Appendix 3: Impervious Cover in Connecticut Municipalities

Contents

Connecticut's Changing Landscape developed by CLEAR

> ***Land cover*** *is what's on the surface of the earth (forest, wetland), as opposed to land use, which is what is planned, practiced or permitted (park, wildlife sanctuary).*

For towns and municipalities that would like more details about their local land cover by municipality, the Center for Land Use Education and Research (CLEAR) has developed a website that includes land cover maps for all 169 municipalities in Connecticut. Connecticut's Changing Landscape (http://clear.uconn.edu/projects/landscape/index.htm) provides basic land cover information about changes to developed, forest and agricultural lands during the period 1985 to 2006. Five directly comparable land cover datasets (derived from satellite data), from 1985, 1990, 1995, 2002 and 2006, allow users to look at, and quantify, landscape change in their town.

Figure 1 shows land cover across the state in 2006 on the left and the change to developed land from 1985 to 2006 on the right. If all of the developed land in Connecticut was clumped together in a square, it would cover the area shown. The smaller square represents all area that was changed to developed between 1985

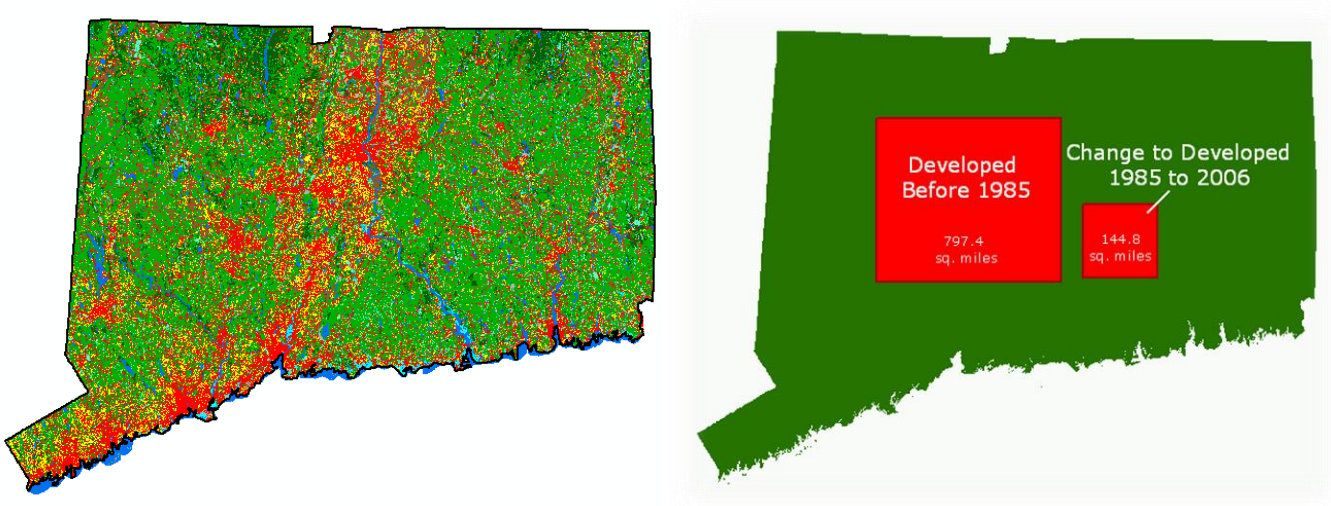

Figure 1: *2006 Statewide Land Cover in Connecticut (left) and the Change in Developed Land in Connecticut from pre-1985 to 2006.*

and 2006. For this project, CLEAR defines developed land as high-density built-up areas typically associated with commercial, industrial and residential activities and transportation routes. These areas can be expected to contain a significant amount of impervious surfaces, roofs, roads, and other concrete and asphalt surfaces.

While the images are useful and instructive, it is still a picture, and the technology for assessing land cover and IC is always changing; more recent data become available periodically. The resultant land cover data, however, can be quantified to show overall land cover patterns.

To access land cover maps specific to your town or municipality:

- Go to: http://clear.uconn.edu/projects/landscape/your/town.asp
- Select your town by clicking on the map or with the pull-down menu. Then press Go.

This page contains static maps and area statistics (scroll down) for all five dates of land cover and for all 169 municipalities in Connecticut. The 1985 and 2006 land cover maps, as well as both change maps, have pdfs for viewing, saving and printing. Don't miss the Interactive Map where you can view all the maps and control the zoom and extent of your view.

Tools for Calculating Impervious Surface

Below are examples of tools that utilize modeling methods to generate impervious surface estimates.

Estimation Tool for Impervious Surfaces

The Estimation Tool for Impervious Surface (ETIS) allows calculating the amount of imperviousness for specified area based on land cover and population density data. It was developed using linear regression equation and a set of coefficients based on the classes of the land cover map used. There are several sets of coefficients included with the Toolbox for Connecticut Land Cover (CCL) 2002 and National Land Cover Data (NLCD) 2001, but ETIS also allows to import custom sets and to demonstrate the effect of change in land cover on the amount of imperviousness. ETIS can estimate percent impervious cover for future land cover scenarios allowing for comparison to current conditions.

ETIS was developed as an Arc Toolbox for ArcGIS 9.2 and ArcView 9.2 using Python Script.

It creates the Output shapefile that has all the Fields and Properties of the Analysis Unit shapefile plus extra "PI" field containing values of estimated imperviousness. http://clear.uconn.edu/tools/is/etis/index.htm

Impervious Surface Analysis Tool

The Impervious Surface Analysis Tool (ISAT) is a GIS extension that estimates impervious surface area using land cover and coefficients. Each land cover dataset requires a specific set of coefficients. Coefficients were developed for use with the Connecticut Land Cover (CCL) 2002 data.

The Impervious Surface Analysis Tool (ISAT), an ArcView 3.x extension, is used to calculate the percentage of impervious surface area of user-selected geographic areas (e.g. watersheds, municipalities, subdivisions). http://nemo.uconn.edu/tools/impervious_surfaces/measure/isat.htm

ISAT was developed as a partnership between NEMO and the National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center, based on a prototype created by NEMO. ISAT can be downloaded free of charge from the Coastal Services Center website. http://coast.noaa.gov/digitalcoast/tools/isat

Calculating Directly Connected Impervious Area (DCIA)

It's become well documented that impervious areas discharge stormwater containing pollutants to surface waters. To reduce stormwater pollution, there is a need to eliminate the areas directly connected to the MS4 outfalls. Directly Connected Impervious Area (DCIA) means that part of the total impervious area that is hydraulically connected to the Permittee's MS4 which discharges straight to a surface water. DCIA typically includes streets, sidewalks, driveways, parking lots, and roof tops. DCIA would not likely include isolated impervious areas that are not hydraulically connected to the MS4 or otherwise drain to a pervious area.

Implementing BMPs in areas with a high percentage of DCIA should provide measurable gains in abating stormwater pollution. It is important to identify these areas of high DCIA to focus the appropriate stormwater BMPs. In order to determine the amount of DCIA, simple calculations can be performed based on the type of land use and percent impervious cover and knowledge of the stormwater collection system. The table* that follows presents these differences and their corresponding equations for determining DCIA. The table also provides two options for determining DCIA for an MS4 outfall.

If resources or information are limited, DCIA can be calculated from the equation in Option 1. This option provides a general assumption for the type of land use related to the MS4 outfall. DCIA from Option 1 only requires using the percent area of impervious cover (IC) calculated for the town. The percent of IC (%IC) is applied to the equation in the Option 1. As an example, a permittee with 12% IC, would then calculate the DCIA as:

Option 1 Equation: Includes the variable for %IC, where %IC = 12%;

$$0.1 \times (12\%)^{\wedge}1.5 = 0.1 \times (42) = 4.2\% \text{ DCIA.}$$

Option 2 allows for more precision, calculating the DCIA across separate land uses where different land uses would mean different levels of DCIA. The percent IC is estimated based on the type of IC and produces a DCIA that applies to each MS4 outfall. The percent IC is estimated and applied to the corresponding equation in the table below for the type of IC. All DCIA equations are calculated similarly as described in the example above.

Option 1: Assume connection between IC and DCIA	Description of Contributing Area	Equation to Apply
Default - No estimated area types of IC required	Mostly storm sewered with curb and gutter, residential rooftops connected to MS4	DCIA%=0.1(%IC)^1.5
Option 2: Area types of IC for connections between IA and DCIA	**Description of Contributing Area**	**Equation to Apply**
Fully	100% storm sewered with all IC	None
Highly	Mostly storm sewered with curb and gutter, residential rooftops connected to MS4	DCIA%=0.4(%IC)^1.2
Average	Mostly storm sewered with curb and gutter, residential rooftops connected to MS4	DCIA%=0.1(%IC)^1.5
Partially	50% storm sewered with some infiltration and residential rooftops not connected to MS4	DCIA%=0.04(%IC)^1.7
Slightly	Small % of urban area storm sewered or mostly infiltration	DCIA%=0.01(%IC)^2

*This table was adapted from EPA guidance on DCIA, for additional information see the EPA technical support document: *Estimating Change in Impervious Area (IA) and Directly Connected Impervious Areas (DCIA) for Massachusetts Small MS4 Permit* (http://www.epa.gov/region1/npdes/stormwater/ma/MADCIA.pdf).

Impervious Cover Maps for Connecticut Towns

Geospatial information has become a widely used method for all types of planning, assessment and management purposes. The potential for geospatial information is somewhat limitless with everything from sewer infrastructure to hiking trails and much of the collected information is already available to the public.

Publicly available geographical information system (GIS) data can be used to develop individual maps of impervious cover for each town in Connecticut. The National Land Cover Database provides a percent imperviousness estimate layer for the conterminous United States (http://www.mrlc.gov/nlcd2011.php).

This 30 meter resolution data is based primarily on the unsupervised classification of 2011 Landsat Enhanced Thematic Mapper satellite data. The data can be used depict different levels of impervious cover across each town which in many cases highlights roads, urban centers and forested areas.

CT DEEP developed maps in the municipal stormwater fact sheets which are available on the CT DEEP website. http://www.ct.gov/deep/cwp/view.asp?a=2719&Q=567354&deepNav_GID=1654

An objective of these maps is simply to inform the public and municipalities of available GIS information. Also, this information could support large scale planning as well as be a potential guide for best management practices. These maps provide a small example of GIS information available to the public. Just to name a few, here are some GIS resources: ESRI ArcGIS, UConn CLEAR, CT ECO, and CT DEEP.