WATER QUALITY TARGET REFINEMENT PROJECT

Task 2: Seagrass Target Development

Interim Report 2

Prepared for:

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1. INTRODUCTION

1.1 Purpose

The Charlotte Harbor National Estuary Program (CHNEP) identified the need to develop water quality targets that preserve and restore seagrass health throughout the estuarine system. The resource based water quality targets address the Priority Problems identified in the CHNEP Comprehensive Conservation and Management Plan (CCMP) of Hydrologic Alterations and Water Quality Degradation. Initial resource based water quality targets were developed based on measured depth of seagrass growth and percent light requirements (CHNEP, 2006).

CHNEP recently contracted with Janicki Environmental, Inc. to complete the "Water Quality Target Refinement Project." The purpose of this project is to develop resource-based water quality targets based on seagrass targets. The project includes four tasks:

1. refine CHNEP harbor segmentation scheme;
2. determine seagrass targets based on historical acreage;
3. develop water clarity targets; and
4. develop pollutant loading estimates.

This is Interim Report 2, which summarizes the results of Task 2.

Establishment of seagrass targets provides a necessary basis for management decisions regarding water quality and other issues that can influence the distribution and persistence of this valuable submerged habitat. The primary goal of this project is to establish targets designed to maintain and/or restore seagrass acreage to its historical extent. Restoration targets are defined through an analysis of historic and recent aerial surveys of the study area. Historic photos of the area were taken around 1950. As many alterations have occurred to the shoreline in the study area, as well as channelization of the Intracoastal Waterway (ICW), the following analyses have accounted for these changes as non-restorable areas. Additionally, trends in seagrass coverage throughout the CHNEP, based on recent aerial surveys, have been identified. These analyses are not an assessment of the quality of seagrasses currently or historically present in Charlotte Harbor, nor are they intended to identify causal explanations for the observed changes in seagrass distribution over time.

1.2 Location

The Charlotte Harbor estuarine system is located in southwest Florida (Figure 1-1) and includes 224,000 acres (230 square miles) of estuaries downstream from a 3,008,000 acre (4,700 square mile) watershed. The CHNEP is a partnership of citizens, elected officials, resource managers and commercial and recreational resource users working to improve the water quality and ecological integrity of the greater charlotte Harbor watershed. A cooperative decision-making process is used within the program to address diverse resource management concerns in the study area.

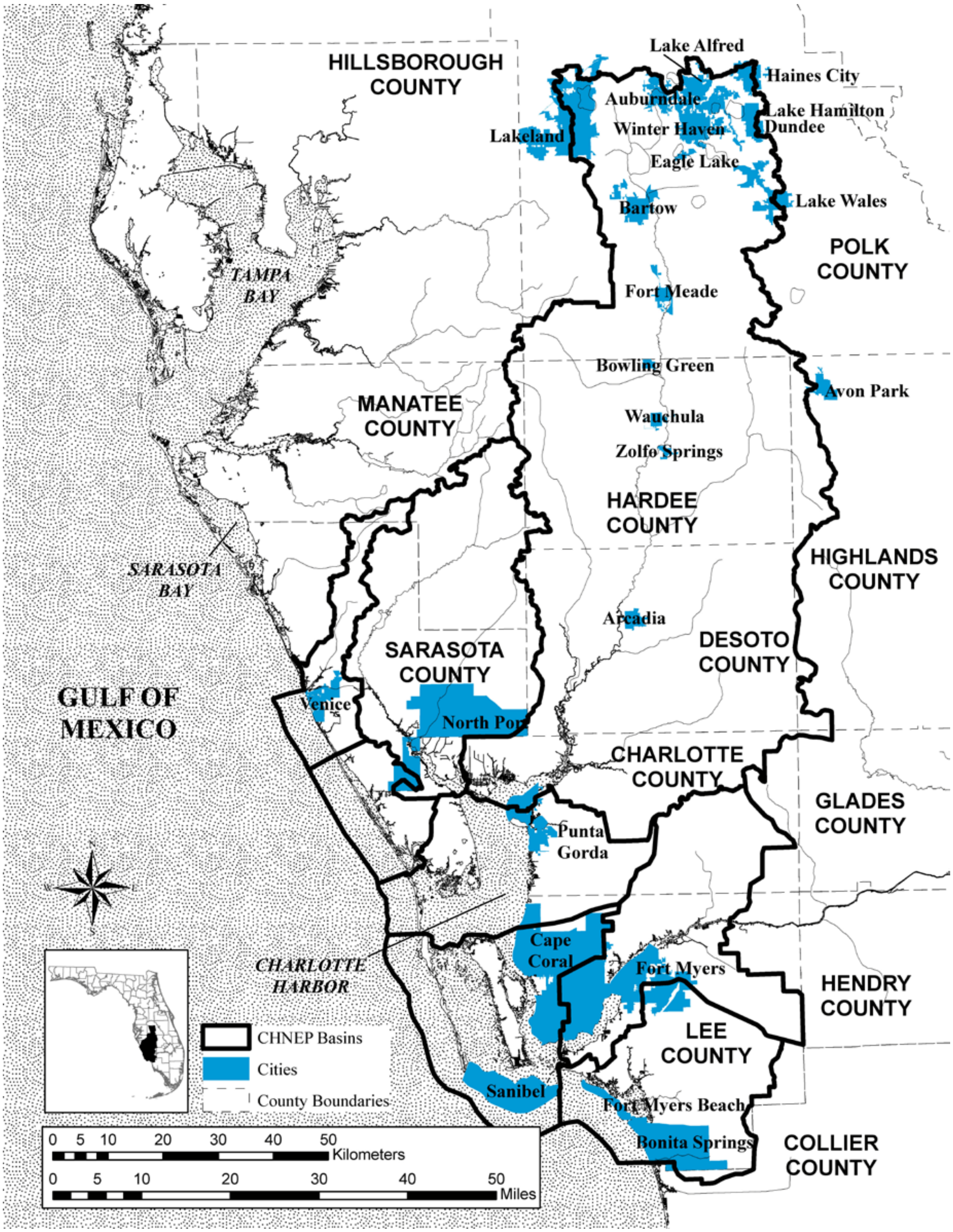

Figure 1-1. Location of CHNEP estuaries and watershed.

1.3 Background

Seagrasses are an important marine resource, functioning as keystone species in healthy estuaries. Seagrasses are sessile organisms that are effective integrators of water quality and function as sentinel species in estuarine and marine environments (Orth *et al.*, 2006). The strong link between water quality and seagrass distribution makes seagrass a good indicator of ecosystem health (Tomasko *et al.*, 1996; Dawes *et al*., 2004; Moore *et al.*, 2004; and Greening and Janicki, 2006). Healthy seagrass populations are critical resources that provide a multitude of benefits to estuarine ecosystems (Dawes *et al.*, 2004) including:

- providing structural habitat for recreationally and commercially important fish and invertebrate species and stabilization of submerged shoreline sediments,
- providing support for epiphytic and macro algae, and
- functioning as an important component of nutrient cycles.

In addition to providing habitat and food for invertebrates, small vertebrate marine organisms, and large grazing herbivores, seagrass beds also support epiphytic and macro algae as substrata for their development. Seagrass communities constitute highly productive and diverse ecosystems, in part due to the presence of these epiphytes, which include diatoms, green algae, and cyanobacteria (Moncreiff and Sullivan, 2001). The epiphytic algal assemblage present on the surface of seagrass leaves functions as a primary food source within these communities, in addition to the seagrasses and their detrital material (Moncreiff and Sullivan, 2001). Macro algae also attach themselves to seagrasses for stability, and thus increase diversity within these systems (Janicki *et al.*, 1995).

Nutrient cycling and assimilation is another of the many habitat function that seagrass communities provide. Seagrasses filter nutrients and contaminants, which helps improve water quality and support adjacent habitats and fisheries (Dawes *et al.*, 2004). They are hotspots for organic-matter accumulation and nutrient regeneration and recycling, which support primary production and sustain food webs (Dawes *et al.*, 2004). They can also serve as sinks for nitrogenous loads from watershed sources, which can aid attenuation of nutrient loads when seagrasses are found sufficiently abundant.

Anthropogenic nitrogen loads can lead to excessive algae growth, which adversely affects light penetration to submerged seagrasses (Dennison *et al*., 1993; SBEP, 1995; CHNEP, 2000; Chesapeake Bay Program, 2000; Morris and Virnstein, 2004; Greening and Janicki, 2006). Sediment deposition related to development of shorelines and the watershed also negatively impact seagrass growth (Moore *et al.*, 2004). As seagrasses live in the shallow, protected coastal waters that are generally directly proximal to the shore and watershed, these systems are highly susceptible to nutrient and sediment inputs (Orth, *et al.*, 2006).

A vast array of estuarine and marine organisms relies upon seagrass habitats for a portion or all of their life cycles (Dawes *et al.*, 2004). The canopy structure of a seagrass bed provides protection and cover for fish in their fry and juvenile stages, essentially serving as a nursery ground (Dawes *et al.*, 2004; Orth *et al.*, 2006). Primary production within seagrass beds provides food for recreationally and commercially important fish species and serves as a trophic foundation for the ecosystem. Additionally, megaherbivores such as sea turtles and manatees graze on seagrasses as an important food source (Orth *et al.*, 2006). The stability for these valuable habitats is provided by the hearty root systems of seagrasses (Janicki *et al.*, 1995). These root systems provide stability not only for the seagrass communities, but also for sediments and the benthic production that is found at the sea floor (Dawes *et al.*, 2004).

Seagrass restoration is a major focus in the management of many estuarine resources including the following estuaries:

- Chesapeake Bay,
- Long Island Sound,
- Indian River Lagoon,
- Tampa Bay, and
- Sarasota Bay.

A common pattern in seagrass coverage has emerged throughout each region. As the shorelines and watersheds proximal to seagrass beds become more developed, anthropogenic loadings of nitrogen and sediments have increased. These increases in loadings have had detrimental effects on water quality; of particular importance to seagrass health are the resultant algal blooms from nitrogenous loads and increased turbidity from sedimentation. Algal blooms and increased turbidity each negatively impact light attenuation in the water column above seagrass communities, which is devastating to green leafy plants. Seagrass populations have declined as such.

As researchers and managers within these systems began to identify this pattern, the notion of seagrass as an ecological bellwether developed. As sentinel species, due to the effectiveness of seagrasses to integrate water quality parameters, these communities were soon realized to be *in-situ* indicators of estuarine health and thus employed as components of watershed-based management and planning tools. Harbor-wide water quality was inherently linked to seagrass health, which was then used as an indicator of the success of efforts to reduce watershed pollutant loads, in estuaries as diverse as Chesapeake Bay, Long Island Sound, the Indian River Lagoon, Tampa Bay, and Sarasota Bay.

The Chesapeake Bay program was the first major estuary in the United States to make seagrass restoration and protection a vital component of their water pollution control framework. The 1987 Chesapeake Bay Agreement identified the "need to determine the essential elements of habitat quality and environmental quality necessary to support living resources and to see that these conditions are attained and maintained" as instrumental to overall bay health. Researchers in Chesapeake Bay estimated that only about 15% of the bay's historical seagrass distribution presently exists (Moore *et al.*, 2004). Having reviewed aerial photography dating back to 1937, the researchers suggested that these declines in seagrass were linked to deteriorating water quality conditions in Chesapeake Bay (Moore *et al.*, 2004). The Chesapeake Bay Program (2002) established seagrass restoration targets and defined water quality and habitat-based requirements for seagrasses in Chesapeake Bay.

Similar to Chesapeake Bay, the Indian River Lagoon (IRL), on Florida's east coast, witnessed a dramatic decrease in seagrass coverage. This decline is seagrass coverage occurred while development of the watershed increased and water quality declined. Since 1980, some regions within the IRL have lost up to 95% of their coverage (Virnstein *et al*., 2007; Rey and Rutledge, 2001). This trend prompted the Indian River Lagoon National Estuary Program (1996) to initiate a seagrass restoration program within its boundaries, in recognition of the unique and valuable contribution of these communities to overall ecosystem health (Morris and Virnstein, 2004). It is estimated that, within the IRL, seagrasses form the foundation of a fishery industry worth approximately one billion dollars annual (Rey and Rutledge, 2001).

The conceptual model for this current CHNEP study was originally developed for the Tampa Bay Estuary Program. After decades of losses, seagrass meadows were identified by the Tampa Bay Estuary Program (TBEP) as critical estuarine habitats for fish and wildlife targeted for protection and restoration (Janicki *et al.*, 1995). In addition to the proximity that Charlotte Harbor and Tampa Bay have with one another on Florida's west coast, similar patterns of development and urbanization also make Tampa Bay a relevant framework for establishing seagrass protection and restoration targets in Charlotte Harbor. The methodology employed in the present study is based largely on work done by the TBEP in 1995.

Multiple studies have been completed on seagrass communities in Sarasota Bay in recent years, with a focus on water quality and spatial and temporal and trends in seagrasses. Sarasota Bay is of particular importance to the present study due to its proximal location to the CHNEP. Tomasko *et al.* (1996) analyzed the impacts of anthropogenic nutrient loads on distribution patterns within four turtle grass meadows in Sarasota Bay. Turtle grass biomass and productivity was negatively correlated with watershed nitrogen inputs (Tomasko *et al.*, 1996). Additionally, light attenuation has been studied in relation to Sarasota Bay's seagrass communities (Dixon and Kirkpatrick, 1995). The researchers have asserted that light limitation is a major factor in losses of seagrasses at the deep edge of once-extensive meadows (Dixon and Kirkpatrick, 1995). The Sarasota Bay Estuary Program has identified light attenuation as a controlling abiotic factor in the density and distribution of seagrass beds within Sarasota Bay (Dixon and Kirkpatrick, 1995).

Five species of seagrasses have been observed in the Charlotte Harbor ecosystem, and are generally found in waters less than 6 ft deep (CHNEP, 1999). The seagrasses found in Charlotte Harbor are likely depth limited by water transparency as in other Floridian estuaries, including Tampa Bay and Indian River Lagoon (CHNEP, 1999). Variability in seagrass distribution has been observed in Charlotte Harbor seagrasses since 1945, on both a long-term and year-to-year basis (CHNEP, 1999). A recent study of seagrass communities in Charlotte Harbor has documented observable decreases in acreage on the order of 29% throughout the ecosystem from 1945 to 1982, with an overall 6% decrease in the period from 1982 to 1999 (Corbett, 2006). Corbett (2006) stressed the importance of watershed alterations, in addition to anthropogenic nutrient loading, which were likely causative in the long-term decrease of seagrasses, including dredging and construction programs, such as the Intracoastal Waterway (ICW) and the Sanibel Bridge, and freshwater inflow alterations from the Myakka, Peace, and Caloosahatchee rivers. Interannual variability in rainfall is directly related to freshwater inflows, with wet years resulting in lost seagrass coverage and drier years leading to gains (CHNEP, 1999).

As in other West Central Florida estuaries, reduced availability of light has been linked to loss of seagrasses, particularly in deeper waters, in Charlotte Harbor (McPherson and Miller, 1994; Dixon and Kirkpatrick, 1999). Increasing turbidity and total suspended solids can account for up to half of all light attenuation in Charlotte Harbor, having a direct impact on the health of seagrass communities (Dixon and Kirkpatrick, 1999). McPherson and Miller (1994) cited these factors, as well as nutrient and color loads from the freshwater inflow coming from the Peace River, as major causes of light attenuation in Charlotte Harbor, particularly the northern portions of the system.

Kurz *et al.* (1999) examined recent trends in seagrass distribution in coastal waters throughout Southwest Florida, including Charlotte Harbor. Tomasko *et al.* (2005) observed that seagrass remained relatively constant in Lemon Bay and Charlotte Harbor from the 1980s through 2002. However, the researchers also observed more extensive seagrass coverage in 2002 in

Sarasota Bay and Tampa Bay than in the 1980s, linked to decreases in anthropogenic nitrogen loads in these watersheds and greater water clarity. These results suggest that a system-specific approach is an appropriate resource management strategy (Tomasko *et al.*, 2005).

1.4 Study Area

The CHNEP is comprised of 14 harbor segments (Figure 1-2), as defined in Task 1:

- Coastal Venice,
- Upper Lemon Bay,
- Lower Lemon Bay,
- Tidal Myakka River,
- Tidal Peace River,
- West Wall,
- East Wall,
- Cape Haze,
- Bokeelia,
- Pine Island Sound,
- Matlacha Pass,
- San Carlos Bay,
- Tidal Caloosahatchee River, and
- Estero Bay.

The analyses for this project were performed by harbor segment, as defined in Figure 1-1, and are presented as such in this report.

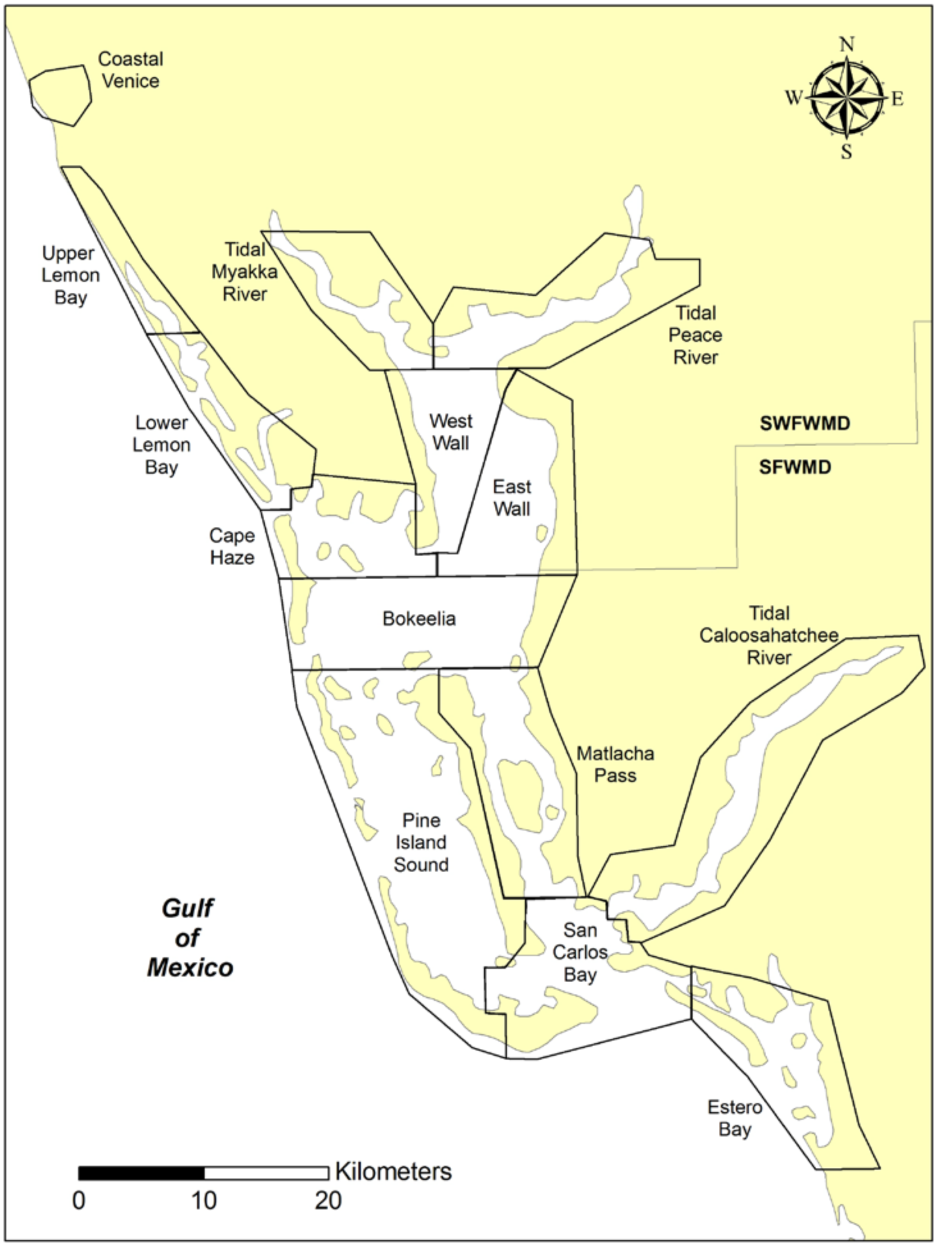

Figure 1-2. Location of harbor segments of the Charlotte Harbor National Estuary Program.

2. METHODS

The following section summarizes the methodology defined by Janicki *et al.* (2008) for the development of seagrass targets in the Charlotte Harbor estuary system. To set seagrass targets, the following data are required:

- baseline (historic) seagrass coverage,
- current and recent seagrass coverages, and
- current shoreline extent.

The seagrass targets are based on the spatial extent of 1950 baseline seagrass coverage in Charlotte Harbor. The 1950 baseline provides the best available estimate of pre-development seagrass distribution since a consistent set of aerial photos and photo-interpretation were used. A similar baseline was used to establish seagrass targets for Tampa Bay in the mid-1990s (Greening and Janicki, 2006) and more recently, Sarasota Bay (Janicki *et al*., 2009).

It should be noted that the use of aerial photography provides a repeatable, quantitative tool that can be used to estimate seagrass coverage in the harbor. The estimates derived using this tool should be considered as a consistent but relative estimate rather than an estimate of absolute seagrass acreage. It is likely that the actual seagrass coverage is greater than that derived from aerial photography due to some minimum but unknown density of seagrass required to be identified by this method. The method does not differentiate seagrasses based on density, species, or quality.

2.1 Data Sources

Below is a description of the data sources used as the foundation for establishing seagrass protection and restoration targets.

2.1.1 Baseline Seagrass Coverage

Baseline seagrass coverage was determined through photo-interpretation of aerial photos of the study area from circa 1950 obtained from the National Archives in Washington, DC. A contract to Photo Science for photo-interpretation services provided electronic data coverage of the area of interest for the CHNEP using ArcGIS (ESRI 2009). The time of the year in which these photos were taken is variable, however, the recent rainfall in the Charlotte Harbor watershed is not known.

The baseline data from 1950 include a category for areas that may have potentially been seagrasses, but could not be classified as seagrasses as a result of limitations to the photo interpretation process. These areas were instead classified as ‘9999’ and are documented in Appendix A.

2.1.2 Recent Seagrass Coverages

Recent seagrass coverages are provided by the Southwest Florida Water Management District (SWFWMD) for the northern segments of the harbor system and by the South Florida Water Management District (SFWMD) for the southern segments.

SWFWMD has produced a series of seagrass GIS coverages performed at intermittent intervals since 1988. These coverages were developed through photo interpretation work performed by Photo Science, Inc. GIS shapefiles for seagrass extent in the northern segments of Charlotte Harbor are available for the following years:

- October, 1988,
- January, 1994,
- December, 1999,
- January, 2002,
- January, 2004 , and
- February, 2006.

Current seagrass extent is available from the SFWMD. The projects conducted to provide these data included:

- Estero Bay 2006 Seagrass Distribution from Boca Grande to Wiggins Pass Seagrass Mapping Project.
- Estero Bay 2004 Seagrass Distribution from Boca Grande to Wiggins Pass Post 2004 Hurricanes Project.
- 2003 seagrass extent is available from the SFWMD Lower Charlotte Harbor Seagrass Mapping and Estero Bay Seagrass Mapping Project.
- 1999 seagrass extent is available from the Southwest Florida Seagrass Project, produced for the Florida Marine Research Institute (FMRI) in partnership with SFWMD.

2.1.3 Shorelines

SWFWMD and SFWMD provide the current shoreline data for the harbor system.

Additionally, harbor segment boundaries and ICW spatial data were needed for this analysis. A shapefile containing harbor segment boundary data was provided by CHNEP. A shapefile of the ICW extent was developed through digitization of its current location based on topographical maps.

2.2 Description of GIS Analysis

Seagrass acreages were calculated by survey year and by harbor segment. The post-1988 GIS coverages contain two classes of seagrass coverage, patchy and continuous. No distinction was made between patchy and continuous seagrasses. The seagrass acreage estimates represent the sum of both classes which is consistent with the methodology used by the TBEP and the SBEP. This was accomplished by joining the seagrass shapefiles with the harbor segment shapefile defined in Task 1. The areal estimate within each harbor segment was then calculated using ArcGIS V9.3 (ESRI 2009).

Non-restorable areas were also calculated using ArcGIS. The 1950 seagrass coverage was intersected with the shoreline and ICW coverages (Janicki *et al.*, 2008). These areas include filled and dredged areas. The resultant shapefile includes areas where seagrass recovery cannot reasonably be expected to occur. The non-restorable areas shapefile was then joined with the harbor segment shapefile. The area of each non-restorable area polygon was then calculated and summed by harbor segment.

The results of these analyses yield a baseline seagrass extent, an estimate of non-restorable areas, and recent estimates of seagrass coverage in the system, which will be used to determine seagrass restoration targets in the Charlotte Harbor system.

3. RESULTS

This section presents the results of the analysis of historical seagrass acreages, recent seagrass acreages, persistence in seagrass coverage, and non-restorable areas.

3.1 Historical Seagrass Acreages

The estimates of the historical seagrass acreages are:

- Coastal Venice - 133 acres
- Upper Lemon Bay - 1,005 acres
- Lower Lemon Bay - 3,114 acres
- Tidal Myakka River - 350 acres
- Tidal Peace River - 1,039 acres
- East Wall - 3,986 acres
- West Wall - 2,117 acres
- Cape Haze - 5,798 acres
- Bokeelia - 3,058 acres
- Pine Island Sound - 24,113 acres
- Matlacha Pass - 9,577 acres
- San Carlos Bay - 3,243 acres
- Tidal Caloosahatchee River - 211 acres
- Estero Bay - 3,769 acres

In total, 61,513 acres are estimated to have been present historically in the CHNEP. Figures 3-1a through 3-1n present maps depicting the spatial extent of historical seagrass.

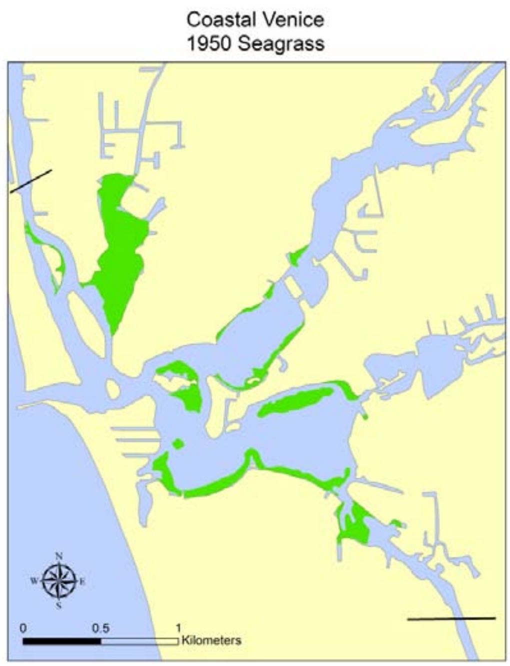

Figure 3-1a. Baseline seagrass coverage in Dona and Roberts Bay

Figure 3-1b. Baseline seagrass coverage in Upper Lemon Bay.

Figure 3-1c. Baseline seagrass coverage in Lower Lemon Bay.

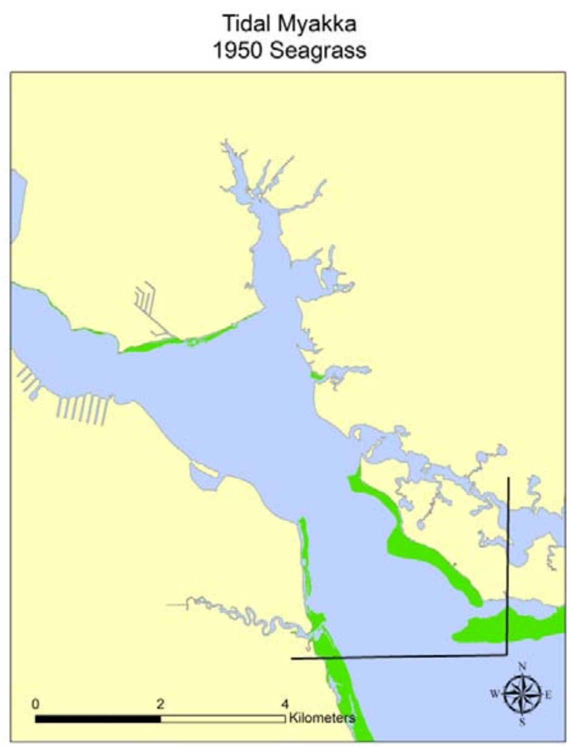

Figure 3-1d. Baseline seagrass coverage in Tidal Myakka River.

Figure 3-1e. Baseline seagrass coverage in Tidal Peace River.

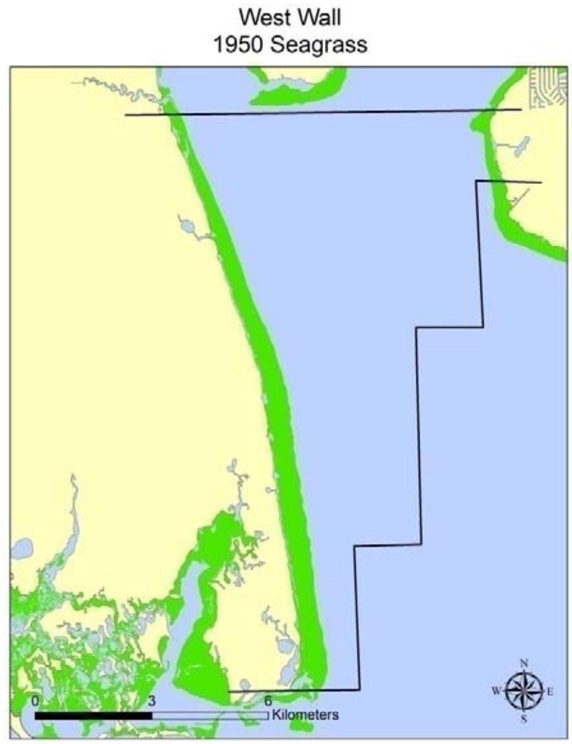

Figure 3-1f. Baseline seagrass coverage in West Wall.

Figure 3-1g. Baseline seagrass coverage in East Wall.

Figure 3-1h. Baseline seagrass coverage in Cape Haze.

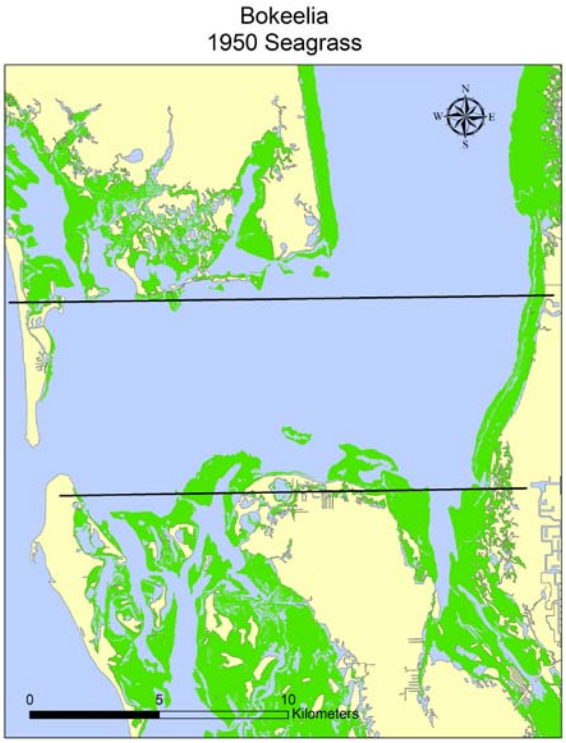

Figure 3-1i. Baseline seagrass coverage in Bokeelia.

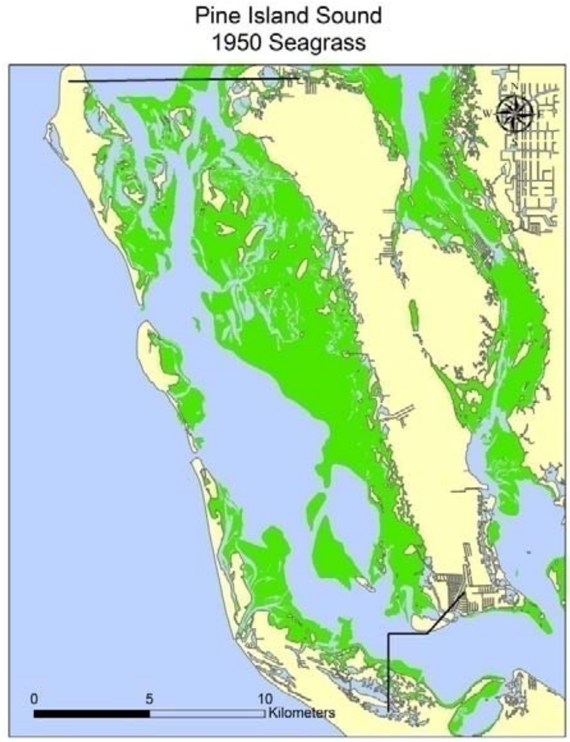

Figure 3-1j. Baseline seagrass coverage in Pine Island Sound.

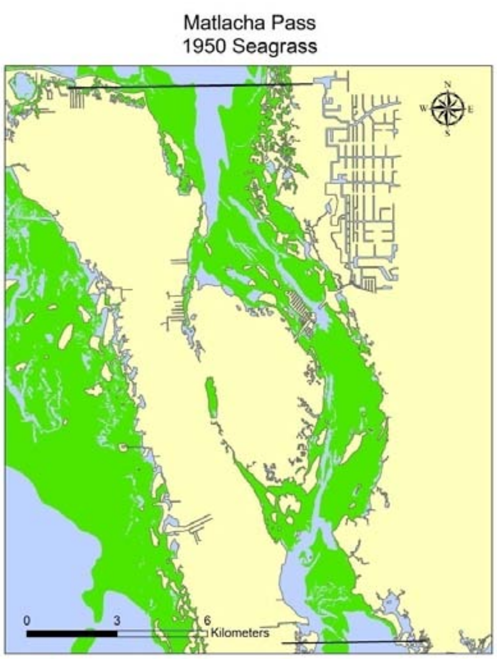

Figure 3-1k. Baseline seagrass coverage in Matlacha Pass.

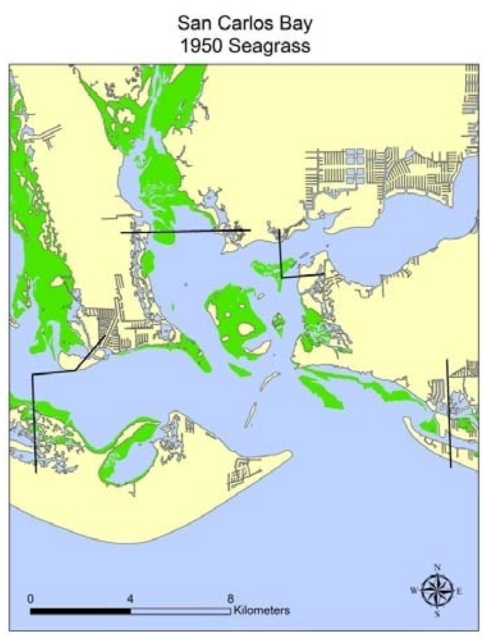

Figure 3-1l. Baseline seagrass coverage in San Carlos Bay.

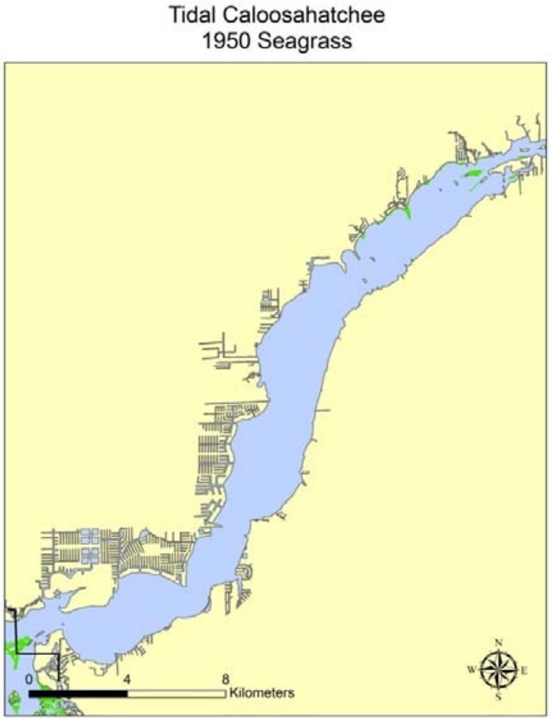

Figure 3-1m. Baseline seagrass coverage in Tidal Caloosahatchee River.

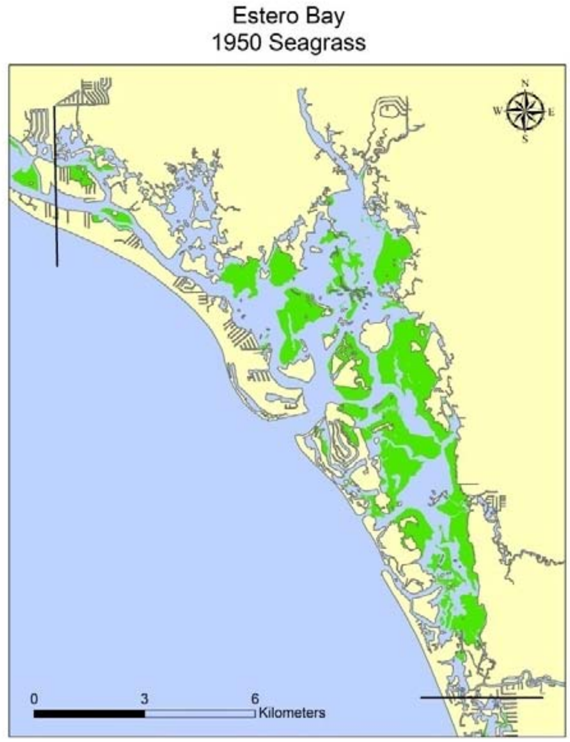

Figure 3-1n. Baseline seagrass coverage in Estero Bay.

As described above there were a number of areas in the historical seagrass coverage identified as '9999' that could not defensibly be defined as seagrass. These areas total approximately 27,000 acres. Most of these areas are located in Lemon Bay, Pine Island Sound, Matlacha Pass, San Carlos Bay, and Estero Bay. Appendix A presents the results of the 9999 analysis.

3.2 Recent Seagrass Acreages

Recent seagrass coverage data throughout the 14 harbor segments within the CHNEP are presented in Tables 3-1 and 3-2. The following observations were made:

- Coastal Venice - seagrass coverage was lowest in 1988 and 1994, but has returned to near baseline levels in 2006.
- Upper Lemon Bay – seagrass coverage has remained relatively consistent throughout the survey period, with the exception of a spike in 2004.
- Lower Lemon Bay - from 1988 through 2006, seagrass coverage was consistent throughout the survey period.
- Tidal Myakka River - seagrass coverage peaked in 1999, but has decreased in the two most recent surveys.
- Tidal Peace River - seagrass coverage has decreased in recent surveys since a peak in 1994.
- West Wall - seagrasses have generally increased in this segment in recent surveys, significantly peaking in 2006.

- East Wall - seagrass has remained relatively constant throughout the survey period, with a slight decrease in 2004 and 2006.
- Cape Haze - very little change in seagrass coverage has been observed from 1988 to 2006.
- Bokeelia - seagrass coverage has been consistent throughout the survey period.
- Pine Island Sound - seagrass coverage has increased each survey of the study period since 1999.
- Matlacha Pass - like in neighboring Pine Island Sound, seagrasses have been increasing in each survey since 1999.
- San Carlos Bay - as in Pine Island Sound and Matlacha Pass, seagrass coverage has increased every year since 1999.
- Tidal Caloosahatchee River – seagrass coverage peaked in 2003, and has remained stable since 2004.
- Estero Bay - seagrass coverage increased significantly between the 2003 and 2004 surveys.

The recent increasing trends in Pine Island Sound, Matlacha Pass and San Carlos Bay are impressive; however, a change in methodology to avoid capturing photographs when turbidity plumes are prevalent in the sampling area may have contributed to this outcome in segments influenced by coastal passes. Maps depicting seagrass coverage for each year of the recent surveys, by harbor segment, can be found in Appendix B. Figures 3-6a through 3-6n present both the baseline and recent seagrass acreages for each harbor segment.

Table 3-1. Annual seagrass coverage (acreages) in the SWFWMD portion of the CHNEP.

Harbor Segment	1988	1994	1999	2001	2004	2006
Dona and Roberts Bay	75	70	88	85	103	124
Upper Lemon Bay	952	1,035	972	973	1,175	949
Lower Lemon Bay	2,509	2,457	2,550	2,500	2,396	2,597
Tidal Myakka River	447	518	539	527	331	375
Tidal Peace River	414	573	302	376	295	341
West Wall	1,676	1,879	1,993	1,989	1,784	2,121
East Wall	3,427	3,526	3,587	3,591	3,275	3,382
Cape Haze	7,068	7,059	6,709	6,776	7,464	6,911
Bokeelia	3,471	3,304	3,101	3,298	3,359	3,520
TOTAL	20,039	20,421	19,841	20,115	20,185	20,320

Table 3-2. Annual seagrass coverage (acreages) in the SFWMD portion of the CHNEP.

Harbor Segment	1999	2003	2004	2006
Pine Island Sound	25,941	26,892	28,034	29,204
Matlacha Pass	6,055	7,182	7,479	7,619
San Carlos Bay	3,709	4,338	5,192	5,376

Tidal Caloosahatchee River	2	103	61	56
Estero Bay	2,488	2,393	3,409	3,298
TOTAL	38,195	40,908	44,175	45,553

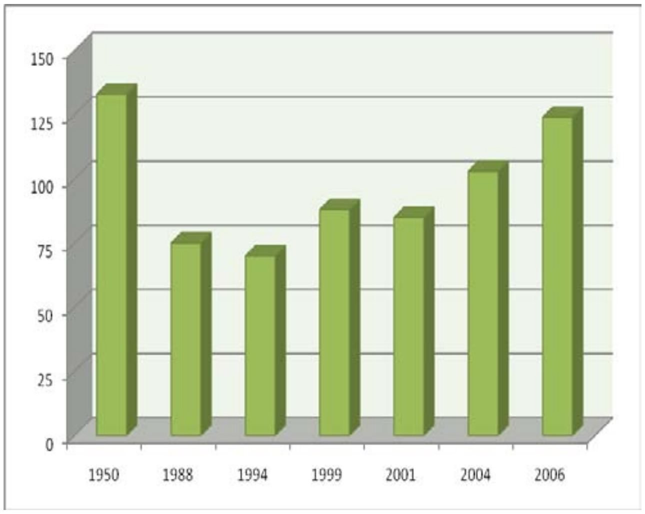

Figure 3-2a. Annual seagrass acreages in Dona and Roberts Bay.

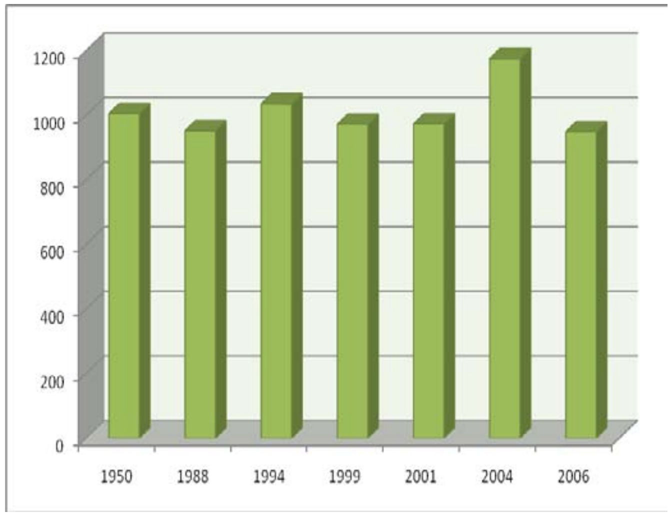

Figure 3-2b. Annual seagrass acreages in Upper Lemon Bay.

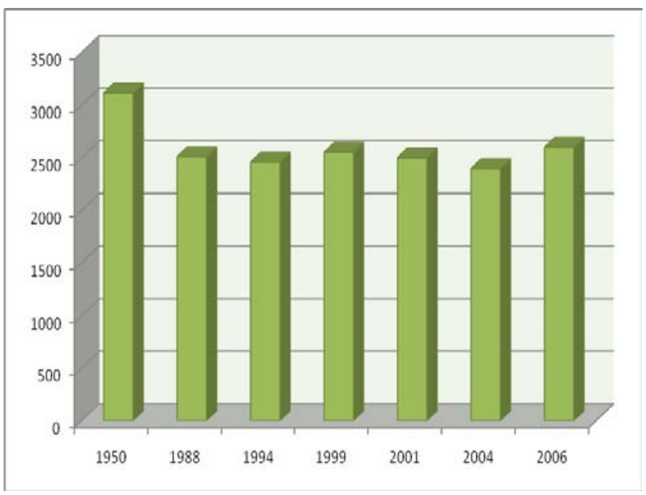

Figure 3-2c. Annual seagrass acreages in Lower Lemon Bay.

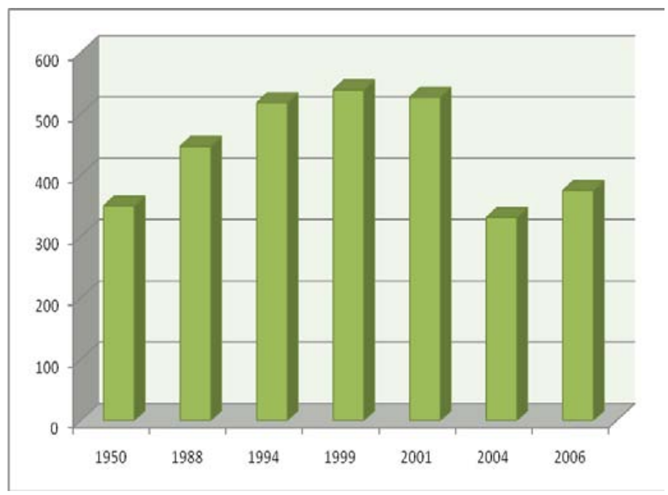

Figure 3-2d. Annual seagrass acreages in Tidal Myakka River.

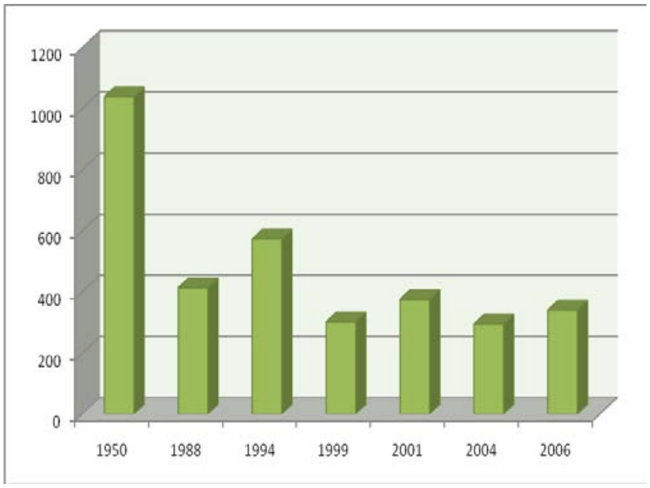

Figure 3-2e. Annual seagrass acreages in Tidal Peace River.

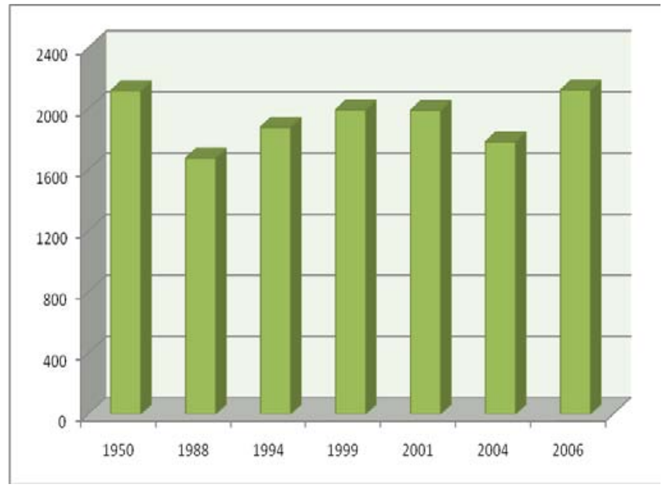

Figure 3-2f. Annual seagrass acreages in West Wall.

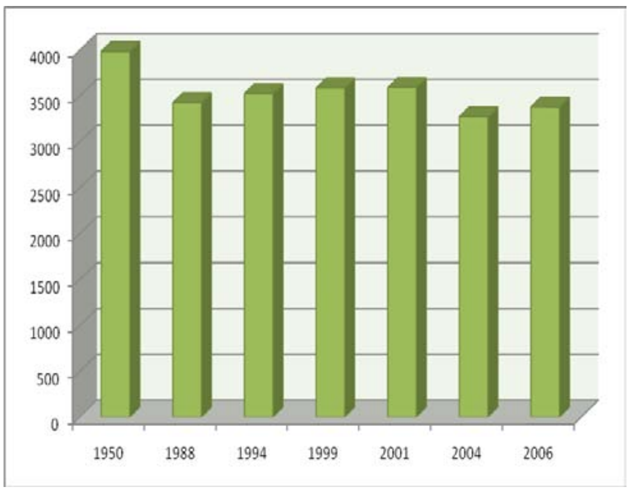

Figure 3-2g. Annual seagrass acreages in East Wall.

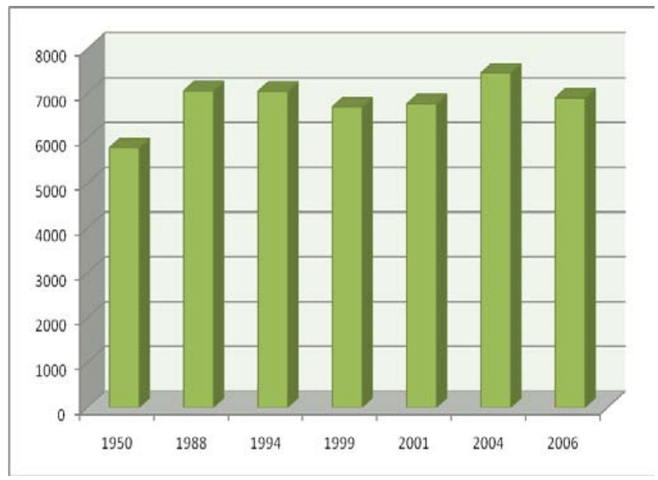

Figure 3-2h. Annual seagrass acreages in Cape Haze.

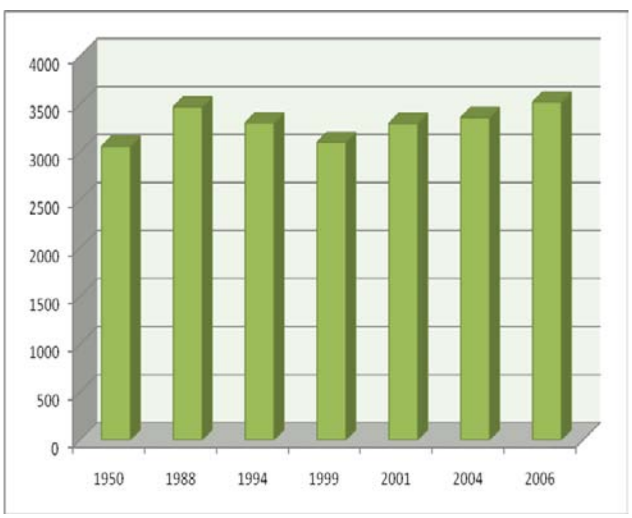

Figure 3-2i. Annual seagrass acreages in Bokeelia.

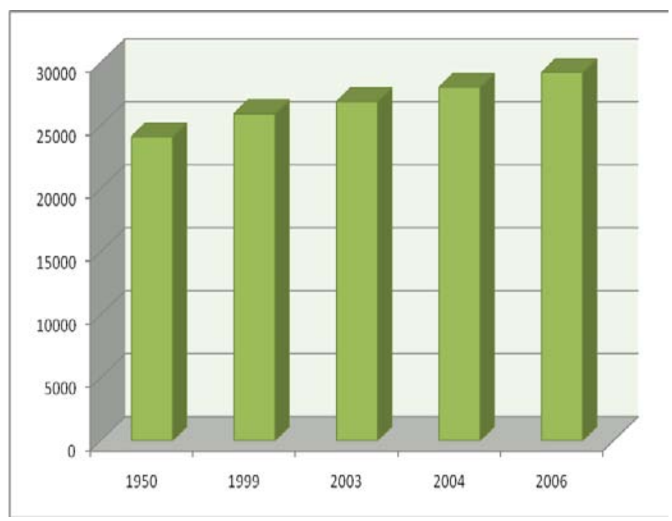

Figure 3-2j. Annual seagrass acreages in Pine Island Sound.

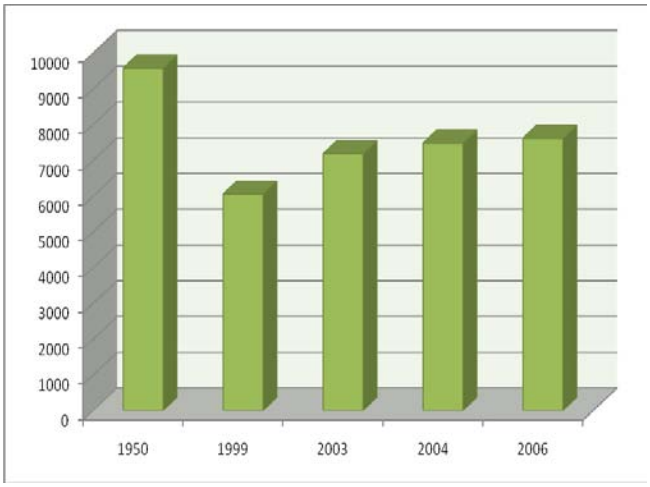

Figure 3-2k. Annual seagrass acreages in Matlacha Pass.

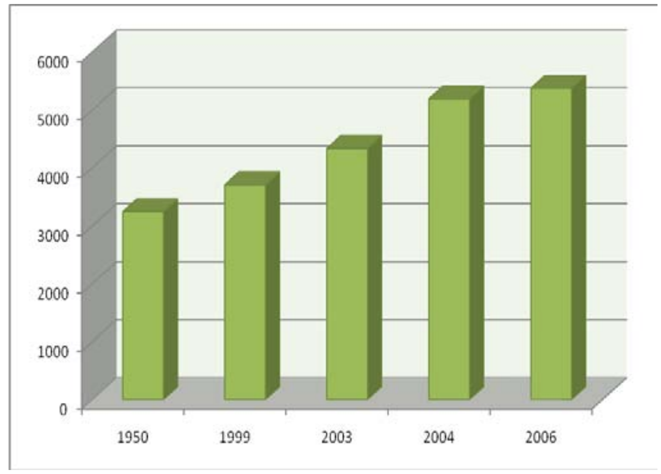

Figure 3-2l. Annual seagrass acreages in San Carlos Bay.

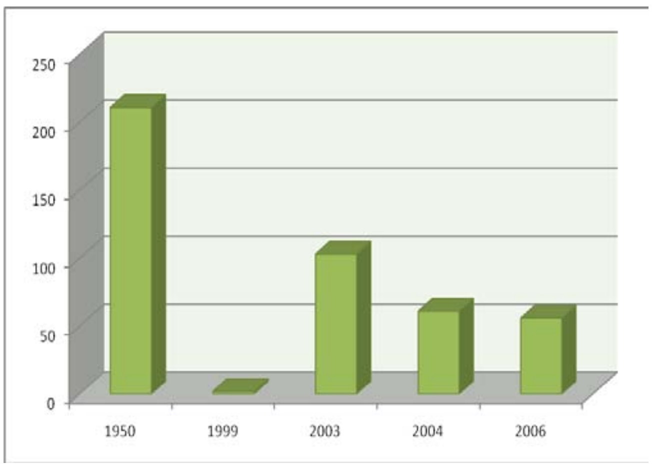

Figure 3-2m. Annual seagrass acreages in Tidal Caloosahatchee River.

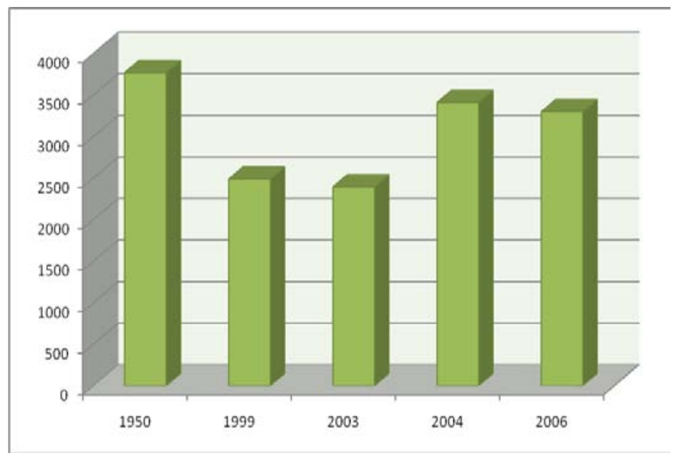

Figure 3-2n. Annual seagrass acreages in Estero Bay.

3.3 Persistence of Seagrass Acreages

Persistence maps were also created based on the recent surveys used to identify areas where seagrasses have been most likely to be found within the CHNEP. Figures 3-4a through 3-4b present the results of the persistence analysis. The most persistent seagrass areas are generally located in the near-shore portions of the estuary, which tend to be shallower. In contrast, the least persistent areas are more likely found in deeper portions of the harbor. Additionally, the results of the persistence analysis show that some areas never have been, nor will likely be, well-suited for seagrass recovery.

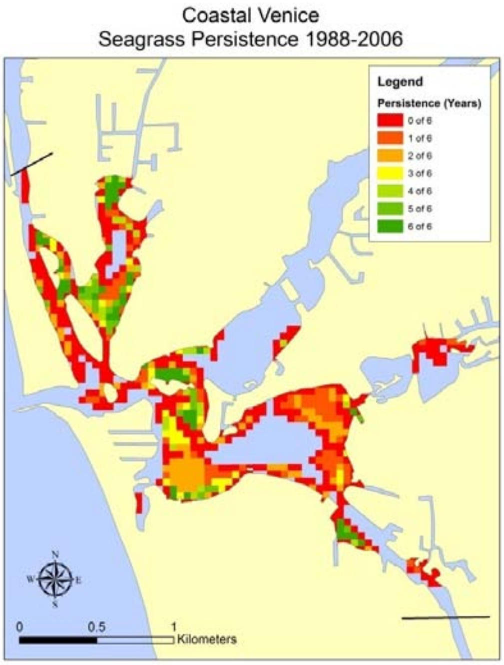

Figure 3-3a. Seagrass persistence in Dona and Roberts Bay 1988-2006..

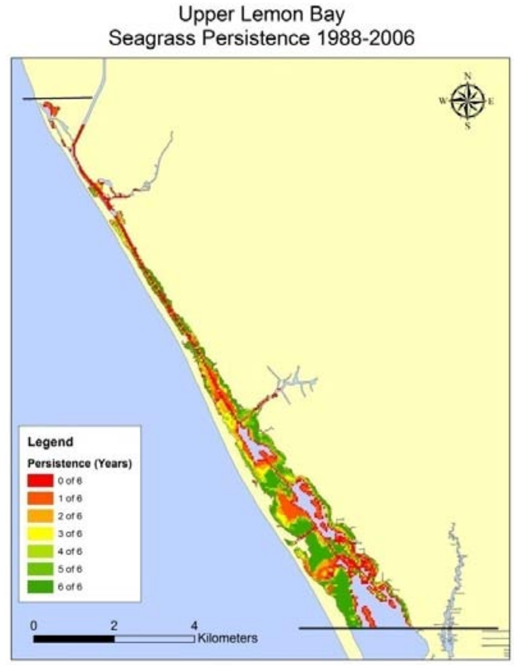

Figure 3-3b. Seagrass persistence in Upper Lemon Bay, 1988-2006.

Figure 3-3c. Seagrass persistence in Lower Lemon Bay, 1988-2006.

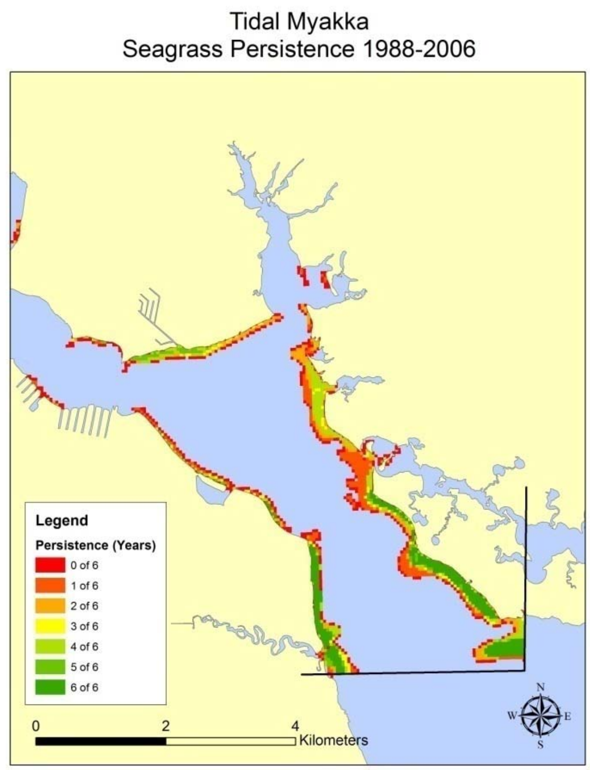

Figure 3-3d. Seagrass persistence in Tidal Myakka River, 1988-2006.

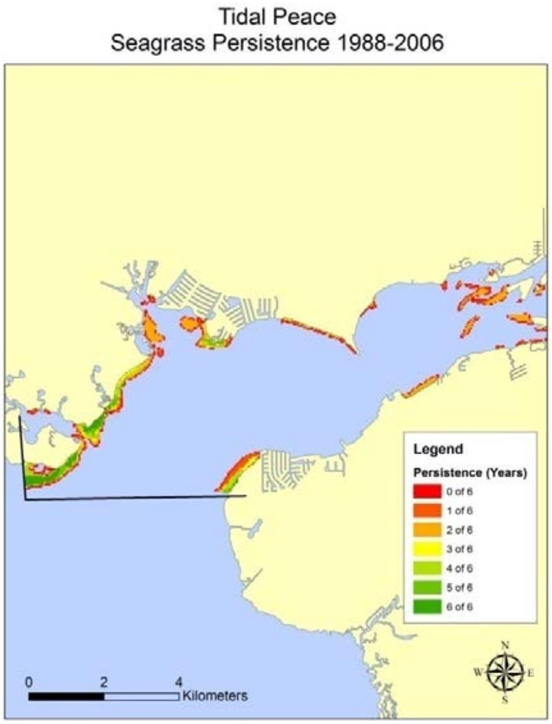

Figure 3-3e. Seagrass persistence in Tidal Peace River, 1988-2006.

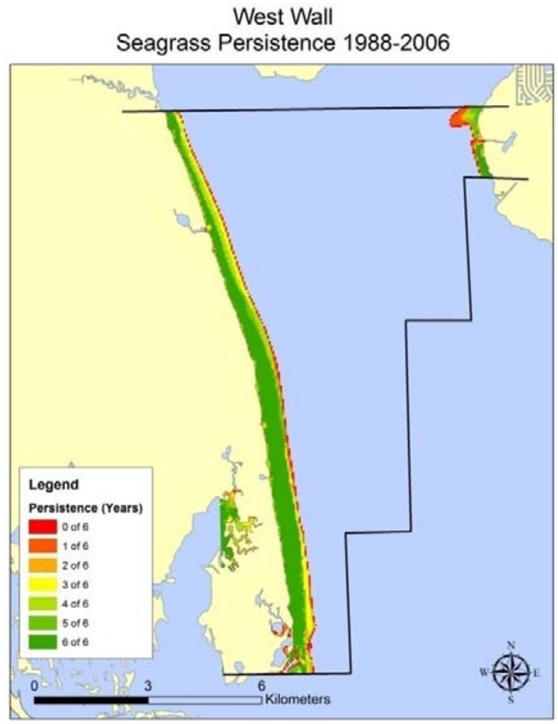

Figure 3-3f. Seagrass persistence in West Wall, 1988-2006.

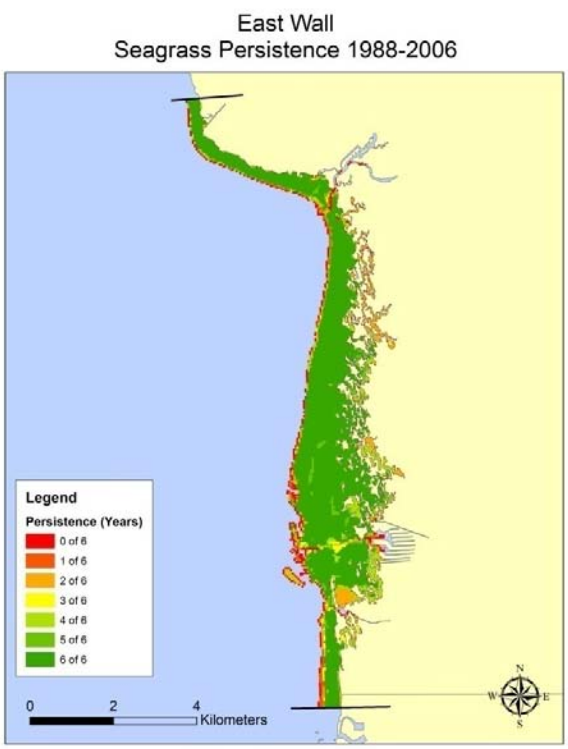

Figure 3-3g. Seagrass persistence in East Wall, 1988-2006.

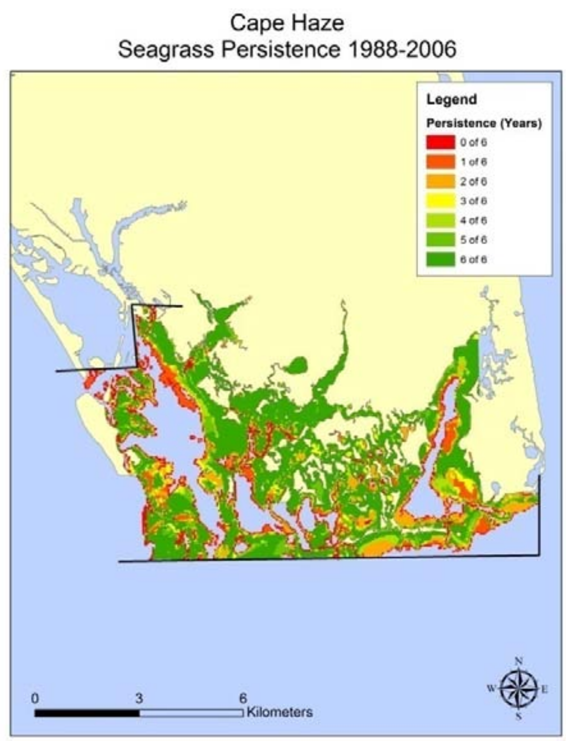

Figure 3-3h. Seagrass persistence in Cape Haze, 1988-2006.

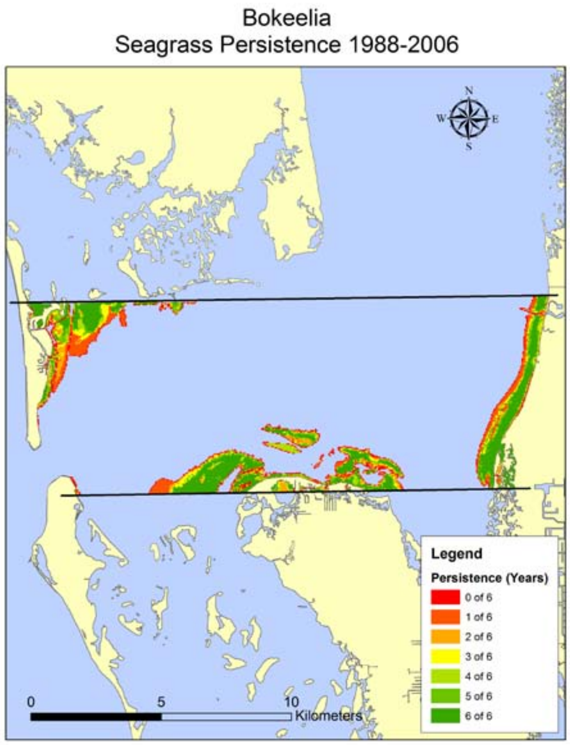

Figure 3-3i. Seagrass persistence in Bokeelia, 1988-2006.

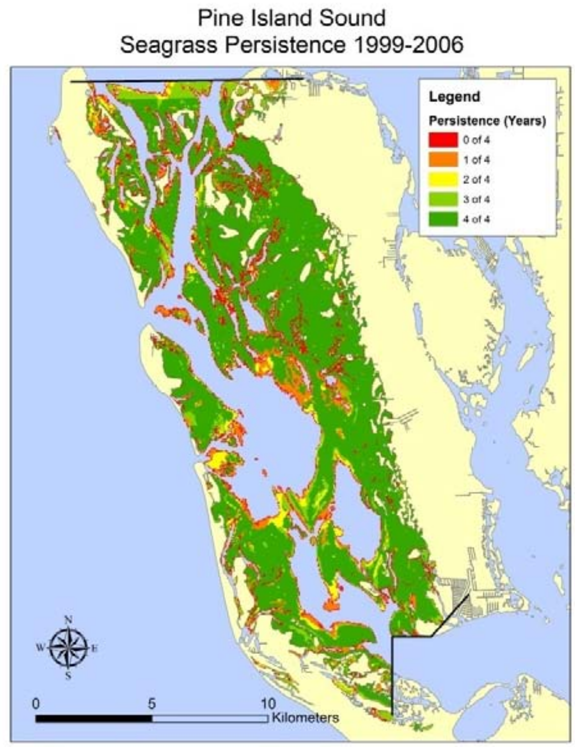

Figure 3-3j. Seagrass persistence in Pine Island Sound, 1999-2006.

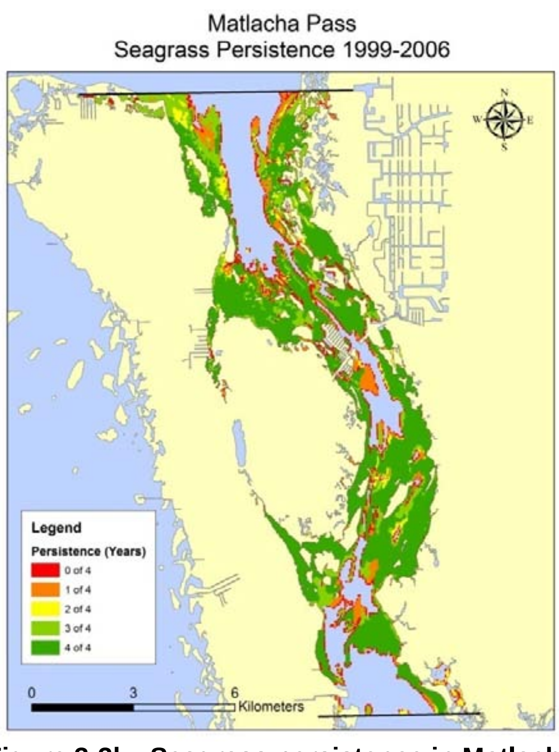

Figure 3-3k. Seagrass persistence in Matlacha Pass, 1999-2006.

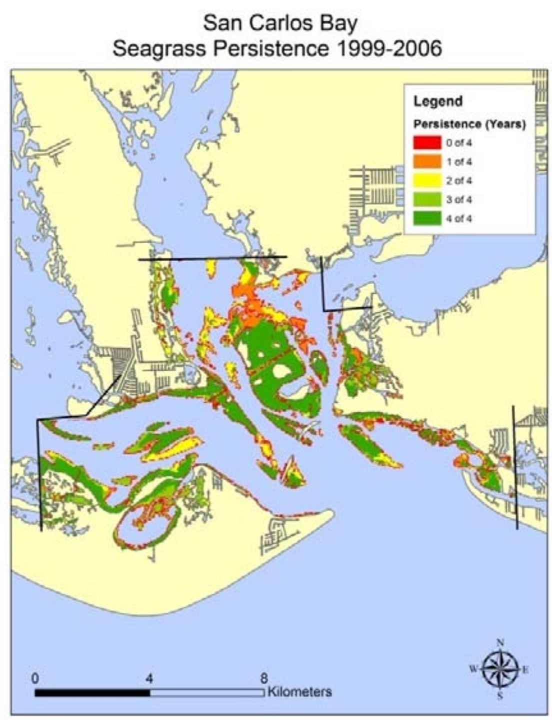

Figure 3-3l. Seagrass persistence in San Carlos Bay, 1999-2006.

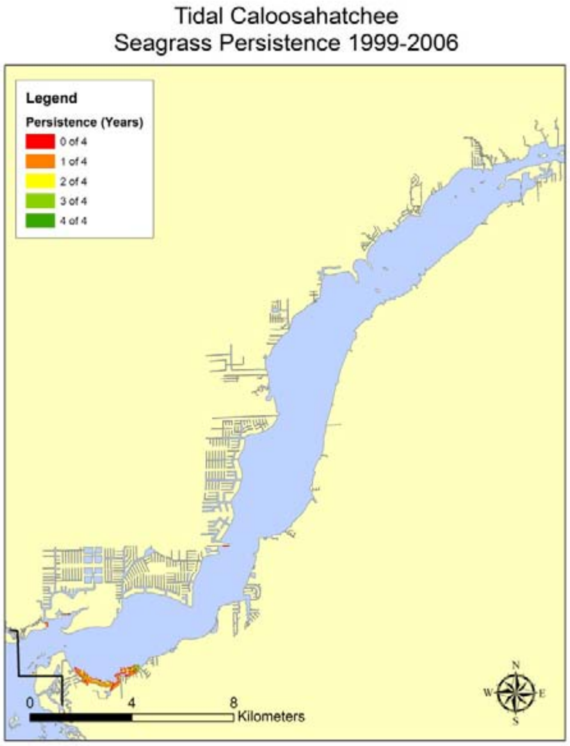

Figure 3-3m. Seagrass persistence in Tidal Caloosahatchee River, 1999-2006.

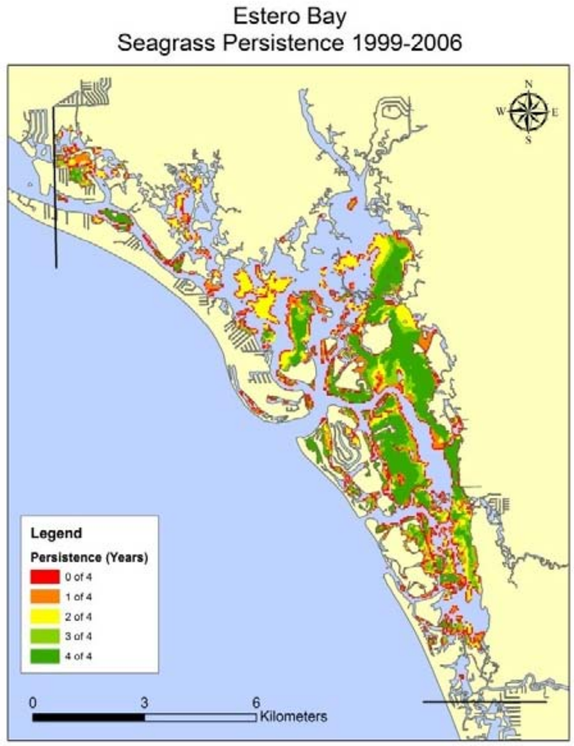

Figure 3-3n. Seagrass persistence in Estero Bay, 1999-2006.

3.4 Non-Restorable Seagrass Acreages

The estimated non-restorable areas in each harbor segment are as follows:

- Coastal Venice - 21 acres
- Upper Lemon Bay - 125 acres
- Lower Lemon Bay - 295 acres
- Tidal Myakka River - 6 acres
- Tidal Peace River - 64 acres
- West Wall - 11 acres
- East Wall - 88 acres
- Cape Haze - 128 acres
- Bokeelia - 94 acres
- Pine Island Sound - 356 acres
- Matlacha Pass - 262 acres
- San Carlos Bay - 125 acres
- Tidal Caloosahatchee River - 118 acres
- Estero Bay - 107 acres

Maps depicting non-restorable areas for each harbor segment can be found in Figures 3-5a through 3-5n.

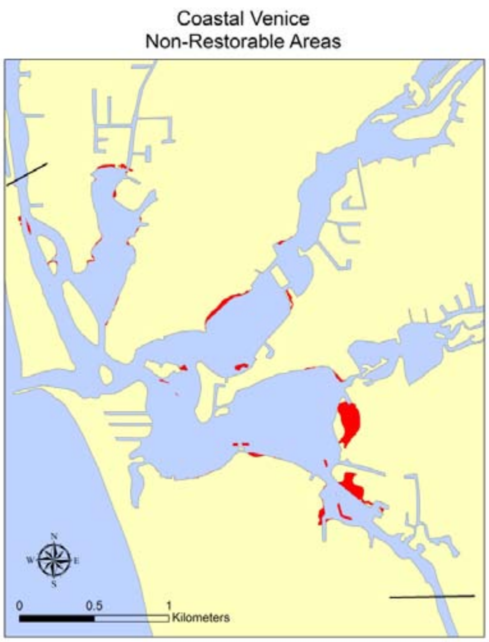

Figure 3-4a. Non-Restorable Seagrass Areas in Dona and Roberts Bay.

Figure 3-4b. Non-Restorable Seagrass Areas in Upper Lemon Bay.

Figure 3-4c. Non-Restorable Seagrass Areas in Lower Lemon Bay.

Figure 3-4d. Non-Restorable Seagrass Areas in Tidal Myakka River.

Figure 3-4e. Non-Restorable Seagrass Areas in Tidal Peace River.

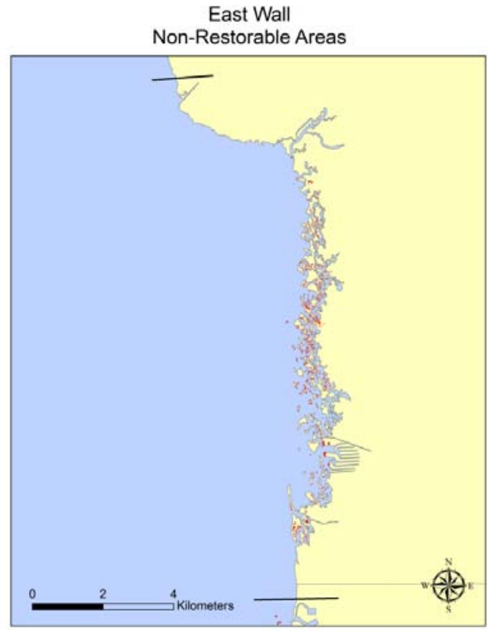

Figure 3-4f. Non-Restorable Seagrass Areas in East Wall Charlotte Harbor.

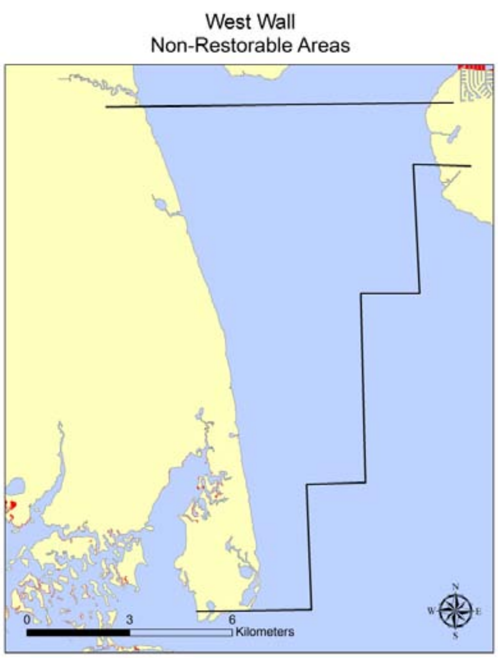

Figure 3-4g. Non-Restorable Seagrass Areas in West Wall Charlotte Harbor.

Figure 3-4h. Non-Restorable Seagrass Areas in Cape Haze.

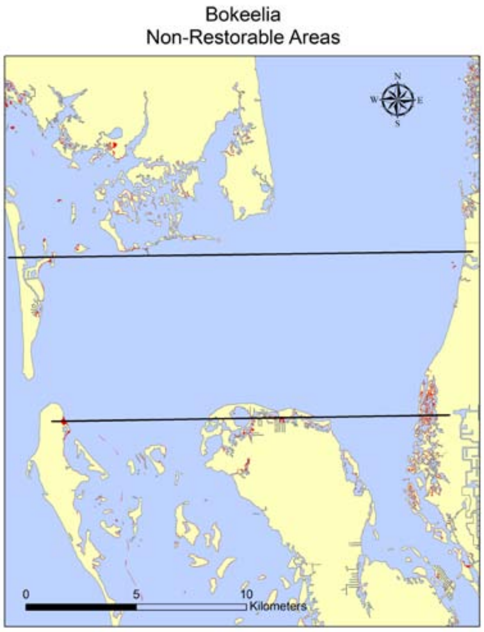

Figure 3-4i. Non-Restorable Seagrass Areas in Bokeelia.

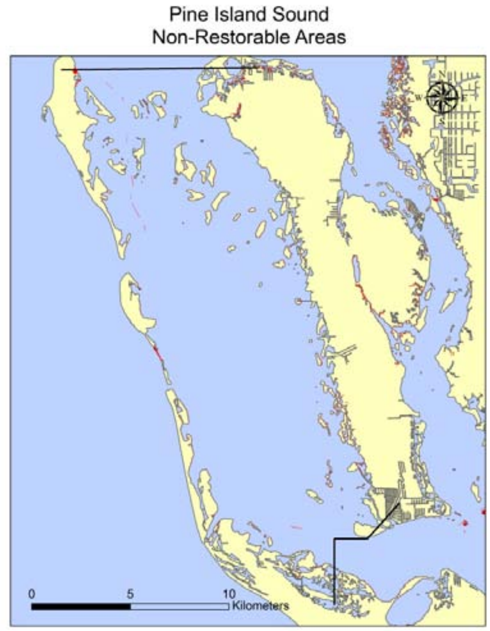

Figure 3-4j. Non-Restorable Seagrass Areas in Pine Island Sound.

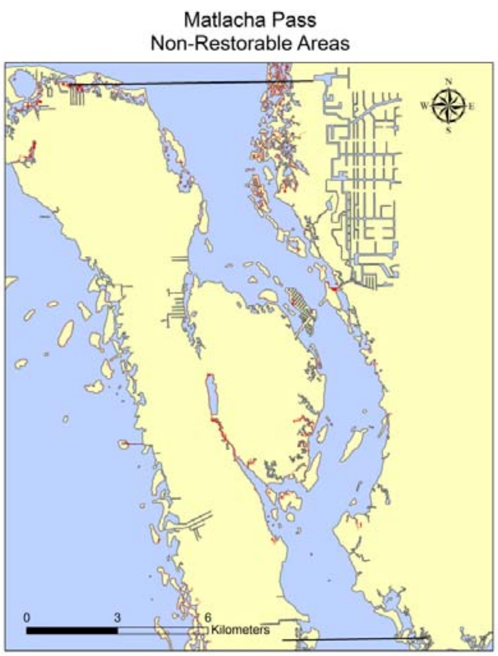

Figure 3-4k. Non-Restorable Seagrass Areas in Matlacha Pass.

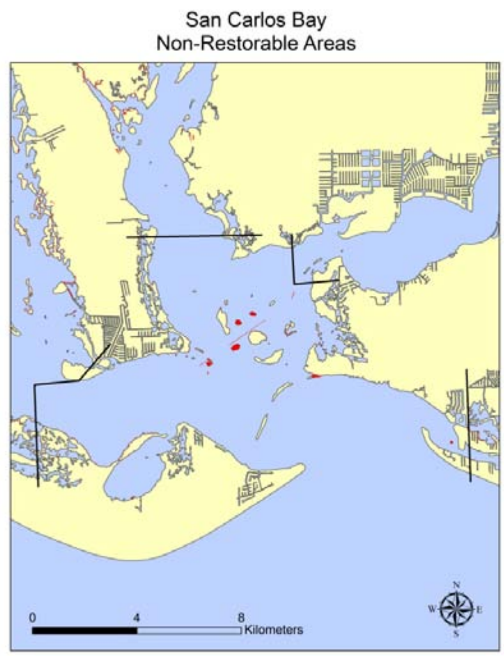

Figure 3-4l. Non-Restorable Seagrass Areas in San Carlos Bay.

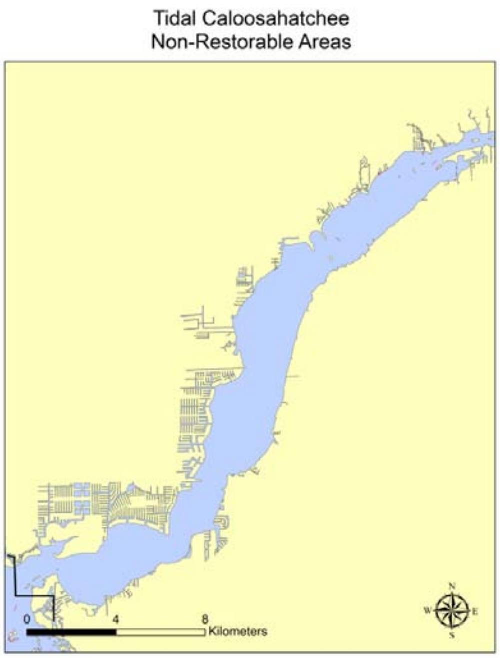

Figure 3-4m. Non-Restorable Seagrass Areas in Tidal Caloosahatchee River.

Figure 3-4n. Non-Restorable Seagrass Areas in Estero Bay.

3.5 Establishing Seagrass Targets

Having determined the extent of the baseline seagrass coverages, recent seagrass coverages, and delineated the non-restorable areas in the CHNEP, potential restoration and protection targets were then calculated.

A number of potential definitions of seagrass restoration and protection targets (Table 3-3) were presented to a special subcommittee to the TAC on May 28, 2009. A summary of the discussions from that meeting is provided in Appendix C. These potential targets included:

- maximum annual extent,
- mean annual extent over all recent surveys,
- mean annual extent over the last 3 surveys, and
- most recent annual extent.

The adjusted baseline acreage is the difference between the baseline acreage and the non-restorable acreage in each harbor segment, therefore, correcting the baseline for the areas in which seagrass recovery is unexpected.

The discussion focused on the choice of appropriate seagrass restoration and protection targets for each harbor segment. The following definition was adopted based on the outcome of that meeting:

The CHNEP seagrass target for each harbor segment is the greater of either the adjusted baseline acreage or the mean of all recent seagrass surveys.

Application of this definition to the results in Table 3-3 provides the targets identified for each harbor segment in Table 3-4.

In addition to defining these targets, an appropriate definition of a target range, i.e., the range of acceptable seagrass area, was also desired. It is recommended that this target range be defined by the range between the minimum and maximum areas from the recent seagrass surveys.

Please note that the seagrass restoration targets established are segment-wide acreages and that they do not identify specific locations within each segment which are suitable for restoration. Additionally, as discussed above, in the segments where recent seagrass extent exceeds the baseline extent, the final management decision will be made based on input received from the CHNEP's Technical Advisory Committee and acceptance by both the Management and Policy committees.

The Technical Advisory Committee recognized that aerial photography may not be the best technique for determining the extent of seagrass in the rivers draining into Charlotte Harbor, due to the impacts of water color. False negatives, where water color is obscuring the ability to identify seagrasses, can lead to significant underreporting of seagrass coverage in these segments. For this reason, on-the-ground methodologies may be the better approach for identifying seagrasses in the river segments of the Charlotte Harbor ecosystem. Older studies on the Caloosahatchee River estuary suggest that seagrasses were distributed throughout the length of the tidal portion of the river (George B. Hills Co., 1927; Phillips and Springer, 1960; Gunter and Hall, 1962). As far back as 1927, seagrasses were observed throughout the channel of the tidal portion of the Caloosahatchee River (George B. Hills Co., 1927). Phillips and Springer (1960) observed 11 different attached epiphytic algal species at five different stations within the tidal portion of the Caloosahatchee River. Contrasting Phillips and Springer (1960) with the 1950 seagrass coverage data presented in Figure 3-1m suggests that the aerial methodology may be underreporting seagrass for the Tidal Caloosahatchee segment. The Phillips and Springer (1960) field observations were identifying seagrasses in the region between the upstream-most and downstream-most meadows observed historically in Figure 3-1m. Gunter and Hall (1962) also observed a multitude of seagrass species in the shallower portions throughout the Caloosahatchee River and the near-vicinity bays and sounds.

W. Dexter Bender and Associates, Inc. (1994) identified four different species of seagrass in the tidal portion of the Caloosahatchee River in preparation of the Lee County Manatee Protection Plan (Figure 3-5). Seagrass meadows were identified in field observations throughout an approximately one-quarter mile buffer along the Caloosahatchee River shoreline (T. King, pers. comm.) These seagrasses comprise an area of nearly 2,800 acres, which contrasts with the estimates developed in the present study via aerial photo-interpretation. Seagrass was observed throughout the near-shore areas of the Tidal Caloosahatchee segment

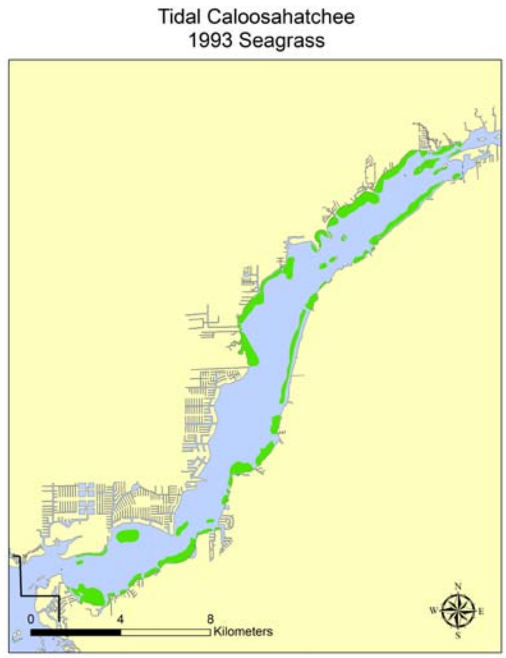

Figure 3-5. Seagrass coverage in Tidal Caloosahatchee River, 1993. (W. Dexter Bender and Associates, Inc., 1994).

Based on these studies of seagrasses in the Caloosahatchee River, the river segments in Table 3-4 have been denoted as being difficult to interpret using aerial photography and careful consideration should be given to establishing seagrass targets based on aerial photography in these segments.

The estimates provided above for the three major tidal rivers (Caloosahatchee, Myakka, and Peace) which drain into Charlotte Harbor and for the Dona and Roberts Bay segment are affected to a large degree by conditions at the time of sampling. The Technical Advisory Committee subcommittee agreed that seagrass extent calculations should be provided for completeness in these segments but that they should not be used for establishing restoration or protection targets in these segments as tanic river waters may have reduced the ability to capture the bottom profile of these segments with aerial photography. Local observations of sparse but substantial coverage of seagrass in areas previously characterized by aerial photography as being devoid of seagrass also contributed to this decision that the estimates from aerial photography in these segments may contain a large degree of uncertainty.

Table 3-3. Baseline, non-restorable, and adjusted baseline seagrass extents and potential seagrass targets (acres).

	Dona and Roberts Bay	Upper Lemon Bay	Lower Lemon Bay	Tidal Myakka	Tidal Peace	West Wall	East Wall	Cape Haze	Bokeelia	Pine Island Sound	Matlacha Pass	San Carlos Bay	Tidal Caloosa-hatchee	Estero Bay	Total
Baseline	133	1,005	3,114	350	1039	2,117	3,986	5,798	3,058	24,113	9,577	3,243	211	3,769	61,513
Non-restorable Areas	21	125	232	6	64	11	88	128	94	356	262	125	118	107	1,737
Adjusted Baseline	112	880	2,882	344	975	2,106	3,898	5,670	2,964	23,757	9,315	3,118	93	3,662	59,776
Maximum Annual Extent	124	1,175	2,597	539	573	2,121	3,591	7,464	3,520	29,204	7,619	5,376	103	3,409	67,415
Mean Annual Extent: all years	91	1,009	2,502	456	384	1,907	3,465	6,998	3,342	26,837	7,582	4,372	87	3,071	62,103
Mean Annual Extent: last 3 years	104	1,032	2,498	411	337	1,965	3,416	7,050	3,392	28,043	7,427	4,969	72	3,033	63,749
Most Recent Annual Extent	124	949	2,597	375	341	2,121	3,382	6,911	3,520	29,204	7,619	5,376	56	3,298	65,873

Table 3-4. Draft CHNEP Seagrass Targets							
Harbor Segment	**Baseline, adjusted (B)**	**Mean Annual Extent all years (A)**	**Standard Deviation**	**Protection Target**	**Restoration Target**	**Total Target**	**Target Range**
Dona and Roberts Bay*	112	91	20	91	21	112	70-124
Upper Lemon Bay	880	1,009	87	1,009		1,009	949-1,175
Lower Lemon Bay	2,882	2,502	70	2,502	380	2,882	2,396-2,597
Tidal Myakka River*	344	456	87	456		456	331-539
Tidal Peace River*	975	384	103	384	591	975	295-573
West Wall	2,106	1,907	161	1,907	199	2,106	1,676-2,121
East Wall	3,898	3,465	126	3,465	433	3,898	3,275-3,591
Cape Haze	5,670	6,998	271	6,998		6,998	6,709-7,464
Bokeelia	2,964	3,342	148	3,342		3,342	3,101-3,520
Pine Island Sound	23,757	26,837	1,413	26,837		26,837	25,941-29,204
Matlacha Pass	9,315	7,582	710	7,582	1,733	9,315	6,055-7,619
San Carlos Bay	3,118	4,372	775	4,372		4,372	3,709-5,376
Tidal Caloosahatchee*	93	87	41	87	6	93	2-103
Estero Bay	3,662	3,071	530	3,071	591	3,662	2,393-3,409
TOTAL	59,776	62,103	N/A	62,103	3,954	66,057	N/A

***** These riverine segments may have underreported seagrass acreages, due to water color impacts, as described in section 3.5 and are therefore presented for completeness only. The numbers in these segments should not be used for reporting of seagrass loss or gain over time.

4. NEXT STEPS AND RECOMMENDATIONS

Upon approval by the Management and Policy committees, these targets will be used in the refinement of water clarity and quality targets for each harbor segment. This effort is being completed in Task 3 of this project. As discussed above, there are clear linkages between seagrass growth and reproduction, water quality, and nutrient loading. Specifically, increased nutrient loading can result in elevated chlorophyll concentrations, which in turn affects water clarity. Decreased water clarity reduces the amount of light needed to support seagrass growth and reproduction. Therefore, the results from this task provide the basis for appropriate water quality and nutrient loading targets for the harbor.

The following bullet points provide recommendations for the application of these seagrass targets in managing the Charlotte Harbor system:

- Establish process for reporting annual and biennial assessments of water quality and seagrass coverage relative to these targets in each harbor segment.
- Define appropriate management responses to deviations from either water quality and/or seagrass targets in each harbor segment.

- Analyze the relationship between the seagrass coverage data presented here and the Florida Department of Environmental Protection's Charlotte Harbor Aquatic Preserve (CHAP) seagrass transect monitoring data.

- Further research on the quality of seagrass in Charlotte Harbor estuary as part of an on-going effort to understand seagrass distribution and health in this ecosystem;

- Continue study of inter-annual variation in water quality, clarity, and seagrass coverage in the Charlotte Harbor estuary; and

- Consider other methods in the estimation of seagrass coverage in the three major tidal rivers (Caloosahatchee, Myakka, and Peace) which drain into Charlotte Harbor and Dona and Roberts Bays.

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APPENDIX A: Analysis of 9999 Areas

Further investigation using current known seagrass locations as well as historic and current aerial photographs suggest that these areas likely were not seagrasses. The patch of 9999s in Pine Island Sound and San Carlos Bay is especially suspect given the depth of the estuary in this location. The greatest potential for 9999s as historic seagrass are those areas which are directly proximal to the shore and the near-shore seagrasses, but the available 1950s/historical imagery for some areas of Charlotte Harbor was not of sufficient quality to determine/photo-interpret features in those areas with the required confidence for inclusion with the baseline coverage.

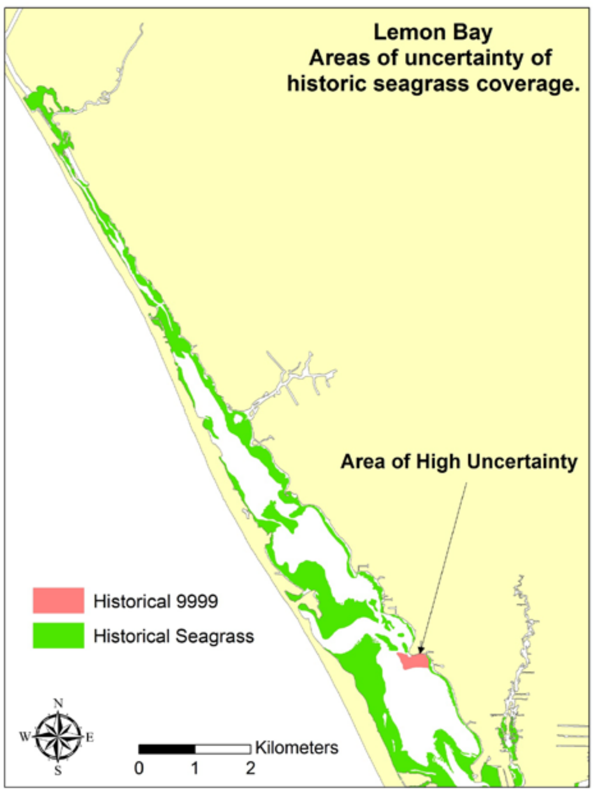


Figure A-1a. Lemon Bay historic seagrass coverage highlighting areas of uncertainty (pink: 9999) and areas of certainty (green).

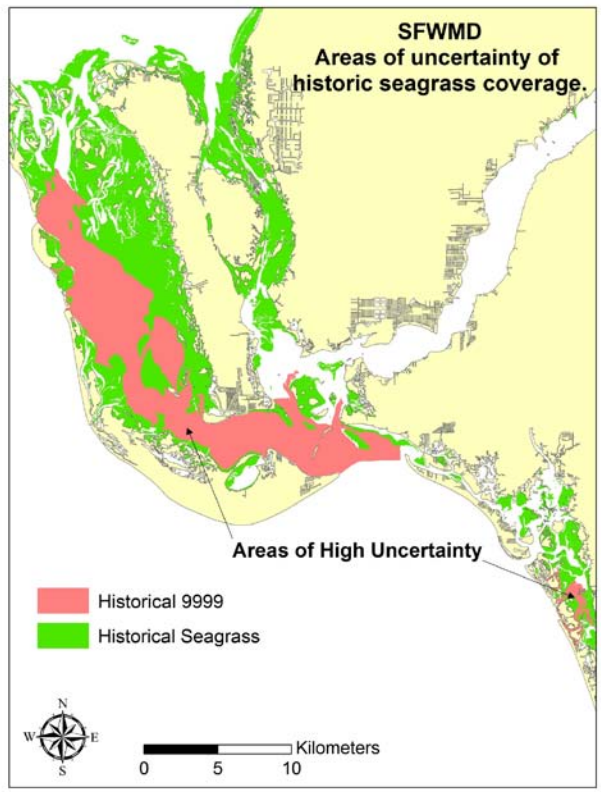
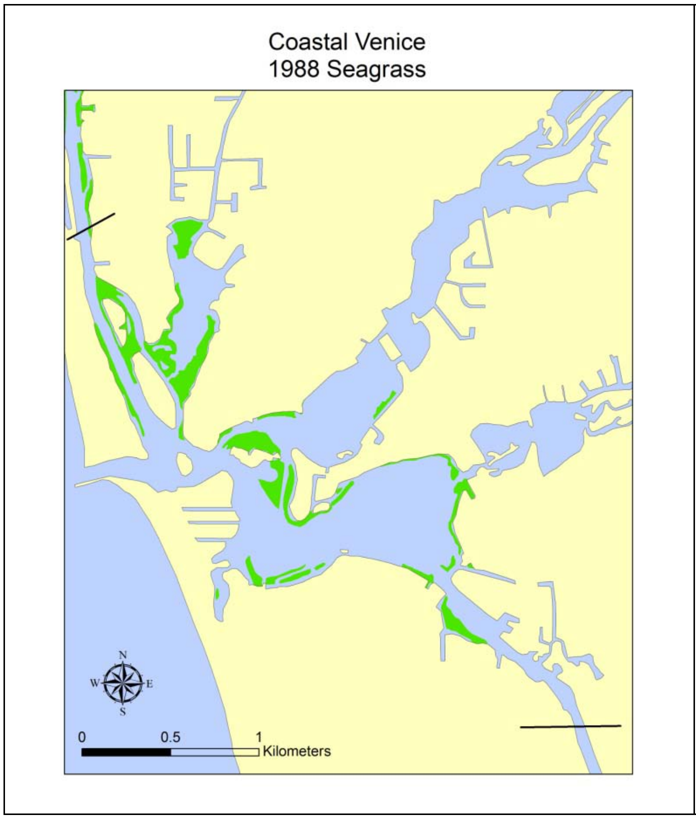
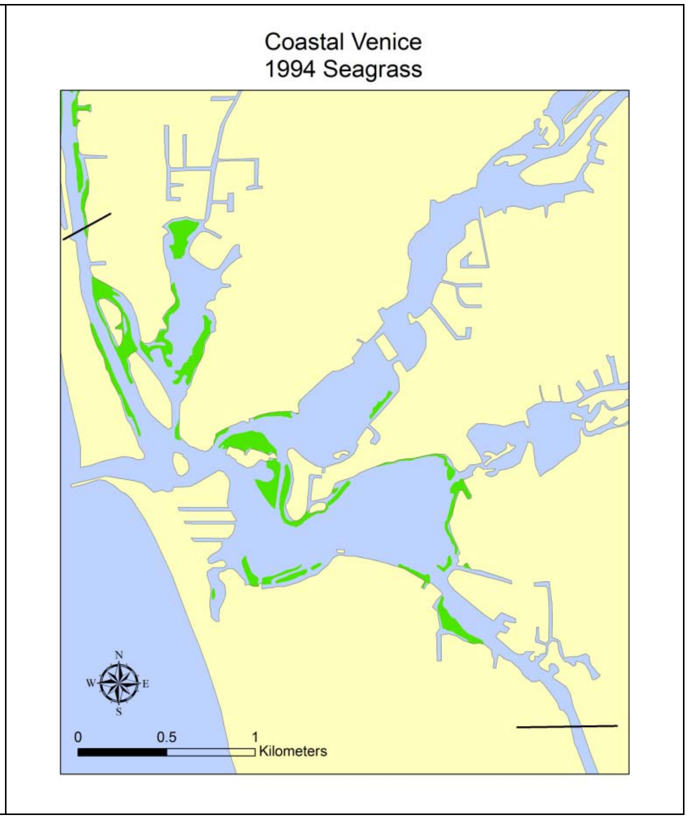


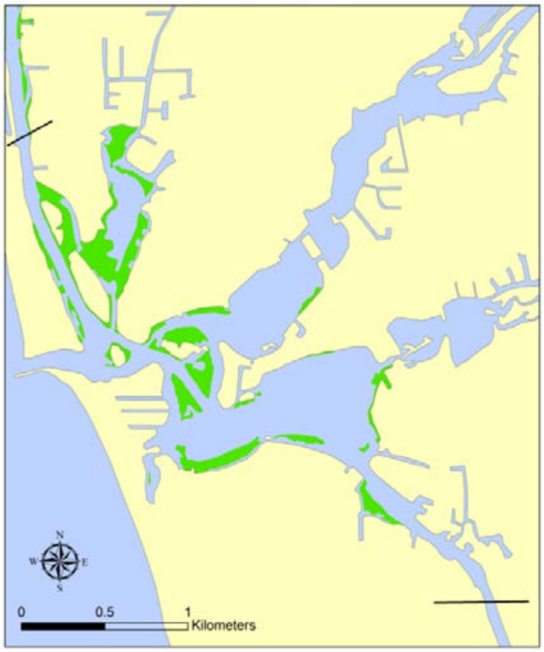
Figure A-1b. SFWMD historic seagrass coverage highlighting areas of uncertainty (pink: 9999) and areas of certainty (green).

APPENDIX B: Annual Seagrass Coverage Maps for Each Harbor Segment

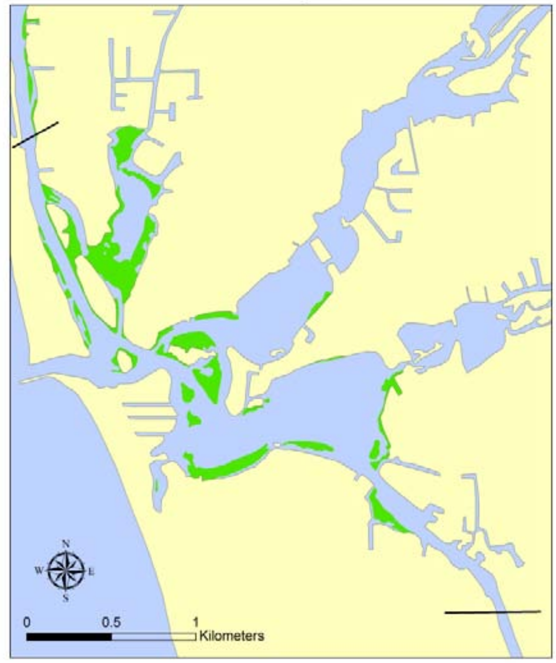




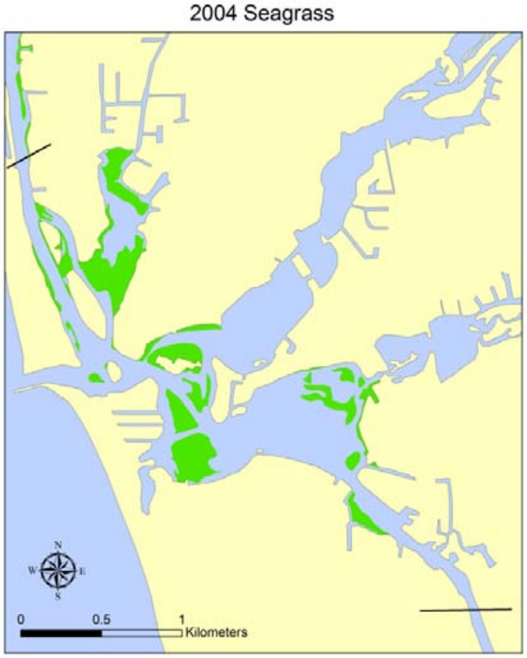
Coastal Venice
1999 Seagrass



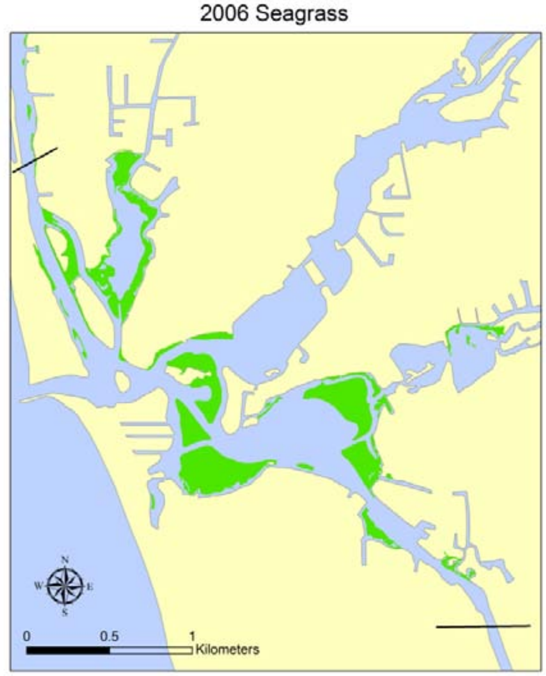
Coastal Venice
2001 Seagrass



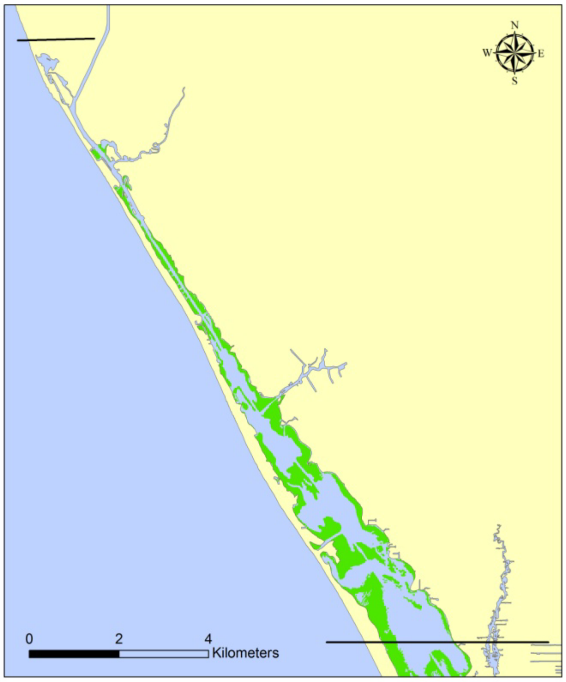
Coastal Venice
2004 Seagrass



Coastal Venice
2006 Seagrass

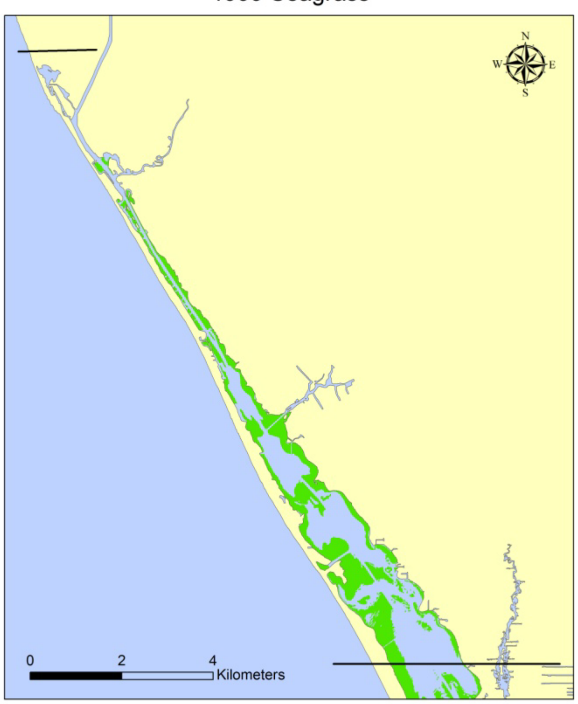


Upper Lemon Bay
1988 Seagrass



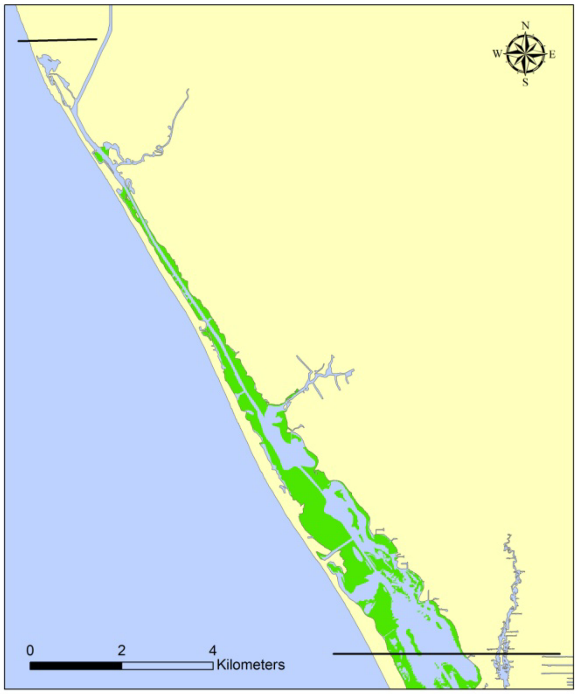
Upper Lemon Bay
1994 Seagrass

Upper Lemon Bay
1999 Seagrass

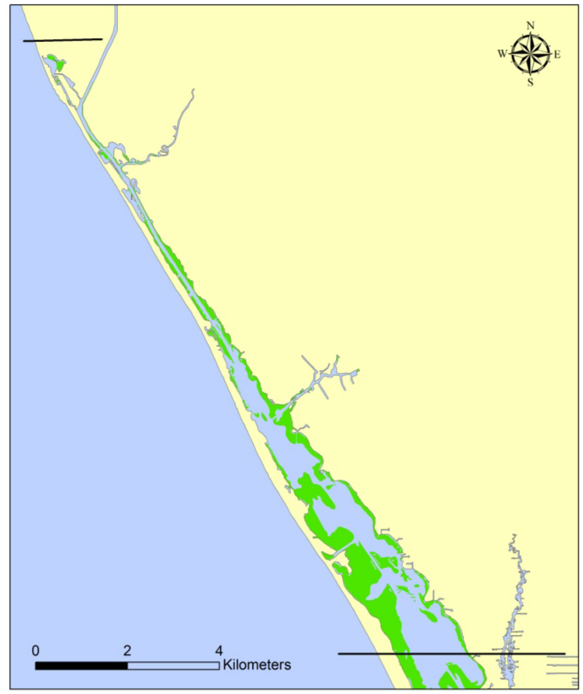


Upper Lemon Bay
2001 Seagrass

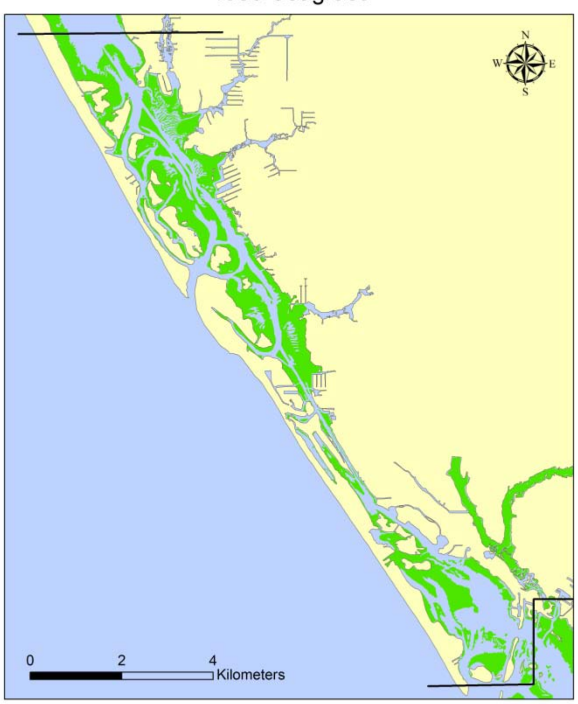
Upper Lemon Bay
2004 Seagrass



Upper Lemon Bay
2006 Seagrass



Lower Lemon Bay
1988 Seagrass



Lower Lemon Bay
1994 Seagrass

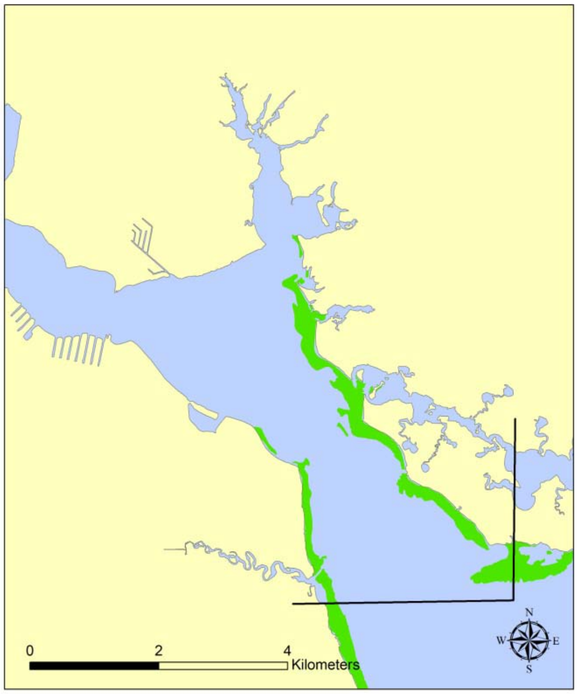
Lower Lemon Bay
1999 Seagrass

Lower Lemon Bay
2001 Seagrass

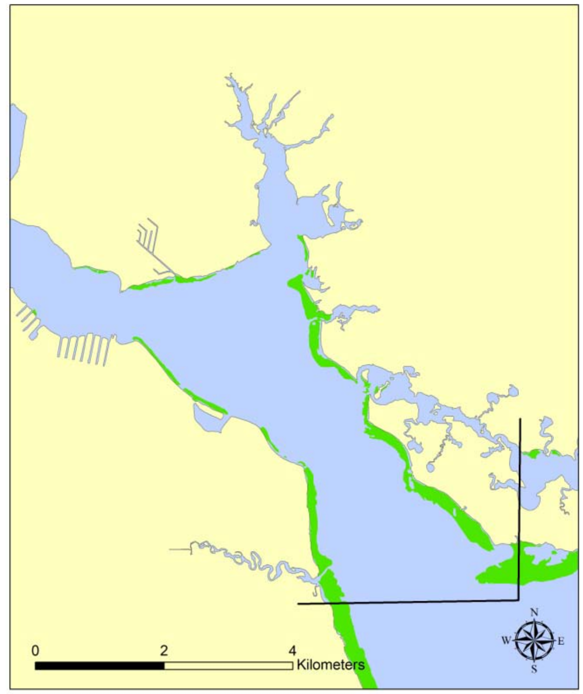
Lower Lemon Bay
2004 Seagrass

Lower Lemon Bay
2006 Seagrass

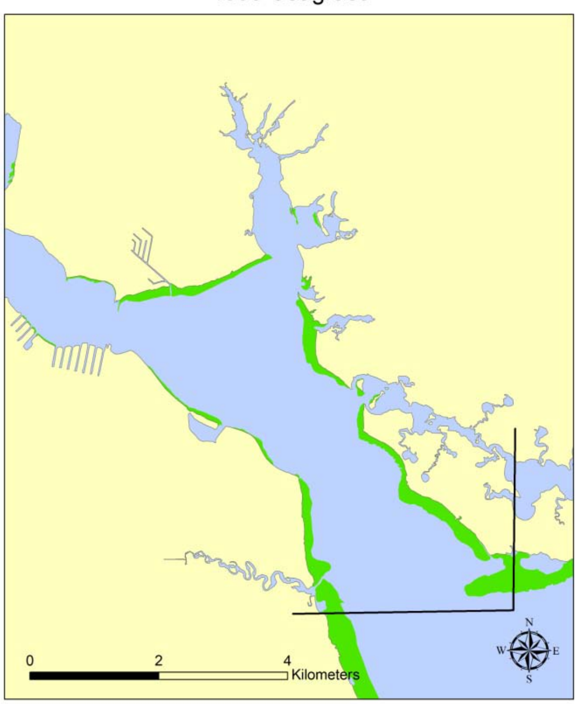
Tidal Myakka
1988 Seagrass



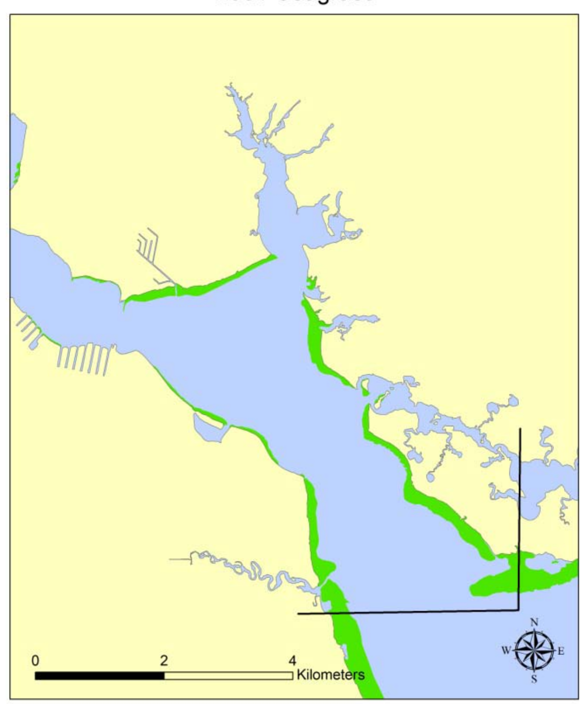
Tidal Myakka
1994 Seagrass



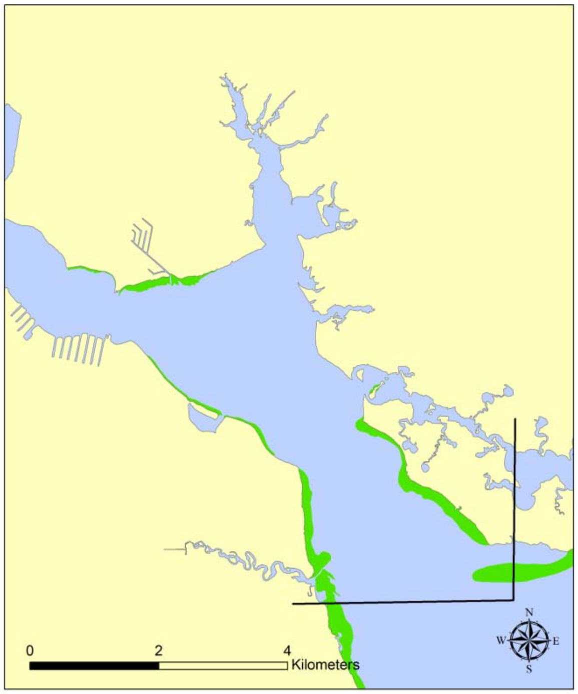
Tidal Myakka
1999 Seagrass



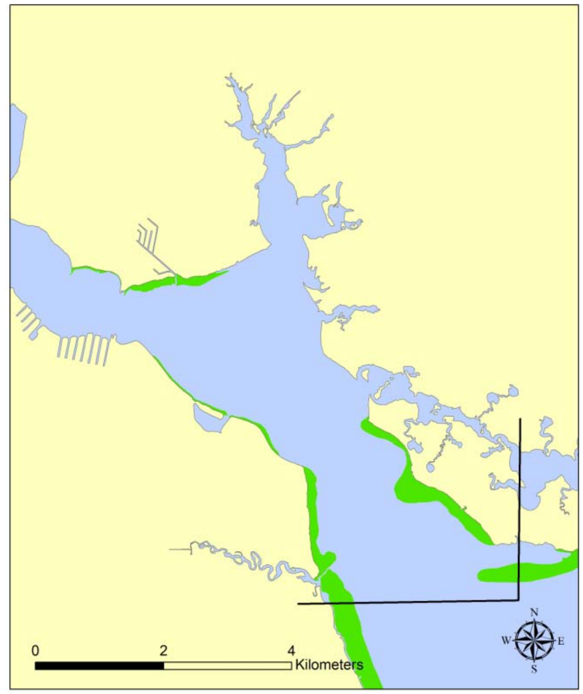
Tidal Myakka
2001 Seagrass



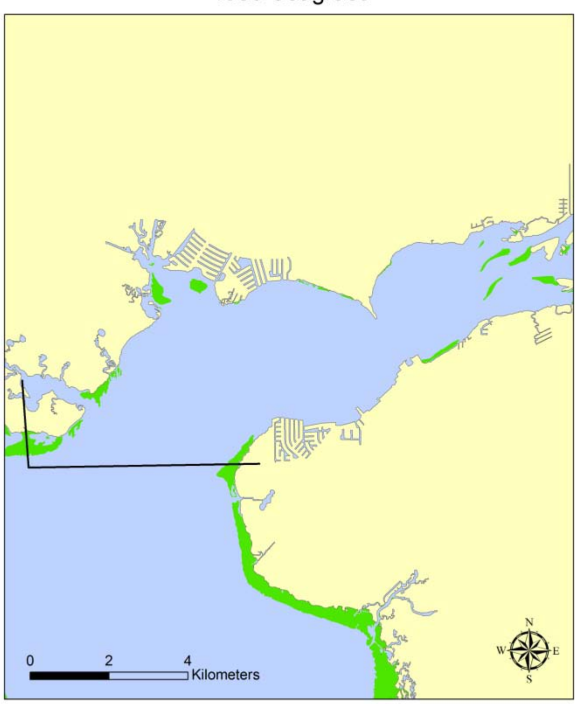
Tidal Myakka
2004 Seagrass



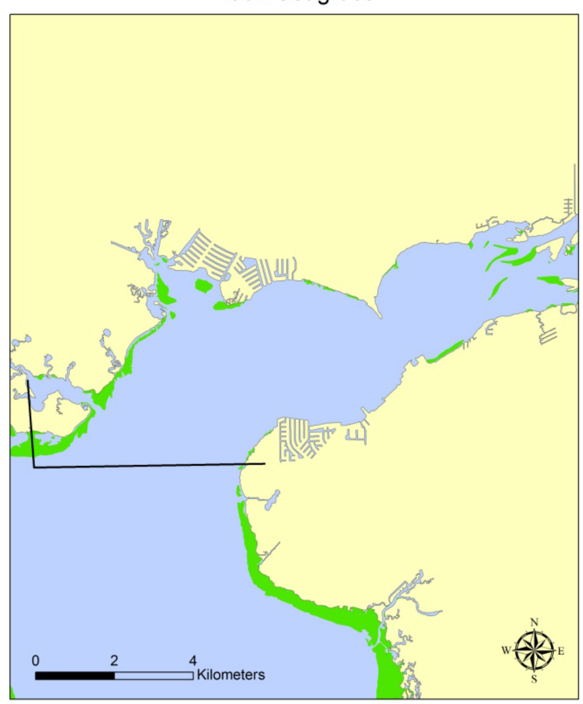
Tidal Myakka
2006 Seagrass



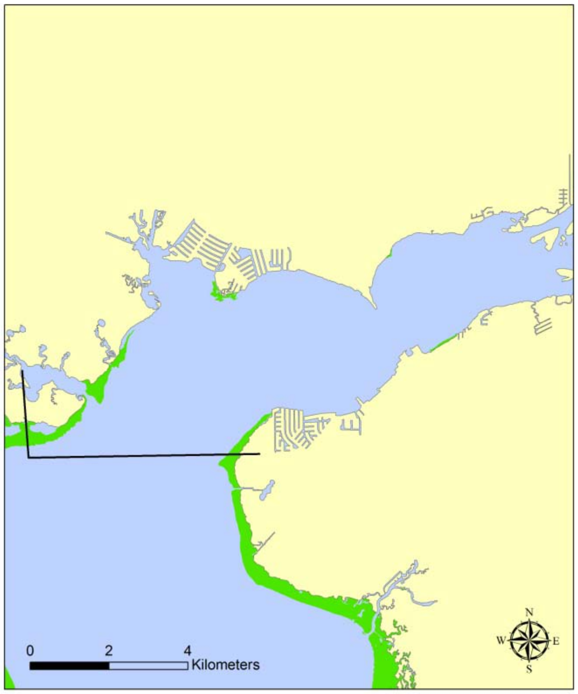
Tidal Peace
1988 Seagrass



Tidal Peace
1994 Seagrass



Tidal Peace
1999 Seagrass



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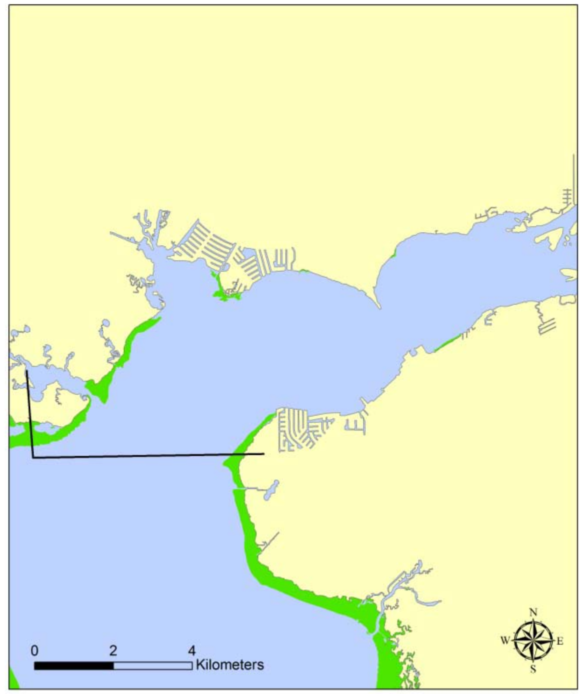
2001 Seagrass



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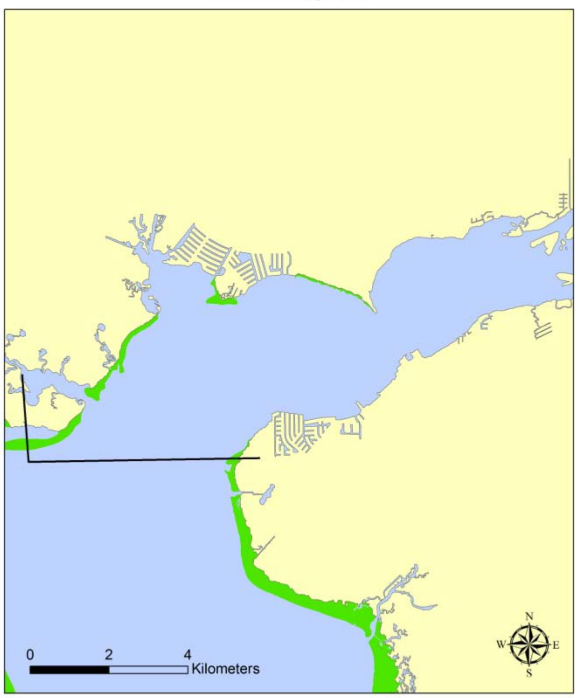
2004 Seagrass



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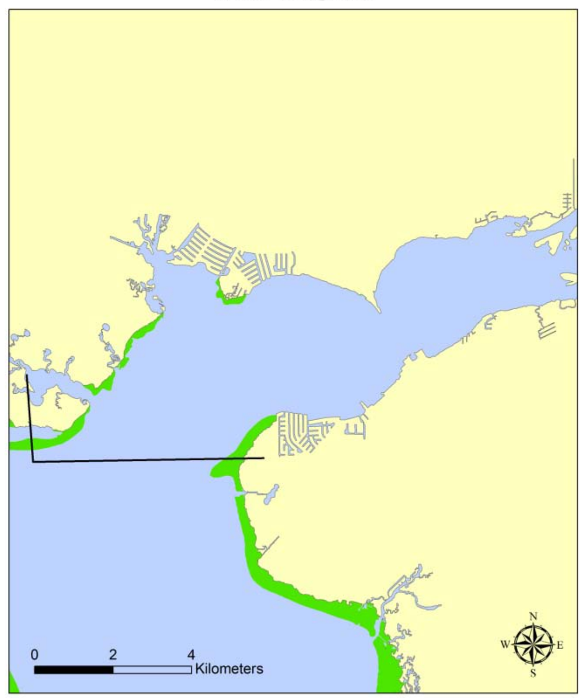
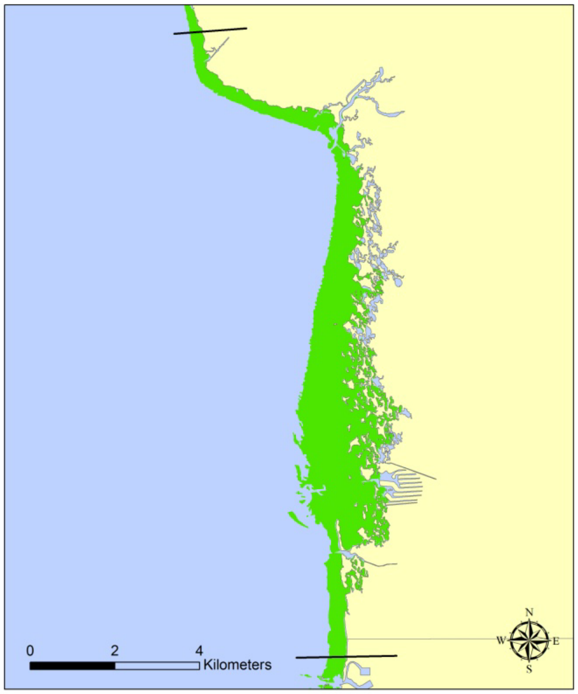
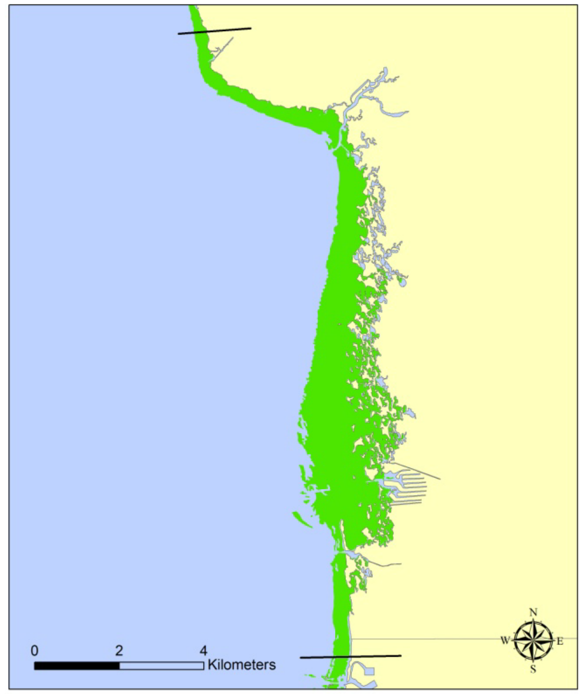
2006 Seagrass



East Wall
1988 Seagrass



East Wall
1994 Seagrass



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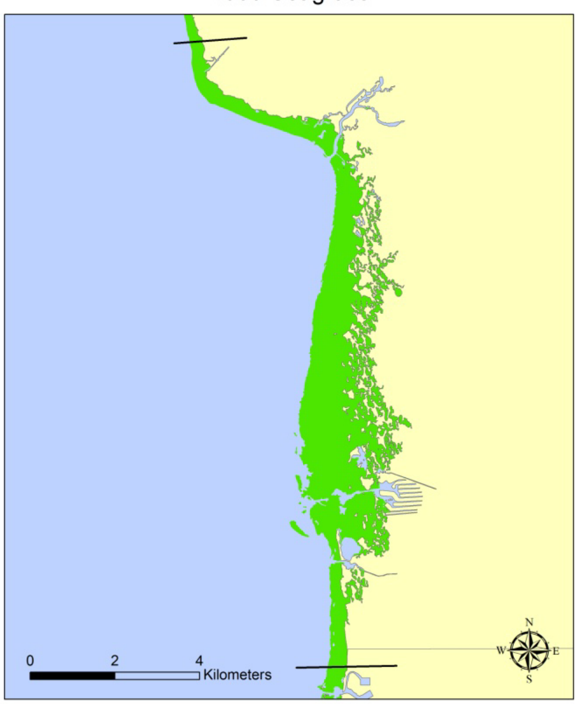
1999 Seagrass



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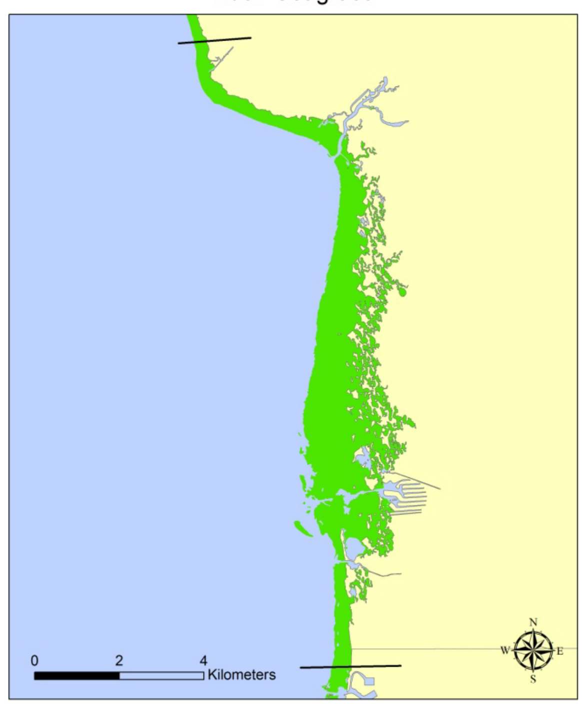
2001 Seagrass



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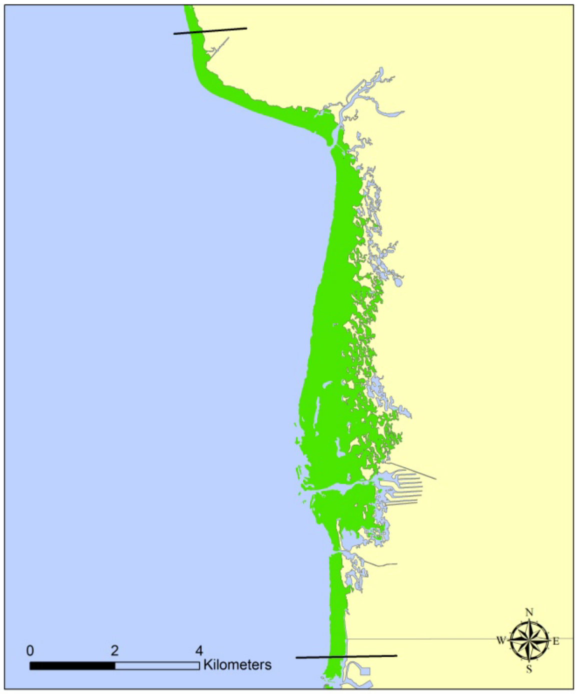
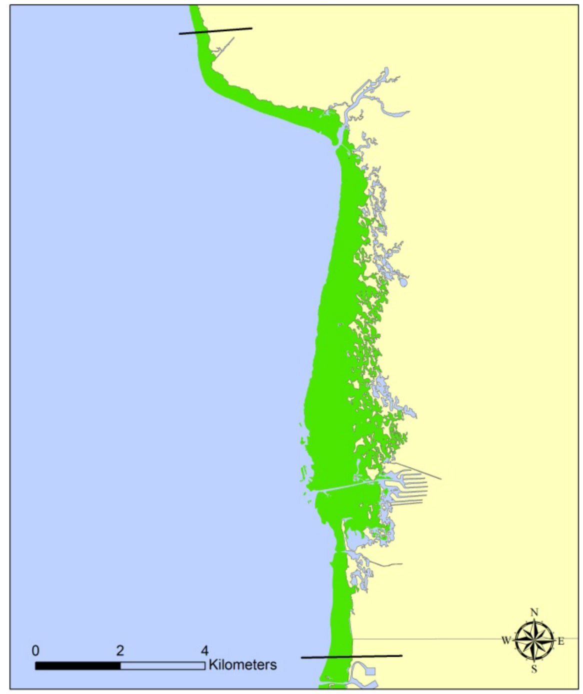
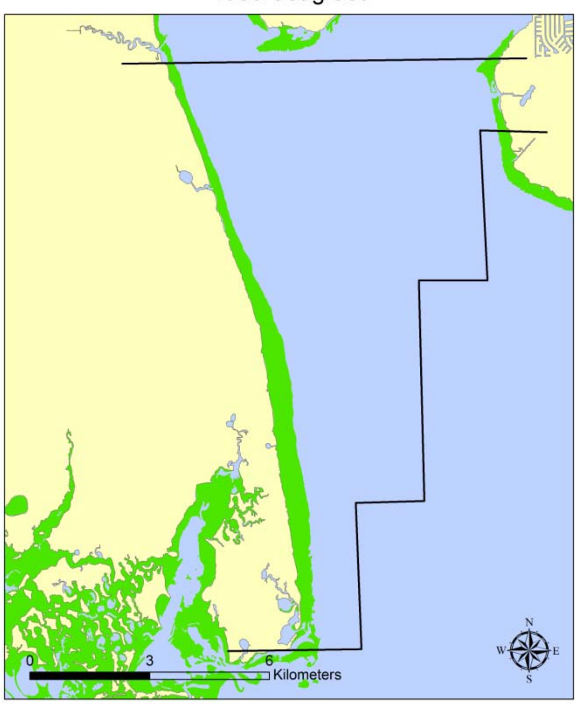
2004 Seagrass



East Wall
2006 Seagrass



West Wall
1988 Seagrass



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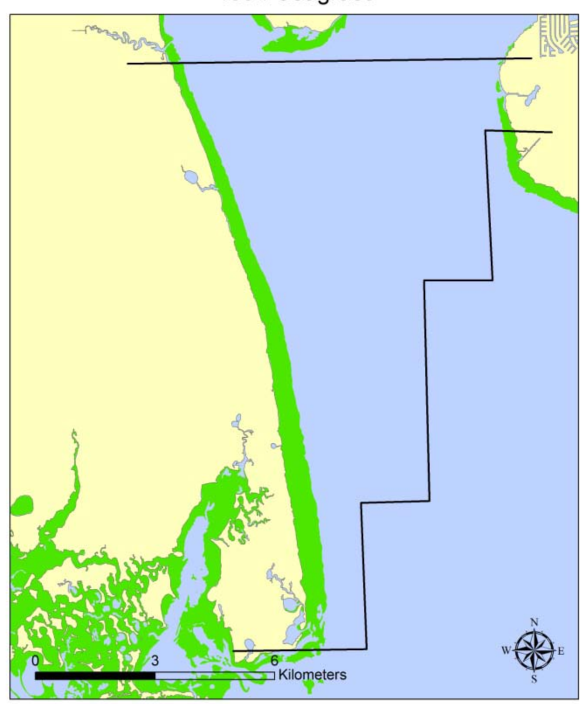
1994 Seagrass



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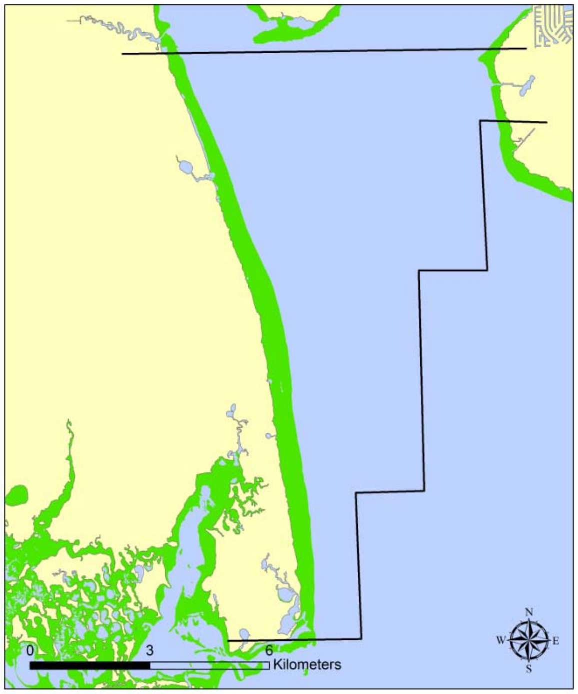
1999 Seagrass



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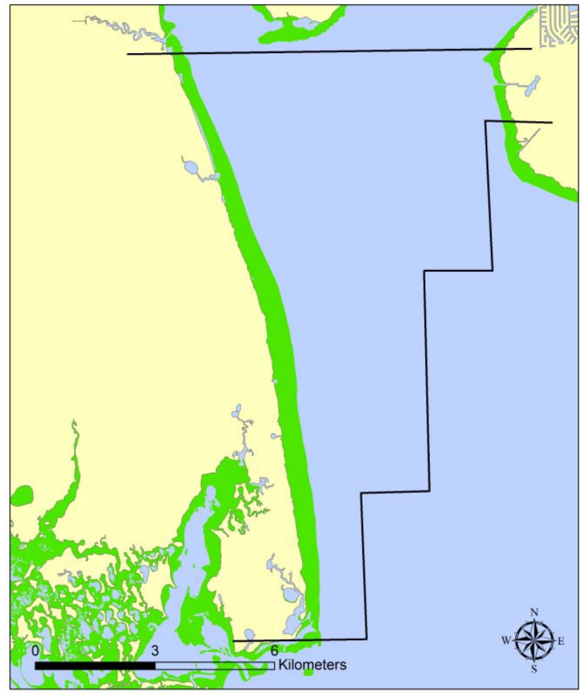
2001 Seagrass



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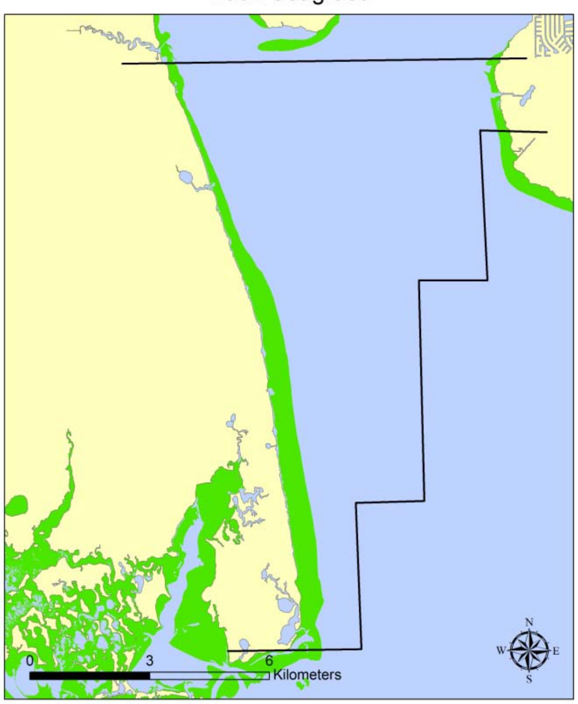
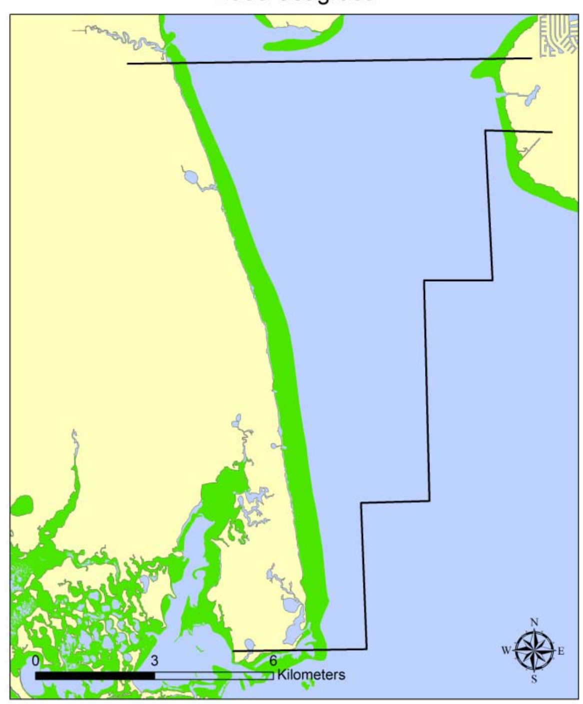
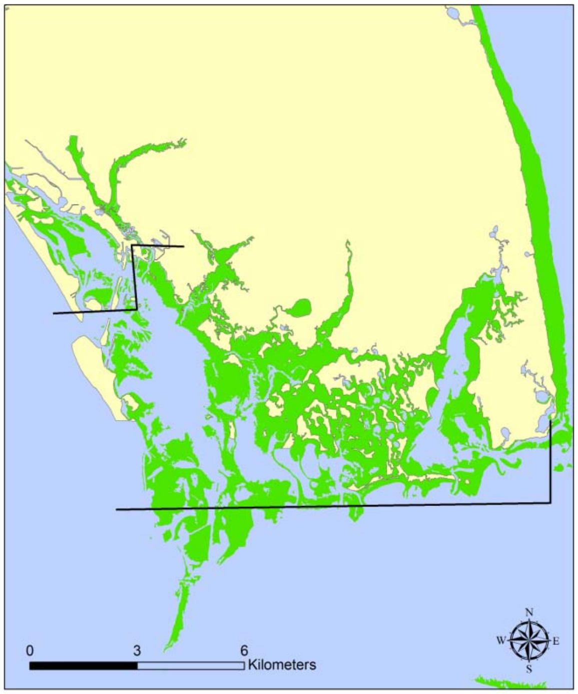
2004 Seagrass



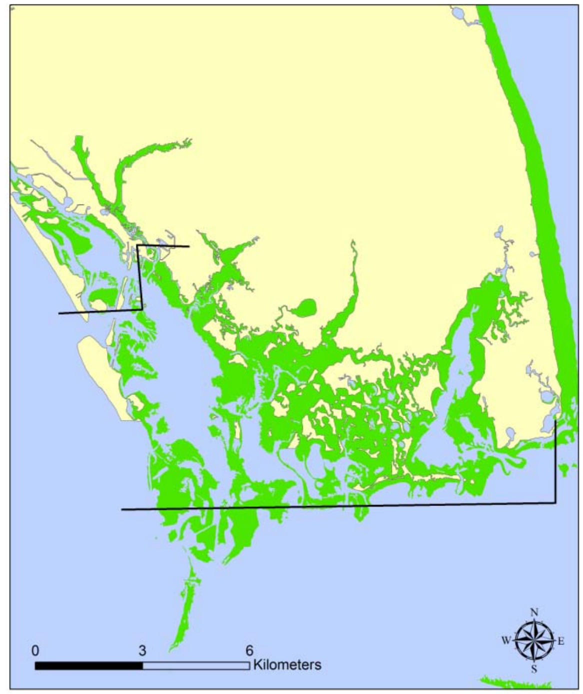
West Wall
2006 Seagrass



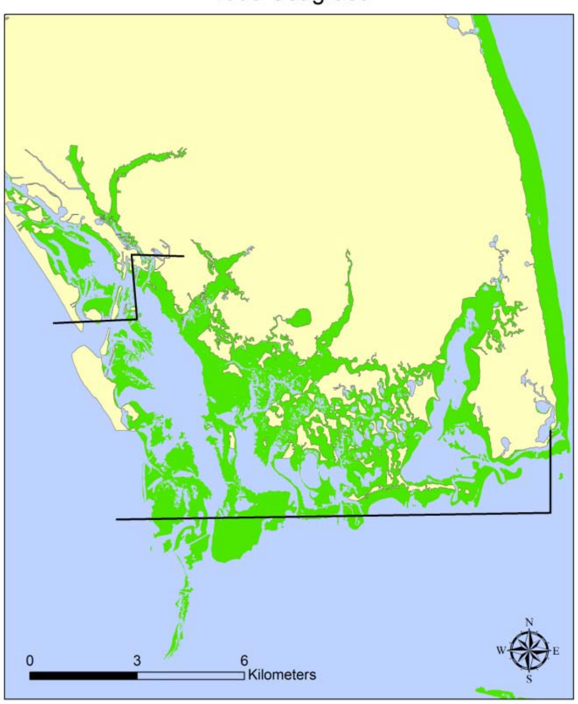
Cape Haze
1988 Seagrass



Cape Haze
1994 Seagrass

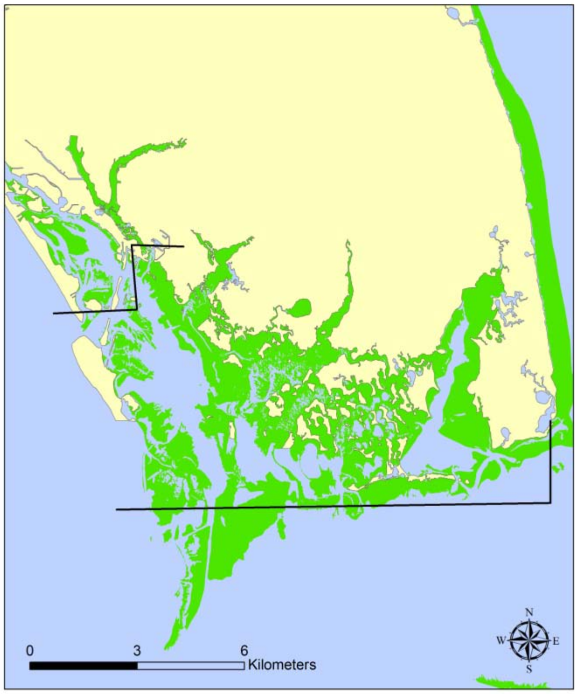


Cape Haze
1999 Seagrass

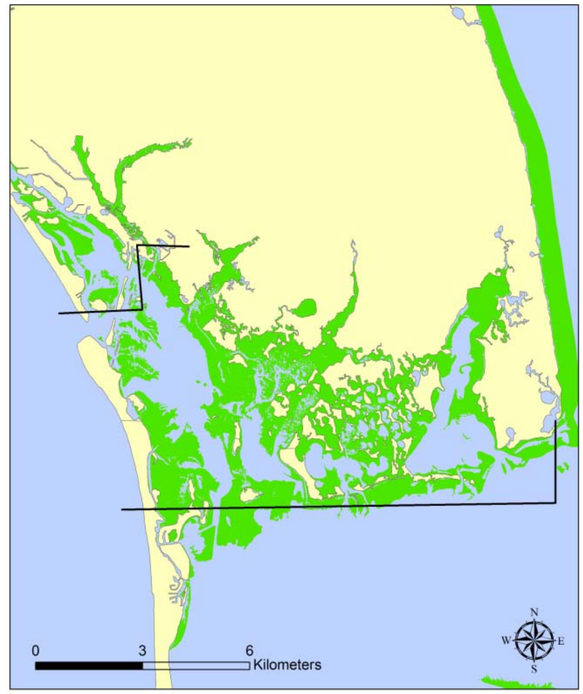


Cape Haze
2001 Seagrass

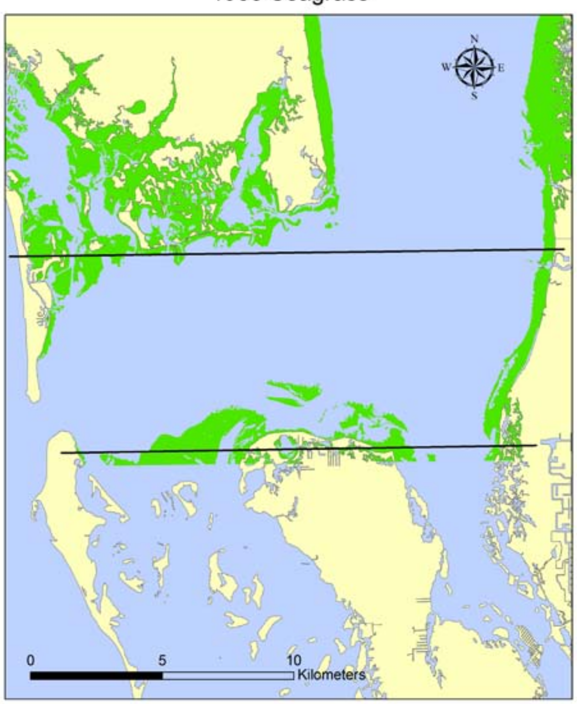
Cape Haze
2004 Seagrass



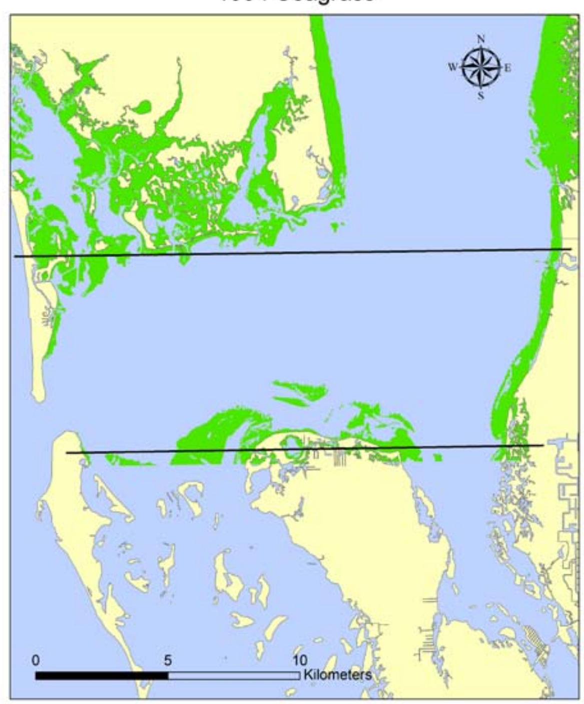
Cape Haze
2006 Seagrass



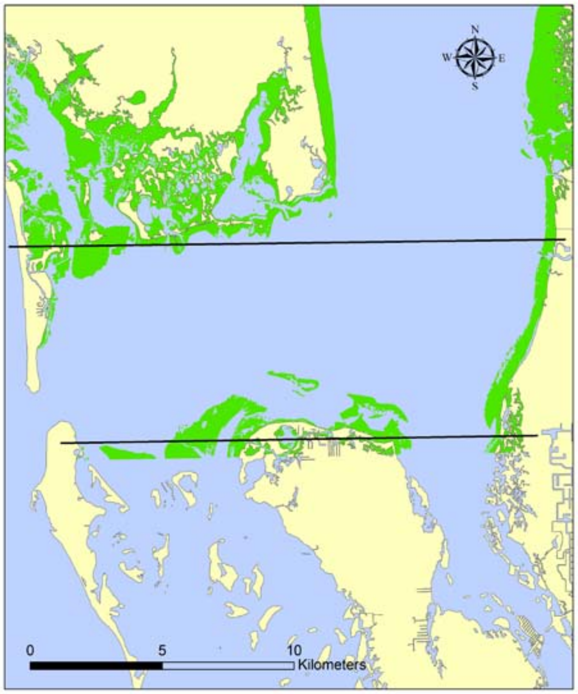
Bokeelia
1988 Seagrass



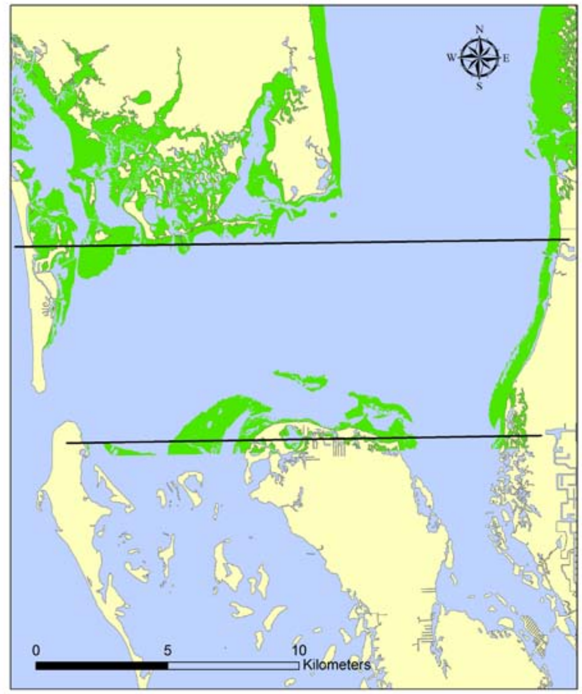
Bokeelia
1994 Seagrass



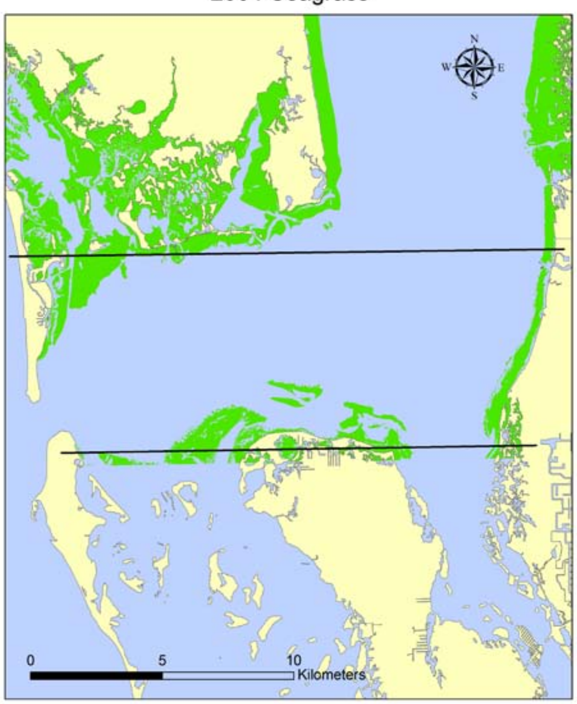
Bokeelia
1999 Seagrass



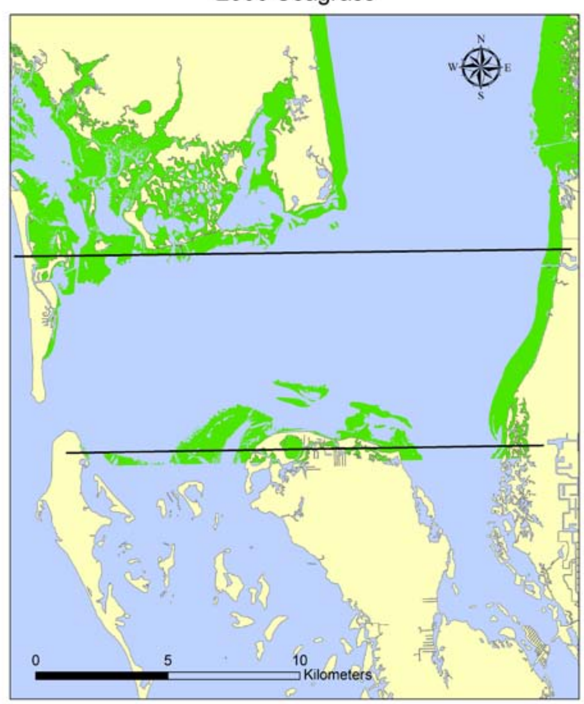
Bokeelia
2001 Seagrass



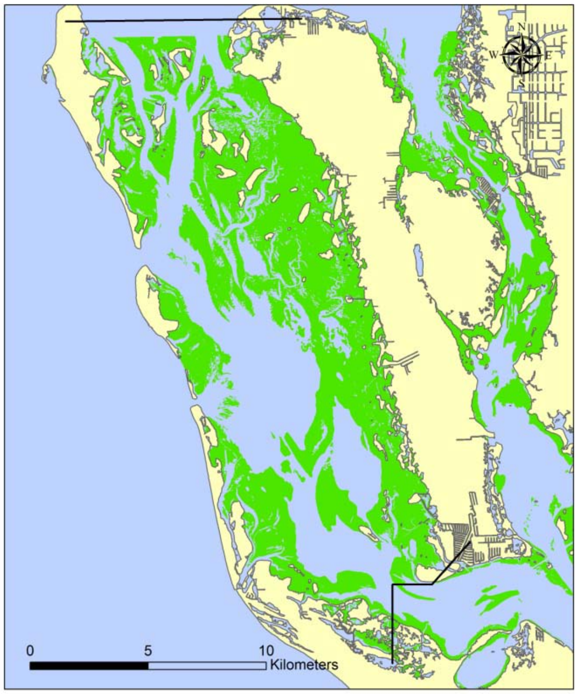
Bokeelia
2004 Seagrass



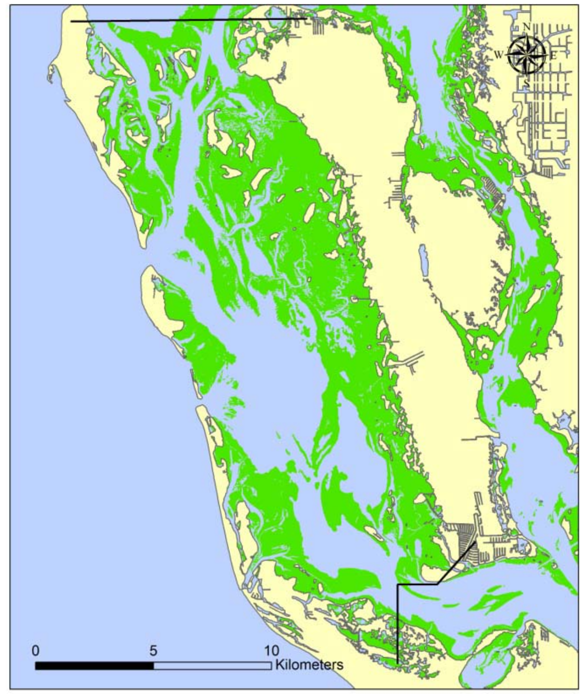
Bokeelia
2006 Seagrass



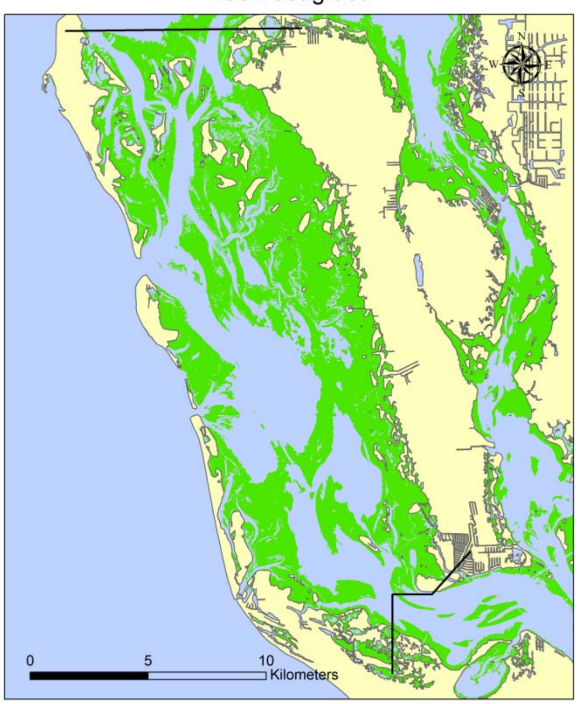
Pine Island Sound
1999 Seagrass



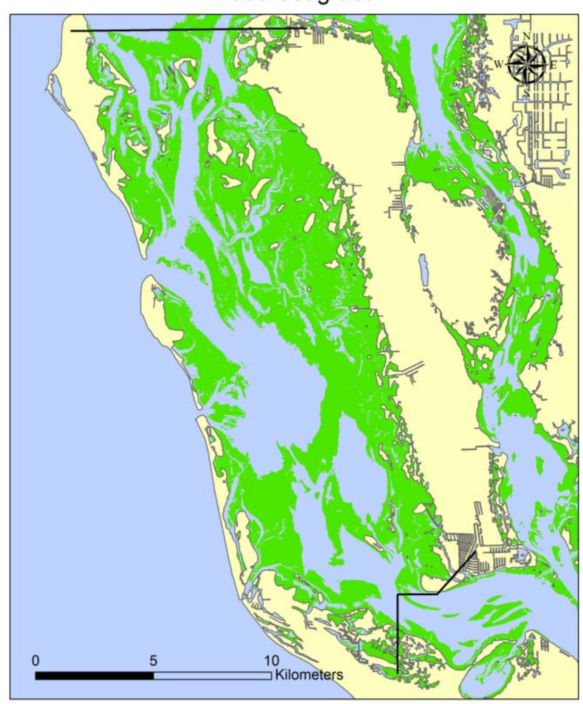
Pine Island Sound
2003 Seagrass



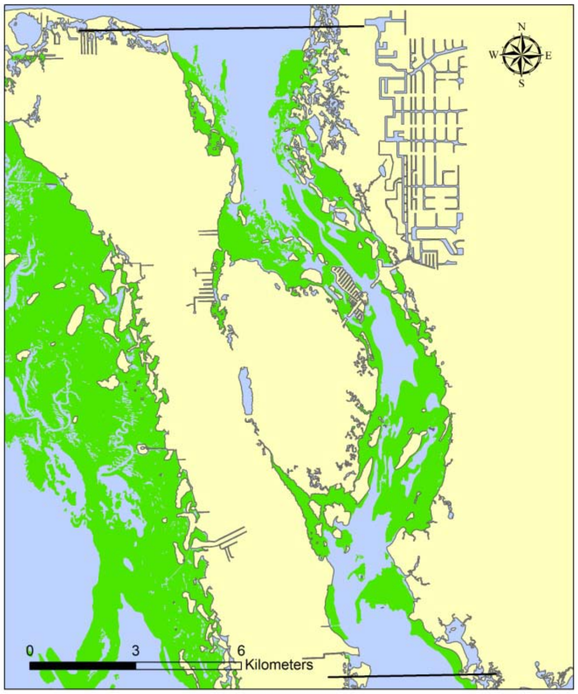
Pine Island Sound
2004 Seagrass



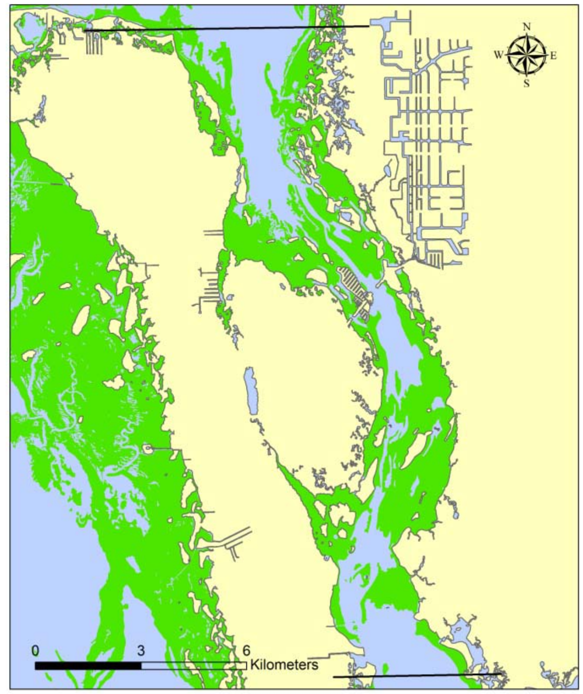
Pine Island Sound
2006 Seagrass



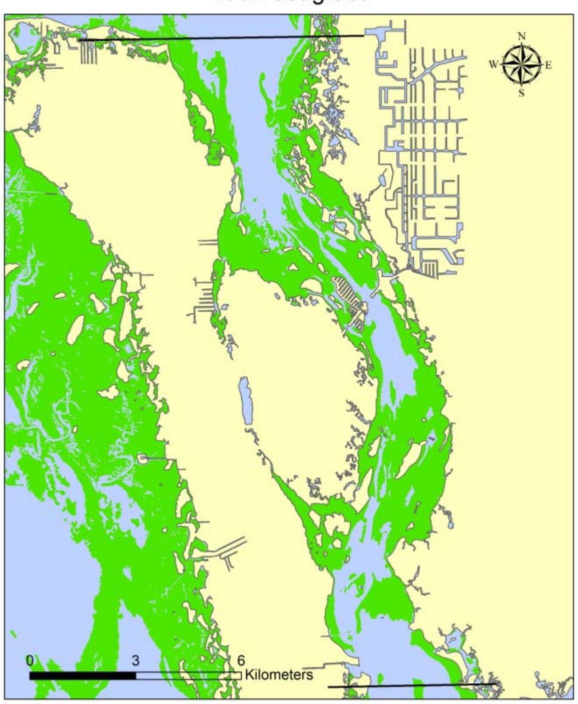
Matlacha Pass
1999 Seagrass



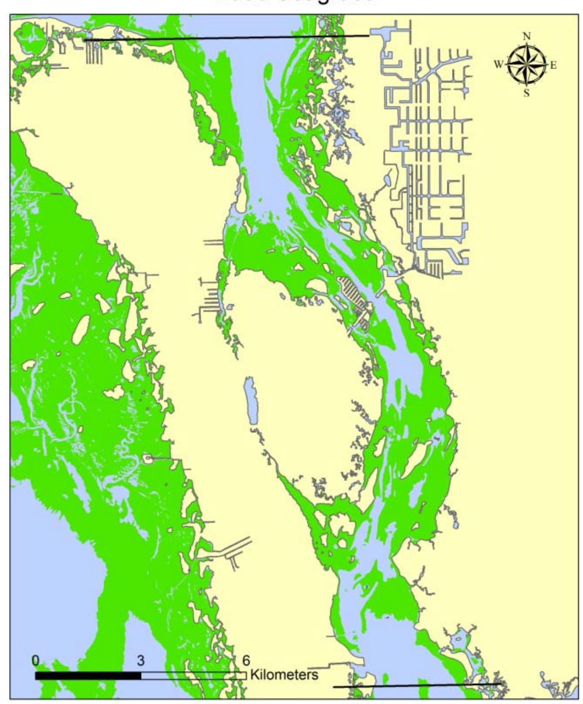
Matlacha Pass
2003 Seagrass



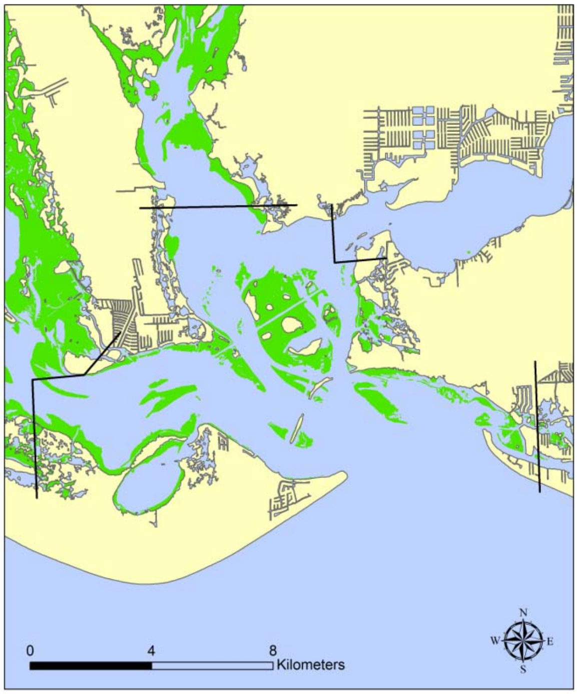
Matlacha Pass
2004 Seagrass



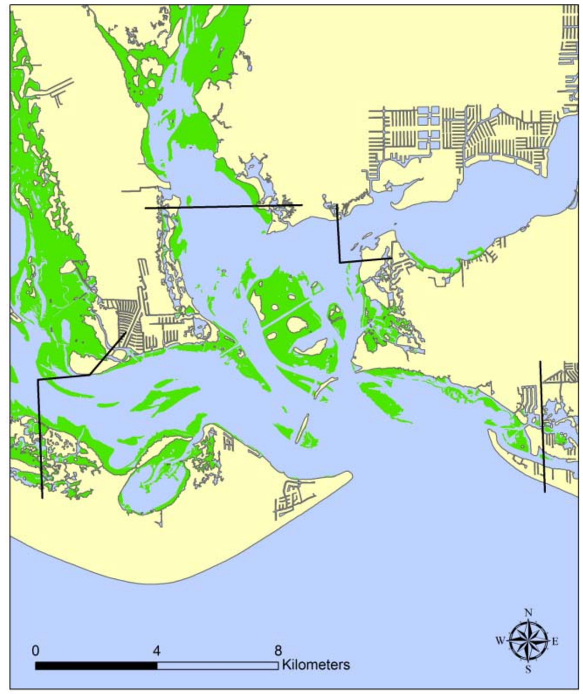
Matlacha Pass
2006 Seagrass



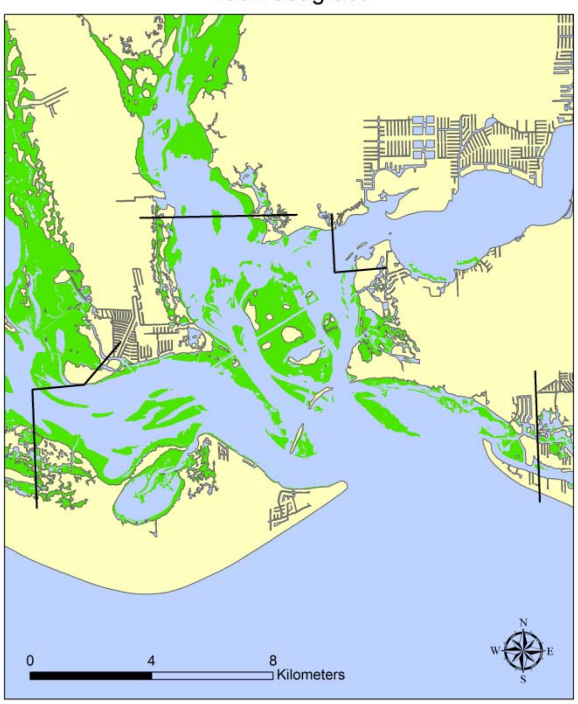
San Carlos Bay
1999 Seagrass



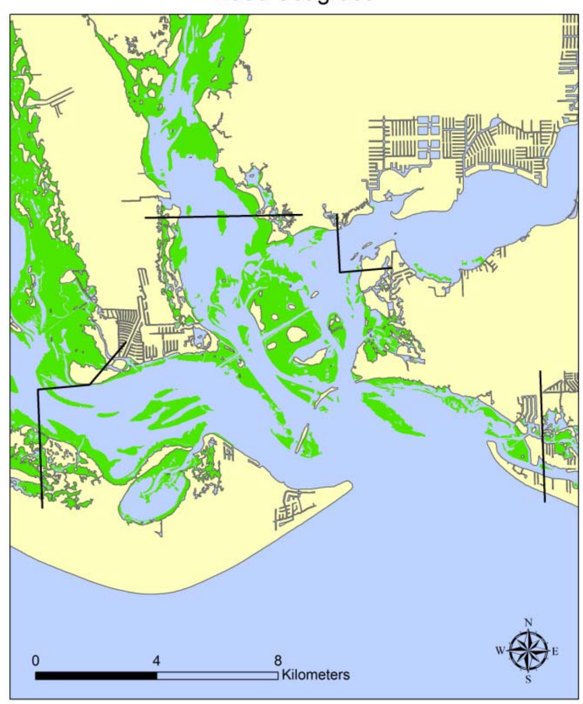
San Carlos Bay
2003 Seagrass



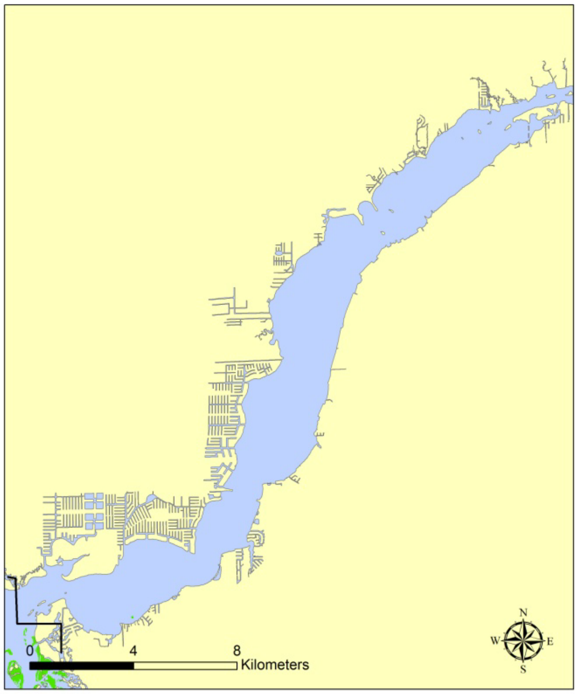
San Carlos Bay
2004 Seagrass



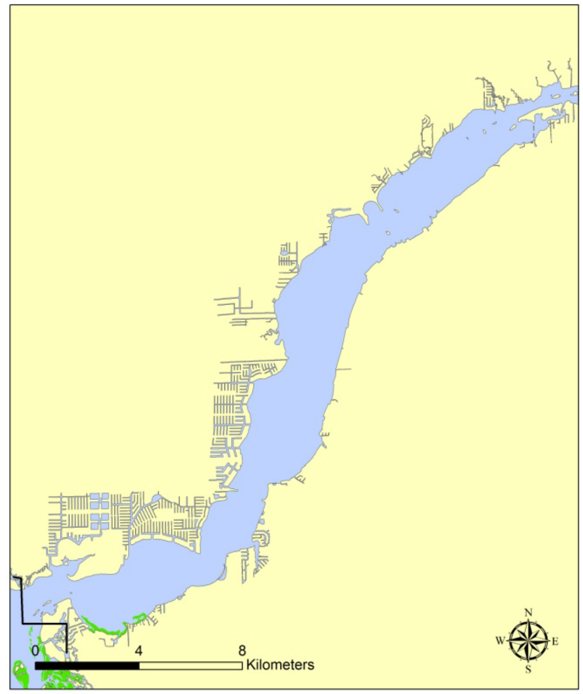
San Carlos Bay
2006 Seagrass



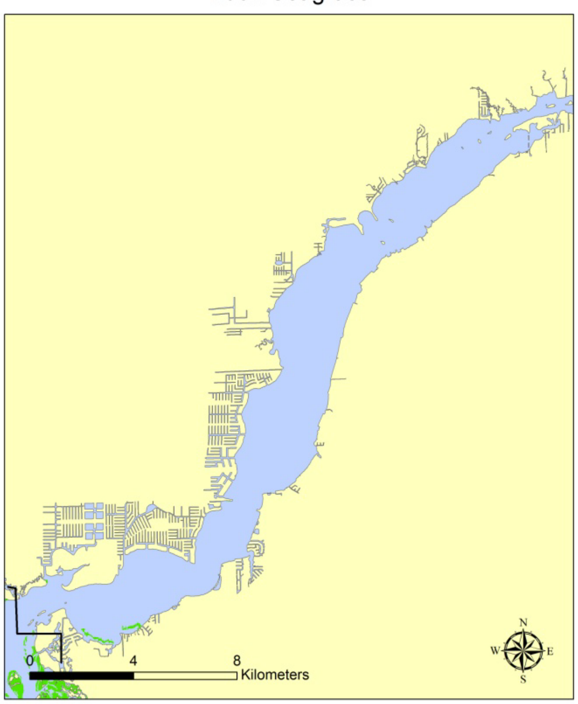
Tidal Caloosahatchee
1999 Seagrass



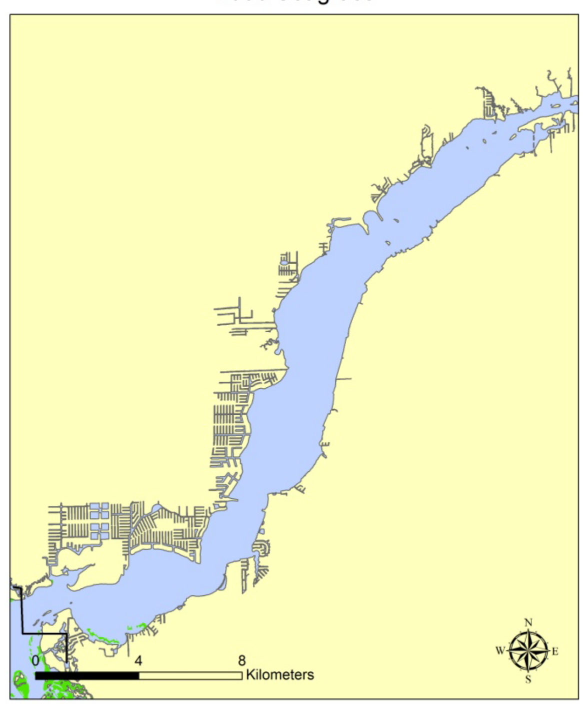
Tidal Caloosahatchee
2003 Seagrass



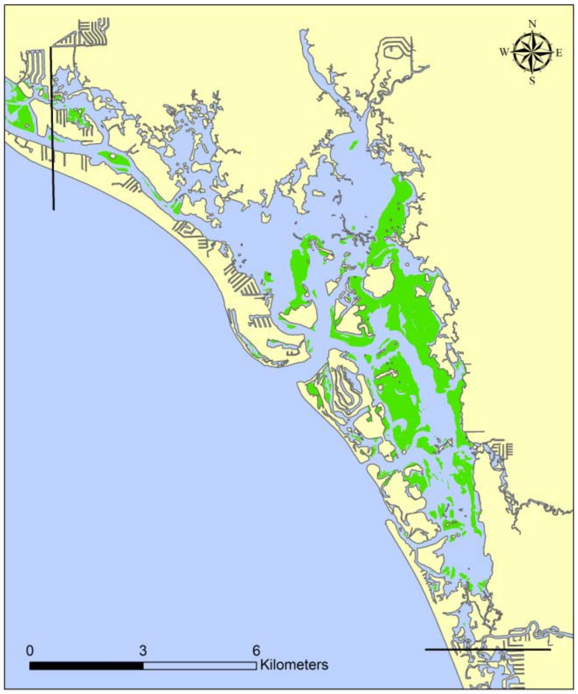
Tidal Caloosahatchee
2004 Seagrass



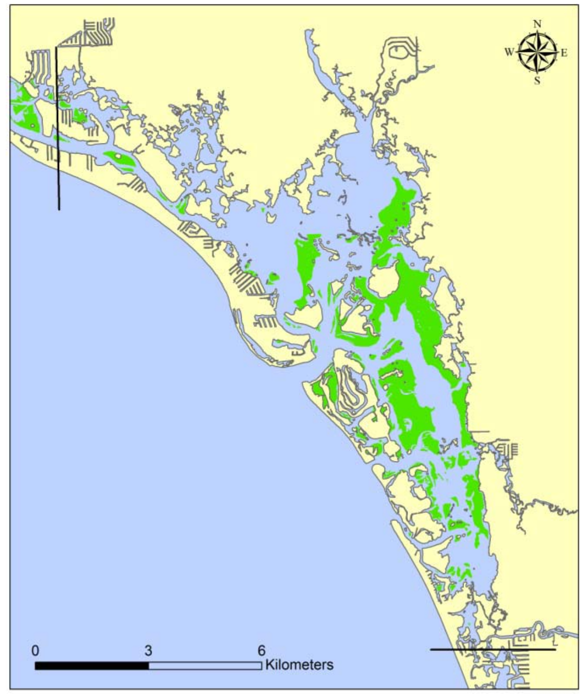
Tidal Caloosahatchee
2006 Seagrass



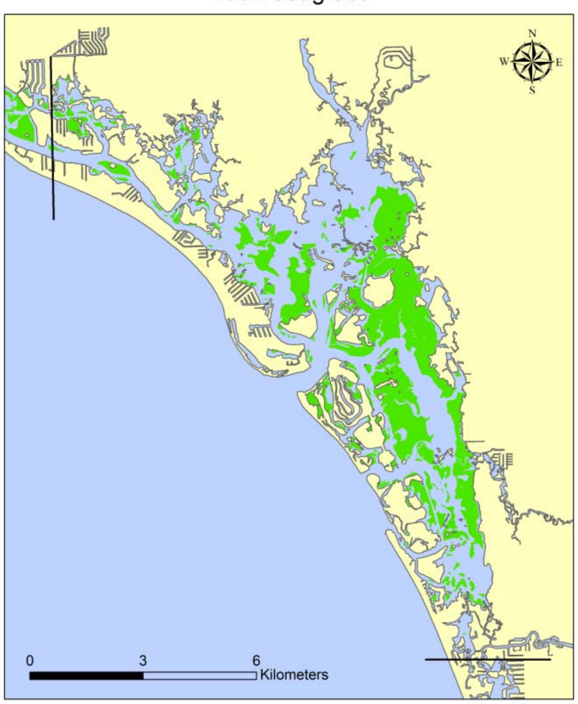
Estero Bay
1999 Seagrass



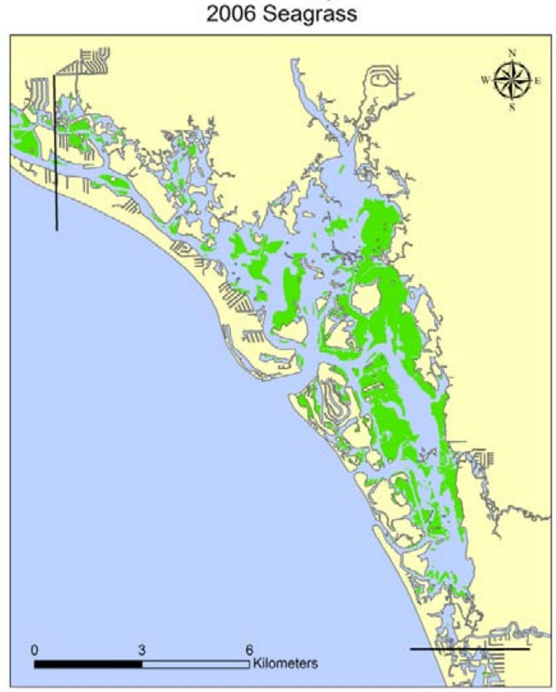
Estero Bay
2003 Seagrass



Estero Bay
2004 Seagrass



Estero Bay
2006 Seagrass



APPENDIX C: May 28 TAC Subcommittee Meeting Summary and Attendees

MEMORANDUM

TO: CHNEP Targets Subcommittee

FROM: Janicki Environmental, Inc.

DATE: May 28th, 2009

SUBJECT: Summary of meeting on May 28th 2009

Tony Janicki presented a summary of a draft report submitted to the CHNEP defining the process by which targets could be established to evaluate changes in seagrass areal extent through time. Seagrass acreage estimates for each segment of the CHNEP study area were based on all available photo-interpreted aerial surveys including estimates from historical photos from the 1950's and biennial District surveys since 1988. To estimate change in acreage over time, non-restorable areas (e.g. dredging of the ICW and fill projects within the system) were accounted for prior to estimating acreages for all years. A table was provided that summarized the change in acreage within each segment over all survey years and options were presented to guide the selection of the appropriate target for each segment.

Comments on the document were received from several committee members; however, the due date for comments was extended to June 10th.

Comments expressed during the meeting included that non restorable areas be explicitly identified. That changes in acreage be expressed as a proportion of the total area and that the shoreline coverage should remain consistent when evaluating future changes in areal extent. The distinction between seagrass quality and quantity was emphasized and it will be explicitly stated in the report that the targets will be established based on areal extent and do not reflect estimates of seagrass quality. Further, the document will include an analysis of a large un-interpretable area in the historic shoreline coverage that affected the historic estimate for the Pine Island Sound and San Carlos Bay segments.

Additions to the draft document will include an Implementation and Management section. This section will express the mechanism by which the newly acquired seagrass data will be evaluated in the context of the targets. Natural variability will be expressed as a range bracketing the target value to put the difference between the current survey and the target in the context of natural variation and measurement error.

Table 5-1 lists the potential targets for each segment. These options are expressed in the document as follows:

- the maximum areal extent observed in any of the survey years,
- the mean areal extent over all recent survey years,
- the mean areal extent over the last three survey years, or
- the most recent areal extent, i.e., 2006.

NOTE: *The segment Lower Charlotte Harbor in the following tables was later renamed "Bokeelia" to better differentiate the segment from the region.*

Table 5-1. Baseline, non-restorable, and adjusted baseline seagrass extents and potential seagrass targets (acres).

	Coastal Venice	Upper Lemon Bay	Lower Lemon Bay	Tidal Myakka	Tidal Peace	West Wall	East Wall	Cape Haze	Lower Charlotte Harbor	Pine Island Sound	Matlacha Pass	San Carlos Bay	Tidal Caloosa-hatchee	Estero Bay	Total
Baseline	133	1005	3114	350	1039	2117	3986	5798	3058	24113	9577	3243	211	3769	61513
Non-restorable Areas	21	125	232	6	64	11	88	128	94	356	262	125	118	107	1737
Adjusted Baseline	112	880	2882	344	975	2106	3898	5670	2964	23757	9315	3118	93	3662	59776
Maximum Annual Extent	124	1175	2597	539	573	2121	3591	7464	3520	29204	7619	5376	103	3409	67415
Mean Annual Extent: all years	91	1009	2502	456	384	1907	3465	6998	3342	26837	7582	4372	87	3071	62103
Mean Annual Extent: last 3 years	104	1032	2498	411	337	1965	3416	7050	3392	28043	7427	4969	72	3033	63749
Most Recent Annual Extent	124	949	2597	375	341	2121	3382	6911	3520	29204	7619	5376	56	3298	65873

Subsequently, a table (below) was constructed that identifies potential protection and restoration targets for each segment based on the group meeting discussion.

Draft CHNEP Seagrass Targets (May 22, 2009)

Segment	Baseline, adjusted (B)	Mean Annual Extent all years (A)	Higher of 2	Protective Target	Restoration Target	Total Target
Dona and Roberts Bay	112	91	B	91	21	112
Upper Lemon Bay	880	1,009	A	1,009		1,009
Lower Lemon bay	2,882	2,502	B	2,502	380	2,882
Tidal Myakka	344	456	A	456		456
Tidal Peace	975	384	B	384	591	975
West Wall	2,106	1,907	B	1,907	199	2,106
East Wall	3,898	3,465	B	3,465	433	3,898
Cape Haze	5,670	6,998	A	6,998		6,998
Lower Charlotte Harbor	2,964	3,342	A	3,342		3,342
Pine Island Sound	23,757	26,837	A	26,837		26,837
Matlacha Pass	9,315	7,582	B	7,582	1,733	9,315
San Carlos bay	3,118	4,372	A	4,372		4,372
Tidal Caloosahatchee	93	87	B	87	6	93
Estero Bay	3,662	3,071	B	3,071	591	3,662
Total	59,776	62,103		62,103	3,954	66,057

The group went through each segment and generally agreed the higher of the adjusted baseline or the mean annual extent of all recent survey years be used as the targets. Exceptions were the Tidal Peace River, Pine Island Sound and Matlacha Pass.

The Tidal Peace - Lost ~50% of the historic seagrass. This may be due to altered geomorphology of the river due to erosion forces or potentially the occurrence of hurricane Charley in 2004 changing the bottom contour in this portion of the river.

Pine Island Sound – A large un-interpretable area in the historic photography requires further consideration of the appropriate target for this segment. Further evaluation will include an assessment of whether this un-interpretable area is sufficient for seagrass colonization and success.

Matlacha Pass – This area appears to have significant losses compared to historic photography; however, this is a high energy area with large tidal forcing that may have eroded potential seagrass bottom area. Further evaluation and discussion will be required to establish the appropriate target for Matlacha Pass.

Caloosahatchee River- there was one survey were the recorded acreage was 2 acres of seagrass. The group suggested that this value be removed when calculating the average of recent years for that value as a potential target.

Final comments on draft report are due June 10th

Final document will be delivered June 26th

Targets will be presented to TAC on July 8th and pending approval to the Management committee in August 2009.