

# Ecological Design, Construction and Maintenance Handbook

best practices for balancing  
site construction & land protection



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# Introduction

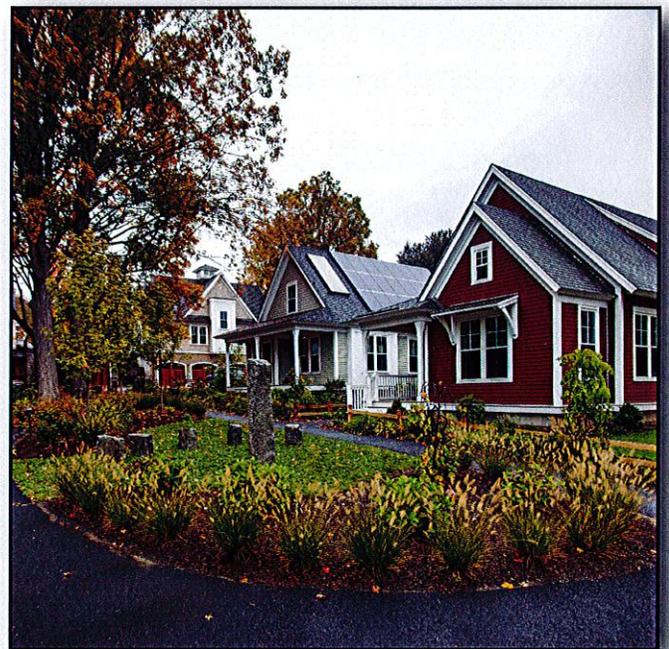
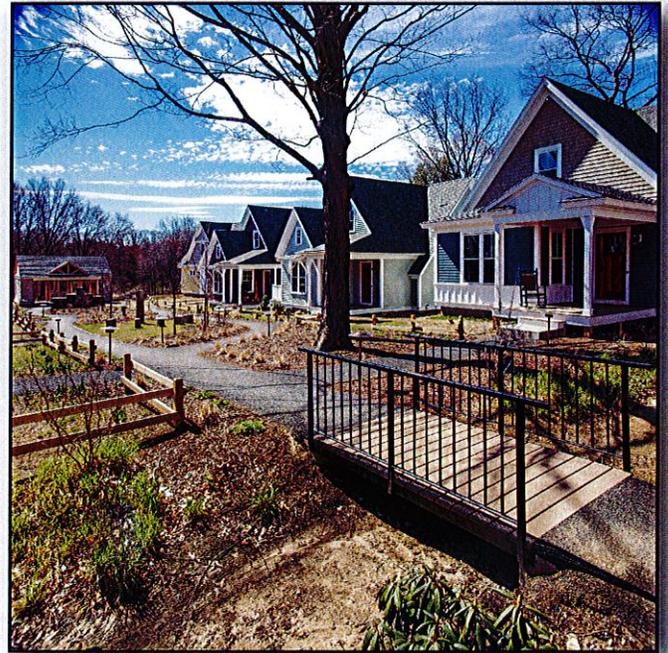
Building construction, resource protection and stormwater management are controlled by a variety of local, state and federal permits. The Conservation Commission is charged with protecting Lincoln's wetland and buffer zone resource areas under the MA Wetlands Protection Act and Lincoln Wetlands Protection Bylaw. In addition, the Commission reviews qualifying projects that must meet the MA Stormwater Management Standards. The U.S. EPA and MA DEP jointly administer stormwater discharge permits for construction projects that disturb more than one acre of land through the National Pollutant Discharge Elimination System (NPDES) permitting process.

Although various permitting programs have improved site development practices throughout Massachusetts, the Lincoln Conservation Department created this handbook as an outreach tool to further its dedication toward site-sensitive development and natural resource protection. This handbook introduces residents, developers, designers and project reviewers to several principles that govern ecologically sustainable development. It describes preferred design and construction practices related to site planning, building and landscape construction, stormwater management and property maintenance. Many of these practices use common sense and can be implemented on new construction and redevelopment, as well as on existing properties. These tools are often less expensive than conventional methods and they result in long-term benefits to your home and landscape, your family's health and the environment.

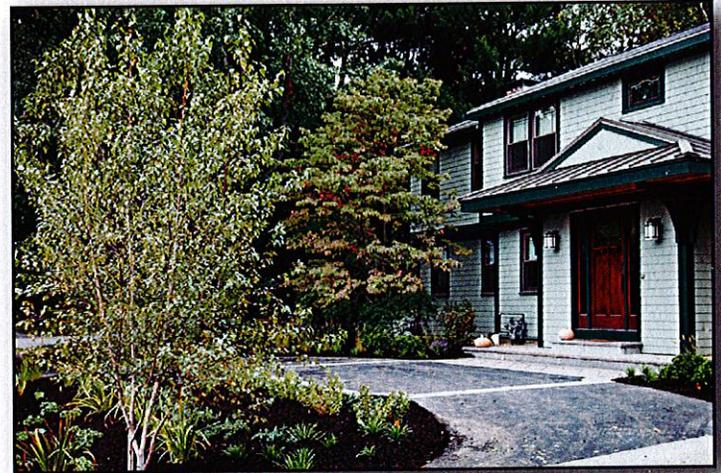
Smart Growth, Green Building, Green Infrastructure, and Low-Impact Development are current best-practice concepts in the planning & construction industry.

**Smart Growth** is a planning concept that advocates for compact, transit-oriented, walkable and bicycle-friendly development that combines schools and mixed-use development with a range of housing choices. Whether you are a developer or homeowner, you can target your search toward properties within a few miles of a Town Center. In so doing, you will:

- **Be part** of a unique sense of community and place
- **Expand** your range of transportation, employment and housing choices
- **Share** in the costs and benefits of development
- **Preserve** and enhance natural and cultural resources
- **Promote** your health by biking or taking the train to work, walking to the grocery store, post office and local businesses and by using public parks, trails and community gardens
- **More Info** @ [smartgrowth.org](http://smartgrowth.org)



*"Buildings annually consume more than 30% of the total energy and more than 60% of the electricity used in the U.S. Each day five billion gallons of potable water are used solely to flush toilets. A typical North American commercial construction project generates up to 2.5 pounds of solid waste per square foot of completed floor space." (USGBC)*



**Green Building** is a process whereby a building's construction is evaluated for its environmental and life-cycle performance. All building projects should strive to meet these goals:

- **Employ** site development practices that minimize impact on ecosystems and water resources
- **Promote** smart use of water, indoors and outdoors, to reduce potable water consumption
- **Maximize** energy performance through innovative strategies
- **Be efficient** with resources and use sustainable building materials
- **Design** for indoor air quality
- **More Info @** [usgbc.org](http://usgbc.org)

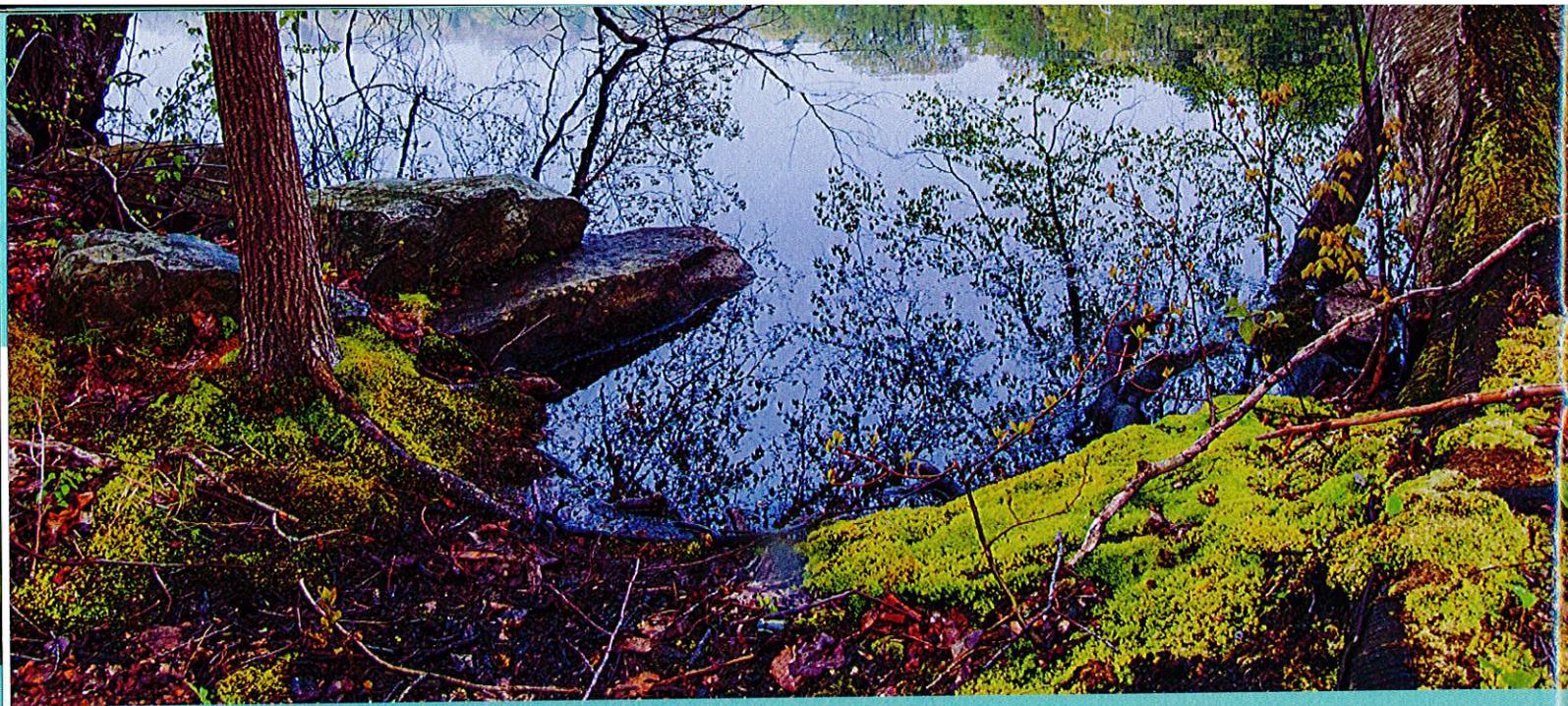
**Green Infrastructure** mimics natural processes to infiltrate and reuse stormwater. Unlike systems that use pipes to eliminate rainwater, green infrastructure uses soil and vegetation to manage it.

- **Swales**, like small streams, filter sediments. They hold stormwater and can carry it to larger basins
- **Rain Gardens** are planted depressions that collect runoff and infiltrate it back into the soil
- **Detention Basins** and ponds provide maximum water storage to prevent flooding and erosion
- **More Info @** [EPA's Green Infrastructure Page](#) and use the models to analyze the cost/benefit of different systems



**Low-Impact Development (LID)** is a sustainable approach to land development that preserves existing natural features of the property, minimizes land clearing and manages water on-site.

- **Identify** important wildlife habitats and environmentally sensitive areas including wetlands, woodlands and fields. Develop a site plan that protects these areas.
- **Preserve** natural landscape features including ledge outcrops, native vegetation and wildlife travel corridors. Preserve existing slopes and water routes.
- **Minimize** land clearing and grading. Use narrow roadways, smaller parking areas and permeable paving on sidewalks and overflow parking areas. Plant islands in driveways and parking lots and consider green roofs and on-site energy alternatives.
- **Design** the site to create many small sub-watersheds and micromanage runoff close to where it is created in small decentralized structures. Use a 'treatment train' of multiple systems to maximize infiltration and recharge. Design stormwater features to serve as open space, wildlife habitat and snow storage areas.
- **Disconnect** existing downspouts and other point-source discharges from catchbasins, storm drains and wetland resource areas and direct them into green infrastructure.
- **Eliminate** the use of chemical pesticides, herbicides, toxic cleaning agents and other pollutants that will eventually enter wetlands and streams.
- **More Info @** [mapc.org/resources/low-impact-dev-toolkit](http://mapc.org/resources/low-impact-dev-toolkit)



# Ecological Design, Construction & Maintenance

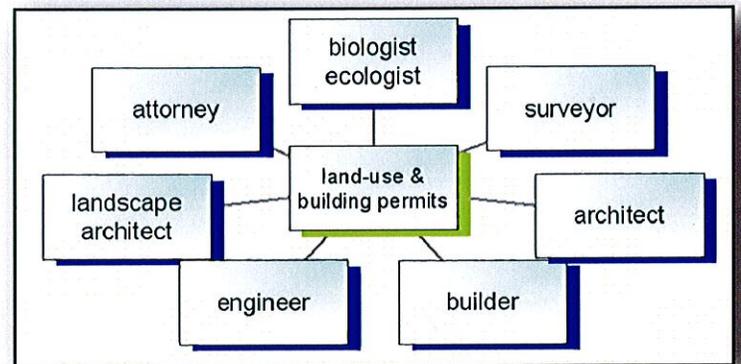
Ecological Design, Construction and Maintenance encompasses all the industry concepts described above: identifying and preserving natural resources, understanding the life-cycle costs of products and processes, reducing waste and looking for ways to realize environmental and economical savings.

However, it considers additional measures to preserve and enhance the ecological integrity of the land throughout the design and construction process. It also identifies ways to improve property maintenance activities over time.

*The principal advantages of designating a "Limit of Work" and "Building Envelope" are: erosion control; stormwater detention and biofiltration; preservation of natural resources, wildlife habitat, physical and audio/visual buffers; and cost savings on site work, material processing, landscaping and maintenance.*

### Build a Collaborative Team

Establishing a well-qualified team early in the process will ensure that details from all aspects of the project are coordinated in the proper sequence; ultimately saving you time and money. The team should consist of a landscape planner, surveyor, architect, engineer, general contractor and specialists as necessary. Each professional is specialized in different aspects of the building process and will help you to identify critical resources and sensitive site features that must be accounted for early in the design process.



### Create a Building Envelope

Preliminary design involves analysis of the natural, cultural and historic features on the property. A strict "Limit of Work" should be used to prevent clearing, grading, development and other site work from adversely affecting sensitive site features.

The inverse of the "Limit of Work" is the "Building Envelope" - the area in which site work is confined to. When delineating the boundary, allow work crews enough room to move around the building, but eliminate the creep of vehicles, equipment and materials into the sensitive areas of the site.



Topography	Drainage	Soils	Native Vegetation
Steep and long slopes see more erosion. Avoid the following thresholds: <ul style="list-style-type: none"> <li>• Slopes of 5-7% longer than 300'</li> <li>• Slopes of 7-15% longer than 150'</li> <li>• Slopes of more than 15% longer than 75'</li> </ul>	Retain natural drainage paths & utilize for stormwater conveyance.	Consider permeability, wetlands, depth to water table and bedrock. The most erodible soils contain high portions of silt and very fine sand and clay. Organic soils tend to decrease erosion potential.	This is the most important factor in preventing erosion. Vegetated buffers filter runoff, decrease runoff velocity and increase infiltration.



**Control Erosion** by following these practices to reduce topsoil loss and prevent off-site sedimentation damage:

- **Strategically place** erosion-control measures to reduce the cost of materials and installation
- **Use** silt fencing, checkdams, temporary and permanent drywells and cover-crop seeding
- **Use sediment trapping facilities** on large developments where significant grading is planned and where it is impossible or impractical to control erosion
- **Combine temporary and permanent measures** to save money and protect the site from erosion and loss of topsoil

**Minimize Impervious Surfaces** by following these practices to reduce the heat-island effect and infiltrate water:

- **Reduce** the length and width of roads, turnarounds and driveways
- **Combine** driveways and parking
- **Plant** islands with native species
- **Use** permeable paving on driveways, walks and parking areas
- **Incorporate** green roofs and gray-water recovery systems
- **Eliminate** curbs and gutters and direct water into planted or grass swales. Learn more about [Grassed Swales](#) in the linked fact sheet.



### **Short and Long-term Best Management Practices (BMP's) for Managing Stormwater Runoff**

Best Management Practices are effective, structural or nonstructural methods that prevent or reduce the movement of sediment, nutrients, pesticides and other pollutants from the land to surface water or groundwater, or which otherwise protect water quality. Conventional development practices typically manage stormwater with “pipe-and-pond” systems that collect rainwater and discharge it off site. However, studies show that these conventional practices are not sufficient to improve water quality. Ecological design considers stormwater management at the forefront of the process, using hydrology as an integrated framework for site design. Specifically, stormwater should be infiltrated back into the ground as close to the source as possible and it should be conveyed by vegetated landforms such as vegetated swales, filter strips, constructed wetlands and bioretention cells. These practices are well studied and easy to construct. They offer superior flood attenuation, pollution control and groundwater recharge and they can be designed to harvest water for reuse in the landscape and garden.



# design considerations

- Make 'best spots' on the land destinations
- Simplify, consolidate & reuse structures
- Bigger isn't always better. Think quality
- Minimize, reuse & consider the impacts
- Harness natural light & build efficiently
- Treat yourself to a porch or window seat
- Include edible & wildlife-friendly gardens
- Layer the landscape with suitable natives



# construction considerations

- Live in your home first & build in phases
- Establish a construction sequencing plan
- Prepare a pollution prevention plan
- Obtain permits. Work within a building envelope
- Preserve native slopes, soil & vegetation
- Build a stone driveway apron & staging area
- Stabilize soil during and after construction
- Minimize the import & export of materials



# maintenance considerations

- Keep your septic system in working order
- Reduce lawn, pull invasives & plant natives
- Build pervious walkways, patios & driveways
- Employ organic land-care practices
- Keep fertilizers from fertilizing waterways
- Compost and keep biomass on your property
- Apply salt & sand judiciously

# Resources

## BOOKS

Wasowski, Andy. Building Inside Nature's Envelope. New York: Oxford Press, 2000. USGBC.

New Construction & Major Renovation Reference Guide. Washington, DC, 2006.

Massachusetts Stormwater Technical Handbook (Volume 2). <http://www.stormwatercenter.net>

Town of Franklin, MA. Best Development Practices Guidebook. Version 1, November 2001.

Wisconsin Stormwater Manual. Grassed Swales. University of Wisconsin-Extension, 2000.

US EPA Water Quality Research (<http://www.epa.gov/ednrmrl/repository/abstrac2/abstra2.htm>). EPA Pesticides Page (<http://www.epa.gov/pesticides/>). Field Evaluation of Permeable Pavements for Stormwater Management (<http://www.epa.gov/owow/nps/pavements.pdf>).

UNH Center (<http://www.unh.edu/erg/unh-stormwater-center>).

## WEBSITES

EPA Green Infrastructure. <http://water.epa.gov/infrastructure/greeninfrastructure/index.cfm>

EPA Stormwater Outreach Materials. <http://cfpub.epa.gov/npdes/stormwatermonth.cfm#cgpfactsheet>

Metropolitan Area Planning Council. [mapc.org/resources/low-impact-dev-toolkit](http://mapc.org/resources/low-impact-dev-toolkit)

Smart Growth Online. [smartgrowth.org](http://smartgrowth.org)

Smart Growth Online Audio. [smartgrowthonlineaudio.org](http://smartgrowthonlineaudio.org)

U.S Green Building Council. [usgbc.org](http://usgbc.org)

## OTHER

Make Your Home the Solution to Stormwater Pollution Brochure Provides tips on a wide variety of simple things that homeowner's can do to prevent stormwater pollution.

Guide for Sustainable Landscaping and Water Smart Templates

Does Your Construction Site Need a Stormwater Permit? A Construction Site Operator's Guide to EPA's Stormwater Permit Program Provides construction companies with a brief overview of EPA's Construction General Permit (CGP) and its requirements for sites disturbing one acre or more.

MA DEP – Wetlands and Waterways