Technical Procedure Document

Subject: Conceptual Planning for Stormwater and Low Impact Development

Introduction

As land changes from a wooded or vegetated condition to one with roofs, streets, and parking lots, the stormwater runoff generated from those sites also increases due to the reduction of infiltration, abstraction, and vegetation uptake. The increased stormwater runoff may lead to problems, such as flooding. This is especially true in coastal areas, such as Charleston, South Carolina, where other factors (tidal influence, storm surge, low-lying areas below sea level) contribute to the severity of flooding.

To address this flooding concern, a new approach is needed for site development. Site development can no longer be done envisioning stormwater as an afterthought in the development plan. Instead, the developer needs to work with the land available and stormwater needs to be viewed as a resource to be managed early in the design process. Designing the development from the beginning with stormwater and environmental considerations in mind will result in better site design and ultimately save the developer time and possibly money.

Principles of Low Impact Development

Low impact development (LID) employs principles such as preserving and recreating natural landscape features, minimizing effective imperviousness to create functional and appealing site drainage that treat stormwater as a resource rather than a waste product (US EPA, 2018). By employing these principles early in the conceptual planning process, developers and designers can produce aesthetically pleasing, low cost, and effective stormwater site design that complies with the local stormwater regulations. Below are the six fundamental principles of LID (MAPC, 2010).

Working with the Landscape

Working with the landscape integrates existing and natural systems as the framework for site planning. The designer identifies environmentally sensitive areas and important local features and outlines them in a development envelope to protect those areas. Other existing or natural features may be effective to convey stormwater, reducing the amount of hard stormwater infrastructure, and possibly reducing stormwater management costs.

Focus on Stormwater Runoff Prevention

While runoff may not be preventable, it can be minimized by reducing road widths and parking areas, using shared driveways, and disconnecting impervious areas. Clearing and regrading can be minimized by clustering and reducing building footprints. To aid in reducing runoff, techniques like green roofs can store and evaporate rainfall before it reaches the existing ground/grade.

Micromanage Stormwater

Creating smaller sub-watersheds on site will aid in micromanaging stormwater runoff through a series of small LID structures and maximize sheet flow to where there will be little to no runoff for low-intensity storms. The strategy is to manage stormwater where it falls instead of trying to convey it long distances.

Keep it Simple

Emphasize simple. Nonstructural, low-tech, and low-cost methods such as open drainage systems and filter strips, disconnection of roof runoff, rain barrels/cisterns, street sweeping, public education, and minimizing areas that are disturbed for development are the goal.

Practice Multi-tasking

Design and create a multifunctional landscape with stormwater management practices that provide filtration, treatment, and infiltration and assist with meeting other development requirements. Some of the additional ancillary benefits of LID can be wildlife habitat and reduced heat island effects.

Maintain and Sustain

Landscaping designs, especially associated with stormwater management, should incorporate native plants that are resistant to extreme conditions (wet and dry), are low maintenance, and have a deeper root system that promotes infiltration and vegetative update of stormwater and associated pollutants. Vegetation should be selected that reduces the use of pesticides, herbicides, and fertilizers. These lower maintenance designs are more likely to be maintained and result in improved water quality.

Conceptual Site Planning

There are many resources and references that can be used for conceptual site planning that involves LID. The City of Charleston (City) uses the *Low Impact Development in Coastal South Carolina: A Planning and Design Guide* (Ellis et al., 2014) as a resource in the *City of Charleston Stormwater Design Standards Manual*. *Low Impact Development in Coastal South Carolina: A Planning and Design Guide* (Ellis et al., 2014) can be found on the South Carolina Sea Grant Consortium website at:

https://www.scseagrant.org/wp-content/uploads/LID-in-Coastal-SC-low-res.pdf

The following is a quick guide of how LID can be successfully incorporated into any development:

Early Site Recognition

Before a site is bought, a developer/designer should assess property with the **Principles of Low Impact Development** in mind. The developer/designer has the ability to consult with the City prior to investing in the property to make an initial estimate of developable land, specific permits, and any potential obstacles that may come up during development. By consulting with the City prior to buying the site, the developer can make a more informed and realistic estimate of investment return. After the investment has been made, a proper **Inventory and Site Evaluation** should be conducted to create a conceptual site design that is sustainable and cost effective.

Inventory and Site Evaluation

- Review Ordinances from all applicable City Departments (e.g., Department of Stormwater Management, Department of Planning, Preservation, & Sustainability)
- Locate environmentally sensitive resources: wetlands, mature trees, slopes, drainageways, permeable soils, waterway buffers to consider challenges, and opportunities for LID implementation
- Assess existing hydrology and soil characteristics on a watershed level. LID requires an understanding of the site in the context of the overall watershed.
  - Determine if the site is located in a Special Protection Area
  - Determine if the site drains to impaired waters or other waters with existing water quality sensitivities
  - Evaluate downstream flooding potential or run-on issues from neighboring properties

  - Assess planned future development in the area
  - Erodibility of the soil
  - Steepness of slopes
- Assess existing hydrology on a site-specific level
  - Hydrological functions of the site: surface water, groundwater, and tidal influences
  - Natural resource locations
  - Geotechnical evaluation: soils for potential infiltration and water table depth
  - Effect of project size and shape on stormwater management
  - Determine areas best suited for development and those that should be avoided.
  - Determine if areas exist where LID infiltration practices should be avoided due to historical land use and contamination.

Initial Concept Design Using Non-Structural BMPs

Develop an initial concept plan based on information gathered during the ***Inventory & Site Evaluation*** process. Be sure to incorporate non-structural BMPs such as woodland and wetland protection, clustering, and minimizing and disconnecting impervious surfaces.

Preliminary Site Plan Development Incorporating Structural BMPs

Incorporate structural BMPs to address site specific stormwater needs while developing the preliminary site plan.

- Define development envelope/locate potential site
  - Cluster buildings and reduce building footprints to minimize clearing/grading
  - Determine possible LID Best Management Practices (BMPs) for the site
  - Keep open space and wildlife habitat
  - Create small watersheds to route stormwater to a LID BMP
    - Use BMPs that promote filtration, treatment, and infiltration components
    - Use green rooftops and disconnection from rooftop to impervious areas
  - Maintain natural flow paths and use open drainage
  - Flatten slopes as much as possible to lengthen sheet flow
  - Reduce road widths
  - Use shared driveways/reduce parking areas with permeable paving
  - Align roads along grades
  - Minimize high maintenance lawn areas
- Draw the lot lines (for Residential Developments)

Maintenance

Developers and designers typically shy away from LID due to the estimated maintenance cost. Depending on the BMP, the maintenance cost can be very low and may even be rolled into the landscaping budget of the City or homeowners association (HOA). If maintenance cost is rolled into the landscaping budget, the landscapers need to be educated on where the LID BMPs are located to avoid accidental damages or creation of obstacles (e.g., filling in a bioretention cell, installation of trim guards around any BMP). Maintenance schedules for each BMP can be found in the *Low Impact Development in Coastal South Carolina: A Planning and Design Guide* (Ellis et al., 2014).

If the responsibility of a site's BMP remains private and a HOA is responsible for maintenance, LID BMPs are typically more affordable and is more easily accessible for the HOA to maintain. It is easier for an HOA to maintain BMPs that are smaller and part of landscaping budget than it is to maintain and monitor a stormwater pond that requires a Pond Manager Certification. Below is a comparison of maintenance cost estimates for LID infrastructure and traditional stormwater infrastructure:

Table 1. Annual Maintenance Cost Comparison

Best Management Practice	Maintenance Cost
Wet Pond	$4,411
Wetland	$752
Bioretention Cell	$583

Source: Low Impact Development in Coastal South Carolina: A Planning and Design Guide (Table 1.2-5) (Ellis et al., 2014)
Note: Estimates are for a 10-acre watershed with a CN = 80.

References

Ellis, K., C. Berg, D. Caraco, S. Drescher, G. Hoffmann, B. Keppler, M. LaRocco, and A.Turner. 2014. Low Impact Development in Coastal South Carolina: A Planning and Design Guide. ACE Basin and North Inlet – Winyah Bay National Estuarine Research Reserves, 462 pp. Available at http://www.northinlet.sc.edu/LID/

Metropolitan Area Planning Council (MAPC). 2010. LID Principles and Techniques. Metropolitan Area Planning Council, Massachusetts. Available at https://www.mapc.org/resource-library/lid-principles-and-techniques/

US EPA. 2018. Urban Runoff: Low Impact Development. U.S. Environmental Protection Agency. Available at https://www.epa.gov/nps/urban-runoff-low-impact-development

Oregon Sea Grant. Low Impact Development Fact Sheet, "*The LID Site Planning Process"*. Available at Oregon Sea Grant LID Site Planning Process