RESTORATION OF THE WORMSLOE PLANTATION SALT MARSH IN SAVANNAH, GEORGIA

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Abstract. The Diamond Causeway was constructed across the Isle of Hope in 1972 to provide road access from Savannah, Georgia to Skidaway Island. The area on the Isle of Hope intersected by the road was originally salt marsh dominated by *Spartina alterniflora*. The road was constructed across the marsh on dredge materials resulting in a hydrologic barrier and a bisection of the marsh. Excess dredge material was deposited within the marsh north of the Causeway, resulting in upland hammocks. The remaining marsh has converted from low marsh to high marsh with many barren and thinly vegetated salt flats.

Recent plans to widen the Causeway have presented an opportunity to restore the functional and physical parameters of a healthy salt marsh community. This restoration will be accomplished by installing a series of culverts under the widened Causeway, removing the fill material north of the Causeway, restoring tidal channels, and installing transplants of *Spartina alterniflora*. The plans include culvert design, tidal channel design, and grading design based upon tidal data collected with automated data loggers, existing elevations and tidal channels from an adjacent reference marsh, and estimated elevations of buried marsh remnants. We will present these data and designs as a work in progress.

INTRODUCTION

The Diamond Causeway was constructed across the southern end of the Isle of Hope in 1972 to provide road access from Savannah, Georgia to Skidaway Island. The road was constructed across a salt marsh on dredge materials resulting in a hydrologic barrier and a bisection of the marsh. Excess dredge material was deposited within the marsh north of the Causeway, resulting in upland hammocks. The remaining marsh has converted from low marsh to high marsh with many barren and thinly vegetated salt flats.

Plans to widen the Causeway have presented the Georgia Department of Transportation (GDOT) with an opportunity to restore the functional and physical parameters of a healthy salt marsh community. The restoration plan is based on the following four goals: (1) increase density and coverage of *Spartina alterniflora*; (2) restore tidal exchange; (3) remove fill material and man-made upland areas; and (4) protect the existing historic resource. Restoration plans began with a study of existing conditions both within the degraded marsh and adjacent healthy marsh areas. These data were used to prepare a restoration plan consisting of the following four components: (1) installing culverts under the road, (2) removing much of the fill material out of the marsh, (3) designing new tidal channels, and (4) replanting *Spartina alterniflora*.

PROJECT LOCATION AND HISTORY

The approximate 90-acre project site is located in Savannah, Georgia on the Isle of Hope, a high ground peninsula between the Moon River and Skidaway Narrows. The project lies immediately north of the Diamond Causeway, within the boundaries of the Wormsloe State Historic Site, which is owned and operated by the Georgia Department of Natural Resources. The project area is located immediately south of Wormsloe Plantation (Figure 1).

The Wormsloe Plantation site and marsh area have undergone numerous changes since it was first granted to Noble Jones by King George in 1736. Nineteenth century maps and notations as well as twentieth century aerial photographs indicate an extensive network of tidal channels flowing from north and south across what is now Diamond Causeway.

However, prior to construction of the road, other activities had some effect on this marsh. In the 1860s, during the Civil War, an artillery battery was built along the banks of the Moon River and an earthen causeway/dam was built across the marsh as a potential escape route for Confederate soldiers (SAS 2001). Remnants of this dam are located in the northern end of the project area. In 1910,

Figure 1. Project location map.

the U.S. Army Corps of Engineers dredged the Skidaway Narrows to establish an inter-coastal waterway. These changes likely altered the tidal hydrology within the marsh (SAS 2001). However, a 1952 aerial photograph indicates there remained a relatively undisturbed salt marsh community in the area of the Causeway (Figure 2).

The road was constructed in 1972. Despite an attempt to construct a tidal connection to Moon River along the north side of the road, tidal exchange was dramatically altered, and as a result, the vegetation community changed from an undisturbed, functioning low marsh community to a sparsely vegetated high marsh community. In addition, excess spoil material was deposited north of the road resulting in higher elevations and hummocks. These areas have now established forested "islands" dominated by pine trees (*Pinus taeda*) and Eastern Red Cedar (*Juniperus virginiana*). In 1974, the old-growth, mixed hardwood-pine forest on the Isle of Hope was severely infested with the Southern Pine Beetle (*Dendroctonus frontalis*) and had

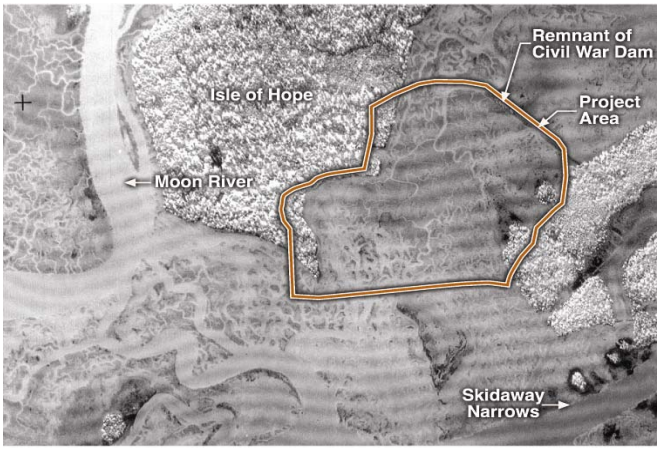

Figure 2. 1952 Aerial photograph of project site.

to be virtually clear-cut. A 2001 aerial photograph indicates current conditions (Figure 3.)

METHODOLOGY

Data were collected in both the restoration area (project site) and the adjacent undisturbed marsh area (reference site).

Topography

Existing elevations of the project and reference sites were surveyed using standard survey techniques to establish a one-foot contour map of the area.

Vegetation

The existing vegetative community was assessed and documented by conducting baseline percent cover measurements along five transects established across the project site and one transect established across the reference site. Aerial cover estimates of each species were estimated within 1 m^2 plots. Sampling points were selected along the transect utilizing a random number table to determine the distance between sampling points.

Tidal Data

Two years of tidal data have been collected at three monitoring stations. Station Number 1 is located south of the Causeway in the Reference Site. Station Number 2 is located in the tidal connection to Moon River which was cut through the marsh during the time of road construction. Station Number 3 is located immediately north of the project site in the tidal channels flowing into the project site from the north. Tidal data loggers are *In Situ Inc.* miniTROLL® units housed in screened PVC wells attached to galvanized pipes that were installed into the marsh substrate. Tidal elevations are collected every six minutes. Data are downloaded from the loggers

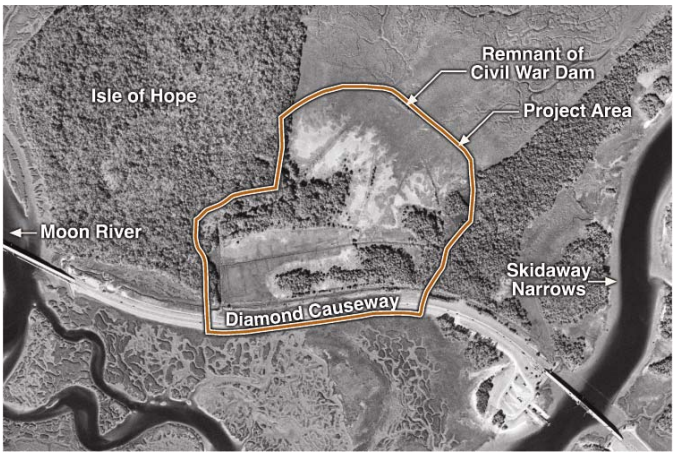

Figure 3. 2001 Aerial photograph of project site.

approximately every two months and compared to a tidal gauge on the Savannah River at Ft Pulaski (approximately 12 miles northeast of the site) operated by the National Oceanographic and Atmospheric Administration (NOAA 2004).

Soil

To determine the depth of buried remnant marsh material, a core sampler was used to excavate material along transects established for vegetative measurements. If preserved marsh plant material was found, depths to that point were recorded and converted to an elevation based on existing topography. These elevations were compared to marsh elevations of the reference site.

Channel Sinuosity

The sinuosity of existing tidal channels in the reference site was measured on aerial photography to determine channel dimensions. Channel dimensions determined include belt width, meander length and radius of curvature based upon natural channel design techniques (Rosgen 1996).

Historic Resources

A Phase I archaeological survey was conducted by Southeastern Archaeological Services (SAS) to identify archaeologically significant areas.

RESULTS AND DISCUSSION

The vegetation present in the reference site is almost exclusively *Spartina alterniflora* tall-form which is more typical in a healthy low marsh community. The dominant vegetation in the project site is *Spartina alterniflora* short-form and *Salicornia* sp. with some *Distichlis spicata* and *Juncus roemerianus*. *Juncus roemerianus* appears in patchy, clumps adjacent to ditches and upland wooded areas. *Salicornia* sp., *Distichlis spicata*, and *Spartina alterniflora* short-form are more typical of a high marsh community that is exposed to high levels of salinity. The influence of high soil salinities is further supported by the extensive salt flats existing across the project site. Salinity levels are likely high due to peak high tides which flow into these areas and stagnate. As a result of evapotranspiration and decreased drainage, increased soil salinity levels begin to stress *Spartina alterniflora* resulting in less density and more salt tolerant species such as *Salicornia* sp. (Pennings and Bertness 2001). In the barren salt flats, soil salinity levels are likely too high for salt tolerant plants. Salt pans are common in areas subject to human disturbance such as roads and levees (Weigert and Freeman 1990).

The tidal data compare favorably to NOAA data; however, at peak low tide the project site and the reference site are typically dry for up to approximately three hours. However, Station 2 does not always go dry at low tide. As expected, there is a lag in the project site station data as compared to the NOAA data. However, this lag is enhanced at Station 2; the tide does not recede as fast as the other stations. These differences at Station 2 are a result of a riprap dam that was placed at the mouth of this channel at the Moon River. This resulting lag extends the inundation period of the project site at high tide, which exacerbates the potential for standing high tides and excess soil salinities.

The tidal data indicate that Stations 1 and 3 ebb and flow in a similar matter. Historical photographs indicate that these points were the sources of tidal exchange for the project site prior to road construction. To restore tidal exchange, a series of culverts are proposed for placement under the Causeway during road construction. Tidal data were used to run hydraulic models (HEC-RAS) estimating flow velocities for potential culvert dimensions. To reduce velocities to approximately two feet per second, estimated tidal flow will require five 10-foot x 6-foot culverts. We are proposing a triple barrel culvert to be installed in-line with the largest channel extending from the reference marsh south of the road up to the road as well as two single barrel culverts to accommodate two channels also extending from south of the road.

The topographic survey indicates that the project site is approximately 4 to 7 feet above mean sea level (MSL) whereas the reference site is approximately 1 foot below to 2 feet above MSL. These data compare favorably to the estimated elevations of the buried marsh. The results of the soil core sampling indicate that buried marsh remnants are approximately 1.5 feet below to 2.0 feet above MSL. Proposed grading plans will result in removing the upland hammocks and fill material. This will result in a final elevation of approximately 1 to 3 feet above MSL with tidal channel inverts sitting at approximately 0 to 1 feet above MSL and high marsh hammocks sitting at approximately 5 feet above MSL.

In addition to grading the site back to its historic marsh elevation, the majority of the existing shallow, straight tidal ditches will be filled with the cut material. The primary channel leading from Moon River to the site will remain. In addition, new tidal channels will be excavated throughout the site. The channels' width and sinuosity will be based upon estimated channel sinuosity dimensions in the reference site. These dimensions vary by channel width.

The archaeological survey (SAS 2001) concluded that the remnants of the causeway constructed during the Civil War be recommended as elegible for listing in the National Register of Historic Places (NRHP). This feature is located at the northern edge of the site. In addition, there are three potentially eligible pre-historic

sites located along the eastern edge of the project. These sites will be avoided in the restoration plan.

A concept grading plan has been prepared indicating proposed culvert locations, proposed grading changes, and tidal channels (Figure 4). The grading plan is designed so that tidal channels flow through the site from the north and the south. The high point in the project area is 5 feet above MSL in the upper third of the project site.

Tidal channels are designed so that at peak high tide, channels extending from the north will connect to channels extending from the south. One-hundred foot buffers areas protect the remnants of the Civil War dam and prehistoric sites at the north and eastern edge of the project sites.

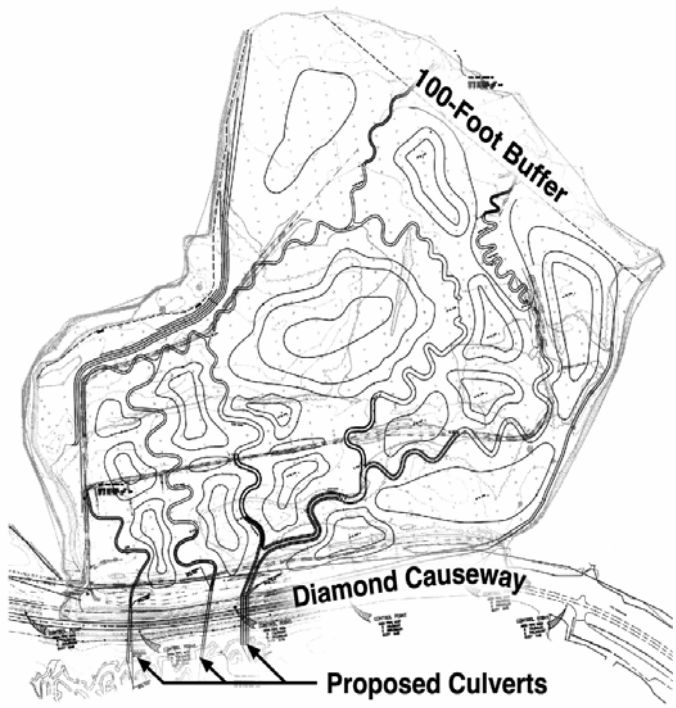

Figure 4. Proposed grading plan.

SUMMARY

The proposed restoration plan is to be constructed at the time of the widening of the Diamond Causeway. The widening of the Causeway is pending the approval of the Finding of No Significant Impact (FONSI). The concept grading plan will be incorporated into the design plans of the road for culvert placement. Next steps will include conducting bridge foundation investigations in the areas proposed for culverts as well as preparation of planting and construction plans.

The restoration of the Wormsloe Plantation Salt Marsh presents an opportunity to restore a degraded salt marsh in an environmentally and historically significant setting. In conducting, this restoration, not only can we restore ecosystem function, but we can restore the landscape of this historically rich setting.

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