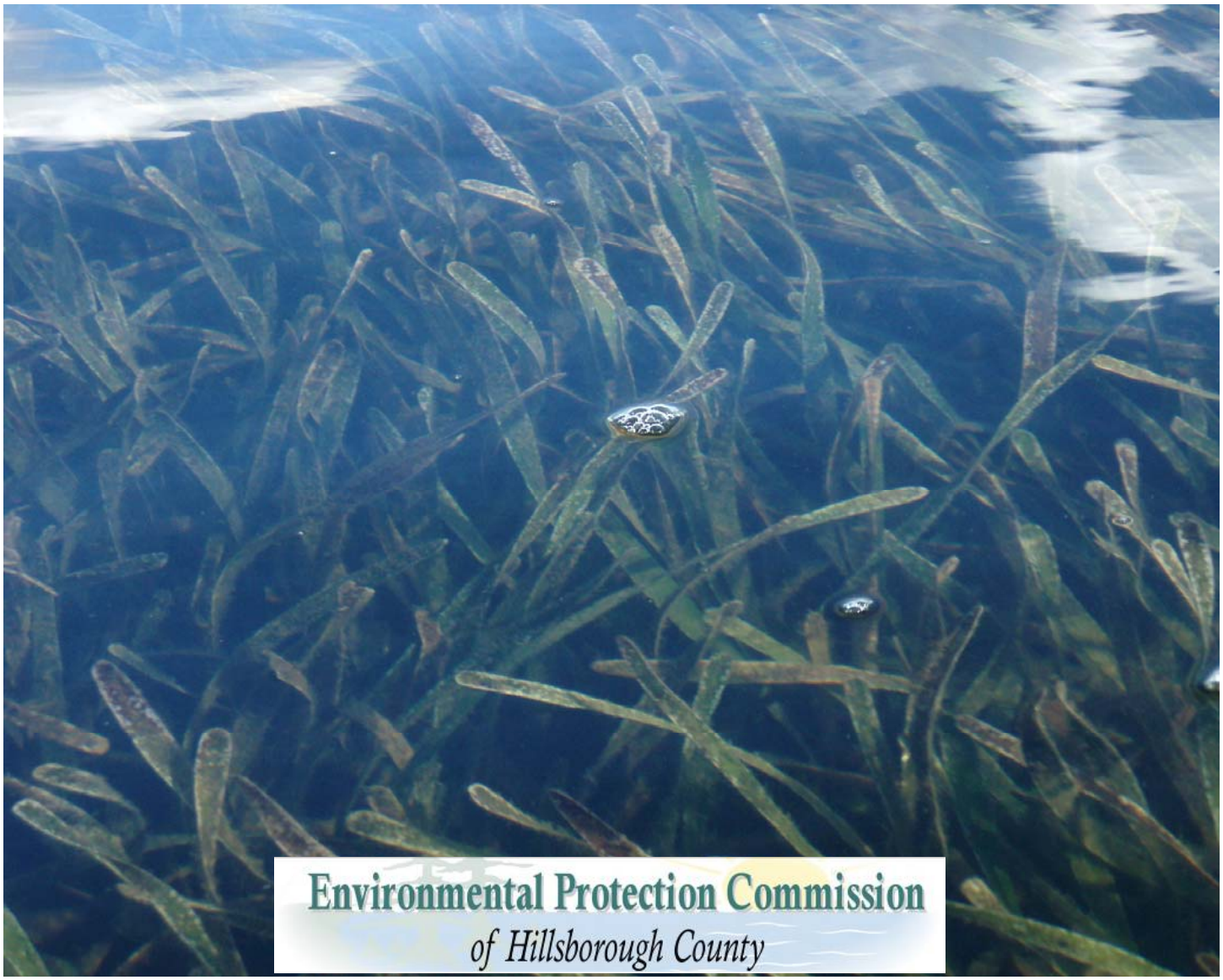
Hillsborough County Seagrass Management Action Plan



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Executive Summary

Seagrasses have been identified as critical resources in many estuary management programs because of the habitat they provide for many important fish and shellfish species and because they contribute to estuarine productivity, help to stabilize bay-bottom sediments, and serve as sensitive early-warning indicators of water quality degradation. In the case of Tampa Bay, the Tampa Bay Estuary Program (TBEP) – a regional partnership that includes the Environmental Protection Commission, Hillsborough County and several other public-sector and private-sector participants – has adopted a number of quantitative seagrass protection and restoration goals as part of its overall bay management program.

In order to support these seagrass protection and restoration efforts within the Hillsborough County portion of Tampa Bay, staff of the Environmental Protection Commission (EPC) have developed this seagrass management action plan, which is focused on issues affecting seagrass resources in Hillsborough County waters.

This report includes:

- background information on seagrass management in Tampa Bay, and the seven geographic areas that EPC staff propose to address as seagrass management areas (Sect. 2);
- an overview of local seagrass management issues (Sect. 3);
- a proposed prioritization system for the management areas (Sect. 4); and
- a set of seven management actions (Sect. 5) that are proposed by staff for immediate implementation;

The management actions proposed for immediate implementation, include:

- continuing to manage nitrogen loads to Tampa Bay
- continuing to monitor seagrass condition and species composition;
- taking additional steps to address propeller scarring and other boating impacts in existing seagrass beds;
- encouraging greater on-water enforcement of environmental laws and rules;
- continuing to assess effects of wave energy on seagrass resources;
- continuing to address impacts of dredging and dredge material management; and
- continuing to track seagrass status and trends, and evaluating priority management issues.

To ensure consistency with bay-wide seagrass management efforts, each of these actions was taken from the Tampa Bay Comprehensive Conservation and Management Plan (TBEP 2006), which was approved by the TBEP Management and Policy boards, with support from EPC and Hillsborough County, in 2006. These bay-wide actions were modified, where necessary, to have greater applicability to specific conditions or situations occurring in Hillsborough County.

In terms of resource needs, all of the EPC actions proposed in this plan can be implemented by existing staff, using resources that are anticipated to be available during fiscal years 2007 and 2008. In addition, two proposed actions will require

participation by outside agencies for implementation, which would require the expenditure of resources by those agencies. These proposed actions are:

- Action 3, Step 1 (establishing experimental “Pole & Troll” areas for seagrass protection within the Cockroach Bay Aquatic Preserve), which if implemented will require expenditure of additional resources by the Hillsborough County Department of Parks, Recreation and Conservation to provide signage designating the affected area; and

- Action 4 (encouraging greater on-water enforcement of environmental laws and rules in Hillsborough County’s coastal waters) which, if implemented by the County, or by state law enforcement agencies, may require the commitment of additional resources by those organizations.

Acknowledgments

This project was carried out with funding provided by the Environmental Protection Commission of Hillsborough County, the National Fish and Wildlife Foundation and the Pinellas County Environmental Fund, whose contributions are gratefully acknowledged. During the development of this report, helpful feedback on seagrass management issues was provided by a number of local groups, including the Agency on Bay Management, the Manatee Awareness Coalition, the Hillsborough County Marine Law Enforcement Citizens Advisory Committee, and the Southwest Florida Seagrass Working Group. The report was improved by review comments and other recommendations provided by Chuck Coleman and Richard Sullivan (Hillsborough County Parks, Recreation and Conservation Department), Suzanne Cooper (Tampa Bay Regional Planning Council, Agency on Bay Management), Richard Eckenrod, Holly Greening and Nanette O'hara (Tampa Bay Estuary Program), Charles Feldschau (Cockroach Bay Users Group and Manatee Awareness Coalition), Ann Hodgson (Audubon of Florida), Roger Johansson (City of Tampa, Bay Studies Group), Robin Lewis (private consultant), Gus Muench (Manatee Awareness Coalition and commercial fisherman), and Brad Robbins (South Florida Water Management District).

1. Background

1.1. Tampa Bay Seagrasses

Seagrasses are flowering marine plants that live submerged in Florida's lagoons, bays and other coastal waters. Because seagrasses require sunlight to flourish, the densest and most luxuriant beds in Tampa Bay are usually found in shallow, clear waters of three meters depth or less. Seagrass health is inextricably linked to water quality: the clearer the water, the deeper seagrasses can grow. Activities that impact water quality and clarity — such as dredging and filling or excessive nutrient loading from urban, industrial, and agricultural land uses — may severely restrict the growth of seagrasses or cause them to disappear altogether.

Seven species of seagrass are commonly found in Florida, and five of these species occur in Tampa Bay (Fig. 1). *Thalassia testudinum* ("turtle grass") has long strap-shaped leaves and robust rhizomes, and is the species on which the Tampa Bay seagrass restoration effort is primarily focused. *Syringodium filiforme* ("manatee grass") can be distinguished by its cylindrical leaves which, because they are brittle and buoyant, are frequently broken off from the parent plant and dispersed widely by winds and currents. *Halodule wrightii* ("shoal grass") is currently the most abundant species in Tampa Bay. It has flat, narrow leaves and a shallow root system. *Halodule* is thought to be an early successional species in the development of seagrass beds in the Gulf and Caribbean. Because it is able to survive more frequent and prolonged exposure during periods of low tide, it is usually the predominant species at the shallow-water fringe of large meadows in Tampa Bay. In some areas, *Halodule* also dominates the deep-water edge of meadows.

Ruppia maritima ("widgeon grass") tolerates a wide range of salinities. In Tampa Bay it most often occurs in lower salinity areas, such as those found in the upper Tampa Bay. In recognition of its broad salinity tolerance, some researchers have suggested that *Ruppia maritima* might be thought of as a freshwater plant that is also capable of living in saline environments, rather than a seagrass in the strictest sense.

The fifth species found in Tampa Bay, *Halophila englemanii* (star grass) is a small, compact species that is tolerant of low light levels and often occurs as an understory component of seagrass meadows.

Over the past several decades seagrasses in Tampa Bay have experienced dramatic declines and, more recently, an impressive recovery. Seagrass coverage in 1950 was estimated at 38,000 acres (Fig. 2). By 1982, seagrasses had declined by more than 40 percent, to about 23,000 acres. This loss had a number of causes, with the primary bay-wide factors being reduced water clarity and increased light attenuation (caused by algae blooms and other sources of turbidity) and physical removal or burial as a result of dredge and fill projects. More localized factors are thought to include excessive propeller scarring and altered bay hydrodynamics (Lewis et al. 1985; TBEP 1996; Lewis 2002).

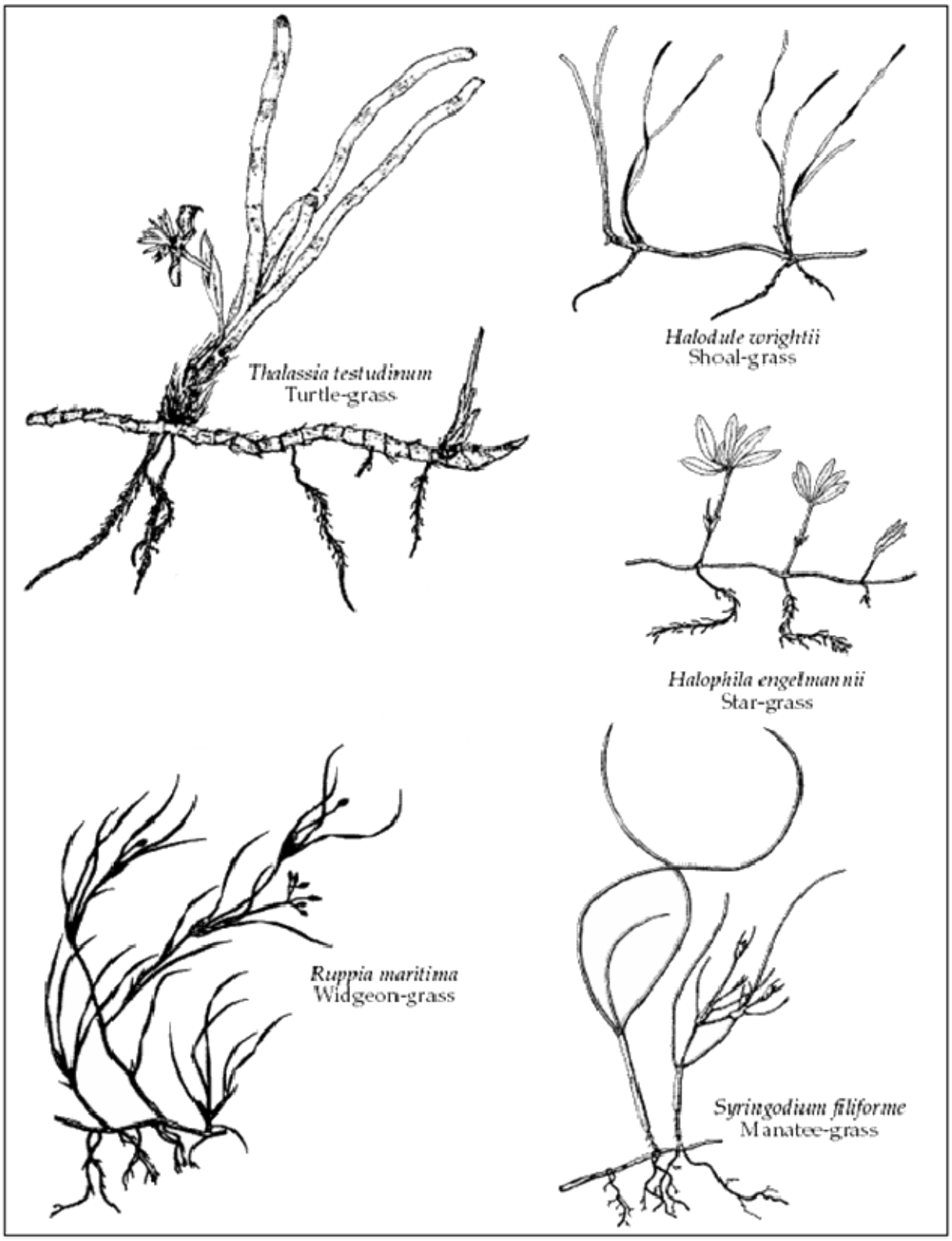

Figure 1: Seagrass species commonly found in Tampa Bay.

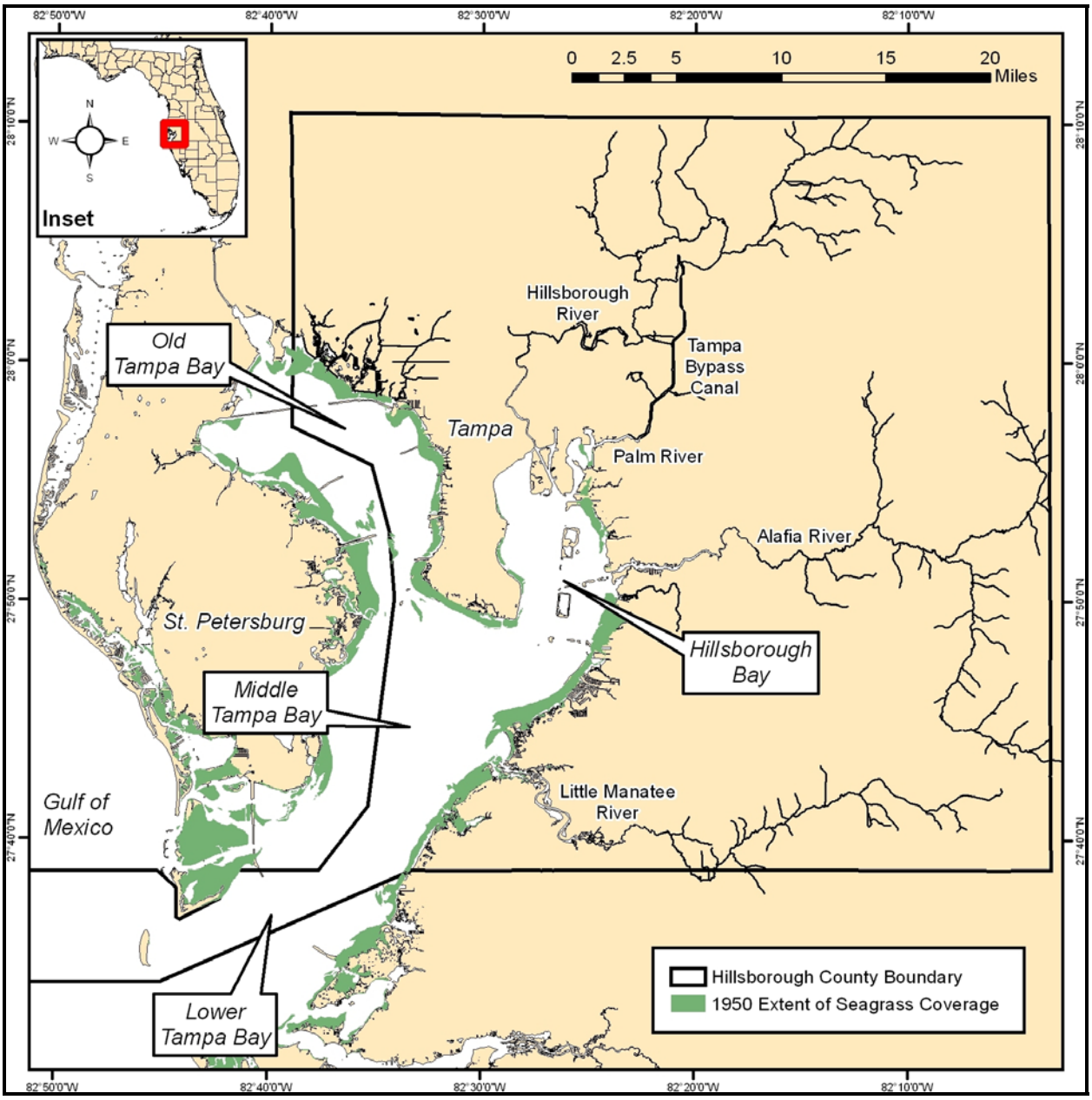

Figure 2: Estimated extent of seagrass coverage in Tampa Bay circa 1950. Source: Florida Department of Natural Resources and US Fish and Wildlife Service (TBRPC 1986).

Improvements in wastewater treatment mandated by the State's Grizzle-Figg Act (Sect. 403.086, Florida Statutes) in the late 1970s, combined with new regulations governing stormwater management and the treatment of nonpoint-source discharges, reduced nitrogen loadings to the bay by an estimated 60% between 1982 and 1996, resulting in a steady recovery of seagrasses. By 1996, more than 4,000 acres of new seagrasses had been documented. The acreage gains were particularly dramatic in areas such as Hillsborough Bay, which had previously

received the largest anthropogenic nutrient loads and had become almost devoid of seagrasses.

Seagrass recovery suffered a setback during 1997-1998, when an unusually strong El Niño event produced large amounts of rainfall during the winter and early spring. The heavy rainfall generated large discharges of highly-colored and nutrient-laden stormwater, which were followed by the temporary loss of approximately 2,000 acres, or 8 percent, of the bay's seagrasses.

More recent estimates of seagrass cover, based on aerial photography and digitized mapping conducted every 2-3 years by the Southwest Florida Water Management District, indicate that more than 1,200 acres were regained bay-wide between 1999 and 2002. An estimated 950 acres were gained bay-wide between 2002 and 2004.

Updated bay-wide seagrass coverage maps and acreage estimates were published by the SWFWMD in February, 2007, based on aerial photography that was taken during January, 2006. These maps indicated that baywide seagrass coverage increased by 1,925 acres between 2004 and 2006. Unlike the maps and acreage estimates produced for earlier periods, however, the 2006 map products were based on high-resolution digital photography that may not be completely comparable to the film-based imagery used in the earlier mapping efforts.

While the change to digital photography is a positive step for the mapping program, interpretation of seagrass acreage changes between 2004 and 2006 will require caution. An extended period of consideration and discussion may be needed before local seagrass managers reach consensus on the baywide and segment-specific acreage changes that occurred between the 2004 and 2006 mapping periods. The seagrass acreage levels and trends discussed in this report are based on all available information, including the 2006 acreage estimates. Once local consensus is reached on the interpretation of acreage levels and trends in the 2006 maps, EPC staff will revise this management plan, if necessary, to incorporate any changes in interpretation.

1.2. Value of Seagrass Habitats

Seagrasses in Tampa Bay provide critical habitat for recreationally and commercially important fish and invertebrate species. They provide nursery areas for juveniles and feeding areas for adult red drum, spotted seatrout, spot, silver perch, sheepshead, snook, shrimp and the bay scallop (Zieman and Zieman, 1989). Seagrass meadows are also an important source of food for the endangered Florida manatee.

Seagrasses serve to improve water quality by reducing nutrients in the water column, and are important components in energy and nutrient cycles, and in estuarine and coastal food webs. The root systems of established seagrass meadows also serve to stabilize bay sediments and prevent erosion.

Because of their pivotal role in the Tampa Bay ecosystem, seagrasses have been chosen as the primary biological and environmental indicator of the bay's health by the Tampa Bay Estuary Program, a partnership of local, state and federal agencies and private-sector interests that has coordinated bay management efforts since the early 1990s.

1.3. Importance of Seagrass Management

Because seagrass coverage and condition are closely linked with overall water quality, a management plan that seeks to preserve existing seagrass coverage, while identifying and promoting restoration of additional seagrass meadows, is closely interrelated with water quality management efforts in Tampa Bay.

Comprehensive management efforts should provide accurate assessments of status and trends in seagrass coverage, and facilitate long-term planning which seeks to avoid unnecessary impacts to seagrass, identify appropriate mitigation strategies when those impacts cannot be avoided, and direct limited research and management resources to areas of greatest need.

In recent years, a key focus of seagrass management efforts in Tampa Bay has been the adoption of quantitative, science-based goals for restoration, and regular assessment of progress toward those goals. The approach of adopting and measuring progress toward quantitative goals offers a number of benefits, including:

- increased accountability;
- clearer identification of monitoring priorities;
- improved efficiency in the allocation of funding and manpower; and
- more rapid identification of management actions that are most cost-effective and environmentally beneficial.

Setting quantitative, science-based seagrass management goals — and regularly measuring and reporting progress in achieving them — is also critically important for securing support for seagrass protection from the citizens of Hillsborough County and their elected officials, who must balance the funding needs of resource management programs with a host of competing obligations and services.

Seagrass management efforts should also allow for adaptive management, and include an element of flexibility, to allow managers to adapt and respond quickly to changing conditions in seagrass meadows.

1.4. Seagrass Management in Tampa Bay

In 1990, Tampa Bay was accepted into the U.S. Environmental Protection Agency's National Estuary Program. The Tampa Bay Estuary Program (TBEP), a partnership that includes federal and state regulatory agencies, six local governments and several private-sector organizations, was tasked with developing and implementing a community-based Comprehensive Conservation and Management Plan (CCMP)

for Tampa Bay. The initial CCMP, adopted in 1996, identified seagrass protection and restoration as a top priority, and set numeric goals for seagrass recovery based on reductions in anthropogenic nitrogen loading (TBEP 1996).

Specifically, the CCMP seeks to recover more than 12,000 acres of seagrasses over time, while preserving the bay's existing 26,000 acres, for a total bay-wide minimum coverage of 38,000 acres. This is comparable to the seagrass acreage estimated to have been present in Tampa Bay in the early 1950s, before rapid population growth began in the watershed.

To achieve the seagrass recovery goal, the 1996 CCMP called for nitrogen loadings to the bay to be capped at 1992-1994 levels. Modeling studies conducted by TBEP and the Southwest Florida Water Management District (SWFWMD) indicated that this "hold the line" strategy should provide adequate water clarity to meet the goal. Achieving the nitrogen loading target is estimated to require TBEP partners – such as local governments and industries – to reduce their anticipated future nitrogen contributions to the bay by about 7% per year, or approximately 17 tons per year, in order to compensate for anticipated growth.

The TBEP formed a non-regulatory public-private partnership, the Tampa Bay Nitrogen Management Consortium, to facilitate achievement of the nitrogen reduction goals. The Consortium includes the six local governments, as well as key industries such as fertilizer manufacturers, electric utilities and agricultural operations. Consortium members committed by resolution to collectively achieve the nitrogen reduction targets, and identified more than 120 existing or proposed projects which will contribute to achieving the goal. Progress is tracked through an electronic database that calculates expected reductions based on acreage and type of treatment applied (e.g., stormwater management or emission control improvements).

Consortium partners submit information on completed projects to the TBEP, which summarizes the estimated nitrogen load reductions achieved by the projects in five-year increments. These estimates indicate that the projects completed by the partners met the baywide nitrogen reduction goals during the 1995-1999 and 2000-2004 periods, and are expected to meet the goals once again during the 2005-2009 period (H. Greening, TBEP, personal communication).

The success of the "hold the line" initiative and the Consortium partnership has resulted in the endorsement of this strategy by the Florida Department of Environmental Protection (FDEP) as providing reasonable assurance that Tampa Bay can meet the total maximum daily load (TMDL) limits for nitrogen established by the U.S. EPA.

1.5. Benefits of a Hillsborough County Seagrass Management Plan

A comprehensive, long-term management plan addressing seagrass resources within Hillsborough County will provide multiple dividends, including:

- an affirmation of seagrasses as a key natural resource worthy of protection;
- identification of priority management areas and issues within the county, to focus limited financial resources most effectively, and
- improved integration of local projects into the broader bay-wide management effort that is being coordinated by the TBEP.

The 2000 national census estimated Hillsborough County's population at 998,948 – fourth highest in the state behind Miami-Dade, Broward and Palm Beach counties. Population is expected to increase to about 1,460,900, or nearly 46 percent, by the year 2025. With this growth will come additional urban and suburban development, additional volumes of wastewater and stormwater runoff, and an increase in the number of registered boaters and other recreational users of Tampa Bay. To deal with these increasing stresses, an effective management program will be needed to ensure that existing seagrass beds are preserved and protected; and that recent substantial gains in seagrass recovery continue well into the 21st century.

1.6. Proposed Hillsborough County Seagrass Management Areas

EPC staff, working with the TBEP-sponsored Southwest Florida Seagrass Working Group, have identified seven potential seagrass management areas along the Hillsborough County shoreline of Tampa Bay (Fig. 3). The areas were chosen to include hydrologically and physically similar sites that appear to be facing similar stresses and seagrass management issues. The seven proposed management areas, which are characterized in more detail in Figs. 4-10 below, are:

1) Northern Old Tampa Bay
2) Eastern Old Tampa Bay
3) Interbay Peninsula/MacDill Airforce Base
4) Western Hillsborough Bay
5) Eastern Hillsborough Bay
6) Eastern Middle Tampa Bay, and
7) Egmont Key.

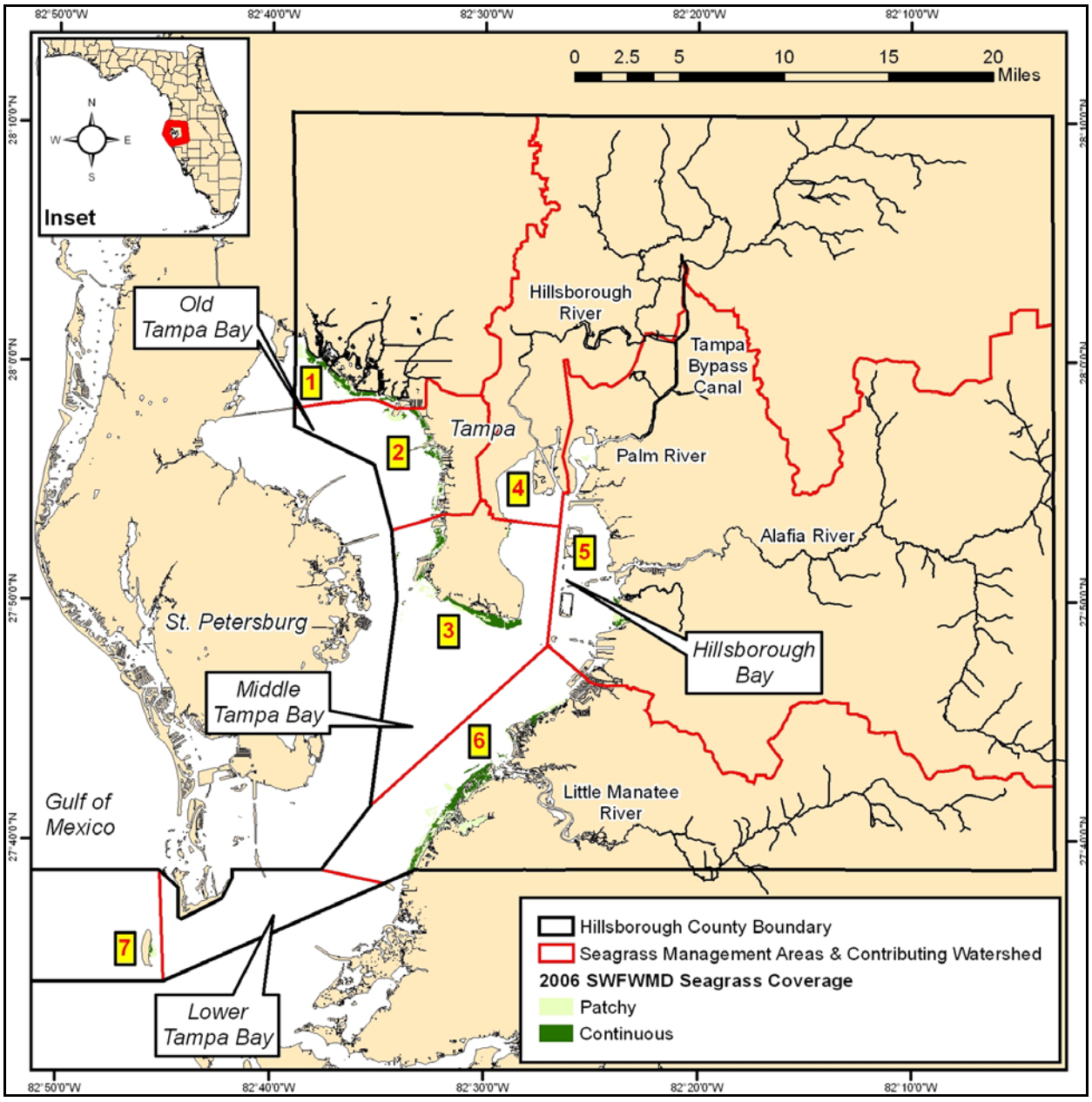

Figure 3: Proposed Hillsborough County seagrass management areas.

1.6.1. Northern Old Tampa Bay (Area 1)

Pinellas County line to the Courtney Campbell Causeway

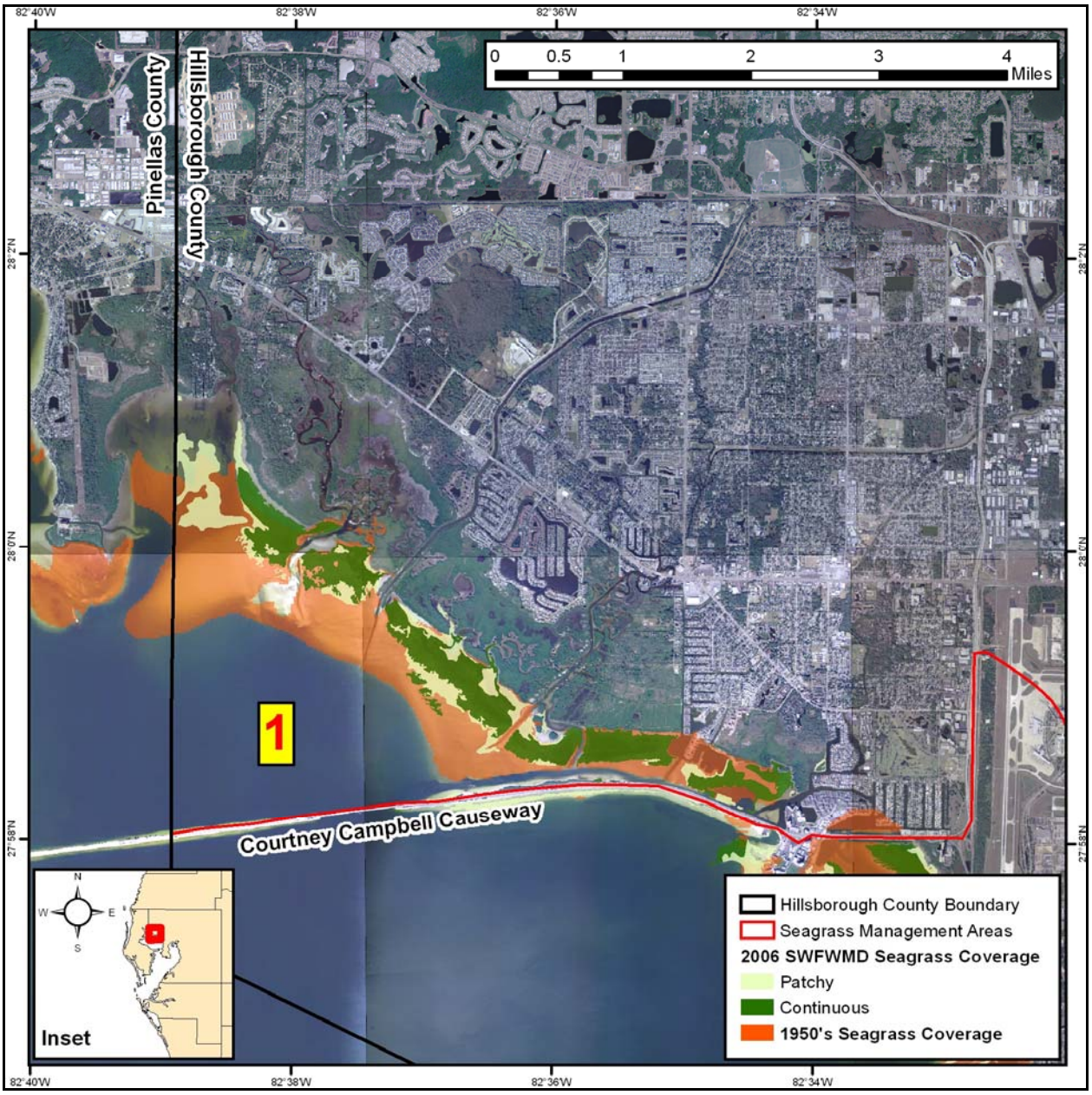

Figure 4: Location and extent of Northern Old Tampa Bay, Management Area 1.

1.6.2. Eastern Old Tampa Bay (Area 2)

Courtney Campbell Causeway to Gandy Bridge

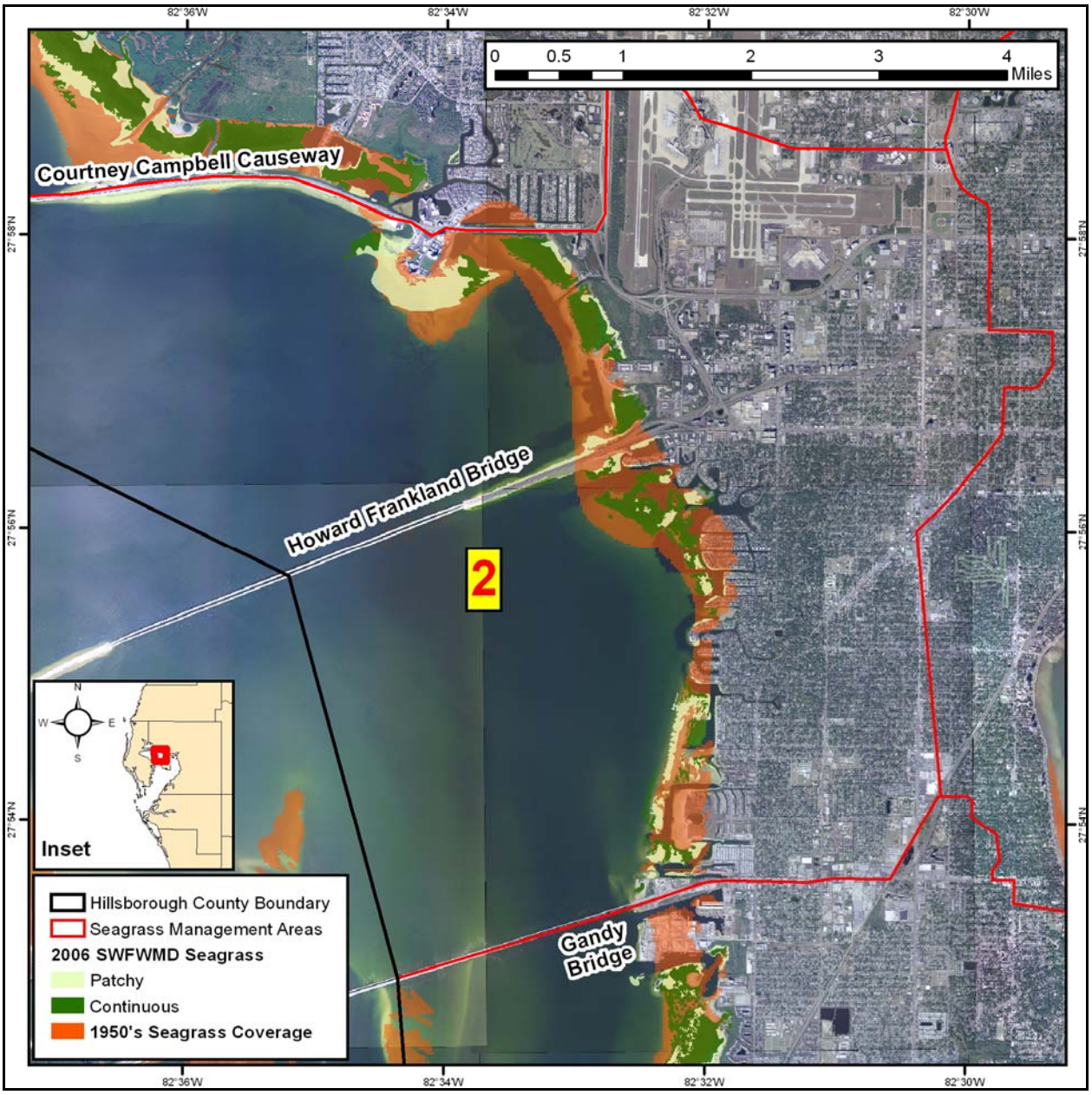

Figure 5: Location and extent of Eastern Old Tampa Bay, Management Area 2.

1.6.3. Interbay Peninsula / MacDill Air Force Base (Area 3)

Gandy Bridge to Ballast Point

Figure 6: Location and extent of Interbay Peninsula/MacDill AFB, Management Area 3.

1.6.4. Western Hillsborough Bay (Area 4)

Ballast Point to the Hillsborough River mouth

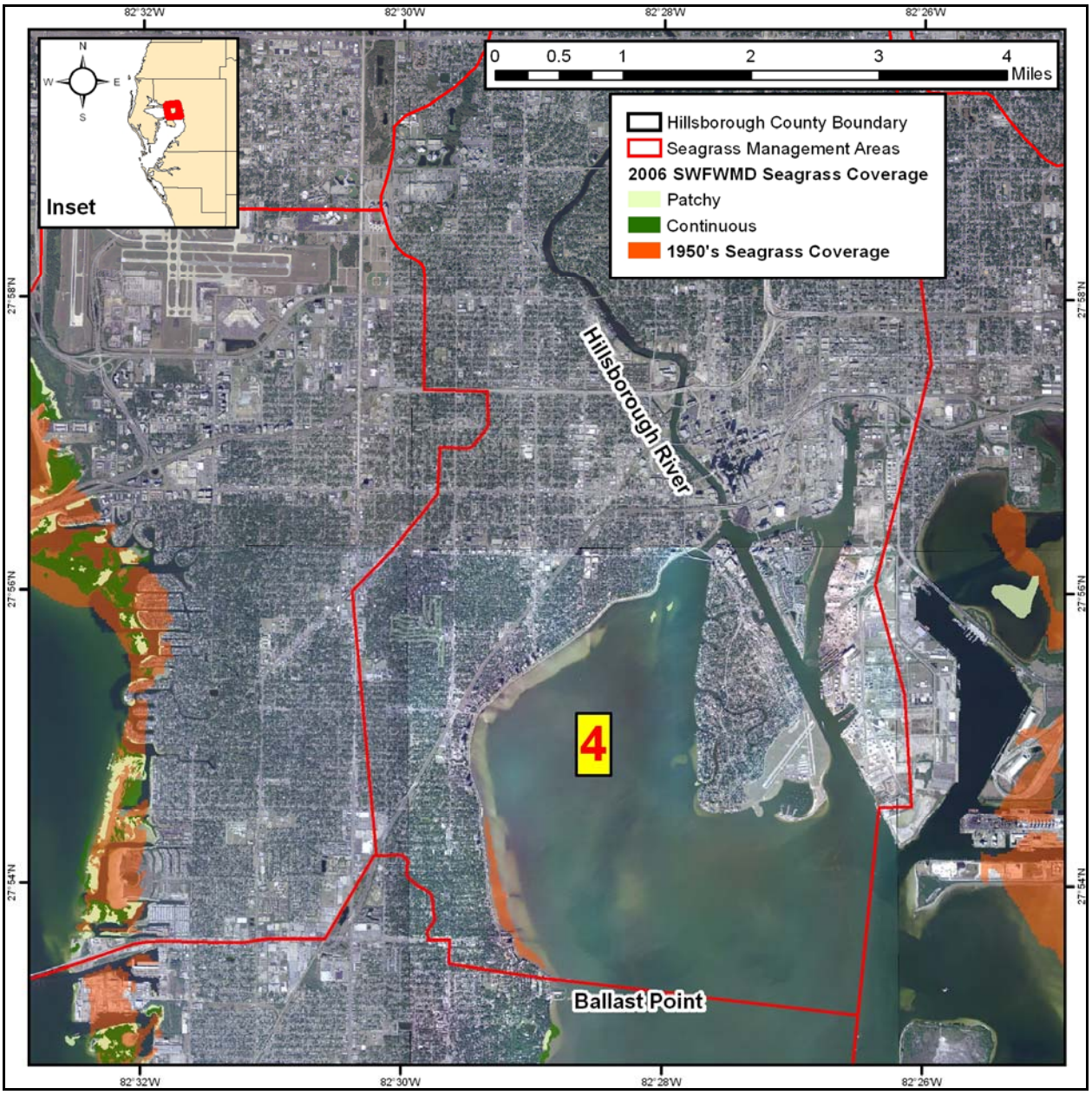

Figure 7: Location and extent of Western Hillsborough Bay, Management Area 4.

1.6.5. Eastern Hillsborough Bay (Area 5)

McKay Bay to Apollo Beach

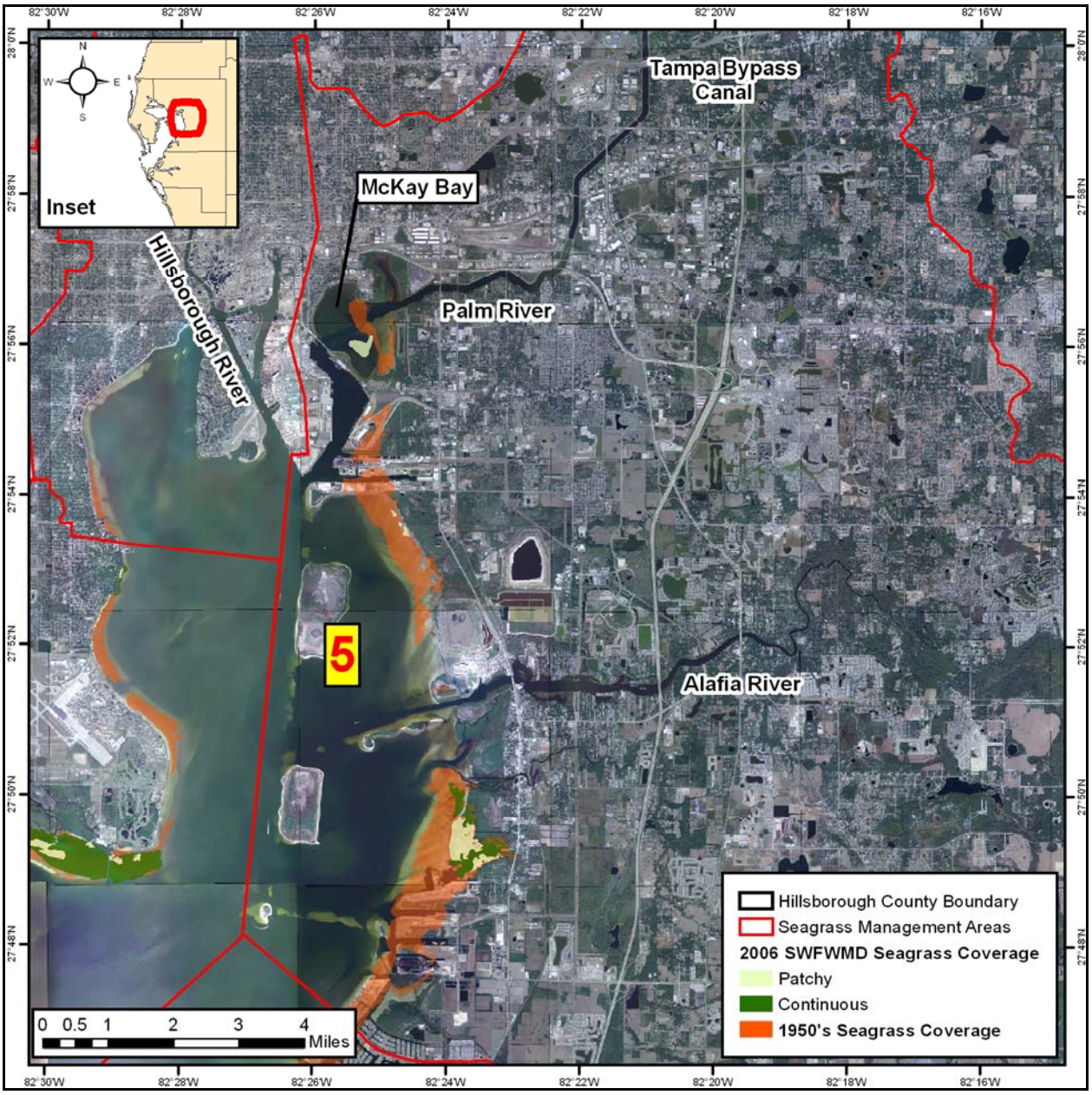

Figure 8: Location and extent of Eastern Hillsborough Bay, Management Area 5.

1.6.6. Eastern Middle Tampa Bay (Area 6)

Apollo Beach to Manatee County line

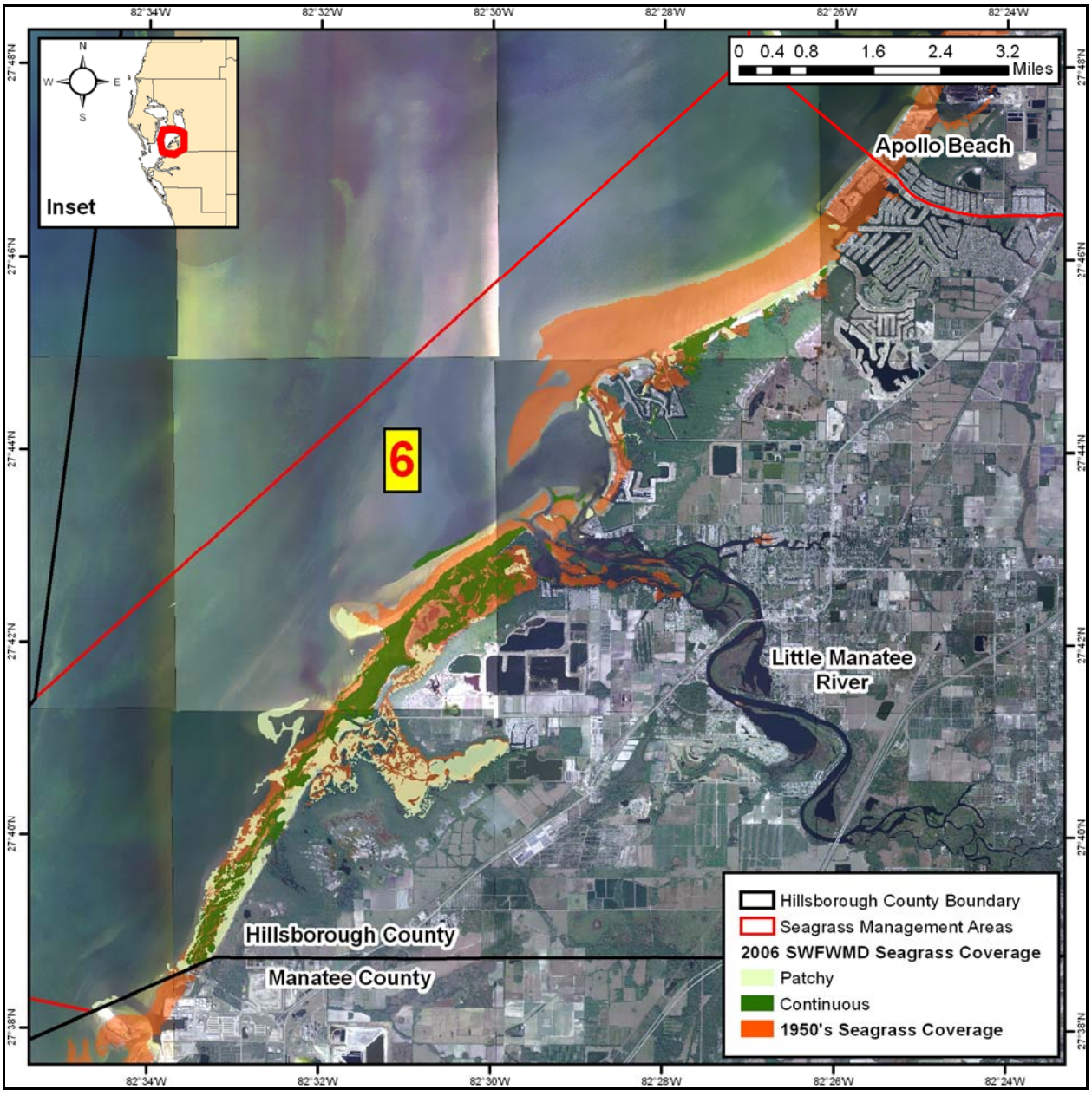

Figure 9: Location and extent of Eastern Middle Tampa Bay, Management Area 6.

1.6.7. Egmont Key (Area 7)

Mouth of Tampa Bay

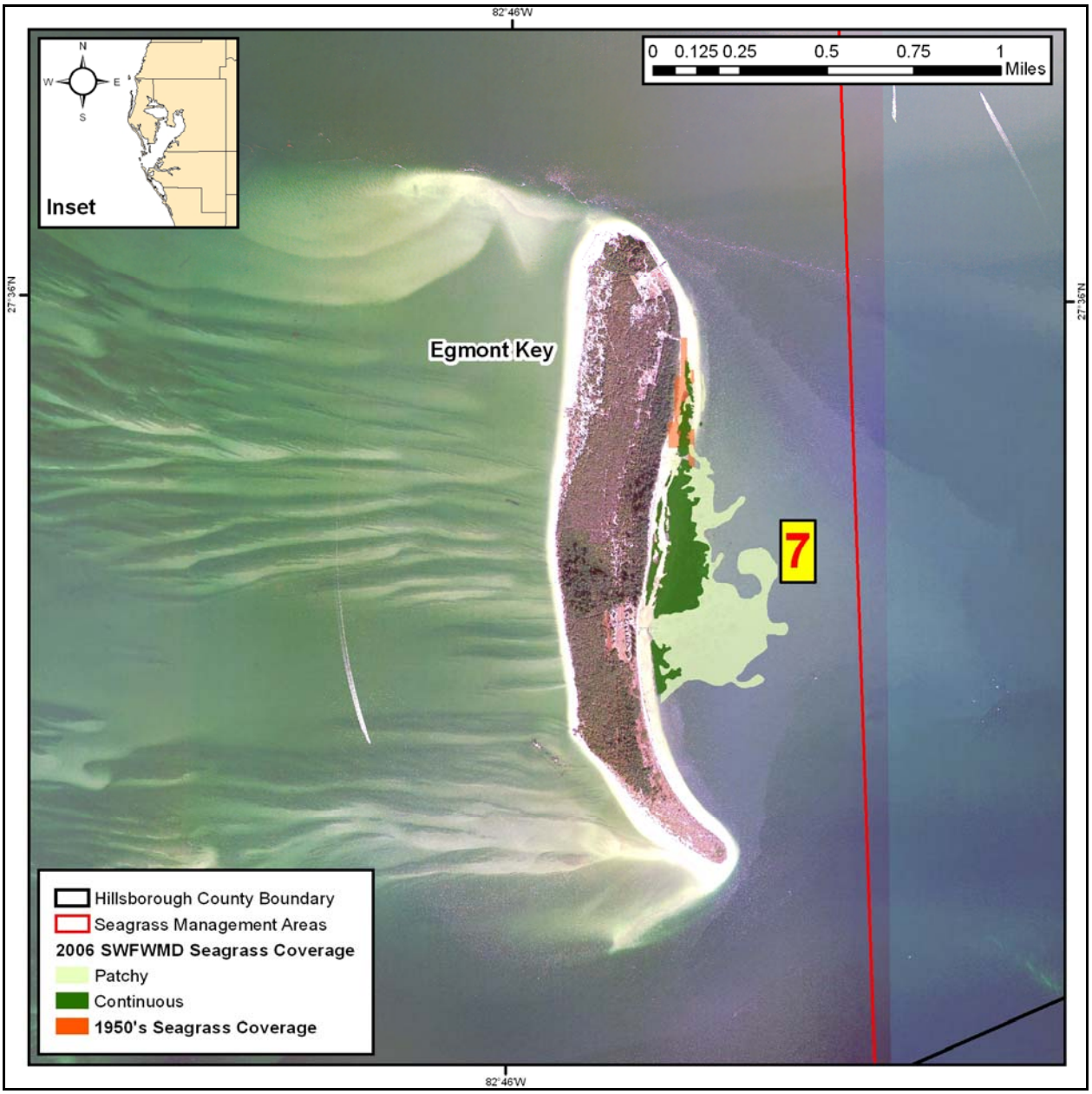

Figure 10: Location and extent of Egmont Key, Management Area 7.

1.7. Seagrass Coverage Trends

1.7.1. Bay-wide trends

As noted earlier, the TBEP and the Southwest Florida Water Management District (SWFWMD) have estimated and tracked trends in seagrass coverage in the major segments of Tampa Bay since 1982, as part of a regional seagrass mapping effort. As shown in Fig. 11, generally increasing coverage trends have been documented on a bay-wide scale during the 1982 – 2006 period.

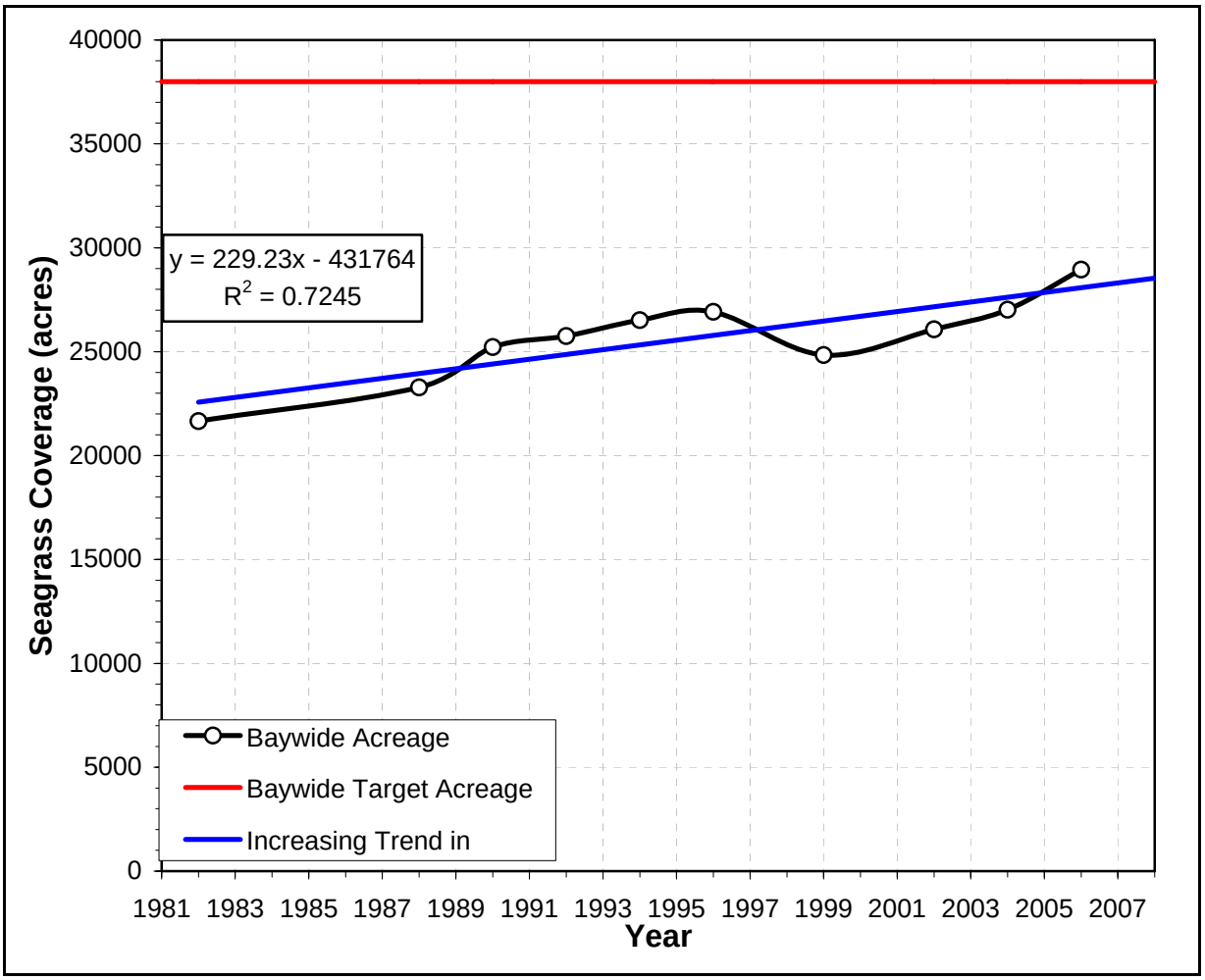

Figure 11: Change in total seagrass coverage in Tampa Bay from 1982 – 2006. Source: SWFWMD.

As also noted earlier, the SWFWMD released updated bay-wide seagrass coverage maps and acreage estimates in February, 2007. Those maps are based on aerial photography that was taken during January, 2006. Unlike the maps and acreage estimates produced for the 1982 through 2004 period, however, the 2006 map products are based on high-resolution digital photography that may not be completely comparable to the film-based imagery used in the earlier mapping efforts.

While the change to digital photography is a positive step for the mapping program, interpretation of seagrass acreage changes between 2004 and 2006 will require caution. An extended period of consideration and discussion may be needed before local seagrass managers reach consensus on the baywide and segment-specific acreage changes that occurred between the 2004 and 2006 mapping periods. The seagrass acreage levels and trends discussed in this report are based on all available information, including the 2006 acreage estimates. Once local consensus is reached on the interpretation of acreage levels and trends in the 2006 maps, EPC staff will revise this management plan, if necessary, to incorporate any changes in interpretation.

1.7.2. Trends in Hillsborough County management areas

In addition to the bay-wide acreage trends observed between 1982 and 2006, localized patterns of gains and losses in seagrass coverage have been seen during the same period in the seven proposed management areas. Based on the 2006 SWFWMD estimates, the Interbay Peninsula/MacDill AFB (Area 3) and Eastern Middle Tampa Bay (Area 6) management areas represent approximately 72% of the seagrass resources currently present in the Hillsborough County portion of Tampa Bay (Table 1). Whereas Area 6 has remained relatively stable over the 1988 – 2006 period, Area 3 has shown an increasing trend in seagrass coverage over this same period (Figure 12). Fluctuations in total, patchy, continuous and total seagrass coverage in each of the seven proposed management areas, for the period 1988 through 2006, are summarized in Table 1 and Figs. 13-19 below.

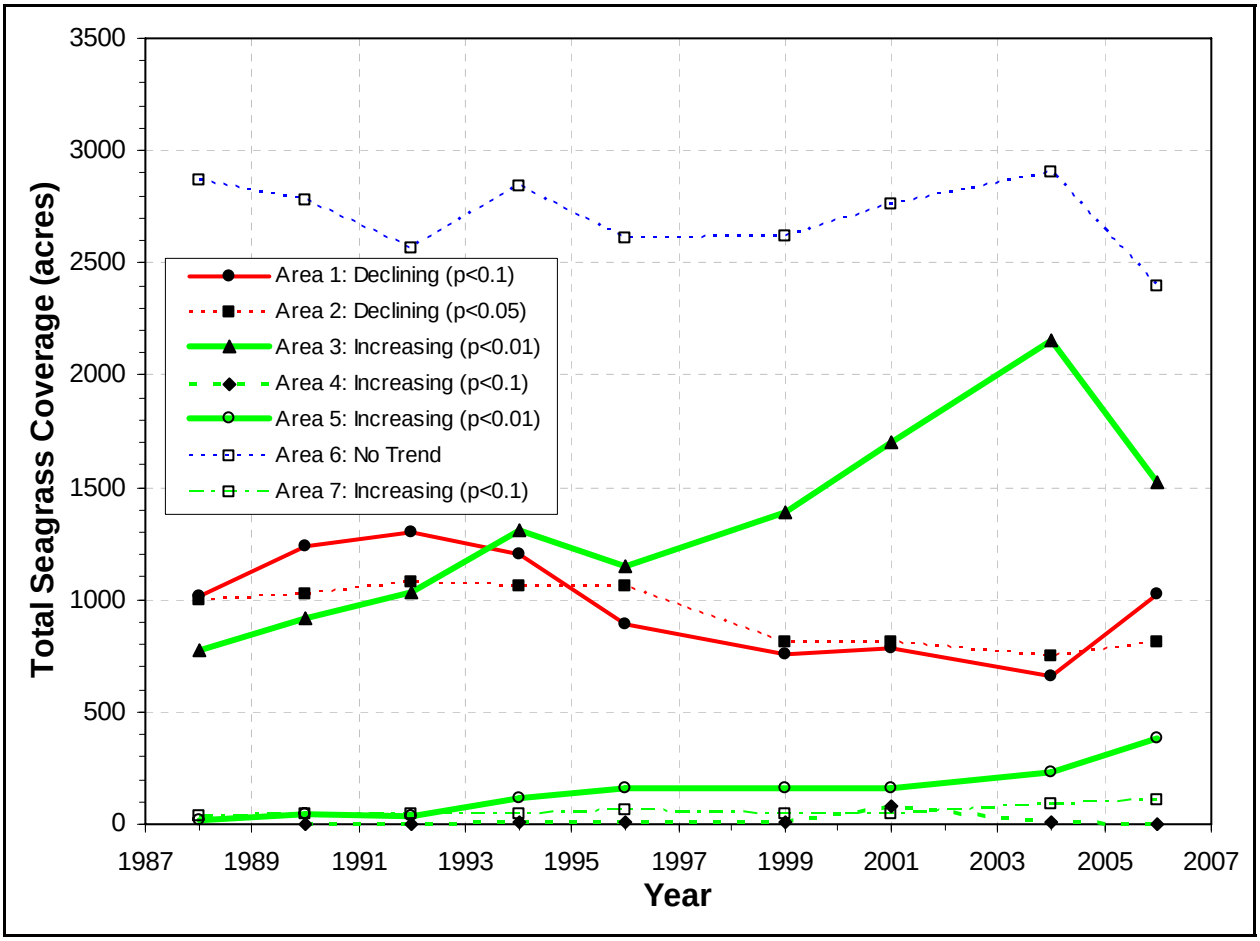

Figure 12: Trends in total seagrass coverage from 1988 – 2006 in each of the seven management areas. Red lines indicate a decreasing trend, blue lines represent no trend, and green lines indicate an increasing trend. Data Source: SWFWMD.

Table 1: Estimated seagrass coverage (acres and percent) in "patchy" and "continuous" coverage categories, in each of the seven management areas, during the 1950 and 2006 time periods. Data Sources: SWFWMD, TBEP.

Management Area	2006 Patchy Coverage acres (% of Total)	2006 Continuous Coverage acres (% of Total)	2006 Total Coverage acres (% of Total)	1950 Total Coverage acres (% of Total)	Change 1950 to 2006 acres (% Change)
(1) Northern Old Tampa Bay	353.4 (12.6%)	666.9 (19.4 %)	1020.3 (16.4 %)	2042.9 (14.3%)	-1022.6 (-50.1%)
(2) Eastern Old Tampa Bay	379.2 (13.5%)	427.1 (12.4 %)	806.3 (12.9%)	1727.9 (12.1%)	-921.6 (-53.3%)
(3) Interbay Peninsula MacDill AFB	542.5 (19.4%)	984 (28.7%)	1526.6 (24.5%)	2795.9 (19.5%)	-1269.3 (-45.4%)
(4) Western Hillsborough Bay	3.2 (0.1%)	0 (0%)	3.2 (0.1%)	51.2 (0.4%)	-48.0 (-93.8%)
(5) Eastern Hillsborough Bay	211.3 (7.5%)	167.7 (4.9%)	379.1 (6.1%)	2659 (18.6%)	-2279.9 (-85.7%)
(6) Eastern Middle Tampa Bay	1246.3 (44.5%)	1152.6 (33.6%)	2399 (38.5%)	5020.4 (35.1%)	-2621.4 (-52.2%)
(7) Egmont Key	67.2 (2.4%)	35.7 (1.0%)	102.9 (1.6%)	8.9 (0.1%)	+94.0 (1056.2%)
TOTAL	**2803.1 (100%)**	**3434.2 (100%)**	**6237.3 (100%)**	**14306.2 (100%)**	**-8068.9 (-56.4%)**

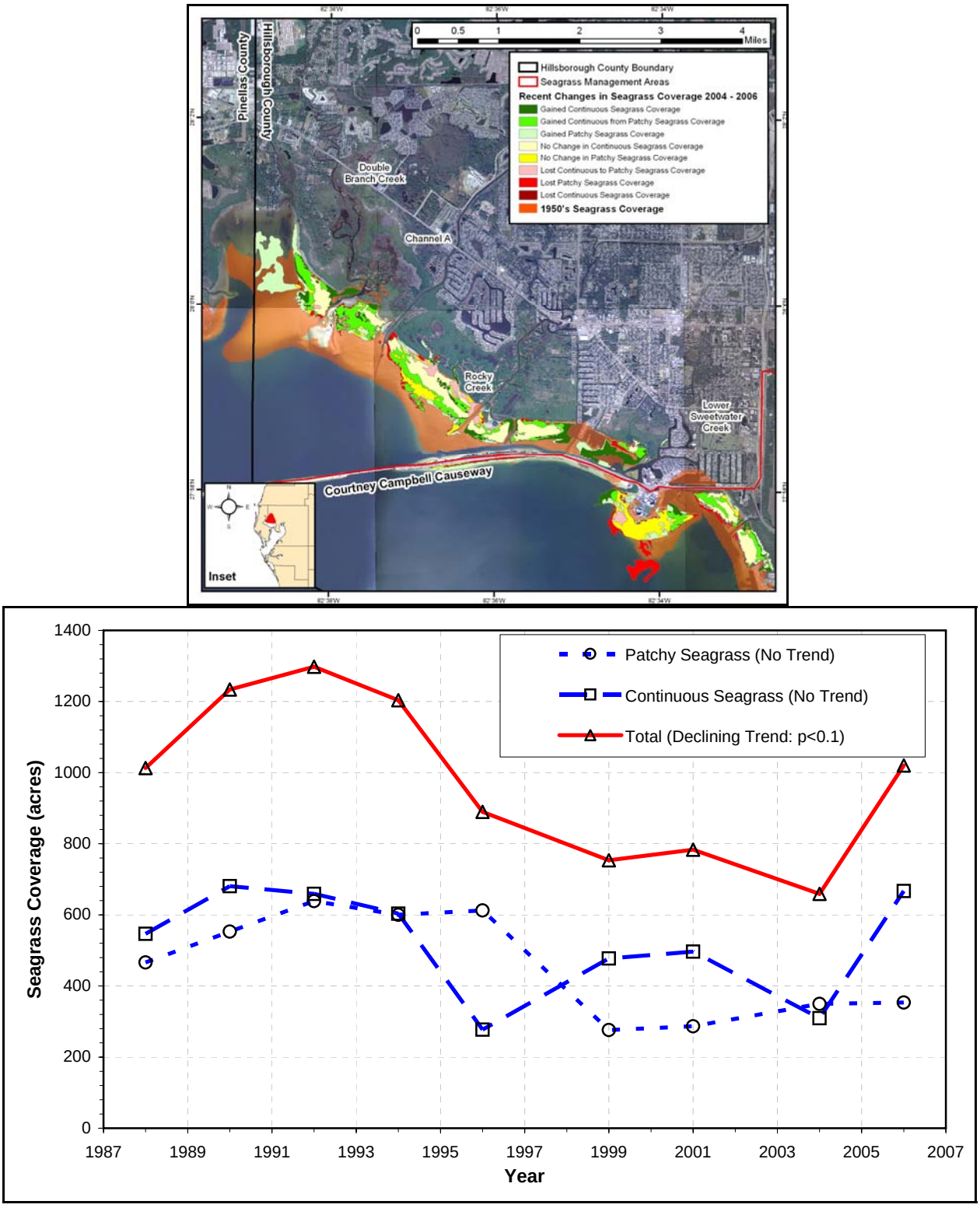

Figure 13: Spatial extent of recent changes in seagrass coverage from 2004 – 2006 (map) and 1988 – 2006 seagrass coverage trends (chart) in Northern Old Tampa Bay, Management Area 1. Source: SWFWMD.

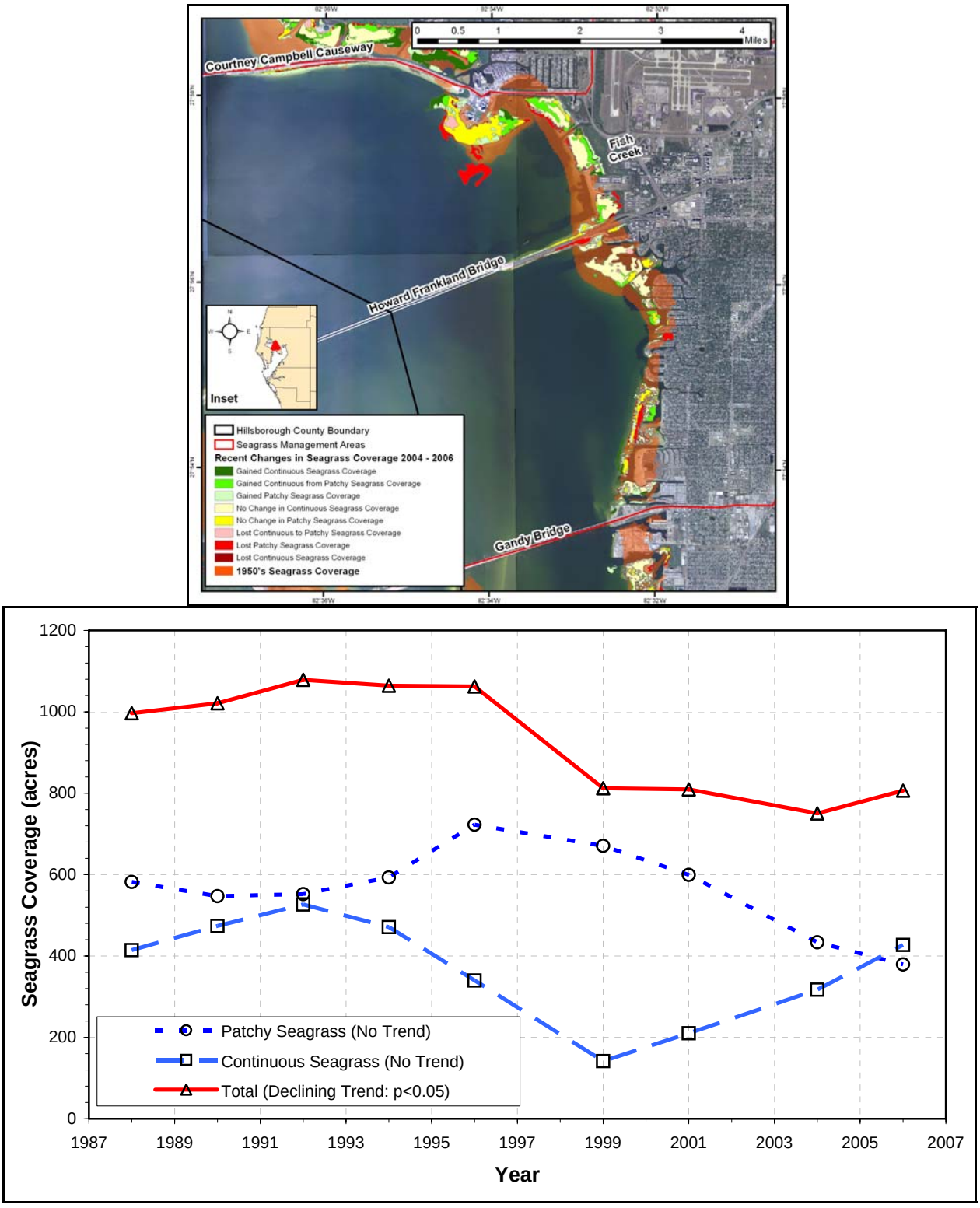

Figure 14: Spatial extent of recent changes in seagrass coverage from 2004 – 2006 (map) and 1988 – 2006 seagrass coverage trends (chart) in Eastern Old Tampa Bay, Management Area 2. Source: SWFWMD.

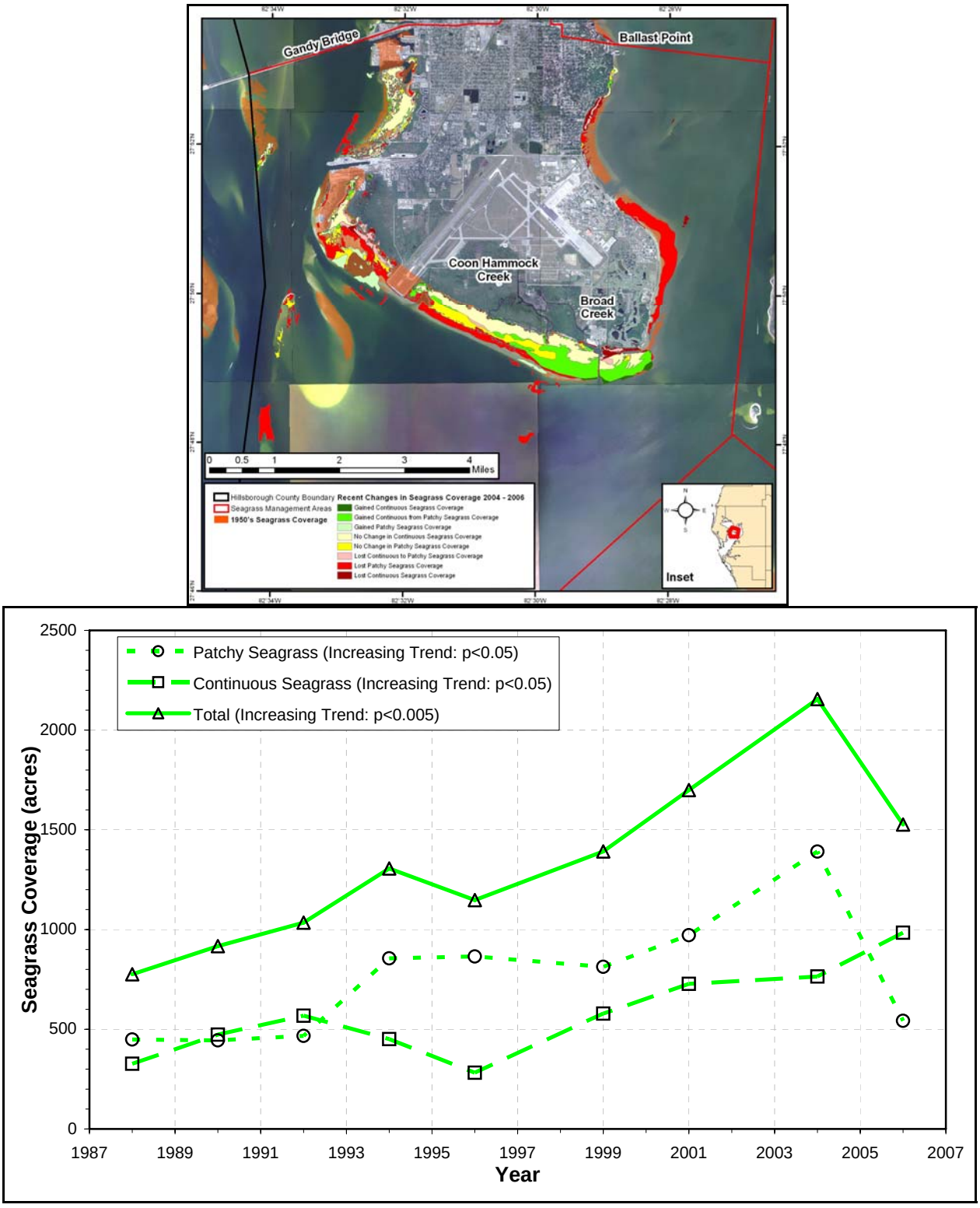

Figure 15: Spatial extent of recent changes in seagrass coverage from 2004 – 2006 (map) and 1988 – 2006 seagrass coverage trends (chart) in Interbay Peninsula/MacDill AFB, Management Area 3. Source: SWFWMD.

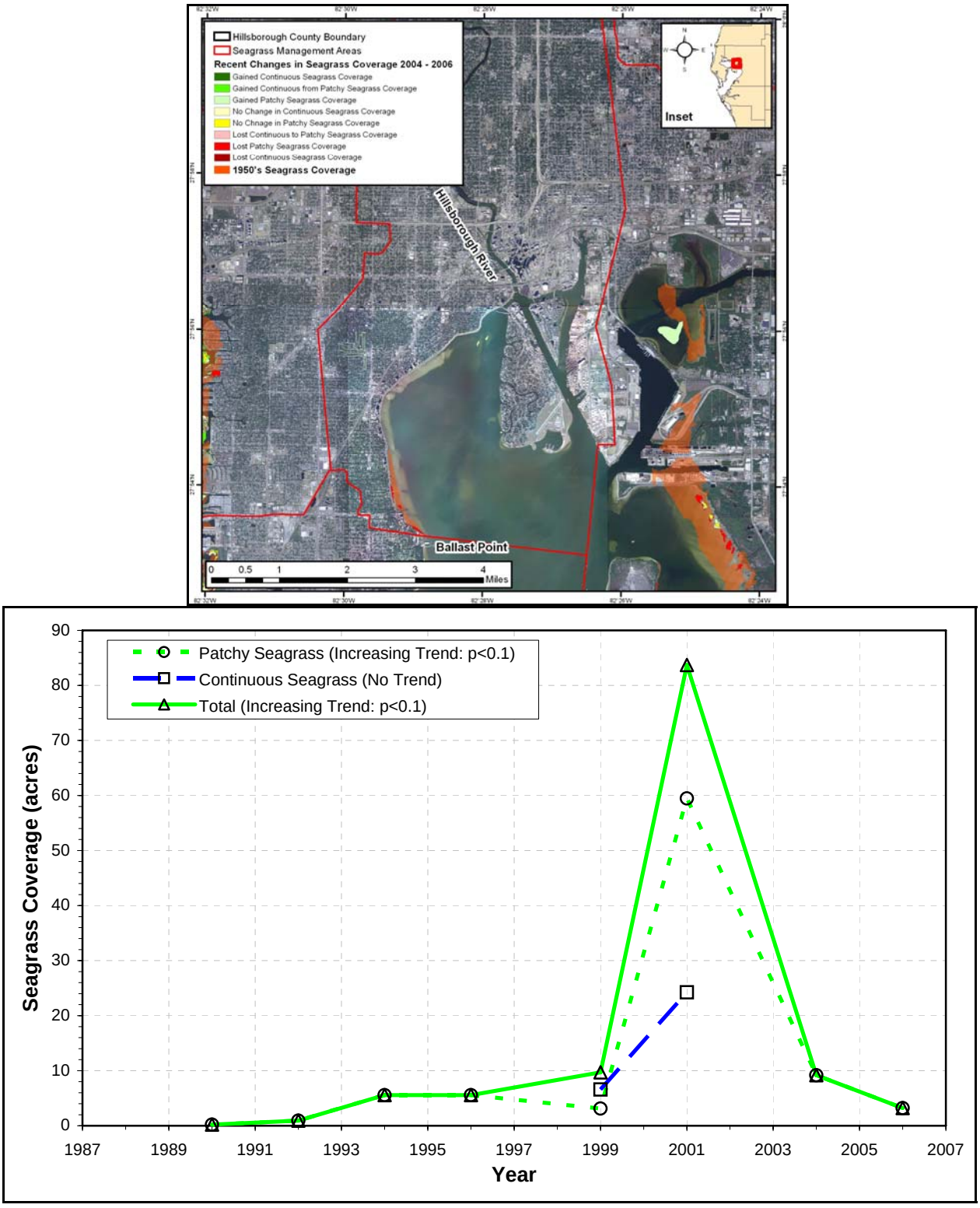

Figure 16: Spatial extent of recent changes in seagrass coverage from 2004 – 2006 (map) and 1988 – 2006 seagrass coverage trends (chart) in Western Hillsborough Bay, Management Area 4. Source: SWFWMD.

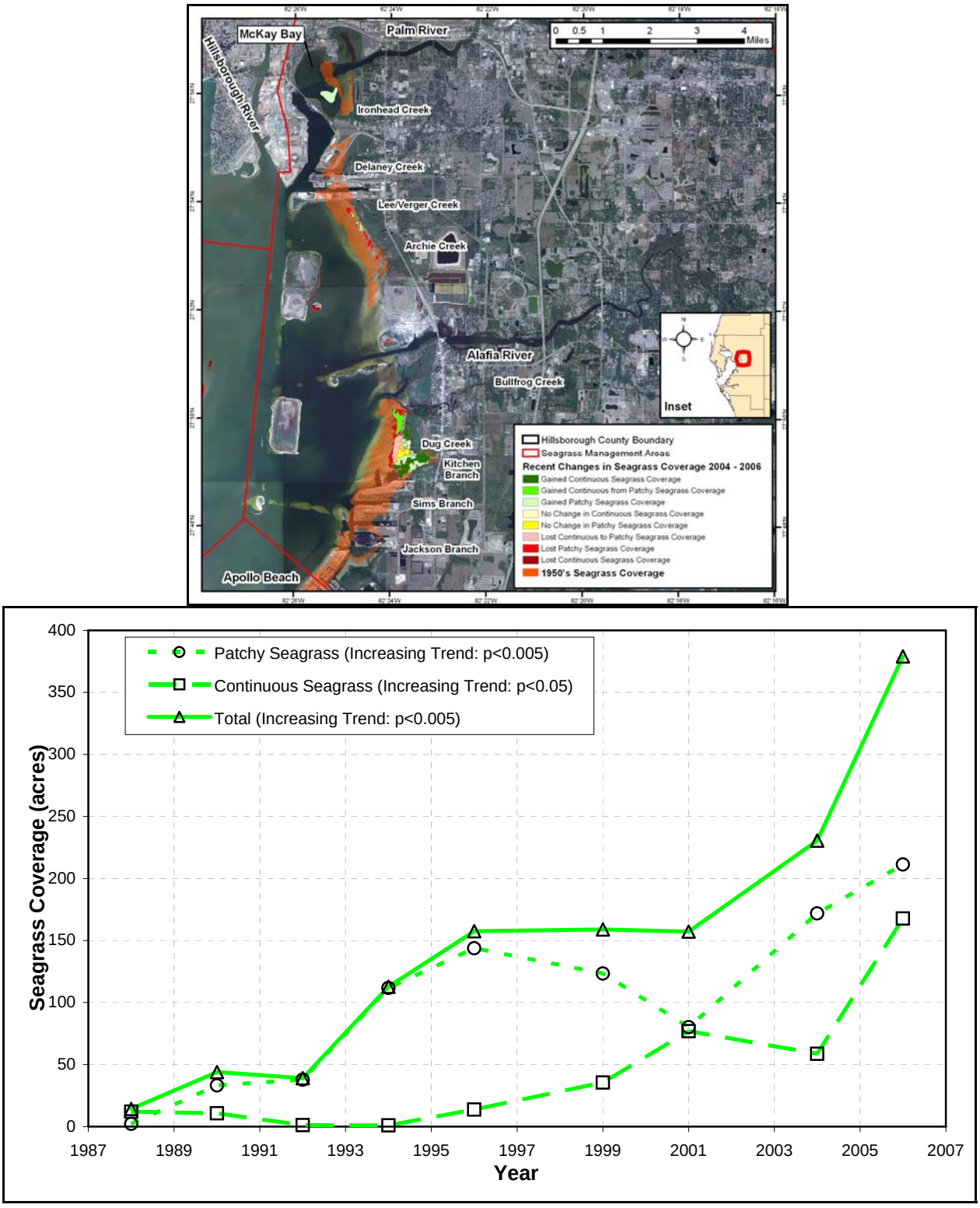

Figure 17: Spatial extent of recent changes in seagrass coverage from 2004 – 2006 (map) and 1988 – 2006 seagrass coverage trends (chart) in Eastern Hillsborough Bay, Management Area 5. Source: SWFWMD.

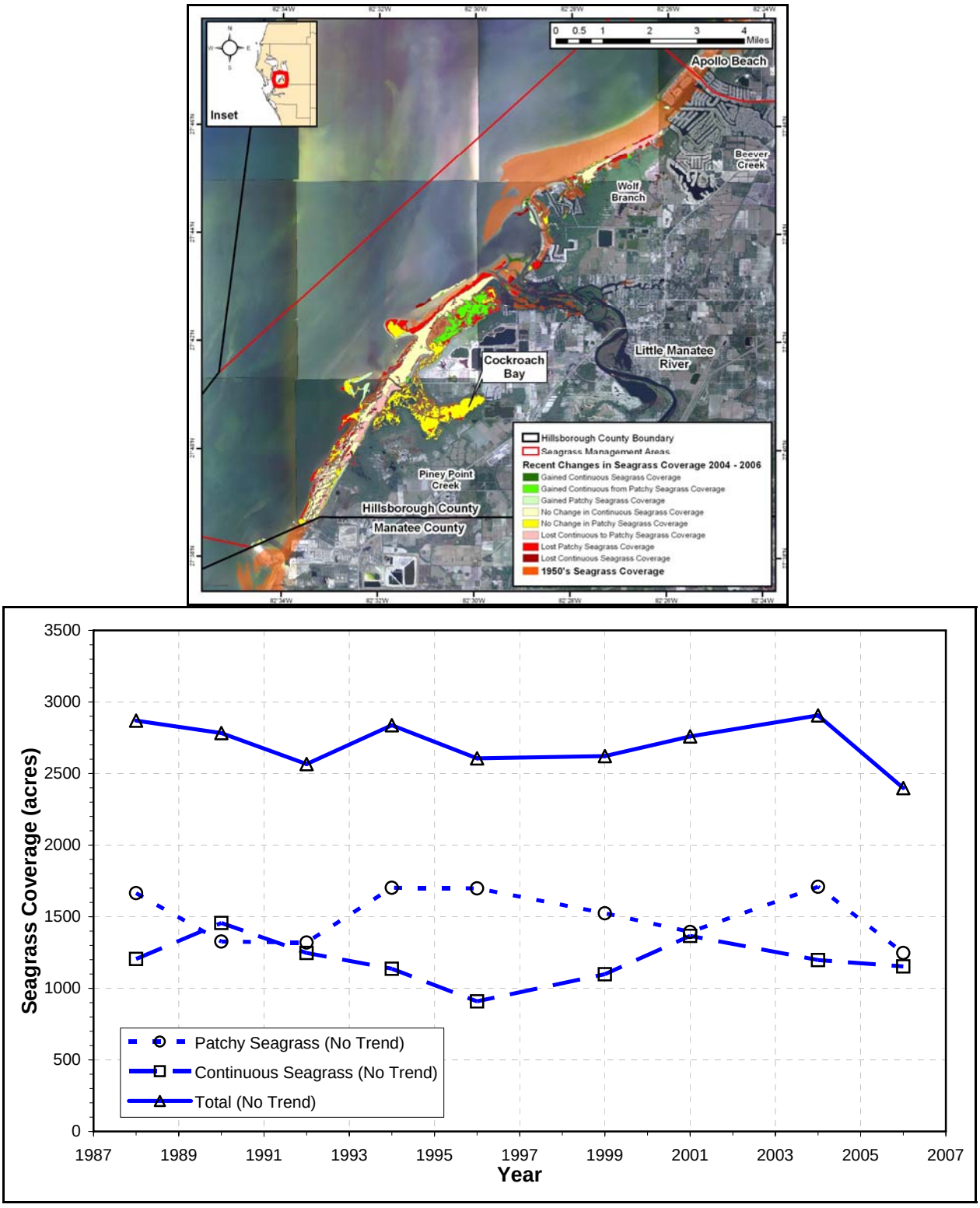

Figure 18: Spatial extent of recent changes in seagrass coverage from 2004 – 2006 (map) and 1988 – 2006 seagrass coverage trends(chart) in Eastern Middle Tampa Bay, Management Area 6. Source: SWFWMD.

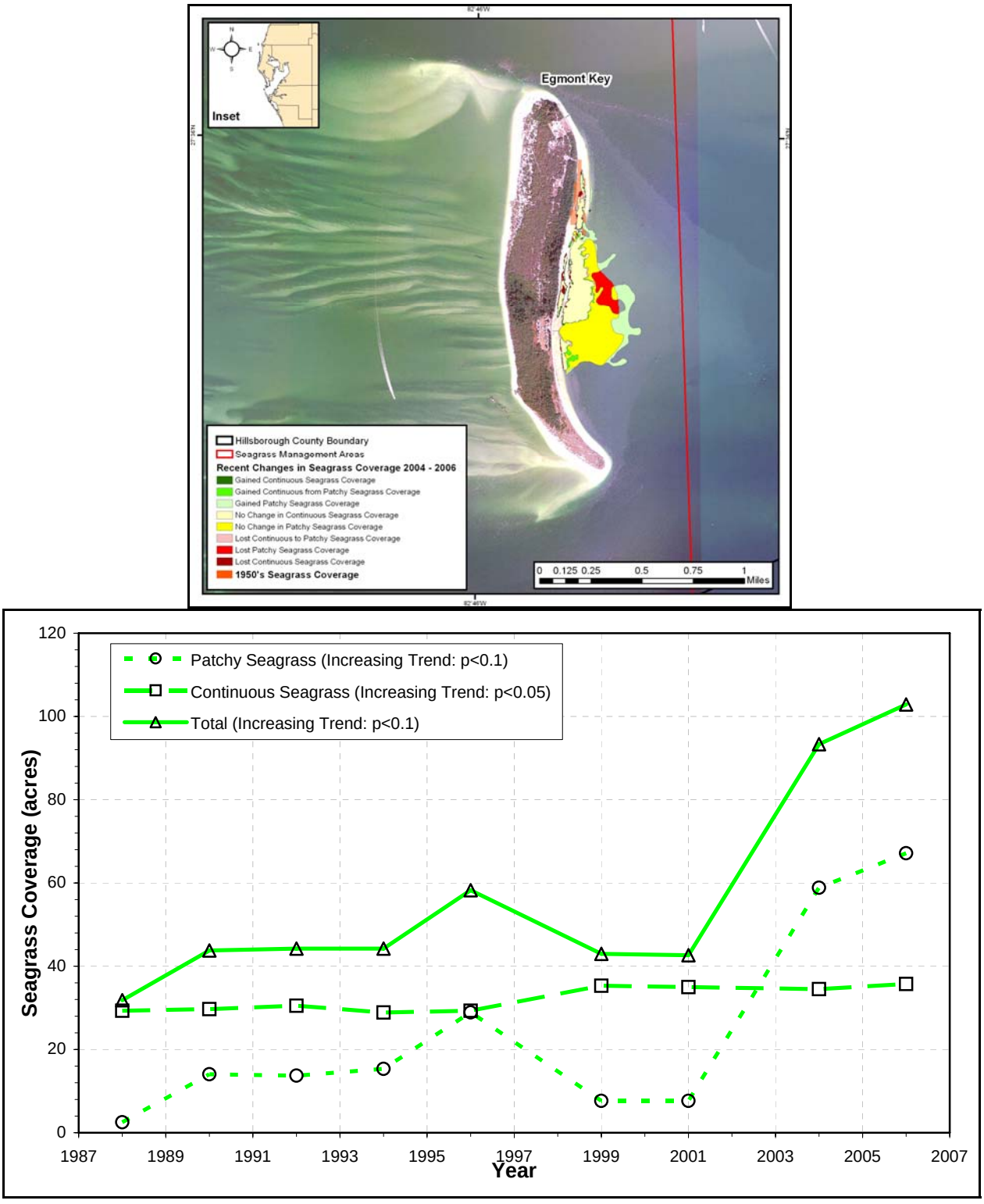

Figure 19: Spatial extent of recent changes in seagrass coverage from 2004 – 2006 (map) and 1988 – 2006 seagrass coverage trends (chart) in Egmont Key, Management Area 7. Source: SWFWMD.

2. Local Seagrass Management Issues

EPC staff also surveyed the members of the Southwest Florida Seagrass Working Group to obtain their input on potential management issues that should be addressed in the seven proposed management areas. Based on input from this group, and follow-up research performed by EPC staff, the following groups of priority management issues were identified. For planning purposes they were divided into two sets: "well-documented issues", which have received considerable study and have been shown to have substantial effects on seagrass resources in Hillsborough County, and "potential issues", which appear likely to have important impacts but whose actual effects have not yet been as thoroughly documented.

2.1. Well-Documented Issues

2.1.1. Water Quality

The major water quality parameters that control seagrass distribution and coverage in Tampa Bay (and other estuaries) appear to be water clarity and light attenuation (Bortone 2000; Dawes et al. 2004). Light attenuation – the reduction in the intensity of incoming sunlight that occurs in the water column – is caused by the scattering and absorption of light by water molecules and suspended particles. Suspended algae cells (phytoplankton) and other suspended solids, along with dissolved organic matter (water "color"), are important sources of light attenuation in Tampa Bay (Dixon 2000; Greening and Janicki 2006).

In the case of turtle grass (*Thalassia testudinum)*, the primary seagrass species for which water quality targets have been set in the bay, the deepest meadows grow to a depth at which 20.5% of incident light reaches the bay bottom on an annual average basis (Dixon 2000). The TBEP seagrass coverage goal can thus be re-stated as a water clarity and light penetration target: in order to restore seagrass to early-1950s levels in a given portion of the bay, water clarity in that area should be restored to the point that allows 20.5% of incident sunlight to reach the same depths that were reached in the early 1950s. These depths range from 1.0 m for Hillsborough Bay to 2.0 m for Lower Tampa Bay (Greening and Janicki 2006).

Loadings and concentrations of nutrients, such as nitrogen, phosphorus, and silica, are also important water quality parameters because they stimulate the growth of phytoplankton and thus contribute indirectly to light attenuation. While concentrations of bio-available phosphorus and silica probably play an important role in the ecology of Tampa Bay, through their influence on the types of phytoplankton that occur there, studies supported by the TBEP indicate that nitrogen is a key nutrient-related water quality parameter with respect to seagrass management. The nitrogen load that enters the bay each year has been found to be a reliable predictor of phytoplankton biomass (Johansson 1992; Wang et al. 1999; Greening and Janicki 2006), which is estimated using

measurements of chlorophyll-*a,* a pigment found in all photosynthetic phytoplankton.

Anthropogenic nitrogen loads, which enter the bay from sources such as stormwater runoff, wastewater discharges and atmospheric deposition from sources such as automobiles and power plants, can be reduced by managing human activities that take place in the bay's watershed and airshed. Maintaining annual anthropogenic nitrogen loads below certain critical levels is thus a key element of the Tampa Bay water quality and seagrass management strategy (TBEP 1996).

Water quality monitoring data indicate that annual mean chlorophyll-*a* concentrations during the years 1992 through 1994 allowed an annual average of more than 20.5% of incident light to reach target depths (i.e., depths to which seagrasses grew in 1950) in most areas of Tampa Bay (Greening and Janicki 2006). As noted earlier, this suggests that a management strategy based on "holding the line" at 1992-1994 nitrogen loading rates should be adequate to achieve the seagrass restoration goals. This "hold the line" approach, combined with regular monitoring of water quality and seagrass extent, was adopted by the TBEP partnership in 1996 as its initial water quality management strategy.

Anthropogenic nutrient loadings can also contribute to the excessive growth of epiphytic algae on seagrass leaves, which can act as an additional source of light attenuation, and to the development of locally-dense accumulations of macro-algae which can impact seagrass growth and condition. While potentially important, these impacts of nutrient loading are currently thought to be secondary to the light attenuation caused by excessive phytoplankton growth. As a result, they have not yet been addressed as an explicit part of the TBEP water quality and nitrogen load management process.

2.1.2. Dredging and Filling

In addition to reductions in water clarity, dredging and filling for navigational access and waterfront development also contributed to the seagrass coverage losses that occurred in Tampa Bay between the 1950s and early 1980s. Since the early 1900s an estimated 13,200 acres of bay bottom have been filled, with more than 90 percent of the activity occurring in shallow areas near the bay's shorelines, where seagrasses once grew. Hillsborough Bay is one of the most impacted areas in this regard. Its surface area has been reduced by 14 percent as a result of filling for waterfront residential development, creation of spoil islands, and construction of port and power generating facilities. This compares to a surface area reduction of 3.6 percent for the entire bay caused by filling (TBEP 1996).

Tampa Bay supports three major seaports and a cruise ship industry that contribute more than $10 billion dollars annually to the region's economy. The

Port of Tampa is the state's largest port and consistently ranks among the top 10 in the nation in trade activity. Smaller harbors at Port Manatee and St. Petersburg also are economically important to the region.

Maintaining the bay's network of shipping channels requires continuous dredging and disposal of the sediments that accumulate in the channels. Over time, these activities have dramatically changed the bay bottom. The Tampa Harbor Deepening Project, begun in 1972 and completed in 1988, required the removal of more than 100 million cubic yards of sediments. Another million cubic yards of material — enough to fill 100,000 dump trucks — is removed from the bottom of the bay each year, at an estimated cost of $10 million, to service the bay's three major ports.

With an average depth of only 12 feet, regular dredging of the bay is necessary to serve ships entering the bay. The main shipping channel has been dredged to a control depth of 43 feet to allow safe passage of large cargo vessels.

In areas adjacent to active dredging projects, turbidity plumes can cloud bay waters, inhibiting light penetration to seagrasses. Dredging projects can also cause smothering of bottom-dwelling animals and can release nutrients such as ammonia, which can contribute to algal blooms, from the sediments. In some cases, however, dredging can also benefit the bay, by improving tidal circulation and removing contaminated sediments.

If coordinated planning does not occur, long-term disposal of dredged material will represent a significant challenge. Currently, Tampa Bay has two approved disposal sites, on large man-made islands owned and operated by the Tampa Port Authority. At current disposal rates, these islands are expected to serve the disposal needs of the upper bay for another decade.

In the future, proper regulation of dredging and filling activity will play an important role in the bay-wide seagrass management effort. Over the next several years dredging for navigational access may be an issue of critical concern for local resource managers. The U.S. Army Corps of Engineers is currently completing its Congressional mandate to re-evaluate channels and ports in Tampa and St. Petersburg, as well as a "passing zone" for ships at Cut B near Port Manatee. Depending on final design criteria, estimates for the passing zone range from 1.5 to 2.8 million cubic yards of dredged material. Officials at the Tampa Port Authority and Southwest Florida Water Management District are hopeful that much of the spoil from these proposed new projects can be piped to the shell pit at Cockroach Bay where it would be used to create a series of habitats. If that is not feasible, dredged material could perhaps be placed in an offshore site where capacity is not an issue.

Impetus for the navigation channel expansion is coming from an increase in shipping activity at the Ports of Tampa and Manatee. Larger ships – particularly

the Fantasy-class cruise ships – require wider channels and possibly a wide passing zone to reduce congestion in the main navigation arteries.

Several environmental concerns must be addressed regarding the harbor re-evaluation. Among the issues potentially affecting seagrasses:

- Possible alteration of the salinity regime in portions of the bay. Breaching of the aquifer during dredging could facilitate increased freshwater flows, lowering salinity beyond the preferred range of some seagrasses. Conversely, deepening and widening the channels could increase the tidal prism in portions of the bay, allowing more saltwater to enter than some seagrass species can tolerate.

- Turbidity created during the dredging process, which could smother nearby seagrasses.

- Changes in circulation and hydrodynamics, including a possible acceleration of the loss of nearby longshore bars that buffer wave exposure of seagrass beds.

Congress directed the Corps to begin the re-evaluation of the navigation channels serving the ports of Tampa, St. Petersburg and Manatee in 2001, but construction is not scheduled to begin until at least 2008. A formal Environmental Impact Statement will be required before work can begin.

2.1.3. Boating Impacts

Scarring of seagrass beds by boat propellers can restrict seagrass growth through physical damage to the grasses themselves, and by creating areas of separation within formerly-continuous beds which can lead to erosion of sediment material by scouring and increased wave action. Studies indicate the recovery of scarred grass beds to normal density may take 3.6 to 6.4 years, if no additional scarring occurs in that period. When scarring becomes severe, entire beds may lose the ability to regenerate and cease to exist (Sargent et al. 1995).

Impacts of seagrass bed scarring on the abundance of fish and shellfish have not been widely studied, but a recent study conducted in Tampa Bay and Charlotte Harbor did not find significant impacts in beds that had experienced up to 50% scarring (Bell et al. 2002). Fonseca and Bell (1998) provided information suggesting that a rapid loss of structural complexity occurs in seagrass habitat at approximately the 50% coverage level, and Bell et al. (2002) recommended that field studies of faunal abundance in beds with >50% scarring be carried out to test the relevance of this idea to the scarring issue.

A statewide assessment of seagrass scarring conducted by the Florida Marine Research Institute in 1995 found that 64.8 percent of Hillsborough's 6,320 acres

of seagrasses were scarred (Sargent et al, 1995). The largest percentage of beds (38.3 percent) fell within the "moderately scarred" category, while 26.6 percent were lightly scarred and 2.9 percent exhibited severe scarring (Table 2). Hillsborough County ranked sixth overall in moderately scarred seagrass among all Florida counties with seagrass resources.

In addition to propeller scarring, other boating-related impacts commonly observed in seagrass beds include accidental groundings and scars caused by anchoring, both of which can cause physical disturbances similar to those produced by propeller scars.

Table 2: Percentage of scarred seagrasses, by intensity level, within each Florida coastal county, reported by Sargent et al. (1995). "Light scarring" is defined as the presence of scars in less than 5 percent of the delineated polygon, "moderate scarring" as the presence of scars in 5 to 20 percent of the polygon, and "severe scarring" as the presence of scars in more than 20 percent of the polygon. The percentage of scarred seagrasses for the entire state in each category is light = 4.1%, moderate=1.8%, severe=0.6%, mod.+severe= 2.4%, and total scarring=6.5%. (Source: Sargent et al. 1995).

County	Total Seagrass Acres	Percent Light Scarring	Percent Moderate Scarring	Percent Severe Scarring	Percent Moderate +Severe	Percent Total Scarring
Bay	10,530	38.4	7.8	0.7	8.5	47.0
Brevard	46,190	9.0	4.2	0.2	4.4	13.4
Broward	1	100.0	0.0	0.0	0.0	100.0
Charlotte	14,190	10.8	39.6	2.0	41.6	52.4
Citrus	147,810	17.4	1.2	0.1	1.3	18.7
Collier	5,250	37.5	30.3	1.7	32.0	69.5
Dade	145,650	1.9	2.7	3.1	5.8	7.7
Dixie	111,130	2.2	0.9	0.0	0.9	3.1
Escambia	2,750	18.7	6.4	0.3	6.7	25.4
Franklin	19,840	2.2	1.9	0.0	1.9	4.1
Gulf	8,170	51.4	6.6	1.3	7.9	59.3
Hernando	146,870	5.3	0.5	0.0	0.5	5.8
Hillsborough	6,320	26.6	35.3	2.9	38.2	64.8
Indian River	2,940	4.8	0.3	1.1	1.4	6.2
Jefferson	10,500	4.0	0.8	0.0	0.8	4.8
Lee	50,510	11.7	14.1	2.6	16.7	28.4
Levy	132,400	7.5	0.1	0.0	0.1	7.6
Manatee	12,160	20.4	18.1	6.5	24.6	45.0
Martin	2,310	1.0	0.4	0.0	0.4	1.4
Monroe	1,452,800	1.0	0.7	0.4	1.1	2.1
Okaloosa	3,450	9.0	2.2	0.1	2.3	11.3
Palm Beach	2,510	2.1	0.9	0.0	0.9	3.0
Pasco	85,570	2.5	2.1	0.4	2.5	5.0
Pinellas	22,920	16.6	16.9	8.8	25.7	42.3
Santa Rosa	2,720	16.4	4.1	0.0	4.1	20.5
Sarasota	4,160	17.2	7.2	0.8	8.0	26.0
St. Lucie	6,920	0.6	0.6	0.0	0.6	1.2
Taylor	162,860	5.0	0.0	0.0	0.0	5.0
Volusia	8,490	16.9	11.9	4.2	16.1	33.0
Wakulla	29,630	6.9	2.5	0.0	2.5	9.4
Walton	710	1.6	0.0	0.0	0.0	1.6

2.2. Potential Issues

2.2.1. Restoration of Dredged Holes

In 2002 the TBEP received a grant from the U.S. EPA to evaluate the existing habitat value and restoration potential of dredged holes in Tampa Bay. Using those funds TBEP, EPC, FMRI and other partners examined 11 dredged holes, including four located in Hillsborough County.

The primary objective of the dredged hole habitat assessment project was to assess the current habitat value of dredged holes in Tampa Bay, with an ultimate goal of developing specific management recommendations for each of the 11 dredged holes studied. Physical characteristics, sediment and benthic characteristics, the presence and abundance of fish and invertebrate species, and the use of the holes by recreational and commercial anglers were studied for each hole. This multi-agency study involved scientists, managers, and, very importantly, the local recreational fishing community. Using data gathered during this two-year study, an assessment of the habitat value was made and recommendations for an appropriate long-term strategy for each of the selected dredged holes were developed.

The study concluded that seven of the 11 studied holes are providing suitable habitat for aquatic animals and should remain in their current condition (TBEP 2005). In the remaining four holes, it appears that restoration of the bay bottom to more natural conditions, through complete or partial filling, could enhance their habitat value. The project team recommended that further study of the remaining dredged holes in Tampa Bay should be completed prior to developing management recommendations for additional holes.

The following recommendations were provided for the four dredged holes located in Hillsborough County:

- Cypress Point Dredge Hole – partially fill to stabilize shoreline
- MacDill AFB Runway Extension Dredge Hole – do not fill
- McKay Bay/Palm River Dredge Cuts – fill hole to achieve water depth comparable to surrounding area
- Whiskey Stump Key Holes – do not fill.

In cases where a dredged hole is filled to achieve a water depth similar to the surrounding area, it may prove possible to establish seagrass meadows on some or all of the filled site. At a site near Lassing Park in St. Petersburg, for example, a filled dredged hole has been successfully colonized by seagrasses from a dense bed immediately adjacent the former hole. Site-specific factors (e.g., shallow water depths and the presence of a dense seagrass bed in the immediate vicinity of the dredged hole) may have played an important role in allowing seagrass colonization at that location, however, and to the best of our

knowledge the amount of additional seagrass coverage that would be predicted to occur if additional dredged holes were filled has not yet been estimated on a baywide or bay-segment basis.

2.2.2. Wave Energy

In recent years, Tampa Bay has experienced substantial natural recovery of seagrasses due to improved water quality. However, it now appears that seagrass recovery has slowed in several areas, including some where water quality appears sufficient to support regrowth. One hypothesis regarding the slowdown is that the disappearance of natural long-shore sandbars, which once buffered grass beds from wave action, may be allowing higher wave energies to occur in some areas, thus inhibiting seagrass recovery (Lewis 2002).

Seagrass meadows in Wolf Branch Creek, for example, were historically buffered by a nearly continuous longshore bar system extending north from the mouth of the Little Manatee River for approximately eight kilometers (five miles). That bar system has disappeared in the last 40 years, and seagrasses along the deep edges of the nearby shoreline have substantially retreated (Lewis 2002).

In 2002 the Tampa Bay Estuary Program contracted with NOAA's Center for Coastal Fisheries and Habitat Research to employ a wave exposure model (WEMo; Robbins et al. 2002) to examine the influence of longshore bars on seagrass cover. Evaluation of historic wind data and geomorphology indicated that sites on the eastern side of the bay may be particularly vulnerable to storm events, while those on the western shore are more sheltered. The model also demonstrated the strong effects of longshore bars on REI, or wave exposure, reduction. The greater the water depth and the greater the REI, the lower the probability of seagrass cover. This work provided support for the hypothesis that the loss of longshore bars, particularly on the exposed eastern margin of the bay, may have contributed to reductions in seagrass coverage – although changes in wave intensity may not be solely responsible for those reductions. The study recommended that seagrass restoration in affected areas be accompanied by wave-reducing techniques to maximize potential for seagrass regrowth.

The extent to which ship wakes contribute to increased wave energy and loss of near-shore bars was not considered in the NOAA model. This may be an important factor, particularly in areas exposed to repeated wakes from large vessels. A modification of the model to assess the duration and intensity of ship-generated wakes may help to assess this issue and identify potentially vulnerable seagrass beds. This is relevant given the expected increase in large vessels, such as the Fantasy-class cruise ships, associated with the proposed expansion of navigation channels in Tampa Bay.

Analysis of aerial photos from the 1950s suggests that further examination of the effects of wave exposure may be warranted in the following areas of Hillsborough

County, where long-shore bars historically existed but have since diminished or disappeared:

- Pendola Point to Archie Creek
- the Kitchen
- Wolf Branch Creek
- MacDill/Gadsden Point Area.

The portion of Hillsborough Bay adjacent to Bayshore Boulevard may also be an area where wave energy is impacting seagrass recovery, although the shoreline there has been altered for so many years that it is difficult to say what conditions were present prior to the alteration. It is also not clear if longshore bars were ever present in the area to buffer the shoreline there.

2.2.3. Invasive Exotic Species

The invasive Asian green mussel (*Perna viridis*) was first discovered in Tampa Bay in 1999, in the intake pipes of Tampa Electric Company's Big Bend power station. Since then, the green mussel has spread throughout the bay, heavily colonizing artificial substrates such as docks, artificial reefs and bridge pilings.

In February 2003, scientists with the City of Tampa's Bay Study Group noted green mussels flourishing in sandy sediments within established *Halodule wrightii* meadows (R. Johansson, City of Tampa, personal communication). Mussels also were found in bare sand areas currently lacking seagrass coverage, but with the potential for seagrass colonization.

The presence of green mussel beds in established Hillsborough Bay seagrass meadows and potential seagrass areas raised concerns that an aggressive invasion and expansion of mussel beds in such areas may ultimately displace large areas of Tampa Bay seagrass habitat (Johansson and Avery 2004). It was also noted, however, that a limited and stable establishment of green mussel beds in or near seagrass areas might act to benefit local seagrass meadows (Johansson and Avery 2004), due to factors such as:

- improved water column clarity, as a result of mussel filter feeding;
- increased availability of sediment nutrients from mussel fecal deposition; and
- reductions in wave energy due to the protective effects of green mussel bars.

In the future, the potential positive and negative impacts of these and other invasive exotic species – new instances of which appear in Tampa Bay relatively frequently (Baker et al. 2004) – will clearly need to be tracked and addressed by seagrass managers.

2.2.4. Other Potential Issues

A number of additional issues have been noted by EPC staff, members of the Seagrass Working Group, and others as factors that may be affecting seagrass coverage or condition in Tampa Bay. These have not yet received a great deal of study, but will be kept in mind as potential management issues in the Hillsborough County seagrass management areas in which they may apply:

- Bioturbation – stingrays and other bottom-feeding animals can disturb seagrass roots or completely uproot plants, slowing or preventing seagrass recovery in some areas;

- Sediment quality – the chemical or physical properties of sediments (such as hypoxia, elevated sulfide levels, or very fine and easily re-suspended sediments) may act to inhibit seagrass recovery in some areas;

- "Halo" formation – zones devoid of seagrasses have been noted on recent aerial photographs, particularly in sections of Old Tampa Bay, in the vicinity of tidal stream mouths and large stormwater outfalls. The causes and significance of these "halos" has not yet been determined.

- Sea-level rise – in the Tampa Bay region, sea level rise has recently been occurring at a rate of 2.3mm per year (TBRPC 2006). Using methods developed by the U.S. EPA, the Tampa Bay Regional Planning Council (TBRPC) has estimated that a 50% probability exists that sea level in the area may rise to 9.4 inches above the 1990 level by the year 2050, and to 14.4 inches above the 1990 level by the year 2100 (TBEPC 2006). TBEP staff have raised a concern that, in sections of the bay with hardened shorelines that prevent the landward migration of existing seagrass beds, the amount of bay bottom with adequate light levels to support seagrass growth and survival may become compressed – and overall seagrass acreage in the bay may decline – as sea level increases (H. Greening, TBEP, personal communication).

2.3. Ranking issues among management areas

Based on their own experience, and information provided by the Southwest Florida Seagrass Working Group and others, EPC staff prepared a preliminary listing of seagrass management issues that are likely to prove important in the seven proposed management areas, which is shown in Table 3. The issues are ranked in order of anticipated importance (with a ranking of 1 indicating the highest importance).

Because sea level rise is such a recently-identified potential issue, it was not included in this ranking process. It will presumably be addressed by the TBEP in work that is expected to occur during 2007 updating the baywide seagrass restoration goals.

Table 3: Preliminary ranking of issues to be addressed in Hillsborough County seagrass management areas.

Management Area	Management Issue	Rank
(1) Northern Old Tampa Bay	Water quality	1
	Boating impacts (prop-scarring and anchoring/mooring)	2
	Cause of seagrass 'halos'	3
	Sediment quality	4
	Dredging impacts	5
(2) Eastern Old Tampa Bay	Water quality	1
	Boating impacts (prop-scarring and anchoring/mooring)	2
	Longshore bar loss/wave energy	3
	Dredging impacts	4
	Cause of seagrass 'halos'	5
	Sediment quality	6
(3) Interbay Pen./MacDill AFB	Longshore bar loss/wave energy	1
	Dredge holes as potential restoration sites	2
	Water quality	3
	Dredging impacts	4
	Boating impacts (prop-scarring and anchoring/mooring)	5
(4) W. Hillsborough Bay	Water quality	1
	Longshore bar loss/wave energy	2
	Bioturbation	3
	Cause of seagrass 'halos'	4
	Green mussel colonization	5
	Sediment quality	6
	Direct non-point source stormwater	6
	Dredging impacts	8

Table 3 (continued).

Management Area	Management Issue	Rank
(5) E. Hillsborough Bay	Longshore bar loss/wave energy	1
	Dredge holes as potential restoration sites	2
	Boating impacts (prop-scarring & anchoring/mooring)	3
	Water quality	4
	Bioturbation	5
	Dredging impacts	6
	Sediment quality	7
	Industrial contaminants	8
(6) E. Middle Tampa Bay	Longshore bar loss/wave energy	1
	Boating impacts (prop-scarring and anchoring/mooring)	2
	Water quality	3
	Bioturbation	4
	Manatee management	5
(7) Egmont Key	Boating impacts (prop-scarring and anchoring/mooring)	1
	Longshore bar loss/wave energy	2
	Bioturbation	3
	Historic bar protection/colonial nesting bird habitat protection	4

3. Prioritizing Management Areas

In order to develop a preliminary ranking of the proposed management areas – to serve as a guide in determining how staff time and funding resources should be applied to the different areas – the following table (Table 4) was constructed showing the "seagrass protection potential" (acres of seagrass currently present in each area) and "seagrass restoration potential" (acres of seagrass present in each area in the early 1950s, minus currently non-restorable dredged and filled areas).

Based on this simple ranking system, the Eastern Middle Tampa Bay management area (Area 6) is the highest priority for both protection and restoration efforts, and the Western Hillsborough Bay (Area 4) and Egmont Key (Area 8) areas are the lowest priorities. Intermediate priorities are placed on the remaining areas, with the Interbay Peninsula (Area 3) and Old Tampa Bay areas (Areas 1 and 2) being more highly ranked based on protection potential, and the Eastern Hillsborough Bay area (Area 5) being more highly ranked based on restoration potential.

Table 4: Proposed prioritization of management areas, based on "seagrass protection potential" (acres of seagrass currently present) and "seagrass restoration potential" (acres of seagrass present in the early 1950s, minus non-restorable dredged and filled areas).

Management Area Number	Management Area Name	Protection Potential (2006 Acres)
6	Eastern Middle Tampa Bay	2,399
3	Interbay Peninsula / MacDill AFB	1,527
1	Northern Old Tampa Bay	1,020
2	Eastern Old Tampa Bay	806
5	Eastern Hillsborough Bay	379
7	Egmont Key	103
4	Western Hillsborough Bay	3

Management Area Number	Management Area Name	Restoration Potential (1950 Acres)
6	Eastern Middle Tampa Bay	2,749
5	Eastern Hillsborough Bay	2,428
1	Northern Old Tampa Bay	1,384
2	Eastern Old Tampa Bay	977
3	Interbay Peninsula / MacDill AFB	641
4	Western Hillsborough Bay	46
7	Egmont Key	N/A (current acreage is greater than estimated 1950s levels)

4. Seagrass Management Actions

To maintain consistency with regional seagrass management efforts, the following proposed actions are based on plans developed by the Tampa Bay Estuary Program (TBEP 1996, 2006) to address seagrass-related issues. As noted earlier, the TBEP was established in 1991 to assist the Tampa Bay community in developing a Comprehensive Conservation and Management Plan (CCMP) for Tampa Bay. The CCMP includes a number of strategies and activities that are relevant to seagrass management, including:

- management of nitrogen loads entering the bay;
- protection and restoration of important bay habitats;
- protection and restoration of fish and wildlife populations;
- addressing dredging and dredged material management issues; and
- maintaining active public education and involvement programs.

These have served as the core of the proposed actions outlined below.

The management efforts proposed in the CCMP emphasize flexibility, allowing local government programs to focus their limited resources in the most cost-effective and environmentally beneficial manner. They seek to identify the bay's most pressing needs, and present strategies to achieve bay goals and maximize the community's long-term return on investment.

In terms of resource needs, all of the EPC actions proposed in this plan can be implemented by existing staff with resources that are anticipated to be available during fiscal years 2007 and 2008. In addition to the actions that EPC staff can address on its own, two proposed actions will require participation by outside agencies for implementation, which would require the expenditure of resources by those agencies. These proposed actions are:

- Action 3, Step 1 (establishing experimental Pole & Troll areas for seagrass protection in Little Cockroach Bay), which if implemented will require expenditure of additional resources by the Hillsborough County Department of Parks, Recreation and Conservation to provide signage designating the affected area; and
- Action 4 (encouraging greater on-water enforcement in Hillsborough County's coastal waters) which, if implemented by the County or by State law enforcement agencies, may require the commitment of additional resources by those organizations.

Following the format of the CCMP, each proposed action begins with an introduction to the issue followed by the proposed actions. Preliminary analyses suggest that the cost to meet certain water quality goals for Tampa Bay will be relatively minimal over the plan's lifetime. For example, local communities and industries are being asked to reduce future nitrogen loadings to the bay by about 17 tons per year (or about one-half percent of the existing annual load) below potential levels in order to maintain water quality and provide for continued seagrass recovery. The cost of achieving that goal

was estimated by the TBEP (1996) at an additional $2 to $4 million per year over current expenditures, or about $2 per bay area resident. If the next re-evaluation of seagrass acreage goals and water quality targets, which the TBEP expects to complete during 2007, causes the requested load reductions to be greater than these levels, the anticipated cost of achieving those reductions could potentially increase.

Action 1: Manage Nitrogen Loads

Action: Continue supporting the Tampa Bay nitrogen management strategy to facilitate recovery of seagrasses

STATUS: Ongoing.

BACKGROUND: Managing the amount of nitrogen that is discharged to the bay from its watershed and airshed has been a central initiative in the Tampa Bay region's seagrass management effort. As noted earlier, excess nutrient loadings stimulate undesirable levels of algal growth. In cases where nutrient loadings reach extreme levels – as occurred in Tampa Bay during the 1970s – algal blooms can reduce water clarity to the point that seagrass meadows no longer receive the levels of sunlight they require to survive and grow.

The current Tampa Bay nitrogen management goal, based on modeling studies carried out by TBEP and SWFWMD in the early 1990s, is to "hold the line" on nitrogen loadings, maintaining them at or below the average annual levels estimated to have occurred during 1992 – 1994. Models indicate that this will support the recovery of bay-wide seagrass coverage to the levels that are estimated to have occurred in the early 1950s (TBEP 1996). Achieving this goal will require implementation of projects that provide net reductions in annual nitrogen inputs of about 17 tons per year, or 84 tons each 5 years, to offset anticipated loading increases associated with population growth in the region.

As part of the TBEP-sponsored nitrogen management effort, Hillsborough County and other local governments in the Tampa Bay region have agreed to meet this nitrogen load reduction goal by implementing projects to reduce loadings from non-agricultural stormwater runoff and municipal point sources in their jurisdictions. The remaining load reductions are addressed by partners in the Nitrogen Management Consortium, whose members have pledged additional actions to meet the goal.

EPC provides support for the nitrogen management effort in several ways, which involve both regulatory and non-regulatory programs. These include:

- Permitting, compliance and enforcement programs carried out by the Water Management Division, addressing NPDES-related regulation of domestic and industrial point sources;
- A county-wide water quality monitoring program carried out by the Environmental Resources Management (ERM) Division, which has provided much of the data used by the TBEP to develop water quality and nitrogen-loading goals for Tampa Bay;
- Ongoing participation by EPC technical staff in the TBEP water quality and nitrogen loading goal development and assessment process;
- Recent initiation, in partnership with the TBEP and other local entities, of a program to develop Basin Management Action Plans (BMAPs) addressing

impaired waters, pollutant load reductions and TMDLs in the Hillsborough County portion of the Tampa Bay watershed.

This action calls for the continuation of these efforts, providing regulatory and technical support to the TBEP nitrogen management program.

STRATEGY:

Step 1. Continue implementing the permitting, compliance and enforcement programs carried out by the Water Management Division, addressing NPDES-related regulation of domestic and industrial point sources;

Responsible parties: EPC

Schedule: N/A (ongoing)

Step 2. Continue implementing the county-wide water quality monitoring program carried out by the Environmental Resources Management (ERM) Division

Responsible parties: EPC

Schedule: N/A (ongoing)

Step 3. Continue participating in the TBEP water quality and nitrogen management process, including the re-evaluation of water clarity, seagrass recovery and nitrogen reduction goals that are scheduled to occur during 2007.

Responsible parties: EPC, providing in-kind support to TBEP and its partner organizations

Schedule: N/A (ongoing)

Step 4. Continue working, in partnership with the TBEP and other local entities, to develop Basin Management Action Plans (BMAPs) addressing impaired waters, pollutant load reductions and TMDLs in the Hillsborough County portion of the Tampa Bay watershed.

Responsible parties: EPC, providing in-kind support to TBEP and its partner organizations

Schedule: Develop initial group of BMAP documents by July 2007

Action 2: Monitor Seagrass Condition and Species Composition

Action: Continue supporting annual transect-based monitoring of Tampa Bay seagrasses, and assist in additional monitoring of species composition if requested by the TBEP.

STATUS: Ongoing.

BACKGROUND: In 1998, a consortium of regional agencies initiated a seagrass monitoring program under the auspices of the TBEP. Nearly 60 transects are visited each fall in order to document changes within seagrass communities found in the major subsections of Tampa Bay. Transects generally start at the shoreline, extend seaward, and approach the seagrass restoration depths established by the TBEP for each bay segment. Seagrass coverage along each transect is estimated at specific intervals using the Braun-Blanquet rating criteria.

Data on species composition and zonation over the depth gradient provides information that can be used to assess changes in these seagrass attributes over time in each study area (Avery et al. 2002).

The interagency seagrass monitoring program has proven that multiple agencies with a common goal can effectively combine their resources to generate valuable scientific information that will assist in the protection and restoration of Tampa Bay seagrass meadows (Avery et al. 2002).

STRATEGY:

Continue to provide in-kind technical support – in the form of transect monitoring, geodatabase construction and management, and GIS mapping by EPC staff – to the baywide seagrass transect monitoring program. Assist in additional monitoring of species composition if requested by the TBEP.

Responsible parties: EPC, providing in-kind support to the other consortium members (City of Tampa Bay Study Group; Florida Fish & Wildlife Conservation Commission - Florida Marine Research Institute; Hillsborough County Cockroach Bay Aquatic Preserve; Manatee County Environmental Management; Pinellas County Department of Environmental Management; Tampa BayWatch, Inc.**)**

Schedule: N/A (ongoing)

Action 3: Address Propeller Scarring and Seagrass Restoration

Action: Reduce propeller scarring of seagrass, and pursue restoration of scars and other areas of seagrass loss where appropriate and cost-effective

STATUS: Ongoing.

BACKGROUND: In an effort to reduce propeller scarring rates in existing seagrass beds, several "Pole & Troll" areas – where boating access is allowed using push-poles and electric trolling motors but the active use of internal combustion engines is prohibited – have been established in selected shallow-water portions of Tampa Bay. The existing areas are located in Pinellas and Manatee counties (Fig. 20). In addition, for security reasons, a special "no-entry" area where all boating activity is prohibited has been established in the vicinity of MacDill Air Force Base in Hillsborough County (Fig. 20). Seasonal "no-entry" areas have also been established in the vicinity of power stations, including the TECO Big Bend and Progress Energy Corporation Bartow stations, whose warm-water discharges support dense aggregations of Florida manatees during winter.

In addition, the State of Florida has established a combination of year-round and seasonal slow speed zones in several portions of Tampa Bay to reduce boating-related injuries to manatees. These areas may also serve to reduce boating impacts to seagrasses, although that is not their primary intent. In Hillsborough County the largest of these zones is a shoreline area within the Hillsborough Bay and Eastern Middle Tampa Bay seagrass management areas (extending eleven miles, from the mouth of the Alafia River south to Bahia Beach) that requires boaters to operate at slow speeds in areas where the water is less than six feet deep (Fig. 21). In addition, a new shoreline slow speed zone was recently added that extends six miles from the mouth of the Little Manatee River south to the Manatee County line and includes the waters of Cockroach Bay and Little Cockroach Bay. These speed-restricted areas are shown in Fig. 21.

Despite these management efforts, Tampa Bay is estimated to trail only the Florida Keys in levels of seagrasses scarring (Sargent et al. 1995). Additionally, results of a three-year monitoring project coordinated by the TBEP-sponsored Manatee Awareness Coalition (MAC) as part of its Manatee Watch program indicate that educational programs have generally been less effective than regulatory efforts in improving boaters' operating practices in shallow-water seagrass beds. Further evaluation of techniques should include considering other seagrass protection measures, such as the "four point program" (education, channel marking, increased enforcement, and implementation of protective zones where internal combustion engine use is restricted) that was developed in the Florida Keys during the 1990s. The MAC also revised its educational efforts in 2005 to refine target audiences, and bring in additional partners to help deliver its "Bay Friendly Boating" message. Additional work is needed to refine boater education programs to more

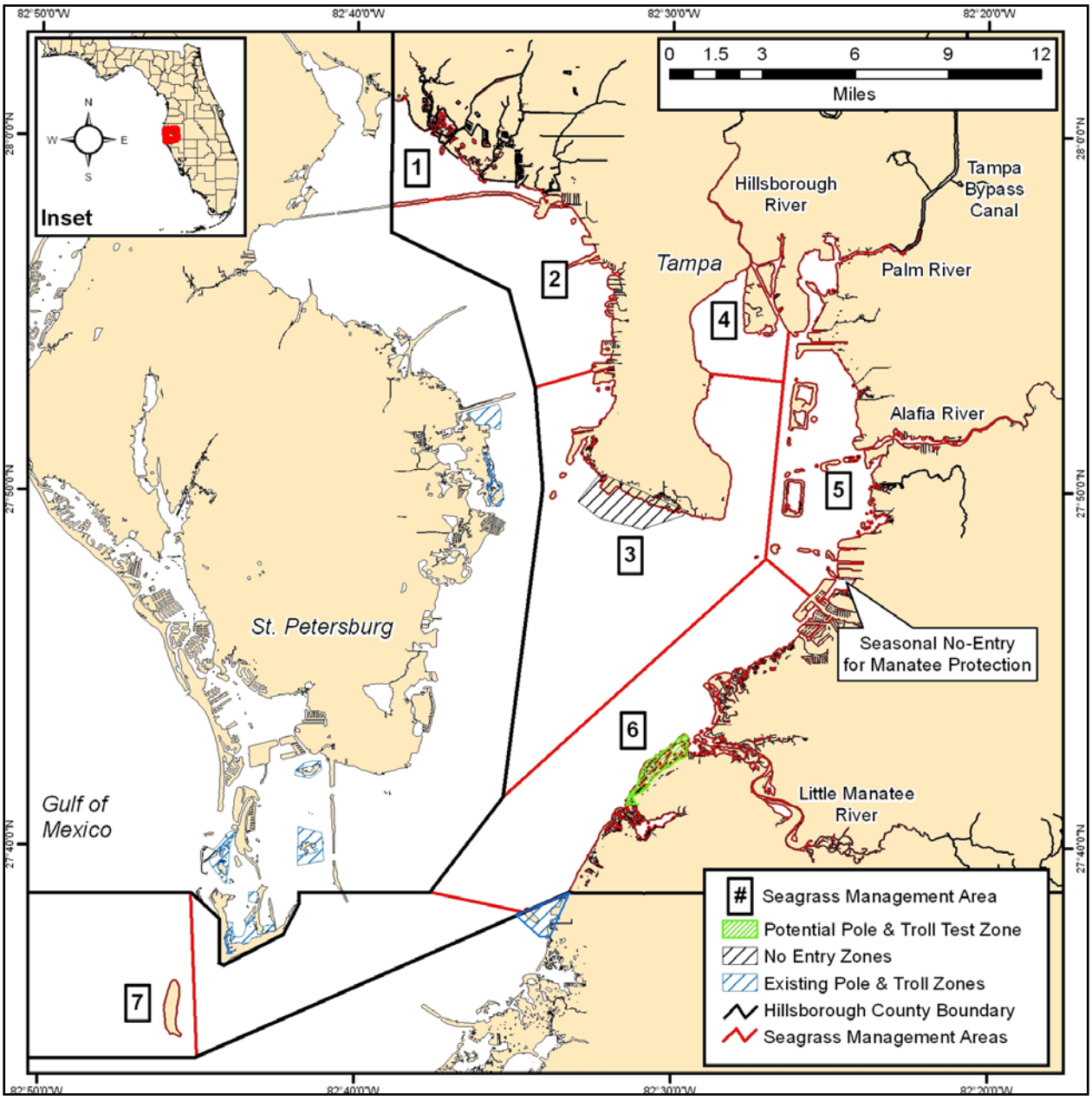

Figure 20: Existing regulated boating zones and potential Pole & Troll test zone. (Sources: PCDEM, MCEMD, EPCHC.)

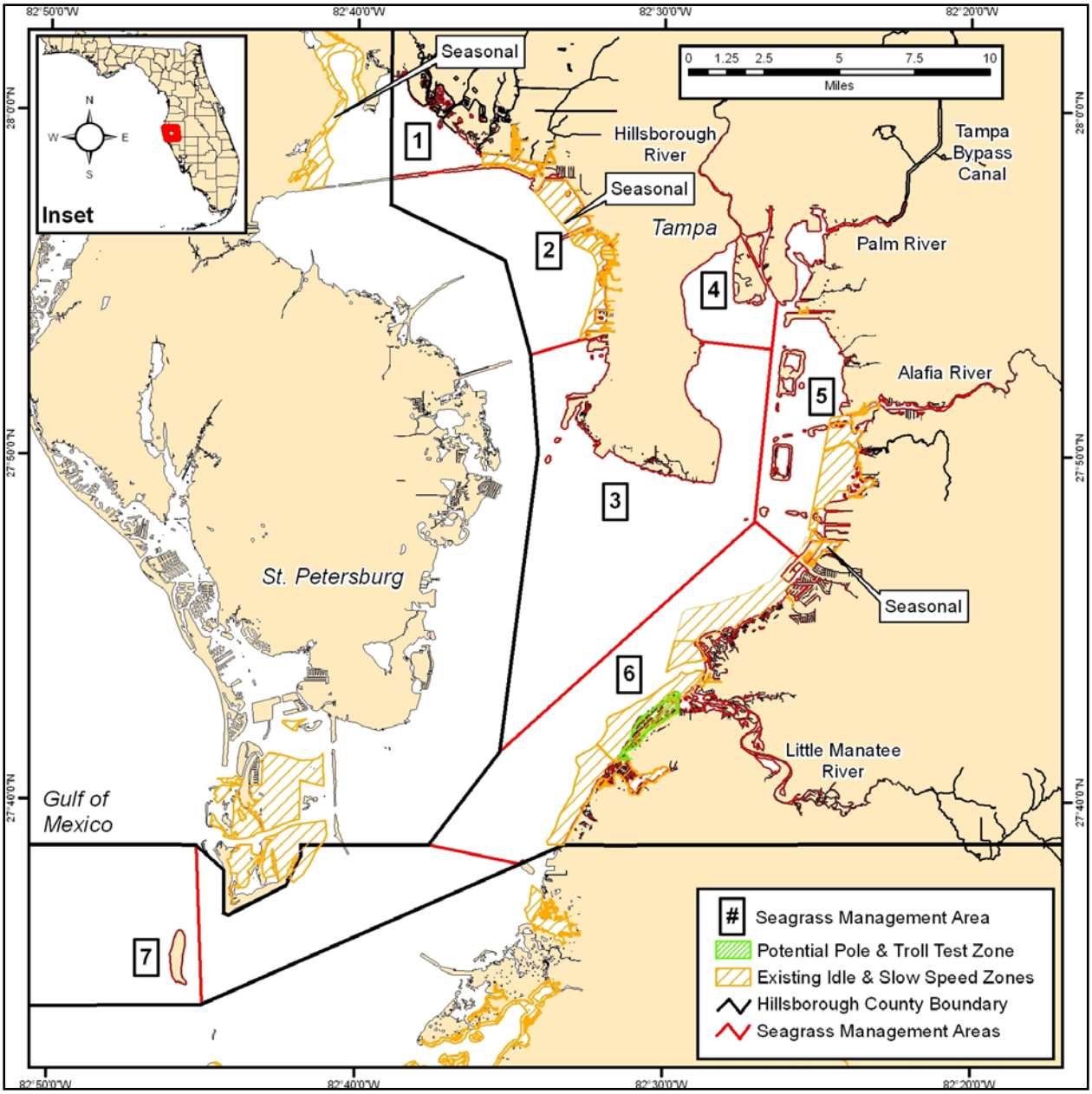

Figure 21: Existing regulated boating speed zones and potential Pole and Troll test zone. (Sources: PCDEM, MCEMD, EPCHC.)

successfully reach target audiences, and to assess the potential need for additional regulatory slow-speed zones, outboard use exclusion zones, or waterway markers to protect seagrasses.

A number of approaches have also been proposed to restore seagrasses in areas where propeller scars and other impacts have caused losses. These include seagrass transplanting, and assessing the effects of site-specific factors such as water quality, sediment quality, and bioturbation levels (by rays and other animals) on transplant success rates. Several methods of transplanting have recently been tried in Tampa Bay and elsewhere. However, the relative costs and long-term success rates of these techniques have not yet been thoroughly documented. When sufficient information on the costs and success rates of different restoration techniques becomes available, it should be possible to identify and implement the most cost-effective methods in appropriate locations.

STRATEGY:

Step 1. Assist the Florida Department of Environmental Protection and the Hillsborough County Parks, Recreation and Conservation Department in establishing one or more experimental "Pole & Troll" zones – where boating is allowed but the operation of outboard motors and other internal combustion engines is forbidden – within a heavily-scarred portion of the Cockroach Bay Aquatic Preserve. (A potential Pole & Troll zone, which includes Little Cockroach Bay and a small waterway that connects Little Cockroach Bay to the Cockroach Bay boat ramp, is shown in Figs. 20 and 21.) Maintain the Pole & Troll designation in the experimental zone(s) for a minimum of five years, and measure and document changes in seagrass scarring rates during that period.

Responsible parties: The Florida Department of Environmental Protection will be responsible for requesting Pole & Troll designation for one or more pilot areas within the Cockroach Bay Aquatic Preserve. The Hillsborough County Parks, Recreation and Conservation Department will be responsible for providing signage demarcating the designating areas. EPC staff will be responsible for designating the sites as Wetland Recovery Areas, pursuant to Chap. 1-11, Part II, Rules of the EPC, and for ensuring that the documentation, monitoring and evaluation requirements of the rule are met. EPC staff will also be responsible for estimating prop scar intensity levels at the beginning and end of the five-year trial period, and providing recommendations on the continuation or elimination of the Pole & Troll designation at the end of that period.

Schedule: To be initiated in FY07. Broad public input will be sought regarding the locations and sizes of the areas that will be designated as experimental Pole & Troll zones. EPC Board approval will be required in order for the proposed Pole & Troll zones to be designated as Wetland Recovery Areas. Federal and state approvals will be necessary to designate and erect signage indicating the locations of the Pole & Troll areas.

Step 2. Assist the TBEP in evaluating the effectiveness of the existing slow-speed manatee protection zones, and the possibility that additional slow speed and/or Pole & Troll zones (where boating is allowed but the use of internal combustion engines is prohibited) may be needed to provide adequate seagrass protection.

Responsible parties: EPC staff, the Seagrass Working Group and others will provide recommendations to TBEP; implementation by local governments as part of CCMP implementation

Schedule: Ongoing

Step 3. Continue to assist the TBEP and other education-oriented groups to update and refine educational materials (such as the Cockroach Bay Boater's Guide) to improve boater compliance with non-regulatory manatee protection efforts.

Responsible parties: EPC (ERM, Legal, and Public Outreach staff), providing in-kind support to TBEP and other education-oriented groups

Schedule: Ongoing

Step 4. Assist the TBEP in assessing the comparative success and viability of various seagrass restoration methods

Responsible parties: EPC, providing in-kind technical support to the Southwest Florida Seagrass Working Group in assessing experimental designs and restoration results, and providing recommendations to TBEP

Schedule: Ongoing

Step 5. Assist the TBEP in developing a coordinated program that combines seagrass restoration techniques, if proven successful, with slow speed and/or Pole & Troll zones in appropriate areas.

Responsible parties: EPC, providing in-kind technical support to the Seagrass Working Group to generate recommendations, and to TBEP and its other partners for implementation

Schedule: Implementation is anticipated to follow FWRI and Seagrass Working Group evaluation of transplanting methods and other seagrass restoration techniques

Action 4: Encourage Greater On-Water Enforcement of Environmental Laws and Rules in Hillsborough County Waters

ACTION: Encourage Hillsborough County and appropriate state agencies to increase on-water enforcement of environmental regulations on Bay waters located within the county

STATUS: To be initiated in FY07

BACKGROUND: Although some progress has been made in improving on-water enforcement of environmental rules in Tampa Bay over the past decade, these gains have been largely offset by increasing demands placed on enforcement agencies by homeland security directives, natural disaster response, and the ongoing increase in the number of boaters and anglers using bay waters.

At the state level, the recent merger of fresh and saltwater law enforcement agencies within the Florida Fish and Wildlife Conservation Commission (FWC), which occurred in 1999, has expanded the pool of officers trained to enforce both salt and freshwater regulations, and provided officials the flexibility to shift officers around to target "hot spots" or priority problems, such as illegal gill-netting or enforcement of manatee protection zones. However, there has not been an appreciable increase in the number of officers working in Tampa Bay. Currently, only 1-4 FWC officers are usually on duty at any given time in a four-county patrol area that extends from Pasco to Sarasota.

Also, because the formerly-separate "freshwater" and "saltwater" enforcement staffs have been merged within the FWC, officers often are diverted from on-water patrols in Tampa Bay to respond to land-based complaints (e.g., nuisance alligators, poaching). Additionally, recruitment and retention of officers in the FWC Law Enforcement Division is a growing problem, as experienced officers leave state employment to pursue better-paying positions elsewhere.

Local government marine units, such as that operated by the Hillsborough County Sheriff's Office, have the potential to provide a much-needed supplemental enforcement presence on the water. However, like their state and federal counterparts, they too have been increasingly tasked with homeland security-targeted patrols, such as enforcing safety zones in the shipping channels, or no-entry zones around port facilities and power plants.

From June 1, 2006 to August 31, 2006, the Sheriff's Marine Unit issued 13 warnings and 0 citations in the five Manatee Protection Areas (MPAs) in Hillsborough County. Because boaters are required to travel at slow speed in these zones, which extend out to the 6-foot contour, the manatee protection zones also provide some degree of protection for seagrasses. Twelve of the 13 warnings noted above were written in the Harbor Bay Protection Area, where a waterfront development is required (as part of a legal settlement) to pay for off-duty deputies to enforce this Manatee Protection Area.

By comparison, the Sheriff's Marine Unit issued 146 warnings and 16 citations for other violations in the same time frame – mostly homeland security infractions, violations of the safety zones for large commercial ships transiting the bay, or general reckless boating infractions.

Statewide, additional resources for law enforcement may be available in the next few years if the state enacts proposed legislation to remove the fishing license exemption for shore-based anglers. The elimination of this exemption could raise about $5 million more per year from license sales and from matching funds through the Federal Aid in Sportfish Restoration Act, which rebates excise taxes on fishing tackle. A portion of the additional revenues would be used to enhance FWC's law enforcement capabilities. A stakeholder survey by FWC staff showed that more than 76 percent of Floridians support this option.

Additionally, other regions of the state (specifically, Lee County and Northeast Florida) have established interagency law enforcement teams that have been successful in conducting targeted joint patrols as well as allocating limited manpower resources to maximize effectiveness. These could potentially serve as a model for an interagency collaboration effort in Hillsborough County.

Despite these positive developments, it appears that adequate marine enforcement in a water body as large and heavily-used as Tampa Bay will remain a challenge for the foreseeable future.

STRATEGY:

Step 1. Encourage Hillsborough County and/or other appropriate entities to fund, train, equip and deploy an adequate number of on-water law enforcement personnel to provide effective enforcement of slow-speed zones, pole and troll zones and other environmental regulations in seagrass management and manatee protection areas.

Responsible parties: EPC (ERM, Legal, Public Outreach, and Administrative staff)

Schedule: To be initiated in FY07

Step 2. Encourage Hillsborough County to support the formation of a Tampa Bay Interagency Marine Law Enforcement Task Force, and to actively participate in such a Task Force.

Responsible parties: EPC (ERM) staff, working with the county's Marine Law Enforcement Citizens Advisory Committee

Schedule: To be initiated in FY07

Action 5: Assess Effects of Wave Energy

Action: Continue to assist in the TBEP-coordinated evaluation of the potential effects of wave energy, whose impacts may be associated with storm events, ship wakes, and the loss of longshore bars, on seagrass recovery rates in several Hillsborough County seagrass management areas.

Status: Ongoing

Background: In recent years Tampa Bay has experienced substantial natural recovery of seagrasses due to improved water quality. Since 1982 estimated seagrass acreage has been increasing at an average rate of about 230 acres per year. If recovery continued steadily at this rate, the TBEP's baywide seagrass coverage goal of 38,000 acres would be met in about 50 years. A number of local researchers and managers are concerned, however, that water quality improvements alone may not be sufficient to meet the baywide acreage goal. Several have suggested that, in some portions of the bay, additional steps such as the restoration of long-shore sandbars – which formerly protected grass beds from wave action, creating a quiescent setting conducive to seagrass survival and growth – may also be necessary to ensure that the baywide acreage goal is met (e.g., Lewis 2002).

Seagrass meadows in eastern Middle Tampa Bay, for example, were historically buffered by a nearly continuous longshore bar system extending north from the mouth of the Little Manatee River for approximately seven kilometers (four miles). That bar system has disappeared in the last 40 years, and seagrasses along the deep edges of this shoreline have substantially retreated. Similar examples may exist in the Feather Sound area north of the Howard Frankland Bridge in Pinellas County (Lewis, 2002).

EPC staff analysis of recent and historical (1950s) aerial photography suggests that further examination of the effects of wave exposure may also be appropriate in the following areas, where bar-like features that were evident in the earlier photographs are less apparent in more recent images:

- Pendola Point to Archie Creek (management area 5)
- the Kitchen (management area 5)
- MacDill/Gadsden Point Area (management area 3)
- Bayshore Boulevard (management area 4).

In 2002, the Tampa Bay Estuary Program contracted with NOAA's Center for Coastal Fisheries and Habitat Research to employ a wave exposure model (Relative Exposure Index or REI model) to examine the potential influence of longshore bars on seagrass cover. Evaluation of historic wind data indicated that exceedance events (top 5% of wind events) and geomorphology make sites on the eastern side of the bay particularly vulnerable to storm events, while those on the western shore are more sheltered. The model also demonstrated the strong effects of the bars on REI, or wave exposure, reduction. The greater the water depth and the greater the REI, the lower the probability of seagrass cover (Fonseca et al, 2002). This work confirmed that the loss

of longshore bars, especially on the exposed eastern margin of the bay, has likely resulted in the loss of large areas of seagrass – although changes in wave intensity may not be solely responsible for these losses. The study strongly recommended that seagrass restoration in these areas be accompanied by wave-reducing techniques to maximize potential for seagrass regrowth.

The extent to which ship wakes contribute to increased wave energy and loss of near-shore bars was not considered in the NOAA model, but may be an important factor, particularly in areas exposed to repeated wakes from large vessels. A modification of the model to assess the duration and intensity of ship-generated wakes may help to assess the severity of this problem, and identify vulnerable seagrass beds. This is particularly important given the expected increase in large vessels, such as the Fantasy-class cruise ships, associated with the proposed expansion of navigation channels in Tampa Bay.

Through the Pollution Recovery Fund (PRF), as well as in-kind support by technical staff, EPC is assisting in these TBEP-sponsored assessments. In addition to EPC and TBEP, other participants in the effort include FDEP, the National Fish and Wildlife Federation, Tamp Bay Water, the City of Tampa, the U.S. Fish and Wildlife Service, the U.S. Geological Survey, the Tampa Port Authority, Mote Marine Lab, and Coastal Resources Group, Inc. Work on the project was initiated in early 2005, and is expected to result in construction of a demonstration longshore bar restoration project by 2008.

STRATEGY:

Step 1. Continue to assist TBEP and other partners in evaluating the effects of wave energy, longshore bar loss and ship wakes on seagrass survival and recovery rates in the seven Hillsborough County seagrass management areas.

Responsible parties: EPC (ERM), providing in-kind and funding support to TBEP and other partners.

Schedule: Ongoing

Action 6: Address Impacts of Dredging and Dredge Material Management

ACTION: Assist in implementing the TBEP's long-term dredging and dredged material management strategy for Tampa Bay in a way that minimizes impacts to water quality and seagrass resources

STATUS: Ongoing

BACKGROUND: The U.S. Army Corps of Engineers (Corps) completed the long-term dredge material management plan for Tampa Bay in July 2000. The report outlined dredging projections, spoil placement options, and capacity shortfalls, noting that existing dredge disposal sites may be full to capacity within five to ten years unless steps are taken soon to expand storage areas or find beneficial uses for the material.

The long-term plan will be updated to incorporate new projections for capacity, shortfall and timing based on reassessments and recent surveys of islands 2D and 3D in Hillsborough Bay, along with updates on beneficial use projects.

Dredging to maintain the bay's navigation channels – which are up to 43 feet deep in places – generates about a million cubic yards of material each year, enough to fill Raymond James Stadium 10 times. Sediment dredged from the upper portions of the bay, where most dredging occurs, has traditionally been piped onto two manmade islands in Hillsborough Bay but they are rapidly reaching capacity. An offshore dredged material site with unknown capacity receives sediment material from the lower bay.

Plans are being finalized now to double the height of the dikes on the Hillsborough Bay spoil islands to 40 feet using dredged material already stored inside the dikes. That will increase total capacity to about 30 million cubic yards each, extending the life of the dikes until at least 2030. Another option calls for raising the dikes again, this time to 50 feet, when additional capacity is needed.

Since 1999, the Corps has found beneficial uses for all material from federal dredging projects in the bay, reflecting a strong commitment to alternative options. Beneficial use projects – including stabilizing the shoreline at Egmont Key— helped redirect almost 2 million cubic yards of sediment. Another 200,000 cubic yards of sediment from maintenance dredging in the Alafia River was used to create a series of habitats at abandoned shell pits near Cockroach Bay. Unfortunately, however, the Alafia River material contained high levels of turbidity and nutrients which caused water quality impacts when discharged to Little Cockroach Bay (seagrass management area 6) during 2004.

One of the challenges in identifying beneficial uses is that the Corps is required to find "the least-cost environmentally acceptable" option, which limits alternatives. Another is that much of the material dredged from Tampa Bay comes from existing navigation channels or port areas, and is not of suitable quality for beach renourishment. The cost of transporting dredged material for beneficial uses can also be prohibitively high.

Finding non-federal partners to help support and fund beneficial use projects will be critical for these projects to materialize in the future. Minimizing the environmental impacts of the projects will also be an ongoing challenge.

One possible use for material from maintenance dredging may be in re-filling manmade holes that were dug in Tampa Bay decades ago, to provide fill material that was used to create residential finger canals. However, such projects should only be conducted in cases where filling or partially filling the holes will improve habitat value. During 2002-2005 TBEP, FWRI and EPC staffs, with assistance from local fishermen, spearheaded an effort to assess the habitat values provided by the existing dredged holes. That research project identified three holes where filling or partial filling might enhance water quality and habitat, while concluding that eight holes should be left as they are.

Another beneficial use the Corps is considering is re-creating longshore bars in areas where waves and currents may be restricting seagrass recovery. Habitat restoration projects such as the one at Cockroach Bay also are possibilities, potentially saving taxpayers money that would otherwise be spent on fill material, but must be done in ways that limit their impacts on water quality and seagrass resources in downstream waters.

Another idea being evaluated is the possible use of rocky dredged material to provide additional hard bottom habitat in Tampa Bay.

While discussions of dredged material often focus on new construction, material from maintenance dredging currently outpaces new work by a ratio of 3:1. Corps staff anticipate that maintenance dredging will generate about 30 million cubic yards of material through 2030, compared with about 11 million cubic yards in planned construction projects. Those estimates do not include projections for the expansion at Port Manatee, which has its own upland disposal site.

This ratio may change, however, when the Corps completes the Tampa Harbor and St. Petersburg Harbor re-evaluation studies that are currently underway. For instance, widening the main shipping channel to create a “passing zone” for ships near the turnoff to Port Manatee might generate from 1.5 to 2.8 million cubic yards of material. Along with the costs – estimated at $20 million – local scientists and resource managers will also need to assess the environmental impact of further widening the channel, including the impacts of ship wakes, and other projects being considered.

STRATEGY:

Step 1. Continue to assist the TBEP in completing annual updates to the long-term dredging and dredged material management plan, including new projections on capacity and shortfalls.

Responsible parties: EPC, providing technical input to TBEP and the Corps.

Schedule: Annual updates

Step 2. Continue to assist TBEP and the Corps in pursuing beneficial uses for dredged material to facilitate and accelerate bay habitat restoration and enhancement supporting the CCMP, identify cost-sharing sponsors, and encourage expedited permitting for beneficial uses, while minimizing impacts to water quality and seagrass resources.

Responsible parties: EPC, providing technical input to TBEP, FDEP, and the Corps

Schedule: Ongoing

Step 3. Continue to assist ABM, FDEP, TBEP and the Corps in identifying critical environmental issues and potential impacts associated with the Tampa and St. Petersburg Harbor Re-evaluation studies.

Responsible parties: EPC, providing technical support to ABM, FDEP, TBEP and the Corps

Schedule: Ongoing

Step 4. Assist ABM, FDEP, TBEP and the Corps in ensuring that environmental impacts are adequately addressed in the Tampa and St. Petersburg harbor re-evaluation studies.

Responsible parties: EPC, providing technical support to ABM, FDEP, TBEP and the Corps

Schedule: Ongoing

Action 7: Continue Tracking Seagrass Status and Trends, and Evaluating Priority Management Issues

Action: Continue assisting TBEP, SWFWMD and other partners in the tracking and reporting changes in seagrass coverage and condition on a biennial basis. Continue evaluating, updating and prioritizing management issues within each of the seven management areas, based on observed changes in seagrass coverage and condition in those areas.

STATUS: Ongoing.

BACKGROUND: The adaptive management process that is being used to address seagrass-related issues in Tampa Bay requires an ongoing monitoring element to track changes in seagrass coverage and condition. If the monitoring data show continuing progress toward achieving the Bay's coverage goals, and if seagrass condition remains adequate in each area to support other habitat-related goals, managers can adopt a "stay-the-course" approach while implementing their strategies and projects. If the data show lack of progress, or if seagrass coverage or condition show deteriorating trends in one or more of the management areas, managers are required to re-evaluate and adjust their actions in those areas to correct the shortcomings.

STRATEGY:

Step 1. Continue providing in-kind technical support to the TBEP-sponsored biennial reviews of bay-wide seagrass coverage, based on digitized aerial imagery provided by SWFWMD. Continue participating on the Seagrass Working Group, which evaluates seagrass condition trends and other issues affecting seagrass resources on an as-needed basis. Continue providing GIS and technical support to local scientists in determining extent, trends, and condition of seagrass resources in Hillsborough County waters.

Responsible Parties: EPC staff (ERM Division), assisting TBEP, SWFWMD, the Seagrass Working Group and other partners in the management effort.

Schedule: Ongoing

Step 2. Using the information provided in Step 1, evaluate priority management issues affecting seagrass coverage and condition in each of the seven management areas on a biennial basis. Re-prioritize issues and management activities as required based on these evaluations.

Responsible Parties: EPC staff (ERM Division), with technical input from TBEP and the Seagrass Working Group

Schedule: Ongoing

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