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Department of Natural Resources
Coastal Restoration Division and
Coastal Engineering Division

2004 Operations, Maintenance, and Monitoring Report

for

Sweet/Willow Lake Hydrologic Restoration

State Project Number CS-11b
Priority Project List 2

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Cameron Parish

Prepared by:

Mike Miller, Biological Monitoring Section (CRD)
And
Melvin Guidry, Field Engineering Section (CED)
LDNR/Coastal Restoration and Management
Lafayette Field Office
635 Cajundome Boulevard
Lafayette, LA 70506

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I. Introduction

The Sweet Lake/Willow Lake shoreline protection project is composed of approximately 6,000 ac (2,428 ha) of open water and freshwater wetlands surrounding Sweet Lake and Willow Lake in northeastern Cameron Parish (figure 1). The project area is bounded on the south and west by the Gulf Intracoastal Waterway (GIWW), and on the north and east by Pleistocene prairie formations along La. Hwy. 384 and La. Hwy. 27.

The three soil types occurring in the project area are Allemands muck, Aquents, and Udifluvents. (U.S. Department of Agriculture, Soil Conservation Service [USDA/SCS] 1995; USDA/Natural Resources Conservation Service [USDA/NRCS] 1997). Allemands muck is a very poorly drained organic soil found in freshwater marshes, making up 90% of the project area. The remaining 10% consists of frequently flooded Aquents Series and Udifluvents Series soils that comprise the dredged spoil along GIWW.

The plant community in the project area is fresh marsh is dominated by *Sagittaria lancifolia* (bulltongue), with lesser amounts of *Panicum hemitomon* (maiden cane), *Schoenoplectus californicus* (California bullwhip), *Spartina patens* (marshay cordgrass), *Typha* sp. (cattail), *Phragmites australis* (common reed), *Colocasia esculenta* (elephant ear), and *Alternanthera philoxeroides* (alligator weed). A canopy layer of *Sesbania drummondii* (rattlebox), *Salix nigra* (black willow), *Sapium sebiferum* (Chinese tallow tree), and *Cephalanthus occidentalis* (buttonbush) is present on higher ground and on the remains of ridges formed by old levees and spoil banks in the area. Shallow open water areas support a number of aquatic plants, with stands of *Nelumbo lutea* (American lotus) and *Potamogeton diversifolius* (common pondweed) dominant. *Eichhornia crassipes* (water hyacinth) is also prevalent, with large floating mats often developing in open water areas by the summer.

When the GIWW was constructed in the early 1900's, its route lay just south of the southern shorelines of both lakes, but the high energy associated with the navigation channel has and continues to impact the lakes and surrounding marshes. Erosion of the banks of the GIWW has been caused by the water level drawdown effect and wave wash from boat and barge wakes (Good et al. 1995),. Along with the widening and deepening of the channel from its original dimensions of 40 ft (12.2 m) wide x 5 ft (1.5 m) deep to 125 ft (38 m) wide x 12 ft (3.7 m) deep in the 1940's (United States Army Corps of Engineers [USACE] 1978) and subsequent erosion of its banks, this erosion has resulted in the breaching of the narrow strip of marsh and spoil bank between the canal and the southern shoreline of both lakes.

These hydrological connections have led to increased mechanical erosion of the lake shorelines and the surrounding organic marsh soils, followed by the suspension and transport of organic and mineral sediments from the lakes and surrounding marshes into the deeper water of the

GIWW channel, resulting in a significant loss of fresh marsh in the project area. Such "blowouts," where direct connections between a channel and inland water body form, exposing fragile organic marsh soils to high energy and increased erosion, are a common problem along navigation channels in coastal Louisiana (Good et al. 1995).

Land loss studies by Britsch (1994) indicate that in 1956, approximately 19 percent of the project area was classified as open water, and 61 percent was classified as fresh emergent marsh. By 1993, approximately 74 percent of the project area was classified as open water, and only 26 percent as fresh emergent marsh, most of which was deteriorated and converting to open water (Britsch 1994).

Between 1952 and 1975, the average shoreline erosion rate was 3.8ft/yr (1.2 m/yr) at Willow Lake and 2.6 ft/yr (0.8 m/yr) at Sweet Lake (Adams et al. 1978). Between 1978 and 1990, this rate increased to 11ft/yr (3.4 m/yr) along the northern and eastern shorelines of Willow Lake, and averaged 22 ft/yr (6.7 m/yr) along the Sweet Lake shoreline. (Brown & Root 1992).

In May 2001, the placement of 17,460 linear feet of foreshore rock dike was completed along the GIWW. In August 2001, construction of 25,931 linear feet of open water terraces north of Sweet Lake was initiated; however due to complications with the contractor, timing of the installation of plants and inclement weather, the contract was terminated in October 2001, after only partial completion of the terraces (figure 1). In June 2002, the construction of 20,650 linear feet of shoreline terraces along the Willow Lake shoreline (figure 1 and 2) was initiated. After completion of the Willow Lake terraces, construction began on the terraces in Sweet Lake. In October 2002, construction of 29,897 linear feet of terraces in Sweet Lake (figure 1 and 3), was completed.

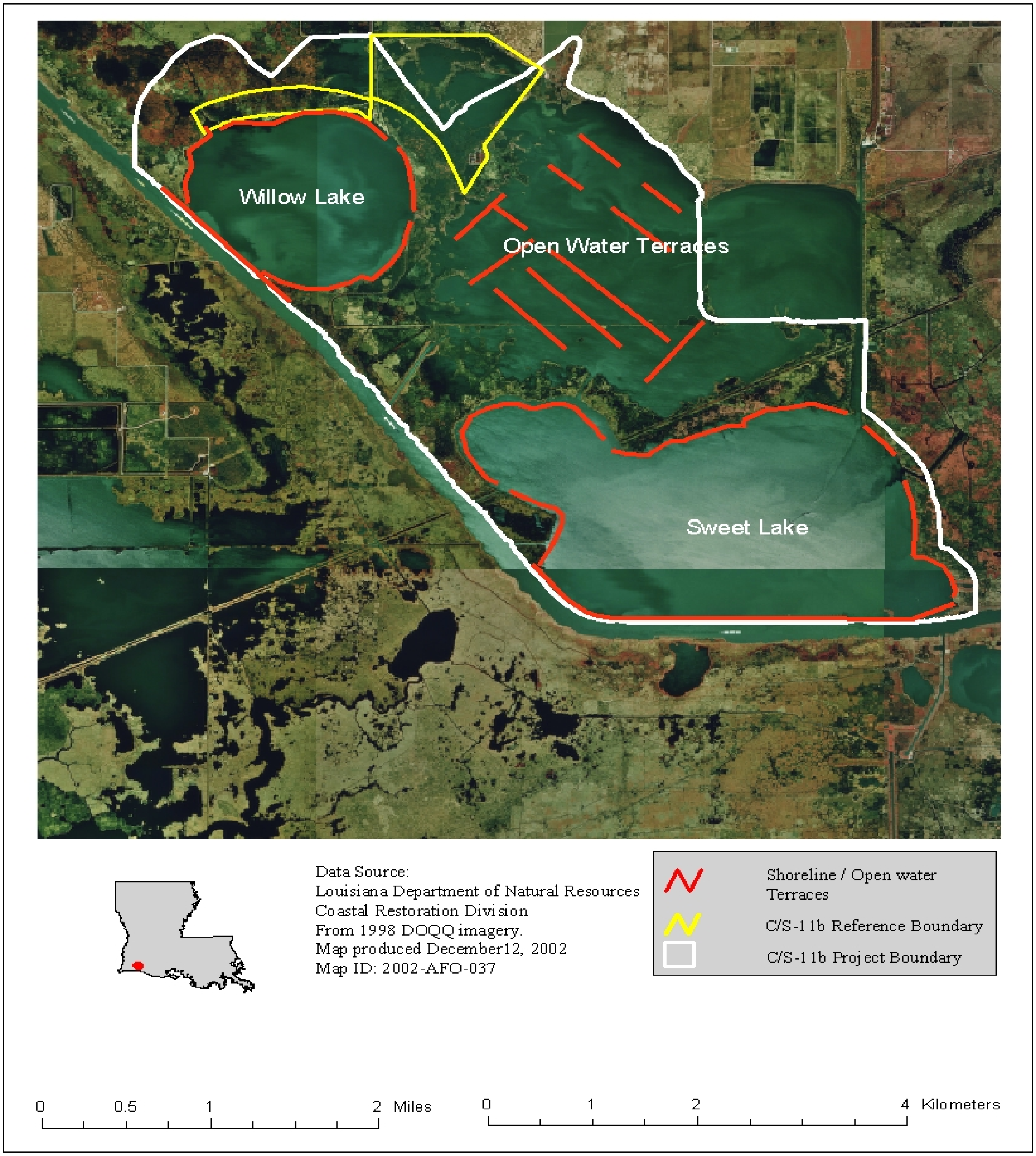

Figure 1. Sweet/Willow Lake (CS-11b) project features, project area boundaries and reference area boundaries.

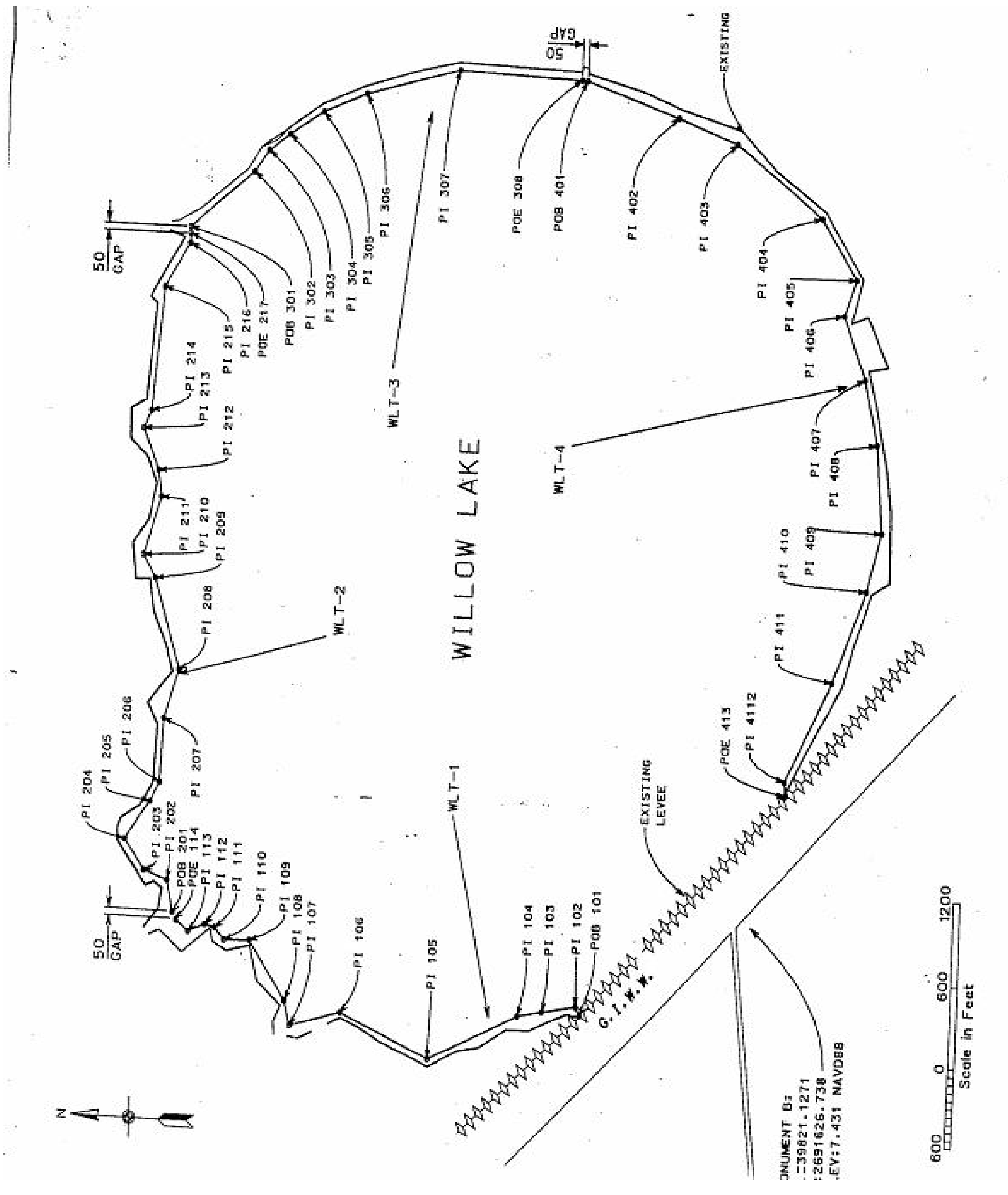

Figure 2. As-built location of shoreline terraces within the Willow Lake area of the Sweet/Willow Lake Hydrologic Restoration (CS-11b) project area.

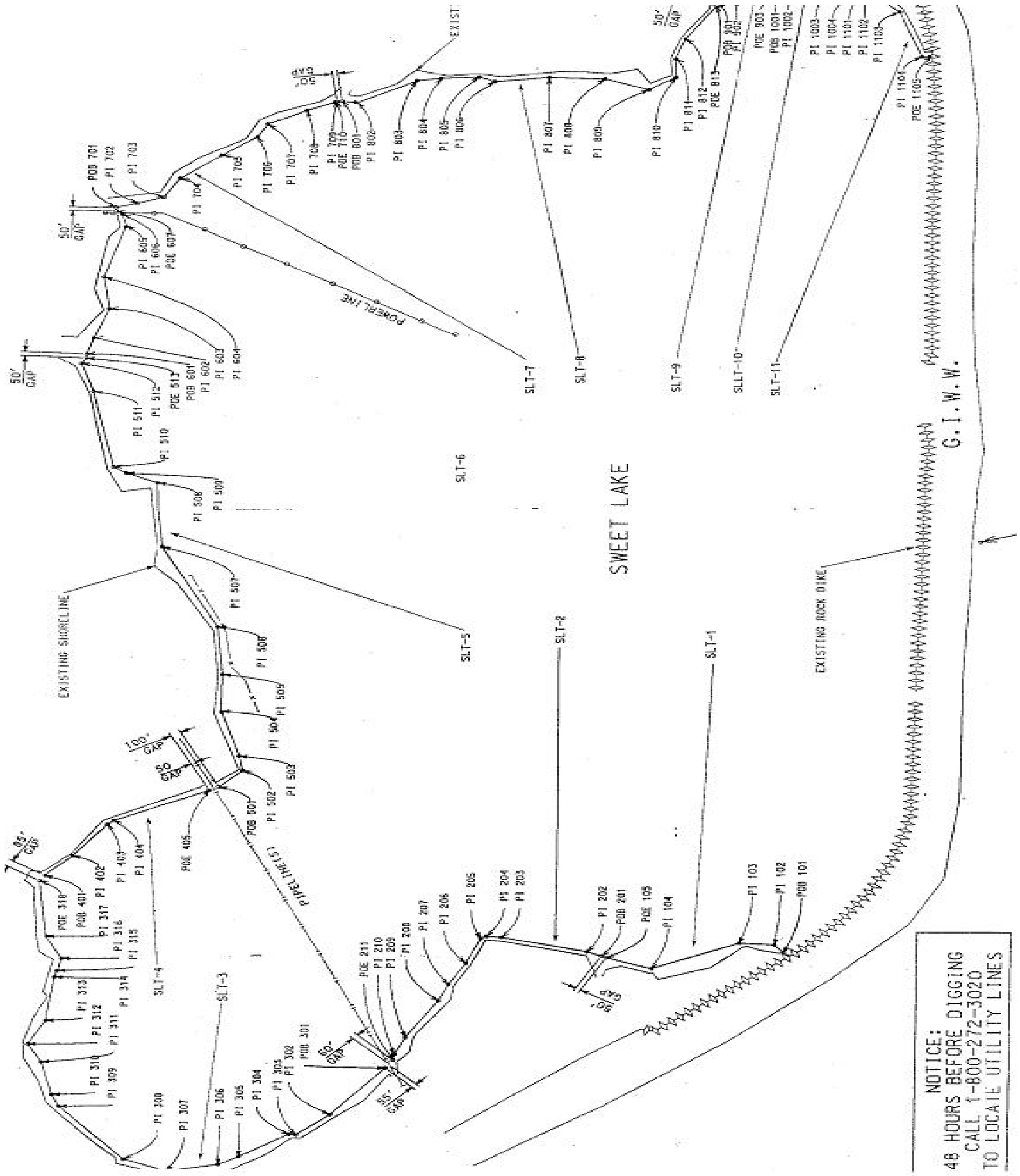

Figure 3. As-built location of shoreline terraces within the Sweet Lake area of the Sweet/Willow Lake Hydrologic Restoration (CS-11b) project area.

I Maintenance Activity

a. Project Feature Inspection Procedures

The purpose of the annual inspection of the Sweet/Willow Lake Hydrologic Restoration Project (CS-11b) is to evaluate the constructed project features to identify any deficiencies and prepare a report detailing the condition of project features and recommended corrective actions needed. Should it be determined that corrective actions are needed, LDNR shall provide, in the report, a detailed cost estimate for engineering, design, supervision, inspection, and construction contingencies, and an assessment of the urgency of such repairs (LDNR 2002). The project was inspected on November 18, 2003, by Stan Aucoin, Pat Landry and Dewey Billodeau of CED and Glenn Harris & Steve Reagan of USFWS.

The field inspection included a complete visual inspection of the entire rock dikes from the GIWW. Photographs were taken and a Field Inspection form was completed in the field to record measurements and deficiencies. Vegetative planting and earthen terraces were not inspected.

b. Inspection Results

The dikes are in good condition. There are a few low places along the length of the rock dike. No gauges were available to determine the water level.

c. Maintenance Recommendations

i. Immediate/ Emergency Repairs
None

ii. Programmatic/ Routine Repairs
None

II. Operation Activity

a. Operation Plan

There are no active operations associated with this project.

b. Actual Operations

There are no active operations associated with this project.

IV. Monitoring Activity

a. Project Objective and Goals

The objectives of the Sweet/Willow Lake Hydrologic Restoration Project are to protect the emergent marsh by reducing shoreline erosion and to increase the acreage of emergent and submerged aquatic vegetation (SAV) within the project area.

The following goals will contribute to the evaluation of the above objectives:

1. Reduce the erosion rate along the Sweet Lake shoreline adjacent to the vegetative plantings of *Zizaniopsis mileacea*.

2. Decrease the rate of marsh loss in the terracing/vegetative planting section of the project area.

3. Increase the coverage of emergent wetland vegetation and submerged aquatic vegetation (SAV) in the shallow open water areas in the terracing/vegetative planting section of the project.

b. Monitoring Elements

Aerial Photography: To document land and open water areas, and marsh loss/gain rates in the terracing/planting section of the project area and the terracing reference area, near-vertical, color-infrared aerial photography (1:12,000 scale) was obtained in 1998 prior to construction, and will be obtained, post-construction in 2009 and 2016. The original photography was checked for flight accuracy, color correctness, and clarity and was subsequently archived. Aerial photography was scanned, mosaicked, and georectified by USGS/NWRC personnel according to standard operating procedures (Steyer et al. 1995) for determining land-to-water ratios and corresponding acreage through GIS analysis. In addition, the length of the shoreline of Sweet Lake adjacent to the vegetation plantings will be determined using the most current aerial photography available at the time of construction. Shoreline length will be used to estimate marsh loss/gains along the Sweet Lake shoreline over time using shoreline erosion rates determined through Global Position System (GPS) shoreline surveys, as described below.

Shoreline Change: To document shoreline movement along the Sweet Lake shoreline, GPS surveys of unobstructed sections of shoreline adjacent to the *Z. mileacea* plantings were conducted in August 2001, at the vegetative edge of the bank (figure 5). A survey monument established in the vicinity of the rock dike was used to establish a GPS control point at the beginning and end of each day of surveying. GPS readings taken at this control point were used as an accuracy check and for determining error associated with each GPS shoreline survey. Future shoreline surveys will be conducted post-construction in 2004, 2009, and 2016. A similar survey was conducted concurrently along a 1-mi (1.6 km) long section of the north shoreline of Willow Lake in reference area 1 (figure 1) for use as a reference.

Vegetation Plantings: The survival and general condition of the *Z. mileacea p*lantings along the Sweet Lake shoreline were documented by monitoring a 5% subsample of the plantings randomly selected from areas where GPS surveys were conducted. Each sampling plot consists of 16 plants. The locations were marked with a labeled post and a GPS reading. Within each sampling plot, survival was determined as a percentage of the number of live plants to the number planted (percent survival = no. plants/no. planted x 100), after Mendelssohn and Hester (1988) and Mendelssohn et al. (1991). Survival was monitored 1 month post-planting in 2001 and 1 year post-planting in 2002. Data will be collected in 2004, 2009, and 2016, or until the individual plantings become indistinguishable. These data will be used to determine if the plantings have an effect on the Sweet Lake shoreline erosion rate, as compared with rates similarly estimated along Willow Lake shoreline in reference area 1, as described above.

In order to determine planting success, and to estimate the amount (acreage) of emergent vegetation that becomes established on the terraces, random sampling plots of 16 plants were established to include a 3% sub-sample of the *Z. mileacea* plantings on the terraces constructed in the open water area north of Sweet Lake. Each plot includes 16 plants, and consists of a rectangular section of terrace with eight plantings that parallel each side of the terrace section. The area of each plot was determined by measuring the length and width of the terrace for each plot. Ocular estimates of percent canopy cover were recorded for each plot. The percent cover for each plot was broken down into the percent cover provided by the *Z. mileacea* plantings, by other wetland and upland species. The terracing plantings will also be monitored in 2004, 2009, and 2016.

Submerged Aquatic Vegetation: The rake method (Chabreck and Hoffpauir 1962; Nyman and Chabreck 1996) was used to document changes in the relative frequency of SAV in the project and reference areas. Transects were established in the shallow open water area north of Sweet Lake where the terraces and plantings were installed. For comparison and use as a reference, transects were similarly established in an open water area in the marsh northeast of Willow Lake. Open water areas were sampled for presence or absence of SAV at 25 to100 random points along each transect line, depending on the size of the water body. Species composition and relative frequency of occurrence (frequency = number of occurrences/number of samples taken x 100) were determined. Because extensive colonies of *Eichhornia crassipes* are likely to be present in the open water areas during the fall season, SAV was monitored during May in 2000 pre-construction and will be monitored post-construction in 2004, 2009, and 2016.

IV. Monitoring Activity

c. Preliminary Monitoring Results and Discussion

Aerial Photography

Pre-construction land to water classification from photography obtained December 17, 1998 indicated 23.0% land and 77.0% water within the project area versus 44.0% land and 56.0% water within reference area (figure 4).

Shoreline Change

Data were collected in August 2001 (pre-construction) as baseline data and will be used to verify shoreline position over time (figure 5).

Vegetative Plantings

Data collected 1 month post-planting in December 2001, and 1 year post-planting in November 2002 on the open water terraces indicate mean survival of *Z. mileacea* decreased from 80.2 % to 33.7 % (figures 6 and 7).

Data collected in October 2002 on shoreline terraces along the Sweet Lake and Willow Lake perimeters indicate initial mean survival was 83.4 %and 94.1 % respectively (figures 8 and 9).

Submerged Aquatic Vegetation

Data collected pre-construction in May 2000 indicate unvegetated areas within the project and reference areas were 50.9 % and 27.2 %, respectively (figure 10 and 11). *Ruppia maritima* (widgeon grass) was found only in the project area while *Nelumbo lutea* (water lily) was found only in the reference area. Species present in both the project and reference area included *Vallisneria americana* (water celery), *Ceratophyllum demersum* (coontail) and an unidentified green alga.

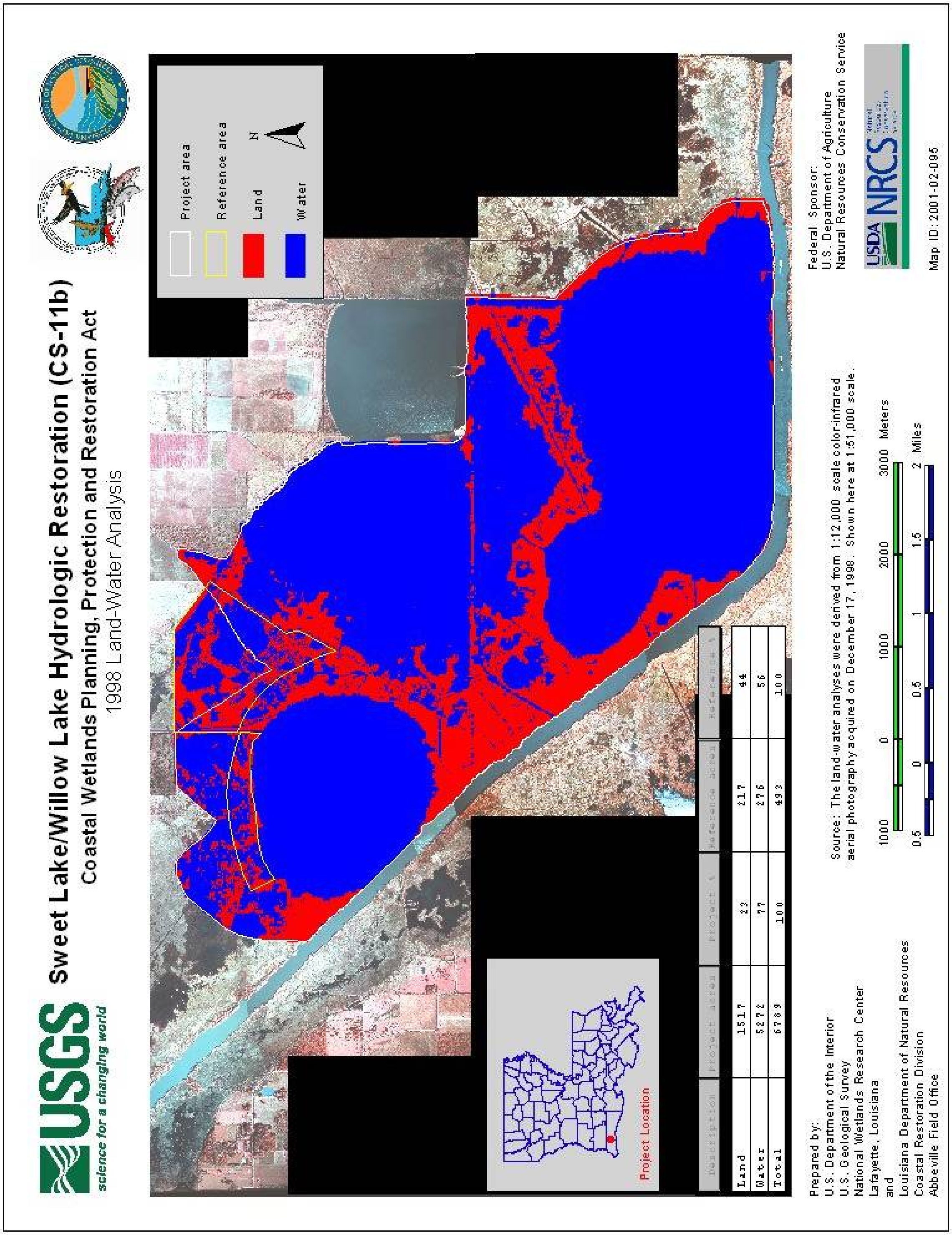

Figure 4. Land to Water analysis of the Sweet/Willow Lake Hydrologic Restoration (CS-11b) project area from photography obtained December 17, 1998.

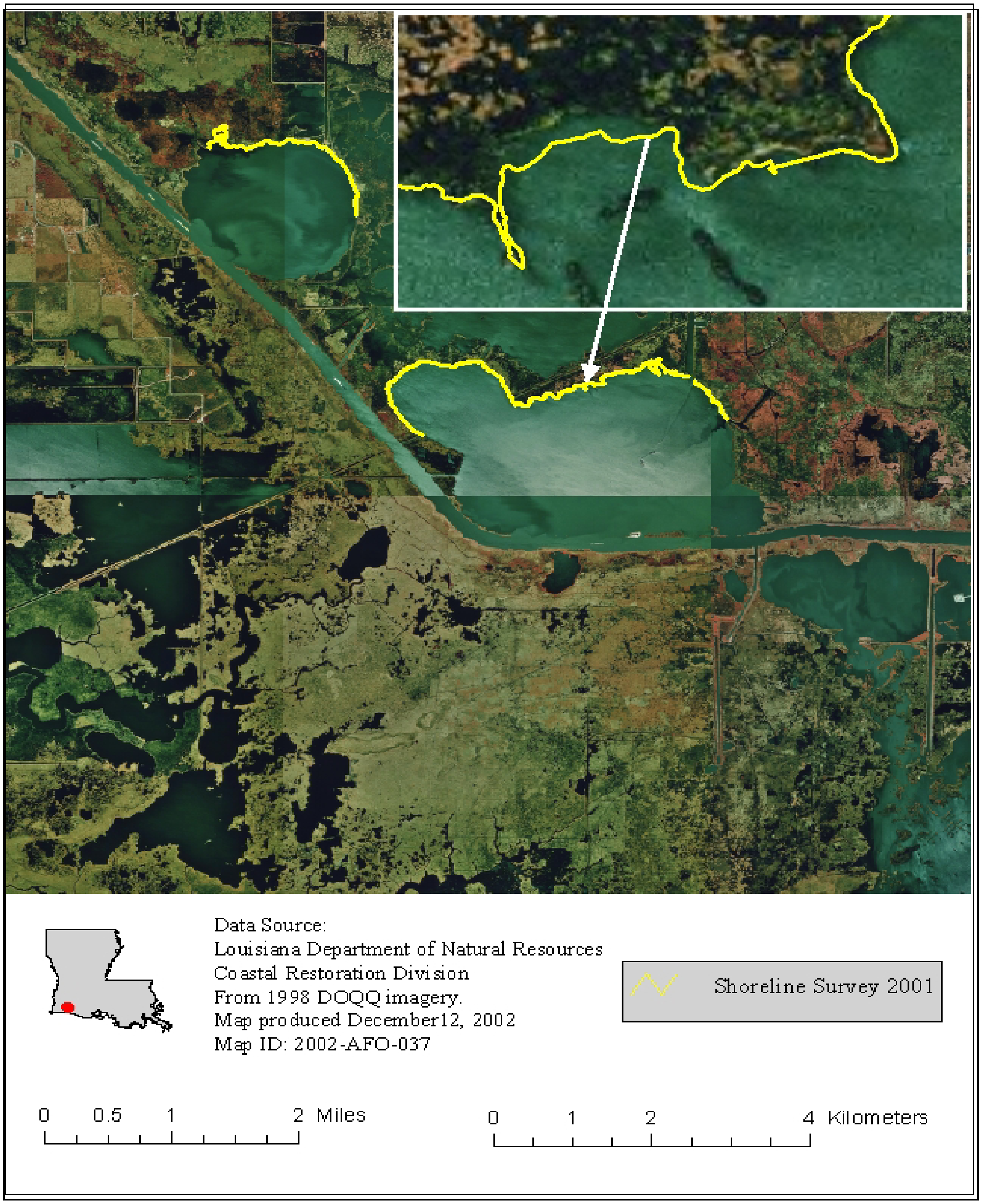

Figure 5. Baseline shoreline position survey of the Sweet/Willow Lake Hydrologic Restoration (CS-11b) project area from data obtained August 2001.

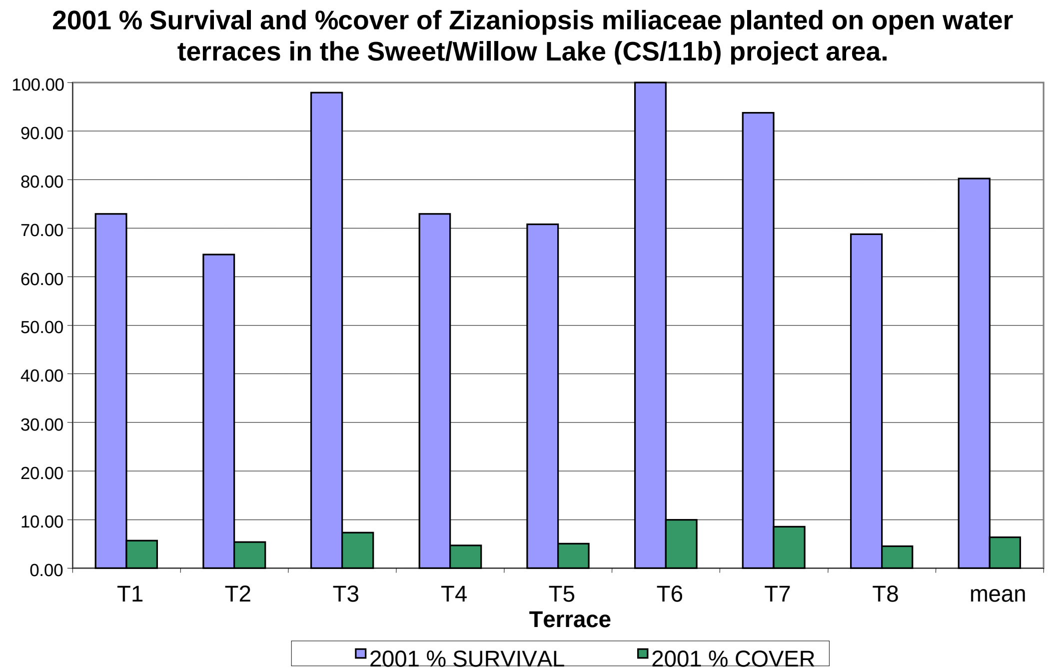

Figure 6. Percent survival and percent cover of vegetative plantings on the open water terraces located in the Sweet/Willow Lake Hydrologic Restoration (CS-11b) project area sampled 1 month post-planting in December 2001.

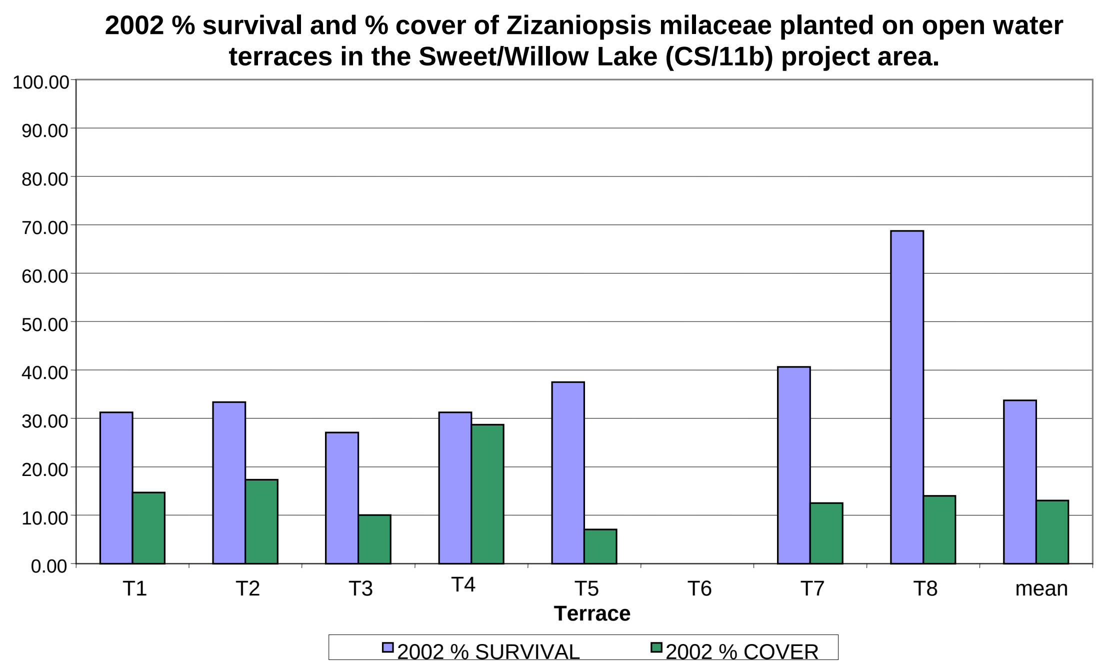

Figure 7. Percent survival and percent cover of vegetative plantings on the open water terraces located in the Sweet/Willow Lake Hydrologic Restoration (CS-11b) project area sampled 1 year post-planting in November 2002.

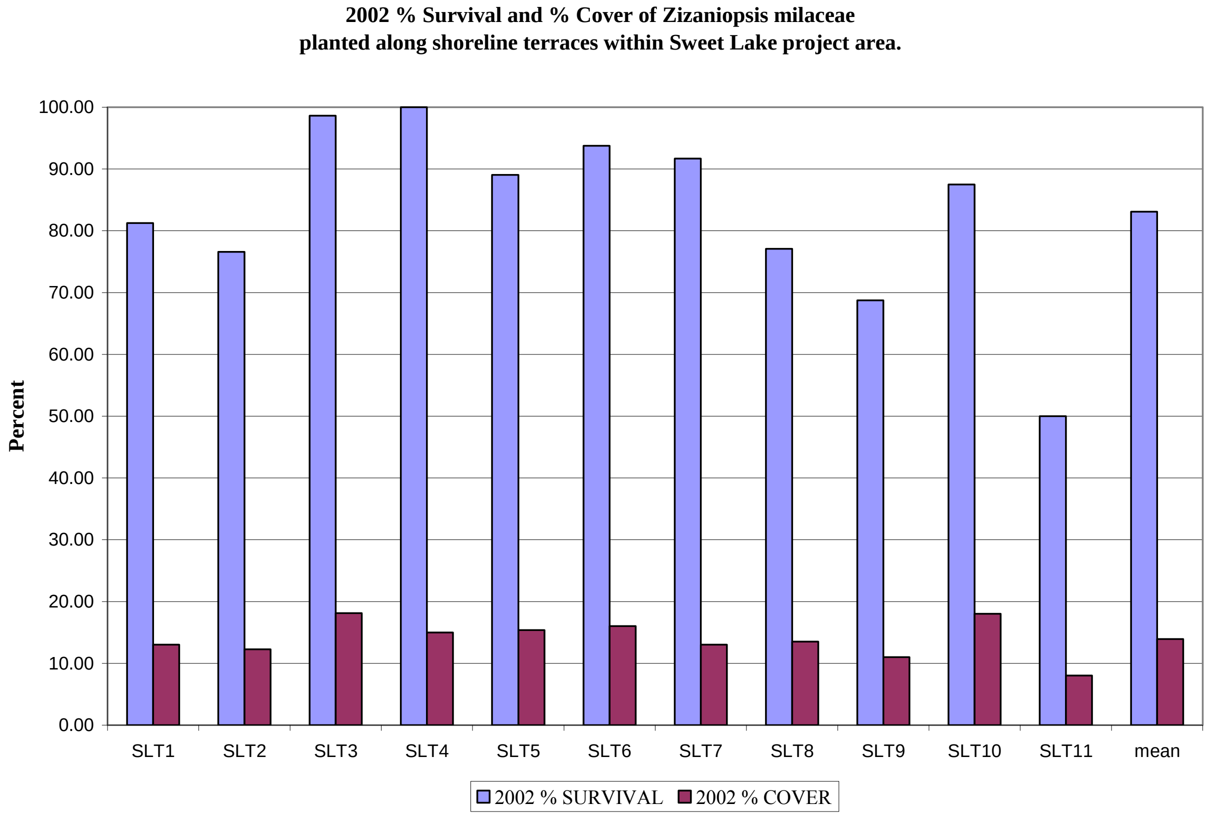

Figure 8. Percent survival and percent cover of vegetative plantings along the Sweet Lake shoreline terraces located in the Sweet/Willow Lake Hydrologic Restoration (CS-11b) project area sampled when post-planting in October 2002.

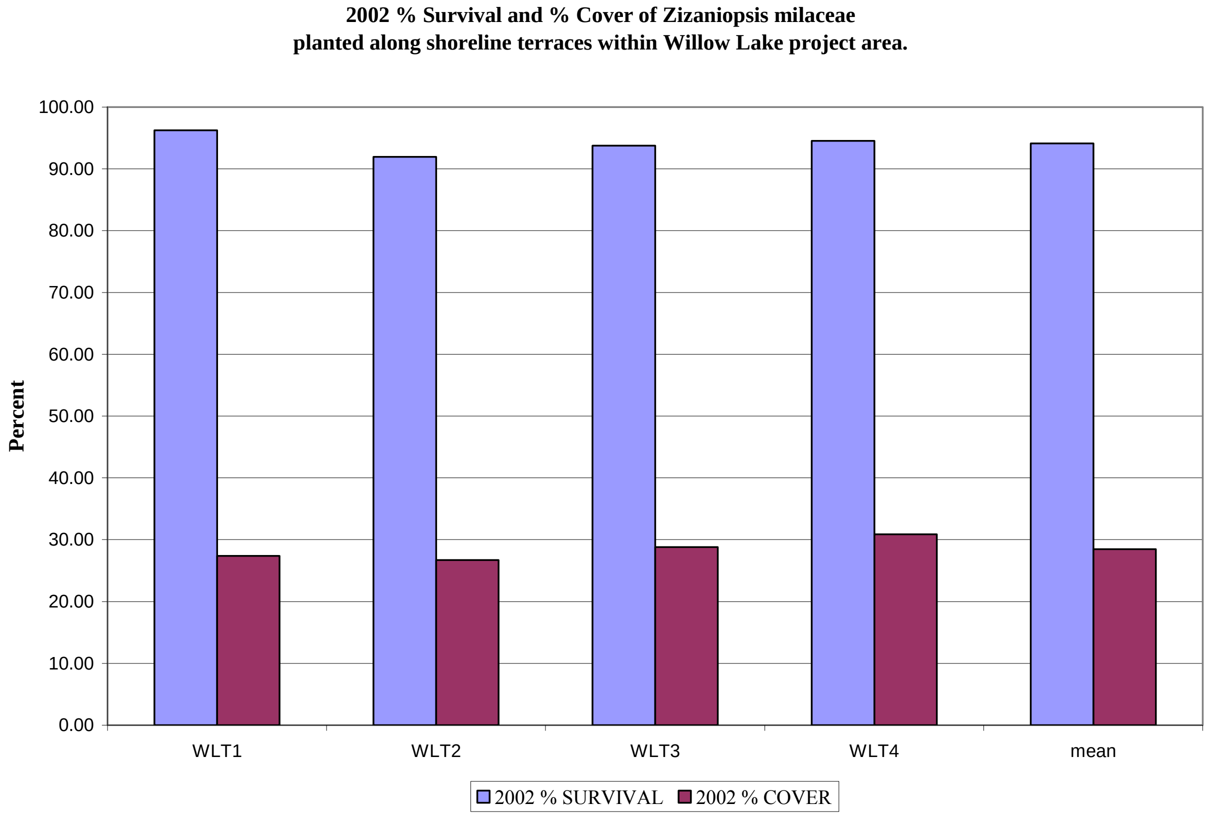

Figure 9. Percent survival and percent cover of vegetative plantings along the Willow Lake shoreline terraces located in the Sweet/Willow Lake Hydrologic Restoration (CS-11b) project area sampled when post-planting in October 2002.

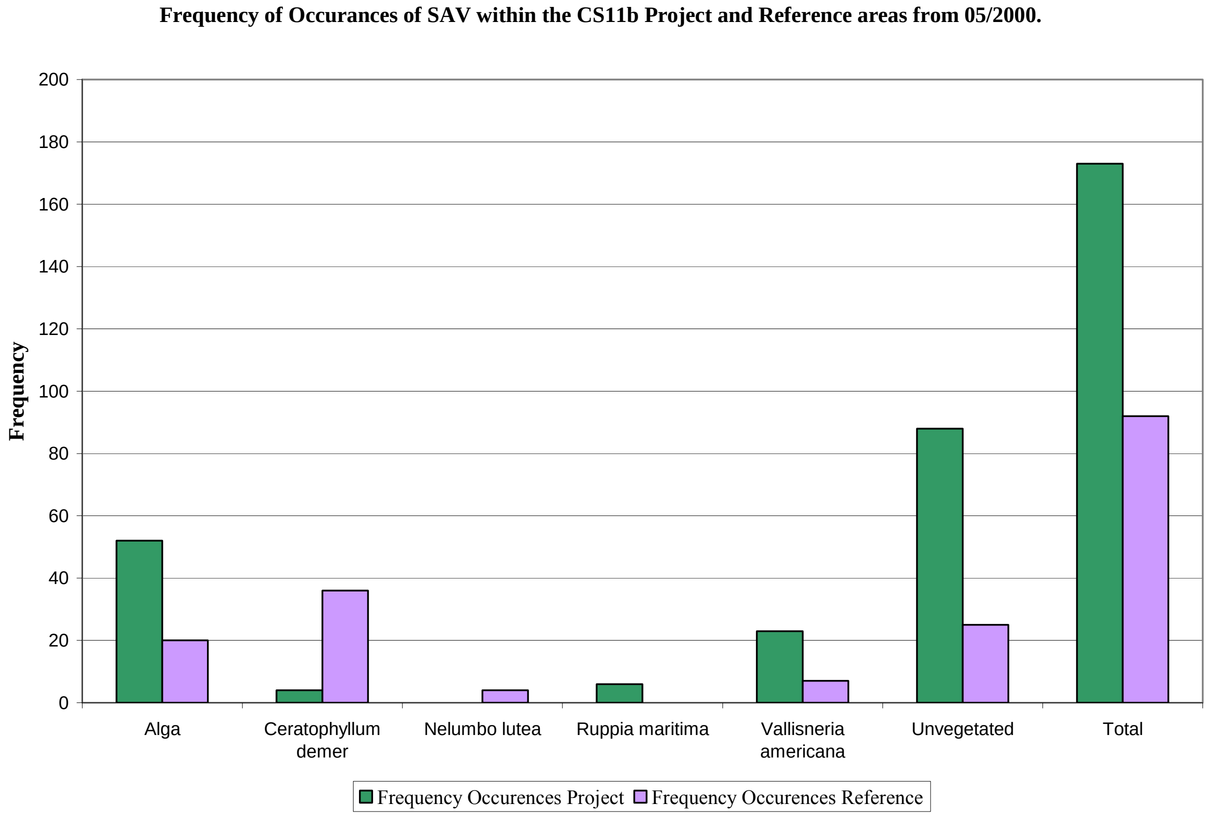

Figure 10. Frequency of occurrence of submerged aquatic vegetation in the Sweet/Willow Lake Hydrologic Restoration (CS-11b) project and reference areas, sampled pre-construction in May 2000. Frequency = number of occurrences species present from the total number of samples taken. (project n = 173, reference n = 92)

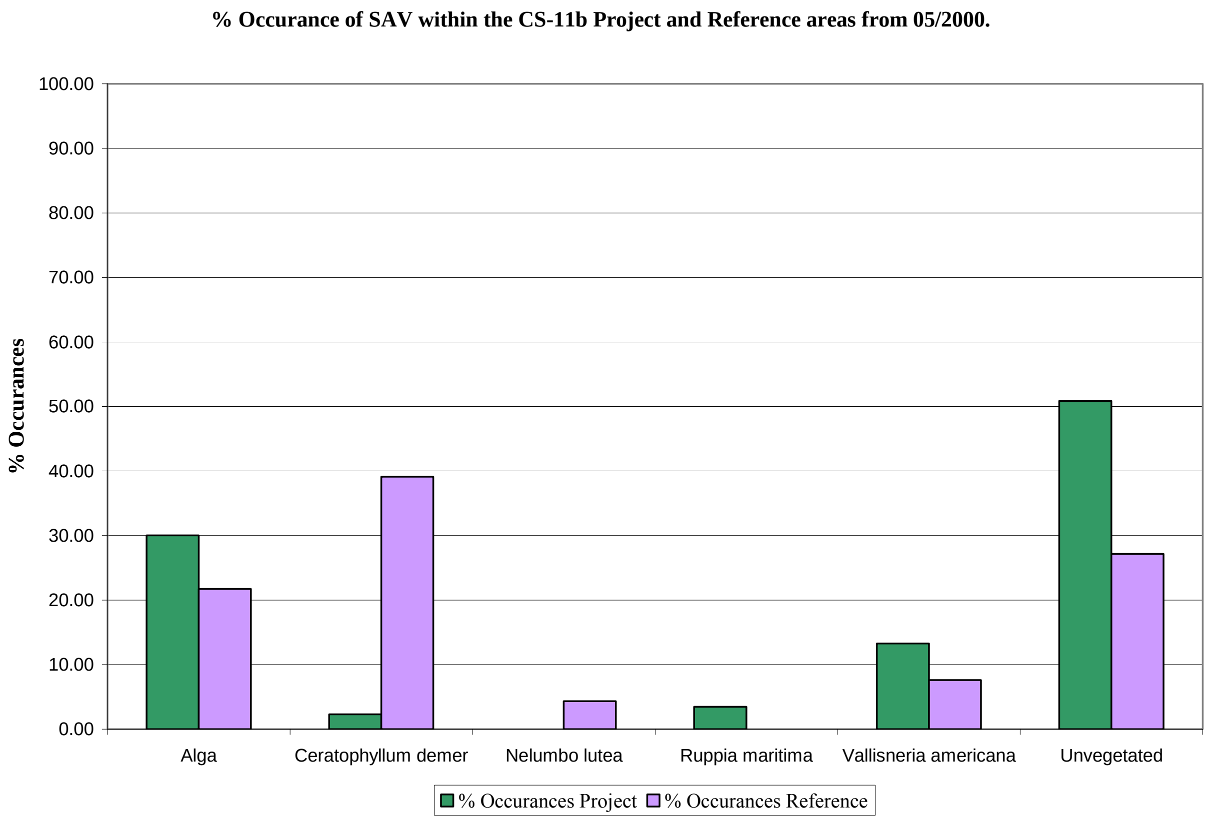

Figure 11. 2000 preconstruction data for percent occurrences of submerged aquatic vegetation within the Sweet/Willow Lake Hydrologic Restoration (CS-11b) project and reference areas. Percentage = number of occurrences/number of samples taken x 100.

V. Conclusions

a. Project Effectiveness

The rock dike is very effective at restraining the volume of water and suspended sediments that once flowed into the GIWW. This will allow interior sediment deposition over time thus allowing for the interior marshes to be revived.

The open water terraces were ineffective at reducing wave energy (Pers. Obs. Mike Miller). The lack of consolidated material and high water events during construction caused the terraces to deteriorate rapidly. The vegetative plantings were ineffective when planted along the unconsolidated open water terraces. The lack of suitable planting medium and rapid terrace deterioration did not allow enough time for the plantings to become established.

Observations made during monitoring events suggest that the shoreline terraces in Sweet Lake and Willow Lake are moderately effective at reducing wave energy (Pers. Obs. Mike Miller). High water during construction and the long fetch generated wave erosion, causing the crowns of the terraces to deteriorate until the water levels subsided. Initial data collected for *Z. mileacea* plantings indicated a high percent survival with low cover values. This is expected until the plantings become established over time.

b. Recommended Improvements

In order to evaluate dike settlement, stability of the rock structure, toe scour, and any vertical accretion on the land side of the rock structure, a structural assessment survey performed by a licensed engineering/land surveying firm is recommended within the first 5 years of construction. The date of assessment survey is to be agreed upon by the state and federal sponsor at the annual maintenance inspection.

Staff gages are needed in the vicinity of the project area.

c. Lessons Learned

Based on multiple O & M inspections, the foreshore rock dike has proven to be very effective in reducing shoreline erosion along the GIWW, while experiencing no deterioration and requiring little maintenance.

Vegetative plantings should be installed as early as possible within the growing season to allow time for the plantings to become established.

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