

Table of Recommendations

Goal 1: Protect Natural Resources and Open Space	Goal 2: Promote Efficient, Compact Development Patterns and Infill	Goal 3: Smart Designs That Reduce Overall Imperviousness	Goal 4: Adopt Green Infrastructure Stormwater Management Provisions	Goal 5: Encourage Efficient Parking
<p><i>Soils managed for revegetation</i></p> <p>Best practice would be to prohibit removal of topsoil from site and require rototilling for soils impacted during construction. Language needs to be added to Stormwater, Site Plan Review and Subdivision Regs. These regulations currently suggest that site disturbance be minimized.</p> <p><i>Limit clearing, lawn size, require retention or planting of native vegetation/naturalized areas</i></p> <p>For lot size: Letting the developer vary lot sizes and place the units on the parcel subject to the conservation requirement of the Open Space Design as well as subdivision, health, and other applicable regulations allows the flexibility necessary to maximize resource conservation. Best practice is to establish limits on the extent of lawn area on residential lots, either area or percentage of lot. (MA LID Toolkit).</p> <p>For clearing: Prohibit removal of topsoil and require rototilling following construction.</p>	<p><i>Lot size</i></p> <p>Letting developers vary lot sizes and place units on the parcel subject to the conservation requirement of the OSRD Bylaw as well as subdivision, health, and other applicable regulations allows the flexibility necessary to maximize resource conservation. State that this is the preferred option.</p> <p><i>Setbacks</i></p> <p>Currently there is some flexibility for Traditional Neighborhood Development + Sutton Village Overlay District, and not much flexibility for setbacks in OLI and I. The committee should set standards in the Use and Dimensional Regulations Requirements that minimize and, in specific situations, eliminate setbacks in residential districts to increase flexibility with regard to house location (MA LID Toolkit).</p> <p><i>Frontage</i></p> <p>Currently, the Zoning bylaw says frontage should be minimized for cul-de-sacs which is better than conventional, but the Town should go further and eliminate minimums in certain instances and ensure that any frontage language is tied into the OSRD bylaw. Permit reduction in frontage (and corresponding road length/paved area) where appropriate, such as in open space residential developments, at the outside sideline of curved streets, and around cul-de-sacs (MA LID Toolkit).</p>	<p><i>Street location</i></p> <p>Within the Subdivision Regulations, Sutton mostly has numeric and geometric standards based primarily on vehicular travel and safety. Language could be added to say that OSRD is preferred by right to minimize grading and road lengths and avoid important natural features.</p> <p><i>Road width</i></p> <p>Language should be added to Subdivision Regulations for three categories of roads, encouraging narrow roads wherever possible depending on the district type. Example: determine if certain streets need wide, medium, or narrow line categories, with 20'-24' turnarounds as the widest option for two lane roads, and 16'-20' as the widest option for low traffic roads, 2' shoulders. Alleys, low traffic roads, and secondary emergency access roads, and road shoulders should encourage the use of permeable materials. (MassAudubon Bylaw Assessment Tool, Tighe & Bond Report)</p> <p><i>Road ROW Width</i></p> <p>Current Subdivision Regulations require 50 feet ROW for all road types, which is too high. Best practice is 20-50 feet depending on the type of road.</p> <p><i>Access Options</i></p> <p>Common drives should be allowed up to 4 units, not 3. Consider adding language for one-way loop streets in the Subdivision Regulations. State that permeable paving is preferred.</p> <p><i>Dead-Ends/Cul-De-Sacs</i></p> <p>Allow hammerhead turnaround. Currently the Subdivision Regulations have 176 feet minimum for turnarounds which is too high. Minimize end radii to 35 feet. (MA Bylaw Assessment Tool)</p> <p><i>Cul-De-Sacs</i></p> <p>The Town should require center landscaping with bioretention for cul-de-sacs in Zoning bylaw.</p> <p><i>Curbing</i></p>	<p><i>Rooftop runoff</i></p> <p>Rooftop runoff is generally not addressed in any regulations/bylaws. The Town should adopt language to require that clean rooftop runoff be directed to onsite landscaped areas (i.e., "A vegetated filter strip may be used as a qualifying pervious area for purposes of the LID Site Design Credits for disconnecting rooftop and nonroof top runoff." (MA Stormwater Handbook Vol. 2) LID Model Bylaw from MA SmartGrowth Toolkit has language about rooftop runoff credit language that could be included on Page 28.</p> <p><i>Overall stormwater design; piping and surficial retention vs. LID</i></p> <p>Stormwater Bylaw mostly defaults to MS4 references and does not include significant LID language additions beyond this. Very conventional piping standards outlined in Subdivision Regulations. Surficial ponding of retained runoff for up to 72 hours should be allowed. Credit for green roofs towards stormwater requirements should be prioritized. (MassAudubon Bylaw Assessment Tool) The EPA has examples of green roof incentives programs linked in the "sources" section below.</p> <p><i>Site Plan Requirements</i></p> <p>Route 146 Overlay District currently has language that counts bioretention/other vegetated LID features towards open space requirements. This should be expanded to other districts. Use of LID features should be encouraged more in Site Plan Review and Stormwater Regulations as well.</p> <p><i>Allow easy siting of LID features</i></p> <p>Add language saying that LID features need to be outlined in the site plan application in Site Plan review. LID features should be allowed on lots, common open space, or road ROW with an easement recorded. During permitting process, encourage use of green roofs, rainwater</p>	<p><i>Parking</i></p> <p>It is recommended that 2 parking spaces maximum in all residential districts be preferred instead of 2 spaces minimum. Tenants should be allowed the option for separate, optional lease agreements for residential parking.</p> <p><i>Commercial Parking</i></p> <p>Ensure that shared parking is allowed based on different peak demand times in all districts, not just Route 146 Overlay District - should include Business, OLI, and I. Parking reqs. should be reduced near public transit areas. Allow reduction of parking reqs. if shared parking is proposed. Provide model shared parking agreements that can be included as deed restrictions or permit reqs. Model optional lease is provided in the "sources" section below. How to determine shared parking requirements: "1. Determine minimum parking for each</p>

<p>Encourage 75% native plantings and require vegetation species shown on site plans. Consider expanding non-invasive planting requirements to more districts beyond Route 146 Overlay District. Set specific standards to minimize clearing in the Stormwater Bylaw (and other local land use regulations) by requiring retention or planting of, for example, 75% of native vegetation.</p> <p><i>Require native vegetation and trees</i></p> <p>Require 75% native plantings in Route 146 Overlay District and expand this to other districts in Zoning bylaw. Add a specific 75% threshold for subdivision bylaw, site plan review and stormwater regulations (MassAudubon Bylaw Assessment Tool).</p>	<p><i>Common driveways</i></p> <p>Special permits are currently required in the Zoning Bylaw and there is nothing mentioned in the Subdivision Regulations or Site Plan Review. Common driveways should be allowed for up to 4 residential units. Language should be added saying that permeable pavers are preferred.</p> <p><i>Limit impervious area</i></p> <p>Sutton should adopt language to limit total impervious surface cover of a proposed development to less than 10% of the total area. Limitations should also be set on impervious surface area in high density areas to allow infiltration rates to be equal to or greater than pre-development levels. Groundwater Protection District impervious surface % is too high – this needs to be changed to 10% instead of 15%. Sutton should consider adding impervious cover maximums depending on the community type, such as a maximum of 15% impervious cover in low density areas of Town. Additionally, the Town should consider adding a Cottage Housing Bylaw to cluster housing units with small frontages and share impervious surface area.</p>	<p>Add more LID language for the Route 146 Overlay District. Provide design standards for open drainage along curbs – Sutton’s Subdivision Regulations don’t have design procedures for open drainage but there is a lot there for closed drainage. Do not require the use of conventional curbs for the full length of all streets in residential neighborhoods. Where curbs are deemed necessary to protect the roadway edge, allow the use of perforated curbs (that allow runoff to flow into swales or “invisible curbs” (flush with road surface) (MA LID Toolkit)</p> <p><i>Roadside Swales</i></p> <p>State that roadside swales are preferred, and closed drainage is not preferred in Subdivision Regulations and Stormwater Bylaw. Criteria for proper design should be included. Subdivision Regulations currently require curbing for new subdivisions and around intersections. Allows open drainage/swales as an option instead of traditional curbing, but does not explicitly say it's preferred.</p> <p><i>Utilities</i></p> <p>Utilities are allowed under roads, but it would be useful to include some language to connect to bioswale placement. Best practice would be to permit placement of utilities under the paved section of the right of way or immediately adjacent to the road edge (so that the land adjacent to the roadway can be used for swales.) (MA LID Toolkit).</p> <p><i>Sidewalks</i></p> <p>The Town should say that sidewalks are preferred to be constructed with permeable pavers/other permeable materials.</p> <p><i>Sidewalk location</i></p> <p>Currently, at least one sidewalk is required on all streets, two may be required near schools. Best practices recommend further minimizing sidewalk location requirements and incentivizing building sidewalks around land contours, so it is encouraged rather than simply an option. Provide flexibility with sidewalk layout; e.g., alternative pedestrian circulation layout that uses common areas, rather than street rights of way. (MA LID Toolkit)</p> <p><i>Sidewalk drainage</i></p> <p>Subdivision Regulations and Stormwater Regulations could include more language about disconnecting drainage from the road system and preferring open drainage with adjacent green strips or within vegetated areas beside to absorb sidewalk flow.</p>	<p>harvesting, and downspout disconnection, especially for commercial district. (LaRochelle, Tighe and Bond Bylaw Assessment, 2022.)</p> <p><i>Permeable paving</i></p> <p>Bituminous concrete is preferred in Stormwater Regulation and Zoning bylaw. Permeable paving should be allowed for residential drives, parking stalls, spillover parking spaces and emergency accessways (with engineering support as needed for emergency vehicles). Two-track design should be allowed for driveways and secondary emergency access. (MassAudubon Bylaw Assessment Tool).</p> <p><i>Stormwater Management O&M Plan</i></p> <p>Stormwater O&M Plan is currently required for Route 146 Overlay District. This should be required in more districts. This plan is only mentioned in Zoning Bylaw, and not mentioned anywhere else in the regulations/ bylaws. Surficial retention and swales should be preferred and closed underground systems that require special inspection and cleaning should be discouraged (MassAudubon Bylaw Analysis Tool).</p> <p><i>Construction Erosion and Sedimentation Plan Required</i></p> <p>Land Disturbance permit is required before any site disturbance work begins (Stormwater Regulations). Sutton could go beyond basic NPDES requirements: require minimization of site disturbance altogether (MassAudubon Bylaw Assessment Tool) and require hydrologic calculation to determine pre and post peak rates and volumes of stormwater runoff for 2-, 10-, 25- and 100-year 24-hour storm events. (MA Stormwater Handbook)</p>	<p>land separately. 2. Calculate the total parking required across each time period. 3. Set the minimum requirement at total number of spaces needed during the busiest time period.” (MA Smart Parking Toolkit, MA LID Toolkit)</p> <p><i>LID in Parking Areas</i></p> <p>It is recommended that 10% of interior parking areas in all districts be landscaped, not just 5% (this needs to be changed in Route 146 Overlay District as well) and that a minimum of 25 square feet of the island planting area be planted (currently there is no minimum). Other recs from MA Smart Parking Toolkit include:</p> <ul style="list-style-type: none"> -Maximize on-street parking in front of buildings. -Establish provisions for compact car spaces. -Establish provisions for parking requirements to be met with unpaved reserve parking. -Create incentives for using permeable pavers -Adopt language that requires parking lots to be constructed of permeable pavement.
--	--	--	---	---

Open Space Residential Design Bylaw Recommendations

Minimum open space	Currently Sutton's OSRD bylaw requires that 40% of parcel area should be set aside as open space. Best practice would be 75% or more.
Review process	<p>MA Conservation Subdivision Model Bylaw: DESIGN PROCESS MODEL LANGUAGE</p> <p><i>"a) At the time of the application for a special permit for OSRD in conformance with Section VI.1, applicants are required to demonstrate to the Planning Board that the following Design Process was performed by a certified Landscape Architect and considered in determining the layout of proposed streets, house lots, and open space.</i></p> <p><i>i) Step One: Identifying Conservation Areas. Identify preservation land by two steps. First, Primary Conservation Areas (such as wetlands, riverfront areas, and floodplains regulated by Conservation Subdivision Design Model Bylaw, August 2000 3 state or federal law) and Secondary Conservation Areas (including unprotected elements of the natural landscape such as steep slopes, mature woodlands, prime farmland, meadows, wildlife habitats and cultural features such as historic and archeological sites and scenic views) shall be identified and delineated. Second, the Potentially Developable Area will be identified and delineated. To the maximum extent feasible, the Potentially Developable Area shall consist of land outside identified Primary and Secondary Conservation Areas.</i></p> <p><i>ii) Step Two: Locating House Sites. Locate the approximate sites of individual houses within the Potentially Developable Area and include the delineation of private yards and shared amenities, so as to reflect an integrated community, with emphasis on consistency with the Town's historical development patterns. The number of homes enjoying the amenities of the development should be maximized.</i></p> <p><i>iii) Step Three: Aligning the Streets and Trails. Align streets in order to access the house lots. Additionally, new trails should be laid out to create internal and external connections to existing and/or potential future streets, sidewalks, and trails.</i></p> <p><i>iv) Step Four: Lot Lines. Draw in the lot lines."</i></p>
Minimum parcel size	Current minimum parcel size requirement is somewhat flexible (15,000 square feet or one-third (1/3) the square footage otherwise required by the Zoning District (whichever is less)) but ideally there would be no minimum size
Ownership of open space	Ownership of open space could be more specific - it currently does not ID between ownership of active vs. passive open space.
Monitoring	Monitoring provisions in the OSRD bylaw could be made to be more specific. This bylaw needs specified provisions to aid endowed monitoring by a conservation organization at stated intervals. Conservation Commission should be the organization monitoring.
Low Impact Design	LID is mostly encouraged instead of required
Yield Calculation	<p>Recommendation from MA Conservation Subdivision Design Model Bylaw (page 5):</p> <p>[Choose either Option One or Two]</p> <p>a) OPTION ONE: Determination of Yield, Formula</p> <p>i) The Basic Maximum Number shall be derived after the preparation of a Yield Plan. The Yield Plan shall be the following calculation to determine the total number of lots (or dwelling units): Total Number of Lots = $TA - (0.5 \times WA) - (0.1 \times TA)$ / district minimum lot area</p> <p>TA = Total Area of Parcel WA = Wetlands and Riverfront Areas of Parcel</p> <p>----- OR -----</p> <p>b) OPTION TWO: Determination of Yield, Sketch Plan i) The Basic Maximum Number shall be derived from a Yield Plan. The Yield Plan shall show the maximum number of lots (or dwelling units) that could be placed upon the site under a conventional subdivision. The Yield Plan shall contain the information required for a [choose either Sketch Plan or Preliminary Plan accordingly], as set forth above in Section VI. The proponent shall have the burden of proof with regard to the Basic Maximum Number of lots (or dwelling units) resulting from the design and engineering specifications shown on the Yield Plan.</p>

Sources:

Commercial parking model agreements and deed restrictions: Model shared parking agreement: Gardiner, Maine
https://www.gardinermaine.com/sites/g/files/vyhlif611/f/news/appendix_d_sampleparkingagreement_0.pdf

Smart Parking (MA SmartGrowth Toolkit): <https://www.mass.gov/doc/smart-growthsmart-energy-slideshows-smart-parking-basic/download>

MA LID Toolkit: Checklist for Regulatory Review http://www.mapc.org/wp-content/uploads/2017/11/LID_Local_Codes_Checklist.pdf

Yield Calculation: <https://www.mass.gov/doc/open-space-residential-development-or-conservation-subdivision-design-osrd-model-by-law-special/download> (page 5)

Tighe & Bond Assessment for Boylston: (attached as a PDF document to e-mail)

Low Impact Development Site Design Credits (MA Stormwater Handbook starting on page 42) <https://www.ipswichma.gov/DocumentCenter/View/2732/DEP-Stormwater-Manual---vol-3-chapter-1>

- ➔ “The credits allow project proponents to reduce or eliminate the structural stormwater BMPs otherwise required to meet Standards 3 and 4 by directing stormwater runoff to qualifying pervious surfaces that provide recharge and treatment. The credits are based on research published by Schueler 1994 and others indicating that the greater the impervious area, the more stream channel erosion, water quality impacts, and reductions in base flow”
- ➔ CREDIT 1. Environmentally Sensitive Development;
CREDIT 2. Rooftop Runoff Directed to Qualifying Pervious Area;
CREDIT 3. Roadway, Driveway or Parking Lot Runoff Directed to Qualifying Pervious Area
(examples of each credit and how to set it up are listed in the above link as well)

Northampton's credit and incentives policy: https://northamptonma.gov/DocumentCenter/View/4776/Stormwater-Credit-Policy_rev2015_final

Pioneer Valley Planning Commission short report about setting up discounts, credits and stormwater utility fees and associated case studies: <https://www.pvpc.org/sites/default/files/files/PVPC-Stormwater%20Utilities.pdf>

MAPC how-to toolkit to set up incentives programming: <https://www.mapc.org/resource-library/stormwater-financing-utility-starter-kit/> with credit and incentive sample plan: https://www.mapc.org/wp-content/uploads/2018/05/Credit_Incentive_Plans.pdf

Comparison study of Newton's, Reading's, and Burlington VT's incentives/funding mechanisms by the Charles River Watershed Association: https://www.mapc.org/wp-content/uploads/2018/05/Municipal_SFMA_Case_Studies_Repo.pdf

(more info on the above case studies are available on this EPA website: <https://www3.epa.gov/region1/npdes/stormwater/assets/pdfs/FundingStormwater.pdf>)

Other EPA incentive program recommendations: <https://www.epa.gov/sites/default/files/2015-09/documents/bbfs7encouraging.pdf>

Greening Your Community

Cost-effective LID solutions



conserve



restore



protect



save money

#1 of 5

Fact Sheet 1 of 5

Preserving Natural Assets—Nature Based Solutions

Competing Priorities & Cost-Effective Solutions

Communities are facing many pressures. More jobs and housing are needed, while the costs of providing essential services rise faster than revenues. Infrastructure maintenance needs for roads, bridges, and water systems are growing. An estimated \$40 billion is needed over the next 20 years for water, sewer, and stormwater system improvements across Massachusetts.¹ There is pressure to increase the local tax base and opposition to “unfunded mandates” such as federal and state water resource management regulations.

In the midst of these challenges, we also need to address persistent water pollution and increased flooding due to more intense storm patterns that are only increasing in the face of climate change. How do we do it all?

Luckily, local communities do have primary control over one important factor — land use. Well-planned land use can create housing and reduce municipal costs, while also preserving community character and the capacity of the natural landscape to provide clean air, water, and a host of other “free” services.

We Need to Change Course

Every day in Massachusetts, an average of 13 acres of land are developed.² Traditional development uses large lot subdivisions —converting forests and farmlands to roads, driveways, houses, and lawns. This creates more impervious surfaces and generates more stormwater, while also requiring more of our groundwater to water lawns. Managing that stormwater with pipes and engineered treatment (grey infrastructure) can reduce pollution and minimize flooding, but they come at a high price in terms of installation, monitoring, and maintenance.

However, there is another way. Nature-based solutions that use plants and soil to absorb and filter water can be cost-effective and provide many benefits to your community. By developing smarter with GI and LID, conservation and development can occur together, providing a win-win scenario.

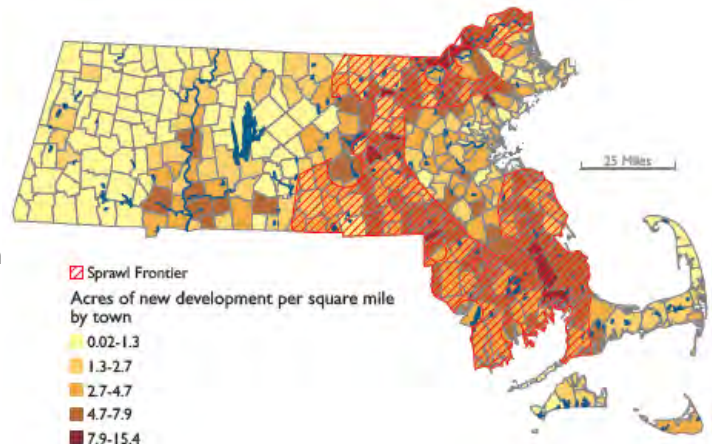
What are Green Infrastructure (GI) and Low Impact Development (LID)?

Green Infrastructure (GI) includes both natural features such as forests and wetlands as well as engineered landscapes that mimic these natural processes like a rain garden.

Low Impact Development (LID) works to preserve the natural landscape and minimize impervious surfaces to keep stormwater close to the source and use it as a resource rather than a waste product.

Together, LID and GI not only manage stormwater and improve groundwater supplies, but also offer many free ecosystem services including cleaner air and water, flood control, shade and energy savings, recreational opportunities, and enhanced property values and quality of life.

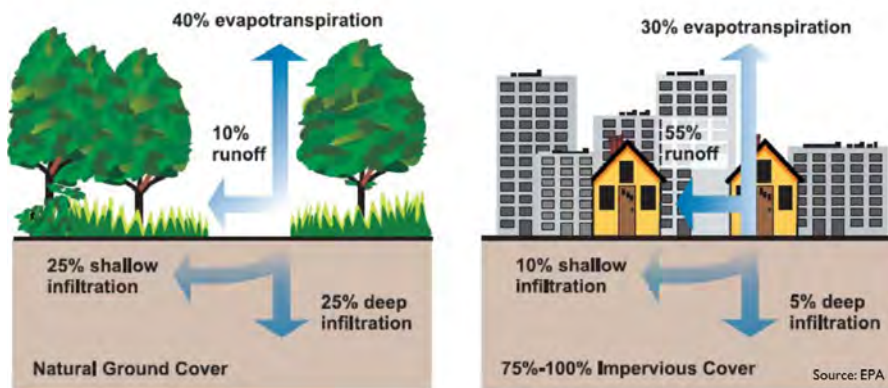
Preserving our existing GI is our first line of defense against climate impacts such as increased storm frequency and intensities as well as achieving long-term cost savings.



Mass Audubon, *Losing Ground: Planning for Resilience*

Understanding the Land Use—Water Resources Connections

Our land use choices affect the health of our waterways. Massachusetts has abundant water resources, but many waterways are impaired due to pollution and/or reductions in natural flows. Maintaining or restoring the capacity of the land to absorb and filter precipitation improves the health of our rivers and streams.

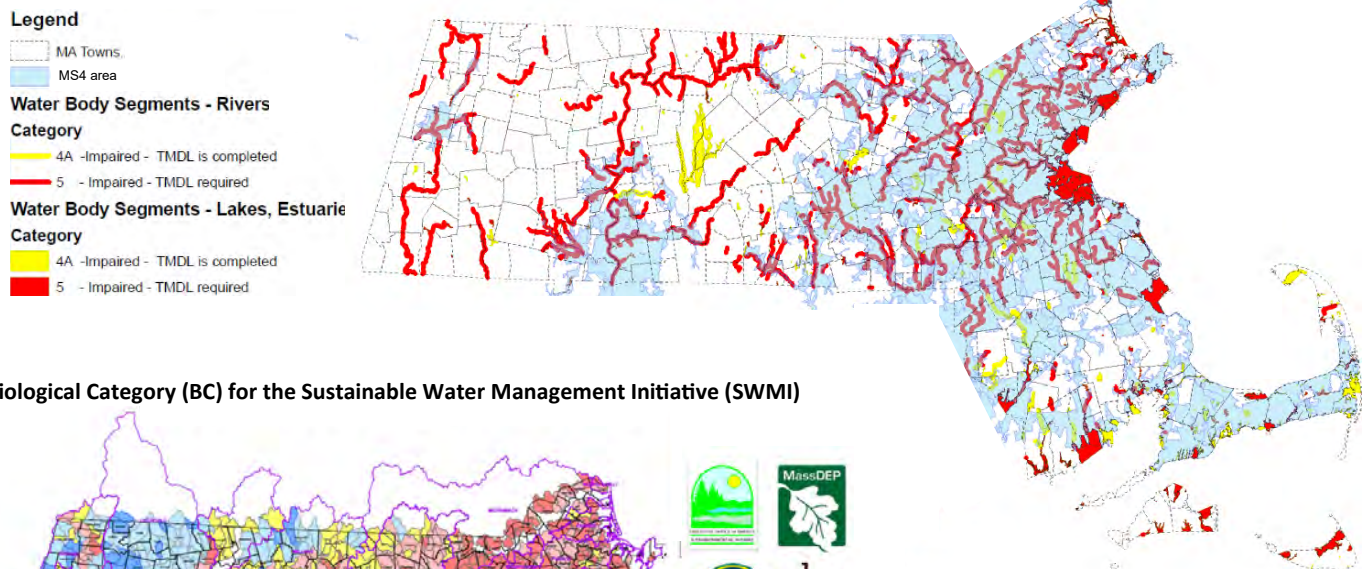


Left: A Natural landscape has about 10% runoff and 50% infiltration.

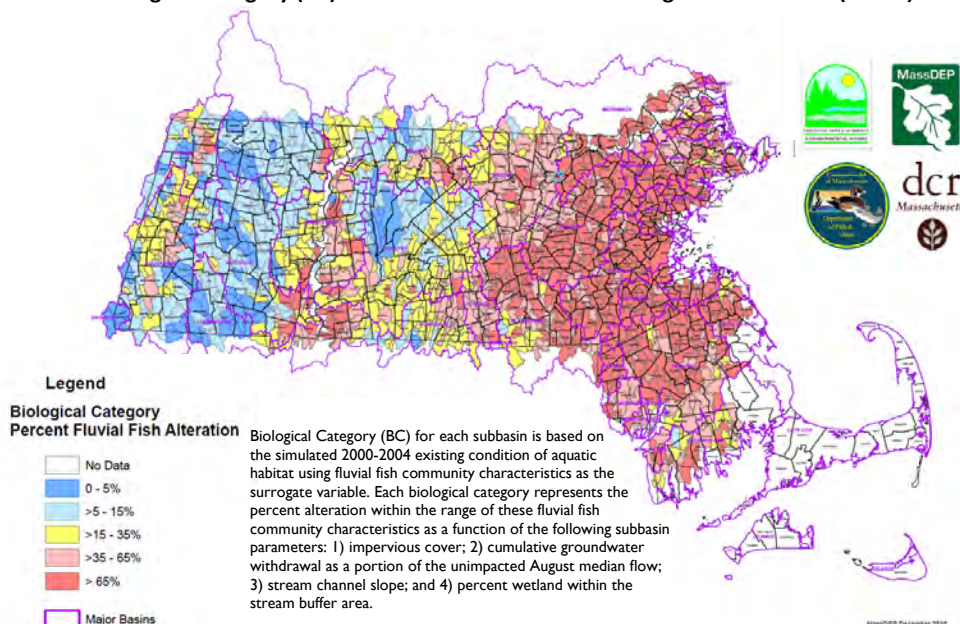
Right: A highly developed landscape with high impervious cover has 55% runoff and only 15% infiltration.

These maps illustrate water management issues across the state. Many communities are facing limits under the state Water Management Act on how much water they can withdraw. Requirements for managing stormwater under the federal Clean Water Act are also being imposed to help clean up stormwater pollution, which contributes to more than half of water quality impairments in the state, as seen below. The MS4 area covers parts of Massachusetts with high amounts of impervious surface, which often correlates with impaired waterways.

Impaired Waters and MS4 area in Massachusetts



Biological Category (BC) for the Sustainable Water Management Initiative (SWMI)



Above: Impaired waters in Massachusetts (those that do not meet state water quality standards) and the MS4 (Municipal Separate Storm Sewer System) permit area regulated under the federal Clean Water Act. About 55% of water quality impairments in the state are due to stormwater runoff.³ Map source: EPA

Left: Impervious surfaces and groundwater pumping reduce groundwater levels that provide flow to streams during dry weather. This impacts habitat for flow-dependent (fluvial) fish. Map source: DEP

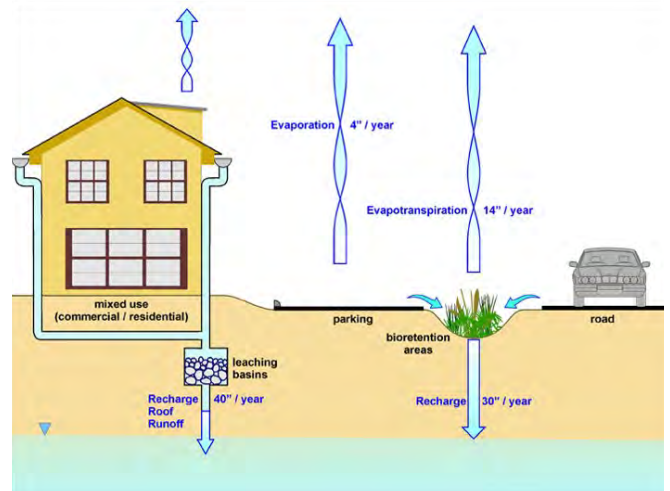
Development + Conservation = Opportunities Everywhere

While traditional approaches to development are not sustainable, affordable solutions are available. As we develop and redevelop, there are opportunities to reduce water management cost burdens on taxpayers while enhancing the environment and quality of life.

First, the value of the natural landscape – particularly forests and vegetated buffers to wetlands and waterways – needs to be recognized to maintain the free services it provides (see chart below).

Secondly, where land is altered by development or redevelopment, LID techniques can be used to retain and filter water on the site in order to preserve or restore water quality and infiltration.

LID techniques can maintain pre-development water conditions and groundwater recharge. In some instances, development or redevelopment can even increase or restore the capacity of the land to absorb water, as seen in the image to the right.



Positive Impact Development, Horsley Witten Group

The Value of Green Infrastructure: Free Ecosystem Services



Reduced Flooding: Green infrastructure acts as a sponge for excess water, providing flood protection and avoiding costly repairs to flood-damaged roadways and culverts. Systems like rain gardens can reduce runoff by up to 90%.⁴ A single, mature tree can intercept nearly 2,000 gallons of stormwater per year.⁵



Improved Water Quality: Polluted runoff contributes to more than half of water quality impairments in the Commonwealth.³ Natural streamside vegetation filters pollutants and reduces erosion. Vegetated buffers also remove an average of 74% of nitrogen pollution in runoff, depending on buffer width, soil type, and vegetation.⁶



Water Quantity: Vegetation and soils capture and infiltrate water, recharging groundwater that feeds streams. Water harvesting systems like rain barrels and cisterns can save the average homeowner 1,300 gallons of water during peak summer months.⁷ With good design, a development can rely entirely on natural precipitation for all landscape irrigation.



Recreational Opportunities: Clean, flowing waters support recreation and tourism, including boating, fishing, and swimming, while open space provides areas for hiking and biking.



Improved Quality of Life: Open space and street trees create a more enjoyable walking environment, benefiting community connection, health, and economic benefit in downtowns and commercial areas.



Improved Public Health: Trees and vegetation reduce the urban heat island effect, reducing smog that contributes to asthma and other respiratory diseases. Managing stormwater through soils and vegetation reduces the need for retention ponds and catch basins, avoiding creation of mosquito habitat. More than \$11 million is spent annually on mosquito control in Massachusetts.⁸



Creation of Habitat: Open space and clean waters maintain healthy habitat for fish, birds, and other wildlife.



Climate Change Mitigation: Protecting forests allows them to continue absorbing CO₂ and acting as a carbon sink, while also reducing flooding from increased storm events. Massachusetts forests store an average of 85 tons of C per acre⁹—14% of the Commonwealth's annual gross carbon emissions each year.¹⁰



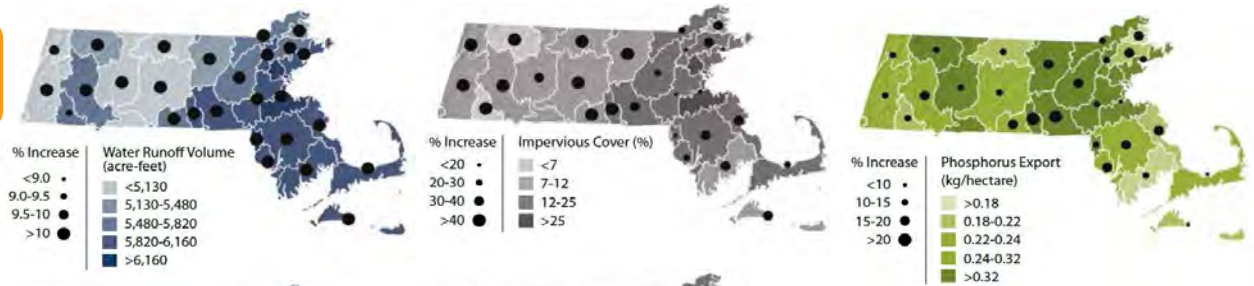
Economic Value: Access to open space and mature vegetation increases home value by 10-30%. Every dollar invested in land conservation provides a \$4 payback in terms of the above benefits.¹¹

Developing Smarter

Harvard Forest's 2014 study *Changes to the Land* analyzed several scenarios for land use through 2060, including two with nearly the same amount of development, but with different effects on land and water resources. The first scenario allowed unregulated, sprawling growth. The second retained forests for their natural green infrastructure values and clustered development. Retaining forests resulted in reduced runoff, less impervious cover, and less phosphorus pollution. Runoff would increase by less than 10% in every watershed except one (some runoff was unavoidable due to increased precipitation from climate change). Tree species with high commercial value would increase by 20% and timber harvests would double, while the carbon storage capacity would increase by 35% compared to 2010. Forests (and the benefits they provide) would remain intact, with 25% less fragmentation and an additional 750,000 acres conserved — again, all with nearly the same amount of development.¹²

1.

Recent Trends



2.

Forests as Infrastructure



Harvard Forest, *Changes to the Land*, 2014

Protecting Land, Protecting Water, and Saving Money

Carefully targeting land for water quality protection can offer significant cost savings. Two and a half million people receive their drinking water from the Quabbin and Wachusett Reservoirs. Over the last 20 years, the Massachusetts Water Resources Authority (MWRA) spent \$130 million to protect approximately 22,000 acres of watershed lands that naturally filter the water flowing into the reservoir. This saved MWRA ratepayers from building a \$250 million filtration plant as well as spending \$4 million each year in operating costs.¹³

By valuing our natural green infrastructure and restoring urban landscapes through LID, communities can enhance their safety, resiliency, community character, and budget while simultaneously growing in a sustainable manner. We can set Massachusetts on a new path to reduce our impervious surfaces, increase water infiltration, and reduce runoff, while minimizing nutrient loading into our waterways and protecting water quality. Allowing green infrastructure to do the work of soaking up and filtering water reduces the burden on our costly engineered systems while also improving quality of life, meeting regulations, and saving money.

Learn More

For more information, including all five fact sheets, a local land use regulatory review template, presentations, references, and related resources check out www.massaudubon.org/shapingthefuture.



This project was funded by an agreement (CE96184201) awarded by the Environmental Protection Agency to the New England Interstate Water Pollution Control Commission on behalf of the Narragansett Bay Estuary Program. Although the information in this document has been funded wholly or in part by the United States Environmental Protection Agency under agreement CE96184201 to NEIWPCC, it has not undergone the Agency's publications review process and therefore, may not necessarily reflect the views of the Agency and no official endorsement should be inferred. The viewpoints expressed here do not necessarily represent those of the NBEP, NEIWPCC, or U.S. EPA nor does mention of trade names, commercial products, or causes constitute endorsement or recommendation for use.



This project is funded in part by the Massachusetts Environmental Trust. Learn more about the Trust and the programs it supports through specialty license plate offerings at www.mass.gov/eea/met



Greening Your Community

Cost-effective LID solutions



conserve



restore



protect



save money

#2 of 5

Fact Sheet 2 of 5 Conservation Design

Balancing Growth & Character

As our communities grow and develop, it's important to consider the cultural and aesthetic value of the landscape. Cutting down forests and substituting expansive lawns without any mature trees sacrifices the classic charm of New England, and reduces our ability to enjoy foliage in the fall, shade in the summer, and privacy, recreation, and walkable neighborhoods all year long.

Conservation design (CD) can offer all of these benefits along with the valuable free ecosystem services described in Fact Sheet #1 while meeting communities' development needs. Building homes closer together and preserving adjacent land for shared use creates attractive, cohesive communities where neighbors know one another and have recreational and aesthetic benefits right outside their doorstep. CD also improves property values while decreasing building costs and protecting water resources.

What is Conservation Design?

Conservation design looks at the existing characteristics in a landscape and works to protect the most important aspects during development—whether it's a historic rock wall, a scenic overlook, or a critical habitat area. In these cases, when a developer purchases a land parcel for a subdivision, they typically put at least 50% of the land into permanent protection.¹ Then a land trust, conservation commission, or other relevant group receives the protected land and its benefits without having to purchase the land themselves.

This type of development allows communities to grow while also preserving local natural resources and sense of character – at no additional cost to the community.

This fact sheet reviews how to create a conservation design and explores examples of successes and challenges communities have faced in implementing this type of design.

What are Green Infrastructure (GI) and Low Impact Development (LID)?

Green Infrastructure (GI) includes both natural features such as forests and wetlands as well as engineered landscapes that mimic these natural processes like a rain garden.

Low Impact Development (LID) works to preserve the natural landscape and minimize impervious surfaces to keep stormwater close to the source and use it as a resource rather than a waste product.

Together, LID and GI not only manage stormwater and improve groundwater supplies, but also offer many free ecosystem services including cleaner air and water, flood control, shade and energy savings, recreational opportunities, and enhanced property values and quality of life.

Preserving our existing GI is our first line of defense against climate impacts such as increased storm frequency and intensities as well as achieving long-term cost savings.

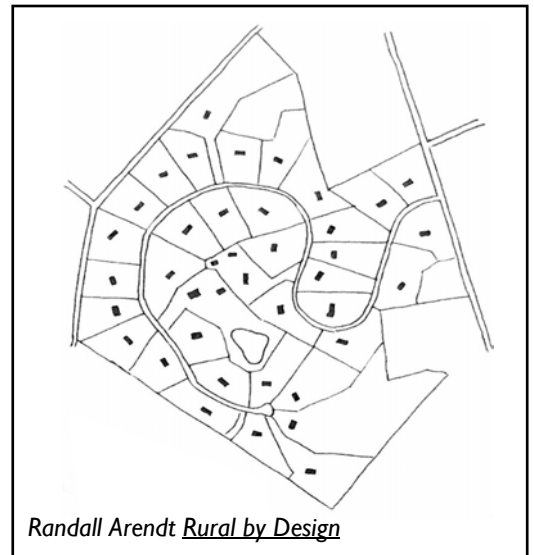


Horsley Witten

A classic New England village look at the Cottages on Green in East Greenwich, RI

Conservation design follows a 4-part process:¹

1. **Calculate** the traditional amount of allowed lots (not including unsuitable building areas, such as wetlands and steep slopes)
2. **Identify** significant natural, cultural, or historic features such as critical habitat, scenic views, or historic buildings
3. **Concentrate** development away from these features through flexible requirements to achieve a similar amount of lots (or more, if a density bonus is offered)
4. **Preserve** permanently at least half of the land, whether for natural, agricultural, or forest use — and give it to appropriate conservation commission/land trust/etc.



Conventional “By-Right” Design

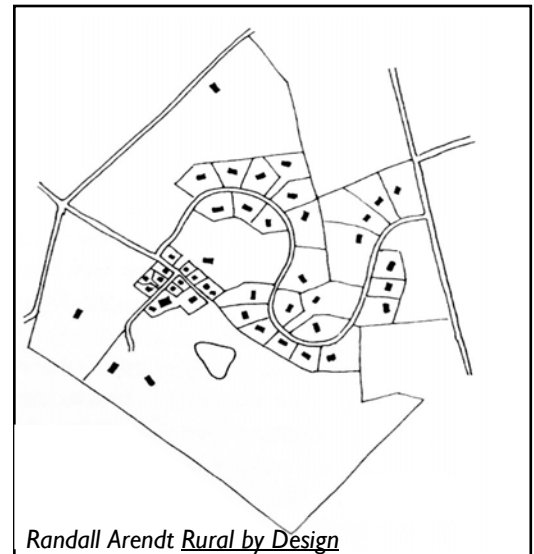
38 units on 3+ acre lots

No open space and no preservation of rural character

Avoid Fragmentation and Enhance Value

Many communities have already discovered the negative effects of unplanned development and losing many of the benefits from intact green infrastructure—from the classic New England village feel to reduced habitat and increased stormwater management burdens. Between 2005 and 2013, Ayer, MA ranked highest in the state for total development per square mile at a rate of 15 acres per square mile, and 9 acres per square mile of natural land converted to development.²

In comparison, on the following page are three developments in Massachusetts that have successfully implemented conservation design and LID practices.



Conservation Design

46 units, varied sizes:

26 one-acre lots, 16-unit village, 4 units on farms

68% open space and rural character preserved

Below: An aerial view of Pingry Hill in Ayer before development (left) and after (right). This large lot design fragmented the landscape. Conservation design clusters homes closer together and protects a larger, more contiguous portion of the existing landscape with less roadways and other impervious surfaces.



From Theory to Practice: Conservation Design Works



Cottages on Greene – East Greenwich, RI³

Walkable, affordable neighborhoods were sparse in East Greenwich and the community had one of the highest housing values in the state, with little developable land available. However, a group of developers took a creative approach and transformed a derelict .85 acre parcel into 15 mixed affordable and market rate homes less than half a mile from the waterfront.

These 2-bedroom, 1,000 ft² “cottages” require minimal homeowner maintenance. They are organized around a series of courts that incorporate bioswales, rain gardens, and pervious pavement in the parking lot—features that together manage stormwater on site. By incorporating small bridges across retention ponds, developers brought attention to these LID features. By reducing traditional piping and catch basins, developers also saved nearly 17% on their site design (see chart to the right for details).

Green “LID” Alternative	Quantity	Unit	Unit Cost	Total Cost
Bioretention	2,215	sf	\$20.00	\$44,300
Bioswale	430	lf	\$15.00	\$6,450
Perforated CPP Underdrain	350	lf	\$15.00	\$5,250
Pavement Section (typ.)	540	sy	\$35.00	\$18,900
Permeable Bituminous Section	450	sy	\$43.75	\$19,688
Drywell	3	each	\$5,000.00	\$15,000
				\$109,588
Conventional Alternative	Quantity	Unit	Unit Cost	Total Cost
Catch Basin	5	each	\$3,000.00	\$15,000
12” CPP	200	lf	\$30.00	\$6,000
Drain Manhole	4	each	\$4,000.00	\$16,000
Stormceptor Unit	1	each	\$20,000.00	\$20,000
Underground Recharge System	1	each	\$40,000.00	\$40,000
Pavement Section	990	sy	\$35.00	\$34,650
				\$131,650
Green alternative savings =				\$22,063
Horsley Witten Group, Inc.				16.8%



Pinehills – Plymouth, MA⁴

The Pinehills is a 3,174 acre New England village style development in Plymouth, MA that preserved over 2,000 acres. The remaining third of the property is peppered with a variety of homes including townhomes, condos, and single family – all of which are densely developed but in a quaint style that retains New England’s classic character by preserving the natural landscape and mature trees surrounding the homes.



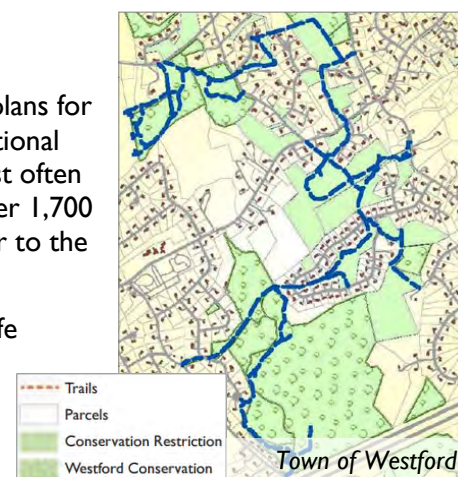
Developers also preserved Old Sandwich Road, the oldest unpaved public way in continuous use in the country, and instead created new, narrow roadways that follow the contour of the existing land. They incorporated numerous LID and green infrastructure elements into the built areas, including bioswales and rain gardens to handle on-site stormwater management. Additionally, The Pinehills incorporated 10 miles of walking trails that residents use to reach the mixed-use town center.

By working with the land, the developers not only saved money on clearing, grading, and piping, but also created over \$1 billion in new assessed property value for the town of Plymouth since 2001 while residents enjoy increased aesthetics, community health, and historic charm.

Westford, MA²

In 1978, the Town of Westford adopted a bylaw requiring developers to submit two plans for any proposed subdivision – one using conservation design and the other using conventional design. The Planning Board is then able to choose their preferred design, which is most often the conservation design. This early innovation has led to 48 developments creating over 1,700 acres of permanently protected land, through either conservation restrictions, transfer to the town, or application of a special overlay zoning district.

Just by adopting this bylaw, Westford has successfully protected both their local wildlife habitat and water resources as well as creating approximately 13 miles of hiking trails for public recreation—all without the town having to purchase the land themselves.



Benefits

By preserving much of the natural landscape, the remaining open space continues to provide a wide host of free ecosystems services, including reduced flooding, improved public health, and improved air and water quality. For more information on these benefits, see Fact Sheet #1.

Reducing sprawling impervious surfaces also reduces the amount of stormwater created and helps municipalities meet water management regulations such as MS4. A study of a conservation subdivision in Ipswich, MA found that the preservation of open space was the largest driving factor in reducing peak and total runoff — even more so than installed LID features such as rain gardens and grass pavers.⁵



**\$2,500/
acre**

Savings in clearing and grading costs for conservation design. Not developing the entire parcel means not paying to clear and grade the land.⁶ Save land, save money.

47%

Savings on energy bills for residents in CDs. Trees cool homes with shade in the summer and warm homes by insulating and blocking wind in the winter.⁷

**1/4
acre lots**

Increasing development to this density offers significant cost savings for municipalities, especially rural ones. Condensing homes means fewer roadways and reduced construction and maintenance costs.⁸

**\$250,000/
mile**

Savings by narrowing a road from 28' to 20'.⁹ When the entire road is shortened for condensed development instead of sprawling, that savings grows to the millions.

30%

Property value increase of CDs over traditional subdivisions due to walkability, beautiful views, accessibility to recreation, and neighborhood feel.^{10, 11} Added perk: they also sell about 50% faster.¹⁰

**\$4,500/
acre**

Savings on maintenance each year using native grasses and natural landscaping instead of traditional turf. Installation savings are from \$4000-8000/acre.¹² Added perks: increased curb appeal and improved stormwater retention.

Learn More

For more information, including all five fact sheets, a local land use regulatory review template, presentations, references, and related resources check out www.massaudubon.org/shapingthefuture.



This project was funded by an agreement (CE96184201) awarded by the Environmental Protection Agency to the New England Interstate Water Pollution Control Commission on behalf of the Narragansett Bay Estuary Program. Although the information in this document has been funded wholly or in part by the United States Environmental Protection Agency under agreement CE96184201 to NEIWPCC, it has not undergone the Agency's publications review process and therefore, may not necessarily reflect the views of the Agency and no official endorsement should be inferred. The viewpoints expressed here do not necessarily represent those of the NBEP, NEIWPCC, or U.S. EPA nor does mention of trade names, commercial

**NARRAGANSETT BAY
ESTUARY PROGRAM**

NEIWPCC
New England Interstate Water
Pollution Control Commission

This project is funded in part by the Massachusetts Environmental Trust. Learn more about the Trust and the programs it supports through specialty license plate offerings at www.mass.gov/eea/met



Greening Your Community

Cost-effective LID solutions

#3 of 5



conserve



restore



protect



save money

Fact Sheet 3 of 5

Low Impact Development Best Management Practices

Engineered + Nature Based Systems = Successful Solutions

Preserving the existing capacity of the natural land is the absolute best bang for your buck in terms of reducing stormwater and improving community character. However, it's not always possible to preserve large areas of land, especially in urban settings. When communities need to grow, they can incorporate smart growth techniques and layouts like those discussed in Fact Sheet #2 that ensure engineered systems and nature-based solutions work together.

Engineered systems include underground piping, outfalls, and catch basins to intercept and transport stormwater. Nature-based solutions include Low Impact Development (LID) best management practices such as rain gardens and vegetated filter strips. Together, these systems offer a comprehensive approach to managing stormwater in a way that's smart for your budget and your community character.

Minimizing Imperviousness with BMPs

Best Management Practices (BMPs) can be installed in both new and redevelopment. Any time land will be disturbed, find ways to minimize impervious surfaces and keep stormwater at its source. Soil and vegetation break down pollutants and infiltrate water—whether by the side of a road or from rooftops. By slowing the rate of runoff, these BMPs also reduce flooding and associated financial and health-related costs.



Bioretention strips filter parking lot runoff

Trees and other plants also offer additional benefits such as air quality protection, improved aesthetics, reduced energy use, and cost savings.

What are Green Infrastructure (GI) and Low Impact Development (LID)?

Green Infrastructure (GI) includes both natural features such as forests and wetlands as well as engineered landscapes that mimic these natural processes like a rain garden.

Low Impact Development (LID) works to preserve the natural landscape and minimize impervious surfaces to keep stormwater close to the source and use it as a resource rather than a waste product.

Together, LID and GI not only manage stormwater and improve groundwater supplies, but also offer many free ecosystem services including cleaner air and water, flood control, shade and energy savings, recreational opportunities, and enhanced property values and quality of life.

Preserving our existing GI is our first line of defense against climate impacts such as increased storm frequency and intensities as well as achieving long-term cost savings.

5 Tips for A Successful LID Project

1. Preserve the **natural vegetation** as much as possible and use native species that will need less maintenance
2. Keep **slopes** gentle to avoid erosion
3. Make sure the **subsurface** is highly permeable—this may mean installing a constructed subsurface
4. Get the **community** involved!
5. Visible, simple, and easily understood projects are those that will be **loved** and successful!

Low Impact Development Techniques

Green Roof

What is it?	Planting vegetation on a roof so that rain can be taken up by plants instead of running off. There are many types of green roofs and they can serve as additional recreation space or simply a stormwater storage area.
Cost	<ul style="list-style-type: none"> • \$10-30/ft² ^{1, 2} • Becomes up to 50% cheaper by the square foot as the square footage exceeds 10,000 feet ³
Runoff	Reduces runoff by 30-86%. ⁴
Additional benefits	<ul style="list-style-type: none"> • A 5,000 ft² green roof sequesters 170 lbs of carbon/yr ² • Reduces heating and cooling costs for buildings by \$6-8/ft² ³ • Can extend life expectancies of roofs by more than double ^{1, 2, 3}
But what about...	Maintenance on green roofs entails general weeding and debris removal, but since they're watered by stormwater, which has nutrients, they usually don't need any fertilizer or irrigation.



U.S. General Services Administration
Boston, MA: John W. McCormack US Post Office and Courthouse. This 9,654 ft² green roof sits atop the EPA Region 1 Headquarters on a historic 1933 building.

Rain Barrel & Cistern

What is it?	A structure to store rooftop runoff and reuse it for landscaping and other non-potable uses. There are many different styles, including an above ground 50 gallon barrel or a below ground several hundred or thousand gallon cistern.
Cost	<ul style="list-style-type: none"> • Average 50 gallon rain barrel costs around \$100 • Cisterns can be more expensive, depending on the size
Runoff	At scale, cisterns can store 100% of rooftop runoff except in extreme storms.
Additional benefits	<ul style="list-style-type: none"> • A one-inch rainstorm generates 623 gallons of stormwater per 1,000 square foot of roof that can be collected • Water can be used to landscape in hot summer months, saving water costs
But what about...	Installation is a cinch – simply attach a downspout elbow to divert rainwater from your lawn or driveway into the barrel. When you're ready to harvest the water, just attach a hose and go! Above ground cisterns can be just as easy, though below ground cisterns require more work for siting and installation.



EPA
A small, slanted green roof in Craftsbury, VT.



Great American Rain Barrel Company
An example of 60-gallon rain barrels. Some communities in MA offer a rain barrel program that offers significant discounts to residents.

Rain Garden

What is it?	A depression in the ground to filter stormwater that is filled with highly permeable subsurface and water-loving vegetation. May have an engineered overflow drain system as well.
Cost	<ul style="list-style-type: none"> • Costs about \$2-12/ft² ⁵ • Costs about \$200/yr in labor for maintenance ^{6, 7}
Runoff	Reduces runoff by 90%. ⁸
Additional benefits	<ul style="list-style-type: none"> • Reduces pollutants, including Nitrogen, Phosphorus, metals, and TSS by 65-90% ⁸ • Improves aesthetics
But what about...	Ownership and maintenance can be held by the individual residential property owners, homeowners' associations, or by local public works. If outside entities need to be on private property to maintain bioretention such as rain gardens, be sure to include this in deeds so that homeowners understand what is their responsibility and what is the municipality's.



This rain garden in Devens, MA gathers runoff from a curb-less road and sidewalk to infiltrate stormwater back into the ground while also offering beautiful home landscaping. Rain gardens can be made in any size and shape to fit your location.

Permeable Pavement

What is it?	Permeable, or porous, pavement or concrete allows water to infiltrate the driving surface to reduce stormwater runoff, eliminate puddles, and increase groundwater recharge.
Cost	Costs range from \$10-12ft ² installed. ⁷
Runoff	Can infiltrate as much as 70-80% of annual rainfall.
Additional benefits	<ul style="list-style-type: none"> • Reduces the amount of land needed for stormwater management • Reduced flood risk may increase property value by 2-5% ² • Massachusetts communities typically spend over \$100,000 annually on salting. ⁹ Areas with permeable pavement can reduce salt use by as much as 75%, leading to enormous cost savings ¹⁰ and reduced salt pollution
But what about...	Winter weather is no trouble for permeable pavement. In fact, studies at the University of NH Stormwater Center have found that before icing, precipitation melts into the ground and unsalted porous pavement offers a shorter stopping distance than salted traditional pavement. This improves safety and can reduce salting by 75%, saving money as well.



Horsley Witten Group

This parking lot in Narragansett, RI shows traditional asphalt on the left, where puddles have formed, and permeable pavement on the right, where it has soaked through.



National Asphalt Pavement Association

This insert shows a University of NH parking lot one hour after plowing. The inset photo shows a close up of the permeable pavement section of the lot at the same time.

Stormwater Wetland

What is it?	A type of detention basin where runoff is diverted into an engineered, shallow wetland area to temporarily store water. Must be used with another BMP that filters sediment. Smaller, pocket wetlands fed only by stormwater can be used when less space is available.
Cost	<ul style="list-style-type: none"> • Costs range from \$25,000-30,000 per acre of impervious area treated ^{6,7} • \$1,500-2,000/yr in labor for maintenance and vegetation control ^{6,7}
Runoff	Can infiltrate 100% of peak flow when built to size.
Additional benefits	<ul style="list-style-type: none"> • Total Suspended Solids (TSS) - 80% with pretreatment ⁸ • Reduces pollutants, including Nitrogen (20-55%), Phosphorus (40-60%), metals (up to 85%), and pathogens (up to 75%) ⁸
But what about...	Building near natural wetlands is regulated under the Wetlands Protection Act. However, constructed stormwater wetlands are not so strictly regulated and additional permits are not required for ongoing maintenance.



Devens Enterprise Commission

These Devens, MA homes have met the required 20' wide emergency vehicle access in a unique way. They installed 12' of pavement and 8' of permeable grass pavers to the left to minimize pavement without compromising safety.



Massachusetts Watershed Coalition

This stormwater wetland in Leominster uses the land's natural capacity to filter and infiltrate water.

Other Bioretention Systems

Rain gardens and stormwater wetlands are just two types of bioretention systems, which allows the landscape to filter pollutants and infiltrate stormwater into the ground. These systems give excess water a place to go, and reduce flooding and infrastructure damage.

Other systems include vegetated parking lot medians, roadside swales or "country drainage," and curb cuts, which take stormwater from streets and filter it into a roadside rain garden or tree box.

LID Site Design: Less Pavement, More Savings

By reducing the amount of pavement, communities are not only reducing their impervious surface and allowing more space for stormwater infiltration, but also realizing a huge cost savings. Traditional paving costs about \$6ft². Reducing just a short two-mile road from 28' wide to 20' equates to a savings of over \$500,000. Less pavement also means reduced maintenance costs, including plowing, salting, and sweeping.

Narrower Roads

What is it & benefits	Designing and installing 10' or 12' lanes on neighborhood roads reduces the amount of impervious surface and enhances the land's ability to infiltrate water and pollutants.
But what about...	Safety should always be a top concern, which is why narrow roads are a smart idea. Studies have shown that 10' lanes are as safe as – if not safer than – wider lanes. ¹¹ When roads are narrower, drivers go slower, pay closer attention to the road, and have fewer accidents. Street-lined trees that provide a shaded lane and homes closer to the roadways also enhance these safety benefits.



This narrow road in Devens, MA easily fits two lanes of traffic and offers room for a vegetated buffer, sidewalk, and street trees.

Alternative Cul-de-sacs

What is it & benefits	Instead of having a wide road with a large paved circle at the end, the circle can be vegetated to increase infiltration. Alternatively, the road could make a loop and be enclosed with vegetated area that's perfect for community spaces.
But what about...	Emergency vehicles and plow trucks need space to turn around, which narrower roads and alternative cul-de-sac options still provide. National Fire Protection Association requires a 20' wide passage for fire trucks. ¹² However, communities have met this requirement in innovative ways. Some homes in Devens, MA have rear garages on 12' of pavement bordered by 8' of grass pavers on the side. This structure is still heavy weight bearing and the combined 20' roadway was accepted by the local fire department. ¹³



Cyburbia

An alternative cul-de-sac design that allows for recreational space as well as a place to improve stormwater infiltration.

Shared Driveway

What is it & benefits	Instead of each home having a separate driveway from the street, shared driveways that then split to each home offer access to homeowners while still reducing impervious surfaces and increasing stormwater infiltration.
But what about...	Marketable homes with shared driveways don't deter potential buyers. In fact, homes in Concord and Plymouth with shared driveways and parking still brought high value and sold quickly – including during the 2008 recession. ^{14, 15}



This shared driveway in the Pinehills in Plymouth, MA provides easy access to garages, plenty of parking, and less impervious surface. Retention of mature trees also offers privacy.

Learn More

For more information, including all five fact sheets, a local land use regulatory review template, presentations, references, and related resources check out www.massaudubon.org/



This project was funded by an agreement (CE96184201) awarded by the Environmental Protection Agency to the New England Interstate Water Pollution Control Commission on behalf of the Narragansett Bay Estuary Program. Although the information in this document has been funded wholly or in part by the United States Environmental Protection Agency under agreement CE96184201 to NEIWPCC, it has not undergone the Agency's publications review process and therefore, may not necessarily reflect the views of the Agency and no official endorsement should be inferred. The viewpoints expressed here do not necessarily represent those of the NBEP, NEIWPCC, or U.S. EPA nor does mention of trade names, commercial



This project is funded in part by the Massachusetts Environmental Trust. Learn more about the Trust and the programs it supports through specialty license plate offerings at www.mass.gov/eea/met



Greening Your Community

Cost-effective LID solutions



conserve



restore



protect



save money

#4 of 5

Fact Sheet 4 of 5

LID in Local Zoning and Regulations

Making Regulations Reflect Priorities

Local conservation lands and green infrastructure are important assets for communities, and include environmental, economic, health, and social benefits.

However, many communities' plans and land-use rules unintentionally encourage sprawling development that comes with many costs.

Whether it's an outdated open space plan that doesn't prioritize conservation needs or bylaws that require large lots, wide roads, and big, water intensive lawns, there are lots of opportunities to revise regulations and guide development in a more sustainable direction.



*A shared driveway and mature trees
in Plymouth, MA*

Planning Ahead for the Community You Want to Have



Local land-use regulations have the ability to make or break communities' ability to enhance conservation and incorporate LID techniques described in previous fact sheets. You get what you zone for — what will your community look like if fully built-out in accordance with the local rules as they currently stand?

It's important to periodically review and update local plans and rules and determine how they work together, and whether they encourage or discourage smart growth. By analyzing and updating local plans and land use rules such as zoning, subdivision rules and regulations, site plan review, and stormwater regulations, communities can ensure that development is consistent with local goals and values. This fact sheet will review how to get started and prioritize.

What are Green Infrastructure (GI) and Low Impact Development (LID)?

Green Infrastructure (GI) includes both natural features such as forests and wetlands as well as engineered landscapes that mimic these natural processes like a rain garden.

Low Impact Development (LID) works to preserve the natural landscape and minimize impervious surfaces to keep stormwater close to the source and use it as a resource rather than a waste product.

Together, LID and GI not only manage stormwater and improve groundwater supplies, but also offer many free ecosystem services including cleaner air and water, flood control, shade and energy savings, recreational opportunities, and enhanced property values and quality of life.

Preserving our existing GI is our first line of defense against climate impacts such as increased storm frequency and intensities as well as achieving long-term cost savings.

Let's Coordinate: Master Plan, Open Space, and Bylaws

Master plans, open space plans, and land use regulations should coordinate with one another to reflect the community's goals. Together, these create local priorities for both development and conservation, and define a municipality's future character and economy. In order to prioritize and encourage sustainable growth, the local regulations must be consistent with one another to achieve the desired goals.

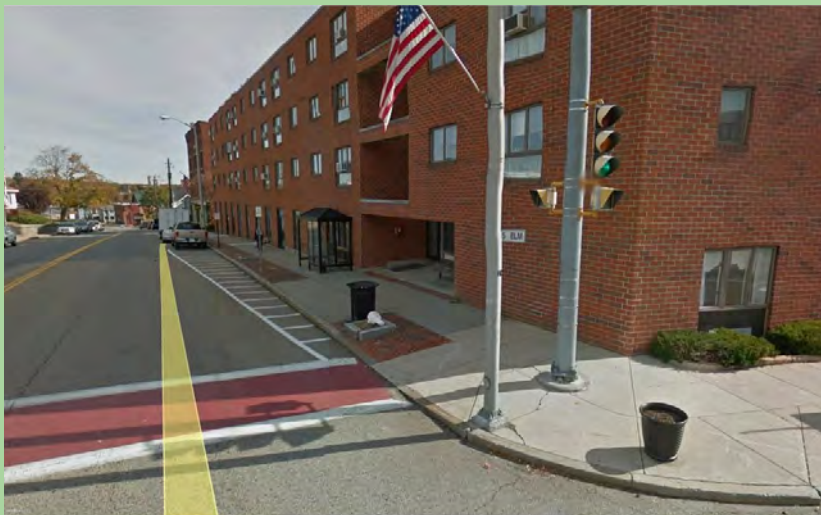
For instance, if a stormwater bylaw requires LID, but zoning requires large lots with strict dimensional standards and the subdivision regulations require wide streets and curbing running along throughout—there isn't much LID that can be done. The rules essentially require a developer to clear and grade all available upland and create extensive impervious surfaces with centralized, piped stormwater drainage. If your community has a modern Master Space plan that identifies sustainable development with LID and land protection as goals, but local regulations don't allow that type of development to happen, the plan will never be achieved.

Can Your Bylaws Do This?

Below is a typical Main Street intersection in a Massachusetts mill town. The top image shows what the street looks like in 2016.

The bottom image is the redesigned Main Street intersection that incorporates bioretention bump-out areas and street trees to capture and filter stormwater and enhance aesthetics. These also improved pedestrian safety by reducing the walking distance and improving sight lines, without altering existing parking or bus stops.

Which version would your local rules support?



What Do Your Regulations and Zoning Encourage?

Low Impact Development techniques are broad in range and design and should be incorporated within a variety of local bylaws and regulations, including: Zoning Bylaw, Subdivision Rules and Regulations, and Site Plan Review in addition to any Stormwater or LID Bylaw.

Check out the chart to the right and compare these best practices to your own local plans and regulations.

Additional Local Options

State laws and regulations provide a minimum framework. Your municipality has the authority to do more. Here are a couple of examples:

Wetlands Bylaw

The state wetlands regulations provide limited review in buffer zones. More than half of all communities have adopted local bylaws to protect buffer zones, set development back away from the edge of wetlands and waterways, or otherwise enhance local protections.

Community Preservation Act

This provides additional funding from a combination of local and state sources for open space protection, historic preservation, and affordable housing.

Planning Document	What does it do?	What should I look for?	How do I change it?
Master Plan (MP)	Comprehensive guiding document that sets community goals	<ul style="list-style-type: none"> Current, reflects changing priorities? Prioritizes sustainable development? Defines specific measures to retain local community character & values? 	Planning Board often with assistance of a special Master Planning Committee
Open Space and Recreation Plan (OSRP)	Identifies local natural resource and recreation priorities and plans for protection and management	<ul style="list-style-type: none"> Current, reflects current parcel status, priorities? Allows variety of OS uses: recreation, conservation? Considers land and water resources? Consider local context of existing OS? 	Conservation Commission, often with assistance of a special OS Committee. Must meet state guidelines
Zoning Bylaw/ Ordinance	Determines how parcels may be used and sets dimensional requirements	<ul style="list-style-type: none"> Focuses development near existing infrastructure, away from natural resources? Allows flexible dimensional requirements? Prioritizes protection of natural features? Limits clearing/grading, impervious areas? Requires LID features? 	Adoption and revision requires approval through Town Meeting (TM) or City Council
Open Space Residential Design (OSRD)	Type of conservation development that maximizes protection of natural resources	<ul style="list-style-type: none"> Allowed by right (not by special permit)? Requires ≥ 50% of open space protection on a parcel? References priority areas from local MP/OSRP? Connects OS within and on adjoining parcels? Allow flexible dimensional requirements? Requires LID features? 	Adoption/revision requires approval through TM/City Council
Site Plan Review	Reviews development design for consistency with local standards	<ul style="list-style-type: none"> Limits clearing/grading, impervious areas? Requires LID features? Allows easy siting of LID features, including near roadways and in parking islands? 	Adoption requires approval through TM/City Council
Stormwater or LID Bylaw	Reduces stormwater pollution and/or specifically encourages LID	<ul style="list-style-type: none"> Requires LID features? Discourages curbing and limits impervious areas? Prohibits topsoil removal? Limits clearing/grading? 	Adoption requires approval through TM/City Council
Subdivision Rules and Regulations	Govern how a parcel of land is subdivided in a development	<ul style="list-style-type: none"> Limits clearing/grading? Requires protection of existing landscape? Limits impervious areas? Requires revegetation with native plants? Requires LID? Allows narrow roads, no curbing? 	Planning Board has administrative authority

Working Together is Key

When it comes to allowing low impact and conservation development, coordination among local boards is key. By working together, the community can ensure the permit application and review requirements are clear to developers and bylaws don't conflict with one another when one encourages a practice but another makes it difficult.

Through interdepartmental cooperation, communities can create an efficient system that reduces the burden on local officials, lets developers understand exactly what the community is looking for, and encourages projects that prioritize local character and natural assets.

Analyze & Act

Taking time out of our busy schedules to prioritize long-term planning can be tough. But time is well spent updating outdated plans, bylaws and regulations since these are so vital in determining your community's future.

After identifying potential updates to improve cohesion within regulations and encourage smart development, the next—and critical—step is to determine which changes are most feasible for your community and make a plan of action. What changes have political support? What changes are more easily made administratively and what's the long-term strategy for changes that require Town Meeting approval? Who can be community champions and who are potential partners in making these changes understood and accepted? What resources or outreach tools do you need to help you achieve success?

Your Community's Future Needs You

You can play an active role in shaping the future of your community. One person can make a huge difference, especially at the local level. Most local boards are made up of citizen volunteers. Whether it's joining the conservation commission, planning board, master planning committee, or beautification committee, your community can use your energy and skills!

By joining a board, attending meetings, or otherwise staying involved in the local process, you can directly make a positive difference to create a safe, healthy, and sustainable community for yourself and future generations.



Trish Garrigan



Horsley Witten Group

Clockwise from top left: Narrow roads in Devens, MA; pervious pavers and rain gardens in MetroWest Boston; permeable pavement; clustered homes in Concord Riverwalk. These are all governed by local zoning bylaws and subdivision rules and regulations. What do your bylaws allow?

Learn More

For more information, including all five fact sheets, a local land use regulatory review template, presentations, references, and related resources check out www.massaudubon.org/shapingthefuture.



This project was funded by an agreement (CE96184201) awarded by the Environmental Protection Agency to the New England Interstate Water Pollution Control Commission on behalf of the Narragansett Bay Estuary Program. Although the information in this document has been funded wholly or in part by the United States Environmental Protection Agency under agreement CE96184201 to NEIWPCC, it has not undergone the Agency's publications review process and therefore, may not necessarily reflect the views of the Agency and no official endorsement should be inferred. The viewpoints expressed here do not necessarily represent those of the NBEP, NEIWPCC, or U.S. EPA nor does mention of trade names, commercial



This project is funded in part by the Massachusetts Environmental Trust. Learn more about the Trust and the programs it supports through specialty license plate offerings at www.mass.gov/eea/met



Greening Your Community

Cost-effective LID solutions



conserve



restore



protect



save money

#5 of 5

Fact Sheet 5 of 5 Urban Water Quality Improvements

Impaired Waters and LID

The majority of Massachusetts' urban waterways are impaired—meaning they don't meet state water quality standards and are not providing ideal habitat for fish and wildlife, and may also be leading to beach closures and other negative economic effects. Pollution from stormwater runoff from impervious surfaces contributes to 55% of the water quality impairments in MA.¹

This fact sheet will review how LID Best Management Practices (BMPs) are also cost effective in removing nutrients and other pollutants compared to traditional stormwater systems in an urban environment.

Monoosnoc Brook: A Success Story of Urban Water Retrofits

Beginning in 2008, a series of projects were undertaken to address the sediments, nutrients, and bacteria from stormwater flowing into Monoosnoc Brook and the North Nashua River.

The brook stretches 6.1 miles through the city of Leominster and is an important downtown feature and place for outdoor recreation and aquatic habitat. This densely developed area encompasses residential, industrial, and commercial zoning that all contributed to polluted runoff entering the waterway. It was therefore critical to the success of the project to engage a wide variety of stakeholders, including schools, businesses, church groups, and residents throughout the restoration process.

After mapping the location of catch basins and outfalls along the Monoosnoc watershed, the pollutant loading was calculated from the impervious areas draining to the waterbody. This identified areas in which to focus restoration, while mapping soils pinpointed the best locations for stormwater infiltration.

Through community involvement and the installation of BMPs, the pollutant loading into Monoosnoc Brook was significantly reduced to create a healthy and productive waterbody for the ecosystem and the community.

What are Green Infrastructure (GI) and Low Impact Development (LID)?

Green Infrastructure (GI) includes both natural features such as forests and wetlands as well as engineered landscapes that mimic these natural processes like a rain garden.

Low Impact Development (LID) works to preserve the natural landscape and minimize impervious surfaces to keep stormwater close to the source and use it as a resource rather than a waste product.

Together, LID and GI not only manage stormwater and improve groundwater supplies, but also offer many free ecosystem services including cleaner air and water, flood control, shade and energy savings, recreational opportunities, and enhanced property values and quality of life.

Preserving our existing GI is our first line of defense against climate impacts such as increased storm frequency and intensities as well as achieving long-term cost savings.



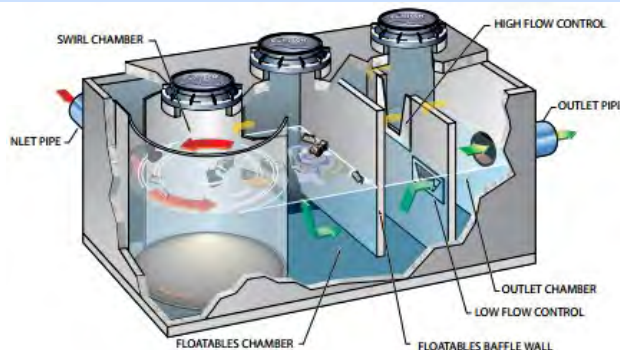
Massachusetts Watershed Coalition

Costs, Benefits, and Effectiveness of BMPs in Leominster

Numerous BMPs were installed to improve water quality by increasing infiltration and reducing the amount of polluted runoff discharged to the brook. These included bioretention areas, gravel wetlands, deep sump catch basins, a hydrodynamic separator, and infiltration trenches and sediment vaults. Below is an overview of their effectiveness in reducing nitrogen (N), phosphorus (P), and total suspended solids (TSS).

BMP	% Reduction	0	10	20	30	40	50	60	70	80	90	100
Hydrodynamic Separator	TSS				35%							
Deep Sump Catch Basin	TSS			25%								
Gravel Wetlands	N								75%			
	P						58%					
Bioretention	N				30-50%							
	P				30-50%							
	TSS									90%		
Infiltration Trench	N					40-70%						
	P					40-70%						
	TSS									80%		

Hydrodynamic Separator



Contech—Vortechs System

Benefits



Cost effective



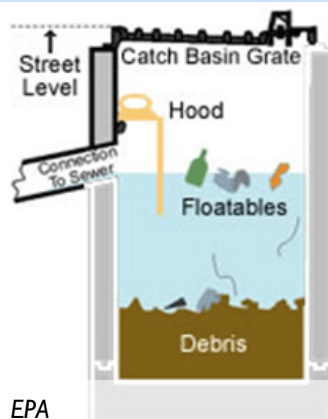
Solids reduction



TSS is removed before it enters the stormwater drainage system. The separator can fit underground in small areas where available surface land is limited and also works to reduce oil and grease. In Leominster, the system was placed under a parking lot to collect stormwater from residential and industrial areas.

- Total P removal of 10-30%⁷
- Fine particle removal down to 50 microns⁸

Deep Sump Catch Basins



EPA

Benefits



Cost effective



Solids reduction



Flood control



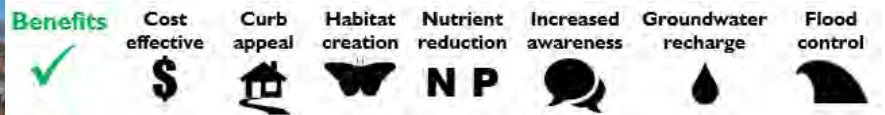
These basins trap sediment (e.g. sand and dirt) before it enters the stormwater treatment systems or waterways. Nine sump catch basins were installed from 2008 to 2014.

- Costs about \$5,000-6,000 to install^{4,5}
- Costs about \$200/yr in labor for sediment removal & disposal^{4,5}
- 25%TSS removal credit when used for pretreatment⁶

Gravel Wetland



Massachusetts Watershed Coalition



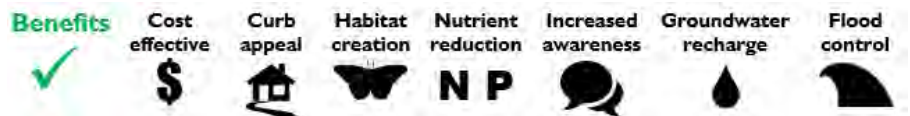
Water flows through a series of cells with plants and saturated soils where microbes break down nutrients and other pollutants. The gravel wetland is installed with pretreatment BMPs to capture stormwater sediments.

- Costs about \$25,000-30,000 per acre of impervious area treated ^{4,5}
- Costs about \$1,500-2,000/yr in labor for maintenance and vegetation control ^{4,5}
- 80% TSS removal credit with adequate pretreatment ⁶
- Varied % removal of nutrients, metals & pathogens ⁶

Bioretention



Massachusetts Watershed Coalition



Soil and native plants filter and reduce stormwater contaminants – including up to 90% of metals – allowing the purified water to soak into the ground and replenish the groundwater that sustains streamflow during dry times. Examples include tree filters, bioswales, and rain gardens.

Bioswale

- Costs about \$20,000/acre impervious area treated
- Costs about \$300-500/yr in labor for maintenance (varies by size of swale) ^{4,5}
- 70% TSS removal credit with adequate pretreatment ⁶

Rain Garden

- Costs about \$2-12/ft ^{2,3}
- Costs about \$200/yr in labor for maintenance ^{4,5}
- Reduces runoff by up to 90% ³
- Reduces pollutants, including N, P, metals, and TSS by 65-90% ³

Sediment Vault & Infiltration Structures (Trench or Chamber)



Massachusetts Executive Office of Energy and Environmental Affairs



Stormwater passes through a sediment vault (an oil and grit separator) that allows coarse sediment to settle before flowing to the infiltration trench or chamber. This section is a shallow, excavated area filled with crushed stone and provides underground storage that allows the stormwater to soak into the ground as well as remove up to 90% of pathogens. This method was installed in the Granite Stormwater Park and on Mill St.

- Costs about \$15,000-20,000 per acre of impervious area treated ^{4,5}
- Costs about \$400-600/yr for sediment removal & disposal ^{4,5}
- 80% TSS removal credit with adequate pretreatment ⁶
- Varied % removal of nutrients, metals and pathogens ⁶

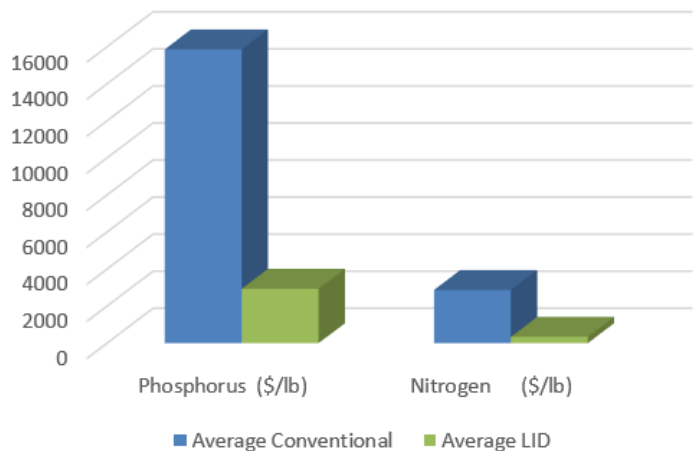
By the Numbers...

The Leominster LID project was significantly less expensive compared to how much it would have cost to remove the amount of N and P by conventional stormwater practices (represented by dry detention basins).

Using Leominster's Rockwell Pond and Lower Monoosnoc projects, the Horsley Witten Group, Inc. calculated a cost comparison of conventional vs. LID methods. The Rockwell Pond represented a cost savings of 79% for P reduction and 85% for N reduction. Similarly, the Lower Monoosnoc project represented a cost savings of 83% for P reduction and 69% for N reduction.

These cost comparisons are represented in the graph to the right.

Comparison of Present Value Costs in Nitrogen and Phosphorus Reduction: LID vs Conventional Detention Systems



Cost comparison by Scott Horsley, Horsley Witten Group, Inc. based on comparison between a conventional detention basin vs. gravel wetland and bioretention. See supplemental information online for more details on how this was calculated.

Conclusion

The BMPs installed in Leominster demonstrate that LID solutions can offer the best of both worlds. They're not only cost-effective solutions to stormwater management, but also address several social and ecological concerns. Urban stream restoration improves local water quality, re-establishes aquatic ecosystems, reduces public health risks such as flooding and infrastructure damage, and renews community enjoyment of local waters.

A special thank you to the city of Leominster and the Massachusetts Watershed Coalition, who received an EPA 319 Grant⁹ to accomplish this work and provide the basis for this case study. Thank you also to Sondra Lipshutz, Tufts Urban and Environmental Policy student, who contributed to the drafting of this case study.



Location of BMPs in relation to catch basins and the impervious areas draining into Monoosnoc Brook and Rockwell Pond in Leominster. Map by Massachusetts Watershed Coalition

Learn More

For more information, including all five fact sheets, a local land use regulatory review template, presentations, references, and related resources check out www.massaudubon.org/shapingthefuture.



This project was funded by an agreement (CE96184201) awarded by the Environmental Protection Agency to the New England Interstate Water Pollution Control Commission on behalf of the Narragansett Bay Estuary Program. Although the information in this document has been funded wholly or in part by the United States Environmental Protection Agency under agreement CE96184201 to NEIWPCC, it has not undergone the Agency's publications review process and therefore, may not necessarily reflect the views of the Agency and no official endorsement should be inferred. The viewpoints expressed here do not necessarily represent those of the NBEP, NEIWPCC, or U.S. EPA nor does mention of trade names, commercial



This project is funded in part by the Massachusetts Environmental Trust. Learn more about the Trust and the programs it supports through specialty license plate offerings at www.mass.gov/eea/met



Model Open Space Design / Natural Resource Protection Zoning

Provided here is a model Open Space Design (OSD) / Natural Resource Protection Zoning (NRPZ) bylaw/ordinance and companion subdivision and special permit language. This model bylaw/ordinance was adapted from the NRPZ bylaws of the Towns of Brewster, New Salem, Shutesbury, and Wendell as well as the Open Space Residential Design bylaw/ordinance this model replaces in the Commonwealth's Smart Growth/Smart Energy Toolkit. In the planning process, local officials are encouraged to work with legal counsel and to involve diverse stakeholders in the bylaw development process including developers, landowners, conservation groups, and their regional planning agency.

Because the Open Space Design model bylaw/ordinance deals specifically with subdivision of land and/or the site design process, communities will need to think carefully about existing provisions in the subdivision rules and regulations and any other local regulations (e.g., wetland protection bylaws, board of health regulations, etc.). As an innovative approach, Open Space Design may create conflicts with other dimensional regulations. Criteria for right-of-way and travel lane width, sidewalk specifications, utilities, finished grading, turning radii, and stormwater management are examples of site design elements that should be reviewed and modified as appropriate. The recent [Sustainable Neighborhoods Roadway Design Guidebook](#) issued jointly by the American Planning Association - Massachusetts Chapter and the Home Builders Association of Massachusetts is an excellent source of guidance on road related design elements.

The Commonwealth provides this model zoning to promote adoption by communities of bylaws/ordinances that require open space design (OSD). MassGIS data indicate that about 1.6 million acres of developable farm and forest land are zoned for conversion to residential development at lot sizes of one acre or more. Conventional development of these acres under current zoning and subdivision regulations would be environmentally, fiscally, and in other ways disastrous. Excessive habitat consumption, increased greenhouse gas emissions, unnecessary costs to build and maintain infrastructure, and diminished water quality and quantity are but a few of the negative impacts. Promoting Open Space Design, with its dramatically reduced environmental and fiscal impacts, advances the energy conservation and environmental stewardship objectives of the Patrick Administration while providing needed housing and treating landowners equitably.

Requiring OSD and making it the standard or by-right path to a development permit is important. Many Massachusetts communities – over 50% – already have cluster, open space residential design, conservation subdivision, or some other variant of cluster zoning. However, very few cluster subdivisions are built due in part to flaws in these bylaws/ordinances. For example, many communities require a special permit for a cluster subdivision, but not a conventional one. Other local bylaws have unreasonable minimum parcel requirements, complicated and time consuming procedures for determining allowable development rights, or other significant flaws. Placing OSD subdivision on even footing with conventional subdivisions should be a given. For those communities truly motivated to conserve their natural landscape guaranteeing permanent land protection through mandatory OSD (or transfer of development rights) is the way to go. A table enabling rapid assessment of cluster zoning bylaws for best practices is included as Appendix A.

Communities will, however, need to exercise care when requiring open space design. An important consideration for all communities implementing OSD is the relationship between the number of housing units produced under OSD and those units possible under the previous conventional zoning. Landowners have certain expectations based on the zoning in place. For example, a landowner with 20 acres zoned for a house lot on every acre would expect to be able to construct nearly 20 units after taking into account reductions due to the amount of land constrained by natural resources or topography or required for roads and other infrastructure. However, in some circumstances the yield under OSD can actually be higher than under conventional zoning due to the advantages afforded by the formulaic calculation of development rights, use of shared driveways, and reduced or eliminated dimensional requirements.

Regardless, landowner expectations have political ramifications and are important factors in considering where an OSD bylaw/ordinance is applied and how it is structured. Passing new zoning is a challenge to begin with, given the need for a two-thirds vote. Proposing OSD zoning that has the potential (real or perceived) to affect the financial wherewithal of a large numbers of landowners compounds the difficulty, as town meeting or city council tends (justifiably) to be very sensitive to fiscal impacts. Affected landowners will likely raise questions about fairness and raise the specter of takings, substantive due process, or other constitutional challenges. While the Executive Office of Energy and Environmental Affairs believes that these claims would be very difficult to substantiate legally, politically it can be the death-knell of a zoning proposal if the community is not prepared. Thus, it is important to be aware of the fiscal impacts of OSD zoning (essentially the ratio of housing units or the square footage of commercial or industrial space possible under the previous zoning to that which will result under OSD) when formulating an OSD bylaw/ordinance.

In those municipalities lacking public sewer and water systems supportive board of health policies and regulations will be particularly important to ensuring equity. While reductions in yield or return on investment resulting from properly justified zoning changes are legal unless they deprive the property owner of virtually all value, a significant drop in the net worth of property will likely be perceived as unfair by town meeting voters or city council. However, it is also important to recognize that this form of zoning does offer offsets to possible reductions in unit count, including prompt and predictable permitting, greater design flexibility, more diverse housing, and attractive features such as density bonuses, shared driveways, transfers of development rights, and the ability of the owner to retain possession of the preserved open land. Careful advance work, education, and compatible board of health and other local regulations can help a community avoid or overcome these potential political pitfalls. Thus far, the four NRPZ/OSD bylaws in place have passed by overwhelming margins at each town meeting.

Equity concerns aside, Open Space Design could allow more units than the prior zoning, or less. Mindful of the obligation to provide affordable housing and the benefits of a diverse housing stock a community can reduce the unit count or total buildout. Reduced yield is very appropriate for some communities. Many small, rural, and natural resource rich communities are presently zoned for far more growth than is reasonable. In a rural town with existing densities of 20-30 acres per dwelling unit, zoning for a dwelling unit on every acre could be considered excessively dense and a low-density version of OSD more appropriate. For example, zoning in the Berkshire County community of Egremont, which presently has about 600 housing units, prescribes construction of more than 5,000 additional units. Communities in this circumstance should work with landowners and other stakeholders to rationalize yield consistent with a balanced approach to resource protection and future housing needs.

Even when application of the OSD bylaw itself results in a comparable number of units to that possible under the previous zoning it is very important to examine other rules and regulations to see how they will impact unit count. Of primary concern are wastewater disposal regulations in communities lacking sewer and/or water infrastructure. If wastewater disposal precludes the construction of a high percentage of the lots the OSD zoning allows this can be problematic.

Under state regulations conventional subdivision lot sizes of one acre can generally accommodate an on-site well and septic system without significant loss of yield. This of course can vary if a local board of health enforces stricter regulations. However, as OSD reduces lot size by 50% or more applying the technique to districts where lot sizes were previously one acre or smaller becomes challenging. Landowners and developers may complain, and have a reasonable case, in the event that a community requires OSD for districts where lot sizes fall below that possible for well/septic if the community fails to provide relief. A potential route out of this problem is to offer OSD as an alternative rather than a mandate; the obvious problem being that few projects are likely to take advantage of the OSD zoning. Communities can equitably require OSD and insist on conservation of a high percentage of the parcel when preexisting zoning allows one acre or smaller lots by aligning their board of health regulations and policies. For example, making it clear to landowners/developers that the community will approve aggregate calculations (where the protected open space is counted along with the individual lots toward the area needed to support a septic system under Title V) and shared septic systems, or reduce the amount of required open space to accommodate underground wastewater disposal facilities, will help the community to conserve as much land as possible while providing a reasonable outcome to property owners.

An example of ways to reconcile a small lot size requirement and on-site wastewater disposal water is warranted. Again, recognizing that a one acre lot is the minimum necessary to site a four bedroom home using a conventional well and septic system, assuming a previous one acre lot size requirement, and that water and sewer are not available, a landowner is likely to experience a drop in yield if 60% of the developable land must be conserved. When zoning is already at the minimum for a conventional on-site well and septic system, and OSD requires lot sizes to drop, in this case to below ½ acre, either the number of bedrooms or the number of homes has to decrease or the means of supplying water or treating wastewater has to change. If conventional well and septic are used either the number of 4 bedroom homes would have to drop (to a maximum of 10) or a larger number of 3 bedroom homes would have to be constructed instead (to a maximum of 13). The landowner could increase yield by constructing a shared well, but this would require a permit from DEP and ongoing monitoring. Should the community facilitate an aggregate nitrogen loading calculation (described above) approximately the full unit count allowed under the prior zoning may be realized. Similarly, if the community readily approves a shared septic system this would permit the landowner to construct the full unit count and reduce equity concerns for those projects under 22 four bedroom units (88 bedrooms produce the maximum amount of flow allowed under Title V).

If a community has water and sewer applying OSD throughout the served area makes tremendous sense. In fact, it is quite wasteful of land, natural resources, and money to do otherwise. Sewered large lots don't make environmental or fiscal sense. However, communities with water and sewer to support growth will need to think about a practical top end. In city and town centers, transit stops, and other suitable locations once sufficient land is set aside for parks, greenways, and the like it probably makes more sense to develop the entire parcel with mixed-uses at relatively high density than to require or encourage residential only OSD. In these locations growth contributes to the vitality of the community and has many other environmental and fiscal benefits. It also provides needed homes and businesses in a location and form that makes sense. To the extent additional density in such a district is feasible this type of location also represents a potential receiving area for growth moved from a sensitive location via a transfer of development rights bylaw/ordinance.

The Executive Office of Energy and Environmental Affairs believes that this model bylaw/ordinance conforms to the 2008 Wall Street Development Corporation v. Planning Board of Westwood decision. In its decision the Appeals Court found that Westwood's Major Residential Development bylaw ran afoul of the Subdivision Control Law by making subdivision approval subject to a discretionary special permit. This was found to be impermissible under state law because subdivision approval must be a matter of right.

Purpose and Intent:

The primary purposes for this [bylaw/ordinance] are to:

1. Further the goals and policies of the [CITY/TOWN] Master and Open Space and Recreation Plans;
2. Provide for the by-right construction of Open Space Design (OSD);
3. Encourage the permanent preservation of open space, agricultural land, forestry land, wildlife habitat, other natural resources including aquifers, water bodies and wetlands, and historical and archaeological resources;
4. Enable landowners to realize equity from development of a small percentage of their land while current uses continue on the majority of the property;
5. Expedite the permitting of projects;
6. Encourage a less sprawling and more efficient form of development that consumes less open land and conforms to existing topography and natural features;
7. Facilitate the construction and maintenance of housing, streets, utilities, and public services in a more economical and efficient manner.
8. Reduce energy consumption and greenhouse gas emissions;
9. Minimize the total amount of disturbance on the site; and
10. Promote the incorporation of Low Impact Development and Green Infrastructure into development designs.

Municipalities should customize the purpose and intent statement to suit their physical and cultural resources and motivation for implementing the bylaw/ordinance. In addition to the above, other potential purposes include provision of design flexibility, construction of a more diverse housing supply, protection of large blocks of un-fragmented habitat, and prevention of roadside development.

Open Space Design is most often used to address residential subdivision. However, OSD can also be applied to commercial or mixed-use projects. In fact, doing so can help to achieve positive development outcomes that are not possible with solely residential growth, such as easier access to goods, services, and jobs that reduces car travel and has other benefits.

Definitions:

“Homeowners Association” shall mean the corporation, trust, or association owned by the unit owners within an Open Space Design and used by them to manage and regulate their affairs, including any commonly owned land or facilities.

“Open Space Design” shall mean a process for the development of land that: (a) calculates the amount of development allowed up-front by formula; (b) requires a Conservation Analysis to identify the significant natural, cultural, and historic features of the land; (c) concentrates development, through design flexibility and reduced dimensional requirements, in order to preserve those features; and (d) permanently preserves at least [sixty] percent of the land in a natural, scenic or open condition or in agricultural, farming or forest use.

Alternative: [50-90%]

The percentage of land permanently conserved should correspond to that required by the community in the Open Space section of this zoning.

Applicability:

- A. Open Space Design is allowed by right under zoning, subject only to the requirements of the subdivision regulations or site plan review as applicable and any other generally applicable non-zoning land use regulations, and may be proposed anywhere in [CITY/TOWN]. Within the [list designated districts] [all single family housing developments (including residential subdivisions or residential developments where the property is held in condominium, cooperative ownership, or other form where the property is not subdivided)] and within [Districts as designated by the CITY/TOWN] [all housing developments] shall comply with the Open Space Design provisions of this section, unless the planning board allows a development that deviates from the requirements of this section by Special Permit. Such deviations may be approved if the applicant demonstrates that the proposed alternative development configuration provides adequate protection of the site's environmental resources and fulfills the purposes of this Section as well as or better than an Open Space Design.

If excessive land is being consumed OSD should be applied regardless of housing type. Also, allowing units to take the form of duplexes, townhouses, or multi-family structures produces greater housing diversity and affordability and enables the preservation of more land.

Alternative: all residential and commercial developments

OSD bylaws can also apply to non-residential development. However, since in the vast majority of cases OSD will be used to solely to regulate residential development, the model has been drafted as such. Those communities applying OSD to non-residential uses will need to make appropriate changes to the Applicability, General Requirements, Dimensional Requirements, and other sections of this model. While making these modifications will require careful consideration, applying OSD to non-residential uses is perfectly feasible within the framework of this model. For example, a floor area yield for commercial or mixed use can be calculated by formula just as readily as residential development.

A primary benefit of OSD is permanent preservation of open space at no cost to the municipality while providing housing and ensuring an adequate return for the landowner. Thus, OSD is most often applied where the principal land use goal is to retain land in its undisturbed state and significant natural resources are present that warrant conservation. It also has many other benefits including reduced costs of construction and maintenance of roads and utilities and reduction in impervious surfaces and stormwater runoff. Water supply protection, preservation of agricultural land, protection of wildlife habitat, conservation of greenway corridors, and retention of forest cover in order to support timber production and tourism are but a few of the motivations to use OSD to preserve open space. However, unless lot sizes are small enough it makes little sense to require conventional subdivisions that consume more land and natural resources than necessary. Therefore, even if land does not contain special or unique natural resources it is a good idea to make OSD the default standard. On the other hand, when an area is already largely developed or is highly suited for growth due to a lack of natural resources and the presence of infrastructure then it likely makes more sense to preserve just enough land for parks and trails for active recreation and to develop the balance as efficiently as is politically or practically feasible.

Note that existing zoning in rural areas often calls for much more development than is rational or desirable. Communities should not feel that they must accommodate all the units that were possible under the zoning that preceded OSD. The by-right nature of OSD, reduced development costs, greater design flexibility, and other benefits help ensure that landowner expectations are met.

As an alternative, Open Space Designs need not be done on a strictly parcel by parcel basis. It is feasible, if politically and practically more complicated, to use non-contiguous parcels for an OSD development. This would be a simpler approach to transfer of development rights (a technique which is covered in detail in the Smart Growth/Smart Energy Toolkit at http://www.mass.gov/envir/smart_growth_toolkit/index.html.)

By way of illustration, if a parcel of land near town is less desirable as open space and a parcel away from town is great open space, why have even an Open Space Design project on the highly desirable piece and less than the desired density on the parcel closer to town? This is especially true since the parcel close to town is more likely to have water and/or sewer service, and it will be closer to schools, libraries, police stations, and other services. If considered as a whole the development area could be the in-town parcel and the conservation area the more rural parcel.

- B. Subsection A above does not apply to construction of homes on individual lots that existed prior to [date of the first publication of notice of the public hearing on the adoption of this section] or to lots created through the “Approval Not Required” (ANR) process with frontage on existing ways that meet the standard specified in the [CITY/TOWN] Subdivision Regulations. However, if subdivision approval is not required an applicant may nevertheless voluntarily apply for an Open Space Design under this section. In such a case, prior to lot creation via the ANR process the application shall be subject to site plan review as described in [cite relevant section of CITY/TOWN zoning].

Alternative: Communities concerned that development of existing lots or of new lots created through the “Approval Not Required” process may defeat their intent in adopting OSD zoning may wish to also adopt language such as that found below limiting the rate of development of such lots. This language, similar to that in place in the town of Wendell, provides landowners and developers a strong incentive to develop under the Open Space Design bylaw/ordinance.

Residential Uses – Except for Open Space Designs under [cite relevant section of CITY/TOWN zoning] of the Zoning Bylaw/Ordinance new primary dwellings are allowed, subject to all other provisions of these [bylaws/ordinances], at the rate of no greater than one new primary dwelling unit in any seven year period either: 1) on a buildable lot in existence on [date of adoption of the OSD bylaw/ordinance] or 2) a new buildable lot divided from a lot in existence on [date of adoption of the OSD bylaw/ordinance].

- C. If the proposed Open Space Design involves [one or more shared driveways, density bonuses, transfer of development rights, and/or any other use that requires a special permit, or site plan review for lot configuration or any other purpose], the proceedings for all such special permits and the Site Plan review shall occur in one consolidated special permit proceeding before the planning board.

Alternative: If a project requires a permit from two different permit granting authorities, the Planning Board, Board of Appeals, or Special Permit Granting Authority may request that a joint public hearing be held and shall conduct reviews simultaneously, to the extent possible.

In the case of an Open Space Design the language of sub-section C above transfers permitting authority to the Planning Board. This may not be palatable to all communities. The alternate language provided here would serve to expedite permitting without transferring authority.

Yield: Allowable Residential Units

The base maximum number of residential units in an Open Space Design is calculated by a formula based upon the net acreage of the property. This formula takes into account site-specific development limitations that make some land less suitable for development than other land. This calculation involves two steps, calculating the net acreage and dividing by the allowed density.

OSD bylaws can also apply to non-residential development. However, since in the vast majority of cases OSD will be used to solely to regulate residential development, the model has been drafted as such. Those communities applying OSD to non-residential uses will need to make appropriate changes to the Applicability, General Requirements, Dimensional Requirements, and other sections of this model. While making these modifications will require careful consideration, applying OSD to non-residential uses is perfectly feasible within the framework of this model. For example, a floor area yield for commercial or mixed use can be calculated by formula just as readily as the number of dwelling units in a residential development.

Net Acreage Calculation

The factors named below are included for net acreage calculation purposes only and do not convey or imply any regulatory constraints on development siting that are not contained in other applicable provisions of law, including this zoning bylaw. To determine net acreage, subtract the following from the total (gross) acreage of the site:

Alternatives: *In regard to wetlands delineation municipalities may wish to enable several alternatives including peer review under the aegis of the Planning Board and utilization of geographic information systems data available from the Massachusetts Department of Environmental Protection and MassGIS office.*

Communities should carefully consider subtractions from the gross acreage of the site. Particular attention should be paid to the 100-year floodplain and wetlands provisions of subsection C due to the variability of local bylaws/ordinances regarding these items. Municipalities desiring to do so can keep the number of units resulting from OSD comparable to that of a conventional subdivision by accounting for reductions in yield that result from local wetlands bylaws/ordinances.

An important consideration in regard to the net acreage calculation is simplicity. This model utilizes a formula and suggested “weighting” that should realize a yield comparable to that resulting from the much more complicated, costly, uncertain, and time-consuming process of producing a yield plan. Municipalities are encouraged to use a formula in order to ease the administrative burden and time and cost of reaching a decision and to customize yield reductions and their weight in order to achieve an outcome that meets local objectives and provides equity for landowners.

Finally, wastewater treatment, often a factor in yield calculations, is not addressed within the net acreage calculation (or elsewhere within this model zoning). In the event on-site wastewater disposal is required the yield allowed under zoning may subsequently be reduced as the open space design is permitted by the board of health. Compatibility between zoning and wastewater disposal regulations, important to the success of OSD, is discussed in the wastewater disposal box of this model zoning.

- A. [*Half*] of the acreage of land with slopes of [*20%*] or greater;
- B. [*The total acreage*] of land subject to easements or restrictions prohibiting development, lakes, ponds, vernal pools, 100-year floodplains as most recently delineated by FEMA, Zone I and A around public water supplies, and all wetlands as defined in Chapter 131, Section 40 of the General Laws and any state or local regulations adopted there under, as delineated by an accredited wetlands specialist and approved by the Conservation Commission; and
- C. [*Ten*] percent of the remaining site acreage after the areas of A and B are removed to account for subdivision roads and infrastructure.

Unit Count Calculation

The base maximum number of allowable residential dwelling units on the site is determined by dividing the net acreage by the required acreage (allowed density) for a dwelling unit in the district under this [*bylaw/ordinance*]. Fractional units of less than .5 shall be rounded down and .5 or more shall be rounded up. The required acreage for each district is:

<u>District</u>	<u>Required Acreage per Unit</u>

List in the table each district where OSD is possible and the required minimum acreage per unit in that district. Note that OSD may be compulsory in some districts and optional in others. Also, the necessary acreage (allowed density) need not be that previously required in the district.

Lots in More than One District

For lots in more than one district, the allowable unit count (excluding bonuses) and required open space for each district shall be computed separately first. These totals shall be added together and then rounded as above. The allowable maximum bonus for the entire development shall be calculated based upon this combined total number of units. The permitted location of the units and protected open space shall be wherever the planning board determines best fits the characteristics of the land, based upon the Conservation Analysis and Findings.

General Requirements:

1. **Housing Types.** Housing units within [Districts as designated by the CITY/TOWN] shall be single-family structures. Within [Districts as designated by the CITY/TOWN] all housing types allowed under the [CITY/TOWN] [bylaw/ordinance] are permitted.

The model is drafted in this manner to allow communities to designate certain districts for single family only open space designs (the most common application of OSD) and others for all housing types allowed in the community (which helps to further advance the objectives of OSD). Many variations are possible to accommodate local objectives.

Local officials will need to ensure that allowed housing types are consistent with the objectives of the local master plan. Because of the ease of siting, allowing two-family or multi-family structures facilitates the preservation of more than the minimum required open space. It would also enable the community to produce a more diverse and affordable housing supply. Communities may wish to modify the allowed housing types by district. This can be done in a manner that offers an incentive to build OSD if it is not obligatory within a district.

Accessory Dwelling Units: *Communities may wish to allow accessory units within an OSD in order to provide a more diverse and affordable housing supply. This particularly makes sense if they are already allowed in districts where this bylaw/ordinance will apply. In doing so, communities should carefully define accessory apartment. Typically an accessory unit is self-contained, limited to a relatively small size, (500-900 square feet), and located on the lot of or within an owner occupied single-family home. Lack of care to the definition can lead to unintended permitting of multi-family housing with larger impacts. Guidance can be found in the Accessory Apartments Toolkit module at http://www.mass.gov/envir/smart_growth_toolkit/pages/mod-adu.html.*

Municipalities electing to authorize accessory units should add the following language to the end of the Housing Types section. Municipalities should also be aware that authorizing accessory units will likely necessitate further changes to the OSD zoning bylaw/ordinance and other local regulations to ensure that parking, waste water disposal, access, and other standards are compatible.

Alternative: *Accessory apartments are permitted in Open Space Designs and do not count toward the total number of allowable dwelling units. Accessory apartments within an OSD shall comply with the accessory apartment requirements of the [CITY/TOWN] [bylaw/ordinance] except that [insert a list of conflicting & non-applicable requirements from the community's current accessory apartment standards such as lot areas, frontages, or setbacks] shall not apply.*

2. Parking. Each unit shall be served by [two] off-street parking spaces.

As drafted the model requires two spaces per unit and is intentionally silent about location beyond requiring the spots to be off-street. This allows flexibility for parking to be provided on a driveway, in a garage, in a common parking lot, etc. Communities will want to be very thoughtful in regard to the amount and type of parking that they require. Too much parking is wasteful of space and impacts natural resources. A great deal of information on smart parking is available in the Smart Growth/Smart Energy Toolkit Module by the same name found at http://www.mass.gov/envir/smart_growth_toolkit/pages/mod-smart-parking.htm and the smart parking model bylaw/ordinance found at http://www.mass.gov/envir/smart_growth_toolkit/bylaws/SP-Bylaw.pdf. Ultimately, Communities should customize the amount and location of required parking to suit their individual circumstances, remembering the benefits of requiring less and allowing flexibility.

Alternative: Each unit shall be served by [two] off-street parking spaces except that for one bedroom and studio units AND structures containing four or more units, the applicant shall provide [one and a half] parking spaces per unit. Calculations for parking spaces in these developments shall be rounded up to the nearest integer where necessary.

This version decreases parking requirements for larger scale high-density housing under the assumption that many of the people who live in one-bedroom condominiums or other multi-family housing will require only one parking space. These condominium situations generally involve a condominium association that can manage and assign any residual spaces that exist.

Dimensional Requirements:

Lot size and shape, unit placement, and other dimensional requirements within an Open Space Design are subject to the following limitations:

Objectives: Lots/units shall be located and arranged to advance the resource conservation objectives of the master and open space and recreation plans and to protect: views from roads and other publicly accessible points; farmland; wildlife habitat; large intact forest areas; hilltops; ponds; steep slopes; and other sensitive environmental resources.

Monumentation: Industry accepted monumentation of a type consistent with the use of the open space shall clearly delineate the boundaries of the protected open space in manner that facilitates monitoring and enforcement.

Area: There is no required minimum lot size for zoning purposes. The limiting factor on lot size in Open Space Design is typically the need for adequate water supply and sewage disposal. This does not affect the ability of the Board of Health to require area on a lot for water supply protection and the disposal of wastewater.

The total number of units is set through the yield calculation. Letting the developer vary lot sizes and place the units on the parcel subject to the conservation requirement of the Open Space Design as well as subdivision, health, and other applicable regulations allows the flexibility necessary to maximize resource conservation. Communities will want to carefully consider wastewater disposal regulations and policies as they can have a big impact on the successful implementation of OSD. See the introductory and wastewater disposal comment boxes for further discussion.

Alternative: Lots within an Open Space Design shall be at least [5,000] square feet in area.

Communities that feel the need to specify a lot size in zoning should select one that meets their needs. A lot size of 5,000 square feet (an eighth of an acre) is common in many urban and first-tier suburban communities, allowing for a small private yard and in the case of an Open Space Design subdivision an abundance of shared open space.

Frontage: There is no numerical requirement for road frontage in an Open Space Design. Each lot must have legally and practically adequate vehicular access to a public way or a way approved under the subdivision regulations either directly across its own frontage or via a shared driveway approved by special permit.

This language is intended to allow maximum flexibility so that housing units can be accommodated in a manner that maximizes resource conservation. At the same time, the requirement for legal and practical access follows a long line of precedent setting court cases and ensures adequate access for fire protection and provision of services.

Alternative: Lots within an Open Space Design shall have at least [50] feet of road frontage.

Communities that feel the need to specify a frontage requirement should select one that meets their needs. The Commonwealth suggests 50 feet as this works well with a 5,000 square foot (an eighth of an acre) area standard, producing lots that are 50 feet wide by 100 feet deep.

Setbacks: The minimum setback for any building from a property line shall be [10] feet. In no event shall principal structures (whether single-family, multi-family, or any other principal use) be closer than [20] feet to each other.

The recommended area, frontage, and setback standards offer the applicant and the Planning Board flexibility, typically exercised during subdivision review, to achieve a design that best conserves natural and cultural resources. The ten foot setback affords some distance between homes in the open space design and structures on abutting properties, and allows for on-property vehicular access around the perimeter of a building. Within the open space design each structure can contain units in any configuration - town or row houses, duplexes, triple-deckers, etc-allowed under the Housing Types section of this bylaw/ordinance. In some instances communities may wish to vary the setback requirement by zoning district.

Open Space Requirements:

Minimum: A minimum of [60%] of the land area of the OSD shall be set aside as permanently conserved open space. A greater percentage may be set aside voluntarily or in exchange for additional housing units as authorized by a planning board approved special permit. The minimum percentage of required open space may be reduced by no more than [10%] provided the full required minimum open space is mapped and the land that would otherwise be permanently conserved is shown. This land shall be subject instead to a Restrictive Covenant under G.L. Chapter 184, Sections 26-30, which shall be approved by the planning board and [City Council or Board of Selectmen/Town Counsel] and enforceable by the [CITY/TOWN]. Said land may be utilized for common water supply wells and associated infrastructure, common subsurface leaching fields and other underground components of wastewater systems, and rain gardens, constructed wetlands, and other decentralized stormwater management systems consistent with Low Impact Development (LID) that serve the Open Space Design. Treated stormwater may be discharged into the protected open space or land subject to a restrictive covenant. All protected land must be shown on approved plans.

Alternative: [50-90%]

Fifty percent is generally accepted as the minimum for Open Space Designs and similar zoning measures. Based on local circumstances - such as the nature of the natural resources to be conserved and the amount/pattern of existing development - communities should consider a range of [50-90%]. A percentage at the higher end of the range is often warranted to protect particularly sensitive natural resources or attain a prominent local conservation objective. The amount of open space applicants are required to protect can be varied by zoning district, as is done for required square footage per unit in the Unit Count Calculation section of this model zoning.

The best open space designs are the result of advance planning and prescriptive preservation and design requirements. Communities may wish be quite specific as to how the Open Space Design section best advances the goals of the master or open space plan. An example would be referring to specific geographic areas (or maps of land targeted for conservation) or natural resources the community desires to preserve. Carefully implemented, a series of Open Space Designs that follow these plans can conserve contiguous blocks of open space and trail corridors. A lot of resources are available to assist in the selection of conservation priorities including regional policy plans drafted by the 13 regional planning agencies and natural resource mapping (such as BioMap2) available from the MassGIS office at <http://www.mass.gov/mgis/laylist.htm>.

It will be a challenge for some OSD projects, particularly those where a high percentage of the land must be conserved, to accommodate infrastructure serving the project within the developed portion of the site. In order to facilitate construction of OSD projects communities can reduce by up to 10% the otherwise required amount of open space to accommodate LID stormwater, water, and wastewater infrastructure. Communities should evaluate how constrained their developable land is and how difficult it will be for project proponents to realize full dwelling unit count when deciding whether to do so. The terms of ownership and maintenance of these areas would need to be addressed during subdivision review.

The rationale behind reducing the required amount of open space for the listed infrastructure, rather than allowing this infrastructure within the protected open space, is that conservation commissions may be reluctant to own open space that has an easement for wastewater disposal or another purpose listed above. Also, non-profit conservation organizations may be reluctant to hold a restriction on properties with these facilities due to potential enforcement implications. Finally, approval under by the Secretary of EEA under Chapter 184 may be jeopardized. Instead, the land area devoted to water, LID, or wastewater infrastructure must be subject to a simple deed restriction (shared permanent easement) dedicating that area to shared use.

Contiguity of Open Space: Preserved open space shall be contiguous to the greatest extent practicable. Where noncontiguous pockets of open space are preferable to protect conservation areas, applicants shall attempt to connect these resources area to the greatest extent practicable through the use of trails and/or vegetated corridors. Open Space will still be considered contiguous if it is separated by a shared driveway, roadway, or an accessory amenity (such as a barn, paved pathway or trail, or shed for the storage of recreational equipment).

In addition to implementing contiguity requirements to protect large blocks of open space, corridors between open space blocks should be preserved in order to allow for wildlife movement. Designating desired blocks and corridors in open space and recreation or other plans allows developers and regulators to incorporate them from the outset.

Permanent Conservation of the Required Open Space: Any land required to be set aside as open space, voluntarily preserved in excess of that required, conserved as a condition of site plan approval, or protected in exchange for additional density pursuant to a special permit, shall be permanently protected pursuant to Article 97 of the Articles of Amendment to the Constitution of the Commonwealth of Massachusetts or a perpetual restriction under G.L. Chapter 184 Section 31-33. Unless conveyed to the [CITY/TOWN of NAME] Conservation Commission, the required open space shall be subject to a permanent Conservation, Watershed, or Agricultural Preservation Restriction conforming to the standards of the Massachusetts Executive Office of Environmental Affairs, Division of Conservation Services, or Department of Agricultural Resources in accordance with G.L. Chapter. 184 Section 31-33, approved by the planning board and [City Council or Board of Selectmen/Town Council] and held by [INSERT CITY/TOWN NAME], the Commonwealth of Massachusetts, or a non-profit conservation organization qualified to hold conservation restrictions under G.L. Chapter 184, Section 31-33. Any proposed open space that does not qualify for inclusion in a Conservation Restriction, Watershed, or Agricultural Preservation Restriction or that is rejected from inclusion in these programs by the Commonwealth of Massachusetts shall be subject to a Restrictive Covenant in perpetuity under G.L. Chapter 184, Sections 26-30, which shall be approved by the planning board and [City Council or Board of Selectmen/Town Council] and held by or for the benefit of the [CITY/TOWN].

The restriction shall specify the prohibited and permitted uses of the restricted land, which would otherwise constitute impermissible development or use of the open space, consistent with the Allowable and Prohibited Uses subsections of this [bylaw/ordinance] and any permits. The restriction may permit, but the planning board may not require, public access or access by residents of the development to the protected land.

Planning Boards should weigh the benefits of public access against potential detriment to the conservation values of the open space.

Timing: Any restriction or other legal document necessary to permanently conserve open space as required herein shall be recorded before lots are released or building permits are issued, whichever comes first.

Allowable Use of the Open Space: Such land shall be perpetually kept in an open state, preserved exclusively for the purposes set forth herein and in the deed and/or in the restriction, and maintained in a manner which will ensure its suitability for its intended purposes. Proposed use(s) of the open space consistent with this section shall be specified in the application.

- a. The open space shall be used for wildlife habitat and conservation and the following additional purposes: historic preservation, outdoor education, passive recreation, aquifer protection, agriculture, horticulture, forestry, or a combination of these uses, and shall be served by suitable access for such purposes.

Alternative: Active Recreation: Where appropriate to the topography and natural features of the site up to [10%] of the open space may be altered and used for active recreation (e.g. ball fields) or community gardens;

Ball fields and other active recreational uses of conserved open space can be appropriate, particularly in more urban communities. However, limiting the percentage of the open space that can be devoted to such uses keeps the bulk of the land in its natural state.

Alternative: Motorized Recreation: The use of [motorized vehicles] [snowmobiles] is permitted within protected open space only on trails in non-sensitive areas approved as part of the open space design.

Municipalities should recognize that active and especially motorized uses could easily destroy the natural resource value of the conserved open space, that conservation commissions are not authorized to hold land used for these purposes, that conservation organization may be reluctant to hold restrictions on open space where these uses are allowed, and that these uses make approval of a restriction by EEA pursuant to Chapter 184 unlikely.

- b. The planning board may permit a small portion of the open space, not to exceed [5%], to be paved or built upon (preferably using permeable pavement and other means of retaining natural hydrology) for structures accessory to the dedicated use or uses of such open space (i.e. barns or other farm structures, parking to facilitate public access for passive recreation, informational kiosks, pedestrian walks, ADA access, and bike paths) so long as the conservation values of the open space are not compromised.
- c. The open space may be used as the land subject to a restriction for the purpose of an aggregate calculation under Title V.

Prohibited Use of the Open Space: The open space within an OSD shall be perpetually kept in an open state, preserved exclusively for the purposes set forth in the Allowed Uses section of this [bylaw/ordinance], and maintained in a manner that will ensure its suitability for its intended purposes. The following uses are expressly prohibited except in conformance with an allowed use:

- a. Constructing or placing of any temporary or permanent building, tennis court, landing strip, mobile home, swimming pool, fences, asphalt or concrete pavement, sign, billboard or other advertising display, antenna, utility pole, tower, conduit, line or other temporary or permanent structure or facility on, above, or under the open space that is not in conformance with an authorized use of the open space (e.g. a barn or other structure associated with agriculture);
- b. Mining, excavating, dredging, or removing soil, loam, peat, rock, gravel or other mineral resource or natural deposit;
- c. Placing, filling, storing, or dumping of soil, refuse, trash, vehicles or parts thereof, rubbish, debris, junk, waste, or other substance or material whatsoever or the installation of underground storage tanks;

- d. Cutting, removing, or destroying of trees, grasses or other vegetation unless in conformance with an authorized use such as agriculture, forestry, or recreation;
- e. Subdivision; neither further division of the protected open space into lots or the use of the protected open space toward any further building requirements on this or any other lot is permitted;
- f. Activities detrimental to drainage, flood control, water conservation, water quality, erosion, soil conservation, or archeological conservation;
- g. Purposefully introducing or allowing the introduction of species of plants and animals recognized by the Executive Office of Energy and Environmental Affairs to pose a substantial risk of being invasive or otherwise detrimental to the native plant and animal species and plant communities on the property;
- h. The use, parking or storage of motorized vehicles, including all-terrain vehicles (ATVs), motorcycles, and campers, except in conformance with an authorized use of the open space or as required by the police, firefighters, or other governmental agents in carrying out their duties; and

Communities for whom the use of snowmobiles and other motor vehicles is consistent with their open space objectives should:

- *Edit Prohibited Use subsection h as appropriate;*
- *Add the Motorized Recreation subsection to the Allowed Use of Open Space section;*
- *Recognize and take precautions to prevent such use from destroying the natural resource value of the conserved open space;*
- *Place conditions upon vehicular use (e.g. restricting vehicles to established trails in non-sensitive areas);*
- *Be aware that conservation commissions are not authorized to hold land used for these purposes; and*
- *Understand that EEA approval, which is required to make a restriction permanent pursuant to G.L. Chapter 184, is unlikely when motor vehicle use is allowed.*

- i. Any other use or activity which would materially impair conservation interests unless necessary in an emergency for the protection of those interests.

Ownership of the Open Space: At the applicant's discretion the open space may be owned by:

- (1) A private owner for agricultural, horticultural, forestry or any other purpose not inconsistent with the conservation restriction;
- (2) A non-profit organization or agency of the Commonwealth, with their consent, whose principal purpose is the conservation of open space for any of the purposes set forth herein;
- (3) The [CITY/TOWN] Conservation Commission; or

(4) A homeowners association (HOA) as defined in herein owned jointly or in common by the owners of lots or units within the project. If option four is selected the following shall apply:

- a. The documents organizing the HOA shall be drafted and approved by the planning board before final approval of the OSD development, recorded prior to the issuance of building permits, comply with all applicable provisions of state law, and pass with conveyance of the lots or units in perpetuity. Each individual deed, and the deed, trust, or articles of incorporation, shall include language designed to effect these provisions.
- b. Membership must be mandatory for each property owner, who must be required by recorded covenants and restrictions to pay fees to the HOA for taxes, insurance, and maintenance of common open space, private roads, and other common facilities.
- c. The HOA must be responsible in perpetuity for liability insurance, property taxes, the maintenance of recreational and other facilities, private roads, and any shared driveways.
- d. Property owners must pay their pro rata share of the costs in subsection c above, and the assessment levied by the HOA must be able to become a lien upon individual properties within the OSD.
- e. The HOA must be able to adjust the assessment to meet changed needs.
- f. The applicant shall make a conditional grant to the [CITY/TOWN], binding upon the HOA, of the fee interest to all open space to be conveyed to the HOA. Such offer may be accepted by the [CITY/TOWN], at the discretion of the [City Council/Board of Selectmen], upon the failure of the HOA to take title to the open space from the applicant or other current owner, upon dissolution of the association at any future time, or upon failure of the HOA to fulfill its maintenance obligations hereunder or to pay its real property taxes.

A conditional grant offer is a legal contract that a CITY/TOWN can invoke to take title to the open space in an OSD should an HOA fail to fulfill its responsibilities relative to the open space. The exact terms (the conditions) of the grant should include at least those in section f above.

- g. Ownership shall be structured in such a manner that real property taxing authorities may satisfy property tax claims against the open space lands by proceeding against individual property owners in the HOA and the dwelling units they each own.
- h. [CITY/TOWN] Counsel must find that the HOA documents presented satisfy the conditions in Subsections a through g above, and such other conditions as the planning board shall deem necessary.

Selection of ownership option one, two, or four requires:

- a) The conveyance of a conservation restriction as outlined herein; and
- b) The granting of an access easement over such land sufficient to ensure its perpetual maintenance as agricultural, conservation, or recreation land. Such easement shall provide that in the event the trust or other owner fails to maintain the open space in reasonable condition, the [CITY/TOWN] may, after notice to the lot owners and public hearing, enter upon such land to maintain it in order to prevent or abate a

nuisance. The cost of such maintenance by the [CITY/TOWN] shall be assessed against the properties within the development and/or to the owner of the open space. Pursuant to G.L. Chapter 40 Section 58 the [CITY/TOWN] may file a lien against the lot or lots to ensure payment for such maintenance. Pursuant to G.L. Chapter 40 Section 57 the [CITY/TOWN] may also deny any application for, or revoke or suspend a building permit or any local license or permit, due to neglect or refusal by any property owner to pay any maintenance assessments levied.

The municipality could also require the posting of a performance bond in the bylaw/ordinance to ensure upkeep of the area.

Maintenance:

The planning board shall require the establishment of ongoing maintenance standards as a condition of development approval to ensure that utilities are properly maintained and the open space land is not used for storage or dumping of refuse, junk, or other offensive or hazardous materials. Such standards shall be enforceable by the Town against any owner of open space land, including an HOA. If the Board of Selectmen finds that the maintenance provisions are being violated to the extent that the condition of the utilities or the open land constitutes a public nuisance, it may, upon 30 days written notice to the owner, enter the premises for necessary maintenance, and the cost of such maintenance by the Town shall be assessed ratably against the landowner or, in the case of an HOA, the owners of properties within the development, and shall, if unpaid, become a property tax lien on such property or properties.

Submission Requirements: In order to enable the planning board to determine whether or not a proposed open space design satisfies the purposes and standards of the Open Space Design section of the Zoning [Bylaw/Ordinance] an applicant must present sufficient information on the environmental and open space resources for the Board to make such a determination. The required information shall be provided in the form of a “conservation analysis” as described in the Subdivision Regulations. In the case of an Open Space Design that is not a subdivision, and that is presented as a site plan review application, the planning board may require the submission of all or only part of a conservation analysis as described in the subdivision regulations. Proposed use(s) of the open space consistent with this section shall be specified in the application.

Wastewater Disposal: Wastewater disposal is often cited as concern in regard to permitting and construction of open space designs. Indeed, many communities utilizing this model zoning bylaw/ordinance will not have sewers available. However, particularly with cooperation from the local Board of Health it is entirely feasible to construct open space design projects in the absence of sewer lines and a conventional wastewater treatment plant. With careful planning and regulation instead of wastewater as a control density can be determined by local zoning and subdivision regulations, providing flexibility in design and land use management

Standard Title 5 systems are often the preferred approach to on-site wastewater management within an open space design because the permitting process is relatively fast and the technique is familiar and predictable. While a standard Title V system requires 10,000 square feet of lot area per bedroom – a builder's acre of 40,000 square feet for a four bedroom home – a number of options are available to decrease lot sizes consistent with open space design. The first way in which additional density can be realized under Title V is for a builder to provide water via a common well instead of individual wells on each lot. This eliminates the need to accommodate the required 100 foot setback between well and septic on each lot. An acknowledged disincentive to this approach is that a water source with more than 15 connections or that serves more than 25 individuals is deemed a "public water supply" which requires a permit from the Department of Environmental Protection and ongoing water quality monitoring. Another alternative that applies to Title V systems is approval of a Nitrogen Loading Aggregation Plan. Plan approval allows a developer to meet land area requirement for wastewater discharge by getting credit for land in the common open space.

Next, allowing construction of a shared septic system is another logical means for municipalities to facilitate the construction of open space designs. Shared systems can accommodate up to 10,000 gallons per day (larger systems are administered by the Department of Environmental Protection). This is the equivalent of thirty homes with 3 bedrooms or 22 homes with four bedrooms. Following this approach, the wastewater disposal needs of all houses in the open space design are calculated and added together. Then, a common system is constructed with standard Title V system components sized sufficiently to accommodate flow from the entire development. The leaching field can be placed in the most advantageous location eliminating the need to find a suitable site on each lot. It worth noting that a 2006 change to Title V gives cluster or OSD developments an advantage over conventional subdivisions in that it need not be proven that a conventional Title V system could sited on the lot of each home. This affords the flexibility to design a site consistent with OSD, especially on sites with shallow depth to groundwater or poor soils that make it difficult to prove each lot can support its own system. The following example is from the Massachusetts Smart Growth/Smart Energy Toolkit:

"To give an idea of the increased density possible with a shared system, consider a 30-acre parcel where the local zoning has a one-acre minimum lot size as a base requirement. If the development of thirty homes is clustered on 0.25-acre lots with a shared system, the development only requires 7.5 acres of land (plus some area for roads, wastewater disposal, and drainage facilities). In this manner, over 50% of the lot area can remain undeveloped. In this case the leaching field would be approximately 13,400 square feet in an area with permeable soils. "

Title V also provides for the utilization of innovative and alternative septic technologies. A range of technologies has emerged that provide enhanced treatment of pollutants, thus allowing for higher densities of development than those supported by standard systems. Alternative system that provides additional wastewater treatment prior to discharge can increase allowed flow to 660 gallons per 40,000 square feet of lot area, the equivalent of a three bedroom home on a half acre lot.

In addition to working with Title V systems, developers can ease design constraints by constructing a package treatment plant to serve the open space design. The use of a wastewater treatment plant expands the options for higher density development as lot sizes are not controlled by the need to provide an on-site septic system. While this option is expensive, it can make financial sense under certain circumstances – such as the higher densities that occur within the developed portion of an open space design.

For further information on these and other options communities should consult the Wastewater Alternatives module of the Commonwealth's Smart Growth/Smart Energy Toolkit at

http://www.mass.gov/envir/smart_growth_toolkit/pages/mod-ww.html.

Model Open Space Design Subdivision Regulations

The Design Process - Conservation Analysis and Site Design:

In order to enable the planning board to determine whether or not a proposed Open Space Design satisfies the purposes and standards of the Open Space Design section of the Zoning [Bylaw/Ordinance] and complies with the subdivision regulations an applicant must follow a prescribed design process and provide sufficient information on the environmental and open space resources found on the proposed project site.

At the time of the application for subdivision approval applicants are required to demonstrate to the planning board that the following design process was utilized by a certified landscape architect to determine the site layout including proposed streets, house lots, unit placement if treated as a condominium, and designation of all common areas and open space.

Design Process:

- A. Informational Meeting: Prior to filing an application, an applicant is encouraged to meet with the planning board to discuss the conservation resources on the site. At such a meeting, the planning board shall indicate to the applicant which land is likely to have the most conservation value and be most important to preserve and where development may be most appropriately located.

Technically the conservation analysis and findings must be done as part of the formal subdivision review. A developer must be able to walk in and file a completed definitive plan, application, and fee, accompanied by their conservation analysis, and have it date stamped as submitted. The clock on the hearing will start, as does the review of the analysis that will lead to findings. As with any subdivision the plan can be modified during the hearing or decision period, though the conservation analysis and findings process should not change any numbers from zoning (e.g. yield or conserved open space).

However, it makes much more sense to do the analysis at the pre-application stage. A developer can avoid a lot of potential cost and aggravation by doing so. Even presenting a sketch plan to the Planning Board in lieu of the more formal analysis is helpful at the informational stage. Since under state statute an informational meeting can't be mandated, communities are strongly urged to encourage it in their subdivision regulations and informal interaction with developers.

B. Conservation Analysis: Identification of Conservation Areas and Potentially Developable Area

Primary Conservation Areas, such as wetlands, riverfront areas, and floodplains regulated by state or federal law, are to be identified and delineated. Development is prohibited within Primary Conservation Areas. Secondary Conservation Areas including unprotected elements of the natural landscape such as steep slopes, upland buffers to wetlands, streams, and vernal pools, mature woodlands, prime farmland, meadows, wildlife habitats including corridors for wildlife movement, and cultural features such as historic and archaeological sites and scenic views shall also be identified and delineated. Master and open space and recreation plan conservation goals are to be considered when delineating such conservation areas. Land outside identified Primary and Secondary Conservation Areas is the Potentially Developable Area.

Conservation Areas and Potentially Developable Areas shall be delineated such that open space is contiguous to the extent feasible. Open space will still be considered contiguous if it is separated by a roadway with undeveloped frontage. The planning board may waive the contiguity requirement for all or part of the required open space where it is determined that allowing noncontiguous open space will promote the goals of this [Bylaw/Ordinance] and/or protect identified Primary and Secondary Conservation Areas.

The planning board, in consultation with the conservation commission shall study the conservation analysis, may conduct field visits, and shall formally determine which land should be preserved and where development may be located. As part of its decision the planning board shall make written findings supporting this determination (the “conservation findings”). These findings must provide a viable location for the number of units specified in the zoning. Once the Potentially Developable Area has been determined applicants shall layout the components of the subdivision within that area including road rights of way, streets, any shared driveways approved via special permit, trails, sidewalks, and other infrastructure as well as lot lines.

- C. Standard for Approval: The planning board shall deny any application that does not include sufficient information to make conservation findings, that deviates from the zoning requirements, or that does not preserve land that the planning board determines should be preserved from development as a result of the conservation analysis and findings. The conservation findings shall show land to be permanently preserved by a conservation restriction, and include recommended conservation uses, ownership, and management guidelines for such land. The planning board’s conservation findings shall be incorporated into its decision to approve, approve with conditions, or deny an application. The conservation findings shall also indicate preferred locations for development if the OSD plan is denied based upon such findings.

The conservation analysis and findings process cannot be used to directly or indirectly deny a subdivision application or to make it technically or financially infeasible. This is true of any conditions or requirements imposed on a subdivision or site plan.

Communities should recognize that they are applying the conservation analysis to a by-right use, and in this way the process is analogous to site plan review of a by-right use. Unlike a special permit under zoning, the review is not discretionary and the planning board can't just say no. An applicant will get its subdivision, but the exact layout is being worked out through the design process. The amount of developable land is guaranteed by the zoning and the board must, in its findings, provide a viable location for the number of units specified in the zoning. It's just the location of the units and open space relative to the whole property that is the subject of the conservation analysis and findings. Denials should be extremely rare and only occur if conditions cannot be applied sufficient to ensure that the subdivision conforms to the regulations. In the exceptional circumstance where the developer and the board reach an impasse on the design the board should indicate in its denial the areas that would be acceptable for development.

The applicant can be required to submit all information reasonably necessary to provide the basis for an informed planning board decision that addresses specific site planning and subdivision criteria. This information can then be used to shape the conditions of approval, but such conditions cannot have the effect of a de facto denial. This applies to all kinds of conditions and requirements, including conservation analysis and findings. Locating and defining conservation areas, uses, and requirements, and tying this process in with open space planning, is good practice in site planning and subdivision approval.

Design Standards:

The following standards shall apply to all Open Space Designs, and govern the design and development process:

- A. Disturbed Areas: In order to maximize the amount and contiguity of preserved open space, and consistent with the planning board's conservation findings, every effort shall be made to minimize and concentrate the amount of disturbed area (defined as any land not left in its natural vegetated state), by minimizing tree and soil removal. Any grade changes shall be in keeping with the general appearance of the neighboring developed areas. The orientation of individual building sites shall maintain maximum natural topography and cover. Topography, tree cover, surface water buffers, and natural drainage ways shall be treated as fixed determinants of road and lot configuration rather than as malleable elements that can be changed to follow a preferred development scheme.
- B. Ways: Streets shall be located and designed to maintain and preserve natural topography, significant landmarks, and trees; to minimize cut and fill; and to preserve and enhance views and vistas on or off the subject parcel. The planning board may modify the applicable road

construction requirements for new road within an Open Space Design as provided in the Subdivision Regulations if it finds that such modifications will be consistent with the purposes of this section, the Open Space Design requirements of the Zoning [Bylaw/Ordinance] and the Master Plan.

- C. Aesthetics: Development shall relate harmoniously to the terrain and the use, scale, and architecture of existing buildings in the vicinity that have functional or visual relationship to the proposed buildings. All open space (landscaped and usable) shall be designed to add to the visual amenities of the area by maximizing its visibility for persons passing the site or overlooking it from nearby properties.
- D. Cultural Resources: The removal or disruption of historic, traditional or significant uses, structures, or architectural elements shall be minimized insofar as practicable, whether these exist on the site or on adjacent properties.
- E. Stormwater Management: The use of Low Impact Development techniques - practices that limit off-site stormwater runoff (both peak and non-peak flows) to levels substantially similar to natural hydrology by emphasizing decentralized management practices and the protection of on-site natural features - is required. Drainage design shall comply with the most recent version of the Massachusetts Stormwater Management Policy standards. A conceptual landscape plan shall be provided demonstrating that the facility will have dedicated access for maintenance, shall be adequately screened from view, and protected from trespass.
- F. On-site Pedestrian and Bicycle Circulation: Walkways, trails and bicycle paths shall be provided to link residences with recreation facilities (including parkland and open space) and adjacent land uses where appropriate.

Wastewater Disposal:

The applicant shall show on the plan sufficient information with respect to existing and proposed underground structures and septic disposal areas to enable the Board of Health to evaluate whether there is adequate area for a septic disposal system to be located on a lot to serve any permitted use of the lot. Where a lot(s) is to be served by public sewers or by a package treatment plant, the application shall contain a certificate from the Board of Health stating that such public sewers or package treatment plant are adequate to serve any permitted use of the lot(s).

Open Space Design: Special Permit for an Increase in Permissible Density

Because this model permits open space design as of right, with a typical project requiring only subdivision plan approval, it is necessary for density bonuses to be enabled via an optional special permit provision.

The planning board may award via special permit a density bonus to increase the number of dwelling units beyond that otherwise allowed. The density bonus for an Open Space Design shall not, in the aggregate, exceed [30%] of the allowable residential units. When determining the final total number of bonus dwelling units fractions of less than .5 shall be rounded down to the nearest integer and .5 or more shall be rounded up. A density bonus may be awarded in the following circumstances:

The highest level of density bonus, listed above as 30%, is a critical consideration. The higher the number, the more enticing the density bonus will be. If the community is very serious about maximizing open space protection, providing public access, preserving historic structures, producing affordable housing, or realizing some other public benefit it will want to consider increasing this number to 50%, if not more.

There is another possible use of density bonuses that municipalities may wish to consider. As drafted this model bylaw permits Open Space Design by-right, recognizing that a discretionary special permit is a significant disincentive to a developer. However, Ipswich has opted to permit Open Space Design by special permit, while offering a significant enough increase in density - 100% - that most developers select this option despite the uncertainty. This allows a community to retain the ability to carefully condition a proposed project after submittal instead of exercising discretion up-front through prescriptive zoning and subdivision standards. Of course, a community implementing this option will need to be comfortable with the resulting overall increase in housing units.

- A. If deeded public access to the open space portion of the property is provided for the purpose of passive recreation only and the planning board finds that such access provides a significant recreational benefit, a maximum of [10%];

Planning Boards should weigh the benefits of public access against potential detriment to the conservation values of the open space.

- B. For every historic structure on the project site that is 1) listed or eligible for listing on the state register of historic places or 2) has been determined by the [CITY/TOWN] historic preservation commission to be significant in the history, archeology, architecture or culture of the [CITY/TOWN] that is made subject to a permanent historic preservation restriction in accordance with G.L. c. 184 § 31, [one] dwelling unit may be added;

Communities may wish to limit this bonus to principal structures or to define a structure for this purpose. Is it the intent of the community to give a dwelling unit for the preservation of a barn, cabin, or other accessory structure?

- C. For each additional [10%] of the property permanently preserved as defined in Article 97 of the Articles of Amendment to the Constitution of the Commonwealth of Massachusetts as natural open space (over and above the required [minimum percentage as set by the CITY/TOWN in the bylaw/ordinance], a bonus of [10%]; or
- D. For every [two] dwelling units restricted in perpetuity in accordance with G.L. c. 184 § 31 to occupancy by Moderate-Income Households*, or for every [one] dwelling unit restricted in perpetuity to occupancy by Low-Income Households*, [two] market rate dwelling units may be added. Affordable housing units may receive a density bonus only if they can be counted toward the municipality's subsidized housing inventory as determined by the Massachusetts Department of Housing and Community Development. The applicant shall provide documentation demonstrating that the unit(s) shall count toward the community's subsidized housing inventory to the satisfaction of the planning board.

* Those listed as "Very Low Income" and "Low Income" respectively in statistics published annually by the Department of Housing and Urban Development.

Municipalities should carefully select those public benefits for which they will offer an incentive. The four listed above are the most common. Communities will also wish to consider the level of incentive offered for each in order to fine-tune the bylaw/ordinance to meet their needs. The suggested density bonus for the provision of affordable units is responsive to discussions with housing developers who cite the high costs associated with integrating affordable units into a standard market-rate subdivision.

Open Space Design: Special Permit for Shared Driveways

Definition: A shared driveway is not a street, but provides legally and practically adequate common vehicular access to and from a public street to lots/units which would otherwise be required to have their own access and frontage. A shared driveway is jointly owned in fee or as an easement as specified on the deeds of the owners of the properties to which it provides access. Maintenance of a shared driveway is arranged between the joint owners as specified in deeded covenants.

1. The planning board may issue special permits allowing shared driveways that serve up to **[five]** dwelling units. The owner(s) of all lots or dwelling units to be served by the shared driveway must be party to the application for a special permit. A shared driveway must lie entirely within lots being served or the open space within an Open Space Design. If serving more than two units a shared driveway will be called a “way” with a sign placed in plain view of its intersection with a way on which the public has a right of access.

Municipalities should adjust the number of units that can be served by a shared driveway based on the unit types allowed, local subdivision road standards, and other factors. For example, multi-family buildings and/or accessory dwelling units will generate a different number of cars and frequency of trips than a shared driveway serving solely four bedroom single-family homes. Ultimately, when setting a unit count communities will want to weigh the open space design advantages of shared driveways against roads that more closely mirror subdivision standards.

Applicants must provide:

- a. Evidence of deeded covenants for all lots or dwelling units served by the shared driveway which include provisions that are adequate in the opinion of the planning board and **[CITY/TOWN]** counsel to:
 - i. Establish a maintenance association comprised of the owners of all lots or units served by the shared driveway;
 - ii. Ensure continued maintenance of the shared driveway surface and its drainage structures;
 - iii. Provide for the collection of dues and assessments for any necessary ongoing maintenance, repairs, and any plowing/sanding of the shared driveway; and
 - iv. Provide a compliance mechanism enforceable by the maintenance association in the event of non-payment of dues or assessments by a member.
- b. Guarantees including but not limited to financial security as provided by the Subdivision Regulations that the shared driveway will be constructed if the permit is issued;
- c. A plan signed by a registered professional engineer for the shared driveway showing alignments, grades, subsurface preparation, drainage facilities, and surface materials.

2. The shared driveway shall be designed to safely handle the proposed traffic and provide year-round access for emergency vehicles, and shall satisfy at least the regulations for driveways in this [bylaw/ordinance]. In no instance shall a shared driveway be longer than [750] feet or have a grade of over [6%] if gravel or [12%] if constructed of a hardened surface such as asphalt, concrete, or oil and stone. The planning board may require enhanced subsurface preparation, drainage, alignment, width, turnouts, and surfacing as long as the standards for the least stringent road standards within the Subdivision Regulations are not exceeded.

If subdivision regulations permit cul-de-sacs longer than 500 feet allowing shared driveways of the same maximum length will facilitate OSD.

3. The municipality may not be compelled to provide construction, reconstruction, maintenance, snow plowing, school bus pick-up, police patrols, or other services along a shared driveway.
4. Shared driveways need not become public ways.
5. A shared driveway shall not exempt an applicant from meeting applicable parking requirements for individual dwelling units.

Communities that set no frontage requirement as suggested in the model zoning do not need sections 6 and 7 below. However, if a community has chosen to require frontage it should adopt the following language allowing the frontage standard to be waived.

Alternative:

6. A shared driveway shall in no way exempt an applicant from meeting applicable frontage requirements for each individual building lot unless a reduction in frontage requirements is granted in accordance with the following flexible frontage provision.

7. Flexible Frontage: In order to reduce the number of curb cuts onto roadways, preserve the natural and cultural resources visible along these roadways, facilitate the movement of wildlife across roadways, protect recreational access to backland, and improve the design of Open Space Designs and other smaller residential neighborhoods the planning board may approve in its special permit for a shared driveway a reduction or elimination in frontage requirements for one or more of the lots proposed to be served by the shared driveway. Such reduction or elimination of frontage requirements shall not affect any other dimensional requirement for the lots to be served by a shared driveway or result in more than twice the number of lots otherwise possible without such reduction or elimination. In order to take advantage of this provision an applicant shall obtain the required special permit for the shared driveway prior to seeking approval for the creation of the subject lots under the "approval not required" provisions of the subdivision regulations. The planning board may approve such frontage reductions or eliminations only if it finds that the goals listed in the first sentence of this paragraph will be better achieved than without the reductions or eliminations.

OSRD/Cluster Type Subdivisions: Rapid Assessment for Best Practices

<u>Factors (by approx. import)</u>	<u>Best Practice</u>	<u>Better</u>	<u>Good</u>
<u>Permit Type</u>	Mandatory	By Right	Special Permit
<u>Land area to which the zoning is applicable</u>	All developable land zoned residential ¹	Land of particular environmental sensitivity	Only a small amount of developable land
<u>Minimum Open Space</u>	≥ 75%	65-75%	50-65%
<u>Yield Calculation</u>	By formula	Sketch plan with selected percolation test(s)	Full plan with full percolation tests
<u>Minimum parcel size</u>	None	5-10 acres	≥ 10 acres
<u>Review Process</u>	Flexible "OSRD" 4 Step	Cluster layout	Cluster layout
<u>Ownership of Open Space</u>	Appropriate to the resources present. For example, agricultural land by the farmer, watershed land by a water dept. or district, habitat land by the conservation commission, or recreational open space by a parks and recreation commission or homeowners association.		
<u>Dimensional Standards; area, frontage, etc.</u>	None set or small minimums	Formulaic reduction with specified minimums	Specified, < than for standard subdivision
<u>Quality of open space conserved: Specificity of local priorities for natural, cultural, and historic resource conservation</u>	Local priorities clearly and unambiguously stated and mapped for use in site design.	Lack of specificity regarding local conservation priorities; no map of priority locations	No indication of local conservation priorities, or language that refers only to regulated resource areas.
<u>Contiguity of open space; relationship to previously protected open space</u>	Contiguity required; adjacent land considered	Contiguity required within subdivision	No contiguity requirement
<u>Quality of open space conserved: Allowed uses of open space</u>	Clear list of allowed uses consistent with conservation and recreation goals	Vague language regarding use of conserved open space	Allowed use of open space not addressed
<u>Quality of open space conserved: Submission requirements - GIS maps, data, etc. to inform the review process</u>	Specific plans, maps, & comprehensive data regarding natural, cultural, and historic resources required and used as the basis for open space conservation.	General non-comprehensive data and mapping requirements; vague process for the application of the data to site design and open space conservation.	Vague or no language regarding submission of information on site resources and no specified process for the use of the data submitted.
<u>Relationship to Plans</u>	Required consideration of open space goals of OSRP, master, and/or regional policy plan	Optional consideration of open space goals of OSRP, master, and/or regional policy plan	Relationship to plans not discussed
<u>Low Impact Design</u>	Required	Encouraged	Not addressed
<u>Density bonus for enhanced public benefit(s)</u>	Automatic or formulaic bonus	Bonus by special permit	No bonus offered
<u>Review Entity</u>	planning board	planning board	ZBA, council or selectmen as special permit authority
<u>Flexibility re: open space protection to facilitate wastewater treatment facilities</u>	Required open space reduced by ≤ 10% to accommodate; disposal area deed restricted; aggregate calculations allowed by BoH, etc.	Aggregate calculations allowed by board of health	No flexibility provided
<u>Monitoring of open space</u>	Specific provisions to aid endowed monitoring by a conservation org. @ stated intervals	Loose provisions to facilitate, municipal monitoring, or no specificity regarding monitoring interval	No specified monitoring requirements and no requirements that would assist the party responsible for monitoring

¹ The technique can also be applied to non-residential development, including mixed-use.

Other: Municipalities should ensure that subdivision & other local regulations do not interfere with implementation including board of health wastewater disposal regulations and carefully determine how to address wetlands when setting open space & dimensional standards.

MODEL LOW IMPACT DEVELOPMENT (LID) BYLAW

BACKGROUND/FINDINGS

It is hereby determined that:

Land development projects and other land use conversions, and their associated changes to land cover, permanently alter the hydrologic response of local watersheds and increase stormwater runoff rates and volumes, which in turn increase flooding, stream channel erosion, and sediment transport and deposition, and decrease groundwater recharge;

Land development projects and other land use conversions also contribute to increased nonpoint source pollution and degradation of receiving waters;

The impacts of post-development stormwater runoff quantity and quality can adversely affect public safety, public and private property, surface water drinking water supplies, groundwater resources, drinking water supplies, recreation, aquatic habitats, fish and other aquatic life, property values and other uses of lands and waters;

These adverse impacts can be controlled and minimized through the application of Low-Impact Development (LID), which includes careful site planning and the application of both structural and nonstructural Best Management Practices;

Localities in the Commonwealth of Massachusetts are required to comply with a number of both State and Federal laws, Bylaws and permits which require a locality to address the impacts of post-development stormwater runoff quality and nonpoint source pollution.

Therefore, the *[LID Authority]* has established this LID bylaw to provide reasonable guidance for site planning and for the Bylaw of post-development stormwater runoff for the purpose of protecting local water resources from degradation. This bylaw regulates the post-construction stormwater controls for both new and re-development projects.

It has been determined that it is in the public interest to minimize the impacts associated with land development and to regulate post-development stormwater runoff discharges in order to control and minimize increases in stormwater runoff rates and volumes, post-construction soil erosion and sedimentation, stream channel erosion, and nonpoint source pollution associated with post-development stormwater runoff.

1.0 PURPOSE AND INTENT

- A) The purpose of this Bylaw is to protect, maintain and enhance the public health, safety, environment and general welfare by establishing minimum requirements and procedures to control the adverse effects of increased post-development stormwater runoff and nonpoint source pollution associated with new development and redevelopment. It has been determined that LID site planning and proper management of post-development stormwater runoff will minimize damage to public and private property and infrastructure, safeguard the public health, safety, environment and general welfare of the public, protect water and aquatic resources, and promote groundwater recharge to protect surface and groundwater drinking supplies. This Bylaw seeks to meet that purpose through the following objectives:

- 1 Establish decision-making processes surrounding land development activities that protect the integrity of the watershed and preserve the health of water resources;
 - 2 Require that new development, redevelopment and all land conversion activities maintain the natural hydrologic characteristics of the land in order to reduce flooding, stream bank erosion, siltation, nonpoint source pollution, property damage, and to maintain the integrity of stream channels and aquatic habitats;
 - 3 Establish minimum post-development LID Management standards and design criteria for the control of stormwater runoff quantity and quality, the protection of properties and aquatic and groundwater resources downstream from land development, and to minimize nonpoint source pollution from stormwater runoff which would otherwise degrade water quality;
 - 4 Establish design and application criteria for the construction and use of structural stormwater control facilities that can be used to meet the minimum post-development LID Management standards;
 - 5 Encourage the use of LID practices such as reducing impervious cover and the preservation of greenspace and other natural areas, to the maximum extent practicable; Coordinate site design plans, which include greenspace, with the Town's greenspace protection plan;
 - 6 Establish provisions for the long-term responsibility for and maintenance of structural stormwater control facilities and nonstructural LID Management practices to ensure that they continue to function as designed, are maintained, and pose no threat to public safety;
 - 7 Establish provisions to ensure there is an adequate funding mechanism, including surety, for the proper review, inspection and long-term maintenance of stormwater facilities implemented as part of this Bylaw;
 - 8 Establish administrative procedures for the submission, review, approval or disapproval of LID plans, and for the inspection of approved active projects, and long-term follow up; Establish certain administrative procedures and fees for the submission, review, approval, or disapproval of stormwater plans, and the inspection of approved projects.
 - 9 Meet certain provisions of the Town's requirements to comply with the Clean Water Act National Pollutant Discharge Elimination System (NPDES) Regulations for the Revision of the Water Pollution Control Program Addressing Storm Water Discharges (Phase I and II Rules). Phase I of the storm water program covers municipal storm sewer systems serving populations over 100,000, construction sites above five acres, and industrial activities. The Phase II rule expands the existing NPDES storm water program to address storm water discharges from small (those serving less than 100,000 persons) municipal separate storm sewer systems (MS4) and construction sites that disturb one to five acres. The bylaw will ensure that the town meets the requirements of their NPDES Storm Water General Permit, submitted to the Massachusetts Department of Environmental Protection on July 15, 2003, particularly the specific elements of their Stormwater Management Program outlined in the Permit.
- B) Nothing in this Bylaw is intended to replace the requirements of either, the Town of [_____] Flood Plain Zoning Bylaw, the Town of [_____] General Wetlands Protection Bylaw, or any other Bylaw that may be adopted by the Town of [_____]. Any activity subject to the provisions of the above-cited Bylaws must comply with the specifications of each.

2.0 DEFINITIONS

The following definitions shall apply in the interpretation and implementation of this Bylaw. Additional definitions may be adopted under promulgated regulations.

ALTER: Any activity, which will measurably change the ability of a ground surface area to absorb water or will change existing surface drainage patterns. Alter may be similarly represented as “alteration of drainage characteristics,” and “conducting land disturbance activities.”

APPLICANT: A property owner or agent of a property owner who has filed an application for a LID Permit.

BEST MANAGEMENT PRACTICE (BMP): Structural, non-structural and managerial techniques that are recognized to be the most effective and practical means to prevent and/or reduce increases in stormwater volumes and flows, reduce point source and nonpoint source pollution, and promote stormwater quality and protection of the environment. “Structural” BMPs are devices that are engineered and constructed to provide temporary storage and treatment of stormwater runoff. “Nonstructural” BMPs use natural measures to reduce pollution levels, do not require extensive construction efforts, and/or promote pollutant reduction by eliminating the pollutant source.

CONVEYANCE: Any structure or device, including pipes, drains, culverts, curb breaks, paved swales or man-made swales of all types designed or utilized to move or direct stormwater runoff or existing water flow.

DEVELOPMENT: The modification of land to accommodate a new use or expansion of use, usually involving construction.

DISTURBANCE OF LAND: Any action that causes a change in the position, location, or arrangement of soil, sand, rock, gravel or similar earth material.

DRAINAGE EASEMENT: A legal right granted by a landowner to a grantee allowing the use of private land for LID Management purposes.

LIMITED IMPACT DEVELOPMENT PERMIT (LIDP): A permit for projects in the categories and meeting the standards and defined herein and as authorized in the Town of [_____] LID Bylaw. Projects in these categories that meet these generic standards and are properly implemented are assumed to meet the requirements and intent of the Town of [_____] LID Bylaw.

GRADING: Changing the level or shape of the ground surface.

GROUNDWATER: All water beneath any land surface including water in the soil and bedrock beneath water bodies.

HIGHER POTENTIAL POLLUTANT LOADS. These areas include auto salvage yards, auto fueling facilities (gas stations), fleet storage yards, high-intensity commercial parking lots, road salt storage areas, commercial nurseries, outdoor storage and loading areas of hazardous substances, and marinas or other areas defined in the Massachusetts Stormwater Standards, Volume 1, Stormwater Policy Handbook.

HOTSPOT: Land uses or activities with higher potential pollutant loadings, such as auto salvage yards, auto fueling facilities, fleet storage yards, commercial parking lots with high intensity use, road salt storage areas, commercial nurseries and landscaping, outdoor storage and loading areas of hazardous substances, or marinas.

MUNICIPAL SEPARATE STORM SEWER SYSTEM (MS4) or MUNICIPAL STORM DRAIN SYSTEM: The system of conveyances designed or used for collecting or conveying stormwater, including any road with a drainage system, street, gutter, curb, inlet, piped storm drain, pumping facility, retention or detention basin, natural or man-made or altered drainage channel, reservoir, and other drainage structure that together comprise the storm drainage system owned or operated by the Town of [____].

NEW DEVELOPMENT: Any construction or land disturbance of a parcel of land that is currently in a natural vegetated state and does not contain alteration by man-made activities.

NONPOINT SOURCE POLLUTION: Pollution from many diffuse sources caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into water resource areas.

OPERATION AND MAINTENANCE PLAN: A plan that defines the functional, financial and organizational mechanisms for the ongoing operation and maintenance of a LID Management system to insure that it continues to function as designed.

OWNER: A person with a legal or equitable interest in a property.

PERSON: Any individual, group of individuals, association, partnership, corporation, company, business organization, trust, estate, the Commonwealth or political subdivision thereof to the extent subject to Town Bylaws, administrative agency, public or quasi-public corporation or body, the Town of [____], and any other legal entity, its legal representatives, agents, or assigns.

POINT SOURCE: Any discernible, confined, and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, or container from which pollutants are or may be discharged.

POST-DEVELOPMENT: The conditions that reasonably may be expected or anticipated to exist after completion of the land development activity on a specific site or tract of land. Post-development refers to the phase of a new development or redevelopment project after completion, and does not refer to the construction phase of a project.

RECHARGE: The replenishment of underground water reserves.

REDEVELOPMENT: Any construction, alteration, transportation, improvement exceeding land disturbance of [5,000] square feet, where the existing land use is commercial, industrial, institutional, or multi-family residential.

RESOURCE AREA: Any area protected under including without limitation: the Massachusetts Wetlands Protection Act, Massachusetts Rivers Act, or Town of [____] Wetlands Protection Bylaw.

RUNOFF: Rainfall, snowmelt, or irrigation water flowing over the ground surface.

SEDIMENTATION: A process of depositing material that has been suspended and transported in water.

SITE: The parcel of land being developed, or a designated planning area in which the land development project is located.

LID AUTHORITY: Town of [_____] [*Planning Board, Conservation Commission, Board of Health or other duly authorized Town entity that has the authority to administer, implement, and enforce these LID Bylaws*]. The [*LID Authority*] is responsible for coordinating the review, approval and permit process as defined in this Bylaw. Other Boards and/or departments participate in the review process as defined in Section 5 of these LID Bylaws.

LID MANAGEMENT: The use of structural or non-structural practices that are designed to reduce storm water runoff pollutant loads, discharge volumes, and/or peak flow discharge rates.

LIMITED IMPACT DEVELOPMENT PERMIT: A permit issued by the [*LID Authority*], after review of an application, plans, calculations, and other supporting documents, which is designed to protect the environment of the Town from the deleterious affects of uncontrolled and untreated stormwater runoff.

3.0 AUTHORITY

This Bylaw is adopted under authority granted by the Home Rule Amendment of the Massachusetts Constitution, the Home Rule statutes, and pursuant to the Bylaws of the federal Clean Water Act found at 40 CFR 122.34, and as authorized by the residents of the Town of [_____] at Town Meeting, dated [_____].

4.0 ADMINISTRATION

- A) The (Planning Board, Conservation Commission, Board of Selectmen, Board of Health, etc.) is hereby designated as the LID Authority. The LID Authority shall administer, implement and enforce this bylaw. The LID Authority may, with the concurrence of the Applicant, designate another Town Board, including the Planning Board, Conservation Commission, Board of Health, as its authorized agent for the purposes of reviewing all LID submittals and issuing LID permits for any project within that particular Board's (the Reviewing Board") jurisdiction.

(The intent of the above is to streamline the application process. All Board's should include, as part of their instruction, notice of this procedure. An Applicant must concur to having a delegated board handle the LID process in conjunction with another required permit)

- B) LID Regulations. The LID Authority may adopt, and periodically amend, rules and regulations relating to the terms, conditions, definitions, enforcement, fees (including application, inspection, and/or consultant fees), procedures and administration of this LID Bylaw by majority vote of the LID Authority, after conducting a public hearing to receive comments on any proposed revisions. Such hearing dates shall be advertised in a newspaper of general local circulation, at least seven (7) days prior to the hearing date. After public notice and public hearing, the LID Authority may promulgate rules and regulations to effectuate the purposes of this Bylaw. Failure by the LID Authority to promulgate such rules and regulations or a legal declaration of their invalidity by a court shall not act to suspend or invalidate the effect of this Bylaw.

Through promulgated LID regulations, the LID Authority may specify circumstances or conditions under which permit issuance authority is delegated without deliberation to the Planning Director/Agent or to another town board or authority (such as minor projects or projects in wetland areas).

- C) **Reviewing Boards.** When a Reviewing Board is designated as the LID Authority's agent, the Applicant shall submit an LID Management Plan and an Operation and Maintenance Plan, in compliance with any promulgated LID rules and regulations, to the Reviewing Board, in addition to any requirements of the Reviewing Board. There shall be no additional fee or application form required other than that specified in the Bylaw. The Reviewing Board shall review the submittal for compliance with the performance standards of this Bylaw or promulgated LID rules and regulations as part of its public hearing process on the proposed project. The Reviewing Board shall grant an LID permit if the proposed project complies with this bylaw, in addition to any other approval or permit it may grant. The Reviewing Board shall notify the LID Authority of all LID permits it grants. Both the LID Authority and the Reviewing Board shall have authority to enforce this bylaw.
- D) **Actions by the LID Authority or Reviewing Board.** The LID Authority or Reviewing Board may take any of the following actions as a result of an application for a LID Permit as more specifically defined as part of any LID regulations promulgated as a result of this Bylaw: Approval, Approval with Conditions, Disapproval, or Disapproval without Prejudice.
- E) **Appeals of Action by the LID Authority or Reviewing Board.** A decision of the LID Authority or Reviewing Board shall be final. Further relief shall be to a court of competent jurisdiction.

5.0 SCOPE AND APPLICABILITY

- A) This bylaw shall be applicable to all new development and redevelopment, including, but not limited to, site plan applications, subdivision applications, grading applications, land use conversion applications, any activity that will result in an increased amount of stormwater runoff or pollutants flowing from a parcel of land, or any activity that will alter the drainage characteristics of a parcel of land, unless exempt pursuant to Section 5B of this Bylaw. All new development and redevelopment under the jurisdiction of this Bylaw as prescribed in this Bylaw shall be required to obtain a LID Permit.

An alteration, redevelopment, or conversion of land use to a hotspot such as, without limitation: auto salvage yards, auto fueling facilities, fleet storage yards, commercial parking lots with high intensity use, road salt storage areas, commercial nurseries and landscaping, outdoor storage and loading areas of hazardous substances, or marinas, shall require a LID Permit.

- B) **Exemptions**

No person shall alter land within the Town of [_____] without having obtained a LID Permit for the property with the following exceptions:

1. Any activity that will disturb an area less than [5000] square feet or less than [25%] of a contiguous property, whichever is less. This exception may not be applied for the following conditions:
 - a) Contiguous properties held in common ownership at the time of adoption of this Bylaw that may have been previously subdivided and/or are attributed to multiple separate owners;
 - b) Any development or redevelopment involving land uses with "higher potential pollutant

loads” as defined by the Massachusetts Stormwater Standards, Volume 1, *Stormwater Policy Handbook*, and described in Section 2 or this Bylaw.

(Another option could be based on impervious area such as “Any activity that will increase a contiguous impervious area of less than [5,000] square feet.”)

2. Normal maintenance and improvement of land in agricultural use as defined by the Wetlands Protection Act Bylaw 310 CMR 10.04 and MGL Chapter 40A Section 3;
3. Maintenance of existing landscaping, gardens or lawn areas associated with a single family dwelling;
4. Repair or replacement of an existing roof of a single-family dwelling;
5. The construction of any fence that will not alter existing terrain or drainage patterns;
6. Construction of utilities (gas, water, electric, telephone, etc.) other than drainage, which will not alter terrain, ground cover, or drainage patterns;
7. Emergency repairs to any Stormwater Management facility or practice that poses a threat to public health or safety, or as deemed necessary by the *[LID Authority]*;
8. Any work or projects for which all necessary approvals and permits have been issued before the effective date of this Bylaw;
9. Redevelopment projects are presumed to meet the specified LID requirements described in the LID Bylaw of the Town of *[_____]* if the total impervious cover is reduced by *[40%]* from existing conditions. Where site conditions prevent the reduction in impervious cover, LID practices shall be implemented to provide stormwater controls for at least *[40%]* of the site’s impervious area. When a combination of impervious area reduction and LID practice implementation is used for redevelopment projects, the combination of impervious area reduction and the area controlled by a LID practice shall equal or exceed *[40%]*.

6.0 PERMIT PROCEDURES AND REQUIREMENTS

Permit Procedures and Requirements shall be defined and included as part of any rules and regulations promulgated as permitted under Section 4 of this Bylaw.

7.0 ENFORCEMENT

The LID Authority or an authorized agent of the LID Authority shall enforce this Bylaw, regulations, orders, violation notices, and enforcement orders, and may pursue all civil and criminal remedies for such violations. Enforcement shall be further defined and included as part of any LID regulations promulgated as permitted under Section 4 of this Bylaw.

8.0 SEVERABILITY

The invalidity of any section, provision, paragraph, sentence, or clause of this Bylaw shall not invalidate any section, provision, paragraph, sentence, or clause thereof, nor shall it invalidate any permit or determination that previously has been issued.

MODEL LOW IMPACT DEVELOPMENT (LID) REGULATIONS

1.0 PURPOSE AND INTENT

The purpose of these LID Regulations is to protect, maintain and enhance the public health, safety, environment and general welfare by establishing minimum requirements and procedures to control the adverse effects of increased post-development stormwater runoff and nonpoint source pollution associated with new development and redevelopment. It has been determined that LID site planning and proper management of post-development stormwater runoff will minimize damage to public and private property and infrastructure, safeguard the public health, safety, environment and general welfare of the public, protect water and aquatic resources, and promote groundwater recharge to protect surface and groundwater drinking supplies.

2.0 DEFINITIONS

The definitions contained herein apply to issuance of a LID Permit established by the Town of [____]. Terms not defined in this section shall be construed according to their customary and usual meaning unless the context indicates a special or technical meaning.

ALTER: Any activity, which will measurably change the ability of a ground surface area to absorb water or will change existing surface drainage patterns. Alter may be similarly represented as “alteration of drainage characteristics,” and “conducting land disturbance activities.”

APPLICANT: A property owner or agent of a property owner who has filed an application for a LID Permit.

BEST MANAGEMENT PRACTICE (BMP): Structural, non-structural and managerial techniques that are recognized to be the most effective and practical means to prevent and/or reduce increases in stormwater volumes and flows, reduce point source and nonpoint source pollution, and promote stormwater quality and protection of the environment. “Structural” BMPs are devices that are engineered and constructed to provide temporary storage and treatment of stormwater runoff. “Nonstructural” BMPs use natural measures to reduce pollution levels, do not require extensive construction efforts, and/or promote pollutant reduction by eliminating the pollutant source.

BETTER SITE DESIGN: Site design approaches and techniques that can reduce a site’s impact on the watershed through the use of nonstructural LID Management practices. Better site design includes conserving and protecting natural areas and greenspace, reducing impervious cover, and using natural features for LID Management.

CERTIFICATE OF COMPLETION (COC): A document issued by the [LID Authority] after all construction activities have been completed which states that all conditions of an issued LID Permit have been met and that a project has been completed in compliance with the conditions set forth in a LID permit.

CONVEYANCE: Any structure or device, including pipes, drains, culverts, curb breaks, paved swales or man-made swales of all types designed or utilized to move or direct stormwater runoff or existing water flow.

DEVELOPER: A person who undertakes or proposes to undertake land disturbance activities.

DEVELOPMENT: The modification of land to accommodate a new use or expansion of use, usually involving construction.

DISTURBANCE OF LAND: Any action that causes a change in the position, location, or arrangement of soil, sand, rock, gravel or similar earth material.

DRAINAGE EASEMENT: A legal right granted by a landowner to a grantee allowing the use of private land for LID Management purposes.

LIMITED IMPACT DEVELOPMENT PERMIT (LIDP): A permit for projects in the categories and meeting the standards and defined herein and as authorized in the Town of [_____] LID Bylaw. Projects in these categories that meet these generic standards and are properly implemented are assumed to meet the requirements and intent of the Town of [_____] LID Bylaw.

GRADING: Changing the level or shape of the ground surface.

EROSION CONTROL: The prevention or reduction of the movement of soil particles or rock fragments.

EROSION CONTROL PLAN: A plan that shows the location and construction detail(s) of the erosion and sediment reduction controls to be utilized for a construction site.

FLOOD CONTROL: The prevention or reduction of flooding and flood damage.

FLOODING: A local and temporary inundation or a rise in the surface of a body of water, such that it covers land not usually under water.

GROUNDWATER: All water beneath any land surface including water in the soil and bedrock beneath water bodies.

HOTSPOT: Land uses or activities with higher potential pollutant loadings, such as auto salvage yards, auto fueling facilities, fleet storage yards, commercial parking lots with high intensity use, road salt storage areas, commercial nurseries and landscaping, outdoor storage and loading areas of hazardous substances, or marinas.

IMPERVIOUS SURFACE: 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.

INFILTRATION: The act of conveying surface water into the ground to permit groundwater recharge and the reduction of stormwater runoff from a project site.

MASSACHUSETTS STORMWATER MANAGEMENT POLICY: The Policy issued by the Department of Environmental Protection, and as amended, that coordinates the requirements prescribed by state Bylaws promulgated under the authority of the Massachusetts Wetlands Protection Act G.L. c. 131 § 40 and Massachusetts Clean Waters Act G.L. c. 21, §. 23-56. The Policy addresses stormwater impacts through implementation of performance standards to reduce or prevent pollutants from reaching water bodies and control the quantity of runoff from a site.

MUNICIPAL SEPARATE STORM SEWER SYSTEM (MS4) or MUNICIPAL STORM DRAIN SYSTEM: The system of conveyances designed or used for collecting or conveying stormwater, including any road with a drainage system, street, gutter, curb, inlet, piped storm drain, pumping facility, retention or detention basin, natural or man-made or altered drainage channel, reservoir, and other drainage structure that together comprise the storm drainage system owned or operated by the Town of [____].

NEW DEVELOPMENT: Any construction or land disturbance of a parcel of land that is currently in a natural vegetated state and does not contain alteration by man-made activities.

NONPOINT SOURCE POLLUTION: Pollution from many diffuse sources caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into water resource areas.

OPERATION AND MAINTENANCE PLAN: A plan that defines the functional, financial and organizational mechanisms for the ongoing operation and maintenance of a LID Management system to insure that it continues to function as designed.

OWNER: A person with a legal or equitable interest in a property.

PERSON: Any individual, group of individuals, association, partnership, corporation, company, business organization, trust, estate, the Commonwealth or political subdivision thereof to the extent subject to Town Bylaws, administrative agency, public or quasi-public corporation or body, the Town of [____], and any other legal entity, its legal representatives, agents, or assigns.

PRE-DEVELOPMENT: The conditions that exist at the time that plans for the land development of a tract of land are submitted to the *[LID Authority]*. Where phased development or plan approval occurs (preliminary grading, roads and utilities, etc.), the existing conditions at the time prior to the first plan submission shall establish pre-development conditions.

POINT SOURCE: Any discernible, confined, and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, or container from which pollutants are or may be discharged.

POST-DEVELOPMENT: The conditions that reasonably may be expected or anticipated to exist after completion of the land development activity on a specific site or tract of land. Post-development refers to the phase of a new development or redevelopment project after completion, and does not refer to the construction phase of a project.

RECHARGE: The replenishment of underground water reserves.

REDEVELOPMENT: Any construction, alteration, transportation, improvement exceeding land disturbance of *[5,000]* square feet, where the existing land use is commercial, industrial, institutional, or multi-family residential.

RESOURCE AREA: Any area protected under including without limitation: the Massachusetts Wetlands Protection Act, Massachusetts Rivers Act, or Town of [____] Wetlands Protection Bylaw.

RUNOFF: Rainfall, snowmelt, or irrigation water flowing over the ground surface.

SEDIMENTATION: A process of depositing material that has been suspended and transported in water.

SITE: The parcel of land being developed, or a designated planning area in which the land development project is located.

LID AUTHORITY: Town of [____] *[Planning Board, Conservation Commission, Board of Health or other duly authorized Town entity that has the authority to administer, implement, and enforce these LID Bylaws]*. The *[LID Authority]* is responsible for coordinating the review, approval and permit process as defined in this Bylaw. Other Boards and/or departments participate in the review process as defined in Section 5 of these LID Bylaws.

LID MANAGEMENT: The use of structural or non-structural practices that are designed to reduce storm water runoff pollutant loads, discharge volumes, and/or peak flow discharge rates.

LIMITED IMPACT DEVELOPMENT PERMIT: A permit issued by the *[LID Authority]*, after review of an application, plans, calculations, and other supporting documents, which is designed to protect the environment of the Town from the deleterious affects of uncontrolled and untreated stormwater runoff.

STOP WORK ORDER: An order issued which requires that all construction activity on a site be stopped.

TSS: Total Suspended Solids.

WATER QUALITY VOLUME (WQV): The storage needed to capture a specified average annual stormwater runoff volume. Numerically (WQV) will vary as a function of drainage area or impervious area.

3.0 AUTHORITY

- A) The Rules and Regulations contained herein have been adopted by the *[applicable town boards, commissions and/or departments]* in accordance with the Town of *[_____]* LID Bylaw.
- B) Nothing in these Rules and Regulations is intended to replace or be in derogation of the requirements of the Town of *[Town General Wetlands Protection Bylaw]* or the Town of *[_____]* *Floodplain Zoning Bylaw* or any Rules and Regulations adopted thereunder.
- C) These LID Regulations may be periodically amended by the *[LID Authority]* in accordance with the procedures outlined in Section 4.0 of the Town of *[_____]* LID Bylaw.

4.0 ADMINISTRATION

The LID Authority shall administer, implement and enforce these Regulations. The LID Authority shall, with the concurrence of the Applicant, designate another Town Board, including the Planning Board, Conservation Commission, Board of Health, as its authorized agent for the purposes of reviewing all LID submittals and issuing LID permits for any project within that particular Board's (the Reviewing Board") jurisdiction. These Town Boards must formally adopt these regulations, either directly, or by reference, and must issue and LID Permit under the rules set forth in Section 4 of the LID Bylaw. Each approving *[insert board, commission or department]* must forward written documentation of an issued permit to the *[LID Authority]* within *[10 business days]* of said issuance.

(Note: The above provision is designed to allow existing Town Boards, Commissions and/or Departments who have current jurisdiction over project approval activities to continue their current review procedures, but to add a provision that would authorize these entities to review and approve development/redevelopment projects designed in accordance with this Regulation.)

5.0 SCOPE AND APPLICABILITY

These LID Regulations apply to all activities in accordance with the applicability section of the Town of *[_____]* LID Bylaw.

6.0 PERMIT PROCEDURES AND REQUIREMENTS

- A) Projects requiring a LID permit shall be required to submit the materials as specified in this section, and are required to meet the LID criteria as specified in Section 7. Applicants filing a LID permit application under the currently regulated jurisdiction of the Town of *[_____]* *[insert*

applicable town board, commission and department] need only to comply with Subsections 6.0 L, and 6.0 M of these Regulations. Any references to the Massachusetts Department of Environmental Protection (“MA DEP”) Stormwater policies or Stormwater Management Manual do not signify or imply endorsement of these Regulations by MA DEP.

B) Permit Required

- 1 No land owner or land operator shall receive any of the building, grading or other land development permits required for land disturbance activities without first meeting the requirements of these Regulations prior to commencing the proposed activity.
- 2 Should a land-disturbing activity associated with an approved plan in accordance with this section not begin during the *[180-day]* period following permit issuance, the *[LID Authority]* may evaluate the existing LID Management plan to determine whether the plan still satisfies local program requirements and to verify that all design factors are still valid. If the authority finds the previously filed plan to be inadequate, a modified plan shall be submitted and approved prior to the commencement of land-disturbing activities.

C) Filing Application

The applicant shall file with the *[LID Authority]*, *[three (3)]* copies of a completed application package for a LID Permit. Permit issuance is required prior to any site altering activity. While the applicant can be a representative, the permittee must be the owner of the site or holder of an easement. The LID Application package shall include:

1. A completed *[Application Form]* with original signatures of all owners;
2. A list of abutters, certified by the Assessors Office; (abutters at their mailing addresses shown on the most recent applicable tax list of the assessors, including owners of land directly opposite on any public or private street or way, and abutters to the abutters within 300 feet of the property line of the applicant, including any in another municipality or across a body of water);
3. LID Management Plan and project description;
4. Operation and Maintenance Plan;
5. Payment of the application and review fees;
6. Inspection and Maintenance agreement;
7. Erosion and Sediment Control Plan;
8. Surety bond.

(The LID Authority can designate the content of the Erosion & Sediment Control Plan or reference another document such as the “Massachusetts Erosion & Sediment Control Guidelines for Urban & Suburban Areas (FHHCD, 1997)).

D) Entry

Filing an application for a permit grants the *[LID Authority]*, or its agent, permission to enter the site to verify the information in the application and to inspect for compliance with the resulting permit.

E) Fees

The *[LID Authority]* shall obtain with each submission an Application Fee established by the *[LID Authority]* to cover expenses connected with the review of the LID Permit and a technical review fee sufficient to cover professional review services for the project. The *[LID Authority]* is authorized to retain a Registered Professional Engineer or other professional consultant to advise the *[LID Authority]* on any or all aspects of these plans. Applicants must pay review fees before the review process may begin.

1. Rules:

- a) Application fees are payable at the time of application and are non-refundable.
- b) Application fees shall be calculated by the [LID Authority] in accordance with the fee schedule below.
- c) These fees are in addition to any other local or state fees that may be charged under any other law, Bylaw, or local ordinance.
- d) The fee schedule may be reduced or increased by the [LID Authority]. Any such change shall be made at a posted public hearing of the [LID Authority] not less than [30] days prior to the date upon which the change is to be effective.

2. Application Fees.

A non-refundable application fee of the larger of [\$30.00] or \$0.0030 per square foot of the parcel to which the permit will be issued shall be due and payable to the Town of [] at the time an application is filed.

(Or, the [LID Authority] may adopt reasonable administrative fees and technical review fees for site plan review.)

3. Engineering and Consultant Reviews and Fees:

- a) The [LID Authority] is authorized to require an applicant to pay a fee for the reasonable costs and expenses for specific expert engineering and other consultant services deemed necessary by the [LID Authority] to come to a final decision on the application. This fee is called the “Engineering and Consultant Review Fee.”
- b) Payment may be required at any point in the deliberations prior to a final decision.
- c) Any application filed with the [LID Authority] must be accompanied by a completed [Engineering Consultant Fee Acknowledgement] form.
- d) Consultant fees shall be determined at the time of project review based on a specific scope of work, and shall be calculated at a rate of [as the LID Authority may determine].
- e) The services for which a fee may be utilized include, but are not limited to, wetland survey and delineation, hydrologic and drainage analysis, wildlife evaluation, stormwater quality analysis, site inspections, as-built plan review, and analysis of legal issues.
- f) The [LID Authority] is authorized to require an applicant to pay reasonable costs and expenses for certain activities which utilize the services of Town Staff. This includes such activities as inquiries concerning potential projects as well as site inspections not associated with a pending permit application.
- g) The [LID Authority] may require any applicant to pay an additional fee of [\$30.00] per hour for review, inspection and monitoring services for any project filing that requires an excess of two (2) hours of review, inspection, and monitoring time by a Town Staff member.
- h) Subject to applicable law, any unused portion of any fees collected shall be returned by the [LID Authority] to the applicant within forty-five calendar days of a written request by the applicant, unless the [LID Authority] decides in a public meeting that other action is necessary.
- i) The Engineering and Consultant Review fees collected under this section shall be deposited in a revolving account. The [LID Authority] shall include a full accounting of the revolving account as part of its annual report to the Town.

4. Revision Of Fee Schedules And Bylaws Governing Fees.

The *[LID Authority]* may review and revise its Bylaws, Regulations, and fee schedules periodically as it sees fit, yet must adhere to the following procedures:

- a) Amendments shall be preceded by a public hearing.
- b) A copy of the written decision will be filed with the town clerk within *[10]* days after final action is taken.

F) Public Hearings

The *[LID Authority]* need not hold a public hearing for projects or activities outside the currently regulated jurisdiction of *[insert existing town boards, commissions and/or departments]*. For projects or activities within the currently regulated jurisdiction of *[insert existing town boards, commissions and/or departments]*, the applicable town board, commission and/or department shall hold a public hearing in accordance with their own Bylaws and procedures.

G) Actions

The *[LID Authority]*'s action, rendered in writing, shall consist of either:

- 1 Approval of the LID Permit Application based upon determination that the proposed plan meets the Standards in Section 7 and will adequately protect the water resources of the community and is in compliance with the requirements set forth in these Regulations;
- 2 Approval of the LID Permit Application subject to any conditions, modifications or restrictions required by the *[LID Authority]* which will ensure that the project meets the Standards in Section 7 and adequately protects water resources, set forth in these Regulations;
- 3 Disapproval of the LID Permit Application based upon a determination that the proposed plan, as submitted, does not meet the Standards in Section 7 or adequately protects water resources, as set forth in these Regulations; or
- 4 Disapproval of an application "without prejudice" where an applicant fails to provide requested additional information that in the *[LID Authority's]* opinion is needed to adequately describe the proposed project. Information shall generally be limited to those items listed in Section 6.0 L) of these Regulations.

H) Failure of the *[LID Authority]* to take final action upon an Application within *[30 calendar days]* of receipt of a complete application shall be deemed to be approval of said Application. Upon certification by the Town Clerk that the allowed time has passed without *[LID Authority]* action, the *[LID Authority]* must issue a LID Permit.

I) Plan Changes

The permittee, must notify the *[LID Authority]* in writing of any drainage change or alteration in the system authorized in a LID Permit before any change or alteration is made. If the *[LID Authority]* determines that the change or alteration is significant, based on the LID Standards in Section 7 and accepted construction practices, the *[LID Authority]* may require that an amended or new application be filed.

J) Appeals of Actions of the *[LID Authority]*

A decision of the *[LID Authority]* shall be final. Further relief of a decision by the *[LID*

Authority] made under these Bylaws shall be reviewable in the Superior Court in an action filed within *[60 days]* thereof, in accordance with M.G.L. Ch 249. § 4. An appeal of an action by a board, commission or department that has current regulatory authority for a project and/or activity shall be conducted under the applicable appeal provisions of said board, commission and/or department of the Town of *[]*. Such an appeal shall result in revocation of the written approval as described under Section 4 of the LID Bylaw, until such time as the appeal process of the applicable board, commission and/or department has been resolved.

K) Project Completion

At completion of the project the permittee shall submit as-built record drawings of all structural stormwater controls and treatment best management practices required for the site as required in Section 7. The as-built drawing shall show deviations from the approved plans, if any, and be certified by a Registered Professional Engineer.

L) LID Management Plan Contents

1. The application for a LID Permit shall include the submittal of a LID Management Plan to the *[LID Authority]*. This LID Management Plan shall contain sufficient information for the *[LID Authority]* to evaluate the environmental impact, effectiveness, and acceptability of the site planning process and the measures proposed by the applicant for reducing adverse impacts from stormwater runoff. This plan shall be in accordance with the criteria established in these Bylaws and must be submitted with the stamp and signature of a Professional Engineer (PE) licensed in the Commonwealth of Massachusetts.
2. The LID Management Plan shall fully describe the project in drawings, narrative, and calculations. It shall include:
 - a) Contact Information. The name, address, and telephone number of all persons having a legal interest in the property and the tax reference number and parcel number of the property or properties affected;
 - b) A locus map;
 - c) Existing site plan;
 - d) The existing zoning, and land use at the site;
 - e) The proposed land use;
 - f) The location(s) of existing and proposed easements;
 - g) The location of existing and proposed utilities;
 - h) The site's existing & proposed topography with contours at 2-foot intervals;
 - i) The existing site hydrology (both groundwater recharge and surface runoff);
 - j) A description and delineation of existing stormwater conveyances, impoundments, wetlands, drinking water resource areas, shellfishing areas, swimming beaches or other critical environmental resource areas, on or adjacent to the site or into which stormwater flows;
 - k) A delineation of 100-year flood plains, if applicable;
 - l) Estimated seasonal high groundwater elevation in areas to be used for stormwater retention, detention, or infiltration;
 - m) The existing and proposed vegetation and ground surfaces with runoff coefficients for each;
 - n) A drainage area map showing pre and post construction watershed boundaries, drainage area and stormwater flow paths, including municipal drainage system flows; o) A recharge area analysis that calculates pre-and post-project annual groundwater recharge rates on the parcel; p) A description and drawings of all components of the proposed LID Management system including:
 - i) Locations, cross sections, and profiles of all brooks, streams, drainage swales and their method of stabilization;
 - ii. All measures for the detention, retention or infiltration of water;

- iii. Description of non-structural BMPs;
 - iv. All measures for the protection of water quality;
 - v. The structural details for all components of the proposed drainage systems and LID Management facilities;
 - vi. Notes on drawings specifying materials to be used, construction specifications, and expected hydrology with supporting calculations;
 - vii. Proposed site plan including location of buildings or other structures, impervious surfaces, and drainage facilities, if applicable;
 - viii. Any other information requested by the *[LID Authority]*.
- q) Hydrologic and hydraulic design calculations for the pre-development and post-development conditions for the design storms specified in this Bylaw. Such calculations shall include:
- i. Description of the design storm frequency, intensity and duration;
 - ii. Time of concentration;
 - iii. Soil Runoff Curve Number (RCN) based on land use and soil hydrologic group;
 - iv. Peak runoff rates and total runoff volumes for each watershed area;
 - v. Information on construction measures used to maintain the infiltration capacity of the soil where any kind of infiltration is proposed;
 - vi. Infiltration rates, where applicable;
 - vii. Culvert capacities;
 - viii. Flow velocities;
 - ix. Data on the increase in rate and volume of runoff for the specified design storms, and
 - x. Documentation of sources for all computation methods and field test results.
- r) Post-Development downstream analysis if deemed necessary by the *[LID Authority]*; *(The LID Authority may request that the applicant evaluate the hydrologic impacts immediately downstream of the project (to a location where the watershed to project size is approximately equal to 10:1))*
- s) Soils Information from test pits performed at the location of proposed LID Management facilities, including but not limited to soil descriptions, depth to seasonal high groundwater, depth to bedrock, and percolation rates. Soils information will be based on site test pits logged by a Massachusetts Registered Soil Evaluator, or a Massachusetts Registered Professional Engineer;
- t) Landscaping plan describing the woody and herbaceous vegetative stabilization and management techniques to be used within and adjacent to the stormwater practice.

M) Operation and Maintenance Plan Contents

An Operation and Maintenance plan (O&M Plan) is required at the time of application for all projects. The maintenance plan shall be designed to ensure compliance with the Permit, these Regulations, and that the Massachusetts Surface Water Quality Standards, 314, CMR 4.00 are met in all seasons and throughout the life of the system. The Operation and Maintenance Plan shall remain on file with the *[LID Authority]* and shall be an ongoing requirement. The O&M Plan shall include:

1. The name(s) of the owner(s) for all components of the system;
2. A map showing the location of the systems and facilities including catch basins, manholes/ access lids, main, and stormwater devices;
3. Maintenance agreements that specify:
 - a) The names and addresses of the person(s) responsible for operation and maintenance;
 - b) The person(s) responsible for financing maintenance and emergency repairs;
 - c) An Inspection and Maintenance Schedule for all LID Management facilities including routine and non-routine maintenance tasks to be performed;
 - d) A list of easements with the purpose and location of each;
 - e) The signature(s) of the owner(s).

4. LID Management Easement(s):
 - a) LID Management easements shall be provided by the property owner(s) as necessary for
 - i. Access for facility inspections and maintenance;
 - ii. Preservation of stormwater runoff conveyance, infiltration, and detention areas and facilities, including flood routes for the 100-year storm event;
 - iii. Direct maintenance access by heavy equipment to structures requiring regular maintenance.
 - b) The purpose of each easement shall be specified in the maintenance agreement signed by the property owner.
 - c) Stormwater Management easements are required for all areas used for off-site stormwater control, unless a waiver is granted by the [LID Authority].
 - d) Easements shall be recorded with the _____ County Registry of Deeds prior to issuance of a Certificate of Completion by the [LID Authority].
5. Changes to Operation and Maintenance Plans:
 - a) The owner(s) of the LID Management system must notify the [LID Authority] of changes in ownership or assignment of financial responsibility.
 - b) The maintenance schedule in the Maintenance Agreement may be amended to achieve the purposes of this Bylaw by mutual agreement of the [LID Authority] and the Responsible Parties. Amendments must be in writing and signed by all Responsible Parties. Responsible Parties shall include owner(s), persons with financial responsibility, and persons with operational responsibility.

7.0 PERFORMANCE STANDARDS: LID CRITERIA

- A) At a minimum all projects shall comply with the performance standards of the most recent version of Massachusetts Department of Environmental Protection (DEP) _____ Policy, as well as the following:

- B) General Criteria:

The following general performance criteria shall be applicable to all LID plans, unless otherwise provided for in this Bylaw:

1. Site Planning Process:

The site planning process shall be documented and shall include the following steps: 1) identify and map critical environmental resources, 2) delineate potential building envelopes avoiding environmental resource areas and appropriate buffers, 3) develop methods to minimize impervious surfaces, and to protect and preserve open space.

2. No Untreated Discharges:

All stormwater runoff generated from land development and land use conversion activities shall not discharge untreated stormwater runoff directly to a wetland, local water body, municipal drainage system, or abutting property, without adequate treatment.

3. Channel Protection:

Protection of channels from bank and bed erosion and degradation shall be provided by *[attenuating the 24-hour extended detention storage of runoff of the post-development 1-year, 24hour return frequency storm event] (Default option – optimal.) OR [controlling the peak discharge rate from the 2-yr storm event to the pre-development rate as required by the MA DEP LID Management Policy] (Alternative option – minimum.)*

4. Overbank Flooding Protection:

Downstream overbank flood and property protection shall be provided by [attenuating the post-development peak discharge rate to the pre-development rate for the 10-year, 24-hour return frequency storm event as required by the MA DEP LID Management Policy]. (default option - optimal)

5. Extreme Flooding Protection:

Extreme flooding and public safety protection shall be provided by [attenuating the peak discharge rate from the 100-yr, 24-hour return frequency storm event to the pre-development rates] (Default option – optimal.) OR [controlling and safely conveying the 100-year, 24 hour return frequency storm event such that flooding is not exacerbated] (Alternative option – minimum.) OR [evaluating the 100-year, 24-hour return frequency storm event to demonstrate no increased flooding impacts off-site, as required by the MA DEP LID Management Policy] (Another alternative option – minimum.)

6. Recharge:

- a) Annual groundwater recharge rates shall be maintained, by promoting infiltration and recharge through the use of structural and non-structural methods. At a minimum, annual recharge from the post development site shall equal the annual recharge from pre-development site conditions.
- b) The stormwater runoff volume to be recharged to groundwater should be determined using the methods prescribed in the latest version of [the Massachusetts DEP Stormwater Management Manual or an equivalent qualifying local manual]. The recharge requirements shall apply to all activities within the jurisdiction of this Bylaw except as noted, and unless specifically waived by [LID Authority]. The recharge criterion is not required for any portion of a site designated as a stormwater hotspot (see Section 7.10 of this Bylaw). In addition, the [LID Authority] 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.

7. Structural Practices for Water Quality:

Presumed Compliance with Massachusetts Water Quality Standards (default option - minimum)

All structural Stormwater Management facilities shall be selected and designed using the appropriate criteria from the most recent version of the Massachusetts DEP Stormwater Management Manual.

For other structural stormwater controls not included in the Massachusetts Stormwater Management Manual, or for which pollutant removal rates have not been provided, the effectiveness and pollutant removal of the structural control must be documented through prior studies, literature reviews, or other means and receive approval from the [LID Authority] before being included in the design of a Stormwater Management system.

Structural best management practices (BMPs) must be designed to remove [80%] of the average annual post development total suspended solids (TSS) and [40%] for total phosphorus [TP], and [30%] for total nitrogen (TN). It is presumed that a BMP complies with this performance goal if it is:

- a) Sized to capture the prescribed water quality volume;
- b) Designed according to the specific performance criteria outlined in the *[Massachusetts Stormwater Management Manual or an approved local equivalent]*;
- c) Constructed properly; and
- d) Maintained regularly.

8. Water Quality Volume:

The prescribed water quality volume required in the sizing of a structural stormwater practice shall be

[calculated as $1.2 \times \text{total watershed area} \times \text{runoff coefficient (Rv)}$, where $Rv = 0.05 + 0.009(I\%)$ and $I\% = \text{percent of impervious area}$] (default option – optimal) OR

[0.50 inches \times the total impervious area of the drainage area and 1.0 inches \times the total impervious area of the drainage area in critical areas, as specified in the Massachusetts DEP Stormwater Policy.] (alternative option – minimum)

9. Hydrologic Basis for Design of Structural Practices:

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

- a) 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.
- b) Off-site areas shall be assessed based on their “pre-developed condition” for computing the water quality volume (i.e., treatment of only on-site areas is required). However, if an offsite area drains to a proposed BMP, flow from that area must be accounted for in the sizing of a specific practice.
- c) Off-site areas draining to a proposed facility should be modeled as “present condition” for peak-flow attenuation requirements.
- d) The length of sheet flow used in time of concentration calculations is limited to no more than 50 feet for predevelopment conditions and 50 feet for post development conditions.
- e) Detention time for the one-year storm is defined as the center of mass of the inflow hydrograph and the center of mass of the outflow hydrograph.
- f) The models TR-55 and TR-20 (or approved equivalent) will be used for determining peak discharge rates.
- g) The standard for characterizing pre-development land use for on-site areas shall be woods.
- h) For purposes of computing runoff, all pervious lands in the site shall be assumed prior to development to be in “good hydrologic condition” regardless of conditions existing at the time of computation.
- i) If an off-site area drains to a facility, off-site areas should be modeled, assuming an “ultimate buildout condition” upstream for assessment of 100-year flows for sizing of spillways.
- j) Flooding and channel erosion impacts to receiving streams due to land development projects shall be determined at each point of discharge from the development project and such determination shall include any runoff from the balance of the watershed which also contributes to that point of discharge.
- k) The specified design storms shall be defined as a 24-hour storm using the rainfall distribution recommended by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) or the Northeast Regional Climate Center “Atlas of Precipitation Extremes for the Northeastern United State and Southeastern Canada.”

- l) Proposed residential, commercial, or industrial subdivisions shall apply these Stormwater Management criteria to the land development as a whole. Individual lots in new subdivisions shall not be considered separate land development projects, but rather the entire subdivision shall be considered a single land development project. Hydrologic parameters shall reflect the ultimate land development and shall be used in all engineering calculations.

10. Sensitive Areas:

Stormwater discharges to critical areas with sensitive resources (i.e., shellfish beds, swimming beaches, aquifer recharge areas, water supply reservoirs) may be subject to additional criteria, or may need to utilize or restrict certain LID Management practices at the discretion of the *[LID Authority]*. The *[LID Authority]* may designate sensitive areas and specific criteria for these areas after conducting a public hearing in accordance with the provisions of Section 4.0 of the Town of *[_____]* LID Bylaw.

11. Hotspots:

Stormwater discharges from land uses or activities with higher potential pollutant loadings, known as “hotspots,” as defined in the most recent version of the *[MA DEP Stormwater Management Manual or an equivalent qualifying local manual]* –require the use of specific Stormwater Management BMPs as specified in the most recent version of the *[MA DEP Stormwater Management Manual or an equivalent qualifying local manual]*. The use of infiltration practices without pretreatment is prohibited.

12. Low-Impact Development (LID) Credits:

The use of Better Site Design and nonstructural LID Management measures is encouraged to minimize reliance on structural management measures. The use of one or more site design measures by the applicant may allow for a reduction in the water quality treatment volume required and the stream channel protection volume required. The applicant may, if approved by the *[LID Authority]*, take credit for the use of stormwater better site design practices to reduce some of the requirements specified in the criteria section of these Regulations. The site design practices that qualify for these credits and procedures for applying and calculating the credits are identified in Appendix A of these Regulations.

8.0 ENFORCEMENT

- A) The *[LID Authority]* or an authorized agent of the *[LID Authority]* shall enforce these Regulations, Bylaws, orders, violation notices, and enforcement orders, and may pursue all civil, criminal and non-criminal remedies for such violations.

B) Notices and Orders:

1. The *[LID Authority]* or an authorized agent of the *[LID Authority]* may issue a written notice of violation or enforcement order to enforce the provisions of these Regulations, which may include requirements to:
 - a) Cease and desist from construction or land disturbing activity until there is compliance with the Bylaw and the LID Permit;
 - b) Repair, maintain; or replace the Stormwater Management system or portions thereof in accordance with the operation and maintenance plan;
 - c) Perform monitoring, analyses, and reporting; and/or
 - d) Fix adverse impact resulting directly or indirectly from malfunction of the Stormwater Management system.

2. If the enforcing person determines that abatement or remediation of adverse impacts is required, the order may set forth a deadline by which such abatement or remediation must be completed. Said order may further advise that, should the violator or property owner fail to abate or perform remediation within the specified deadline, the Town of [_____] may, at its option, undertake such work, and the property owner shall reimburse the Town of [_____] for expenses incurred.
 3. Within thirty (30) days after completing all measures necessary to abate the violation or to perform remediation, the violator and the property owner shall be notified of the costs incurred by the Town of [_____] including administrative costs. The violator or property owner may file a written protest objecting to the amount or basis of costs with the [LID Authority] within thirty (30) days of receipt of the notification of the costs incurred. If the amount due is not received by the expiration of the time in which to file a protest or within thirty (30) days following a decision of the [LID Authority] affirming or reducing the costs, or from a final decision of a court of competent jurisdiction, the costs shall become a special assessment against the property owner and shall constitute a lien on the owner's property for the amount of said costs. Interest shall begin to accrue on any unpaid costs at the statutory rate provided in G.L. Ch. 59, § 57, after the thirty-first day at which the costs first become due.
- C) Any person who violates any provision of the Town of [_____] LID Bylaw, Regulations, order or permit issued thereunder, may be ordered to correct the violation and/or shall be punished by a fine of not more than [\$/_____]. Each day or part thereof that such violation occurs or continues shall constitute a separate offense.
- D) Non-Criminal Disposition. As an alternative to criminal prosecution or civil action, the Town of [_____] may elect to utilize the non-criminal disposition procedure set forth in G.L. Ch. 40, §21D and [the citation town enabling vote/bylaw (if applicable)] of the Town of [_____] in which case [title or other authorized agent] of the Town of [_____] shall be the enforcing person. The penalty for the 1st violation shall be [\$/_____]. The penalty for the 2nd violation shall be [\$/_____]. The penalty for the 3rd and subsequent violations shall be [\$/_____]. Each day or part thereof that such violation occurs or continues shall constitute a separate offense.
- E) Appeals. The decisions or orders of the [LID Authority] shall be final. Further relief shall be to a court of competent jurisdiction.
- F) Remedies Not Exclusive. The remedies listed in these Regulations are not exclusive of any other remedies available under any applicable federal, state or local law.

9.0 SURETY

The [LID Authority] may require the permittee to post before the start of land disturbance or construction activity, a surety bond, irrevocable letter of credit, cash, or other acceptable security. The form of the bond shall be approved by town counsel, and be in an amount deemed sufficient by the [LID Authority] to ensure that the work will be completed in accordance with the permit. If the project is phased, the [LID Authority] may release part of the bond as each phase is completed in compliance with the permit but the bond may not be fully released until the [LID Authority] has received the final inspection report as required by Section 10 of these Regulations and issued a Certificate of Completion.

10.0 CONSTRUCTION INSPECTIONS

- A) Notice of Construction Commencement. The applicant must notify the *[LID Authority]* in advance before the commencement of construction. In addition, the applicant must notify the *[LID Authority]* in advance of construction of critical components of stormwater management facility.
- B) At the discretion of the *[LID Authority]*, periodic inspections of construction and stormwater management facilities shall be conducted by the Town Officer or a professional engineer or their designee who has been approved by the *[LID Authority]*. All inspections shall be documented and written reports prepared that contain the following information:
1. The date and location of the inspection;
 2. Whether construction is in compliance with the approved stormwater management plan;
 3. Variations from the approved construction specifications; and
 4. Any other variations or violations of the conditions of the approved stormwater management plan.
- C) The *[LID Authority]* or its designee shall inspect the project site at the following stages, at a minimum.
1. Initial Site Inspection: prior to approval of any plan;
 2. Erosion Control Inspection: to ensure erosion control practices are in accord with the filed plan;
 3. Stormwater Management System Inspection: An inspection will be made of the completed stormwater management system, prior to backfilling of any underground drainage or stormwater conveyance structures.
 4. Final Inspection:
 - a) After the project, including the stormwater management facilities, have been constructed and before the surety has been released, all applicants are required to submit actual “as built” plans for after final construction is completed and must be certified by a Professional Engineer.
 - b) The *[LID Authority]* shall inspect the site to determine its conformity to “as-built” features. This inspector shall also evaluate the effectiveness of the stormwater management system in an actual storm. If the inspector finds the system to be adequate he/she shall so report to the *[LID Authority]*, which will issue a Certificate of Completion. As built plans shall be full size plans which reflect the “as built” conditions, including all final grades, developed by a Professional Engineer. All changes to project design should be recorded in red ink on plans to define changes made. All work deleted, corrections in elevations, and changes in materials, should be shown on the as built drawings.
- D) Inadequacy of Stormwater Management Facilities
1. If the stormwater management facilities are found to be inadequate by virtue of physical evidence of operational failure, even though it was built as called for in the LID Management Plan, it shall be corrected by the applicant before the Certificate of Completion is released. If the applicant fails to act the *[LID Authority]* may use the surety bond to complete the work.
 2. If the *[LID Authority]* determines that there is a failure to comply with the plan, the property owner shall be notified in writing of the nature of the violation and the required corrective actions. A Stop Work Order shall be issued until any violations are corrected and all work previously completed has received approval by the *[LID Authority]*.

11.0 CERTIFICATE OF COMPLETION

- A) Upon completion, the applicant is responsible for certifying that the completed project is in accordance with the approved plans and specifications and shall provide regular inspections sufficient to adequately document compliance.
- B) The *[LID Authority]* will issue a letter certifying completion upon receipt and approval of the final inspection and reports and/or upon otherwise determining that all work of the permit has been satisfactorily completed in conformance with these Regulations.

12.0 PERPETUAL INSPECTION AND MAINTENANCE

A) Maintenance Responsibility

- 1. Stormwater management facilities and practices included in a LID management plan with an inspection and maintenance agreement, in accordance with Section 6.M of these Regulations, must undergo ongoing inspections to document maintenance and repair needs and ensure compliance with the requirements of the agreement, the plan and these Regulations.
- 2. The owner of the property on which work has been done pursuant to these Regulations for private stormwater management facilities, or any other person or agent in control of such property, shall maintain in good condition and promptly repair and restore all grade surfaces, walls, drains, dams and structures, vegetation, erosion and sedimentation controls, and other protective devices. Such repairs or restoration and maintenance shall be in accordance with approved plans.

B) Maintenance Inspections

- 1. All stormwater management facilities must undergo inspections to document maintenance and repair needs and ensure compliance with the requirements of these Regulations and accomplishment of its purposes as specified in the Operation and Maintenance Plan and Maintenance Agreement described under Section 6.M of these Regulations.
- 2. At a minimum, inspections shall occur during the first year of operation and at least once every [three] years thereafter. In addition, a maintenance agreement as specified under Section 6.M of these Regulations between the owner and the *[LID Authority]* shall be executed for privately-owned stormwater management systems that specifies the Responsible Party for conducting long term inspections.
- 3. Inspection reports shall be submitted to and maintained by the *[LID Authority]* for all stormwater management systems. Inspection reports for stormwater management systems shall include:
 - a) The date of inspection;
 - b) Name of inspector;
 - c) The condition of:
 - i. Pretreatment devices
 - ii. Vegetation or filter media
 - iii. Fences or other safety devices
 - iv. Spillways, valves, or other control structures
 - v. Embankments, slopes, and safety benches
 - vi. Reservoir or treatment areas
 - vii. Inlet and outlet channels and structures
 - viii. Underground drainage
 - ix. Sediment and debris accumulation in storage and forebay areas (including catch basins)
 - x. Any nonstructural practices

- xi. Any other item that could affect the proper function of the stormwater management system
- d) Description of the need for maintenance.

C) Right-of-Entry for Inspection

The terms of the inspection and maintenance agreement as specified in Section 6.M of these Regulations shall provide for the [LID Authority] or its designee to enter the property at reasonable times and in a reasonable manner for the purpose of inspection. The [LID Authority], its agents, officers, and employees shall have authority to enter upon privately owned land for the purpose of performing their duties under this Bylaw and may make or cause to be made such examinations, surveys, or sampling as the [LID Authority] deems necessary, subject to the constitutions and laws of the United States and the Commonwealth.

D) Records of Maintenance and Repair Activities

Parties responsible for the operation and maintenance of a stormwater management facility shall provide records of all maintenance and repairs to the [LID Authority], upon request. Parties responsible for the operation and maintenance of a stormwater management facility shall make records of the installation and of all maintenance and repairs, and shall retain the records for at least [5] years. These records shall be made available to the [LID Authority] during inspection of the facility and at other reasonable times upon request.

E) Failure to Maintain

1. If a responsible person fails or refuses to meet the requirements of the inspection and maintenance agreement, the [LID Authority], after [thirty (30)] days written notice (except, that in the event the violation constitutes an immediate danger to public health or public safety, 24 hours notice shall be sufficient), may correct a violation of the design standards or maintenance requirements by performing the necessary work to place the facility or practice in proper working condition. The [LID Authority] may assess the owner(s) of the facility for the cost of repair work which shall be a lien on the property.

(Note: Each Town should investigate whether the [LID Authority] would be authorized to impose a lien on property through its bylaws and/or has the ability to automatically establish a lien. The authority to establish a lien is sometimes by specific statute.)

2. After notification is provided to the person responsible for carrying out the maintenance plan of any deficiencies discovered from an inspection of a stormwater management system, the person responsible for carrying out the maintenance plan shall have 30 days or other time frame mutually agreed to between the [LID Authority] and the person responsible for carrying out the maintenance plan to correct the deficiencies. The [LID Authority] shall then conduct a subsequent inspection to ensure completion of repairs.

MODEL LOW IMPACT DEVELOPMENT (LID) BYLAW APPENDICIES

APPENDIX A: EXAMPLE SYSTEM OF LIMITED-IMPACT DEVELOPMENT (LID) CREDITS AND INCENTIVES

Low-Impact Development encourages minimization of impervious surfaces, protection of critical environmental resource areas, and preservation of naturally-vegetated buffers. Any reductions in impervious cover result in reduced stormwater runoff and, consequently, smaller land consumption areas and lower construction costs. In an effort to apply a more holistic approach to stormwater management, five specific non-structural practices called *LID credits*, or incentives for better environmental site design, are provided for designers that will significantly reduce the size and cost of structural practices.

Non-structural practices are increasingly recognized as a critical feature of effective stormwater management, particularly with respect to site design. In most cases, non-structural practices will need to be combined with structural practices to meet stormwater requirements. The key benefit of non-structural practices is that they can reduce the generation of stormwater from the site. In addition, they can provide partial removal of many pollutants and contribute to groundwater recharge. The five proposed non-structural LID credits are:

1. Environmentally Sensitive Development Credit
2. Disconnection of Rooftop Runoff Credit
3. Disconnection of Non-Rooftop Runoff Credit
4. Stream Buffers Credit
5. Grass Channels

This section describes each of the credits for the five groups of non-structural practices and specifies minimum criteria to be eligible for the credit.

(Towns may need to update or revise some of the local subdivision regulations and/or zoning bylaws to ensure that the credit will be applicable to their jurisdiction. In addition, the Massachusetts Department of Environmental Protection (DEP) may need to validate the volume reductions in order to ensure compliance with the Massachusetts Wetlands Protection Act and Regulations.)

The application of these credits does not relieve the design engineer or reviewer from the standard of engineering practice associated with safe conveyance of stormwater runoff and good drainage design.

Several of the stormwater credits apply towards meeting the Massachusetts Stormwater Policy's recharge requirement. The Massachusetts Stormwater Policy currently only recognizes a volume based approach to meeting this criterion. Recently however, it has been demonstrated that disconnecting impervious area to drain over pervious areas can result in significant recharge to groundwater. Therefore, some jurisdictions (most notably the States of Vermont and Maryland) have developed recharge criterion that credit recharge based on an "area method," as opposed to strictly a volume method. To better understand this approach both the "volume method" and "area method" are described as follows.

The intent of the recharge criteria (which is often denoted as Re) is to maintain pre-developed groundwater recharge rates at development sites to preserve existing water table elevations, thereby helping to support baseflow to streams and wetlands, as well as to help augment drinking water supplies.

The objective of the criteria is to mimic the average annual recharge rate for the prevailing hydrologic soil group(s) (HSG) present at a development site. Therefore, the recharge volume can be determined as a function of annual predevelopment recharge for a given soil group, average annual rainfall volume,

and amount of impervious cover at a site. Being a function of site impervious cover, the criterion provides an incentive to engineers and developers to reduce site imperviousness.

The recharge can be satisfied by one of two methods or a combination of both. The first is designated as the “Percent Volume Method,” and is based on infiltrating the recharge volume using one or more of the approved structural practices (such as infiltration trench, infiltration basins, or drywells). The second method is designated as the “Percent Area Method,” and is based on draining runoff from some or all of a site impervious area through one or more of the approved nonstructural practices.

Based on this approach, the Percent Volume Method is as follows:

$$Re_v = (F)(A)(I)/12$$

Where: Re = Recharge volume (acre-feet)

F = Recharge factor (in inches, see below)

A = Site area (in acres)

I = Site imperviousness (expressed as a decimal)

Hydrologic Soil Group Recharge Factor (F)

A 0.40 B 0.25 C 0.10 D waived

An example calculation of this method is provided below.

Example: A 50-acre site is to be developed as a residential subdivision near Burlington, MA. The impervious area for the development will be 20 acres (i.e., 40% imperviousness). Half of the impervious area overlays HSG “B” soils and half of the impervious area overlays HSG “C” soils. The recharge requirement would be calculated as follows:

Compute a weighted $F = [(0.25 \text{ in})(10 \text{ ac}) + (0.10 \text{ in})(10 \text{ ac})]/20 \text{ ac} = 0.175 \text{ inches}$

$$Re_v = (0.175 \text{ in}) (50 \text{ ac}) (0.4)/(12 \text{ in/ft}) = 0.29 \text{ ac-ft}$$

(The pervious area method is an option to the volume method to allow nonstructural practices to meet the volume-based recharge criteria.)

Under the Percent Area Approach, the recharge requirement can be met by draining a calculated recharge area through one or more of several nonstructural approaches (this is where stormwater credits are most applicable). The calculation is as follows:

$$Re_a = (F)(A)(I)$$

Where: Re = Recharge area requiring treatment (acres)

F = Recharge factor based on Hydrologic Soil Group (HSG) (same values as above, but dimensionless)

A = Site area in acres

I = Site imperviousness (expressed as a decimal)

The required recharge area (Re) is equivalent to the recharge volume and can be achieved by a non-structural practice (e.g., filtration of sheet flow from disconnected impervious surfaces). In addition, a combination of both of the methods can be used to meet the recharge requirement at a site.

If an applicant elects to utilize both the Percent Volume and Percent Area Methods to meet the recharge requirement, the following applies:

- 1 Calculate both the Re_v and Re_a for the site;
- 2 The site impervious area draining to an approved nonstructural practice is subtracted from the Re_v calculation from step 1, above;
- 3 Re_a The remaining Re_v is divided by the original Re_a to calculate a pro-rated percentage that needs to be met by the Percent Volume Method;
- 4 The pro-rated percent is multiplied by the original Re_v to calculate a new Re_v that must be met by an approved structural practice(s).

With this basic understanding of how the recharge requirement can be met on a project, it is now appropriate to review the suite of stormwater credits that can meet both recharge, water quality and, in a few cases, some of the water quantity controls as well.

Credit No. 1: Environmentally Sensitive Development Credit

This credit is given when a group of environmental site design techniques are applied to lower density or rural residential development. The credit eliminates the need for structural practices to treat both the Re_v and water quality and can reduce required volumes for peak control of the 2-year, 10-year and 100-year storms.

Minimum Criteria for Credit

The Re_v and water quality requirements are completely met without the use of structural practices in certain low density (less than 1 dwelling unit per acre) residential developments when the following conditions are met:

- The total impervious cover footprint is less than 15 % of lot area;
- A minimum of 25% of the site is protected in natural conservation areas;
- Rooftop runoff is disconnected in accordance with the criteria outlined under Credit 2;
- Grass channels are used to convey runoff versus curb and gutter for roads and/or driveways (with no specific constraints on water quality volume, velocity or minimum retention time); and
- Stream buffers are incorporated into the site design on both perennial and intermittent streams (where applicable).

The designer must still address applicable stormwater detention for all roadway and connected impervious surfaces (i.e, 2-year, 10-year, and 100-year control).

Environmentally Sensitive Rural Development Credit Example Application

Base Data Site Data: a single-family lot that is part of an 8-acre low density subdivision in a critical area
 Lot Area = 2.5 ac Conservation Area = 0.65 ac Impervious Area = .35 ac = 14% Site Soils Types: 100%
 “B” F = 0.25 Original water quality volume = 1.0” (.35) (43,560/12) = 1,270.5 ft³ Original Re_v = (2.5)
 (0.08) (.25) (43,560/12) = 182 ft³

Environmentally Sensitive Rural Credit (see Figure 1)

Required recharge is considered met by site design.

Required water quality volume is considered met by site design.

2-year, 10-year & 100-year control: No change in CN, t_c may be longer which would reduce storage requirements.

Percent Reductions Using Environmentally Sensitive Rural Credit:

- $R_e = 100\%$
 - v
- Water quality requirement = 100%

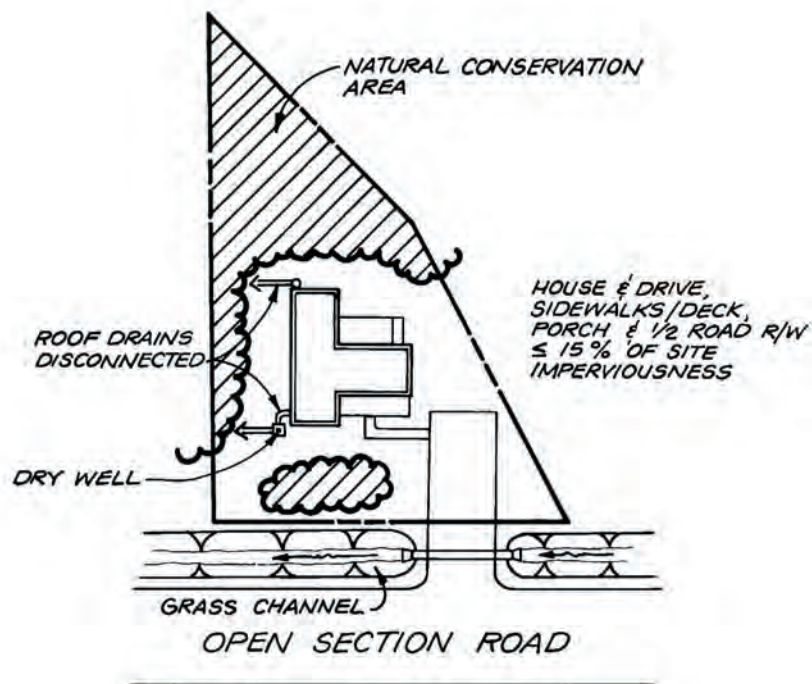


Figure 1. Schematic of Environmentally Sensitive Rural Development Credit

Credit No. 2: Disconnection of Rooftop Runoff Credit

A credit is given when rooftop runoff is “disconnected” and then directed over to a pervious area where it can either infiltrate into the soil or flow over it with sufficient time and velocity to allow for filtering. The credit is typically obtained by grading the site to promote overland flow through vegetated channels or by providing bioretention areas either on-lot or in common areas.

If a rooftop is adequately disconnected, the disconnected impervious area can be deducted from total impervious cover, therefore reducing water quality volume requirements. In addition, disconnected rooftops can be used to meet the recharge requirement as a non-structural practice under the Percent Area Method.

Restrictions on the Credit

The rooftop disconnection credit is subject to the following restrictions:

Disconnection must be designed to adequately address the issue of basement seepage;

- The contributing length of rooftop to a discharge location shall be 75 feet or less;
- The rooftop contributing area to any one discharge location cannot exceed 1,000 ft²;
- The length of the "disconnection" shall be equal to or greater than the contributing rooftop length;
- Disconnections will only be credited for residential lot sizes greater than 6,000 sq. ft;
- The entire vegetative "disconnection" shall be on a slope less than or equal to 5.0%;
- Where provided, downspouts must be at least 10 feet away from the nearest impervious surface to discourage re-connection to the drainage network;
- Where a gutter/downspout system is not used, the rooftop runoff must drain as either sheetflow from the structure or drain to a subsurface drain field that is not directly connected to the drainage network;
- Disconnections are encouraged on relatively permeable soils (HSGs A and B); therefore, no soil evaluation is required;
- In less permeable soils (HSGs C and D), the water table depth and permeability shall be evaluated by a responsible professional engineer to determine if a spreading device is needed to provide sheetflow over grass surfaces. In some cases, dry wells (see Figure 2), french drains or other temporary underground storage devices may be needed to compensate for a poor infiltration capability;
- For those rooftops draining directly to a stream buffer, one can only use either the rooftop disconnection credit or the stream buffer credit (Credit 3), not both; and
- To take credit for rooftop disconnection for a designated hotspot land use, the rooftop runoff must not co-mingle with runoff from any paved surfaces.

An example of this credit is provided below.

Bioretention systems (also referred to as “rain gardens” or “biofilters”) are so-called low impact development stormwater management systems that manage and treat stormwater runoff using a conditioned planting soil bed and planting materials to filter runoff stored within a shallow depression. The method combines physical filtering and adsorption with bio-geochemical processes to remove pollutants. The system consists of an inflow component, a pretreatment element, an overflow structure, a shallow ponding area (less than 9” deep), a surface organic layer of mulch, a planting soil bed, plant materials, and an underdrain system to convey treated runoff to a downstream facility.

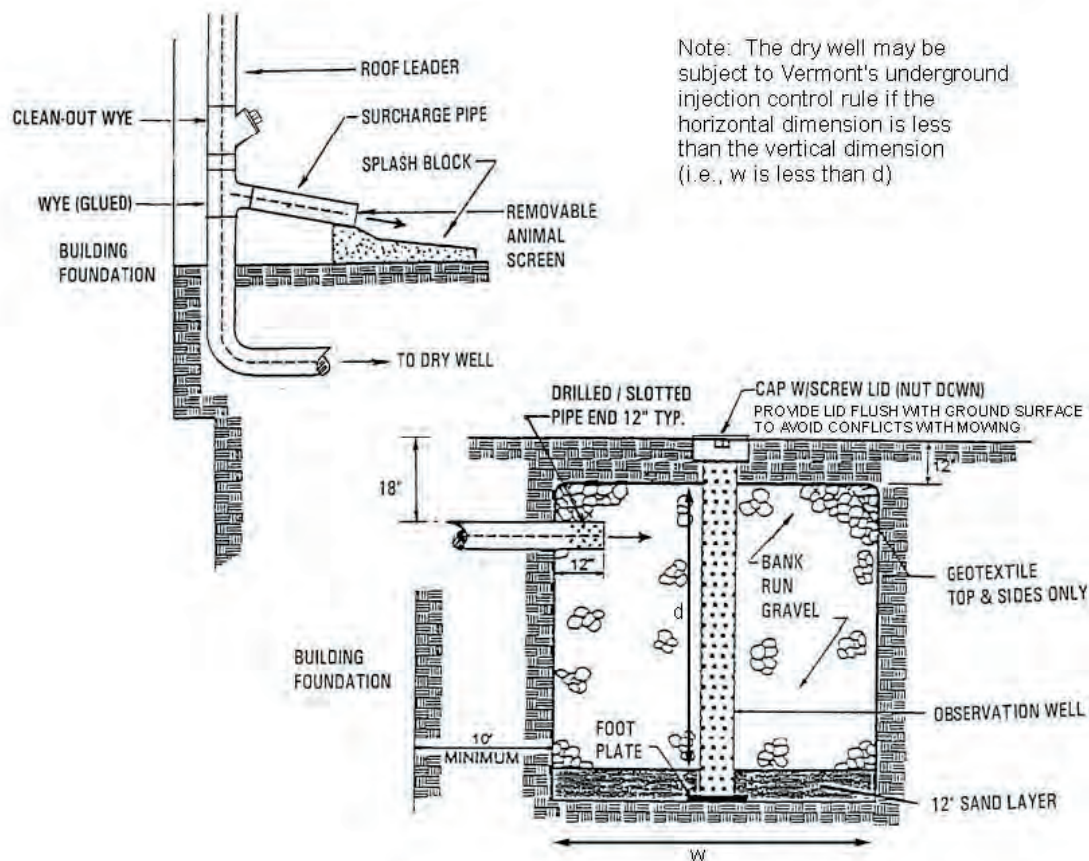


Figure 2. Schematic of Dry Well (Source: adapted after Howard County, MD)

Rooftop Disconnection Credit Example Application

Given the following base data:

Site Data: 108 Single-Family Residential Lots (~ ½-acre lots) Site Area = 45.1 ac Original Impervious Area = 12.0 ac; Site Soils Types: 78% "C", 22% "D" Composite Recharge Factor, $F = 0.08$ Original $Re_v = 0.08$ acre-feet; $Re_a = 0.96$ acres
 Original water quality requirement = $1.0''/\text{impervious acre} = 1.0''(12.0 \text{ ac})/12 = 1.0$ acre-foot (site is located in a critical area)

Rooftop Credit (see Figure 3) 42 houses disconnected Average house area = $2,500 \text{ ft}^2$ Net impervious area reduction = $(42)(2,500 \text{ ft}^2) / (43,560 \text{ ft}^2/\text{ac}) = 2.41$ acres New impervious area = $12.0 - 2.41 = 9.59$ acres;

Required recharge (Re_v) is 0.96 acres and 2.41 acres were disconnected thereby meeting 100% of the recharge requirement.^a

New water quality volume = $1.0'' (9.59)/12 = 0.80$ acre-feet; or a 0.20 acre-foot reduction

Percent Reductions Using Rooftop Disconnection Credit:

- $Re = 100\%$

v

- Water quality = $(1.0 - 0.8) / 1.0 = 20.0\%$

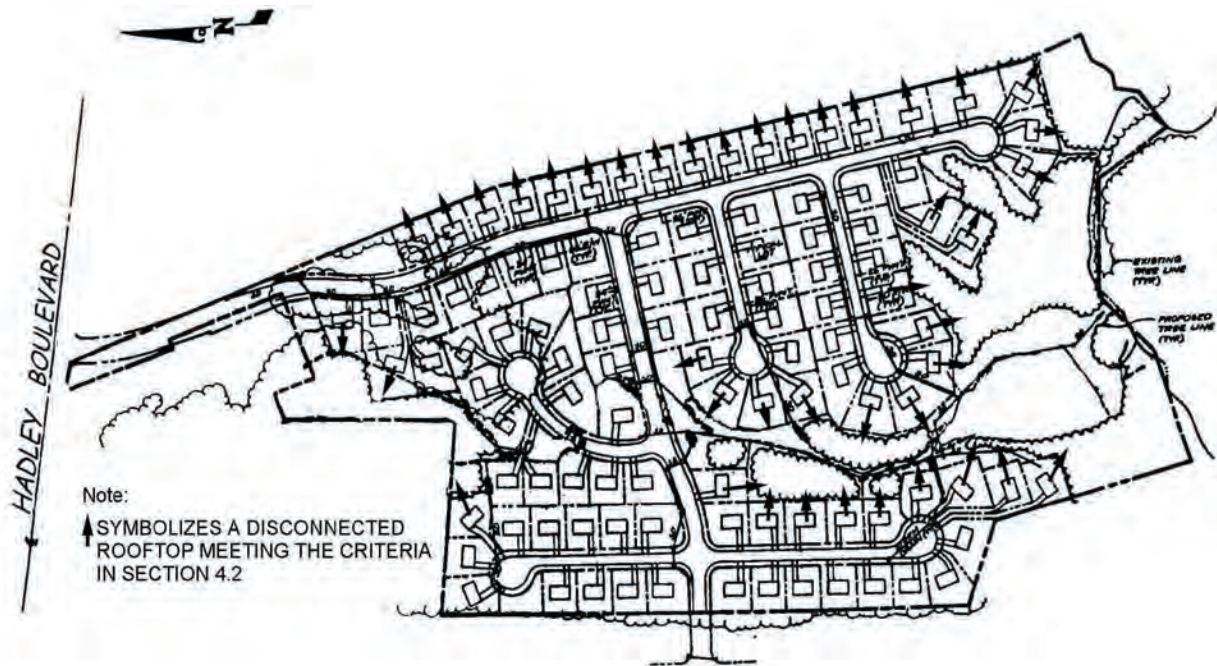


Figure 3. Schematic of Rooftop Disconnection Credit

Credit No 3: Disconnection of Non-Rooftop Runoff Credit

Credit is given for practices that disconnect surface impervious cover runoff by directing it to pervious areas where it is either infiltrated into the soil or filtered (by overland flow). This credit can be obtained by grading the site to promote overland vegetative filtering.

These “disconnected” areas can be subtracted from the site impervious area when computing the water quality treatment volume. In addition, disconnected surface impervious cover can be used to meet the recharge requirement as a non-structural practice under the Percent Area Method.

Restrictions on the Credit

The credit is subject to the following restrictions:

- The maximum contributing impervious flow path length shall be 75 feet;
- Runoff cannot come from a designated hotspot land use;
- The length of the “disconnection” must be equal to or greater than the contributing length;
- The entire vegetative “disconnection” shall be on a slope less than or equal to 5.0%;
- The surface impervious area to any one discharge location cannot exceed 1,000 ft²;
- Disconnections are encouraged on relatively permeable soils (HSGs A and B); therefore, no soil evaluation is required;

In less permeable soils (HSGs C and D), the water table depth and permeability shall be evaluated by a professional engineer to determine if a spreading device such as a french drain, gravel trench or other temporary storage device is needed to compensate for poor infiltration capability; and For those areas draining directly to a wetlands or stream buffer, only the non-rooftop disconnection credit or the stream buffer credit can be used, not both.

Credit No. 4: Stream Buffer Credit

This credit is given when stormwater runoff is effectively treated by a stream buffer. Effective treatment constitutes capturing runoff from pervious and impervious areas adjacent to a stream buffer and treating runoff through the overland flow in a natural vegetative or forested buffer. The use of a filter strip is also recommended to treat overland flow in the green space of a development site (see Figure 4). The credits include:

- The impervious area draining by sheet flow to a stream buffer is subtracted from the site's initial impervious area in the water quality calculation.
- The impervious area draining to stream buffer contributes to the recharge requirement, (Rev), under the Percent Area Method.

Restrictions on the Credit

The credit is subject to the following conditions:

- The minimum stream buffer width (i.e., perpendicular to the stream flow path) shall be 50 feet as measured from the bank elevation of a stream or the boundary of a wetland;
- The maximum contributing path shall be 150 feet for pervious surfaces and 75 feet for impervious surfaces;
- The average contributing overland slope to and across the stream buffer shall be less than or equal to 5.0%;
- Runoff shall enter the stream buffer as sheet flow. A level spreading device shall be utilized where local site conditions prevent sheet flow from being maintained;
- The credit is not applicable if rooftop or non-rooftop disconnection is already provided (i.e., no double counting); and
- Stream buffers shall remain ungraded and uncompacted, and the over-story and under-story vegetation shall be maintained in a natural condition.

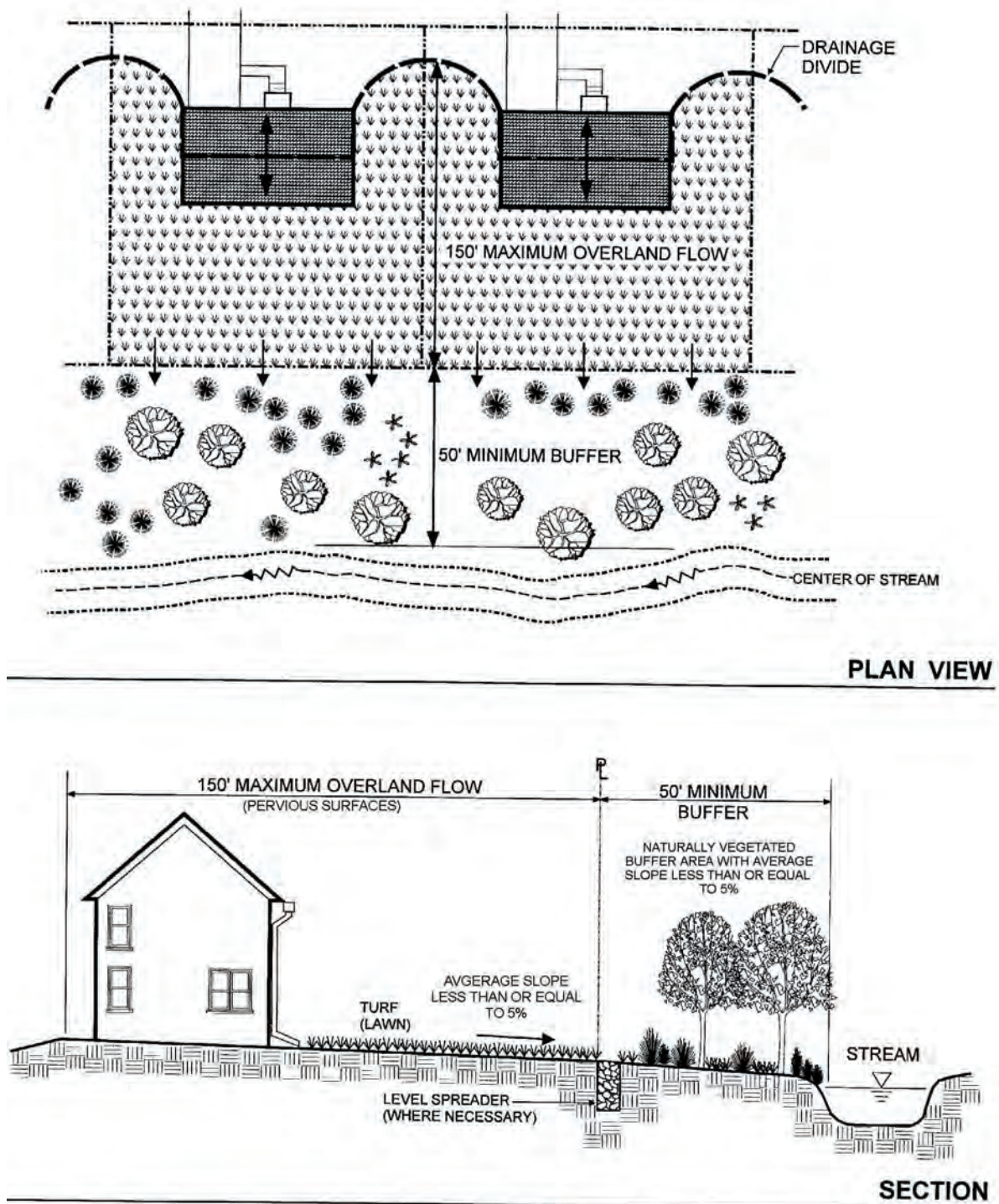


Figure 4. Example of Stream Buffer Credit Option

Credit No. 5: Grass Channel Credit

Credit may be given when open grass channels are used to reduce the volume of runoff and pollutants during smaller storms (i.e., 1.0 inches and less).

Use of a grass channel will automatically meet the minimum recharge Re requirement (under the Percent Area Method) regardless of the geometry or slope. If designed according to the following design criteria, the grass channel will meet the water quality treatment requirements for certain kinds of residential development.

Note: Runoff curve numbers (CNs) for 2-year, 10-year, and 100-year control will not change.

Grass Channel Design Criteria

The credit is obtained if a grass channel meets the following criteria.

- Land use is moderate to low density residential (maximum density of 4 dwelling unit/ac);
- The bottom width shall be 2 foot minimum and 6 foot maximum (if a larger channel is needed, a compound cross section may be used);
- The side slopes shall be 3Horizontal:1Vertical or flatter;
- The channel slope shall be less than or equal to 4.0%; and
- The length of the grass channel shall be equal to the roadway or parking lot length.

Grass Channel Credit Example Application

Base Data

Site Data: 108 Single Family Residential Lots (~ ½ acre lots) Site Area = 45.1 ac Original Impervious Area = 12.0 ac; or $I = 12.0/45.1 = 26.6\%$ Site Soils Types: 78% “C”, 22% “D” Composite F = 0.08 Original $Re = 0.08$ acre-feet; $Re = 0.96$ acres
Original $WQ_v = 1.0$ acre-feet^a

Grass Channel Credit (see Figure 5)

Entire site is open section road, but only 11.2 acres meet the water quality requirement design criteria for the grass channel credit (i.e., 3:1 sideslopes, 2 foot bottom width and slope less than or equal to 4%).

Required recharge (Re) is 0.96 acres and the full site is drained by grass channels, thereby meeting 100% of the recharge requirement.

New water quality Area = $(45.1 - 11.2) = 33.9$ acres, assume new impervious cover = 0.266(33.9 ac) = 9.0 acres. New $WQ_v = 1.0''(9.0 \text{ acres})/12 \text{ inches/foot} = 0.75$ acre-feet; or a 0.25 acre-foot reduction

Percent Reductions Using Grass Channel Credit:

- $Re = 100\%$
- $WQ_v = (1.0 \text{ acre-feet} - 0.75) / 1.0 \text{ acre-feet} = 25.0\%$

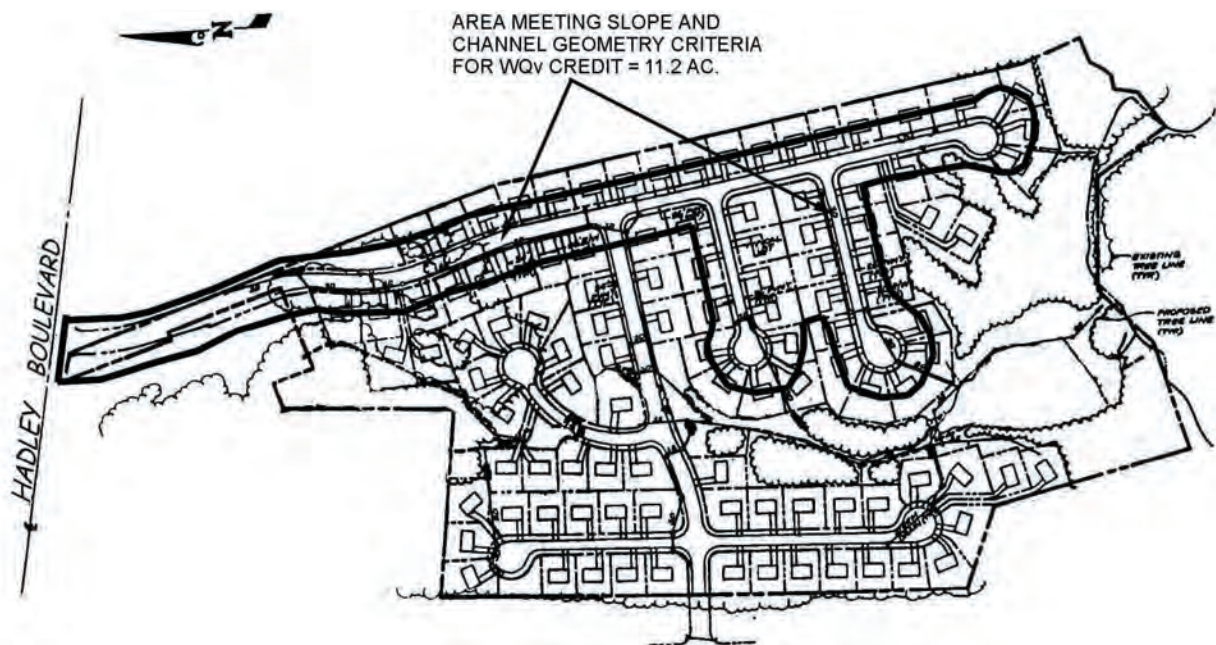


Figure 5. Schematic of Grass Channel Credit

Dealing with Multiple Credits

Site designers are encouraged to utilize as many credits as they can on a site. Greater reductions in stormwater storage volumes can be achieved when many credits are combined together (e.g., disconnecting rooftops and utilizing grass channel for drainage design). However, credits cannot be claimed twice for an identical area of the site (e.g., claiming credit for stream buffers and disconnecting rooftops over the same site area, draining to the same location).

Other Strategies to Reduce Impervious Cover

Site planning practices that reduce the creation of impervious area in new residential and commercial developments and therefore reduce the water quality requirements for the site should be encouraged whenever feasible². Examples of progressive site design practices that minimize the creation of impervious cover include:

- Narrower residential road sections;
- Shorter road lengths;
- Smaller turnarounds and cul-de-sac radii;
- Permeable spill-over parking areas (these areas should be valued as 50% impervious, unless designed specifically for infiltration);
- Smaller parking demand ratios;
- Smaller parking stalls for a percentage of lots;
- Angled one way parking;
- Cluster subdivisions;
- Smaller front yard setbacks;
- Shared parking and driveways; and
- More creatively designed pedestrian networks.

Where these techniques are employed, it may be possible to reduce stormwater storage volumes. For example, since the water quality treatment volume is directly based on impervious cover, a reduction in impervious cover reduces required storage. For 2-year, 10-year, and 100-year management, the designer can compute curve numbers (CNs) based on the actual measured impervious area at a site using the following equation (adopted from TR-55, 1986):

$$(98) I + (CN) P = CN$$

where: I = percent impervious area at the site, P = percent pervious area at the site, CN = curve number for the appropriate pervious cover

Figures 6 and 7 show an example of a retail site designed as a conventional development, and as a site planned using improved site design practices and techniques, respectively. Some of the noteworthy features of the innovative site plan include: preservation of some forested areas, establishment of a stream buffer, reduced parking ratios, compact and pervious overflow parking spaces, and use of vegetated stormwater practices such as filter strips and bioretention areas.

Though not all land use types and developments are amenable to every approach described here, there are more opportunities for flexibility and creativity in site design than many realize. Redevelopment sites also can utilize several of these practices and techniques in the redesign of an area.

The following example (using Figures 6 and 7) quantifies the water quality and recharge requirement reductions that can be realized by implementing several of these practices and design techniques.

The reader is referred to the following two references for a more detailed presentation of better site design and low impact development: 1) Center for Watershed Protection. 1998. *Better Site Design A Handbook for Changing Development Rules in Your Community*. Ellicott City, MD; and 2) Prince George's County MD Dept. of Environmental Resources. 1999. *Low Impact Development Design Strategies: An Integrated Design Approach*. Largo, MD.

Base Data (see Figure 6)

Site Area = 9.3 ac
Original Impervious Area = 6.5 ac; or $I = 6.5/9.3 = 69.9\%$
Site Soils Types: 50% "B", 50% "C," split evenly over the impervious area
Composite $F = [0.25 (6.5/2) + 0.10 (6.5/2)]/6.5 = 0.18$
Original $Re = 0.18 (6.5)/12 = 0.10$ acre-feet
Original Water Quality Requirement = $1.0''(6.5 \text{ ac})/12 = 0.54$ acre-feet

Site Planning Strategies (see Figure 7)

The revised site incorporates the following features:

- 1.8 acres preserved in a conservation easement.
- 0.46 acres of parking lot drain to a buffer with an overland flow path less than 75 feet (Credit No. 3: stream buffer credit).
- 0.28 acres of parking lot/loading area drain to a filter strip with an overland flow path less than 75 feet (Credit No. 2: disconnection of non-rooftop runoff credit).
- The total site impervious area was reduced from 6.3 acres to 5.8 acres by the site design revision; the new site $I = 5.8/9.3 = 62.4\%$.

The new storage requirements for Re :

- New composite $F = [0.25 (5.8 \text{ ac}/2) + 0.10 (5.8 \text{ ac}/2)]/5.8 = 0.18$
- New Re (Percent Volume Method) $= 0.18 (5.8 \text{ ac})/12 = 0.09$ acre-feet
- New Re^v (Percent Area Method) $= FAI = 0.18 (9.3 \text{ ac})(.624) = 1.04$ acres
- Using the^a Percent Area Method and noting that 0.46 acres drain to the buffer and 0.28 acres drain to a filter strip, then $Re = 1.04 \text{ ac} - (0.46 \text{ ac} + 0.28 \text{ ac}) = 0.3$ acres

Therefore, the remaining^a $Re_v = (0.3 \text{ ac}/1.04 \text{ ac}) (0.09 \text{ ac-ft}) = 0.02$ acre-feet

0.02 acre-feet must be managed by an approved “structural” practice.

The new storage requirement for water quality control is:

- New Impervious Area (to take credit for non-rooftop disconnection and buffer credits) $= 5.8 \text{ ac} - (0.28 \text{ ac} + 0.46 \text{ ac}) = 5.06$ acres;
- New water quality requirement $= 1.0^v(5.06 \text{ ac})/12 = 0.42$ acre-feet; or a 0.12 acre-foot reduction
- Percent Reductions Using Site Planning Strategies:
- $Re = (0.10 - 0.02) / 0.10 = 80.0\%$
- $WQ_v = (0.54 - 0.42) / 0.54 = 22.0\%$

Also, with a 0.5-acre net reduction in site imperviousness, the CN for computing the 2-year, 10-year and 100-year control will be lower, thereby reducing the storage requirements for these storms by a modest amount.

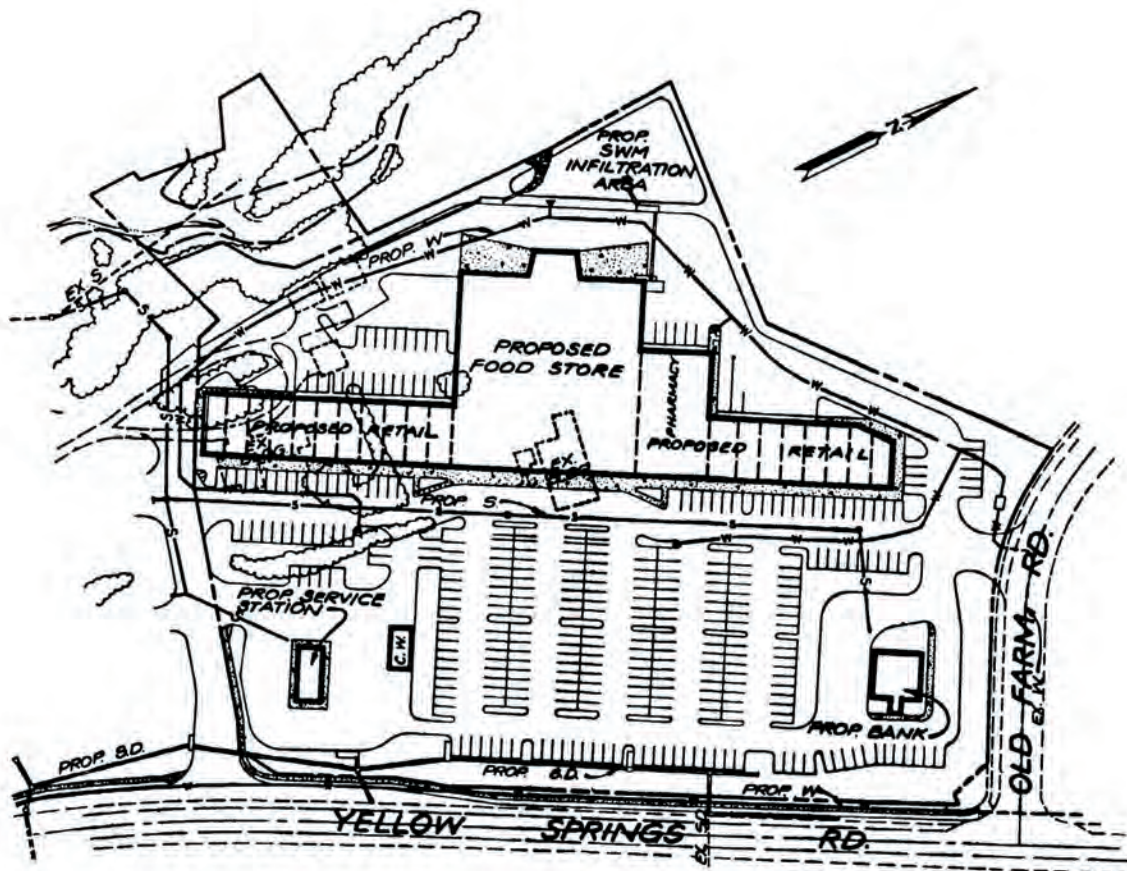


Figure 6. Example of Conventional Retail Site Design

Town of Boylston – Local Code Assessment

To: Boylston Stormwater Committee

FROM: Cassandra LaRoche, PE, Project Manager
Emma Burleson, EIT, Staff Engineer

COPY: Emily Scerbo, PE, Project Director

DATE: June 30, 2022

Section 2.3.6.b and 2.3.6.c of the United States Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NDPES) General Permits for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems in Massachusetts (referred to **herein as "2016 Small MS4 General Permit"**) **requires permittees within four (4) years of the Permit effective date to:**

- Develop a report assessing current street design and parking lot guidelines and other local requirements that affect the creation of impervious cover; and
- Develop a report evaluating existing local regulations to determine the feasibility of making the following green infrastructure practices allowable when appropriate site conditions exist:
 - Green roofs;
 - Infiltration practices, such as rain gardens, curb extensions, planter gardens, porous and pervious pavements, and other designs to manage stormwater using landscaping and structured or augmented soils; and
 - Water harvesting devices, such as rain barrels and cisterns, and the use of stormwater for non-potable uses.

This memorandum summarizes Tighe & Bond's assessment of the Town of Boylston's local code related to these practices with potential to impact stormwater runoff. The assessment included review of current street design and parking lot guidelines that affect the creation of impervious cover and requirements related to stormwater management to allow the Town to determine if changes to design standards for streets and parking lots can be made to support low impact development (LID) options as required by the 2016 Small MS4 General Permit. The assessment also included review of allowable green infrastructure practices and under what circumstances they are allowed.

What are GI and LID?

Green Infrastructure (GI) includes both natural features such as forests and wetlands, as well as engineered landscapes that mimic these natural processes such as a rain garden.

Low Impact Development (LID) works to preserve the natural landscape and minimize impervious surfaces to keep stormwater close to the source and use it as a resource rather than a waste product.

Together, LID and GI not only manage stormwater and improve groundwater supplies, but also offer many free ecosystem services including cleaner air and water, flood control, shade and energy savings, recreational opportunities, and enhanced property values and quality of life.

Source: [MassAudubon LID Fact Sheets. https://www.massaudubon.org](https://www.massaudubon.org)

According to the 2016 Small MS4 General Permit:

Section 2.3.6.b. related to generation of impervious cover: *If the assessment indicates that changes can be made, the assessment shall include recommendations and proposed schedules to incorporate policies and standards into relevant documents and procedures to minimize impervious cover attributable to parking areas and street designs. The permittee shall implement all recommendations, in accordance with the schedules, contained in the assessment.*

Section 2.3.6.c. related to allowing specific practices: *If the practices are not allowed, the permittee shall determine what hinders the use of these practices, what changes in local regulations may be made to make them allowable, and provide a schedule for implementation of recommendations. The permittee shall implement all recommendations, in accordance with the schedules, contained in the assessment.*

Recommended changes to the Town's by-laws and regulations are outlined in this memorandum and **should be refined through collaboration with the Town's** Planning Board, Conservation Commission and Stormwater Committee.

Review of Existing By-Laws and Regulations

The following existing by-laws and regulations of the Town of Boylston were assessed relative to requirements that affect the creation of impervious cover or implementation of green infrastructure practices.

- Zoning By-Laws for the Town of Boylston (as amended June 7, 2021), including:
 - **Section 5** – Senior Residential Development
 - **Section 6** – Flood Plain District Regulations
 - **Section 7** – Wellhead Protection District Regulations
 - **Section 9** – Dimensional Requirements
 - Section 10 – Special Regulations (Off-Street Parking and Loading, Site Plan Review)
 - **Section 17** – Common Driveways
- **Rules & Regulations** Governing the Subdivision of Land in Boylston (as amended June 4, 2012)
- **Boylston Conservation Commission Rules & Regulations** for Stormwater (as revised February 2022 – draft for adoption in 2022)
- General By-Laws of the Town of Boylston
 - Article VI, Section 6 – Earth Removal By-Law (as amended May 2009)
 - Article VI, Section 7 – Driveways (as amended May 2009)
 - Article VI, Section 9 – Stormwater Control By-Law (as amended May 2009)
 - Article VI, Section 22 – Storm Drain By-Laws (as amended May 2009)

To document our review of local code and understand opportunities for improvement, Tighe & Bond used Mass Audubon's *By-law Review for LID & Climate-Smart, Nature Based Solutions*.¹ As described in the Mass Audubon checklist, it provides a framework to:

...evaluate local land use regulations in relation to models and examples from the Commonwealth of Massachusetts' Smart Growth/Smart Energy Toolkit and other sources in relation to the use of LID and Green Infrastructure (GI) techniques. The focus is primarily on residential development, but the concepts are also applicable to other forms of development and redevelopment.

Best practices minimize the alteration of natural green infrastructure such as forests; reduce creation of impervious surfaces; support retention of naturally vegetated buffers along wetlands and waterways; minimize grading and alterations to natural flow patterns; and support the use of LID techniques as the preferred, most easily permitted methods for managing stormwater.

The key areas of analysis in the checklist include overall site design (such as open space residential design or "OSRD" versus conventional subdivisions), project design and layout standards in relation to LID (such as preservation and protection of natural resources, minimizing the area of disturbance, road layout and width, curbing, drainage, sidewalks, parking, landscaping), maintenance and operations, and mechanisms for enforcement. See Tabs 1 through 4 in the checklist for additional information about the tool.

The analysis portion of the checklist is separated into two tabs; Tab 5 summarizes factors related to OSRD and Tab 6 summarizes factors related to Mass Audubon's five major goals of a robust LID program:

- Goal 1: Protect natural resources and open space
- Goal 2: Promote efficient, compact development patterns and infill
- Goal 3: Smart designs that reduce overall imperviousness
- Goal 4: Adopt green infrastructure stormwater management provisions
- Goal 5: Encourage efficient parking

A color-coded ranking system is used to categorize the state of current code compared to Mass Audubon's "Conventional", "Better", and "Best" categories for each factor. This allows the Town to visually perceive whether the Town's current code related to a particular LID goal or factor follows a more conventional approach and therefore may present an opportunity to update the code with more LID-focused parameters. Note that there is no EPA requirement to meet the "Best" category for each factor in the checklist, and the recommendations presented here are primarily focused on meeting the Small MS4 General Permit requirements.

Tighe & Bond met with the Town on June 21, 2022 to obtain initial input on this assessment. The final Code Assessment Summary checklist is enclosed in this memorandum (delivered electronically in Excel). During the meeting, it was noted that the Town of Boylston is in the process of updating the Master Plan with the Master Plan Steering Committee² and simultaneously completing a Municipal Vulnerability Preparedness (MVP) project, with the goal

¹ Mass Audubon. *By-Law Review: Encouraging Nature-Based Solutions*. URL: <https://www.massaudubon.org/our-conservation-work/policy-advocacy/shaping-climate-resilient-communities/publications-community-resources/bylaw-review>

² Additional information about the Boylston Master Plan update is available at the following websites: <https://www.boylston-ma.gov/master-plan-steering-committee>, <https://www.boylstonmasterplan.com>

of completing both in 2022. The draft reports include the following recommendations³ related to open space design, LID, and protecting natural resources, which Tighe & Bond has incorporated as applicable into the Recommendations section of this memorandum:

Recommendations from the draft MVP report:

- *Improve and expand stormwater management practices and infrastructure*
- *Prioritize environmental and open space planning*
- *Expand resource protection efforts*
- *Fortify utilities*

Recommendations from the draft Master Plan:

- *Land Use: Concentrate new development around existing infrastructure to preserve natural resources and limit service provision costs.*
- *Open Space & Natural Resources:*
 - *Explore zoning changes such as Open Space Residential Design, Cluster Development, and other bylaws to require conservation of open space with new subdivisions.*
 - *Pursue adoption of conservation-related bylaws and policies, particularly zoning incentives for preserving open space and natural resources.*
 - *Explore establishing a No Disturb Zone around wetland resource areas to a defined distance.*

Summary of Findings

Tighe & Bond's assessment of the Town of Boylston's local code has determined that several By-laws and Regulations include provisions that affect the creation of impervious cover. As noted in the Recommendations section of this memorandum, there are some opportunities to update the code to incorporate policies and standards to minimize impervious cover attributable to parking areas and street designs.

Several By-laws and Regulations allow for the implementation of green roofs, infiltration practices, and water harvesting devices when appropriate site conditions exist. Tighe & Bond found no hinderances to these practices within the existing local codes, however there are opportunities to encourage their use more proactively, as described in the Recommendations section of this memorandum.

This section provides a brief summary of findings from each code reviewed. For a more detailed summary of existing provisions included in the By-laws or Regulations listed below, refer to the enclosed Code Assessment Summary.

Zoning By-Laws for the Town of Boylston

The Town's Zoning By-Laws were enacted in accordance with M.G.L., Chapter 40A, and the Home Rule Amendment, Article 89 of the Massachusetts Constitution. The purpose of the by-laws are to lessen congestion in the streets; to conserve health; to secure safety from fire, flood, panic, and other dangers; to provide adequate light and air; to prevent overcrowding of land; to avoid undue concentrations of population, to encourage housing for persons of all income levels; to facilitate the adequate provision of transportation, water, water supply, on-lot sewerage disposal, drainage, schools, parks, open space and other requirements of the residents of Boylston; to conserve the value of land and buildings, including the conservation

³ These recommendations, provided by the Boylston Stormwater Committee, should be considered draft and may change upon completion of the Master Planning Process and MVP project.

of natural resources and the prevention of blight and pollution of the environment; to encourage the most appropriate use of land throughout the Town of Boylston, including consideration of the recommendations of a Master Plan adopted by the Boylston Planning Board and the land use recommendations, as they may relate to the Town of Boylston, of the Central Massachusetts Regional Planning Commission, and to preserve and increase the amenities of the Town by promulgation of regulations to fulfill the above objectives.

Boylston's Zoning By-Laws include specific provisions related to this assessment for different uses in various zoning districts and overlay districts which include the following:

- Residential Districts (Rural Residential, Residential, General Residential);
- Residential Office Overlay District;
- Business Districts (Village Business, Highway Business, Flexible Business Development District; Neighborhood Business District, Route 140 Business District);
- Commercial District;
- Heritage District;
- Industrial Districts (Industrial Park, Mixed Use Industrial District);
- Flood Plain District; and
- Wellhead Protection.

The Dimensional Requirements included in Section 9 of the Zoning By-Laws includes specifications on minimum lot frontage and width, minimum yard dimensional limits, maximum building height, maximum lot coverage percentages, and minimum lot landscaping percentages. Requirements related to the creation of impervious cover and use of green infrastructure techniques may be more or less stringent depending on the zoning or overlay district the proposed development is located within. The Zoning By-law typically provides provisions to protect natural resources and open space and promote designs that reduce overall imperviousness, but there are opportunities to encourage efficient parking and promote efficient, compact development patterns with flexible or minimized lot sizes, setbacks, and frontage areas, as discussed in the Recommendations section of this memorandum. Applicable standards as they relate to street design, parking, impervious cover, and green infrastructure are summarized in more detail in the Code Assessment Summary (see Enclosure, Tab 6).

While Boylston does not have a standalone Open Space Residential Design (OSRD) or Flexible Development By-law, open space standards are included in the Zoning By-Laws under Section 5, Senior Residential Development (SRD), which is intended to provide more affordable housing options for a maturing population, to reduce demands on municipal and educational services, to promote development that is in harmony with the town's natural features and resources, its historic and traditional landscapes, the existing and probable future use of adjacent land, and to establish flexible residential development standards and procedures that will support these objectives. In general, the SRD has some factors that are considered "Better" or "Best Practice" by the Mass Audubon standards for OSRD or Flexible Development, but also has areas that could be improved in terms of design requirements, application submittals, and promoting LID, as discussed in the Recommendations section of this memorandum. Applicable standards as they relate to open space residential design are summarized in more detail in the Code Assessment Summary (see Enclosure, Tab 5).

Note that the Zoning By-law includes requirements for Site Plan Review in Section 10, Special Regulations. This section outlines the procedural process and submittal requirements for applications requiring a special permit site plan approval, and does not include specific design

requirements related to this assessment. Therefore, evaluation of this section of the By-law was not included in the enclosed Code Assessment Summary.

Rules & Regulations Governing the Subdivision of Land in Boylston

The Rules and Regulations Governing the Subdivision of Land in Boylston (herein referred to as the "Subdivision Regulations") contain paved street width, cul-de-sac requirements, and sidewalk requirements that affect the creation of impervious cover associated with subdivisions. The Subdivision Regulations set forth street layout and design standards that regulate the location, alignment, intersections, widths, and access of the streets of Boylston. In general, streets shall be designed to provide safe vehicular travel through the proper provision of adequate sight distances, width of pavement, grades, intersection design, and other engineering standards.

Overall, the Subdivision Regulations provide good protection for natural resources and open space within subdivisions and have many provisions requiring LID practices (e.g., bioretention areas in cul-de-sacs and permeable pavement for sidewalks). Because Definitive Subdivision Plans explicitly require a permit under the Town's Stormwater Control By-law and Regulations, these projects will meet the most up-to-date State and Federal design requirements, and will also require a Stormwater Management Plan, Operation and Maintenance Plan, and Erosion and Sediment Control Plan.

There are opportunities to support the reduction of impervious cover during development and to further encourage the use of green infrastructure stormwater provisions, as discussed in the Recommendations section of this memorandum. Refer to the Code Assessment Summary (see Enclosure, Tab 6) for an outline of the applicable standards within the Subdivision Regulations relative to the creation of impervious cover and use of green infrastructure within Boylston.

Boylston Stormwater Control By-Law and Conservation Commission Rules & Regulations for Stormwater

The Town's Stormwater Control By-Law outlines activities requiring Stormwater Control Permits (subdivisions requiring a Definitive Plan, activities that result in a land disturbance greater than one acre, and activities that result in a land disturbance less than one acre if the project is part of a larger common plan of development which eventually will disturb greater than one acre); permit procedures; performance standards for erosion and sediment control and post-construction stormwater management (including stormwater and low impact development performance standards); waivers; and enforcement.

The Conservation Commission adopted associated Rules & Regulations for Stormwater in 2007 to provide submittal requirements and detailed performance standards and design criteria for applicants. The Regulations were recently updated for consistency with the 2016 Small MS4 General Permit and will be adopted in 2022; these updated Regulations were used for this assessment.

For compliance with the standards in the Regulations, the applicant must include a Stormwater Management Plan, Operation and Maintenance Plan, Erosion and Sediment Control Plan, and Inspection and Maintenance agreement with the application for a Stormwater Control Permit. Section 7.0 of the Regulations define performance standards for stormwater management and LID and state that stormwater management shall be designed in accordance with the requirements of the Small MS4 General Permit and the Stormwater Management Standards described in the Massachusetts Stormwater Handbook using current Best Management Practices (BMPs).

Additionally, the Regulations require that LID site planning and design strategies must be utilized where adequate soil, groundwater, and topographic conditions allow. Within the Regulations, LID is defined as "site planning and design strategies that use or mimic natural processes that result in the infiltration, evapotranspiration, or use of stormwater in order to protect water quality and associated habitat. Low impact development techniques employ principles such as preserving and recreating natural landscape features, minimizing effective imperviousness to create functional and appealing site drainage that treats stormwater as a resource rather than a waste product. Low impact development techniques include, but are not limited to, bioretention facilities, rain gardens, vegetated rooftops, rain barrels, and permeable pavement."

Refer to the Code Assessment Summary (see Enclosure, Tab 6) for more detail of the applicable standards within the Stormwater Control By-Law and Regulations relative to the creation of impervious cover and green infrastructure within Boylston.

General By-Laws of the Town of Boylston

As noted on page 2 of this memorandum, some of the Town's General By-laws were reviewed as part of the assessment, including the Earth Removal, Driveways, Stormwater Control (discussed previously), and Storm Drain By-laws. These by-laws include some additional provisions related to street design, parking, and green infrastructure. Commentary was included in the checklist for earth removal, driveway design, illicit discharge control, and permeable paving.

Recommendations

The majority of Tighe & Bond's recommendations are limited to updates to the Zoning By-Laws and Subdivision Regulations, which have the most opportunity to generate impervious cover through construction of buildings, parking, streets, and sidewalks. While Tighe & Bond has provided recommended areas for potential improvement, the ultimate updates to Town code will be determined after careful consideration by the Town's professional staff, discussion with the Planning Board and other enforcing entities, and a process for public input.

As previously noted, the Town's Master Plan Steering Committee is in the process of updating the Master Plan, and the Town is simultaneously completing an MVP project. Recommendations from these draft Plans are included on page 4 of this memorandum, and have also been incorporated in this Section as applicable because implementation of the recommendations will result in improvements to local code in terms of open space, protection of natural resources, and LID.

Recommended Revisions to Zoning By-Laws

Responsible Parties: Planning Board

Target Completion Date: July 2025 (As noted at the June 21, 2022 working meeting, the schedule for modifications may be adjusted as needed to coordinate with the schedule for implementation of Master Plan and/or MVP project recommendations.)

The Town's Zoning By-Laws have established a Senior Residential Development District, which allows for more flexible dimensional requirements to create open space for a targeted residential use. Other sections including the Schedule of Dimensional Requirements Table in Section 9.02 also have requirements for the creation of less impervious surface and better stormwater management.

The list below provides more specific recommendations on how to further promote LID and reduce impervious area in the Town of Boylston for discussion and collaboration with the **Town's Planning Board** and Highway Department based on recommendations from the Massachusetts Low Impact Development Toolkit⁴ and the American Planning Association (APA) guidebook, Sustainable Neighborhood Road Design: A Guidebook for Massachusetts Cities and Towns.⁵

Promoting Efficient Development

- The **Zoning By-Laws** establish minimum lot setbacks in the Schedule of Dimensional Requirements Table and additional setback requirements are presented for varying uses and overlay districts throughout the By-Laws. Look for opportunities to examine minimum setback requirements in certain districts such as Commercial and Industrial. Consider adding language to set impervious cover limits tailored to the community and district type.
- In **low-density** areas, consider establishing limits on impervious lot coverage (e.g., <15%). This is addressed within the **Wellhead Protection District** currently. Note this is **not appropriate for town centers or moderate density neighborhoods** where compact development should be encouraged. Consider adding language to set impervious cover limits tailored to the community and district type.
- Incorporate recommendations from the recently approved Housing Production Plan (2021) developed by the Master Plan Steering Committee, such as **exploring a Cottage Housing Bylaw**. "A Cottage Housing Bylaw is like an open space bylaw in that it provides density bonuses in exchange for a common open space set-aside but focuses on houses on smaller lots with pedestrian oriented layout. In a cottage development, housing units (typically single-family) are clustered with smaller than typical frontages along shared spaces, walkways or other amenities."⁶

Street Design, Parking, and Common Driveways

- **Street design and roadway widths are not addressed within the Zoning By-Law, other than within the Senior Residential Development District**. Consider adding specificity to the By-laws, or referencing the Subdivision Regulations, and allowing flexible pavement and right-of-way widths depending on anticipated traffic volumes and availability of on-site parking.
- Section 10.02 of the Zoning By-laws include parking requirements, which specify a minimum number of parking spaces based on the land use and building types. The Route 140 Development District has additional off-street parking provisions and provides consideration of shared parking (i.e., common off-street parking areas) by special permit. Consider opportunities to reduce impervious area creation while still providing reasonable parking accommodations by updating the parking requirements to set a maximum number of parking spaces and/or providing additional opportunities in other overlay districts for Shared Parking.
- Common driveways are permitted by special permit, with the maximum number of lots served by a common driveway being 3 in residential districts and 5 in commercial, business, and industrial districts. Consider increasing the density of lots allowed for

⁴ <https://www.mapc.org/resource-library/low-impact-development-toolkit/>

⁵ https://www.apa-ma.org/wp-content/uploads/2018/12/NRB_Guidebook_2011.pdf

⁶ Boylston Housing Production Plan Sub-Committee of the Master Plan Steering Committee and the Central Massachusetts Regional Planning Commission. *Town of Boylston Housing Production Plan*. 2021. URL: <https://www.mass.gov/doc/boylston-plan/download>

common driveways. Also consider requiring or encouraging common driveways to be constructed with permeable pavers or pavement.

Stormwater Management and Landscaping Requirements

- Consider adding provisions to the Zoning By-Laws to allow for easy siting of LID features on lots, common open space, setback areas, or road rights-of-way and easements. Green infrastructure could count toward fulfillment of landscaping and open space requirements. Examples include allowing an increase in floor area ratio or other developmental incentives for green roofs for commercial development, specifying commercial landscaping requirements for parking areas, and allowing for vegetated areas with bioretention functions in commercial landscaping areas.
- The Zoning By-Laws require non-invasive plantings and street trees within certain districts (Route 140 Development). Many districts also require greenbelts/buffers or open space with trees (Commercial/Industrial contiguous to a residential zone, Residential-Office overlay district). Consider expanding this requirement to apply to additional districts.

OSRD/Flexible Development

- Consider creating a standalone Open Space Residential Design or Flexible Development by-law. Currently, Section 5 of the Zoning By-law outlines requirements for open space and flexible development within the Senior Residential Development District. The draft Master Plan also recommends exploring "Open Space Residential Design, Cluster Development, and other bylaws to require conservation of open space with new subdivisions and development".

Recommended Revisions to Subdivision Regulations

Responsible Parties: Planning Board

Target Completion Date: July 2025 (As noted at the June 21, 2022 working meeting, the schedule for modifications may be adjusted as needed to coordinate with the schedule for implementation of Master Plan and/or MVP project recommendations.)

The Town's Subdivision Regulations were last amended in 2012 and would benefit from additional modifications designed to promote the use of LID and stormwater management techniques that improve water quality. In general, such modifications would reduce impervious area, incorporate more LID and GI, and better preserve open space.

The list below provides more specific recommendations on how to further promote LID in the Town of Boylston **for discussion and collaboration with the Town's** Planning Board, Highway Department, and Fire Department based on recommendations from the Massachusetts Low Impact Development Toolkit and the American Planning Association (APA) guidebook, *Sustainable Neighborhood Road Design: A Guidebook for Massachusetts Cities and Towns*.

Street Design

- Consider adding provisions to the Subdivision Regulations to require that the location of streets minimize grading and road length and avoid important natural features.
- The Subdivision Regulations specify in Section 6.2.4 that the minimum width of pavement shall be 24 feet for local streets, and 28 feet for collector streets. Consider minimizing road widths by specifying the following tiered road width standards in the Subdivision Regulations to reduce pavement to the extent possible (e.g., wide, medium, narrow, and alley categories—20 to 24-foot widest for 2 travel lanes, 16 to

20-foot for low traffic residential neighborhood, plus 2-foot shoulders.) Consider allowing narrow widths in lower density residential areas or where on-street parking is not anticipated. This will require meeting with the Fire Department to resolve conflicts between standards in Subdivision Regulations and requirements and/or preferences of the Fire Department for emergency vehicle access. Note that the draft Master Plan also includes a recommendation action to "Identify changes to roadway width, parking, and other requirements in ... subdivision bylaws that reduce impervious cover."

- Consider giving preference to roadside swales over closed drainage. Currently, vegetated open channels are only allowed in lieu of traditional curbs and gutters when deemed appropriate by the Planning Board.

Stormwater Management

- Although Definitive Subdivision Plans explicitly require a permit under the Town's Stormwater Control By-law and Regulations, consider updating Section 6 (Design and Construction Standards) for consistency with the Stormwater Management Regulations by reference, the MA Stormwater Handbook, and the Town's current design preferences. The Town could consider encouraging additional green infrastructure and LID practices where deemed appropriate for Subdivisions
- Consider requirements to address runoff from roofs. Roof runoff is not specifically required to be infiltrated or directed to landscaped or naturally vegetated areas capable of absorbing clean water. Green roofs, downspout disconnection, and rainwater harvesting could be encouraged in some cases through the permitting process. Downspout disconnection and rainwater harvesting are both considered green infrastructure elements.⁷

Additional Recommendations

Responsible Parties: Planning Board/Highway Department/Conservation Commission

Target Completion Date: Consider selecting one to three of these potential recommendations by July 2025

- Consider updating the Scope and Applicability of the Stormwater Control By-law to reduce area of land disturbance required to trigger a Stormwater Control Permit. This might create a clearer review process and design criteria for smaller projects that are not currently captured by the By-law.
- Provide opportunities for professional staff and members of the Zoning Board of Appeals, Planning Board, and Conservation Commission to participate in workshops or conferences about the benefits of LID, GI, and sustainable stormwater management.
- Consider implementing a new green infrastructure or LID demonstration project on Town-owned property.

⁷ U.S. EPA. *What is Green Infrastructure?* URL: <https://www.epa.gov/green-infrastructure/what-green-infrastructure>

- Modify and distribute public education materials available from MassDEP and EPA to developers regarding design, uses, and appropriate site conditions for green infrastructure such as rain gardens and porous pavement.^{8 9 10 11 12}
- Participate in a rain barrel sale and distribution program such as those offered by the Great American Rain Barrel company.¹³ Provide education to residents and developers about rainwater harvesting.

Next Steps

The proposed recommendations for revision presented herein should be discussed and refined **through a joint working meeting of relevant boards and commissions including the Town's Planning Board, Stormwater Committee, and other Town staff, boards, or committees involved in implementing recommendations of the updated Master Plan.** Per the 2016 Small MS4 General Permit, recommended changes must have a corresponding proposed schedule to incorporate policies and standards into relevant documents and procedures to minimize impervious cover attributable to parking areas and street designs. The joint meeting should also include development of a schedule of implementation of proposed revisions and recommended actions.

Enclosures

Boylston **Code Assessment Summary via Mass Audubon's** *By-Law Review for LID & Climate-Smart, Nature Based Solutions* (delivered electronically)

J:\B\B0768 Boylston Stormwater Assistance\011 - FY22 Stormwater Assistance\Local Code Review\Boylston Local Code Assessment Memo.docx

⁸ <https://www.epa.gov/green-infrastructure/overcoming-barriers-green-infrastructure>

⁹ <https://www.epa.gov/soakuptherain>

¹⁰ <https://www3.epa.gov/region1/npdes/stormwater/assets/pdfs/BMPRetrofit.pdf>

¹¹ <https://www.thinkbluemassachusetts.org/>

¹² <https://www.mass.gov/guides/stormwater-outreach-materials-to-help-towns-comply-with-the-ms4-permit>

¹³ <https://www.greatamericanrainbarrel.com/>