Stormwater Decision-Making Tool (DMT)

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In the absence of land-use and transportation strategies, site-level design practices alone cannot protect aquatic ecosystems from decline (Cohn-Lee et al.1992). An analysis of current regulatory conditions, land use trends, and water quality monitoring data in the Saluda-Reedy Watershed in South Carolina suggests that the best way to protect water quality while continuing to accommodate growth and development in our region is both to improve site-level measures of stormwater runoff management *and* to encourage more compact development near existing urban areas (Stone et al. 2010, SCDNR, 2008). With funding provided by an EPA Targeted Watershed Implementation Grant, the Decision-Making Tool (DMT) was developed by Upstate Forever and Clemson University for the purpose of evaluating residential development sites based on its anticipated impacts to water quality. The DMT will also serve as a means for land developers of residential projects to participate in the market-driven Stormwater Banking Program (SBP), which will offer Greenville County land developers a residential density bonus in exchange for reducing water quality impacts (attaining a high DMT score) and paying a participation fee. An ultimate goal of the DMT is to decrease the negative of development on water quality through better site choice and site design.

The DMT is essentially a set of questions that, when identified for a particular development, output a score that is indicative of the development's anticipated impacts to water quality. Users of the DMT will learn about the water quality impacts of different development types, and will have the option and incentive to improve their score through different means. The DMT is divided into the Site, Neighborhood, and Regional Scales, which represent the main categories of development impacts to water quality.

The water quality benefits using Site Scale practices, such as Best Management Practices (BMP's) and low-impact development (LID), for treating stormwater runoff from specific sites are well-documented. The Site Scale Criteria of the DMT takes into consideration factors including the soils, runoff generated, vegetation, and infiltration areas on site. This section is based on results of the Integrated Design, Evaluation and Assessment of Loadings (IDEAL) model, the use of which is required for all land development permits in Greenville County. While the benefits of BMP's are significant, an overall strategy focused on individual on-site storm water management ignores the cumulative impervious coverage impacts of residential development. Although continued research is needed to quantify the relationship between land use, transportation and water quality, studies consistently show that land use and transportation strategies to improve water quality can far outweigh the use of site-scale BMP's (Berke et al. 2006). For this reason, additional land use and transportation-related characteristics were added into the DMT to make it a more robust reflection of a development's true impacts.

A cursory review of current regional growth patterns and the regulatory process in Greenville County supports taking this alternative approach to reducing development's impacts to water quality. Multiple growth studies for Greenville County, as well as several nationwide publications, have shown that the Greenville-Spartanburg area is one of the fastest-growing regions of the country and is expected to continue to be so (Stone et al. 2010). A growth study completed by Clemson University's Strom Thurmond Institute indicates that Greenville County is consuming land at an alarming rate compared to population growth, and that if this growth trend continues a loss of hundreds of thousands of acres of currently-undeveloped land will be stripped of the hydrological benefits of natural vegetation and non-compacted soils (Campbell et al. 2007). Reedy River water quality monitoring data and land use studies from the South Carolina Department of Natural Resources (SCDNR) and Department of Health and Environmental Control (DHEC) suggest that as a priority for improving water quality, it would be best to focus development and growth in already-degraded subwatersheds and preserve those that are have not yet been impaired (SCDNR 2008). An abundance of nationwide research agrees with this conclusion (Boothe 1991). Furthermore, current local regulations, land costs and physical land constraints make it easier to employ LID practices on peripheral lands, where land is generally cheaper and more readily available, rather than in areas with existing infrastructure and services. Given local growth trends and the limitations of LID as a stand-alone remedy, the DMT attempts to take into consideration not only LID but also land consumption, the total impervious cover needed to support population growth and residential development, and transportation patterns resulting from that development.

The Neighborhood and Regional Scales of the DMT identify characteristics of a residential development that greatly reduce the impervious footprint per household. These characteristics were devised based on a review of nationwide studies and programs relating water quality degradation to urban sprawl and automobile dependency. Several EPA studies and others have illustrated the strong link between higher density, transportation and water quality, concluding that higher density, compact development is much less land-consumptive than low-density, spread-out development and is thereforebetter for water quality (USEPA 2007; USEPA 2009; SCCCL 1997). Meanwhile, numerous studies point to the considerable transportation-related impervious cover such as roads, driveways and parking lots that result from low-density, peripheral development, accounting for as much as 75% of the impervious surface of a neighborhood; conversely, neighborhoods with higher density are found to have lower overall impervious cover (Cappiella 2001; May et al. 1997). Additionally, improving transportation options by encouraging walking and transit use can dramatically decrease regional overall impervious cover (CWP 2000). Other studies have shown the strong link between vehicle-miles travelled (VMT) and pollutant deposition on roads and in the air, all or much of which ultimately ends up as water pollution (Boesch 2001; Steuer et al. 1997; Van Metre et al. 2000); as well as the link between VMT and increased demand for parking spaces and road volume capacities (Kahn 2006). One study found that transportation-related land uses have the second-highest level of pollutant concentrations, second only to piped industrial sources (NRDC 2000). The review of this relatively small sampling of studies relating water quality to compact growth strategies provides the foundation used to develop the Neighborhood and Regional Scales of the DMT.

More research, specifically that which related to urban planning and landscape architecture, was collected in order to develop the neighborhood location and design criteria that would lead to the reduction in reliance on transportation-related impervious surfaces. Some of the major characteristics influencing land consumption and travel behavior include the following:

- **Use of redevelopment and infill sites**: Such sites often have previously been altered or disturbed, and are already served by existing infrastructure, thereby they require significantly fewer new disturbances of natural land than their undisturbed counterparts, which in itself is better for water quality.

- **Proximity to a mix of uses**: Historic land use regulations have often resulted in the separation of uses, which thereby requires the creation of roads and long travel distances for household errands. Locating residential development near existing services and employment centers can either eliminate or greatly reduce the amount of driving per household (Chapman et al. 2003; Frank 2007; Goldberg 2007).

- **Neighborhood street connectivity**: Street network design also greatly impacts travel distances and likelihood of residents to walk. High street connectivity is linked to a reduction in VMT (Goldberg 2007).

- **Neighborhood design**: A multitude of research supports the link between travel behavior and specific neighborhood design measures, such as parking placement, block length, sidewalks, street width and street trees (Cambridge Systematics 1994; Ewing 1996; Frank 2000).

- **Residential density**: The direct impact of accommodating more households per acre is a dramatic first step in accommodating a given population while consuming less land than has been historically consumed (USEPA, 2007; Berke et al. 2003). Additionally, higher density development correlates with reduced VMT (Braza 2004; Goldberg 2007; Holtzclaw 1994).

The abundance of data indicates how crucial it is for stormwater managers and urban planners to work together to ensure that land use, transportation planning and site design measures are all ingredients that are inseparable for protecting water quality. The DMT is an attempt to harmonize growth and development in Greenville County with maintaining, even improving water quality. As the Greenville area is not unique in its struggle to accommodate rapid growth with maintaining its natural resources, it is hoped that the DMT and this overall incentive program will be transferrable to other regions of the country, thereby causing a shift in the conventional thinking on stormwater management.

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