NEMO

Developing A Sustainable Community

A Guide to Help Connecticut Communities Craft Plans and Regulations that Protect Water Quality

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COLLEGE OF AGRICULTURE AND NATURAL RESOURCES

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Introduction

Many communities around Connecticut are interested in a more sustainable approach to development. Though there are many considerations, the protection of natural resources, particularly water resources, is a key component to attaining a more sustainable community. The specific practices you need to implement to protect these resources, and how you integrate them into your town' s regulations, is challenging. It is often hard to know where to start.

This guide is meant as a way to take the information you have gotten from NEMO education and help you focus on where these practices can be integrated into your town's regulations. The guide is general in nature and we leave it to you, your town attorney and, ultimately, the public to decide on the standards for your community. The key is to start identifying areas of the regulations you would like to target.

An approach to stormwater management: The Runoff Reduction Method

Water is the great integrator. It ties how we use the land to the quality and health of our town's aquatic resources. As your town's landscape moves from it's natural land cover of trees and fields to a more developed land of parking lots and rooftops, the quality of your local streams and ponds become degraded. This is tied to the increased surface runoff from the impervious surfaces that are an integral part of the developed landscape.

How do you manage this increased runoff? The NEMO program suggests a three-step approach to managing stormwater. This approach is based on the work of stormwater professionals over several decades (CWP, 2008) and is called the Runoff Reduction Method. It focuses first on the site planning process and only secondarily on the use of best management practices:

1. *Site-Sensitive Design* – The first step in minimizing runoff is to reduce the impact of development on the natural landscape. Minimize soil disturbance and conserve or replace tree cover to the maximum extent possible. The pre-development landscape knows how to deal with precipitation and limits the amount of runoff generated. Protecting and preserving as much of that original landscape, therefore, means you will not have to deal with as much stormwater from the site.

2. *Runoff Reduction Practices* – Reducing the total quantity of stormwater runoff coming off a site, reduces the impacts of "peak flow" discharges on local streams and reduces the total amount of pollutants leaving the site. Simple practices, like disconnecting impervious surfaces from the stormwater drainage system by diverting runoff to open, pervious areas on the site, have huge benefits. Newer site design/stormwater management techniques, such as low impact development (LID), can also reduce total runoff significantly.

3. *Pollutant Removal Practices* – For runoff that does come off the site, a set of treatment practices should be designed to capture and treat pollutants. A number of engineered practices can be utilized, such as stormwater wetlands, gravel wetlands or wet ponds. LID practices also have a high degree of pollutant treatment. So emphasizing LID in your stormwater management strategy can give your town a real leg up in developing sustainable development practices.

What needs to be changed?

Certainly changing regulations is important if you want to effect long-term change in your community. But that isn't necessarily the place to start...or finish. When looking to make changes in your community we suggest the below approach:

1. *Plan of Conservation and Development* – Your town's plan is the basis for all decision making in your town. Therefore it is a good idea to make sure that the sustainable goals you wish to achieve are articulated in the plan. By state statute the plan must be reviewed at least every 10 years, but this should not preclude changes to be made before the deadlines elapse. Make sure you get a copy of your town's plan and see what it says for natural resources, such as water. It could well be the specific goals are already articulated.

2. *Land use regulations* – The primary regulations you will review are the ***zoning*** and ***subdivision*** regulations. They provide the standards by which new development must abide. Your town may also have other ordinances that are important. For example, some communities have separate ***road ordinances*** or ***stormwater management ordinances*** that will be important in addressing water quality issues. Generally, any town regulation and/or ordinance that provides standards for development and the generation of impervious surfaces should be considered.

3. *Town Practices and Facilities* – Beyond the plan and regulations, how the town "does business" and maintains its facilities and infrastructure has an enormous impact on water and natural resource quality. Make sure you include key town departments in the discussion and incorporate their concerns into your planning and regulatory processes. Advocate for adequate funding for longterm maintenance. And encourage continuing education for all town staff so they can learn about new techniques and practices that protect water quality and public safety.

Using this Guide

This guide outlines specific practices that will help protect water quality and natural resources. Each practice provides a brief description, specific recommendations, rationale and potential concerns. The specific regulation (i.e. zoning, subdivision) where the standards for this practice would be found is mentioned, though there can be variability between towns. Also, towns who have addressed this practice in their regulations will be listed. Example regulations for many towns can be found in the NEMO's Low Impact Development (LID) Regulation Database (http://nemo.uconn.edu/tools/lidregs/). This should help you get started to make these important changes in your community.

Good luck!

Recommended Site Planning & Development Practices

1. Residential Streets and Parking

Practice #1: Street Width

Design residential streets for the minimum required pavement width needed to support travel lanes, on-street parking, emergency services and maintenance access.

Rationale

Residential streets are often designed to be overly wide. This excessive width is one of the chief components of impervious cover in a new residential developments (Center for Watershed Protection, 1998). Encouraging the use of narrower streets can reduce total impervious cover in a development significantly, while promoting lower vehicular speeds and increased safety.

Many Connecticut towns have tied the width of residential streets to the amount of vehicular traffic generated by a development. The latest AASHTO standards for Local Roads and Streets of less than 400 average daily trips allow for a total minimum width of the traveled way of 20 feet and a shoulder width of 2 feet when the design speed is 50 mph or less (see Figure 1).

Recommendation

1. Reduce the minimum required street pavement width for new subdivision roads to follow the latest American Association of State Highway and Transportation Officials (AASHTO) standards for local roads (Figure 1). Road width should be related to the volume of traffic and traffic speed.

	Figure 1. Minimum width of traveled way (feet) for specified design volume (vehicles/day)			
Design Speed (miles per hour)	Under 400	400 to 1500	1500 to 2000	Over 2000
15	**18**	20	20	22
20	**18**	20	22	24
25	**18**	20	22	24
30	**18**	20	22	24
40	**18**	20	22	24
45	**20**	22	22	24
50	20	22	22	24
55	22	22	24	24
60	22	22	24	24
	Width of graded shoulder on each side of road (feet)			
All Speeds	2	5	6	8

From: *A Policy on Geometric Design of Highways and Streets*, 2004, by the American Association of State Highway and Transportation Officials, Washington, D.C.

2. New roads should include shoulders designed to AASHTO standards that are a minimum of 2 feet. Road shoulders will be designed to be able to support parked vehicles.

Things to Consider

1. On-street parking may be an issue on roads less than 24 feet, particularly with emergency vehicles. Curbless road design with graded and supported shoulders could address this issue (see Practice #4).

2. Areas with steep slopes would need curb to protect downhill properties.

3. Lots with steep driveways may need area for on-street parking.

4. Transition areas between curbed/non-curbed roads need to be carefully designed to accommodate snow plowing.

Case Studies

From the CT LID Regulation Inventory ((http://clear.uconn.edu/tools/lid_reg/)

- East Haddam- Subdivision, Section 5.10 (Street Specifications)
- Tolland – LID Design Manual, Section II (Section II - Road and General Drainage Standards)

Practice #2: Cul-de-Sacs

Minimize the number of residential cul-de-sacs and, where they do exist, incorporate landscaped areas to reduce impervious cover and encourage infiltration of stormwater runoff. The radius should be the minimum required to accommodate emergency/maintenance vehicles. Alternative turnarounds should be considered.

Rationale

The most recent AASHTO (2004) guidelines include dimensions for traditional and alternative cul-de-sac designs for single-unit delivery trucks, that include landscaped islands. Landscaped islands designed for stormwater management can be used for snow storage, stormwater infiltration and treatment.

Recommendation

1. Consider revising road standards to allow the use of alternative turnarounds and cul-de-sac design (see Figure 3 as example). In Connecticut the "tear drop" design was used in the Glen Brook Green subdivision in Waterford.

Figure 2. The "tear drop" cul-de-sac design used in the Glen Brook Green Subdivision

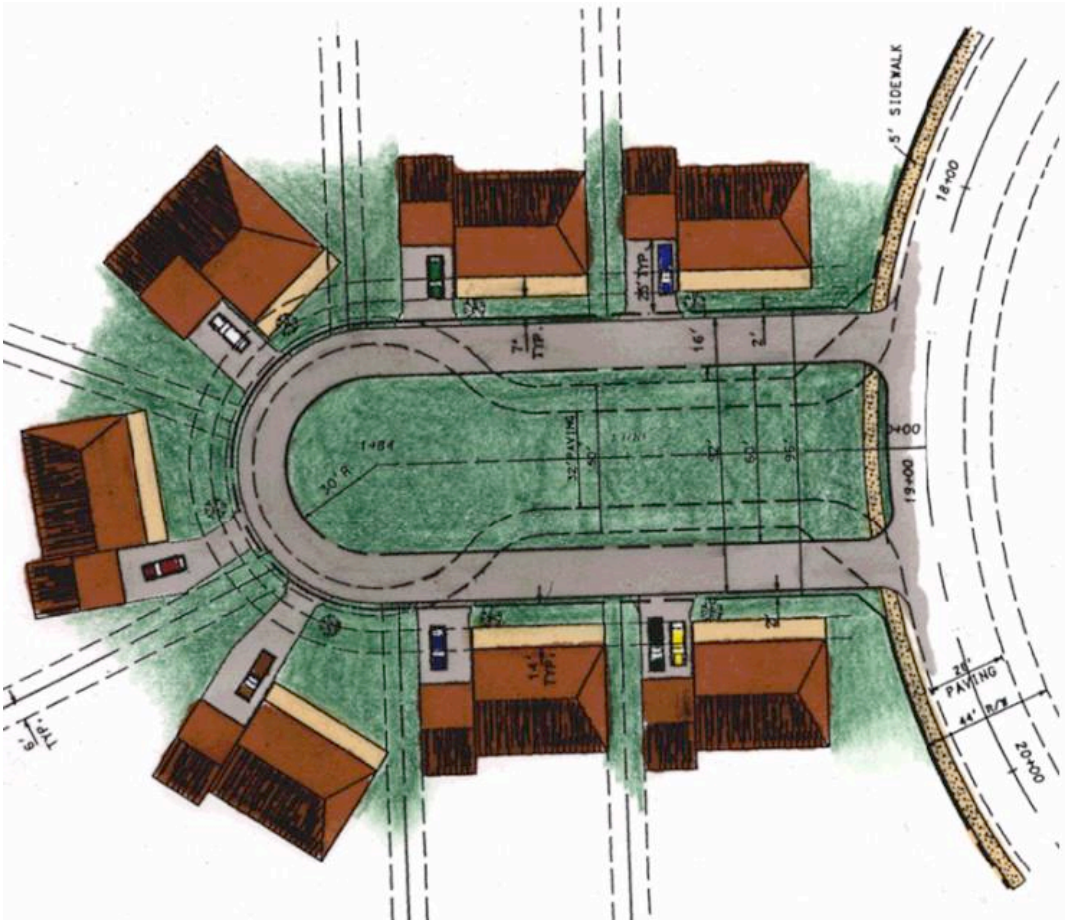

Figure 3. An alternative cul-de-sac design, termed a "loop de lane," is designed to be a one way loop roads. A conventional cul-de-sac design is shown with dotted lines.
Source: Center for Watershed Protection, 2000.

This design, with a vegetated center island that accepts stormwater, provides for the needs of both emergency services and public works. (See Figure 2)

2. The standards should emphasize the reduction in cul-de-sac width and installation of a “sunken” vegetated center island. Where feasible, stormwater management practices, such as bioretention, should be used in these areas. Design of bioretention areas, including sizing and planting, should follow the guidance of the 2004 CT Stormwater Quality Manual, as amended.

Things to Consider

1. Placement of fire hydrants within the cul-de-sac is critical and should be specified within the road standards.

2. Responsibility for the care of the landscaped turnarounds should be clearly determined.

Case Studies

From the CT LID Regulation Inventory ((http://clear.uconn.edu/tools/lid_reg/)

- Tolland – LID Design Manual, Section II (I. Road Design)

- Jordan Cove Project, Waterford, CT (http://jordancove.uconn.edu)

Practice #3: Road Drainage

Where density, topography, soil and slopes permit, vegetated swales should be used in the street right-of-way to convey and treat stormwater runoff, replacing curb and gutter drainage systems.

Rationale

Vegetated swales are beneficial for treatment of stormwater runoff. According to research, residential streets contribute higher loads of pollutants than any other source area (Bannerman, et al., 1993). Swales can reduce the pollutant loads from road runoff considerably, while reducing the quantity of stormwater by allowing infiltration into the ground. The use of a water quality swale design that encourages infiltration of runoff into the ground would also reduce the number and size of detention basins.

Swales can also save money, both during development through the avoidance of costly infrastructure and during long-term maintenance that no longer requires expensive equipment for sediment removal from storm drains.

Recommendation

1. Change the town's subdivision and/or road standards to allow the use of vegetated swales where practical.

2. The design of these swales should be of a level to include primary stormwater quality treatment, and should follow the standards set forth for water quality swales in the 2004 CT Stormwater Quality Manual (see Figure 4).

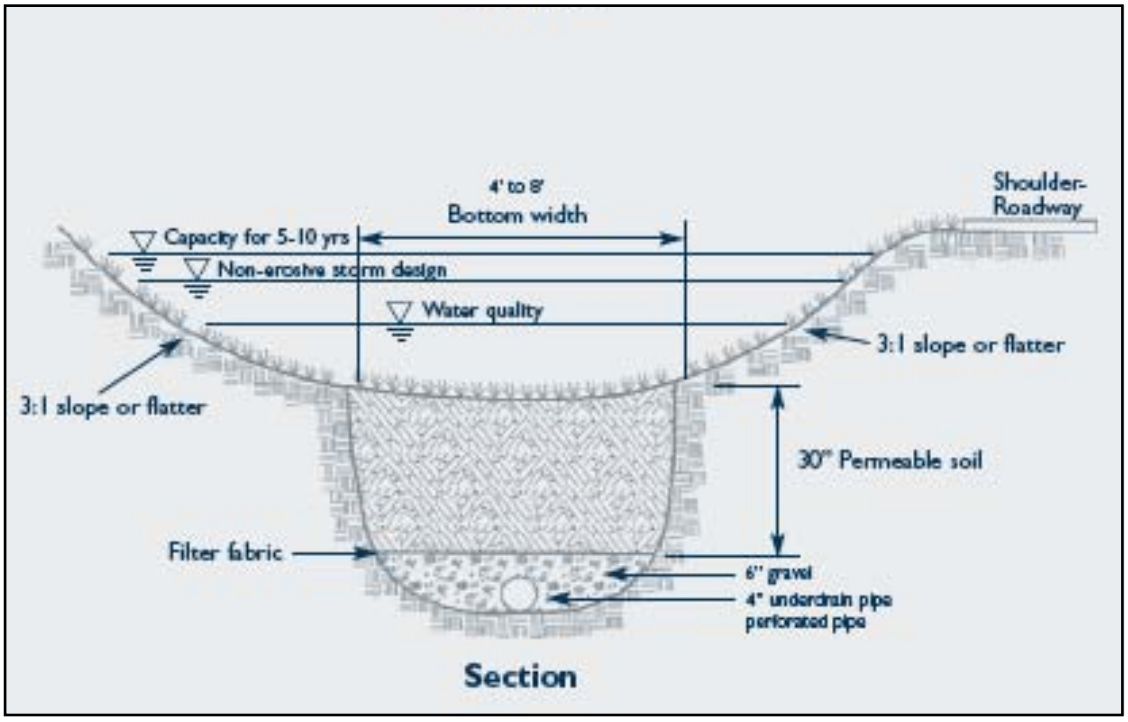

Figure 4. Cross-section of a dry water quality swale from the 2004 CT Stormwater Quality Manual.

Things to Consider

1. Design of the roadway/shoulder interface should limit the likelihood of vegetation creating a "grassed curb" that will inhibit roadway drainage from entering the swale. Proper roadside pitch or the use of a gravel diaphragm should be used.

2. A determination should be made of how much “credit” a design engineer can get in terms of reduced detention requirements when they incorporate these LID practices.

Case Studies

From the CT LID Regulation Inventory ((http://clear.uconn.edu/tools/lid_reg/)

- East Haddam- Subdivision, Section 5.10 (Street Specifications)
- Tolland – LID Design Manual, Section II (Section II - Road and General Drainage Standards)

Figure 5. Road swale in a subdivision in Old Saybrook, CT

Practice #4: Parking Ratios/ Parking Lot Size

Required parking ratios governing a particular land use or activity should be enforced as both a maximum and a minimum in order to curb excess parking construction. Existing regulations should be reviewed for conformance with local/regional standards. Further, reduce the overall imperviousness associated with parking lots by minimizing stall dimensions and incorporating efficient parking lanes.

Rationale

Parking is by far the largest component of impervious coverage in commercial and industrial land uses. Designing parking lots to their peak efficiency will, therefore, both satisfy the parking needs of the given land use, while minimizing the impact of the resulting impervious surface on water resources.

A recent study, "Model Zoning Regulations for Parking for Northwestern Connecticut" (Fitzgerald & Halliday, 2003), has provided specific recommendations and standards based on a parking utilization study of 20 towns in northwestern Connecticut. This study found that parking in that region was considerably overbuilt with utilization rates below 50%. Given that parking lots contribute significantly to the impervious cover of a region, matching parking ratios to actual usage would lower the impacts of these land uses on water quality and quantity.

Recommendation

1. Review and revise the zoning requirements based on the locally derived parking ratios.

2. The review of parking ratios should consider including both minimum and maximum parking standards for each land use.

3. Consider a review of drive-up window standards to assure that the designed queue length is not overly long.

4. Review the parking requirements and standards in the zoning regulations. The Northwestern CT parking study has specific recommendations for parking layouts that recommend the use of angled parking with narrower aisle widths.

Case Studies

From the CT LID Regulation Inventory ((http://clear.uconn.edu/tools/lid_reg/)

- East Haddam- Zoning Regulations, Section 11 (Parking)
- Enfield Zoning Regulation, Section 10.10.6 (Parking Design, Layout, and Location)
- Tolland – LID Design Manual, Section II (Section II - Road and General Drainage Standards)
- Model Zoning Regulations for Parking for Northwestern CT (available at http://nemo.uconn.edu/tools/stormwater/parking_lots.htm)

Practice #5: Parking Lot Runoff/Alternative Surfaces

Wherever possible, provide stormwater treatment for parking lot runoff using bioretention areas, filter strips and/or other practices that can be integrated into required landscaping areas and traffic islands

Rationale

Research has found that parking lots contribute high levels of contaminants in runoff and produce high quantities of runoff. Stormwater treatment in landscaped areas can reduce the impacts of these water quality and quantity impairments on local water resources, without significantly affecting the cost of construction. Pervious pavements can reduce the overall volume of stormwater runoff, while preserving valuable land area on the site.

Recommendation

1. Applicable sections of the zoning regulations should set standards for landscaping that ensure that landscape islands or areas are either at-grade or below-grade, to accept parking lot runoff, using stormwater practices such as bioretention, swales and sand filters.

2. Pervious pavements materials have been used in several projects in Connecticut. The continued use of these products in primary and overflow parking areas should be encouraged. The Northwestern CT parking study has developed code language to encourage pervious pavement materials for parking areas.

3. The Northwestern Connecticut parking study (Fitzgerald & Halliday, 2003) provided code language on stormwater management and landscaping for parking lots.

Case Studies:

From the CT LID Regulation Inventory ((http://clear.uconn.edu/tools/lid_reg/)

- East Haddam Zoning Regulations, Section 11.8.c (Landscaping Standards for Parking Lots Stormwater Management)
- Deep River Zoning Regulations, Section 11.12 Stormwater Management in Parking Lots
- Northwestern CT Parking Study (available at http://nemo.uconn.edu/tools/stormwater/parking_lots.htm)

Figure 6. Bioretention practices used to accept and treat stormwater from parking areas in Portland, Oregon (left) and Evergreen Walk Mall in Manchester, CT (Right).

Figure 7. Overflow lot at L&M Hospital out-patient facility in Old Saybrook.

Figure 8. A porous asphalt parking lot at the University of Connecticut. This 106 car lot significantly reduces runoff that would come off a traditional asphalt lot.

Figure 9. A bioretention area at the Waterford Town Hall parking lot. Simple landscaping practices such as these can treat parking lot runoff while reducing stormwater volume leaving the site.

2. Lot Development Practices

Practice #6: Conservation Subdivision Design

Encourage development designs that minimize total impervious area, reduce total construction costs, conserve natural areas, provide community recreational space and promote watershed protection.

Rationale

Conservation subdivisions provide a key way to protect natural resources while still providing land owners the ability to use the development potential of their lands. These subdivisions have been in wide usage in Connecticut and have been found to be beneficial to both developers and the environment. To be effective, however, the regulations need to be carefully crafted to ensure that the full benefit of this technique is realized. In particular, allowing conservation subdivisions "by right" and/or allowing the commissions the ability to decide the type of subdivision (conservation vs traditional) will greatly expand the usage of these subdivisions.

Recommendation

1. Clearly define a conservation design process that identifies and preserves key natural or cultural resources on the property through the use of a site inventory.

2. A review of the mathematical process for the determination of lots needs to be done to assure that the number of lots approved for cluster subdivision does not exceed the traditional subdivision allowance. A lot yield plan should be equitable for both types of development.

3. Include a goal of reducing the amount of impervious surface and protecting water resources in the purpose section of your regulations.

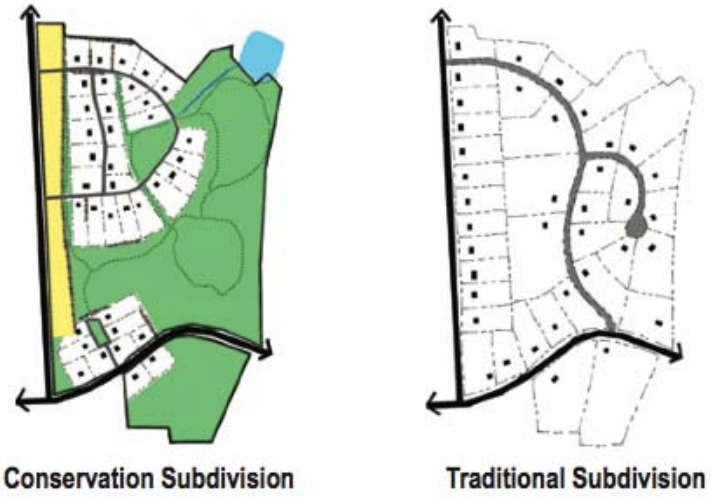

Figure 10. Conservation subdivision design conserves open lands and protects natural resources. Drawing by Green Valley Institute, UConn

4. Potentially include both minimum and maximum lot sizes in the cluster subdivision regulations.

5. Flag lots are often allowed in cluster subdivision, but can reduce the value of these designs. Flag lots should be used only where they would minimize the impact on the overall open space.

6. Be clear in your regulation when the conservation design process will and will not be used. Determine who makes this choice, the commission or the applicant.

Things to Consider

1. The ownership responsibilities of the resulting open space needs to be carefully considered, and any town acceptance should be tied to the town's open space plan.

2. Lots can be cluster only insofar as the land can accept the increased density. In areas without public sewer and water, this means that adequate area exists for both on-site utilities, or the development of a community system.

Resources and Case Studies

To find out more about the conservation subdivision design process, refer to Randall Arendt's series on conservation design:

Arendt, Randall. 1996. Conservation Design for Subdivisions: A practical guide to creating open space networks. Island Press. 184pp

Arendt, Randall. 1999. Growing Greener: putting conservation into local plans and ordinances. Island Press. 236pp

Many towns in Connecticut are using a modified conservation subdivision design process. Below are a few who have taken different approaches to the process:

- Haddam – any subdivision over 5 lots must be a conservation subdivision. http://www.haddam.org/landuse/zon%204.pdf
- East Haddam – any subdivision over 4 lots must submit both a preliminary traditional and conservation design for an informal review. The commission can then choose which design the applicant should pursue.
- Woodstock – only conservation subdivisions permitted as of right; no legal challenge to date. http://www.townofwoodstock.com/Portals/0/Docs/Woodstock%20Zoning%20Regs%20Effective%2008-17-2007.pdf see pg. 43
- Ledyard can choose to mandate cluster subdivisions depending on the circumstances.
- Mansfield retains a right to require a cluster subdivision but each submission is reviewed on a case by case basis.
- South Windsor mandates cluster subdivisions if the property to be subdivided is shown in one of the town's master plans as desired for conservation/preservation.
- Farmington mandates cluster if the property contains certain natural or man-made resources found on a list contained in our regulations. http://www.farmington-ct.org/downloads/Zoning%20Regulations.pdf see pg 71
- Somers adopted an Open Space Subdivision Zoning and Subdivision Regulation that allows open space subdivisions as of right. The Planning Commission determines whether the applicant should revert back to conventional subdivision if there are mitigating circumstances. The application is a regular subdivision application, no Special Permits.

Practice #7: Setbacks and Frontages

Relax side yard setbacks and allow narrower frontages to reduce total road length in the community and overall site imperviousness. Relax front setback requirements to minimize driveway lengths and reduce lot imperviousness.

Rationale

Lot dimension and size are set by the zoning regulations and can have a profound effect on the design of subdivisions and the amount of impervious surface. Minimum setbacks and frontages can increase impervious cover by dictating how far houses are from the street thus determining driveway length, or by dictating lot width thus determining the length of road needed to serve the lot. Smaller setbacks and frontage distances can reduce the overall imperviousness of a site and provide more flexibility to site designers.

Recommendations

1. Review existing zones to see if frontages and setbacks can be relaxed. All reviews must consider the importance of including some on-site parking.

2. The zoning regulations that govern development in historic village areas need revisions to encourage infill in the historic areas. The town should consider a flexible setback/frontage regulation that focuses on matching the existing lot dimensions of the area.

Things to Consider

1. Adequate room must be provided on each lot for on-site parking

Case Studies

Connecticut Village District Zoning - adopted by the Connecticut General Assembly in 1998, this zoning tool allows you to develop flexible setback and frontage requirements for designated zones. Village Districts are specifically designed for “historic” areas and have many other design-based standards, however, the concepts used for dimensional lot requirements could be applied to other zones in your town.

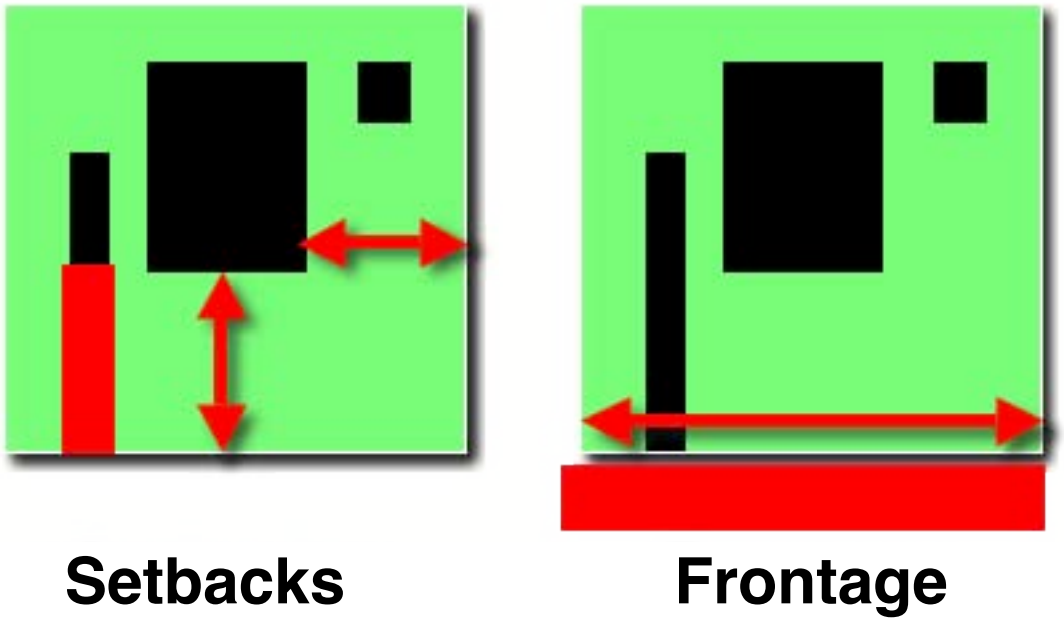

Figure 11. Diagram showing the setback and frontages of a typical house lot.

Practice #8: Sidewalks

Promote more flexible design standards for residential sidewalks on only one side of the street and provide common walkways linking pedestrian areas.

Rationale

Sidewalks are a necessary component of a residential area, tying residents to critical cultural centers and reducing dependence on automobiles. Sidewalks are, however, a component of the impervious budget of a development so have a clear sidewalk plan that eliminates isolated and duplicative walkways is important to reducing the overall imperviousness of a site.

Recommendation

1. Consider creating or revising a sidewalk master plan . Ensure connectivity of pedestrian pathways and avoid the creation of isolated, unnecessary sidewalks.

2. Separate pedestrian pathways (paved or non-paved) from established road ROW should be encouraged where feasible as an alternative to sidewalks

3. Encourage the use of pervious pavement where practical, or divert sheet flow from sidewalks to pervious areas.

Practice #9: Driveways

Reduce overall lot imperviousness by promoting alternative driveway surfaces and shared driveways that connect two or more homes together.

Rationale

Studies by the Center for Watershed Protection (1998) have shown that 20% of the impervious cover in residential subdivisions can consist of driveways. Flexibility in the codes allow site designers the ability to address this concern while minimizing impervious surfaces.

Recommendation

1. Allow for the use of shared parking as an option, particularly in areas where reducing impervious cover is a concern.

2. Allow for the installation of pervious pavements that are appropriately constructed to support delivery and emergency vehicles.

Things to Consider

1. Driveways need to provide emergency vehicle access to homesites

2. Many driveways have slopes greater than 10% which could be a challenge to the proper function of pervious pavements. The performance of pervious pavements in these conditions should be demonstrated.

3. The long-term maintenance of shared driveways need to be considered and included in the property documents of the homeowners in order to avoid neighbor-to-neighbor conflicts.

Figure 12. Unilock paver driveway in Middletown, CT. The space between the pavers allows water to infiltrate to a stone base that allows the storage and infiltration of water.

Figure 13. A two track driveway design, once common in early residential development, reduces the total imperviousness of the drive, while preserving the function.

Practice #10: Roof Runoff

Direct roof runoff to pervious areas such as yards, open channels or vegetated areas and avoid routing rooftop runoff to the roadway and the stormwater conveyance system.

Rationale

Rooftop runoff contributes significantly to the quantity of stormwater leaving a site. Bioretention areas, infiltration practices and rain barrels installed on individual lots can reduce the annual volume from residential development by up to 50%.

Recommendation

1. Where practical and feasible, require that drainage of rooftop runoff be directed into rain gardens or a suitable designed and landscaped area on the property.

2. Encourage the use of on-lot stormwater treatment practices such as bioretention areas and rain gardens, vegetated swales, infiltration practices and rain barrels or cisterns.

Things to Consider

1. Developers and engineers should be referred to the 2004 Connecticut Stormwater Quality Manual for design specifications.

2. Management responsibility and management schedules for these on-lot stormwater practices should be included with the approved plans.

Figure 14. Use of a rain garden, or bioretention basin, to accept roof runoff from two homes in the Glen Brook Green subdivision in Waterford. Other techniques include the use of rain barrels and cisterns for water storage and use for landscape watering.

Practice # 11: Stormwater Management Plans

As a minimum, a stormwater management plan (SMP) should be required for sites that have disturbance equal to or greater than 1 acre, as proposed by the CT Stormwater Quality Manual. The purpose of the plan is to identify potential water quality and quantity impacts of the proposed development, and to propose selected source controls and treatment practices to mitigate against those impacts.

Rationale:

Stormwater contains pollutants that have detrimental effects on ecological processes and coastal habitats. In order to preserve these habitats and processes, new development and redevelopment must delineate a specific plan on how water resources will be protected from the deleterious effects of stormwater in both the short- and long-term.

Recommendation:

1. The regulations, particularly subdivision and uses requiring a site plan or a erosion and sedimentation plan, should lower the threshold of land disturbance for triggering a SMP to 0.5 acres.
2. SMPs should also be required for: greater than 5 residential units, residential development involving the construction or reconstruction of a road, stormwater discharges to wetlands/watercourses or less than 500-feet from a tidal wetlands, and land uses with a potential for higher pollutant loadings such as industrial or certain commercial uses.
3. The SMP should follow the goals, criteria and suggested content found in the 2004 Connecticut Stormwater Manual.
4. The SMP can be enacted by inclusion in subdivision and zoning, or by enacting a separate stormwater ordinance. Regardless, the SMP should be prepared by a licensed civil engineer.

Case Studies:

From the CT LID Regulation Inventory ((http://clear.uconn.edu/tools/lid_reg/)

- East Haddam Zoning Regulations, Section 11.8 (Stormwater Management)
- Guilford Zoning Regulations, Section 273-75 F.3
- Torrington Subdivision Regulations, Section 7.0 (Stormwater Management)

3. Conservation of Natural Areas

Practice # 12: Buffer Systems and Management

Create a naturally vegetated buffer system along all water resources that also encompasses critical environmental features such as the 100-year floodplain, steep slopes and wetlands. The riparian stream buffer should be preserved or restored with native vegetation. The buffer system should be maintained through the plan review, delineation, construction and post-development stages.

Rationale:

Riparian buffers provide a number of ecological, water quality and economic benefits, including:

1. Filter sediments, nutrients, pesticides and other pollutants in runoff.
2. Provide for infiltration of stormwater runoff.
3. Reduce erosion and stabilized both the stream banks and bed.
4. Provide flood control.
5. Increase property values.
6. Provide shade, which helps keep summer water temperatures cool. This is of importance to a number of native fish and other aquatic species.
7. Provide food and habitat for a number of terrestrial and aquatic life.
8. Protect quality of drinking water supplies.
9. Helps maintain stream flows in summer.
10. Provide linear natural areas which provide valuable habitat for mammals, reptiles, amphibians and birds.
11. Support recreation and tourism industries by providing pleasant areas to fish and enjoy streams.
12. Allow for future restoration of stream banks.

To be truly effective buffer management must be more than a physical setback line. Effective management will provide strategies that help to maintain a healthy riparian ecosystem, and allow for good communication between land owners, developers and the town commissions and staff.

Recommendation:

A study of the town's riparian and coastal buffers should be conducted by the town's environmental staff or a consultant. The study should detail the existing condition of these buffer systems and will make recommendations on how to protect and/or restore these systems.

References and Case Studies:

To learn the status of riparian buffers in your town or local watersheds, visit NEMO's Habitat website tools (http://nemo.uconn.edu/tools/)

Eightmile River Watershed Buffer Recommendations (http://www.eightmileriver.org)

Practice # 13: Clearing and Grading

Clearing and grading of forests and native vegetation at a site should be limited to the minimum amount needed to build lots, allow access, and provide fire protection.

Rationale:

Conservation of natural areas and existing hydrology within a development site through site fingerprinting and LID techniques can reduce erosion and sedimentation as well as clearing and grading costs, while maintaining natural features of the site and protecting environmentally sensitive areas. LID integrates site ecological and environmental goals and requirements into all phases of planning and design from the individual residential lot level to the entire watershed. LID is based on maintaining or restoring the hydrologic integrity and functions of each site using small-scale source controls that are designed to address specific water quality objectives.

Recommendation:

1. Ensure that clearing, grading and tree preservation requirements are delineated both on project plans and in the field.
2. The cluster/conservation subdivision regulations should be reviewed to ensure they protect natural areas and to the extent practical promote "site fingerprinting." All subdivisions should first clearly identify environmentally sensitive areas (wetlands, streams, steep slopes) and second confine ground disturbance to areas where structures, roads, rights-of way and other infrastructure will be completed.
3. Low impact development (LID) techniques (as discussed earlier) should be encouraged within the building envelope so as to minimize additional clearing or grading.

Practice # 14: Tree Conservation & Use of Native Plants

Conserve trees and other vegetation at each development by protecting trees and other vegetation during construction and by planting additional vegetation, clustering tree areas, minimizing native vegetation disturbance, and promoting the use of native plants.

Rationale:

Trees and native grasses help to mitigate the effects of urban runoff, air pollution and noise. Native trees, shrubs and grasses generally are better adapted to Connecticut's climate than non-native species and do not have a deleterious effect on the environment. This can, in turn, provide direct economic benefits to developers and homeowners by reducing runoff and keeping houses cool in the summer.

Recommendation:

1. Review all pertinent sections of the regulations that require landscaping and require the use of native tree and shrub species as outlined in the CT DEP Stormwater Quality Manual or from urban forestry experts.
2. Provide an invasive species plant list to homeowners and developers to discourage the use of invasive plant and/or non-native species in landscape design. The list should be in compliance with the Connecticut Invasive Plant Working Groups amended list of invasive plants.
3. Ensure that your regulations provide guidance on the protection of specimen trees. Contact the UConn or DEP Urban Forestry programs for further information.

Case Study:

Torrington, Subdivision Regulations, Sections 5.6 (Street Trees) and 5.7 (Preservation of Natural Features) ((http://clear.uconn.edu/tools/lid_reg/)

Regulation Checklist

Use the table below to assess your town regulations compliance with the proceeding practices. If the practice exists in your regulations, note the section number. If not, note where it could be inserted and make any comments you feel with help to improve your town's regulations.

Practice #	Practice Description	How Regulated*	Addressed?/ Reference	Comments
1	Street Width	Subdivision or Street Ordinance		
2	Cul-de-Sacs	Subdivision or Street Ordinance		
3	Road Drainage	Subdivision or Street Ordinance		
4	Parking	Zoning		
5	Parking Runoff	Zoning		
6	Conservation Subdivision	Zoning and Subdivision		
7	Setbacks/Frontages	Zoning		
8	Sidewalks	Subdivision		
9	Driveways	Subdivision		
10	Roof Runoff	Subdivision or Stormwater Ordinance		
11	Stormwater Management Plans	Subdivision or Stormwater Ordinance		
12	Buffer Systems	Zoning and Subdivision		
13	Clearing and Grading	Zoning and Subdivision		
14	Tree Conservation	Zoning and Subdivision		

*Regulations vary from town-to-town, so some of the practices may be addressed in other sections of your regulations or in separate ordinances.

References and Further Reading

American Association of State Highway and Transportation Officials (AASHTO). A Policy on Geometric Design of Highways and Streets, Washington, D.C., 2004

Arnold, C. and C.J. Gibbons. 1996. Impervious Surface: The Emergence of a Key Environmental Indicator. Journal of the American Planning Association,

Bannerman, et al. 1993. Sources of Pollutants in Wisconsin Stormwater. Water Science Technology, 28(3-5): 241-259.

Center for Watershed Protection. Technical Memorandum: The Runoff Reduction Method. Ellicott City, MD. 2008

Center for Watershed Protection. Impacts of Impervious Cover on Aquatic Systems. Ellicott City, MD. 2003.

Center for Watershed Protection. Better Site Design: A Handbook for Changing Development Rules in Your Community. Ellicott City, MD. 1998.

Connecticut Department of Environmental Protection. Connecticut Stormwater Quality Manual. Hartford, CT. 2004

Fitzgerald & Halliday, Inc. Model Zoning Regulations for Parking for Northwestern Connecticut. Northwestern Connecticut Council of Governments and Litchfield Hills Council of Elected Officials. 2003. *(available on the Planning for Stormwater website, below, or the Fitzgerld & Halliday website).*

Nonpoint Education for Municipal Officials (NEMO). Addressing Imperviousness in Plans, Site Design and Land Use Regulations. 1998

Websites

Planning for Stormwater (http://nemo.uconn.edu/tools/stormwater/)

Connecticut LID Inventory (http://nemo.uconn.edu/tools/lid)

Connecticut LID Regulations Inventory (http://nemo.uconn.edu/tools/lid_regs)

Connecticut Habitat Tools: (http://nemo.uconn.edu/tools/habitat/)

Jordan Cove Website (http://jordancove.uconn.edu)

Center for Watershed Protection (http://www.cwp.org)