SEAGRASS TARGETS FOR THE SARASOTA BAY ESTUARY PROGRAM

Prepared for:

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EXECUTIVE SUMMARY

The objective of this project is to provide technically-defensible quantitative restoration and protection targets for seagrasses in the Sarasota Bay ecosystem. 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 resource. The primary goal of this project is to maintain and/or restore seagrass coverage to its historic extent. Restoration targets were defined through an analysis of historic and recent aerial surveys of the study area. Historic photos of the area were taken in 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 SBEP based on recent surveys have been identified.

The methodology employed for this project is GIS-based. Historic aerial photos were used to establish a baseline extent of seagrass in the study area circa 1950. Recent trends in and persistence of seagrass throughout the SBEP were determined through analysis of GIS shapefiles based on aerial surveys executed by the SWFWMD since 1988. Due to anthropogenic modifications in the estuary such as shoreline build-out and the dredging of the Intracoastal Waterway (ICW), certain areas have been altered to the extent that they have no reasonable potential for restoration; these so-called non-restorable areas have been identified and removed from the analyses contained in this report.

The results of these analyses varied by bay segment. The trend analyses show that Sarasota Bay is currently at its highest seagrass level since the 1950 and exceeds the baseline extent. The seagrass coverage in Roberts Bay and Blackburn also increased since the baseline period. In Palma Sola Bay, the seagrass coverage has remained very similar over the entire period of record. In contrast, Little Sarasota Bay has shown a decline in seagrasses since 1950.

Given the differences among bay segments when baseline and current seagrass coverages are compared, the definition of seagrass targets will vary among segments. Five potential seagrass target definitions have been identified. These include:

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

The definition of the most appropriate seagrass targets was reached with input from the Technical Advisory Committee (TAC). The TAC recommended that the greater of either the historic or recent (2004-2006) seagrass coverages be established as the target in each segment. The sole exception to this rule was Little Sarasota Bay. Since 1984, the direct connection to the Gulf of Mexico (Midnight Pass) has been closed. This physical alteration may have contributed to the difference in seagrass coverage between the historic and current coverages. However, a recent FDEP decision precludes re-opening of this pass. Therefore, the recent coverage in Little Sarasota Bay has been established as the target. The following table presents the seagrass targets that were adopted by the SBEP Management and Policy boards.

SBEP seagrass coverage and targets. Unit of measure = acres.			
Bay Segment	**Historical (1950)**	**Current 2004-2006 Average**	**Seagrass Target**
Palma Sola	1,031	1,015	1,031
Sarasota	7,269	7,041	7,269
Roberts	283	348	348
Little Sarasota	883	702	702
Blackburn	273	447	447
Total	9,739	9,552	9,997

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1.0 INTRODUCTION

Seagrasses are an important marine resource, functioning as keystones 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 (Moore *et al.*, 2004). Healthy seagrass populations are critical resources that provide a multitude of benefits to estuarine ecosystems, 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 (Dawes et al., 2004; Janicki *et al.*, 1995).

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 ecosystem services 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 to nutrient polluting when seagrasses are located in abundance.

Anthropogenic nitrogen loads can lead to excessive algae growth, which adversely affects light penetration to submerged seagrasses (Dennison *et al.*, 1993; SBEP, 1995; Chespeake 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 directly proximal to the shore and watershed, these systems are highly susceptible to nutrient and sediment inputs (Orth, *et al.*, 2006).

In Florida, 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 and lotic 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, and
- Tampa 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 load increases 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 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. Bay-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, the Indian River Lagoon, and Tampa Bay.

Chesapeake Bay was perhaps the first major estuary in the United States to make seagrass restoration and protection a key cog within a greater 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 estimate 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 are 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 has witnessed a dramatic decrease in seagrass coverage since development strains in the watershed have manifest in water quality drop-offs. 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 has also 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 function these communities contribute (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 model for the current project in the SBEP is from Tampa Bay. 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 Sarasota Bay and Tampa Bay have with one another, similar patterns of development and urbanization also make Tampa Bay a conducive model for restoration target setting in Sarasota Bay. 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 studies and spatial and temporal and trends in seagrasses. 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 were 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).

Kurz *et al.* (1999) examined recent trends in seagrass distribution in coastal waters throughout Southwest Florida, including Sarasota Bay. Tomasko *et al.* (2005) observed that there is more extensive seagrass coverage in 2002 than in the 1980s, linked to decreases in anthropogenic nitrogen loads in the Sarasota Bay watershed and greater water clarity. Similar trends were observed in Tampa Bay, but seagrass was constant in adjacent Lemon Bay and Charlotte Harbor, which suggests that a system-specific approach is an appropriate resource management strategy (Tomasko *et al.*, 2005).

1.1 Definition of Study Area

The SBEP is comprised of five bay segments (Figure 1-1):

- Palma Sola Bay,
- Sarasota Bay,
- Roberts Bay,
- Little Sarasota Bay, and
- Blackburn Bay.

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

1.2 Objective

The objective of this project is to provide technically-defensible quantitative restoration and protection targets for seagrasses in the Sarasota Bay ecosystem. 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 resource. This analysis is not an assessment of the quality of seagrass currently or historically present in Sarasota Bay nor is intended to identify potential reasons for the observed changes in seagrass distribution over time. Rather, the primary goal of this project is to establish targets designed to maintain and/or restore seagrass coverage to its historic extent. Restoration targets were defined through an analysis of historic and recent aerial surveys of the study area. Historic photos of the area were taken in 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 SBEP based on recent surveys have been identified.

Figure 1-1. Location of bay segments of Sarasota Bay Estuary Program (SBEP).

2.0 METHODOLOGY

The methodology employed for this project is GIS-based, using ArcGIS v 9.2. Seagrass targets are proposed to be based on the spatial extent of 1950 baseline seagrass coverage in Sarasota Bay. The 1950 baseline provides an estimate of pre-development distribution of this critical resource and will be assumed to be the maximum potential current extent. This baseline level was also used to establish seagrass targets for similar work in Tampa Bay in the mid-1990s (Greening and Janicki, 2006) and are currently being used to establish seagrass targets for the Charlotte Harbor National Estuary Program (Janicki *et al.*, in prep.).

Aerial photography of seagrasses in the bay has been gathered approximately every two years since 1988 by the SWFWMD. Some of the 1988 areas mapped as seagrasses were later found to actually represent attached macro-algae. From 1990 on, the aerial photography was field checked to verify presence of seagrasses (Kurz *et al*., 1999). For the purposes of this data report, only the SWFWMD seagrass coverages for 1988, 1994, 1999, 2001, 2004 and 2006 are utilized.

The SWFWMD aerial photography was 1:24,000-scale true color and were generally obtained during the late fall/early winter time period (November-February) when water clarity in West-Central Florida estuaries is typically greatest (Kurz *et al*., 1999). To develop GIS coverages from the aerial photography, the SWFWMD analyzed the photos using zoom transfer methodology registered to U.S. Geological Survey (USGS) 7.5-minute quadrangles. The minimum mapping unit for seagrasses was 0.5 acres. Seagrass polygons were delineated on mylar overlays and transferred to an ARC/INFO database.

In 2006, seagrass GIS coverages were developed from 1:24K natural color digital aerial photography using stereoscopic photo-interpretation. Digital photogrammetric workstations are utilized with software that allow for the direct capture of digital data for later importation to an ArcGIS geodatabase. The minimum mapping unit for delineating features was 0.5 acres.

The post-1988 SWFWMD coverages contain two classes of seagrass coverage, patchy and continuous. For the purposes of this data report, the acreages of both classes were combined to yield total seagrass acreage.

Previous work on seagrasses in Sarasota Bay has shown that of six available seagrass survey years, different areas show seagrass occurrence at different times. A persistence rule will be used to determine what the areal extent is where seagrass coverage is most constant over the period of record. The persistence rule involves converting the seagrass cover into a grid format. Each grid cell will be designated as having seagrass if more than 50% of the grid cell contained seagrass. Next, we determine which grid cells had seagrasses in all survey years to identify the most persistent seagrass areas. Section 4 presents the results of this analysis.

The current extent of seagrass is defined as the 2006 extent, the most recent completed seagrass survey in the study area. By comparing the current extent with the maximum potential extent, candidate areas for protection and restoration can be identified. The Sarasota Bay basin has experienced major urban development since 1950, and some areas have been altered to the extent that they have no reasonable potential for restoration. It is quite possible that certain anthropogenic modifications or areas that have changed as a result of natural processes have led to new areas where seagrasses are currently present but were not in the 1950 baseline extent. Such areas will be identified and targeted for protection as well.

2.1 Data Sources and Description

To set seagrass targets, the following data sources were used:

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

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 GIS coverage of the area of interest for the Sarasota Bay Estuary Program. 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 were investigated further before proceeding with the analysis (Appendix C).

The Southwest Florida Water Management District (SWFWMD) has also 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 SBEP, in addition to the baseline, were available for the following years:

- October, 1988,
- January, 1994,
- December, 1999,
- January, 2001,
- January, 2004 , and
- January, 2006.

Trends in seagrass coverage in each bay segment were identified through analysis of these shapefiles.

Current shoreline extent was also provided by GIS data obtained from SWFWMD (Kaufman, pers. Comm.). Two candidate shorelines were considered, including one developed by Photo Science and a second based on the most recent SWFWMD land use/cover database. A comparison of the two extents was performed, and little difference was seen between the two shapefiles.

Additionally, bay segment boundaries and ICW spatial data were needed for this analysis. A shapefile containing bay segment boundary data was provided by the SBEP. A shapefile of the ICW extent was developed through digitization of its current location based on topographical maps and was categorized in this analysis as non-restorable areas.

2.2 Description of GIS Analysis

Seagrass acreages were calculated by survey year and by bay segment:

- In order to assign bay segment, the seagrass shapefiles were joined with the bay segment shapefile.
- The area of each seagrass polygon was then calculated in ArcGIS, and summed by bay segment.

Non-restorable areas were also calculated in ArcGIS:

- The 1950 seagrass coverage was intersected with the SWFWMD shoreline coverage and the ICW coverage. The resultant shapefile consisted of only the non-restorable areas, or areas that had been altered so significantly since 1950 that restoration could not be considered an option.
- The non-restorable areas shapefile was then joined with the bay segment shapefile.

- The area of each non-restorable area polygon was then calculated in ArcGIS, and summed by bay segment.

2.3 Approach and Rationale

In order to determine seagrass targets, the 1950 baseline seagrass coverage, the 2006 current seagrass coverage, and the non-restorable areas were overlain in ArcGIS. Clipping the non-restorable areas from the baseline coverage leaves the area of restorable seagrass.

Ultimately, the goal of this exercise is to compare recent trends in seagrass coverage throughout the SBEP with historical estimates in order to determine what needs to be protected, how much can be restored, and on what basis should the target be made. By comparing 2006 with the baseline, or, if pertinent, averages or more recent maxima, we can determine what these restoration goals should be. These five different options will be examined, with the most conservative estimate (i.e., the estimate that leads to the greatest amount of seagrass targeted for protection and restoration) being the final recommendation:

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

The rationale behind evaluating each of these scenarios is as follows. By looking at the most recent coverage first, the current seagrass spatial extent can be compared to past extents; if the maximum is occurring now, a target consisting of the total of these acres surveyed in 2006 can be chosen. If this number is less than the baseline or a more recent index, a restoration target can be set based on some metric of past seagrass coverage.

If the maximum coverage occurred at some point in the past, a couple of options exist. One is to determine restoration targets based on averages of some or all of the recent surveys. Using the average acknowledges both the year-to-year variability in seagrass coverage, particularly in terms of water quality and precipitation and how they can impact light attenuation, as well as the variability in consistency of the methodology employed in identifying acreages of seagrass from survey to survey. The maximum past coverage approach recognizes that if this coverage was met at one time, then it could plausibly be met once more. The total observed extent represents the amount of seagrass in each of the recent surveys overlain with one another to determine all areas where seagrass has been observed recently. Use of the total observed extent sets a restoration target that is the most conservative in terms of total seagrass acreage.

3.0 RESULTS – HISTORICAL SEAGRASS

Estimates of the historical seagrass acreages used as the baseline in this project are presented by bay segment. Historical seagrass coverage, in acres, were:

- Palma Sola Bay: 1,087 acres
- Sarasota Bay: 7,557 acres
- Roberts Bay: 342 acres

- Little Sarasota Bay: 958 acres
- Blackburn Bay: 302 acres

In total, 10,246 acres are estimated to have been present historically in the SBEP. Figures 3-1 through 3-5 present maps depicting the location of historical seagrass circa 1950, as estimated from the photointerpretation process described in Section 2.

Additionally, approximately 6,450 acres were classified as 9999s, primarily in Sarasota Bay proper. Appendix A provides a more detailed explanation of the process of determining these so-called 9999 areas and presents a map detailing where these areas were located.

Figure 3-1. Baseline seagrass coverage in Palma Sola Bay.

Figure 3-2. Baseline seagrass coverage in Sarasota Bay.

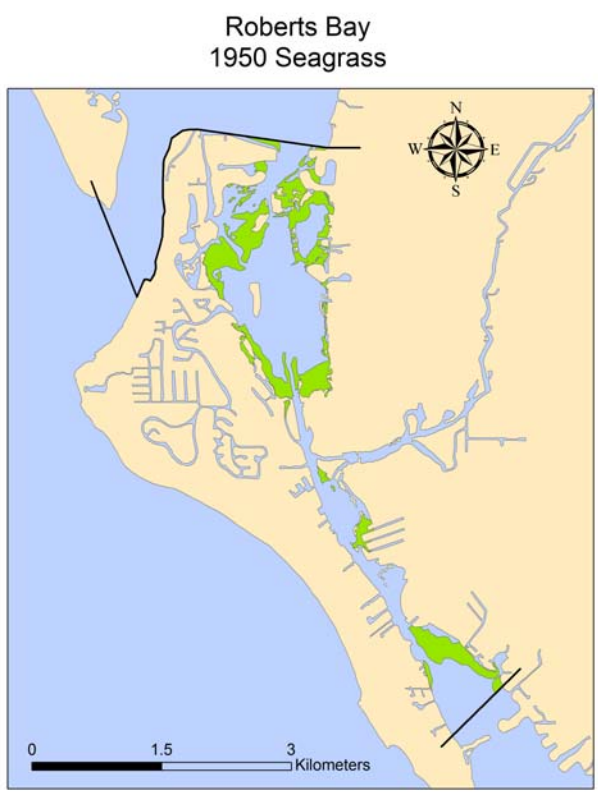

Figure 3-3. Baseline seagrass coverage in Roberts Bay.

Figure 3-4. Baseline seagrass coverage in Little Sarasota Bay.

Figure 3-5. Baseline seagrass coverage in Blackburn Bay, ca. 1950.

4.0 RESULTS – RECENT TRENDS IN SEAGRASS COVERAGE

Recent seagrass coverage data throughout the five embayments within the SBEP are presented in Table 4-1. Trends in seagrass coverage between 1988 and 2006 were identified in each embayment:

- Palma Sola Bay - Areal seagrass coverage peaked in 1988 and remained at relatively similar extents from 1994 through 2006.
- Sarasota Bay - From 1988 through 2004 seagrass coverage was very similar, ranging between 6,323 and 6,862 acres. In 2006, more than 7,400 acres of seagrass were observed.
- Roberts Bay - Similar to both Palma Sola and Sarasota bays, seagrass extent in Roberts Bay remained fairly consistent through the recent survey years.
- Little Sarasota Bay - Seagrass extent varied in the recent survey years relatively more in Little Sarasota Bay than in other bay segments.
- Blackburn Bay - Seagrass coverage varied between 301 and 468 acres during the recent survey years.

Maps depicting seagrass coverage for each year of the recent surveys, by bay segment, can be found in Appendix B.

Table 4-1. Annual seagrass coverage (acreages) in the SBEP.

Bay Segment	1988	1994	1999	2001	2004	2006
Palma Sola	1111	1089	1025	1046	1002	1028
Sarasota	6323	6910	6750	6862	6646	7436
Roberts	334	347	332	273	371	325
Little Sarasota	533	592	770	699	763	640
Blackburn	411	411	374	301	468	425
Total	8712	9349	9251	9181	9250	9854

Persistence maps were also created based on the recent surveys (1988-2006) used to characterize trends in seagrass within the SBEP. Figures 4-1 through 4-5 present the results of the persistence analysis, where persistence is based on presence in a grid cell in a given survey year. For example, if seagrass was present 5 out of 6 years, it signifies that a location showed seagrass in 5 of the 6 surveys used for this analysis. Also, persistence in 5 out of 6 years does not mean 5 consecutive years. Note that the most persistent seagrass areas are located near the shore in the shallowest portions of the estuary, whereas the least persistent areas are in the middle of the channel, where light attenuation is at its lowest levels, due to the increased depths in these locations. Additionally, the results of the persistence analysis show that some areas never have been, nor will be, well-suited for seagrass growth.

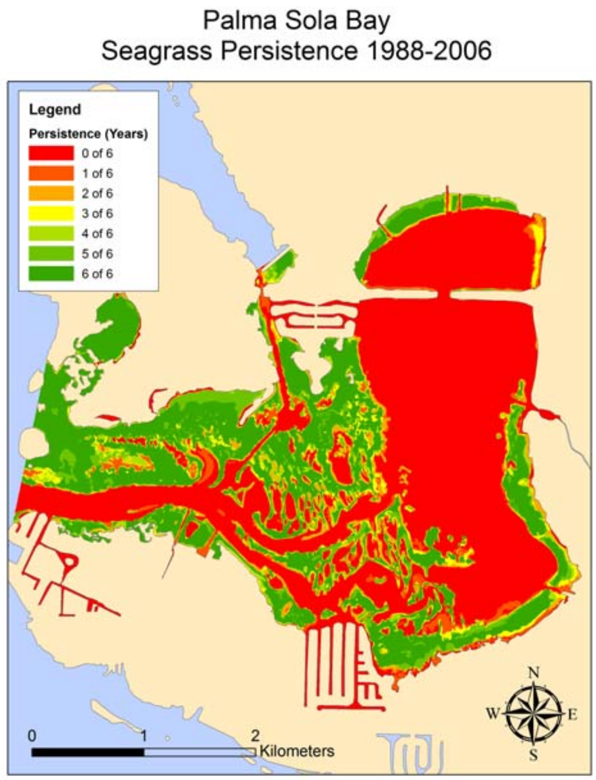

Figure 4-1. Map showing seagrass persistence throughout Palma Sola Bay, 1988-2006.

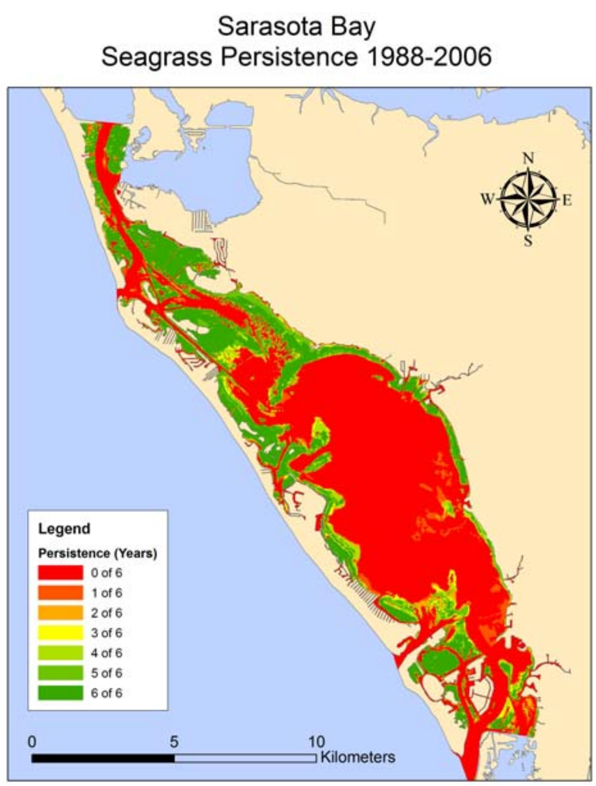

Figure 4-2. Map showing seagrass persistence throughout Sarasota Bay, 1988-2006.

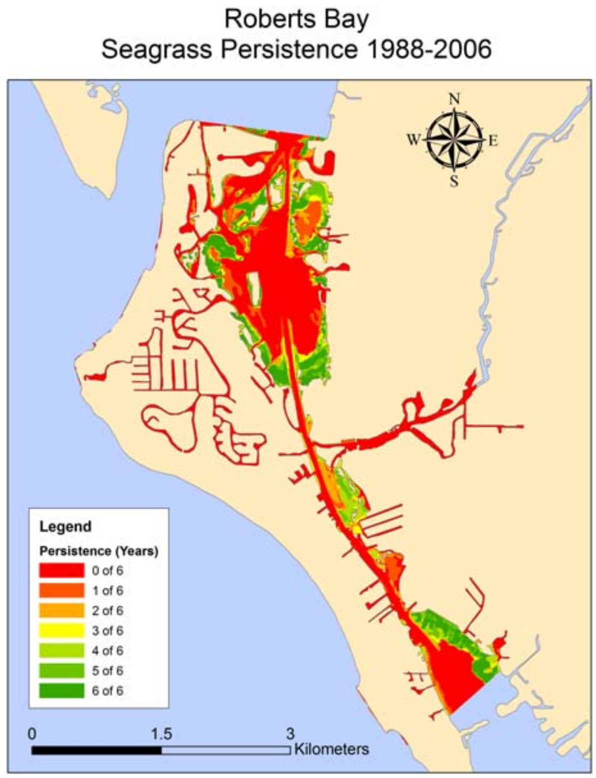

Figure 4-3. Map showing seagrass persistence throughout Roberts Bay, 1988-2006.

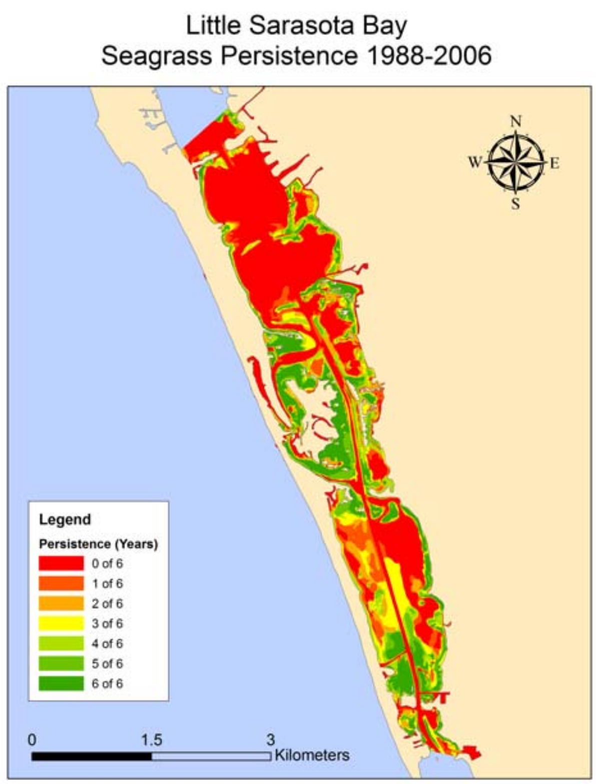

Figure 4-4. Map showing seagrass persistence throughout Little Sarasota Bay, 1988-2006.

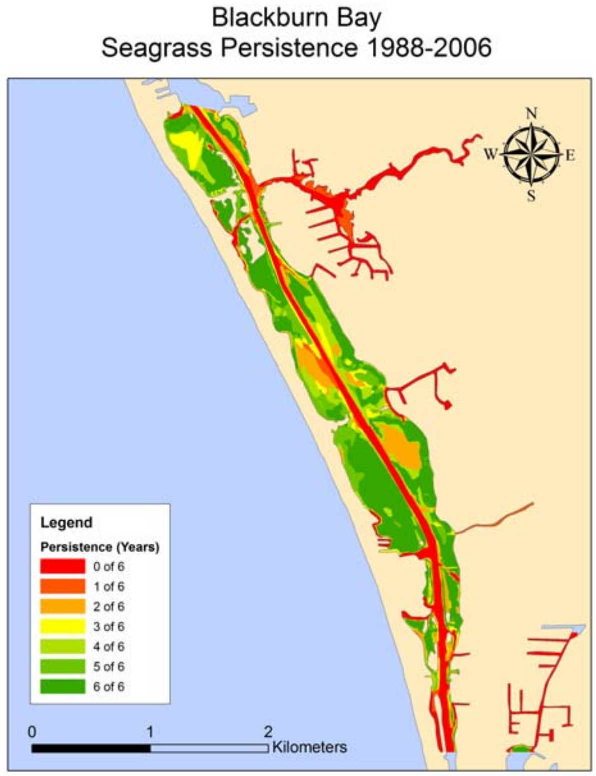

Figure 4-5. Map showing seagrass persistence throughout Blackburn Bay, 1988-2006.

5.0 ESTABLISHMENT OF TARGETS

Seagrass target establishment also relies upon the determination of areas which are unable to be included as potential targets due to build-out, dredging, or other anthropogenic development. These areas, referred to as non-restorable areas, include shoreline development and the Intracoastal Waterway (ICW), and are removed from baseline acreages when they are assessed as potential targets. Non-restorable areas in each bay segment are as follows:

- Palma Sola Bay: 56 acres
- Sarasota Bay: 288 acres
- Roberts Bay: 59 acres
- Little Sarasota Bay: 75 acres
- Blackburn Bay: 29 acres

Maps depicting non-restorable areas for each bay segment can be found in Appendix C.

Having determined the extent of the baseline seagrass coverages, identified trends in recent seagrass coverages, and delineated the non-restorable areas in the SBEP, potential restoration targets can be calculated. Figures 5-1 through 5-5 present both the baseline and recent seagrass acreages for each bay segment. From these histograms, baseline, mean, maximum, and most recent seagrass acreages can be determined. These key statistics, along with total observed extent, are presented in Table 5-1.

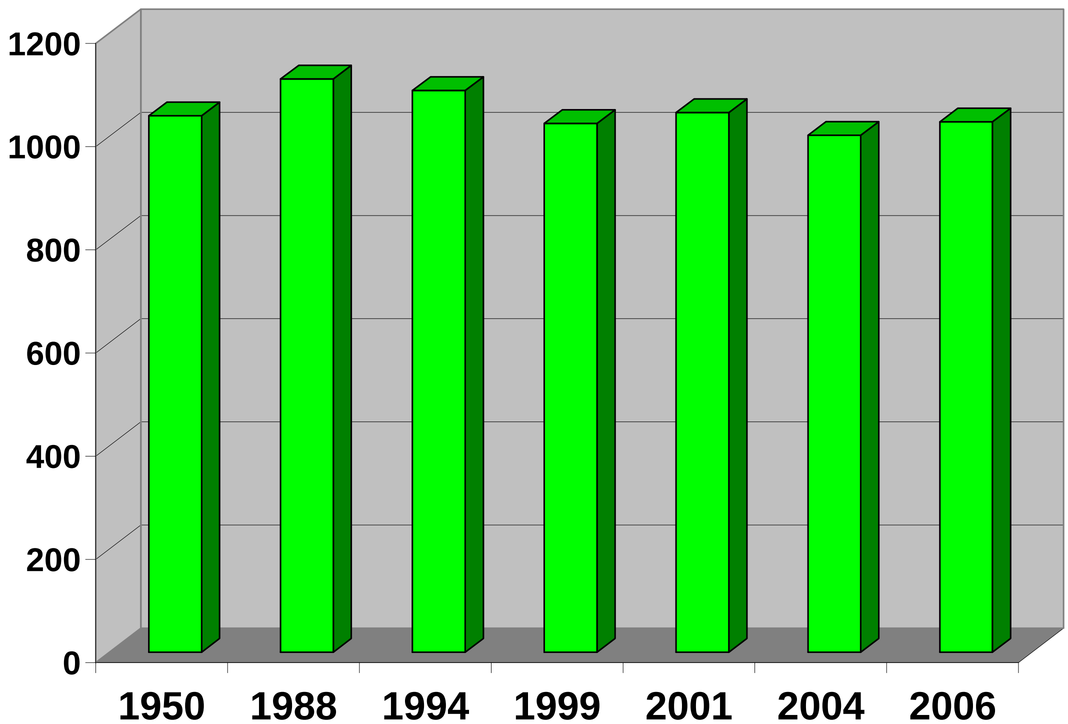

Figure 5-1. Annual seagrass acreages in Palma Sola Bay.

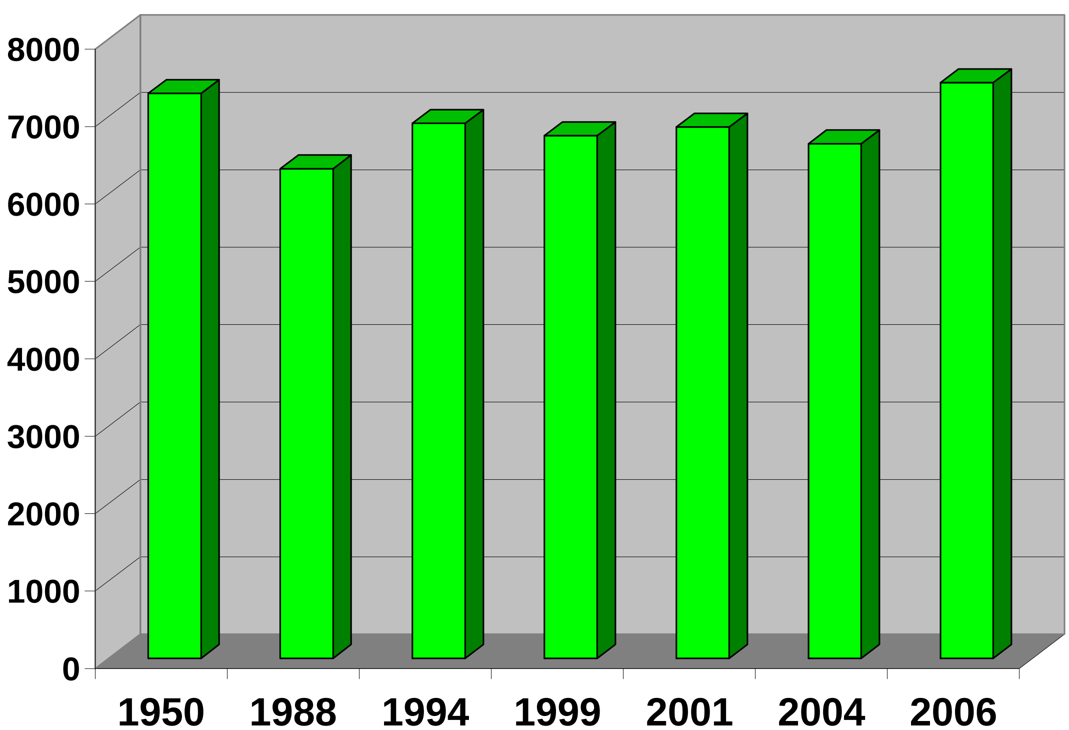

Figure 5-2. Annual seagrass acreages in Sarasota Bay.

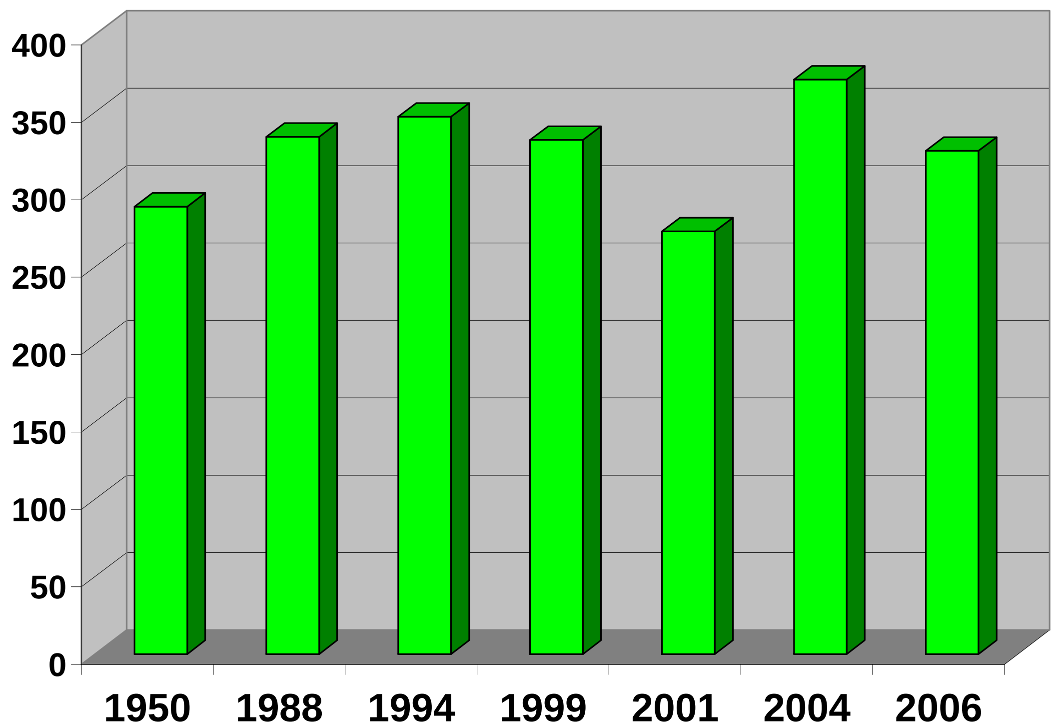

Figure 5-3. Annual seagrass acreages in Roberts Bay.

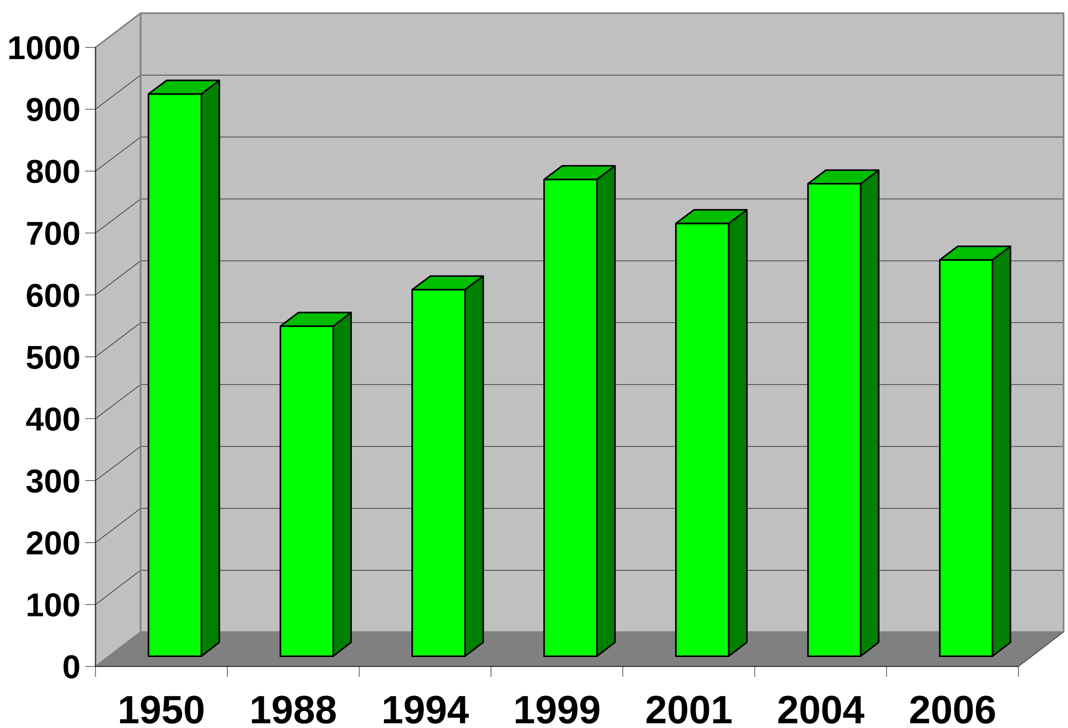

Figure 5-4. Annual seagrass acreages in Little Sarasota Bay.

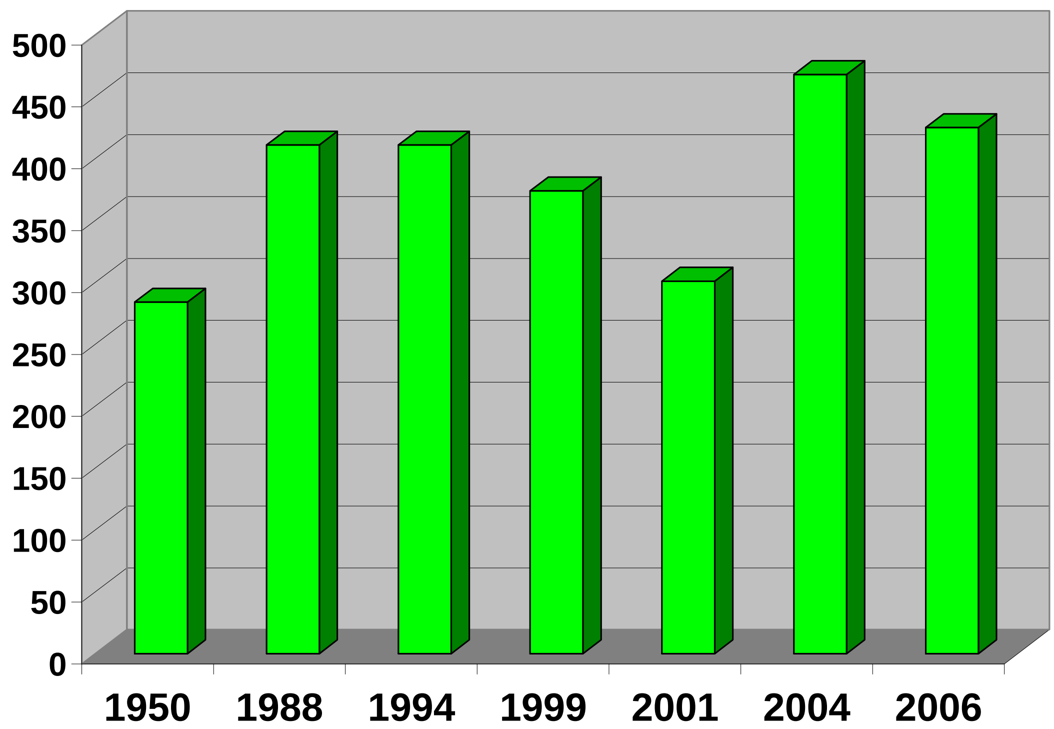

Figure 5-5. Annual seagrass acreages in Blackburn Bay.

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

	Palma Sola Bay	Sarasota Bay	Roberts Bay	Little Sarasota Bay	Blackburn Bay	Total
Baseline	1087	7557	342	958	302	10246
Non-restorable Areas	56	288	59	75	29	507
Adjusted Baseline	1031	7269	283	883	273	9739
Maximum Annual Extent	1089	7436	371	770	468	10134
Mean Annual Extent – all years	1038	6921	330	693	396	9378
Mean Annual Extent – last 3 years	1025	6981	323	701	398	9428
Most Recent Annual Extent	1028	7436	325	640	425	9854
Total Observed Extent	1395	8946	592	1116	539	12588

Assuming that the most conservative estimate for seagrass targets are chosen in each bay segment, the potential targets would be as follows:

- Palma Sola Bay – Three of the potential targets exceed the 1031 acres of restorable seagrass represented by the adjusted baseline. The total observed extent of seagrass, 1395 acres, is the most conservative of the potential targets.

- Sarasota Bay - The annual maximum observed seagrass was 7436 acres in 2006 and exceeds the estimated 7269 acres of restorable seagrass from the baseline period. Although seagrass coverage has increased since the baseline, the most conservative seagrass target for Sarasota Bay would be 8946 acres, the total observed seagrass extent.

- Roberts Bay - All potential targets exceed the 283 acres of restorable seagrass. The most conservative target would be 592 acres, the total observed seagrass extent.

- Little Sarasota Bay - The restorable seagrass observed in the adjusted baseline is 883 acres and exceeds the seagrass extent observed in each of the recent survey years. The most conservative restoration target is the total observed extent of 1116 acres.

- Blackburn Bay - All potential targets exceed the 273 acres of restorable seagrass. The most conservative target would be 539 acres, the total observed seagrass extent.

Please note that the seagrass restoration goals established are segment-wide acreage numbers and that they do not identify locations within each segment which are suitable for restoration.

The definition of the most appropriate seagrass targets was reached with input from the Technical Advisory Committee (TAC). The TAC recommended that the greater of either the historic or recent (2004-2006) seagrass coverages be established as the target in each segment. The sole exception to this rule was Little Sarasota Bay. Since 1984, the direct connection to the Gulf of Mexico (Midnight Pass) has been closed. This physical alteration may have contributed to the difference in seagrass coverage between the historic and current coverages. However, a recent FDEP decision precludes re-opening of this pass. Therefore, the recent coverage in Little Sarasota Bay has been established as the target. Table 5-2 presents the seagrass targets that were adopted by the SBEP Management and Policy boards.

Table 5-2. SBEP seagrass coverage and targets. Unit of measure = acres.

Bay Segment	Historical (1950)	Current 2004-2006 Average	Seagrass Target
Palma Sola	1,031	1,015	1,031
Sarasota	7,269	7,041	7,269
Roberts	283	348	348
Little Sarasota	883	702	702
Blackburn	273	447	447
Total	9,739	9,552	9,997

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APPENDIX A – 9999 Analysis

The 9999s represent the areas within the photos that Photo Science was not inclined to define as seagrass or not. This total area of approximately 6,450 acres is located primarily in Sarasota Bay (Figure A-1). 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 Sarasota Bay is especially suspect given the depth of the bay in this location and the actual, irregular shape of the 9999 area. The greatest potential for 9999s as historic seagrass are those areas which are directly proximal to the near-shore seagrasses, but the available 1950s/historical imagery for some areas of Sarasota Bay was not of sufficient quality to determine/photo-interpret features in those areas with the required confidence for inclusion with the baseline coverage.

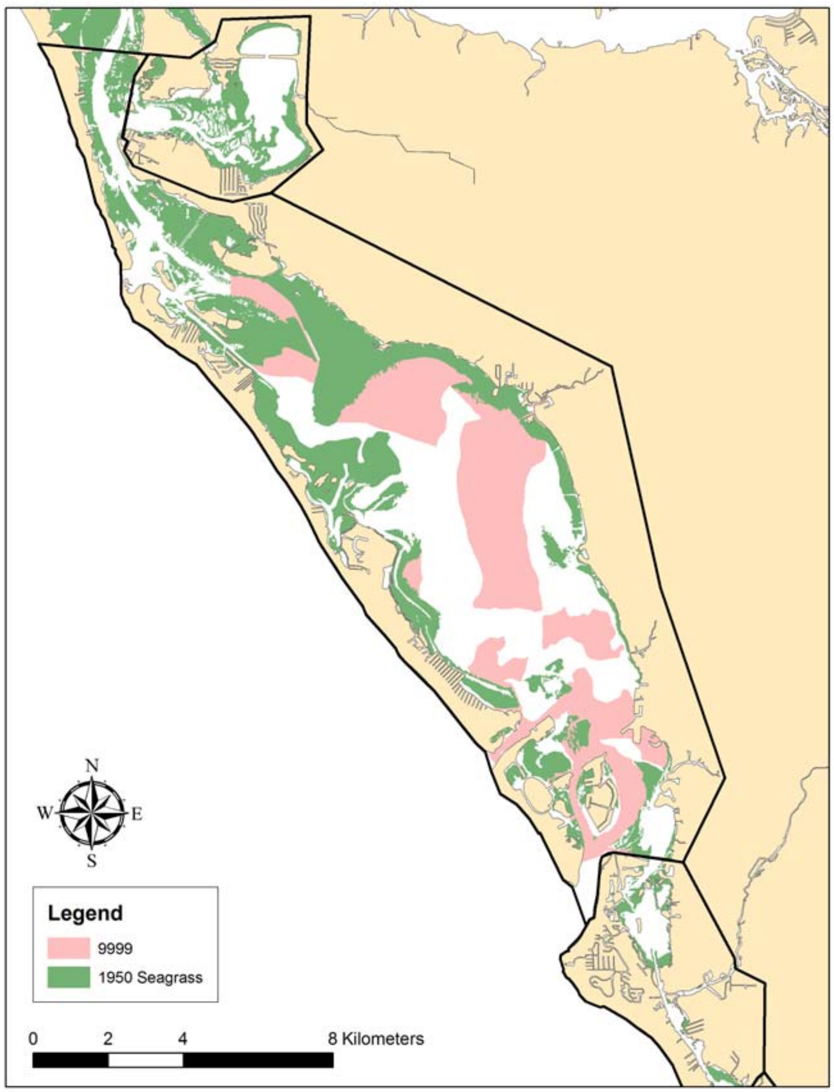
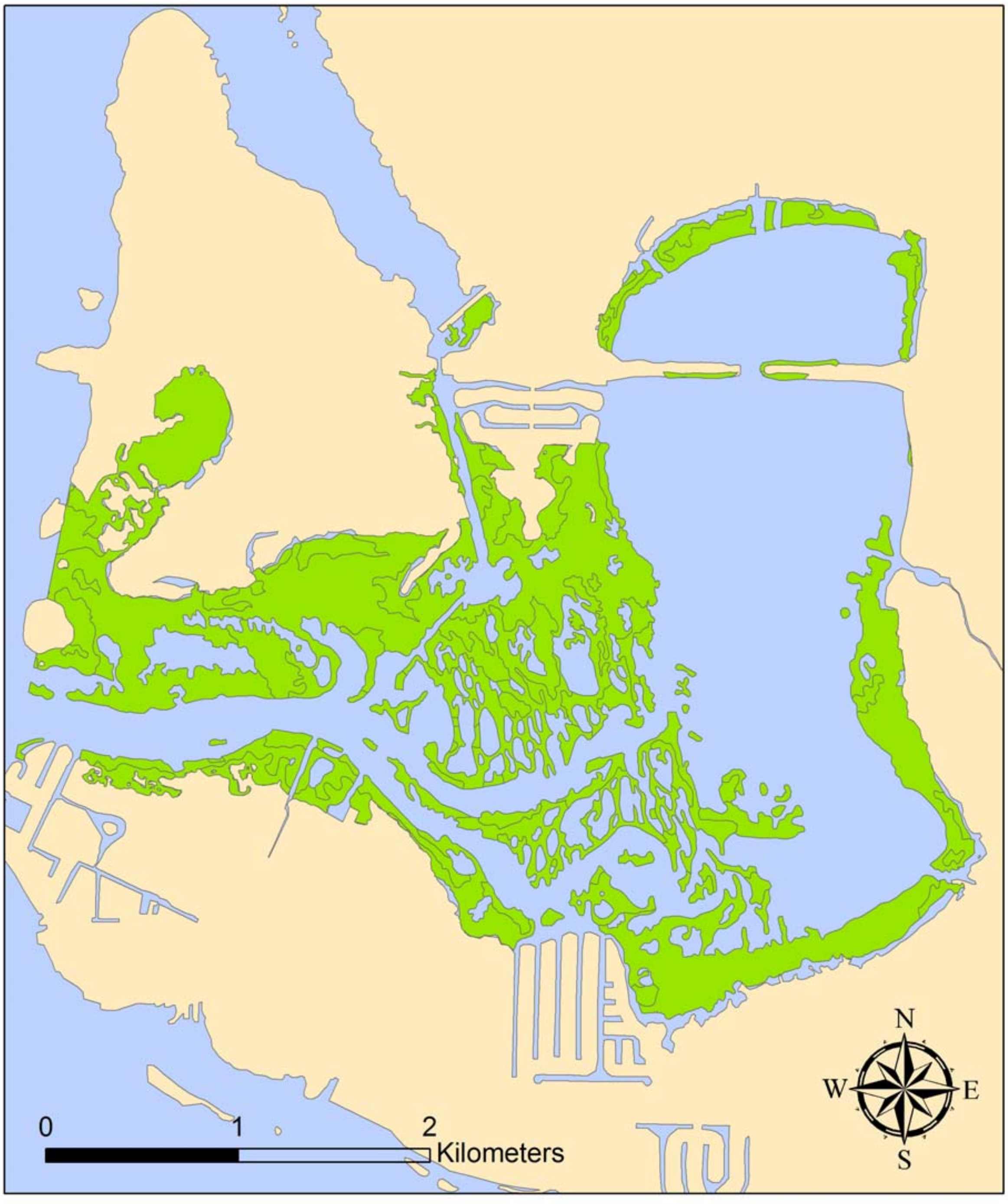


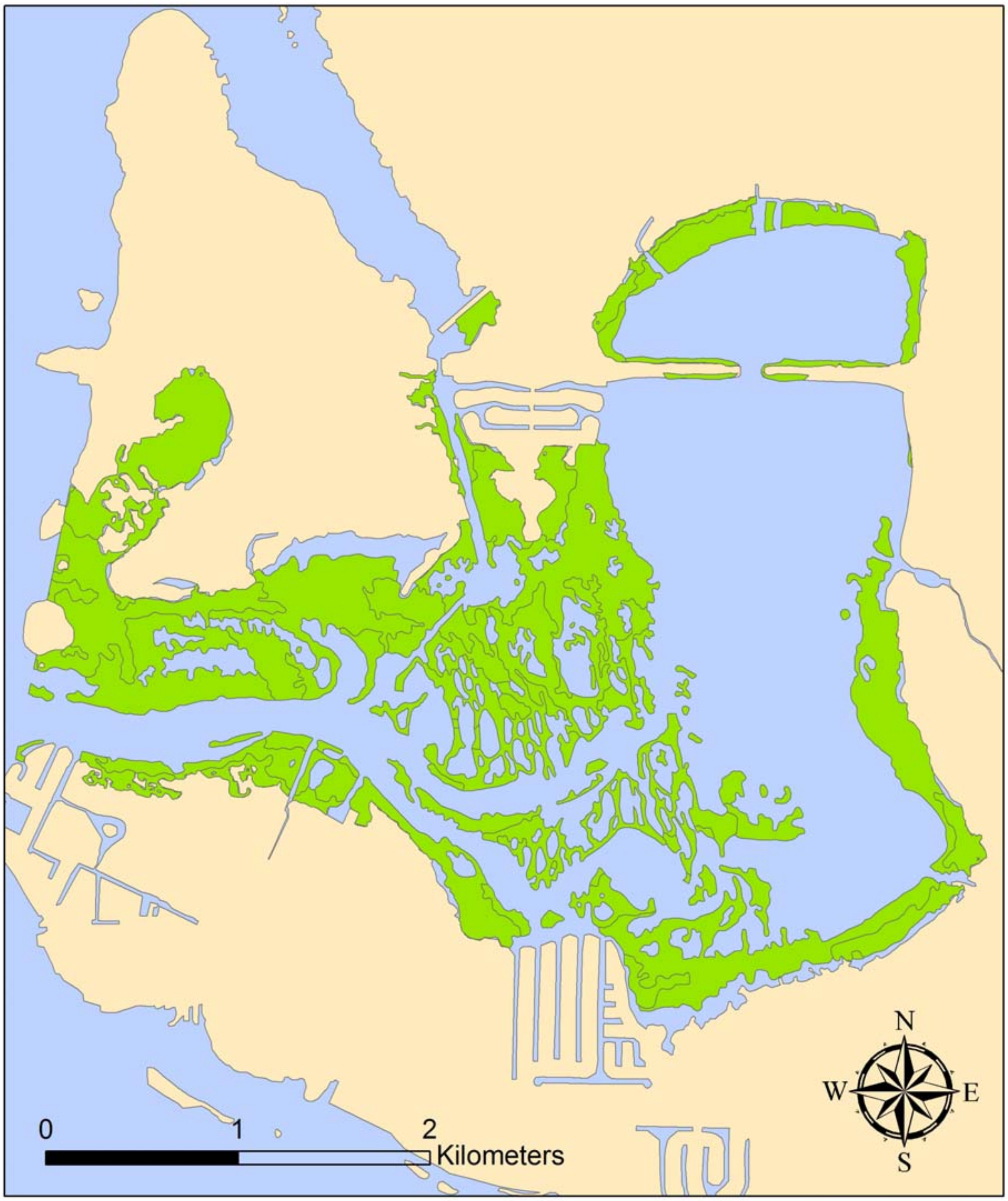
Figure A-1. Sarasota Bay historic seagrass coverage highlighting areas of uncertainty (pink: 9999) and areas of certainty (green).

APPENDIX B – Annual Seagrass Coverages In Each Bay Segment

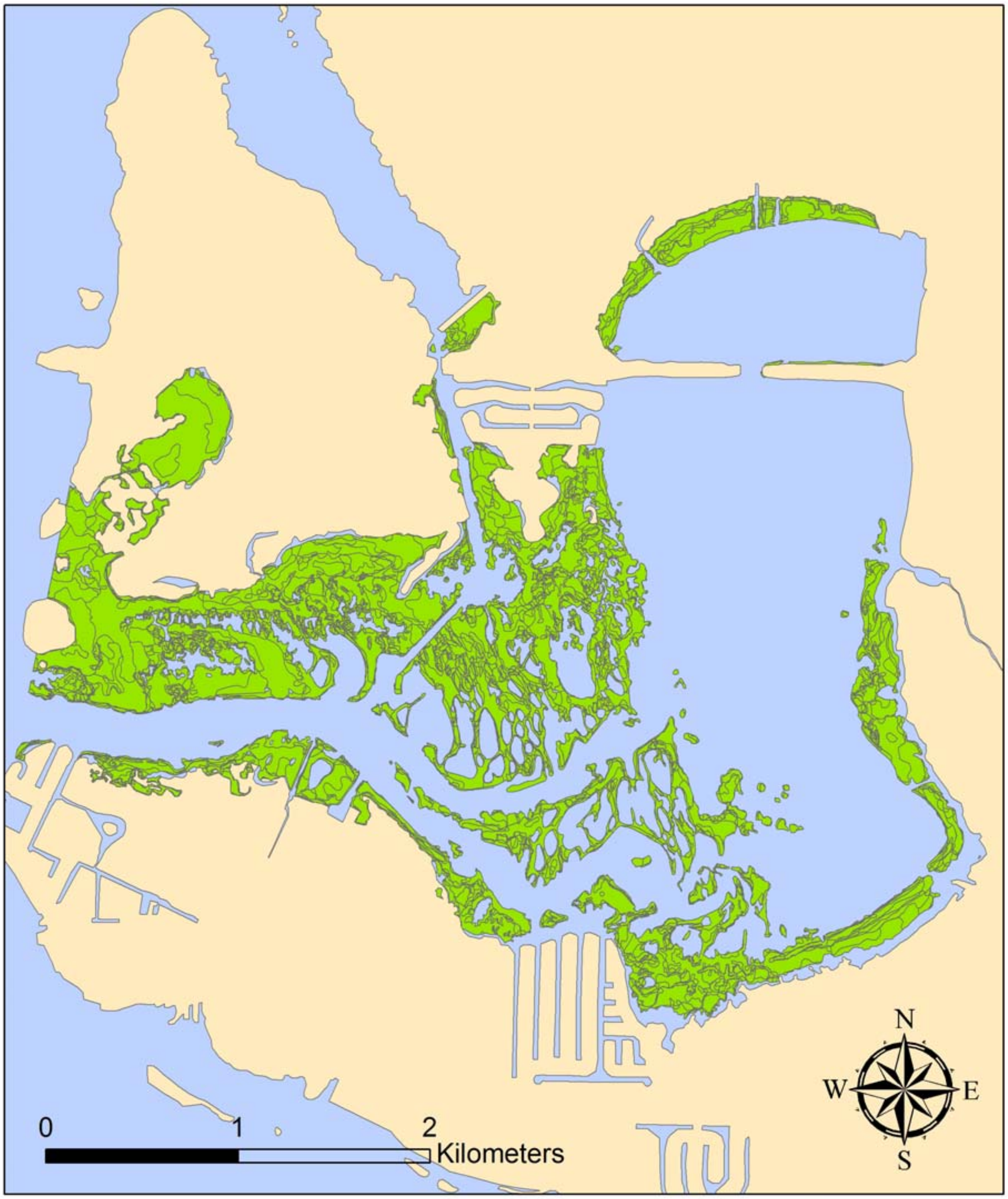
Palma Sola Bay
1988 Seagrass



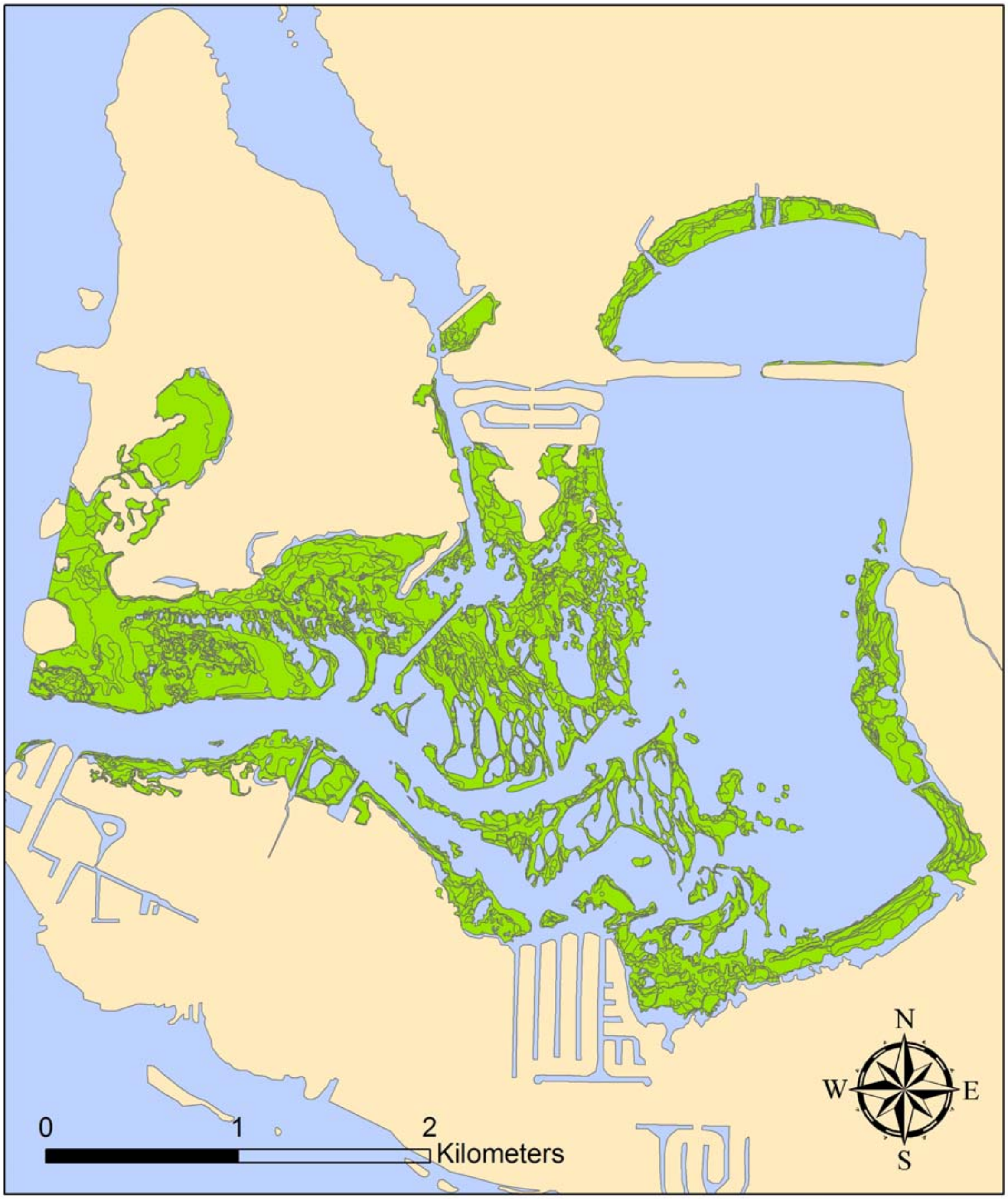
Palma Sola Bay
1994 Seagrass



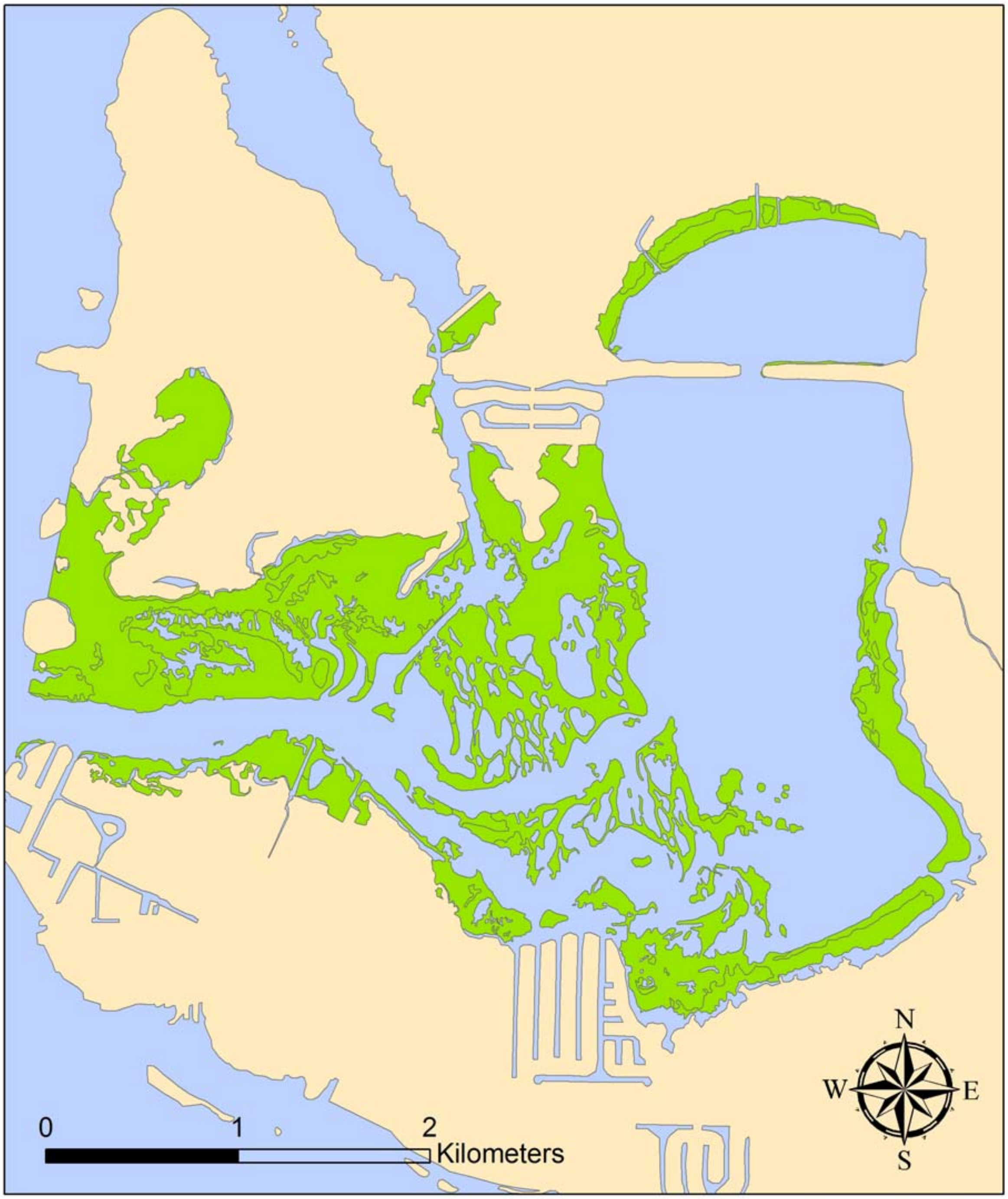
Palma Sola Bay
1999 Seagrass



Palma Sola Bay
2001 Seagrass



Palma Sola Bay
2004 Seagrass



Palma Sola Bay
2006 Seagrass

Sarasota Bay
1988 Seagrass

Sarasota Bay
1994 Seagrass

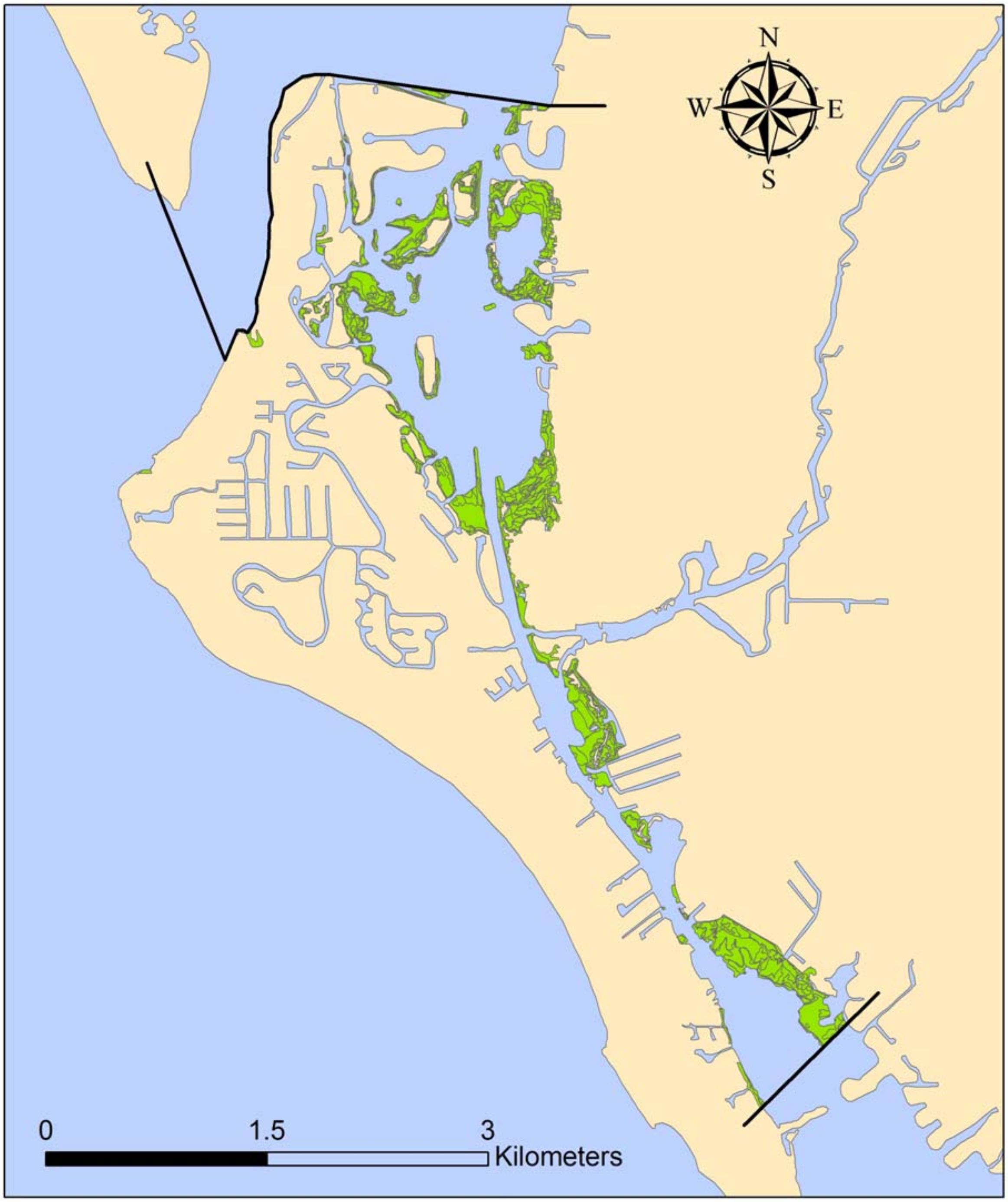
Sarasota Bay
1999 Seagrass

Sarasota Bay
2001 Seagrass

Sarasota Bay
2004 Seagrass

Sarasota Bay
2006 Seagrass

Roberts Bay
1988 Seagrass



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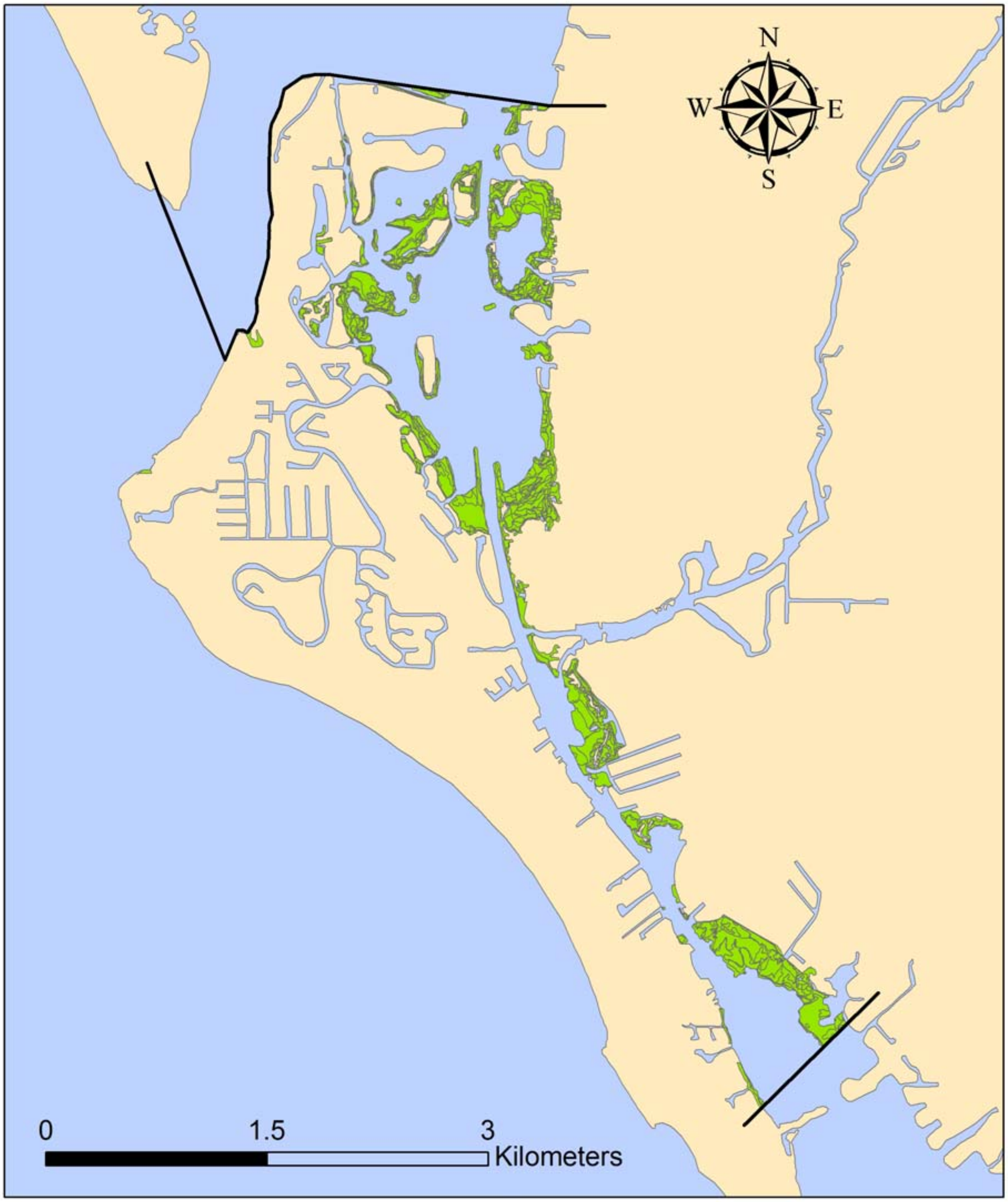
1994 Seagrass



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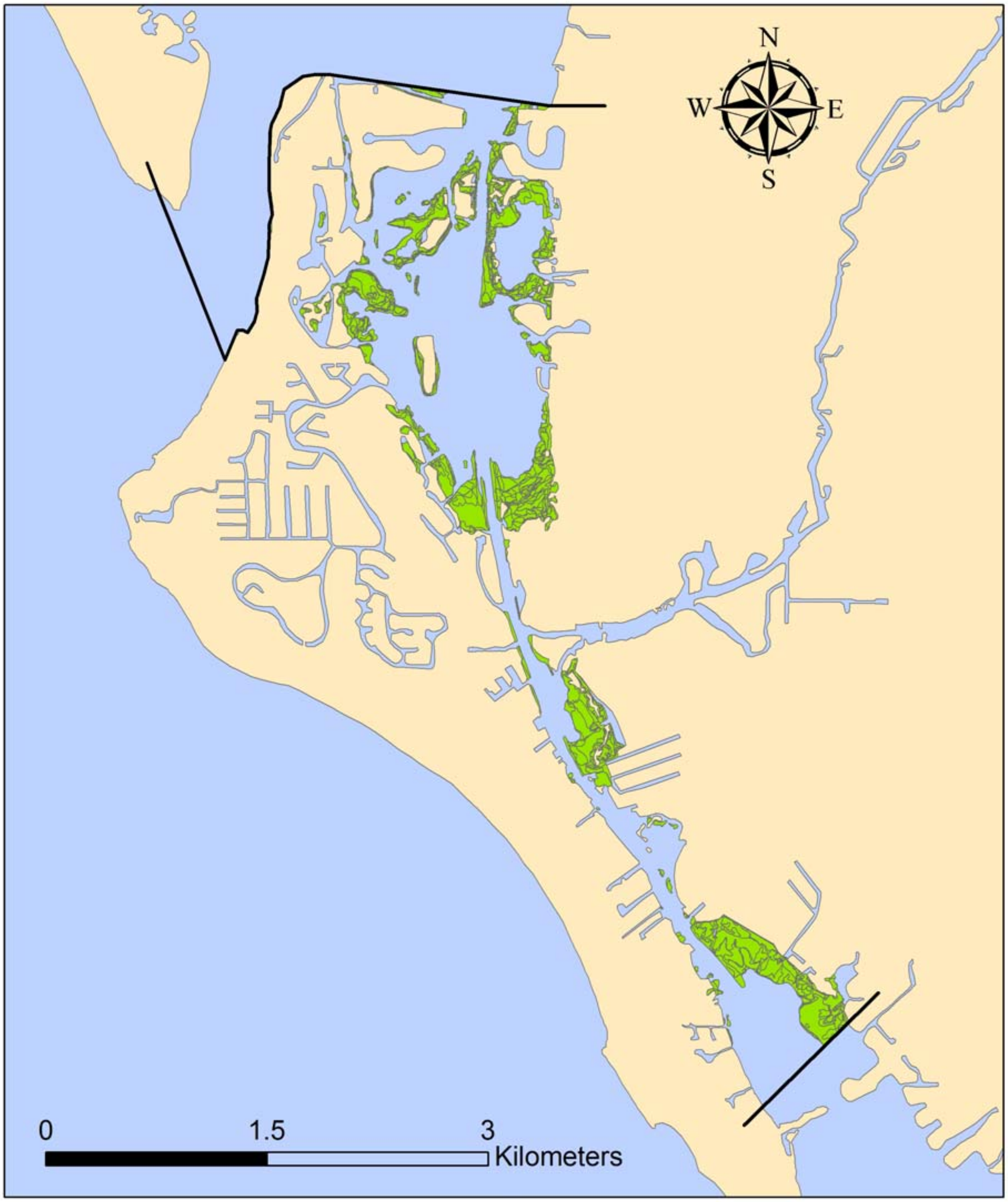
1999 Seagrass



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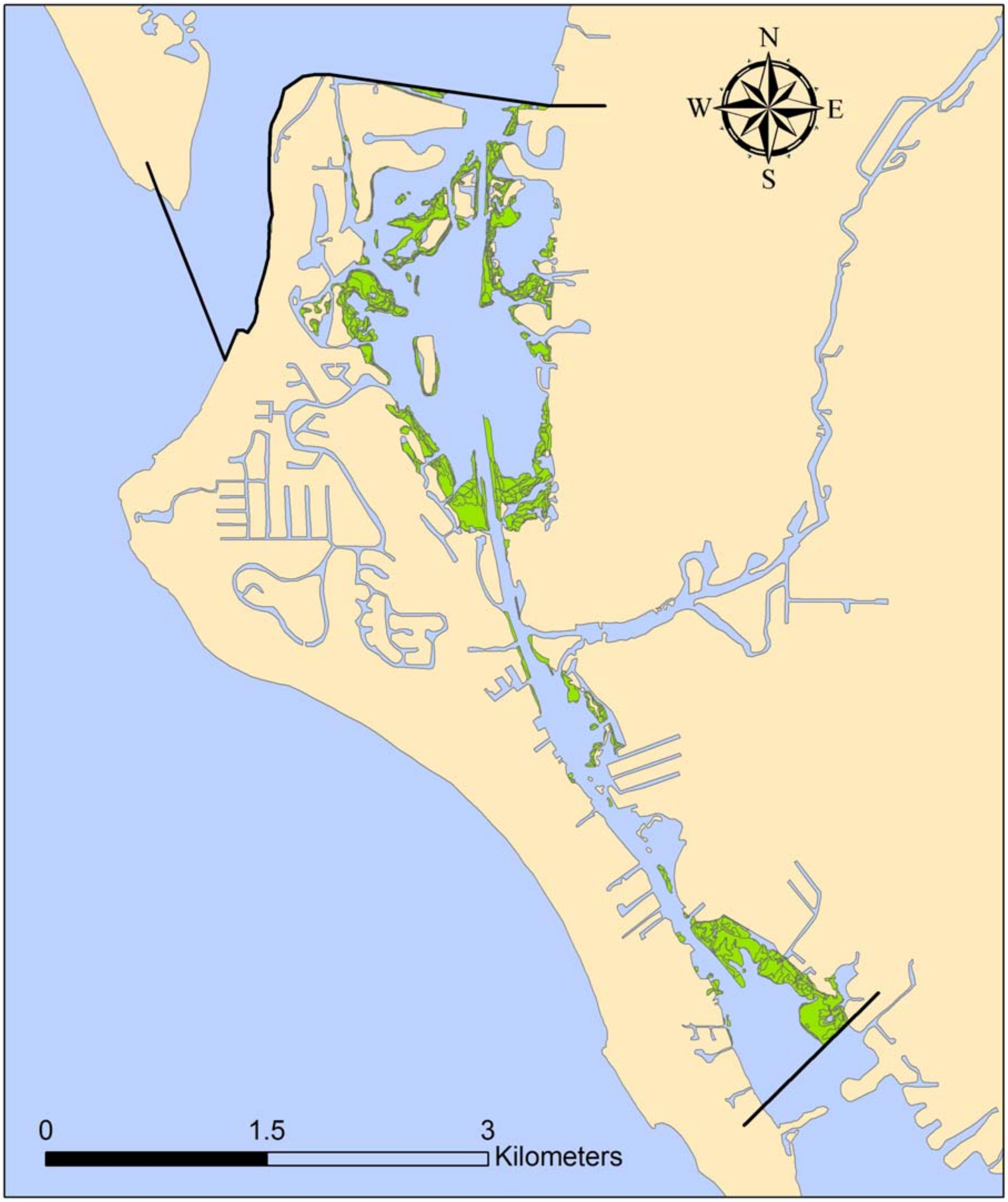
2001 Seagrass



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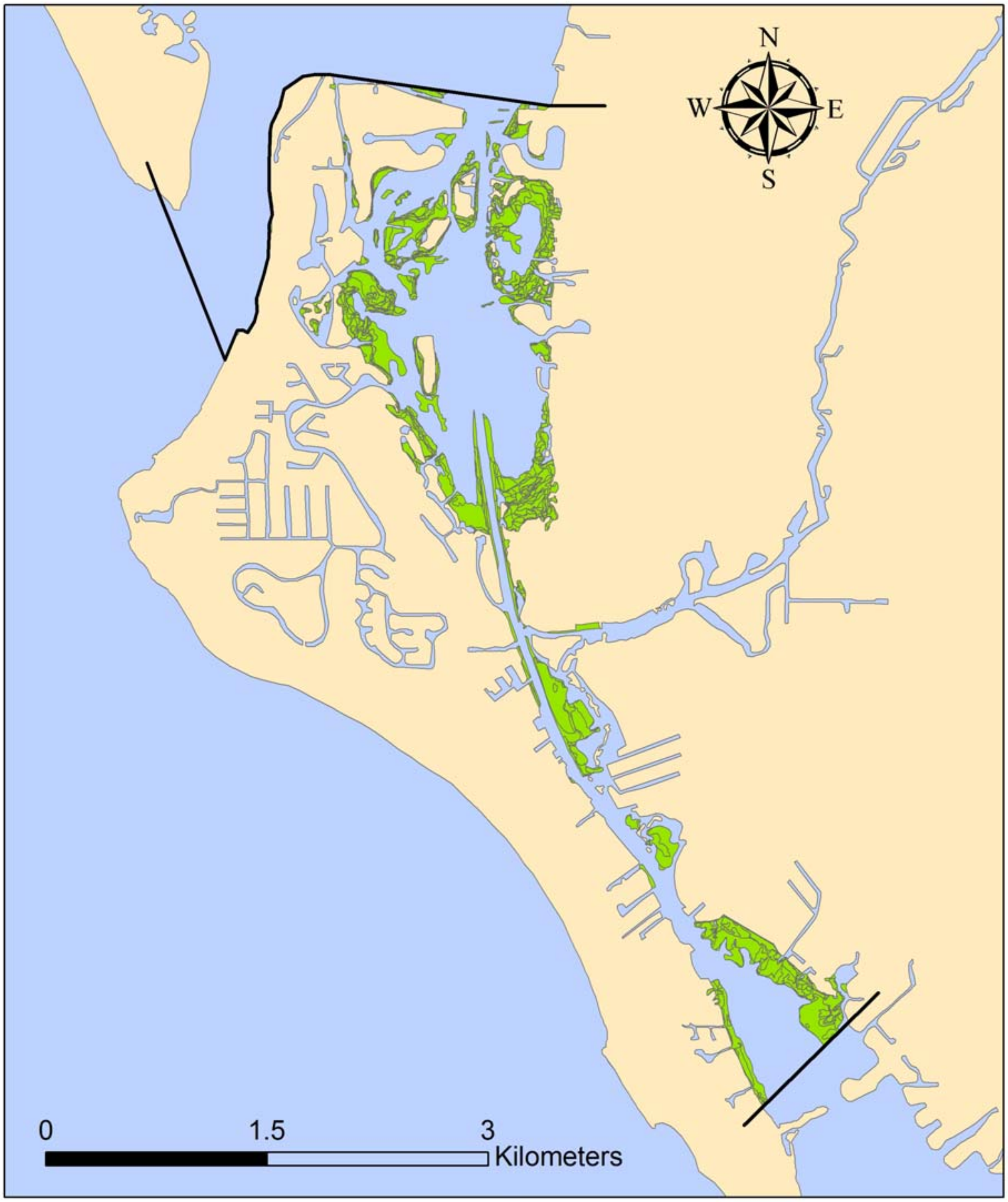
2004 Seagrass



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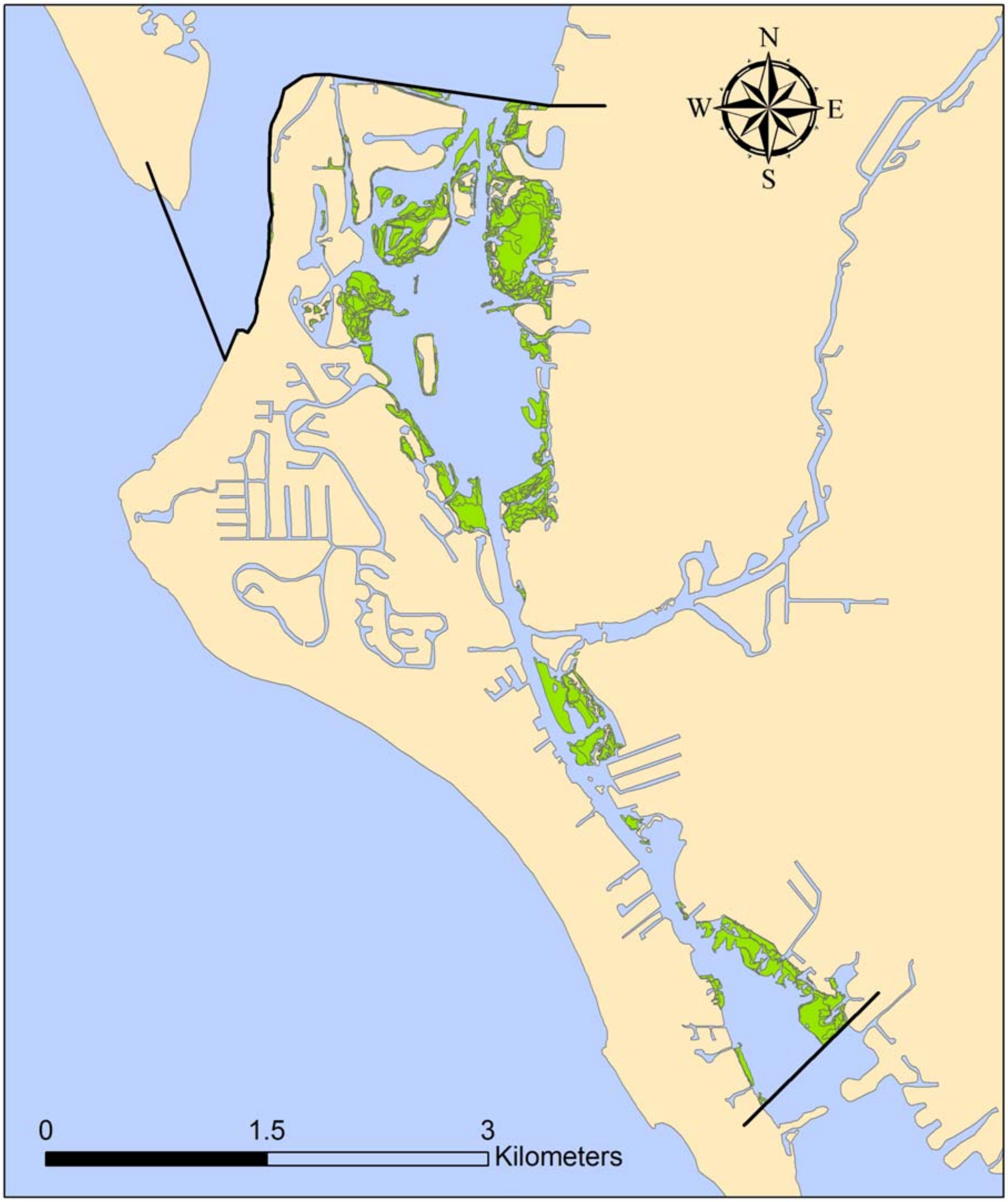
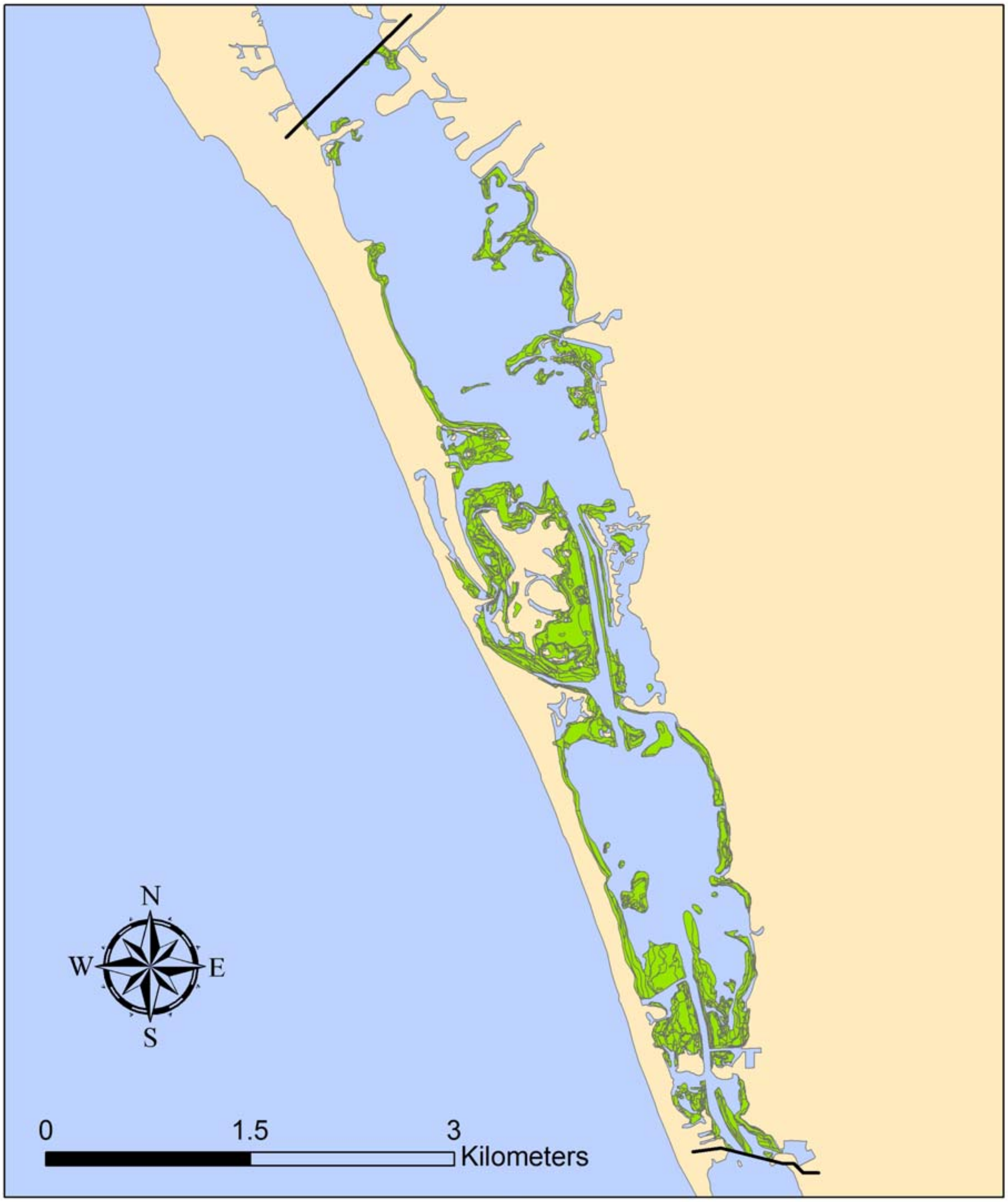
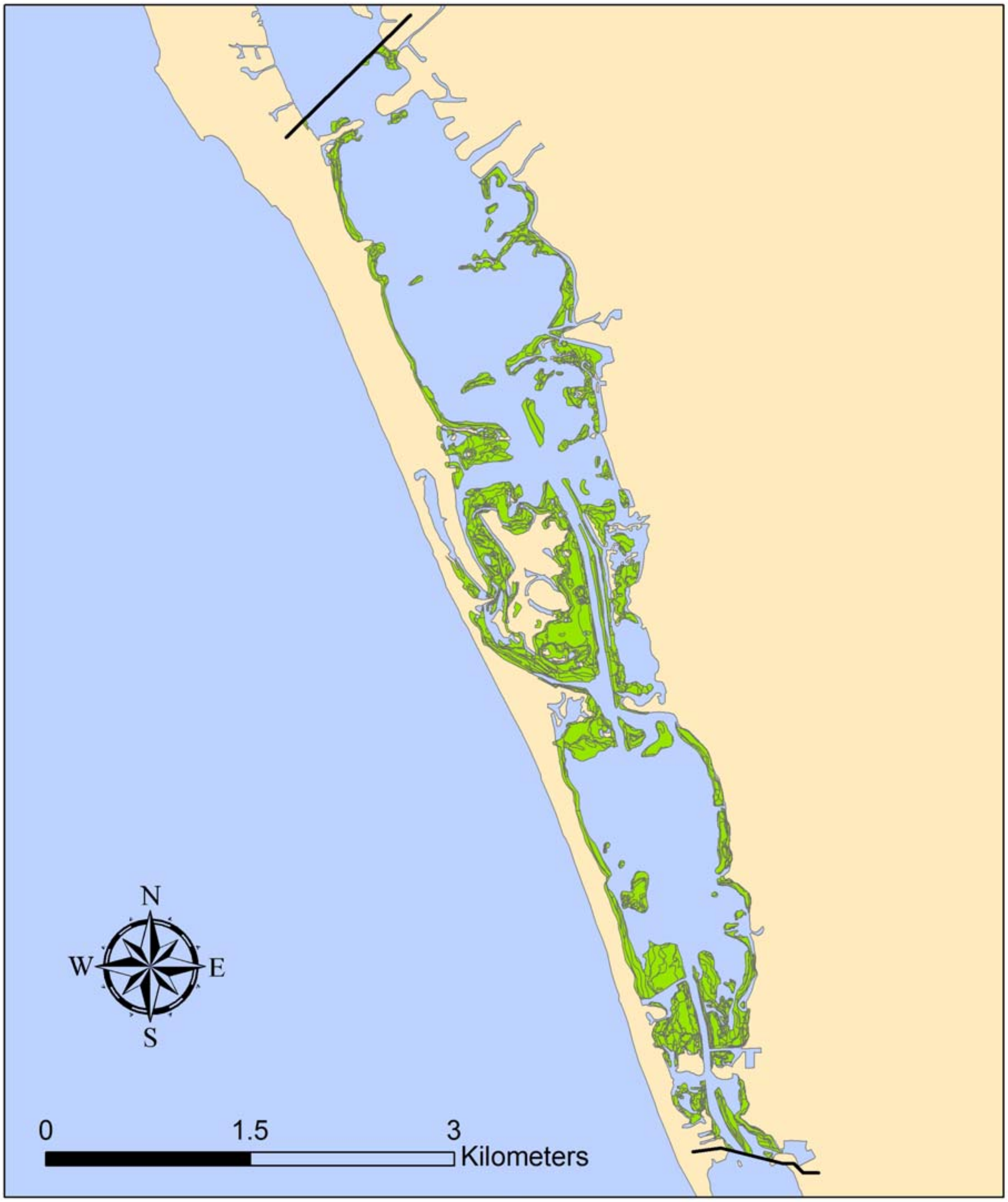
2006 Seagrass



Little Sarasota Bay
1988 Seagrass



Little Sarasota Bay
1994 Seagrass



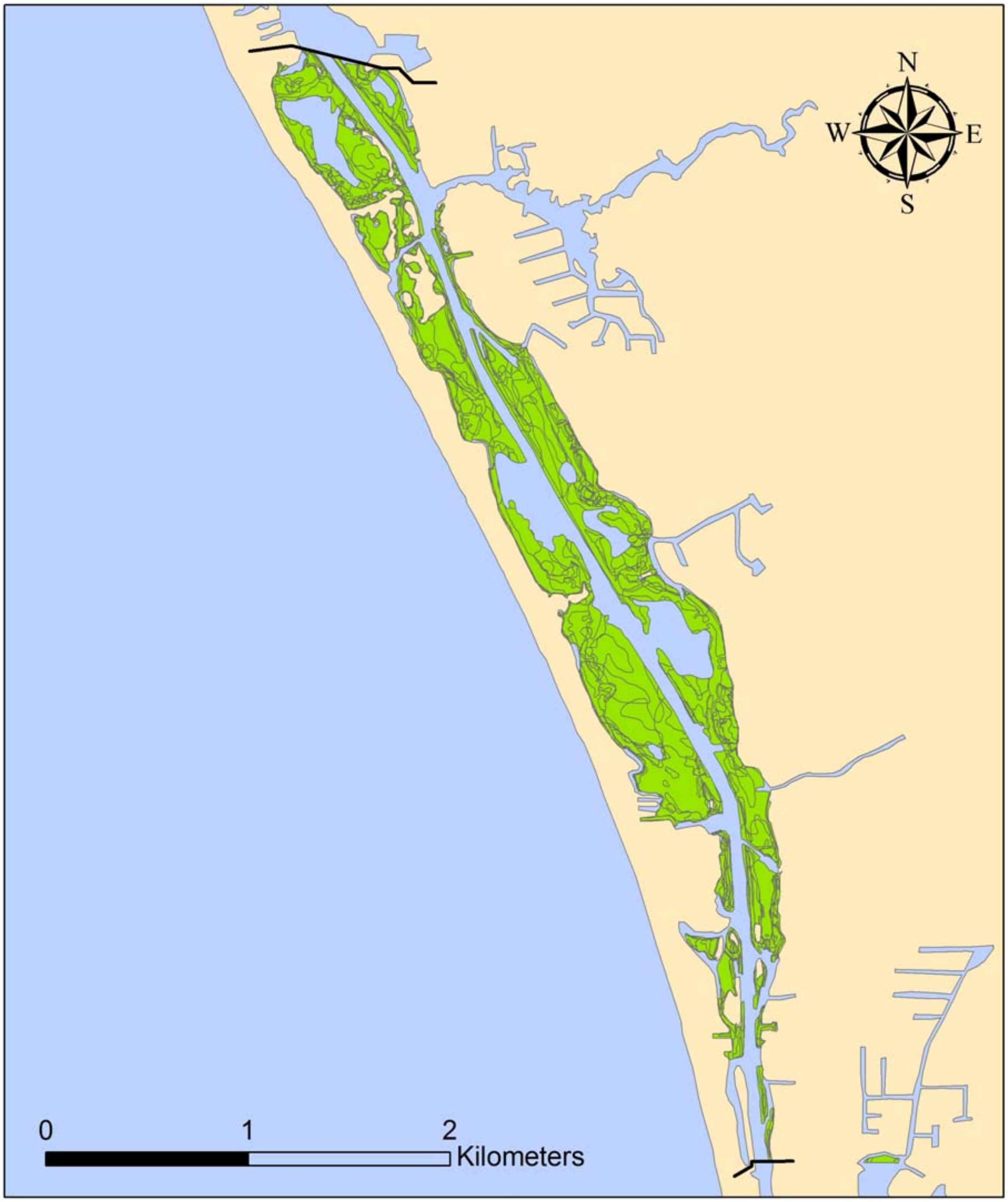
Little Sarasota Bay
1999 Seagrass

Little Sarasota Bay
2001 Seagrass

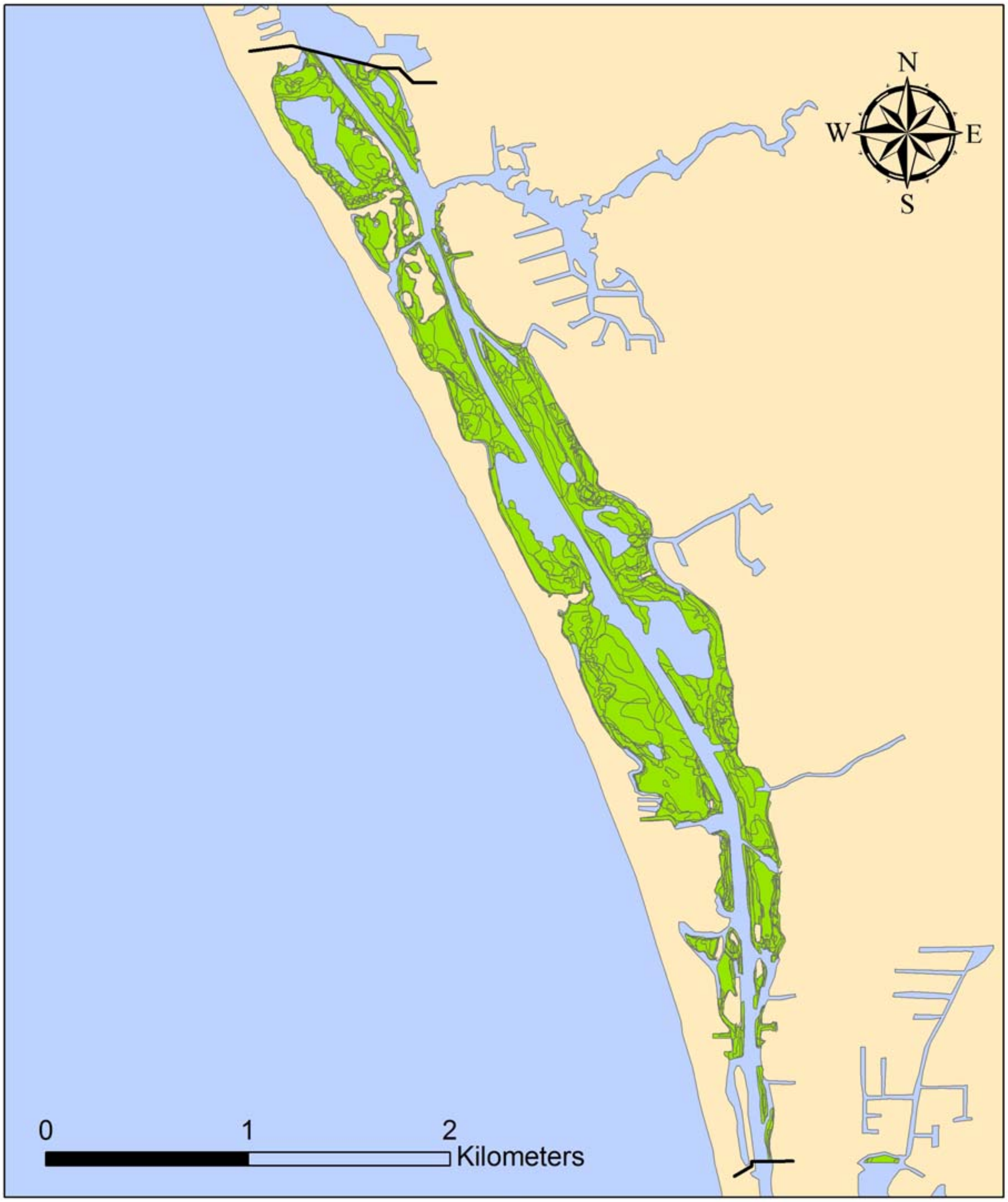
Little Sarasota Bay
2004 Seagrass

Little Sarasota Bay
2006 Seagrass

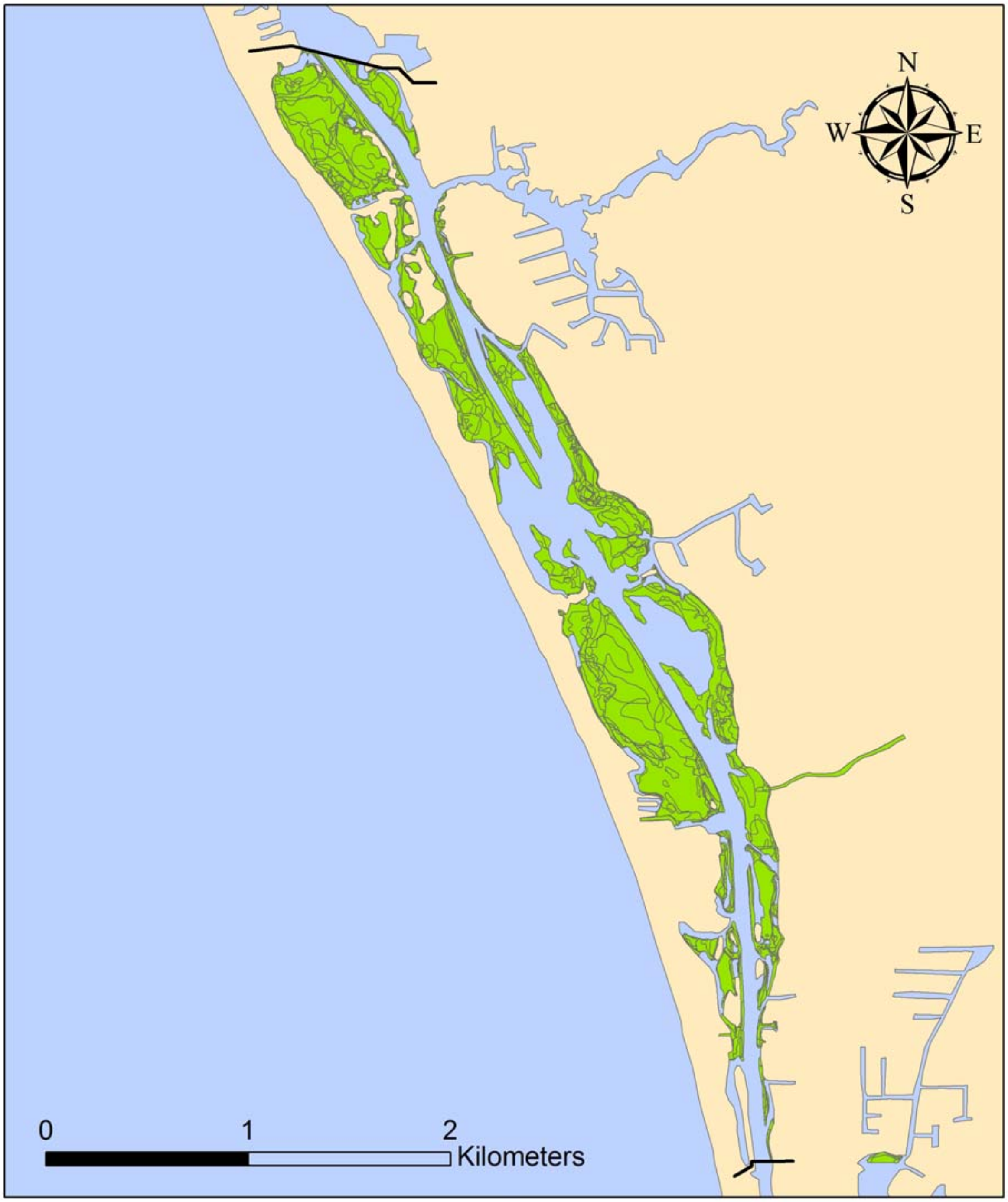
Blackburn Bay
1988 Seagrass



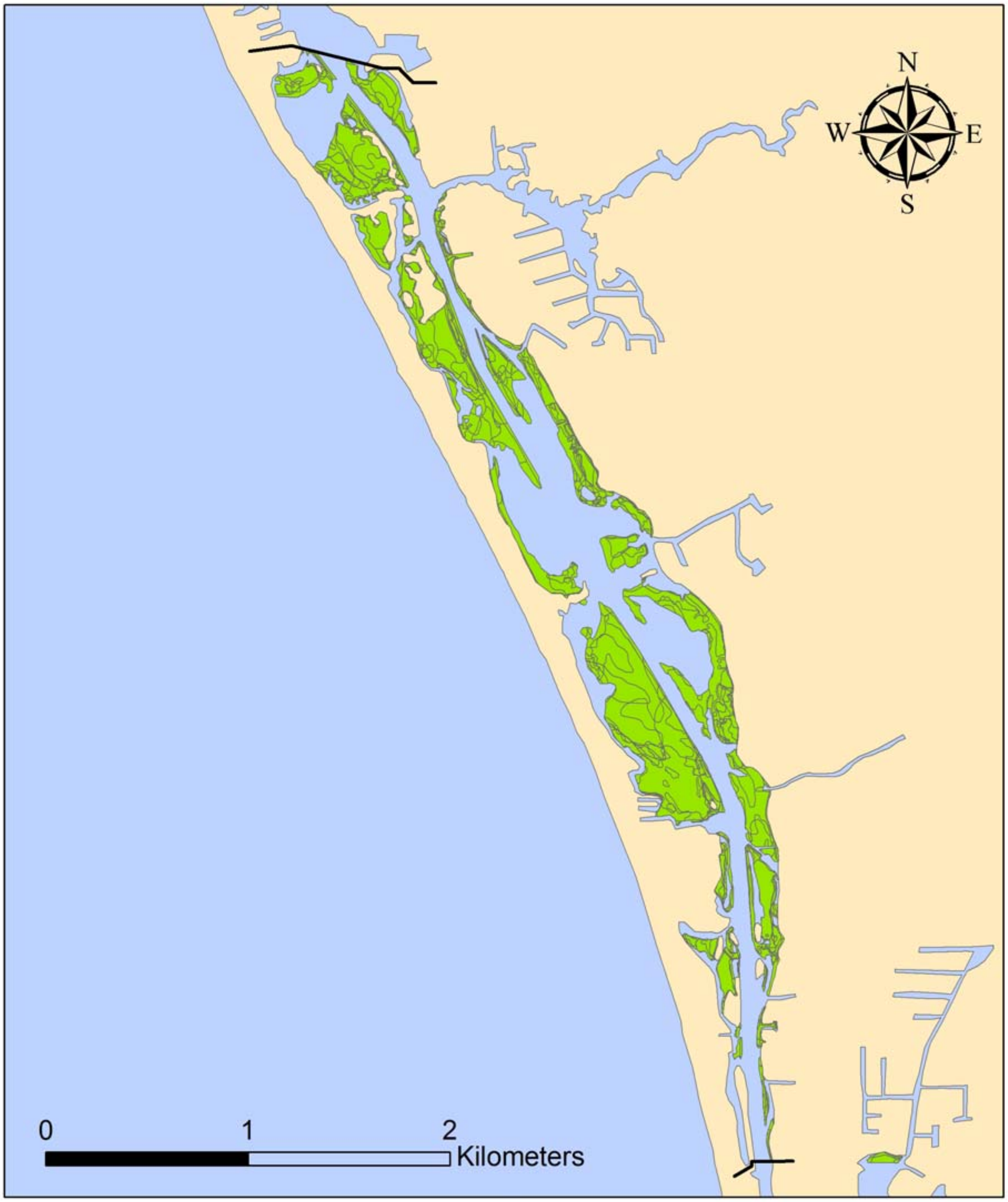
Blackburn Bay
1994 Seagrass



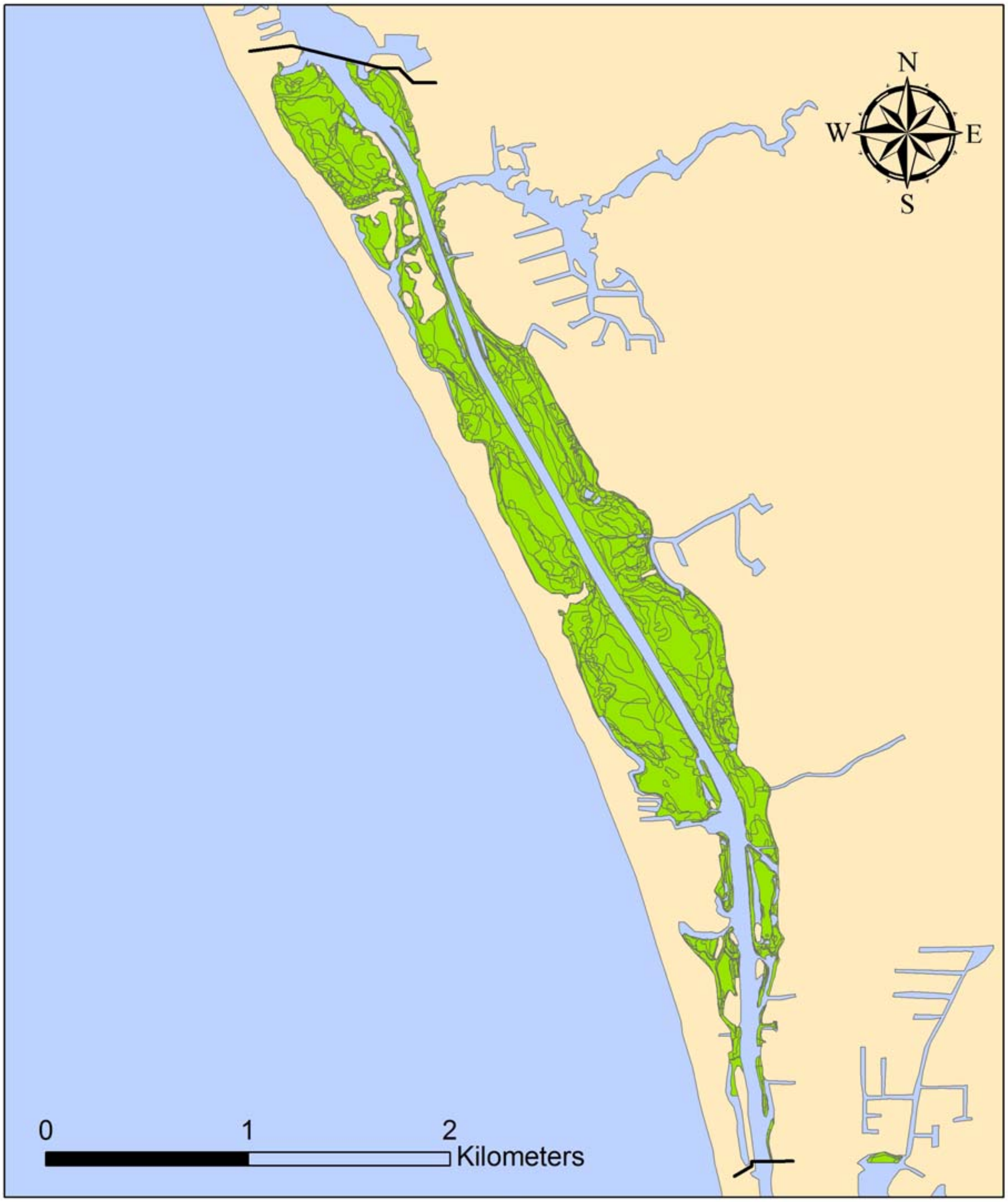
Blackburn Bay
1999 Seagrass



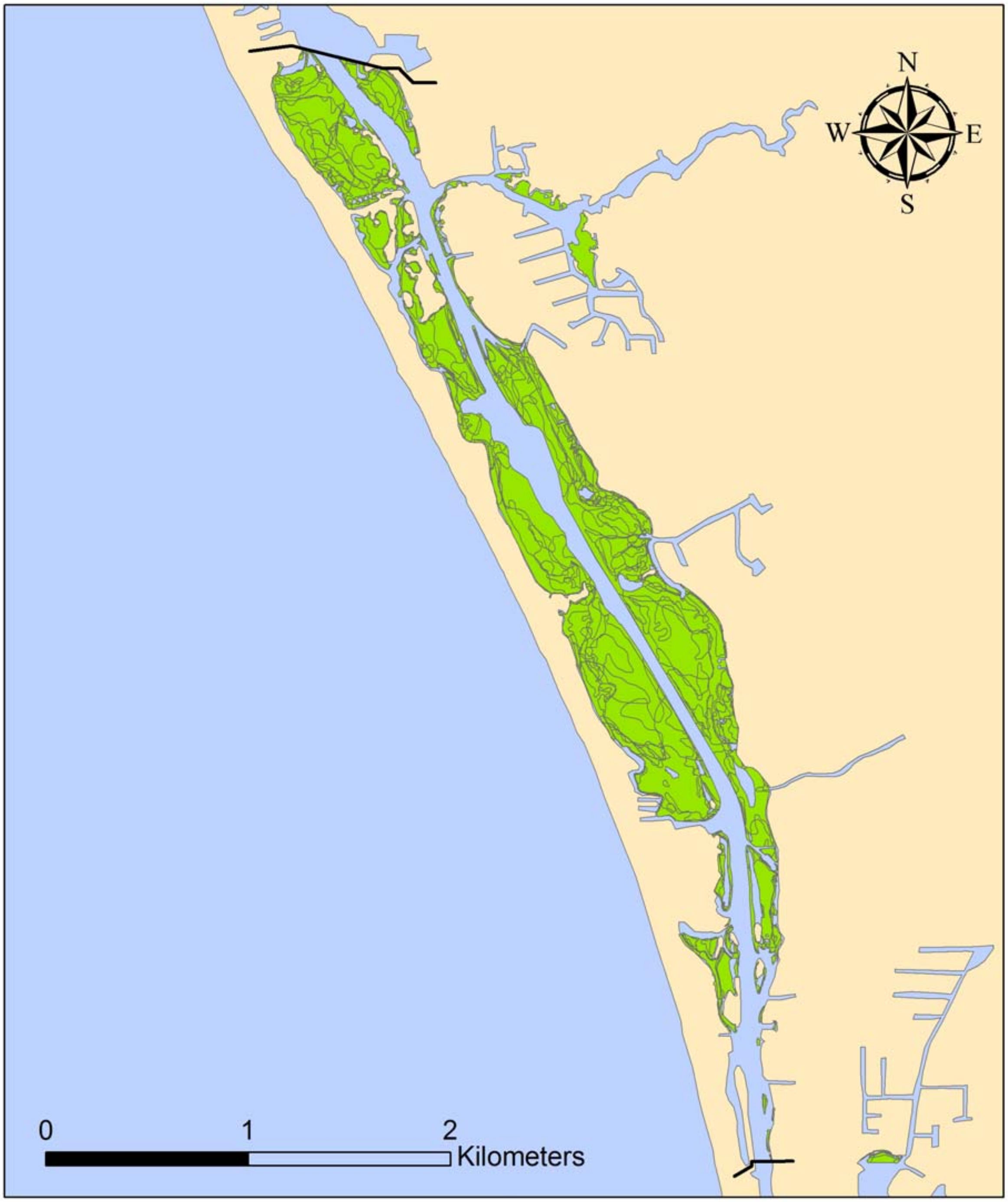
Blackburn Bay
2001 Seagrass



Blackburn Bay
2004 Seagrass

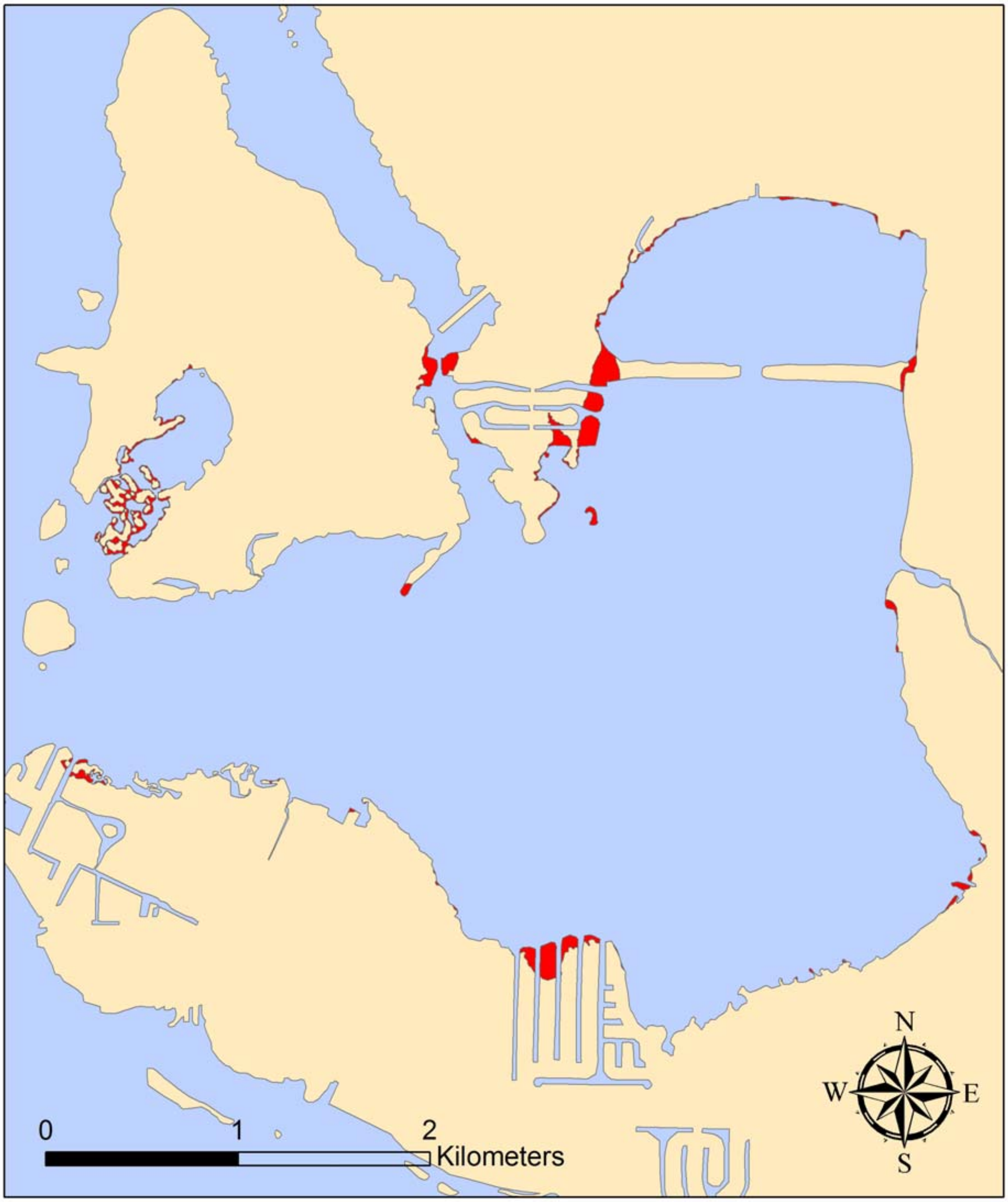


Blackburn Bay
2006 Seagrass

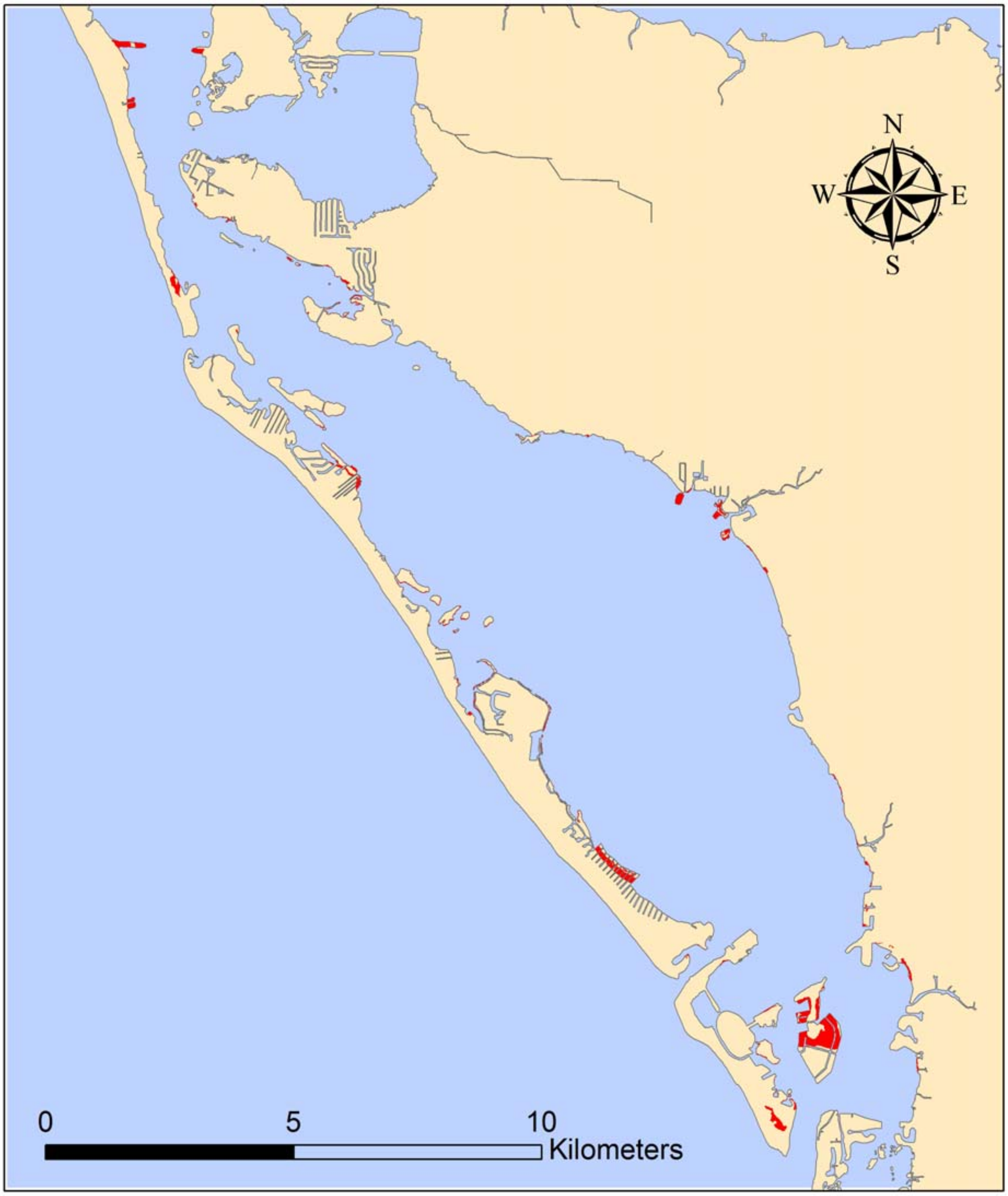


APPENDIX C – Non-Restorable Areas In Each Bay Segment

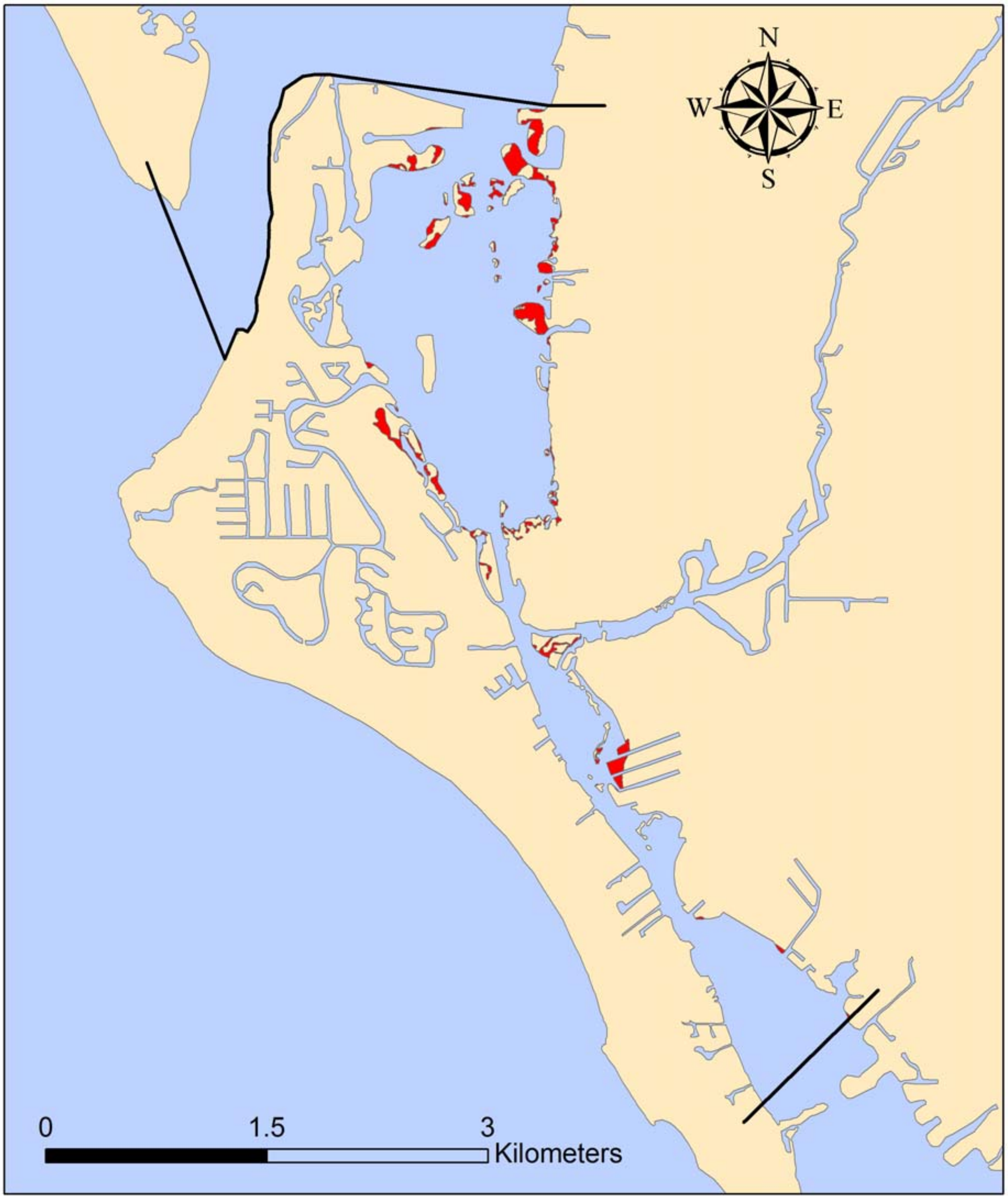
Palma Sola Bay
Non-Recoverable Areas



Sarasota Bay
Non-Restorable Areas



Roberts Bay
Non-Recoverable Areas



Little Sarasota Bay
Non-Restorable Areas

Blackburn Bay
Non-Restorable Areas