5 Channel Protection Waiver – Requirements for stream channel protection may be waived for:

1. Small sites (i.e., sites requiring less than 1-inch diameter orifice); or

2. Sites with post-development discharges less than 2 cubic feet per second (cfs); or

3. Direct discharges to 4th order or greater streams, lakes, and reservoirs, where the development area is less than 5% of the watershed area upstream of the development site; or

4. Indirect discharges to an existing drainage network with adequate capacity to accommodate the flows from the site where the ultimate discharge is to a 4th order or greater stream, lake, or reservoir.

1.5.6 Flooding Protection (Qp) – Downstream flood, property, and public safety protection shall be provided by attenuating the post-development peak discharge rates for the 10-year, 25-year and 100-year 24-hour return frequency storm events to the pre-development rates. In addition, designers must demonstrate that runoff from the site for storms up to the 100-year, 24-hour Type III design storm events actually reach proposed structural practices designed to meet this standard. The objective of this standard is to prevent an increase in the frequency and magnitude of overbank flooding and to protect downstream and abutting structures from flooding.

1.5.7 Downstream Impacts – Analysis of potential impacts to downstream channels, infrastructure, or property shall be required consistent with the guidance provided in Chapter 7 of the Connecticut Stormwater Quality Manual.

1.5.8 Conveyance Criteria

Where practicable, low impact development practices to promote sheet flow of roadway run-off to vegetated areas, permeable soils and water quality treatment facilities shall be incorporated to reduce concentrated run-off volumes and velocities.

1. The proposed stormwater conveyance system shall, at a minimum, accommodate the runoff from a 10-year storm event. The discharge from any stormwater facility must be conveyed through properly constructed water courses to provide for non-erosive flows during all storm events. Rip-rap (or other approved energy dissipaters) shall be placed at all flared-end sections, pipe outlets, overflow weirs, drainage swales, and any other location. Rip-rap shall be sized such that the stones will be able to resist movement due to discharge velocity.

2. All drain lines to be connected to the municipal drain line shall be constructed by way of a drain manhole being installed between the existing drain line and the proposed drain line(s).

3. Emergency outlets must safely pass the post-development peak runoff from the 100-year design storm event in a controlled manner without erosion of the outlet works or downstream drainage system and provide a freeboard of at least one (1) foot.

1.6 Hydrologic Basis for Design of Structural Practices

For facility sizing criteria, the basis for hydrologic and hydraulic evaluation of development sites are as follows:

1.6.1 Impervious cover is measured from the site plan and includes any material or structure on or above the ground that prevents water from infiltrating through the underlying soil. Impervious surface is defined to include, without limitation: paved parking lots, sidewalks, roof tops, driveways, patios, and paved, gravel, and compacted dirt surfaced roads. Alternative surfaces (e.g., porous pavement, grass pavers, etc.) are encouraged for low-traffic sidewalks and parking lots, and these areas may be removed from the total impervious area calculations when designing the stormwater system for recharge and water quality criteria only. General design guidance is included in the most recent version of the Connecticut Stormwater Quality Manual.

1.6.2 Off-site areas draining to the site shall be included in the hydrologic and hydraulic analyses.

1.6.3 The models TR-55 and TR-20 (or approved equivalent) shall be used for sizing all stormwater practices other than those used strictly for conveyance.

1.6.4 Stormwater conveyance features shall be sized using the Rational Method.

1.6.5 For purposes of computing runoff and assigning hydrologic curve numbers, all pervious lands in the site prior to development shall be assumed to be in "good" condition regardless of conditions existing at the time of computation.

1.6.6 The specified design storms shall be defined as 24-hour, Type III distribution design storm events using the rainfall amounts specified for (insert County Name) County in the latest revision to the Connecticut D.O.T. drainage manual.

1.6.7 All projects shall apply these stormwater management criteria to the land development as a whole. Hydrologic parameters shall reflect the ultimate land development and shall be used in all engineering calculations.

1.7 Stormwater Impact Mitigation

Practices to mitigate impacts of stormwater run-off may include one or more of the following components including, but not limited to:

1. Pollution source controls/best management practices;

2. Water quality swale, bio-retention basins/swales and rain gardens to capture and treat the water quality volume of stormwater run-off;

3. Extended wet basins, created wetlands and sub-surface gravel wetland treatment systems to attenuate pollutants prior to discharge;

4. Stormwater ponds and detention ponds to attenuate peak flows;

5. Tree filters, infiltration swales, chambered infiltration systems, permeable surfaces and vegetated/ green roofs to reduce and infiltrate clean run-off;

6. Proprietary pre-treatment components provided independent performance data is available to assess effectiveness in pollutant control.

7. Other potential stormwater management practices include:

- Catch basins with deep sumps Rain barrels
- Catch basin inserts Vegetated filter strips
- Hydrodynamic separators Vegetated buffers
- Oil/particle separators
- Permeable /porous paving materials

1.8 Redevelopment Projects.

Redevelopment projects shall, at a minimum, comply with one of the following:

1. Reduce the total impervious cover by 40% from existing conditions; or

2. Where site conditions prevent a reduction in impervious cover, implement stormwater controls for at least 40% of the site's impervious cover; or

3. Implement a combination of impervious cover reduction and area treated with stormwater controls that shall equal or exceed 40% of the site's impervious cover.

1.9 Site Stormwater Management Plan and Report

A site stormwater management plan is required and shall be prepared by a State of Connecticut Licensed Professional Engineer. A Stormwater management plan shall be prepared for each of the following:

1. Zoning compliance permits associated with development of single family lots within an approved Open Space (Cluster) Subdivision.

2. Zoning Compliance permits associated with development of single family lots within a conventional subdivision.

3. Additions or exterior improvements associated with existing single family lots with disturbance equal to or greater than 10,000 square feet.

4. Construction of an Accessory Dwelling Unit that expands building footprint.

5. Any project involving a common driveway serving three or more lots.

6. Any new construction associated with any use other than single family including but not limited to multi-family, commercial, institutional, and industrial.

7. Additions or exterior improvements associated with the uses identified in item 6 above and when the total disturbance is equal to or greater than 10,000 square feet.

1.10 Site Stormwater Management Plan Contents

The stormwater management plan shall contain an executive summary, drainage area maps, calculations, descriptions, and other data sufficient to demonstrate compliance with these standards. The plan shall include all items as listed and described in Site Stormwater Management Plan Review Checklist as amended and the following information:

1. Soil characteristics of the site and any soil boring/test results.

2. Location of surface water bodies and wetlands on and adjacent to the site, and the depth to any groundwater or aquifer areas on or adjacent to the site;

3. CT DEEP water quality classifications for surface water and groundwater on and adjacent to the site and identification of any waterbodies on or adjacent to the site documented by CT DEEP as not meeting water quality standards pursuant to Section 303(d) of the Federal Clean Water Act.

4. Description of potential pollutant sources, anticipated stormwater pollutants and calculations for removal of total suspended solids and other pollutant removal rates where required using published pollutant concentrations and pollutant reduction efficiencies.

5. The design and functional performance of the stormwater management system shall at a minimum conform to the CT DEEP 2004 Stormwater Quality Manual and pertinent watershed management plans where applicable.

6. Stormwater management systems shall be designed and maintained to manage site run-off in order to eliminate surface and groundwater pollution, prevent flooding and control peak discharge.

7. Location and description of all proposed LID measures, stormwater controls and Best Management Practices (BMP) for both construction activities and post-construction / long-term stormwater control. These controls should address:

a. Measures to limit extent & duration of soil disturbance

b. Measures to divert off-site run-off and control on-site run-off

c. Measures to reduce run-off velocity and concentrated flows

d. Measures to capture sediment and reduce soil erosion

e. Phasing/ sequence of site construction

f. Measures to reduce run-off volume

g. Measures to control and treat post-construction stormwater run-off

8. Proposed operation manuals and inspection and maintenance schedule for all stormwater quality treatment BMP devices used to prevent runoff, encourage sheet flow or infiltration, or treat stormwater.

9. Identification of the party responsible for maintenance, inspection and repair of site stormwater BMP's.

10. Calculations for impervious surface area, run-off coefficient, stormwater runoff rates, and soil infiltration rates before and after completion of the activity proposed in the application.

11. A hydrologic study of pre- and post-development site conditions where required. Hydrologic studies shall be prepared to a level of detail commensurate with the probable impact of the proposed activity and should extend downstream to the point where the proposed activity causes less than a five percent increase in peak flows rates after peak flow attenuation.

12. Calculations for sizing of pipes, swales, rip rap aprons, plunge pools or other conveyance and energy dissipation devices.

13. Calculations for the design water quality volume (WQV) to be treated by the proposed stormwater treatment practices and the groundwater recharge volume(GRV) using the procedures outlined in CT DEEP 2004 Connecticut Stormwater Quality Manual, as amended.

14. The following notes shall be placed on the design plans for each project requiring stormwater management or treatment facilities:

"This property contains a stormwater treatment facility that is a condition of approval to develop the property and shall be maintained by the property owner for the life of the project/development. The facility shall not be altered, except for maintenance as described in the facility's operation and maintenance plan, without the approval of the permitting agency."

"No change in a site plan shall be permitted until a revised stormwater management plan has been approved by the Commission or its agent."

1.11 Construction Inspection

The Town shall have the right to inspect construction of any stormwater facility at reasonable times during construction. The Town may charge the applicant an application fee that covers the cost of inspections performed by an outside consultant engaged by the Town.

The Town may require the permittee to have the construction of the stormwater facility inspected by a Connecticut Licensed Professional Engineer during construction to ensure construction is in accordance with the approved plans, specifications and permit conditions.

1.12 Bonding

The Town may require the applicant to provide a bond for the cost of construction and any performance monitoring of the stormwater facility required per conditions of permit or plan approval. The bond shall be in the amount of 100% of the estimated cost of the stormwater facility. The estimated cost shall be based on a detailed estimate prepared by a Connecticut Licensed Professional Engineer or other qualified person and subject to the review of the Town. Bonds shall be provided in a manner acceptable to the Town's Attorney. The Town may utilize the bonds to complete the stormwater facility in the event the property owner fails to do so; inspect, to repair or remedy any such facility that is improperly installed or constructed; to provide additional measures where those implemented by the

owner are insufficient to achieve the goals of this regulations; to perform periodic inspections; to perform maintenance that, following reasonable notice, the owner fails or refuses to perform; and to otherwise assure compliance with the requirements and objectives of this section.

1.13 Right of Entry

The Town shall have the right to enter upon the property to conduct inspections for compliance with this section during construction, maintenance operations and routine operations, upon reasonable notice for the circumstances. By the filing of a land use or permit application to the Town, the property owner shall have deemed to have consented to access for the above.

1.14 Operation & Maintenance Standards

1. The stormwater treatment facility shall not be modified or removed without the approval of the Commission.

2. The responsible party shall inspect and maintain the stormwater facilities on a regular basis in accordance with the Operations and Maintenance Plan.

1.14.1 Operations and Maintenance Plan

An Operations and Maintenance (O&M) Plan for all stormwater management systems, including structural and non-structural controls, shall be submitted for Commission approval as part of the application documents. The O&M Plan shall be developed to ensure the system and its components function as designed and is maintained so as not to create or result in a nuisance condition, such as but not limited to flooding, erosion, pollutant discharge, excessive algal growth, over-grown vegetation, mosquito breeding, unsightly debris, or impairments to public safety and health. The property owner shall have primary responsibility for implementing the operations and maintenance plan and submitting the annual inspection report to the zoning enforcement officer.

1.14.2 The Operations and Maintenance Plan shall contain at a minimum the following:

1. Stormwater management system(s) owners and contact information.

2. The party or parties responsible for operation and maintenance, including how future property owners will be notified of the presence of the stormwater management system and the requirement for proper operation and maintenance.

3. The routine and non-routine inspection and maintenance tasks for each stormwater management practice, a schedule for implementing these tasks and identification of the professional qualifications or certifications required by the entity conducting the inspection and maintenance tasks to be undertaken after construction is complete.

4. An outline of the annual maintenance inspection report.

5. A maintenance log for tracking inspections and repairs.

6. A plan that is drawn to scale and shows the location of all stormwater management facilities along with the discharge point.

7. A description and delineation of public safety features.

8. An estimated operation and maintenance budget.

9. Funding source for operation and maintenance activities and equipment.

10. Annual Maintenance Inspection Report template.

11. The Seal and Signature of a registered Connecticut Professional Engineer.

1.14.3 Maintenance Requirements:

1. The responsible party shall perform routine maintenance in accordance with the approved stormwater plan and permit.

2. The responsible party shall identify and perform non-routine maintenance and/or repairs based on regular inspection of the stormwater facilities as needed. Notification of repair work shall be provided to the Commission or its designated agent prior to initiating activity. All maintenance shall be performed in a timely manner to maintain functions of the stormwater facility.

3. The responsible party shall submit a signed statement to the _____Planning office once per year indicating that the stormwater facility has been properly maintained and is functioning as designed. The Town may require that this statement be signed by a Licensed Professional Engineer.

4. Failure to perform maintenance in accordance with the approved plan and conditions of permit shall constitute a violation of the land use approval, and may result in enforcement action.

Glossary of Terms

Core Forests: Large, un-fragmented blocks of forest offer habitat for edge-intolerant species, provide connectivity and corridors for species migration in response to climate change, including warming temperatures and changes in precipitation, and increased opportunity to maintain overall biodiversity. Core forest come in three size-classes based on scientific literature for general thresholds of patch size for different purposes. For edge-intolerant species, the recommended minimum core forest block size is 500 acres, while the absolute minimum is 250 acres. Less than 250 acre core forest blocks may not be useful for those species, but do have great value in terms of resiliency, carbon storage and sequestration, habitat, and forest management. [40]

Groundwater Recharge: The process by which water that seeps into the ground, eventually replenishing groundwater aquifers and surface waters such as lakes, streams, and the oceans. This process helps maintain water flow in streams and wetlands and preserves water table levels that support drinking water supplies.[41]

Hypoxia is a condition of low dissolved oxygen concentrations in the waters of Long Island Sound that impacts up to half of the Sound's waters each summer.

Impervious Surface Coverage is the percentage of land area that does not readily absorb water, including but not limited to building roofs, parking areas, driveway areas, sidewalks and paved areas or other than Pervious Paving Materials or Porous Pavement.[42]

Low Impact Development (LID) is a site design strategy intended to maintain or replicate predevelopment hydrology through the use of small- scale controls integrated throughout the site to manage runoff as close to its source as possible.[43]

Navigable Waters: Connecticut defines "navigable waters" to mean Long Island Sound, any cove, bay or inlet of Long Island Sound, and that portion of any tributary, river or stream that empties into Long Island Sound upstream to the first permanent obstruction to navigation for watercraft from Long Island Sound."[44]

Permeable Paving Materials are materials that are alternatives to conventional pavement surfaces designed to increase infiltration and reduce stormwater runoff and pollutant loads. Alternative materials include modular concrete paving blocks, modular concrete or plastic lattice, cast-in-place concrete grids, and soil enhancement technologies. Stone, gravel, and other low-tech materials can also be used as alternatives for low traffic applications such as driveways, haul roads, and access roads.[45]

Phosphorus Pollution: Too much phosphorus can cause increased growth of algae and large aquatic plants, which can result in decreased levels of dissolved oxygen– a process called eutrophication. High

---

[40] Dan Peracchio, Forest Planner, Connecticut's 2020 Forest Action Plan, Connecticut Department of Energy and Environmental Protection Forestry Division, 2020, p. 18
[41] New Hartford, CT Zoning Regulations, 2016, p. 132.
[42] Ibid, p. 9.
[43] Ibid p. 132
[44] Public Act 12-101, An Act Concerning the Coastal Management Act and Shoreline Flood and Erosion Control Structures, Connecticut State legislature, October 2012.
[45] New Hartford, CT Zoning Regulations, 2016, p. 132.

levels of phosphorus can also lead to algae blooms that produce algal toxins which can be harmful to human and animal health.[46]

Protected River Corridor means "...any river, river segment and adjacent lands deemed worthy of permanent protection, preservation and resource management because of environmental, historic, hydrologic, ecologic, agricultural or recreational qualities."[47]

Riparia means of or belonging to the bank of a river. It encompasses the biotic assemblages of the aquatic-terrestrial transition zones associated with running waters. Riparian communities consist not only of higher plants, but also of flora and fauna, including those associated with the soil/sediment system.[48]

Stream Order indicates the relative size of a stream based on Strahler's (1957) method. Streams with no tributaries are first order streams, represented as the start of a solid line on a 1:24,000 USGS Quadrangle Sheet. A second order stream is formed at the confluence of two (2) first order streams, and so on.

Total Suspended Solids (TSS) refers to waterborne particles that exceed 2 microns in size. Total Suspended Solids are one of the most common contaminants found in urban storm water. Solids originate from many sources including erosion of pervious surfaces and dust, litter and other particles deposited on impervious surfaces from human activities and the atmosphere. Erosion at construction sites are also major sources of solids. TSS contributes to many water quality, habitat and aesthetic problems in urban waterways. Elevated levels of solids increase turbidity, reduce penetration of light at depth within the water column, and limit growth of desirable aquatic plants. Solids that settle out as bottom deposits contribute to sedimentation and can alter and eventually destroy habitat for fish and bottom-dwelling organisms. Solids also provide a medium for the accumulation, transport and storage of other pollutants including nutrients and metals.[49]

References for Riparian Corridor Protections

Books

Naiman, Robert J., Henri Decamps, and Michael E. McClain. *Riparia: Ecology, Conservation and Management of Streamside Communities.* Burlington, MA: Elsevier Academic Press, 2005.

National Research Council. *Riparian Areas: Functions and Strategies for Management.* Washington DC: The National Academies Press, 2002.

Shaver, Earl, Richard Horner, Joseph Skupien, Chris May, and Graeme Ridley. *Fundamentals of Urban Runoff Management: Technical and Institutional Issues.* Washington DC: U.S. Environmental Protection Agency, 2007.

---

[46] U.S. Environmental Protection Agency, National Aquatic Resource Surveys: Indicator Phosphorus

[47] Public Act 84-522, An Act Concerning River Protection Commissions, Connecticut State legislature, June 13, 1984.

[48] Naiman, Robert J., Henri Decamps, and Michael E. McClain. *Riparia: Ecology, Conservation and Management of Streamside Communities.* Burlington, MA: Elsevier Academic Press, 2005, p. 12.

[49] Water and Waste Digest, What are Total Suspended Solids? And Minnesota Stormwater Manual website, Total Suspended Solids (TSS) in stormwater

Center for Watershed Protection. "The Tools of Watershed Protection." In *The Rapid Watershed Planning Handbook*, 11. Ellicott City, MD: Center for Watershed Protection, 1998.
Schulz, R.C. "Riparian and Upland Buffer Practices." Chap. 8 In *North American Agroforestry: An Integrated Science and Practice, 2nd Edition*, edited by H.E. "Gene" Garrett, 163–218. Madison, Wisconsin: American Society of Agronomy, Inc., 2009.
Palone, Roxane S., and Albert H. Todd, eds. *Chesapeake Bay Riparian Handbook: A Guide for Establishing and Maintaining Riparian Forest Buffers*. Edited by Forest Service. Revised Edition ed. Annapolis Maryland: U.S. Department of Agriculture, 1998.

Government Documents

Cappiella, Karen, and Kenneth Brown. "Impervious Cover and Land Use in the Chesapeake Bay Watershed." edited by U.S. EPA Chesapeake Bay Program, 61. Ellicott City, MD: Center for Watershed Protection, 2001.
City of Boulder Planning and Development Services. "Wetland and Stream Buffers: A Review of the Science and Regulatory Approaches to Protection." 52. Boulder, Colorado: City of Boulder, Colorado, 2007.
Connecticut Bureau of Water Management. "Guidelines; Upland Review Area Regulations – Connecticut's Inland Wetland & Watercourses Act." Edited by Wetlands Management Section. Hartford, Connecticut: Connecticut Department of Environmental Protection, 1997.
Connecticut Department of Energy and Environmental Protection. "Connecticut Statewide Lake Nutrient Total Maximum Daily Load Core Document." (Draft), Edited by Connecticut Department of Energy and Environmental Protection, Hartford, CT: Connecticut Department of Energy and Environmental Protection July 2021
Connecticut Department of Energy and Environmental Protection. "Connecticut Nonpoint Source Management Program Plan." Edited by Connecticut Department of Energy and Environmental Protection, Hartford, CT: Connecticut Department of Energy and Environmental Protection, 2019.
Connecticut Department of Environmental Protection. "Manual of Best Management Practices for Agriculture." edited by Connecticut Department of Environmental Protection, 287. Hartford, CT: Connecticut Department of Environmental Protection, 1996.
Connecticut Department of Environmental Protection, and New York State Department of Environmental Conservation. "A Total Maximum Daily Load Analysis to Achieve Water Quality Standards for Dissolved Oxygen in Long Island Sound." Hartford, CT: Connecticut Department of Environmental Protection, 2000.
Cruz, Javier. "Where the Land and Water Meet a Guide for Protection and Restoration of Riparian Areas." 118. Tolland, CT: USDA Natural Resources Conservation Service, 2003.
Leopold, Luna B. "Hydrology for Urban Land Planning: A Guidebook on the Hydrologic Effects of Urban Land Use." edited by U.S. Department of the Interior, 26. Washington DC: U.S. Geological Survey, 1968.
Lowrance, Richard. "Water Quality Functions of Riparian Forest Buffer Systems in the Chesapeake Bay Watershed." edited by Nutrient Committee of the Chesapeake Bay Program, 84. Washington DC: U.S. Environmental Protection Agency, 1995.
Mayer, Paul M., Jr. Steven K. Reynolds, and Timothy J. Canfield. "Riparian Buffer Width, Vegetative Cover, and Nitrogen Removal Effectiveness: A Review of Current Science and Regulations." edited by National Risk Management Research Laboratory Ground Water and Ecosystems Restoration Division, 40. Ada Oklahoma: U.S. Environmental Protection Agency, 2005.
Mullaney, John R., and Gregory E. Schwarz. "Estimated Nitrogen Loads from Selected Tributaries in Connecticut Draining to Long Island Sound, 1999-2009." 65. Reston, Virginia: U.S. Geological Survey, 2013.

Mullaney, John R., Gregory E. Schwarz, and Elaine C. Todd Trench. "Estimation of Nitrogen Yields and Loads from Basins Draining to Long Island Sound, 1988–98." East Hartford, CT: U.S. Geological Survey, 2002.
Murphy, Brian D. "Utilization of 100 Foot Buffer Zones to Protect Riparian Areas in Connecticut." 6. 1991: Connecticut Department of Environmental Protection, 1991.
Nataluk, Douglas M., and Richard Dooley. "The Practice of Low Impact Development." edited by Office of Policy Development and Research U.S. Department of Housing and Urban Development, 131. Washington, D.C.: U.S. Department of Housing and Urban Development.
Schueler, Thomas. "Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs ", edited by Metropolitan Washington Council of Governments, 277. Washington DC: Washington Metropolitan Water Resources Planning Board, 1987.
Soil Conservation Service. "A Guide for Streambelts: A System of Natural Environmental Corridors in Connecticut." 21. Storrs, CT: USDA Soil Conservation Service, 1972.
Strassler, Eric, Jesse Pritts, and Kristen Strellec. "Preliminary Data Summary of Urban Storm Water Best Management Practices." 214. Washington DC: U.S. Environmental Protection Agency, 1999.
U.S. Army Corps of Engineers. "Buffer Strips for Riparian Zone Management." 62. Waltham, Massachusetts: U.S. Army Corps of Engineers, 1991.
U.S. Environmental Protection Agency. "National Management Measures to Control Nonpoint Source Pollution from Urban Areas." 518. Washington DC: United States Environmental Protection Agency, 2005.

Journal Articles

Arnold Jr., Chester L. ., and C. James Gibbons. "Impervious Surface Coverage the Emergence of a Key Environmental Indicator." *American Planning Association* 62, no. 2 (Spring 1996): 243-58.
Blinn, Charles R., and Michael A. Kilgore. "Riparian Management Practices: A Summary of State Guidelines." *Journal of Forestry*, no. August (2001): 11-17.
Booth, Derek B., David Hartley, and Rhett Jackson. "Forest Cover, Impervious Surface Area, and the Mitigation of Stormwater Impacts." *Journal of the American Water Resources Association* 38, no. 3 (June 2002): 835-45.
Booth, Derek B., James R. Karr, Sally Schauman, Christopher P. Konrad, Sarah A. Morley, Marit G. Larson, and Stephen J. Burges. "Reviving Urban Streams, Land Use, Hydrology, Biology and Human Behavior." *Journal of the American Water Resources Association* (October 2004): 1351-64.
Clausen, J.C., K. Guillard, C.M. Sigmund, and K. Martin Dors. "Ecosystem Restoration: Water Quality Changes from Riparian Buffer Restoration in Connecticut." *Journal of Environmental Quality* 29, no. November-December (2000): 10.
Killheffer, Jason. "Connecticut's Inland Wetlands & (and) Watercourses Act after Queach V. Inland Wetlands Commission: A Safe Harbor in a Sea of Regulatory Confusion." *Quinnipiac Law Review* 23, no. 4 (2005).
King, S.E., D.L. Osmond, J. Smith, M. Burchell, M. Dukes, R.O. Evans, S. Knies, and S. Kunickis. "Effects of Riparian Buffer Vegetation and Width: A 12 Year Longitudinal Study." *Journal of Environmental Quality* 45 (July 7, 2016 2016): 1243-51.
Klein, Richard D. "Urbanization and Stream Quality Standards Impairment." *Water Resources Bulletin* 15, no. 4 (August 1979): 948-63.
May, Christopher W., Richard R. Horner, James R. Karr, Brian W. Mar, and Eugene B. Welch. "Effects of Urbanization on Small Streams in the Puget Sound Lowland Ecoregion." *Watershed Protection Techniques* 2, no. 4 (June 1997): 483-94.
Miller, Jeffrey G. "Plain Meaning, Precedent and Metaphysics: Interpretation the "Navigable Waters" Element of the Clean Water Act Offense." 45 (2015): 40.

Murphy, James. "Muddying the Waters of the Clean Water Act: Rapanos v. United States and the Future of America's Water Resources." *Vermont Law Review*, 31 (2007): 355-379.
Richardson, John S., Robert J. Naiman, and Peter A. Bisson. "How Did Fixed-Width Buffers Become Standard Practice for Protecting Freshwaters and Their Riparian Areas from Forest Harvest Practices?" *Freshwater Science* 31, no. 1 (2012): 232-38.
Schueler, Thomas. "Invisibility of Stream/Wetland Buffers: Can Their Integrity Be Maintained." *Center for Watershed Protection* (2000): 239-41.
Slater, L., G. Villarini, S. Archfield, D. Faulkner, R. Lamb, A. Khouakh, and J. Yin. "Global Changes in 20-Year, 50-Year, and 100-Year River Floods." *Geophysical Research Letters* (2021): 10.
Wilhere, George F, and Timothy Quinn. "How Wide Is Wide Enough: Science, Values, and Law in Riparian Habitat Conservation." *Natural Resources Journal* 58, no. 2 (Summer 2018): 279-318.
Wilson, Emily, Juliana Barrett, and Chester L. Arnold. "Land Cover Change in the Riparian Corridors of Connecticut." *Watershed Science Bulletin* (Fall 2011 2011): 27-32.
Zeilman, Timothy. "Connecticut by Canoe: Navigability in the Nutmeg State." *Connecticut Bar Journal* 84, no. 4 (2010): 305-24.

Legal Rule or Regulation

Connecticut Department of Energy and Environmental Protection. "Stream Flow Standards and Regulations." In *§§ 26-141b-1—26-141b-8*, 22. Hartford, CT: Connecticut Department of Energy and Environmental Protection, 2011.
Connecticut Department of Public Health. "Connecticut Public Health Code: On-Site Sewage Disposal Regulations and Technical Standards for Subsurface Sewage Disposal Systems." 71. Hartford, CT: Connecticut Department of Public Health, 2018.
Connecticut State Legislature. "An Act Concerning the Coastal Management Act and Shoreline Flood and Erosion Control Structures." In *Public Act 12-101*. Hartford, CT: Connecticut State Legislature, 2012.
———. "An Act Concerning the Zoning Enabling Act, Accessory Apartments, Training for Certain Land Use Officials, Municipal Affordable Housing Plans and a Commission on Connecticut's Development and Future." In *Public Act 21-29*. Hartford, CT: The Connecticut State Legislature, 2021.

Reports

Chesapeake Bay Program Forestry Workgroup. "Expanded Riparian Forest Buffer Goals." 12. Annapolis, ME: Chesapeake Executive Council, 2003.
Connecticut River Joint Commission New Hampshire and Vermont. "Introduction to Riparian Buffers for the Connecticut River Watershed." 4. Charlestown, NH: Connecticut River Joint Commission, New Hampshire and Vermont, 1998.
Hawes, Ellen, and Markelle Smith. "Riparian Buffer Zones: Functions and Recommended Widths." 15. New Haven, CT: Yale School of Forestry, 2005.
Massachusetts Association of Conservation Commissions. "MACC Buffer Zone Guidebook." 120. Belmont, MA: Massachusetts Association of Conservation Commissions, 2019.
May, Christopher W. "Stream-Riparian Ecosystems in the Puget Sound Lowland Eco-Region: A Review of Best Available Science." Poulsbo, Washington: Watershed Ecology LLC, 2003.
Schueler, Thomas. "Impacts of Impervious Cover on Aquatic Systems." 158. Ellicott City, MD: Center for Watershed Protection, 2003.
Wenger, Seth. "A Review of the Scientific Literature on Riparian Buffer Width, Extent and Vegetation." 60. Athens, Georgia: Office of Public Service & Outreach, Institute of Ecology, University of Georgia, 1999.
Wetland Buffer Scientific Work Group. "Scientific Wetland Buffer Report." 20. Concord, NH: New Hampshire Association of Natural Resource Scientists, 2017.