Glossary

"Applicant" means a property owner or agent of a property owner who has submitted an application for a post-construction stormwater management permit.

"Aquatic Buffer" means an area of land located around or near a stream, wetland, or waterbody that has intrinsic value due to the ecological services it provides, including pollutant removal, erosion control and conveyance and temporary storage of flood flows.

"Aquatic Resource Protection" means measures taken to protect aquatic resources from several negative impacts of the land development process, including complete loss or destruction, stream channel enlargement and increased salinity fluctuations.

"Better Site Design Techniques" means site design techniques that can be used during the site planning and design process to minimize land disturbance and the creation of new impervious and disturbed pervious cover. Better site design techniques include reducing clearing and grading limits, reducing roadway lengths and widths and reducing parking lot and building footprints.

"Better Site Planning Techniques" means site planning techniques that can be used during the site planning and design process to protect valuable aquatic and terrestrial resources from the direct impacts of the land development process. Better site planning techniques include protecting primary and secondary conservation areas.

"Building" means any structure, either temporary or permanent, having walls and a roof, designed for the shelter of any person, animal or property and occupying more than 100 square feet of area.

"Channel" means a natural or artificial watercourse with a definite bed and banks that conducts continuously or periodically flowing water.

"Conservation Areas" means permanently protected areas of a site that are preserved, in perpetuity, in an undisturbed, natural state.

"Conservation Easement" means a legal agreement between a land owner and a local, state or federal government agency or land trust that permanently protects conservation areas on the owner's land by limiting the amount and type of development that can take place within them but continues to leave the conservation areas in private ownership.

"Dedication" means the deliberate appropriation of property by its owner for general public use.

"Detention" means the temporary storage of stormwater runoff in a stormwater management practice for the purpose of controlling the peak discharge rates and providing gravitational settling of pollutants.

"Developer" means a person who undertakes a land development project.

"Development Project" means a new development or redevelopment project.

"Development Site" means a parcel of land where land disturbing activities have been or will be initiated to complete a land development project.

"Drainage Easement" means a legal right granted by a land owner to a grantee allowing the grantee to convey, treat or manage stormwater runoff on the private land subject to the drainage easement.

"Easement" means a legal right granted by a land owner to a grantee allowing the use of private land for conveyance, treatment and management of stormwater runoff and access to green infrastructure and stormwater practices.

"Ecotone" means a transitional area between two adjacent ecological communities. Ecotones may appear on the ground as a gradual blending of two ecological communities across a broad area, or they may manifest themselves as sharp boundary lines.

"Erosion and Sediment Control Plan" means a plan that is designed to minimize and control the accelerated erosion and increased sediment loads that occur at a site during land disturbing activities.

"Evapotranspiration" means the loss of water to the atmosphere through both evaporation and transpiration, which is the evaporation of water from the aerial parts of plants.

"Extended Detention" means the temporary storage of stormwater runoff in a stormwater management practice for an extended period of time, typically 24 hours or greater.

"Extreme Flood Protection" means measures taken to protect downstream properties from dangerous extreme flooding events and help maintain the boundaries of the existing 100-year floodplain.

"Fee in Lieu Contribution" means a payment of money in place of meeting all or part of the stormwater management criteria required by a post-construction stormwater management ordinance.

"Flooding" means a volume of stormwater runoff that is too great to be confined within the banks of a stream, river or other aquatic resource or walls of a stormwater conveyance feature and that overflows onto adjacent lands.

"Green Infrastructure Practices" means the combination of three complementary, but distinct, groups of natural resource protection and stormwater management practices and techniques, including better site planning and design techniques and low impact development practices, that are used to protect valuable terrestrial and aquatic resources from the direct impacts of the land development process, maintain pre-development site hydrology and reduce post-construction stormwater runoff rates, volumes and pollutant loads.

"Hydrologic Soil Group (HSG)" means a Natural Resource Conservation Service classification system in which soils are categorized into four runoff potential groups. The groups range from group A soils, with high permeability and little runoff produced, to group D soils, which have low permeability rates and produce much more runoff.

"Impaired Waters" means those streams, rivers, lakes, estuaries and other water bodies that currently do not meet their designated use classification and associated water quality standards under the Clean Water Act.

"Impervious Cover" means a surface composed of any material that greatly impedes or prevents the natural infiltration of water into the underlying native soils. Impervious surfaces include, but are not limited to, rooftops, buildings, sidewalks, driveways, streets and roads.

"Industrial Stormwater Permit" means a National Pollutant Discharge Elimination System (NPDES) permit issued to an industry or group of industries that regulates the pollutant levels associated with industrial stormwater discharges or specifies on-site pollution control strategies.

"Infill Development" means land development that occurs within designated areas based on local land use, watershed and/or utility plans, where the surrounding area is generally developed, and where the site or area is either vacant or has previously been used for another purpose.

"Infiltration" means the process of allowing stormwater runoff to percolate into the underlying native soils.

"Infiltration Practice" means a green infrastructure or stormwater management practice designed to provide infiltration of stormwater runoff into the underlying native soils. These stormwater management practices may be above or below grade.

"Inspection and Maintenance Plan" means a written agreement and plan providing for the long-term inspection and maintenance of all green infrastructure practices, stormwater management practices, stormwater conveyance features and stormwater drain infrastructure on a development site.

"Interception" means the process by which precipitation is caught and held by foliage, twigs and branches of trees, shrubs and other vegetation, and lost by evaporation, never reaching the surface of the ground.

"Jurisdictional Wetland" means an area that is inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation.

"Land Development" means any project undertaken to change or improve a site that involves one or more land disturbing activities.

"Land Disturbing Activity" means any activity that changes stormwater runoff rates, volumes and pollutant loads on a site. These activities include, but are not limited to, the grading, digging, cutting, scraping, or excavating of soil, the placement of fill materials, paving, construction, substantial removal of vegetation and any activity that bares soil or rock or involves the diversion or piping of any natural or man-made watercourse.

"Land Owner" means the legal or beneficial owner of land, including those holding the right to purchase or lease the land, or any other person holding proprietary rights in the land.

"Low Impact Development Practice" means small-scale stormwater management practices that are used to disconnect impervious and disturbed pervious surfaces from the storm drain system and reduce post-construction stormwater runoff rates, volumes and pollutant loads. Low impact development practices include soil restoration, site reforestation/revegetation, green roofs, vegetated filter strips and rain gardens.

"National Pollutant Discharge Elimination System (NPDES) Stormwater Discharge Permit" means a permit issued by the EPA, or by a State under authority delegated pursuant to 33 USC § 1342(b), that authorizes the discharge of pollutants to waters of the State, whether the permit is applicable on an individual, group, or general area-wide basis.

"New Development" means a land development project undertaken on a previously undeveloped or unimproved site.

"Nonpoint Source Pollution" means pollution from any source other than from a discernible, confined and discrete conveyance, such as a wastewater treatment plant or industrial discharge. Sources of nonpoint source pollution include, but are not limited to, agricultural, silvicultural, mining and construction activities, subsurface disposal and urban stormwater runoff.

"Nonstructural Stormwater Management Practice" means any natural resource protection or stormwater management practice or technique that uses natural processes and natural systems to intercept, convey, treat and/or manage stormwater runoff. Nonstructural stormwater management practices include, but are not limited to, protecting primary and secondary conservation areas, reducing clearing and grading limits, reducing roadway lengths and widths, reducing parking lot and building footprints, soil restoration, site reforestation/revegetation, green roofs, vegetated filter strips and rain gardens.

"Off-Site Stormwater Management Practice" means a green infrastructure or stormwater management practice located outside the boundaries of a development site.

"On-Site Stormwater Management Practice" means a green infrastructure or stormwater management practice located within the boundaries of a development site.

"Overbank Flood Protection" means measures taken to protect downstream properties from damaging overbank flooding events.

"Owner" means the legal or beneficial owner of a piece of land, including, but not limited to, a mortgagee or vendee in possession, receiver, executor, trustee, lessee or other person, firm, or corporation in control of the site.

"Permanent Stormwater Management Practice" means a green infrastructure or stormwater management practice that will be operational after the land disturbing activities are complete and that is designed to become a permanent part of the site for the purposes of managing post-construction stormwater runoff.

"Permit" means the permit issued by a local development review authority to an applicant, which is required for undertaking any land development project or land disturbing activities.

"Person" means any individual, partnership, firm, association, joint venture, public or private corporation, trust, estate, commission, board, public or private institution, utility, cooperative, city, county or other political subdivision, any interstate body, or any other legal entity.

"Post-Development Hydrology" refers to the set of hydrologic conditions that may reasonably be expected to exist on a development site, after the completion of all land disturbing and construction activities.

"Pre-Development Hydrology" refers to the set of hydrologic conditions that exist on a development site prior to the commencement of any land disturbing activities and at the time

that plans for the land development project are approved by the local development review authority.

"Receiving Stream" or **"Receiving Aquatic Resource"** means the body of water or conveyance into which stormwater runoff is discharged.

"Recharge" means the replenishment of groundwater aquifers.

"Redevelopment" means a change to previously existing, improved property, including but not limited to the demolition or building of structures, filling, grading, paving, or excavating, but excluding ordinary maintenance activities, remodeling of buildings on the existing footprint, resurfacing of paved areas and exterior changes or improvements that do not materially increase or concentrate stormwater runoff or cause additional nonpoint source pollution.

"Regional Stormwater Management Practice" means a stormwater management practice designed to control stormwater runoff from multiple properties, where the owners or developers of the individual properties may participate in providing land, financing, design services, construction services and/or maintenance services for the practice.

"Responsible Party" means any individual, partnership, co-partnership, firm, company, corporation, association, joint stock company, trust, estate, governmental entity, or any other legal entity; or their legal representatives, agents, or assigns that is named on a stormwater inspection and maintenance agreement and plan as responsible for the long-term operation and maintenance of one or more green infrastructure or stormwater management practices.

"Site" means development site.

"Stop Work Order" means an order issued that requires that all land disturbing activity on a site be stopped.

"Stormwater Hotspot" means an area where land use or pollution generating activities have the potential to generate highly contaminated runoff, with concentrations of pollutants in excess of those typically found in stormwater runoff. Stormwater hotspots include, but are not limited to, fueling stations (including temporary fueling stations during construction), golf courses, public works yards and marinas.

"Stormwater Management" means the interception, conveyance, treatment and management of stormwater runoff in a manner that is intended to prevent increased flood damage, channel erosion, habitat degradation and water quality degradation and to enhance and promote the public health, safety and general welfare.

"Stormwater Management Plan" means a written document that details how stormwater runoff will be managed on a development site and that shows how the stormwater management criteria that apply to the development project have been met.

"Stormwater Management Practice" means a practice or technique, either structural or nonstructural, that is used to intercept stormwater runoff and change the characteristics of that runoff. Stormwater management practices are used to control post-construction stormwater runoff rates, volumes and pollutant loads to prevent increased flood damage, channel erosion, habitat degradation and water quality degradation.

"Stormwater Management System" means the entire suite of green infrastructure and stormwater management practices and stormwater conveyance features that are used to intercept, convey, treat and manage stormwater runoff on a development site.

"Stormwater Retrofit" means a green infrastructure or stormwater management practice designed for an existing development site that previously had no green infrastructure or stormwater management practice in place or had a practice that was not meeting local stormwater management criteria.

"Stormwater Runoff" means surface water resulting from precipitation.

"Stormwater Runoff Reduction" means providing for the interception, evapotranspiration, infiltration, or capture and reuse of stormwater runoff to help maintain pre-development site hydrology and help protect aquatic resources from several indirect impacts of the land development process, including decreased groundwater recharge, decreased baseflow and degraded water quality.

"Subdivision" means the division of a parcel of land to create one or more new lots or development sites for the purpose, whether immediately or in the future, of sale, transfer of ownership, or land development, and includes divisions of land resulting from or made in connection with the layout or construction of a new street or roadway or a change in the layout of an existing street or roadway.

"Watercourse" means a permanent or intermittent stream or other body of water, either natural or man-made, which gathers or carries surface water.

"Watershed Management Plan" or **"Subwatershed Management Plan"** means a document, usually developed cooperatively by government agencies and other stakeholders, to protect, restore and/or otherwise manage the water resources found within a particular watershed or subwatershed. Watershed or subwatershed management plans commonly identify threats, sources of impairment, institutional issues and technical and programmatic solutions or projects to protect and/or restore water resources.

"Water Quality Protection" means adequately treating stormwater runoff before it is discharged from a development site to help protect downstream aquatic resources from water quality degradation.

"Wetland Hydroperiod" means the pattern of fluctuating water levels within a wetland caused by the complex interaction of surface water, groundwater, topography, soils and geology within a wetland.

Appendix A High Priority Plant and Animal Species and Habitat Areas

A.1 Introduction

At least 71 high priority animal species can be found in coastal Georgia, including 27 birds, 14 reptiles, 10 mammals, 7 amphibians, 7 mollusks, 5 fish and 1 aquatic arthropod (WRD, 2005). These high priority animal species are listed in Table A.1, along with information on global and state rarity ranks, protected status (if any) under federal or state law and habitat and range in coastal Georgia. In addition, at least 91 high priority plants species can be found in coastal Georgia (WRD, 2005). These species are listed in Table A.2.

Because of the habitat that they provide for these high priority plant and animal species, a total of 25 high priority habitat areas can be found in coastal Georgia. These priority habitat areas are listed and briefly described in Table A.3.

Table A.1: High Priority Animal Species Found in Coastal Georgia (Source: WRD, 2005)							
Scientific Name	**Common Name**	**Global Rank**	**State Rank**	**Federal Status**	**State Status**	**Habitat in Georgia**	**Range in Georgia**
Cordulegaster sayi	Say's spiketail	G2	S1			Trickling hillside seepages in deciduous forest near weedy fields	Southeastern coastal plain only.
Ambystoma cingulatum	Flatwoods salamander	G2G3	S2	LT	T	Pine flatwoods; moist savannas; isolated cypress/gum ponds	Lower CP, extremely localized throughout large but fragmented range. Only four sites with known extant populations
Desmognathus auriculatus	Southern dusky salamander	G5	S3			In or around the margins of slowly moving or stagnant bodies of water with mucky, acidic soils; cypress swamps, floodplains, sloughs	Lower CP
Necturus punctatus	Dwarf waterdog	G4	S2			Sluggish streams with substrate of leaf litter or woody debris	Atlantic drainages, primarily CP, one record in the PD
Notophthalmus perstriatus	Striped newt	G2G3	S2		R	Pine flatwoods, sandhills; isolated wetlands	CP
Pseudobranchus striatus	Dwarf siren	G5	S3			Swamps; marshes; limesink ponds; cypress ponds	lower CP
Rana capito	Gopher frog	G3G4	S3			Sandhills; dry pine flatwoods; breed in isolated wetlands	CP
Stereochilus marginatus	Many-lined salamander	G5	S3			Sluggish, swampy streams and bayheads with substrate of leaf litter	eastern CP
Aimophila aestivalis	Bachman's sparrow	G3	S3	SAR	R	Open pine or oak woods; old fields; grassy forest regeneration	RV, PD, CP: where appropriate habitat
Ammodramus henslowii	Henslow's sparrow	G4	S3	SAR		Grassy areas, especially wet grasslands; wet pine savanna & flatwoods	CP, PD - historically and migrants
Ammodramus savannarum	Grasshopper sparrow	G5	S4			Grassland surrounded by open country (ag, grassland etc.)	CP, PD predominantly, less common in CU, RV, rare in BR
Calidris canutus	Red knot (SE winter population)	G5	S3	SAR		Beaches and sandbars	Coastal
Charadrius melodus	Piping plover	G3	S1	(LE,LT)	T	Sandy beaches; mud and sand flats; isolated sand spits	CP - coastal
Charadrius wilsonia	Wilson's plover	G5	S2		R	Sandy beaches; sand and mud flats, dunes and back dune swales	CP - coastal
Colinus virginianus	Northern bobwhite	G5	S4			Early successional mixed grass/forb habitat; longleaf pine savanna	CP most numerous; uncommon in PD, RV; scattered in CU, BR
Egretta tricolor	Tricolored heron	G5	S3			Coastal aquatic environments, salt and fresh, nests with other waders in low thick cover	All coastal counties
Elanoides forficatus	Swallow-tailed kite	G5	S2	SAR	R	River swamps and upland adjacent habitats particularly with large, emergent pines and pine islands; marshes	CP - nesting primarily in SE CP with scattered records statewide post breeding

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Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Habitat in Georgia	Range in Georgia
Falco sparverius paulus	Southeastern American kestrel	G5T4	S3	SAR		Pine sandhills and savannas; open country with scattered trees for nesting; military base habitats; artificial/man-made nesting habitats include nest boxes, power poles, building columns	CP
Grus canadensis pratensis	Florida sandhill crane	G5T2T3	S1			Freshwater prairies	Restricted to Okefenokee and Grand Bay
Haematopus palliatus	American oystercatcher	G5	S2	SAR	R	Sandy beaches; tidal flats; salt marshes, oyster shell bars	CP - coastal
Haliaeetus leucocephalus	Bald eagle	G4	S2	(PS:LT,PDL)	E	Edges of lakes & large rivers; seacoasts	CP - primarily and reservoirs and rivers PD, BR, RV
Himantopus mexicanus	Black-necked stilt	G5	S3	(PS)		Shallow ponds; lagoons; isolated freshwater wetlands; dredge spoil sites; managed wetlands	CP - coastal
Ixobrychus exilis	Least bittern	G4	S3			Freshwater and brackish marshes with tall, dense emergent vegetation. Nests close to open areas	Probably more common as a breeder in CP due to much more potentially suitable habitat than in PD
Lanius ludovicianus migrans	Loggerhead shrike	G4T3Q	S?	SAR		Open woods; field edges; savannas	CP - primary area of abundance; scattered and low number in the PD (none in 20-county metro Atlanta area); low numbers in RV
Laterallus jamaicensis	Black rail	G4	S2?	SAR		Freshwater marsh grassy margins; wet grassy meadows; brackish high marsh	PD, CP - most likely breeding would occur in eastern PD or along Coast
Limnothlypis swainsonii	Swainson's warbler	G4	S3	SAR		Dense undergrowth with heavy litter (CP,M); canebrakes in swamps and river floodplains (CP)	Although found widespread, bulk of population restricted to river floodplains of CP and PD; small BR population
Mycteria americana	Wood stork	G4	S2	(PS:LE)	E	Cypress/gum ponds; freshwater marshes; saltmarshes, river swamps; bays, isolated wetlands, ephemeral wetlands, coastal hammocks	1,200 pairs nesting in Coastal Plain 2002, with post-nest dispersal throughout state
Numenius phaeopus	Whimbrel	G5	S3			Saltmarsh openings, Mud flats, shell rakes, outer barrier sand spits	All coastal counties
Passerina ciris	Painted bunting	G5	S3	SAR		Shrub-scrub and open grassy habitats; open mature pine forest and maritime oak forest associated with freshwater wetlands	CP - primarily barrier islands and immediate coast with scattered occurrences up major river corridors; occurrences in CP agricultural lands reduced and poorly understood

Table A.1: High Priority Animal Species Found in Coastal Georgia (Source: WRD, 2005)							
Scientific Name	**Common Name**	**Global Rank**	**State Rank**	**Federal Status**	**State Status**	**Habitat in Georgia**	**Range in Georgia**
Picoides borealis	Red-cockaded woodpecker	G3	S2	LE	E	Open pine woods; pine savannas	Found mostly in CP, also lower PD. Disjunct populations in counties of Muscogee, Chattahoochee (Ft Benning); Liberty, Long, Bryan (Ft Stewart); Charlton, Brantley (Okefenokee NWR, private); Jones, Jasper (Piedmont NWR, Oconee NF, Hitchiti); Thomas, Grady
Rallus elegans	King rail	G4G5	S3			Freshwater marshes, often cattail bulrush, cutgrass, for breeding; also brackish marshes non-breeding (saltmarshes?)	Principally Piedmont and CP; possibly R&V
Rynchops niger	Black skimmer	G5	S1			Sandy beaches, isolated accretional sand spits, N and S tips of barrier islands	Strictly outer coast
Sterna antillarum	Least tern	G4	S3	(PS:LE)	R	Sandy beaches; sandbars, large flat gravel roof tops	Coastal Counties
Sterna nilotica	Gull-billed tern	G5	S1		T	Outer sand beaches and mud flats, Salt marshes; fields on barrier islands; Isolated sand spits	Coastal
Tyto alba	Barn owl	G5	S3/S4			Grassland savanna with large cavity trees, also neighborhoods with large cavity trees, generally needs open country	Local: CP, PD, RV, CU, rare in BR
Acipenser brevirostrum	Shortnose sturgeon	G3	S2	LE	E	Estuaries; lower end of large rivers in deep pools with soft substrates	Atlantic drainage large rivers
Elassoma okatie	Bluebarred pygmy sunfish	G2G3	S1S2			Temporary ponds and stream backwaters with dense aquatic vegetation	Fort Gordon
Enneacanthus chaetodon	Blackbanded sunfish	G4	S1		R	Blackwater streams; bays; cypress/gum ponds	Disjunct historic locales in SE GA; T. Peterson (recent) able to find at one historic locale outside of OK Swamp
Lucania goodei	Bluefin killifish	G5	S1		U	Heavily vegetated ponds and streams with little or no current; frequently associated with springs	Lower Flint River system and in McIntosh County on east coast of GA
Micropterus notius	Suwannee bass	G3	S2		R	Flowing water over rocky shoals or large springs and spring runs	Suwanee drainage so. GA
Condylura cristata	Star-nosed mole	G5	S2?			Moist meadows; woods; swamps	Known only from Charlton, Chatham, Clinch, Effingham, Jackson and Union counties
Corynorhinus rafinesquii	Rafinesque's big-eared bat	G3G4	S3?		R	Pine forests; hardwood forests; caves; abandoned buildings; bridges; bottomland hardwood forests and cypress-gum swamps	Range in state disjunct--C.r.rafinesquii found in northern BR and C. r. macrotis found in lower CP. Not known from PD, but either subsp might occur there.

Table A.1: High Priority Animal Species Found in Coastal Georgia (Source: WRD, 2005)

Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Habitat in Georgia	Range in Georgia
Eubalaena glacialis	North Atlantic right whale	G1	S1 and S?	LE	E	Inshore and offshore oceanic waters of Georgia	Occurs along the entire Georgia coast and also observed offshore up to 40 nm. Most frequently observed in waters > 8ft. Maximum depth or distance from shore is unknown but strongly suspected to occur West of the Gulf Stream
Geomys pinetis	Southeastern pocket gopher	G5	S4			Sandy well-drained soils in open pine woodlands with grassy or herbaceous groundcover, fields, grassy roadsides	Fairly widespread over CP, but population apparently greatly reduced and fragmented; small local populations
Lasiurus intermedius	Northern yellow bat	G4G5	S2S3			Wooded areas near open water or fields	Has been found only in lower CP
Neofiber alleni	Round-tailed muskrat	G3	S3		T	Freshwater marshes; bogs	Okefenokee and surrounding areas in Camden, Charlton and Ware; also Grand Bay WMA in Lanier and Lowndes; also Brooks.
Sciurus niger shermani	Sherman's fox squirrel	G5T2	S?			Pine forests; pine savannas	Some sources say this subspecies only occurs in extreme SE corner of Georgia around Okefenokee Swamp. However, Turner and Laerm (1993) say S.n. shermani occurs up into Piedmont.
Trichechus manatus	West Indian manatee	G2	S1S2	LE	E	Inshore ocean; estuaries, tidal rivers, warm and fresh water discharges	Found in six coastal counties. These animals are unique because they can migrate between fresh and salt water.
Tursiops truncatus	Bottlenose dolphin	G5	S?			Coastal estuarine and offshore waters of Georgia	Bottlenose dolphins range in all 6 coastal counties; Camden, Glynn, McIntosh, Liberty, Bryan and Chatham. All tidal rivers and creeks provide dolphin habitat. They also extend offshore. CP.
Ursus americanus floridanus	Florida black bear	G5T2	S2			Large undeveloped wooded tracts in areas that include multiple forest types	Parts of Echols, Clinch, Charlton, Ware and Brantley counties support breeding population. Individuals frequently wander into surrounding counties and along Altamaha corridor.
Alasmidonta triangulata	Southern elktoe	G2Q	S1			Large creeks and river mainstems in sandy mud and rock pools	Confined to the Chattachoochee, Flint, Ogeechee, Savannah river drainages

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Scientific Name	**Common Name**	**Global Rank**	**State Rank**	**Federal Status**	**State Status**	**Habitat in Georgia**	**Range in Georgia**
Alasmidonta varicosa	Brook floater	G3	S2			Small rivers and creeks in sand and gravel shoals	Present distribution includes 4 sites in the Chattooga River in Rabun County (Savannah River drainage).
Elliptio fraterna	Brother spike	G1	SU			Sandy substrates of river channels with swift current	Uncertain of range in Savannah River system
Fusconaia masoni	Atlantic pigtoe	G2	S1		E	Moderate to fast current in substrate of sand or gravel	Historical range included 6 sites in the Ogeechee and Savannah River basins-all of which have been extirpated. One newly discovered population was found in Williamson Swamp Creek in Jefferson County (Alderman 1991).
Medionidus walkeri	Suwannee moccasinshell	G1	SH			Large creeks and medium-sized rivers with sand and gravel substrate	Endemic to the Suwannee River basin in GA and FL
Quincuncina kleiniana	Suwanee pigtoe	GU	S2			Small to large rivers in the Suwannee Basin, in slow to moderate current, pools of flowing rivers, often in detritus. More common in Alapaha and Withalacoochee rivers and tribs	Endemic to the Suwannee River basin in GA and FL
Toxolasma pullus	Savannah lilliput	G2	S2			Altamaha River; Savannah River	Historical distribution included the Altamaha River basin (Johnson 1970, Sepkoski and Rex 1974, Keferl 1981). Present distribution from recent surveys appears to be only the Ohoopee River (Keferl pers. com.).
Caretta caretta	Loggerhead	G3	S2	LT	T	Open ocean; sounds; coastal rivers; beaches	Ocean, sounds, coastal rivers, beaches
Chelonia mydas	Green sea turtle	G3	S2	(LE,LT)	T	Open ocean; sounds; coastal rivers; beaches	Ocean, sounds, coastal rivers, beaches
Clemmys guttata	Spotted turtle	G5	S3		U	Heavily vegetated swamps, marshes, bogs and small ponds; nest and possibly hibernate in surrounding uplands	Widely distributed across CP
Crotalus adamanteus	Eastern diamondback rattlesnake	G4	S4			Early successional habitats on barrier islands and mainland; pine flatwoods; sandhills	CP, including barrier islands
Dermochelys coriacea	Leatherback sea turtle	G3	S2	LE	E	Open ocean; sounds; coastal beaches	Ocean, sounds, beaches
Drymarchon couperi	Eastern indigo snake	G4T3	S3	LT	T	Sandhills; pine flatwoods; dry hammocks; summer habitat includes floodplains and bottomlands	Middle and lower CP
Eumeces anthracinus	Coal skink	G5	S2			Mesic forests; often near streams, springs or bogs	Very little known about range especially in CP

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Eumeces egregius	Mole skink	G4	S3	(PS)		Coastal dunes; longleaf pine-turkey oak woods; dry hammocks	Widespread throughout CP
Gopherus polyphemus	Gopher tortoise	G3	S2	(PS:LT)	T	Sandhills; dry hammocks; longleaf pine-turkey oak woods; old fields	CP
Heterodon simus	Southern hognose snake	G2	S2			Sandhills; fallow fields; longleaf pine-turkey oak	CP
Lepidochelys kempii	Kemp's or Atlantic ridley	G1	S1	LE	E	Open ocean; sounds; coastal rivers; beaches	Ocean, sounds, coastal rivers
Macrochelys temminckii	Alligator snapping turtle	G3G4	S3		T	Large streams and rivers; impoundments; river swamps	Gulf CP drainages
Malaclemys terrapin	Diamondback terrapin	G4	S3			Entire coast, esturine and marine edge. All saltmarsh, beaches	Strictly Coastal
Ophisaurus mimicus	Mimic glass lizard	G3	S2			Pine flatwoods; savannas; seeapge bogs	Lower CP, substantial gaps in range
Pituophis melanoleucus mugitus	Florida pine snake	G4T3?	S3			Sandhills; scrub; old field	CP
Rhineura floridana	Florida worm lizard	G4	S1			Dry upland hammocks, sand pine and longleaf pine-turkey oak sandhills; old fields	Lanier Co. in CP
Tantilla relicta	Florida crowned snake	G5	S1			Sandhills, scrub and moist hammocks	Lowndes Co. in CP

Table A.2: High Priority Plant Species Found in Coastal Georgia (Source: WRD, 2005)							
Scientific Name	**Common Name**	**Global Rank**	**State Rank**	**Federal Status**	**State Status**	**Habitat in Georgia**	**Range in Georgia**
Amorpha georgiana var. georgiana	Georgia indigo-bush	G3T2	S1			River terraces; floodplain woods; flint kaolin outcrop; mesic habitats with wiregrass,longleaf pine, mixed oaks	UCP
Amorpha herbacea var. floridana	Florida leadbush	G4T?Q	S1			River terraces along the Alapaha River	LCP, if accepted as taxonomically significant
Arabis georgiana	Georgia rockcress	G2	S1	C	T	Rocky or sandy river bluffs and banks, in circumneutral soil	PD, RV, UCP; along Coosa, Oostanaula and lower Chattahoochee Rivers
Aristida simpliciflora	Chapman three-awn grass	G3	SH			Longleaf pine-wiregrass savannas	UCP
Arnoglossum diversifolium	Variable-leaf Indian-plantain	G2	S2		T	Calcareous swamps	UCP
Arnoglossum sulcatum	Grooved-stem Indian-plantain	G2G3	S1			Bottomland forests	UCP
Asplenium heteroresiliens	Morzenti's spleenwort	G2Q	S1		T	Limestone and marl outcrops; tabby ruins	UCP, LCP
Astragalus michauxii	Sandhill milkvetch	G3	S2			Longleaf pine-wiregrass savannas; turkey oak scrub	UCP
Balduina atropurpurea	Purple honeycomb head	G2G3	S2		R	Wet savannas, pitcherplant bogs	UCP, LCP
Baptisia arachnifera	Hairy rattleweed	G1	S1	LE	E	Pine flatwoods	LCP, entire global range in parts of Brantley and Wayne Cos.
Brickellia cordifolia	Heartleaf brickellia	G2G3	S2			Mesic hardwood forests	UCP
Calamintha ashei	Ashe's wild savory	G3	S2		T	Ohoopee dunes	UCP, Tattnall and Candler Cos.
Campylopus carolinae	Sandhills awned-moss	G1G2	S2?			Fall line sandhills; Altamaha Grit outcrops in partial shade of mesic oak forests	UCP
Carex calcifugens	Lime-fleeing sedge	G2G4	SR			Said by FNA to occur in "Mesic deciduous forests, in sandy loams and sands, usually on stream bank slopes."	LCP (only?)
Carex dasycarpa	Velvet sedge	G4?	S3		R	Evergreen hammocks; mesic hardwood forests	LCP, UCP
Carex decomposita	Cypress-knee sedge	G3	S2?			Swamps and lake margins on floating logs	LCP, UCP
Carex godfreyi	Godfrey's sedge	G3G4	S3?			Forested depressional wetlands.	UCP, possibly LCP?, uncertain, verification needed

Table A.2: High Priority Plant Species Found in Coastal Georgia (Source: WRD, 2005)							
Scientific Name	**Common Name**	**Global Rank**	**State Rank**	**Federal Status**	**State Status**	**Habitat in Georgia**	**Range in Georgia**
Carex lupuliformis	Mock hop sedge	G5	SU			Said by FNA to occur in "Wet forests, especially in openings around forest ponds, riverine wetlands, marshes, wet thickets, 0-500 m."	LCP?, uncertain, verification needed
Coreopsis integrifolia	Tickseed	G1G2	S1S2			Floodplain forests, streambanks	UCP, LCP
Ctenium floridanum	Florida orange-grass	G2	S1			Moist pine barrens	LCP
Dicerandra radfordiana	Radford's dicerandra	G1Q	S1			Sandridges	LCP, entire global range consists of 2 small areas in McIntosh Co.
Eccremidium floridanum	Florida eccremidium moss	G1?	S1			Sandy or sometimes clay soil in open, disturbed sites, often in areas that are wet part of the year and quite dry other parts of the year, fields and roadsides, thin soil over rock outcrops, around margins of cypres	UCP
Eleocharis tenuis var. tenuis	Slender spikerush	G5T?	SU			Moist to wet sandy-peaty soils; pine flatwoods	RV, PD, where doubtfully recorded and in need of comparison with other named varieites known to be present
Elliottia racemosa	Georgia plume	G2G3	S2S3		T	Scrub forests; Altamaha Grit outcrops; open forests over ultramafic rock	PD, UCP, LCP; from Ft. Stewart to Ashburn, Turner Co.;disjunct on piedmont on Burks Mtn., Columbia Co.
Epidendrum conopseum	Green-fly orchid	G4	S3		U	Epiphytic on limbs of evergreen hardwoods; also in crevices of Altamaha Grit outcrops	UCP, LCP; widespread, sometimes locally abundant especially in bottomland forests along major rivers in Southeast Georgia
Eriochloa michauxii var. michauxii	Michaux's cupgrass	G3G4T 3T4	S1?			Coastal freshwater and brackish marshes; flatwoods	LCP; map in FNA shows records from Charlton, Glynn, Liberty and McIntosh Cos.
Eupatorium anomalum	Florida boneset	G2G3	SU			Wet, low ground	LCP, UCP; likely close to Florida pending scrutiny of closely related E. mohrii and E. rotundifolium
Evolvulus sericeus var. sericeus	Creeping morning-glory	G5T?	S1		E	Altamaha Grit outcrops; open calcareous uplands	UCP
Forestiera godfreyi	Godfrey's wild privet	G2	S1			Mesic, maritime forests over shell mounds	LCP, Camden Co.
Forestiera segregata	Florida wild privet	G4	S2			Shell mounds on barrier islands in scrub or maritime forests	Restricted to shell middens overlooking or upon barrier islands; LCP
Fothergilla gardenii	Dwarf witch-alder	G3G4	S2		T	Openings in low woods and swamps; edges of seepage bogs	UCP, LCP; widely distributed from Fall Line Sandhills to more southern flatwoods

Table A.2: High Priority Plant Species Found in Coastal Georgia (Source: WRD, 2005)							
Scientific Name	**Common Name**	**Global Rank**	**State Rank**	**Federal Status**	**State Status**	**Habitat in Georgia**	**Range in Georgia**
Habenaria quinqueseta var. quinqueseta	Michaux's orchid	G4G5T ?	S1			Moist shade, Altamaha Grit outcrops; open pine woods	UCP, LCP; widely scattered sites
Hartwrightia floridana	Hartwrightia	G2	S1		T	Wet savannas; ditches, sloughs and flatwood seeps	LCP, restricted to Okefenokee Basin
Hypericum sp. 3	Georgia St.-John's-wort	G2G3	S2S3			Seepage bogs; roadside ditches	UCP, LCP, upper Ogeechee and Canoochee watersheds (only?) and near Eulonia, McIntosh Co.
Justicia angusta	Narrowleaf water-willow	G3Q	SH			Roadside ditches; perhaps with Hartwrightia in shallow sloughs and wet savannas	LCP
Lachnocaulon beyrichianum	Southern bog-button	G2G3	S1			Flatwoods	UCP, LCP
Leitneria floridana	Corkwood	G3	S1			Swamps; sawgrass-cabbage palmetto marshes	UCP, LCP
Lindera melissifolia	Pondberry	G2	S1	LE	E	Margins of seasonal ponds, both sandhill and limesink with swamp blackgum (Nyssa biflora).	LCP, UCP
Litsea aestivalis	Pondspice	G3	S2		T	Cypress ponds; swamp margins	UCP, LCP; especially southeastern Georgia
Lycium carolinianum	Carolina wolfberry	G4	S1			Coastal sand spits	LCP, Cumberland Island, Camden Co.
Malaxis spicata	Florida adders-mouth orchid	G4?	S1			Low hammocks; spring-fed river swamps	UCP, LCP, potentially over Coastal Plain based on Florida distribution; documented recently only from LCP; historic from UCP in Jenkins Co.
Matelea alabamensis	Alabama milkvine	G2	S1		T	Open bluff forests; mesic margins of longleaf pine sandridges	UCP, LCP; on Gulf CP and an area of Atlantic CP along the Altamaha River, Wayne Co..
Matelea pubiflora	Trailing milkvine	G3G4	S2		R	Exposed sandy soils; sandridges	UCP, LCP
Myriophyllum laxum	Lax water-milfoil	G3	S2		T	Bluehole spring runs; shallow, sandy, swift-flowing creeks; clear, cool ponds	UCP, in many watersheds, most often in westcentral Georgia sandhills
Orbexilum virgatum	Slender leather-root	G1	SH			Sandridges	LCP, Charlton Co.
Oxypolis ternata	Savanna cowbane	G3	S2			Wet pine savannas and bogs	UCP, widely scattered
Peltandra sagittifolia	Arrow arum	G3G4	S2?			Swamps; wet hammocks on pristine sphagnum mats	UCP, LCP; locally abundant in Okefenokee Swamp
Penstemon dissectus	Cutleaf beardtongue	G2	S2?		R	Altamaha Grit outcrops and adjacent pine savannas; rarely sandridges	UCP, endemic to Altamaha Grit (Tifton Uplands)

Table A.2: High Priority Plant Species Found in Coastal Georgia (Source: WRD, 2005)							
Scientific Name	**Common Name**	**Global Rank**	**State Rank**	**Federal Status**	**State Status**	**Habitat in Georgia**	**Range in Georgia**
Phaseolus polystachios var. sinuatus	Trailing bean-vine	G4T3?	S2?			Sandhills; dry pinelands and hammocks	UCP, LCP
Physostegia leptophylla	Tidal marsh obedient-plant	G4?	S2S3		T	Freshwater tidal marshes; perhaps disjunct in wet savannas of extreme SW Georgia	LCP, coastal cos. on tidally influenced shorelines; reports from UCP in SW Georgia need verification
Plantago sparsiflora	Pineland plantain	G3	S2			Open, wet pine savannas; shallow ditches	UCP, LCP
Platanthera blephariglottis var. blephariglottis	White fringed-orchid	G4G5T 4?	S1?				
Platanthera blephariglottis var. conspicua	Southern white fringed-orchid	G4G5T 3T4	S2?			Bogs, seeps, roadsides, wet savannas	UCP, LCP; scattered from Fall Line Sandhills to coast and South Georgia plantations
Platanthera chapmanii	Chapman's fringed-orchid	G4?	S1			Open, wet meadows; pine flatwoods	UCP, LCP, extreme Southeast Georgia; historic in Southwest Georgia
Platanthera integra	Yellow fringeless orchid	G3G4	S2			Wet savannas, pitcherplant bogs	UCP, LCP; documented from 9 cos., scattered on coastal plain
Polygonum glaucum	Sea-beach knotweed	G3	SH			Coastal beaches in dune depressions and among protected accumulations of beach wrack	LCP
Portulaca biloba	Grit portulaca	G1G2	S1			Altamaha Grit outcrops	UCP
Pteroglossaspis ecristata	Wild coco	G2	S1			Grassy saw palmetto barrens; longleaf pine grasslands, sometimes with Schwalbea americana	LCP, UPC; widely scattered, including barrier islands
Ptilimnium sp. 1	Mock bishop-weed	G1	SH			Tidal freshwater marshes	LCP, narrow endemic from Savannah into South Carolina
Rhynchospora breviseta	Short-bristle beakrush	G3G4	SU			Bogs; flatwoods	Uncertain, documentation needed, UCP, LCP
Rhynchospora decurrens	Decurrent beakrush	G3G4	S1?			Swamps	UCP, LCP
Rhynchospora fernaldii	Fernald's beakrush	G3G4	SR			Flatwoods depressions	LCP (only?), to be considered as a rarity from Okefenokee Swamp, whence all specimens from Georgia came
Rhynchospora macra	Many-bristled beakrush	G3	S1?			Peaty, sandhill seepage slopes; streamhead pocosins	LCP an old record from Coffee Co. near Douglas
Rhynchospora pleiantha	Clonal thread-leaved beakrush	G2	SH			Margins of limesink depression ponds (dolines)	UCP
Rhynchospora punctata	Spotted beakrush	G1?	S1?			Wet savannas, pitcherplant bogs	UCP, LCP

Table A.2: High Priority Plant Species Found in Coastal Georgia (Source: WRD, 2005)							
Scientific Name	**Common Name**	**Global Rank**	**State Rank**	**Federal Status**	**State Status**	**Habitat in Georgia**	**Range in Georgia**
Ruellia noctiflora	Night-blooming wild petunia	G2	SH			Open, slash pine flatwoods	LCP, outer Coastal Plain on the Barrier Island Sequence
Sageretia minutiflora	Climbing buckthorn	G4	S1?		T	Calcareous bluff forests; maritime forests over shell mounds	UCP, LCP
Sagittaria graminea var. chapmanii	Chapman's arrowhead	G5T3?	S3?			Low woods and seasonal wet swamps with Carex leptalea, Rhynchospora miliacea	UCP, LCP, perhaps widespread, including a pond on Sapelo Island
Sapindus saponaria	Soapberry	G5	S1			Shell mound forests	LCP
Sarracenia flava	Yellow flytrap	G5?	S3S4		U	Wet savannas, pitcherplant bogs	UCP, LCP
Sarracenia minor var. minor	Hooded pitcherplant	G4T4	S4			Wet savannas, pitcherplant bogs	UCP LCP
Sarracenia minor var. okefenokeense	Okefenokee giant	G4T2T3	S2S3			Wet savannas, pitcherplant bogs	LCP, Okefenokee Basin only
Sarracenia psittacina	Parrot pitcherplant	G4	S2S3		T	Wet savannas, pitcherplant bogs	UCP, LCP
Sarracenia rubra	Sweet pitcherplant	G3	S2	(PS)	E	Atlantic white cedar swamps; wet savannas	UCP, in two areas, Atlantic Coastal Plain and Fall Line Sandhills west of Macon
Schoenolirion elliottii	White sunnybell	G3	S1?			Wet savannas	LCP, few observations from Wayne and Brantley Cos.
Scutellaria altamaha	Altamaha skullcap	G2G3	S1?			Sandy, deciduous woods	UCP, LCP. (only?), perhaps adjacent Piedmont, of Southeast Georgia
Scutellaria arenicola	Sandhill skullcap	G3G4	SH			Sandy scrub	LCP, Trail Ridge; Camden Co.
Scutellaria mellichampii	Mellichamp's skullcap	G?Q	S1?			Sandy deciduous woods	LCP, UCP; widely scattered
Sideroxylon sp. 1	Dwarf buckthorn	G3Q	S3			Dry longleaf pine woods with oak understory; often hidden in wiregrass	UCP, LCP
Sideroxylon thornei	Swamp buckthorn	G2	S2		E	Forested limesink depressions; calcareous swamps	UCP, LCP
Sphagnum cyclophyllum	Round-leaved peat-moss	G3	S2			CP: bare sand where wet or submerged for part of the year and then drying, as around seasonal ponds in pine barrens.. PD: seepage over granite outcrops	PD, LCP, UCP
Spiranthes floridana	Florida ladies-tresses	G1	S1?				
Sporobolus pinetorum	Pineland dropseed	G3	S2?			Wet savannas with wiregrass	LCP

Table A.2: High Priority Plant Species Found in Coastal Georgia (Source: WRD, 2005)							
Scientific Name	**Common Name**	**Global Rank**	**State Rank**	**Federal Status**	**State Status**	**Habitat in Georgia**	**Range in Georgia**
Stewartia malacodendron	Silky camellia	G4	S2		R	Along streams on lower slopes of beech-magnolia or beech-basswood-Florida maple forests	PD, UCP
Tillandsia bartramii	Bartram's airplant	G4	S2				
Vaccinium crassifolium	Evergreen lowbush blueberry	G4G5	SH			Open margins of Carolina bays	LCP, historically in or near Screven Co.
Xyris drummondii	Drummond's yellow-eyed grass	G3	S1			Pine flatwoods	UCP, LCP
Xyris scabrifolia	Harper's yellow-eyed grass	G3	S1			Sedge bogs; pitcherplant bogs; pine flatwoods	UCP, LCP

Table A.3: High Priority Habitat Areas Found in Coastal Georgia (Source: WRD, 2005)	
Priority Habitat Area	**Description**
Alluvial (Brownwater) Rivers and Swamps	Large, low-gradient, meandering rivers with sandbars, sloughs and extensive floodplain swamps. Floodplains of these systems may remain inundated for extensive periods. Sand and silt are the dominant substrata and these rivers typically carry heavy sediment loads. Dominant canopy trees are baldcypress and tupelo gum; the understory tree/shrub vegetation may be patchy, often consisting of swamp privet, water elm, swamp dogwood, red maple and Carolina ash. Cypress and gum-dominated swamps can be found along the Altamaha, Savannah and Ogeechee rivers. These systems have been impacted by altered flows from upstream dams.
Barrier Island Freshwater Wetlands and Ponds	Usually found in broad flats or in elliptical to linear interdune depressions on Georgia's coastal barrier islands. These wetland habitats are variable in physiognomy and species composition; deeper, more permanently flooded ponds often have a large extent of open water; shallower ponds are usually dominated by a combination of submergent, emergent and/or floating macrophytes. Trees or shrubs are present mainly along the edges of the ponds. These habitats have been impacted by groundwater withdrawals, fire suppression and invasive exotic plants such as Chinese tallow tree.
Bayheads and Titi Swamps	Forested wetlands dominated by broad-leaved evergreen trees: sweetbay, redbay and loblolly bay. Usually found in domed peatlands, broad interstream flats, or shallow drainageways. Includes shrubby areas dominated by titi (Cyrilla racemiflora). These are considered late successional communities in a variety of hydrogeomorphic settings in the Coastal Plain.
Beech-Magnolia Slope Forests	These are uncommon Coastal Plain hardwood forests, typically found on very mesic river bluffs, and occasionally on gentle slopes that are naturally protected from fire by topographic setting. In addition to American beech and southern magnolia, may contain water oak, water hickory, American holly and other fire-intolerant species. Often small in extent and occupying a narrow zone between wetland and fire-maintained upland forests. May contain epiphytic species such as green-fly orchid. Often associated with and in close proximity to hillside seeps.
Bottomland Hardwood Forests	Diverse hardwood-dominated forests found on natural levees, upper floodplain flats and terraces along brownwater and blackwater rivers. Characterized by a diverse canopy of hardwood species dominated by various oaks, green ash, sweetgum, red maple, water hickory and other mesic species. These extensive forested systems provide habitat for a wide variety of wildlife species, and are especially important for wide-ranging forest interior species. Bottomland hardwood forests have been impacted by altered hydrologic conditions, forest conversion and invasive exotic species.
Brackish Marsh and Salt Marsh	Salt marshes are salt-tolerant grasslands, dominated by cordgrasses and rushes, over soils with circumneutral pH. These are extremely productive habitats. Brackish marshes occupy a wide ecotonal zone in the vicinity of river mouths.
Canebrakes	Thickets of native river cane found along rivers and creeks under sparse to full tree cover. Canebrakes represent important wildlife habitat for a variety of neotropical birds and insects. These habitats require periodic fire or other form of disturbance for maintenance.
Coastal Beaches and Sand Bars	Beaches and sand bars are dynamic, high-energy intertidal systems that represent important habitat for shorebirds and sea turtles. Longshore movement of sand on barrier islands results in erosion at the north end and building up at the south end. These unvegetated habitats are important foraging areas for coastal shorebirds; sea turtles nest in the foredunes at the upper ends of sandy beaches.
Coastal Dunes and Bluffs	These habitats consist of sparsely vegetated sandy interdunes, rear dunes and bluffs. They constitute important habitats for a number of high priority species adapted to harsh temperatures and salt spray. Coastal dune habitats include a number of important microhabitats such as interdune meadows and depressions, shrub thickets and dune scrub forests. Similar vegetation can be found along eroded or exposed coastal bluffs.
Coastal Scrub-Shrub Wetlands	Shrub dominated estuarine communities found along the upper border of salt marsh or brackish marsh. These habitats are infrequently flooded by tidal action and form ecotones between wetland and terrestrial environments. Typical shrubs include groundsel tree, marsh elder, yaupon holly, wax myrtle, Florida privet and false willow. Wind-pruned redcedar may also be present.

Table A.3: High Priority Habitat Areas Found in Coastal Georgia (Source: WRD, 2005)	
Priority Habitat Area	**Description**
Estuarine and Inshore Marine Waters	Estuaries (brackish waters between barrier islands and mainland) and near-shore ocean waters. Estuaries serve as nurseries for many species of fish and shellfish as well as habitats for manatees and other marine mammals. Species composition in these aquatic communities is influenced by tidal regime and salinity.
Evergreen Hammocks and Mesic Hardwood Forests	Evergreen hammocks are typically associated with small isolated uplands within a floodplain or depressional wetland. Protected from frequent fire, these habitats are characterized by a canopy of submesic oaks and hickories, with southern magnolia, American holly, ironwood, flowering dogwood and spruce pine. Mesic hardwood forests are similar, and may occur in terraces above bottomland hardwood forests, ravines, or nonalluvial flats protected from frequent fire.
Forested Depressional Wetlands	Seasonally or semi-permanently flooded forests of depressional features in broad interstream flats. Soils range from mineral to organic and canopy dominants may include bays, pondcypress and/or pond pine. Fire plays a role in maintaining some of these systems. Isolated wetlands that do not support fish populations are very important breeding habitats for amphibians such as the flatwoods salamander.
Freshwater "Prairies"	Semipermanently flooded freshwater wetlands dominated by emergent vegetation and floating macrophytes, with scattered cypress, buttonbush and swamp blackgum. The primary example in this region is the Okefenokee Swamp. Fluctuations in water levels and/or periodic fire are required for maintenance. Many of these habitats have been impacted by altered hydrology (impoundment with dams or drainage) and/or fire suppression.
Hillside Seeps	Small patch habitats found on moist to wet lower slopes in sandy terrain. These seeps represent natural groundwater discharge points. May be dominated by shrubs or herbs (including pitcherplants), with scattered trees such as pond, slash, or longleaf pine. Most Georgia examples are fire-suppressed.
Longleaf Pine-Scrub Oak Woodlands	Sparse-canopied xeric longleaf pine system with patchy oak understory composed of turkey oak, sand post oak, bluejack oak, blackjack oak and other scrub oak species. Typically found on deep sand soils, on ridges and upper slopes. Contains a fairly diverse groundlayer of xerophytic grasses and forbs and scattered shrubs.
Longleaf Pine-Wiregrass Savannas	Large patch or matrix upland habitats characterized by a sparse canopy of longleaf pine (sometimes with slash pine) and a diverse herb layer dominated by wiregrass. Can range from mesic to dry, depending on topographic position and soils.Transition downslope into wet pine savannas, pine flatwoods, or other wetlands. These habitats are heavily dependent on frequent fire for maintenance.
Maritime Forest and Coastal Hammocks	Coastal forests dominated by live oak and palmetto; hammocks are small islands of maritime forest usually surrounded by brackish water and/or salt marsh. These are restricted to a narrow band of shoreline and barrier islands. Characterized by sandy soils and wind-pruned canopy trees. Provide important habitat for neotropical migrant birds.
Mud and Sand Flats	Periodically inundated mud and sand deposits located in estuarine or inshore marine waters. These unvegetated habitats are generally covered at high tide and exposed at low tide. They serve as important feeding areas for a number of coastal shorebirds such as plovers, sandpipers and dowitchers.
Nonalluvial (Blackwater) Rivers and Swamps	Large, meandering rivers with tea-stained, but translucent waters and narrow to wide floodplains. Dominant substrate is sand, which may form bars in larger systems. In contrast to blackwater streams, forest canopy may only shade a portion of the stream width. Runs and pools are dominant habitats. Large snags are a significant component of habitat heterogeneity. Limestone shoals occur on some of these rivers.
Offshore Marine Waters	Georgia's offshore marine waters provide habitat for a number of high priority species, including loggerhead, green, Kemp's ridley and leatherback turtles, North Atlantic right whales and bottlenose dolphins. Hard-bottom areas are especially important habitats for marine fish and sessile organisms.
Open-Water Ponds and Lakes	Open water aquatic habitats ranging from isolated depressions to impoundments created by beaver. Vegetation is sparse and consists primarily of emergent and floating macrophytes. These habitats are relatively uncommon in this region, and are maintained by periodic fire and fluctuating water levels.

Table A.3: High Priority Habitat Areas Found in Coastal Georgia (Source: WRD, 2005)	
Priority Habitat Area	**Description**
Pine Flatwoods	Mesic or wet forests on flat, poorly-drained areas of the lower Coastal Plain. Dominated formerly by longleaf pine, now typically by slash pine, occasionally with loblolly or pond pine. Contains a well-developed shrub layer consisting of saw palmetto, gallberry, lowbush blueberry and other ericaceous species. One of the most extensive and prevalent habitats of this ecoregion.
Tidal Rivers and Freshwater Tidal Marsh	Includes tidally influenced portions of rivers and creeks and associated wetlands. Freshwater tidal marshes are wetlands found along the margins of tidal rivers and creeks above the brackish water zone, typically dominated by giant cutgrass, sawgrass, pickerel weed, wild rice, cattail, rushes and a variety of other herbs.
Wet Pine Savannas, Herb and Shrub Bogs	Wet pine savannas are poorly drained wetlands with open to sparse canopies dominated by longleaf, slash and/or pond pine. The shrub layer may be sparse, consisting mainly of gallberry, wax myrtle and blueberries. The herbaceous layer is often diverse and dense, dominated by grasses, sedges, composites, orchids and lilies. May include small peat-filled depressions dominated by titi and other shrubs or by herbaceous bog plants.

References

Georgia Department of Natural Resources Wildlife Resources Division (WRD). 2005. *A Comprehensive Wildlife Conservation Strategy for Georgia*. Georgia Department of Natural Resources. Wildlife Resources Division. Social Circle, GA. Available Online: http://www1.gadnr.org/cwcs/Documents/strategy.html.

Appendix B Coastal Georgia Rainfall Analysis

B.1 Introduction

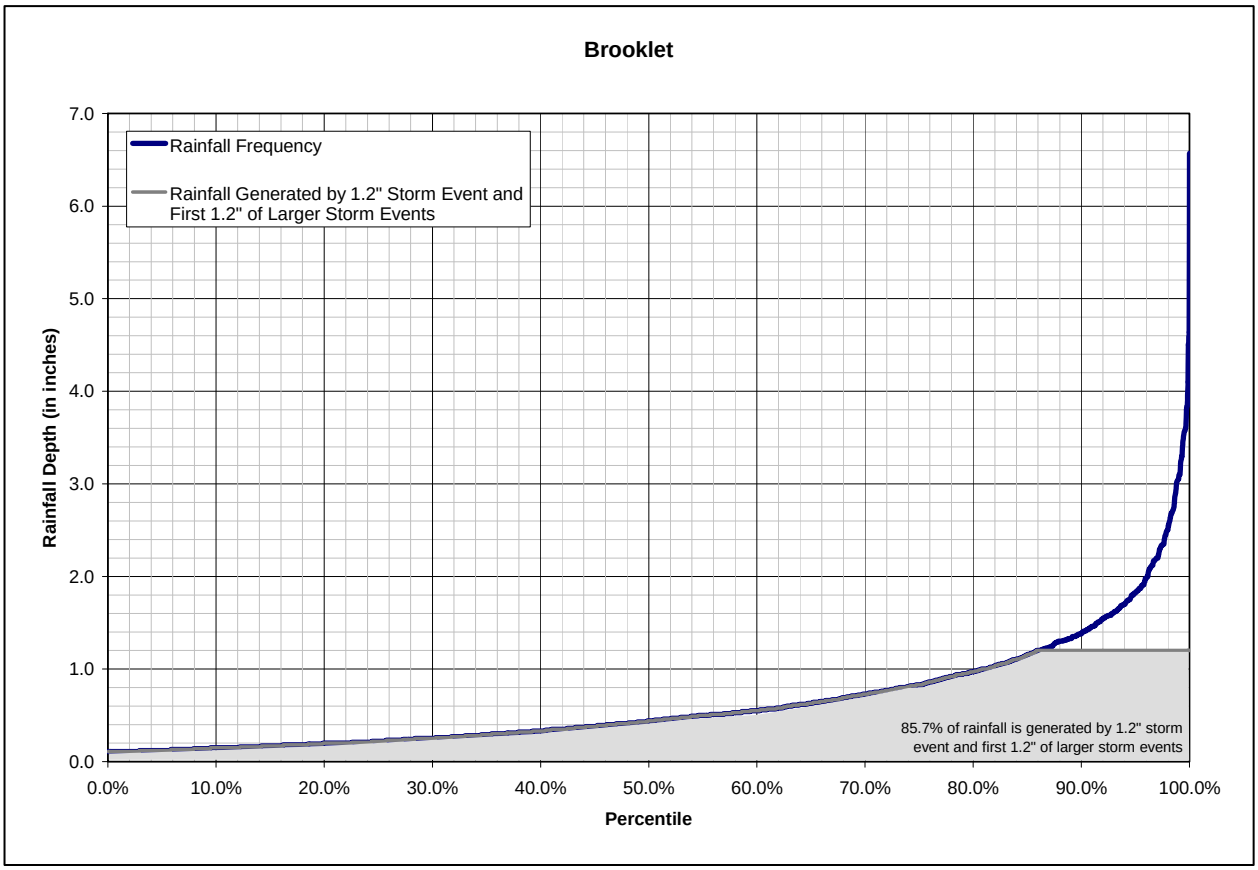
Many storm events occur within Georgia's 24-county coastal region over the course of a given year. Most of these storm events are quite small, but a few can generate several inches of rainfall or more. A Rainfall Frequency Spectrum (RFS) analysis can be used to illustrate how often, on average, each of these various precipitation events can be expected to occur. This Appendix presents RFS analyses for six communities that are distributed across the Coastal Nonpoint Source Management Area and Area of Special Interest: Brooklet, Brunswick, Douglas, Folkston, Jesup and Savannah.

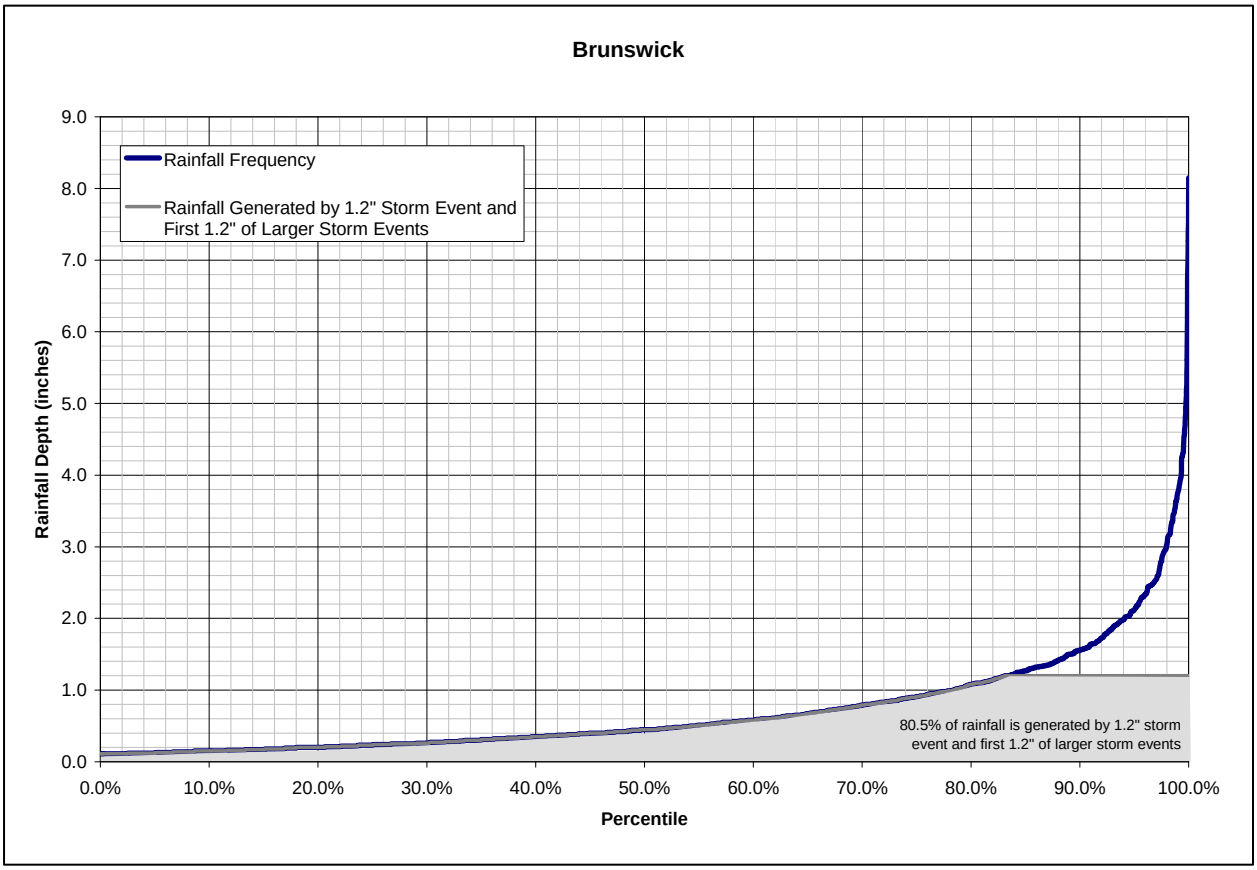
The RFS analyses presented in this Appendix were created using 30 years of historical rainfall data collected in each of the six communities. These analyses illustrate that small, but frequent storm events account for a majority of the storm events that occur in the 24-county coastal region. In fact, as the analyses show, storm events up to and including the 1.2 inch rainfall event account for, on average, 85 percent of all the rainfall events that occur in coastal Georgia.

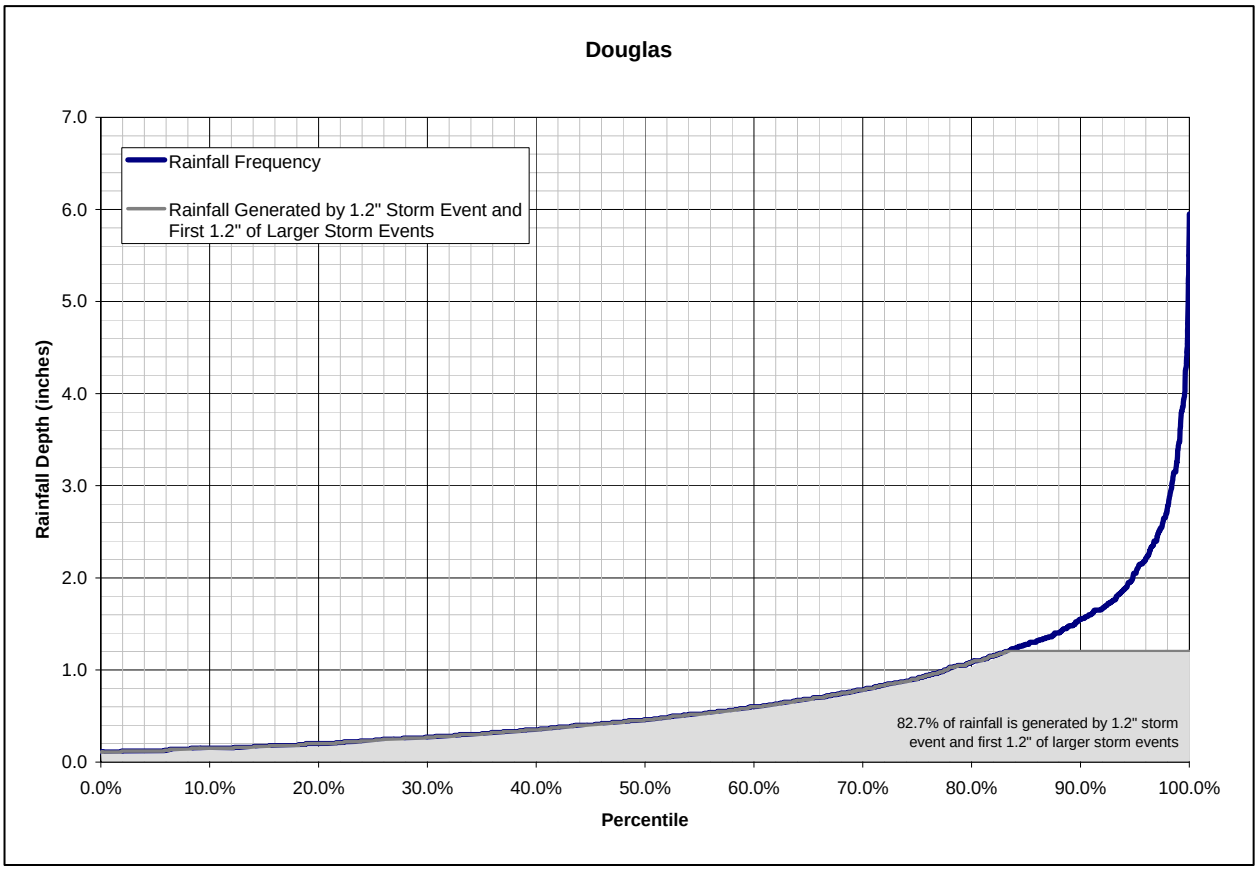
The RFS analyses also illustrate that these small, but frequent storm events are also responsible for a majority of the stormwater runoff volumes (and pollutant loads) that are generated on development sites located within the 24-county coastal region. As shown by the RFS analyses, the 1.2 inch storm event (and the first 1.2 inches of all larger storm events) accounts for, on average, 82.7 percent of the total rainfall that occurs in coastal Georgia over any given period of time.

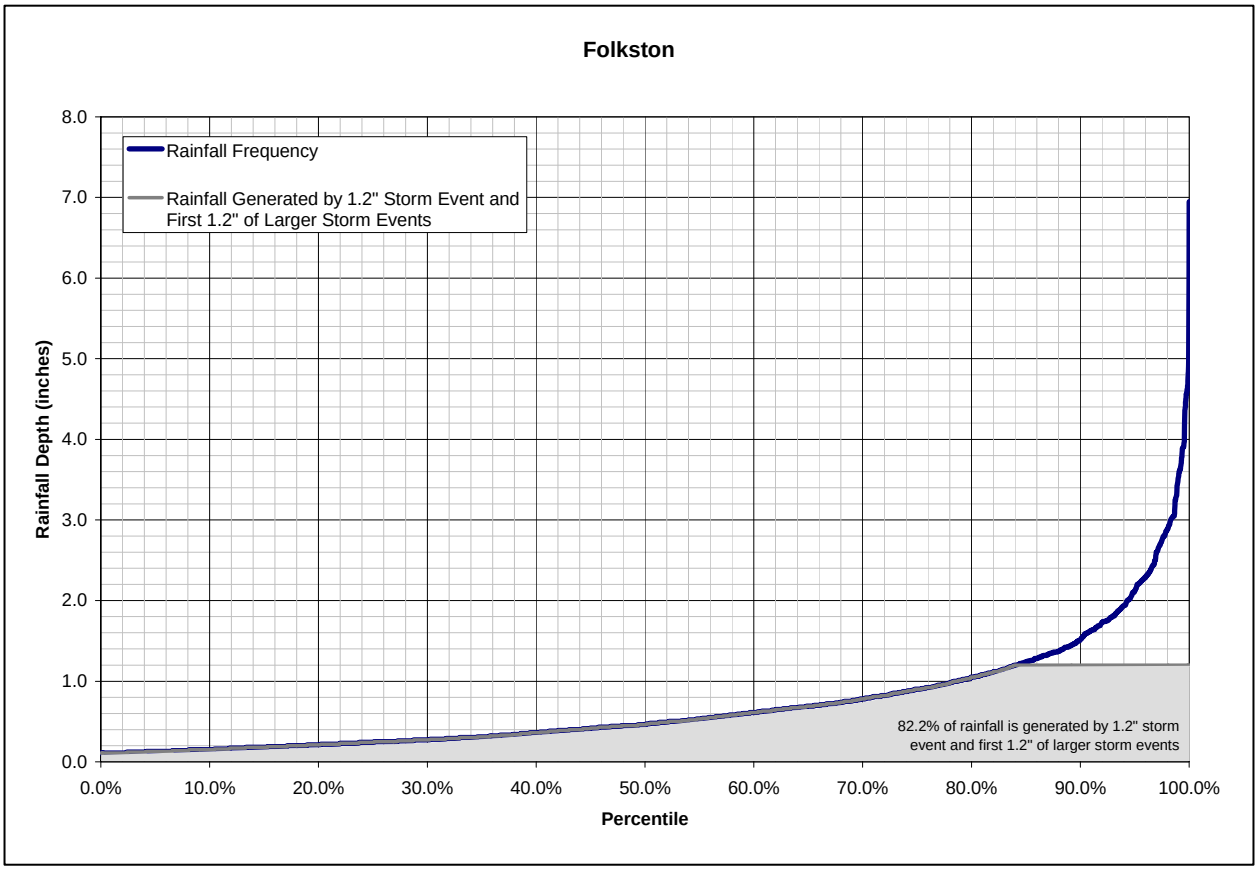
B.2 Rainfall Frequency Spectrum (RFS) Analyses

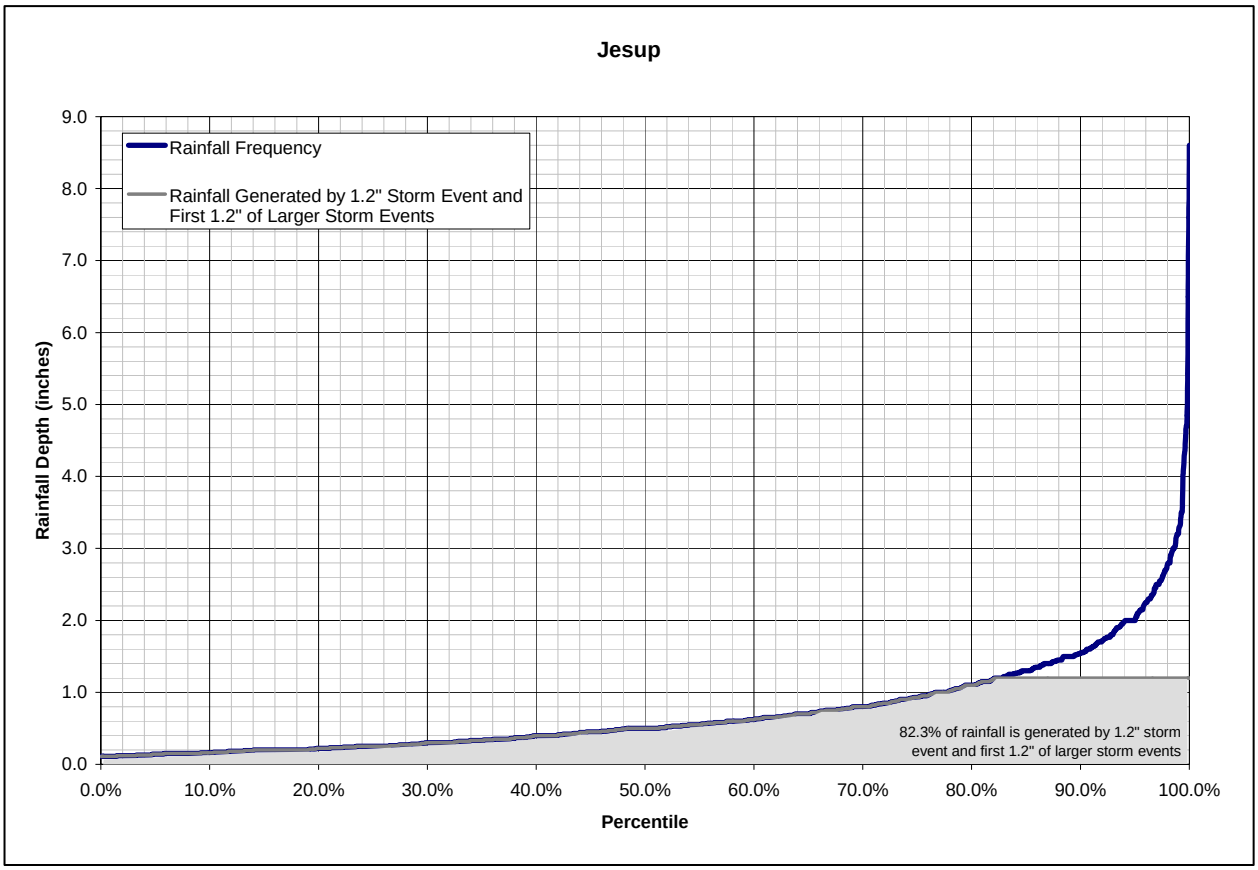
RFS analyses for the communities of Brooklet, Brunswick, Douglas, Folkston, Jesup and Savannah are provided below.

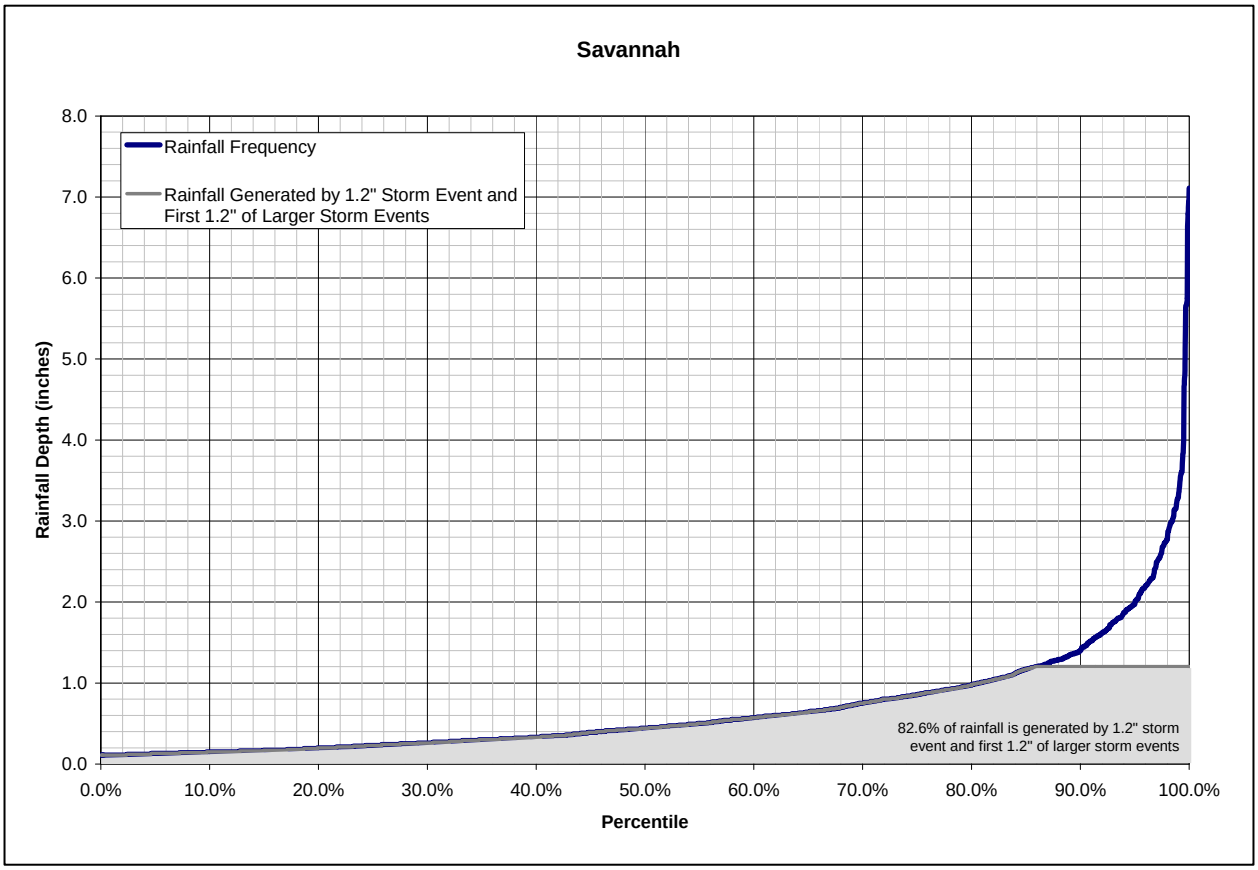

Brooklet
Rainfall Frequency
Rainfall Generated by 1.2" Storm Event and First 1.2" of Larger Storm Events
Rainfall Depth (in inches)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0.0%
10.0%
20.0%
30.0%
40.0%
50.0%
60.0%
70.0%
80.0%
90.0%
100.0%
Percentile
85.7% of rainfall is generated by 1.2" storm event and first 1.2" of larger storm events


Brunswick
Rainfall Frequency
Rainfall Generated by 1.2" Storm Event and First 1.2" of Larger Storm Events
Rainfall Depth (inches)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0.0%
10.0%
20.0%
30.0%
40.0%
50.0%
60.0%
70.0%
80.0%
90.0%
100.0%
Percentile
80.5% of rainfall is generated by 1.2" storm event and first 1.2" of larger storm events


Douglas
Rainfall Frequency
Rainfall Generated by 1.2" Storm Event and First 1.2" of Larger Storm Events
Rainfall Depth (inches)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0.0%
10.0%
20.0%
30.0%
40.0%
50.0%
60.0%
70.0%
80.0%
90.0%
100.0%
Percentile
82.7% of rainfall is generated by 1.2" storm event and first 1.2" of larger storm events


Folkston
Rainfall Frequency
Rainfall Generated by 1.2" Storm Event and First 1.2" of Larger Storm Events
Rainfall Depth (inches)
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0.0%
10.0%
20.0%
30.0%
40.0%
50.0%
60.0%
70.0%
80.0%
90.0%
100.0%
Percentile
82.2% of rainfall is generated by 1.2" storm event and first 1.2" of larger storm events


Jesup
Rainfall Frequency
Rainfall Generated by 1.2" Storm Event and First 1.2" of Larger Storm Events
Rainfall Depth (inches)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0.0%
10.0%
20.0%
30.0%
40.0%
50.0%
60.0%
70.0%
80.0%
90.0%
100.0%
Percentile
82.3% of rainfall is generated by 1.2" storm event and first 1.2" of larger storm events


Savannah
Rainfall Frequency
Rainfall Generated by 1.2" Storm Event and First 1.2" of Larger Storm Events
Rainfall Depth (inches)
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0.0%
10.0%
20.0%
30.0%
40.0%
50.0%
60.0%
70.0%
80.0%
90.0%
100.0%
Percentile
82.6% of rainfall is generated by 1.2" storm event and first 1.2" of larger storm events

Appendix C Coastal Stormwater Management Practice Monitoring Protocol

This monitoring protocol provides information that can be used to evaluate the performance of green infrastructure and stormwater management practices in coastal Georgia. The protocol presents a simple, yet comprehensive monitoring approach that can be used to accurately evaluate the performance of a wide range of green infrastructure and stormwater management practices.

C.1 Introduction

On a national level, the need to monitor the performance of both green infrastructure and stormwater management practices is often overlooked. Given their widespread use and acceptance, the ability of green infrastructure and stormwater management practices to manage post-construction stormwater runoff rates, volumes and pollutant loads is rarely questioned. However, performance monitoring should be conducted to confirm that these practices are indeed protecting both on-site and downstream aquatic resources from the negative impacts of the land development process.

Currently, there are two primary sources of information on stormwater management practice performance. These include the *National Pollutant Removal Performance Database* (CWP, 2007), which summarizes 166 individual stormwater management practice performance studies, and the *International Stormwater Best Management Practice (BMP) Database* (WWE and Geosyntec, 2008), which contains information on the performance of over 300 individual stormwater management practices. Although these two databases contain a significant amount of data, several groups of green infrastructure and stormwater management practices are not well represented in either of them, including bioretention areas, infiltration practices and many other low impact development practices. Additionally, much of the information contained in the two databases was collected from sites located outside of the coastal plain (Novotney, 2007). Performance monitoring can be conducted in coastal Georgia to help fill both of these data gaps.

Keep in mind that no single monitoring effort can, by itself, be used to define performance of a stormwater management practice. However, it can contribute to the growing body of research on these practices, which will help define their effectiveness in protecting coastal Georgia's valuable aquatic resources from the impacts of the land development process. The results of individual monitoring efforts can also be used to improve the way that green infrastructure and stormwater management practices are designed and maintained.

C.1.1 What Stormwater Management Issues Can Monitoring Address?

Monitoring data collected from green infrastructure and stormwater management practices can be used to:

- Document the performance of commonly used practices
- Document the performance of new or innovative practices
- Document the effectiveness of these practices in removing local pollutants of concern (e.g., total suspended solids, nitrogen, bacteria) from post-construction stormwater runoff
- Evaluate whether or not certain design features (e.g., aquatic benches, vegetated forebays) improve performance
- Evaluate how local conditions (e.g., tidal influences, high groundwater) influence performance

- Determine whether or not the performance of the green infrastructure and stormwater management practices used in the coastal plain differs from the performance of practices used in other physiographic regions
- Provide a scientific basis for future modification or revision of this Coastal Stormwater Supplement (CSS)

C.2 Monitoring Program Development

Figure C.1 illustrates a process that can be used to develop a stormwater management practice monitoring program. Additional information about each step in this process is provided below.

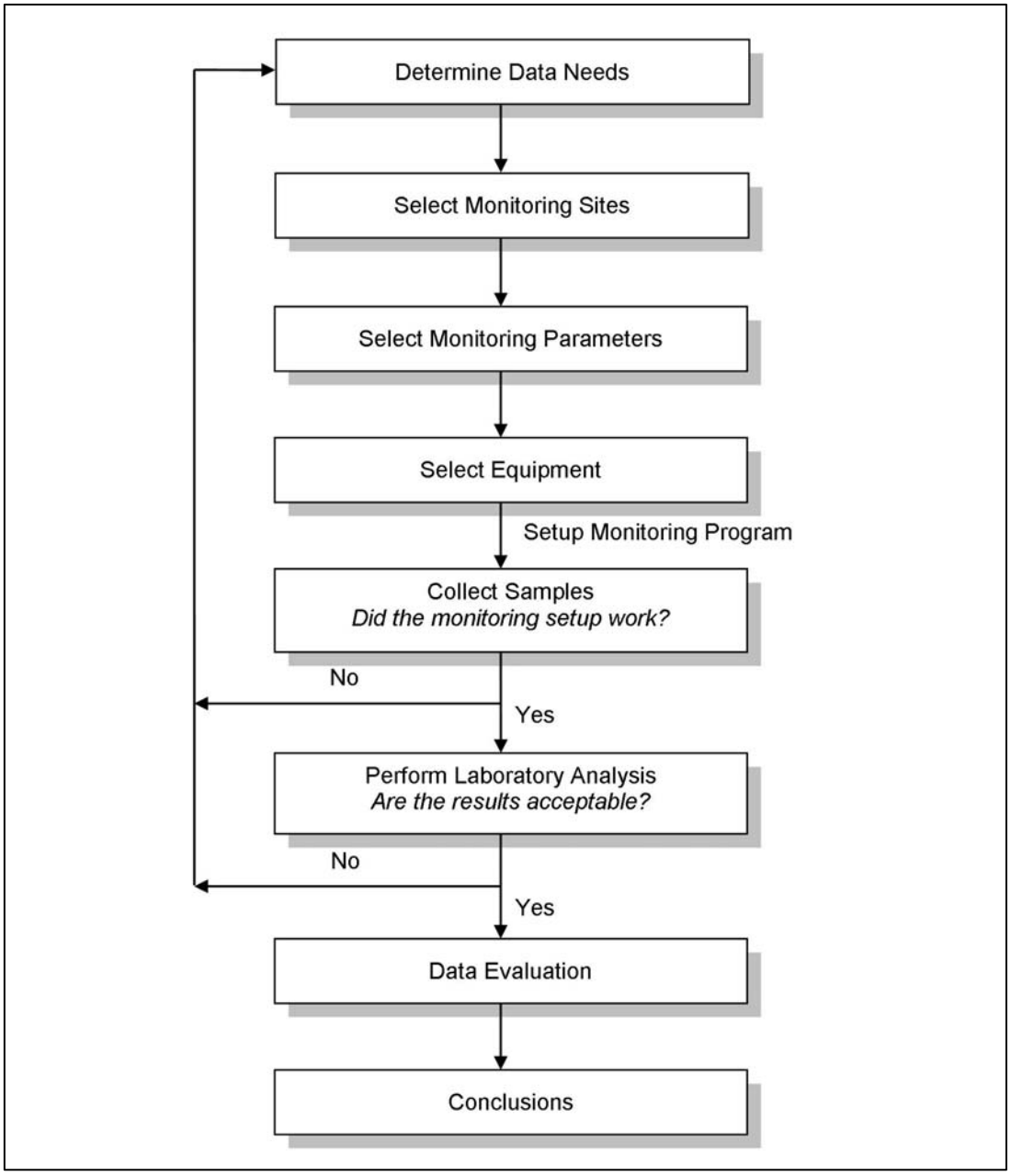


Figure C.1: Developing a Stormwater Management Practice Monitoring Program
(Source: Center for Watershed Protection)

C.2.1 Determining Data Needs

The monitoring program should be designed to collect the data necessary to produce a statistically valid measurement of performance. The amount and type of data that needs to be collected varies according to the method that will be used to evaluate the performance of the stormwater management practice. The two methods most commonly used are the mass efficiency method (also known as the *summation of loads* method) and the event mean concentration efficiency method (also known as *efficiency ratio* method). Table C.1 provides additional information about each of these methods.

Table C.1: Methods Used to Measure Stormwater Management Practice Performance

Method	Calculation	Data Needs
Mass Efficiency	$[(SOL_{in} - SOL_{out}) \div (SOL_{in})] \times 100$	Precipitation, Inflow, Outflow, Pollutant Concentrations
Event Mean Concentration Efficiency	$[(Conc_{in} - Conc_{out}) \div (Conc_{in})] \times 100$	Precipitation, Pollutant Concentrations

Notes:
SOL = sum of pollutant loads
Conc = average pollutant event mean concentration

Of the two methods, the mass efficiency method is recommended because it is generally considered to be more accurate than the event mean concentration method. The mass efficiency method also allows for a mass balance to be performed, which accounts for the stormwater runoff reduction and pollutant load removal provided by the green infrastructure or stormwater management practice.

Although the mass efficiency and event mean concentration efficiency methods are the two methods most commonly used to measure stormwater management practice performance, under certain conditions, they can result in over or underestimation of actual performance. For example, data collected from a stormwater management practice receiving inflow with a very high concentration of a given pollutant (e.g., total suspended solids) may show that the practice provides very good removal of that pollutant (on a percentage basis). However, the outflow from that same stormwater management practice may still contain an unacceptably high concentration of that particular pollutant (Strecker et al., 2004).

Conversely, data collected from a stormwater management practice that receives inflow with a very low concentration of a given pollutant (e.g., total nitrogen) may show that the practice is not performing very effectively (on a percentage basis). This is particularly true when the influent concentration of a particular pollutant approaches its irreducible concentration, which is the lowest possible concentration of a pollutant that can be observed in the field. Irreducible concentrations are dependent on the physical and chemical properties of each pollutant and often result from the pollutant production that occurs internally within a stormwater management practice (e.g., suspended solids and nutrients produced by decaying plant matter). When influent pollutant concentrations approach irreducible values, it becomes very difficult to further reduce the amount of those pollutants through stormwater treatment. In that case, it may be more useful to monitor the performance of a stormwater management practice relative to the achievable level of treatment (Schueler, 2000, ASCE and US EPA, 2002).

How Much Data Is Needed?

Measurements of stormwater management practice performance are only valid if a sufficient number of samples are collected and used in the measurement. The number of samples that

need to be collected to produce statistically valid measurements of performance can be determined based on the pollutant of interest. In general, the more that the concentration of a particular pollutant varies from sample to sample and the smaller the difference between inflow and outflow concentrations, the greater the number of samples that must be collected to produce valid measurements of performance. As more samples are collected, the uncertainty associated with each of the individual samples is reduced and more statistically valid performance measurements of performance can be produced (Burton and Pitt, 2002).

Table C.2 shows the number of samples needed to characterize the performance of a stormwater management performance, with a 95 percent confidence level, based on the difference between mean inflow and outflow concentrations, typical sample concentrations (e.g., coefficient of variation of about 1) and a power of 80 percent. As can be seen from the table, if a high level of confidence is required (a 95 percent confidence level is typically used) and the difference between the mean inflow and outflow concentrations is small, a significant sampling effort will be needed. This could require a multi-year monitoring program.

Table C.2: Number of Samples Needed to Characterize the Performance of a Stormwater Management Practice Based on the Difference in Mean Inflow and Mean Outflow Concentrations (confidence level = 95%, power = 80%, coefficient of variation = 1)

Difference in Sample Set Means	80%	60%	40%	20%
# Samples Needed	20	50	75	300

Prior to initiating a monitoring program, some criteria should be established for determining when the monitoring results will be deemed statistically significant and when additional monitoring will be required. Once the number of samples required to produce a statistically valid measurement of performance has been determined, an iterative process may be needed to re-scope the monitoring effort to remain within budget and on schedule. When scoping a monitoring effort, it is reasonable to expect to collect between 5-10 paired storm event samples per year.

What Storm Events Should Be Sampled?

Consideration should not only be given to the number of samples that are needed to produce statistically valid measurements of performance, but also to the storm events that will need to be sampled. Ideally, samples would be collected during a variety of storm events with a range of intensities and durations in order to evaluate the performance of the stormwater management practice over a wide range of conditions (ASCE and US EPA, 2002). Although small rainfall events occur frequently in coastal Georgia (Appendix B) and can be used to quickly build the data set, they should not be overemphasized in the monitoring program (Burton and Pitt, 2002). A number of paired samples should be collected during larger, less-frequent rainfall events (e.g., 1-year, 24-hour storm, 10-year, 24-hour storm) to better characterize the performance of the stormwater management practice over a wider range of storm events. Historical rainfall data should be investigated to help determine a monitoring approach that might be used to evaluate practice performance over a wide range of storm events.

C.2.2 Selecting Monitoring Sites

The selection of good monitoring sites is an important step in developing a meaningful monitoring program. Selecting good monitoring sites will help ensure that the monitoring program stays on schedule and on budget and that enough samples will be collected to produce statistically significant measurements of performance.

When selecting monitoring sites, it is important to take into account the availability of existing monitoring data and the overall objectives of the monitoring program. A preliminary list of potential monitoring sites can be generated based on these considerations. Where there is an overall lack of local monitoring data, it may be better to select monitoring sites that will allow the performance of commonly used green infrastructure and stormwater management practices to be evaluated. Where new or innovative practices are being put in the ground, it may be better to select monitoring sites that will allow the performance of these practices to be evaluated. Regardless of the type of green infrastructure or stormwater management practice that will be monitored, it is always better to select monitoring sites that have characteristics that are representative of local conditions, rather than sites that have unique or unusual characteristics. This allows the results to be applied on a larger geographical basis, rather than just on the individual monitoring site.

Once a preliminary list of potential monitoring sites has been generated, each of the sites should be assessed using a set of basic screening factors. A set of potential screening factors is provided in Table C.3.

Table C.3: Potential Monitoring Site Screening Factors

- Type of Stormwater Management Practice
- Site Characteristics
- Stormwater Management Practice Design Features
- Complexity of Monitoring Situation
- Watershed Location
- Availability of Existing Monitoring Data
- Existing water quality criteria and designated use information
- Existing 303(d) impairments
- Existing Total Maximum Daily Load (TMDLs)
- Site Accessibility
- Site Safety
- Availability of Electricity
- Space to Install Equipment
- Property Ownership

At a minimum, the site screening process should consider the availability of existing monitoring data, the types of stormwater management practices installed at each potential monitoring site, the characteristics of each potential monitoring site and whether or not the stormwater management practices installed at each potential monitoring site were designed and constructed in accordance with the information presented in this CSS or an equivalent stormwater management manual. If a stormwater management practice was not well designed, it may be better to select another monitoring site; it is simply impractical to monitor a poorly-designed stormwater management practice, as the monitoring data will not provide any insights into the performance of that particular type of practice.

Another factor that should be considered during the site screening process is the complexity of the monitoring situation at each potential monitoring site. Although a monitoring program can be designed for both simple and complex monitoring situations (Table C.4), the design of a monitoring program for a simple monitoring situation tends to be less complicated than the design of a monitoring program for a complex one. Complex monitoring situations often require special sample collection procedures and devices (Table C.5), which increases the complexity of the monitoring program.

Table C.4: Simple and Complex Monitoring Situations	
Monitoring Situation	**Description**
Simple Monitoring Situation (e.g., wet pond)	• Flow into and out of the stormwater management practice occurs at defined inlet and outlet structures and can be effectively characterized by sampling at the inlet and outlet.
Complex Monitoring Situation (e.g., bioretention areas, dry swales)	• Flow into or out of the stormwater management practice is distributed and cannot be effectively characterized by sampling at the inlet and outlet. • Flow must be redirected and concentrated at the inlet or outlet or additional sampling points must be established.

Another important factor to consider during the site screening process is the location of the potential monitoring site within the watershed. Selected monitoring sites can be spread across a large geographical area to permit comparisons from one monitoring site to the next or can be focused in a single priority area. The decision on whether to conduct a broad-based or focused monitoring program typically depends on the overall objectives of the monitoring program.

The site screening process may require both desktop and field investigations and can take some time to complete. Typically, only a small number of potential monitoring sites (e.g., 5 to 10%) will satisfy the screening criteria, so patience is certainly needed when conducting the site screening and selection process.

C.2.3 Selecting Monitoring Parameters

Typical monitoring parameters include:

- Nitrogen
- Phosphorus
- Total Suspended Solids (TSS)
- Biochemical Oxygen Demand (BOD)
- Fecal Coliform
- E. Coli
- Copper
- Lead
- Zinc
- Fats, Oils and Greases (FOG)
- Hydrocarbons

Some communities in the Coastal Nonpoint Source Management Area and Area of Special Interest may already be required to sample for one or more of these parameters. For example, due to National Pollutant Discharge Elimination System (NPDES) Stormwater Program requirements, Chatham County, which is a regulated Municipal Separate Storm Sewer System (MS4) community, is required to sample for BOD, TSS, nitrogen, phosphorus, copper, lead, zinc, FOG, fecal coliform and organic compounds. The selection of local monitoring parameters should take into account any pertinent permit requirements, existing monitoring data, existing resources, the overall objectives of the monitoring program and the local pollutants of concern. In coastal Georgia, the primary pollutants of concern are total suspended solids, nitrogen and bacteria (Novotney, 2007). If possible, these parameters should be monitored as a part of any monitoring program initiated in coastal Georgia.

C.2.4 Selecting Equipment

The equipment needed to collect samples and generate monitoring data on precipitation, inflow and outflow and pollutant concentrations (Table C.1) includes: rain gauges, flow meters, automated samplers and sample bottles. A digital camera is also recommended for photographic documentation of a monitoring site. If monitoring is to be conducted during cold weather months, snow gauges are also recommended to measure any precipitation that may occur in the form of snowfall. Rain and snow gauges should be installed as close as possible to the monitoring stations (e.g., inflow and outflow points) because precipitation can be highly variable even within a small geographic area. Manual rain gauges are also recommended to check the accuracy and consistency of different gauges installed on the monitoring site (ASCE and US EPA, 2002).

Automated samplers are recommended for sample collection. They eliminate the need for an operator to be on-site to perform sample collection and allow for the collection of flow-weighted, composite samples. Although an operator will not need to be on-site to collect samples, it is important to keep in mind that routine inspection and maintenance will need to be performed on all automated samplers to help ensure that the equipment will be functioning properly when a storm event does occur (ASCE and US EPA, 2002).

ISCO and American Sigma are two of a number of manufacturers that make automated sampling equipment that can be used to monitor the performance of stormwater management practices. These samplers are specifically designed for sampling stormwater runoff. They have flexible programming capabilities and can be programmed to begin collecting samples when a specific inflow or outflow rate is detected. These samplers can also be equipped with flow meters and rain gauges so that rainfall and flow data can be collected at the same time as water quality data. Many of the newest automated samplers can also be set up to interface with water quality monitoring probes, such as the YSI 6000, which can provide a continuous record of standard water quality parameters, such as temperature, salinity, pH and turbidity. The YSI 6000 can also be used to trigger sample collection when specific water quality conditions are detected in the inflow or outflow stream.

Although automated samplers are recommended for sample collection, it is important to note that they cannot be used to collect bacteria samples. Bacteria samples must be collected using sterile sample cells and must be preserved using ice. Manual collection of bacteria samples is required to ensure that these sample collection and holding procedures are not compromised during sample collection.

Note that even with specialized equipment, it can be difficult to collect water quality samples under complex monitoring situations. Flow into or out of these practices may occur as sheet flow, may be distributed among multiple inflow or outflow points or may occur underground (e.g., infiltration, groundwater interaction). Complex monitoring situations usually require paired site monitoring, where one monitoring site acts as a control and the other acts as a treatment. The variability in the characteristics of the two monitoring sites adds some uncertainty to the monitoring study, but paired site monitoring provides more accurate results for complex situations than a single site approach, where assumptions need to be made concerning any unmonitored and unaccounted for losses. Paired site monitoring can include one site with a stormwater management practice and one without, or it can include two sites with the same type of stormwater management practice as a way to monitor losses that may be difficult to measure or account for on a single site. Additional options for collecting samples under complex monitoring situations are presented in Table C.5.

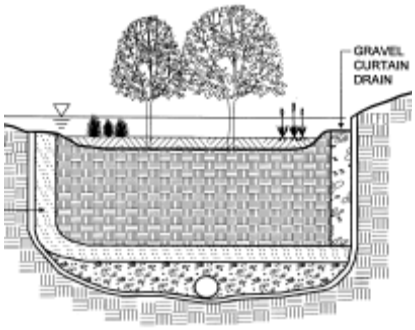
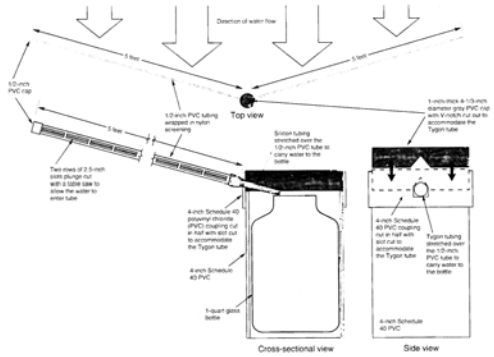
Table C.5: Options for Collecting Samples Under Complex Monitoring Situations	
Option	**Description**
Sump and Weir  Source: Smith et al. (No Date)	Install a defined sump and weir at the inflow or outflow point to collect and measure runoff that would have otherwise entered or exited the stormwater management practice as sheet flow
Underdrain  Source: Claytor and Schueler (1996)	Install an underdrain to collect and measure runoff that would have otherwise exited the stormwater management practice via infiltration
Source Area Sampler 	Use source area samplers to collect and measure runoff that would have otherwise entered or exited the stormwater management practice as sheet flow
Lysimeter  Source: Soilmoisture Equipment (1999)	Use lysimeters or soil water sampling devices to monitor the quality of water within the soil column immediately down gradient of the storm water management practice

Table C.5: Options for Collecting Samples Under Complex Monitoring Situations	
Option	**Description**
Runoff Estimation $L = [(P)(R_v) \div (12)](C)(A)(2.72)$ Where: L = Pollutant load in influent (pounds) P = Rainfall depth (inches) R_v = Runoff coefficient, which expresses the fraction of rainfall that is converted into runoff C = Event mean concentration of the pollutant in urban runoff (mg/l) A = Area of the contributing drainage (acres) 12 and 2.72 are unit conversion factors Source: Schueler (1987)	Measure outflow and, using the Simple Method, information on pollutant event mean concentrations from the National Stormwater Quality Database and rainfall data, estimate the runoff and pollutant load that entered the stormwater management practice as sheet flow

C.3 Monitoring Procedures

Once monitoring data needs have been determined, monitoring sites and monitoring parameters have been selected and sampling equipment has been purchased, the next step is to set up the monitoring program and begin collecting data. This part of the process is described in more detail below.

C.3.1 Characterize Site Conditions

The characteristics a particular monitoring site will likely have some influence on the performance of the stormwater management practice that is being monitored. For example, the distribution of different land cover types within a stormwater management practice's contributing drainage will influence the type and amount of pollutants that are conveyed into the practice. For this reason, it is important to accurately characterize the site conditions before monitoring begins. The following information should be collected to accurately characterize the conditions of a monitoring site:

- Size of the contributing drainage area
- A narrative description of the contributing drainage area, including information about the different land uses found within
- An estimate of the amount of impervious cover found within the contributing drainage area
- A basic characterization of the pollutants conveyed to the green infrastructure or stormwater management practice
- An narrative history of the stormwater management practice, including information about its age, maintenance history and current condition
- As-built drawings to identify the design features (e.g., forebay, aquatic benches) that were included in the stormwater management practice

C.3.2 Select Monitoring Points

Monitoring stations should be established at the points where flow enters and exits the stormwater management practice. This facilitates a comparison of the quality of the stormwater runoff that is entering and exiting the practice. This comparison can be completed using either the mass efficiency method or the event mean concentration efficiency method (Table C.1). While selecting monitoring points is fairly straightforward in simple monitoring situations, selecting monitoring points in complex monitoring situations is more difficult. Complex monitoring situations typically require a specialized monitoring setup (Table C.4).

Accurate measurement of the flow into and out of the stormwater management practice is important. Inaccurate measurement of inflow or outflow is the single largest source of error in efforts to monitor the performance of individual stormwater management practices. It is important to note that, as the complexity of the monitoring situation increases, so does the difficulty in obtaining accurate measurements of both inflow and outflow.

C.3.3 Collect Samples

Data should be collected to satisfy the needs of the selected performance measurement method (Table C.1). Automated sampling is recommended because it eliminates the need for an operator to be on-site for sample collection and allows for the collection of flow-weighted, composite samples. Samples should be collected throughout the duration of each individual storm event, rather than for specified periods at the very beginning of each event. This is due to the fact that the "first flush" effect is not always observed for all monitoring parameters (Maestre et al., 2004) and can vary depending upon site and rainfall characteristics (Strecker et al., 2005). Therefore, it is recommended that samples be collected throughout the duration of each rainfall event and composited on a flow-weighted basis prior to laboratory analysis. These composite samples provide more accurate results than composite samples collected during only the first 30 minutes or 1 hour of a storm event (Maestre et al., 2004).

After the initial sampling and laboratory analyses have been completed, preliminary data evaluation should be completed to determine if the monitoring program is working and providing the necessary data. If not, adjustments can be made to ensure that the program will provide the data necessary to produce statistically valid measurements of stormwater management practice performance.

What Special Sample Collection Procedures Should Be Observed?

Carefully planned and executed sample collection is required to achieve meaningful results. Sample collection and handling does little to alter the in-situ concentrations of many common monitoring parameters but, for others, it can cause significant changes in concentration. For this reason, sample collection and handling protocol should be followed to ensure that laboratory results are representative of the actual conditions found at the monitoring site. Additional information about proper sample collection and handling techniques is provided in *Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments* (CWP and Pitt, 2004). The *Stormwater Effects Handbook: A Toolbox for Watershed Managers, Scientists and Engineers* (Burton and Pitt, 2002) is another good resource for information about proper sample collection and handling techniques.

What Sample Collection Problems Can Be Expected?

Sample collection always appears to be easier on paper than it is in real life. Odds are that a number of problems will be encountered as samples are being collected during a monitoring study. Problems commonly encountered when monitoring green infrastructure and stormwater management practices include:

- Sensitive or sticky triggers on automated sampling equipment that cause problems with sample collection
- Extreme weather events, such as extended droughts and tropical storms, that cause damage to sampling equipment and extend the required length of the monitoring study
- Limited capacity of automated sampling equipment that results in samples being collected for only part of a storm event
- Trash and debris loads that cause damage to sampling equipment
- Vandalism that causes damage to sampling equipment
- Samples that do not account for the total pollutant load contained in either the inflow or outflow, which causes problems when evaluating the sample data

Precautions, such as installing trash racks and other protective measures to prevent equipment damage, can often be taken to address many of these and other common sample collection problems.

C.3.4 Perform Laboratory Analysis

Once they are collected, samples can be analyzed for selected monitoring parameters in-house or at a contract laboratory. The decision on whether to conduct analysis in-house or at a contract laboratory depends upon a number of factors, including the availability of lab space and equipment, staff expertise, staff time, cost, safety considerations and how quickly the sampling results are needed.

C.3.5 Data Evaluation and Management

Once laboratory results are available, they can be used to evaluate the performance of the stormwater management practice using either the mass efficiency method or the event mean concentration efficiency method (Table C.1). Results should not be considered conclusive until a sufficient number of samples have been collected. After conclusive results have been obtained, they should be compared to national (e.g., CWP, 2007) or regional (e.g., data taken only from sites in coastal Georgia) performance data to obtain a sense of how the performance of the practice compares with other similar stormwater management practices.

Paired box and whisker plots of influent and effluent quality are also useful data evaluation tools. Box and whisker plots typically illustrate the median, the 25th and 75th percentiles and the upper and lower 95 percent confidence intervals (Strecker et al., 2004). Figure C.2 presents an example box and whisker plot for the concentration of copper present in the flow into and out of a bioretention area.

Stormwater management practice monitoring can generate a considerable amount of information in a variety of formats. Consequently, both hard copy and electronic information needs to be stored in a manner that will make it easy to be both retrieved and transferred. A central file can be used to house hard copy information, while a single electronic database can be used to house information collected in digital format (ASCE and US EPA, 2002).

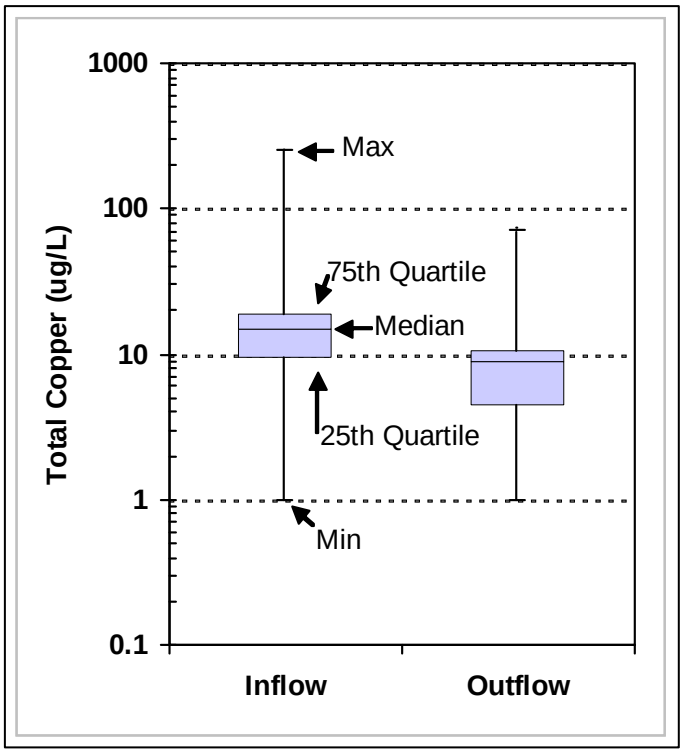


Figure C.2: Example Box and Whisker Plot for a Bioretention Area
(Source: Center for Watershed Protection)

What Data Evaluation and Management Issues Can Be Expected?

Quality control is necessary to ensure that useful and accurate data is collected throughout the duration of the monitoring program. Data should be reviewed as it becomes available to identify any results that may indicate that samples are being incorrectly collected, handled or analyzed. Any questionable results should not be used in the calculations performed to define stormwater management practice performance. Recommended quality controls include checking that the timing on all automated sampling equipment is synchronized, that runoff is entering and exiting the stormwater management practice as expected and that an equivalent number of aliquots are being collected at both the inflow and outflow points during storm events.

Particular attention should be given to "non-detected" values returned from laboratory analyses. These results can present problems during data evaluation.

The detection limit is the lowest concentration of a monitoring parameter that can be measured in the laboratory with a certain degree of confidence. If a parameter is "non-detected" in the laboratory analysis, it means that the concentration of that parameter is less than the detection limit for that parameter. If either a few or many of the observations are below the detection limit, they will not present a serious problem during data analysis. However, if between 25% and 75% of the observations are below the detection limit, statistical data analysis will be severely limited. In this case, it would be better to have the concentrations for all parameters, even if they are below a parameter's detection limit (Burton and Pitt, 2002).

The amount of stormwater runoff reduction provided by a stormwater management practice should also be estimated when evaluating practice performance. This is perhaps the most

crucial piece of information needed in complex monitoring situations and can be used to confirm that green infrastructure practices are providing the runoff reduction that this CSS "credits" them with providing. Under complex monitoring situations, stormwater runoff volumes usually must be estimated at either the inlet or outlet because flow into or out of these practices may occur as sheet flow, may be distributed among multiple inflow or outflow points or may occur underground (e.g., infiltration, groundwater interaction) and cannot be directly measured.

C.4 Budgeting

An example budget for monitoring an individual stormwater management practice, under both simple and complex monitoring situations, is provided in Table C.6. Keep in mind that the table provides general budgeting guidance and that the total budget for a local monitoring program will vary according to a number of factors, including the length of the monitoring study, the equipment used, local site constraints and the laboratory analysis procedures used.

Table C.6: Example Budget for Monitoring an Individual Stormwater Management Practice

	Simple Monitoring Situation			Complex Monitoring Situation		
	Staff Time	Unit Cost	Total Cost	Staff Time	Unit Cost	Total Cost
Planning		**5%**			**6%**	
Background Research[1]	40 hr	$50/hr	$2,000	40 hr	$50/hr	$2,000
Desktop Analysis[2]	32 hr	$50/hr	$1,600	32 hr	$50/hr	$1,600
Field Reconnaissance and Site Selection	32 hr	$50/hr	$1,600	32 hr	$50/hr	$1,600
Site Characterization	8 hr	$50/hr	$400	16 hr	$50/hr	$800
Monitoring Plan Development	16 hr	$50/hr	$800	32 hr	$50/hr	$1,600
Subtotal			**$6,400**			**$7,600**
Implementation		**95%**			**95%**	
Equipment[3]			$15,000			$17,000
Equipment Installation and Maintenance[4, 5]	256 hr	$50/hr	$12,800	512 hr	$50/hr	$25,600
Training	32 hr	$50/hr	$1,600	32 hr	$50/hr	$1,600
Sample Collection[6]	512 hr	$50/hr	$25,600	512 hr	$50/hr	$25,600
Sample Storage and Transport			$10,000			$10,000
Laboratory Analysis[7]		$200/ea	$8,800	$200/ea		$8,800
Data QA/QC	40 hr	$50/hr	$2,000	40 hr	$50/hr	$2,000
Data Evaluation and Management	80 hr	$50/hr	$4,000	80 hr	$50/hr	$4,000
Final Report	80 hr	$50/hr	$4,000	80 hr	$50/hr	$4,000
Subtotal			**$83,800**			**$98,600**
Planning and Implementation						
Total			**$90,200**			**$106,200**

Notes:
1) Includes determination of data needs, selection of monitoring parameters and preliminary identification of potential monitoring sites
2) Includes preliminary review of potential monitoring sites and generation of maps for field reconnaissance (major tasks include: preliminary site selection, preliminary site characterization, generate field maps)

Table C.6: Example Budget for Monitoring an Individual Stormwater Management Practice

Notes:

3) Equipment for simple monitoring situation includes 2 automatic samplers, triggering sensors, pump, lumber, concrete, battery, waders, clipboards, fieldbooks, first aid kits; equipment for complex monitoring situation includes 2 automatic samplers, triggering sensors, pump, lumber, concrete, battery, underdrain, sump and weir at inlet, waders, clipboards, fieldbooks, first aid kits
4) Installation for simple monitoring situation includes 3 people for 2 days; installation for complex monitoring situation assumes 3 people for 4 days.
5) Assumes maintenance burden of 1 person at 2 hours per week for 2 years.
6) Includes 2 people for 8 hours for each storm event; assumes 30 storm events and 2 baseflow events will be sampled; out of the 30 sampled events, only 20 are expected to meet QA/QC standards.
7) Assumes contract laboratory analysis for nitrogen, phosphorus, total suspended solids, fecal coliform, zinc, lead and hydrocarbons; assumes one composited inflow and one composited outflow sample will be analyzed for 20 storm and 2 baseflow events.

C.5 Alternative Monitoring Methods

As Table C.6 shows, it can be expensive to accurately evaluate the performance of individual green infrastructure and stormwater management practices. Given limited resources, many communities in coastal Georgia will not be able to conduct intensive monitoring on more than a handful of green infrastructure and stormwater management practices. To overcome this constraint, and still collect valuable information about stormwater management practice performance, communities can complete less intense field surveys that evaluate physical indicators of practice performance, such as design features, sediment accumulation and vegetation health.

Although less than a dozen of this type of visual survey have been conducted around the country, they have been extremely valuable in identifying problems with existing stormwater management practice design, as well as in defining new directions for stormwater management practice installation and maintenance. These synoptic surveys are relatively low cost, but can yield important information that can be directly incorporated into local stormwater design guidance, development review procedures and day-to-day operations. Examples of these types of surveys include:

- A study conducted by the U.S. EPA on erosion and sediment control (E&SC) practices at construction sites, in a community thought to have one of the strongest E&SC programs in the nation, found that poor installation and implementation of E&SC practices was a widespread problem (Malcolm et al., 1990)
- Investigations into the pollutant dynamics and habitat quality of stormwater ponds (Campbell, 1995, Leersnyder, 1993, Dewberry and Davis, 1990, Oberts and Osgood, 1988, Bascietto and Adams, 1983).
- Assessments of the failure rate and functional life span of infiltration practices (Galli, 1993, Hilding, 1993).
- Investigations into the performance of biofilters and oil/grit separators (Reeves, 1995, Shepp, 1995).

While these surveys typically only involve visual inspections, they can be supplemented with some water quality sample collection and analysis in an effort to determine whether or not a particular stormwater management practice is working to protect local aquatic resources from the negative impacts of the land development process. Interviews with adjacent residents or property owners can also be used to supplement the results of these visual surveys.

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Appendix D Model Post-Construction Stormwater Management Ordinance

This model ordinance addresses the management of post-construction stormwater runoff on development sites. It establishes a set of post-construction stormwater management and site planning and design criteria and permitting procedures and requirements that can be applied to new development and redevelopment activities occurring within the Coastal Nonpoint Source Management Area and Area of Special Interest. It also establishes guidelines for the inspection and maintenance of green infrastructure and stormwater management practices installed on development sites.

This model post-construction stormwater management ordinance is intended to complement and support the information presented in the Coastal Stormwater Supplement (CSS). Communities may adapt the model ordinance "as-is" or may review and modify it to meet more specific local natural resource protection and stormwater management goals and objectives. Additional guidance on using the model post-construction stormwater management ordinance is provided below:

- Summary boxes can be found at the very beginning of each section of the model ordinance. These summary boxes provide a descriptive overview of and additional information about the content that follows.

- Italicized language can be found throughout the model ordinance. This language may be adopted "as-is" or may be modified or removed to suit the specific needs of a community.

- The model ordinance also includes italicized language that is contained in parenthesis to indicate where a community should input more specific information. One example is *(administrator)*, which, at the local level, is the person or department responsible for operating the local post-construction stormwater management program.

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1.0 General Provisions

1.1 Findings of Fact

It is hereby determined that:

(1) The land development process significantly alters the hydrologic response of development sites, increasing stormwater runoff rates, volumes and pollutant loads, and increases flooding, channel erosion and pollutant transport and deposition in rivers and streams;

(2) The land development process significantly alters the hydrologic response of development sites, increasing stormwater runoff rates, volumes and pollutant loads, and alters water levels and fluctuations and increases pollutant transport and deposition in wetlands;

(3) The land development process significantly alters the hydrologic response of development sites, increasing stormwater runoff rates, volumes and pollutant loads, and alters salinity concentrations and fluctuations and increases primary productivity and pollutant transport and deposition in estuaries;

(4) The land development process significantly alters the hydrologic response of development sites, increasing stormwater runoff rates, volumes and pollutant loads, and increases bacteria transport and deposition in near coastal waters, which leads to beach contamination and poses a serious threat to human health;

(5) The land development process significantly alters the hydrologic response of development sites, increasing stormwater runoff rates and volumes, and decreases the amount of rainfall that is available to recharge shallow groundwater aquifers;

(6) The negative impacts of the land development process on local aquatic resources can adversely affect the health, safety and general welfare of the general public;

(7) The negative impacts of the land development process can be controlled and minimized through the management of stormwater runoff rates, volumes and pollutant loads;

(8) Communities located within Georgia's Coastal Nonpoint Source Management Area and Area of Special Interest are required to comply with a number of state and federal regulations that require the adverse impacts of the land development process to be controlled and minimized;

(9) Therefore, the *(local jurisdiction)* has determined that it is in the public interest to control and minimize the adverse impacts of the land development process and has established this set of local stormwater management regulations to control post-construction stormwater runoff rates, volumes and pollutant loads on development and redevelopment sites.

1.2 Purpose and Intent

Purpose and Intent
- Most post-construction stormwater management ordinances have a Purpose and Intent section that establishes the reasons that the local jurisdiction is regulating stormwater runoff.
- This section is usually tied to the protection of public health and safety and may also refer to state and/or federal regulatory requirements (e.g., NPDES MS4 permit requirements).

The purpose of this ordinance is to protect and maintain the integrity of local aquatic resources and, consequently, the health, safety and welfare of the general public, by establishing local stormwater management regulations that control and minimize the adverse impacts of the land development process. The ordinance seeks to achieve these goals by:

(1) Establishing decision-making processes that can be applied during the site planning and design process to help protect the integrity of local aquatic resources;

(2) Establishing post-construction stormwater management and site planning and design criteria to help protect natural resources from the direct impacts of the land development process and preserve existing hydrologic conditions on development sites;

(3) Establishing post-construction stormwater management and site planning and design criteria to help reduce flooding, channel erosion and pollutant transport and deposition in local aquatic resources;

(4) Establishing design guidelines for green infrastructure and stormwater management practices that can be used to meet the post-construction stormwater management and site planning and design criteria;

(5) Encouraging that green infrastructure practices, which include better site planning techniques, better site design techniques and low impact development practices, be used to the maximum extent practical on development sites;

(6) Establishing provisions for the long-term inspection and maintenance of green infrastructure and stormwater management practices to ensure that they continue to function as designed and pose no threat to public safety; and,

(7) Establishing administrative procedures for the submittal, review, approval and disapproval of stormwater management plans and for the inspection of approved development projects.

1.3 Applicability and Exemptions

Applicability and Exemptions

- The Applicability and Exemptions section establishes the "mesh size" for the ordinance; that is, the site size or site characteristics that trigger application of the ordinance and its provisions.
- Applicability can be based on site impervious cover, a land disturbance threshold, overall site size, number of lots and/or the type of development (e.g., stormwater hotspots).
- The most common threshold is one acre of land disturbance. The advantage of this threshold is that it is consistent with the NPDES threshold for construction sites. However, impervious cover is often a more precise trigger for the regulations contained in a post-construction stormwater management ordinance.
- Some local post-construction stormwater management ordinances will have a variable trigger for new development and redevelopment activities, especially if redevelopment is a critical component of an overall land use policy that encourages infill and redevelopment projects.
- The most important consideration regarding exemptions is to identify only those development projects that should not be regulated. Since exemptions categorically exclude activities from the provisions of the ordinance, ordinance language must be clearly written to avoid having well-intentioned exemptions turn into loopholes.

(1) This ordinance shall be applied to all land disturbing activities, unless exempt pursuant to Section 1.3.2 below. The stormwater management regulations presented within shall be applied to any new development or redevelopment activity that meets one or more of the following criteria:

(a) New development that involves the creation of *(5,000 square feet or more)* of impervious cover or that involves other land disturbing activities of *(one acre or more)*;

(b) Redevelopment that involves the creation, addition or replacement of *(5,000 square feet or more)* of impervious cover or that involves other land disturbing activities of *(one acre or more)*.

(c) New development or redevelopment, regardless of size, that is part of a larger common plan of development, even though multiple, separate and distinct land disturbing activities may take place at different times and on different schedules.

(d) New development or redevelopment, regardless of size, that involves the creation or modification of a stormwater hotspot, as defined by the *(administrator)*.

(2) The following activities are exempt from this ordinance:

(a) New development or redevelopment that involves the creation, addition or replacement of *(less than 5,000 square feet)* of impervious cover and that involves *(less than one acre)* of other land disturbing activities.

(b) New development or redevelopment activities on individual residential lots that are not part of a larger common plan of development and do not meet any of the applicability criteria listed above.

(c) Additions or modifications to existing single-family homes and duplex residential units that do not meet any of the applicability criteria listed above.

(d) Development projects that are undertaken exclusively for agricultural or silvicultural purposes within areas zoned for agricultural or silvicultural land use;

(e) Maintenance and repairs of any green infrastructure or stormwater management practices deemed necessary by the (*administrator*);

(f) Any part of a land development project that was approved by the (*administrator*) prior to the adoption of this ordinance; and,

(g) Redevelopment activities that involve the replacement of impervious cover when the original impervious cover was wholly or partially lost due to natural disaster or other acts of God occurring after (*date of adoption*).

1.4 Designation of Ordinance Administrator

Designation of Ordinance Administrator, Compatibility with Other Regulations, Severability, Stormwater Guidance Manual

- These sections appear in some, but not all, post-construction stormwater management ordinances for various legal reasons.
- Consult with legal staff to determine the applicability of these sections within your local jurisdiction.

The (*administrator*) is hereby appointed to administer and implement the provisions of this ordinance.

1.5 Compatibility with Other Regulations

This ordinance is not intended to interfere with, modify or repeal any other ordinance, rule, regulation or other provision of law. The requirements of this ordinance should be considered minimum requirements, and where any provision of this ordinance imposes restrictions different from those imposed by any other ordinance, rule, regulation or other provision of law, whichever provision is more restrictive or imposes higher protective standards for human health or the environment shall control.

1.6 Severability

If the provisions of any section, subsection, paragraph, subdivision or clause of this ordinance shall be judged invalid by a court of competent jurisdiction, such judgment shall not affect or invalidate the remainder of any section, subsection, paragraph, subdivision or clause of this ordinance.

1.7 Stormwater Guidance Manual

The *(local jurisdiction)* will utilize the information presented in the latest edition of the *Coastal Stormwater Supplement to the Georgia Stormwater Management Manual*, and any relevant local addenda, to assist in the proper implementation of this ordinance. These references may be updated and expanded periodically, based on additional information obtained through scientific research, performance monitoring and local experience.

2.0 Definitions

Definitions
- The Definitions section ensures that terms are defined consistently across other related guidance and regulatory documents.

"Applicant" means a property owner or agent of a property owner who has submitted an application for a post-construction stormwater management permit.

"Aquatic Buffer" means an area of land located around or near a stream, wetland, or waterbody that has intrinsic value due to the ecological services it provides, including pollutant removal, erosion control and conveyance and temporary storage of flood flows.

"Aquatic Resource Protection" means measures taken to protect aquatic resources from several negative impacts of the land development process, including complete loss or destruction, stream channel enlargement and increased salinity fluctuations.

"Better Site Design Techniques" means site design techniques that can be used during the site planning and design process to minimize land disturbance and the creation of new impervious and disturbed pervious cover. Better site design techniques include reducing clearing and grading limits, reducing roadway lengths and widths and reducing parking lot and building footprints.

"Better Site Planning Techniques" means site planning techniques that can be used during the site planning and design process to protect valuable aquatic and terrestrial resources from the direct impacts of the land development process. Better site planning techniques include protecting primary and secondary conservation areas.

"Building" means any structure, either temporary or permanent, having walls and a roof, designed for the shelter of any person, animal or property and occupying more than 100 square feet of area.

"Channel" means a natural or artificial watercourse with a definite bed and banks that conducts continuously or periodically flowing water.

"Conservation Areas" means permanently protected areas of a site that are preserved, in perpetuity, in an undisturbed, natural state.

"Conservation Easement" means a legal agreement between a land owner and a local, state or federal government agency or land trust that permanently protects conservation areas on the owner's land by limiting the amount and type of development that can take place within them but continues to leave the conservation areas in private ownership.

"Dedication" means the deliberate appropriation of property by its owner for general public use.

"Detention" means the temporary storage of stormwater runoff in a stormwater management practice for the purpose of controlling the peak discharge rates and providing gravitational settling of pollutants.

"Developer" means a person who undertakes a land development project.

"Development Project" means a new development or redevelopment project.

"Development Site" means a parcel of land where land disturbing activities have been or will be initiated to complete a land development project.

"Drainage Easement" means a legal right granted by a land owner to a grantee allowing the grantee to convey, treat or manage stormwater runoff on the private land subject to the drainage easement.

"Easement" means a legal right granted by a land owner to a grantee allowing the use of private land for conveyance, treatment and management of stormwater runoff and access to green infrastructure and stormwater practices.

"Erosion and Sediment Control Plan" means a plan that is designed to minimize and control the accelerated erosion and increased sediment loads that occur at a site during land disturbing activities.

"Evapotranspiration" means the loss of water to the atmosphere through both evaporation and transpiration, which is the evaporation of water from the aerial parts of plants.

"Extended Detention" means the temporary storage of stormwater runoff in a stormwater management practice for an extended period of time, typically 24 hours or greater.

"Extreme Flood Protection" means measures taken to protect downstream properties from dangerous extreme flooding events and help maintain the boundaries of the existing 100-year floodplain.

"Fee in Lieu Contribution" means a payment of money in place of meeting all or part of the stormwater management criteria required by a post-construction stormwater management ordinance.

"Flooding" means a volume of stormwater runoff that is too great to be confined within the banks of a stream, river or other aquatic resource or walls of a stormwater conveyance feature and that overflows onto adjacent lands.

"Green Infrastructure Practices" means the combination of three complementary, but distinct, groups of natural resource protection and stormwater management practices and techniques, including better site planning and design techniques and low impact development practices, that are used to protect valuable terrestrial and aquatic resources from the direct impacts of the land development process, maintain pre-development site hydrology and reduce post-construction stormwater runoff rates, volumes and pollutant loads.

"Hydrologic Soil Group (HSG)" means a Natural Resource Conservation Service classification system in which soils are categorized into four runoff potential groups. The groups range from group A soils, with high permeability and little runoff produced, to group D soils, which have low permeability rates and produce much more runoff.

"Impaired Waters" means those streams, rivers, lakes, estuaries and other water bodies that currently do not meet their designated use classification and associated water quality standards under the Clean Water Act.

"Impervious Cover" means a surface composed of any material that greatly impedes or prevents the natural infiltration of water into the underlying native soils. Impervious surfaces include, but are not limited to, rooftops, buildings, sidewalks, driveways, streets and roads.

"Industrial Stormwater Permit" means a National Pollutant Discharge Elimination System (NPDES) permit issued to an industry or group of industries that regulates the pollutant levels associated with industrial stormwater discharges or specifies on-site pollution control strategies.

"Infill Development" means land development that occurs within designated areas based on local land use, watershed and/or utility plans where the surrounding area is generally developed, and where the site or area is either vacant or has previously been used for another purpose.

"Infiltration" means the process of allowing stormwater runoff to percolate into the underlying native soils.

"Infiltration Practice" means a green infrastructure or stormwater management practice designed to provide infiltration of stormwater runoff into the underlying native soils. These stormwater management practices may be above or below grade.

"Inspection and Maintenance Agreement and Plan" means a written agreement and plan providing for the long-term inspection and maintenance of all green infrastructure practices, stormwater management practices, stormwater conveyance features and stormwater drain infrastructure on a development site.

"Jurisdictional Wetland" means an area that is inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation.

"Land Development" means any project undertaken to change or improve a site that involves one or more land disturbing activities.

"Land Disturbing Activity" means any activity that changes stormwater runoff rates, volumes and pollutant loads on a site. These activities include, but are not limited to, the grading, digging, cutting, scraping, or excavating of soil, the placement of fill materials, paving, construction, substantial removal of vegetation and any activity that bares soil or rock or involves the diversion or piping of any natural or man-made watercourse.

"Land Owner" means the legal or beneficial owner of land, including those holding the right to purchase or lease the land, or any other person holding proprietary rights in the land.

"Low Impact Development Practice" means small-scale stormwater management practices that are used to disconnect impervious and disturbed pervious surfaces from the storm drain system and reduce post-construction stormwater runoff rates, volumes and pollutant loads. Low impact development practices include soil restoration, site reforestation/revegetation, green roofs, vegetated filter strips and rain gardens.

"National Pollutant Discharge Elimination System (NPDES) Stormwater Discharge Permit" means a permit issued by the EPA, or by a State under authority delegated pursuant to 33 USC § 1342(b), that authorizes the discharge of pollutants to waters of the State, whether the permit is applicable on an individual, group, or general area-wide basis.

"New Development" means a land development project undertaken on a previously undeveloped or unimproved site.

"Nonpoint Source Pollution" means pollution from any source other than from a discernible, confined and discrete conveyance, such as a wastewater treatment plant or industrial discharge. Sources of nonpoint source pollution include, but are not limited to, agricultural, silvicultural, mining and construction activities, subsurface disposal and urban stormwater runoff.

"Nonstructural Stormwater Management Practice" means any natural resource protection or stormwater management practice or technique that uses natural processes and natural systems to intercept, convey, treat and/or manage stormwater runoff. Nonstructural stormwater management practices include, but are not limited to, protecting primary and secondary conservation areas, reducing clearing and grading limits, reducing roadway lengths and widths, reducing parking lot and building footprints, soil restoration, site reforestation/revegetation, green roofs, vegetated filter strips and rain gardens.

"Off-Site Stormwater Management Practice" means a green infrastructure or stormwater management practice located outside the boundaries of a development site.

"On-Site Stormwater Management Practice" means a green infrastructure or stormwater management practice located within the boundaries of a development site.

"Overbank Flood Protection" means measures taken to protect downstream properties from damaging overbank flooding events.

"Owner" means the legal or beneficial owner of a piece of land, including, but not limited to, a mortgagee or vendee in possession, receiver, executor, trustee, lessee or other person, firm, or corporation in control of the site.

"Permanent Stormwater Management Practice" means a green infrastructure or stormwater management practice that will be operational after the land disturbing activities are complete and that is designed to become a permanent part of the site for the purposes of managing post-construction stormwater runoff.

"Permit" means the permit issued by a local development review authority to an applicant, which is required for undertaking any land development project or land disturbing activities.

"Person" means any individual, partnership, firm, association, joint venture, public or private corporation, trust, estate, commission, board, public or private institution, utility, cooperative, city, county or other political subdivision, any interstate body, or any other legal entity.

"Post-Development Hydrology" refers to the set of hydrologic conditions that may reasonably be expected to exist on a development site, after the completion of all land disturbing and construction activities.

"Pre-Development Hydrology" refers to the set of hydrologic conditions that exist on a development site prior to the commencement of any land disturbing activities and at the time that plans for the land development project are approved by the local development review authority.

"Receiving Stream" or **"Receiving Aquatic Resource"** means the body of water or conveyance into which stormwater runoff is discharged.

"Recharge" means the replenishment of groundwater aquifers.

"Redevelopment" means a change to previously existing, improved property, including but not limited to the demolition or building of structures, filling, grading, paving, or excavating, but excluding ordinary maintenance activities, remodeling of buildings on the existing footprint, resurfacing of paved areas and exterior changes or improvements that do not materially increase or concentrate stormwater runoff or cause additional nonpoint source pollution.

"Regional Stormwater Management Practice" means a stormwater management practice designed to control stormwater runoff from multiple properties, where the owners or developers of the individual properties may participate in providing land, financing, design services, construction services and/or maintenance services for the practice.

"Responsible Party" means any individual, partnership, co-partnership, firm, company, corporation, association, joint stock company, trust, estate, governmental entity, or any other legal entity; or their legal representatives, agents, or assigns that is named on a stormwater inspection and maintenance agreement and plan as responsible for the long-term operation and maintenance of one or more green infrastructure or stormwater management practices.

"Site" means development site.

"Stop Work Order" means an order issued that requires that all land disturbing activity on a site be stopped.

"Stormwater Hotspot" means an area where land use or pollution generating activities have the potential to generate highly contaminated runoff, with concentrations of pollutants in excess of those typically found in stormwater runoff. Stormwater hotspots include, but are not limited to, fueling stations (including temporary fueling stations during construction), golf courses, public works yards and marinas.

"Stormwater Management" means the interception, conveyance, treatment and management of stormwater runoff in a manner that is intended to prevent increased flood damage, channel erosion, habitat degradation and water quality degradation and to enhance and promote the public health, safety and general welfare.

"Stormwater Management Plan" means a written document that details how stormwater runoff will be managed on a development site and that shows how the stormwater management criteria that apply to the development project have been met.

"Stormwater Management Practice" means a practice or technique, either structural or nonstructural, that is used to intercept stormwater runoff and change the characteristics of that runoff. Stormwater management practices are used to control post-construction stormwater runoff rates, volumes and pollutant loads to prevent increased flood damage, channel erosion, habitat degradation and water quality degradation.

"Stormwater Management System" means the entire suite of green infrastructure and stormwater management practices and stormwater conveyance features that are used to intercept, convey, treat and manage stormwater runoff on a development site.

"Stormwater Retrofit" means a green infrastructure or stormwater management practice designed for an existing development site that previously had no green infrastructure or

stormwater management practice in place or had a practice that was not meeting local stormwater management criteria.

"Stormwater Runoff" means surface water resulting from precipitation.

"Stormwater Runoff Reduction" means providing for the interception, evapotranspiration, infiltration, or capture and reuse of stormwater runoff to help maintain pre-development site hydrology and help protect aquatic resources from several indirect impacts of the land development process, including decreased groundwater recharge, decreased baseflow and degraded water quality.

"Subdivision" means the division of a parcel of land to create one or more new lots or development sites for the purpose, whether immediately or in the future, of sale, transfer of ownership, or land development, and includes divisions of land resulting from or made in connection with the layout or construction of a new street or roadway or a change in the layout of an existing street or roadway.

"Watercourse" means a permanent or intermittent stream or other body of water, either natural or man-made, which gathers or carries surface water.

"Watershed Management Plan" or **"Subwatershed Management Plan"** means a document, usually developed cooperatively by government agencies and other stakeholders, to protect, restore and/or otherwise manage the water resources found within a particular watershed or subwatershed. Watershed or subwatershed management plans commonly identify threats, sources of impairment, institutional issues and technical and programmatic solutions or projects to protect and/or restore water resources.

"Water Quality Protection" means adequately treating stormwater runoff before it is discharged from a development site to help protect downstream aquatic resources from water quality degradation.

"Wetland Hydroperiod" means the pattern of fluctuating water levels within a wetland caused by the complex interaction of surface water, groundwater, topography, soils and geology within a wetland.

3.0 Permit Procedures and Requirements

Permit Procedures and Requirements

- The Permit Procedures and Requirements section outlines the requirements for development plan submittal and the general conditions for plan approval.
- Plan approval can be a local jurisdiction's last chance to influence several important issues, such as ensuring long-term access to green infrastructure and stormwater management practices and assigning ongoing maintenance responsibility.
- The ordinance should establish the plan review and approval process as a mechanism to secure an inspection and maintenance agreement and plan that will ensure the long-term viability of green infrastructure and stormwater management practices.

3.1 Permit Application Requirements

No owner or developer shall undertake any development activity without first meeting the requirements of this ordinance and receiving a permit for the proposed development activity from the *(local jurisdiction)*. Unless specifically exempted by this ordinance, any owner or developer proposing a development project shall submit to the *(local jurisdiction)* a permit application on a form provided by the *(local jurisdiction)*. Unless otherwise exempted by this ordinance, the following items shall accompany a permit application:

(1) Stormwater management concept plan prepared in accordance with Section 3.2;

(2) Record of a consultation meeting held in accordance with Section 3.3;

(3) Stormwater management design plan prepared in accordance with Section 3.4;

(4) Stormwater management system inspection and maintenance agreement and plan prepared in accordance with Section 3.5;

(5) Permit application and plan review fees prepared in accordance with Sections 3.6 and 3.7; and,

(6) Performance bond prepared in accordance with Section 3.8.

3.2 Stormwater Management Concept Plan

Prior to the preparation and submittal of a stormwater management design plan and permit application, the owner or developer shall submit to the *(local jurisdiction)* for review and approval, a stormwater management concept plan illustrating the layout of the proposed development project and showing, in general, how post-construction stormwater runoff will be managed on the development site.

The stormwater management concept plan shall include the following information:

(1) Project Narrative: The project narrative shall include a vicinity map, the common address of the development site and a legal description of the development site.

(2) Site Fingerprint: The site fingerprint shall illustrate the results of the natural resources inventory (Section 4.1), which is used to identify and map the natural resources found on the development site, as they exist prior to the start of any land disturbing activities.

(3) Existing Conditions Map: The existing conditions map shall include all of the information shown on the site fingerprint and shall illustrate:

(a) Existing roads, buildings, parking areas and other impervious surfaces;

(b) Existing utilities (e.g., water, sewer, gas, electric) and utility easements;

(c) Existing primary and secondary conservation areas;

(d) Existing low impact development and stormwater management practices;

(e) Existing storm drain infrastructure (e.g., inlets, manholes, storm drains); and,

(f) Existing channel modifications (e.g., bridge or culvert installations).

(4) Proposed Conditions Map: The proposed conditions map shall illustrate:

(a) Proposed topography (minimum two-foot contours recommended);

(b) Proposed drainage divides and patterns;

(c) Proposed roads, buildings, parking areas and other impervious surfaces;

(d) Proposed utilities (e.g., water, sewer, gas, electric) and utility easements;

(e) Proposed limits of clearing and grading;

(f) Proposed primary and secondary conservation areas;

(g) Proposed low impact development and stormwater management practices;

(h) Proposed storm drain infrastructure (e.g., inlets, manholes, storm drains); and,

(i) Proposed channel modifications (e.g., bridge or culvert installations).

(5) Post-Construction Stormwater Management System Narrative: The post-construction stormwater management system narrative shall include information about how post-construction stormwater runoff will be managed on the development site, including a list of the low impact development and stormwater management practices that will be used. It shall also include calculations showing how initial estimates of the post-construction stormwater management criteria that apply to the development project were obtained, including information about the existing and proposed conditions of each of the drainage areas found on the development site (e.g., size, soil types, land cover characteristics).

In accordance with Section 4.2, green infrastructure practices (i.e., better site planning techniques, better site design techniques, low impact development practices) shall be used to the maximum extent practical during the creation of a stormwater management concept plan. Green infrastructure practices include, but are not limited to, protecting primary and secondary conservation areas, reducing clearing and grading limits, reducing roadway lengths and widths, reducing parking lot and building footprints, soil restoration, site reforestation/revegetation, green roofs, vegetated filter strips and rain gardens.

3.3 Consultation Meeting

All applicants are encouraged to hold a consultation meeting with the *(local jurisdiction)* to discuss the proposed development project, the stormwater management concept plan and the approach that was used to satisfy the post-construction stormwater management and site planning and design criteria that apply to the development site. This consultation meeting shall take place *on-site* after submittal, but prior to approval, of the stormwater management concept plan, for the purposes of verifying site conditions and the feasibility of the stormwater management concept plan.

3.4 Stormwater Management Design Plan

Subsequent to approval of the stormwater management concept plan, the owner or developer shall submit to the *(local jurisdiction)* for review and approval, a stormwater management design plan that details how post-development stormwater runoff will be controlled or managed on the development site. The stormwater management design plan shall detail how the proposed development project will meet the post-construction stormwater management and site planning and design criteria that apply to the development site.

The stormwater management design plan shall include all of the information contained in the stormwater management concept plan, plus:

(1) Existing Conditions Hydrologic Analysis: The existing conditions hydrologic analysis shall include:

   (a) Existing conditions map (Section 3.2.3);

   (b) Information about the existing conditions of each of the drainage areas found on the development site (e.g., size, soil types, land cover characteristics);

   (c) Information about the existing conditions of any off-site drainage areas that contribute stormwater runoff to the development site (e.g., size, soil types, land cover characteristics);

   (d) Information about the stormwater runoff rates and volumes generated, under existing conditions, in each of the drainage areas found on the development site;

   (e) Information about the stormwater runoff rates and volumes generated, under existing conditions, in each of the off-site drainage areas that contribute stormwater runoff to the development site; and

   (f) Documentation (e.g., model diagram) and calculations showing how the existing conditions hydrologic analysis was completed.

(2) Proposed Conditions Hydrologic Analysis: The proposed conditions hydrologic analysis shall include:

   (a) Proposed conditions map (Section 3.2.4);

   (b) Information about the proposed conditions of each of the drainage areas found on the development site (e.g., size, soil types, land cover characteristics);

(c) Information about the proposed conditions of any off-site drainage areas that contribute stormwater runoff to the development site (e.g., size, soil types, land cover characteristics);

(d) Information about the stormwater runoff rates and volumes generated, under proposed conditions, in each of the drainage areas found on the development site;

(e) Information about the stormwater runoff rates and volumes generated, under proposed conditions, in each of the off-site drainage areas that contribute stormwater runoff to the development site; and

(f) Documentation (e.g., model diagram) and calculations showing how the proposed conditions hydrologic analysis was completed.

(3) Post-Construction Stormwater Management System Plan: The post-construction stormwater management system plan shall illustrate:

(a) Proposed topography;

(b) Proposed drainage divides and patterns;

(c) Existing and proposed roads, buildings, parking areas and other impervious surfaces;

(d) Existing and proposed primary and secondary conservation areas;

(e) Plan view of existing and proposed low impact development and stormwater management practices;

(f) Cross-section and profile views of existing and proposed low impact development and stormwater management practices, including information about water surface elevations, storage volumes and inlet and outlet structures (e.g., orifice sizes);

(g) Plan view of existing and proposed storm drain infrastructure (e.g., inlets, manholes, storm drains);

(h) Cross-section and profile views of existing and proposed storm drain infrastructure (e.g., inlets, manholes, storm drains), including information about invert and water surface elevations; and

(i) Existing and proposed channel modifications (e.g., bridge or culvert installations).

(4) Post-Construction Stormwater Management System Narrative: The post-construction stormwater management system narrative shall include information about how post-construction stormwater runoff will be managed on the development site, including a list of the low impact development and stormwater management practices that will be used. It shall also include documentation and calculations that demonstrate how the selected low impact development and stormwater management practices satisfy the post-construction stormwater management criteria that apply to the development site, including information about the existing and proposed conditions of each of the

drainage areas found on the development site (e.g., size, soil types, land cover characteristics).

(5) Certification by Plan Preparer: The stormwater management design plan shall be prepared by a certified design professional, such as a landscape architect, professional surveyor or professional engineer, who must certify that the design of the stormwater management system meets the requirements of this ordinance and the latest edition of the *Coastal Stormwater Supplement to the Georgia Stormwater Management Manual*, and any relevant local addenda.

(6) Certification by Owner: The owner shall certify that all land disturbing and development activities will be completed in accordance with the approved stormwater management design plan.

A copy of the stormwater management concept plan (Section 3.2) shall be included with the submittal of the stormwater management design plan. The stormwater management design plan should be consistent with the stormwater management concept plan. If any significant changes were made to the plan of development, the *(administrator)* may ask for a written statement providing rationale for any of the changes that were made.

3.5 Stormwater Management System Inspection and Maintenance Agreement and Plan

Stormwater Management System Inspection and Maintenance Agreement and Plan

- The Stormwater Management System Inspection and Maintenance Agreement and Plan section is intended to ensure the long-term maintenance of green infrastructure and stormwater management practices installed on a development site. This section should be used to:
  - Ensure that maintenance agreements are recorded.
  - Ensure that easements for maintenance and access are platted.
  - Establish maintenance inspection and reporting requirements.

(1) Prior to the issuance of a permit for any new development or redevelopment activity that requires one, the applicant or owner of the development site, if different, must execute an inspection and maintenance agreement and plan that shall be binding on all subsequent owners of the site, unless the stormwater management system is dedicated to and accepted by the *(local jurisdiction)*.

(2) The inspection and maintenance agreement and plan shall include the following information:

(a) Identification by name or official title the person(s) responsible for carrying out the inspection and maintenance;

(b) A statement confirming that responsibility for the operation and maintenance of the stormwater management system, unless assumed by the *(local jurisdiction)*, shall remain with the property owner and shall pass to any successive owner;

(c) A provision stating that, if portions of the development site are sold or otherwise transferred, legally binding arrangements shall be made to pass responsibility for the operation and maintenance of the stormwater management system to the appropriate successors in title; these arrangements shall designate, for each

portion of the stormwater management system, the person(s) to be permanently responsible for its inspection and maintenance;

(d) A maintenance schedule stating when and how often routine inspection and maintenance will occur to ensure proper function of the stormwater management system; and,

(e) Plans for annual inspections to ensure proper performance of the stormwater management system between scheduled maintenance activities.

(3) The inspection and maintenance agreement and plan shall be approved by the *(local jurisdiction)* prior to approval of the stormwater management design plan and recorded with the deed upon approval of the stormwater management design plan.

(4) In addition to enforcing the terms of the inspection and maintenance agreement and plan, the *(local jurisdiction)* may also enforce all of the provisions for ongoing inspection and maintenance contained in Section 6.0 of this ordinance.

(5) The terms of the stormwater management system inspection and maintenance agreement and plan shall provide for the *(local jurisdiction)* to enter the property at reasonable times and in a reasonable manner for the purpose of inspection. These terms include the right to enter a property when the *(local jurisdiction)* has a reason to believe that a violation of an approved stormwater management system inspection and maintenance agreement and plan has occurred and when necessary for abatement of a public nuisance or correction of a violation of this ordinance or an approved stormwater management system inspection and maintenance agreement and plan.

3.6 Permit Application Procedure

(1) Applications for permits shall be filed with the *(local jurisdiction)* on a permit application on a form provided by the *(local jurisdiction)*.

(2) Permit applications shall include the items set forth in Section 3.1. *Two copies of the stormwater management design plan and stormwater management system inspection and maintenance agreement and plan shall be included with the permit application.*

(3) The *(local jurisdiction)* shall inform the applicant whether the application, stormwater management design plan and inspection and maintenance agreement and plan are approved or disapproved.

(4) If the permit application, stormwater management design plan or inspection and maintenance agreement and plan are disapproved, the *(local jurisdiction)* shall notify the applicant of that fact in writing. The applicant may then revise any item not meeting the requirements of this ordinance and resubmit the application, in which event Section 3.5.3 shall apply to such re-submittal.

(5) Upon a finding by the *(local jurisdiction)* that the permit application, stormwater management design plan and inspection and maintenance agreement and plan, if applicable, meet the requirements of this ordinance, the *(local jurisdiction)* may issue a permit for the development project, provided that all other legal requirements for the issuance of such permit have been met.

(6) Notwithstanding the issuance of the permit, in undertaking the new development or redevelopment activity, the applicant or other responsible person shall be subject to the following requirements:

(a) The applicant shall comply with all applicable requirements of the approved stormwater management design plan and the provisions of this ordinance and shall certify that all land disturbing and development activities will be completed in accordance with the approved stormwater management design plan;

(b) The development project shall be conducted only within the area specified in the approved stormwater management design plan;

(c) The *(local jurisdiction)* shall be allowed to conduct periodic inspections of the development project in accordance with Sections 5.0 and 6.0;

(d) No changes may be made to an approved stormwater management design plan without review and written approval by the *(local jurisdiction)*; and,

(e) Upon completion of the development project, the applicant or other responsible person shall submit a statement certifying that the project has been completed in accordance with the approved stormwater management design plan. The applicant or other responsible person shall also submit as built plans for the stormwater management system, as required under Section 5.3.

3.7 Application Review Fees

Application Review Fees
- The local jurisdiction should insert an appropriate fee schedule into this section of the post-construction stormwater management ordinance.
- If a local jurisdiction does not currently charge fees for plan review, waivers and inspections, then it should consider fees as a possible revenue source for its post-construction stormwater management program.

A non-refundable permit fee *(shall/may)* be collected at the time the permit application is submitted to the *(local jurisdiction)*. Any permit fees that are collected shall be used to support the administration and management of the plan review and approval process and the inspection of all development projects subject to the requirements of this ordinance. The *(local jurisdiction) (shall/may)* develop a fee schedule based on the area of land disturbed by the project and may amend the fee schedule from time to time.

3.8 Performance Bonds

The (local jurisdiction) shall require, from the applicant, a surety or cash bond, irrevocable letter of credit or other means of security acceptable to the (local jurisdiction) prior to the issuance of a permit for any new development or redevelopment activity. The amount of the security shall not be less than the total estimated construction cost of the post-construction stormwater management system to be installed on the development site. The bond shall include provisions relative to forfeiture for failure to complete the work specified in the approved stormwater management design plan, compliance with the provisions of this ordinance, other applicable laws and regulations and any time limitations. The bond shall not be fully released without a final inspection of the completed work by the (local jurisdiction), submittal of as built plans, a

recorded inspection and maintenance agreement and plan and certification by the applicant that the stormwater management system complies with the approved stormwater management design plan and the requirements of this ordinance. A procedure may be used to release parts of the bond held by the (local jurisdiction) after various stages of construction have been completed and accepted by the (local jurisdiction). The procedures used for partially releasing performance bonds must be specified by the (local jurisdiction) in writing prior to the approval of a stormwater management design plan.

3.9 Compliance Through Off-Site Stormwater Management Practices

All stormwater management design plans shall include on-site green infrastructure and stormwater management practices, unless arrangements are made with the *(local jurisdiction)* to manage post-construction stormwater runoff in an off-site or regional stormwater management practice. The off-site or regional stormwater management practice must be located on property legally dedicated to that purpose, be designed and sized to meet the post-construction stormwater management criteria presented in Section 4.0 of this ordinance, provide a level of stormwater quality and quantity control that is equal to or greater than that which would be provided by on-site green infrastructure and stormwater management practices and have an associated inspection and maintenance agreement and plan (Section 3.5). In addition, appropriate stormwater management practices shall be installed, where necessary, to protect properties and drainage channels that are located between the development site and the location of the off-site or regional stormwater management practice.

To be eligible for compliance through the use of off-site stormwater management practices, the applicant must submit a stormwater management design plan to the *(local jurisdiction)* that shows the adequacy of the off-site or regional stormwater management practice and demonstrates, to the satisfaction of the *(local jurisdiction)*, that the off-site or regional stormwater management practice will not result in the following impacts:

(1) Increased threat of flood damage or endangerment to public health or safety;

(2) Deterioration of existing culverts, bridges, dams and other structures;

(3) Accelerated streambank or streambed erosion or siltation;

(4) Degradation of in-stream biological functions or habitat; or,

(5) Water quality impairment in violation of state water quality standards and/or violation of any other state or federal regulations.

4.0 Post-Construction Stormwater Management and Site Planning and Design Criteria

Post-Construction Stormwater Management and Site Planning and Design Criteria

- Criteria are the core of a post-construction stormwater management ordinance. They establish the design objectives for green infrastructure and stormwater management practices, and will influence the types of practices that are used on a development site.
- Criteria in the ordinance should remain fairly simple, with technical detail relegated to the stormwater guidance manual, which, in this case, is the *Coastal Stormwater Supplement to the Georgia Stormwater Management Manual*.

The following post-construction stormwater management and site planning and design criteria shall be applied to all new development and redevelopment activities that are subject to the provisions of this ordinance. The criteria have been designed to protect valuable local natural resources from the negative impacts of the land development process.

If local natural resource protection and stormwater management goals and objectives warrant greater protection than that provided by the post-construction stormwater management and site planning and design criteria outlined below, the *(local jurisdiction)* may impose additional requirements on new development and redevelopment activities that it has determined are necessary to protect local aquatic and terrestrial resources from the negative impacts of the land development process.

4.1 Natural Resources Inventory

Prior to the start of any land disturbing activities, including any clearing and grading activities, acceptable site reconnaissance and surveying techniques should be used to complete a thorough assessment of the natural resources, both terrestrial and aquatic, found on a development site. The natural resources inventory shall be completed in accordance with the information presented within the latest edition of the *Coastal Stormwater Supplement to the Georgia Stormwater Management Manual*.

The preservation and/or restoration of the natural resources found on a development site, through the use of green infrastructure practices, may, at the discretion of the *(local jurisdiction)*, be assigned quantifiable stormwater management "credits" that can be used when calculating the stormwater runoff volumes associated with the post-construction stormwater management criteria outlined in Sections 4.3 through 4.7 of this ordinance. The green infrastructure practices that qualify for these "credits," and information about how they can be used to help satisfy the post-construction stormwater management criteria outlined in Sections 4.3 through 4.7 of this ordinance, is provided in the latest edition of the *Coastal Stormwater Supplement to the Georgia Stormwater Management Manual*.

4.2 Use of Green Infrastructure Practices

Green infrastructure practices shall be used to the maximum extent practical during the creation of a stormwater management concept plan (Section 3.2) for a proposed development project. Green infrastructure practices can be used to not only help protect local terrestrial and aquatic resources from the direct impacts of the land development process, but also to help maintain pre-development site hydrology and reduce post-construction stormwater runoff rates, volumes and pollutant loads.

4.3 Stormwater Runoff Reduction

The stormwater runoff volume generated by the runoff reduction storm event, as defined in the latest edition of the *Coastal Stormwater Supplement to the Georgia Stormwater Management Manual*, shall be reduced on-site in order to help maintain pre-development site hydrology and help protect local aquatic resources from several indirect impacts of the land development process, including decreased groundwater recharge, decreased baseflow and degraded water quality. A stormwater management system is presumed to comply with this criteria if:

(1) It includes green infrastructure practices that provide for the interception, evapotranspiration, infiltration or capture and reuse of stormwater runoff, that have been selected, designed, constructed and maintained in accordance with the information presented in the latest edition of the *Coastal Stormwater Supplement to the Georgia Stormwater Management Manual* and any relevant local addenda; and,

(2) It is designed to provide the amount of stormwater runoff reduction specified in the latest edition of the *Coastal Stormwater Supplement to the Georgia Stormwater Management Manual*.

The *(administrator)* may reduce the amount of stormwater runoff reduction needed to satisfy this criteria on development sites that are considered to be stormwater hotspots or that have site characteristics or constraints, such as high groundwater, impermeable soils, contaminated soils or confined groundwater aquifer recharge areas, that prevent the use of green infrastructure practices that provide for the interception, evapotranspiration, infiltration or capture and reuse of stormwater runoff. When seeking a reduction in the amount of stormwater runoff reduction that needs to be provided in order to satisfy this criteria, applicants shall:

(1) Use green infrastructure practices that provide for the interception, evapotranspiration, infiltration or capture and reuse of stormwater runoff, to provide the minimum amount of stormwater runoff reduction specified in the latest edition of the *Coastal Stormwater Supplement to the Georgia Stormwater Management Manual* and any relevant local addenda; and,

(2) Provide adequate documentation to the *(local jurisdiction)* to show that no additional runoff reducing green infrastructure practices can be used on the development site.

In accordance with Section 4.4 of this ordinance, any of the stormwater runoff volume generated by the runoff reduction storm event that is not reduced on the development site shall be intercepted and treated in one or more stormwater management practices that provide at least an 80 percent reduction in total suspended solids loads and that reduce nitrogen and bacteria loads to the maximum extent practical.

4.4 Water Quality Protection

In order to protect local aquatic resources from water quality degradation, post-construction stormwater runoff shall be adequately treated before it is discharged from a development site. Applicants can satisfy this criteria by satisfying the stormwater runoff reduction criteria (Section 4.3). However, if any of the stormwater runoff volume generated by the runoff reduction storm event, as defined in the latest edition of the *Coastal Stormwater Supplement to the Georgia Stormwater Management Manual*, cannot be reduced on the development site, due to site characteristics or constraints, it shall be intercepted and treated in one or more stormwater management practices that provide at least an 80 percent reduction in total suspended solids

loads and that reduce nitrogen and bacteria loads to the maximum extent practical. When seeking to satisfy this criteria through the use of one or more stormwater management practices, applicants shall:

(1) Intercept and treat stormwater runoff in stormwater management practices that have been selected, designed, constructed and maintained in accordance with the information presented in the latest edition of the *Coastal Stormwater Supplement to the Georgia Stormwater Management Manual* and any relevant local addenda; and,

(2) Provide adequate documentation to the *(local jurisdiction)* to show that total suspended solids, nitrogen and bacteria removal were considered during the selection of the stormwater management practices that will be used to intercept and treat stormwater runoff on the development site.

4.5 Aquatic Resource Protection

In order to protect local aquatic resources from several other negative impacts of the land development process, including complete loss or destruction, stream channel enlargement and increased salinity fluctuations, applicants shall provide aquatic resource protection in accordance with the with the information provided in the latest edition of the *Coastal Stormwater Supplement to the Georgia Stormwater Management Manual*.

4.6 Overbank Flood Protection

Overbank Flood Protection

- Most local jurisdictions establish an overbank flood protection criteria that is matched with the design storm used to design open channels, culverts, bridges and storm drain systems. Consequently, many local jurisdictions require that the peak discharge generated by the 10-year and/or 25-year, 24-hour storm event under post-development conditions be controlled in a manner that ensures that it does not exceed the peak discharge generated by the same storm event(s) under pre-development conditions.

All stormwater management systems shall be designed to control the peak discharge generated by the overbank flood protection storm event, as defined in the latest edition of the *Coastal Stormwater Supplement to the Georgia Stormwater Management Manual*, to prevent an increase in the duration, frequency and magnitude of downstream overbank flooding. A stormwater management system is presumed to comply with this criteria if it is designed to provide overbank flood protection in accordance with the information provided in the latest edition of the *Coastal Stormwater Supplement to the Georgia Stormwater Management Manual*.

The *(administrator)* may modify or waive this criteria on development sites where both the on-site and downstream stormwater conveyance systems are designed to safely convey the peak discharge generated by the overbank flood protection storm event to a receiving stream, tidal creek or other aquatic resource without causing additional downstream flooding or other environmental impacts, such as stream channel enlargement or degradation of habitat.

4.7. Extreme Flood Protection

Extreme Flood Protection
- Some local jurisdictions establish an extreme flood protection criteria to maintain the boundaries of existing floodplains, reduce the threat of flooding and protect public health and safety. Even if an extreme flood protection criteria is not established, local jurisdictions should require that all green infrastructure and stormwater management practices that impound stormwater runoff can safely pass the 100-year storm without overtopping or creating damaging or dangerous downstream conditions.

All stormwater management systems shall be designed to control the peak discharge generated by the extreme flood protection storm event, as defined in the latest edition of the *Coastal Stormwater Supplement to the Georgia Stormwater Management Manual*, to prevent an increase in the duration, frequency and magnitude of downstream extreme flooding and protect public health and safety. A stormwater management system is presumed to comply with this criteria if it is designed to provide extreme flood protection in accordance with the information provided in the latest edition of the *Coastal Stormwater Supplement to the Georgia Stormwater Management Manual*.

The *(administrator)* may modify or waive this criteria on development sites where both the on-site and downstream stormwater conveyance systems are designed to safely convey the peak discharge generated by the extreme flood protection storm event to a receiving stream, tidal creek or other aquatic resource without causing additional downstream flooding or other environmental impacts, such as stream channel enlargement or degradation of habitat.

4.8 Redevelopment Criteria

Redevelopment Criteria
- Include a separate Redevelopment Criteria section when the local jurisdiction wants to encourage redevelopment as part of a greater land use planning or Smart Growth strategy.
- With these criteria, post-construction stormwater management requirements are tailored to the unique conditions of redevelopment projects. These criteria may include less rigorous post-construction stormwater management requirements or provisions for off-site mitigation in lieu of full on-site compliance.
- In some local jurisdictions, redevelopment projects may be required to meet more rigorous stormwater management criteria if downstream flooding and/or water quality are important local issues.

Development activities that are considered to be redevelopment activities shall meet at least one of the following criteria:

(1) ***Reduce Impervious Cover****: Reduce existing site impervious cover by at least 20%.*

(2) ***Provide Stormwater Management****: Manage the stormwater runoff from at least 20% of the site's existing impervious cover and any new impervious cover in accordance with the post-construction stormwater management criteria outlined in Sections 4.3 through 4.7 of this ordinance. The green infrastructure and stormwater management practices used to comply with these criteria shall be selected, designed, constructed and maintained in accordance with the information presented in the latest edition of the*

Coastal Stormwater Supplement to the Georgia Stormwater Management Manual and any relevant local addenda.

(3) ***Provide Off-Site Stormwater Management****: Provide, through the use of off-site stormwater management practices, a level of stormwater quality and quantity control that is equal to or greater than that which would be provided by satisfying the post-construction stormwater management criteria outlined in Sections 4.3 through 4.7 of this ordinance on the development site.*

(4) ***Combination of Measures****: Any combination of (1) through (3) above that is acceptable to the (local jurisdiction).*

4.9 Green Infrastructure and Stormwater Management Practices

All green infrastructure and stormwater management practices shall be selected, designed, constructed and maintained in accordance with the information presented in the latest edition of the *Coastal Stormwater Supplement to the Georgia Stormwater Management Manual* and any relevant local addenda. Applicants are referred to the latest edition of the *Coastal Stormwater Supplement to the Georgia Stormwater Management Manual*, and any relevant local addenda, for guidance on selecting green infrastructure and stormwater management practices that can be used to satisfy the post-construction stormwater management criteria outlined in Sections 4.3 through 4.7 of this ordinance.

For green infrastructure or stormwater management practices that are not included in the *Coastal Stormwater Supplement to the Georgia Stormwater Management Manual*, or for which pollutant removal and runoff reduction rates have not been provided, the effectiveness of the green infrastructure or stormwater management practice must be documented through prior studies, literature reviews or other means, and receive approval from the *(local jurisdiction)* before being included in a stormwater management system.

4.10 Stormwater Conveyance Practices

Stormwater conveyance practices, which may include, but are not limited to, storm drain pipes, culverts, catch basins, drop inlets, junction boxes, headwalls, gutters, ditches, open channels, swales and energy dissipaters, shall be provided when necessary to convey post-construction stormwater runoff and protect private properties adjoining development sites and/or public rights-of-way. Stormwater conveyance practices that are used to convey post-construction stormwater runoff on development sites shall meet the following requirements:

(1) Methods used to calculate stormwater runoff rates and volumes shall be in accordance with the information presented in the latest edition of the *Georgia Stormwater Management Manual* and any relevant local addenda;

(2) All culverts, pipe systems and open channel flow systems shall be sized in accordance with the information presented in the latest edition of the *Georgia Stormwater Management Manual* and any relevant local addenda; and,

(3) Planning and design of stormwater conveyance practices shall be completed in accordance with the information presented in the latest edition of the *Georgia Stormwater Management Manual* and any relevant local addenda.

5.0 Construction Inspection of Stormwater Management Systems

Construction Inspection of Stormwater Management Systems

- The Construction Inspection section of a post-construction stormwater management ordinance outlines the regulatory requirements for inspecting and reporting on permanent green infrastructure and stormwater management practices during construction.
- The ordinance should be clear about who is responsible for conducting inspections (the responsible party, a local government department, or some combination of the two), and the type and frequency of reporting that must be submitted.

5.1 Notice of Construction Commencement

The applicant must notify the *(local jurisdiction)* prior to the commencement of construction on a development site. In addition, the applicant must notify the *(local jurisdiction)* in advance of the installation of critical components of the stormwater management system shown on the approved stormwater management design plan. The *(local jurisdiction)* may, at its discretion, issue verbal or written authorization to proceed with the installation of critical components of the stormwater management system, such as permanent green infrastructure and stormwater management practices, based on the stabilization of contributing drainage areas and other factors.

5.2 Inspections During Construction

Periodic inspections of the green infrastructure and stormwater management practices shown on the approved stormwater management design plan shall be conducted by staff or representatives of the *(local jurisdiction)* during construction. Construction inspections shall utilize the approved stormwater management design plan for establishing compliance with the provisions of this ordinance. All inspections shall be documented in written reports that contain the following information:

(1) The date and location of the inspection;

(2) The name of the inspector;

(3) Whether construction is in compliance with the approved stormwater management design plan;

(4) Violations of the approved stormwater management design plan; and,

(5) Any other variations from the approved stormwater management plan.

If any violations are found, the applicant shall be notified in writing about the nature of the violation and the remedial measures that are required to bring the action or inaction into compliance with the approved stormwater management design plan, as described in Section 7.1 of this ordinance. In the event that the remedial measures described in such notice have not been completed by the date set forth in the notice, any one or more of the enforcement actions outlined in Section 7.2 of this ordinance may be taken against the applicant.

5.3 Final Inspection and As Built Plans

Subsequent to the final installation and stabilization of all green infrastructure and stormwater management practices shown on the approved stormwater management design plan, and before the issuance of a certificate of occupancy, the applicant is responsible for certifying that the project has been completed in accordance with the approved stormwater management design plan and submitting as built plans for all green infrastructure and stormwater management practices shown on the approved stormwater management design plan. The as built plans must show the final design specifications for all green infrastructure and stormwater management practices and must be certified by a licensed design professional such as a landscape architect, professional surveyor or professional engineer. A final inspection shall be conduced by the staff or representatives of the (local jurisdiction) to confirm the accuracy of the as built plans. A final inspection is required before any performance bond or other guarantee can be released.

6.0 Ongoing Inspection and Maintenance of Stormwater Management Systems

6.1 Maintenance Responsibility

The responsible party named in the recorded stormwater management system inspection and maintenance agreement and plan (Section 3.4), shall maintain in good condition and promptly repair and restore all green infrastructure and stormwater management practices, maintenance access routes and appurtenances, including, but not limited to surfaces, walls, drains, dams, structures, vegetation, erosion and sediment control practices and other protective devices. Such repairs and restoration and maintenance activities shall be performed in accordance with an approved inspection and maintenance agreement and plan.

If the responsible party named in the recorded inspection and maintenance agreement and plan is a homeowner's association or other owner's association, such as a unit owner's association, the responsible party shall submit to the *(local jurisdiction)* a copy of a recorded declaration that provides:

(1) That green infrastructure and stormwater management practices are part of the common elements of the development site and shall be subject to the requirements of the stormwater management system inspection and maintenance agreement and plan;

(2) That membership in the association shall be mandatory and automatic for all homeowners or unit owners of the development site and their successors;

(3) That the association shall have lien authority to ensure the collection of dues from all members;

(4) That the requirements of the inspection and maintenance agreement and plan shall receive the highest priority for expenditures by the association except for any other expenditures that are required by law to have a higher priority;

(5) That a separate fund shall be maintained by the association for the routine maintenance, reconstruction and repair of the green infrastructure and stormwater management practices, and kept in an account insured by the Federal Deposit Insurance Corporation (FDIC) or by another entity acceptable to the *(local jurisdiction)*;

(6) That the routine maintenance, reconstruction and repair fund shall contain at all times the dollar amount reasonably determined from time to time by the *(local jurisdiction)* to be adequate to pay for the probable reconstruction and repair cost (but not routine maintenance cost) of the stormwater management system for a three-year period; and,

(7) That, to the extent permitted by law, the association shall not enter into voluntary dissolution unless responsibility for the green infrastructure and stormwater management practices is transferred to an appropriate successor.

The *(local jurisdiction)*, in lieu of an inspection and maintenance agreement and plan, may accept the dedication of any existing or future green infrastructure or stormwater management practice for maintenance, provided that such practice meets all of the requirements of this ordinance, is in proper working order at the time of dedication and includes adequate and perpetual access and sufficient area for inspection and regular maintenance. Such adequate and perpetual access shall be accomplished by granting of an easement to the *(local jurisdiction)* or through a fee simple dedication to the *(local jurisdiction)*.

6.2 Maintenance Inspections

Periodic inspections of the green infrastructure and stormwater management practices shown on an approved stormwater management design plan, and subject to the terms and conditions of an approved inspection and maintenance agreement and plan, shall be conducted by staff or representatives of the *(local jurisdiction)* to document repair and maintenance needs and ensure compliance with the requirements of the approved inspection and maintenance agreement and plan and provisions of this ordinance. All inspections should be documented in written reports that contain the following information:

(1) The date and location of the inspection;

(2) The name of the inspector;

(3) The condition of:

- (a) Vegetation and filter media;
- (b) Fences and other safety devices;
- (c) Spillways, valves and other hydraulic control structures;
- (d) Embankments, slopes and safety benches;
- (e) Reservoirs and permanent pools;
- (f) Inlet and outlet channels and structures;
- (g) Underground drainage structures;
- (h) Sediment and debris accumulation in storage and forebay areas;
- (i) Any other item that could affect the proper function of the stormwater management system; and,

(4) A description of repair, restoration and maintenance needs.

If any repair, restoration or maintenance needs are found, the responsible party named in the recorded stormwater management system inspection and maintenance agreement and plan shall be notified in writing about the repair, restoration or maintenance needs and the remedial measures that are required to bring the stormwater management system into compliance with the approved stormwater management system inspection and maintenance agreement and plan, as described in Section 7.1 of this ordinance. In the event that the remedial measures described in such notice have not been completed by the date set forth in the notice, any one or more of the enforcement actions outlined in Section 7.2 of this ordinance may be taken against the responsible party named in the approved stormwater management system inspection and maintenance agreement and plan.

6.3 Records of Maintenance Activities

The responsible party shall make and maintain records of all inspections, maintenance and repairs, and shall retain the records for a minimum of five years. These records shall be made available to the *(local jurisdiction)* during inspections and at other reasonable times upon request of the *(local jurisdiction)*.

6.4 Failure to Maintain

If the responsible party fails or refuses to meet the terms and conditions of an approved stormwater management system inspection and maintenance agreement and plan and/or the requirements of this ordinance, the *(local jurisdiction)*, after thirty (30) days written notice (except, that in the event the violation constitutes an immediate danger to public health or safety, 24 hours notice shall be sufficient), may correct a violation by performing the work necessary to place the green infrastructure or stormwater management practice in proper working condition. The *(local jurisdiction)* may assess the responsible party for the cost of the repair work, which shall be a lien on the property, and may be placed on the ad valorum tax bill for such property and collected in the ordinary manner for such taxes by the *(local jurisdiction)*.

7.0 Violations, Enforcement and Penalties

Any action or inaction that violates the provisions of this ordinance or the requirements of an approved stormwater management design plan, permit or inspection and maintenance agreement and plan, may be subject to the enforcement actions outlined in this section. Any such action or inaction that is continuous with respect to time may be deemed to be a public nuisance and may be abated by injunctive or other equitable relief. The imposition of any of the penalties described below shall not prevent such equitable relief.

7.1 Notice of Violation

If the *(local jurisdiction)* determines that an owner, applicant or other responsible person has failed to comply with the provisions of this ordinance, or the terms and conditions of an approved stormwater management design plan, permit or inspection and maintenance agreement and plan, it shall issue a written notice of violation to said owner, applicant or other responsible person. Where a person is engaged in a new development or redevelopment activity covered by this ordinance without having first secured a stormwater management permit, the notice of violation shall be served on the owner or the person in charge of the new development or redevelopment activity being conducted on the development site.

The notice of violation shall contain the following information:

(1) The name and address of the owner, applicant or other responsible person;

(2) The address or other description of the site upon which the violation is occurring;

(3) A statement specifying the nature of the violation;

(4) A description of the remedial measures necessary to bring the action or inaction into compliance with the provisions of this ordinance, or the terms and conditions of the approved stormwater management design plan, permit or inspection and maintenance agreement and plan, and the date for the completion of such remedial measures;

(5) A statement of the penalty or penalties that may be assessed against the person to whom the notice of violation is issued; and,

(6) A statement that the determination of violation may be appealed to the *(local jurisdiction)* by filing a written notice of appeal within thirty (30) days after the notice of violation (except, that in the event the violation constitutes an immediate danger to public health or safety, a written notice of appeal must be filed within 24 hours after the notice of violation).

7.2 Penalties

Penalties
- Many local post-construction stormwater management ordinances do not have a schedule of civil penalties as laid out below**.** The advantage of having such a schedule is that it makes the civil penalties easier for the local jurisdiction to apply and administer. The violations that are tied to each penalty and the penalty amounts themselves can be modified.
- It is important to check with legal staff before including a schedule of civil penalties within a local post-construction stormwater management ordinance. Other state or local codes may specify how civil penalties can be applied.

In the event that the remedial measures described in the notice of violation have not been completed by the date set forth for completion in the notice of violation, any one or more of the following actions or penalties may be taken or assessed against the person to whom the notice of violation was issued.

Before taking any of the following actions or imposing any of the following penalties, the *(local jurisdiction)* shall first notify the owner, applicant or other responsible person in writing of its intended action and shall provide a reasonable opportunity of not less than ten days (except, that in the event the violation constitutes an immediate danger to public health or safety, 24 hours notice shall be sufficient) to correct the violation. In the event the owner, applicant or other responsible person fails to correct the violation by the date set forth in said notice, the *(local jurisdiction)* may take any one or more of the following actions or impose any one or more of the following penalties.

(1) **Stop Work Order**: The *(local jurisdiction)* may issue a stop work order that shall be served on the owner, applicant or other responsible person. The stop work order shall remain in effect until the owner, applicant or other responsible person has taken the remedial

measures set forth in the notice of violation or has otherwise corrected the violation or violations described therein. The stop work order may temporarily be withdrawn or modified by the *(local jurisdiction)* to enable the applicant or other responsible person to take the remedial measures necessary to correct such violation or violations.

(2) **Withhold Certificate of Occupancy**: The *(local jurisdiction)* may refuse to issue a certificate of occupancy for the building or other structure constructed or being constructed on the development site until the owner, applicant or other responsible person has taken the remedial measures set forth in the notice of violation or has otherwise corrected the violation or violations described therein.

(3) **Suspension, Revocation, or Modification of Permit**: The *(local jurisdiction)* may suspend, revoke or modify the permit authorizing the development project. A suspended, revoked or modified permit may be reinstated after the owner, applicant or other responsible person has taken the remedial measures set forth in the notice of violation or has otherwise corrected the violation or violations described therein. The permit may be modified by the *(local jurisdiction)* to enable the owner, applicant or other responsible person to take the remedial measures necessary to correct such violation or violations.

(4) **Civil Penalties**: In the event the owner, applicant or other responsible person fails to take the remedial measures set forth in the notice of violation or otherwise fails to correct the violation or violations described therein, by the date set forth in the notice of violation, the *(local jurisdiction)* may impose a penalty not to exceed $1,000 (depending on the severity of the violation) for each day the violation remains unremedied after the date set forth in the notice of violation.

(5) **Criminal Penalties**: For intentional and flagrant violations of this ordinance, the *(local jurisdiction)* may issue a citation to the owner, applicant or other responsible person, requiring said person to appear in *(appropriate municipal court)* court to answer to criminal charges for such violation. Upon conviction, such person shall be punished by a fine not to exceed $1,000, imprisonment for up to 60 days or both. Each act of violation and each day upon which any violation shall occur shall constitute a separate offense.

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