Natural Resources Appendices

Impervious Surfaces and Water Quality

Impervious surfaces aid in contributing to the hydrologic changes that degrade water quality, prevent natural pollutant processing in the soil by making the landscape impenetrable and serving as a conveyance system transporting pollutants into streams, lakes, reservoirs and rivers via stormwater. This relationship integrates a complex web of impacts resulting from urbanization. As an indicator, impervious cover has the potential to be widely applied to various land use planning and design scenarios.

In addition to introducing pollution into waterbodies and lowering groundwater recharge, impervious surfaces increase the rate in which water flows through the landscape. Faster flowing stormwater reduces the opportunity for water to be stored and for pollutants to settle out. It also increases the volume of water entering waterbodies, which may create or exacerbate flooding, erosion, sedimentation and habitat destruction.

The type and volume of pollutants carried by stormwater runoff into receiving water bodies, such as streams, lakes, reservoirs and estuaries, like Long Island Sound, varies by the type of land use. For example, low and medium density residential developments, especially those with less land disturbance, generally contribute less nutrient (phosphorus and nitrogen) pollutants than high density residential development, according to studies available through the University of Connecticut's Center for Land Use Education and Research (CLEAR) and Nonpoint Source Pollution for Municipal Officials (NEMO), available at http://clear.uconn.edu/ and http://nemo.uconn.edu/, respectively. A detailed summary of each Long Island Sound subwatershed in Connecticut and New York analyzed by CLEAR is included in the appendices.

In general, according to NEMO, the water quality in streams and other water resources begins to decline when between 12 % and 15 % of the watershed has been covered by impervious surfaces, such as parking lots, roads and buildings. Nonpoint source pollution (NPS) has been cited as one of the top contributors to water quality problems in the United States (U. S. EPA, 1994). Nitrogen and phosphorus have been identified as the primary nutrients responsible for algal blooms caused by eutrophication which results in fish die-off, endangers human health, and impacts the economic and recreational use of riverine, palustrine, and estuarine waters (U.S. EPA, 1996). Urban runoff has been found to contribute a significant amount of these and other nonpoint source pollutants to our water resources (Beach, 2002; Boyer *et al*., 2002; U.S. EPA, 2002). It has been well-documented that urbanization increases the volume, duration, and rate of stormwater runoff (Booth and Reinfelt, 1993).

Imperviousness influences hydrology (*e.g.,* an increase in imperviousness is directly related to increase in the volume and velocity of runoff), stream habitat (*e.g.*, the hydrological impacts of increased imperviousness lead to increased stream bank erosion, loss of riparian habitat, and degradation of in-stream habitat), chemical water quality (*e.g.,* increases in imperviousness and runoff directly effect the transport of non-point source pollutants including pathogens, nutrients, toxic contaminants, and sediment), and biological water-quality (*e.g.,* all the above changes have an adverse impact on the diversity of in-stream fauna) (Schueler, 1994; Arnold and Gibbons, 1996).

Additional research has also suggested that the amount of urban runoff and its impacts on stream conditions and water quality are strongly correlated to the percent area of impervious surfaces within a watershed (Schueler, 1994; Arnold and Gibbons, 1996; Clausen *et al.*, 2003). This strong relationship implies impervious surfaces can serve as an important indicator of water quality, not only because imperviousness has been consistently shown to affect stream hydrology and water quality, but because it can also be readily measured at a variety of scales (*i.e.*, from the parcel level to the watershed and regional levels) (Schueler, 1994).