5—RECREATIONAL FACILITIES DEVELOPMENT & MANAGEMENT

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Introduction

The beauty of Georgia's coast can be mainly attributed to its unique and abundant natural resources. Diverse and interconnected, these ecosystems are highly functional components of the landscape and collectively, offer a myriad of recreational opportunities.

Recreational developments such as golf courses and marinas can be both positive and negative, offering access to natural resources but often doing so at the cost of the surrounding environment. Because these activities are carried out in or around the water itself, there is a strong potential for the degradation or even destruction of the very resources we are seeking to enjoy.

Golf courses and parks have the potential to degrade water quality by removing riparian buffers, increasing impervious surfaces, and introducing excessive nutrients and chemicals into coastal waters. Equally problematic, in-water structures, like marinas and community docks, can concentrate many boats in one area, leading to the release of petroleum hydrocarbons, sewage, anti-foulants and other harmful pollutants into wetlands and waterways. Water pollution can potentially threaten the health of aquatic organisms and ultimately, people recreating in these areas.

The continued use and accessibility of Georgia's coastal resources strongly depends on the sustained function and health of these systems. In this chapter, the Green Growth Guidelines (G3) are expanded to address the added challenges of recreational developments. G3 provides a host of conservation measures intended to protect and preserve the present and future natural capital generated by these vital ecosystem services.

Developers, state and local governments, as well as the general public stand to benefit by implementing G3:

- Better water quality
- Healthier commercial and recreational fisheries
- Cleaner, safer conditions for recreational activities
- Increased resiliency against coastal hazards such as hurricanes and floods
- Reduced construction and maintenance costs
- More efficient operations
- Increased recreational opportunities
- Increased property values
- Enhanced visual appearance
- Better regulatory compliance

Golf Courses, Parks & Trails—Planning & Design Guidelines

Golf courses, parks, and trail systems can alter the natural features of the landscape resulting in poor water quality, loss of wildlife habitat, and land erosion. For these reasons, recreational developments should be planned, designed, and constructed with consideration for the unique conditions of the surrounding environment for which they are a part. When managed properly, these areas can serve as valuable hubs and links in the *Green Infrastructure Network*.

Incorporating natural features into the development plan protects vital ecosystem functions, reduces site development and maintenance costs, and ensures better regulatory compliance.

St. Simons Golf Club. Source: LC Lambrecht

Recommended Planning & Design Guidelines for Golf Courses, Parks and Trail Systems
Compact or condense the overall development footprint and retain large, contiguous blocks of greenspace.
 Sustain biodiversity by keeping greenspace in its natural state. Set aside as much as 50% of the total site as natural greenspace (75% or more of this area should contain native trees and vegetation).
Preserve continuous buffers and conservation areas along aquatic resources. G3 recommends 200' from major rivers, 100' from streams and tributaries, 50-100' from marshlands and estuaries, and 25-50' from forested interior wetlands.
Reduce unnecessary clearing, grading, filling, or piping of natural drainageways by tailoring the site design to fit the natural topography, hydrology, and soils found on-site (e.g. locate buildings and roadways in higher elevations and stormwater controls in lower-lying areas).
Avoid the direct discharge of concentrated stormwater runoff to natural waterbodies—instead direct runoff away from sensitive natural resources and towards areas where ponding and infiltration (pre-treatment) can occur.

Recommended Planning & Design Guidelines for Golf Courses, Parks and Trail Systems
Design green infrastructure and low impact stormwater practices which remove pollutants (phosphorus, nitrogen, fecal coliform and heavy metals) from runoff before it reaches open waters.
Design stormwater controls where post-construction runoff rates are equal to or less than pre-construction runoff rates. Check engineering specifications in the *Georgia Stormwater Management Manual—Coastal Stormwater Supplement* @ www.georgiastormwater.com
Incorporate rain harvesting practices such as underground cisterns and rain barrels to capture runoff from the rooftops of clubhouses and other supporting buildings that can be used to irrigate the greens and other surrounding landscaped areas.
For landscaped areas, plant native, non-invasive trees, shrubs and plants which require less water, fertilizers and pesticides to maintain.
Minimize effective impervious surfaces to 15% or less of the total site area. Visit www.coastalgadnr.org/pe/eic to calculate the effective impervious cover for your specific site.
Locate impervious surfaces a minimum of 50' away from rivers, creeks, marshlands and other sensitive areas. Disconnect impervious surfaces—route stormwater from rooftops and roads to grassed areas instead of concrete.
Minimize impervious surfaces by reducing the width and length of roads, right-of-ways, driveways, sidewalks and cart paths.
Use pervious materials such as porous concrete, modular pavers or geotextiles for all drivable and walkable surfaces within close proximity to coastal wetlands and waterways. Utilize grass or dirt pave, mulch or other safe recyclable surfaces for less travelled access roads, sidewalks and recreational trails.
Avoid areas of erosion when locating buildings, roads, and supporting infrastructure. If erosion is present and stabilization is necessary, apply bioengineering and non-structural practices to failing banks and unstable slopes.
Locate community sewer and private septic systems a minimum of 100' from open waters.

Construction Practices for Golf Courses, Parks & Trails

Golf courses, parks and other recreational developments near coastal waters and wetlands should implement the following construction practices:

Avoid clearing and mass grading of the site to minimize sediment erosion which can lead to turbidity of nearby waterways.

During construction, implement temporary erosion and sediment control measures such as silt curtains, hay bales and sediment traps to protect wetlands and open waters.

For detailed practices, go to www.gaswcc.georgia.gov to access the latest version of the *"Green Book"— Manual for Erosion and Sediment Control in Georgia, GA Soil & Water Conservation Commission.*

Protect native trees and vegetation during construction, especially within buffers and green space areas. If disturbance is inevitable, transplant native trees and vegetation to another area on-site.

Minimize soil compaction caused by heavy equipment to the greatest extent possible. Restore compressed soils by aerating (tilling) and amending with organic matter which improves stormwater absorption and uptake. See Ch. 3 for Soil Restoration practices.

Stabilize disturbed areas by gently sloping soils and re-establish with quick-growing, drought/ pest-resistant plants. Visit www.coastscapes.org for a list of appropriate species.

All construction equipment should be operated and stored within the limits of designated access roads and upland staging locations. Equipment maintenance and repairs should be performed off-site when possible. Any on-site maintenance should be carried out on pre-selected upland areas to reduce the risk of harmful chemicals such as motor oils, hydraulics fluids, and cleaning agents reaching nearby wetlands and waterways.

Keep construction debris piles, dumpsters and refuse containers away from open waters and wetlands.

Management Measures for Golf Courses, Parks & Trails

To ensure long-term natural resource protection goals are met, management measures should be integrated into the development's routine operation and maintenance procedures. Proper and consistent implementation of these practices is a win-win strategy—safeguard free assets (i.e. ecosystem services and the natural capital they generate) while lowering operational and maintenance costs.

The next section provides recommended practices in 4 main categories:

- Stormwater Management
- Landscape Management
- Wildlife Habitat
- Erosion Control

Basic Stormwater Maintenance Measures:
For effective pollutant removal, prune, trim and replace stressed or dead vegetation in detention, biorention and filtration areas.
When needed, aerate and amend compacted soils with organic matter for maximum stormwater infiltration.
Maintain control structures in good working order for optimal function—remove sediments and trash debris from forebays, ditches, ponds, inlets and outfalls, as well as filtration and separator devices.
To prevent clogging, routinely remove leaf debris and sediments from pervious pavers and porous concrete surfaces.

In addition to regular maintenance, a water quality monitoring plan can be established to track and maintain acceptable water quality conditions in stormwater ponds and receiving waterbodies.

Basic Water Quality Sampling & Testing Parameters

The U.S. Environmental Protection Agency Rapid Bio-Assessment Protocols and the Georgia Department of Natural Resources Standard Operating Procedures should be followed when performing biological assessments in coastal waters.

Biological assessments can also be conducted to assess macro-invertebrate and fish communities which serve as excellent indicators of water quality. Aquatic and terrestrial organisms function as continual monitors of environmental quality, capable of detecting both the effects of episodic and cumulative pollution. They inhabit these areas for most or all of their life cycles and, therefore reflect recent, as well as past, environmental conditions.

Landscape Management

Chemical Application

Recreational developments, especially maintained golf courses and parks, should prepare and implement an *Integrated Pest Management* (IPM) plan that specifically addresses the handling, storage, application and use of all on-site landscaping chemicals.

Basic Tenets of an Integrated Pest Management (IPM) Plan	
Establish "no chemical zones" in and around open waters and other environmentally sensitive areas. Chemical application (pesticides or herbicides) into open waters and tidal marshlands is strictly prohibited. Educate and train maintenance staff of the importance of this rule.	
Landscape using native trees, shrubs, and plants. See www.coastscapes.org for a list of appropriate species suited to your area.	
Use organic fertilizers such as compost, blood meal, fish meal, amino acids, humic acid, and green manure.	
Observe and record the type, severity, location, and treatment of pest problems.	
Use biological (algae-eating fish/bacteria) or physical (aeration) methods to control weeds and pests in ponds and lagoons.	
Establish and support populations of natural predators of pests—beneficial microbes, insects, birds, fish, amphibians, and mammals.	
Only use what is absolutely needed. Routinely test soils and apply fertilizers on a prescriptive basis according to site-specific needs.	
Use water-insoluble nitrogen (WIN) fertilizer which provides a slow-release of nitrogen.	
Use disease and pest-resistant turf grass varieties.	
Mow turf grass to heights that can be maintained with minimal chemical additives.	
Avoid application of fertilizers and pesticides prior to high winds or heavy rainfall.	

Basic Tenets of an Integrated Pest Management (IPM) Plan
Follow applicable federal and state regulations for chemical storage, handling, application, and disposal. See the most current version of the *Georgia Rules for Hazardous Waste Management* for specific practices and protocols. Visit www.gaepd.org for a complete copy of the manual.
Establish a specific pollution prevention plan that addresses all chemicals used and stored on-site.
Consider the environmental impact of chemical application—runoff and leaching potential, toxicity to humans and wildlife, soil absorption capacity, pest resistance, and water solubility.
Educate and train maintenance staff about the risks chemicals pose to human health and the environment. Provide staff with prevention and control measures they can use to avoid or reduce the effects of water pollution.
 Ban the use of fertilizers, herbicides, and pesticides that are known to cause human and wildlife health problems including, but not limited to, 2,4-D, carbonyl, diazinon, dursban, diuron, malathion, triclopyr BEE, trifluralin, mancozeb, chlorothalonil, triazoles, chlordane monosodium, methane arsenate.
Keep a Material Safety Data Sheets (MSDS) for each chemical used on-site. Follow MSDS directions for specific chemicals.
Store chemicals in a secure, well-ventilated structure located away from sensitive water resources.
Maintain gasoline, motor oil, brake, and transmission fluid, solvents and other potentially hazardous chemicals in spill and fire-proof containers. Keep a spill containment kit readily available in the event of an emergency. Provide staff members with guidance documentation on how to use containment equipment. Post emergency contact information for reporting incidents to the appropriate authorities. 

Water Conservation & Irrigation

Golf course and park maintenance often requires large amounts of water for irrigation purposes. The biggest challenge of maintaining these recreational amenities is the constant need for hydration. Most turf grasses require quite a bit more water for their survival compared to other plants indigenous to the area. Additionally, manicured lawns consume large amounts of synthetic fertilizers, pesticides and other harsh chemicals that can contribute to nonpoint source pollution.

The following water conservation measures provide multiple benefits including reduced water use, decreased energy use (less pumping and treatment required), decreased stormwater and irrigation runoff, fewer lawn wastes, and lower maintenance costs.

Water Conservation and Irrigation Management Measures
Employ xeriscape methods—plant native trees and vegetation that can withstand local climate conditions and require little or no irrigation. Visit www.coastscapes.org for a list of native plants suitable for coastal Georgia.
Provide irrigation only on an as needed basis, especially during extended drought periods.
Harvest or collect water by cisterns, rain barrels or stormwater ponds and re-use (when possible) for landscaping irrigation.
Group plants with similar water needs to maximize irrigation.
Locate plants that require more water in lower elevations to make the most of rainwater naturally flowing to these areas.
Use bioretention areas or rain gardens which are depressed landscaped areas designed to capture stormwater. (See Ch. 3 for specific design guidelines for Bioretention Practices)
Consider evapotranspiration rates and weather conditions when scheduling irrigation. Schedule irrigation for specific early morning or evening hours to reduce water wasted due to evaporation.

Water Conservation and Irrigation Management Measures	
Use cycle and soak irrigation methods which improve infiltration, reduce runoff and achieve optimal growth by applying the right amount of water to the best location at the most favorable time.	
Use water-efficient irrigation methods such as low-precipitation sprinklers, bubbler, soaker, and drip systems that have uniform distribution patterns.	
Inspect, repair, and upgrade irrigation systems on a routine (scheduled) basis for optimal performance and efficiency.	
Equip irrigation systems with rain sensors to minimize inefficient use of water.	

RAINWATER HARVESTING

A 100-acre golf course can easily use over 100,000 gallons of water a day. Water usage can triple (300,000+ GPD) during periods of drought. Municipal water systems often place restrictions on supplies as wells can fluctuate depending on the amount of groundwater available. Usage restrictions, coupled with rising water prices, have lead golf courses to consider alternate solutions to supplement their existing irrigation systems. One logical practice is known as Rainwater Harvesting which involves simply catching the water we receive naturally from the sky. The most common way for golf courses to capture rainwater is with man-made collection ponds. Stormwater runoff captured in these ponds can then be filtered, pumped out and used for irrigating golf course greens. Rainwater can also be collected from rooftops and stored in underground cisterns or rain barrels for future uses (e.g. landscape irrigation, cart washing, etc.).

Wildlife Habitat

Golf courses, parks and trails serve as important recreational areas but also function as vital components of the Green Infrastructure system. "These connections are critical to maintaining the migration and biodiversity of wildlife populations. Links and hubs, when connected, serve as biological conduit for wildlife." (Benedict MA and McMahon ET, 2006.)

Recommended Wildlife Habitat Conservation Measures
 Preserve existing native trees and vegetation in three consecutive layers: herbaceous ground cover, shrub/sapling, and tree canopy. Maintain native trees and plants that provide food and shelter for wildlife. Trees and shrubs producing a variety of nuts and berries are preferred.
Maintain contiguous buffers for wildlife habitat—200' from major rivers, 50-100' from freshwater streams, 50'-100' from marshlands and 25-50' from interior forested wetlands.
Keep buffers in a natural state—selectively thin native trees and vegetation for scenic views and passive recreational purposes only.
Leave dead trees standing for bird-roosting habitat when they do not pose a safety hazard.
Maintain a water source for wildlife, especially shallow water with aquatic and emergent plants.
Remove trash and debris from natural areas when necessary.
Confine roads, cart paths, trails and necessary vegetation removal to the edges of existing natural areas to minimize habitat disturbance and fragmentation.
Locate and mark critical wildlife habitat on development plans. Post signage to designate natural areas and promote wildlife awareness. Construct wildlife structures that provide habitat (e.g. bird houses, osprey pads, eagle perches, etc.) 

Erosion Control

Coastal recreational developments are often built along rivers, creeks and beaches for accessibility and scenic views of these resources. Due to location and use, these developments can accelerate natural erosion or cause land loss in areas that were previously stable.

Erosion Prevention and Control Management Measures
Maintain thick, vegetated buffers along open waterways which stabilize the banks and prevent erosion. Buffer effectiveness increases as a function of width. Generally, the wider the buffer—the greater level of protection provided.
Establish and measure reference points along banks or slopes to track the rate of erosion.
Determine the cause of erosion and make adjustments as necessary to mitigate effects.
Cease or minimize man-made activities (e.g. direct stormwater discharge, boat/jet ski wakes, removal of riparian buffer) that can worsen or accelerate erosive conditions.
Stabilize eroded areas using environmentally-sensitive methods. See Chapter 4 for specific practices.

Audubon Cooperative Sanctuary Certification Program

The *Audubon Cooperative Sanctuary Program for Golf* (ACSP) is an award winning education and certification program that helps golf courses protect the environment and preserve the natural heritage of the game. As a cooperative effort between the *United States Golf Association (USGA)* and *Audubon International*, this program promotes ecologically sound land management and natural resource conservation strategies.

Membership includes a Guide to Environmental Stewardship and a Certification Handbook that helps golf course operators to plan, organize, and document environmental efforts. Golf courses work toward certificates of recognition in six categories:

Environmental Planning—Generate a written plan outlining goals, staff, budget, and schedule. The plan is a useful tool for golf establishments to monitor their progress in meeting their goals. *Audubon International* provides one-on-one assistance for devising an appropriate environmental plan.

Wildlife and Habitat Management—Management of non-play areas is crucial to providing habitat for wildlife on the golf course. Emphasis is placed on maintaining the best possible habitat for the course considering its location, size, layout, and type of property.

Outreach and Education—Gaining the support of golfers for an environmental program is an invaluable asset. Focus is placed upon generating public awareness through education.

Chemical Use Reduction and Safety—A comprehensive and responsible program to control pests will ensure a healthy environment for both people and wildlife. Managing turf areas with environmental sensitivity requires educating workers and members about plant management, pesticide application, and use of fertilizers.

Water Conservation—Consumption of water resources remains an issue at most golf courses. Attention is directed toward irrigation systems, recapturing and reuse of water sources, maintenance practices, and turfgrass selection.

Water Quality Management—Strategies are devised to monitor the use of chemicals and the impact on the water quality of adjacent waterways and wetlands.

By implementing and documenting environmental management practices in these areas, a golf course is eligible for designation as a Certified *Audubon Cooperative Sanctuary Golf Course*. The program has the potential to improve environmental performance and community relations, reduce liability, save money, and contribute to the conservation of environmental resources. Visit www.audubonintemational.org/acspgolf for more information.

Marine Facilities—Access to Coastal Waters

Historically, Georgians relied upon tidal waters to obtain food and shelter materials, transportation, maritime commerce, and military defense. Present day, more and more people make use of these areas for boating, swimming, nature observation, and other water-dependent recreational activities. Additionally, these areas are essential to the livelihood of the local shrimping, oystering, and fishing industries.

Marine facilities are used for residential, commercial and recreational purposes by visitors, local residents, businesses, and community members. While these facilities vary in location, size and use, they all present some degree of risk to the quality of surrounding water resources.

Marinas, docks, and piers occupy coastal waterways and extend across lands where the general public has certain rights to access and usage. Therefore in the interest of the present populace and future generations, federal, state, and local governments regulate activities within these areas.

Green Growth Guidelines (G3) promotes marine development and management strategies that protect environmental health, provide for safe navigation and access, as well as preserve the visual character of the area. The following sections of this chapter provide planning and design guidelines, construction practices, and management measures for new and existing marine developments.

Promoting Community Docks & Shared Access

In order to provide deepwater access to as many users as possible, developers and their design teams are encouraged to plan and construct community docks in lieu of multiple private-use docks. Community docks can be used by many properties within the development, not just the waterfront lots. This approach grants multiple users access, but does so with substantially less impacts to adjacent riparian buffers and salt marshes. This is mainly because there is only one point of access versus many walkways, decks, and floating docks. In addition to environmental benefits, community docks often cost less to build and maintain when compared to multiple private structures.

If a community facility is not feasible for a specific project, developers and landowners should at a minimum, consider joint-use docks where the structure can be shared by two or more properties.

The following table compares the impacts of private versus community docks for a planned development that contains 10 waterfront lots. The community dock alternative provides access and comparable mooring, but the overall area covered (impacted) by the structure is decreased by 86%.

Dock Component	Private Dock Size (Ft)	10 Private Docks Impact (SF)	Community Dock Size (Ft)	Community Dock Impact (SF)	Impact Reduction (%)
Walkway	6' x 500'	30,000	6' x 500'	3,000	-90%
Fixed Deck	15' x 20'	3,000	20' x 20'	400	-86.7%
Terminal Float	8' x 30'	2400	10' x 200'	2000	-16.7%
Boat Hoist	16' x 30'	4800	N/A	N/A	-100%
Total		40,200		5,400	-86.6%

Planning Marine Facilities

When planning a marine facility, benefits derived from the project should be weighed against potential negative impacts such as poor water quality, loss of wildlife habitat, and public inaccessibility. The main objective is to locate marine facilities in areas with the least impact to coastal waters and wetlands. Consideration of site conditions early in the development process will likely result in improved access, better ecological value and fewer water pollution problems. G3 focuses on wetland impact avoidance and minimization strategies which provides for better regulatory compliance and consequently, a more efficient permitting process.

The first, and perhaps the most important step in planning a marine development is the site selection process (i.e. find a site that lends itself to the project goals and objectives instead of force-fitting the development concept on the wrong site).

Site Selection

Prior to property acquisition, evaluate a proposed marine facility site based on the following criteria:
Find a site that is appropriately zoned and designated for marine structures and boating activities.
Consider previously-developed waterfront properties as opposed to natural (undisturbed) sites.
In lieu of multiple private-use docks, search for a site that can accommodate a community dock or marina which provides both neighborhood and public access. This approach maximizes user benefits, minimizes impacts to navigable waterways and tidal marshlands and in most cases, reduces construction and maintenance costs.
Check the surrounding area to see if other community docks or marinas are in close proximity to the prospective site and plan the capacity of the marine structure based on the actual need and demand for access. To avoid oversized and underutilized facilities, select a site that allows for future growth and expansion in a phased approach.

Prior to property acquisition, evaluate a proposed marine facility site based on the following criteria:
Search for, and select a site with physical characteristics compatible to the planned development requirements and objectives. The property should be suitable for the proposed marine facility, the type and size of vessels it will house, and possess adequate upland space for buildings and supporting infrastructure including necessary parking, fueling and sanitary facilities.
All marine structures serving boaters should be limited to waterways that are 20' or greater in width (measured at mean low water conditions). Avoid sites that require crossing over smaller tributaries (feeder creeks) to access deepwater.
Avoid sites that require long walkways (>500') over large expanses of vegetated marshlands to access navigable waters.
Ensure the site has adequate water depths to accommodate the proposed facility and anticipated watercraft without the need for sediment dredging. Additionally, avoid areas that are particularly susceptible to erosion and shoaling, as these conditions typically result in the need for continuous bank stabilization measures and/or maintenance dredging of waterbottoms.
Study the area to see if there are any geographical or man-made physical restrictions present (e.g. bridges, causeways, shoals, and other marine structures). If so, evaluate whether the proposed marine structure can operate at its fullest potential with these obstacles in the way.
Avoid areas where poor water quality conditions exist, especially listed degraded or impaired waterways. Check www.epa.gov or www.gaepd.org for a current list of these areas.
Do not site a marina near high-value natural resources such as oyster and clam beds. Give special consideration to FDA-regulated commercial and/or GDNR-approved recreational harvest areas (areas that meet the National Shellfish Sanitation Program criteria).

Preliminary Site Evaluation

The physical location and ecological characteristics of both the waterway itself and the nearby uplands is essential when planning a marine structure of any kind. Once a suitable site is selected, a preliminary evaluation of existing site conditions should be carried out to gain a general knowledge of the affected area.

The following basic information sources are readily available for planning purposes:
National Wetland Inventory Maps (U. S. Fish & Wildlife Service) www.fws.gov/wetlands
Topographic Maps (U.S. Geologic Survey) www.topomaps.usgs.gov/drg
Floodplain Maps (Federal Emergency Management Agency) www.msc.fema.gov
Navigational Charts (National Oceanic & Atmospheric Administration) www.nauticalcharts.noaa.gov/staff/chartspubs.html
Soil Surveys (U.S. Department of Agriculture) www.soils.usda.gov/survey
Water Quality—List of Impaired Waterways (Georgia DNR-Environmental Protection Division) www.georgiaepd.org/Documents/305b.html
Georgia Coastal Hazards Portal—Sea Level Rise, Shoreline Change, Storm Surge (NOAA Coastal Services Center, UGA Skidaway Institute of Oceanography) gchp.skio.usg.edu
Heritage Preserve Areas near Wildlife Management Areas www.georgiawildlife.org
Designated FDA Shellfish Harvest Areas www.coastaldnr.org/maps
See Appendix B for an expanded list of available site assessment resources

Assessments and Surveys

Compared to upland developments, water-dependent projects require additional consideration and evaluation due to the location of construction within environmentally-sensitive areas.

The following surveys and assessments are essential to identifying and addressing potential concerns during the initial planning phase of the development process:
Property survey showing legal boundaries (extended to show riparian access as designated and/or approved by Georgia Department of Natural Resources).
Limits of existing riparian buffers. Estimate the percent coverage of trees, shrubs and plants within buffer areas. Note old-growth specimens as well as rare, threatened or endangered species.
Bathymetry survey showing underwater relief (contour lines) and water depths (soundings). Note proximity to any known Designated FDA Shellfish Harvest Areas.
Width and depth of the waterway at mean high and low tidal stages. Note: The limit of the navigable channel is generally measured as the distance between the mean low water (MLW) lines on both sides of the waterway. Width and depth of tributaries located in the pathway of the proposed structure.
Direction and rate of water currents. If tidal, indicate ebb and flow patterns.
Spot elevations (measured in feet above mean sea level) showing extent of notable intertidal areas—mud flats, shoals, vegetated marshlands, and top and toe of bank slopes. Record location and extent of erosion, if present.
Location of adjacent docks, bridges, or other navigational obstructions or restrictions.
Survey of significant trees located on upland portion of site.
Topographic Survey—Ground elevations (height above mean sea level) of upland and wetland portions of the site. Include height of tidal vegetation in bloom.
Jurisdictional boundaries of salt marshes, freshwater wetlands and shore protection areas (as approved by the U.S. Army Corps of Engineers and/or Georgia Department of Natural Resources).
Drainage features including any tidally-influenced tributaries, ditches, ponds or lagoons.

Jurisdictional Wetland Delineations

If geographic conditions are favorable for marine development, a survey of actual site conditions should be conducted. The delineation process involves the marking and surveying of the boundary between the wetland and upland portions of the site. Wetlands are determined based on three main factors: hydric soils, native wetland vegetation and local hydrology. These conditions are different for each individual site. All wetland delineations should be performed by a qualified professional scientist and verified by the appropriate regulatory agencies. Delineations may vary by resource type (i.e. fresh vs. tidal vegetated wetlands, navigable waterways, and shorelines).

Navigable waterways and freshwater wetlands are under the regulatory jurisdiction of the U.S. Army Corps of Engineers whereas the Georgia Department of Natural Resources generally oversees activities within tidally-influenced waters, wetlands and shorelines. Proposed marine developments must be reviewed and approved by the appropriate authorities before any work can be performed in or around these protected areas.

Sea Level Rise, Storm Surge & Flooding

Georgia, in particular, is vulnerable to sea level rise impacts due to its more than 2,300 miles of tidally influenced shoreline and growing population which now exceeds 500,000 people in outermost six coastal counties (Concannon et al 2010; U.S. Census 2010).

To help developers, designers, natural resource managers, and landowners, the *Skidaway Institute of Oceanography* developed a web-based interactive map that displays information about sea level rise, shoreline change, storm surge, FEMA flood zones, historical hurricane tracks, land use/cover, and armored shorelines. The **Georgia Coastal Hazard Portal** (www.gchp.skio.usg.edu) is a user-friendly decision-support aid that can be used to evaluate how sea level rise and erosion may affect properties along coastal marshlands and waterways. Additional community maps and visuals are available at *NOAA Coastal Services Center's* website www.csc.noaa.gov/slr.

Designing Marine Facilities

By knowing and understanding the existing features of the site, the proposed marine structure can be designed within the constraints of the natural landform. Designing with nature, instead of against it, helps to protect and sustain vital ecosystems and the complimentary benefits they provide (e.g. storm surge protection, ecotourism, commercial fisheries, etc.)

The main objective during the design phase of the project is to minimize or reduce the cumulative impacts of the proposed marine structure on waterways and wetlands. Location, size, and use of the facility are major factors to consider, as well as the appropriateness of the structure given the physical and ecological characteristics of the site.

Marine Design Guidelines
Once the actual need for, and intended use of the structure is established, design the structure's capacity based on the demand for access at the time with an incremental projection for growth based on trend patterns from the surrounding area (i.e. Maximize usage and then employ a phased approach to expansion).
Position, size, and configure the structure based on the geographic features of the site, normal navigation patterns in the area, and the size of watercraft likely to use the facility.
To maximize the use of the docks, provide temporary mooring on a first-come, first-serve basis instead of permanent mooring designations. Design dry stack boat storage in a designated upland location to reduce in-water mooring.
In lieu of multiple private-use structures on smaller creeks; design public, community or joint-use docks on larger waterways, that are more amenable to recreational boating activities.
Locate the structure in the most practical and least environmentally-damaging area of the site. For example, locate the access walkway in a previously disturbed portion of the riparian buffer and over the shortest expanse of vegetated marshlands.
Reduce or compact the total size of the structure over tidal waters, especially the access walkway which typically crosses vegetated marshlands to access deepwater. Locate only water-dependent structures over jurisdictional wetlands and waterways.
Do not locate marinas or community docks in areas with degraded or impaired water quality conditions as these waters generally lack the carrying capacity to endure additional boating activities.

Marine Design Guidelines
Maintain continuous buffers along aquatic resources. G3 recommends 200' from major rivers, 100' from streams and tributaries, and 50-100' from marshlands and estuaries.
Avoid direct stormwater discharge, instead provide for upland detention and treatment of potentially polluted runoff before it reaches nearby waterbodies.
As an alternative to hard-armoring the banks of the waterway, use non-invasive techniques that control erosion and provide valuable habitat for aquatic and terrestrial species. See Ch. 4 for specific Streambank & Shoreline Stabilization Practices
Locate supporting infrastructure (parking, pumpout facilities, septic systems, fuel tanks, etc.) landward of the protective wetland buffer. Vehicular access within the buffer is not allowed, unless this activity is dependent on water access.

Navigational Access

Marine structures, regardless of the type, should not alter natural water flow patterns or interfere with existing navigational access in the area.

Apply the following design guidelines for safe navigational access:
The structure should be sited in a location with navigable water depths to avoid initial and maintenance dredging activities.
The proposed facility should not extend more than one-quarter to one-third the width of the navigable channel (measured from one side of the waterway to the other side at mean low water).
All marine structures serving boaters should be limited to waterways that are a minimum of 20' wide (at mean low tide conditions).
Locate the structure in an area with sufficient water depths to avoid floating docks and boats resting on the creek bottom, tidal flats, or marshlands during low tides.
All support piling/piers should be positioned to allow for free water movement beneath the structure. The horizontal bracing should be placed above the mean high tide line so that floating plant debris or "wracks" can easily pass below the support members of the structure.
The facility design should account for normal water currents and tidal conditions (daily ebb and flow cycles).
Avoid designing marinas with breakwater walls or enclosures as these structures interfere with natural water circulation and flow-through currents.
The proposed structure should not cross over tributaries and creeks used by small boats or non-motorized watercraft (e.g. canoes or kayaks). The alignment of the proposed facility should be adjusted as necessary to avoid blocking these waterways. If complete avoidance is impractical, the fixed walkway should span over the tributary and have a minimum clearance of 6' at high tide to ensure future passage beneath the structure.
For ease of construction, navigation and future maintenance, a 20-25' distance from the property line (or combined distance of 40-50' between docks) is recommended for marinas and community docks. For smaller private recreational docks, a 10-15' distance from the property line (combined distance of 20-30' between docks) should be sufficient.

Riparian Buffers & Setbacks

A key element to the design of a green marine development is the incorporation of an adequate protective buffer along the water's edge. This forested/vegetated area intercepts and treats stormwater runoff from nearby uplands, protects against erosion, and offers wildlife habitat to a host of terrestrial and aquatic species. In addition, buildings and supporting infrastructure should be located a safe distance away from rivers, streams, and wetlands for added resiliency against coastal hazards such as flooding, storm surge, and sea level rise.

Georgia has a number of laws and regulations that apply to riparian buffers, thus the required minimum buffer width can vary from property to property.

- The Georgia Erosion and Sedimentation Control Act restricts land disturbance and trimming of vegetation within 25' of creeks, streams, rivers, saltwater marshes, and most lakes and ponds, and within 50' of trout streams.
- The Mountain and River Corridors Protection Act and the Georgia Planning Act require some local governments to adopt a 100' buffer and restrict certain land uses along various large river corridors in the state.
- Water supply reservoirs, streams that flow into reservoirs, and streams above drinking water intakes may also require wider protective buffers. As of 2012, the State requires all water supply watersheds provide a 100' buffer along tributaries within a 7-mile radius of a public water intake. Additionally, impervious surfaces, septic tanks and drain fields must be setback a minimum of 150'. Water supply watersheds less than 100 square miles must have a 50' riparian buffer and a 75' setback for impervious surfaces, septic tanks and drain fields.

In addition to State requirements, many local governments have adopted more stringent ordinances regulating riparian buffers and building setbacks. Contact the local planning and zoning department for specific requirements in your area.

While there is general agreement about the benefits of buffers—the specific design criteria, such as buffer width, types of vegetation, and management—are the subjects of considerable debate. Width is considered the most important variable when determining the effectiveness of buffers in reducing pollutants and protecting stream health. In the interest of water quality, flood protection, and wildlife habitat, G3 encourages developers and landowners meet or exceed regulatory standards when possible.

G3 Riparian Buffer Width Recommendations	
Buffer Type	**Preferred Width (ft)**
Major Rivers & Streams	200’
Freshwater Tributaries & Streams	50-100’
Tidal Marshes & Waters	50-100’
Forested Wetlands	25-50’

Additionally, the actual composition and makeup of the buffer has the potential to enhance normal functions. In order to support a broad range of wildlife, riparian buffers should be left in a natural state or restored with native trees, shrubs, and herbaceous plants. An overall goal is to retain at least 50% of the total site as green space (including protective buffers) and maintain a minimum of 75% of this green space as natural area with indigenous vegetation. Selectively prune or trim foliage within protective buffers only when necessary for access or scenic views.

Often, marinas and commercial docks must clear the buffer for normal water-dependent operations. In this case, utilize buffer averaging to mitigate the loss of a fully-functional, natural buffer.

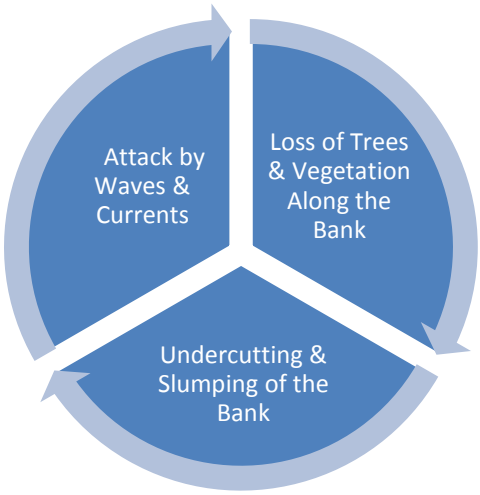
Wildlife Habitat

The Georgia coast features some of the most biologically-productive ecosystems in the world—a labyrinth of freshwater, brackish and salt-water rivers, streams and estuaries bordered by maritime forest—offering habitat to a variety of unique plant and animal communities. More than 70% of the State's most-important recreational and commercial fishes, crustaceans and shellfish depend solely on these areas for their survival.

In an effort to sustain the health and function of these essential coastal resources, marine developments should be planned and designed to coexist with terrestrial and aquatic wildlife. During the planning phase of the development, the design team is encouraged to collect important ecological information from existing data sources, field surveys, and visual observations.

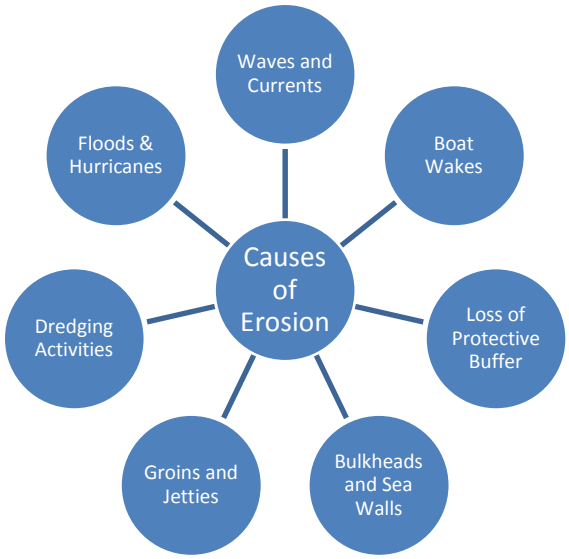
Relevant ecological information sources and recommended field observations:
Review aerial photography, maps, and previous habitat surveys of the immediate area.
Inspect federal, state, and local flora and fauna lists and maps to determine if rare, threatened or endangered species are supported by on-site habitat. If these species are present, devise a plan to preserve these critical areas.
Contact the US Fish & Wildlife Service, National Marine & Fisheries Service, Georgia Department of Natural Resources Wildlife Resources Division and the Georgia Natural Heritage Program to obtain lists, maps, and database information regarding critical habitat.
Consider the geographic location and historical uses of the area.
Identify designated wildlife management areas (WMA) in close proximity of the proposed development.
Classify substrate, vegetation types, and salinity regime to determine potential habitat suitability.
Identify and survey FDA-designated shellfish harvest areas in the project area. Maintain a minimum distance of 1000' from active harvest areas to allow natural growth and propagation.
Maintain sufficient vegetated buffers along water bodies and wetlands that can be used by a diverse population of resident and transient species.

Stream Bank & Shoreline Erosion



Erosion and sedimentation (the removal and deposition of sediments) are natural occurrences; however human activities as well as natural disasters can alter the normal balance of these processes resulting in degraded water quality, impeded navigation and ultimately, the physical loss of waterfront property.

When planning a marine facility, the site should be checked for signs of past or present erosion. If shoreline or streambank erosion is visually observed, the extent of erosion should be quantified prior to the selection of an appropriate stabilization method. An easy, relatively inexpensive way to accomplish this is to establish reference points (metal or wooden stakes installed on the uplands parallel to the eroded banks). The distance between the reference markers and the eroded streambank or shoreline can be measured over time to determine the general rate of erosion.



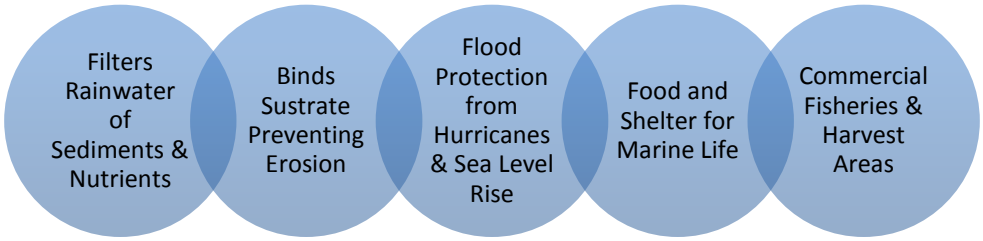
Based on the extent of erosion in the project area, the marine structure's location and configuration may need to be adjusted to prevent further erosion and possible structural failure. In addition to preventive measures, control strategies may also be warranted.

The use of hard-armored solutions—such as concrete lining or vertical bulkheads—are discouraged as these methods lack wildlife habitat value and typically alter the local hydrology and hydraulics in the area which can lead to erosion upstream or downstream of the structure. Additionally, vertical bulkheads prohibit the accretion of sediments and establishment of vegetation which provides long-term stability of the bank slope. For these reasons, G3 recommends the use of multi-functional techniques to control erosion and provide ecological benefits (See Chapter 4 for Streambank & Shoreline Stabilization Practices).

Planning & Design Guidelines for Streambank and Shoreline Erosion
Consider existing conditions when selecting the appropriate stabilization method: • slope • flow rate • water currents • tide cycle • rate of erosion • substrate properties • exposure to waves, boat wakes, flooding, and storm surge
For gently-sloping stream banks, use native vegetation to slow stormwater runoff and bind the surface together (e.g. pole plantings, brush layering, brush trenches, etc.).
For low-velocity streams, use biodegradable or synthetic materials (coir mats, filter fabrics, geo-grids/matrices) that holds soils in place and allows for the re-establishment of vegetation.
Use non-invasive structural means such as vegetated gabions or crib walls for moderate to high-velocity waters.
For tidally-influenced waters, implement "living shorelines" which is a combination of structural and organic materials (e.g. oyster shells, coir rolls, and gabions) that become naturally colonized with oysters, crabs, shrimp and fish larvae over time.

Shading Impacts

Freshwater & Tidal Vegetation



Coastal salt marshes, freshwater estuaries, swamps, and bogs provide a wide array of free ecosystem services and benefits.

Coastal marshlands are highly susceptible to impacts caused by routine access to navigable waters. Access walkways and fixed decks can prevent sunlight from reaching beneath the structure which can potentially damage or even destroy essential wetland vegetation.

Below are various strategies that can be employed to lessen the shading effects of access walkways:
Design elevated access walkways to extend the shortest distance over vegetated marshlands.
If possible, position the walkway in a north-south orientation for maximum sunlight exposure.
All floating portions of the facility, with exception of the walkway, should be positioned over open water. Observation decks and other non-water dependent structures must be located on available uplands.
The access walkway should be designed a minimum height of 3’ above native vegetation (measured in bloom stage).
Limit the width of the walkway to 6’ for community dock and marinas and 3-4’ for joint or private use structures.
Consider the use of alternative decking materials such as metal, aluminum or composite grating with holes or perforations that allow sunlight through the structure.
Space deck boards to permit light penetration beneath walkway.

Sand Dunes

Sand dunes are constantly forming and simultaneously eroding depending on wind, waves, currents, sand supply, and sea level. In addition to geologic conditions, man-made activities can also dramatically affect the sand-sharing system. Sea oats, the dominant grass on sand dunes, as well as other shrubs and plants can be shaded by elevated dune walkways (e.g. crossovers) used to gain access to the beach and ocean.

The following design recommendations will help to reduce shading impacts caused by dune access walkways:
Design a crossover structure that is elevated (supported by pilings) above the dune system. At-grade pedestrian pathways are discouraged due to the impacts caused by continuous foot traffic.
Use existing nearby public access points. If public access in unavailable, consider designing a crossover that can be used by the community, or at a minimum, several adjacent properties.
Beach crossovers must be designed for access purposes only. Viewing platforms and other non-access related structures should be located on available uplands, not over the dynamic dune system.
Crossovers should be located a minimum of 50’ away from adjacent crossovers or joint usage of the existing crossover must be explored as a viable option.
Design the crossover to span the shortest distance over the sand dunes. When possible, adjust the structure’s location so to avoid passing over the peak (or crest) of the dunes.
The structure should be at least 3’ above the existing ground elevation of the dunes/dune field, plus an additional 1’ minimum height above existing mature vegetation, if present.
The crossover should commence at the landward toe of the landward most dunes and terminate at the seaward toe of the most seaward dune.
The structure should be constructed of sturdy construction materials capable of withstanding hurricane-force winds and storm surge, but also easily modified to accommodate changes in the beach-dune system. Select construction materials that are resilient, but temporary in nature (e.g. wood and composite products as opposed to concrete and steel).

The following design recommendations will help to reduce shading impacts caused by dune access walkways:
The crossover should not encroach seaward of the ordinary high water line in the active intertidal beach. If the beach erodes in this area and the structure is seaward of the high water line, the crossover should be moved back to dry sand. Therefore, in rapidly eroding areas, the rate of erosion is necessary for proper design and maintenance.
For crossovers that do not require handicap access, decrease the width of the walkway to 3-4'.
Selectively clear no more than 6" of vegetation on either side of the crossover. If necessary, prune trees, shrubs, and plants to allow for scenic vistas (i.e. selective lines of sight through thick vegetation).

Impervious Surfaces & Stormwater Runoff

Coastal wetlands and waterways can be dramatically affected by the addition of stormwater runoff from adjacent, developed uplands. Research has shown a direct link between impervious surface cover and the water quality of nearby surface waters. The amount of impervious surface area covering the site controls the volume and rate by which stormwater reaches receiving water bodies.

Runoff from parking areas, repair yards, and access roads can carry nutrients, metals, suspended solids, hydrocarbons, and other potentially harmful pollutants into marina basins. Direct discharge to wetlands, marshes, and open waters should be avoided or minimized to the greatest extent possible by implementing low impact development practices that capture and filter stormwater using native vegetation and soils. See Chapter 3 for more information on various stormwater management practices.

The following standards should be applied to the upland component of marinas and community docks:
Reduce effective impervious cover to 15% as required by current regulations (G3 recommends 10% or less). Visit www.coastalgadnr.org/pe/eic to calculate the effective impervious cover for your particular project.
Use pervious surfaces for low traffic access roads, parking, boat storage, and sidewalks. While pervious materials often cost more during construction, these materials allow for natural infiltration of stormwater which reduces the costs of conventional stormwater controls (e.g. curb and gutter, concrete pipes, and storm drains).
Use biorention areas to collect and control stormwater. Design forebays or sediment catch basins that can be easily cleaned and maintained over time (See Ch. 3 for Stormwater Practices).
Add filters/screens, absorbents, separators, and other proprietary technologies to storm inlets or outfalls to trap and contain oils, trash, coarse sediments, and other debris.
Locate boat cleaning and maintenance stations away from open waters.
Design vegetated filter strips between impervious areas and riparian buffers for the purpose of intercepting runoff from adjacent developed uplands (i.e. overland sheet flow).

Supporting Infrastructure

In addition to the in-water portion of the project, marine facilities often include a network of supporting infrastructure located on the adjacent mainland. This area, commonly referred to as the "service area", contains accessory buildings, restrooms, roads, parking, dry boat storage, as well as fuel, sewage, water, and electrical utilities.

Supporting Infrastructure Design Guidelines
All non-water dependent structures (e.g. restrooms, fish cleaning stations, observation decks) should be located away from wetlands and waterways.
The overall disturbed footprint of necessary buildings, roads, and parking should be minimized to the greatest extent possible.
Use pervious surfaces for roads, parking, and boat storage areas.
Provide adequate parking spaces proportionate to the number of slips offered by the facility (e.g. maximum of one space for every slip as well as shared visitor parking).
Fish cleaning stations must be located on available uplands, not over marsh or open waters. Cleaning stations should be equipped with grinders capable of breaking down fish waste and connected to municipal sanitary waste systems for proper disposal.
Fuel lines, sewage pipes, and electrical lines should be bundled and secured beneath the decking of the marine structure. Utilities beneath marine structures or buried underground in adjacent uplands should be encapsulated to prevent leaks or spills into open waters or wetlands.
Locate boat fueling station in a protected area of the marina to reduce exposure to passing boat traffic, storm surge, etc.
Design fuel pump dispensing nozzles and storage tanks with an automatic closing device. Open-latch or holding clip devices are prohibited.

Sanitary Waste Disposal

Untreated or minimally-treated human waste from boats and septic systems can overload waterways and lead to local water quality problems. Excessive nutrients in waste stimulates algal growth which lowers oxygen levels in the water and often results in fish kills. Even worse, bacteria, viruses, and protozoa in contaminated water, fish, and shellfish pose a serious threat to human health if contacted or consumed.

Sanitary Waste Disposal Design Recommendations
Marinas and community docks should provide on-shore restrooms, pumpout facilities, and dump stations to prevent boaters from discharging sanitary waste into State waters.
Consider existing available services in the area (offered by nearby marine facilities) when designing the type and capacity of the pumpout/dump stations needed at your marina or community dock.
Estimate the average number, size, and type of boats to select the type of sanitary waste system that fits the needs of permanent and transient customers. If the marina will service smaller boats without holding tanks, install a portable marine toilet dump station. Larger boats with holding tanks require access to a permanent pumpout station.
Pumpouts and dump stations should be strategically located in an area that allows for safe and convenient use, as well as efficient cleanout and maintenance.
To offset the cost of installation and operation, consider allowing public access to disposal facilities for a reasonable cost.
For portable pumpout stations with above-ground storage tanks, design a concrete pad with walls to contain accidental leaks or spills.
Restrooms should be located on the upland portion of the site and connected to a municipal sewage system if possible.
Avoid the use of septic tanks and drain fields near sensitive water resources. If septic systems are the only sanitary option available, locate tanks and drain fields a minimum of 100’ away from open waters and wetlands.
Design upland fish cleaning stations to dispose of fish waste from commercial and sports fishing. Equip the station with a grinder capable of breaking down fish skeletons and connect to the municipal sanitary sewer system when possible.

Clean Vessel Act Grant Program

The *Clean Vessel Act Grant Program* provides funding for the construction, renovation, operation, and maintenance of pumpout stations and waste reception facilities for recreational boaters. Additionally, funds are used to inform boaters about the use, benefits, and availability of these facilities in the area. The grant program funds 75% of the total project cost—including new equipment, the renovation/upgrade of existing equipment, as well as necessary pumps, piping, lift stations, on-site holding tanks, pier or dock modifications, signs, permits, and other miscellaneous equipment needed for a complete and efficient station. The grant recipient is responsible for at least 25% of the installed costs (25% match can be cash, the fair market value of any labor or materials provided, or a combination thereof).

For more information on this program, please visit www.coastalgadnr.org/pumpout or contact GDNR @ (912) 280-6926.

Construction Practices for Marine Developments

Special protective measures should be taken when building in close proximity to sensitive water resources. Typical construction activities—clearing, grading, filling, and excavating on adjacent uplands—can cause soil erosion, disturb wildlife habitat, and degrade water quality. In addition, marine structures themselves can be constructed of materials treated with substances that can potentially contaminate surrounding waterways.

Recommended Marine Construction Practices
Heavy equipment used to install docks and piers should be staged on available uplands, on the completed portion of the structure, or on a floating platform or barge. If heavy equipment must go over marshlands, mud flats or the banks of the waterway, it should be done so using specially-designed construction matting to minimize substrate compaction and permanent damage to marsh vegetation. The size of the mats and duration of use should be reduced to the greatest extent possible.
Floating vessels and barges loaded with construction equipment and materials should remain floating even during low tide conditions.
For navigational safety, construction equipment on floating barges must remain landward of the terminal end of the proposed facility.
Use previously disturbed or cleared areas of vegetative buffer for construction access. If buffer is undisturbed, clear only what is necessary for safe passage of equipment.
Construct the facility in the least invasive manner possible by maintaining pre-construction topographical and hydrological conditions. Construction activities should not alter the existing elevation of the marsh or waterbottom or change the natural water patterns in the area.
Implement proper soil erosion and sedimentation control practices to prevent and manage temporary effects of land-disturbing activities on uplands adjacent to coastal waters. See Manual for Erosion & Sediment Control in Georgia (a.k.a the Green Book). Free digital copies are available @ http://gaswcc.georgia.gov/manual-erosion-and-sediment-control-georgia.
Avoid the use of potentially hazardous materials—wood preserved with copper chromate arsenic (CCA), creosote and polystyrene/styrofoam products. Alternatively, use enviro-safe materials such as pressure treated lumber, concrete or recycled plastics. There are several arsenic-free wood treatments approved for marine use including Ammoniacial Copper

Recommended Marine Construction Practices
Quaternary (ACQ) or "Kodiak Wood", Copper Azole, Copper Dimethyldithiocarbamate, Copper Citrate, Copper Boron Azole, Copper 8 Quinolinate, Borate-based Products.
Implement pile driving techniques that minimize impacts to submerged vegetation and bottom sediments (e.g. Sharpen pile ends to facilitate installation or if pile jetting technique is used, opt for less disruptive, low-pressure methods).
Take special care to avoid impacts to shellfish harvest areas and essential fish nurseries.
Implement a *Species Awareness Program* for the education and training of construction supervisors and personnel. The program should provide essential information regarding plants and animals that inhabit the area and best management practices that avoid or at least minimize the negative effects to these creatures and their habitat. This information should be posted in a highly visible area of the construction site. Contact GDNR-Wildlife Resources Division 912-264-7218 for more information.

Management Measures for Marine Developments

To effectively protect water resources over the long term, environmental management measures should be taken to control nonpoint source pollution associated with marine developments and recreational activities.

The following sections provide operations and maintenance practices for marinas and community docks that when properly implemented can result in multiple benefits including:

- Sustained wildlife habitat
- Acceptable water quality conditions
- Reduced human health risks
- More attractive to customers
- More effective work procedures and reduced operational costs
- Better employee awareness of environmental issues
- Enhanced positive image with the community and regulating authorities
- Recognition for good practices

Environmental Management Plan (EMP)

Depending on the size and uses of the facility, an *Environmental Management Plan* or EMP should be established. The EMP helps marinas meet environmental goals and keep track of management activities. It also documents key information including environmental policies, responsibilities, applicable standard operating procedures, best management practices, reports, communication, training, monitoring, and corrective actions.

EMP Development Process

To effectively develop an EMP, one must have an understanding of potential pollution sources at the marina, the physical characteristics of the site, and the specific needs of customers and their boats. The following information is necessary when developing a functional EMP for the site:

- Site Plan showing property boundary, limits of jurisdictional areas, topography, trees, and bathymetry (underwater contours of the water body).
- Facility use (boating, fishing, kayaking, wildlife observation, etc.)
- Facility capacity and services (Wet slips, dry storage, average boat size and mooring duration, total number of boaters, average vacancy, hoist capacity, fueling and pumpout amenities, community/public accessibility).

Georgia Clean Marina Program

The *Georgia Clean Marina Program* was developed by the *Georgia Department of Natural Resources* in collaboration with the *Georgia Marine Association* to recognize marinas that reduce or eliminate the sources and effects of associated water pollution. All marinas that create and properly carry out an Environmental Management Plan (EMP) may be eligible for certification through the program.

Environmental management is easier if the marine facility has a specific plan. The EMP helps implement and track environmental management activities in a more organized and streamlined manner. The *Clean Marina Program* assists marina owners with the development and implementation of an EMP customized to fit the needs of that particular marine facility.

For more information on the program visit www.uga.edu/cleanmarina/.

Water Quality Monitoring

To ensure applicable standards are met, prepare and implement a water quality monitoring program to include the following steps:
Collect and review regional and local water quality data and maps.
Observe and record existing site conditions on a frequent, routine basis. Record any unusual occurrences—strong odors, algal blooms, surface sheens or slicks, etc.
Collect representative water samples and test for basic water quality parameters—dissolved oxygen, temperature, pH, turbidity, and fecal coliform.
For calibrated results, compare samples taken within the limits of the marina to healthy reference waterways in the area.
If problems exist (visible signs of stress and/or irregular test results), increase the frequency and intensity of monitoring events in an effort to find the source of the problem. Once identified, prepare a corrective action plan to address the issue(s). Any activities found to be directly or indirectly linked to degraded water conditions should be discontinued and/or modified to rectify adverse effects.

Riparian Buffers

The following management measures are recommended for marinas and community docks:
G3 recommends wider riparian buffers to increase effectiveness. Maintain 200' along major rivers, 100' from rivers and streams, 50-100' from tidal marshlands, and 25-50' from forested interior wetlands.
Maintain a minimum of 75% of the buffer in its natural state (i.e. preserved native trees, shrubs and plants).
Restore previously disturbed buffers with indigenous trees, shrubs, and plants. Select species that require little to no irrigation, fertilizers, or pesticides.
Preserve existing native trees and vegetation in three consecutive layers (herbaceous-ground cover, shrub-sapling, and tree canopy).
Maintain trees and plants that provide food and shelter for wildlife. Visit www.coastscapes.org for a list of species suitable for your area.
Avoid clearing riparian buffers for scenic views. Viewsheds or observation corridors can be accomplished by selectively pruning and trimming vegetation in the preferred line of site. (See Ch. 2 Riparian Buffers)
Place the buffer in conservation easement or under restrictive covenants for long-term protection.
Plant native plants or grasses between impervious areas and open waters. These vegetated strips intercept and filter stormwater increasing the effectiveness of the riparian buffer.
Implement low impact stormwater practices in combination with protective buffers for enhanced water quality and overbank flood protection. (See Ch. 3 for recommended practices)

Wildlife Habitat

The following management measures should be put into place to protect wildlife habitat:
Use rapid bio-assessment techniques to monitor existing ecological conditions.
Establish a *Species Awareness Program* to educate staff members and boaters on threatened and endangered species as well as common species of concern. Make special provisions to protect these sensitive resources—prepare and disseminate brochures or post signs to increase awareness.
Establish and enforce "no wake" zones for manatees, dolphins, sea turtles and other susceptible species.
Keep area free of trash, especially fishing line and hooks which can injure marine life.
Avoid excessively bright lighting on marine structures as this can change normal behavior patterns of wildlife in the area. Limit brightness to a threshold required for safe pedestrian access and/or navigation. Reflective markers and signs can also assist with illuminating the structure.
Disallow marine users from throwing excess food, fish waste or bait near the marina as this attracts birds, fish and other animals which pose a hazard to wildlife and boaters alike.
If maintenance dredging activities (removal of waterbottom sediments) are necessary for navigation purposes, schedule event outside of active biological periods, typically March through December in coastal Georgia.

Erosion Control

Implement the following management measures to control erosion along the water's edge:
Establish a monitoring plan to establish the rate and extent of erosion.
Identify activities that contribute to or accelerate bank erosion in the immediate area and cease or minimize such activities to the greatest extent possible.
For minor to moderate erosion, apply bioengineered solutions such as sloping and grading the banks to a stable angle, adding organic topsoil and mulch, and planting with native trees, shrubs and vegetation.
Maintain natural vegetated buffers or restore areas previously disturbed.
Use bioengineered bank stabilization techniques such as fiber mats and rolls, geo-grids and matrices, cribwalls and gabions to hold the soil in place so vegetation can become re-established. (See Chapter 4 for details)
Establish and enforce "no wake" zones to control erosion caused by boat and jet ski traffic.

Fueling Operations & Storage

The following management measures can help marina operators avoid or reduce petroleum spillage and subsequent costs of cleanup and fines:
Locate boat fueling stations in a protected area of the marina to reduce exposure to passing boat traffic, storm surge, etc.
Store spill containment equipment and supplies such as booms and absorbent pads in close proximity to the fuel dock for immediate access in case of an incidental drips, spills, and overflow.
Provide emergency procedures and contact information in the event of a fire and/or explosion. Locate fire extinguishers a minimum of 100' from each pump, dispenser, and pier-mounted liquid storage tank (As per NFPA 30A, Section 10-4:7).
Install dispensing nozzles equipped with automatic-closing devices (open-latch or holding clip devices are prohibited). Additionally, fuel pumps and storage tanks should be fitted with shutoff valves that can be manually controlled in the event of an emergency.
Regularly inspect, repair, and replace leaking or damaged fuel hoses, pipes and tanks.
Full-service stations should be attended by trained employees capable of dealing with normal fueling operations as well as emergency situations. Staff should be trained in spill prevention, containment, and cleanup procedures as per HAZWOPER Protocol.
Self-service stations should have signs posted in the dispensing area that provide boaters with instructions for proper fueling procedures, spill prevention, and containment measures as well as first responder contact information in the event of an emergency.
Provide spill prevention/containment supplies such as vent line whistles, vent cups, oil absorbent collars, pillows, etc. in the marina store.
The discharge of bilge water mixed with gas and oil is strictly prohibited. Use vacuum-type systems to change oil and suction potentially contaminated water from bilge compartments.
Prohibit the use of detergent bilge cleaners. Instead, promote the use of materials that capture and digest oil in bilges. Encourage boaters to use bilge socks, pads, or pillows to absorb oil and fuel from bilge compartments.

If aboveground petroleum storage volume is greater than 1,320 gallons or underground storage is more than 42,000 gallons, a site-specific Spill Prevention, Control and Countermeasure (SPCC) Plan may be required (40 CFR 112).

Solid & Liquid Waste

Marine facilities, especially full-service marinas and community docks produce solid and liquid wastes, that if released are harmful to the surrounding environment. A customized solid/liquid waste management plan should be developed to fit the specific needs of the facility to protect against nonpoint source pollution.

Solid & Liquid Waste Management Measures
Install and maintain suitable containers for trash cans, dumpsters, and other receptacles as required by the *Act to Prevent Pollution of Ships* 33 (USCA 1901 & CFR 158).
Identify trash receptacles with signs encouraging boaters to properly discard their waste. If possible, supply trash bags as a free amenity to ensure a clean marina.
Provide trash receptacles with lids. Secure containers so wind and animals cannot cause spills.
Locate trash dumpster(s) away from open waters. Construct containment berms/barriers around dumpsters and liquid storage tanks to control potentially harmful leachate from reaching nearby waterways.
Locate hazardous liquids or solid materials away from areas subject to flooding or high winds.
Store all hazardous waste materials as per *OSHA RCRA Hazardous Waste Regulations*.
Encourage boaters and marina employees to recycle potentially hazardous substances such as antifreeze, lead batteries, kerosene, mineral spirits, gasoline, engine oil, transmission fluid, scrap metals, and some water-based paints and solvents. Provide separate, clearly labeled, containers for the disposal or recycling of liquid wastes.
Prepare a site-specific plan for proper handling, disposal, and spill procedures for hazardous substances typically found around marine developments.
Keep spill response equipment and emergency protocol on-site. Post signs to inform boaters and staff members of emergency procedures.
Hire a hazardous waste hauler to collect and dispose of the following: aerosol cans, paint cans, gasoline, glue and other liquid adhesives, oil filters, paints and varnishes, pesticides, pressure washing residue, paint chips and sanding/scraping debris, resins and bilge absorbent pads.

Sanitary Waste

Sanitary Waste Management Measures
Post signs strictly prohibiting boaters from discharging sanitary waste, bilge water, or gray water into surface waters or wetlands.
Provide pumpout service at a reasonable cost to encourage use and allow for public access to help defray the expense of operation. If pumpout facilities are open to the public, your marina may qualify for a grant that pays up to 75% of the cost of installing, operating and maintaining the facility. For more information on the *Clean Vessel Act Grant Program*, contact GDNR @ (912) 280-6926 or visit www.coastalgadnr.org/pumpout.
Clearly identify pumpout/dump station(s) with signage that instructs boaters on how to use the facility properly. Provide an emergency contact number for accidental spills or leaks.
Develop a contingency plan in the event of a sewage leak or spill. Inform staff and boat owners to report emergencies immediately. Provide a main point of contact to avoid confusion or delays in cleanup response.
Remove waste from pumpout/dump station(s) on a regular basis. Routinely examine waste disposal systems and keep a record of all inspections, maintenance and repairs.
Educate and train staff on how to properly operate and clean pumpout/dump station(s). If necessary, hire a professional waste service to inspect and maintain on-site facilities.
Promote the use of biodegradable and non-toxic holding tank deodorants. Make these products available to boaters at the marina store.
Provide and maintain in working order, restrooms for facility users (2 restrooms per 100 slips is recommended).
If restrooms use a septic system, pump tank regularly, and inspect and repair drain field as needed.

Fish Waste

In addition to noxious odor and unsightly appearance, fish refuse can attract nuisance birds, sharks and other wildlife to the docks. Most importantly, fish waste degrades water quality by lowering dissolved oxygen in surrounding waters.

Marina operators and boaters should employ the following management measures for fish waste:
Post signs promoting off-shore fish cleaning or the use of on-shore waste stations.
Provide fish cleaning stations on adjacent uplands. Cleaning stations should not be located over or discharge directly to marshlands or open waters.
Clearly identify the fish cleaning station with signs that list the rules and regulations for their use.
Equip fish cleaning station with a grinder to make chum out of fish skeletons. Freeze and sell at marina store.
Participate in the *GDNR's Sportfish Carcass Recovery Project* where saltwater anglers can donate their fish remains for scientific research and discovery. Contact GDNR @ (912) 617-1607 or visit www.coastalgadnr.org/FishCarcass.com for fish freezer locations or if your marina would like to participate in the program.
Contact local farms and gardens to see if they compost and reuse fish waste products.

Boat Cleaning, Maintenance & Storage

To protect the water quality, the following management measures should be applied to boat cleaning and other maintenance activities:
Boat cleaning and maintenance activities should be performed out of the water and away from critical resources. Boat repairs, painting, and other activities that result in the discharge of harmful pollutants is prohibited near open waters for human health and safety reasons.
Limit the amount of do-it-yourself work unless individuals follow management measures. Post signs which clearly identify designated boat maintenance areas and provide rules governing activities in these areas.
Boats should be cleaned frequently to reduce the use of harsh chemical cleaners. If using cleaners, use environmentally-safe products.
Avoid in-water hull scraping or other abrasive underwater removal methods.
Designate a suitable upland location for boat cleaning and repair activities. Maintenance areas should be swept or vacuumed on a regular basis to prevent oil, paint chips, detergents, etc. from reaching open waters.
Use spray booths or tarp enclosures when scraping, sanding, and painting in outdoor locations.
Use dustless or vacuum sanders to collect and remove paint from hulls. Place tarps or filter cloths beneath boat repairs to catch residual waste.
Provide a covered collection of containers for paint chips, scraping debris and dust from vacuum sanders.
Encourage the use of long-lasting, non-toxic, antifouling paints.
Promote the use of non-toxic products—soy or water-based paints/strippers, low volatile organic primers, reusable hull-blasting medium, etc.
If boaters store their boats on racks or trailers most of the time, recommend the use of polyurethane, bottom wax or non-metallic epoxies since antifouling paint is not necessary for boats that are not continuously moored in the water.

Boater Education & Signage

When marina operators, customers, contractors, and employees are well-informed, they tend to make better environmental choices.

Education and Awareness Management Measures
Mark shallow waters and sensitive marine resources such as manatee habitat or oyster harvest areas with advisory signage.
Restrict speed of boats and jet skis by posting “no wake” signs.
Mark stormwater drains with signs that discourage marina users from discarding harmful pollutants that lead to municipal sanitary sewer system or even worse, into adjacent surface waters.
Post warning signs prohibiting the direct discharge of sewage, wastewater, or solid refuse from boating vessels into open waters.
Provide signs that promote the reuse and recycling of liquid, solid, and hazardous wastes generated by the marina.

Maintenance Dredging

Excess sediments can settle and accumulate over time and impede navigational passage in and around marinas and community docks. In order to maintain sufficient water depths for navigational access, the dredging (or removal) of waterbottom sediments is often necessary. Trapped toxic substances can be released into the water column upon disturbing the substrate. For this reason, dredged materials should be removed, transported, and contained in a manner as to prevent the dispersal of potentially contaminated sediments into adjacent wetlands and waterways.

The following best management practices should be applied when removing, handling, and disposing of dredged sediments to minimize turbulence and potential contaminant release:
Agitation dredging is prohibited. Remove excess sediments by mechanical or hydraulic means to reduce turbidity impacts.
Lessen impacts to marine life by limiting dredge activities to times of the year when biological activity (spawning, recruitment, and migration) of sensitive aquatic species is low (December through March in coastal Georgia).
Reduce turbidity in receiving waters by filtering dredge spoil prior to disposal using enclosed buckets, turbidity curtains, monitoring devices, upland settling ponds, barges or scows.
Avoid dredging during hot summer temperatures or drought periods as the waters are often already naturally under-oxygenated and stressed.
Soil sampling and testing may be required to ensure waterbottom sediments do not contain harmful chemical contaminants that can be released in the surrounding aquatic environment during the removal process. The extent of testing varies based on the type of soils, the past uses of the property and the proposed removal method.
Locate a suitable upland location, preferably on or nearby the marine facility property, for a sediment containment area. This area is usually enclosed by earthen or concrete dikes fitted with weirs or pipes that allow for sediments to undergo the gravitational settling and dewatering process.
The upland disposal facility should be engineered to withstand the estimated volume of excess water and sediments being deposited in the containment area. If continued maintenance is required, the disposal site must be capable of holding these additional volumes as well.

The following best management practices should be applied when removing, handling, and disposing of dredged sediments to minimize turbulence and potential contaminant release:
Protective measures such as silt curtains, weirs, etc. should be properly installed prior to construction activities and maintained in working order until project completion.
Additional sediment and erosion control methods may be necessary for unstable banks of the dredged area or disposal site. Use bio-engineered techniques and other natural means to stabilize these areas. (See Ch. 4 for Recommended Bank Stabilization Practices)
If the dredged material is deemed as potentially hazardous, a plan for safe extraction, transport and disposal is required. Depending on the extent of contamination, the dredged sediments may need to be placed in a landfill approved for hazardous materials.
Consider the re-use of dredged sediments for streambank stabilization, beach nourishment, or wetland creation projects. This material can also be used as cover material for landfill closures. The physical and chemical makeup is the limiting factors for reuse options—dredged material must be an appropriate grain size, be clean of harmful toxins, and be compatible with the particular application (e.g. silts or clays taken from a river bottom would not be appropriate for a beach nourishment project).

Sediment Sampling

Representative samples should be taken from the area to be dredged as well outside the project limits for comparison purposes. In accordance with the *Georgia Environmental Protection Division Rules for Hazardous Site Response, Solid Waste Management Guidelines*, and *In-Stream Water Quality Standards*, the samples should be analyzed for the following chemical constituents:

- Aluminum
- Antimony
- Arsenic
- Beryllium
- Cadmium
- Chromium
- Copper
- Iron
- Lead
- Manganese
- Mercury
- Nickel
- Selenium
- Silver
- Thallium
- Zinc
- Ammonia
- Nitrates
- Phosphorus
- Cyanide
- Total Sulfides
- Fecal Coliform
- Polynuclear Aromatic Hydrocarbons
- Pesticides
- PCB congeners
- Phenols

Regulatory Requirements for Marine Structures

Marine development projects require developers and landowners obtain regulatory permits prior to construction. The *U.S. Army Corps of Engineers* has jurisdiction over U.S. waters and wetlands. The *Georgia Department of Natural Resources* manages all tidally influenced waters and marshlands. Additionally, local government approvals and permits may also be necessary.

Depending on their size, use, and location; some projects can be allowed by streamlined permits (General Programmatic Permits) while larger, more complex projects must go through a more extensive review (Individual Permits). If the project is located over State Waters, a revocable license must be obtained from the GDNR. Additionally, most marinas must execute a marina lease for the use of public lands. Consult with the appropriate federal, state and local regulatory agencies during the planning and design phase of the development to determine which permits apply to your specific project.

Regulatory Contact Information

U.S. Army Corps of Engineers
Savannah District
100 W. Oglethorpe Avenue
Savannah, GA 3140
(912) 652-5279/5770

U.S. Fish and Wildlife Service
Southeast Region
1875 Century Blvd, Suite 400
Atlanta, GA 30345
(404) 679-4000

Georgia DNR - Coastal Resources Division
One Conservation Way
Brunswick, GA 31520
(912) 264-7218

Georgia DNR - Environmental Protection Division Watershed Protection Branch
4220 International Parkway, Suite 101 Atlanta, GA 30354
(404) 675-6240

Georgia DNR – Historic Preservation Division
254 Washington Street SW
Atlanta, GA 30334
(404) 656-2840

Local Governments
(City or County Building Permit/Regulatory Services)