EXPEDITED PERMIT PROPOSAL FOR CREATED INTERTIDAL OYSTER REEFS IN COASTAL GEORGIA

by

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DEDICATION

I dedicate this thesis to my grandpa, who brought me out to low tide on Anna Maria Island, Florida with a net and a bucket, and introduced me to the most amazing world I had ever seen.

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ABSTRACT

Created oyster reefs replicate natural oyster reefs, and restoring oyster reefs is a viable coastal zone management tool for coastal ecosystems. The purpose of this research is to create an expedited permit (EP) to streamline the permitting procedure for oyster reef restoration in coastal Georgia. The Georgia Department of Natural Resources (GADNR) and the University of Georgia Marine Extension Service (UGA-MAREX) have identified the current permitting procedure as an impediment for the development of a state-based oyster reef restoration program. The EP is specific to oyster restoration projects ≤ 0.50 acre in state-owned waterbottoms adjacent to privately-owned uplands. The EP could reduce the current permit timeline for the GADNR and UGA-MAREX from 2-4 months to < 40 days. In support of the EP, a Georgia Environmental Policy Act (GEPA) public interest factor analysis was performed, which found oyster reef restoration projects have no adverse impacts, and provide beneficial impacts for 16 of the 29 public interest factors evaluated. The restoration projects authorized by the EP would support coastal ecosystems and enhance water quality, essential fish habitat, and commercial and recreational fisheries.

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

CHAPTER I: INTRODUCTION

Multiple community-based organizations, nongovernmental organizations, and 15 states have initiated oyster reef restoration programs in recognition that oyster reefs are fundamental components of healthy coastal ecosystems (Newell et al., 2002; Brumbaugh and Coen, 2009). Virginia, North Carolina, South Carolina, Florida, and Alabama have state-based oyster reef restoration programs (Brumbaugh and Coen, 2009). Since 2003, the community-based Generating Enhanced Oyster Reefs in Georgia's Inshore Areas (G.E.O.R.G.I.A.) program operated by the University of Georgia Marine Extension Service (UGA-MAREX) has completed multiple oyster reef restoration projects in Chatham and Glynn counties. The Georgia Department of Natural Resources (GADNR), The Nature Conservancy (TNC), and UGA-MAREX have collaborated to restore oyster reefs in McIntosh County, and recently, the GADNR Marine Fisheries Section (MFS) obtained a grant to create oyster reefs coastwide to support essential fish habitat (EFH).

The GADNR Coastal Resources Division (CRD) would like to develop a state-based oyster reef restoration program; however, the current permitting procedure has been identified as an impediment to program development. The purpose of this research is to create an expedited permit (EP) to streamline the permitting procedure for the GADNR and UGA-MAREX for oyster reef restoration projects up to 0.50 acre that are located in state-owned waterbottoms adjacent to privately-owned uplands. In support of the EP, a Georgia Environmental Policy Act (GEPA) public interest factor analysis was performed to assess the project impacts of the proposed permit action. The 24 GEPA public interest factors were evaluated to determine created oyster reef project impacts for six of the Georgia coastal counties, and the environmental effects indicated (no effect, negligible, undetermined, beneficial (minor or major), or adverse (minor or major)). In addition, five relevant National Environmental Policy Act (NEPA) public interest factors were evaluated.

Background

Oyster populations have declined greater than 90% in the United States since European colonization (Beck et al., 2009). In terms of abundance and total biomass removed, oysters represent one of the most heavily overexploited marine animals, and they are functionally extinct in many areas of North America (Beck et al., 2009). Removal of the oysters has had a negative impact on coastal waters because oysters perform a variety of wetland functions (Dame, 1996; Grabowski et al., 2005). As coastal populations continue to grow, management actions that support the creation of oyster reefs may be able to restore oyster abundance and counteract the impacts of coastal development.

A. History of Decline

Oyster reefs were once so numerous they were navigational hazards and ships had to maneuver around them to avoid grounding (Beck et al., 2009). Destructive oyster fishing practices caused the initial oyster population declines (Sweet, 1941; Newcombe, 1950; MacKenzie, 1996; Kirby and Miller, 2005; Beck et al., 2009). Millions of tons of oysters were harvested for food; to pave roads; fill lowlands; supply ship ballast; and as the raw materials for tabby houses, railway embankments, lime, poultry grit, fertilizer, and cement (MacKenzie, 1996). Removal of the oyster shell made it difficult for oysters to recolonize harvested areas because hard substrate is fundamental for recruitment of the next generation (Brumbaugh and Coen, 2009). Dredging the bottom for oysters was the most destructive fishing practice because it fragmented entire reefs and reduced reef elevations from the seafloor, which increased susceptibility to sedimentation, anoxia, fouling organisms, and disease (Kirby, 2004; Beck et al., 2009). Widespread removal of oyster biomass created negative feedback whereby water filtration and other fundamental ecological services provided by the oysters were severely diminished (Newell, 1988; Coleman and Williams, 2002; Beck et al., 2009).

The oyster fishery along the U.S. Atlantic coast peaked in 1890, with 120 million pounds of meats landed (Mackenzie, 2007). By the end of the 19th century, oyster-harvesting grounds in New England and Chesapeake Bay had collapsed in many areas, and the oyster houses from traditional oystering grounds migrated down the Atlantic coast to the Southern states (Kirby, 2004). The migration of oystermen from the North resulted in the overexploitation and subsequent collapse of the oyster stocks in North Carolina, South Carolina, Georgia, and the east coast of Florida. In 1908, the South Atlantic Region harvested nearly 20 million pounds of oyster meat; that year Georgia led the nation with eight million pounds landed, the highest yield in the history of the Georgia oyster fishery (Burrell, 1986; Kirby, 2004). From 1890 to 2004, oyster harvests declined 98.7% along the Atlantic coast of the U.S. (MacKenzie, 1996; MacKenzie, 2007). Oyster recovery has been inhibited to date by substrate deficits, sedimentation, poor water quality, and diseases (Beck et al., 2009).

B. Ecosystem Functions

The Eastern oyster *Crassostrea virginica* (Gmelin, 1791) is a keystone species that provides water filtration, habitat, shoreline stabilization, food production, particle aggregation, carbon sequestration, and landscape diversity (Jones et al., 1994; Grabowski and Peterson, 2007). A high-density oyster reef improves water quality by filtering phytoplankton, sediment, pollutants, and heavy metals from the water column (Butler, 1966; Newell et al., 2002; Peterson et al., 2003; Kirby, 2004; Nelson et al., 2004; Apeti et al., 2005; Newell et al., 2005). The habitat created by oysters provides refuge and food for marine life and wildlife, and the interstitial spaces allow co-competitors to occupy the same niches (Lenihan and Peterson, 1998; Coleman and Williams, 2002; Grabowski et al., 2005; Luckenbach et al., 2005; Nestlerode et al., 2007). Many commercially and recreationally important species rely on oyster reefs for all or part of their lifecycle (Coen et al., 1999; Lenihan et al., 2001; Lellis-Dibble et al., 2008). Compared to mudflat habitats, oyster reefs have higher biodiversity and support greater species abundance (Lenihan and Peterson, 1998; Grabowski et al., 2005; Luckenbach et al., 2005; Tolley and Volety, 2005). Furthermore, the three-dimensional reef attenuates wave energy, decreases turbidity, stabilizes bottom sediments, and protects *Spartina alterniflora* stands and upland vegetation by controlling erosion (Meyer et al., 1997; Widdows and Brinsley, 2002; Piazza et al., 2005).

The Magnuson-Stevens Fishery Conservation and Management Reauthorization Act (MSRA) of 2006 defines oyster reefs as essential fish habitat (EFH) and contains required provisions to identify actions that encourage EFH conservation and enhancement (16 USC § 1853 (303.3)(a)(7); Coen et al., 1999). Creating intertidal oyster reefs is a viable action for the conservation and enhancement of EFH, and supports commercial and recreational fisheries that are threatened by habitat loss and degradation. The National Fishing Enhancement Act recognizes "overfishing and the degradation of vital fishery resources have caused a reduction in the abundance and diversity of United States fishery resources," and assigns the states to be the lead regulatory agencies to create artificial reefs to enhance habitat and diversity in coastal waters (33 USC § 2103, *et seq.*). The U.S. Army Corps of Engineers (USACE) has authority to implement wetland restoration projects, and created oyster reefs are frequently design features in restoration plans (PL No 102-580; Henderson and O'Neil, 2003).

Legal Context of Oyster Reef Restoration

The typical method of creating oyster reefs in Georgia involves depositing cultch materials in the intertidal zone in areas that can support living oysters (Brumbaugh and Coen, 2009). Cultch materials are natural or artificial media purposefully placed into estuarine and marine environments to create oyster reefs by providing hard substrate and increased surface area for spatfall and growth to maturity (Brumbaugh and Coen, 2009). In the United States, a permit is needed to create oyster reefs because the media (cultch materials) deposited into the marsh to be utilized as hard substrate are defined as "fill" material, and fill material is regulated under Section 404(b)(1) of the Clean Water Act of 1972 (CWA; 33 USC § 1344). The USACE has federal jurisdictional authority to administer Section 404(b)(1) of the CWA (33 USC § 1344) and Section 10 of the Rivers and Harbors Act of 1899 (33 USC § 403). The Coastal Marshlands Protection Committee (CMPC) has state jurisdictional authority to approve permits under the Coastal Marshlands Protection Act of 1970 (CMPA) and confers regulatory and enforcement authority to the GADNR (OCGA § 12-5-280).

The CMPA mission is to regulate coastal activities and structures "to ensure that the values and functions of the coastal marshlands are not impaired and to fulfill the responsibilities of each generation as public trustees of the coastal marshlands for succeeding generations" (OCGA § 12-5-281). The CMPA created the CMPC, which consists of five members: the Commissioner of Natural Resources and four citizens selected by the Board of Natural Resources, of whom three must be coastal residents of Chatham, Bryan, Liberty, McIntosh, Glynn, or Camden counties (OCGA § 12-5-283(a)). The CMPC has jurisdiction over all tidally influenced waters and marshlands 5.6 feet above and below mean tide level (MTL; OCGA § 12-5-282(7)). In addition to federal permit requirements, the CMPC has authority to evaluate and approve the permitting of oyster reef restoration projects (OCGA § 12-5-280, *et seq*.).

The CMPA "recognizes the state marshlands as vital natural resources that provide habitat for many species of marine life and wildlife, food for the survival of these species, a nursery area for commercially and recreationally important fish and shellfish, a buffer against flooding and erosion, and a filter to help control and disseminate pollutants." The overriding purpose of the CMPA is to protect the public interest, which is determined using the following three criteria:

> (1) Whether or not unreasonably harmful obstruction to or alteration of the natural flow of navigational water within the affected area will arise as a result of the proposal;
>
> (2) Whether or not unreasonably harmful or increased erosion, shoaling of channels or stagnant areas of water will be created; and
>
> (3) Whether or not the granting of a permit and the completion of the applicant's proposal will unreasonably interfere with the conservation of fish, shrimp, oysters, crabs, clams, or other marine life, wildlife, or other resources, including but not limited to water and oxygen supply (OCGA § 12-5-286(12)(g)(1-3)).

All projects located in marshlands must pass the public interest test, and the CMPC has the authority to administer permits for activities that do not adversely impact coastal marshlands. If the project is deemed not unreasonably harmful to the public interest, the project has no alternatives (OCGA § 12-2-286(h)), and the project is water dependent (OCGA § 12-5-288), the CMPC will permit the project.

<u>Georgia Coastal Marshlands Protection Act (GCMP) Joint Permit Application</u>

To restore oyster reefs in coastal Georgia, a Georgia Coastal Marshlands Protection Act (GCMP) joint permit application must be submitted to the GADNR and to the USACE for approval (Figure 1). The USACE will issue a provisional Nationwide Permit 27 (NWP 27) to the applicant, which enters into force 30 days after the state authority certifies the permit satisfies the Coastal Zone Management Act (CZMA) consistency requirement. After the application is submitted to the GADNR, there is a 30-

day public notice period, wherein all submitted comments are noted and addressed.

Marsh permits are divided into minor alterations and major alterations. A minor alteration may impact up to 0.10 acre, and a major alteration is any impact greater than 0.10 acre, which involves a lengthier permitting process. Permit applications for projects less than 0.10 acres are mailed to the four CMPC members, and the permit decision is typically made by the Commissioner of Natural Resources. Project footprints greater than 0.10 acre are automatically scheduled for the next CMPC meeting and placed on public notice on the GADNR website (Lisia Kowalczyk, GADNR, 2010 pers. comm.).

The CMPC meets every six to eight weeks to evaluate permits, and the permit must be advertised for public comment at least seven days prior to the meeting (OCGA § 12-5-286(c)). Whenever there is sufficient public interest, the CMPC may call a public hearing. After the 30-day public notice comment period ends, the CMPC posts the decision to approve, conditionally approve, or deny the permit. Conditional approval means extra conditions have been added to the permit, which must be adhered to, and become enforceable. After the permit decision, there is an additional 30-day appeal period wherein citizens may seek legal action. If an appeal is filed, no construction may be undertaken until a decision is made on the appeal. The GADNR coordinates the permitting process and serves as a clearinghouse to notify the other agencies and the applicant when the permit is approved, conditionally approved, or denied. Processing for the GCMP permit is a minimum of 60 days up to several months. The length of time it takes to obtain a GCMP permit has been identified by the GADNR-CRD and UGA-MAREX as an impediment for expanding oyster reef restoration efforts in the state of Georgia. Although the GADNR-CRD and UGA-MAREX are state agencies, they are not exempt from obtaining a permit, and the project may not commence until the permitting procedure is complete.

The GCMP permit complicates the creation of oyster reefs because the GADNR and UGA-MAREX are funded and operate under grant deadlines and request for proposal (RFP) deadlines, and the time required to obtain a permit interferes with the agencies' ability to complete restoration projects within project deadlines. Timing is also critical for restoring oyster reefs because the cultch materials used as hard substrate for larval oysters (spat) to settle on and colonize must be in place prior to spat recruitment (Brumbaugh and Coen, 2009). Otherwise, the peak spatfall times will have passed, and the spat will not have enough time to colonize the cultch material. Colonization is critical during the first season because cultch materials may become covered by sediment if living oysters are not on the surfaces prior to the end of the first oyster recruitment season (Alan Power, UGA-MAREX, 2008 pers. comm.).

Coastal Marshlands Protection Committee (CMPC) Permit #600

In February 2009, the GADNR-CRD Marine Fisheries Section (MFS) obtained CMPC Permit #600 to create oyster reefs at multiple locations throughout coastal Georgia in state-owned water bottoms adjacent to state and municipal-owned lands. The permit may be utilized by the GADNR, UGA-MAREX, and TNC. For each project location, one of the three approved agencies provides site-specific details to the GADNR regulatory authorities and obtains a letter of permission (LOP) and permit placard (Figure 2). Federal NWP 27 from the USACE is still required for each site location. Projects may commence 30 days after LOP receipt, provided there are no legal appeals and all other federal, state, and local authorizations are obtained.

CMPC permit #600 is an alternative to the GCMP permit that allows GADNR, UGA-MAREX, and TNC-restoration projects to begin less than 40 days from submitting the request for an LOP to project commencement because CMPC deliberation is not required. By not requiring the individual sites to undergo CMPC review, the six to eight week interval between CMPC meetings is eliminated. Furthermore, the 30-day public comment period is concurrent with the legal appeal period, which reduces the time span by an additional 30 days when compared to the GCMP permit procedure.

CMPC permit #600 reduced the timeframe for oyster reef restoration projects adjacent to state and municipal-owned uplands; however, the GADNR and UGA-MAREX would like an abbreviated permit procedure that is not restricted to state and municipal-owned uplands. For example, city planners from Tybee Island approached UGA-MAREX in 2008 to restore oyster reefs in Horse Pen Creek, and the lengthier GCMP permit process was required because the uplands were privately-owned. Expediency in the permit approval process would assist the GADNR and UGA-MAREX in their ability to create oyster reefs in state-owned waterbottoms adjacent to privately-owned uplands in coastal Georgia.

CHAPTER II: EXPEDITED PERMIT (EP)

In recognition of the importance of oyster reefs, the GADNR-CRD anticipates expanding oyster reef restoration efforts throughout coastal Georgia by creating a state-based oyster reef restoration program. Unfortunately, the current permitting procedure at the state level has been identified as an impediment to program development. A permit must be obtained to create oyster reefs because the materials deposited into the marsh for oyster recruitment are characterized as "fill" material, which is regulated under the Clean Water Act of 1972 (CWA; 33 USC § 1344). The current procedure for permitting oyster reef restoration projects adjacent to privately-owned uplands follows the same procedure as a major shoreline-engineering project. The timeline to obtain a GCMP permit is a minimum of 60 days up to several months. There are truncated permit procedures for single-family docks, community docks, and shoreline hardening structures such as riprap, and it seems reasonable to develop an alternative permit for oyster reef restoration projects. Therefore, I propose the creation of an expedited permit (EP) that, if approved by the CMPC, would take less than 40 days.

The EP would be used by the GADNR and UGA-MAREX for oyster reef restoration projects located in the intertidal zone of state-owned water bottoms, adjacent to privately-owned uplands in the six Georgia coastal counties adjacent to the Atlantic Ocean: Chatham, Bryan, Liberty, McIntosh, Glynn, and Camden counties. The GADNR and UGA-MAREX would be able to utilize the EP provided the restoration projects satisfy the standard and special conditions (Tables 1 and 2). The restoration projects authorized by the EP would improve water quality, increase shoreline stability, decrease erosion, and provide habitat for the conservation of marine life and wildlife. The scope of the projects authorized by the EP is small compared to the volume of water encompassed by coastal Georgia; however, the overall cumulative impacts are beneficial to Georgia coastal ecosystems and protect the public interest (for more details, see Chapter III).

The EP seeks to establish a regulatory procedure that would waive the CMPC meeting and combine the initial 30-day public comment period with the 30-day legal action period. Instead of attending the CMPC meeting, the GADNR and UGA-MAREX would request a letter of permission (LOP) for each site-specific location from GADNR regulatory staff. The EP timeline from submitting the request for the LOP to project readiness should not exceed 37 days: approximately one week for GADNR regulatory staff to review and approve, followed by a 30-day public comment and legal action appeal period (Figure 3). The CMPC meeting could be waived because a permit decision by the CMPC for each project site would not be required, and the time spent on public notice could be combined with the legal action period.

The timeline prior to requesting the LOP would be variable, depending upon the number of adjacent landowners that must be contacted. Prior to requesting a LOP from GADNR regulatory authorities, all adjacent upland landowners would be contacted by letter and asked to sign and return the enclosed consent letter. When the request for the LOP is submitted, a list of landowners, landowner addresses, deeds, and consent letters for all adjacent landowners affirming their support for the oyster reef restoration project are copied to the file given to the GADNR regulatory staff. Ten to 30 days prior to project commencement, the GADNR-CRD or UGA-MAREX would notify the GADNR regulatory staff to schedule a site visit to confirm the project footprint and obtain a construction placard.

Standard Permit Conditions

There are standard permit conditions required of all approved or conditionally approved CMPA marsh permits, and the EP is not exempt from the standard conditions (Table 1). The GADNR and UGA-MAREX must obtain NWP 27 from the USACE, and submit the three-page EP application (Appendix A), which requires:

- Name
- Address
- Area plat, latitude, and longitude
- Statement of oyster reef restoration goal(s)
- Plan outlining the manner and method for restoring oyster reefs
- Description of cultch materials including type, quantity, and composition
- Description of conveyance for transporting materials to site
- Four figures:
    - Project footprint with square footage and evidence plan will not extend into navigation channel
    - Cross-section to illustrate elevation from grade
    - Rough illustration of anticipated final project appearance or photograph of similar project type
    - Delineation of marshland component with notation of extant permitted structures (docks, piers, etc.)

- Adjacent landowner addresses and copies of deeds
- Landfill/Hazardous Waste Statement
- Erosion and Sedimentation Statement
- Letter from local governing authority stating project is not in violation of local zoning laws
- Satisfies Public Interest Statement

Special Conditions

In addition to the standard permit conditions that are required for all marsh permits, the EP defines special conditions that must be abided by, and become enforceable (Table 2). The CMPC must ensure the oyster reef restoration projects do not negatively impact the marsh, and the special conditions are required components that provide a means whereby the CMPC may ensure the public interest and public safety are upheld. Furthermore, the stipulations of the required monitoring component and success criteria ensure consistency. In addition, the special conditions codify whether or not the oyster reef restoration project is a success or failure, and when the removal of the cultch material is necessary.

All restoration sites will require signage to inform the public that shellfish harvest is prohibited from the project site and to minimize vessel interactions. Monitoring is required every six months and after major storm events, with a short description and photographs provided to the CMPC within one month of the assessment; this special condition applies until the fall at the end of year three. If the project is unsuccessful per the success criteria guidelines, the cultch materials must be removed, and the GADNR must be informed prior to reef removal (for success criteria, see Table 2).

A. Project Locations

Project locations may be sited in tidally influenced sounds, marshes, rivers, and creeks within Chatham, Bryan, Liberty, McIntosh, Glynn, and Camden counties with the appropriate salinity (15-30+ ppt) to support oysters. Created reefs will be sited in locations adjacent to privately-owned uplands in state-owned water bottoms only. Georgia oysters are predominantly intertidal, and all cultch materials will be placed on banks above mean low water (MLW) and below mean high water (MHW; Nestlerode et al., 2007). Restoration projects will not be sited to pose navigational hazards, and the created oyster reefs will not extend into navigable channels since all cultch materials will be deposited on banks in the intertidal zone. Furthermore, the created oyster reefs, like natural oyster reefs, will be visible at low tide.

The restoration projects will be performed in state-owned water bottoms adjacent to privately-owned uplands. All property owners will be contacted by mail to sign and return the consent letter (Appendices B and C). Property owners that do not respond will be contacted by phone individually. The consent letter will clearly state the project purpose and restoration goal(s), as well as the materials and methods to be employed, and the time period(s) for project construction. The consent letter the landowner signs affirms they are the owners of said land, they support and give consent for the project, and they do not have any objections. All adjacent landowners must support and not object to the project, and the signatures must be on file or the project will not be sited in that location. An educational component for the landowners and/or community is recommended, but not required.

Adjacent or vestigial oyster reefs are a good indication hydrographic conditions are acceptable for oyster recruitment to cultch materials. Prior evaluation of the salinity, temperature, water flow, dissolved oxygen, sediment type, sedimentation rate, and channel width and depth at MLW and MHW are recommended parameters to check for project siting (Luckenbach et al., 2005). Project sites will be evaluated prior to cultch material deployment by the agency responsible for conducting the restoration, and the criteria will not be duplicated here. For example, the GADNR and UGA-MAREX have existing protocols to determine appropriate locations for restoration projects, which will be explained by applicants in questions two and three of the EP application (Appendix A).

B. Materials and Methods

Intertidal oyster reefs will be created with cultch materials placed on the bottom to serve as hard substrate for oyster colonization. Cultch materials are natural or artificial media purposefully placed into the marine environment to create or restore oyster reefs. Universal materials or methods to create or restore oyster reefs do not exist because the restoration technique must accommodate site differences in hydrography, tidal amplitude, bank slope, sedimentation, and substrate type. As a result, the projects authorized by the EP will vary greatly in scope and goals. Whereas the materials, methods, and restoration goals will vary by project, the special conditions for the EP must be followed for all projects.

Cultch materials may only be placed on banks in the intertidal zone. Cultch materials may not exceed 1.0 meter in height from the marsh floor, and the maximum width will not extend below MLW or above MHW. This maximum height and width keeps the living oysters within the tidal zone, in concurrence with the natural landscape, and on the bank, away from navigation channels. Oyster reef growth atop the cultch materials over time is a natural phenomenon that may cause reefs to exceed 1.0 meter; however, the created oyster reef will not be deemed out of compliance if this occurs because the 1.0 meter height maximum only applies to the deployment of cultch materials. Total project footprint must be equal to or less than 0.50 acre per project location. Signs will be placed at or near the restoration sites indicating the presence of the restored reef, the benefits of oyster reef restoration, and prohibition of shellfish harvest.

Currently, the majority of oyster reefs in Georgia have been created using the recycled oyster shell bagging method; however, the cost of oyster shell is prohibitive for large restoration projects (Piazza et al., 2005; Alan Power, 2007 pers. comm.). The EP will allow state-approved cultch materials in addition to recycled oyster shell. The Georgia state aquaculture code permits the deployment of a broad range of cultch and cultch materials in state-owned water bottoms for shellfish aquaculture (OCGA § 27-4-196(a)(1)). Cultch is defined as oyster, clam, and shellfish shells originating from Georgia waters; oak brush; cement-coated shingles; nongalvanized wire fencing; small gravel; and other materials with prior approval from the GADNR (OCGA § 27-4-196(a)(1)). Cultch material is any material conducive to larval oyster attachment and approved by the GADNR, generally on a case-by-case basis (OCGA § 27-4-196(a)(2)).

Shellfish aquaculture leaseholders are mandated to return to the marsh at least 33.33% of the total harvest weight from the preceding harvest by volume in shell or approved cultch materials (OCGA § 27-4-196(b)(1); Dominic Guadagnoli, GADNR, 2007 pers. comm.).

All cultch materials authorized by the EP will be inert materials that are already permitted by the Georgia state aquaculture code. Furthermore, the deployment of cultch materials will adhere to Georgia state aquaculture code standards, and will not be a source of contamination to water resources. If recycled oyster shell is utilized as the cultch material, it will not be placed into the marsh until it has been cured for more than two months because dead shells can be vectors for nonnative organisms (Cohen and Zabin, 2009). Curing consists of placing the oyster shell on the ground away from saltwater to kill marine organisms that may be present (Cohen and Zabin, 2009). This prevents the introduction of invasive species, fouling organisms, and diseases that could become waterborne upon placement in the marsh (Bushek et al., 2004).

A universal fit for restoration projects is unlikely in the future because of the site-specific differences between coastlines, currents, tides, sediments, siltation factors, and restoration goals. Because of the inherent variability in each project and the coastal dynamics of Georgia, benchmarks for oyster recruitment to the cultch materials have been established via the monitoring protocol outlined below.

The EP requires a restoration goal statement to characterize the type of restoration project. Restoration goals and objectives are inherent to restoration projects and the goal(s) statement identifies the overall purpose of the project to be conducted. The National Oceanic and Atmospheric Administration (NOAA) Restoration Portal recognizes the following restoration goals: habitat creation (including EFH), increasing species biodiversity, creating shellfish spawner sanctuaries, improving water quality, shoreline protection, enhancement of ecological functions, and the protection/enhancement of *Spartina alterniflora* restoration projects. To date, restoration projects in Georgia have been conducted to improve water quality and create to EFH.

C. Monitoring

Monitoring is a useful tool to evaluate project performance (Thayer et al., 2003). Restoration projects must be monitored after construction for a minimum of three years. Pre-monitoring reporting is not required, but onsite conditions *should* be thoroughly investigated for potential restoration success. Monitoring for three years is an appropriate timeline because the GADNR and UGA-MAREX restoration projects may be funded by short-term grant deadlines and annual operating budgets are subject to change. If the monitoring component extends greater than three years it may be difficult for the two agencies to fund staff and resources to perform site evaluations. Three years is likely longer than necessary, because success typically can be measured within a year and a half from the initial deployment of cultch (i.e., at least 500 oysters m^{-2}). CMPC permit #600 special conditions state monitoring may be discontinued after the restored reef has been determined to be stable from shifting. The EP exceeds these conditions, because success criteria are measured by structural *and* functional performance criteria. Standardized success criteria for created oyster reefs do not exist because restoration goals vary by project and multiple performance measures may be chosen (Henderson and O'Neil, 2003; Luckenbach et al., 2005).

Luckenbach et al. (2005) suggest oyster density and age structure represent one of the best measures to evaluate the success of restoration projects. The ecological services provided by oyster reefs do not necessarily depend upon the presence of living oysters; however, living oysters are necessary for the reef to be self-sustaining and to maintain the habitat (Luckenbach et al., 2005). The EP will measure the number of living oysters on cultch materials per square meter to determine success criteria because oyster density is a good indicator of oyster reef sustainability over time. Since oyster settlement is variable in Georgia, beginning in April or May to September or October in Georgia, the mean oyster density will be assessed annually in the fall, from the first autumn of project initiation through year three (O'Beirn et al., 1996). The date chosen in the fall will be at the discretion of the primary agency, with results and photographs provided to the CMPC within one month of the assessment.

From the fall of year one through year two, there must be at least 200 oyster shells m^{-2} on the cultch material. During the fall of year three, mean oyster density must be at least 500 oyster shells m^{-2} for the project to be determined successful. Areas of the created reef with less than 500 oyster shells m^{-2} will result in the designation of failure, and those portions of the reef must be removed. The areas will be measured using multiple replicates (number may be chosen by the agency), and the mean calculated. The mean value must be equal to, or greater than, the success criteria for the given year. Reference oyster density values for restored reefs using shell bags in South Carolina ranged from 584-10,857 oysters m^{-2} and the G.E.O.R.G.I.A. program typically uses 500 oysters m^{-2} as its target structural parameter (Brumbaugh and Coen, 2009, Alan Power, UGA-MAREX, 2009 pers. comm.). It is likely the number of oysters per square meter will be higher, since annual recruitment often far exceeds these benchmarks (O'Beirn et al., 1996; Daniel Harris, UGA-MAREX, 2007 pers. comm.).

The created reefs will be visually monitored for stability and shifting a minimum of every six months and within a week after major storm events. Monitoring the project site a minimum of every six months is considered an adequate monitoring standard, because site visits will occur after major storm events, which is typically when shifting and/or the loss of stability occurs (Alan Power and Daniel Harris, UGA-MAREX, 2009 pers. comm.). Photographs will be obtained and provided to the CMPC within one month of the assessment. Cultch materials that have lost stability, or appear to be losing stability, will be removed or reinforced. Cultch materials and recycled oyster bags that have shifted outside of the intertidal zone will be removed. After project deployment, monitoring will occur every six months until the end of year three; if the oyster reefs meet the functional and structural criteria by the end of year three it is likely they will provide essential ecosystem functions for an indefinite period in coastal Georgia.

D. Experimental Research Clause (Optional)

The experimental research clause is an optional component allowing up to 10% of the project footprint for the research of novel cultch materials because of the high price of oyster shell (Piazza et al., 2005). The novel materials will not be a source of contamination to water resources. The CMPC will be informed of the nature and feasibility of the novel cultch materials or methods, which will be authorized on a case-by-case basis with prior approval. Researching new techniques can keep costs down and aid the enhancement of future restoration projects. For example, wooden pallets placed underneath shell bags has greatly enhanced first year oyster survivorship due to reduced sedimentation on the bags (Alan Power, UGA-MAREX, 2010 pers. comm.). Future restoration efforts are encouraged to research new substrates for cultch material and designs, which may lead to greater restoration success and lower costs (Nestlerode et al., 2007).

E. Recommendations

The following are recommendations, but not requirements, of the EP.

Spat Sticks

Coen et al. (2004) recommend evaluating natural oyster recruitment prior to site restoration. In Georgia, spatfall is ample for recruitment to restored oyster reefs, although there is a gradient, with the headwaters of tidal creeks typically being the most conducive to spat recruitment (O'Beirn et al., 1995). Ideally, at least one year prior to project initiation, the site should be evaluated for spatial and temporal patterns of spat recruitment at the proposed site. Spat sticks may be placed to aid this evaluation and can help indicate recruitment success for the project area. Spat sticks are placed in the water column and changed monthly to record site specific larval recruitment patters, which indicates larval abundance in the adjacent area.

NOAA National Estuaries Restoration Inventory (NERI)

Recording accessory environmental variables as part of the monitoring protocol to add to NOAA's Restoration Portal would be beneficial but not required. The Estuaries and Clean Waters Act of 2000 set a goal of one million acres of coastal habitat to be restored throughout the United States by 2010, with NOAA responsible for developing a monitoring guidance system. Section 103 of the Estuary Restoration Act (ERA; 33 USC § 2902) mandates compilation of a database to inventory all estuary habitat restoration projects. The database includes techniques, standard data formats for monitoring, and suggested requirements for the type of data collected and the frequency of monitoring. The Restoration Monitoring Planner is helpful in this regard (see http://habitat.noaa.gov/restoration/rmp/PUBLICSITE/step1.cfm?clearSesh=1). One structural and one functional monitoring parameter are required for the restoration project footprint to be included in the database. If these data are collected, the project footprint may be reported to NOAA's National Estuaries Restoration Inventory (NERI) to be included toward the goal of one million acres restored. Furthermore, the ERA mandates NOAA to require all ERA-funded projects have quantitative monitoring. In the future, all NOAA-funded restoration projects will be expected to comply with this requirement (https://habitat.noaa.gov/restoration/rmp/pdf/monitoring_noname.pdf).

Expedited Permit (EP) Summary

In summary, the EP is an abbreviated permit procedure wherein a letter of permission (LOP) is obtained from the GADNR regulatory authorities by the GADNR-CRD or UGA-MAREX for each site-specific oyster reef restoration project. Under the terms of the LOP, CMPC approval is not required for each project site, provided the standard and special conditions are adhered to (Tables 1 and 2). The EP may be used by the GADNR and UGA-MAREX in state-owned waterbottoms adjacent to privately-owned uplands on intertidal banks in Chatham, Bryan, Liberty, McIntosh, Glynn, and Camden counties. The EP special permit conditions would meet or exceed the special conditions required by the existing CMPC permit #600 that may be used by the GADNR, TNC, and UGA-MAREX in state-owned waterbottoms adjacent to state or municipal-owned lands (Table 3). All adjacent homeowners must provide their permission by signing the consent letter, which will be attached to the LOP request from the GADNR regulatory authorities. Oyster reef restoration projects will not be sited in areas without the consent of all adjacent property owners. The EP could reduce the amount of time it takes the GADNR and UGA-MAREX to obtain a permit to less than 40 days, which is a reduction from the current time-period, which currently has a lower limit of 60 days, and may entail several months.

CHAPTER III: GEORGIA ENVIRONMENTAL POLICY ACT (GEPA) AND RELEVANT NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) PUBLIC INTEREST FACTOR REVIEW

The Georgia Environmental Protection Act (GEPA) of 1991 was signed into law to support the disclosure of environmental impacts that may result from proposed government actions (OCGA § 12-16-3(1)). According to the text of the law, the Georgia General Assembly finds that:

(1) The protection and preservation of Georgia's diverse environment is necessary for the maintenance of the public health and welfare and the continued viability of the economy of the state and is a matter of the highest public priority;

(2) State agencies should conduct their affairs with an awareness that they are stewards of the air, land, water, plants, animals, and environmental, historical, and cultural resources;

(3) Environmental evaluations should be a part of the decision-making processes of the state; and

(4) Environmental effects reports can facilitate the fullest practicable provision of timely public information, understanding, and participation in the decision-making processes of the state (OCGA § 12-16-2).

In support of the expedited permit (EP), a GEPA public interest factor analysis was performed to assess the impacts of the proposed permit action in Chatham, Bryan, Liberty, McIntosh, Glynn, and Camden counties. The 24 GEPA public interest factors were evaluated to assess created oyster reef project impacts and the environmental effects indicated (no effect, negligible, undetermined, beneficial (minor/major), or adverse (minor/major)). In addition, five relevant National Environmental Policy Act (NEPA) public interest factors were evaluated. Tables 4 and 5 are summaries of the

GEPA and NEPA public interest factor reviews.

Analysis of all 29 public interest factors found no determination of adverse impacts, minor or major. Furthermore, a determination of beneficial-minor was found for 16 of the public interest factors. No beneficial-major determinations were found, which was explained by the small project footprints in comparison to the volume of water in the Georgia coastal zone. A determination of no effect, negligible, and undetermined was found for 11, 1, and 1 categories, respectively (Tables 4 and 5). The cumulative environmental impacts of created oyster reef projects appear to support what the USACE would call a finding of no significant impact (FONSI). In light of this finding, a formal GEPA environmental effects report (EER), comparable to a NEPA environmental impact statement (EIS), was not prepared.

Georgia Environmental Policy Act (GEPA) Public Interest Factor Analysis (for summary of project impacts, see Table 4)

(1)Wetlands: Nationwide, marine wetlands are lost at ~4,740 acres per year as salt marshes convert to open water systems due to subsidence, dredging, and hydrodynamic changes (Lellis-Dibble et al., 2008). Per the Georgia Coastal Marshlands Protection Act (CMPA) of 1970, the marshes of Georgia are "a vital natural resource system that affords habitat for species of marine life and wildlife, food for their survival, nursery areas for commercial and recreational fisheries, and for the control of flood, erosion, and pollution" (OCGA § 12-5-281). In the past, the tremendous number of suspension feeders supported by undisturbed oyster reefs provided immense ecological services and maintained water quality (Kirby, 2004). Marshes and estuaries have suffered trophic structure changes due to overfishing, destructive oystering, nutrient loading, and influx of upland sediment (Kirby, 2004).

Oyster reefs enhance the functional and structural sustainability of the marsh (Dame, 1996; Lenihan et al., 2001). When oyster reefs are degraded, or no longer present, the ability of the marsh ecosystem to remove organic matter is substantially reduced because oysters filter seston and serve as a sink for primary production (Peterson et al., 2003; Kirby, 2004; Kotta et al., 2004). The Eastern oyster *Crassostrea virginica* is capable of filtering 7-10 L of seawater per hour per gram of dry tissue (Newell et al., 2004). Marshes are susceptible to nutrient overloading because the majority function as traps for suspended particles and dissolved organic material (DOM) and natural sinks where these materials are processed and retained (Dame et al., 2000). Oysters keep the marsh ecosystem in balance, and function as important benthic-pelagic couplers linking the water column to the benthos (Newell et al., 2002). When clearance rates for removing particulate matter were compared with 3 other bivalve species, oysters were the most efficient at removing chlorophyll *a* and red tide brevotoxin (Kirby and Miller, 2005; Leverone et al., 2007). Declining populations of filter feeders increase cumulative impacts of phytoplankton blooms because biofiltration capacity is reduced (Thompson et al., 2002). Excess phytoplankton and other organic matter can lead to hypoxia, harmful algal blooms (HABs), and diseases that have detrimental effects on marsh environments (Kirby, 2004). Semi-enclosed waters are particularly at risk, because eutrophication may kill fish and shellfish (Thompson et al., 2002).

Creating intertidal oyster reefs on marsh mudflats can augment juvenile fish nursery grounds leading to increases in fish and decapods biomass (Grabowski et al., 2005; Tolley and Volety, 2005). Oysters are critical for marsh trophic interactions because the mid-Atlantic coastal zone is characterized by sedimentary mudflat, and oyster reefs provide the primary source of hard substrate (Nestlerode et al., 2007). The calcium carbonate structure rising in vertical and horizontal relief attracts transient and resident predators, grazers, and browsers (Lenihan, 1999). The three-dimensional oyster reef increases surface area, and the interstitial matrices are important for refuge and marsh species reproduction (Nestlerode et al., 2007). Increased complexity affords more places for refuge from predators and allows co-competitors to occupy the same niches (Lenihan and Peterson, 1998; Nestlerode et al., 2007). Oyster reefs are important breeding and nursery grounds for many marsh species, including the oyster toadfish *Opsanus tau*, striped blennies *Chasmodes bosquianus*, gobies *Gobiosoma*, and skilletfish *Gobiesox strumosus*, which all need the protection of dead oyster shells to lay their eggs (Breitburg, 1999).

Furthermore, higher densities of living oysters can improve water quality and clarity. The purpose of the expedited permit (EP) is to support the restoration of oyster colonies where they were formerly present in coastal Georgia. The U.S. Army Corps of Engineers (USACE) has authority under Section 206 of the Water Resources Development Act of 1992 to implement wetland restoration projects, and created oyster reefs are frequently design features in restoration plans (PL No 102-580; Henderson and O'Neil, 2003). In consideration of the potential benefits to marshes, activities authorized by the EP would have a minor beneficial impact to wetlands.

(2)Flood Plain/River Corridor: Projects authorized under the EP would be conducted in the intertidal zone in marshlands contained by six of the 11 coastal counties of Georgia. These predominantly submerged areas are by their nature adjacent to floodplains and river corridors. There would be no construction on the adjoining floodplain areas or the river corridors, and so the character and size of adjacent floodplains would be unaffected.

During project construction, there may be some foot traffic to bring cultch materials to the site by individuals or in the form of "human chains" to move materials. Marsh areas that must be traversed to deliver materials would be minimized and care would be taken to reduce the impact to the marsh. The marsh grass quickly rebounds from where it has been crossed by foot traffic. For example, the oyster reef created at Priest's Landing in the Skidaway River used human chains to pass shell bags to the site, and the impacted area during project construction has become indistinguishable from the adjacent marsh areas (Alan Power, UGA-MAREX, 2010 pers. comm.). The use of motorized vehicles or equipment to move cultch materials over these areas is not anticipated. If utilized, the activity would not degrade the site, would not be permanent in nature, nor impair long-term function of the river/river corridor.

River corridors may benefit by shoreline stabilization and wave energy buffering provided by the created intertidal oyster reefs as they mature. Natural vegetative upland buffers are protected by the presence of intertidal oyster reefs, which baffle wave energy and reduce erosion rates to adjacent upland areas (Henderson and O'Neil, 2003). This helps to maintain the integrity of the river corridor, and decreases the amount of sediments entering the water body (Henderson and O'Neil, 2003). The proposed restorative actions authorized by the EP would aid the reversion of upland floodplains and river corridor areas to a state more resilient to rain events and storms. Shoreline stabilization protects upland vegetative buffers, which, in turn, would decrease erosion and help to maintain the stability of upland floodplains and river corridors. In light of the positive benefits of the created intertidal oyster reefs, projects authorized by the EP would have a minor beneficial impact on floodplains and river corridors.

(3)Water Supply: The proposed projects authorized under the EP would occur exclusively in wetland areas that are not used to provide drinking water, and there would be no surface water withdrawals, diversions, or impoundments, nor groundwater withdrawal, obtainment, or utilizing. No water supply watersheds are located within Chatham, Bryan, Liberty, McIntosh, Glynn, or Camden counties. Because the quantity and quality of water available for drinking water supply would be unaffected, the created intertidal oyster reef projects authorized by the EP would have no effect on water supply.

(4)Water Resources: Proposed projects authorized by the EP would occur exclusively in tidally influenced marine and estuarine areas that are not a source of freshwater resources, and would not result in degradation of waters of the state (see "Water Quality" public interest factor for analysis of effect on marine and estuarine water quality). There would be no changes to surface waters, groundwaters, and no water removal from water resources. Therefore, activities authorized by the EP would have no effect on water resources.

(5)Groundwater Recharge Area: The proposed projects authorized under the EP would not affect groundwater recharge areas of the state. Estuaries and tidal creeks are traditionally groundwater discharge areas, and are not typically sources for groundwater recharge. Therefore, activities authorized by the EP would have no effect on groundwater recharge areas.

(6)Stormwater: Estuaries are receiving bodies for stormwater by their nature. Oysters filter suspended sediment and pollutants carried by stormwater, which reduces contaminants in the water column. The cultch materials that would form the created intertidal oyster reefs stabilize underlying sediments. In addition, the three-dimensional oyster reef structure would counteract the loss of the pervious area underneath by baffling the flow of stormwater runoff from adjacent uplands. Stormwater runoff can erode shorelines and may cause benthic sediments and contaminants to become resuspended.

Many coastal Georgia estuaries, such as the Savannah River and Altamaha River piedmont estuaries are fed by vast upland watersheds that discharge a considerable amount of fresh water, and have limited upland wetlands to help filter sediments as they flow down the watershed (Dame et al., 2000). The fresh water flows rapidly (greater than 120 $m^3 s^{-1}$) to the estuaries and contains large amounts of suspended clay particles (Dame et al., 2000). The Ogeechee River estuary is a mixed estuary, having components of both piedmont and coastal estuaries; the majority of the water that flows to the Ogeechee estuary comes from the coastal plains, although the watershed that contributes to it originates in the piedmont (Dame et al., 2000). Coastal riverine estuaries typically have lower fresh water flow rates that are highly variable, contain more wetlands within the contributing watershed, and have a larger zone of saltwater intrusion (Dame et al., 2000). The Ogeechee River, Satilla River, and St. Marys River, called blackwater rivers because of high amounts of tannic and humic acids that color the water black or tea-colored, are coastal riverine estuaries that drain from watersheds completely within the coastal plain (Dame et al., 2000). Coastal riverine estuaries contain the most dissolved organic carbon (DOC) compared to piedmont types (Dame et al., 2000). The Satilla River and St. Marys River have the highest average concentration of DOC levels measured at 19.1 mg C L^{-1} and 27.9 mg C L^{-1}, respectively (Dame et al., 2000). Dissolved organic nitrogen (DON) in the Satilla River and St. Marys River (0.75 mg N L^{-1} and 0.66 mg N L^{-1}, respectively) has the highest concentrations compared with the other Georgia estuaries (Dame et al., 2000). Oyster reefs have the ability to filter out DOC, DON, and other contaminants delivered via stormwater to estuaries and marshes (Newell et al., 2002; Peterson et al., 2003; Nelson et al., 2004; Leverone et al., 2007).

The activities authorized by the EP would create oyster reefs in the intertidal zone, and would minimally increase impervious surface areas where cultch materials rest on the sediment floor; this would occur in a manner consistent with natural adjacent environments by replicating naturally occurring oyster reefs. Oysters ingest and package contaminants from stormwater runoff into the estuaries, which can counteract eutrophication. The minimal loss of permeable surface area from the project footprint is small compared to the desired effect of slowing down stormwater. The proposed actions authorized under the EP would not increase the amount of stormwater runoff to adjacent areas, and there is no potential for stormwater contamination via increased contact with contaminants. The projects authorized by the EP would not contribute to stormwater runoff and would have a minor beneficial impact for stormwater runoff.

(7)Wastewater: Wastewater is water contaminated with sewage or other contaminants that must be treated and disposed of via point-source or nonpoint source discharge to a municipal sewer system or surface stream, respectively. Activities that would be authorized under the EP would not cause any wastewater to be discharged to surface streams, nor municipal sewer systems. Wastewater enters the coastal zone from point-source discharge and nonpoint source discharge during rain events and from surface runoff (Shuval, 2003). Thalassogenic diseases are human diseases that originate from land-based wastewater pollution, which are caused by exposure to contaminated seawater through bathing, swimming and/or swallowing seawater, or the consumption of bivalves located in unsanitary waters (e.g. Hepatitis A; Shuval, 2003). Oysters located in wastewater-polluted areas are able to filter pathogenic microorganisms from land-based industrial and municipal effluent (Shuval, 2003). Oyster reefs improve water quality and may be able to reduce human exposure to thalassogenic diseases (Henderson and O'Neil, 2003).

Furthermore, oysters are able to filter pollutants and heavy metals that may be contained in industrial and municipal wastewater, thus removing them from the water column (Newell et al., 2002; Apeti et al., 2005). In a study by Kwon and Lee (2001), oysters were collected from a wastewater discharging area, and the examined tissues had bioaccumulated the heavy metals zinc, lead, cadmium, nickel, copper, chromium, and strontium. In France, marine land-based fish farms use oysters to treat wastewater using a system called microalgae bivalve filtration (Hussenot et al., 1998). A study by Jones et al. (2001) found oysters reduced total suspended solids, bacteria, nitrogen, phosphorous, and chlorophyll *a* from shrimp aquaculture effluent. Since the projects authorized by the EP would not contribute wastewater to surface streams, and may support the filtration of wastewater after it has entered waterbodies, the EP would have a minor beneficial impact for wastewater.

(8)Air Quality: Air quality may be temporarily affected by boat traffic to transport materials to areas inaccessible by foot traffic; however, it would be consistent with activities already occurring in the vicinity and would be short-term in duration, and without long-term impacts. The only release or discharge of contaminants would be via vehicle or boat fuel, and ambient air quality would be minimally affected consistent with common boating practices in the area, which would be temporary in nature while creating and monitoring the sites. These activities are not considered a significant action and therefore, are not subject to regulation under the Georgia Air Quality Control Act or the U.S. Clean Air Act (GADNR-EPD, 1991). Due to the minimal short-term effect, projects authorized by the EP would have no effect on air quality.

(9)Solid Wastes: Solid waste is defined by the Georgia Comprehensive Solid Waste Management Act as different categories of wastes that exist in a solid form (e.g., household garbage, demolition material, land clearing debris, commercial nonhazardous waste material, et al.). Projects authorized by the EP would not result in the generation of solid wastes for disposal, nor would project locations be sited near active or closed landfills. The amount of solid waste sent to landfills would be lessened, because salvaged and recycled materials are used to create oyster reefs whenever practicable, which results in reducing the amount of solid waste that would otherwise end up in landfills. For example, the G.E.O.R.G.I.A. program operated by the UGA-MAREX established five oyster shell recycling centers on Tybee Island, Skidaway Island, Darien, Brunswick, and Jekyll Island for people to drop off oyster shell. To date, at least 323,500 pounds of oyster shell has been recycled by the G.E.O.R.G.I.A. program, which is then used to create oyster reefs. In addition, two dump truck loads of salvaged tile, more than 1,000 wooden pallets, and toilet tanks from the Savannah toilet retrofit program have been reclaimed in the past 3 years alone. The proposed actions authorized under the EP would not increase the amount of solid wastes in landfills, nor result in land-disturbing activities adjacent to active or inactive landfills; the projects would result in a net decrease of the amount of solid waste sent to landfills. As a result, there would be a minor beneficial impact to solid wastes.

(10)Soil Stability/Erodibility: Marshlands are important buffers for flooding and erosion, and oysters are one component of why marshlands are successful at erosion control (Williams and Stewart, 1996; Widdows and Brinsley, 2002). Wave impacts are higher at shores that do not have oyster reefs present because oyster reefs provide natural breakwaters that protect shorelines from erosion (Coen and Bolton-Warberg, 2005). Oyster reefs protect the shoreline by reducing the amount of energy (wave, tidal, boat wakes) that reaches the shore where sediments may become resuspended and erode (Widdows and Brinsley, 2002; Piazza et al., 2005). Oyster feces and pseudofeces are expelled from the animal packaged into mucus-bound aggregates that have a larger grain size (Haven and Morales-Alamo, 1970; Newell, 1988). One of the oyster reef restoration projects completed by the G.E.O.R.G.I.A. program off Jekyll Island, Georgia found grain size had increased at the site (Alan Power, 2010 pers. comm.). Larger grain sizes are more resistant to resuspension and erosion because the turbulent and/or laminar force needed to raise the particles from the bottom is higher (Newell, 1988; Lalli and Parsons, 1997).

Oyster reefs are natural biostabilizers that shield the underlying sediment from attrition. The ability of oyster reefs to stabilize sediment also enhances the ability of macrophytic vegetation (e.g. *Spartina alterniflora*) and microphytobenthos to protect the marsh from erosive forces (Widdows and Brinsley, 2002). Intertidal oyster reefs also serve as breakwaters protecting *Spartina* stands, which buffers upland water runoff (Coen and Bolton-Warberg, 2005). Microphytobenthos are important biostabilizers because they increase sediment cohesion and increase critical erosion thresholds (Widdows and Brinsley, 2002).

A major trend in recreational boating has been the increase in the number of motorboats up to 25' that are able to access tidal creeks (Coen and Bolton-Warberg, 2005). Recreational and commercial vessels have the potential to affect estuarine systems negatively when boat wakes disturb the marsh-edge where oysters, *Juncus,* and *Spartina* species live (Coen and Bolton-Warberg, 2005). When motorboats disturb the marsh edge, marshland may be lost when sediment embedded with *Spartina alterniflora* is undercut, and cleaves into tidal channels (Coen and Bolton-Warberg, 2005). Dredging and boating can resuspend sediments, increasing water turbidity and re-releasing nutrients to the water column (Thayer et al., 2005). Intertidal oyster reefs protect adjacent patches of *Spartina alterniflora* from boat wakes by dissipating the wave energy affecting the marsh fringe, which decreases erosion (Meyer et al., 1997).

Sea level is increasing along the mid-Atlantic coastline at two times the rate worldwide because of land subsidence and increasing water temperatures (Newell, 2006). Management actions that protect the shoreline from erosion are anticipated to improve water quality quicker than upland watershed actions (Newell, 2006). Upstream-suspended sediments can take years to reach tidal tributaries and estuaries; as a result, it can take years to realize upland reductions in suspended sediments and pollutants (Newell, 2006). The NOAA Restoration Portal states utilizing created oyster reefs to prevent shoreline and beach erosion is an acceptable project goal. There would be no land-disturbing activity as defined by the Georgia Erosion and Sedimentation Act or displacement of any soils offsite during construction of the created intertidal oyster reefs via foot traffic or motorized equipment to bring in the cultch materials. The proposed actions that would be authorized under the EP would increase soil stability and decrease erodibility; therefore, the projects would have minor beneficial impact to soil stability and thus reduce soil erodibility.

<u>(11)Protected Mountains:</u> Protected mountains would not be affected by the proposed activities authorized by the EP. By definition, "Mountain" or "protected mountain" is the cumulative area equal to or greater than 2,200 feet above mean sea level with greater than 25% slope for greater than 500 horizontal feet and to the crests, summits, and ridge tops associated with these areas that are above the areas with these minimum elevations (OCGA § 12-2-8). There are no areas contained within the six Georgia coastal counties

for proposed activity that are elevated at least 2,200 feet above sea level; as a result, the projects authorized under the EP would have no effect on protected mountains.

(12)Protected Species: Protected animal and plant species within the state of Georgia are safeguarded under the United States Endangered Species Act, Marine Mammal Protection Act, Georgia Endangered Wildlife Act, and the Georgia Wildflower Preservation Act. State and federally protected species live within the project areas authorized by the EP, including the wood stork *Mycteria americana* (endangered), West Indian manatee *Trichechus manatus* (endangered), loggerhead turtle *Caretta caretta* (endangered), green sea turtle *Chelonia mydas* (endangered), American oystercatcher *Haematopus palliatus* (rare), and bottlenose dolphin *Tursiops truncatus* (protected). No protected plant species live in the intertidal zone where the projects would be located, and care would be taken not to disturb any upland protected plant species while transferring cultch materials to the site. Whereas the project sites in coastal Georgia are in areas that support protected species, all deployment of materials would occur in the intertidal zone during low tide, so it is unlikely that any protected species would be encountered at the shoreline. Motorboats may be used during project initiation and post-deployment site monitoring; all work would stop if a species of concern presents during project setup or subsequent monitoring.

State and federal protected species would not be harmed during project construction or monitoring and may be enhanced. Georgia has limited submerged aquatic vegetation (SAV), but *Spartina* and *Distichlis* are abundant and consumed by manatees (Dame et al., 2000; MacFadden et al., 2004). Oyster reefs protect *Distichlis* and *Spartina* stands by protecting them from erosion at the base (Meyer et al., 1997). The American oystercatcher *Haematopus palliates* relies upon oysters as a food source, thus increasing oyster abundance could benefit this rare species (Thayer et al., 2005). Improved water quality would benefit all protected species. Projects authorized by the EP would not harm or reduce the population of protected or endangered species and may improve animal welfare by increasing forage cover and restoring ecosystem services. Therefore, projects authorized under the EP would have a minor beneficial impact on protected species.

(13)Critical Habitats: Section IV of the Endangered Species Act of 1973 contains required provisions to identify critical habitat areas for listed species to promote their recovery. Critical habitats are specially protected areas and no projects would be sited in these areas. Although the benefits provided by the created oyster reefs may indirectly contribute to the welfare of protected species by improving the overall quality of marine and estuarine habitats, since no projects would be authorized in areas designated as critical habitat, the EP would have an undetermined effect on critical habitats.

(14)Historical: Oyster reefs once dominated estuaries and coastlines of Georgia, and oysters are a coastal heritage with inherent cultural value (Henderson and O'Neil, 2003; Kirby, 2004). Oyster reefs support the blue crab *Callinectes sapidus*, a cultural symbol along the East coast and ubiquitous in coastal Georgia (Lellis-Dibble et al., 2008). Once oysters completely cover the cultch materials the shore would resemble how it looked prior to overexploitation and the land value of adjacent properties may be increased

(Lellis-Dibble et al., 2008). Projects authorized by the EP would not occur in areas that would negatively affect areas of historical value, and no structure that is on, or eligible for, the Georgia Register of Historic Places would be altered or moved. Therefore, the projects would have no effect on historical places.

(15)Archaeological: Humans have used the coastal zone of Georgia for ~15,000 years, beginning at the end of the Pleistocene Period (Harris et al., 2002). Due to the rise and fall of sea level over this period, it is likely that many potential archaeological sites and artifacts are preserved in marshes. To date, there is no comprehensive information available to citizens concerning the presence or absence of archaeological sites in the coastal zone because Georgia does not have a regional archaeological survey program (Harris et al., 2002). Per the GADNR-Historic Preservation Division reporting requirement: “All findings or sightings of submerged cultural resources or suspended submerged cultural resources shall be reported to the division as provided in these rules within two [business] days of such finding" (OCGA § 12-3-80, *et seq*.). If archaeological sites and/or artifacts are observed, the above requirement would be followed, and the project area would be removed to a new site where no archaeological artifacts are located. Because no archaeological artifacts would be impacted or disturbed, projects authorized under the EP would have no effect on archaeological sites.

(16)Parks/Recreation: Recreational marine fishing is an important pastime in coastal Georgia and part of the cultural heritage. In 1999, marine anglers generated $23,204,392 in state and federal taxes, and 80% of every dollar spent in Georgia remained in the state

(Steinback et al., 2004). In 2006, saltwater fishing generated $192 million in sales, and 219,000 anglers utilized state coastal waters (NMFS, 2009). Estuarine species represent 80% of the fish harvested recreationally in the United States annually, and 85% of all recreationally and commercially harvested species depend upon estuaries at some point in their lifecycle (NRC, 1997 as cited by Lellis-Dibble et al., 2008). Ninety percent of the 297,378,386 lbs. of fish harvested in the mid-Atlantic are estuarine-dependent (Lellis-Dibble et al., 2008). Oyster reefs support a great number of transient nekton that are important recreational fish species: striped bass *Morone saxatilis*, summer flounder *Paralichthys dentatus*, Atlantic croaker *Micropogonias undulatus*, redfish *Sebastes marinus*, snook *Centropomus spp*., rockfish (genus *Sebastes*), snappers (genus *Lutjanus*), bluefish *Pomatomus saltatrix*, spotted seatrout *Cynoscion nebulosus*, king mackerel *Scomberomorus cavalla*, sheepshead *Archosargus probatocephalus*, scup *Stenotomus chrysops*, and weakfish *Cynoscion regalis* (Thayer et al., 2005; Lellis-Dibble et al., 2008). Weakfish, striped bass, red drum, bluefish, penaeid shrimp, and blue crab are harvested species that use oyster reefs for nursery grounds (ASMFC, 2007; Lellis-Dibble et al., 2008). Juvenile blue crabs *Callinectes sapidus* are a recreationally important species that use oyster reefs for nursery grounds and when molting (Lellis-Dibble et al., 2008).

A 10 m^2 oyster reef can increase fisheries production by 2.6 kg yr^{-1}, and the cumulative impact may be 38-50 kg 10 m^{-2} in increased fisheries output over a 20-30 year period (Peterson et al., 2003). Restoring oyster reefs on mudflats can augment juvenile fish nursery grounds, which can lead to increases in fish biomass (Grabowski et al., 2005). The harvest of fish and crabs is higher over oyster reefs compared to adjacent mudflats, and created oyster reefs provide the same economic value as natural oyster reefs (North Carolina Sea Grant 1997 as cited by Henderson and O'Neill, 2003). Oyster reefs are critical components to estuaries and function as vital habitat for juvenile and adult fish (Kirby, 2004; Grabowski et al., 2005). Reviving oyster populations by creating intertidal oyster reefs is one way to protect essential fish habitat (EFH) and increase the viability of recreational fisheries threatened due to habitat loss and degradation.

Fisheries benefit from improvements in water quality, because oysters reduce phytoplankton biomass and red tide blooms that deplete the water of oxygen by preventing the reconversion of NH_4^+ (Newell et al., 2002; Nelson et al., 2004; Leverone et al., 2007). As natural breakwaters, they protect the marsh and reduce shoreline erosion, which makes coastal resources more available for recreation (Henderson and O'Neil, 2003). Filtering phytoplankton improves the appearance of the water, making it more attractive for swimming and boating (Henderson and O'Neil, 2003). The created intertidal oyster reefs would increase fish and shellfish biomass for many harvested species that are a source of recreation and revenue in coastal Georgia and improve the quality of water related activities. Therefore, activities authorized by the EP would provide a minor beneficial impact to parks/recreation.

<u>(17)Energy Supplies:</u> The only energy supplies that would be required during construction of the proposed projects authorized under the EP would be the potential use of motorboats to transport cultch materials to the designated and approved areas, and for routine monitoring outlined in the special conditions contained within this document. Motorboats require the use of oil and/or gas to operate; however, the amount of fuel

consumed is insignificant, temporary in nature, and in accordance with normal use for the surrounding area. Therefore, there would be no effect on energy supplies.

(18)Beaches: Activities that would be authorized under the EP would occur exclusively in estuaries and tidal creeks. It may be necessary during construction of the created reefs and monitoring to traverse beach areas, but only in a manner consistent with standard beach activities. Standard beach activities include foot traffic, delivering kayaks/canoes to the beachfront, and paddling to tidal creek sites, as was done during the creation of the oyster reefs on Beach Creek, Jekyll Island, GA (Daniel Harris, UGA-MAREX, 2007 pers. comm.).

In 2007, the UGA-MAREX G.E.O.R.G.I.A program created oyster reefs in Beach Creek for biological remediation to reduce the number of days with beach closures at St. Andrews beach on Jekyll Island, Georgia (Alan Power, UGA-MAREX, 2007 pers. comm.). Wildlife living upstream of Beach Creek were contributing to high loads of enteric bacteria that discharged from the tidal creek to the north end beaches. Public advisories that the beach was unsafe for swimming were posted frequently. While it is too early to attribute reduced beach advisories for St. Andrews beach to the created reefs, it may be possible as more time elapses and the water quality monitoring continues.

The created oyster reefs have the potential to benefit beaches because water filtration by the oysters removes contaminants, including bacteria, phytoplankton, and sediments from the water column (Henderson and O'Neill, 2003). The proposed projects would not occur on beaches, and any impacts to beaches during construction would be compatible with common beach activities. In light of the possible benefits of created oyster reefs on beaches through the bioremediation of impaired water quality and limiting the number of beach advisories due to enteric bacteria, the EP would provide a beneficial minor impact to beaches.

(19)Dunes: Activities that would be authorized under the EP would occur exclusively in estuaries and tidal creeks. Dunes are sensitive areas that protect shorelines, and it would not be necessary to affect any dunes that may be located near areas designated for use under the EP. All construction and monitoring activity would be conducted to avoid dunes completely. Therefore, projects authorized under the EP would have no effect on dunes.

(20)Shoreline: Intertidal oyster reefs trap silt, baffle wave energy, and stabilize adjacent shorelines and marsh at the intertidal interface (Coen and Bolton-Warberg, 2005). In North Carolina, Meyer et al. (1997) placed created oyster reefs in lower intertidal areas adjacent to 3 created marshes of *Spartina alterniflora*. After 1.7 years, the southward-facing shore behind the created oyster reefs had accreted 6.3 cm and the unaltered (i.e., noncultched) control areas had 3.2 cm of shore erosion (Meyer et al., 1997). At another study site, there was sediment accretion at the shoreline with the cultched treatments (2.9 cm) and shoreline erosion at the noncultched treatments (1.3 cm), even though the location was fronted by a dredge effluent pipe and received boat wake (Meyer et al., 1997). All created reef sites were more effective at protecting the shoreline than control sites, and sediment accreted significantly compared to control sites, even after a strong storm event in 1993 (Meyer et al., 1997). Piazza et al. (2005) created intertidal oyster reefs in soft sediments in Louisiana in an environment similar to coastal Georgia, and the created reefs had less shoreline retreat compared to noncultched control areas, 0.08 ± 0.02 m $month^{-1}$ and 0.12 ± 0.01m $month^{-1}$, respectively.

The organic and inorganic materials expelled from the oyster are bound in mucus, which increases the grain size (Newell, 1988). Larger grain sizes need more energy to become resuspended and erode (Lalli and Parsons, 1997). Oyster reefs are natural biostabilizers that offer physical protection to the underlying sediment from erosion (Widdows and Brinsley, 2002). Creating oyster reefs to protect shorelines and beaches from erosion is an acceptable project goal, but the ecological and economic benefits of each created intertidal oyster reef would vary by project (Henderson and O'Neil, 2003). Because the created intertidal oyster reefs would decrease erosion and increase shoreline stability, there would be a minor beneficial impact to shorelines.

(21)Estuary: The health of estuaries in the United States is declining, and the removal of oyster reefs has likely contributed to the deterioration (Lenihan and Peterson, 1998; Lellis-Dibble et al., 2008). Pickney et al. (2001) found 65% of the estuarine surface areas in the continental United States were in a state of moderate to severe eutrophication. Eutrophication occurs when there is an increase in chemical nutrients, especially Nitrogen (N) and Phosphorous (P), into the water body. Oysters reduce eutrophication by removing phytoplankton from the water column and reduce the amount of N that is bioavailable when they expel feces and pseudofeces (Newell et al., 2002). The waste products enhance denitrification and reduce the amount of biologically available N surrounding the reef (Newell et al., 2002; Kirby and Miller, 2005). The nitrogen removed may be permanent, so conservation and enhancement of oyster populations is a valid management strategy to complement the removal of external nitrogen inputs and improve estuarine water quality (Newell et al., 2002).

Newell (1988) suggested the ~100-fold oyster population decline over the past 150 years has contributed greatly to eutrophication in Chesapeake Bay. Oysters can counteract the effects of eutrophication because they are one of the only resources able to remove N and P from the estuary after it has been deposited and restoration efforts to use created oyster reefs for bioremediation may offset the impacts of eutrophication (Lenihan and Peterson, 1998; Newell, 2006). The purpose of the EP is to create intertidal oyster reefs to restore estuarine function in Georgia; because oysters are a vital natural component of healthy estuaries, it is the determination that there would be a minor beneficial impact on estuaries.

(22)Forest Land: The proposed activities that would be authorized under the EP would cause no changes to forested areas, and no land-disturbing activities would occur. All proposed activities would be conducted in tidal creeks and estuaries, below mean high water (MHW) and above mean low water (MLW). Therefore, projects authorized under the EP would have no effect on forestland habitats.

(23)Barrier Island: The Shore Protection Act of 1979 was enacted to help protect and manage the dynamic relationship of sand sharing that exists on barrier islands and includes the sand dunes, beaches, sandbars, and shoals in the coastal area. “Dynamic dune fields” are defined as the area between the MHW mark landward to the first living native tree 20’in height or more, or an extant structure that existed prior to July 1, 1979

(OCGA § 12-5-232(8)). There would be no use of motorized vehicles on dunes or beaches. There would be no permanent construction on dunes. The natural topography and/or vegetation of the sand sharing system of dynamic dune fields would be unaltered by activities proposed by the EP, and all activities would be conducted in the zone below the jurisdiction/location of the dynamic dune fields. Therefore, projects authorized under the EP would have no impact on barrier islands.

(24)Aquatic Life/Trout Streams: Oysters are a keystone species and an important part of the food web for many forms of aquatic life (Lenihan et al., 2001). Oysters have been called "ecosystem engineers" because the three-dimensional oyster reef creates habitat and influences community dynamics of the resident population (Lenihan and Peterson, 1998). Oyster reefs provide essential fish habitat (EFH) and promote biodiversity in aquatic habitats (Rodney and Paynter, 2006). Invertebrate and fish species use oyster reefs for protection because the inherent structural heterogeneity provides abundant nooks and crannies to hide and live, and more than 658 species rely upon estuaries for at least part of their lifecycle (Lenihan, 1999; Harding and Mann, 1999; Lellis-Dibble et al., 2008). Many of these species are recreationally and commercially important, including blue crab, penaeid shrimp, red drum, sheepshead, mullet, grouper, snapper, stone crab, spotted sea trout, whelk, and oysters (Lenihan et al., 2001; Lellis-Dibble, 2008).

Oysters consume ~70% of the organic material they ingest and expel the remainder, which is an important food source for many benthic organisms and an important link in the food web for benthic- pelagic coupling (Newell, 1988). Oysters improve water clarity and increase the abundance of sediment-living diatoms, an important food source for herbivores (Newell et al., 2002). Intertidal reefs also support an abundance of epifaunal and infaunal organisms (Burrell, 1986). During low tide, oyster reefs protect many invertebrate and fish species from desiccation and other environmental stressors (Lenihan and Peterson, 1998). The interstitial spaces contained within oyster reefs also provide places for microorganisms to colonize (Hargis and Haven, 1999).

Thirty percent of the estuaries in the United States are impaired for aquatic life use, and creating intertidal oyster reefs is a way to improve aquatic habitat (EPA, 2009; Luckenbach et al., 2005; Lellis-Dibble et al., 2008). Oyster reefs that were created in saltmarshes and mudflats increased resident decapod densities 50% and 100%, respectively (Grabowski et al., 2005). Created oyster reefs may contain 6 times the number of total organisms and increased species richness compared to natural oyster reefs (Rodney and Paynter, 2006). The proposed activities authorized under the EP would be conducted to increase oyster densities in areas that contain marine aquatic life. In light of the potential benefits to aquatic life, projects authorized under the EP would have a minor beneficial impact on aquatic life and no impact on trout streams.

National Environmental Policy Act (NEPA) Public Interest Factor Analysis (for summary of project impacts, see Table 5)

(1)Land Use: Georgia law mandates "local governments and regional development centers should acknowledge the importance of wetlands for the public good in the land-use planning process" (OCGA §12-2-8). The Georgia Department of Natural Resources (GADNR) Environmental Planning Criteria were developed to provide minimum planning standards for regional and local governments: pursuant to the Georgia Planning Act of 1989, wetlands should be included in land-use planning provided there are no long-term impairments or net loss to wetland function (OCGA § 391-3-16-.03(d)). Wildlife and fisheries management, natural water quality treatment or purification, and recreation are acceptable uses for wetlands in land use planning, and the created intertidal oyster reefs would benefit these three uses (Henderson and O'Neil, 2003).

Furthermore, the mission statement of the Georgia Coastal Management Program (2003) is to "balance economic development in Georgia's coastal zone with preservation of natural, environmental, historic, archaeological, and recreational resources for the benefit of Georgia's present and future generations." Oyster reefs help to preserve natural, environmental, and recreational coastal resources and provide economic benefits that may extend to the entire watershed (Henderson and O'Neil, 2003). The coast continues to be vulnerable to increasing land development, poor water quality, and trophic structure changes, including the removal of apex predators and introduction of nonnative species that damage the ecosystem in ways that have yet to be studied (Jackson et al., 2001). Manmade bioremediation may be the only way to restore the ecosystem, because the ability of the coastal environment to recover has been impaired (Grabowski et al., 2005). Coastal resources must be managed comprehensively and created intertidal oyster reefs are an acceptable land use because they improve three of the six acceptable uses for wetlands provided for by Georgia law. In light of the benefits at the project site and elsewhere in the watershed, it is the determination that projects authorized under the EP would have a minor beneficial impact for land use.

(2)Navigation: The intertidal oyster reefs would be created exclusively nearshore, above MLW and below MHW, directly adjacent to the upland bank. They would not be placed in areas offset from the bank, where they could pose unseen navigational hazards or in navigation channels. The intertidal oyster reefs would be visible during low tide and would not constitute a navigational hazard to boaters (Alan Power, UGA-MAREX, 2007 pers. comm.) in a manner that is any different from the hazards posed by natural oyster reefs that are ubiquitous in coastal Georgia. Furthermore, unlike natural oyster reefs, all of the created intertidal oyster reef sites would be clearly marked with signs alerting citizens to their location. The Army Corps of Engineers uses created oyster reefs as mitigation for navigation projects (Henderson and O'Neil, 2003). In light of these considerations, the projects authorized by the EP would have negligible impact to navigation.

(3)Shellfish: For the Atlantic coast, landings of oysters have decreased greater than 90% since the turn of the 20^{th} century (MacKenzie, 1996). Oyster landings have declined due to harvesting without the return of hard substrate, overharvesting, overfishing of the brood stock, disease, and environmental degradation (Lenihan and Peterson, 1998). Today, oysters continue to decline because of eutrophication from increased nutrient loading and the complications of two diseases (Dermo, caused by the parasite *Perkinsus marinus* and MSX, caused by the parasite *Haplosporidium nelsoni*; Kirby and Miller, 2004). Oysters have been unable to recover from historical levels because of a lack of hard substrate (Newell et al., 2005). The purpose of the EP is to place cultch materials into tidal water bodies to attract larval oysters for settlement and help oysters recover to former stock sizes. Increasing the brood stock would also help to create spawner sanctuaries, which can increase oyster populations in areas where shellfish can be collected/cultivated (Erbland and Ozbay, 2008). Creating oyster reefs as spawner sanctuaries to increase spatfall is an acceptable project goal for restoration activities.

Oysters have decreased significantly from historical levels due to overexploitation (Sweet, 1941; Newcombe, 1950; Kirby, 2004). Thompson et al. (2002) predict the decline of filter feeders would increase the cumulative impacts of phytoplankton blooms, further reducing oyster stocks. The activities authorized by the EP seek to reverse these trends by increasing the number of shellfish in the state of Georgia. Activities authorized by the EP would have minor beneficial impacts to shellfish by increasing oyster stocks and creating spawner sanctuaries that would enhance adjacent natural reefs in coastal Georgia.

<u>(4)Essential Fish Habitat (EFH):</u> Oyster reefs are essential fish habitat (EFH) (Coen et al., 1999) and must be protected by law pursuant to the Magnuson-Stevens Act amendment of 1996 (16 USC §1801-1883). The Magnuson-Stevens Fishery

Conservation and Management Reauthorization Act (MSRA) of 2006 mandates protection for EFH to support the vitality of the fisheries of the United States. The MSRA officially designates EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity" (16 USC §1802 (3)(104-297)(10)). In addition, the MSRA contains required provisions to identify actions that have the potential to encourage the conservation and enhancement of EFH (16 USC § 1853 (303.3)(a)(7)). Oysters are a keystone species that provide valuable ecosystem services fundamental to species at every trophic level, and restoring oyster reefs on mudflats can augment fish nursery grounds and increase fish biomass (Dame, 1996; Grabowski et al., 2005).

Creating intertidal oyster reefs is a viable action for the conservation and enhancement of EFH and commercial and recreational fisheries threatened by habitat loss and degradation. Activities authorized by the EP would likely increase EFH by increasing habitat for recreationally and commercially important fish stocks in coastal Georgia; therefore, there is a minor beneficial impact for EFH.

<u>(5)Water quality:</u> Oysters contribute to the reduction of many organic and inorganic substances from water resources (Newell et al., 2002; Kirby, 2004). A mature oyster can filter up to 50 gallons of water per day, and remove a significant quantity of heavy metals, inorganic molecules, pesticides, phytoplankton, sediment, bacteria, and brevotoxin from the water column (Butler, 1966; Newell et al., 2002; Peterson et al., 2003; Nelson et al., 2004; Apeti et al., 2005; Leverone et al., 2007). Oysters package organic and inorganic particles filtered from the water column into aggregated forms that

sink to the substrate where they may remain permanently (Newell et al., 2002). Newell et al. (2002) hypothesized that when oysters were abundant in Chesapeake Bay prior to the 19th century they exerted top-down control on suspended particles and phytoplankton. Oysters retain particulate matter on the gills where it is sorted into digestible and indigestible material (Haven and Morales-Alamo, 1966; Kotta et al., 2004). After digestion, feces and pseudofeces (inedible material such as sediment) are expelled in mucus-bound pellets that sink to the seafloor up to 40 times faster than non-aggregated particles (Haven and Morales-Alamo, 1966; Newell et al., 2002; Kotta et al., 2004). In the laboratory, the seston filtered by oysters deposited to the bottom 7 times faster than seston settling by gravity alone (Haven and Morales-Alamo, 1966). One acre of small oysters can deposit up to 981 kg of feces and pseudofeces weekly (Haven and Morales-Alamo, 1966). This process removes a significant quantity of sediment from the water column because 77-91% of these biodeposits are inorganic material consisting of chlorite, illite, and other clays (Haven and Morales-Alamo, 1966). The aggregated particles improve water clarity quicker than non-aggregated particles, which remain suspended longer and contribute to turbid water conditions (Newell et al., 2002). The oyster reef footprint on the benthos also biostabilizes the sediment underneath (Widdows and Brinsley, 2002). Throughout coastal Georgia, the concentration of suspended sediment is typically high, generally ranging from 8-200 mg L^{-1}, depending upon location and water currents (Dame et al., 2000). Removal of particulate matter, including sediment, via oyster filtration, decreases turbidity and improves water clarity (Newell et al., 2002). Decreasing water turbidity also increases the depth that photosynthetically active radiation (PAR) can penetrate, which enhances beneficial benthic diatom communities (microphytobenthos; Newell et al., 2002; Newell et al., 2004). Microphytobenthos are microalgae that help to stabilize marine sediments and limit the flux of nutrients to the overlying water column by absorbing inorganic nutrients from oyster biodeposits and fixing N_2 (Newell et al., 2002). Oysters and microphytobenthos form an important partnership that promotes benthic-pelagic coupling by increasing denitrification and decreasing eutrophication (Newell et al., 2002). The partnership that occurs within these bacterially mediated interactions serves to increase the amount of N and P removed (Newell et al., 2005) at rates that are higher in combination than when uncoupled (Newell et al., 2002). When the microphytobenthos are absent because PAR is deficient, inorganic nutrients may return to the water column, stimulating primary production (Newell et al., 2002).

Estuaries worldwide are anthropogenically enriched with N and P that comes from point source pollution, nonpoint source pollution, and atmospheric deposition (Valiela et al., 1997; Newell et al., 2005). According to Paerl (1997), increases in the coastal population would contribute significantly to an increase in the atmospheric deposition of nitrogen, which is a growing source of nitrogen. Reintroducing oyster reefs to areas where they were historically present would enhance water filtration capability and improve water resources. The benefits associated with created intertidal oyster reefs could possibly extend to the entire watershed (Henderson and O'Neil, 2003).

The materials utilized to create the oyster reefs would not contain contaminant-bearing materials and would follow Georgia state-authorized aquaculture protocols for materials and methods (OCGA § 27-4-196). Cultch materials would not be a source of contamination to water resources. The improvements to water quality would be minor because the scope of the created intertidal oyster reef projects authorized by the EP is small in comparison to the volume of water the six coastal counties included in the EP contain; however, the activities authorized by the EP would have minor beneficial impact to water quality.

CHAPTER IV: SYNTHESIS

Greater than 90% of the oysters that once dominated Georgia estuaries have disappeared, and the coast continues to be vulnerable to land development, poor water quality, and trophic structure changes (Beck et al., 2009). The Georgia coast stretches about 100 miles, yet it contains approximately 17% of the remaining saltwater marshlands along the entire U.S. Eastern seaboard (Bricker et al., 1999; SGCMP, 2003). These values could diminish since 32% of the adjacent land area is considered developable (120,960 acres; Bricker et al., 1999; SGCMP, 2003). Currently, Georgia has one of the smallest coastal populations in the United States, but the coastal population is projected to increase 51% between 2000 and 2030 (Ross et al., 2006).

High population density contributes directly to degradation of coastal resources because urbanization increases point source and nonpoint source pollution that delivers excess nutrients, heavy metals, and other toxic contaminants to coastal ecosystems (Phelps and Warner, 1990; Williamson and Morrissey, 2000; Lellis-Dibble et al., 2008). Georgia's estuaries are less eutrophic compared to neighboring states; however, forecasters predict increasing eutrophication in coastal Georgia by 2020. A long-term study by Verity et al. (2006) found declining dissolved oxygen levels in coastal Georgia, coupled with increases in phytoplankton and nutrients. The nutrient sources are primarily anthropogenic in origin, caused by urbanization, deforestation, application of agricultural fertilizers, and atmospheric deposition from fossil fuel combustion (Nixon, 1995; Paerl, 1997).

Oyster reefs compensate for nutrient enrichment in coastal waters, and mitigate anthropogenic disturbances (Cerco and Noel, 2007). As a result, restoring oyster reefs is a valuable incentive that could increase beneficial ecosystem services for coastal Georgia (Cerco and Noel, 2007). In order to evaluate the impacts of created oyster reefs in Chatham, Bryan, Liberty, McIntosh, Glynn, and Camden counties, I conducted a GEPA public interest factor assessment. The results of the GEPA found created oyster reefs 1) support the public interest factor test for all 29 factors evaluated; 2) have no adverse impacts; 3) have 16 beneficial-minor impacts; and 4) the remaining public interest factors were no effect, negligible, and undetermined for 11,1, and 1 respectively. The GEPA evaluation is the same appraisal the state of Georgia undertakes to disclose the environmental impacts of proposed government actions.

Since restored oyster reef projects are beneficial and support the public interest, it seems reasonable for the state to adopt a shortened permitting procedure for created oyster reefs at the state level. The USACE has a truncated federal permit for restoring oyster reefs, and there are abbreviated state permit procedures for other shoreline alterations, including single-family docks, community docks, and shoreline armoring structures. Since there are shortened permit procedures for these activities, there should be an equivalent abbreviated permit process for oyster reef restoration projects. The EP proposed here could be adopted by the state to fulfill this need, since the current permit procedure has been identified as an obstacle by the GADNR and UGA-MAREX. Furthermore, the only agencies approved to utilize the EP are the GADNR and UGA-MAREX, which are state agencies that promote conservation and stewardship of state resources.

If the EP is approved by the CMPC, the EP could facilitate the creation of oyster reefs by the GADNR and UGA-MAREX, and aid the creation of a state-based program for coastal Georgia. Since the coast has been impaired by anthropogenic disturbances in the past, it seems reasonable that the state should undertake measures to mitigate the damage. The state of Georgia has an opportunity to be proactive in support of healthy coasts by facilitating the creation of oyster reefs, which may provide ecological benefits for coastal Georgia.

The CMPA was enacted to protect coastal marshlands; however, the CMPA does not discriminate between restorative and destructive activities. When the CMPA is amended, I would recommend legislators add a restoration section to the Act, which would require the allocation of state resources to coastal marshlands to reverse past anthropogenic disturbances. Restorative actions would entail a vetting process of some type (specialized permit process, identification of approved agencies, etc.) and mandate scientific research to determine the restorative action is not detrimental. The restoration section could then be used to mitigate marsh activities that are destructive by nature, and define minimum standards within the text of the law that strengthens the legal context for the protection of marshlands.

Creating oyster reefs is a viable management tool, and studies have shown created oyster reefs rapidly replicate the ecological benefits of natural oyster reefs (Luckenbach et al., 2005; Rodney and Paynter, 2006; Walters and Coen, 2006). The research in support of the EP may be used as a framework for oyster restoration parameters because it defines the minimum structural and functional requirements for projects in coastal Georgia. The EP may serve as a guidance document for regulatory staff at the GADNR, who may be unfamiliar with oyster reef restoration processes. In the future, the manuscript may serve as a guidance document outlining restoration policies and procedures for homeowners seeking state support to restore oyster reefs.

The success of oyster restoration projects completed by UGA-MAREX demonstrates the viability of creating oyster reefs to increase the footprint of Georgia's oyster reefs. Furthermore, restoring oyster reefs provides ecological benefits and represents a viable tool for the long-term reduction of eutrophication in coastal waters (Lenihan and Peterson, 1998; Grabowski et al., 2005; Cerco and Noel, 2007). As the coastal population grows, Georgia has the opportunity to operate under a paradigm of prevention and reduce the impacts of urbanization and nutrient loading for the future.

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APPENDIX A: EXPEDITED PERMIT APPLICATION

Applicant Name____

Agency____

Address____

Title____

Project Location:

Area plat___________________ Latitude______________ Longitude__________________

1. Statement of oyster reef restoration goal(s):

2. Plan outlining the manner and method for restoring oyster reefs:

3.   Description of cultch materials including type, quantity, and composition:

4. Attach following four figures:

- Project footprint with square footage and evidence plan will not extend into navigation channel, and indicating the depth and waterway width at mean low water (MLW) and mean high water (MHW)
- Cross-section to illustrate elevation from grade
- Rough illustration of anticipated final project appearance or photograph of similar project type
- Delineation of marshland component with notation of extant structures (docks, piers, etc.)

5. Description of conveyance for transporting materials to site:

1. **Attached list of adjacent landowners with address and letter of release from landowners prior to commencement of restoration project to show authority to proceed.**

2. **Letter from local governing authority stating not in violation of any local zoning laws.**

8. Landfill/Hazardous Waste Statement:

To determine if the site is a landfill or hazardous waste site, visit http://www.gaepd.org/Documents/hazsiteinv.html or contact local government engineer, or the State Hazardous Sites Response Program at 1-888-373-5947. This statement needs to be provided to certify you have inquired into the status of the site chosen.

9. Erosion and Sedimentation Statement:

10. Public Interest Statement:

____________________________________ ________________

Signature of Applicant Date

APPENDIX B: SAMPLE LETTER SENT BY UNIVERSITY OF GEORGIA MARINE EXTENSION SERVICE (UGA-MAREX) TO ADJACENT UPLAND LANDOWNERS FOR THE OYSTER REEF RESTORATION PROJECT ON HORSE PEN CREEK, TYBEE ISLAND, GEORGIA

RE: Oyster Restoration/Enhancement of Horsepen Creek, Tybee Island

The City of Tybee is currently working on improvements to drainage system discharge filtration on the island. The University of Georgia Marine Extension Service (MAREX) recently completed an oyster restoration project on Jekyll Island to use the remarkable filtration capabilities of oysters to remove excessive bacteria from the water. One adult oyster can filter 2.5 gallons/hour of water; therefore, an entire reef can help improve on water quality. We are proposing a new proactive partnership involving MAREX, the City of Tybee, Georgia Power, Coastal Environmental Analysis, the Environmental Protection Division, and the Georgia Department of Natural Resources to conduct a research project on Horsepen Creek, wherein, the impacts of oyster restoration and drainage system filtration devices on water quality are documented.

Baseline water quality monitoring will begin in December 2008 with the on the ground restoration scheduled for May 2009. The oyster restoration component will use the existing GEORGIA (Generating Enhanced oyster reefs in Georgia's Inshore Areas) community based programs methods (see enclosed brochure). Oyster shell is being collected from private roasts and restaurants at recycling centers on Tybee, Skidaway, and Jekyll Islands and in Darien and Brunswick. Volunteers will place this shell into mesh bags and these bags (<5,000) will be placed along the creek bank (to a height <2 ft from the mud surface) in the area between high and low water. Oysters have a very narrow area in the zone between low and high water in which they will survive: if they are too low they will die from being covered with mud, boring sponges and other fouling organisms; if too high they will remain exposed for too long, limiting feeding opportunities. For those reasons, our shell is planted within a narrow (~ 3, 4 m) zone above the low water mark, where reefs naturally occur. Given that shell is confined to the banks and is exposed and visible during low tide, it does not constitute a navigational hazard. Suitable sites within the creeks will be selected by MAREX personnel based on creek bank slope, sediment consistency, and currents. Post-water quality testing will be performed to determine the impact on water quality, and the restored reefs will be monitored to assess the success of oyster growth.

This project is expected to increase essential fish habitat, provide stabilization of the salt-marsh against erosion, educate the public about non-point source pollution, and reduce pollution in Horsepen Creek.

All owners of properties located adjacent to potential restoration sites along Horsepen Creek are being contacted to inform them about our proposed project and to ask for a letter authorizing written permission for our Coastal Marshlands Protection Permit application. In order to be ready for a May 2009 restoration date we need to submit our permit application by mid December. We hope that you will support the project by signing the enclosed release letter and encourage you to contact us should you have any further concerns or questions.

Sincerely,

Alan Power, Ph.D.
University of Georgia
Marine Extension Service
Shellfish Research Laboratory
20 Ocean Science Circle
Savannah, GA 31411

APPENDIX C: COPY OF RELEASE LETTER SENT TO ADJACENT PROPERTY OWNERS FOR THE UNIVERSITY OF GEORGIA (UGA-MAREX) OYSTER RESTORATION PROJECT ON HORSE PEN CREEK, TYBEE ISLAND, GEORGIA

Karl H. Burgess
Habitat Management Program Manager
Coastal Resources Division
Georgia Department of Natural Resources
One Conservation Way, Suite 300
Brunswick, GA 31520

I am the owner of the property located at ______________________________________.

The property is located adjacent to Horse Pen Creek.

The University of Georgia Marine Extension Service Shellfish Research Laboratory has my permission to place oyster reef on the intertidal area adjacent to my property. I support the project and have no objections.

Sincerely,

____ ____________

Signature Date

APPENDIX D: LIST OF ACRONYMS AND ABBREVIATIONS

ASMFC	Atlantic States Marine Fisheries Commission
CGRDC	Coastal Georgia Regional Development Center
CMPA	Coastal Marshland Protection Act
CMPC	Coastal Marshlands Protection Committee
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
DO	Dissolved oxygen
DOC	Dissolved organic carbon
DOM	Dissolved organic material
DON	Dissolved organic nitrogen
EER	Environmental effects report
EFH	Essential fish habitat
EIS	Environmental impact statement
EP	Expedited permit
EPA	Environmental Protection Agency
EPD	Environmental Protection Division
ERA	Estuary Restoration Act of 2000
FONSI	Finding of no significant impacts
GADNR	Georgia Department of Natural Resources
GADNR-CRD	Georgia Department of Natural Resources Coastal Resources Division

GADNR-CRD MFS	Georgia Department of Natural Resources Coastal Resources Division Marine Fisheries Section
GEORGIA	Generating Enhanced Oyster Reefs in Georgia's Inshore Waters
GEPA	Georgia Environmental Protection Act
GCMP	Georgia Coastal Marshlands Permit
HAB	Harmful algal blooms
LOP	Letter of permission
MSRA	Magnuson-Stevens Fishery Conservation and Management Reauthorization Act
MHW	Mean high water
MLW	Mean low water
MTL	Mean tide level
N	Nitrogen
NEPA	National Environmental Protection Act
NERI	National Estuarine Research Inventory
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NWP	Nationwide permit
OCGA	Official code of Georgia annotated
PAR	Photosynthetically active radiation
P	Phosphorous
PL	Public law
RFP	Request for proposal
SAEEA	South Atlantic Estuarine Eutrophication Assessment

SAV	Submerged aquatic vegetation
SC	South Carolina
SCORE	South Carolina Oyster Restoration and Enhancement Program
SGCMP	State of Georgia Coastal Management Program
TNC	The Nature Conservancy
UGA-MAREX	University of Georgia Marine Extension Service
US	United States
USACE	United States Army Corps of Engineers
USC	United States code

TABLES AND FIGURES

Table 1. Standard Permit Conditions for the Expedited Permit (EP)

Standard Permit Conditions	Denote distance to navigable areas and measurement of length across channels from mean low water (MLW) to MLW
	Ensure no hazard to navigation
	Landfill/Hazardous Waste Statement
	Erosion and Sedimentation Statement
	Letter from local governing authority stating project is not in violation of local zoning laws
	Satisfies Public Interest Statement
	Notify GADNR 10-30 days prior to project commencement and arrange a site visit with GADNR regulatory division
	Adhere to all permit conditions and requirements or permit will be revoked
	Construction cannot commence until 30 days after LOP and NWP #27 are approved
	Submit Certification of Compliance and post-construction survey within 30 days of project completion to GADNR

Table 2. Special Permit Conditions for the Expedited Permit (EP)

Project Locations	Tidally influenced sounds, marshes, rivers, and creeks on the banks of Chatham, Bryan, Liberty, McIntosh, Glynn, and Camden counties
	Intertidal banks (above MLW and below MHW) with mean salinity ranges 15-30+ ppt
	State-owned waterbottoms
	Privately-owned uplands
Materials & Methods	Inert cultch materials permitted according to Georgia aquaculture code
	Recycled oyster shell cured ≥ 2 months
	Height of cultch materials will not exceed 1.0 m
	Width of cultch materials will not extend below MLW nor above MHW
	≤ 0.50 acre
	Post signs indicating presence of restored oyster reef and prohibition of shellfish harvest
	≥ 1 restoration goal
Special Conditions	Monitoring is required until the end of year 3
	Monitor stability and shifting ≤ 6 months and after major storms
	Measure mean oyster density m^{-2} annually
	Report all results to CMPC within one month
	Success criteria (year 1-2): = 200 oyster shells m^{-2} on cultch materials[*]
	Success criteria (year 3): >500 oyster shells m^{-2}[*]
	Removal mandated if year 3 success criteria not met; inform GADNR prior to removal
	Letter of consent from all landowners
Protected Species	All work will stop if a species of concern presents during project setup or subsequent monitoring
Historic Places	Projects will not occur in areas that could negatively affect areas of historic value
Experimental Research	10% of project footprint will be available for experimental cultch materials with prior approval (optional)

[*] Reference oyster density values for restored reefs using shell bags in South Carolina ranged from 584-10,857 oysters m^{-2} and the G.E.O.R.G.I.A. program typically uses 500 oysters m^{-2} as its target structural parameter (Brumbaugh and Coen, 2009; Alan Power, UGA-MAREX, 2009 pers. comm.).

Table 3. Standard and special conditions of CMPC Permit #600 compared to the proposed Expedited Permit (EP):

Expedited Permit	CMPC Permit #600
Submit site-specific details for each individual location and obtain a LOP and permit placard from GADNR-CRD prior to commencement of work at each location	SAME
Construction cannot commence until 30 days after LOP and NWP #27 are approved	SAME
Adhere to all permit conditions and requirements or permit will be revoked	SAME
Notify GADNR 10-30 days prior to project commencement and arrange a site visit with GADNR regulatory division	SAME
Submit Certification of Compliance and post-construction survey within 30 days of project completion to GADNR	SAME
Located in Chatham, Bryan, Liberty, McIntosh, Glynn, and Camden counties	SAME
Restricted to state-owned water bottoms	SAME
Privately-owned uplands	State or municipal-owned uplands
Adjacent landowners will be notified in writing. Must have letter of consent from landowner prior to commencement of restoration project to show authority to proceed	N/A
All projects located in intertidal zone (between mean low water (MLW) and mean high water (MHW))	SAME
Maximum acreage ≤ 0.50 acre	SAME
Inert materials authorized by Georgia aquaculture code	SAME
No consumption	SAME
Signage to indicate presence of restoration sites and indicating closed to harvest	SAME
Monitor every 6 months with photos to ensure stability and oyster recruitment	Monitor every 4 months with photos to ensure stability
Monitoring after major storm events	SAME
Monitoring results reported to CMPC within 1 month of assessment	SAME

Expedited Permit	**CMPC Permit #600**
CMPC notified if project is unsuccessful and cultch removal required; inform GADNR-CRD prior to removal	SAME
Maximum height 1.0 m	SAME
10% experimental research clause (optional)	N/A
Landfill/Hazardous Waste Statement required	SAME
Erosion and Sedimentation Statement required	SAME
Letter from local governing authority stating project is not in violation of local zoning laws	SAME
Satisfies Public Interest Statement	SAME

Table 4. Summary of the effects of the expedited permit (EP) on 24 public interest factors as defined by the Georgia Environmental Policy Act (GEPA)

Factors	No Effect	Negligible	Undetermined	Beneficial		Adverse	
				minor	major	minor	major
1.Wetlands				X			
2.Flood plain/ river corridor				X			
3.Water Supply	X						
4.Water resources	X						
5.Groundwater recharge area	X						
6.Stormwater				X			
7.Wastewater				X			
8.Air quality	X						
9.Solid wastes				X			
10.Soil stability/ erodibility				X			
11.Protected mountains	X						
12.Protected species				X			
13.Critical habitats			X				
14.Historical	X						
15.Archaeological	X						
16.Parks/ recreation				X			
17.Energy supplies	X						
18.Beaches				X			
19.Dunes	X						
20.Shoreline				X			
21.Estuary				X			
22.Forest land	X						
23.Barrier island	X						
24.Aquatic life/ trout streams				X			

Table 5. Summary of the effects of the expedited permit (EP) on 5 relevant public interest factors as defined by the National Environmental Policy Act (NEPA)

Factors	No Effect	Negligible	Undetermined	Beneficial		Adverse	
				minor	major	minor	major
1.Land use				X			
2.Navigation		X					
3.Shellfish				X			
4.Essential Fish Habitat (EFH)				X			
5.Water quality				X			

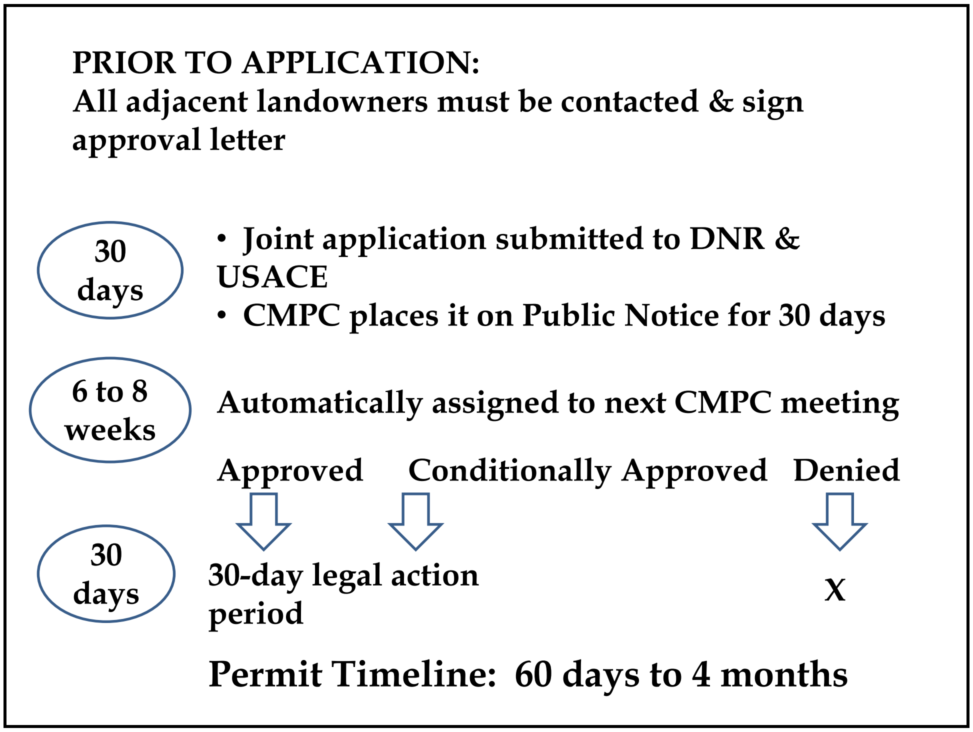

Figure 1. Flowchart of timeline for Georgia Coastal Marshlands Protection Act (GCMP) joint permit application

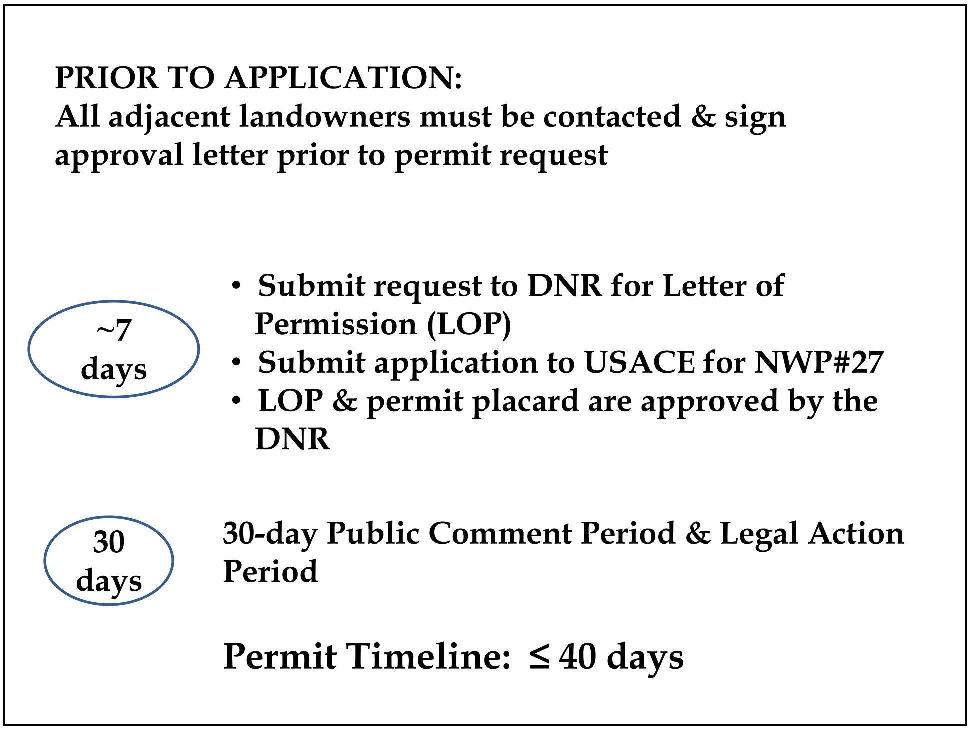

Figure 2. Flowchart of timeline for Coastal Marshlands Protection Committee (CMPC) permit #600

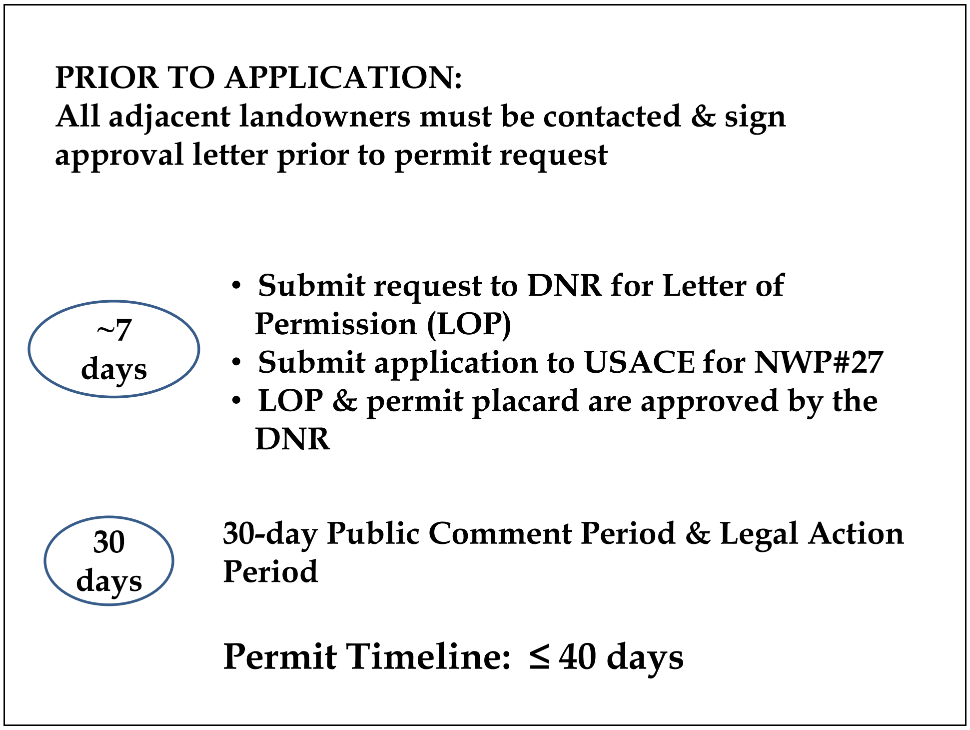

Figure 3. Flow chart of timeline for proposed expedited permit (EP) for GADNR and UGA-MAREX