Determining Implementation Barriers for Green Infrastructure for Coastal Flood Control

Best Practices for Northern Gulf of Mexico Municipalities to Incorporate Green Stormwater Infrastructure in Municipal Ordinances

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August 2022

This publication was supported by the U.S. Department of Commerce's National Oceanic and Atmospheric Administration under NOAA Award NA18OAR4170080 and the Mississippi-Alabama Sea Grant Consortium. The views expressed herein do not necessarily reflect the views of any of these organizations.

MASGP- 22-015-03

Background

The Mississippi-Alabama Sea Grant Consortium awarded a grant to Dr. Cris Surbeck, Kristina Alexander, and Liya Abera (together, Project Team) to assess the costs and efficacies of green stormwater infrastructure (GSI) when used on 5-acre or smaller sites in the Northern Gulf of Mexico. In general, studies point to three obstacles to implementing GSI: technical, financial, and regulatory. The Project Team's diverse background allowed different assessments of these obstacles. Dr. Surbeck is the Chair of the University of Mississippi Department of Civil Engineering Department, Liya Abera is a PhD candidate in Environmental Engineering, and Ms. Alexander is an attorney with the Mississippi-Alabama Sea Grant Legal Program at the University of Mississippi School of Law.

The Project Team evaluated site plans in Biloxi, Mississippi, and Orange Beach, Alabama, to see how the development planned for or built on those sites could use GSI cost-effectively. This required assessing the technical and financial aspects of GSI that could be used on 5-acre or smaller sites. Some types of GSI considered include green roofs, rain barrels, permeable pavement, rain gardens, and grassy ditches. The Stormwater Modeling Report summarizes the assessment of some of those methods. The grassy ditch or rain garden were found to be effective GSI on these smaller sites. (While GSI can be useful in improving water *quality*, this study assessed water *quantity* reductions.)

The Project Team also assessed the costs, including life-cycle costs, of the GSI methods found to be most effective at reducing stormwater runoff on each site. That can include benefits from having more green space or expenses from maintaining rain gardens. The Life-cycle Costs and Co-benefit Analyses Report explains the findings.

As part of the grant, Ms. Alexander analyzed the ordinances of the two cities and offered ordinance revisions to increase GSI usage in those cities consistent with the costs and efficacies determined in the first part of the project. The analysis considered where there were regulatory obstacles limiting GSI implementation.

Best Practices

The team developed these Best Practices for other Northern Gulf of Mexico municipalities to incorporate green infrastructure into their ordinances.

1. **Ensure consistency among city ordinances.** Use identical terms throughout different categories of ordinances – flooding, land use, and stormwater – as well as within each section. A court may find that imprecise wording means an ordinance is vague or ambiguous. Ensure that standards such as for design storms are the same and that materials are described uniformly. A typical problem in ordinances is using synonyms rather than identical terms. For example, it is better to use *permeable* consistently rather than sometimes using *porous* or *pervious*. Define those terms.

2. **Impose different water storage requirements based on topography.** Development in an area that is naturally lower than surrounding areas, thus serving as a natural temporary stormwater detention/retention facility, will offset a greater amount of stormwater than will a level area. This may occur on small plats of land not zoned as a special flood hazard area which would

automatically impose development restrictions. Accordingly, ordinances for building in that bowl-shaped area should require greater stormwater runoff offsets and also place restrictions on how much fill can be used. Additionally, cities should impose stricter standards than those offered by FEMA for building in floodways which allow increasing the base flood elevation by up to 1 foot in those areas (*see* FEMA, *Model Code-Coordinated Ordinances* § 105.3(2)).

3. **Employ green stormwater infrastructure throughout all ordinances to reduce stormwater runoff.** GSI should be part of stormwater ordinances by establishing a preference for low-impact design to reduce runoff rather than using gray infrastructure to hold the runoff. GSI also should be part of other sections of city ordinances as well. For example, by incorporating GSI elements into landscape requirements in land use ordinances, the efficiencies from GSI can be achieved without increasing maintenance duties on the city. For example, landscaped buffers could require a depression to reduce runoff, native species could be required, and specific infiltration rate standards could be set for large landscaped areas to make them more functional.

4. **Establish engineering standards for green stormwater infrastructure.** Properly designed and located GSI is most effective. For example, ordinances should require that plans for retention/detention ponds include a qualified assessment of the water table, topography, and runoff data prior to the city's approval. Additionally, an ordinance will have greater results if the definition of permeable materials establishes infiltrations standards for those materials. Also, ordinances could require large landscaped areas to meet certain infiltration standards to maximize those areas' runoff absorption.

5. **Make long-term maintenance and enforcement obligations clear and permanent.** Perhaps the biggest complaint by cities regarding GSI is ensuring that ongoing maintenance is performed. Frequently, this issue appears in residential areas where a detention/retention facility was required for a subdivision, but maintenance and repair obligations are lost. Cities should require property owners to file an easement with the deed establishing ownership and maintenance of all stormwater facilities to run with the land, and include a covenant to allow a city to act to repair, without notice in emergencies, and recoup its expenses, including labor, from the responsible property owner.

6. **Do not exempt single-family and duplex residential development from stormwater compliance.** While residential areas have a lower percentage of impermeable areas per site, residential areas may make up a great percentage of a municipality. However, many municipalities impose GSI only on commercial or multi-family residential areas or within an approved subdivision plan. Employing this recommendation would expand the reach of typical stormwater ordinances.

7. **Address stormwater as if it is a preventable nuisance.** Enforce BMP requirements not only for design and construction of building sites but for ongoing maintenance, addressing more than detention/retention facilities. This may require a review of litter ordinances to ensure that stormdrains are kept clear, for example. Cities should establish enforceable consequences for systems that fail and cause increased runoff.

8. **Modify existing requirements to allow for informal GSI.** Many ordinances require curbs in parking lots, maximum parking density, and irrigation systems for landscaping. These requirements, and others, can be modified to improve stormwater resilience and to make planned GSI systems work more efficiently. For example, curbs in parking lots should not block water from reaching landscaped areas; parking lots should allow paved areas only to meet daily parking needs with event parking required to be on permeable areas; and irrigation systems should require saturation gauges. Irrigation systems frequently are used automatically, even when it is raining. They can increase runoff by reducing an areas' natural absorbency.

Section	*Need*	*Language*
Stormwater: General purposes	Establish the broad goals and benefits of using Green Stormwater Infrastructure. Identify general standards.	*General purpose and intent.* The purpose of this chapter is to protect and safeguard the public health, safety, and general welfare of the citizens and landowners of [CITY] through the establishment of minimum stormwater management requirements and flood damage prevention controls. These requirements are to be read consistently with Land Development Ordinances, and the language more protective of reducing stormwater runoff shall control. All site designs shall establish stormwater management practices to control the peak flow rates of stormwater discharge associated with a X-year, Y-hour design storm, and reduce the generation of stormwater. These practices should incorporate Green Stormwater Infrastructure and use permeable materials to absorb and reduce stormwater runoff from impermeable surfaces to maximize the treatment of both water quality and quantity to the extent practicable.
Definitions	Enhance or replace existing stormwater definitions to provide consistency in terms and to introduce Green Stormwater Infrastructure.	*Best Management Practices* (BMPs) are ways to manage stormwater runoff by controlling runoff rate and volume and by improving water quality. BMPs depend on the site conditions and proposed activities and are identified within an approved stormwater pollution prevention plan. *Depressed Bioretention Facility*: A grassy depression with a high infiltration rate, designed to capture runoff from X-year Y-hour storms, preferably planted with native plants and trees is an effective, sustainable method to control stormwater runoff. The depressed bioretention facility need not be conduit to natural waterways, but can act as a natural detention facility. Includes rain gardens, swales, and grassy ditches. *Enforceable Maintenance Agreement* shall refer to a legally-enforceable agreement in the form of a covenant assigning the perpetual maintenance and repair obligations for a property's stormwater facility, and including any easements needed to allow reasonable access to the site by the City. *Detention* shall mean the collection and temporary storage of stormwater in such a manner as to limit the post-development peak discharge to pre-development peak discharge rates, with subsequent gradual release of the stormwater. See also *Retention*. *Filtration* shall mean the selective removal of suspended matter from stormwater by passing the water through natural or artificial devices or through at least two feet of suitable fine-textured granular media such as soil, uniformly graded sand, and/or non-compacted gravel or other natural or artificial permeable aggregate, which may be used in conjunction with filter fabric and/or underdrain pipe. *Green stormwater infrastructure*: Systems and practices that use or mimic natural processes to achieve infiltration, evapotranspiration, or use of stormwater in ways that limit runoff and protect water quality. *Hydraulic Conductivity*: the property of soil or rock formations to allow water movement through it. *Impermeable*: Surface that is highly resistant to the absorption of fluids. *Infiltration Rate*: the rate at which water passes through a type soil or rock formation.

Section	*Need*	*Language*
Definitions *(cont.)*		*Low impact development:* Systems and practices such as green stormwater infrastructure that use or mimic natural processes that result in the infiltration, evapotranspiration, or use of stormwater in order to protect water quality. See also, *Green Stormwater Infrastructure.* *Retention* shall mean the collection and temporary storage of stormwater in such a manner as to provide treatment through physical, chemical, or biological processes, with subsequent gradual release of the stormwater by percolation through soil or by evapotranspiration. See also, *Detention*.
Terminology	Ensure that terms are consistent throughout flooding, stormwater, and land use (zoning) ordinances. Preferred terms are permeable and impermeable. Avoid inconsistent terms with similar meanings, such as porous, impervious…	
Design Storm	Establish a design storm, and set standards to meet that storm.	Ex.: 100-year, 24-hour Ex.: 25-year, 24-hour
Exemption	Modify blanket exemption for single-family or duplex homes to prevent increased downgradient water.	The following activities shall be exempt from the stormwater permitting requirements of this regulation: (x) Single-family or duplex homes built on individual lots only where the City has approved the construction plans to ensure that construction shall not increase runoff to any downgradient property. Those homes that are part of a larger subdivision do not require separate lot-by-lot approval of the City where the City has approved a stormwater master plan for the subdivision as not increasing downgradient stormwater runoff.
Detention/ Retention Facilities	Detention/retention facilities that mimic natural processes are preferred. A detention/retention facility's location must be demonstrated as being above the high groundwater elevation so as not to contribute to runoff.	(x) All required retention/detention areas must be installed above the estimated seasonal high groundwater elevation as determined by a registered geologist, geotechnical engineer or geological engineer. (x) All planning documents that include a retention/detention area must include percolation test data to support that the area performs water quality treatment for the 1-inch first flush volume within 72 hours.
Parking Lots	Define what acceptable permeable pavement is.	*Approved permeable pavement* means a load-bearing, durable pavement surface together with an underlying layered structure that temporarily stores water prior to infiltration and releases that stored water by infiltration into the underlying permeable subgrade. Subgrade must have a saturated hydraulic conductivity greater than or equal to [0.X in/hr].
Parking spaces	Reduce number of paved parking spaces at houses of worship and outdoor areas (parks, arboretums, etc.) to allow maintained permeable area (sodded, e.g.) for extra parking spaces.	Ex.: 1 parking space per 10 seats in the principal assembly area may be paved; an additional parking space per two seats may be created in sodded, maintained areas. Ex.: 1 parking space per 250 sf + 1 parking space per 6 persons of maximum outdoor facility capacity; an additional parking space per 2 persons may be created in sodded, maintained areas.

Section	*Need*	*Language*
Landscaping	Require landscaping to incorporate green stormwater infrastructure. Require landscaping elements to allow water runoff from parking. Prohibit curbs from blocking water flow. Establish standard infiltration rates for large landscaped areas to maximize green space's ability to reduce runoff.	Designs shall be consistent with the provisions of Sec. ___ and use green stormwater infrastructure as retention or detention ponds and depressed bioretention facilities to the extent practical. Protective curbing around landscaped areas will leave openings for the flow of water onto unpaved areas. Landscaped areas and perimeter areas shall be so graded as to receive a reasonable portion of the runoff from the surrounding pavement. For any landscaped area greater than 100 sq. ft. the landscape plan shall indicate how that area will (x) provide saturated hydraulic conductivity greater than or equal to 0.50 in/hr for clay soils, 5.00 in/hr for sand soils; or (x) percolate 80 percent of the runoff volume from a three-year, one-hour design storm within 72 hours after a storm event, assuming average antecedent conditions.
Specific landscaping elements	Restrict berms that could increase stormwater runoff. Require biodepressions Encourage green stormwater infrastructure Encourage buffers with high infiltration rates Allow permeable parking surfaces only where properly maintained. Do not allow gravel or other material in drives or parking areas that loses permeability upon being compressed. Do not require irrigation systems or alternatively, require irrigation systems that have moisture sensors.	In no case shall a berm that increases stormwater runoff from a site be allowed without prior approval of green stormwater infrastructure to offset any increase in stormwater runoff. *See* definition, *Depressed bioretention facility*. Where practicable, buffers of at least 100 sq. ft., shall include a rain garden or other green stormwater infrastructure sized to hold stormwater runoff from between 5 and 10 percent of the impervious area draining to it, with native plants planted in a sand/soil matrix soil bed with a mulch cover layer. The use of permeable parking area surfacing materials – including, but not limited to, grass, mulch, "grass-crete," or recycled materials such as glass, rubber, used asphalt, brick, block, and concrete – may be approved for the required off-street parking and loading areas on a site, provided such areas are properly maintained to retain permeability. Where possible, such materials should be used in areas proximate to and in combination with on-site stormwater control devices. A fully automatic, permanent irrigation system shall be installed with fully functioning soil moisture sensors, providing 100 percent coverage of all landscape areas.
Nuisance	Ensure that definition of nuisance includes stormwater related maintenance.	Nuisance shall mean any of the following: … (x) Any accumulation of debris, plants or materials that impairs the drainage or infiltration of rainfall and stormwater runoff.

Section	*Need*	*Language*
Responsibility for Construction Maintenance	Separate sections for maintenance to delineate clearly the responsibilities before and during construction/development versus those that are for the lifetime of the stormwater facility.	Inspection and Maintenance: It is the property owner's responsibility to ensure that required pre-construction and construction BMPs are installed, function properly and are adequately maintained to protect the city's stormwater management system. To ensure the proper maintenance and operation of required BMPs by the property owner for the duration of those facilities' operation, the property owner shall prepare and upon the City's approval, file a covenant and easement assigning the property owner the responsibility for maintaining the facilities and allowing the City an easement to inspect those facilities. This easement shall exist in perpetuity unless the City formally extinguishes the easement by filing the appropriate documentation revoking the easement and dissolving the covenant. The City shall provide written notice to the party that owns the property at the time of filing the documents extinguishing the easement. To rectify deficiencies in facility operations or maintenance as identified by the City, the City shall: Provide notice of the deficiencies to (x) the property owner by certified letter, and (x) the property owner, agent, and/or the responsible person on site at the time the deficiencies are observed via oral notice.
Responsibility for Post Construction Maintenance	Establish enforceable maintenance agreement. Ensure terms are consistent and require enforceable agreement to run with the land. Ensure that maintenance agreement extends for the life of the stormwater facility, and not just during the construction of the project. Ensure the City has authority to access any stormwater facility and, in emergencies, take action without notice.	The maintenance agreement will include all maintenance easements required for the City to access and inspect the stormwater treatment practices and to perform routine maintenance as necessary at the expense of the property owner. The maintenance agreement shall include an acknowledgment by the property owner that if the terms are not upheld to the City's satisfaction, the City has the right to perform, or have performed, such repair and maintenance services as deemed necessary at a cost to be paid by the owner. The maintenance agreement shall be submitted to the engineering division for review, and be executed prior to issuance of any permits for land disturbance activities.