

PALM BEACH COUNTY MANATEE PROTECTION PLAN

**Prepared for:
Palm Beach County
Department of Environmental Resources Management**

**Prepared by:
Catanese Center for Urban and Environmental Solutions
at Florida Atlantic University**

Ecological Associates, Inc.

July 2007

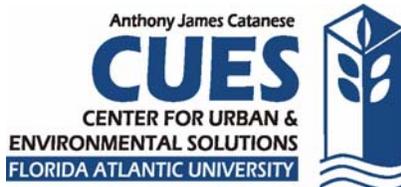


TABLE OF CONTENTS

List of Figures.....	5
List of Tables	9
List of Abbreviations	10
List of Appendices.....	11
List of Definitions.....	12
Executive Summary	19
I. INTRODUCTION.....	27
A. General Setting.....	27
B. Federal, State, and Local Protection Measures.....	29
1. Federal Protection Measures	29
2. Florida’s Manatee Protection Planning Process	30
3. Protecting Manatees in Palm Beach County	32
C. Palm Beach County Demographics	35
D. Palm Beach County Waterways	36
E. Zoning and Land Use.....	42
1. Comprehensive Plan Policies	43
2. Zoning	45
3. Government Coordination	46
a. Overview of Federal and State Permitting Process	46
b. Local Government Approvals	47
II. MANATEES IN PALM BEACH COUNTY.....	47
A. Introduction.....	47
B. The Florida Manatee.....	48
C. Abundance and Distribution.....	52
1. Aerial Distributional Surveys	52
2. Synoptic Surveys.....	56

Palm Beach County Manatee Protection Plan

3. Telemetry Studies.....	59
a. Sirenia Project Methods and Summary Findings.....	59
b. Observations in Palm Beach County	60
4. Synopsis of Abundance and Distribution Data	64
5. Manatees in Lake Okeechobee	65
D. Manatee Mortality	67
1. Introduction.....	67
2. Palm Beach County Mortality	68
a. Overview	68
b. Watercraft-Related Mortality	73
III. HABITAT PROTECTION	78
A. Introduction.....	78
B. Warm Water Refugia.....	78
C. Submerged Aquatic Vegetation	84
D. Freshwater Sources.....	87
E. Resting and Calving Areas	92
F. Water Quality and Quantity.....	93
G. Sanctuaries and Refuges	101
H. Habitat Protection within Lake Okeechobee	102
IV. BOATING ACTIVITY IN PALM BEACH COUNTY	104
A. Existing Boat Facilities	104
1. Port of Palm Beach	107
2. Commercial Marinas	117
3. Public Marinas	110
4. Private Boating Facilities	110
5. Boat Ramps.....	111
6. Existing Mooring Areas.....	111
7. Watersports Areas	111

Palm Beach County Manatee Protection Plan

B. Boating Use	112
C. Speed Zones	113
D. Enforcement	115
V. MANATEE EDUCATION AND AWARENESS PROGRAMS	120
A. Introduction.....	120
B. Existing Educational Programs	120
1. Statewide.....	120
2. Countywide.....	123
a. School District of Palm Beach County	123
b. Other Environmental Education Sources	124
3. Manatee Signage	126
VI. BOAT FACILITY SITING PLAN	131
A. Introduction	131
B. Boat Facility Siting Criteria	132
C. Evaluation Method.....	135
D. Results of the Screening Process.....	159
E. Siting Policy	166
F. Mitigation	174
VII. RECOMMENDATIONS FOR PLAN IMPLEMENTATION	174
REVIEWED LITERATURE.....	182
APPENDICES	191

LIST OF FIGURES

Figure 1: Palm Beach County Municipalities28

Figure 2: Palm Beach County Population Projections.....35

Figure 3: Palm Beach County Referenced Water Bodies38

Figure 4: Typical Aerial Distributional Survey Flight Path, 1990-1993.....E

Figure 5: Aerial Distribution Survey, 1990-1993E

**Figure 6: Average Number of Manatees Observed per Aerial Flight in Palm Beach
County54**

**Figure 7: Relative Seasonal Abundance of Manatees in Palm Beach County’s
Waterway Segments.....55**

**Figure 8a: Aerial Distributional Survey, 1990-1993 by Season,
including Counts, Palm Beach North.....E**

**Figure 8b: Aerial Distributional Survey, 1990-1993 by Season,
including Counts, Lake Worth NorthE**

**Figure 8c: Aerial Distributional Survey, 1990-1993 by Season,
including Counts, Lake Worth CentralE**

**Figure 8d: Aerial Distributional Survey, 1990-1993 by Season,
including Counts, Lake Worth SouthE**

**Figure 8e: Aerial Distributional Survey, 1990-1993 by Season,
including Counts, Palm Beach South.....E**

**Figure 9a: Synoptic Survey Count January-March, 1991-2003,
Palm Beach North.....E**

**Figure 9b: Synoptic Survey Count January-March, 1991-2003,
Lake Worth NorthE**

**Figure 9c: Synoptic Survey Count January-March, 1991-2003,
Lake Worth CentralE**

**Figure 9d: Synoptic Survey Count January-March, 1991-2003,
Lake Worth South.....E**

Palm Beach County Manatee Protection Plan

Figure 9e: Synoptic Survey Count January-March, 1991-2003, Palm Beach South	E
Figure 10: C-Cow Telemetry	E
Figure 11: Palm Beach County Telemetry	E
Figure 12: Palm Beach County Telemetry, Selected Animals	E
Figure 13: Palm Beach County Cumulative Manatee Abundance	E
Figure 14: Total Manatee Mortality among the 13 “Key” Counties.....	70
Figure 15: Mortality in Palm Beach County, 1974-2003.....	71
Figure 16: Manatee Mortality, All Causes of Death, 1976-2003, Countywide.....	E
Figure 17a: Manatee Mortality, All Causes of Death, 1976-2003, Palm Beach North	E
Figure 17b: Manatee Mortality, All Causes of Death, 1976-2003, Lake Worth North	E
Figure 17c: Manatee Mortality, All Causes of Death, 1976-2003, Lake Worth Central	E
Figure 17d: Manatee Mortality, All Causes of Death, 1976-2003, Lake Worth South.....	E
Figure 17e: Manatee Mortality, All Causes of Death, 1976-2003, Palm Beach South	E
Figure 17f: Manatee Mortality, All Causes of Death, 1976-2003, Palm Beach West.....	E
Figure 18: Human-related Manatee Mortality among the 13 “Key” Counties	74
Figure 19a: Watercraft Related Deaths, Before and After Speed Zones were Enacted, Palm Beach North	E
Figure 19b: Watercraft Related Deaths, Before and After Speed Zones were Enacted, Lake Worth North	E

Palm Beach County Manatee Protection Plan

Figure 19c: Watercraft Related Deaths, Before and After Speed Zones were Enacted, Lake Worth Central	E
Figure 19d: Watercraft Related Deaths, Before and After Speed Zones were Enacted, Lake Worth South.....	E
Figure 19e: Watercraft Related Deaths, Before and After Speed Zones were Enacted, Palm Beach South	E
Figure 20: Number of Manatees Sighted at Power Plants in Florida, 1977-2003.....	82
Figure 21: Palm Beach County Seagrass	E
Figure 22a: Seagrass Feeding, Palm Beach North.....	E
Figure 22b: Seagrass Feeding, Lake Worth North.....	E
Figure 22c: Seagrass Feeding, Lake Worth Central.....	E
Figure 22d: Seagrass Feeding, Lake Worth South	E
Figure 22e: Seagrass Feeding, Palm Beach South	E
Figure 23: Palm Beach County Fresh Water Sources.....	E
Figure 24: Palm Beach County Marine Facilities and Ramps 2004	E
Figure 25a: Marine Facilities and Boat Ramps 2004, Palm Beach North	E
Figure 25b: Marine Facilities and Boat Ramps 2004, Lake Worth North	E
Figure 25c: Marine Facilities and Boat Ramps 2004, Lake Worth Central	E
Figure 25d: Marine Facilities and Boat Ramps 2004, Lake Worth South.....	E
Figure 25e: Marine Facilities and Boat Ramps 2004, Palm Beach South	E
Figure 26: Proportion of the Total Number of Slips Within Each Facility Type	105
Figure 27: Marine Facilities Spreadsheet 2004	E

Palm Beach County Manatee Protection Plan

Figure 28: Boat Ramps Spreadsheet 2004	E
Figure 29: Aerial Distributional Survey	139
Figure 30: Synoptic Survey	140
Figure 31: Sirenia Project Telemetry.....	141
Figure 32: Cumulative Manatee Abundance	142
Figure 33: Distance to Ocean Inlets	144
Figure 34: Distance to Boating Destinations	145
Figure 35: Proximity to All Boating Destinations.....	146
Figure 36: Post Speed Zone Watercraft Mortality	148
Figure 37: Manatee Feeding Observations.....	150
Figure 38: Density of Submerged Aquatic Vegetation (SAV)	151
Figure 39: Manatee Feeding Habitat	152
Figure 40: Existing Slip Density	154
Figure 41: Waterway Width	155
Figure 42: Boat Speed Zones	157
Figure 43: Palm Beach County BFSP Suitability Map	160
Figure 44a: Palm Beach County BFSP Map, Palm Beach North.....	161
Figure 44b: Palm Beach County BFSP Map, Lake Worth North.....	162
Figure 44c: Palm Beach County BFSP Map, Lake Worth Central	163
Figure 44d: Palm Beach County BFSP Map, Lake Worth South.....	164
Figure 44e: Palm Beach County BFSP Map, Palm Beach South	165

LIST OF TABLES

Table 1: Dock Permitting Authority in 25 Waterfront Municipalities, Palm Beach County, Florida	34
Table 2: Population Growth in South Florida, 2000-2004	36
Table 3: Population of Top Five Counties in Florida, 2004	36
Table 4: Number of Manatees Sighted During Synoptic Surveys, 1991-2003	58
Table 5: Summary of Mortality in Palm Beach County, 1974-2003	72
Table 6: Monthly Breakdown of Manatee Mortality by Type, 1974-2003	75
Table 7: Palm Beach County Vessel Registrations, 1995-2004.....	77
Table 8: Manatee Sightings During Winter Months in Palm Beach County, 1977-2003	81
Table 9: Surface Waters in Palm Beach County Identified by FDEP as Impaired.....	97
Table 10: Surface Waters in Palm Beach County Identified by FDEP for Delisting.....	97
Table 11: Total Number of Slips at Multi-slip Facilities by Jurisdiction	106
Table 12: Distribution of Marine Enforcement and Speed Zone Regulation	118
Table 13: Survey Rankings of Manatee Abundance Data Sets	137
Table 14: Synopsis of Boat Facility Siting Model Methodology	158
Table 15: Summary of Boat Facility Siting Policy	171

LIST OF ABBREVIATIONS

BFSP	Boat Facility Siting Plan
ERM	Environmental Resource Management
FAC	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FIND	Florida Inland Navigation District
FMRP	Florida Manatee Recovery Plan
FMSA	Florida Manatee Sanctuary Act
FS	Florida Statutes
FWC	Florida Fish and Wildlife Conservation Commission
FWRI	Florida Fish and Wildlife Research Institute
FWS	U.S. Fish and Wildlife Service
ICW	Atlantic Intracoastal Waterway
ISMS	Imperiled Species Management Section (formally FWC’s Bureau of Protected Species Management)
LWLMP	Lake Worth Lagoon Management Plan
MFL	Minimum Flows and Levels
MLW	Mean Low Water
MPF	Manatee Protection Fund
MPP	Manatee Protection Plan
MMPA	Marine Mammal Protection Act
MSA	Metropolitan Statistical Area
PBC	Palm Beach County
PLRG	Pollutant Load Reduction Goals
RPP	Riviera Power Plant
SFWMD	South Florida Water Management District

Palm Beach County Manatee Protection Plan

SFWQPP	South Florida Water Quality Protection Program
SMC	Save the Manatee Club
STMTF	Save the Manatee Trust Fund
SWIM	Surface Water Improvement and Management Plan
USGS	U.S. Geological Survey

LIST OF APPENDICES

A. Attachment K: Manatee Protection Plan Guidelines and FWC Boat Facility Siting Guide	192
B. Manatee Protection Speed Zones (Section 68c-22.009(1), FAC)	199
C. Boating Safety Speed Zones (Section 68d-24.017, FAC)	205
D. Palm Beach County Single-Family Residential Dock Survey	208
E. Figures.....	209

LIST OF DEFINITIONS

Aggregation Site - an area where manatees may be found either seasonally or year-round in large numbers. These sites may include areas that are not traditional warm water sites (natural spring or artificial warm water discharge) such as areas and canals that serve as thermal basins or freshwater attractants. (Source: FWC)

Anchorage - in-water vessel storage either by anchor or fixed mooring device without an associated dock or boat slip. (Source: Sarasota MPP 2003)

Boat - a vehicle designed for operation as a watercraft propelled by sails or one or more electric or internal combustion engine(s). A boat, or vessel, may refer to any size vessel including a personal watercraft to freighters or cruise ships. A boat shall not be considered a recreational vehicle even though it has facilities for temporary living quarters. For purposes of this plan, the word “boat” does not include human-powered vessels, such as canoes or kayaks. (Source: Sarasota MPP)

Boat Facility Siting Category – categories based on location which identify specific densities for slip development (new and expansions of existing). Ratios refer to the number of slips per linear feet of shoreline owned by the applicant. Calculated slip numbers apply to facilities in addition the number of existing slips and represent a project at final build out (a one time allotment representing the maximum density allowed at a particular location). Slip densities are allowable as long as impacts to habitat (i.e., seagrass) have been addressed.

Boating or Marine Facility, or Marina - a public or private structure or operation where boats are moored and/or launched (wet or dry slips), including commercial, recreational, private, governmental, residential marinas, managed anchorages and boat ramps. For the purposes of this plan, facilities with five (5) or more slips are considered boating facilities. (Source: FWC)

Boat Ramp - a structural, man-made or altered natural feature that facilitates the launching and landing of boats into a water body. (Source: FWC)

Palm Beach County Manatee Protection Plan

Boat Yard - a facility used solely for boat repair and/or boat building. (Source: FWC)

Class III Waters - those surface waters of the State of Florida that have been classified according to the following designated uses: recreation, propagation, and maintenance of a healthy well-balanced population of fish and wildlife. (Source: Chapter 62-302.400(1), Florida Administrative Code (FAC))

Coastal Waters - for the purposes of this plan - are that portion of Palm Beach County's tidally influenced waterways, which have direct access to oceanic waters. (Source: FWC)

Commercial Marina - a boat facility constructed and used for the purpose of sale, lease, or rent of boat dockage (dry storage or wet slips) for profit. This type of marina may be owned by private or governmental entities. (Source: FWC)

Conditional – a boat facility siting category that represents relatively moderate manatee use, recommending that moderate increased slip development occur due to its importance to manatees. Facilities located in these areas are allowed up to six slips for every 100 feet of shoreline owned (6:100).

Critical Habitat - any federally designated areas which, pursuant to the Endangered Species Act of 1973, have been determined to include physical and/or biological features that are essential to the conservation of a species (such as the manatee), which may require special management considerations or protection. Under the Florida Manatee Sanctuary Act, the entire State of Florida is designated as “a refuge and sanctuary for the manatee” [Ch. 370.12(2)(a), FS]. (Source: Endangered Species Act, sec. 3(5)(a)(i)(1) and (2), Endangered Species Act, sec. 3(5)(a)(i)(1)(ii) and 50 CFR ch. 1 §17.94)

Dock - A fixed or floating structure, including access walkways, terminal platforms, catwalks, mooring pilings, lifts, davits and other associated water-dependent structures, used for mooring and accessing vessels. (Source: Ch. 18-21.003(16), FAC)

Dry Storage Facility - an upland structure, parking lot, or space used specifically for storing watercraft. A dry storage facility is considered a boat facility if the dry storage facility has the capability of

Palm Beach County Manatee Protection Plan

launching vessels into adjacent waters or water access is provided adjacent to the project. Facilities such as long-term boat storage lots, boat yards, or boat dealership lots that do not have adjacent water access will not be considered boat facilities.

Existing Boat/Marine Facility (or slips) - a boat facility that is permitted and/or authorized, or legally in operation within 10 years of the effective date of this plan.. Facilities permitted but not yet constructed are also considered existing. This definition does not include unauthorized structures.

(Source: FWC)

Exclusionary - a boat facility siting category where no new boating facilities are allowed. Exceptions include the allowance of transitory slips within the basin proposed for the FIND property which is surrounded by the JDNA, and canoe or kayak launches for existing conservation lands that are purchased or managed by Palm Beach County and are designated for passive recreational use by a management plan or conservation easement.

Idle Speed Zone - a speed regulated area in which vessels create no wake and are not permitted to proceed at a speed greater than that necessary to maintain steerageway of the vessel. (Source: Chapter 68C-22.002(2), FAC)

Linear Shoreline - the mean high water line in tidally influenced areas and the ordinary high water line along waterways that are not tidally influenced. Shoreline created after the effective date of this plan shall not be used in the calculation for slip densities. Artificially created shorelines created before the effective date of this plan must have received the proper permitting authorization required at that time. Shoreline along man-made ditches (such as mosquito control, flood control ditches, etc.) shall not qualify as linear shoreline, regardless of their date of construction unless there is documentation of regular navigational use. Linear shoreline shall be calculated (with a precision of at least to the hundredths of feet) using survey quality aerial photographs or by accurate field survey. The calculation of linear shoreline is based upon contiguous shoreline that is owned or legally controlled by the applicant. (Source: FWC)

Palm Beach County Manatee Protection Plan

Long Term Boat Storage Facilities – facilities that only provide storage for vessels that will be stored for long periods of time (at least six months). Boats are typically stored in these facilities seasonally, and are not used during the storage period. The vessels are typically “winterized” and are typically moved to other facilities when brought out of storage to be used. (Source: FWC)

Managed Mooring Field – an anchorage or mooring field that has a state-approved management plan and is associated with a specific marina or park that provides sufficient upland facilities to serve the boaters in the mooring field. (Source: FWC)

Manatee Critical Habitat - all of Lake Worth, from its northernmost point immediately south of the intersection of U.S. Highway 1 and Florida State Highway A1A southward to its southernmost point immediately north of the town of Boynton Beach, Palm Beach County; the Loxahatchee River and its headwaters, Martin and West Palm Beach Counties; that section of the Intracoastal Waterway from the town of Seawalls Point, Martin County to Jupiter Inlet, Palm Beach County. (Source: 50 CFR ch. 1, §17.95)

Mooring - any location where a vessel in the water is secured. It can be at anchor in an anchorage, tied off to a buoy in a “mooring field,” or tied off to a pier, dock, piling, or other physical structure or on a davit or boatlift. (Source: Ecological Associates, Inc.)

Non-Preferred - a boat facility siting category that represents relatively high manatee use, recommending that low increased slip development occur due to its importance to manatees. Facilities located in these areas are allowed up to one slip for every 100 feet of shoreline owned (1:100).

Permanent Use - commercial, residential or private boat facilities that include wet or dry slips, moorings or spaces for the storage of vessels. (Source: FWC)

Personal Watercraft - a vessel less than 16 feet in length which uses an inboard motor powering a water jet pump as its primary source of motive power and which is designed to be operated by a person sitting, standing, or kneeling on the vessel, rather than in the conventional manner of sitting or standing

Palm Beach County Manatee Protection Plan

inside the vessel. (Source: Florida Boat Operator's Course)

Pier - a fixed or floating structure used primarily for fishing or swimming and not designed or used for mooring or accessing vessels. (Source: Ch. 18-21.003(39), FAC)

Powerboat - a vehicle designed for operation as a watercraft propelled primarily by motor, (one or more electric or internal combustion engine(s)). Vessels that have two main propulsion systems (power and sail) shall be defined as powerboats. (Source: FWC)

Preempted Area - the area of sovereignty submerged lands from which any traditional public uses have been or will be excluded by an activity, such as the area occupied by docks, piers, and other structures; the area between a dock and the shoreline where access is not allowed, between docks, or areas where mooring routinely occurs that are no longer reasonably accessible to the general public; permanent mooring areas not associated with docks; and swimming areas enclosed by nets, buoys, or similar marking systems. (Source: Ch. 18-21.003(39), FAC)

Preferred - a boat facility siting category that represents relatively low manatee use, recommending that high increased slip development occur due to its relatively lower importance to manatees. Facilities located in these areas are allowed up to ten slips for every 100 feet of shoreline owned (10:100).

Public Boat Facility or Marina - a facility where 90 percent of slips are designated for rental to the general public and must be available on a "first come, first served" basis. A public boat facility may have wet and/or dry slips. (Source: FWC)

Public Boat Ramp - a facility owned or operated by a governmental entity designated for use to the general public.

Refuge - manatee protection areas in which the U.S. Fish and Wildlife Service has determined that certain waterborne activities would result in the taking of one or more manatees, or that certain waterborne activities must be restricted to prevent the taking of one or more manatees, including but not limited to taking by harassment. A refuge is less restrictive than a sanctuary. (Source: 50 CFR 17.102)

Palm Beach County Manatee Protection Plan

Private Residential Multi-family Dock or Pier¹ - a dock or pier on a common riparian parcel or area that is intended to be used for private recreational or leisure purposes by persons or groups of persons with real property interest in a multi-family residential dwelling such as a duplex, a condominium, or attached single-family residences or a residential development such as a residential or mobile home subdivision. (Source: Ch. 18-21.003(42), FAC)

Private Residential Single-family Dock or Pier - a dock or pier used for private recreational or leisure purposes that is located on a single-family riparian parcel or that is shared by two adjacent single-family riparian owners if located on their common riparian property rights line. (Source: Ch. 18-21.003(43), FAC)

Riparian Rights - those rights incident to lands bordering upon navigable waters, as recognized by the courts and common law. (Source: Ch. 18-21.003(53), FAC)

Sanctuary - a manatee protection area in which the U.S. Fish and Wildlife Service has determined that any waterborne activity would result in the taking of one or more manatees, including but not limited to taking by harassment. Federal sanctuaries are areas reserved exclusively for manatees, where they may conduct activities such as breeding, nursing, and resting, free from any harassment by humans. (Source: 50 CFR 17.102.) The Florida Manatee Sanctuary Act [Ch. 370.12(2)(a), FS] designates the entire State of Florida as “a refuge and sanctuary for the manatee.”

Slip - a space designed for the mooring or storage of a single watercraft, which includes wet or dry slips, anchorage, mooring buoy, beached or blocked, hoist, floating platforms, davits, boat lifts, or a parking space for a boat ramp. Piers authorized only for fishing or observation are not considered wet slips. (Source: FWC)

Slow Speed Zone - an area where vessels may not be operated at greater than Slow Speed, i.e., the speed at which a vessel proceeds when it is fully off plane, completely settled into the water, and not creating an excessive wake or other hazardous condition. (Source: Chapter 68C-22.002(7),(8), FAC)

Palm Beach County Manatee Protection Plan

Sovereignty Submerged Lands - those lands including but not limited to, tidal lands, islands, sand bars, shallow banks, and lands waterward of the ordinary or mean high water line, beneath navigable fresh water or beneath tidally influenced waters, to which the State of Florida acquired title on March 3, 1845, by virtue of statehood, and which have not been heretofore conveyed or alienated. (Source: Ch. 18-21.003(56), FAC)

Submerged Aquatic Vegetation (SAV) - vascular, flowering plants that, except for some flowering structures, live and grow below the water surface. (Source: Atlantic States Marine Fisheries Commission)

Transitory Slip – docks, slips, and other shoreline structures used for the temporary mooring of vessels (less than one day, but may include overnight or multiple-day use if camping), including docks at non-fee public facilities (e.g., city boat ramps, public parks, etc.), facilities used for water-dependent public transportation (e.g., water taxis), designated day-use slips at restaurants and hotels, and staging docks, piers, seawalls and/or slips required for the operation of dry storage facilities or boat ramps. Transitory slips cannot be used for the permanent storage of vessels. Slips used for boat rentals or slips rented to patrons are not considered transitory.

Travel Corridor - a waterway through which manatees travel, either daily or seasonally, in order to reach feeding areas and sources of fresh or warm water.

Unrestricted - a boat facility siting category that represents relatively lower manatee use, recommending that the highest increased slip development occur due to its relatively lower importance to manatees or adequate offsetting measures are in place to protect manatees. The numbers of slips located in these areas are unrestricted by the MPP if all other permit requirements are met.

Warm Water Refuge - a natural or man-made warm water habitat, which maintains a temperature equal to or greater than the minimum for manatees' survival (approximately 20° C or 68° F). (Source: Broward County 1997 Comprehensive Plan)

*Available online at <http://fac.dos.state.fl.us/faconline/chapter18.pdf>.

Palm Beach County Manatee Protection Plan

EXECUTIVE SUMMARY

A Manatee Protection Plan (MPP) is a State-approved planning document of manatee data, strategies, and management actions aimed at protecting manatees from watercraft and other human-related impacts in a specific region or county. In October 1989, the Florida Governor and Cabinet directed 13 “key” manatee counties, including Palm Beach, to prepare a MPP. This document presents background information, an inventory of existing conditions, and recommended strategies for reducing impacts to manatees in Palm Beach County. The plan must be approved by the Florida Fish and Wildlife Conservation Commission with the concurrence of the US Fish and Wildlife Service. The statutory deadline for plan approval is July 1, 2006 (Ch. 370.12(2)(t)2, FS).

The objective of the Palm Beach County MPP is to improve overall protection for manatees while considering the need for adequate boater access to County waterways. Its primary goal is to establish guidelines and policies that direct new (or expanded) boating facilities to areas posing the least risk to manatees and away from areas of relatively high risk. Other goals include protecting manatee habitat, promoting boating safety, and increasing public awareness of the need to protect manatees and their habitat. The Palm Beach County MPP relies heavily on education and enforcement as a means of protecting manatees within the County and mitigating for the effects of new boat slips.

One of the most critical and controversial components of the MPP is the Boat Facility Siting Plan (BFSP). The BFSP provides five categories defining Unrestricted, Preferred, Conditional, Non-preferred, and Exclusionary locations for new boat facilities with five or more slips. Facilities within each category will be required to meet certain criteria to minimize impacts to manatees. Restrictions will be greatest in areas of highest risk to manatees (Non-preferred and Exclusionary locations) and least in areas of lowest risk (Unrestricted and Preferred locations). The MPP does not affect single-family docks with fewer than five slips or existing multi-slip facilities unless they are expanding.

Adoption of a MPP by the County or local municipalities is intended to increase the predictability of permitting outcomes for new boating facilities while streamlining the regulatory process. While the MPP will only apply to those unincorporated areas of the County when the County is authorizing a project, the MPP will apply countywide when implemented by the State and Federal governments. In the

Palm Beach County Manatee Protection Plan

absence of such a plan, State and Federal permitting agencies can only approve new permit applications through a comprehensive case-by-case review, which is time consuming and costly. Prior to approval of this plan, the Corps of Engineers was only approving permits for facilities that have no more than 1 slip for every 100 feet of shoreline. This, along with Federal staffing issues, is causing a bottleneck in the development of new or expanded boat facilities in the County.

Existing data on manatees in Palm Beach County was used to develop this MPP. These data included aerial surveys (biweekly counts of year-round manatee distribution, 1990-1993), synoptic surveys (cold-spell abundance counts, 1991-2003), telemetry data (tracking of tagged manatees by the US Geological Survey, 1986-1998), and the State's manatee mortality database (1976-2003). While it is desirable to have current data on manatee and boater use patterns, the review agencies agreed to use of the older data to avoid further delay of MPP completion and implementation.

The Florida subspecies of the West Indian Manatee (*Trichechus manatus latirostris*) is listed as federally endangered throughout its range and is afforded State protection by the Florida Manatee Sanctuary Act of 1978. In Palm Beach County, manatees are found in all freshwater, estuarine, and marine waterbodies that are physically accessible to them, although their relative abundance may vary appreciably among specific locales and seasons. The only freshwater areas where manatees are reported are in western Palm Beach County in Lake Okeechobee and associated canals (L-8 North Tie Back and the North New River Canal).

Aerial survey and telemetry tracking studies demonstrate that manatees are much more abundant in the County during the winter season (December through March) in comparison to the warm season (April through November). Population increases during the winter are primarily the result of emigration of manatees from central and north Florida. Geographic areas of particularly high abundance include the northern portion of Lake Worth Lagoon, Jupiter Sound, and Lake Wyman within Boca Raton. High abundance in these areas is likely due to the availability of foraging habitat (primarily seagrass), warm-water refugia, or both. The presence of Florida Power and Light's Riviera Power Plant within the north Lake Worth Lagoon, which provides a warm-water refuge, heavily influences the distribution of manatees in the winter.

Palm Beach County Manatee Protection Plan

Protection of manatee habitat is an integral component of the manatee protection process. Manatees generally have five categories of habitat requirements: 1) feeding areas; 2) warm-water refugia for shelter during periods of cold winter weather; 3) fresh water sources; 4) quiet sheltered areas for resting, mating, and calving; and 5) travel and migratory corridors to connect the above habitat elements. Manatees are also affected both directly and indirectly by the quality of the water in which they live. There are a number of local, State, and Federal programs currently in place, under development, or in the planning stages intended to improve foraging habitat and water quality within Palm Beach County. In particular, Palm Beach County has restored mangrove and seagrass habitat at a number of locations and manages the Lake Worth Lagoon Partnership Grant program, which funds stormwater retrofit and sewage conversion projects.

Manatees are subjected to a variety of threats, both natural and human-related. In Florida, there has been a clear increase in the number of manatee deaths over the last quarter-century. Palm Beach County ranks 10th among the 13 key counties, accounting for approximately 3.7 percent of the total State mortality from all causes between 1974 and 2003. The largest single cause (39%) of documented mortality in the County results from collisions with watercraft. Palm Beach County ranks 6th among the 13 key counties in the number of documented watercraft-related mortalities. Manatees are most likely to be struck by boats in areas where there is an overlap between high levels of manatee abundance and boat traffic. Watercraft-related mortalities were highest in the north Lake Worth Lagoon, Jupiter Sound, and the section of Intracoastal Waterway between Delray Beach and Boca Raton. Not surprisingly, 55 percent of all watercraft-related mortalities occurred during January and February, a period of peak manatee abundance. Although watercraft-related mortality has increased within the County since the posting of regulatory speed zones in 1991, the percent of watercraft-related mortality compared to total mortality has remained relatively stable.

One of the key recommendations of the plan is to provide increased funding for improving public education and enforcement of existing speed zones. Manatee protection speed zones are created by the Florida Fish and Wildlife Conservation Commission (FWC) to restrict the speed and operation of vessels where necessary to protect manatees from harassment and potential collision with vessels. In addition to manatee protection speed zones, the FWC has also created boater safety speed zones, which address situations that are hazardous to boaters but have an additional environmental benefit by reducing

Palm Beach County Manatee Protection Plan

the risk of manatee/boat interaction. Studies conducted by the FWC have demonstrated that the single most important factor leading to compliance with speed zones is law enforcement presence on the waterways. In Palm Beach County, 14 local, State, and Federal law enforcement entities assign personnel to enforce speed zone regulations. Only 10 of the 23 municipalities bordering the County's coastal waterways have marine law enforcement units and, of those, the majority of the units spend less than 40 hours a week on the water and less than 50 percent of that time on speed zone enforcement. Enforcement personnel have indicated that compliance with speed zones should be enhanced through an increase in the number of patrol units on the water, licensing of vessel operators, increasing public awareness of speed zone regulations, and other initiatives. The draft MPP proposes potential mechanisms for funding these activities.

The MPP attempts to balance preservation and enhancement of boater access to the waterway with impacts to manatees from boats. The MPP recognizes that boating and boating-related industries are an important facet of our coastal community. The marine industry contributes nearly \$2 billion annually to the economy of Palm Beach County, with more than 800 marine-related businesses generating in excess of 18,200 jobs and \$682 million in personal income.

Data from a number of sources was used to develop a comprehensive inventory of multi-slip boating facilities within the County. This inventory included public and commercial marinas, multi-family complexes (e.g., condos), public and private boat ramps, and other marine-related facilities with five or more slips. A total of 182 marinas were identified that generate boat trips in County waters potentially inhabited by manatees, with a total capacity of 9,059 dry and wet slips combined. Most slips are contained within either commercial marinas or private multi-family developments located primarily within the northern portions of the County. The County has relatively few public municipal marinas and only one industrial facility, the Port of Palm Beach. In addition, the County has 19 boat ramps with approximately 805 boat trailer parking spaces with access to manatee habitat. Boat slips are concentrated within the northern portion of the County. There are also 6,590 docks containing an estimated 8,772 slips located at single-family residences.

A Boat Facility Siting Plan is a primary component of this MPP. The Boat Facility Siting Plan is intended to direct new boat facility siting and/or expansion of existing facilities in areas where the risk

Palm Beach County Manatee Protection Plan

of boat and manatee interaction is relatively low and discourage marina siting in areas of relatively high risk.

A Geographic Information System (GIS)-based methodology adapted from the Department of Community Affairs was used to analyze manatee and boating data and develop a series of maps that were used in developing the boat facility siting plan. The primary factors, or criteria, that contribute to boat and manatee interaction within the coastal waterways of the County were developed. The seven criteria used in the analysis, were:

- Manatee abundance
- Manatee feeding habitat
- Proximity to primary boating destinations
- Watercraft-related manatee mortality
- Existing boat slip densities
- Waterway width
- Presence of speed zones

Using these seven criteria, the coastal waterways of Palm Beach County were partitioned into five major categories: 1) Unrestricted, 2) Preferred, 3) Conditional, 4) Non-preferred and 5) Exclusionary.

Shoreline segments designated as **“Unrestricted”** represent areas where the risk of boat/manatee interaction is relatively low and they are adjacent to speed regulated inlets and have adequate offsetting measures such as slow or idle speed zones (shore to shore). Unrestricted areas within the County include but are not limited to:

- Ocean inlets
- Riviera Beach CRA and Phil Foster Park
- Lake Okeechobee

Shoreline segments designated as **“Preferred”** represent areas where the risk of boat/manatee

Palm Beach County Manatee Protection Plan

interaction is relatively low. Based upon the criteria incorporated into the siting analysis, Preferred areas are considered appropriate for all types of boating facilities and mainly include:

- Portion near Jupiter Inlet
- Portion of Lake Worth Creek near PGA Boulevard
- North Lake Worth Lagoon
- A central portion of Lake Worth Lagoon
- Portion near Lantana

“Conditional” shoreline segments include those areas where there is a moderate risk of boat/manatee interaction. This designation is considered appropriate for moderate development of future boating facilities, provided criteria can be met to minimize impacts to manatees and their habitat. Conditional areas within the County include but are not limited to:

- Portions of the Loxahatchee River
- Portions of Lake Worth Creek
- Portions of Lake Worth Lagoon
- Portions of Atlantic Intracoastal Waterway

The **“Non-preferred”** classification includes those areas where the potential interaction between boaters and manatees is greatest, and therefore boat facility development is discouraged. Non-preferred areas include but are not limited to:

- Jupiter Sound, the C-18 Canal and portions of the Loxahatchee River
- Portions of northern Lake Worth Lagoon and south of the FPL Riviera Power Plant
- Earman River and portions of North Palm Beach
- Portions of southern Lake Worth Lagoon,
- Portions of the Atlantic Intracoastal Waterway in the south part of the County
- Lake Wyman

Palm Beach County Manatee Protection Plan

“Exclusionary” areas include the one “motorboat prohibited” zone in the County as well as existing conservation lands owned or managed by Palm Beach County that are designated for passive recreational use only within a management plan or conservation easement. include but are not limited to:

- Warm water discharge at FPL Riviera Power Plant
- Jupiter Inlet Natural Area
- Jupiter Ridge Natural Area
- Juno Dunes Natural Area (not including the FIND outparcel)
- Limestone Creek Natural Area

Municipalities that adopt the MPP will have the option of adding Exclusionary or Non-Preferred areas based upon upland zoning and land use.

The Boat Facility Siting Plan establishes maximum slip densities for each of the different siting categories. Impacts to manatees associated with new slips will be offset by a program to fund improved public education, increased enforcement of speed zones and environmental restoration. Funding for this program is proposed through a combination of a Manatee Protection Fund (MPF) and municipal, County, and State cost-sharing. The Board of County Commissioners has committed \$1,000,000 per year in ad valorem funding for the MPF. The Manatee Protection Fund will be used for:

- Manatee public awareness and educational programs
- Law enforcement personnel, equipment, and supplies
- Procurement/installation of improved manatee speed zone signage
- Updates to manatee data, boat activity, and boater compliance studies
- Environmental restoration projects that will benefit and improve manatee habitat
- Other measures deemed likely to reduce risks to manatees from boating activities in Palm Beach County

Palm Beach County Manatee Protection Plan

Finally, recommendations are made that address plan implementation, establishment of the Manatee Protection Fund, improved education and awareness, increased law enforcement and plan revision through adaptive management. Ultimately, the plan will be adopted by reference in the Coastal Management Element of the Comprehensive Land Use Plan.

Palm Beach County Manatee Protection Plan

I. INTRODUCTION

The main goal of the Palm Beach County Manatee Protection Plan (MPP) is to protect manatees and manatee habitat. The main objectives of the MPP are to implement management strategies and policies that will protect manatees and manatee habitat, promote and increase public awareness of manatees and manatee habitat, promote safe boating, and allow reasonable recreational and commercial use in the coastal zone in a manner consistent with the protection of manatees and manatee habitat.

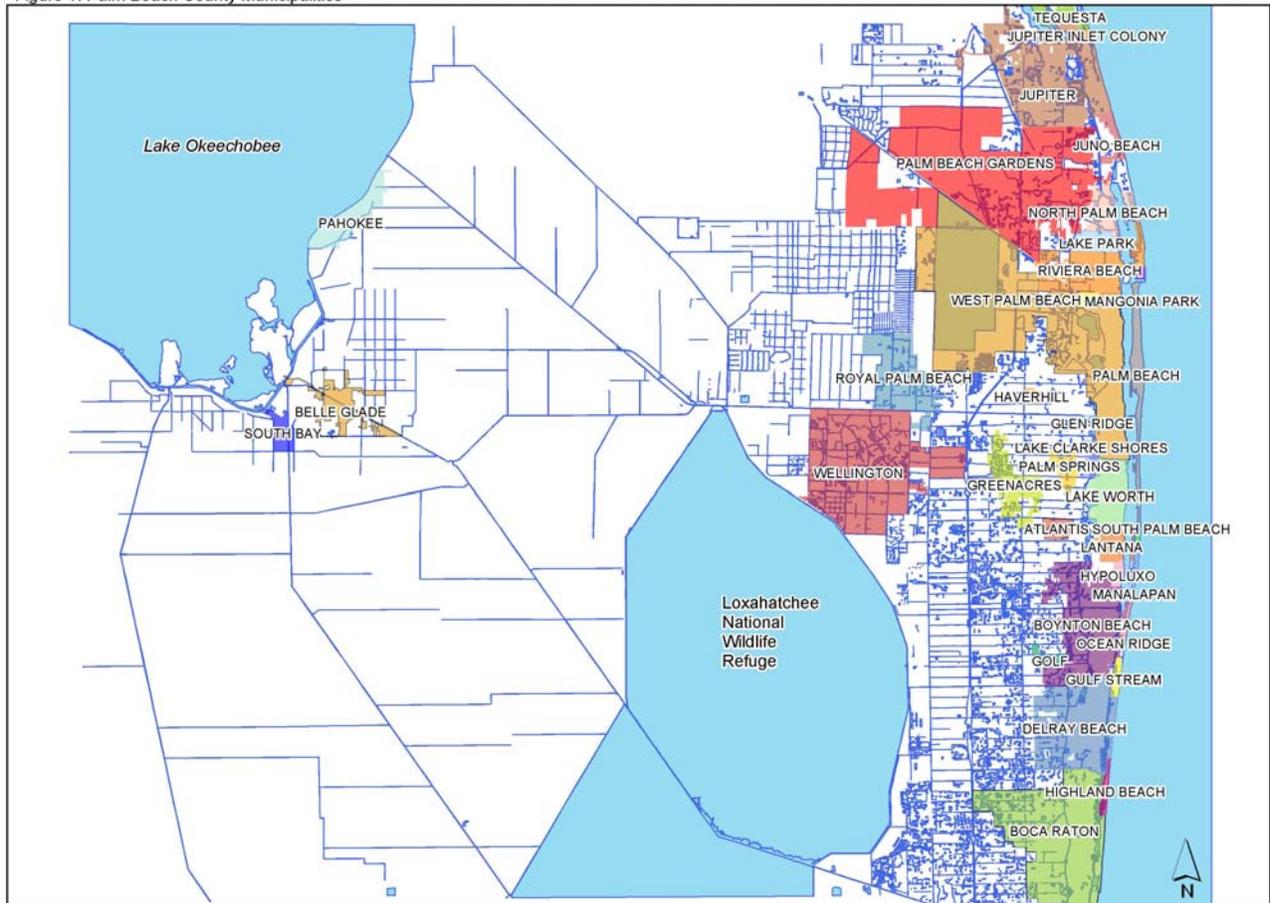
A. General Setting

Located in South Florida's Gold Coast region, Palm Beach County (PBC) lies between the Atlantic Ocean to the east, Broward County to the south, Hendry County to the west, and Martin County to the north. It is the largest of the 67 counties in the State of Florida with a nearly square geometric shape, having an east-to-west width of 53 linear miles and north-to-south length of 45 linear miles. The County's total area is 2,386.5 square miles, of which 1,974.2 square miles is land and the remaining 412.3 square miles is water. Primary water bodies include the southeastern quadrant of Lake Okeechobee, the Arthur R. Marshall Loxahatchee National Wildlife Refuge and the estuarine waters of the Loxahatchee River / Lake Worth Creek Aquatic Preserve in the northern portion of the County and the roughly 20-mile-long Lake Worth Lagoon, bounded by 23 of the County's municipalities (**Figure 1**). Palm Beach County's east coast shoreline along the Atlantic Ocean includes four inlets that connect the Atlantic Intracoastal Waterway (ICW) to the ocean. The eastern part of the County is a thriving urban area while the western portion of the County is more rural with wetlands covering the southwestern part and agriculture dominating the northwestern end.

A major boating industry exists in Florida, an industry that generates revenue nearly twice that of the Florida citrus industry, contributing \$14 billion annually to the State's economy. In Palm Beach County, for example, there are approximately 110 acres of marinas and boatyards located with a combined appraised value of \$48 million (Marine Industries Association of Palm Beach 2005). However, there is a conflict of uses between growing human-related pressures and increasingly limited coastal resources. As the population increases, it is reasonable to assume there will be an increase in boat traffic.

Palm Beach County Manatee Protection Plan

Figure 1: Palm Beach County Municipalities



Data Source: Palm Beach County (www.co.palm-beach.fl.us)
Map created January 2005 by CUES (www.cuesfau.org)

0 3 6 12 Miles

This document presents the background information and an inventory of existing conditions needed for the Palm Beach County Manatee Protection Plan. An MPP is a State-approved planning document of manatee data, strategies, and management actions aimed at protecting manatees in a specific area or county, including the 13 “key” counties described below. It is important for the long-range planning needed to ensure the survival of the manatee in the rapidly growing State of Florida. There are four parts to the plan, including the Boat Facility Siting Plan (BFSP), Education, Habitat Protection and Enforcement. The BFSP provides countywide policies for the future construction, development, or expansion of boat facilities. Such a plan specifies Preferred locations for boating-related facility development based upon an evaluation of potential natural resource impacts, manatee protection needs, zoning, and future land use compatibility. While the BFSP focuses on facility development, the Education and Enforcement sections focus on community sources of information on manatee protection as well as countywide enforcement of waterway rules and regulations.

Palm Beach County Manatee Protection Plan

B. Federal, State, and Local Protection Mechanisms

1. Federal Protection Measures

The Florida subspecies of manatee, *Trichechus manatus latirostris*, was listed as endangered throughout its range in 1967 (32 FR 4061). Federal laws include the Marine Mammal Protection Act (MMPA) of 1972, as amended (16 USC 1461 *et seq.*), and the Endangered Species Act (ESA) of 1973. Critical habitat for the Florida subspecies was designated in 1976 [50 CFR Part 17, Subpart J]. As noted in the U.S. Fish and Wildlife Service (FWS) *Florida Manatee Recovery Plan (FMRP)*, “This was one of the first ESA designations of critical habitat for an endangered species and the first for an endangered marine mammal” (FWS 2001).

The FWS first developed a conservation plan in 1980 because the manatee population was considered “depleted” under the MMPA. Moreover, the ESA authorized the preparation and implementation of a recovery plan for this listed species, together with the potential for downlisting and ultimately delisting the manatee, should the Secretary of the Interior determine that manatees are no longer endangered or threatened according to factors originally leading to its being listed [ESA, §4(a)(1)]. Since then, revisions to the *FMRP* have been based on information gathered about the species, together with the implementation of major protection programs.

The Third Revision of the *FMRP*, completed in October 2001, expresses two goals: 1) “assure the long-term viability of the Florida manatee in the wild, ... and 2) ensure a healthy, self-sustaining population of manatees in Florida by reducing or removing threats to the species’ existence” (*FMRP* 2001). Action recommendations in the Recovery Plan include the need to:

1. Minimize causes of manatee disturbance, harassment, injury, and mortality.
2. Determine and monitor the status of the manatee population.
3. Protect, identify, evaluate, and monitor manatee habitats.
4. Facilitate manatee recovery through public awareness and education (*FMRP*, 2001).

Section 7 of the Endangered Species Act directs Federal agencies to ensure that any action authorized, funded or carried out by them is not likely to jeopardize the continued existence of listed species or modify their critical habitat. Through consultation with the FWS before initiating projects that may

Palm Beach County Manatee Protection Plan

affect such animals as manatees, agencies review their actions to determine whether they could adversely affect listed species or habitat. Such consultation may be either “informal” or “formal.” Informal consultation evaluates proposed projects to determine if formal consultation is needed or if project modifications could be made to reduce adverse impacts to the listed species. If an agency finds an action “may adversely affect” a listed species or designated critical habitat, formal consultation is necessary and results in a biological opinion outlining FWS’ assessment of the proposed activity and its likely impact on the listed species. In Palm Beach County, this designated critical habitat includes:

all of Lake Worth, from its northernmost point immediately south of the intersection of U.S. Highway 1 and Florida State Highway A1A southward to its southernmost point immediately north of the town of Boynton Beach, Palm Beach County; the Loxahatchee River and its headwaters, Martin and West Palm Beach Counties; that section of the intracoastal waterway from the town of Seawalls Point, Martin County to Jupiter Inlet, Palm Beach County (50 CFR Ch. 1, §17.95.)

An agency may proceed with the action as proposed, provided no incidental take is anticipated. If incidental take is anticipated, the applicant must comply with the reasonable and prudent measures and implementing terms and conditions established by the permitting agency. (“Take” means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or to attempt to engage in any such conduct. “Incidental take” without authorization is unlawful.) At present, the FWS cannot allow the incidental take of manatees under current laws and regulations.

2. Florida’s Manatee Protection Planning Process

Following Spanish settlement of Florida and continuing throughout the 1800s, commercial and subsistence hunting are believed to have greatly reduced the manatee population. This led the State of Florida to pass legislation in 1893 prohibiting the killing of the marine mammal, and in 1975 the manatee was officially declared the State Marine Mammal (Ch. 15.038, FS). Currently, the Florida Fish and Wildlife Conservation Commission (FWC) has authority for the protection of manatees under the Florida Manatee Sanctuary Act (FMSA) of 1978 (Ch. 37.12(2), FS), which designates the entire State of Florida as “a refuge and sanctuary for the manatee” [Ch. 370.12(2)(a), FS]. The Act also provides that

Palm Beach County Manatee Protection Plan

“The protections extended to ... the manatee by this act are independent of, and therefore not contingent upon, its status as a State or Federal listed species” [Ch. 370.12(2)(b), FS].

FWC issued a call to action to protect the manatee and improve waterway safety for the boating public, incorporating increased law-enforcement presence to help minimize manatee/watercraft collisions. The Florida Department of Natural Resources [DNR merged with the Florida Department of Environmental Regulation to become the Florida Department of Environmental Protection (FDEP)] made recommendations for providing the desired protection and improvements. As a result, in October of 1989, the Florida Governor and Cabinet, in conjunction with the *FMRP*, directed 13 key manatee counties – Brevard, Broward, Citrus, Collier, Duval, Indian River, Lee, Martin, Miami-Dade, Palm Beach, St. Lucie, Sarasota, and Volusia – to prepare MPPs.

As of July 1, 1999, the Florida Game and Fresh Water Fish Commission was merged with those sections of FDEP involving any marine-related activities (including the Bureau of Protected Species Management, now the Imperiled Species Management Section (ISMS)), forming FWC. FWC has the authority to review and approve MPPs developed by individual counties. The State has also coordinated with the FWS to receive comments on some MPPs. As part of the overall statewide manatee protection strategy, the Florida Fish and Wildlife Research Institute (FWRI), a division of FWC formerly known as the Florida Marine Research Institute, has been collecting, processing, and analyzing manatee data for many years and was the source of much of the information used to prepare this plan. The main goals of the Palm Beach County MPP are to reduce the threats to manatees and manatee habitat by implementing management strategies and policies that will protect manatees and manatee habitat, promote public awareness, promote boating safety, and allow reasonable recreational and commercial use in the coastal zone.

Specifically, a Manatee Protection Plan is to include the following components: 1) a BFSP, which inventories existing boat facilities and natural resources; 2) an evaluation of boat use and traffic patterns; 3) criteria on which proposed sites will be evaluated; 4) lists and maps of locations of potential marina facilities; 5) dock densities; 6) policies for the expansion of existing boat facilities; 7) boating speed zones; 8) provisions to protect water quality and submerged aquatic vegetation; and 9) a local education and awareness element, as well as enforcement (FWC 2000; DCA 2003).

Palm Beach County Manatee Protection Plan

Manatee Protection Plans are a regulatory tool for evaluating permits for new boating facilities in counties where the risk of boat/manatee interactions is relatively high. The BFSP identifies appropriate locations for new facilities and establishes allowable slip densities for different segments of local waterways, thus providing developers with greater predictability of permitting outcomes.

3. Protecting Manatees in Palm Beach County

The Florida Manatee Sanctuary Act identified manatee sanctuary areas in Palm Beach County to include the discharges of the Florida Power & Light (FPL) Riviera Power Plant (RPP) and connecting waters within one-and-one-half miles thereof [see Ch. 370.12(2)(g)(5), FS]. As noted above, Palm Beach County is one of the key counties required to develop a countywide MPP. Plan development must take into consideration the County's 23 municipalities with jurisdictions bordering the coastal waterways. To assist Palm Beach County, FDEP entered into a contract in 1994 with the University of Miami Boating Research Center to conduct a boating activity study (see below Section IV. B., Boating Use).

The FDEP also contracted with the Treasure Coast Regional Planning Council (TCRPC) in 1996 to prepare a draft BFSP for the County. However, the 1996 Draft BFSP was not adopted because Palm Beach County and other agencies were concerned that land use compatibility and seagrass impacts were not adequately addressed. The 1998 Palm Beach County Comprehensive Land Use Plan stated that adoption of a countywide BFSP would be encouraged but was not required.

In a related matter, during revision to the Coastal Element of the Palm Beach County Comprehensive Land Use Plan in 1998, a policy was added (1.1-o) requiring analysis of the impacts of personal watercraft on manatees and seagrasses. The results of that study concluded that enforcement of existing regulations should reduce avoidable environmental impacts to a level no greater than those associated with other types of watercraft. This led staff to conclude that enforcement of existing regulations for personal watercraft should be increased and evaluated before the County considers additional regulation of its own. Changes to the Land Use Comprehensive Plan were not justified by this study.

This MPP is organized to present a discussion of manatees and an analysis of manatee abundance in Palm Beach County. This is followed by an evaluation of manatee habitat and habitat protection

Palm Beach County Manatee Protection Plan

policies, boating activity patterns, education and enforcement activities, and the identification of existing boat facilities. Next, the criteria, methods, and results of a screening process are presented to identify areas of the coastal waterway designated as low, medium, and high risk to manatees. Finally, recommendations are presented to be used to help permit facilities. These planning efforts were designed to reduce the risk of boat-related manatee impacts, promote boating safety, protect manatee habitat, and increase public awareness of the need to protect manatees and their environment while trying to preserve boater access to the water.

The Palm Beach County Board of County Commissioners has the authority to protect the County’s environment by prohibiting or regulating air and water pollution and the destruction of natural resources. Certainly, the construction of new or expansion of existing boating facilities has the potential to impact water quality and natural resources. However, Palm Beach County has land use permitting authority only in unincorporated areas of the County. With regard to permitting of new boating facilities in incorporated areas, the municipalities (see **Table 1**) make those decisions along with State and Federal permitting authorities.

Table 1 – Dock Permitting Authority in 25 Waterfront Municipalities, Palm Beach County, Florida

Municipality	Yes	No	Comments
City of Belle Glade		X	Must go through Army Corps of Engineers.
City of Boca Raton		X	
City of Boynton Beach	X		Must receive approval from outside agency, then can issue dock permit.
City of Delray Beach	X		All work for docks, ramps, mooring buoys in conjunction with a structure, require permits from the city. No authority over dredging.
City of Lake Worth			[Unable to verify as of 6-13-06.]
City of Pahokee		X	Must go through Army Corps of Engineers.
City of Palm Beach Gardens	X		Authority to install or replace docking, mooring facilities for private or commercial water craft, groins, sea walls, jetties, revetments or similar structures and facilities related thereto.
City of Riviera Beach		X	
City of West Palm Beach	X		Must receive approval from outside agency, then can issue dock permit.
Town of Briny Breezes		X	Does not issue permits for Intracoastal (done through outside agencies), but does for canals.
Town of Gulf Stream		X	Does not issue permits for Intracoastal (done through outside agencies), but does for canals.
Town of Highland Beach	X		Issues dock permits.

Palm Beach County Manatee Protection Plan

Town of Hypoluxo		X	
Town of Juno Beach		X	Must go through the County/SFWMD.
Town of Jupiter	X		Must receive approval from outside agency, then can issue dock permit.
Town of Jupiter Inlet Colony		X	
Town of Lake Park		X	Must go through the County/SFWMD.
Town of Lantana	X		Issues permits with Army Corps and DEP approval. Police and Marine Safety Dept issue mooring permits for vessels.
Town of Manalapan		X	
Town of Ocean Ridge		X	
Town of Palm Beach		X	
Town of Palm Beach Shores	X		Must receive approval from outside agency, then can issue dock permit.
Town of South Palm Beach		X	
Village of North Palm Beach	X		Depends on issue/waterway, but must get approval from outside agencies first.
Village of Tequesta	X		Must receive approval from outside agency (DEP/SFWMD), then can issue dock permit.

Since State and Federal agencies also have jurisdictional and operational responsibilities concerning the conservation and protection of natural resources in the County, efforts have been made to achieve consistency with the plans of those agencies. Adoption of an MPP by the County or local municipalities is intended to increase the predictability of dock permitting outcomes while streamlining the State and Federal commenting and permitting process.

It should be noted that the requirement for a Boat Facility Siting Plan only applies to unincorporated areas of Palm Beach County. The State statute does not require BFSPs for municipalities. While the MPP will only apply to those unincorporated areas of the County when the County is authorizing a project, the MPP will apply countywide when implemented by the State and Federal governments. The BFSP also does not apply to single-family docks or facility construction or expansion of fewer than five wet or dry slips. The 25 municipalities in the County that have jurisdiction over waterfront lands have three options with respect to this MPP:

- Elect to take no action (permits may be subject to more stringent review)
- Prepare their own Manatee Protection Plan and adopt it as an amendment to their Comprehensive Land Use Plan

Palm Beach County Manatee Protection Plan

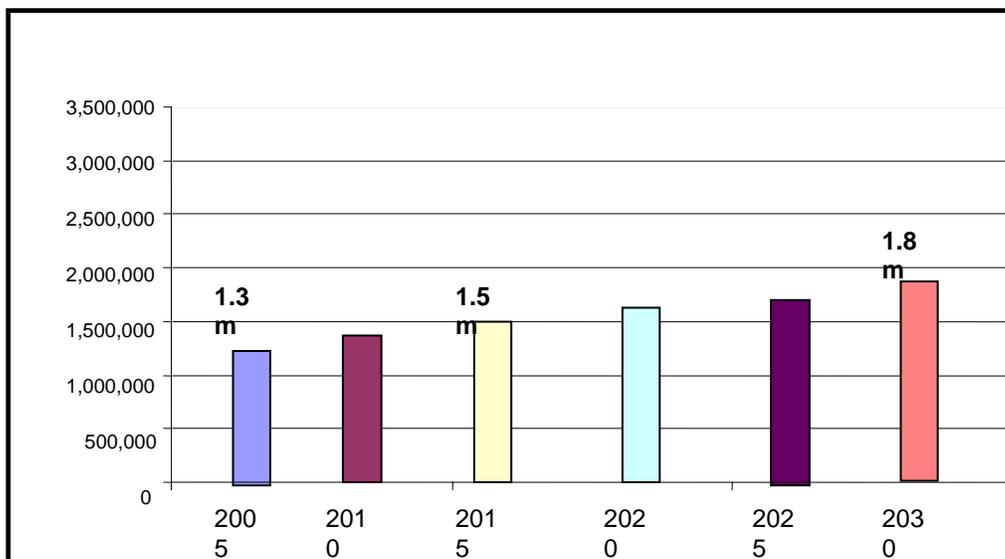
- Adopt the Palm Beach County Manatee Protection Plan by amending their Comprehensive Land Use Plan to incorporate the Manatee Protection Plan

In an effort to obtain municipal input, a number of presentations were made to the League of Cities to make municipalities aware of the plan and relevant issues. Meetings have been conducted with interested municipality representatives including Boca Raton and Riviera Beach.

C. Palm Beach County Demographics

With 1,216,282 residents, Palm Beach County’s population has climbed roughly 30 percent since 1990 (Enterprise Florida 2004). The County’s population is expected to reach roughly 1.8 million by 2030 (Smith 2002; **Figure 2**). The Palm Beach County 2003 Population Allocation Model estimates the 2025 population at 1,737,600. West Palm Beach, the County’s most populous city, had a population of 82,103 according to the 2000 Census, and the cities of Boca Raton, Boynton Beach, and Delray Beach are home to more than 60,000 residents each.

Figure 2 – Palm Beach County Population Projections in Five-year Increments, 2005-2030



Source: Palm Beach County

Palm Beach County Manatee Protection Plan

The U.S. Office of Management and Budget consolidated Miami-Dade, Broward, and Palm Beach counties into a single metropolitan statistical area (MSA) in mid-2003, based on the counties' shared core population area and the high degree of economic, demographic, and social integration (Florida Atlantic University 2004). With a combined population of 5.2 million, this new MSA is the sixth largest in the nation. **Tables 2 and 3** compare the most populous of Florida's counties.

Table 2 – Population Growth in South Florida, 2000-2004

County	Population in 2000	Population in 2004	Percent Change
Miami-Dade	2,253,362	2,356,828	4.6
Broward	1,623,018	1,765,693	8.8
Palm Beach	1,131,184	1,251,087	10.6

Source: Florida Atlantic University 2004

Table 3 – Population of Top Five Counties in Florida, 2004

Miami-Dade	2,356,828
Broward	1,765,693
Palm Beach	1,251,087
Hillsborough	1,081,000
Orange	985,124

Source: Florida Atlantic University 2004

D. Palm Beach County Waterways

Major water bodies in Palm Beach County are illustrated in **Figure 3** and are described in this section.

Lake Okeechobee – Lake Okeechobee, the third largest freshwater lake and fourth largest lake in the Continental U.S., is South Florida's primary water reservoir located in south central Florida and represents a significant portion of the northwest corner of Palm Beach County. It is approximately 35 miles wide (60km), up to 25 miles long (40km), and relatively shallow with a maximum depth of 15 feet and an average depth of nine feet (2.7 meters) spanning more than 730 square miles. Approximately 250

Palm Beach County Manatee Protection Plan

square miles of the lake are within the geographical boundaries of PBC. Its chief source is the Kissimmee River and its main outlet is the Caloosahatchee River.

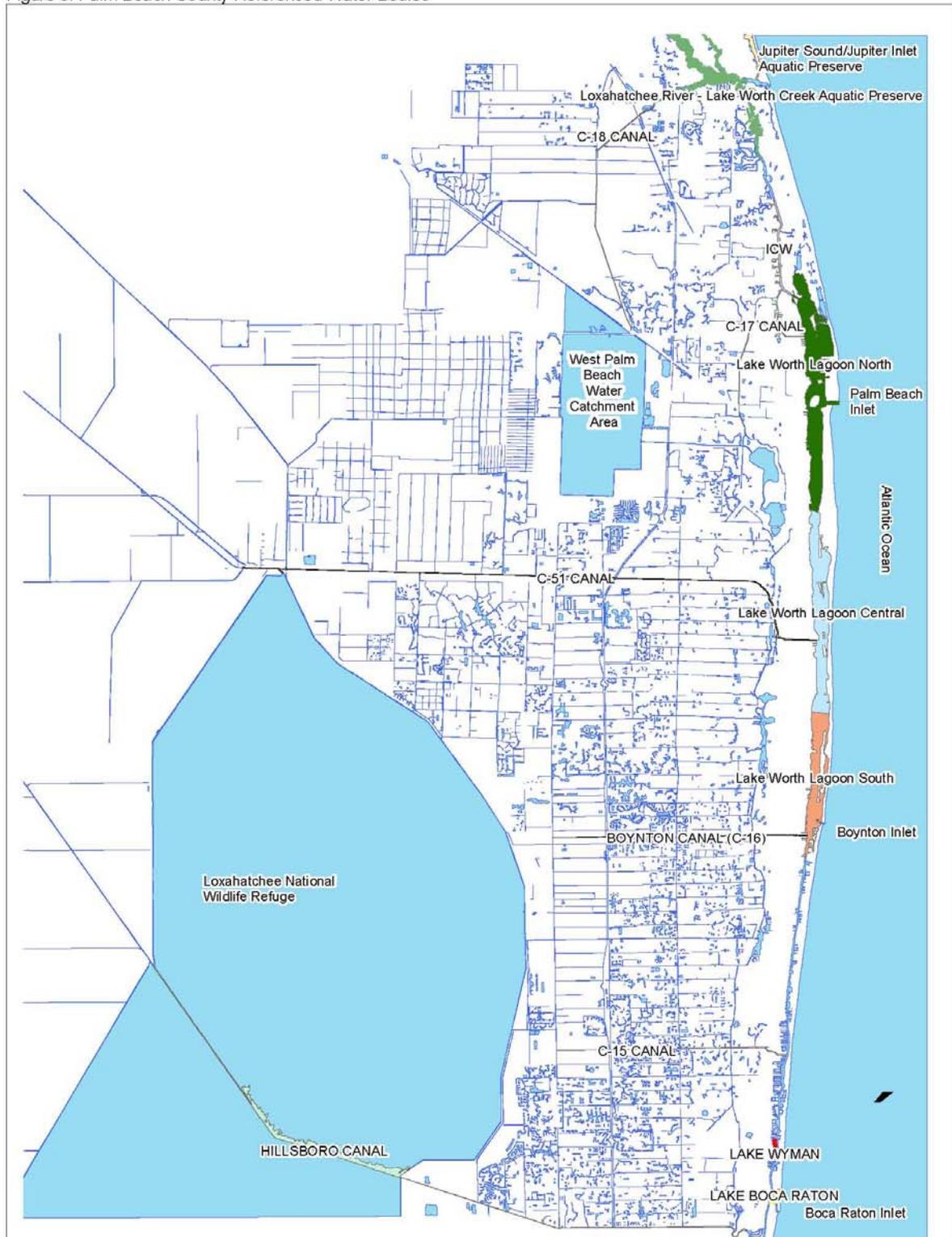
Loxahatchee River – The ICW enters Palm Beach County from the north through Jupiter Sound, which is connected to the Indian River Lagoon to the north and the mouth of the Loxahatchee River and Jupiter Inlet to the south. The Loxahatchee River estuary is comprised of the main embayment and three forks, the North, Northwest, and Southwest Forks. The estuary is relatively shallow with much of it having a depth of no more than four feet. The Southwest Fork, fed by the C-18 Canal, is the largest of the three forks in terms of freshwater flow into the estuary.

Jupiter Sound, Lake Worth Creek, and the Loxahatchee River are three of Palm Beach County's important estuarine environments and are a part of the Indian River Lagoon – Jensen Beach to Jupiter Inlet and Loxahatchee River-Lake Worth Creek Aquatic Preserves. The Loxahatchee Slough is one of the last natural riverine swamp systems on the east coast of Florida, serving as the headwaters of the Loxahatchee River (Comprehensive Plan, Conservation Element, pg. 2-C). A shoreline inventory of the Loxahatchee River was completed for the Jupiter Inlet District. It found 35.5 percent of 36.1 miles of shoreline was bulkheaded (hardened shoreline), while wetlands covered 14.3 miles of the Loxahatchee River shoreline, less than 40 percent of the total shoreline length (Law Environmental, Inc. 1990).

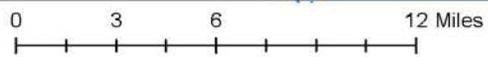
The Loxahatchee River National Wild and Scenic River Management Plan provides additional protection and preservation of the Northwest Fork of the Loxahatchee River and a corridor of adjoining uplands. The area north of river mile 5.5 on the Northwest Fork was designated as a “wilderness preserve,” wherein the primary management objective is the maintenance of these ecosystems in an essentially natural state. The remainder of the Aquatic Preserve has been designated as an “urban preserve,” wherein the primary management objective is the maintenance of essentially natural state, where present, and restoration to that condition where possible. Management is also directed to ensure public recreational opportunities while assuring the continued propagation of fish and wildlife.

Palm Beach County Manatee Protection Plan

Figure 3: Palm Beach County Referenced Water Bodies



Data Source: Palm Beach County (www.co.palm-beach.fl.us)
 Map created April 2006 by CUES (www.cuesfau.org)



Palm Beach County Manatee Protection Plan

The C-18 Canal is deeper than most of the Loxahatchee River. The depth of this portion of the river, and deep water channels in general, tend to hold water temperatures to a few degrees above ambient. This canal has sloping sides with a sandy bottom and ranges in width from 50 to more than 130 feet, averaging about eight feet deep [FWC, *Fish! Southeast Florida Canals: Angler's Guide to Loxachatchee Slough Canal (C-18)*].

ICW North (LW Creek) – This section of the ICW, stretching from southern Jupiter to North Palm Beach, connects the southern portion of the Jupiter River to the northern portion of the LWL, stretching from southern Jupiter to North Palm Beach. This entire stretch of water is comparatively narrow compared with other County waterways. It is approximately 100 feet wide, with a maximum depth of about 10 feet in the ICW channel.

Earman River (C-17 Canal) – Located in northeastern PBC, the C-17 Canal flows northeast from Clear Lake in West Palm Beach to a flood control structure near US 1 in Palm Beach Gardens. The navigable freshwater section of this canal lies west of the flood control structure and a spillway on the north side of the 45th Street bridge. This section of the main canal is 4.4 miles long, ranging in width from 50 to 130 feet with an average depth of about eight feet, and runs through the cities of Riviera Beach and Palm Beach Gardens. The estuarine portion of the canal runs east from the flood control structure. The shoreline is lined with mangroves, seawalls, and slips.

North Palm Beach Waterway – This brackish body of water forks off of the ICW south of RCA Boulevard feeding into the Earman River (C-17 Canal). More than a mile long, the waterway ranges in depth from three to seven feet, becoming more shallow towards its terminus. There are numerous finger canals along the waterway and four basins where the waterway widens. At the junction of the North Palm Beach Waterway and the Earman River, there is a fixed bridge with an 18-foot horizontal clearance and a seven-foot vertical clearance.

Lake Worth Lagoon (LWL) – This water body was originally a freshwater lake closed off from the saltwater of the Atlantic Ocean. The continuous onslaught of environmentally degrading activities over the past 100 years transformed the lake into what is today recognized as an important estuarine lagoon system in Florida. It is the largest estuarine system in Palm Beach County centrally located on its

Palm Beach County Manatee Protection Plan

urbanized east coast and is approximately 20 miles long, one-half mile wide, and eight feet deep. Some of the activities that transformed the lake into an urbanized lagoon include the construction of the Lake Worth and Boynton Inlets, channel dredging, shoreline hardening, dredging and filling, causeway and bridge construction, dock and marina construction, canal development, industrial and sewage waste disposal, stormwater runoff, port development, mosquito control, and power plant construction and operation. Recognizing the need for water quality improvements, habitat restoration, and enhancement within the lagoon, a partnership was formed between partners led by FDEP and Palm Beach County that resulted in the LWL Restoration – Partnership Grant Program, which funds stormwater retrofit and habitat enhancement projects in the LWL drainage basin.

For the purpose of this plan, the LWL was divided into 3 parts:

Lake Worth Lagoon North (LWN) – This waterway includes the waters of LWL north of the Flagler Memorial Bridge. Lake Worth Inlet (also referred to as the Palm Beach Inlet) is one entrance for manatees into this area from the Atlantic Ocean, while the main attractant is the Riviera Power Plant, which is a significant warm water refuge for manatees in Palm Beach County. The C-17 Canal serves as a freshwater source for the lagoon just south of Munyon Island on the west side of the ICW in North Palm Beach. There are extensive seagrass beds in this area of the lagoon located in and around John D. MacArthur Beach State Park, Peanut Island, and south of Peanut Island, primarily along the western shores of the ICW.

Located within this section of LWN, the Port of Palm Beach District is an independent special taxing district (an autonomous port), a sub-division of the State of Florida. It was established under the provisions of the Laws of Florida, Acts of 1915, Chapter 7081, as amended and supplemented. The Port of Palm Beach is located 135 miles south of Port Canaveral and 80 miles north of Miami. Vessel entrance and access to the port is gained through the Palm Beach Inlet, a channel 300 feet wide and 33 to 35 feet deep at mean low water (MLW), with no aerial obstructions leading into Lake Worth Lagoon. The largest vessels capable of entering the LWL via the Port's angled channel are those up to 700 feet in length with drafts less than 32 feet. A turning basin measuring 1,100 feet by 1,400 feet and 35 feet deep provides a safety margin for both cruise and cargo vessels.

Palm Beach County Manatee Protection Plan

Lake Worth Lagoon Central (LWC) – This water body extends south and includes the waters of Lake Worth Lagoon from the Flagler Memorial Bridge to Lake Worth Bridge. This section of the ICW can range anywhere from a few hundred feet across to nearly three-quarters a nautical mile across with depths ranging from 2-3 feet to 16-18 feet. The depth in between channel markers is consistently 10 feet deep. The central lagoon is characterized primarily by single-family residences with armored shorelines, a sand and muck bottom with less seagrass coverage and scattered mangrove islands that are being restored by Palm Beach County. The C-51 Canal has been a major source of fresh water, as well as pollutants, to the lagoon. To address these concerns, Everglades restoration projects are expected to result in a reduction of freshwater discharges from the C-51 Canal to Lake Worth. This will provide flood damage reduction benefits, in addition to improvements in water quality and an increased water supply for the Everglades and other uses.

Lake Worth Lagoon South (LWS) – This water body includes the waters of Lake Worth Lagoon between the Lake Worth Bridge south to the Boynton Beach Bridge at Ocean Avenue. In addition to abundant seagrass beds, LWS also contains two sources of fresh water. These are the Boynton (C-16) Canal and the Wellington Arms Wastewater Treatment Plant discharge. The Wellington Arms plant is a relatively small “package” plant, a pre-manufactured treatment facility used for treating wastewater in the small community.

ICW South – Historically, the freshwater sawgrass marsh referred to as the Spanish River Basin was located south of Lake Worth Lagoon. It was a wandering stream located where the ICW is today. Three embayment areas, Lake Boca Raton, Lake Rogers, and Lake Wyman were part of a freshwater river system that formed a natural drainage system for the Coastal Ridge and flowed to Boca Raton Inlet, a natural inlet. Areas between Lake Boca Raton and Lake Wyman were first dredged in 1882 and later called the Florida Coast Line Canal; however, these areas were later enlarged in 1934 to 100 feet wide, eight feet deep and renamed the ICW. In 1945, another enlargement project of the ICW brought the channel to its current dimensions of 125 feet wide and 12 feet deep. The shoreline is primarily seawall except for moderate expanses of mangroves in Ocean Ridge, Highland Beach, and Boca Raton.

In addition, there are four inlets in Palm Beach County, as follows.

Palm Beach County Manatee Protection Plan

Jupiter Inlet is the natural inlet where the Loxahatchee River, Lake Worth Creek, and Jupiter Sound converge into an entrance to the Atlantic Ocean. Jupiter Inlet District has dredged more than 45,000 cubic yards of sand per year from the inlet during the past 40 years (ERM, 2003). The inlet is between 10 and 14 feet in depth and ranges from 125 to 520 feet across.

Lake Worth Inlet (also known as Palm Beach Inlet) is 800 feet wide by 35 feet deep and is located east/southeast of Peanut Island. This area of the ICW is popular with recreational boaters traveling both through this area and to and from Peanut Island. This inlet is a high-traffic area with a wide variety of vessel types using the inlet to access the Atlantic Ocean.

Boynton Inlet (otherwise known as South Lake Worth Inlet) is 130 feet wide by 9 to 12 feet deep. It was initially opened in 1927 to increase circulation and improve water quality in Lake Worth Lagoon. A fixed sand transfer plant was built on the north jetty in 1937 to help alleviate downdrift erosion. This inlet is the site of the world's oldest sand transfer plant; renovation of the Boynton Inlet sand transfer plant is scheduled to begin in early 2005. Currently, the Boynton Beach inlet is a relatively small, well-traveled inlet, not originally designed for navigation due to its 18-foot bridge clearance.

Boca Raton Inlet was originally a natural waterway and has shifted locations at least three times in the past 200 years. It is located in the extreme southern end of Palm Beach County near the City of Boca Raton. Shoaling and underwater rocks are found adjacent to the north and south sides of the jetties, and the inlet is only dredged deep enough to allow larger pleasure craft to pass through. It is approximately 150 feet in width and 5 feet deep at MLW.

E. Zoning and Land Use

Palm Beach County has 268 miles of estuarine shoreline, with only 14 miles (5%) located within unincorporated areas (1989 Comprehensive Land Use Plan, Ordinance 2002-51, pp. 2-3). Twenty-three municipalities border the Intracoastal Waterway. It is the intent of the County to promote the responsible management of its coastal areas and protection of wildlife and natural habitat (1989 Comprehensive Land Use Plan, Ordinance 2002-51, pp. 2-3). However, the Palm Beach County Comprehensive Land Use Plan and most of the implementing ordinances found in the Palm Beach County Unified Land Development Code do not apply within municipal limits.

Palm Beach County Manatee Protection Plan

The primary responsibility for permitting boat facilities within the County lies at the State and Federal level. Because of the limited regulatory responsibility at the County level, manatee protection efforts in local waterways focuses on State speed zone enforcement, County habitat restoration and environmental enhancement programs, and education.

1. Comprehensive Plan Policies

Current Palm Beach County Comprehensive Plan strategies related to natural resource and manatee protection are excerpted below.

Coastal Management Element of the Palm Beach County Comprehensive Plan

GOAL 1 – to preserve, protect, and enhance coastal resources and to discourage development activities that would destroy or damage coastal resources through a variety of environmental policies [9J-5.012(3)(b)1, 2].

- Policy 1.1-m: The County shall continue to protect manatees and manatee habitats through: the continued coordination, enforcement and possible expansion of the State’s Intracoastal Waterway Speed Zone Program; and through the implementation of applicable sections of the ULDC. The County shall also continue the implementation of the Environmental Enhancement Program; educational activities, and develop a comprehensive boat facility siting plan and a Manatee Protection Plan that may be adopted by all 25 affected local governments [9J-5.012(3)(c)1].

- Policy 1.1-o: The County shall evaluate the impacts of jet-skis and other personal watercraft on seagrasses and manatees by January 2005, and shall make amendments to this element as necessary to implement appropriate recommendations. To the extent possible, existing studies shall be utilized to accomplish this policy [9J-5.012(3)(c)1, 2].

Objective 1.4: Water Dependent Uses – to give preference to water dependent uses and, prohibit, to the extent allowed in the ULDC, activities that degrade the natural functions and values of wetlands [9J-5.012(3)(c)9].

Palm Beach County Manatee Protection Plan

- Policy 1.4-a: The County shall encourage and support development of a countywide boat facility siting plan as required by the executive order entitled, “Recommendations to Improve Boating Safety and Manatee Protection for Florida Waterways: Interim Boating Facility Expansion Policy and County MPPs” (adopted by Governor and Cabinet, October 1989) [9J-5.012(3)(c)9].

Conservation Element of the Palm Beach County Comprehensive Plan

GOAL 2 – Protection of Native Communities and Ecosystems

Objective 2.2: Wetlands

The County shall maintain the functions and values provided by freshwater and marine wetlands so there will be no net loss of wetland functions and values due to development or other activities.

- Policy 2.2-a: The County shall continue to implement the Wetlands Protection Section of the Unified Land Development Code and shall continue to review and comment on wetland alteration applications being reviewed by other agencies to ensure that no activity results in the net loss of wetland values and functions. The County shall ensure that the following steps are taken, in order, when assessing proposed activities that may result in wetland impacts:

1. Avoidance of wetland impacts
2. Minimization of unavoidable wetland impacts
3. Compensation for wetland impacts through mitigation

Objective 2.4: Listed Species

The County shall protect and preserve endangered and threatened species, species of special concern, (hereafter collectively referred to as listed species), and their associated habitats.

- Policy 2.4-a: The County shall use all appropriate means to protect existing listed species, prevent extinction of listed species, and prevent further reductions in the population sizes of listed species and habitat of significant value to existing populations of listed species through its acquisition program, regulatory programs, environmental review processes of Developments of Regional Impact, land development applications, etc., and cooperation with agencies that protect listed species. The County

Palm Beach County Manatee Protection Plan

shall continue to require through the regulatory programs that developers protect, manage, or relocate listed species identified on their property.

- Policy 2.4-e: The County shall not issue a development order when listed plant or animal species are affected until conditions are provided for protection of the listed species.

2. Zoning

Additional portions of the Future Land Use Element of the Palm Beach County Comprehensive Plan are also relevant, as provided below.

Future Land Use Element of the Palm Beach County Comprehensive Plan

GOAL 5 – Palm Beach County will provide for the continual protection, preservation, and enhancement of the County’s various high-quality environmental communities for the benefit of its current and future residents and visitors.

- Policy 5.1-b: The impact of development on natural resources and systems, including high-quality coastal and inland wetlands, as well as future potable water supply wellfield areas as identified in the Future Land Use, Coastal Management, and Conservation Elements, shall be evaluated during the development review process, as outlined in the ULDC, to protect these resources from the adverse impacts associated with incompatible future land uses on or near sites.

Objective 5.3: (John D. MacArthur Beach State Park Greenline Overlay) – The County shall continue to maintain the John D. MacArthur Beach State Park Greenline Overlay to protect resources within park boundaries, such as water, wildlife populations, and the aesthetic quality of recreation in this Park, from impacts caused by activities on adjacent land. The greenline buffer provides:

4. Critical habitat for wildlife, including threatened and endangered species, in accordance with Conservation Objective 2.4.
5. Protection to Manatees, in accordance with Coastal Policy 1.1.m (ERM 2003).

Palm Beach County Manatee Protection Plan

- Policy 5.3a: The Overlay shall continue to be maintained as a peripheral boundary around the State Park as established by the Florida Department of Environmental Protection. The greenline encompasses the north end of Lake Worth, Little Lake Worth, Lake Worth Creek, the Earman River, the North Palm Beach Waterway, and their associated natural and manmade waterways. Seaward, the area extends offshore as far as the park boundary. These extensive systems, or parts thereof, are contained within the greenline because of their actual or potential impact on the Park.

3. Government Coordination

a. Overview of Federal and State Permitting Process

A number of agencies are responsible for conducting permit and development review for boat facilities, docks, and structures located along the shoreline or on submerged lands. Depending upon the size and location of the project, these agencies may include the local government, the Florida Department of Environmental Protection, the South Florida Water Management District (SFWMD), the FWC, United States Corps of Engineers (USACE), and the FWS.

Federal, State and some local governments have regulatory oversight of dock construction projects in Palm Beach County. Agencies have exemptions for some types of docks considered to have minor environmental impacts. For example, all three levels of government have exemptions for repair and replacement of existing docks to the original configuration and size. The permitting agency for Federal authorization is the USACE, except for some projects where the State acts on behalf of the USACE pursuant to a Memorandum of Agreement. The Federal authority for wetland projects is found in Section 10 of the Rivers and Harbors Act 1899 (33 USC 403) and Section 404 of the Clean Water Act, 1972 (33 USC 1344).

The permitting agency for the State authorization of boating facilities is the Florida Department of Environmental Protection or the one of the water management districts (SFWMD in Palm Beach County). The authority for State regulation of wetland activities is found in Chapter 373 and 403 of the Florida Administrative Code. Due to the importance of seagrasses to manatees, mention must also be made of the State's sovereignty over submerged lands and related regulations (Ch. 18-21, FAC). The

Palm Beach County Manatee Protection Plan

Aquatic Preserve Rule (Ch. 18-20, FAC) and Chapter 258, FS, discuss additional management policies, standards, and criteria that apply to sovereignty submerged lands in Aquatic Preserves. For example, these rules contain more stringent standards for dredge and fill activities and docking structures constructed within the Aquatic Preserves, thus serving to help protect the seagrasses upon which manatees forage.

The FWS provides comments related to the protection of listed species to the USACE during the Federal permit process. The FWC has a similar relationship with FDEP or SFWMD to provide comments during the State permit process. The lead permit agencies typically try to incorporate the commenting agencies concerns in the final permits.

b. Local Government Approvals

Palm Beach County and municipalities regulate boat facility approvals through their respective Comprehensive Land Use Plans and building codes. Some municipalities may exercise greater control through environmental permitting programs.

Boat facilities proposed in unincorporated Palm Beach County must meet the criteria established in the Comprehensive Land Use Plan and the Unified Land Development Code (ULDC) which defines zoning and building criteria. A commercial marina in unincorporated Palm Beach County is considered a Class B conditional use, which requires a Public Hearing and approval by Palm Beach County's Zoning Commission prior to Site Plan certification by the County's Development Review Officer. Details on municipal approvals were previously discussed in I.B.2 and Table 1 (page 32).

II. MANATEES IN PALM BEACH COUNTY

A. Introduction

Manatees have long been observed along the eastern seaboard of the United States from Florida to Georgia, although some individuals have been found as far north as Rhode Island (FWS 2001). Recognized as an integral part of Florida's ecology for millions of years, Sirenians evolved from four-

Palm Beach County Manatee Protection Plan

footed land mammals more than 60 million years ago. Their 45 million-year-old fossils have been found in the State. While documentation on manatees prior to the first half of the 20th Century was often inadequate (FWS 2001), it is known that these marine mammals were hunted in Florida as early as pre-Columbian times (FPL 2001). The species has since benefited from the State and Federal protections described below. Today, manatees bring millions of eco-tourism dollars to the State, providing memorable experiences for both residents and visitors (Valade 2000).

B. The Florida Manatee

Note: General information on the Florida manatee is available from a variety of print and on-line sources. Unless otherwise noted by citation, the summary information presented below was compiled from the following sources: O'Shea *et al.* 1995; Reynolds and Odell 1991; FWS 2000; and Van Meter 2001.

Manatees are members of the scientific Order Sirenia, large air-breathing aquatic mammals that inhabit both fresh- and salt-water areas, including oceans, estuaries, rivers, canals, and dredged channels. There are only four living species in this group, and all are found in warm tropical and sub-tropical waters. The West Indian manatee, *Trichechus manatus*, inhabits the southeastern United States, the Caribbean Islands, eastern Mexico and Central America, and the northern coast and rivers of South America. There are two subspecies of the West Indian manatee: the Florida manatee (*T. m. latirostris*), which occurs in the southeastern United States, and the Antillean manatee (*T. m. manatus*), which is found throughout the Caribbean and northern South America. Cool winter temperatures in the Gulf of Mexico and strong currents in the Straits of Florida tend to isolate the two subspecies, although mixing may occur in Texas. As its name implies, the Florida manatee, also referred to as a "sea cow," is found primarily in Florida but may range north to Virginia and west to Texas during warmer months of the year. Manatee bones have been found in the refuse heaps, or middens, of the aboriginal tribes that first inhabited the State. These peoples, as well as the Native American tribes and European colonists that followed, hunted manatees for food, oil, and bones.

The Florida manatee inhabits a variety of riverine (fresh), estuarine (brackish), and coastal (marine) environments where it feeds on the wide range of submerged, floating, and emergent shoreline

Palm Beach County Manatee Protection Plan

vegetation these habitats provide. In addition to foraging areas, manatee habitat includes: natural springs and artificial warm water sites, such as power plants, where the animals take refuge during cold weather; springs and freshwater runoff areas that provide drinking water; quiet, secluded tributaries and feeder creeks where they can rest, give birth, and nurture their young; and open waterways and deep channels, including man-made, dredged canals that provide travel corridors during seasonal migrations and intra-habitat movement. Individuals move freely among habitats and are able to tolerate the extreme shifts in salinity experienced when moving from fresh to salt water. Manatees prefer relatively shallow water depths (3 – 7 feet), but along the coast tend to travel in water 10 – 16 feet deep. They can be found in both clear and muddy water.

Adult manatees average approximately 3.5 m (11.5 ft) in length and weigh about 1,000 kg (2,200 lb). They have seal-like bodies, a large spatulate-shaped tail for locomotion, and two forelimbs that are often used in combination with a muscular upper lip to pull food into their mouths. A manatee's only teeth are molars, which are used for grinding vegetation. Manatees spend up to six to eight hours each day foraging and can consume as much as 10 to 15 percent of their body weight in aquatic vegetation each day. Two to 12 hours each day are spent resting.

Generally, manatees do not have any set daily routines, and feed, rest and perform other activities throughout the day and night. However, in certain areas or at certain times of the year, they may time their activities to coincide with periods of warmest water temperatures (e.g., during the winter) or to avoid human harassment (e.g., boats, divers, etc.). Like other air-breathing marine mammals (dolphins, whales, and seals), manatees must periodically surface for air. Although intervals between breaths vary with the amount of activity, manatees typically come to the surface to breathe every three to five minutes. However, a resting manatee may remain submerged for as long as 20 minutes. During periods of high activity, a manatee may surface to breathe as often as every 30 seconds. Manatees periodically require fresh water, but may survive for extended periods without it. West Indian manatees have been seen congregating at river mouths and drinking from hoses, culverts, and sewage outfalls.

Manatees have two comparatively small eyes with inner membranes that can be drawn across the eyes for protection. They have fairly good underwater visual acuity and can distinguish between different sized objects, colors, and patterns, although sight is significantly affected by water clarity. Despite a lack

Palm Beach County Manatee Protection Plan

of ear lobes, manatee hearing is reasonably good within a relatively narrow low-frequency band. Observations and studies have revealed that manatees emit sounds to communicate with one another, with these vocalizations often being between a cow and its calf. Evidence suggests that despite their relatively good hearing, manatees have difficulty in localizing the source and direction of sound.

Manatees mature at about three years of age, but females do not appear to breed successfully until they are between six and 10 years old. Calving occurs throughout the year with females typically producing a single calf; twins may occur occasionally. The gestation period is 11 to 13 months, and the interval between successive births is typically two to five years. Newborns range in size from 1.2 to 1.4 m (4 to 4.5 ft) and weigh about 30 kg (66 lbs). Calves nurse underwater from teats located at the junction of the mother's forelimbs and body, and they remain dependent on their mothers for up to two years. They often spend at least their sub-adult lives within their mother's range. Manatees are relatively long-lived, with estimates of maximum life expectancy being about 60 years. As adults, they live mostly solitary lives, although temporary associations may be formed between a few animals of the same sex. The principal exception to this occurs during mating when numerous males form a mating herd around a receptive female.

Due to their limited thermoregulatory capabilities, manatees can succumb to hypothermia (cold stress) when exposed to water temperatures below approximately 17°C (63°F) for extended periods. They prefer temperatures warmer than 22°C (72°F). Consequently, their geographic range and seasonal movements are largely dictated by prevailing water temperatures. During winter months they may travel considerable distances as they seek out both natural and man-made warm water refugia, such as natural warm water springs and discharge canals near power plants. In Palm Beach County, FPL's Riviera Power Plant located near the Lake Worth Inlet provides one such haven. When extreme drops in temperature occur, manatees usually remain close to a warm water source and then venture out to nearby feeding areas during breaks in the weather. Sometimes when the weather remains very cold, they may not feed for days at a time.

There are four regional sub-populations of the Florida manatee: Northwest Florida, Southwest Florida, Atlantic Coast (including the northern St. Johns River), and the St. Johns River south of Palatka. Palm Beach County is part of the Atlantic Coast Region. Occasional intermixing of individuals between

Palm Beach County Manatee Protection Plan

populations has been documented, including movement between the east and west coasts. At present, it appears that approximately equal numbers of manatees use the east (47%) and west coasts (49%) of Florida, with the remaining four percent found in the St. Johns River.

Spirited debate exists over the number of manatees in the wild and population trends. These issues are critical to assessing the impact of human-related mortality and the adequacy of existing protection measures. Recreational fishing and marine industry groups argue that data collected by the FWC during annual synoptic surveys (see Section II.C.2. for details) demonstrates an increase in the population of the Florida manatee. They contend that watercraft-related mortality has remained relatively constant relative to other forms of natural and human forms of mortality over the last 25 years and suggest that recent increases in overall mortality are suggestive of an increasing population. However, the majority of manatee experts reject synoptic survey data as a means to determine population trends. The success of synoptic surveys is heavily dependent upon weather conditions. If the weather is cold and clear, then manatees are gathered around warm water sites, making it easier to get a count. Thus, the surveys provide only a one-day snapshot of the population and comparisons among years for the purpose of determining long-term trends are not appropriate. Counts conducted during these surveys are considered minimal, representing only a census of the population and thus cannot be used to calculate population trends over time. Moreover, synoptic surveys do not provide information on sex ratios or survival rates of different age classes, sexes, and subpopulations, all important factors in modeling population trends.

A recent population model developed by scientists with the U.S. Geological Survey (USGS) (Runge *et al.* 2004) indicates that over the most recent 10-year period, the Northwest and St. Johns River sub-populations have experienced annual growth rates of 3.7 and 6.2 percent, respectively, while the Southwest sub-population has declined by 1.1 percent per year. There is uncertainty in the model with respect to the Atlantic region. Although a growth rate of 1 percent per year is shown over the entire 10-year period, that rate was not constant; over the second half of the period, the sub-population showed a decline of 1 percent per year.

The USGS model was incorporated into the Final Environmental Impact Statement for the U.S. Fish and Wildlife Service's proposed Incidental Take rulemaking process to protect manatees under the Federal Marine Mammal Protection Act (Runge 2004). The model assessed the amount of watercraft-related

Palm Beach County Manatee Protection Plan

mortality that would occur among the four Florida sub-populations and found that even if current rates of mortality do not increase, the extent of take could not be considered “negligible” under the proposed rule. The assessment concluded: “In the absence of any new management action, that is, if boat mortality rates continue to increase at the rates observed since 1992, the situation in the Atlantic and Southwest regions is dire, with no chance of meeting recovery criteria within 100 years.”

C. Abundance and Distribution

Manatees are found in marine, estuarine and accessible freshwater bodies throughout Palm Beach County, although their relative abundance may vary appreciably among locales and seasons. This section provides information on the geographic (spatial), relative abundance, and temporal distribution of manatees in the County. Data used in this analysis was obtained from three major sources, each described in detail below:

- Aerial distributional surveys
- Synoptic surveys and
- Telemetry studies.

ArcGIS 8.3 (ArcMap) software was used to prepare the summary maps of the available aerial, synoptic, and telemetry data from information collected by the FWC.

1. Aerial Distributional Surveys

The most comprehensive source of information regarding the distribution and abundance of manatees in Palm Beach County is from data collected during aerial surveys flown by the County’s Department of Environmental Resources Management (ERM) in cooperation with FWC. This data, which was obtained from the FWC-FWRI Atlas of Marine Resources (2000), provides a wealth of information regarding the extent to which manatees utilize different waterways and habitat.

Data was collected using established scientific protocol and included a total of 58 aerial survey flights between August 1990 and June 1993. The surveys were typically performed twice a month by scientists in fixed-wing aircraft flying at an altitude of 500 feet. Flight paths included nearly all of the inshore and

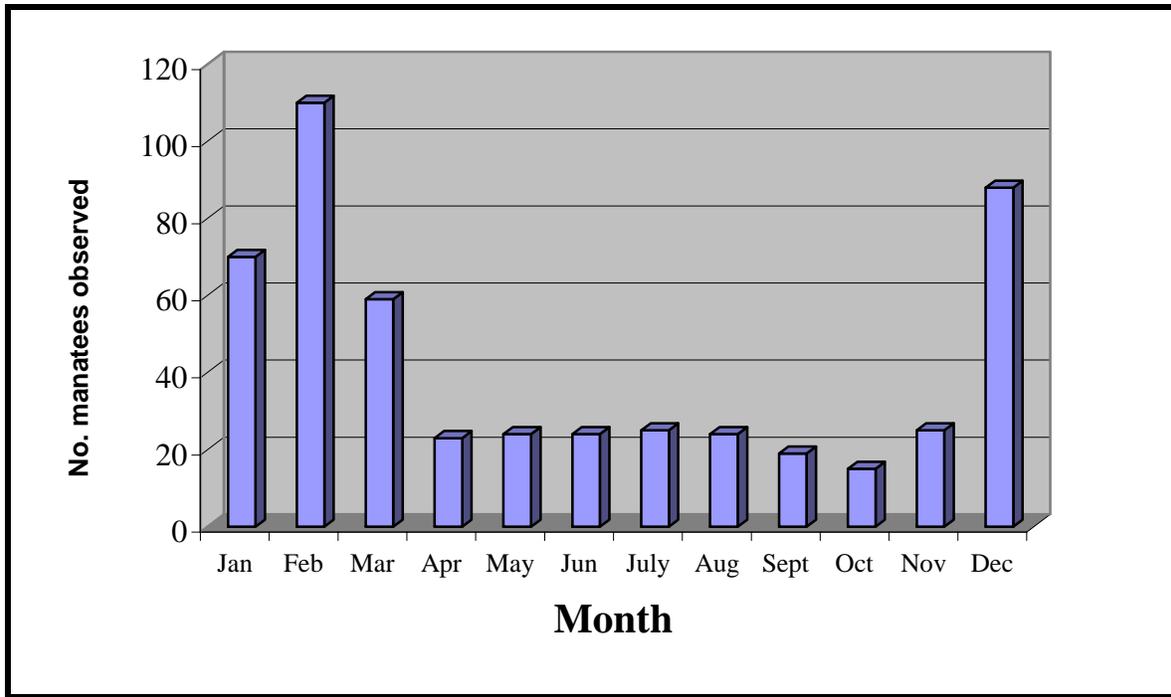
Palm Beach County Manatee Protection Plan

nearshore waterways within the County that are accessible to manatees (**Figure 4, separate Appendix of Figures**). Exceptions include Lake Okeechobee, which is only accessible to east coast manatees via canal systems in Martin, Broward, and Dade counties, and the residential canals along Lake Worth Creek in northern Palm Beach County. Data collected during aerial surveys included geographic location of sighting, total number of manatees sighted, percentage of adults versus calves, and behavior (resting, feeding, direction of travel, or cavorting). A composite map of all aerial sightings in the County is presented in **Figure 5 (separate Appendix of Figures)**.

During the ERM overflights, a total of 1,053 sightings were documented in Palm Beach County over the three year period, representing approximately 2,461 animals. Adult manatees comprised 91 percent of all individuals sighted (N=2,245), with calves representing the remainder of the sightings (N=216). The data suggests a distinct pattern of seasonal abundance. Although manatees were observed year-round, the majority (approximately 67%) were observed during the winter months (December through March). On average, an aerial survey conducted during the winter months observed 78.5 manatees over the entire County, while during the warm season (April through November), only 21.9 manatees were observed during an average overflight. During February, the month of greatest abundance, an average of 110 individual manatees were observed per overflight (**Figure 6**). October was the month of least abundance, with an average of only 14.5 manatees observed per overflight.

Palm Beach County Manatee Protection Plan

**Figure 6 – Average Number of Manatees Observed Per Aerial Flight in Palm Beach County
(August 1990-June 1993)**



Source: FWRI/FWC; Palm Beach County

Based on the aerial survey data, it is apparent that manatees utilize essentially all of the waterways that are physically accessible to them (**Figure 7**). The northern section of Lake Worth Lagoon appears to provide particularly important habitat. Approximately 37 percent of all individuals sighted during the aerial surveys were within this portion of the lagoon. This area includes several attractants. For example, the FPL Riviera Power Plant, a major warm water refuge, is located within this zone. Large aggregations of manatees were consistently observed near this facility during the winter months. Additionally, some of the most extensive seagrass beds in Palm Beach County are found within this zone. Seagrasses are particularly abundant in the vicinity of John D. MacArthur Beach State Park and waters surrounding Peanut Island.

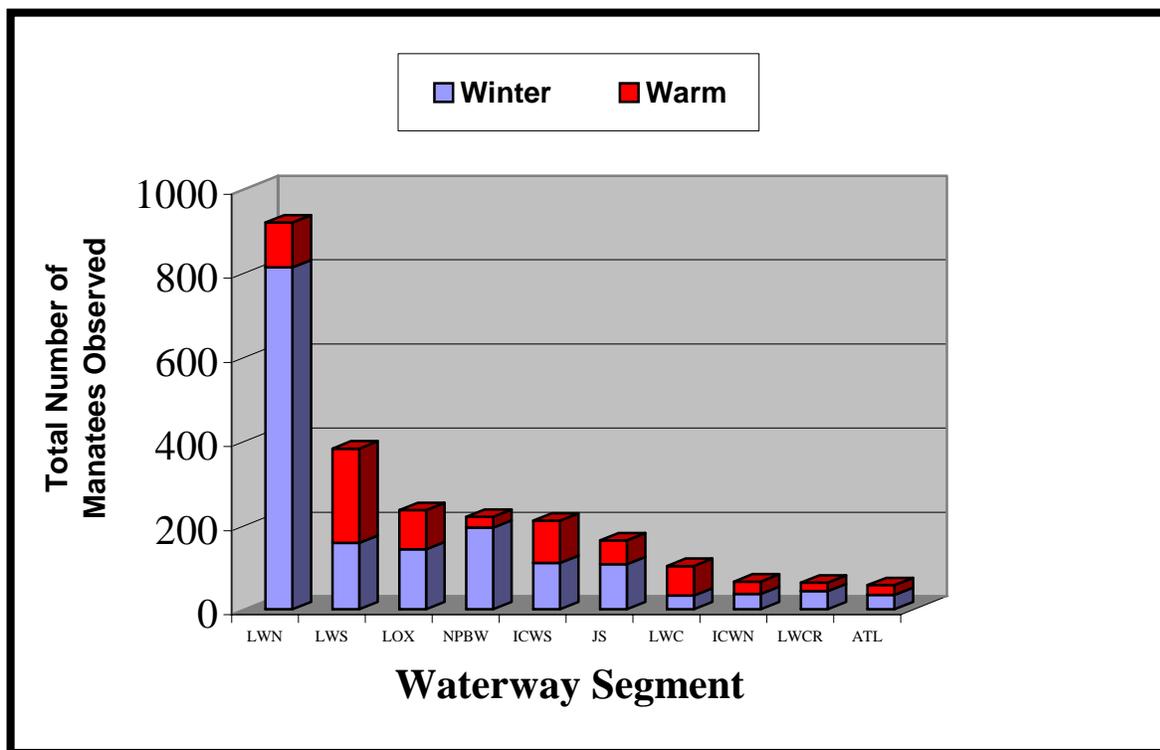
Areas in Palm Beach County that support a relatively moderate abundance of manatees compared to the rest of the County include the North Palm Beach Waterway (NPBW), the southern Lake Worth Lagoon (LWS), Jupiter Sound (JS), Loxahatchee River (LOX), and the section of the Intracoastal Waterway south of Delray Beach (ICWS). The North Palm Beach Waterway contains a number of relatively

Palm Beach County Manatee Protection Plan

isolated finger canals that may serve as important resting and calving habitat and possible thermal refugia, as well as a source of fresh water (C-17 Canal). The remainder of these zones contains freshwater sources and/or good foraging habitat.

Areas of relatively low and moderate abundance compared to the rest of the County include the central portion of the Lake Worth Lagoon (LWC), Lake Worth Creek (LWCR), the section of the Intracoastal Waterway between Boynton Beach and Delray Beach (ICWN), and the Atlantic Ocean (ATL). These areas are generally lacking in seagrass habitat and other resources that might attract manatees. Nonetheless, these zones undoubtedly serve as important travel corridors for manatees moving through and within Palm Beach County. Very few manatees were observed within the Atlantic Ocean (approximately 2% of all individuals sighted). Some manatees likely utilize the ocean as a north-south travel corridor; however, the vast majority appears to move within the inshore coastal waterways.

Figure 7 - Relative Seasonal Abundance of Manatees in Palm Beach County's Waterway Segments (August 1990-June 1993)



Source: FWRI/FWC; Palm Beach County

Palm Beach County Manatee Protection Plan

Manatees were observed in all waterway segments regardless of season, and there was no dramatic seasonal shift in habitat use by manatees within the County. However, some changes in seasonal abundance and distribution are apparent (**Figures 8a-e, separate Appendix of Figures**). Manatees were by far most abundant during the winter (December-March) in the north Lake Worth Lagoon, where approximately 50 percent of all manatees in the County were observed. The adjacent North Palm Beach Waterway also appears to be important winter habitat. During the warm season (April-November), manatees were both less abundant overall and more evenly distributed throughout the County. During this portion of the year, manatees were most abundant within the south Lake Worth Lagoon, followed by the north Lake Worth Lagoon and the Intracoastal Waterway south of Delray Beach. Relatively high abundance within the latter area is likely due to the presence of Lake Wyman, a shallow embayment near Boca Raton that contains extensive seagrass beds.

2. Synoptic Surveys

Synoptic surveys are legislatively mandated as follows: “Each fiscal year the Save the Manatee Trust Fund shall be available to fund an impartial scientific benchmark census of the manatee population in the State. Weather permitting, the study shall be conducted annually by the Fish and Wildlife Conservation Commission and the results shall be made available to the President of the Senate, the Speaker of the House of Representatives, and the Governor and Cabinet for use in evaluation and development of manatee protection measures,” (Ch. 370.12(4)(a), FS).

Counts were conducted 21 times from 1991 through 2004 (FWC 2005). These “synoptic” counts are generally conducted the same two days per year throughout Florida from fixed-wing aircraft to count manatees in places and at times when they are most concentrated. Thus, the synoptic flights are performed during the winter and are timed to coincide with the passage of major cold fronts, periods when manatees gather at various thermal refugia around the State. The number and dates of surveys vary from year to year depending on weather conditions. No surveys were conducted in 1993 or 1994 because of the lack of strong winter cold fronts (FWS 2001). Water clarity/visibility, weather conditions, and time of day significantly affect observations of manatees during these surveys. As such, it remains unknown what percentage of the total manatee population is actually counted in the synoptic surveys.

Palm Beach County Manatee Protection Plan

Therefore, synoptic surveys only provide a snapshot during cold conditions and do not predict population trends.

Synoptic surveys may be somewhat useful in depicting the winter distribution of manatees during cold periods in Palm Beach County, but should not be confused with distributional surveys. The locations and relative abundance of manatees observed during synoptic surveys flown from 1991 to 2003 are shown in **Figures 9a-e, separate Appendix of Figures** (FWC 2000; FWRI 2003). Certain areas of the County, most notably Lake Okeechobee, are not surveyed at all. The data suggests that even during episodic periods of cold weather, manatees are distributed either individually or in small groups (< 4 animals) throughout the County's water bodies.

The only major water body in which no manatees have been observed during synoptic surveys is the Northwest Fork of the Loxahatchee River. However, it is also evident from the data that manatees prefer certain areas of the County during the passage of cold fronts. Manatees observed during synoptic surveys were most abundant in northern Palm Beach County, and especially the north Lake Worth Lagoon. Palm Beach County contains only one major warm water refuge, the FPL Riviera Power Plant, which is located in this waterway. Large numbers of manatees have been observed congregating in and around the warm water discharge of this facility on a consistent basis on the coldest days of the year (**Figure 9b, separate Appendix of Figures**). Aggregations at the discharge containing more than 100 manatees have been observed during synoptic counts seven times since 1991.

The winter distribution of manatees in Palm Beach County is heavily influenced by the presence of the FPL Riviera Power Plant. Aside from providing thermal refugia, the plant is situated near extensive foraging habitat within north Lake Worth Lagoon. Manatees will often move from thermal refugia during mild winter periods to nearby grassbeds to feed (Deutsch *et al.* 2003). This appears to occur in Palm Beach County, where large numbers of manatees have been observed during synoptic surveys utilizing seagrass habitat close to the FPL facility. Other areas of the County may also be used during opportunistic foraging excursions. Manatees were relatively abundant within Jupiter Sound, approximately 20 km (12.5 mi) north of the FPL facility. Packard (1981) suggested that some manatees utilizing the power plant discharge may forage within this area during periods of mild weather.

Palm Beach County Manatee Protection Plan

Manatees will often use other minor sites as temporary thermal refugia during the winter (FWS 2001). These secondary sites are typically deep canals or boat basins where warm temperatures persist due to thermoclines or other physical conditions. Minor winter aggregations of manatees (at least four animals) occurred on a recurrent basis (at least three years) in three areas of PBC:

- Jupiter Sound finger canal
- C-18 Canal near Spillway S-46 (Southwest Fork of Loxahatchee River) and
- South Lake, a small dredged basin connected to the Earman River (C-17 Canal)

Section III.D. contains more information on these sites. The significance of these sites to overwintering manatees is unknown but likely minor in comparison to the FPL plant.

Table 4: Number of Manatees Sighted During Synoptic Surveys, 1991-2003

Survey Year	Palm Beach County Total	Florida Total	Percent of Statewide Count
1991	133	1,478	9.0%
1992	245	1,844	13.3%
1993	**	**	**
1994	**	**	**
1995	98	1,823	5.4%
1996	125	2,630	4.8%
1997	164	2,241	7.3%
1998	48	2,018	2.4%
1999	35	2,360	1.5%
2000	258	2,223	11.6%
2001	257	3,300	7.8%
2002	34	1,758	1.9%
2003	117	3,127	3.7%
** Survey not conducted			

Source: FWRI/FWC; Palm Beach County

Table 4 provides the number of manatees counted statewide each year during the synoptic surveys and the corresponding number of manatees observed in Palm Beach County on that same date. These numbers are considered to represent a minimal count of manatees statewide and cannot be used to accurately assess population trends. The data indicates that although there is considerable intra-annual variation in the numbers of manatees spotted in Palm Beach County, a sizeable percentage of the State's

Palm Beach County Manatee Protection Plan

manatee population spends at least some part of their winter in the County on a consistent basis. As many as 13.3 percent and as few as 1.5 percent of all manatees sighted statewide occurred in Palm Beach County.

3. Telemetry Studies

a. Sirenia Project Methods and Summary Findings

The USGS Sirenia Project provides a wealth of information regarding the distribution, seasonal movements, and migratory behavior of manatees along the Atlantic Coast. The project involved a 12-year (1986-1998) interagency study that tracked individual manatees along the east coast of Florida and Georgia. The following summary of the project methods and findings is derived from Deutsch *et al.* (2003). However, the results should be used with caution since animals tend to be specific in their use of certain waterways. Capture sites are not random, there is a low sample size, and the individual animal's preferences may affect the results. The goal of the Sirenia Project was to characterize migratory behavior, seasonal movements, and site fidelity of manatees across the full distribution of their Atlantic Coast range (**Figure 10, separate Appendix of Figures**). To accomplish this goal, the movements of a total of 78 manatees were tracked using field-monitored (N=15) and satellite-linked (N=63) radio-telemetry for a median duration of 8.3 months per individual. However, numerous manatees were tracked for multiple years. Satellite tags generated a mean of 3.6 locations per day. The project tracked 46 adult females, 21 adult males, 5 subadult females, and 6 subadult males. Of the 78 manatees tracked, 48 study animals (37 female, 11 male) were used in the analyses of distribution and seasonal movement patterns.

The geographic range of tagged manatees along the Atlantic Coast was generally confined to the area between Biscayne Bay in southeast Florida and the Brunswick River in southeastern Georgia. No tagged animals traveled to Lake Okeechobee. The study area was divided into three regions for gross analysis of migratory movements. These included a north (north of Flagler Beach, Florida), central (between Flagler Beach and St. Lucie Inlet), and south (south of St. Lucie Inlet, including PBC) region. Manatees typically were found in the northern region during the summer, the southern region during the winter, and the central region year-round. Most manatees were highly migratory, moving seasonally between

Palm Beach County Manatee Protection Plan

winter- and warm-season areas; however, the extent of the seasonal movements varied widely between individuals. Individual variation was not correlated with sex, age class, or body size. Four principal patterns of seasonal movement were identified. These include:

- Year-round Resident - Manatees that traveled on average less than 50 km between winter- and warm-season areas (N=6).
- Short-distance Migrant - Manatees that traveled on average between 50 to 150 km (N=7).
- Medium-distance Migrant - Manatees that traveled on average between 150 to 400 km between areas (N=29). This category was further subdivided into central-south (C-S) (N=18) and north-central (N-C) (N=11) migrants.
- Long-distance Migrant - Manatees that traveled on average more than 400 km between areas (N=6).

Most (37%) of the tagged manatees migrated seasonally between central and southern Florida. The initiation of movement between summer and winter ranges was usually abrupt and related closely to water temperature. Manatees summering in central Florida typically departed for wintering habitat in South Florida from late November to early January (December 12 ± 25 days). Movements back to their summer range from southeast Florida were generally initiated from late February to early April (March 16 ± 22 days). Overall, manatee movement patterns along the Atlantic Coast were characterized by strong site fidelity to the same seasonal ranges year after year. Most manatees occupied relatively small winter and summer core areas separated from each other by lengthy travel corridors. The authors speculate that differences in habitat quality and the degree of human disturbance may underlie the north-south migratory strategy employed by most manatees.

b. Observations in Palm Beach County

The telemetry data collected during the Sirenia Project provides some insight into the distribution and movements of manatees within Palm Beach County. It should be noted that this data set is based on tracking results for a limited number of individuals and thus may not be representative of the entire Atlantic subpopulation. Nevertheless, when viewed in its entirety the track of each tagged animal provides an accurate characterization of its general location and movement patterns.

Palm Beach County Manatee Protection Plan

A total of 25 of the 78 tagged manatees (32%) in the Sirenia Project included Palm Beach County within their annual range. These manatees were fairly representative of the study population in that the majority of the manatees were female (N=20) and all were adults. Tagged manatees were found to utilize almost all of the County's coastal waterways (**Figure 11, separate Appendix of Figures**) and at least some were within the County during each month of the year. However, the vast majority of tagged manatee locations (approximately 89%) were recorded within northern Palm Beach County, between Jupiter Sound and north Lake Worth Lagoon.

Additionally, most of the manatees (N=13) were medium-distance migrants that moved between winter habitat in South Florida and summer habitat in central Florida. On average, only approximately 2.6 percent (Std. Dev. = 1.77%) of the total location readings for each individual Central-South migrant occurred within Palm Beach, with the remainder of the time being spent either farther south or farther north. Several manatees ranged only as far south as the Palm Beach Inlet, presumably to utilize the warm water discharge of the FPL Riviera Power Plant. This would seem to indicate that for manatees employing this migratory strategy, Palm Beach County is used either primarily as a migratory corridor or represents the extreme southerly limit of some individual's range and is used only briefly during the winter. These conclusions are based on a low sample size and may be different if the sample size was greater.

Of the remaining manatees occurring within the County, short and long distance migrants accounted for three manatees each. For the short-distance migrants, an average of approximately 23.6 percent of their total location readings were in Palm Beach; however, they displayed considerable variation (Std. Dev. = 12.6%). These manatees spent the majority of their time within central Florida (north of PBC). Only one ever traveled farther south than the FPL Riviera Power Plant, occasionally venturing to the southern portion of the County in late summer or fall.

Long-distance migrants spent comparatively little time in the County (1.7% of individual total readings), occasionally making very brief migratory stopovers on their way farther south or north. The remaining six manatees that traveled into Palm Beach either employed variable migratory strategies during different years or were not tracked long enough to reliably categorize. No manatees in the study were categorized as year-round residents of Palm Beach County.

Palm Beach County Manatee Protection Plan

The preceding analysis aside, it is difficult to make blanket assumptions about manatee movements and distribution within the County using the telemetry data. Individual manatees varied considerably in the timing and extent of seasonal movements. To illustrate these differences, the movements of several manatees are described in more detail below (**Figure 12, separate Appendix of Figures**). The individuals selected are generally representative of the tagged animals occurring in Palm Beach, and cover the full range of seasonal movement patterns observed in the study population as a whole.

C-Cow (TBC-09). C-Cow was a medium-distance migrant that typically ranged between Port Everglades (Broward County) and the Cape Canaveral area (**Figure 10, separate Appendix of Figures**). C-Cow included Palm Beach County in its range during most years, with an average of approximately 2.5 percent of its location readings recorded within the County. C-Cow generally spent only brief periods in the County, and only between October and March. Over the course of eight consecutive tracking years, this manatee utilized essentially all of the coastal waterways within the County except the Loxahatchee River, although there was no readily apparent recurrent use of any particular area from year-to-year. C-Cow used Palm Beach primarily as a migratory travel corridor. Freshwater sites and seagrass areas within Palm Beach County were used during temporary migratory stopovers.

Sonny (TRB-01). Sonny was tracked in Palm Beach County for six consecutive years and was present between December and March only. Sonny was a medium-distance migrant that never traveled south of the Palm Beach inlet, and migrated as far north as the Titusville area in north Brevard County. About 4.0 percent of Sonny's location readings were recorded within PBC. Specific areas of high and recurrent use included the vicinity of the FPL RPP and the seagrass beds southeast of Munyon Island, within the north Lake Worth Lagoon. Sonny used Palm Beach County primarily as a thermal refuge during the winter and also frequented the seagrass areas within the vicinity of the power plant.

Moon (TBC-03). Moon was another medium-distance migrant that utilized all of the County's coastal waterways (except the Loxahatchee River) in varying years between the months of December and February. About 3.6 percent of Moon's total location readings were recorded within Palm Beach County. Although the maximum range of this manatee was between Port Everglades and the St. Augustine area (Flagler County), it only rarely moved north of Brevard County. Moon utilized the areas

Palm Beach County Manatee Protection Plan

around the FPL RPP and Munyon Island on a fairly consistent basis. Moon also utilized the south Lake Worth Lagoon in the vicinity of the Boynton Inlet extensively during February of 1991; however, it showed no affinity to this area in other years. It appears that for Moon, Palm Beach County is primarily a migratory corridor; however, significant time was spent around thermal refugia and seagrass areas in some years.

Pamela (TBC-37). Pamela is a short-distance migrant who spent a comparatively large percentage of time in Palm Beach County (approximately 30.2% of total location readings). Its total range was from the Palm Beach Inlet north to the Sebastian Inlet within Indian River County. During the two years this manatee was tracked in the County, its location readings were nearly always concentrated within the north Lake Worth Lagoon, particularly within the vicinity of Munyon Island and the John D. MacArthur Beach State Park. Pamela was present generally within the cooler months (between December and April), but briefly visited Jupiter Sound and the Loxahatchee River in June 1992. Interestingly, trips to the FPL Riviera Power Plant by Pamela were extremely rare, even though Palm Beach County represented its winter habitat. In February and March 1993, Pamela did make repeated daily trips between the Lake Worth Lagoon and South Lake within the Earman River, lending support to the hypothesis that this area serves as a thermal basin.

Ross (TFP-04). Ross spent the most time in Palm Beach County of any of the tagged manatees (34.7% of total readings). A short-distance migrant, this manatee ranged from the Hillsboro canal in Boca Raton, northward to the Titusville area in Brevard County. Ross' foray into south Palm Beach County was brief and was limited to several days in September of 1992; otherwise, it never traveled further south than the Boynton Inlet. Within Palm Beach County, Ross primarily utilized the Loxahatchee River system and Jupiter Sound area. It also spent significant time in the north Lake Worth Lagoon. As a migrant manatee, Ross' annual movements were contrary to the stereotypical manatee movement pattern (i.e., summering in central Florida and wintering in southern Florida). Ross was present in Palm Beach County during all months except April, and seemed to prefer the County in the warm season, when approximately 73% of its total County location readings were recorded. Although Ross occurred within the County on a year-round basis, it was not considered to be a true year-round resident. In comparison to other manatees, Ross did not appear to utilize a restricted seasonal core area, as inter-seasonal movements were often made over its entire range. Even in the coldest months (January

Palm Beach County Manatee Protection Plan

and February), Ross typically traveled between the Palm Beach Inlet and Sebastian River in Indian River County, a distance of approximately 125 km.

Diane (TNC-01). As a long distance migrant, Diane spent comparatively little time in Palm Beach County (approximately 3.5% of total location readings) during its tracking period. Its annual range extended from Port Everglades to the St. Mark's River in Georgia. It appears that during the tracking period, Diane utilized Palm Beach only as a travel corridor. In two out of five years, Diane wintered in the Port Everglades vicinity (within Broward County). In the other years, it wintered primarily within Brevard County. This manatee was a particularly large individual and perhaps had a relatively high tolerance to cold temperatures, enabling it to winter in more northerly areas. During forays into Palm Beach, Diane utilized three areas as brief temporary stopovers: Jupiter Sound, south Lake Worth Lagoon, and Lake Wyman in Boca Raton.

4. Synopsis of Abundance and Distribution Data

Location data from the aerial distributional surveys, synoptic surveys, and telemetry was combined using the Spatial Analyst extension of ArcGIS® (Environmental Systems Research Institute, Inc.) to generate a total surface density of manatees within the coastal waterways of Palm Beach County (see Section VI. for a detailed description of the analysis). Since the aerial distributional surveys provide the most comprehensive information regarding relative abundance and seasonal distribution, this data set was given twice the weight of the other two data sets in calculating the cumulative total. The resultant map shows the total relative density of manatees per square mile within the County for all years, survey flights, and telemetry locations combined (**Figure 13, separate Appendix of Figures**). However, this data does not necessarily represent the resident population of manatees, but refers to distributional patterns and relative abundance.

Geographic areas of particularly high use by manatees correspond to the north and south Lake Worth Lagoon, Jupiter Sound, C-17 and C-18 Canals, and Lake Wyman within Boca Raton. High relative abundance in these areas is likely due to the presence of foraging habitat, warm water refugia, freshwater sources, or all three. Areas with relatively few resources that might attract manatees, such as the central Lake Worth Lagoon, Northwest Fork of the Loxahatchee River, and narrow artificial

Palm Beach County Manatee Protection Plan

waterways such as Lake Worth Creek, support the lowest density of manatees. Based upon the review and analyses of the relative abundance and distribution data sets, the following general observations can be made regarding the occurrence of manatees within PBC:

- Manatees are present year-round and utilize nearly all of the marine, estuarine, and freshwater bodies that are physically accessible;
- The northern approximately one-third of the County supports the greatest relative abundance of manatees;
- Approximately three and a half times as many manatees are present during the winter season (December through March) than during the warm season (April through November);
- Population increases during the winter are largely the result of emigration of manatees from summer habitat within central Florida;
- During the winter season, when manatees are most abundant, the north Lake Worth Lagoon represents the primary manatee habitat within the County;
- The presence of the FPL RPP is a dominant feature, which heavily influences the distribution of manatees in the winter, and represents the southern extent of the annual range of some individuals;
- The Atlantic subpopulation is highly migratory, and Palm Beach County serves as an important travel corridor between summer and winter habitats; and,
- During the warm season, manatees are distributed more evenly throughout the County, albeit in lesser numbers.

5. Manatees in Lake Okeechobee

Lake Okeechobee is the second largest freshwater lake lying entirely within the contiguous United States. It covers 730 square miles within a five-county region and possesses a water storage capacity of 1.05 trillion gallons (USACE 1999). The lake is shallow (mean depth of approximately 9 feet) and eutrophic. The southeast quadrant of the lake, an area of approximately 250 square miles, falls within the geographic boundary of Palm Beach County.

The waters of the Lake Okeechobee are subject to a number of competing uses, some of which are consumptive. For example, the lake is the primary source of urban drinking water for South Florida and

Palm Beach County Manatee Protection Plan

is a primary source of water for agricultural irrigation during dry periods. In addition, the lake is used for navigation, provides flood control for South Florida, supports important recreational and commercial fisheries, provides water to the Everglades, and supports habitat for rare wading birds and migratory waterfowl (USACE 1999). Manatees, although primarily marine and estuarine creatures, are also known to inhabit the lake.

There is no direct access for manatees to Lake Okeechobee through Palm Beach County. Both the C-51 Canal and the Hillsboro Canal interconnect with the lake, however coastal manatees are not capable of bypassing the water control structures within either canal. Most manatees enter and exit the lake through either the St. Lucie Canal (C-44) on the east coast in neighboring Martin County or the Caloosahatchee River (C-43 Canal) on the west coast. Once in the lake, some manatees occasionally are able to pass through outlet structures (S-351, S-352, and S-354) and culverts (C-10A) at the southeast quadrant of the lake and enter the canal systems within western Palm Beach County (CERP Interagency Manatee Task Force 2004). Canals presently accessible to manatees in the western portion of the County include the L-8, L-10, L-14, L-20, and L-25.

In comparison to the coastal areas of Palm Beach County, relatively little information is available to characterize the abundance or distribution of manatees in Lake Okeechobee. Annual synoptic surveys in Palm Beach County do not include the lake, and to date no comprehensive aerial manatee surveys have been conducted there. Also, no manatees tagged along the Atlantic Coast as part of the USGS Sirenia project have ever traveled to Lake Okeechobee. Nevertheless, manatees from the Atlantic subpopulation have been documented in the lake through various anecdotal sightings and from carcass recovery and rescue events conducted by FWC, as discussed below.

At least one manatee identified as an east coast manatee from photo-identification studies (USGS ID number BC299) has been observed within the lake, and a manatee rescued by FWC in the lake had previously been observed wintering at the FPL Riviera Power Plant (CERP Interagency Manatee Task Force 2004). Nonetheless, the extent to which east coast manatees travel to the lake is not clear. In 2003, manatees were observed 162 times moving through the Port Mayaca lock (both directions), which controls access to the lake from the St. Lucie canal (USACE Lock Tender Logs 2003). However, there is no way to ascertain the actual number of individual animals, as the same individual may have been

Palm Beach County Manatee Protection Plan

counted numerous times. Because of its shallow waters and the manatee's sensitivity to cold stress, it is likely that most animals utilize the lake primarily during the summer and leave during the winter as water temperatures start to decline.

Manatees are migratory animals capable of making directed long-distance movements between summer and winter ranges. As such, manatees that travel to Lake Okeechobee may do so purposefully to take advantage of the lake's resources during the warm season. The Lake contains an extensive littoral zone that occupies approximately 180 square miles (Milleson 1987) and another 125 square miles of near-shore zone capable of supporting submerged aquatic vegetation (SAV). SAV normally covers thousands of acres of near-shore area within the lake (SFWMD 2004). SAV within Lake Okeechobee consists of vascular plants such as hydrilla (*Hydrilla verticillata*), eelgrass (*Vallisneria americana*), coontail (*Ceratophyllum demersum*), and southern naiad (*Najas guadalupensis*), and macroalga such as muskgrass (*Chara* sp.). These types of vegetation are consistent with food items utilized by manatees in other natural freshwater systems (CERP Interagency Manatee Task Force 2004).

D. Manatee Mortality

1. Introduction

In Florida, there has been a clear increase in the number of manatee deaths over the last quarter-century (FWS 2001). Manatees are subjected to a variety of threats, both human and non-human related. Red tide, disease, and cold stress are among the natural causes of mortality. Human activities affect manatees both directly and indirectly. Watercraft strikes, entanglement in or ingestion of fishing line and gear, poaching, and crushing in water control structures are among the direct impacts. Indirect impacts result from activities that degrade manatee habitat, such as dredging, water quality degradation resulting from coastal development, loss of warm water refugia, and propeller scarring of seagrass beds. This section describes the causes and spatial distribution of mortalities documented within Palm Beach County, and discusses observable trends in the number or location of mortality types (**Figures 16 and 17a-f, separate Appendix of Figures**).

Palm Beach County Manatee Protection Plan

2. Palm Beach County Mortality

a. Overview

Information on mortality within Palm Beach County is derived from FWC's manatee salvage and rescue program, which has recorded information on the location, time of year, and cause of manatee deaths since April 1974. Mortalities are assigned by FWC to one of nine categories:

- Category 1: Watercraft-related
- Category 2: Floodgate/canal lock
- Category 3: Other human-related
- Category 4: Perinatal (dependent calf)
- Category 5: Cold stress
- Category 6: Other Natural
- Category 7: Carcass verified but not recovered
- Category 8: Undetermined (too decomposed)
- Category 9: Other undetermined.

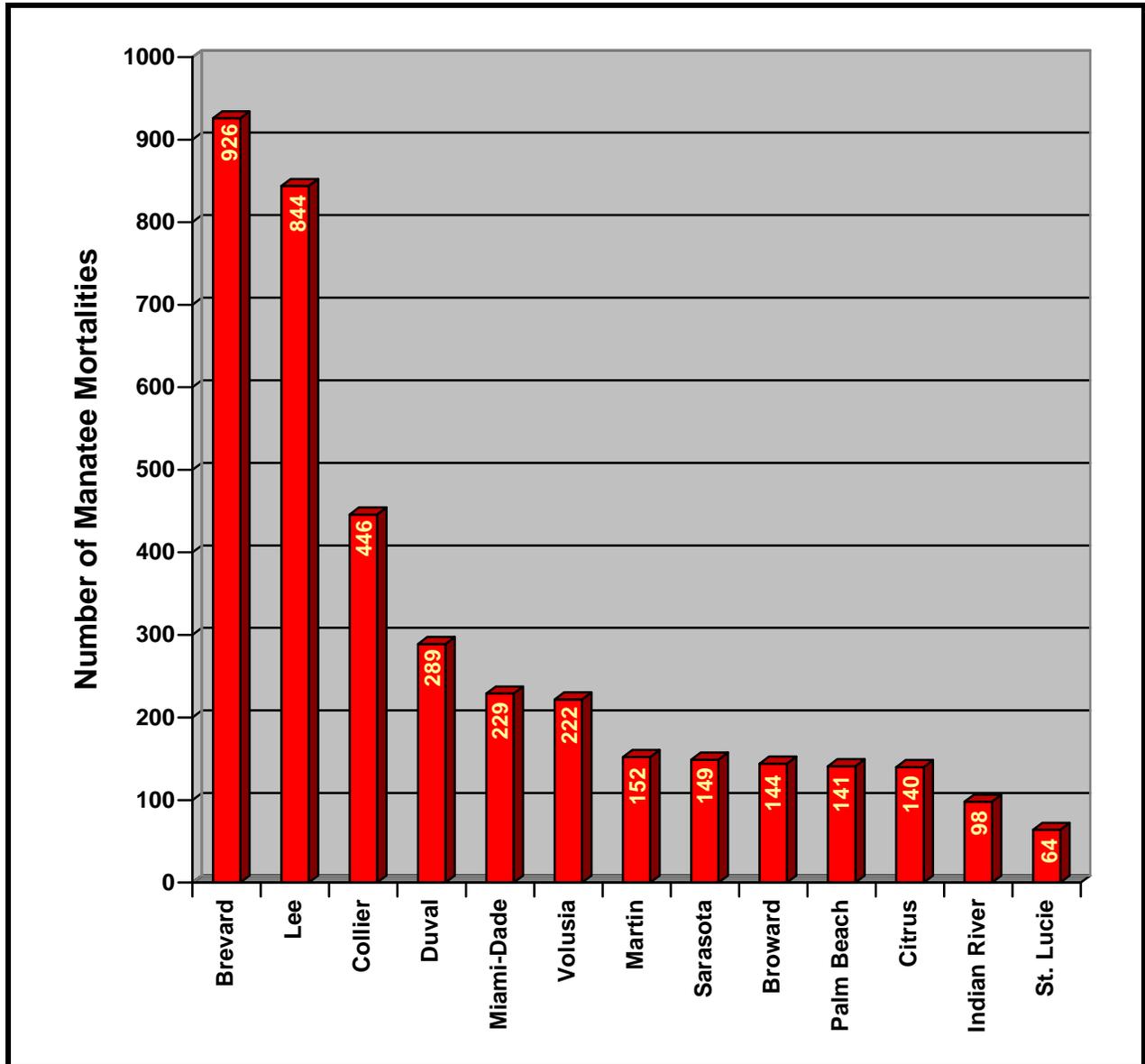
All of the analyses contained in this section are derived from data collected between April 1974 and December 2003. During that period, Palm Beach County accounted for 2.8 percent (n=141) of the total confirmed manatee deaths (n=5,053) throughout the State. **Figure 14** shows all manatee mortality in Palm Beach County in comparison with Florida's other 12 key counties. Palm Beach County ranks tenth among the 13 key counties, accounting for approximately 3.7 percent of total recorded manatee deaths.

Manatee mortalities have been documented in Palm Beach County nearly every year since 1976, with total annual counts ranging from zero to 14 (**Figure 15**). It is apparent that overall mortality within Palm Beach County has increased during recent years. From 1999-2003 there was an annual average of 10 total mortalities documented within the County, whereas during the previous five years (1994-1998) there was an annual average of only 5.4 mortalities. This increase is largely due to an increase in the number of watercraft-related, perinatal, and cold stress deaths.

Palm Beach County Manatee Protection Plan

On an annual basis, the relative contribution of the various causes of mortality to total mortality has varied considerably (**Table 5**). However, the largest single cause of documented mortality results from collisions with watercraft. Since mortality statistics have been kept, approximately 39 percent of all mortalities in Palm Beach County have been firmly attributed to watercraft strikes. This is above the State average of approximately 25 percent. Some manatees whose deaths were assigned to “undetermined” may also have been struck by boats, so the percentage of watercraft-related deaths is probably conservative. Approximately six percent of mortalities have been attributed to other human causes. Perinatal deaths (the death of newborn or dependent calves) have accounted for approximately 13 percent of all mortalities. Most of these deaths likely result from natural causes; however, watercraft-related injuries to pregnant or nursing mothers may also underlie perinatal deaths (FWS 2001).

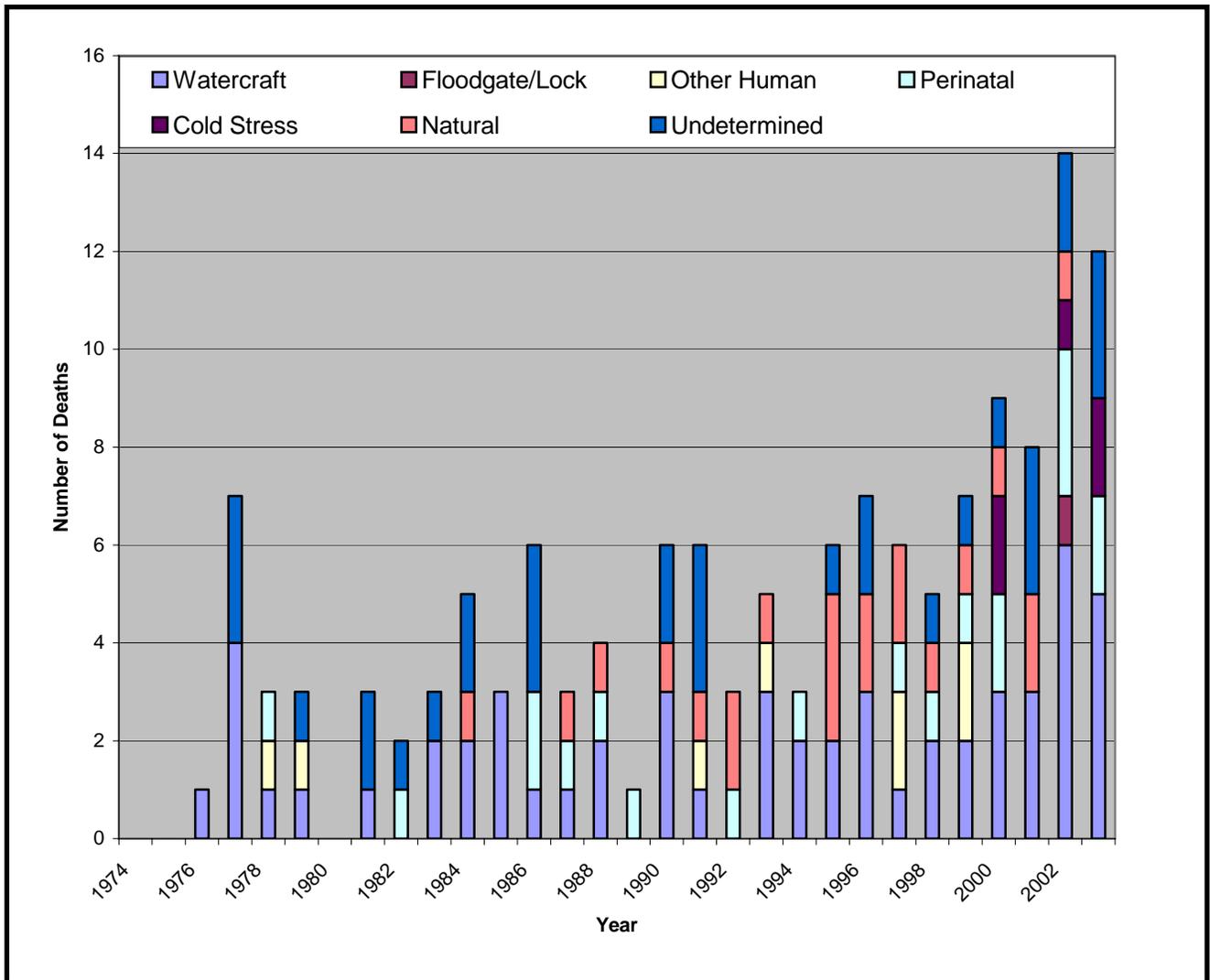
Figure 14 – Total Manatee Mortality among the 13 “Key” Counties, 1974-2003



Source: FWRI/FWC

Palm Beach County Manatee Protection Plan

Figure 15 - Mortality in Palm Beach County, 1974-2003



Source: FWRI/FWC

Palm Beach County Manatee Protection Plan

Table 5 - Summary of Mortality in Palm Beach County, 1974-2003

Waterway Segment	Gate or Lock	Other Human	Perinatal	Cold Stun	Other Natural	Undetermined	Watercraft-related		Total by Waterway
							Pre-speed zone	Post speed zone	
Loxahatchee River						1	2	1	4
Jupiter Sound					6	6	3	7	22
Lake Worth Creek		3	8	1	3	3	1	4	23
North Palm Bch Waterway		1	1	1			1	1	5
Lake Worth Lagoon – north		1	2	4	5	7	6	8	33
Lake Worth Lagoon – central					1	1	0	1	3
Lake Worth Lagoon – south		2			1	4	3	3	13
Intracoastal (Boynton-Delray)		1	1		1		2	1	6
Intracoastal (Delray – Boca)		1	6		1	2	2	6	18
Atlantic beaches			1			1	2	1	5
Okeechobee & Inland canals	1			1		7	0	0	9
Total by Mortality Type	1	9	19	7	18	32	22	33	141
Percent Mortality by Type	0.1	6.4	13.5	5.0	12.8	22.7	15.6	23.4	100.0
Mean Annual Mortality by Type¹	0.03	0.30	0.63	0.23	0.60	1.07	1.22²	2.75³	4.70

¹Unless otherwise specified = 30-year average; ² = 18-year average; ³ = 12-year average.

Palm Beach County Manatee Protection Plan

The distribution of the 141 manatee carcasses recovered in Palm Beach County from 1974 through 2003 is shown in **Figure 16 (separate Appendix of Figures)**. The mortality data confirms that manatees use nearly all of the County's coastal waterways throughout the year (**Table 6**). Thirty-four percent (n=48) of manatee deaths were documented between April and October, outside the typical winter period when manatees frequent the warm waters around the power plants.

The distribution of manatee mortalities appears to be related to some degree to geographic patterns of overall manatee abundance. Areas of low manatee abundance, such as the Loxahatchee River and central Lake Worth, had very few mortalities. Both watercraft-related and other mortalities were highest within the north Lake Worth Lagoon, which corresponds to the area of the County where manatee abundance is highest. This area accounted for approximately 23 percent of total mortality. Other areas of relatively high mortality include Lake Worth Creek and Jupiter Sound. Although manatees typically do not aggregate within these waterways, they do fall within a heavily used seasonal migratory corridor. Within Lake Worth Creek, a relatively high percentage (35%) of mortality was attributed to the perinatal category. These carcasses were mainly recovered from interior canal systems associated with large residential communities such as Admiral's Cove, Jonathan's Landing, and Frenchman's Creek (**Figures 17a-f, separate Appendix of Figures**). Perinatal deaths were also high within the Intracoastal Waterway between Delray Beach and Boca Raton, an area with a large number of isolated finger canals that may serve as calving or nursing areas.

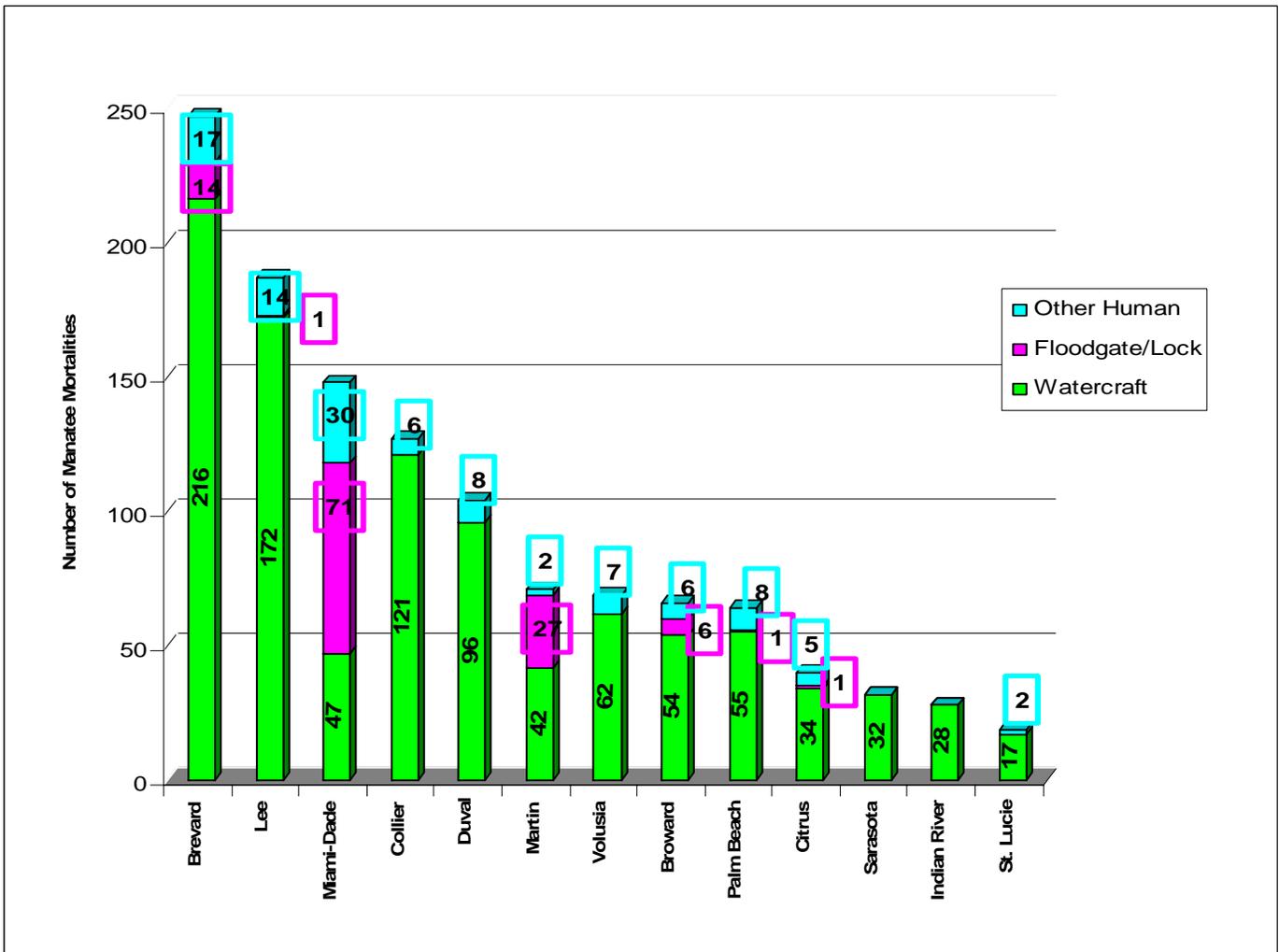
b. Watercraft-Related Mortality

The FWC has categorized Palm Beach County as a relatively high-risk area for watercraft-related mortality based on the average annual number of watercraft-related deaths. During the 10-year period ending in 2003, the County experienced an 81 percent increase in watercraft-related mortalities over the previous 10-year period (1984-1993). Palm Beach County currently ranks ninth in total human-related mortality among the 13 key counties and sixth in the total number of watercraft-related manatee deaths (**Figure 18**). Since data has been systematically collected and up to 2003, 55 manatees have verifiably died from boat collisions in Palm Beach County waterways. However, among the 13 key counties, Palm Beach County is ranked first when considering watercraft-related deaths as a portion of total mortality.

Palm Beach County Manatee Protection Plan

Locations of watercraft-related mortalities are shown in **Figures 19a-e** (separate Appendix of **Figures**). Maps of the spatial distribution of recovered carcasses should be approached with caution: locations represent points of recovery, not necessarily points where animals expired or were initially struck. Manatees can swim relatively long distances with severe injuries before expiring. Therefore, recovery location has limited value in determining areas of high risk for boat strikes. In Palm Beach County, however, areas of recovery may be more accurate than in other counties for two reasons. First, the County is highly developed, and carcasses are likely to be reported relatively quickly upon initial discovery, thus reducing recovery/response time. Second, the County's relatively narrow inshore waterway probably limits the ability of a carcass to drift a great distance in a short time. Note that nearly 55 percent of watercraft mortalities have occurred during January and February (**Table 6**).

Figure 18 - Human-related Manatee Mortality among the 13 "Key" Counties, 1974-2003



Source: FWRI/FWC

Palm Beach County Manatee Protection Plan

Table 6 - Monthly Breakdown of Manatee Mortality by Type, 1974-2003

Mortality Type	Number of Mortalities by Month												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
Watercraft	17	13	4	2	6	1	0	1	1	3	1	6	55
Natural	5	6	1	2	0	1	1	0	0	1	0	4	21
Perinatal	2	2	0	1	2	1	4	3	1	0	2	1	19
Undetermined (too decomposed)	0	4	6	3	0	2	1	0	0	0	0	3	19
Undetermined (other)	2	5	0	1	0	0	0	0	0	0	1	2	11
Human (other)	1	1	1	0	2	2	1	0	0	0	0	0	8
Cold Stress	0	2	1	0	0	0	0	0	0	0	0	2	5
Verified, not recovered	0	0	2	0	0	0	0	0	0	0	0	0	2
Gate/Lock	0	0	0	1	0	0	0	0	0	0	0	0	1
TOTAL	27	33	15	10	10	7	7	4	2	4	4	18	141

Source: FWRI/FWC

Manatees are most likely to be struck by boats in areas where overlap between manatee and boat traffic is greatest. Watercraft-related mortalities were highest (25% of total) in the north Lake Worth Lagoon, and particularly within the vicinity of Peanut Island, the Port of Palm Beach, and the FPL Riviera Power Plant. This area is the nexus of boat and manatee activity within the County. Manatees are attracted in large numbers during the winter to the FPL facility, and this area also contains very high densities of boat slips, large vessel traffic associated with the Port, extensive mooring areas, and two very popular boating destinations (Peanut Island and the Palm Beach Inlet). It is also likely that manatees struck in other areas may be traveling to the RPP where they eventually die. Other areas of the County that had relatively high watercraft-related mortalities include Jupiter Sound and the Intracoastal Waterway between Delray Beach and Boca Raton.

Boat safety speed zones have been in place in Palm Beach County since 1991 (68D-24.017, FAC), and cover approximately 16.3 miles (14.6%) of the waterway. Manatee protection regulations were first

Palm Beach County Manatee Protection Plan

established in parts of Palm Beach County in 1979. These zones, as well as additional zones that were added in 1983, were only in effect during the winter months. A countywide rule for Palm Beach County was adopted in December 1990, with sign posting substantially completed in November 1991. In determining the effectiveness of vessel speed restrictions in Palm Beach County, it may be instructive to compare the number of watercraft-related mortalities that occurred prior to the posting of speed zones to those that have occurred subsequent to those postings. Twenty-two (22) mortalities were reported in the 18 years before speed zones were established (average 1.2 per year), while 33 have been reported since that time (average 2.7 per year). This represents a substantial increase in mortality since the speed zones went into effect. However, the contribution of watercraft-related mortality to total mortality has actually decreased slightly following the implementation of speed zones (before = 41% of total mortality; after = 38%). In addition, increases in watercraft-related mortalities are most dramatic in waterways that have relatively few slow or idle speed zones, such as Lake Worth Creek and the Intracoastal Waterway between Delray Beach and Boca Raton (**Figures 19a-e, separate Appendix of Figures**). These narrow areas typically have speed zones within 50 feet of either shoreline; however, the main channel has a 25-30 mph limit, depending on time of year.

Increases in watercraft-related mortalities may reflect increasing numbers of manatees within the Atlantic subpopulation, a low level of compliance with speed zone restrictions, lack of law enforcement, poor signage, and/or inadequate speed zones. Because there is no method by which to control for the many variables contributing to watercraft-related manatee deaths, it is difficult to assess the effect of any one variable, such as presence or absence of speed zones, on manatee mortality. Moreover, since 1995, the number of vessels registered in Palm Beach County has increased by about 30 percent (**Table 7**).

Palm Beach County Manatee Protection Plan

Table 7 – Palm Beach County Vessel Registrations, 1995 - 2004

Palm Beach County Vessel Registration, FY 1995/1996 through 2003/2004								
1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04
33,216	33,639	34,109	35,024	59,450*	37,996	40,677	42,475	43,339
Palm Beach County Watercraft-related Manatee Deaths, 1995-2003								
1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04
2	1	3	2	2	4	6	3	4
Palm Beach County Total Manatee Deaths, 1995-2003								
1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04
5	6	7	4	8	11	12	10	9
Percent increase in vessel registration FY 1995/96 to 2002/03 = 30 percent								
* Anomaly due to procedural changes in vessel registrations								
Data collected is representative of fiscal year July 1 – June 30 to compare deaths with trends in vessel registration								

Source: FWRI/FWC; Florida Department of Highway Safety and Motor Vehicles.

Palm Beach County Manatee Protection Plan

III. HABITAT PROTECTION

A. Introduction

Five categories of habitat requirements for the Florida manatee have been recognized by State and Federal agencies: 1) warm water refuges for shelter during periods of cold winter weather; 2) feeding areas near warm water refuges; 3) freshwater sources; 4) quiet sheltered areas for normal behaviors such as resting and cavorting (i.e., social interactions such as mating); and 5) travel and migratory corridors connecting the above habitat elements. All of these habitats exist to some extent within Palm Beach County. Protection of existing manatee habitat is essential to the survival of the species. This section describes the availability of these habitat features within the County, and then discusses the existing and ongoing measures that have been implemented to protect manatee habitat. While this MPP incorporates the protection of manatee habitat within the boat facility siting policy, recommendations regarding site-specific impacts to habitat resources will be implemented during the State and Federal environmental permitting process.

B. Warm Water Refugia

Manatees are a sub-tropical species and the southeastern United States represents the northern limit of their range. Water temperatures that fall below approximately 68°F (20°C) will elicit a physiological and behavioral reaction from manatees (Irvine 1983; Worthy 2000), and Hartmann (1979) indicated that manatees become thermally stressed at temperatures below 64°F (18°C). Research indicates that their inability to withstand cold water may be a result of a low metabolic rate combined with a high thermal conductance (Worthy 2000). During the winter, nearly all of Florida's coastal waters reach temperatures that are stressful, and potentially fatal, to manatees (WWTF 2004). In PBC, for instance, approximately four percent of total County manatee deaths have been attributed to cold stress, though these animals may have encountered cold water on their way to Palm Beach County refugia (FWC 2003). As a result, when water temperatures start to cool, manatees generally begin migrating to southern waters and actively seek natural or artificial warm water refugia (i.e., areas with higher than ambient water temperatures).

Palm Beach County Manatee Protection Plan

Warm water refugia in Florida consist of natural artesian springs, warm water basins (both natural and artificial), and heated effluent from industrial plants. Large winter aggregations of manatees are consistently observed at these various warm water sites from year to year, and manatees often return to the same winter refugia each year (Powell and Rathbun 1984; Deutsch 2003). During mother/calf pairing, mothers likely teach the calves where and when to seek out warm water refugia (O'Shea and Shane 1985). During the winter months, manatees stay close to their warm water refuges during the morning and leave in the afternoon to feed on neighboring seagrass beds when water temperatures are highest (WWTF 2004).

The interagency manatee Warm Water Task Force (WWTF), formed under the provisions of the *FMRP*, has concluded that “the most critical factor upon which the continued existence of the Florida manatee depends is the maintenance of warm-water habitat” (WWTF 2004). Historically, warm water sources in the form of heated industrial discharge have influenced the migratory patterns and altered the natural winter range of manatees. This dependence on artificial refugia places manatees at risk, should industrial plants cease to operate or convert to a technology that does not require continuous intake and withdrawal of cooling water.

Palm Beach County contains one major warm-water site, namely FPL's RPP. This facility is located along the western shore of Lake Worth Lagoon approximately 0.4 miles south of Peanut Island and the Palm Beach Inlet and immediately south of the Lake Worth Inlet. The Riviera facility has been in operation since 1946 and currently has two operational units (Units 3 and 4) with a combined maximum output of 580 megawatts of electricity (FPL 2004). Cooling water obtained from the Lake Worth Lagoon is passed through the condensers for Units 3 and 4 and then returned to the lagoon via buried pipelines that extend seaward approximately 3,000 feet. A small discharge canal that previously serviced Units 1 and 2, both of which have been decommissioned, is located along the south side of the plant.

Warm water discharges at the plant are regulated by the facilities' State Industrial Wastewater Permit (DEP Permit Number FL0001546), which also incorporates Federal discharge requirements as part of the National Pollutant Discharge Elimination System (NPDES) Program. As a condition of this permit, from November 15 to March 15 each year, FPL is required to siphon off a portion of the heated effluent from Units 3 and 4 and divert it into the abandoned Unit 1 and 2 discharge area. As a consequence, the

Palm Beach County Manatee Protection Plan

water surrounding this discharge area is generally warmer than adjacent ambient waters of the lagoon, creating a warm water refugia for manatees. Although the location of this de facto warm water refuge is not ideal given its close proximity to boat traffic within the Intracoastal Waterway (located 250 feet east) and Port of Palm Beach (located 600 feet north), any alteration of this configuration would require both Federal and State approval via modification of FPL's wastewater permit.

FPL records water temperatures at the cooling water intake structure (i.e., the ambient water temperature) and the discharge structure for each unit. Daily water temperatures for the power plant were provided by FPL and analyzed over a five-year period (1999-2003). Data was examined for a single day each year corresponding to the date of a synoptic aerial survey. On these days ambient water temperatures are generally coolest and manatees often aggregate in the vicinity of the RPP discharge water. Average daily ambient water temperatures were fairly consistent from year-to-year and ranged between about 71°F (21.6°C) and 73.5°F (23.1°C). The coolest individual hourly water temperature recorded on any of the five days analyzed was 69.0°F (20.6°C). Average daily water temperatures at the discharge structure were more variable and considerably higher, ranging from about 80°F (26.7°C) to 94°F (34.4°C).

The RPP has been determined to be among the most important aggregation sites because of warm water discharge, not only in Palm Beach County but also throughout Florida, because of high sightings of manatees at the plant [see Ch. 370.12(2)(g)(5), FS (2004); Carson and Ackerman, 2004]. Because of this, the designated manatee sanctuary areas include the discharges of the FPL RPP and connecting waters within one and one-half miles thereof.

Manatee usage of RPP during the winter has been well documented. As previously mentioned, for the past 26 years FPL has sponsored aerial surveys at selected South Florida power plants to document the extent to which manatees are using the facilities (**Figure 20**). Comprehensive annual data for RPP has been compiled by Reynolds (2003). **Table 8** shows the maximum number of manatees sighted during individual aerial surveys at RPP from 1977 through 2003. Data is recorded over several aerial surveys each year and typically include total number of manatees, percentage of adults vs. calves, distribution of animals, behavior (feeding or direction of travel), and weather and water conditions.

Palm Beach County Manatee Protection Plan

Table 8 – Manatee Sightings during Winter Months in Palm Beach County, 1977-2003

SURVEY YEAR	RIVIERA POWER PLANT COUNTS
1977-78	68
1978-79	99
1979-80	108
1980-81	102
1981-82	168
1982-83	98
1983-84	60
1984-85	231
1985-86	272
1986-87	107
1987-88	277
1988-89	153
1989-90	266
1990-91	202
1991-92	255
1992-93	90
1993-94	119
1994-95	249
1995-96	345
1996-97	177
1997-98	102
1998-99	64
1999-00	297
2000-01	409
2001-02	373
2002-03	479

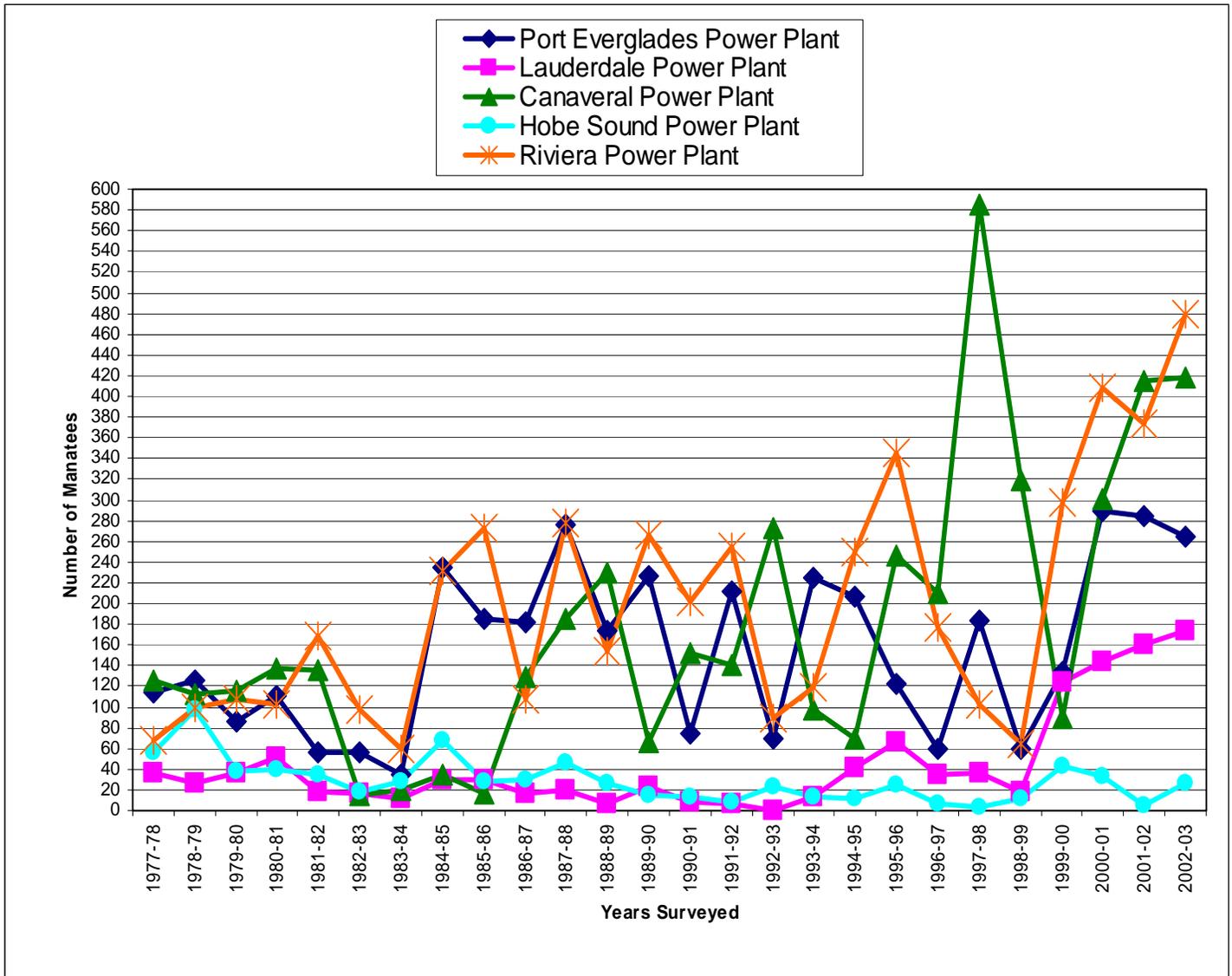
Source: *Distribution and Abundance of Florida Manatees (Trichechus manatus latirostris) Around Selected Power Plants Following Winter Cold Fronts: 2002-2003*. p. 31. John E. Reynolds, III. (Surveys conducted annually.)

Survey data for RPP in recent years indicates a trend toward increasing numbers of manatees in and around the plant. A record number of 479 manatees were counted on one aerial overflight in 2002-03. Reynolds (2003) suggests that manatee populations may be growing along Florida’s Atlantic Coast (coincidentally where a majority of FPL power plant surveys exist); however, a combination of extreme cold weather and near perfect weather conditions during the most recent flight could have contributed to

Palm Beach County Manatee Protection Plan

the high count. Record high counts were also observed at the FPL Lauderdale Power Plant during 2002-2003.

Figure 20 - Number of Manatees Sighted During Winter at Selected Power Plants in Florida, 1977-2003



Source: *Distribution and Abundance of Florida Manatees (*Trichechus manatus latirostris*) Around Selected Power Plants Following Winter Cold Fronts: 2002-2003*, p. 31. John E. Reynolds, III. (Surveys conducted annually.)

Palm Beach County Manatee Protection Plan

Although there is substantial interannual variation in the number of manatees using RPP during the winter, it is readily apparent that RPP represents a major warm water refugia for manatees. The presence of the power plant has an observable and dramatic effect on the relative abundance and distribution of manatees within the County. Surveys specific to the power plant are supported by other aerial survey data (see Section II.C.). Based on historical aerial distributional data, the manatee population in Palm Beach County more than doubles during the winter months (December-March) in comparison to the remainder of the year. Approximately 50 percent of all manatees observed in the County during the winter were in the vicinity of RPP. For comparison, only approximately nine percent of all manatees observed in the County during the other months were in the vicinity of RPP. Analysis of telemetry data shows that RPP and the north Lake Worth Lagoon represents the winter core habitat for at least some of the Atlantic subpopulation. Many manatees spending the summer in northeastern and central Florida spend part of the winter in the warm waters near the power plant.

Due to the high numbers of manatees aggregating at the RPP discharge canal during the winter, it has been designated as a “motorboat prohibited zone.” The precise boundaries and effective period of the zone are posted each year between November 15 and March 31 (FAC 68C-22.009 (1) (e)).

As previously mentioned, the loss of artificial warm water refugia represents a major threat to manatees. RPP is an older fossil fuel plant whose future is unclear, although FPL has no plans to retire RPP within the foreseeable future (Winifred Perkins, personal communication, 2004). FPL’s MPP for RPP, approved by FDEP in August 2000, contains a number of important provisions to help mitigate the temporary or permanent loss of warm water habitat. Key elements include procedures to minimize disruptions of warm water flows during the winter, response procedures in the event of a disruption, and timely notification of any long-term changes in the availability of warm water.

Other sites within the County have been identified as potential secondary warm water sites, based upon the analysis of synoptic field counts during the winter. Secondary sites include those that contain inconsistent thermal plumes or areas with no direct warm water source where thermoclines and other physical conditions slow local cooling processes thereby retaining temporary pockets of relatively warm water (WWTF 2004). These latter areas are typically deep holes or dredged basins. Secondary sites are

Palm Beach County Manatee Protection Plan

generally used predictably but not consistently. Secondary sites in Palm Beach County potentially include:

- South Lake (a small five-foot-deep embayment south of North Lake Boulevard and interconnected to the Earman River (C-17 Canal)). This artificial and isolated basin attracts manatees on a fairly consistent basis during episodic cold spells. The basin is bulkheaded on all sides and surrounded by residential and commercial development. Access to the basin is restricted to a small channel beneath Northlake Boulevard and flushing is likely minimal.
- C-18 Canal near Spillway S-46 (Southwest Fork of Loxahatchee River). This is a channelized waterway with steep-sided vegetated banks. The C-18 Canal is relatively deep and receives freshwater runoff through the S-46 spillway that is generally warmer than that of the Loxahatchee River during the winter (ERM 1992). In addition, thermal stratification may occur of fresh and salt waters.
- Jupiter Sound finger canal. A small artificial canal on the western shore of Jupiter Sound. The canal is bulkheaded and completely surrounded by residential development. Small groups of manatees were consistently observed within the canal during synoptic overflights. The depth and configuration of the canal and presence of a shoal at the mouth of the canal may limit flushing and result in thermal stratification.

C. Submerged Aquatic Vegetation

Manatees are herbivorous, feeding opportunistically on a wide variety of submerged, emergent, floating, and shoreline vegetation (FWS 2001). In coastal areas, they feed primarily on seagrass. However, their diet may also include macroalgae (Husar 1977; Zoodsma 1991), mangroves, and at least some forms of emergent marsh vegetation (Ledder 1986; Hurst and Beck 1988; Baugh *et al.* 1989; O'Shea and Kochman 1990; Zoodsma 1991). O'Shea (1986) observed manatees crawling partway out of the water to reach shoreline vegetation and over-hanging branches. This behavior has been observed in Palm Beach County by ERM staff at a number of locations in the County, most recently at the Peanut Island environmental restoration site where manatees were regularly grazing on *Spartina* planted near the high water line. Manatees also unintentionally ingest invertebrate organisms within seagrass beds, providing a possible source of protein (Best 1981).

Seagrasses are submersed, rooted flowering plants that typically grow within shallow estuarine and marine waters. Seagrass growth is limited by the degree of light penetration, salinity, and temperature. Aside from providing primary forage for manatees, seagrass beds are important in the nearshore marine

Palm Beach County Manatee Protection Plan

environment due to their very high productivity, promotion of sediment disposition and shoreline stabilization, and nutrient cycling capabilities. Six species of the eight south Atlantic seagrass species are known to occur in Palm Beach County (Dames and Moore 1990). Shoal grass (*Halodule wrightii*) is relatively abundant and is the most tolerant of temperature and salinity changes. Turtle grass (*Thalassia testudinum*) and manatee grass (*Syringodium filiforme*) are found less frequently and are most abundant in the north end of the Lake Worth Lagoon and Jupiter Sound. Three species of *Halophila* (*H. engelmannii*, *H. johnsonii* and *H. decipiens*) are also present. Johnson's seagrass (*H. johnsonii*), occurs in both shallow and deeper areas. Paddle grass (*H. deciphens*) and Engelman's seagrass (*H. engelmannii*) typically vegetate in deeper and more turbid areas.

Seagrass beds occurring in Palm Beach County are shown in **Figures 21 and 22a-e (separate Appendix of Figures)**. The seagrass maps are based on the analysis of aerial photographs (2001) by ERM and FWRI. Seagrass is distributed unevenly throughout the coastal areas of the County. Extensive seagrass beds tend to be located near the tidal inlets, where growth is fostered by an increase in tidal circulation and water clarity. Jupiter Sound, located to the north of Jupiter Island, is a shallow embayment that contains a relatively high coverage of grass beds. The north and south portions of the Lake Worth Lagoon also contain significant seagrass beds within the vicinity of the inlets. Within the north Lake Worth Lagoon, nearly continuous seagrass beds are present from south of the Palm Beach inlet to north of Munyon Island. Continuous seagrass beds can be also found on the western shores of Lake Worth Lagoon from Lake Worth Avenue south to Boynton Beach Inlet.

Within southern Palm Beach County, seagrass beds are primarily located within Lake Wyman, a shallow embayment within the Intracoastal Waterway in Boca Raton. Areas of the County with relatively low amounts of seagrass are generally distant from inlets, relatively deep, and/or contain unfavorable salinity regimes due to freshwater input. These areas include the northwest and southwest forks of the Loxahatchee River, Lake Worth Creek, the central Lake Worth Lagoon, and the Intracoastal Waterway between Boynton Beach and Boca Raton. Where present, seagrasses in these areas typically form a sparse fringe in shallow waters along the shore and consist of the diminutive Johnson's seagrass.

Since seagrass represents the primary forage for manatees, the presence and quality of grass beds likely influence the movement and activities of manatees within the County. A spatial analysis of the overall

Palm Beach County Manatee Protection Plan

abundance of manatees within the County suggests that this is indeed the case. The highest areas of manatee relative abundance correspond to waterways with extensive seagrass beds. Seagrass beds within north Lake Worth Lagoon are particularly important as foraging habitat during the winter when manatees seek thermal refuge at the FPL RPP.

Further support of manatee utilization of seagrass beds in Palm Beach County can be gleaned from the aerial survey data collected by ERM and FWRI between 1990 and 1993. During the overflights, the geographic location of obvious feeding activity was recorded. When manatees feed they disturb bottom sediments, leaving a distinctive signal to aerial observers. It is evident that manatees are most often observed feeding in areas with extensive seagrass beds.

Seagrasses are presently threatened throughout Florida by physical damage from boat propellers, shading from moored vessels or docks, dredging and filling projects, muck sediment deposition, and degradation of water quality. Available evidence suggests that seagrass coverage within the Lake Worth Lagoon is declining. Surveys done in 1940 found 4,271 acres of seagrass within the lagoon (Harris *et al.* 1983). In 1990, Dames and Moore estimated that there was a total of only 2,010 acres of seagrass remaining within the lagoon. In 2001, 1,630 acres, or 22 percent of the lagoon bottom, was covered by seagrass. However, due to the differing methodologies used to estimate seagrass coverage, direct comparisons of coverage data between the historical studies are not appropriate. The 2001 Geographic Information System (GIS) coverage of Lake Worth Lagoon seagrasses will serve as the baseline inventory for future studies, using a standard methodology, which are anticipated to occur every five years to document large-scale changes in the resource (ERM and FDEP 2003).

Boat facilities and dredging projects can have significant potential adverse impacts on seagrass and seagrass habitat. During construction, the substrate is disturbed by installation of the pilings and water clarity declines due to siltation. Once completed, boat facilities and docks create shade that has the potential to adversely affect existing seagrass beds or prevent the establishment of new seagrass beds. Boat facilities can also have significant indirect adverse effects. Dredging immediately adjacent to docks and the associated travel corridors to and from docks may significantly affect seagrass beds if appropriate turbidity controls are not used or if water depths are not adequate. Direct and indirect impacts to seagrass should be completely avoided when possible. This can be accomplished by

Palm Beach County Manatee Protection Plan

designing projects to avoid and minimize their potential impacts to seagrasses. Adverse impacts should be minimized to the greatest extent practicable as required by state and federal permitting regulations.

A number of initiatives are underway to aid in the restoration of seagrass beds in Palm Beach County. One of the major goals of the Lake Worth Lagoon Management Plan (1998) is to “attain and maintain water and sediments of sufficient quality to sustain a healthy estuarine ecosystem” within the lagoon. Projects funded under the Lake Worth Lagoon Partnership Grant Program (LWLPGP), the West Palm Beach Master Stormwater Plan, and components of the North Palm Beach County’s Comprehensive Everglades Restoration Plan (CERP) are anticipated to improve water quality and conditions for seagrass within the County (ERM and FDEP 2003). As of March 2004, a total of 16 LWLPGP-funded construction projects have been completed, and another seven projects were under construction. These projects are designed to result in a measurable improvement to Lake Worth Lagoon and its surrounding watershed, and to date, have included the following types of projects:

- Stormwater improvements, such as wet detention, baffle boxes, and other pollution control devices;
- Upgrading septic systems to centralized sewage collection and treatment;
- Marina sewage pumpout systems;
- Artificial reef construction;
- Mangrove planters; and
- Filling dredge holes, which will eliminate muck sumps and encourage seagrass colonization.

D. Freshwater Sources

The freshwater requirements of the manatee are not well understood. Although they can apparently survive for extended periods without it (Ortiz 1994), fresh water is clearly an attractant to those animals inhabiting coastal lagoons, bays, and estuaries. Manatees often congregate at river mouths, floodgates, water treatment facilities, and other sources of fresh water and have been observed drinking from outfalls and culverts.

In some parts of Florida, freshwater springs serve as an excellent habitat for manatees, because they provide a relatively sheltered environment, a stable thermal medium, and a constant supply of fresh

Palm Beach County Manatee Protection Plan

water. There are no accessible springs or artesian wells in Palm Beach County. However, there are six major sources of fresh water that discharge into the coastal waterways of the County (**Figure 23, separate Appendix of Figures**). These serve to varying extents as attractants for manatees. In geographic sequence from north to south, they include:

1. Loxahatchee River System
2. Earman River
3. West Palm Beach Canal
4. Boynton Canal
5. Delray Canal and
6. Hillsboro Canal.

Loxahatchee River System – The Loxahatchee River Estuary is a 9,000-acre system in northern Palm Beach and southern Martin counties. It consists of three tributaries: the North Fork, the Northwest Fork, and the Southwest Fork. The estuary opens easterly into the Jupiter Inlet at its confluence with Jupiter Sound. Due to the extent of development in the region and alteration of natural drainage patterns, the Loxahatchee River drainage basin has been reduced in size over time from about 270 square miles to 210 square miles.

Freshwater from both the North and Northwest Forks of the Loxahatchee River flows naturally into the estuary; a large portion of the Northwest Fork upstream of the Martin/Palm Beach County Line has been federally designated as a Wild and Scenic River. The Southwest Fork of the Loxahatchee River has been channelized (C-18 Canal) and is equipped with a water control structure (S-46 Spillway) approximately 1.4 miles upstream of its confluence with the main body of the river. The C-18 Canal is relatively deep compared with other portions of the Loxahatchee River and contributes relatively large volumes of freshwater into the estuary. These inputs have the potential to alter the natural timing and quantity of freshwater entering the system.

Discharges of freshwater through the S-46 Spillway are greatest during the summer months (April-November), averaging approximately 54 million gallons per day (mgd) over the five-year period ending in December 2003 (South Florida Water Management District, hydrological database, 2004). Winter

Palm Beach County Manatee Protection Plan

discharges (December-March) are considerably lower (average of 7 mgd). The S-46 Spillway presents an upstream boundary to manatee movement in the Southwest Fork. However, downstream of the spillway, aerial survey data collected by FWC indicates that the C-18 Canal is inhabited by more manatees than any other portion of the Loxahatchee River System. Manatees may be attracted to both its secluded location and its freshwater character. Additionally, the depth of this portion of the river often results in bottom water temperatures a few degrees above ambient during colder months of the year. Thus, the canal may serve as a warm water refuge during winter cold fronts.

Earman River – The Earman River drains an extensive system of interior canals that serve a broad expanse of incorporated and unincorporated residential communities on the western side of the Lake Worth Lagoon within and adjacent to the towns of Lake Park and North Palm Beach. Similar to the Southwest Fork of the Loxahatchee River, the Earman River has been channelized (C-17 Canal) and is equipped with a water control structure (S-44 Spillway) near Old Dixie Highway, approximately 1.9 miles upstream of its confluence with the Lake Worth Lagoon.

The C-17 Canal was originally dredged to drain sawgrass marshes in the western part of the County for development, and it presently receives drainage from as far south as Clear Lake in West Palm Beach, as well as from surrounding natural areas and residential communities. Discharges of freshwater through the S-44 Spillway are greatest during the summer months (April-November), averaging approximately 76 million gallons per day (mgd) over the five-year period ending in December 2003 (SFWMD Hydrological Database 2004). Winter discharges (December-March) average 50 mgd. Prior to the 1990s the Anchorage Drive Sewage Treatment Plant discharged effluents to the estuarine portion of the C-17 Canal. This treated freshwater discharge is likely to have been an attractant to manatees until it was taken offline.

Freshwater discharges from the S-44 Spillway currently serve as a potential attractant to manatees. During the most recent FWC aerial surveys (1990-1993), manatees were more abundant in the Earman River than any other canal system in Palm Beach County. As many as 27 animals were observed along the river and its connecting canals and embayments during a single overflight. With the elimination of the sewage plant discharge, it is possible the attractant value of the area may have been reduced since the 1990s but there have been no surveys to confirm this.

Palm Beach County Manatee Protection Plan

West Palm Beach Canal – The West Palm Beach (C-51) Canal is located centrally in Palm Beach County and runs east/west from the SFWMD’s Water Conservation Area No. 1 (Loxahatchee National Wildlife Refuge) in western Palm Beach County to the Lake Worth Lagoon at the boundary of West Palm Beach and Lake Worth. It is a large, steeply banked canal that ranges in width from 80 to 225 feet and in depth from 12 (western areas) to 23 feet (southeast of Summit Boulevard) along much of its length. The drainage basin that contributes water to the C-51 Canal is extensive, encompassing large areas of central the County. It receives inputs from Lake Okeechobee, numerous smaller freshwater lakes, and canals within residential neighborhoods.

A spillway control structure (S-155) located about 0.6 miles upstream of the Lake Worth Lagoon prevents boaters and manatees from accessing those portions of the West Palm Beach Canal upstream of U.S. 1. Because of its large drainage basin, the S-155 Spillway discharges more freshwater into the coastal waterways of Palm Beach County than any other water control structure. As with other canals, discharges are greatest during the summer months (April-November), averaging about 360 mgd over the five-year period ending December 2003 (SFWMD Hydrological Database 2004). Discharges during the winter (December-March) are about 43 percent lower, with an average rate of 205 mgd. Despite the large volume of water discharged by the C-51 Canal, data collected during aerial surveys conducted by the FWC suggests that it is only a minor attractant for manatees. Seagrass beds to the north of the C-51 Canal appear to be the main attractant in this portion of the Lake Worth Lagoon.

Boynton Canal (C-16) and Delray Canal (C-15) – Both the Boynton (C-16) and Delray (C-15) Canals drain eastward towards the Lake Worth Lagoon and are interconnected by several interior canals and freshwater lakes. The Boynton Canal has an average depth of nine feet and ranges in width from 90 to 180 feet in the freshwater section. A water control structure (S-41 Spillway) is located on the C-16 Canal a short distance (0.3 miles) upstream of its confluence with the western shore of the Lake Worth Lagoon approximately one-half mile south of the Boynton Inlet. The canal’s drainage basin includes the E-4 canal, as well as Lake Osborne to the north. Discharges of freshwater through the S-41 Spillway are greatest during the summer months (April-November), averaging approximately 137 million gallons per day (mgd) over the five-year period ending in December 2003 (SFWMD Hydrological Database 2004). Winter discharges (December-March) are only about one-third of the summer rate (average of 47 mgd).

Palm Beach County Manatee Protection Plan

The Delray Canal (C-15) empties into the Intracoastal Waterway in southern Palm Beach County along the boundary between the cities of Delray Beach and Boca Raton. The canal averages eight feet in depth and ranges in width from about 80 to 175 feet. Its drainage basin includes the E-4 canal and Lake Ida to the north. A spillway (S-40) is located about 0.4 miles upstream of the C-15 Canal's confluence with the ICW. Discharges of freshwater through the S-40 Spillway are greatest during the summer months (April-November), averaging approximately 77 million gallons per day (mgd) over the five-year period ending in December 2003 (SFWMD 2004). Winter discharges (December-March) are only about one-quarter of the summer rate (average of 17 mgd). Both the Boynton and Delray Canals provide excellent points of refuge for manatees traveling the narrow portion of the ICW between the Boynton and Boca Raton Inlets. Manatees are attracted to both canals during the winter months, although deep interior access to the canals is blocked by the spillways.

Hillsboro Canal - The Hillsboro Canal is characterized by steep banks with an average depth of eight feet and a width of 70 to 160 feet. Its eastern portion forms the boundary between Palm Beach and Broward Counties. The headwaters of the Hillsboro Canal lie entirely within southern PBC, originating at the boundary of the Loxahatchee National Wildlife Refuge and SFWMD Water Conservation Area 2A. This western section of the canal's drainage basin receives waters from nurseries, pasture lands, and residential developments. As the canal moves further east into developed regions, drainage is mainly from urban sources.

A water control structure (G-56 Spillway) is located approximately 3.8 miles upstream of the Hillsboro Canal's confluence with the ICW. During heavy rainfall events, the SFWMD has typically released large amounts of freshwater to tide through this structure. Discharges of freshwater through the G-56 spillway are of greatest volume during the summer months (April-November), averaging 187 million gallons daily (mgd) over the five-year period ending December 2003 (SFWMD 2004). Winter discharges (December-March) are only slightly lower (159 mgd). Manatees have long been attracted to this region, utilizing the interior areas of the canal not only as a relatively constant source of freshwater but also as a potential warmer water refuge during colder times of the year. Manatees may also utilize the El Rio (E-4) Canal, a minor drainage canal which is interconnected with and extends north from the

Palm Beach County Manatee Protection Plan

Hillsboro Canal. At least one manatee (Ross) with a telemetry tag visited this area and residents have reported manatees in the El Rio Canal.

E. Resting and Calving Areas

The quiet upstream waters of interior canals and shallow water embayments typically provide important refuges for manatees, particularly during resting and calving periods. In this regard, virtually all of the County's coastal waterways contain appropriate resting and calving habitat. Several data sets are available from which inferences can be made regarding the location of resting and calving areas; however, each data set has certain limitations. These data sets include aerial distributional surveys and perinatal mortality locations.

During aerial distributional surveys performed by ERM and FWC, observers recorded the locations of all calves sighted. Approximately nine percent of all individual manatees observed were calves (any manatee less than 50 percent the size of a nearby adult). However, these individuals may or may not be neonates (calf age from birth to approximately one month of age), and calves sighted during aerial surveys may have moved with their mothers some distance away from their birthing location. Analysis of the aerial survey data shows that calves were sighted throughout the County and during all months of the year. However, calves were more abundant in the Southwest Fork of the Loxahatchee River (C-18 Canal), north Lake Worth Lagoon, Earman River (C-17 Canal), south Lake Worth Lagoon, and Lake Wyman. However, these areas also corresponded to areas of relatively high overall manatee abundance (see Section II.C.). Also, most of the relatively secluded interior canals along Lake Worth Creek were not surveyed at all. As such, the aerial distributional survey data set is not particularly helpful in identifying important calving areas.

An additional indicator of calf abundance in the waterways of Palm Beach County is the occurrence of perinatal deaths. However, this data is used with some caution, because the location where a carcass is recovered may not correspond precisely to the location where the individual died. Nevertheless, analysis of the FWC mortality database (FWC 2003) suggests that two areas of the County accounted for the majority of perinatal deaths: Lake Worth Creek and the Intracoastal Waterway between Boynton Beach and Boca Raton. Both of these areas contain a preponderance of interior canals offset from the main

Palm Beach County Manatee Protection Plan

boating channel that provide suitable habitat for calving. Manatees within these canals benefit from existing vessel speed restrictions. All interior canals within Palm Beach County are designated as year-round slow speed zones, and overall adult watercraft-related mortalities there have been comparatively low.

The locations of manatees that appeared to be resting were also identified during ERM and FWC aerial surveys. Not surprisingly, resting manatees were observed throughout the County and were typically within sheltered canals or otherwise outside of main waterway channels. Areas with a particularly high proportion of resting observations (in relation to other behavioral types) included the Loxahatchee River, C-18 Canal, Earman River, interior canals along the North Palm Beach Waterway, the vicinity of FPL's RPP, the eastern side of Hypoluxo Island, and Lake Wyman. Resting animals were rarely observed within channelized waterways such as Lake Worth Creek and the Intracoastal Waterway between Boynton Beach and Delray Beach, nor the central Lake Worth Lagoon.

F. Water Quality and Quantity

Manatees are affected both directly and indirectly by the quality of water in which they live. Manatee health may be directly affected through the release of pathogens and pollutants associated with stormwater runoff and waste water discharges. Additionally, the distribution and abundance of the manatee's primary forage (submerged aquatic vegetation) is related to salinity and other water quality patterns. Thus, manatees are indirectly affected when seagrasses are impacted by runoff and stormwater discharges.

At present, water quality within the estuarine coastal areas of Palm Beach County is highly variable. Generally, water quality is best in the vicinity of the four tidal inlets, where the water bodies are subjected to diurnal flushing and enhanced circulation. This section provides a summary of the information available on the current state of, factors affecting, and initiatives to monitor and improve water quality within the County's coastal water bodies.

Palm Beach County Manatee Protection Plan

In Chapter 17-3, FS, the State designates all surface waters in Florida into one of the following classes:

- Class I Potable Water Supplies;
- Class II Shellfish Propagation or Harvesting (harvesting contingent upon results of periodic FDEP water quality monitoring);
- Class III Recreation, Propagation and Maintenance of a Healthy, Well-Balanced Population of Fish and Wildlife;
- Class IV Agricultural Water Supplies; and
- Class V Navigation, Utility and Industrial Use.

There are separate State water quality standards for each class of surface water. These standards identify acceptable levels for a variety of constituents (e.g., nutrients, suspended solids, turbidity, dissolved oxygen, etc.). All surface waters in Palm Beach County are classified as Class III waters except as noted below:

- Class I Lake Okeechobee, West Palm Beach Water Catchment Area,¹ Lake Mangonia,¹ Clear Lake,¹ M-canal,¹ and
- Class II Loxahatchee River System west of ALT A1A/railroad trestle bridge including the North, Northwest, and Southwest Forks.
(¹not accessible to manatees)

Chapter 17-3, FS, also identifies surface waters that, due to their ecological value and/or sensitivity, are designated as “Outstanding Florida Waters” and “Outstanding National Resource Waters.” Outstanding Florida Waters (OFW) receives special protection under State law due to their natural attributes (Ch. 403.061, FS). In Palm Beach County, OFW that are accessible to manatees include:

- Waters within Loxahatchee National Wild and Scenic River Segment;
- Waters within Loxahatchee River- Lake Worth Creek Aquatic Preserve;
- Waters within John D. McArthur State Park; and
- Waters within Indian River Lagoon Aquatic Preserve (Jensen Beach to Jupiter Inlet).

Palm Beach County Manatee Protection Plan

Over the past century, water quality within the Lake Worth Lagoon (LWL) and other portions of the County has been significantly degraded by various drainage, dredging, and development projects. These projects have caused significant alterations in the timing, distribution, quality and quantity of fresh water that enters the coastal waterways. Water quality within the coastal waters, canals, and freshwater lakes of the County are mainly affected today by urban and agricultural runoff. Water quality issues associated with runoff include those related to low levels of dissolved oxygen (DO), excessive nutrients, metals (copper, mercury, and lead), elevated bacterial levels, and turbidity (FDEP 2003a).

According to the LWLMP (1998), the major issues affecting surface water quality within the lagoon include:

- Undesirable salinity fluctuations;
- Increased sediment matter loadings and sedimentation;
- Increased nutrient loading;
- Increased input of toxic substances;
- Increased levels of pathogens;
- Loss of emergent wetlands;
- Loss of submerged natural resources.

Periodic freshwater discharges into the lagoon, primarily through the C-17, C-51, and C-16, have caused extreme salinity fluctuations. The natural salinity regime in many areas of the LWL has also been affected by increasing residential and commercial development, industry, agriculture and other human land-use activities. Many aquatic organisms, such as oysters and seagrasses, are unable to tolerate these fluctuations, which sometimes occur over relatively short time periods. In addition to altering salinity regimes, freshwater discharges also introduce nutrients and suspended materials.

Fertilizers, pesticides and other pollutants find their way into estuaries via freshwater tributaries, canals, and upland run-off. Suspended materials increase turbidity and thereby decrease the amount of sunlight that reaches the bottom. Nutrients cause proliferation of phytoplankton in the water column further deteriorating water clarity. As sediments fall out of suspension, they accumulate on the bottom, sometimes forming a silty ooze over previously natural sediments. Seagrasses cannot grow on this ooze,

Palm Beach County Manatee Protection Plan

and cannot survive when covered by it. Thus, changes in drainage basin characteristics have significantly impacted the ecosystem causing the loss of oysters and submerged aquatic vegetation from large portions of their historic range.

Natural shoreline vegetation has been altered or removed throughout much of the lagoon's shoreline in PBC. It is estimated that mangroves have been eliminated from 87 percent of the original shoreline of the LWL (ERM and FDEP 1998). Mangroves provide a vital role in the maintenance of water quality by stabilizing sediments and uptake of nutrients.

The Loxahatchee River System has also suffered water quality degradation through alterations to the natural patterns of freshwater input. Hydrologic modifications and diversion of surface water that historically flowed into the Loxahatchee estuary via the C-18 Canal have reduced the amount of water the river receives. Residential and urban growth within the Loxahatchee watershed also has affected water quality in the river (FDEP 2003b). Water quality issues within the Loxahatchee basin are primarily related to low levels of dissolved oxygen, nutrients, bacteria, and impaired biology. Designation of the Northwest Fork of the Loxahatchee River as a Federal Wild and Scenic River has garnered special attention to the river but not fully protected it from urban, residential, and agricultural runoff.

While in general surface waters in Palm Beach County meet many of the applicable water quality standards for their respective classifications, improvements are needed in some areas. Pursuant to Section 303(d) of the Federal Clean Water Act, water bodies that do not meet applicable water quality standards are designated as "impaired waters." In 2004, the FDEP presented a Revised Draft Verified list of Palm Beach County water bodies that were verified impaired (**Table 9**).

Palm Beach County Manatee Protection Plan

Table 9 - Surface Waters in Palm Beach County Identified by FDEP as Impaired

Water Body	Major Causes of Failure to Meet Standards
North and South Portions of the Lake Worth Lagoon	Nutrients, copper, and mercury (in fish tissue)
C-51 Canal ¹	Iron and dissolved oxygen
C-17 Canal ¹	Nutrients, dissolved oxygen, and iron
C-16 Canal ¹	Nutrients, dissolved oxygen, and iron
Hillsboro Canal ¹	Nutrients and historic chlorophyll
¹ Not directly impacting manatees but drains into manatee habitat	

The FDEP has established requirements necessary to remove a water body from impaired status. Each water body class has many designated uses. If a particular water body or segment is able to verifiably achieve the standards for a designated use, the FDEP will propose partial “delisting” of that water body for the designated use. Recommendations include future monitoring to determine if additional designated uses are attained. As recovery and restoration efforts for impaired waters of the Lake Worth Lagoon proceed, the County has some water bodies and segments that are contained in the 2004 FDEP’s Revised Draft List of Waters to be Proposed for Delisting from the 1998 303(d) list (**Table 10**).

Table 10 - Surface Waters in Palm Beach County Identified by FDEP for Delisting

Water Body	Standards for Designated Use Attained
Portions of the Lake Worth Lagoon (Royal Palm Bridge)	Dissolved oxygen, total and fecal coliform
C-51	Nutrients, Chl-a, total and fecal coliform
C-16	Total and fecal coliform

Palm Beach County Manatee Protection Plan

During the next few years, considerable data collection and analysis will be done to establish Total Maximum Daily Loads (TMDLs) for impaired water bodies in Palm Beach County and to establish initial allocations of pollutant loads needed to meet TMDLs (the maximum amount of a pollutant that a water body can assimilate and still meet the water body's designated beneficial uses). The TMDL Program efforts in Palm Beach County will be closely coordinated with other State and Federal restoration efforts in the area.

There are numerous programs that are currently in place, under construction or in the planning stages that collectively are intended to significantly improve water quality in County water bodies inhabited by manatees. These programs include, but are not limited to:

Surface Water Improvement and Management Plan (SWIM)

Adopted by the Florida legislature in 1987, the SWIM Act required that plans be prepared by the SFWMD to address the following concerns:

- Point and non-point source pollution;
- Destruction of natural systems;
- Correction and prevention of surface water problems; and
- Research for better management of surface waters.

A number of SWIM management plans have subsequently been developed throughout the State that address water quality issues.

LWL Restoration Program

The FDEP and Palm Beach County, along with more than 170 key policy leaders representing State, local and Federal Government, formed the Lake Worth Lagoon Ecosystem Management Area team in January 1997 to devise a comprehensive management plan to restore water quality and habitat within the Lake Worth Lagoon. The first draft of the LWLMP was originally developed by ERM following the SWIM Act guidelines to identify goals and objectives for restoring the lagoon. The Lake Worth Lagoon

Palm Beach County Manatee Protection Plan

issues addressed in the management plan are divided into three categories: water and sediment quality; natural habitats; and interagency management of natural resources (ERM 1998). The three goals of the LWLMP are as follows:

- To attain and maintain water and sediment of sufficient quality (Class III or better) to sustain a healthy estuarine ecosystem;
- To attain and maintain the biological integrity of the ecosystem which supports the diversity of fisheries and wildlife, including endangered and threatened species; and
- To achieve heightened awareness and education of public and private interests through coordinated interagency management of the Lake Worth ecosystem that results in the accomplishment of the mission statement from the management plan.

These goals will be accomplished by traditional regulatory programs, adaptive management alternatives, public involvement, and cooperative management between municipalities, County, State, and Federal agencies. Through March 2004, 16 construction projects were completed and seven more are underway, funded through the Lake Worth Lagoon Partnership Grant Program. Individual construction projects include stormwater treatment, habitat restoration and enhancement, and installation of sanitary sewers.

Comprehensive Everglades Restoration Plan (CERP)

CERP is a multibillion dollar Federal and State program to restore the South Florida ecosystem, while providing flood control and enhancing water supplies. Implementation of CERP will be completed over a 35-year period. The plan will provide surface water storage reservoirs, water storage areas, aquifer storage and recovery wells, water quality treatment areas, removal of more than 500 miles of canals and levees that are barriers to natural sheet flow, new infrastructure to move water to meet restoration goals, wastewater reuse facilities, and project operational changes. The North Palm Beach component of CERP focuses on improving water quality in the Lake Worth Lagoon and the Loxahatchee River. Several major projects are collectively designed to improve regional hydrology and water quality, and provide for increased water storage within the L-8, C-51, and C-17 basins. Another CERP component, the Water Preserve Areas Feasibility Study, will improve conditions in the County's coastal waters by regulating and reducing freshwater discharges. By reducing freshwater inputs, nutrients, suspended solids, and

Palm Beach County Manatee Protection Plan

other pollutant loadings to the estuary, these programs will improve both water clarity and quality and lead to a healthier ecosystem.

South Florida Water Quality Protection Program (SFWQPP)

The South Florida Water Quality Protection Program was established in 1999 to aid in “the development and implementation of a comprehensive plan that will facilitate priority corrective actions and compliance schedules to address point and nonpoint source pollution and restore and maintain the chemical, physical, and biological integrity within the South Florida ecosystem” (FDEP 2004). The initial focus of the SFWQPP has been in addressing nonpoint source pollution resulting from watershed urbanization. The program also involves an assessment of water quality conditions and pollutant loadings to water bodies within north Palm Beach County.

Everglades Construction Project (ECF)

The ECF is a massive restoration project consisting of the construction of 12 interrelated stormwater treatment areas (STA) between Lake Okeechobee and the Everglades. The STAs will reduce the level of nutrients, and improve the volume and timing of water entering the Everglades. As a part of the ECF, water will be diverted from the C-51 canal, thus reducing harmful freshwater flows into the Lake Worth Lagoon by approximately 40 percent.

Pollutant Load Reduction Goals (PLRGs)

PLRGs are estimated numeric reductions in pollutant loadings, usually established in a SWIM or other watershed management plan, that are needed to preserve or restore designated uses of receiving bodies of water and maintain water quality consistent with applicable State water quality standards. In some cases, PLRGs may provide the scientific basis for the development of a Total Maximum Daily Load. PLRGs may also be utilized to examine historic and current conditions, establish Minimum Flows & Levels (MFLs) and water quality goals.

Palm Beach County Manatee Protection Plan

The primary purpose of PLRGs is to reduce pollutant discharges from watersheds so that the water quality in the receiving body of water meets State standards. PLRGs have been established in Lake Okeechobee for phosphorus loadings, in the Indian River Lagoon for salinity, in the St. Lucie Estuary for freshwater releases. They are presently being considered in the Lake Worth Lagoon for heavy metals, nutrients and sediment loading.

Agricultural Best Management Practices (BMPs)

Nonpoint source pollution from agricultural areas have been addressed through the development of Best Management Practices (BMPs) as authorized under the Florida Watershed Restoration Act. BMPs are designed to provide industry guidance for various agricultural activities to promote water quality and conservation objectives. There are currently a number of published BMPs that are applicable to agricultural practices within PBC.

Implementation of the various programs identified above will improve the quality of water in manatee habitat in Palm Beach County. As these programs improve water quality in the target waterways, submerged aquatic vegetation should increase in relative abundance, and therefore the foraging habitat for manatees should be enhanced. Improved water quality should also facilitate the restoration of other submerged aquatic resources. Palm Beach County will continue to work cooperatively with the agencies and community groups to assist with implementation of these programs. The County will also continue to coordinate with the State of Florida and EPA to comply with Section 303(d) of the Clean Water Act, and will continue or expand its program to identify waterways that may likely become “impaired” if restorative projects are not undertaken and continue efforts to improve these water bodies.

G. Sanctuaries and Refuges

Both the State of Florida and the Federal Government have the authority to designate specific sanctuaries or refuges where the protection of manatees requires special attention. By virtue of the FMSA, the entire State of Florida is designated a State refuge and sanctuary for the manatee (Ch. 370.12(2), FS). The FMSA and its subsequent amendments make it illegal to harm or harass manatees within Florida waters and provide for the establishment of manatee protection speed zones, motorboat-

Palm Beach County Manatee Protection Plan

prohibited zones, and no-entry zones. Through the provisions of the Endangered Species Act, the FWS may also designate certain waters as Federal manatee sanctuaries (areas where all waterborne activities are prohibited) or Federal manatee refuges (areas where certain waterborne activities may be regulated).

Although the entire State has been designated a refuge and sanctuary for the manatee, special protection areas within Palm Beach County consist mainly of speed zones designated by FWC. These zones are intended to minimize the number of accidental boat collisions with manatees through either seasonal or year-round speed restrictions. Existing manatee speed zones are located throughout Palm Beach County in areas where best available scientific information suggests that manatees are particularly abundant. Speed zones are discussed in more detail in Section IV.C.

There are only two areas in the County where motorboats cannot operate. FPL's RPP discharge canal has been designated by the State of Florida as a "motorboat prohibited zone" from November 15 to March 31, a period when manatees are attracted to the plant by its warm water discharges. Additionally, the State prohibits motorboats year-round in Lake Worth Cove (an enclosed lagoon area within John D. MacArthur Beach State Park; this zone was created by the Park but not specifically for manatee protection). There are currently no other designated manatee sanctuaries, refuges, or vessel prohibited areas in the coastal areas of Palm Beach County.

The establishment of a regional protected habitat network for manatees is identified as a key recovery action within the *FMRP* (FWS 2001). The FWS will assess the need for additional refuges or sanctuaries on a periodic basis. At present, there are no new refuges or sanctuaries proposed within the County.

H. Habitat Protection within Lake Okeechobee

Threats to manatees within Lake Okeechobee are similar to those encountered in other areas of their range, including impacts from boats, entrapment in canal systems, entrapment or crushing within structures/locks, loss of foraging habitat, and degradation of water quality. Numerous manatee carcasses have been recovered from Lake Okeechobee, and FWC has conducted several rescue events for injured manatees within the lake and its outlet canals. According to the FWC-FWRI Manatee Mortality Database, a total of seven (7) mortalities, or about 5 percent of total County mortalities, have been

Palm Beach County Manatee Protection Plan

documented within those portions of the lake and connecting canals lying within Palm Beach between 1974 and 2003. The cause of death for all but one of these mortalities was undetermined. One death was attributed to crushing within a lift gate on a water control structure.

Lakewide, approximately 21 manatees have been struck and killed by watercraft since 1974, although none of the carcasses was recovered within Palm Beach County waters. There are currently no manatee speed zones in Lake Okeechobee. An additional 30 manatees were killed lakewide between 1974 and 2003 by water control or lock structures. As previously mentioned, only one of these deaths occurred in Palm Beach County (in 2002 at the S-352 structure on the L-10 Canal). Water control structures around the perimeter of the lake are operated by both the SFWMD and the USACOE. Since 1990 these agencies, in cooperation with FDEP, FWS, FWC, and DERM (Miami-Dade County) have begun retrofitting the various structures with manatee protection devices such as barriers and piezo sensors. As a result, overall structure-caused mortality within the lake has been declining over the past 10 years. However, none of the structures within Palm Beach County is currently fitted with the devices.

Habitat quality for manatees in Lake Okeechobee is presumably related to the extent of SAV coverage within the lake, which in turn is a function of water level and quality. The lake supports thousands of acres of SAV during periods when water levels are low, but coverage can be reduced to near zero after multiple years of high water levels (SFWMD 2004). Water levels within the lake are completely regulated, largely for flood control and water supply considerations. In 2000, the USACE adopted a regulation schedule (WSE) designed to improve habitat conditions within the lake's littoral and near-shore zones without impacting other management considerations (USACE 1999). Future refinements to this regulation schedule designed to enhance SAV health within the lake are likely.

Because of physical constraints, manatees that make it through the control structures on the southeast side of the lake often become entrapped within the canal systems of the Everglades Agricultural Area (EAA). Between 1994 and 2004, an average of five (5) manatees per year were entrapped in this manner (CERP Interagency Manatee Task Force 2004). Aside from being lost from the reproductive population, these animals are subject to lethal temperatures in the winter and potential starvation from lack of forage resources. Physical barriers that block manatee access to EAA canals are under consideration as part of the Comprehensive Everglades Restoration Plan.

Palm Beach County Manatee Protection Plan

IV. BOATING ACTIVITY IN PALM BEACH COUNTY

A. Existing Boat Facilities

With an annual economic impact of nearly \$2 billion, the marine industry in Palm Beach County generates more than 18,200 jobs and approximately \$682 million in personal income (Murray 2005; Marine Industries Association of Palm Beach 2005). As of 2005, Palm Beach County ranked Number 2 in Florida in annual economic impact, accounting for 10 percent of all statewide sales. (Murray 2005). The Palm Beach Boat Show also has a significant economic impact on the County. In 2002, show participants estimated \$78.1 million in sales. Sales from Florida-based companies reached \$58.3 million while Palm Beach County companies contributed nearly \$14 million in sales. The show generated \$59.2 million in economic output throughout Florida as a result of both infusions of out-of-state purchases and purchases at the show. Total excise and sales taxes generated in the County from the boat show neared \$800 thousand, with more than \$1.5 million statewide (Murray 2002).

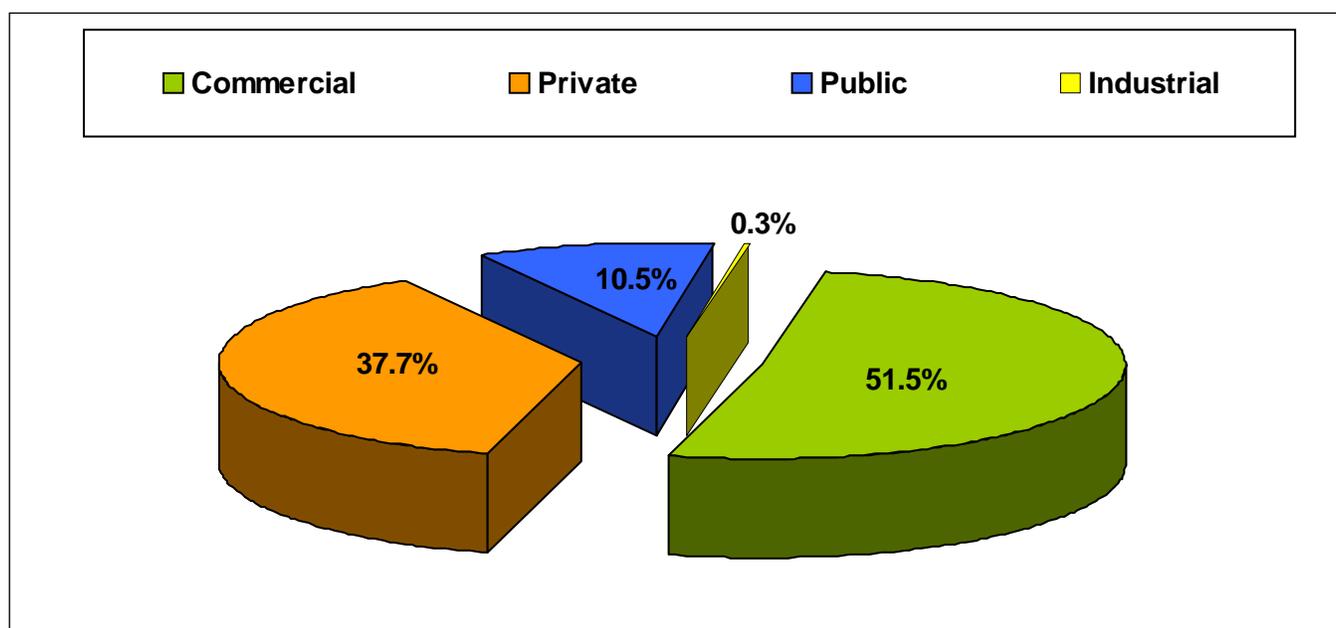
There are approximately 110 acres of marinas, boatyards, and associated boat slips within Palm Beach County (Marine Industries Association of Palm Beach 2005). Data from a number of sources was used to develop a comprehensive inventory of these boat facilities with 3 or more slips in PBC. The inventory is based on information from: 1) existing boat inventory information compiled by Palm Beach County ERM; 2) interviews conducted with marina owners and/or managers; 3) in-water field surveys conducted in August and September 2004; 4) the Boating and Angling Guide to Lake Worth Lagoon (FWC 2001); 5) the 1995 BFSP for Palm Beach County (TCRPC 1995); 6) Public Boating Needs Assessment Study (Palm Beach County Parks and Recreation Department 2002); and, 7) photo-interpretation of recent one-meter resolution aerial photographs. Any marina or boat facility that provided access to waters accessible to manatees and had three or more wet slips, dry slips, and/or boat trailer parking spaces was included within the inventory. The inventory does not include private residential single-family docks or piers.

A total of 182 multi-slip boating facilities (commercial, public, private, and industrial marinas) were identified that generate boat trips within County waters potentially inhabited by manatees (**Figures 24 and 25a-e, separate Appendix of Figures**). The total capacity of all facilities in the County was

Palm Beach County Manatee Protection Plan

calculated to be approximately 6,170 wet boat slips and 2,889 dry storage racks, for a total of 9,059. Commercial marinas accounted for 4,624 wet and dry slips, or a little more than half of the total, within Palm Beach County (**Figure 26**). Private boating facilities, mainly consisting of residential multi-family developments, also represented a significant portion of the total (approximately 3,420 slips). These private facilities were more numerous but generally contained fewer boat slips than the commercial marinas. The County contains relatively few public municipal marinas and only one industrial facility, the Port of Palm Beach.

Figure 26 – Proportion of the Total Number of Slips within Each Multi-slip Facility Type



Boat slips tend to be clustered within certain areas of the County. The number of boat slips at multi-slip facilities within each of the various municipalities of the County is provided within **Table 11**. Two of the County's 25 waterfront municipalities, Riviera Beach and North Palm Beach, collectively contain approximately 27 percent of the total number of slips. The entities surrounding the north end of the Lake Worth Lagoon (north of the Palm Beach Inlet) as a whole currently contain approximately 35 percent of the total slips within the County. By contrast, municipalities within the southern portion of the County (south of the Boynton Inlet) contain roughly three times as much linear waterfront as the north Lake Worth Lagoon but only about 25 percent of the total boat slips.

Palm Beach County Manatee Protection Plan

Table 11 - Total Number of Slips at Multi-slip Facilities by Jurisdiction

Jurisdiction	Total No. of Slips
City of Belle Glade	50
City of Boca Raton	728
City of Boynton Beach	216
City of Delray Beach	626
City of Lake Worth	0
City of Pahokee	117
City of Palm Beach Gardens	719
City of Riviera Beach	1,145
City of West Palm Beach	331
Palm Beach County (unincorporated)	805
Town of Briny Breezes	66
Town of Gulf Stream	0
Town of Highland Beach	302
Town of Hypoluxo	611
Town of Juno Beach	98
Town of Jupiter	815
Town of Jupiter Inlet Colony	40
Town of Lake Park	75
Town of Lantana	473
Town of Manalapan	0
Town of Ocean Ridge	107
Town of Palm Beach	214
Town of Palm Beach Shores	164
Town of South Palm Beach	0
Village of North Palm Beach	1,300
Village of Tequesta	57
TOTAL	9,059

Palm Beach County Manatee Protection Plan

The preceding discussion applies to multi-slip facilities since the Boat Facility Siting Plan only affects facilities with three or more slips. However, it is useful to compare that information to the number of private residential single-family slips that currently exist in the County. Based on an evaluation of recent aerial photography (February 2005), there are 6,590 docks located at single-family residences, which contain an estimated 8,772 slips (**Appendix D**). In other words, about half of the existing slips in the County are at single-family residences and the other half are at multi-slip facilities.

1. Port of Palm Beach

The Port of Palm Beach is Palm Beach County's only deepwater industrial facility, is the fourth busiest container port in Florida, and the eighteenth busiest in the continental U.S. Information on the Port is largely derived from the Port of Palm Beach Master Plan 2005-2015 Update (CH2M Hill *et al.* in press). The Port occupies 211 acres on the western shore of the Lake Worth Lagoon immediately south of the Palm Beach Inlet (**Figure 3, above**). Vessel entrance and access to the port is gained through this inlet, a 300 foot wide channel leading into Lake Worth Lagoon. The Port can accommodate vessels up to 700 feet in length with a draft of 33 feet or less.

The Port is highly diversified in its operations and is a major port for the shipment of containerized cargo, bulk sugar, molasses, produce, utility fuels, water, cement and break bulk cargo. The Port also supports passenger cruise operations with an annual passenger capacity of approximately 800,000 day cruise or ferry passengers. Cargo tonnage at the Port reached about 4.7 million tons in 2003, representing an overall increase in cargo of 22 percent over the past 10 years (Port of Palm Beach 2004). Container shipping, break bulk cargo, and bulk cargo are expected to further increase by an average of approximately 3.5 percent per year. The Port has three "slips" and four marginal wharves for a total of 6,560 linear feet of berthing space. There are 17 ship berths over this linear footage. At present, approximately 70 cargo vessels enter and leave the Port per month (Port of Palm Beach Dockmaster, personal communication, 2004).

There are a number of risks to manatees and manatee habitat associated with Port activities. The Port is, by coincidence, geographically located within an area of particularly high manatee abundance. This is particularly true during the winter when manatees are attracted to the warm water discharge of the

Palm Beach County Manatee Protection Plan

adjacent FPL RPP. As a result, manatees are often concentrated in waters traversed by large commercial shipping vessels. There are also extensive seagrass beds within close proximity to the Port. Periodic maintenance dredging of deepwater port access channels and turning basins is not likely to directly impact seagrass beds or productive hardbottom. However, dredging in close proximity can potentially cause a reduction in light available to seagrass by increasing turbidity or alter hydrological conditions and lead to erosion. Fuel oil, one of the Port's major cargo items, is also a potential threat to marine life in the event of an accidental spill.

Measures to minimize impacts to the manatee are addressed in the Goals, Objectives and Policies (GOPs) component of the Port of Palm Beach Master Plan. Objective 7 (Environmental Protection) set forth a number of policies to ensure that construction and dredging activities at the Port are undertaken in a manner to protect the marine environment and wildlife habitat by avoiding impacts whenever possible, and by minimizing impacts and providing appropriate mitigation when avoidance is not possible. Permits for dredging and filling activities are in full accordance with applicable State and Federal regulations. Objectives 9 (Water Quality) and 10 (Material Cleanup and Handling Rule) set forth policies that ensure stormwater runoff is managed effectively and handling, storage, and cleanup of hazardous materials is in full accordance with Coast Guard requirements. The Port maintains up-to-date oil spill equipment which is kept ready for rapid deployment.

Objective 12 of the Master Plan specifically relates to manatee protection. Policies set forth under this objective require the Port to implement standard manatee protection guidelines and install manatee friendly fenders on all berths. Port facilities are designed to prevent crushing manatees between vessels and docking structures. Seaguard® or tire fenders have been installed in about two-thirds of existing berths to provide a roughly five-foot (in the compressed condition) standoff between vessels and bulkheads. The remaining berths will have new fenders installed as part of ongoing bulkhead replacement activities. As part of Objective 12, the Port has also expressed the commitment to participate in the County Manatee Protection Plan process, partly to determine how best to implement education and information systems for Port users and protect manatees from berthing ships.

Waters in the Port's turning basin are set as an idle speed zone during the time of greatest manatee abundance (November 15 – March 31). A boating safety zone makes this idle speed year-round.

Palm Beach County Manatee Protection Plan

The Port of Palm Beach Master Plan update continues to consider possible land acquisition and associated berthing and harbor expansion to the north and south of the existing turning basins, including expansion into the current Florida Power and Light property. A consequence of this action could be that the potential relocation or removal of the existing warm water discharge associated with the power plant. This discharge currently represents a major warm water site for manatees and is clearly an attractant for manatees throughout the Atlantic Coast subpopulation during the winter months. The Port has committed that relocation or removal of the warm water discharge would be based on the result of extensive study, coordination with regulatory agencies, environmental groups, and other affected parties, and the development of a consensus-based solution.

It is not the intent of this MPP to regulate development within the Port of Palm Beach. Insofar as the Port is currently updating its Master Plan, the siting of new ship berths and wet slips, and dredging to maintain navigational access will be governed by the approved Master Plan. As described previously, provisions to minimize impacts to natural resources, including manatees and seagrasses, will be an integral component of the Master Plan. These provisions have been approved by the Palm Beach County Board of County Commissioners. Following approval, they will be incorporated into the Coastal Management Element and the Transportation Element of the County's Comprehensive Plan.

2. Commercial Marinas

The inventory identified 38 commercial marinas with a total capacity of approximately 2,222 wet slips and 2,402 dry storage racks, with an average of 122 slips each (range of 9 to 431 slips). About 76 percent of the commercial marinas are located within the northern one-half of the County, between Jupiter Inlet and the Royal Park Bridge (Okeechobee Boulevard) in the central Lake Worth Lagoon. There are currently two commercial marinas on Lake Okeechobee with a total capacity of 167 slips.

Information regarding commercial marina services, peak occupancy, presence of educational signage, and the approximate ratio of powerboats to sailboats was obtained during interviews with marina owners and operators (**Figure 27, separate Appendix of Figures**). Certain marinas could not be contacted or were unwilling to participate, so interviews were accomplished at only 28 of the 38 commercial marinas. Most (82%) offered fuel and various marine supplies, and a majority (61%) sold

Palm Beach County Manatee Protection Plan

bait and tackle on premises. Relatively few offered sewage pump-out services (46%) or on-site boat repair (39%). At all of the marinas, powerboats greatly outnumbered sailboats within occupied slips and averaged about 94 percent of all slips. This is similar to the 87-93 percent proportion of powerboats documented in the Palm Beach Boating Activity Study (Baker and Villanueva 1994). Most of the marinas experienced peak occupancy within the winter months (64%), but many others essentially operated at peak occupancy year-round (29%).

3. Public Marinas

Seven public or municipal marinas were identified in the inventory with a total capacity of 453 wet slips and 487 dry storage racks. Most of the publicly available slips are within five miles by boat of the Palm Beach Inlet. The City of Riviera Beach Municipal Marina, located directly across from the Inlet, accounts for more than half of the total public boat slips within the County.

4. Private Boating Facilities

Private boating facilities in Palm Beach County are associated with multi-family developments such as condominiums or townhomes, or are part of a private residential community. Estimates of the number of slips contained within this facility type were obtained during field surveys of the County's coastal waterways in 2004. This is the most common type of multi-slip facility in the County, with 136 facilities identified, and a total capacity of 3,420 wet slips. The number of individual facilities is probably an underestimate, because in some instances it was impossible to determine if two adjacent condominiums were part of the same complex. As such, slips from two separate but adjacent marinas may have inadvertently been lumped together as a single facility. Nonetheless, the total number of slips enumerated in the field should be accurate.

Private boating facilities were relatively small, having an average capacity of about 26 boat slips (range of three to 172 slips), and were scattered throughout the County. They are concentrated near the Jupiter Inlet and Loxahatchee River area, the south end of Lake Worth Creek and the North Palm Beach Waterway, and the Intracoastal Waterway south of Boynton Beach. The only area with relatively few private facilities is the central Lake Worth Lagoon, between West Palm Beach and Boynton Beach.

Palm Beach County Manatee Protection Plan

5. Boat Ramps

Nineteen boat ramps containing a total of 805 boat trailer parking spaces serving saltwater areas and Lake Okeechobee were identified (**Figures 24 and 28, separate Appendix of Figures**). Other freshwater ramps are not included in these totals. All of the identified facilities are open to the general public. Thirteen ramps with approximately 560 trailer spaces provide access to the coastal waters of the County, while the remaining six ramps and 245 spaces provide access to Lake Okeechobee. The latter figure may be an underestimate, as it does not include grass overflow or on street parking areas. The northern half of the County contains roughly 70 percent of the boat trailer spaces with access to coastal waterways. The average boat ramp is located approximately 3.6 miles from the nearest inlet. Ramps are distributed more or less evenly along the County's Lake Okeechobee shoreline.

6. Existing Mooring Areas

Although there are no official Palm Beach County mooring sites, individual boaters have grouped to create more or less unmanaged permanent "mooring fields." These sites were identified through anecdotal observation and analysis of aerial photographs. The Lake Worth Lagoon in the vicinity of the Palm Beach Inlet supports the largest unofficial mooring areas, including south of Peanut Island and east of the ICW, the area between Peanut Island and the Blue Heron Boulevard Bridge, and the area north of Phil Foster Park in Riviera Beach. Another significant mooring area is located at the extreme northern end of Lake Worth Lagoon between Old Port Cove and Lost Tree Village. Elsewhere within the County, smaller mooring fields occur within Jupiter Sound, Summa Beach (west side of Lake Worth Lagoon just north of the C-51 Canal), adjacent to Bryant Park (west side of Lake Worth Lagoon in the City of Lake Worth) and south of Sportman's Park in Lantana.

7. Watersports Areas

There are no restrictions on watersports such as waterskiing and jet skiing outside of boater safety or manatee protection zones in Palm Beach County, but there are currently no official watersports areas within County waters accessible to manatees. Some information suggests that Lake Wyman within Boca Raton is a popular unofficial site for water skiing and wakeboarding (Palm Beach County Parks and

Palm Beach County Manatee Protection Plan

Recreation Department 2002). However, follow-up investigations seem to dispute that this is currently occurring. Lake Wyman supports a particularly high abundance of manatees and currently lies within a year-round slow speed manatee protection zone. As such, usage of this area for high-speed watersports is inconsistent with manatee protection. Increased education and enforcements efforts are recommended for this location. Other popular skiing locations in estuarine waterbodies include:

- North Fork Loxahatchee River
- Loxahatchee River
- Ski Beach (Jupiter Ridge)
- Hypoluxo Cove

Recognizing the need to provide more appropriate and safe locations for watersports the Palm Beach County Parks and Recreation Department has developed boat ramps and alternative watersports areas in freshwater lakes and canals including Lake Ida, John Prince Park, and Okeeheelee Park, a world-class waterskiing facility.

B. Boating Use - University of Miami Study of Recreational Boaters in Palm Beach County

This study was conducted by the Boating Research Center of the Rosenstiel School of Marine and Atmospheric Science at the University of Miami for the Office of Protected Species of FDEP. The purpose of the study was to identify particular spatial and temporal patterns of boat traffic in PBC. This was accomplished using five different types of surveys of boaters: 1) boat ramp intercept surveys, 2) on-water surveys, 3) boat facility surveys, 4) shoreline surveys and 5) a mail survey of registered boaters in Palm Beach County. Thirteen (13) boat access ramp areas, 17 marinas, and 71 of the 89 boat storage facilities were surveyed in Palm Beach County for this study. Results included the following:

- 50% of boaters who responded to the mail survey have boats between 16 and 25 feet in length;
- The most frequent boating activity for summer weekday boaters in Palm Beach County is recreational fishing (34.2% of those surveys), followed by cruising (24%), and skiing and diving with respectively (9% each);
- 36.7% of boaters surveyed listed offshore (for fishing and scuba-diving) as their primary destination during summer weekdays. The ICW was the second most popular destination (27%);
- All boating activities and destinations require a trip through some portion of the ICW;
- The inlet used most frequently by respondents of this study was the Palm Beach Inlet (40%), while half as many (23%) used the Boynton Inlet; and

Palm Beach County Manatee Protection Plan

- 45% of wet berthed boats were launched between 8 and 10am, while dry dock launches (33%) peaked from 8 to 10am and 12 to 2pm.

C. Speed Zones

Certain bodies of water are provided with special heightened protection measures as a result of different mitigating circumstances. To conduct activities on these waters, additional regulations must be satisfied. These regulatory zones are designated by signs throughout the ICW and other relevant bodies of water and provide information concerning the regulated speed, the area of the regulation, the beginning of the zone, and, in some cases, the end point of the zone. Palm Beach County estuarine waterways have several speed zone regulations, depending on both the location within the ICW and time of year. Manatee protection speed zones are rules created by FWC to restrict the speed and operation of vessels where necessary to protect manatees from harassment and from potential collisions with vessels. These rules can prohibit or limit entry into an area, as well as restrict certain activities in an area. FWC is authorized to adopt these rules by the Manatee Sanctuary Act (Ch. 370.12(2), FS). The rules appear in Chapter 68C-22 of the Florida Administrative Code.

Local governments can also create manatee protection speed zones by local ordinance. These zones must be approved by FWC before they can take effect (see Ch. 370.12(2)(o), FS). These local zones cannot include waters within the main marked channel of the Florida Intracoastal Waterway or waters within 100 feet thereof.

As noted in the section on Enforcement, below, boating safety speed zones (see §68D-24.017, FAC) are designed to improve boater safety, but may also serve to protect any manatees found in the area. These are separate from manatee protection speed zones (see §68C-22.009, FAC), which are designed specifically for manatee protection.

The following speed zone designations occur in Palm Beach County.

Idle Speed Zone/No Wake - This is the slowest of all speed restrictions and requires a vessel to operate at the slowest possible speed while still allowing the operator to maintain steering and control of the vessel. This zone can be both seasonal and year-round depending on the area. Idle Speed Zones are

Palm Beach County Manatee Protection Plan

established for boating safety are located primarily near fuel docks, boat ramps, and congested or dangerous areas. Idle Speed Zones established for manatee protection are located in the vicinity of the FPL warm water discharge and are seasonal. There are 10.4 miles of boating safety idle speed zones in Palm Beach County and 2.3 miles of manatee protection idle speed zones.

Slow Speed Zone/Minimum Wake - Slow Speed Zones require that a vessel operate completely off plane, meaning the boat hull has completely settled into the water. In this zone, boats must proceed without creating a wake, or with minimum wake. These zones are also classified as either seasonal or year-round depending on proximity to docks and marinas, seasonal factors, and environmental factors surrounding that particular section of waterway. Countywide, there are 5.9 miles of boating safety slow speed zones and 21.5 miles of manatee protection slow speed zones, of which 13.9 are year-round and 7.6 are seasonal.

Maximum 25 MPH Speed Zone - A controlled area within which a vessel's speed made good over the bottom, measured in statute miles, must not exceed 25 miles per hour. This speed limit is not to be construed as permitting the reckless or careless operation of a vessel. In Palm Beach, 1.3 miles of Jupiter Sound are designated in this manatee protection speed zone.

25-30 MPH Speed Zone - This is a seasonal speed zone in Palm Beach County. In this zone, boats may not exceed 25 MPH from October 1 through May 31; however, boats may proceed at 30 MPH in this zone during the remainder of the year. There are 17 miles of this manatee protection zone designation on Palm Beach County waterways, primarily in the north and south Intracoastal Waterway

Shoreline Buffer Zone- Most Palm Beach County waters have a year-round, slow speed buffer zone along the shoreline that protects manatees that may be using the shallow waters where seagrasses are likely to be present or where the shallow water makes it difficult for a manatee to dive to avoid a boat. There are 3 types of buffer zones of varying widths: 50 feet along narrow waterways such as the north and south Intracoastal Waterway and canals; 300 feet in most of the Lake Worth Lagoon and the Loxahatchee River; and, greater than 300 feet in areas where there are extensive grass flats such as south of J.D. MacArthur State Park, north of Blue Heron Boulevard and between Lantana and Boynton Beach.

Palm Beach County Manatee Protection Plan

No Entry Zone - This is a limited area of critical importance as a safe haven for manatees to rest, feed, reproduce, give birth, nurse, or otherwise habituate undisturbed by human activity. No vessel of any kind, whether power-driven or non-motorized is permitted within the designated area. The FPL warm water discharge west of the ICW channel is a 0.1-mile No Entry manatee protection zone completely off-limits to motorboat traffic or any vessels being propelled or powered by machinery. This area is also classified as a Motorboat Prohibited Zone.

While the channelized segments of certain waterbodies in Palm Beach County, such as Jupiter Inlet, Lake Worth Lagoon, and Lake Okeechobee, do not have speed restrictions, most 50-foot, 25 MPH buffer zones have been established to protect manatees that may be present in shallow waters along the shoreline.

Palm Beach County boating speed zone restrictions are delineated in Section 68D-24.017, FAC, and manatee speed zone restrictions are found in Section 68C-22.009(1), FAC.

D. Enforcement

Manatee protection speed zone restrictions are designed specifically for manatee protection. Boating safety speed zones are designed to improve the safety of boaters, but have an added benefit of protecting manatees that may be in the area. Studies conducted by the FWC have demonstrated that the single most important factor leading to compliance of speed zones is law enforcement presence on the waterways.

A questionnaire was developed and sent to each law enforcement agency with water-related responsibilities in Palm Beach County. Each agency was asked to describe the number of officers assigned to marine duty, the areas patrolled, the number of hours spent on the water each week, and the relative amount of time spent enforcing speed zone regulations. The information provided below is derived from responses to those questionnaires.

Fourteen local, State, and Federal law enforcement entities have the capacity to assign personnel to enforce manatee-related speed zone regulations in Palm Beach County. These entities include:

Palm Beach County Manatee Protection Plan

- Boca Raton Police Department;
- Boynton Beach Police Department;
- Jupiter Police Department;
- Lantana Marine Safety;
- Palm Beach Police Department;
- Palm Beach Shores Police Department;
- Riviera Beach Police Department;
- West Palm Beach Police Department;
- FWC Division of Law Enforcement (formerly Florida Marine Patrol);
- Village of North Palm Beach - Department of Public Safety;
- Village of Tequesta Police Department;
- Palm Beach County Sheriff's Office (PBSO);
- U.S. Coast Guard (USCG); and
- U.S. Fish and Wildlife Service.

All of the jurisdictions listed above responded to the survey with the exception of the Villages of North Palm Beach and Tequesta and the U.S. Fish and Wildlife Service. Only 10 of the 23 coastal municipalities along the Atlantic Intracoastal Waterway have marine law enforcement units. The responsibility for enforcement in the "gaps" falls to a combination of the Palm Beach County Sheriff's Office, the Florida Fish and Wildlife Conservation Commission, and the United States Coast Guard.

The FWC has a conspicuous presence on Palm Beach County's waterways. FWC Division of Law Enforcement personnel based in Northern Palm Beach County are responsible for patrolling several southeast Florida counties. The three officers currently assigned to Palm Beach County collectively spend 8-24 hours on the water each week. Although they patrol all County waterways, the majority of their effort is focused on the area between Jupiter Sound and the City of Boca Raton. They also routinely patrol Lake Okeechobee. Usually three boats are on the water at any given time. The FWC considers enforcement of vessel speed zone restrictions one of its highest priorities, particularly during manatee season (November through March).

Both the United States Coast Guard and the Palm Beach County Sheriff's Office conduct routine patrols of Palm Beach County Waterways. The USCG is responsible for enforcing Federal laws on the ICW and Atlantic Ocean along the eastern seaboard of the United States. Palm Beach County waters lie within the jurisdiction of the USCG Station Lake Worth, at the Lake Worth Inlet. At least five personnel based at Station Lake Worth are responsible for patrolling the Atlantic Ocean and the ICW from the St. Lucie Inlet south to just south of the Boynton Inlet. They utilize two patrol craft and typically spend in excess

Palm Beach County Manatee Protection Plan

of 40 hours per week on Palm Beach County waterways. Ten to twenty-five (10-25) percent of that time is dedicated to enforcement of speed zone regulations.

The PBSO routinely patrols all of Palm Beach County's waterways from Jupiter Sound south to Boca Raton, including Lake Okeechobee and occasionally the Hillsboro Canal. They also patrol the 50 miles of Atlantic coastline up to 12 miles offshore. Thirteen full-time officers are assigned to water-related enforcement activities. On an average day, two boats are on the water at any given time, and collectively PBSO officers spend in excess of 40 hours per week patrolling the County's waterways. At least 50 percent of that time is spent monitoring boater compliance with speed zone regulations.

FWS enforcement personnel are based in Miami-Dade County and are responsible for enforcement of Federal marine laws from Miami north to Merritt Island in Brevard County. Their presence in Palm Beach County waters is limited, and they only participate in specific task force efforts in conjunction with local law enforcement agencies.

All municipal police departments that responded to the questionnaire have a regular presence on the County's waterways (**Table 12**). Most departments have a boat on the water each day with two officers typically assigned to marine enforcement. The cumulative number of hours spent on the water by all officers combined varies among departments, but in nearly all cases that was less than 40 hours/week total with about a quarter to one-half of that time engaged in speed zone enforcement.

Although the cumulative effort of the 14 different agencies identified above provides law enforcement presence on all Palm Beach County waterways, the majority of enforcement effort is focused on the waterways that are used most heavily by boaters, including the Lake Worth Lagoon, the ICW and Jupiter Sound. Most agencies consider enforcement of speed restrictions a medium to high priority. Boaters apprehended violating speed zone regulations may be given verbal warnings, written warnings, or a citation. Fines associated with a citation are typically \$50 per infraction but may be higher. For example, State agencies may issue fines of up to \$500 and sixty days in jail, while maximum penalties under Federal law for egregious infractions range up to \$50,000 and/or one year in prison.

Palm Beach County Manatee Protection Plan

Table 12- Distribution of Marine Enforcement and Speed Zone Regulation

Municipality	Average Number of Vessels on Water Each Day	Number of Patrol Officers Regularly Assigned to Marine Enforcement	Patrol Areas	Average Number of Hours Spent on Water Each Week (All Officers Combined)	Percentage of Hours on Water Spent in Speed Zone Surveillance
Boca Raton Police Department	1	2	ICW, Hillsboro Canal (occasionally)	24-40	26-50%
Boynton Beach Police Department	1	2	ICW	24-40	>50%
Jupiter Police Department	1	1	Loxahatchee River, Jupiter Inlet	24-40	26-50%
Lantana Marine Safety	1	4-5	South Lake Worth Lagoon	8-24	26-50%
Palm Beach Police Department	1	2	Central and South Lake Worth Lagoon	>40	>50%
Palm Beach Shores Police Department	1	2	North and Central Lake Worth Lagoon, North Palm Beach Waterway (occasionally)	8-24	26-50%
Riviera Police Department	1	2	North and Central Lake Worth Lagoon	8-24	>50%
West Palm Beach Police Department	1	2	Central and South Lake Worth Lagoon	1-8	0%

Palm Beach County Manatee Protection Plan

The number of warnings and citations issued by the various agencies varies widely. For example, between January and August 2004, the USCG issued 105 written warnings, 161 verbal warnings and 73 citations. During 2003, the Boca Raton Police Department issued 370 citations for speed zone violations, the Jupiter Police Department issued 38 warnings and two citations, and the Palm Beach Police Department issued 78 warnings and 28 citations. Perhaps some of the highest enforcement effort occurs on the waters of Boynton Beach where the Police Department issued an average of 15 warnings and 10 citations a week during 2003.

Although some of the agencies patrolling Palm Beach County waterways have unmarked patrol craft, they rarely use them when enforcing speed zone regulations. Enforcement personnel questioned during the survey indicated that compliance with manatee protection regulations by the public could be enhanced through a combination of several initiatives, the most important of which are:

- Increasing the number of patrol units and man-hours on the water;
- Licensing vessel operators;
- Increasing public awareness of manatees and vessel speed zone regulations;
- Developing better methods for marking speed zones; and
- Developing and implementing a method to identify repeat violators.

In addition to efforts to enforce speed zone regulations on coastal waterways, both the FWC and the PBSO patrol Lake Okeechobee. FWC has one Lieutenant and six officers that are tasked with spending 50 percent of their patrol time on the water. While there are no speed zones dedicated to manatee protection on Lake Okeechobee, there are several boating safety zones around the lake. Manatees are impacted by the floodgate/navigation lock structures connecting area canals to the lake and are injured in watercraft collisions. FWC reports two to three calls concerning manatees on Lake Okeechobee each year.

Palm Beach County Manatee Protection Plan

V. MANATEE EDUCATION AND AWARENESS PROGRAMS

A. Introduction

Manatee education is essential to raising public awareness of the existence of this endangered species within Palm Beach County waterways. Education also provides information on ways in which harm to this marine mammal can be avoided or reduced. This section of the plan details existing programs.

Since a major goal of an MPP is to reduce the number of human-related manatee deaths, an education and awareness program is one of the provisions set forth in the 1989 Boating Safety and MPP developed by the former Florida Department of Natural Resources, now FWC, and approved by the Governor and Cabinet. The target audience for this program is to include the general public, anglers, boaters, divers, teachers and school children, and the State's millions of annual visitors. Integral to an education and awareness program is the development of 1) a combination boating/anglers' guide for the County that contains educational information on manatees, boating speed zones, and ethical fishing principles such as monofilament line recycling, and 2) a manatee education program within the public school system. Other educational initiatives that go beyond these basic goals are included under Section C., Suggested Improvements/Recommendations, below.

B. Existing Educational Programs

1. Statewide

FWC's ISMS is responsible for planning and implementing management activities directed towards the protection and recovery of marine species like the manatee. These activities include, but are not limited to, developing and administering State manatee protection zones and promoting the education and awareness of manatees. For example, manatee education, information, and regulations can be found at <http://www.myfwc.com/manatee/information/eiwelcome.htm>.

The ISMS provides educational information, such as an historic time-line of manatees in Florida, manatee basic biology and behavioral facts, information for boaters, manatee decal and license plate

Palm Beach County Manatee Protection Plan

information, downloadable brochures, newsletters, posters, and guides, and manatee videos available by contacting ISMS – “The State of Manatees” and “A Closer Look at Manatees” (see below for additional description of these videos).

FWC’s FWRI, in collaboration with other academic, non-profit, and private marine institutions, conducts research that provides both policy and management decision makers with the scientific data necessary for better management of our marine resources. The institute also provides educational and informational materials on many marine features, including boating and angling guides (Lake Worth Lagoon), manatee license plate and decal information, brochures, posters, and coloring sheets, and basic manatee facts.

Florida Power & Light has an excellent website with hotlinks to several more sites with valuable manatee information. This information is the source for the “Florida Manatee” document that was originally written for FPL by Victoria Brook Van Meter 1989 (revised in 2001). It is a 41-page fact-filled booklet with general information about manatees, although it does not give statistics or specific location details.

Save the Manatee Club is a national, non-profit organization that raises funds via its Adopt-A-Manatee program. The group produces and distributes brochures, water-proof decals, free manatee awareness waterway signs for posting by Florida shoreline property owners, student education packets, a 36-page educator’s guide, informative poster, coloring and activities book, free banner to boaters, “Please Slow, Manatees Below”; offers free in-service programs to educators; and provides funding for display boards at manatee education centers and parks. Boater tips, educational material, and other information is also available at www.savethemanatee.org.

Educational videos on manatees are also available. The first two videos listed below have been distributed to schools throughout the State of Florida; Florida educators should check their district media center for availability before ordering. The second two are available by contacting Education Coordinator, FWC, Imperiled Species Management Section, Mail Station 6A, 620 South Meridian St., Tallahassee, Florida 32399-1600 or by calling (850) 922-4330.

Palm Beach County Manatee Protection Plan

1. “Manatee Messages: What You Can Do!” [approximately 12 minutes in length; available in elementary (K-5) and secondary (6-12) formats]. This is an educational videotape for students and teachers produced by SMC with assistance from the Advisory Council on Environmental Education (ACEE; now defunct). The video provides a description of manatees, includes information on their behavior and habitat in addition to conservation measures, and details what students can do to help save manatees from extinction. Educators and other interested parties can order this video from SMC by sending a check for \$9.00, along with their name and mailing address, to the address below. The \$9.00 fee includes shipping. They can also call 1-800-432-5646 and order it using a Visa, Mastercard or American Express. Mailing address: SMC, 500 N. Maitland Avenue, Florida 32751.
2. “Manatees: Species in Peril” (approximately 45 minutes in length; suitable for high school students and adults). The video features underwater footage of manatees in several areas of Florida. Viewers can learn about manatees, the conservation efforts designed to protect them, and what they can do to save manatees for future generations. The videotape can be ordered by phone or mail (see address above) or at SMC’s website for \$17.95, or a DVD can be ordered for \$24.95.
3. “The State of Manatees” (10 minutes in length; produced by Diane Wilkins Productions, Inc., with assistance from FWC ISMS, SMC, and ACEE). This is a boater-awareness video that discusses tips for safe boating (i.e., how to read signs, how to spot manatees, how to avoid causing injury to manatees and their habitat, etc. To order, contact ISMS. Also available is “A Closer Look at Manatees” (10 minutes in length; produced by Diane Wilkins Productions, Inc., with assistance from FWC ISMS, SMC, and ACEE). This video focuses on manatee biology and the FMSA.

Mote Marine Laboratory in Sarasota is an independent, non-profit research organization that houses a permanent exhibit on manatees including a 70,000-gallon habitat holding two captive-born manatees. The education department at Mote offers field trips, family programs, outreach programs, overnights for ages 7-12 (“Moonlight with Manatees”), and summer programs (K-12 students). Mote’s Sea Trek Distance Learning Program (4th thru 8th graders) is for learning about manatees via live video conferences.

Palm Beach County Manatee Protection Plan

Manatee Observation & Education Center, located in Fort Pierce, Florida, offers planned classes for grades K – 5 with various subject material that includes manatees. Center staff members also make presentations to adults, church groups, and other organizations and can be contacted via the education coordinator at (772) 466-1600, ext. 3337 or by e-mail at manatee@manateecenter.com.

Center for Marine Conservation publishes an online internet educational slide show for children called, “Kids Only Manatees & Dugongs,” which was originally published for the United Nations Environment Programme/Caribbean Environment Programme.

2. Countywide

a. School District of Palm Beach County

Environmental Science & Technology at Forest Hill High School and Jupiter High School - The Environmental Science & Field Research Programs are for students who desire an academic curriculum with an emphasis on environmental studies and research. Some of the issues students investigate include ecosystem restoration, water-related problems, agricultural awareness, field research, and sustainability in the 21st century.

Palm Beach Lakes Marine Technology Academy - This program provides opportunities for students to experience and learn about a variety of marine-related topics, from submarines used for oceanographic research to recreational boating and marine construction. The Marine Technology Academy is made available to high school students through a partnership with the Marine Industry Education Foundation.

Benchmark Focus Lessons - The Palm Beach County School System also conducts countywide educational activities dealing with environmental issues. These programs are not limited to specific schools but are designed for specific levels of education including high school and middle school specific curriculum. Lessons have included the Everglades and the Storm (Hurricane) of '28, and while no lessons have dealt specifically with manatees, environmental protection and restoration are consistent themes throughout existing lessons.

Palm Beach County Manatee Protection Plan

b. Other Environmental Education Sources

Palm Beach County Department of Environmental Resources Management has an excellent public outreach initiative, which involves County residents in ERM's stewardship and volunteer programs by allowing the community to actively participate in preserving, protecting, and enhancing the County's remaining natural areas. Several sources of manatee information are offered. ERM has distributed thousands of Lake Worth Lagoon CDs, produced by the Harbor Branch Oceanographic Institute, to schools and other environmental outlets. The CD includes extensive manatee coverage. ERM also has a "Quick Index" link to manatee resources on its website, which provides general information on the Florida Manatee, as well as links to additional national, State, and local manatee resources.

Gumbo Limbo, located in Boca Raton at Red Reef Park on the barrier island between the Atlantic Ocean and the ICW, is an environmental complex designed to educate the community through classes, seminars, workshops, field trips, and research. The focus is primarily on the preservation of a natural plant association known as a tropical hammock, in addition to sea turtle education and preservation.

Okecheelee Nature Center is an environmental-education resource center designed to introduce students to different components of the environment to help them understand the roles that each plays in helping to maintain a balanced ecosystem. The center offers a two-hour marine science program for fifth grade and middle- and high-school students.

Pine Jog, one of eight Earth Force locations in the US, teamed up with Florida Atlantic University in 1970 and is a unit of FAU's College of Education. Located in central Palm Beach County, Pine Jog is an environmental education center with the purpose of developing, modeling, and providing general environmental education programs.

South Florida Science Museum offers a variety of science and educational resources from planetariums to aquariums. There are dozens of aquariums presently on display at the museum ranging from 10 to 900 gallons and housing fish from all over the world. The marine biologists at the aquarium not only take care of the fish and other marine creatures, but also teach classes on marine education to school groups visiting the museum.

Palm Beach County Manatee Protection Plan

Sandoway House Nature Center has programs and activities designed to educate the public about natural communities existing in our area and requirements for sustaining those communities. Located on the oceanfront in Delray Beach, the Sandoway House provides a window into the marine and freshwater ecosystems of the area.

Loxahatchee River District, through environmental education programs, educates visitors about the local environment, including river water quality and health, and provides learning opportunities through educational facilities, such as the Marine Science Center and Busch Wildlife Sanctuary, and activities sponsored by such organizations as Friends of the Loxahatchee River.

Florida Inland Navigation District has several programs to ensure that the ICW and Okeechobee Waterways are kept clear and safe for public usage, to help people enjoy these waterways, and to protect Florida's manatees. FIND currently maintains over 2,500 manatee signs in the waters of the District and has manatee signage information on its website by county.

Palm Beach County Parks and Recreation Department is actively engaged in a number of manatee education and public awareness efforts. For example, the department posts manatee protection signs and provides other information on manatees at all of its boat ramps (4) and one marina. Boater education classes and manatee education are also offered. In addition, this department has been involved in the restoration of Peanut Island, which lies between the Palm Beach Inlet and Port of Palm Beach, in the middle of Lake Worth Lagoon. The Parks and Recreation Department has also opened a new facility called Green Cay Wetlands & Nature Center, which focuses on Florida's natural habitat and environmental protection.

Marinelife Center of Juno Beach promotes conservation of all marine life through education, research, and rehabilitation, with a special focus on threatened and endangered sea turtles and South Florida's fragile coastal resources. Lectures, tours, summer internships, a volunteer program, and a repository of informative booklets and brochures on the marine environment can be obtained at Marinelife Center.

Palm Beach County Boating Guide website is a complete guide to boating in Palm Beach County with boat ramp locations, speed zone rules, law enforcement, local boating hot spots, and County parks, with

Palm Beach County Manatee Protection Plan

descriptions and directions to each of the County’s boating destinations. This “geocities” website focuses on location and destination.

Additional informational materials are available from such entities as the Manatee Awareness Group, the various Marine Industries Associations of South Florida (<http://www.miasf.org> and <http://www.boatflorida.org>), the John D. MacArthur Beach State Park (<http://www.macarthurbeach.org>), the Florida Department of Environmental Protection (<http://www.dep.state.fl.us>), the Coastal Conservation Association – Palm Beach Chapter (<http://www.ccapalmbeach.com>), and the South Florida Water Management District (<http://www.sfwmd.gov>).

3. Manatee Signage

Educational Signs - Educational signs are coordinated by the FWC’s ISMS. These signs can be classified as either education or awareness signs that, although non-regulatory, can still be required by State and Federal regulatory agencies for posting by marinas and boat ramps. Educational signs must be placed in a prominent location for maximum visibility, such as near walkways, dockmaster offices, restrooms, or foot-traffic access points to piers and docks. The awareness signs should be placed facing land on walkways or docks. Permanent manatee signs should not be installed on pilings in the water nor be attached to navigational markers. If a facility has multiple docks with separate walkways, signs should be installed near each walkway or dock. Several examples of these signs are provided. For more information, as well as instructions for installation as required by permit or lease, visit <http://myfwc.com/manatee/signs>.

The “**Caution: Manatee Area**” sign is 3’ by 4’ and is available from all of the companies listed on the FWC’s sign supplier list. These awareness signs are designed with the purpose of reminding boaters and vessel operators of the possible presence of manatees. This sign meets the manatee awareness display requirement of a lease or permit.



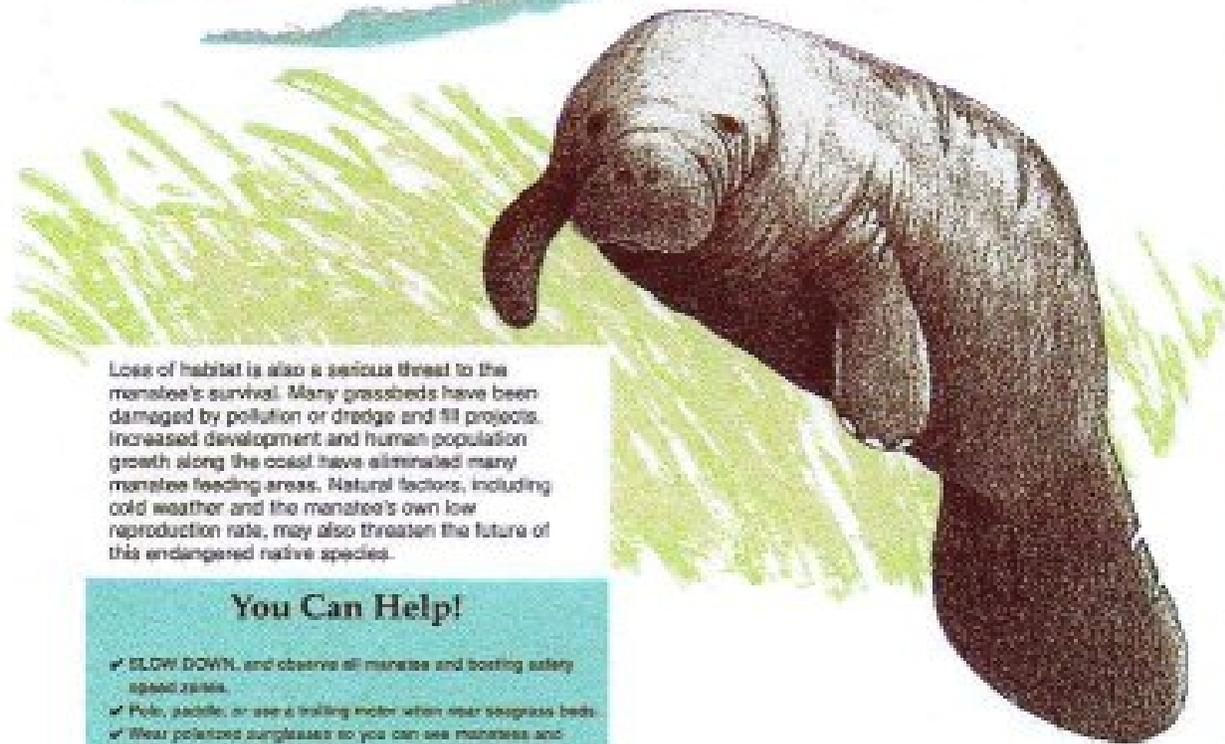
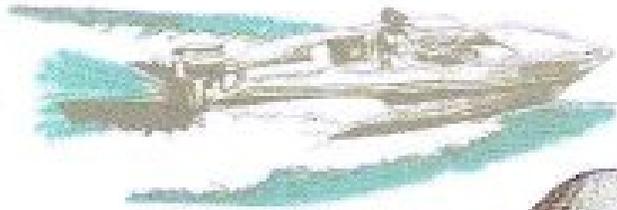
Palm Beach County Manatee Protection Plan

The “**Manatee Basics for Boaters**” sign is 3’ by 4’ and is available from all of the companies listed on FWC’s sign supplier list. This educational sign provides information on both the physical characteristics of manatees and the potential threat to this endangered species from boat operation. This sign will meet the manatee educational display requirement of lease or permit and can be found on the following page.

The “**Protecting the Gentle Giant Sign**” lists the potential threats to manatees and what the public can do to help protect them. “**The Florida Manatee Sign**” provides a general description of manatees and their behavior. These signs will meet the manatee educational display requirement of lease or permit if they are displayed as a pair (signs displayed on the following pages). These signs can be oriented so that boaters using marine facilities will be reminded of the presence of manatees. The signs are not required to be in view of the general boating public, however. Project locations near important manatee habitat, or involving other special circumstances, may warrant additional signs.

Protecting the Gentle Giant

Tragically, this gentle giant, the West Indian manatee, is an endangered species. A significant number of these slow-moving creatures are injured or killed by motorboats each year, and most manatees carry scars from past collisions. Others are killed when caught in flood gates and navigation locks, or when they eat or get entangled in discarded monofilament fishing line or hooks.



Loss of habitat is also a serious threat to the manatee's survival. Many grassbeds have been damaged by pollution or dredge and fill projects. Increased development and human population growth along the coast have eliminated many manatee feeding areas. Natural factors, including cold weather and the manatee's own low reproduction rate, may also threaten the future of this endangered native species.

You Can Help!

- ✓ SLOW DOWN, and observe all manatee and boating safety speed zones.
- ✓ Pull, paddle, or use a trolling motor when near seagrass beds.
- ✓ Wear polarized sunglasses so you can see manatees and seagrass better.
- ✓ Stay in the marked channels where the water is deeper.
- ✓ Do not feed manatees, give them water, or harass them – manatees need to stay wild to survive.
- ✓ Do not throw trash, especially plastics and monofilament fishing line, in the water.

Save A Life!

Report accidental boat strikes to manatees immediately to begin prompt rescue and rehabilitation. To report an injured, dead, or orphaned manatee, or one being harassed, please call:

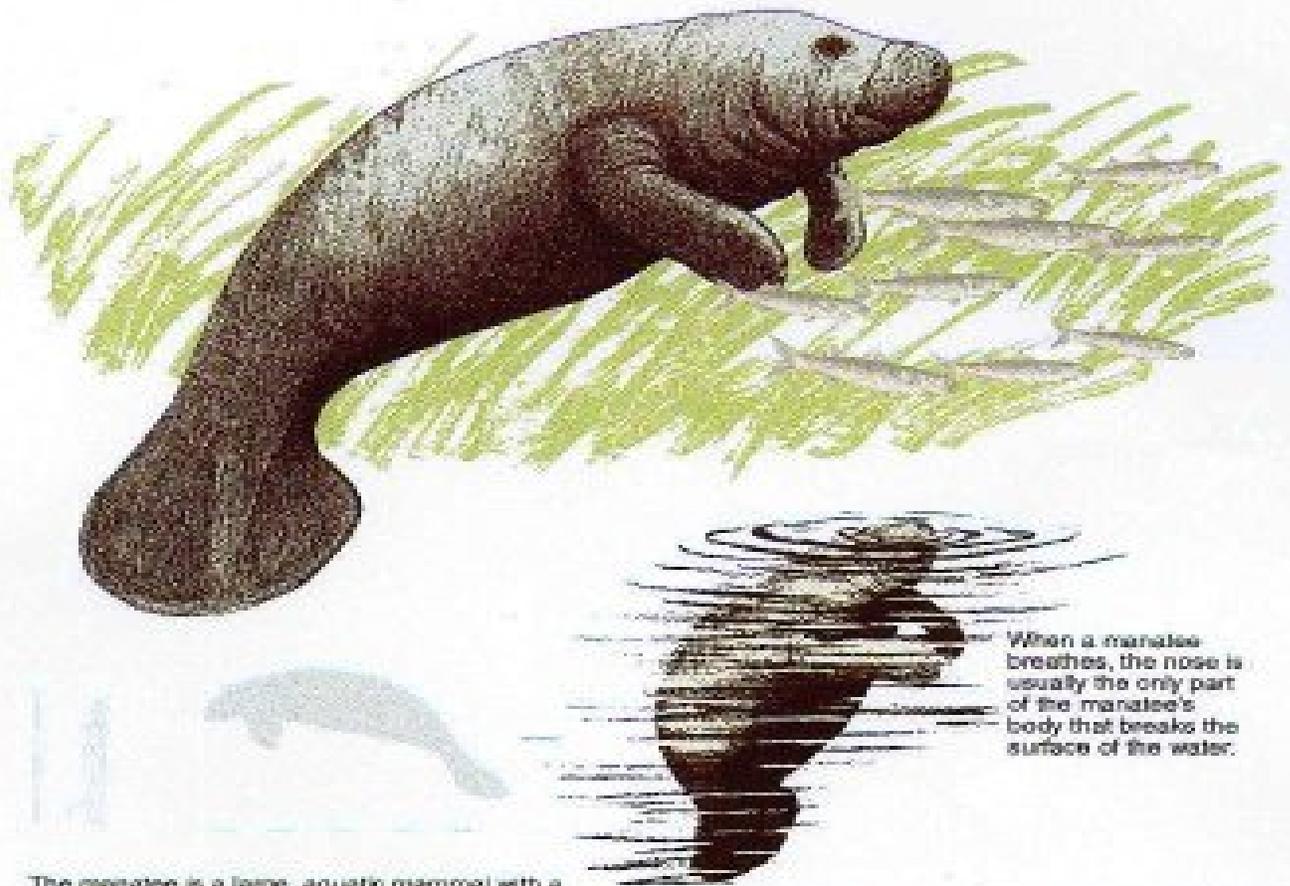
- ✓ 1-800-DEAL-PUP (1-800-342-3267)
- ✓ 4-FWC on mobile phone
- ✓ or use VHF channel 16.

Observe and Follow All Regulatory Signs



The Florida Manatee

Manatees breathe air, just like other mammals. They spend much of their lives underwater, feeding or resting, yet they must surface to breathe. Manatees breathe an average of every 2 to 4 minutes, but can stay submerged 15 to 20 minutes when at rest. The manatee feeds 8-9 hours a day, tearing off plants with its flexible upper lip.



When a manatee breathes, the nose is usually the only part of the manatee's body that breaks the surface of the water.

The manatee is a large, aquatic mammal with a broad, rounded tail. Gray in color, adults are generally 9-10 feet long, and average 800-1,200 pounds, but can weigh more than 3,000 pounds.

The Florida manatee is a subspecies of the West Indian manatee. Florida manatees are an endangered species that is native to Florida. The manatee can live in fresh, brackish, or salt water habitats, including Florida's rivers, springs, harbors, bays and inlets.

SAVE A LIFE!

Report accidental boat strikes to manatees immediately to begin prompt rescue and rehabilitation. To report an injured, dead, or orphaned manatee, or one being harassed, please call:

- ✓ 1-800-DIAL-FWP (1-800-342-6367)
- ✓ * FWC on your mobile phone
- ✓ or use VHF channel 16.

Palm Beach County Manatee Protection Plan

Regulatory Signs - Regulatory signs are coordinated by FWC's Division of Law Enforcement. Manatee protection zones are marked by 3' x 4' or 5' x 7' signs that have an orange circle in the center and an orange border, in addition to the regulatory information. These are approved speed zone or navigational signs posted on waterways that are marked with a rule and permit number. The rule number is shown in the lower right-hand corner and the permit number is shown in the lower left-hand corner. For more information, see <http://myfwc.com/psm/signs/signsreg.htm>.

Due to the different speeds at which vessels of different sizes and configurations may travel while in compliance with these speeds, there is no specific numerical speed assigned to either Idle Speed or Slow Speed. During emergency situations, any person may exceed the posted vessel speed limits if it is reasonably necessary to prevent the loss of life or property due to emergency circumstances or to render emergency assistance. Examples of two of the more common signs are shown below, along with a description of what each regulation requires.

Idle Speed – means the minimum speed that will maintain the steerageway of a vessel.



Slow Speed – means the speed at which a vessel proceeds when it is fully off plane and completely settled into the water. Vessels shall not be operated at a speed that creates an excessive wake or other hazardous condition which endangers other vessels under the existing circumstances.



Palm Beach County Manatee Protection Plan

VI. BOAT FACILITY SITING PLAN

A. Introduction

This section describes the conceptual approach, methodology, and results of the screening process used to develop the Boat Facility Siting Plan (BFSP) for Palm Beach County. The goal of a boat facility siting element of an MPP is to reduce the potential for manatee/watercraft interaction and impacts to important manatee habitat.

It is not the intent of the BFSP to prohibit development of marinas or boat ramps. Rather, the plan is intended to identify and allow new facility siting and/or expansion of existing facilities in a manner consistent with the protection of manatees and their habitat. Using the criteria described below, the BFSP partitions the coastal waterways of Palm Beach County into five major categories, which correspond to the relative risk of manatee/boat interactions: 1) Unrestricted, 2) Preferred, 3) Conditional, 4) Non-Preferred and 5) Exclusionary.

The first step in the boat facility siting process was to identify the factors, or criteria, that contribute to boat and manatee interaction within the coastal waterways of Palm Beach County. Next, the various screening criteria were analyzed to characterize the relative risk to manatees if additional boat trips are generated from a given location.

If a proposed project is inconsistent with MPP provisions, an application for a new or expanding boat facility in an area that is limited in slip density by the Boat Facility Siting Plan can request full review for additional slips on an individual basis. However, full State and Federal consultation with the appropriate wildlife agencies will be required under Section 7 consultations by the U.S. Fish and Wildlife Service (see Section I.B.1., below). The determination of whether an application should be approved will depend on a case-by-case review of existing manatee protections and the adequacy of manatee protections with respect to present and future development, with consideration given to available manatee data. State, Federal, County, and municipal (if applicable) approvals of the location and activity must be based on a finding that the facility will not have an adverse impact on manatees. In

Palm Beach County Manatee Protection Plan

addition, any offsetting measures must present the same level of protection as that required under the MPP recommendation.

B. Boat Facility Siting Criteria

The facility siting criteria used in this plan are derived from either natural resource data (e.g., manatee distributional information or seagrass locations), documented or anticipated boating patterns, and/or physical waterbody characteristics, which are considered when assessing the relative importance of specific areas to manatees and potential risks associated with watercraft activity. Based on State guidelines (see **Appendix A**), the critical determinants (criteria), which represent the relative potential for manatee/watercraft interactions used in this analysis, are:

- manatee abundance
- manatee feeding habitat
- proximity to primary boating destinations
- watercraft-related manatee mortality
- existing slip densities
- waterway width and
- presence of speed zones.

The following discussion explains the rationale for using these seven criteria in the screening process.

Relative Manatee Abundance and Distribution

The relative abundance and distribution of manatees in County waters varies both geographically and temporally. Manatees are known to be particularly abundant in certain areas of the County, a condition that is amplified in the winter months. These differences in manatee distribution are likely the result of availability of critical resources, such as warm water refugia, freshwater discharges, and/or foraging habitat. For purposes of this plan, the greater the number of manatees occurring in a particular area, the greater the risk for manatee and watercraft interaction. Thus, for this criterion, areas of relatively low manatee abundance are considered more desirable for boating facilities than areas of relatively high abundance.

Palm Beach County Manatee Protection Plan

Proximity to Primary Boating Destinations

Data provided in the Palm Beach Boating Activity Study (Baker and Villanueva 1994) indicates that the primary destination of boaters in Palm Beach County is offshore (approximately two-thirds of boaters surveyed indicated they were traveling offshore), and boaters typically access the ocean through the nearest inlet. Since manatees only rarely travel outside of the coastal inlets, it follows that boats traveling offshore have a greatly reduced chance of hitting a manatee. However, until they reach offshore waters, boats pose a risk to manatees roughly proportional to the travel distance between the vessel's point of origin and the inlet, all other factors being equal. Thus, for this criterion, sites located close to inlets are considered more desirable than locations distant to inlets.

The Palm Beach Boating Activity Study indicated that approximately one-third of boaters remain within the County's coastal waterways during their excursions. The County has identified six current or future destinations likely to attract a significant number of coastal boaters (see Section VI.C. Evaluation Method, Proximity to Primary Boating Destinations). These sites provide opportunities to anchor or dock, picnic, use nature trails, observe wildlife, fish, or swim. As with inlets, sites located relatively close to any of these boating destinations are considered more desirable than those located farther away because travel times are reduced.

Use of proximity to boating destinations as a screening criterion assumes that boaters typically travel to the closest inlet or other popular destination. Although this logic seems intuitive, there is no empirical information available to support it.

Watercraft-related Mortality

Areas of relatively high historical watercraft-related mortality indicate a high potential for future manatee impacts due to a combination of high manatee abundance, lack of or inadequate speed restrictions, increased boating activity, and/or other factors. It is recognized that the use of mortality data as a screening criterion is limited by a number of factors. A manatee struck and killed by a boat may drift a significant distance before its carcass is recovered. Additionally, a manatee hit by a boat may not die immediately and may swim some distance before it succumbs to the injury. Nonetheless, carcass

Palm Beach County Manatee Protection Plan

recovery locations represent the best available information for estimating the general area of the County where manatees have an increased probability of being mortally wounded by a boat collision.

Manatee Feeding Habitat

Manatees feed primarily on submerged aquatic vegetation, and in Palm Beach County the principal food source is seagrass. Coverage of seagrass within the coastal waterways is highly variable and primarily related to water depth, water quality, and sediment type. The protection of seagrass beds is imperative for the survival of the manatee (Marine Mammal Commission 1992). The protection of seagrass beds is imperative to ensure an adequate food supply for manatees, as well as a healthy, functioning estuarine system. Moreover, manatees may be at an additional risk for physical harm while feeding in shallow seagrass beds. Analysis of manatee distributional data suggests that manatees are attracted to areas with a high level of seagrass coverage. For purposes of this plan, it is assumed that the greater the coverage of seagrasses in a particular area, the greater the potential for attracting manatees, and thus, the greater the potential for manatee/watercraft interaction. Siting marina development away from extensive seagrass beds will also minimize the extent of dredge-and-fill activities and potential prop scarring within manatee foraging habitat.

Slip Densities

The density of existing wet and dry slips and boat trailer parking spaces is much higher in some areas of the County than in others. The effectiveness of speed zones, law enforcement, and public education efforts can be maximized in areas with relatively high boating activity. This might be considered analogous to concentrating development within urban service centers where provision of public services is most efficient. This approach encourages expansion of existing facilities and siting of new facilities near existing facilities, as opposed to construction of new facilities distant to existing infrastructure (analogous to urban sprawl). Facilities farther away from existing high slip density areas are considered less desirable, because they tend to dilute law enforcement and public awareness efforts, which tend to be more effective if concentrated on a smaller target area. The spread of facilities into previously undisturbed locations also reduces the amount of relatively quiet resting habitat available to the manatees.

Palm Beach County Manatee Protection Plan

Waterway Width

The potential for manatee avoidance of watercraft is dependent, in part, on the physical parameters of the waterway. All other factors being equal, narrow, constricted waterways have the greatest potential for manatee/watercraft collisions. In relatively wide areas, such as the Lake Worth Lagoon, manatees can more easily disperse away from the congested ICW. Conversely, in narrow areas such as Lake Worth Creek and ICW South, manatees have little opportunity to avoid areas congested with boat traffic. Consequently, there is a higher likelihood of boat and manatee interaction in narrow waterways compared with relatively wide waterbodies.

Presence of Speed Zones

Speed restriction zones, in the form of State manatee protection speed zones and boating safety speed zones (§§68C-22.009 and 68C-24.017, FAC; see **Appendices B and C**, respectively), have been in effect in Palm Beach County since 1991. These zones are designed both to reduce the number of boating accidents and to minimize accidental boat strikes to manatees. In Palm Beach County, several categories of speed restriction zones have been designated. These include idle speed, slow speed, and 25- or 30-mile-per-hour zones, depending on the waterway or season (see Section IV.C., above). The level of protection afforded manatees by a speed zone is dependent on the degree and time frame of the speed restriction, extent of the waterway within the speed zone, and the level of boater compliance. Although a large vessel may cause injury or death to a manatee, even at slow speeds, for the purpose of this assessment it is assumed that speed zone restrictions generally reduce the likelihood and/or severity of injuries caused by boat collisions. Thus, in most parts of the County, locations that require the boater to travel to destinations through more restrictive speed zones are more desirable for siting new boating facilities than areas with few restrictions in place.

C. Evaluation Method

The seven criteria identified above were evaluated using the Geographic Information Systems (GIS) “Spatial Analyst” component of ArcGIS (v9.1) software. This approach was developed by the Florida Department of Community Affairs (DCA) in its 2003 document, *Preparing a Boat Facility Siting Plan – Best Management Practices for Marina Siting*. Each criterion was evaluated independently by overlaying a user-defined 100 ft² grid pattern on the County’s manatee accessible waterways and

Palm Beach County Manatee Protection Plan

generating a value for each grid square. These values were calculated by the program using one of three types of spatial analyses, (surface density, distance to, or raster grid), depending on the type of input data set.

Surface density maps were generated for data sets which were comprised of point data (e.g., manatee aerial survey observations). In the creation of a surface density map, the program assigns a value to each grid square that is equal to the density of points (number of points per unit area) within a specified radius of that grid square. For the “distance to” type of spatial analysis, the program assigns a value to each grid square that is equal to its straight-line distance from a specified location, such as an inlet or other boater destination. Input data consisting of polygon data (e.g., seagrass beds) was modeled by creating a raster grid. To accomplish this, a numeric value is first given to each input polygon (e.g., a particular speed zone or seagrass bed). The value of each grid square in the output coverage is simply equal to the value of the input polygon within which the grid square falls.

The output maps derived by Spatial Analyst for each layer consists of a grid with squares whose values fall within a range., which has been grouped into low, moderate, and high categories. The layers are listed in **Table 14** at the end of this section. These maps were used when considering the suitability of a particular shoreline property for future boat facility siting/expansion. Some criteria were considered more important than others in determining appropriate locations for marinas.

Manatee Abundance

Manatee abundance was evaluated using three data sets: bi-monthly aerial surveys, winter synoptic surveys, and telemetry data. The latter two data sets have certain limitations, in that they are either a snapshot of manatee abundance on only one or two days during the coldest times of the year (synoptic data) or are dependent on the behavior of relatively few tagged animals (telemetry data). Additionally, both the synoptic survey and telemetry data should be reflected to some degree in the aerial survey data. For example, aerial surveys flown during the winter should show congregations around the same warm water refugia used for counting manatees during the synoptic surveys. Aerial survey data includes the total number of sightings observed within Palm Beach County per aerial overflight during the entire period of the most recent aerial survey (1990-93). Synoptic data includes the total number of sightings

Palm Beach County Manatee Protection Plan

during all overflights in FWC’s coastal database through 2003. Telemetry data includes all satellite fixes for each tagged manatee that ventured into Palm Beach County in the *Sirenia* database maintained by USGS (1986-98).

For each map layer, category values were manually set so that the output data approximated a normal (bell-shaped) distribution curve, with roughly equal numbers of observations in the high and low categories and a substantially higher grouping in the middle. This methodology compensated for extremely high densities of manatees around the FPL Riviera Power Plant, which greatly exaggerated the overall range of density values. The categories for each of the three manatee abundance data sets are shown below (**Table 13**). It should be noted that even though the data used in these analyses was collected for three very different studies, all three distribution maps (**Figures 29-31**) were in general agreement. They show the highest relative manatee abundance in Jupiter Sound, the C-18 Canal, LWL North, LWL South, and Lake Wyman.

Table 13 – Survey Rankings of Manatee Abundance Data Sets

Database	Ranking		
	Low	Moderate	High ¹
Aerial Surveys ²	0-0.2	0.2-0.95	>0.95 (11.1)
Synoptic Surveys ²	0-6.5	6.5-28	>28 (3,370.3)
<i>Sirenia</i> ³	0-3.5	3.5-35	>35 (276.3)

¹ Numbers in parentheses are the highest values recorded.

² Values represent the number of manatee sightings per square mile per aerial survey.

³ Values represent the cumulative number of manatee sightings (telemetry points) per square mile for the inclusive period of record.

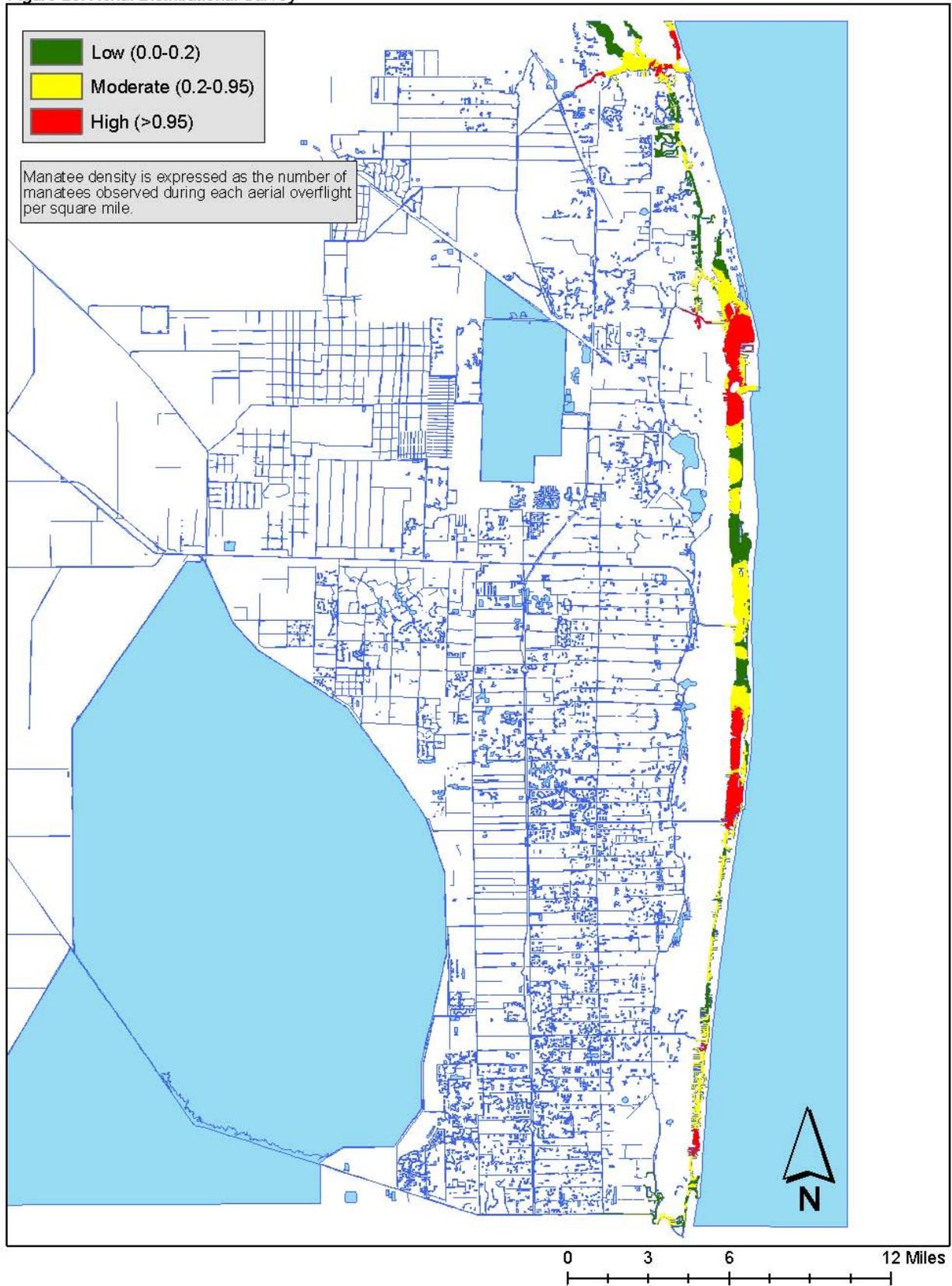
Each of the three map layers (aerial survey, synoptic, and telemetry) was then overlain and summed to produce a cumulative manatee abundance score for each of the grid squares (**Figure 32**). The aerial survey layer accounts for 50 percent of the cumulative score. For this cumulative manatee abundance map, grid squares within the lower-third of the range of values were considered low density, those within the middle-third were considered moderate density, and those within the upper-third were

Palm Beach County Manatee Protection Plan

considered high density (an “equal interval” method was used to classify the data). While this cumulatively derived map provides another perspective to consider, it should not be considered as a replacement for the individual output maps.

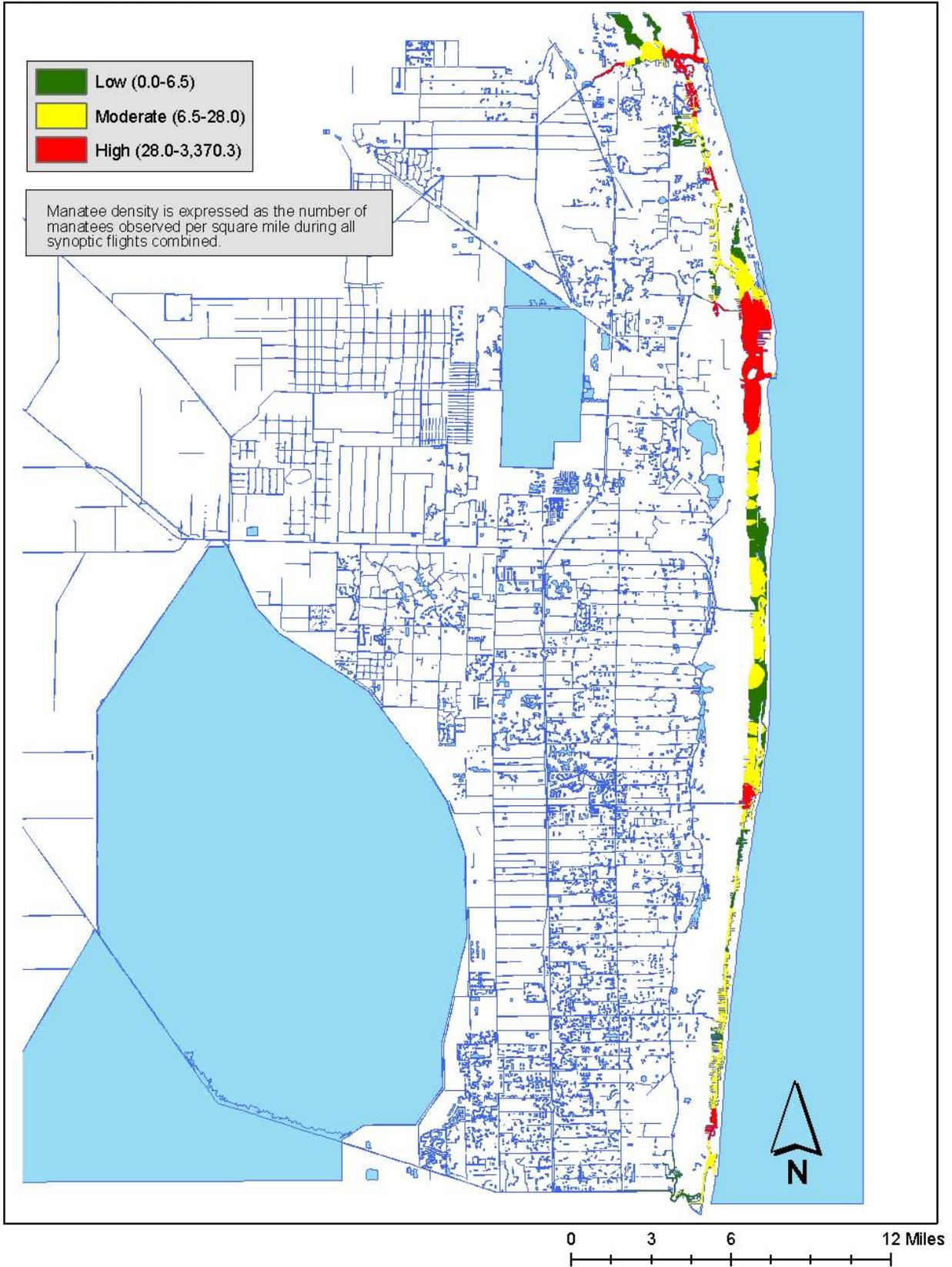
Palm Beach County Manatee Protection Plan

Figure 29. Aerial Distributional Survey



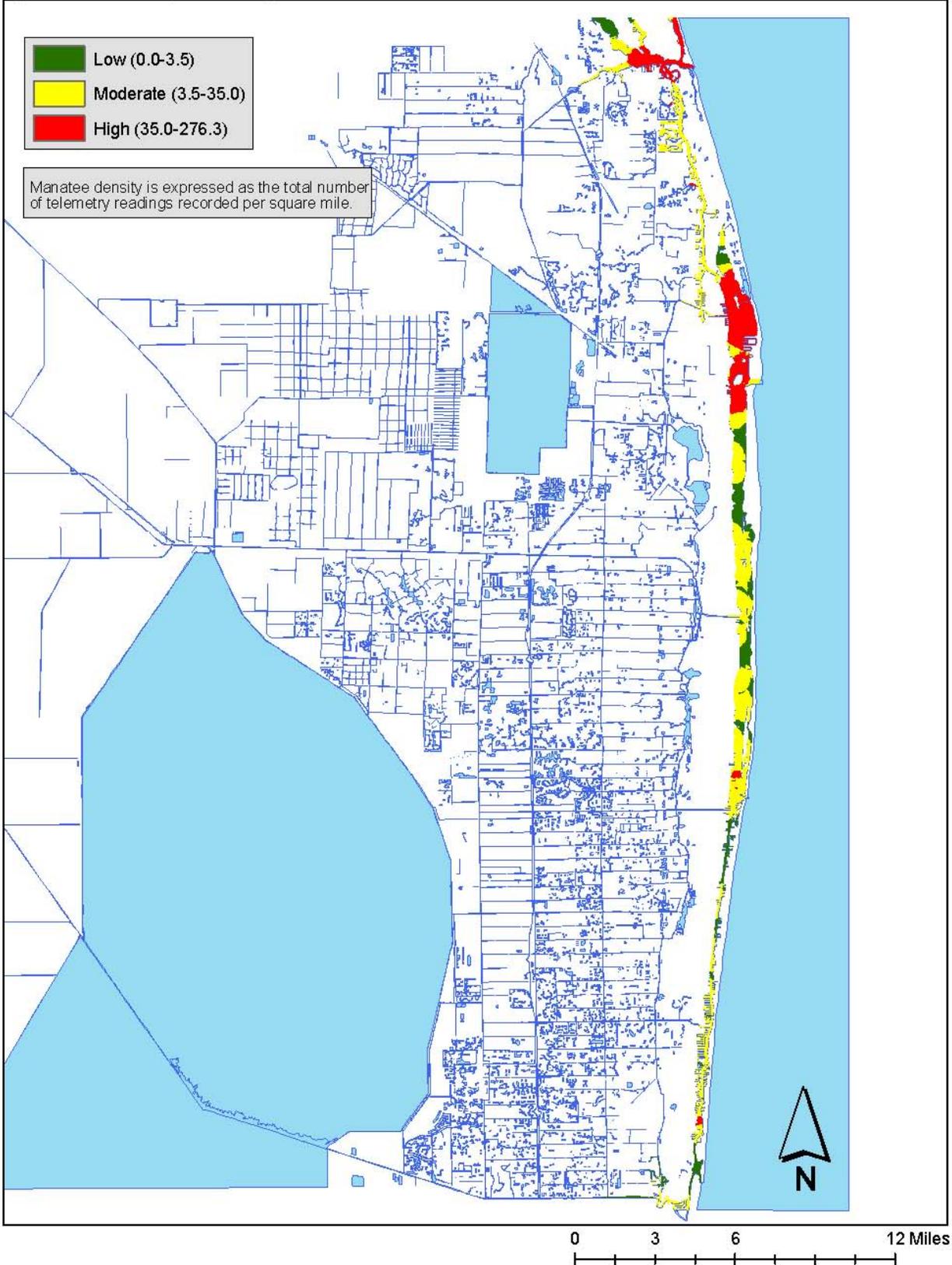
Palm Beach County Manatee Protection Plan

Figure 30. Synoptic Survey



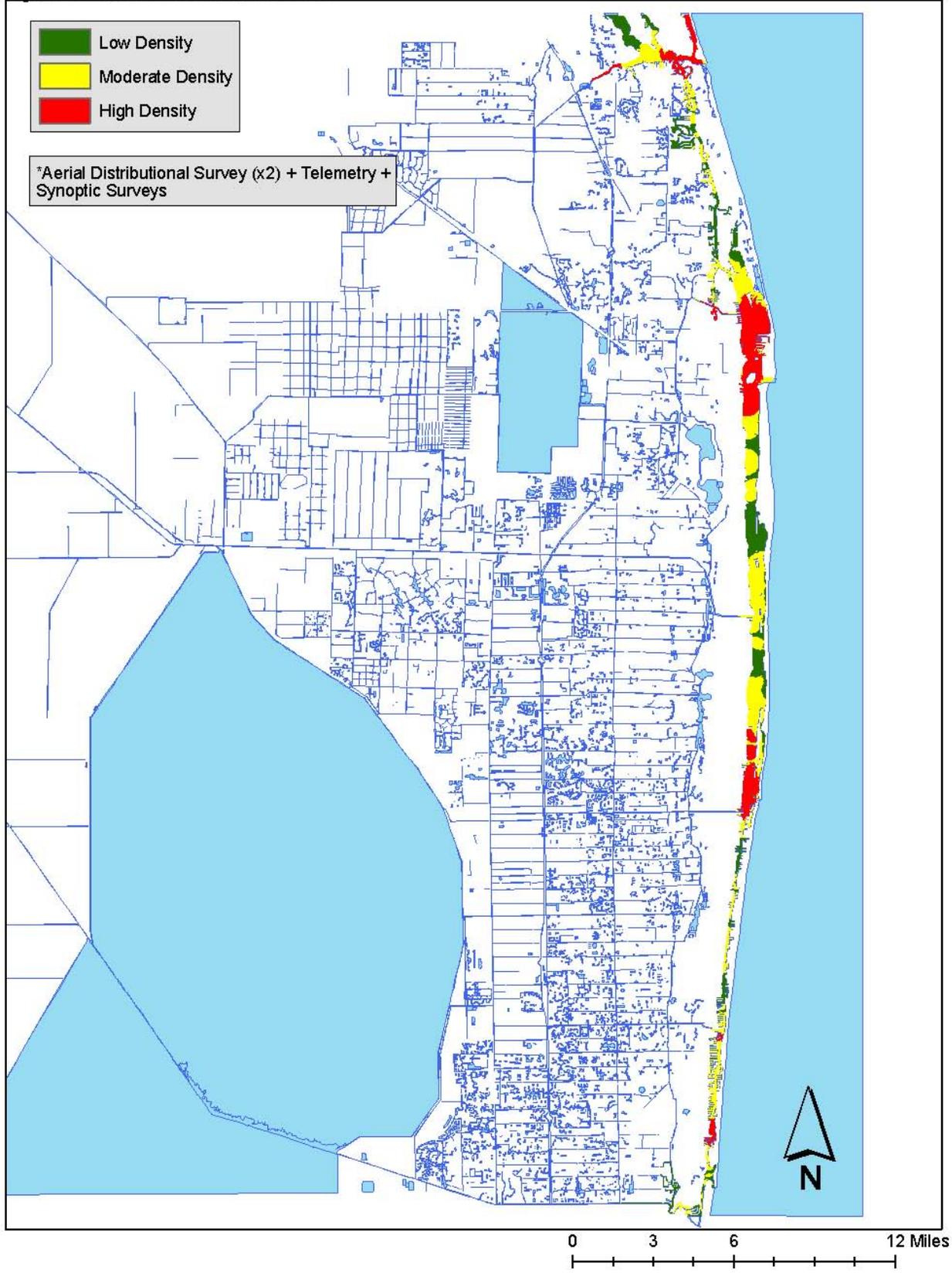
Palm Beach County Manatee Protection Plan

Figure 31. Sirenia Project Telemetry



Palm Beach County Manatee Protection Plan

Figure 32. Cumulative Manatee Abundance*



Palm Beach County Manatee Protection Plan

Proximity to Primary Boating Destinations

In a simplistic approach to quantifying destination, straight-line distances were measured from each grid point to the nearest inlet (**Figure 33**). Although these straight-line distances do not accurately measure total travel distance since the lines sometimes cross land, they suffice for categorizing relative travel distances in an area such as Palm Beach County where boat travel is confined to a narrow band along the coast. Categories for travel distances were established subjectively based on the maximum distance between any two inlets (~ 7.8 miles). Short travel distances were considered less than 1.5 miles and were assigned a one. Anything more than five miles from an inlet was considered to be a long travel distance and received a ranking of three. Intermediate distances were assigned a two.

In addition to the inlet, six other current or future primary boating destinations were included in the analysis (**Figure 34**):

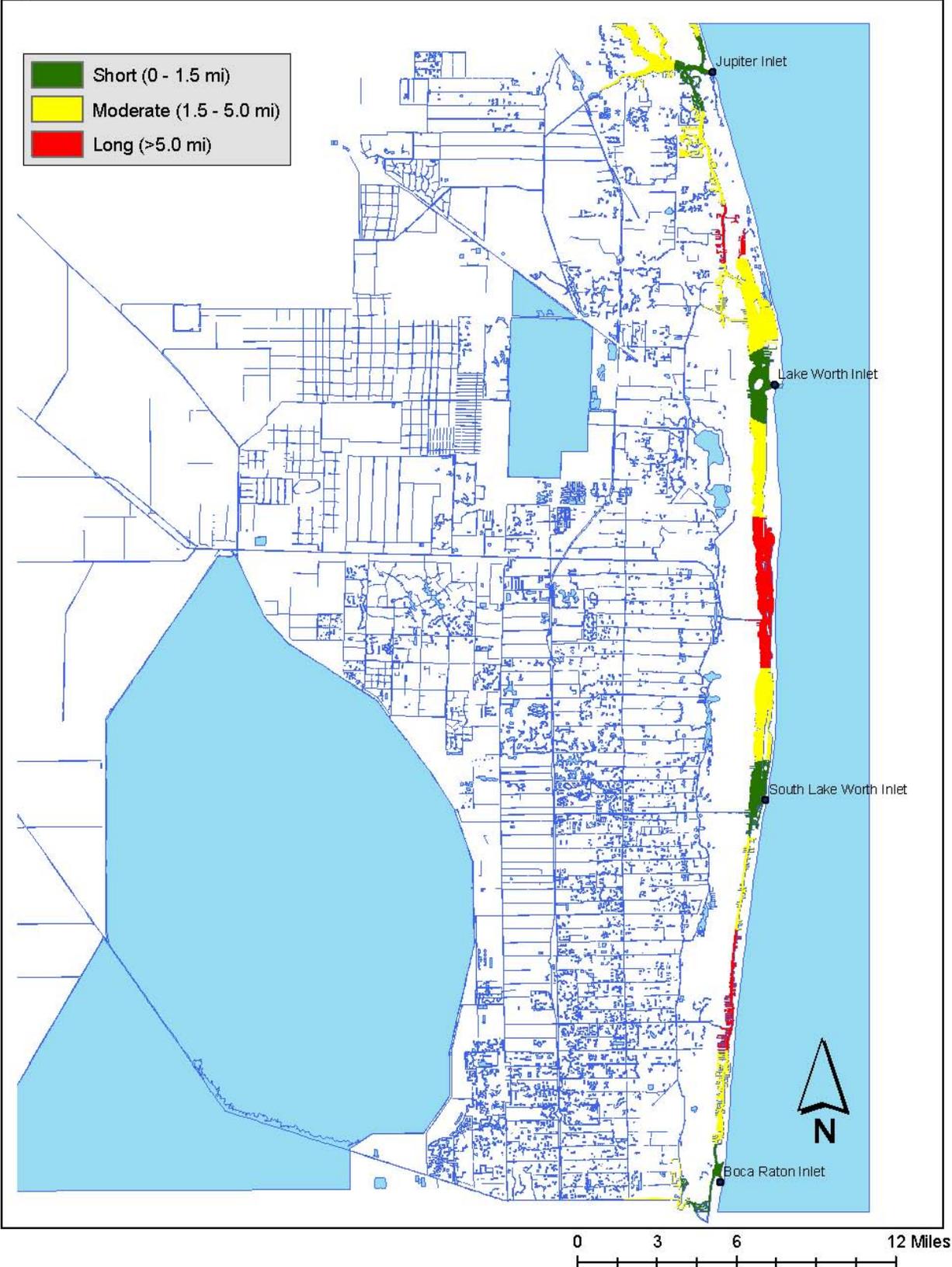
- Harborview Park/Sawfish Bay Island
- Juno Dunes Natural Area
- Munyon Island
- Snook Island Restoration Site
- Ocean Ridge Natural Area Restoration Site
- Spanish River Park

A seventh popular destination, Peanut Island, was not included in this analysis because of its proximity to the Lake Worth Inlet. Distance to the nearest inlet was analyzed separately, and Peanut Island is situated at the mouth of the Lake Worth Inlet. Thus, its inclusion with this data set would give it more weighting than other popular destinations.

The Spatial Analyst program computed the straight-line distances from each grid point to the closest of the six listed popular destinations. The same arbitrary categories (1.5, 1.5-5.0, and >5.0) were assigned as for distance to inlets. The maximum distance a boater would have to travel to get to the closest of these destinations was approximately 6.7 miles. In the cumulative analysis for all boating destinations, distance to inlet was weighted twice as important as distance to other destinations (i.e., 66.7% of total score) (**Figure 35**). This comports with destination information presented in the University of Miami's Boating Activity Study (Baker and Villanueva 1994).

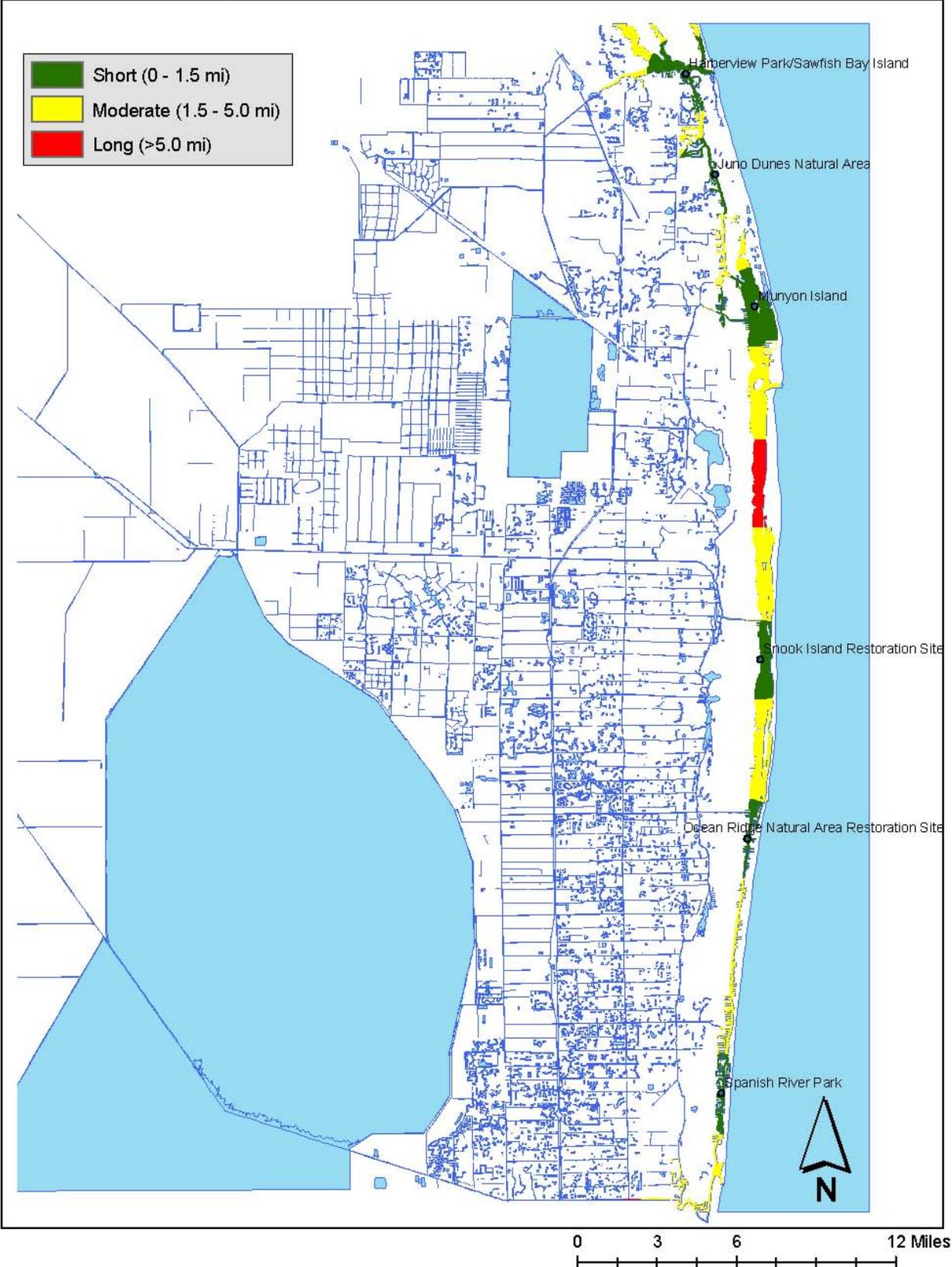
Palm Beach County Manatee Protection Plan

Figure 33. Distance to Ocean Inlets



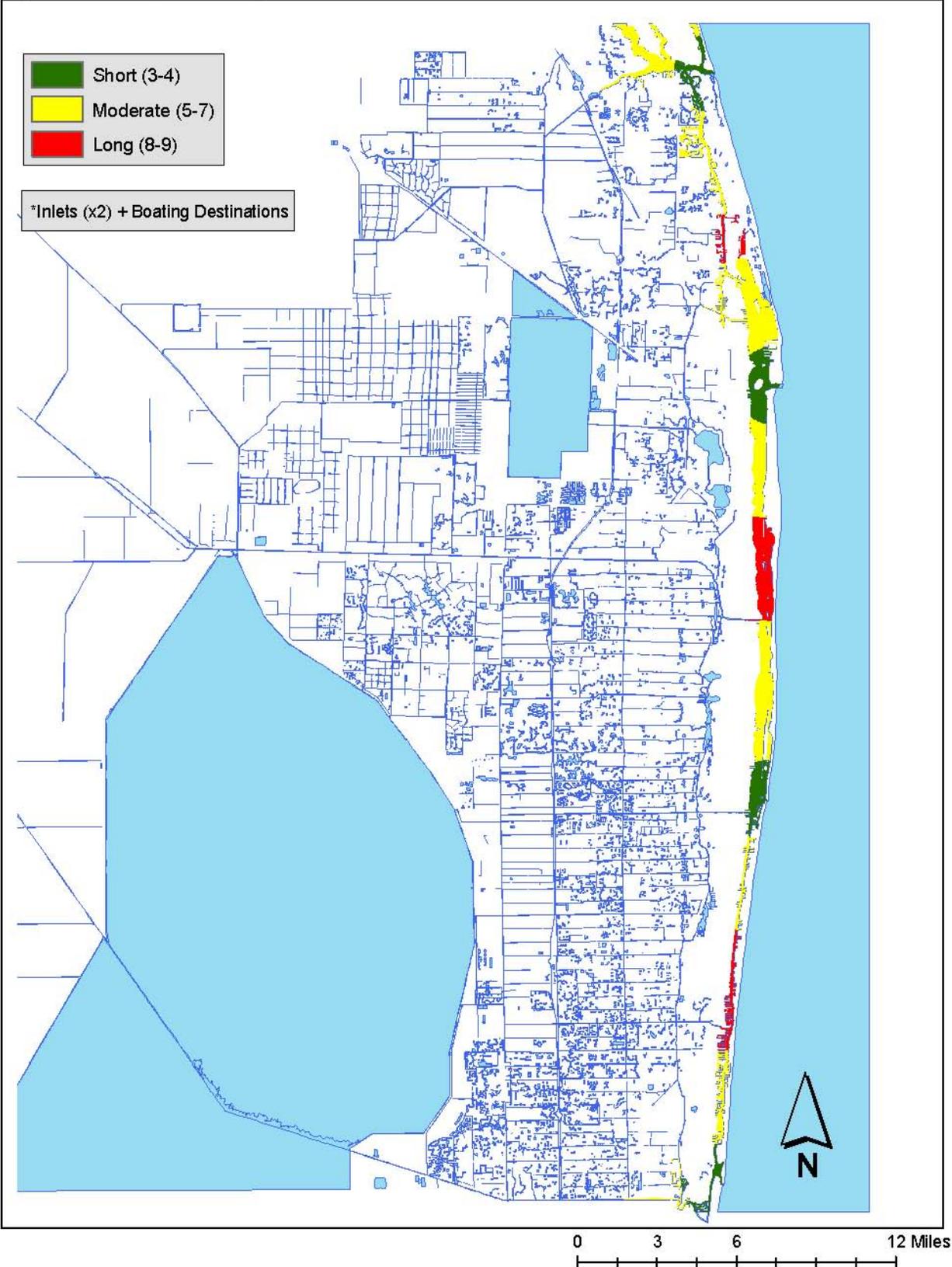
Palm Beach County Manatee Protection Plan

Figure 34. Distance to Boating Destinations



Palm Beach County Manatee Protection Plan

Figure 35. Proximity to All Boating Destinations*



Palm Beach County Manatee Protection Plan

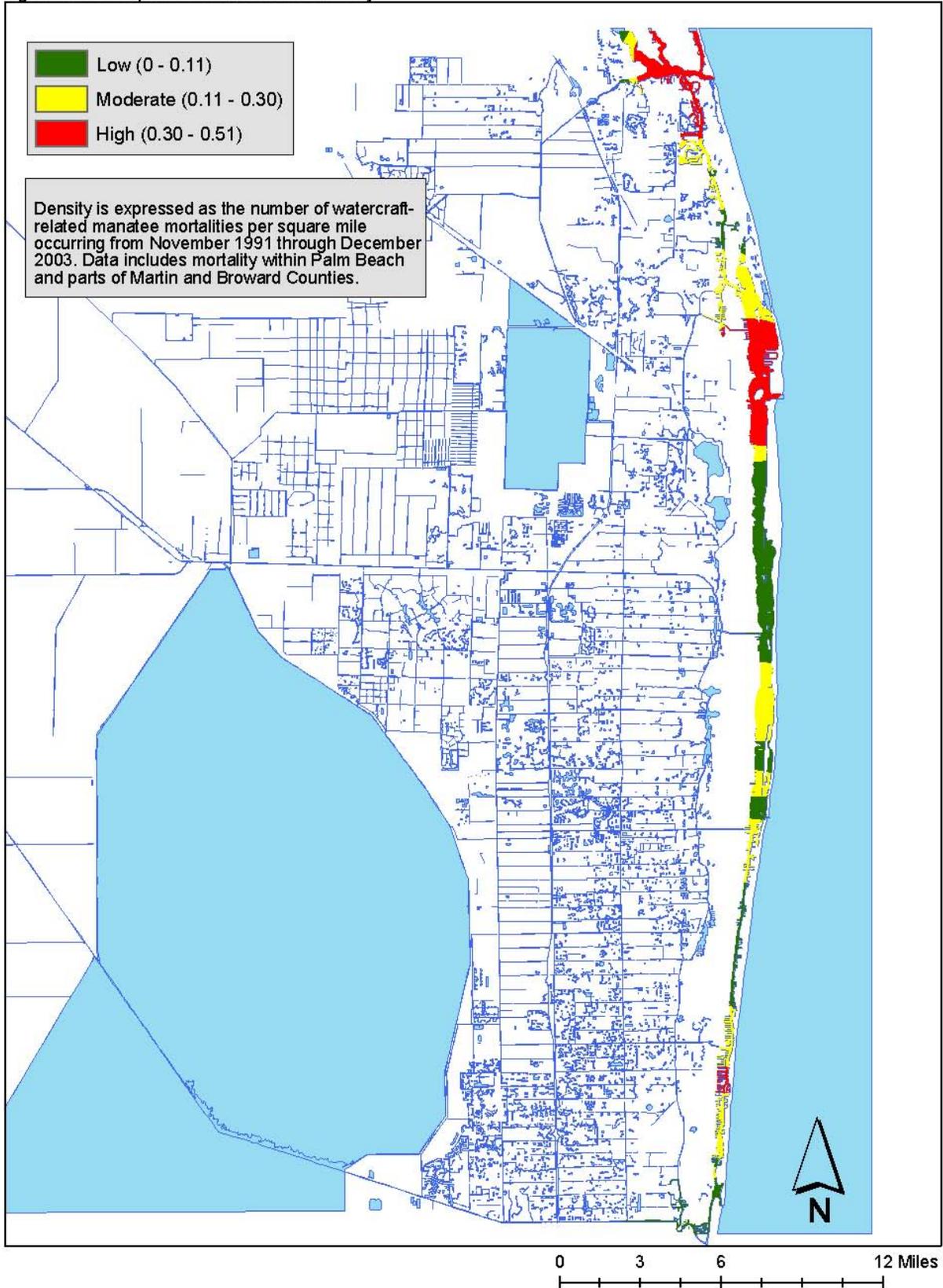
Watercraft-related Manatee Mortality

For purposes of this plan, only data for the period following implementation of manatee speed zone restrictions (November 1991) was used, because this best reflected current conditions and level of risk. Data was analyzed through December 31, 2003, which was the most complete year dataset available when this analysis was begun. While not available when the Spatial Analyst evaluations were performed, more recent data through December 2005 and data earlier than 1991 were also considered when developing the final suitability map. Watercraft mortalities within Palm Beach, northern Broward, and southern Martin Counties were also included within the analysis.

The density of watercraft-related manatee mortalities within a 2.5-mile (13,200 ft) radius of each grid square was calculated. A 2.5-mile search radius was deemed appropriate for Palm Beach County for two primary reasons: 1) the narrowness of most of the County waterways presumably limits the distance that a carcass can drift with tides or winds, and 2) injured and/or dead manatees are likely reported relatively quickly to authorities due to the heavy human presence on and around the waterways. A score of one (low-impact areas) was assigned to those grids with 0.0 to 0.11 manatee mortalities per square mile, and a score of three (high-impact areas) was given to those with 0.30 or more. Values in the intermediate range (0.11 to 0.30) were assigned a rank of two. The highest density of mortalities for all years combined was 0.5 per square mile. **Figure 36** indicates that the areas of highest mortality have been near Jupiter Inlet, Lake Worth Inlet, and ICW South.

Palm Beach County Manatee Protection Plan

Figure 36. Post Speed Zone Watercraft Mortality



Palm Beach County Manatee Protection Plan

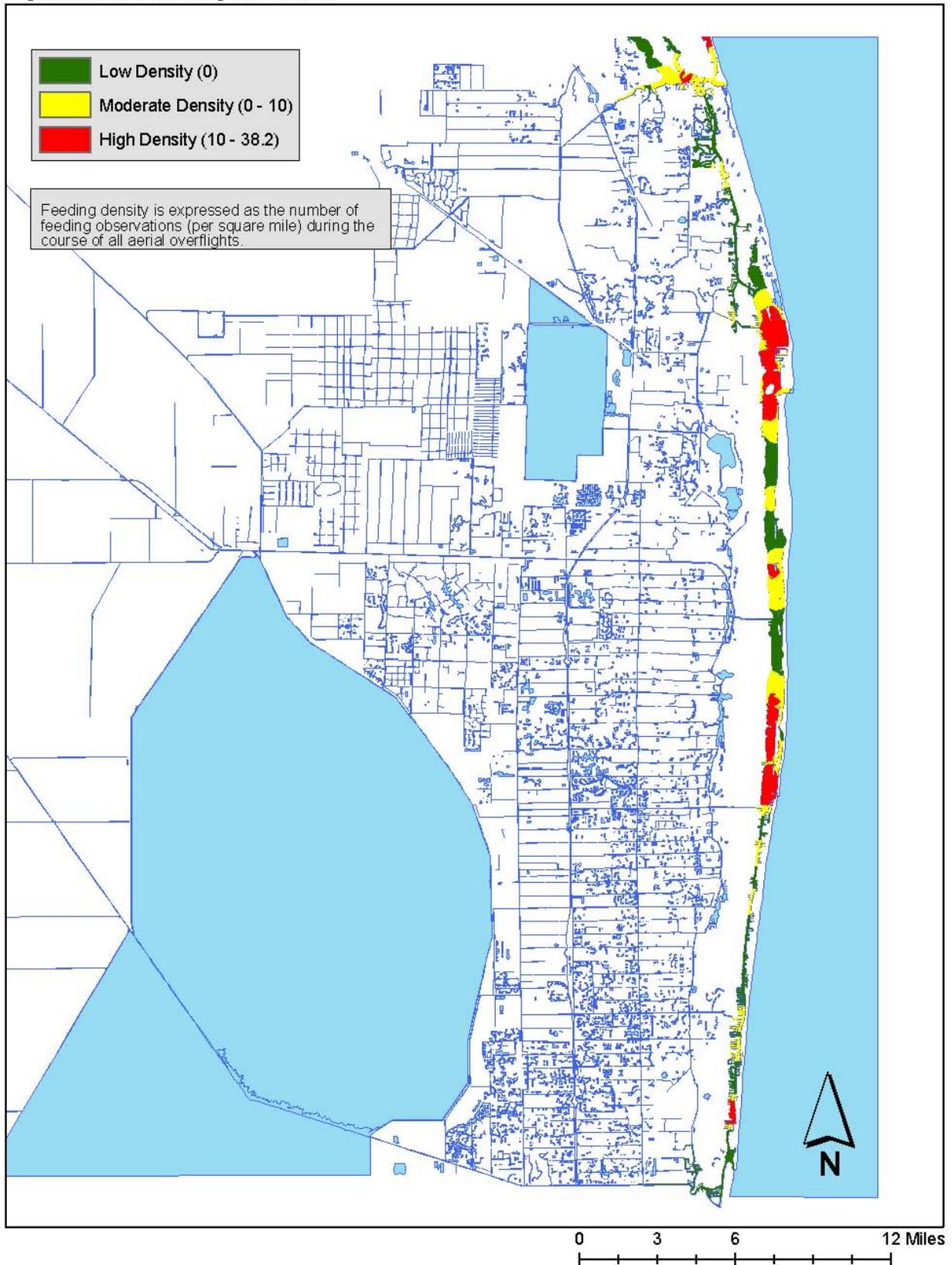
Manatee Feeding Habitat

Two data sets were used to analyze manatee feeding habitat: seagrass coverage (**Figure 21, separate Appendix of Figures**) and observed feeding locations (**Figures 22a-e, separate Appendix of Figures**). The latter information was gleaned from FWC's aerial survey data set. All feeding observations received a value of one, regardless of the size of the group observed. This is because the data did not permit the evaluation of the number of animals in a group that were actively feeding. Sightings of manatee feeding activity were analyzed within a ½ mile (2,640 ft) radius of each grid cell. Areas with no feeding observations were assigned a score of one (low risk). Between zero and 10 (20) feeding observations (per square mile) received a two, and areas with more than 10 observations received a three (high risk). The maximum number of sightings per square mile of manatee feeding activity within a ½ mile radius of any grid point for all aerial surveys combined was approximately 38 (**Figure 37**).

Seagrass data provided by ERM was converted to a raster and a value assigned to each grid point as follows: absent (1), patchy (2), and continuous (3). The Spatial Analyst then computed the average value for all grid squares within a ½ square mile (1,320 ft²) area surrounding each grid point. Grid points with average values from 1.0 (no grasses) to 1.6 were considered low risk and assigned a one. Average values from 1.6 to 2.3 were assigned a two. High-risk areas (3) were those with average values greater than 2.3 (**Figure 38**). The break points were arbitrary and used to ensure that most areas with extensive seagrass beds were classified as high risk. The maximum score for any grid point was 3.0. Following initial analyses, scores for the two indices were then combined. The seagrass data was weighted to give it three times (i.e., 75% of score) as much emphasis as the sighting data, because it represents all potential feeding habitat, not just areas where manatees have actually been observed feeding. Thus, scores derived from the seagrass data were multiplied by three and then added to the feeding activity score. Finally, grid cells within the lower third of the range of values for this cumulative layer were grouped into the low-density category, those within the middle third grouped into the moderate-density category, and those within the upper third into the high-density category (i.e., an equal interval classification method was used). **Figure 39** depicts the combined data layers and illustrates that most feeding habitat is located in Jupiter Sound, Loxahatchee River, LWL North, LWL South, and Lake Wyman.

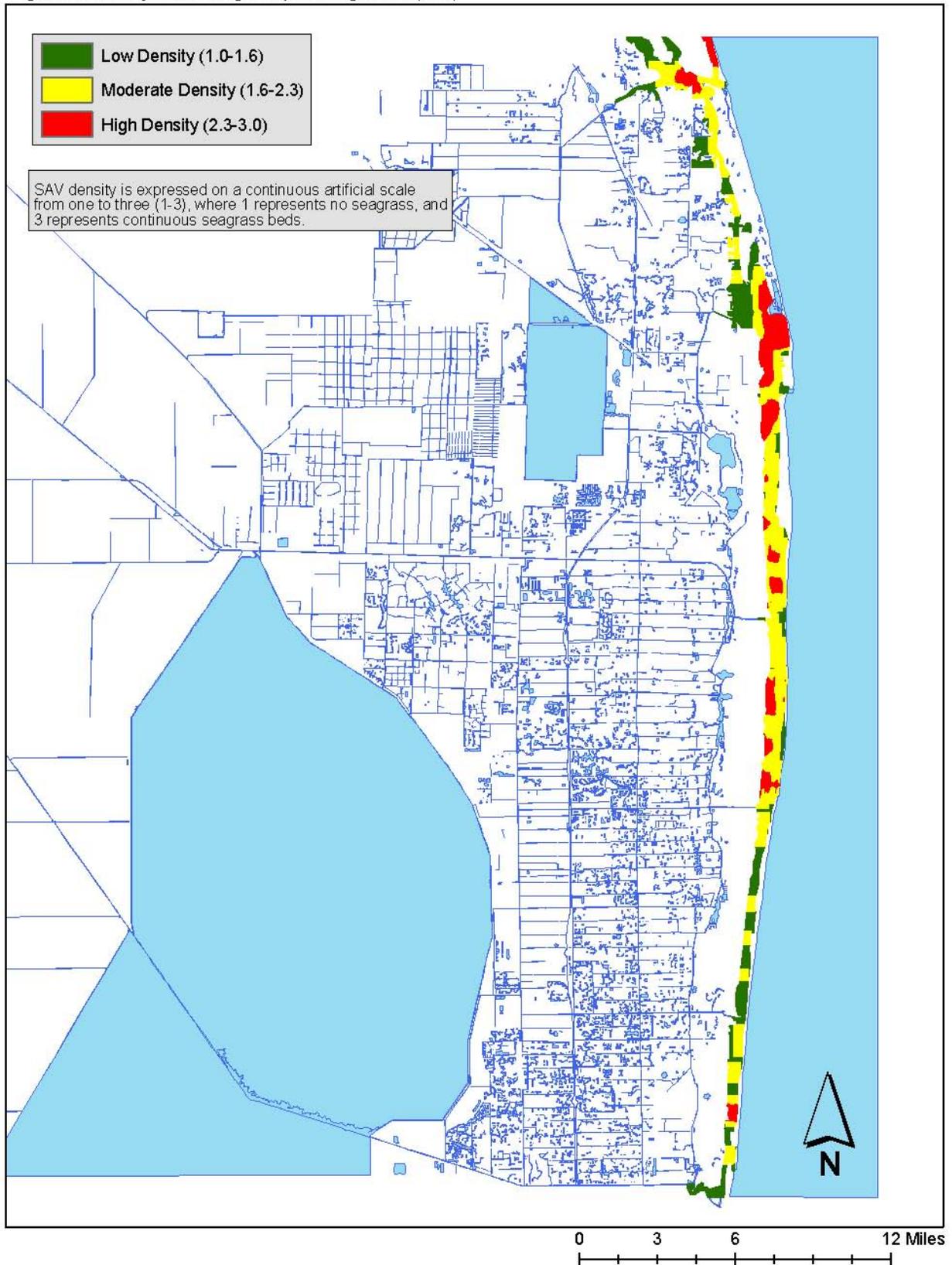
Palm Beach County Manatee Protection Plan

Figure 37. Manatee Feeding Observations



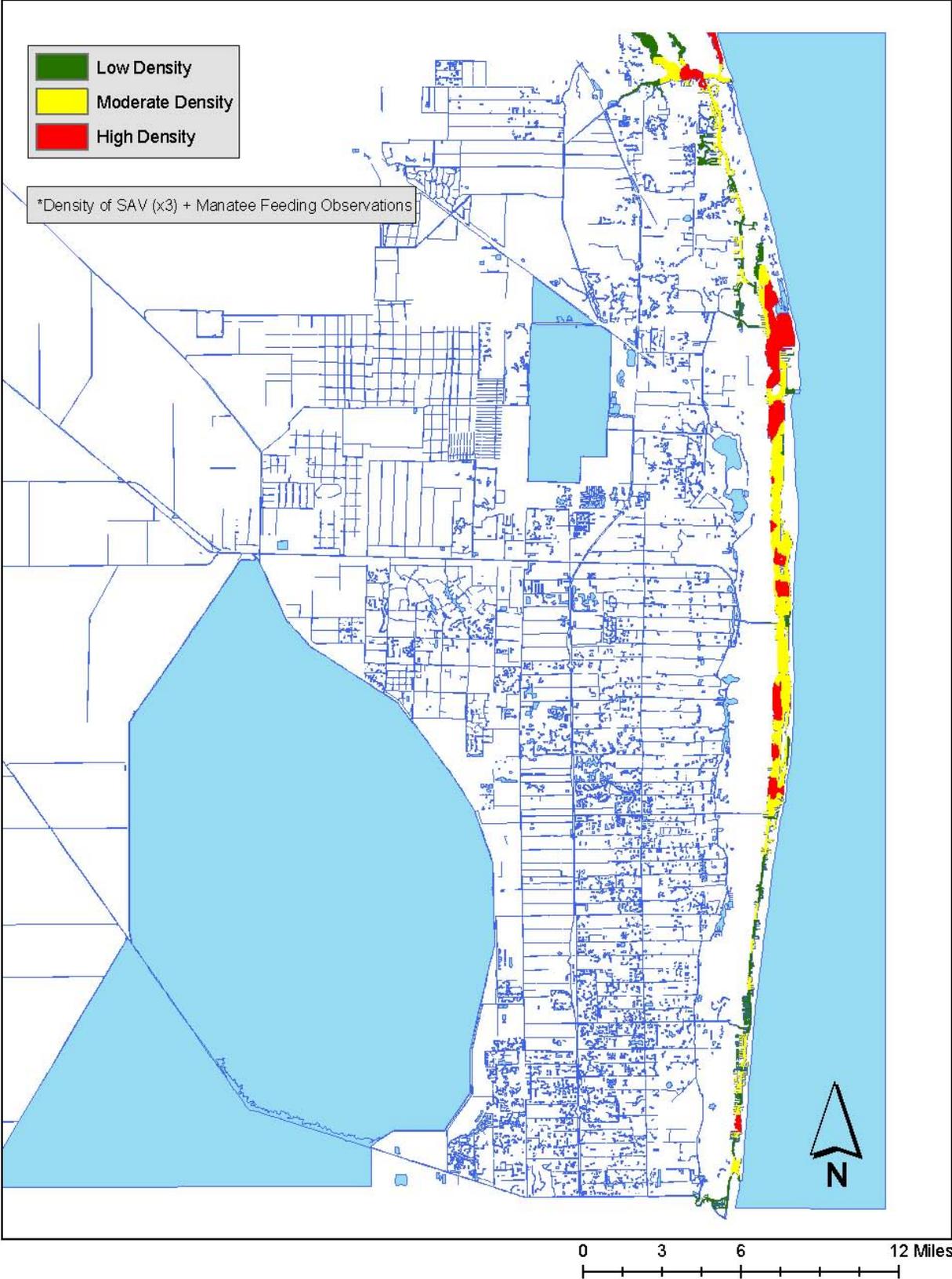
Palm Beach County Manatee Protection Plan

Figure 38. Density of Submerged Aquatic Vegetation (SAV)



Palm Beach County Manatee Protection Plan

Figure 39. Manatee Feeding Habitat*



Palm Beach County Manatee Protection Plan

Slip Densities

The Spatial Analyst program calculated the number of existing wet and dry slips at multi-slip facilities within a ½ mile (2,640 ft) radius of each grid point. Boat ramps were included in this analysis with the number of trailer parking spaces substituted for slips. Areas with relatively high multi-slip densities (>200 slips per square mile) were assigned a one, and areas of relatively low multi-slip densities (zero to 10 slips per square mile) were assigned a three. Intermediate areas received a score of two. The maximum number of slips within a ½ mile radius of any grid point was 1,625.

As discussed earlier, the effectiveness of speed zones, law enforcement, and public education efforts can be maximized in areas with relatively high boating activity. This zoning concept is similar to concentrating development within urban service centers where provision of public services is most efficient. Using this approach, facilities farther away from existing high slip density areas are considered less desirable, because they tend to dilute law enforcement and public awareness efforts, which tend to be more effective if concentrated on a smaller target area. For these reasons, existing high-density areas are given a Preferred (green designation) and low-density areas a Non-preferred (red) designation.

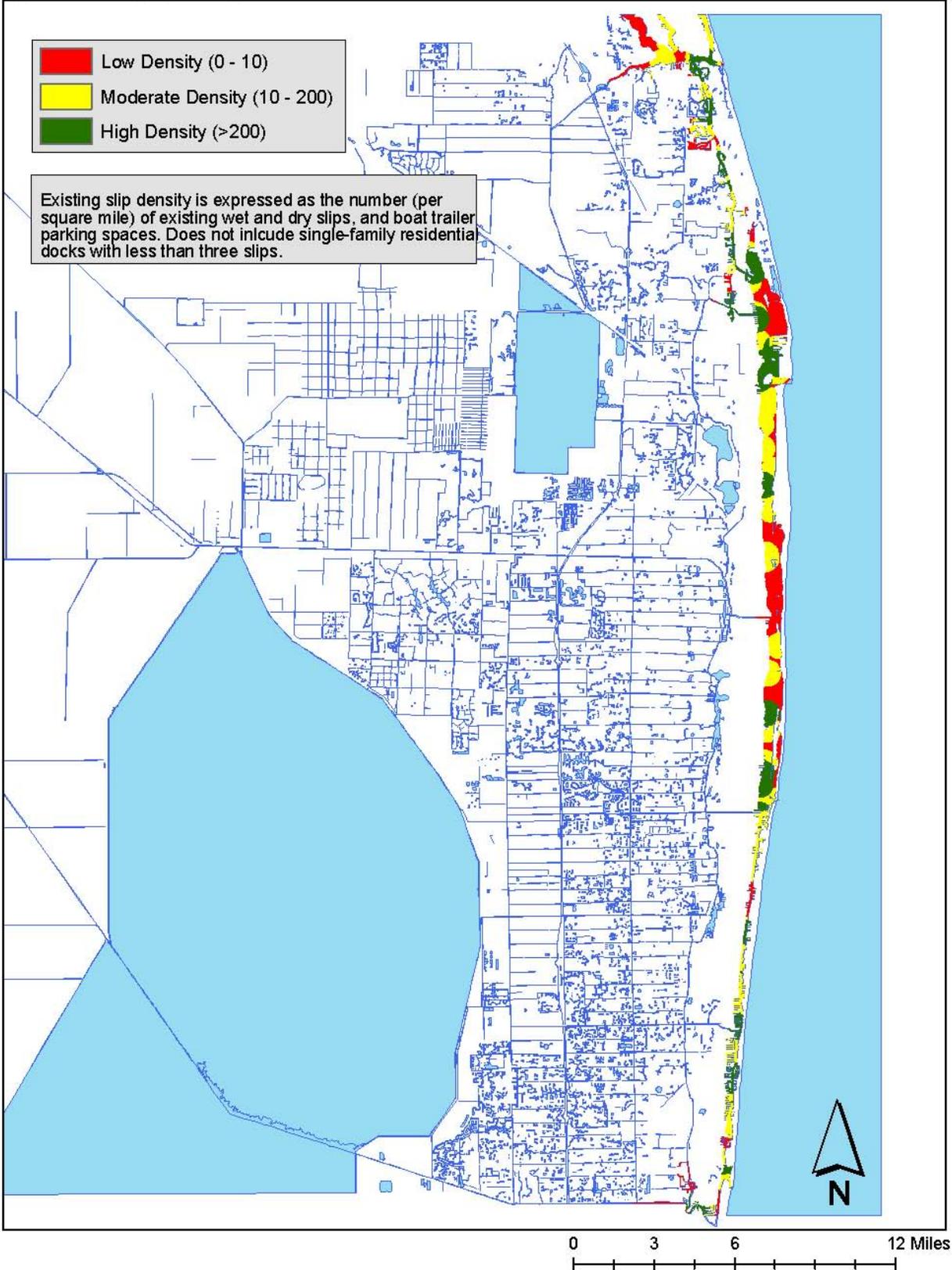
Figure 40 shows that, as expected, the Preferred locations for increased slip density are generally near the inlets and other existing, large, multi-slip facilities.

Waterbody Width

Waterway width was quantified by creating polygon shapes around waterways of differing widths. A width value was then assigned to each polygon. For the purpose of this analysis, water bodies less than 0.1 mile in width were considered narrow and received a three (high risk), while those greater than 0.5 miles in width were considered wide and given a one (low risk). Intermediate widths received a two. These width categories were subjectively based upon the characteristics of the County waterways. Category widths were assigned so that the narrow, channelized waterways, such as Lake Worth Creek and the North Palm Beach Waterway, would be contained within a single category, and uniformly wide waterbodies (such as the Lake Worth Lagoon) would also constitute a separate category as shown in **Figure 41**.

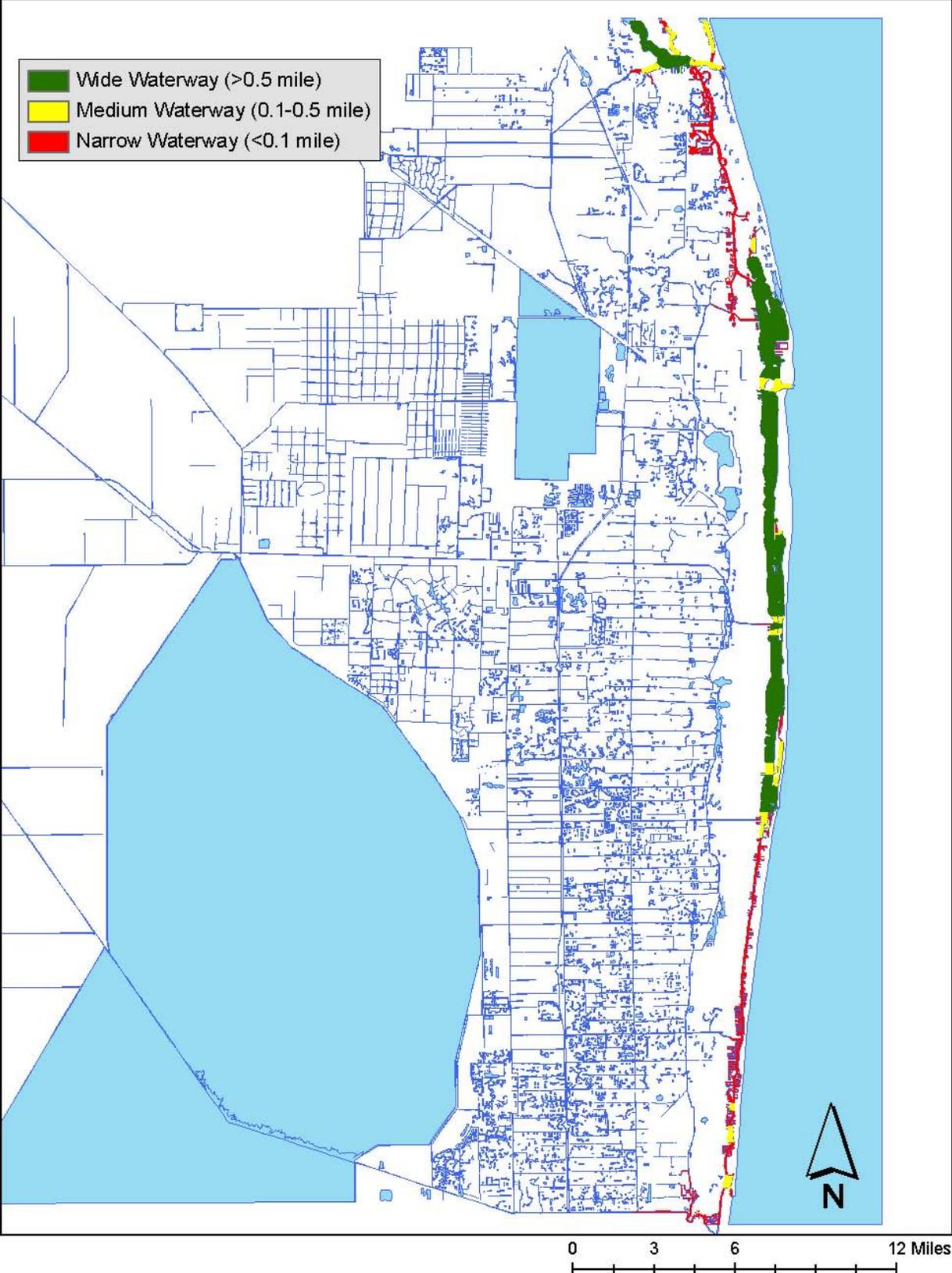
Palm Beach County Manatee Protection Plan

Figure 40. Existing Slip Density



Palm Beach County Manatee Protection Plan

Figure 41. Waterway Width



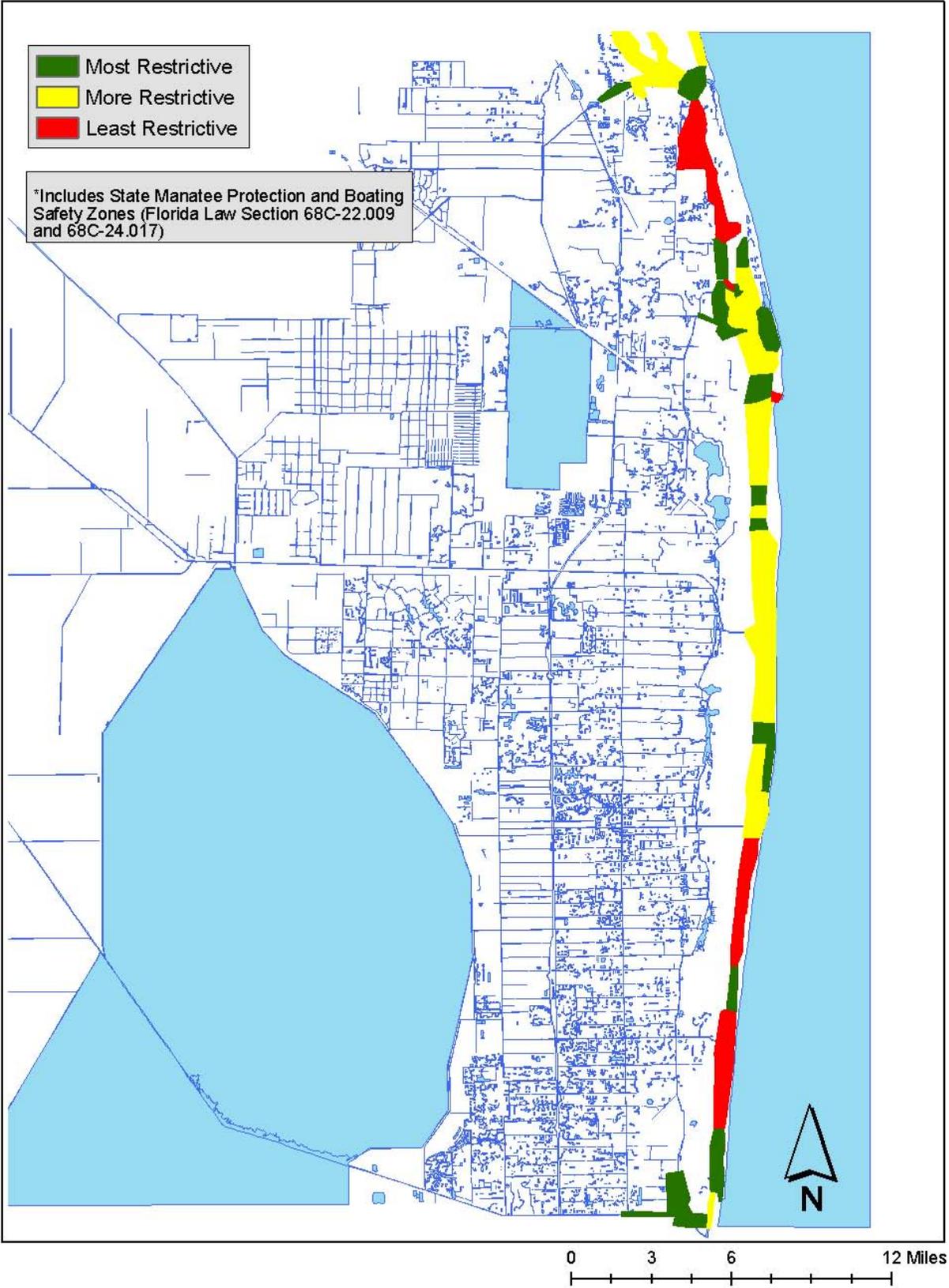
Palm Beach County Manatee Protection Plan

Presence of Speed Zones

Speed zones (both manatee protection zones and boating safety zones) were quantified by creating polygon shapes around waterways with differing speed zone restrictions. A speed zone value was then assigned to each polygon. All of the County's coastal waterways have some level of speed restriction. As such, waterbodies where idle or slow speed zones occur year-round and extend across the entire waterway were considered low risk to manatees and given a value of one. Waterways with only seasonal speed restrictions or with channel exemptions were given a value of two. Narrow waterways where more than 50 percent of the waterway was designated 25 mph or greater, such as the northern portion of Lake Worth Creek, were considered high risk and given a value of three (**Figure 42**).

Palm Beach County Manatee Protection Plan

Figure 42. Boat Speed Zones*



Palm Beach County Manatee Protection Plan

Table 14 – Synopsis of Boat Facility Siting Analysis

Screening Criteria	Data Layer(s)	Source	Data Type	Analysis Type	Description of Spatial Analysis
Manatee Abundance	Manatee Aerial Survey observations	ERM & FWC	Point	Density	Create a simple density map depicting the total number of manatees per aerial overflight within a ½ mile radius of each grid square.
	Synoptic Survey observations	FWC	Point	Density	Create a simple density map depicting the total number of manatees within a ½ mile radius of each grid square.
	Telemetry	USGS Sirenia Project	Point	Density	Assign a value of one (1) to each telemetry reading location. Then create a simple density map depicting the number of telemetry readings within a ½ mile radius of each grid square.
Proximity to primary boating destinations	Inlets	Created data	Point	Distance to	Perform a straight-line distance calculation to the nearest inlet.
	Other destinations	Created data	Point	Distance to	Perform a straight-line distance calculation to the nearest boater destination.
Watercraft Related Mortality	Manatee carcass recovery locations	FWC	Point	Density	Assign a value of one (1) to each carcass recovery location. Then create a simple density map depicting the number of watercraft-related deaths within a 2.5 mile radius of each grid square.
Manatee Feeding Habitat	Seagrass beds	ERM	Polygon	Raster grid	Assign a value of three to all polygons containing continuous seagrass, and a value of 2 for all records with patchy seagrass or algal beds. Then convert the seagrass layer to a raster grid. In the raster grid, convert all No Data (areas of no seagrass) to a value of 1.
	Feeding locations	ERM & FWC	Point	Density	Create a simple density map depicting the total number of manatees observed feeding within a ½ mile radius of each grid square.
Slip Densities	Marina and Boat Ramp locations	Created data	Point	Density	Create a simple density map depicting the total number of slips within a ½ mile radius of each grid square.
Waterbody width	Waterbody width	Created data	Polygon	Raster grid	Create a polygon shapefile where the value of each polygon represents the waterbody width, then convert to raster.
Presence of speed zones	Manatee protection zone and boating safety zone locations	FWC	Polygon	Raster grid	Assign a value of one (1) to all polygons where speed zone restrictions are year-round and include the entire waterway. Assign a value of two (2) to all polygons where speed restrictions are seasonal or exclude the channel. Assign a one (1) to polygons with no slow/idle speed restrictions for majority of waterway year-round.

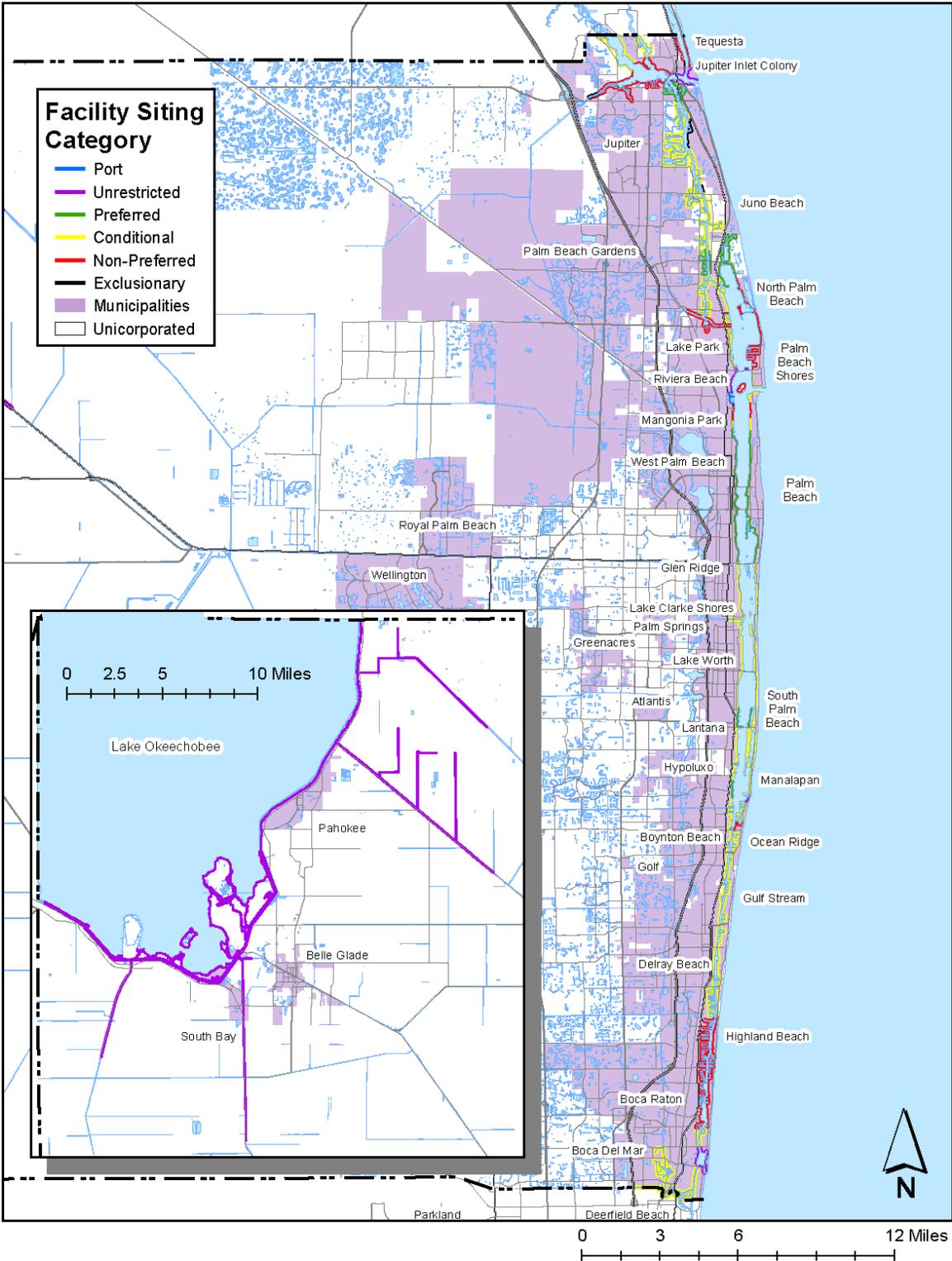
Palm Beach County Manatee Protection Plan

D. Results of the Screening Process

The intent of this analysis was to produce a map that classifies different County waterways with respect to their relative importance to manatees and the relative degree of risk each poses for watercraft/manatee interactions. The degrees of risk can be characterized as low, medium and high, which have been generally categorized as Preferred, Conditional and Non-Preferred areas for boat facility siting locations. Using the maps generated by Spatial Analyst, as well as other pertinent data and information, the analyzed waterways of the County have been designated with specific boat facility siting categories and a final boat facility suitability map has been produced (**Figure 43 and Figures 44a-e**).

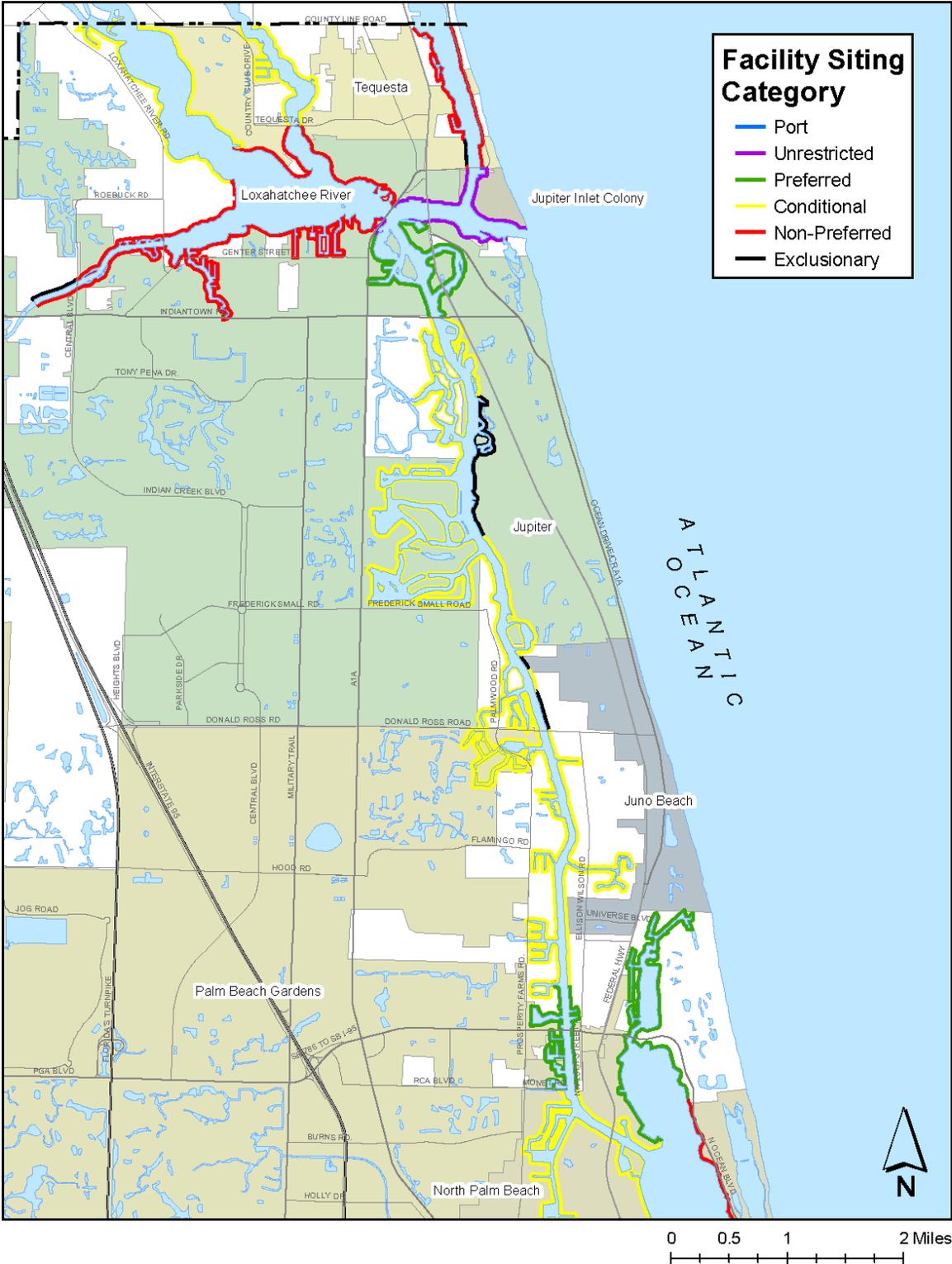
Palm Beach County Manatee Protection Plan

Figure 43. Palm Beach County BFSP Suitability Map



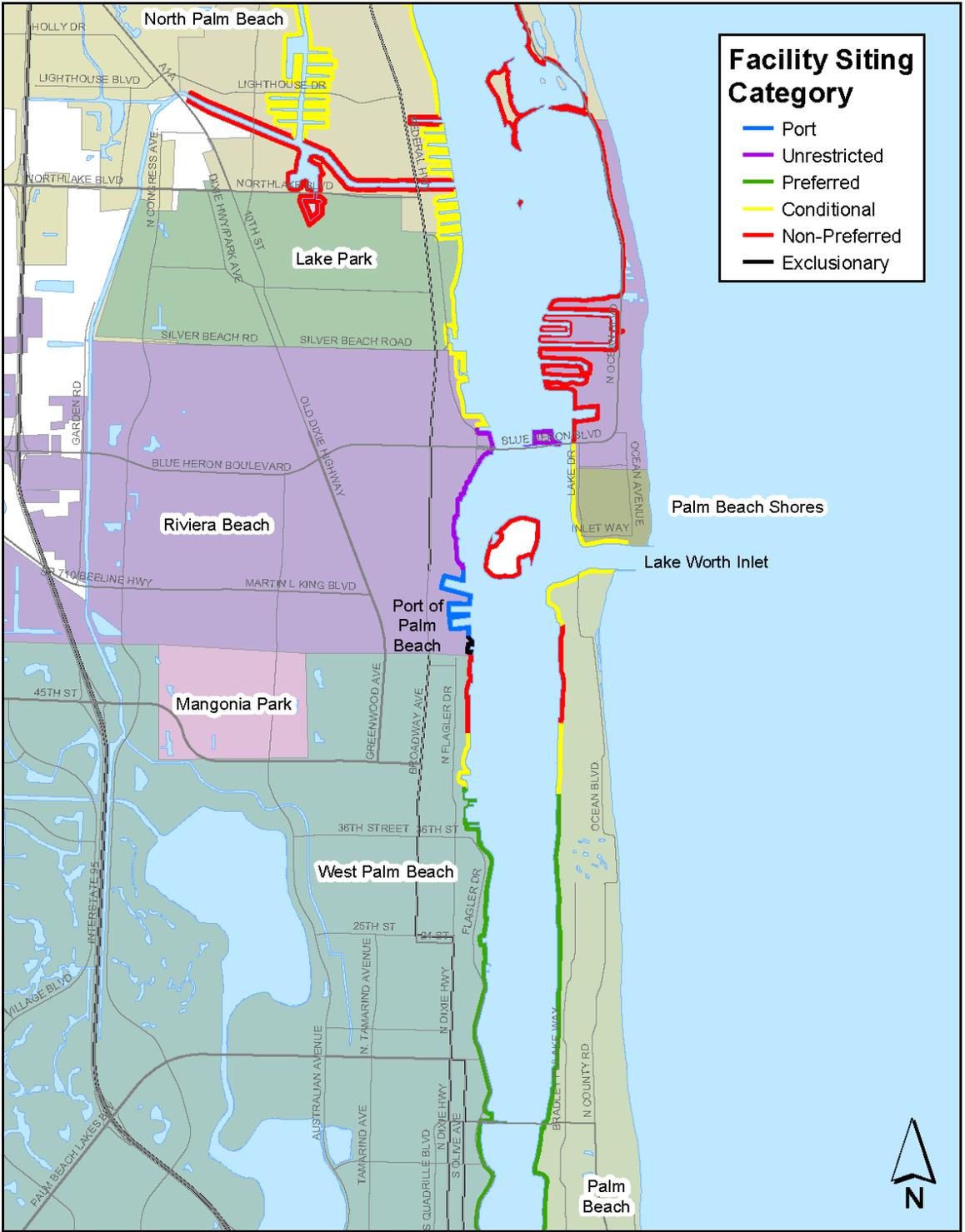
Palm Beach County Manatee Protection Plan

Figure 44a. Palm Beach County BFSP Map, Palm Beach North



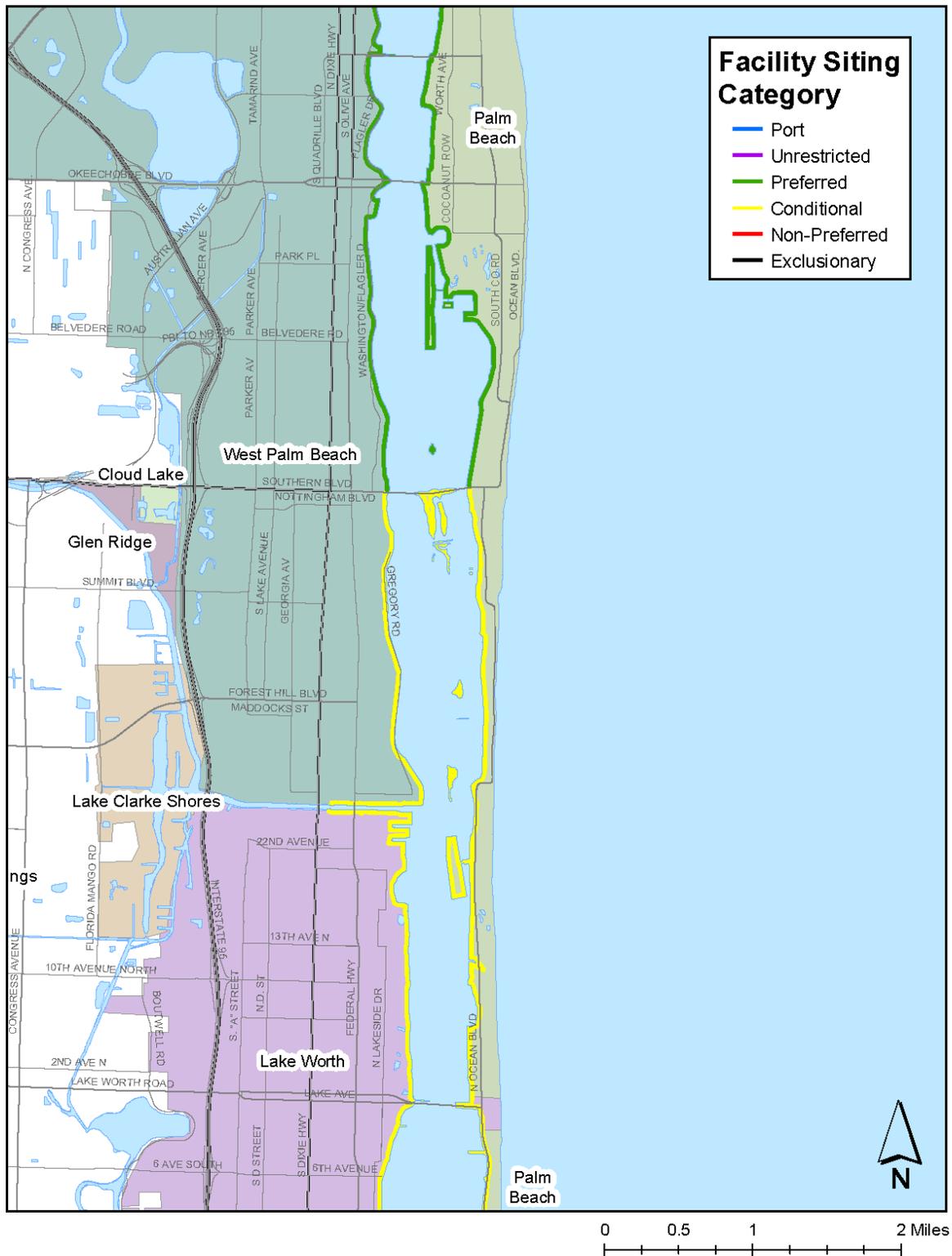
Palm Beach County Manatee Protection Plan

Figure 44b. Palm Beach County BFSP Map, Lake Worth North



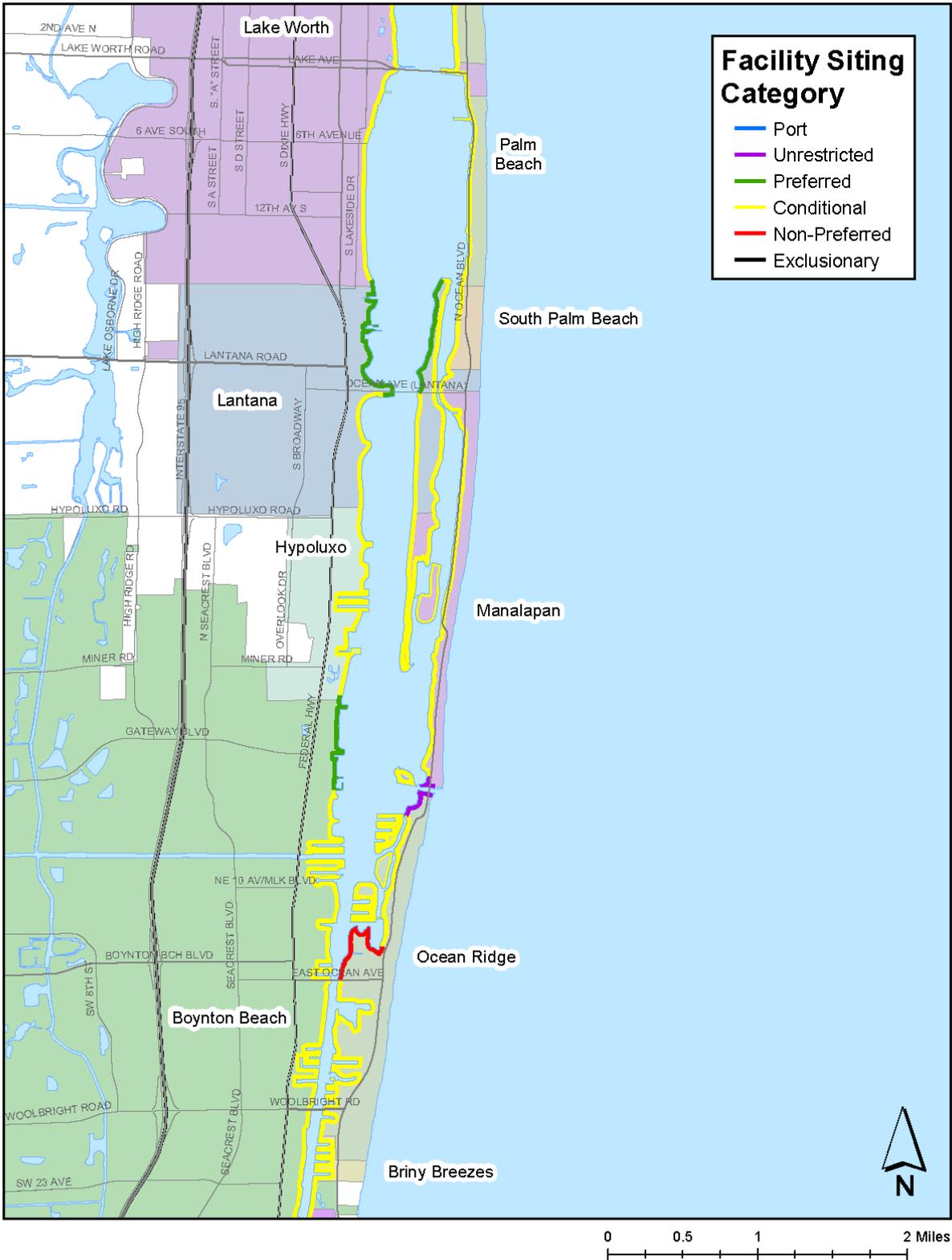
Palm Beach County Manatee Protection Plan

Figure 44c. Palm Beach County BFSP Map, Lake Worth Central



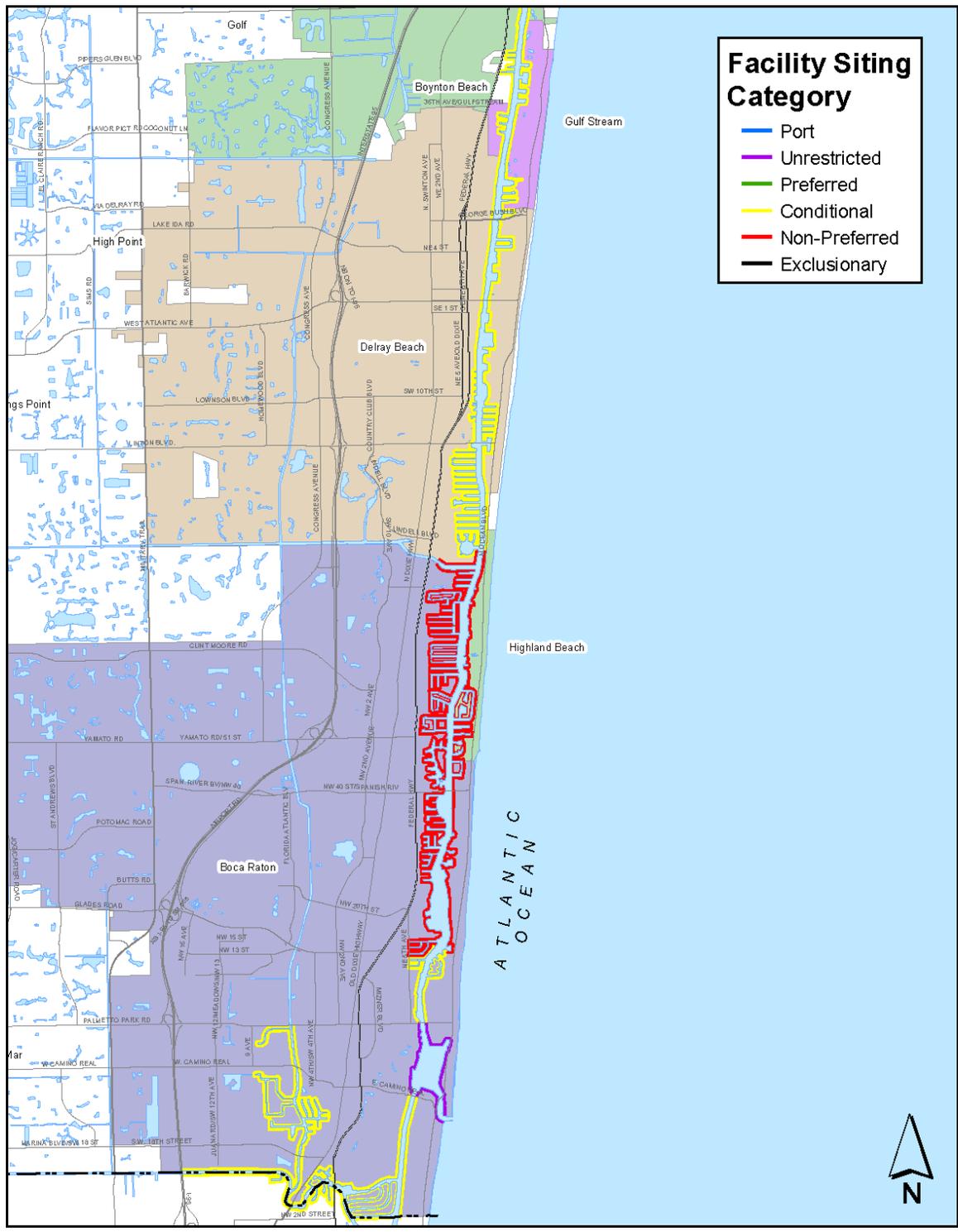
Palm Beach County Manatee Protection Plan

Figure 44d. Palm Beach County BFSP Map, Lake Worth South



Palm Beach County Manatee Protection Plan

Figure 44e. Palm Beach County BFSP Map, Palm Beach South



Palm Beach County Manatee Protection Plan

E. Siting Policy

The primary function of this BFSP is to identify appropriate locations and slip densities for future boating facilities in a manner that minimizes impacts to manatees and directs facilities away from areas where there is a relatively high risk of boat/manatee interactions. Impacts to manatees associated with new allowable slips will be offset by a program to fund improved public education, increased enforcement of speed zones and environmental restoration. For the discussion that follows, future facilities shall include expansion of existing facilities, as well as the development of new facilities. This siting policy does not apply to facilities less than five slips, the Port of Palm Beach or to single family docks. Expansion or other activities that may occur at the Port of Palm Beach will be reviewed and addressed on a case-by-case basis by the state and federal agencies. Boating facility siting recommendations, as described below for each waterway classification, are summarized in **Table 15** and shown on Figure 43 and Figures 44a-e).

Standard Policies

The following apply to all multi-slip facilities regardless of category:

- 1) Slip densities stipulated in this siting policy (Table 15) only pertain to newly proposed slips (for new facilities or expanding facilities). Any existing slips (as stated in the Definitions section) are not counted in calculating this slip density.
- 2) The slip densities noted in #1 above apply to a project at final build out, are a one time allotment and represent the maximum density allowed at a particular location. Slip allowances are not transferable from one location to another.
- 3) All future facilities, regardless of type, having 10 or more slips in any combination (wet slips, dry slips, and/or trailer parking spaces) should install standard educational signage pertaining to manatee and seagrass protection, including information on applicable manatee speed zones. The format and content of the signs will be developed by Palm Beach County ERM in consultation with FWC. These signs will comply with the approved format and specifications, be purchased by the owner's expense, and posted in a location clearly visible to boaters using the facility. For facilities with less than 10 slips, an educational display will be required if the slips are for transient use.
- 4) Any future boat facility that adds 100 or more slips, whether through expansion of an existing facility or construction of a new facility, must have at least one slip, free of charge, dedicated for use by a law enforcement vessel.

Palm Beach County Manatee Protection Plan

- 5) All ingress and egress routes connecting new facilities to the nearest existing marked channel should be clearly marked, and vessels should be instructed by signage or other method to stay within marked channels to minimize impacts to seagrasses.
- 6) Wet slips designed for liveaboard vessels shall be prohibited unless the facility provides suitable sewage pumpout facilities.
- 7) All impacts to submerged aquatic resources (SAV) shall be minimized to the greatest extent practicable as discussed in Chapter III.C. (Habitat Protection).
- 8) Future facilities will be subject to all applicable State and Federal environmental permitting regulations.

Unrestricted

Unrestricted locations are appropriate for the unlimited development of all types of boating facilities. Generally, these are areas that historically have supported a low abundance of manatees, are located adjacent to inlets or include areas where there are shore to shore idle or slow speed zones. Data for manatee use of Lake Okeechobee is limited, but based on what is available, manatee use appears to be relatively low.

Preferred

Generally, these are areas that historically have supported a low abundance of manatees and are lacking in resources that might attract manatees, such as areas of submerged vegetation or warm water refugia. Preferred locations are appropriate for the development of all types of boating facilities. The following recommendations shall apply to all future facilities in Preferred locations:

- 1) Boat slips are allowed at a density of 10 slips for every one hundred feet of linear shoreline owned or controlled by the applicant. Transitory slips shall not be included in the calculation of wet slips.
- 2) The number of launch ramps at future boat ramps shall be limited only by site constraints and applicable State and Federal permitting regulations. The number of new trailer parking spaces at these facilities shall not exceed a density of 10 spaces for every one hundred feet of linear shoreline, including offsite parking. Public Boat ramps may be allowed an unrestricted number of parking spaces.
- 3) All future boating facilities which add 100 or more slips (any combination of wet and dry) are encouraged to apply for Clean Marina Designation with the Florida Department of Environmental Protection Clean Marina Program.

Palm Beach County Manatee Protection Plan

Conditional

These areas support a moderate abundance of manatees and relatively high levels of manatee use and manatee watercraft mortality. The Conditional designation is considered appropriate for the moderate development of future boating facilities provided certain criteria can be met to minimize impacts to manatees and their habitat. The following recommendations shall apply to all future facilities in Conditional locations:

- 1) Boat slips are allowed at a density of six (6) slips for every one hundred feet of linear shoreline owned or controlled by the applicant. Transitory slips shall not be included in the calculation of wet slips.
- 2) The number of launch ramps at future boat ramps shall be limited only by site constraints and applicable State and Federal permitting regulations. The number of new trailer parking spaces at these facilities shall not exceed a density of six (6) spaces for every one hundred feet of linear shoreline, including offsite parking.
- 3) All future boating facilities which add 50 or more slips (any combination of wet and dry) are encouraged to apply for Clean Marina Designation with the Florida Department of Environmental Protection Clean Marina Program.

Non-preferred

The Non-preferred classification includes those areas where the potential interaction between boaters and manatees is highest. In Palm Beach County, these areas typically contain a combination of high quality seagrass habitat, high relative abundance of manatees, and high manatee mortality levels. Non-preferred locations are generally not appropriate for new boating facilities because of the threat boats in these areas pose to manatees. It is the intent of this BFSP to discourage boat facility development within these zones. The following recommendations shall apply to all future facilities in Non-preferred locations:

- 1) Boat slips are allowed at a density of one (1) slip for every one hundred feet of linear shoreline owned or controlled by the applicant. The following are exceptions: Non-fee public facilities, such as municipal boat ramps and transitory slips at public parks located in non-preferred areas shall be limited to 10 transitory slips, regardless of shoreline length owned by the applicant. No permanent mooring of vessels at these wet slips shall be allowed.
- 2) The number of launch ramps at future boat ramps shall be limited only by site constraints and applicable State and Federal permitting regulations. The number of new trailer parking spaces at these facilities shall not exceed a density of one (1) space for every one hundred feet of linear shoreline, including offsite parking.

Palm Beach County Manatee Protection Plan

Exclusionary Zones

Exclusionary zones consist primarily of existing conservation lands that are purchased or managed by Palm Beach County and are designated for passive recreational use only in a management plan or conservation easement. Conservation areas within the Exclusionary zones include Jupiter Inlet Natural Area, Limestone Creek Natural Area, Jupiter Ridge Natural Area, and Juno Dunes Natural Area (JDNA) (**Figure 44a**). Transitory slips such as those within the basin proposed for the FIND property which is surrounded by the JDNA are allowed. No new boating facilities developed for use by motorized vessels are allowed in Exclusionary zones. However, new facilities for use by non-motorized vessels, such as canoes or kayaks, are considered an appropriate use for these areas.

In addition to existing conservation lands, Exclusionary zones shall include all current or future “motorboat prohibited zones” designated by County, State, or Federal regulatory agencies. There is presently one motorboat prohibited zone in Palm Beach County. It is located around the thermal discharge to the FPL Riviera Power Plant where large groups of manatees congregate each winter (**Figure 44b**).

Municipalities that adopt the County’s Manatee Protection Plan may create additional Exclusionary or Non-preferred zones at their discretion. These municipal zones will be incorporated into the MPP. The zones can be based upon incompatible land uses or other factors that the municipality determines sufficient to restrict future land use as a boating facility.

Managed Mooring Fields

As mentioned in Section IV.6., there are no managed mooring fields within Palm Beach County at present. There are several established unmanaged mooring fields, mostly within the northern portion of the Lake Worth Lagoon. In Palm Beach County, these mooring fields are primarily used by sailboats, which are generally considered less of a threat to manatees. One of the issues raised was that an effective managed mooring plan would have to cover a broad area of the County so that the issues are not simply moved from one location to another. That remains a significant challenge since it would affect many governmental jurisdictions. As such, the siting policy developed in this MPP shall not apply to unmanaged mooring fields. However, the County will continue to encourage the development of

Palm Beach County Manatee Protection Plan

comprehensive managed mooring fields with dedicated anchorages in appropriate areas to help minimize impacts to the aquatic environment from moored vessels. Development of these managed mooring fields will be subject to all applicable State and Federal environmental permitting regulations, shall incorporate sufficient upland facilities to serve the boaters, and take into account the rights of riparian property owners.

Dry Storage Facilities

A provision for the allowance for large capacity dry storage stacks has been provided in the plan to address development concerns that the average length of shoreline-owned would preclude 300-400 slip dry storage facilities in any areas except the unrestricted locations. The allotment of slips is 1,500 and would allow three or four large capacity dry storage stacks in various locations throughout the county. The conditions under which the slips can be distributed are described below:

Only those facilities located within the Conditional (yellow) and Preferred (green) locations in the plan are eligible for slips from the dry slip allotment. The applicant must submit a request for slips from the dry stack allotment with their permit application and, if granted, these slips will be in addition to the number of slips calculated based on the shoreline density. Because the proposed locations for these dry storage facilities were unknown during plan development, the distribution of the allotted slips will be done on a case-by-case review of the project proposal. The case-by-case review will depend upon its proposed location and relevant manatee and resource data, as well as the current data available concerning the implementation of the offsetting measures. The factors to be considered include: project location and size, presence of speed zones, effectiveness of zone enforcement, potential impacts to seagrass, manatee data for the area (mortality, distribution, tagged manatees, etc), and boating data.

In order to provide equal opportunity for these slips, no single applicant at one site is eligible for more than 400 of the allotted slips. Slips can be deducted from the allotment, for specific projects, if deemed acceptable in case-by-case reviews performed by the Florida Fish and Wildlife Conservation Commission (FWC) and the U.S. Fish and Wildlife Service (FWS). The FWC and FWS will consult with the county's Environmental Resource Management staff on these slip allotments.

Palm Beach County Manatee Protection Plan

The allocation of slips granted to a permittee is effective as long as the issued permit is active and has not expired. If a permit has expired and the slips have not been legally constructed, the allocation of slips to that particular applicant/project will be considered expired. Those allocated number of slips will revert back to the total allotment of slips remaining for the county. The FWC will maintain records of the dry storage slip allotment dispersal and provide an annual update to the county and FWS. Slips are taken from the allotment on the date the manatee impact review letter is written by FWC, after consultation with FWS and the County. In the event a project is exempted from state review, slips are taken from the allotment on the date the biological opinion is written by FWS.

Table 15 - Summary of Multi-slip Boat Facility Siting Policy Recommendations

Boat Facility Siting Category¹	Boat Slip Density²	Exceptions and Comments
Unrestricted	Unrestricted	No limits on slips or boat ramp parking spaces
Preferred	10:100	Public Boat ramps may be allowed an unrestricted number of parking spaces.
Conditional	6:100	
Non-Preferred	1:100	Non-fee public facilities, such as municipal boat ramps and transitory slips at public parks located in non-preferred areas shall be limited to 10 transitory slips, regardless of shoreline length owned by the applicant.
Exclusionary	Non-motorized only	Transitory slips within the basin proposed for the FIND property surrounded by the JDNA

¹ Boundaries determined by GIS shapefile used to create maps in this plan.

² Maximum slip numbers in all categories apply only to new slips. Existing slips are not to be included in the total. Ratios refer to the number of slips per linear feet of shoreline owned by the applicant. Slip densities are allowable only if there are no significant impacts to habitat (i.e., seagrass, hardbottom, etc.).

Note: Criteria do not apply to individual single-family docks or transitory slips.

F. Mitigation

Palm Beach County Manatee Protection Plan

Impacts to manatees associated with new slips will be offset by a program to improve public education and the enforcement of speed zones. Funding for this program is proposed through the combination of a Manatee Protection Fund (MPF) and municipal, County, and State cost-sharing. \$1,000,000 per year, derived from the County's ad valorem taxes, will be dedicated to funding the MPF. When available, grants from State and Federal sources will be used to augment this funding. The Board of County Commissioners provided guidance for allocation of this funding at their March 28, 2006 workshop. They recommended an annual distribution of \$100,000 for public education, \$200,000 for increased law enforcement, and \$700,000 for environmental restoration projects benefiting manatees. The environmental restoration funds will be made up of \$450,000 in new restoration funds combined with \$250,000 from an existing account (Capital Outlay-Environmental Restoration). It is expected that actual annual costs will deviate somewhat from this distribution based on project needs and schedules and the Board guidance will serve to guide the long-term distribution among the three key categories.

Allocation of the MPF is based upon an extensive public education component including additional staffing for coordination and implementation, funding for law enforcement personnel and equipment sufficient to increase existing enforcement of speed zone regulations by 50 percent, funding for studies necessary to update the plan, and funding that can be used to match other funding sources for environmental restoration. It is anticipated that the Palm Beach County Parks and Recreation Department will continue to be actively involved in a variety of manatee education and public awareness initiatives.

Specifically, these monies will be allocated at the discretion of the County for the following activities:

- Development, production, and/or installation of manatee and seagrass conservation signs including access channel markers and seagrass protection markers.
- Development and implementation of public awareness programs to increase boater awareness of manatee protection issues.
- Development, production, and distribution of manatee speed zone fliers, pamphlets, and posters.
- Procurement and/or installation of manatee speed zone signage on County waterways, in partnership with FWC, which assumed responsibility for installation and maintenance of manatee speed zone signage as of July 1, 2006.

Palm Beach County Manatee Protection Plan

- Other measures deemed likely to reduce risks to manatees from boating activities in Palm Beach County.
- Updates to the manatee distribution, boat use and activity, and boater compliance studies.
- Environmental restoration projects that create, preserve, or enhance manatee habitat.

ERM will consult with the County Parks and Recreation Department, FWC, FIND, and other appropriate agencies to determine the most effective use of these funds, develop a budget, and explore cost-sharing opportunities. ERM will also periodically review its budget for manatee protection programs and request sufficient funding and staffing, as necessary, to ensure implementation of critical programs.

Palm Beach County Manatee Protection Plan

VII. RECOMMENDATIONS FOR PLAN IMPLEMENTATION

This MPP is intended to provide guidance to Palm Beach County and municipalities in developing policies and guidelines for comprehensive manatee protection in local waterways. This section describes activities, programs, and strategies to be considered as a means of implementing the MPP and for ensuring its relevancy into the future.

The following seven “Priority” initiatives shall be undertaken by Palm Beach County to ensure effective implementation of the Manatee Protection Plan. The extent to which these priorities will be implemented is dependent upon the availability of funding.

1. **MPP Implementation** – Upon FWC and Palm Beach County Board of County Commissioner approval, the MPP will be incorporated by reference in the County’s Comprehensive Plan. The County will also encourage local municipalities to adopt the MPP into their respective Comprehensive Plans (by reference including version date). Upon approval, it is expected the local, State, and Federal commenting and permitting authorities will use the MPP to determine appropriate numbers of slips that will be permitted. The MPP will be provided in both hardcopy and electronic formats and will be posted on the ERM website. GIS maps and shapefiles that include boat facility siting categories and property boundaries will be provided to enable reviewers and interested parties to utilize detailed information for planning, development and permitting. The projected date for revision of the comprehensive plan is one year from plan approval.
2. **Manatee Protection Fund** – A dedicated funding source has been established to implement the goals and objectives of the MPP. A process will be developed to enable funding to be used by municipalities, law enforcement agencies, and environmental education centers to meet the MPP goals. The MPF shall be funded by the County and distributed to other governments and environmental education centers through a grant program. Additional or alternative funding sources for the MPF may be available via grants and cost-sharing. The goal is to establish the process within 6 months of plan approval.
3. **Data Collection** – The analysis used to develop the boating facility siting plan was based, in part, on information collected during the 1990s. Collectively, these types of data will be used as part of the County’s adaptive management strategy to ensure that the MPP remains relevant to current conditions. Studies should be initiated independently or in conjunction with FWC during the first seven-year period following adoption of the MPP. Additionally, ERM should continue and increase the sampling frequency of its existing seagrass monitoring program and obtain similar relevant data from on-going studies conducted by the South Florida Water Management District and the Jupiter Inlet District. These data should be incorporated into ERM’s GIS database for use in assessing long-term trends. Similarly, ERM should continue to incorporate manatee synoptic and mortality data provided by FWC into its GIS database for use in adaptive

Palm Beach County Manatee Protection Plan

management of its manatee protection programs. Research programs may be funded in whole or part through the Manatee Protection Fund and cost-sharing with state and local governments. New or updated information required to reflect current conditions includes the following:

- **Undertake a Boater Speed Zone Compliance Study** – A study will be conducted to determine current levels of compliance with boating speed zones and to identify times and locations of greatest non-compliance (e.g., weekends and holidays vs. weekdays, winter vs. summer, etc.) and to the extent practical, reasons for non-compliance (e.g., inadequate signage, unfamiliar with speed zone regulations, etc.). The results of this study will be used to direct law enforcement and public awareness/education efforts in the most effective manner to improve manatee protection. The goal is to conduct the study within 2 years of plan approval.
 - **Updated Manatee Aerial Survey Study** – Bimonthly aerial surveys (12-18 months) will be conducted, as funding permits, to identify any changes that may have occurred in the seasonal and spatial distribution and relative abundance of manatees within Palm Beach County since the last surveys were conducted in the early 1990s. This study will be targeted for completion prior to the first formal MPP performance review.
 - **Updated Boat Activity Study** – A boating activity study will be undertaken, as funding permits, to determine if boating activity patterns have changed since the last study was conducted in 1994. This study will be targeted for completion prior to the first formal MPP performance review.
4. **Law Enforcement** – Initiate a number of measures to provide funding for staff, procure supplies, and increase law enforcement presence and efficiency on the waterways. Another critical component of an effective MPP is dedicated enforcement of the County’s speed zone restrictions. Insofar as a number of law enforcement agencies patrol the County’s waterways, interagency coordination and support is essential. Accordingly, the County will consider the establishment of an intergovernmental/interagency task force to meet annually with the goal of improving cooperation between jurisdictions. The task force should review and assess the following:
- Annual manatee mortality data and long-term trends to determine where to most effectively focus law enforcement efforts
 - Logistical/equipment needs
 - Funding needs
 - Adequacy of speed zone signage
 - Interagency coordination
 - Public education initiatives, special enforcement details, specifically targeting manatee zones, particularly at the beginning of manatee season and winter diving
 - Use of improved technological methods to track/analyze violations information in order to plan efficiently and appropriately for adequate enforcement operations

To the extent practical, the County will support efforts by municipalities, the Sheriff’s Office, and the FWC Law Enforcement Division to increase the number of patrols and man-hours on the

Palm Beach County Manatee Protection Plan

water dedicated to outreach and enforcement of speed zone regulations. Equipment, supplies, and staffing may be funded by the County through the Manatee Protection Fund. Coordination of this initiative will begin within 6 months of plan approval.

5. **Education and Awareness** – Develop and initiate a number of programs designed to raise public awareness of manatees, including improvements in manatee protection zone signage, creation of additional manatee educational kiosks and fliers, identify/utilize additional educational material distribution sources, and public service announcements. Consider creating a traveling manatee informational booth to be displayed at different boating events. The County will also explore the possibility of printing, distributing, and broadcasting educational materials in Spanish and Creole. Other efforts may include developing an educational evaluation plan to track the success of manatee education and awareness programs. This initiative has already begun.
6. **Habitat Protection** – Continue with existing and support future programs within the County to preserve, enhance, and restore manatee habitat and water quality. Programs to improve water quality in Palm Beach County’s waterways enhance habitat for manatees. Accordingly, the County plans to:
 - Continue to support local and regional water quality improvement programs.
 - Continue to support CERP programs to reduce fresh water and nutrient inputs to tidal waters.
 - Continue environmental enhancement and restoration projects in Lake Worth Lagoon, Indian River Lagoon, and the Loxahatchee River.
 - Support gradual lowering of Lake Okeechobee to improve the Lake’s littoral zone habitat and reduce episodic discharges to tidal waters.
 - Explore additional land acquisition opportunities for conservation sites along the County’s shorelines.
7. **Adaptive Management** – ERM will undertake a full assessment of plan performance every seven years to coincide with the required Evaluation and Appraisal Report process of amending the County’s Comprehensive Plan (under §163.3191, FS) and, as necessary, revise the plan to improve performance. Any revisions to the BFSP and MPP shall be reviewed and approved by FWC prior to implementation. The plan will undergo informal review on an annual basis to evaluate manatee mortality and any increase or decrease in boat access. The Palm Beach County Board of County Commissioners may direct staff to implement an emergency review process should the need arise. The County recognizes that manatee population levels, mortality trends, and boating activity patterns may change over time. For the MPP to remain effective, its programs and policies must be periodically reviewed and amended. To accomplish this, Palm Beach County ERM will undertake an annual informal review and an assessment of plan performance every seven years and will amend the plan, as necessary, to reflect current data and/or improve plan performance. Each seven-year assessment will be appended to the MPP as an addendum. Any revisions to boat facility siting policies contained in the BFSP shall be reviewed and approved by FWC prior to implementation. As part of its seven-year MPP assessment, ERM will perform the following:
 - Update and summarize annual manatee mortality data and long-term trends

Palm Beach County Manatee Protection Plan

- Conduct new studies on aerial surveys, boater speed zone compliance, boating activity patterns, seagrass distribution, etc.
- Review, summarize, and incorporate results of new studies
- Update the County’s GIS maps with current manatee, resource, and boating data
- Update boating facility inventory
- Assess effectiveness of law enforcement efforts to affect speed zone compliance
- Review siting policies
- Assess the need for expanding existing or establishing new Exclusionary zones for boating facilities in response to County acquisition of waterfront conservation properties
- Assess adequacy of MPF to fund MPP programs into the future and consider additional and/or alternative funding sources, as necessary, including revisions to established mitigation fees
- Provide recommendations for Comprehensive Land Use Plan amendments, as necessary, to incorporate changes in MPP programs and/or BFSP policies

There are five “Secondary” initiatives, which may be undertaken by Palm Beach County with respect to implementing the Manatee Protection Plan:

1. **Coordination with Local Municipalities** – The County will work closely with local municipalities to explain the programs and policies contained in the MPP and to encourage adoption of BFSP siting policies. This may be accomplished through one-on-one staff level interactions and through the League of Cities. The County will provide local governments with points of contact for addressing MPP issues.
2. **Possible Funding Sources** – Identify and procure other funding sources aside from the MPF. Currently, proceeds from the sale of manatee automobile license plates and decals, vessel registration, and donations are deposited into the STMTF, created by the 1978 FMSA. Monies from this trust fund may be used for educational purposes. The STMTF provides funding for FWC’s Imperiled Species Management Section and FWC’s FWRI. Besides the MPF and the STMTF, the following is a list of possible funding sources:
 - FIND – Florida Inland Navigation District
 - FWC’s Boating and Waterways Section
 - SMC – Save the Manatee Club
 - TDC – Tourism Development Council
 - Corporate sponsors
 - Private sponsors
3. **Other Protection Strategies** – Support CERP activities related to Palm Beach County that preserve, enhance, and restore manatee habitat and water quality. Palm Beach County will support activities designed to prevent manatee entrapment in County canal systems and will promote retrofitting canal lock structures with sensors or barriers to prevent accidental crushing of manatees. One of the primary needs is a proposed CERP project to retrofit structures around Lake Okeechobee to reduce take in freshwater canals in the Everglades Agricultural Area.

Palm Beach County Manatee Protection Plan

4. **Maintenance of Public Access** – The County is considering adoption of a “no net-loss” policy for public access to local waterways and is considering preparation of a Waterfront Needs Study to evaluate public waterfront access requirements. Staff is evaluating options for implementing such a policy through consultation with other Florida counties where similar programs have been implemented. Properties that provide public access in Non-preferred areas are given preferential treatment in the BFSP (Table 15).
5. **Agency-Specific Recommendations** – Coordinate and initiate a variety of educational/awareness programs specific to various County agencies, industries, and boater groups. Public awareness and education are a key component to successful implementation of the MPP. The County’s boaters must understand the need for manatee protection and be aware of existing speed zone restrictions. All Palm Beach County residents and visitors are a potential target audience. Specifically, resident boat owners, seasonal boating visitors, and renters are the primary target audience with sailors, kayakers, and the general public as a secondary audience. Another secondary target audience is high school and college age young adults. Florida residents born after September 30, 1980 must possess a valid Florida boating safety education certificate to operate a vessel powered by 10 hp or more. Boating safety classes can educate the younger boater on manatee conservation issues and on speed zone restrictions in Palm Beach County waterways.

After education, one of the most critical elements in promoting compliance with speed zones is to ensure that existing speed zones are conspicuously and unambiguously marked in the field. To ensure that this policy is successfully implemented, Palm Beach County should undertake the following activities:

- Establish, or participate in, a task force to include FWC, FIND, and the U.S. Coast Guard, as applicable, to improve sign clarity by developing standard language for each of the different speed zones (manatee protection and boating safety) in the County. The signs should identify the type and purpose of the speed zone, the period of the year the regulations are in effect, the length of the speed zone, and the maximum speed for the regulated area.
- Periodically evaluate speed zones to determine if signs are needed.
- Develop an annual schedule for inspecting signs to ensure that they are present and legible with additional inspections scheduled after tropical storms to determine repair priorities.
- Support and improve existing interagency agreements for inspecting and installing signs and improve method for reporting missing or damaged signs.
- Distribute speed maps in multiple formats (brochures, waterproof maps, posters, etc.) to all stakeholders via direct mail to boaters, city halls, boating facilities, and nature centers, and install posters at kiosks at boat ramps. This and other informational material should be provided to the tax collector’s office for distribution during boater registration and distributed to commercial and public boating facilities.

Additional County programs aimed at improving public awareness of manatee conservation issues should include the following:

- Promote and support the use of standardized manatee awareness signs and kiosks at existing and future boating facilities as required in the BFSP.

Palm Beach County Manatee Protection Plan

- Retrofit existing commercial boating facilities with 25 or more wet and/or dry slips and all public boat ramps with manatee awareness signage and speed zone maps, if not currently present.
- Develop, or partner in the development of, a traveling manatee informational booth to be set up at water-related special events and festivals, such as boat shows, that can be used by various stakeholders.
- Prepare Public Service Announcement(s) for distribution to local newspapers, radio and TV announcing the beginning of the manatee winter season (November 15 - March 31) each year. The announcement(s) should alert boaters to the presence of speed zones and the need to be vigilant for manatees while operating on the County's waterways. Schedule existing manatee PSAs on Channel 20 with increased emphasis during manatee season or heavy boating periods such as Memorial Day, July 4th, and Labor Day.

Agency-specific recommendations are as follows:

a. Palm Beach County School District

1. Support manatee education programs in the County school system.
2. Notify appropriate departments/persons, such as a Science Program Planner, of the availability of educational materials such as manatee videos, activities book, educator guides, and posters.
3. Encourage Marine Technology Academies to adapt curriculum to include discussions of boating speed and manatee regulated speed zones.
4. Make educational materials (manatee videos and information on boater safety and environmental protection) available at media centers.

b. Department of Environmental Resources Management

1. Regularly update the ERM website to include latest manatee local and statewide statistics and information, rather than links to other pages.
2. Provide easier navigation to web sites regarding manatee information.
3. Create and distribute manatee brochures and information.
4. Update Lake Worth Lagoon boaters guide to include latest speed zone map and distribute.
5. Create a boaters guide covering the entire County.
6. Create and facilitate distribution of local speed zone maps.
7. Provide law enforcement with data summarizing manatee "hotspots" and mortality locations.
8. Provide grant funding from the Manatee Protection Fund to support education and law enforcement activities by other groups.

c. Parks and Recreation Department

1. Include manatee education in all environmental awareness programs.
2. Provide manatee outreach materials, such as pamphlets and brochures, at all park visitor centers and saltwater parks.
3. Post countywide speed zone maps at all salt water and Lake Okeechobee boat ramps.

d. The Palm Beach County Convention and Visitors Bureau

Palm Beach County Manatee Protection Plan

1. Add information and links to boating guides and manatee information to the bureau's existing website.
2. Develop a manatee awareness campaign aimed at visiting boaters.

e. Coastal Environmental Education Centers (Marinelife Center of Juno Beach, Gumbo Limbo Nature Center, John D. MacArthur Beach State Park, Pine Jog, Sandoway Nature Center)

1. Include manatee education in curriculum, provide informational brochures and boating guides and manatee web page links.
2. Consider creating and distributing a manatee "tool box," which provides outreach materials that can be borrowed by schools and other outreach organizations (similar to the approach promoted by the Manatee Awareness Group).

f. Boater Groups/Organizations

1. Help implement a manatee awareness campaign during fishing tournaments and through boat clubs, boat manufacturers, and distributors.
2. Distribute speed zone maps.
3. Develop a Waterway Watch group that encourages boaters to report speed zone sign problems and violations, establishing a "neighborhood watch" effort to protect both the boating public and environmental resources.

Additional general recommendations are listed below.

- Evaluate ways to provide manatee viewing sites to replace the FPL viewing area that has been closed due to Homeland Security issues. One possibility would be to establish a facility at the Peanut Island lagoons. Such viewing areas would include full-time supervision to deter harassment of manatees.
- Support legislation requiring a manatee education course as part of the requirement for boater registration and/or boating license.
- Continue to support stormwater treatment projects and pollution prevention Best Management Practices (BMP).

Listing of Educational Material Distribution Opportunities

Possible outlets for the distribution of educational and awareness materials:

- Local government agencies – ERM, Governmental Center, Tax Collector's Office, municipalities, special taxing districts, etc.
- State and Federal agencies – ISMS, FWC Manatee Program, DEP, WMD, FIND, COE, USFWS, USCG
- Local Industries – Riviera Power Plant, Port of Palm Beach, etc.
- Environmental groups – Audubon, Sierra Club, Surfrider Foundation, Nature Conservancy, 1000 Friends of Florida

Palm Beach County Manatee Protection Plan

- Local newspapers – Palm Beach Post, Palm Beach Daily News, Sun-Sentinel, Lake Worth Herald, Jupiter Courier
- Ecotourism sites, such as John D. MacArthur Beach State Park, Gumbo Limbo Nature Center, Marineline Center, Busch Wildlife Center
- Parks and Recreation facilities
- Visitor information centers
- Marinas, boat ramps, and other boating-related facilities, bait and tackle shops, boat rental agencies
- Local law enforcement agencies
- Schools
- Boating education classes (Coast Guard Auxiliary, etc.)
- Dive shops
- Boat shows, tournaments, and other special events

Palm Beach County Manatee Protection Plan

REVIEWED LITERATURE

Ackerman, B.B., H.H. Edwards, K.B. Clifton and W.B. Brooks. 2004. Aerial Surveys for Manatee Distribution in Florida, 1984-1999. Florida Fish and Wildlife Conservation Commission FMRI Technical Report.

Ackerman, B.B. 1995. Aerial surveys of manatees: A progress and summary report. Pages 13-33 in T.J. O'Shea, B.B. Ackerman, and H.F. Percival (eds.). Population Biology of the Florida Manatee. National Biological Service, Information and Technology Report No. 1. Washington, D.C.

Aragones, Dr. Lemnuel V, Taylor, Cynthia R. and Dr. James A. Powell. 2003. Draft Manatee-habitat Interactions and Carrying Capacity near Selected Warm Water Sites. Interim Report to the U.S. Department of the Interior Fish and Wildlife Service by the Wildlife Trust Aquatic Conservation Program.

Aragones, Dr. Lemnuel V, Taylor, Cynthia R. and Dr. James A. Powell. 2003. Draft Manatee-habitat Interactions and Carrying Capacity near Selected Warm Water Sites. Second Interim Report to the U.S. Department of the Interior Fish and Wildlife Service by the Wildlife Trust Aquatic Conservation Program.

Baker, E.K., and M.L. Villanueva. 1994. Palm Beach Boating Activity Study Final Report. Rosenstiel School for Marine and Atmospheric Science. 181 pp + Appendices.

Baugh, T.M., J.A. Valade, and B.J. Zoodsma. 1989. Manatee use of *Spartina alterniflora* in Cumberland Sound. Marine Mammal Science 5(1):88-90.

Beeler, I.E. and T.J. O'Shea. 1988. Distribution and Mortality of the West Indian Manatee (*Trichechus manatus*) in the Southeastern United States: A Compilation and Review of Recent Information. Prepared by the Fish and Wildlife Service for the U.S. Army Corps of Engineers. Document No. PB 88-207 980/AS. National Technical Information Service. Springfield, Virginia.

Bell, Dr. Frederick W. 1994. Estimation of Present and Projected Demand and Supply of Boat Ramps for Florida's Coastal Regions and Counties. The Florida Sea Grant College Report R/C-P-19.

Bell, Dr. Frederick W. and Vernon R. Leeworthy. 1984. Estimation of the Demand and Supply of Marina Services in the State of Florida. Prepared for the Bureau of State Lands Management Florida Department of Natural Resources by the Department of Economics at Florida State University.

Bendle, Bradley J and Dr. Frederick W. Bell. 1995. Draft: An Estimation of the Current Economic Value of the Endangered West Indian Manatee by Floridians. Department of Economics Florida State University.

Best, R.C. 1981. Foods and feeding habits of wild and captive Sirenia. Mammal Review 11(1):3-29.

Carson, D.C. and B.B. Ackerman. 2004. Manatee Relative Abundance and Distribution in Broward and Miami-Dade Counties, Florida 1988-1990 *In*: Ackerman, B.B., H.H. Edwards, K.B. Clifton and W.B.

Palm Beach County Manatee Protection Plan

Brooks (eds). 2004. Aerial Surveys for Manatee Distribution in Florida, 1984-1999. Florida Fish and Wildlife Conservation Commission FMRI Technical Report.

CERP (Comprehensive Everglades Restoration Plan) Interagency Manatee Task Force. 2004. Manatee Suitability Survey in the Everglades Region of the Central and Southern Florida Project. November 2004. 26 pp. + appendices.

CH2M Hill, Curtis & Kimball Co., John C. Martin Associates, *et al.*, Port of Palm Beach Master Plan 2005-2015 (in press).

Craig, B.A., and J.E. Reynolds III. 2000. Trends in Manatee Abundance at Selected Warm Water Sites. *In: Proceedings of the FWS Warm Water Workshop, Jupiter, FL, August 24-25, 1999.*

Dames and Moore, Inc., 1990. Lake worth lagoon natural resources inventory and resource enhancement study. In conjunction with Palm Beach County Department of Environmental Resources Management. 226 pp.

Deutsch, C.J., J.P. Reid, R.K. Bonde, D.E. Easton, H.I. Kochman, and T.J. O'Shea. 2003. Seasonal movements, migratory behavior, and site fidelity of West Indian manatees along the Atlantic coast of the United States. Supplement to Journal of Wildlife Management, Vol. 67(1). The Wildlife Society, Inc. 77 pp.

Deutsch, C.J. 2000. Winter Movements and Use of Warm Water Refugia by Radio-tagged West Indian Manatees Along the Atlantic Coast of the United States. Prepared for Florida Power and Light Company and U.S. Geological Survey.

Deutsch, C.J., J.P. Reid, R.K. Bonde, D.E. Easton, H.I. Kochman, and T.J. O'Shea. 2000. Seasonal Movements, Migratory Behavior, and Site Fidelity of West Indian Manatees Along the Atlantic Coast of the United States as Determined by Radio-telemetry. Final report of the Florida Cooperative Fish and Wildlife Research Unit under Research Work Order No. 163.

Enterprise Florida. (2004). South East Florida Regional Economic Profile, Retrieved January 18, 2004 <http://www.eflorida.com/profiles/CountyReport.asp?CountyID=31&Display=all>

Etheridge, K., G.B. Rathbun, J.A. Powell, and I.J. Kochman. 1985. Consumption of Aquatic Plants by the West Indian manatee. *Journal of Aquatic Plant Management* 23:21-25.

Final Biological Status Review of the Florida Manatee (*Trichechus manatus latirostris*). 2002. Report by the Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute.

Florida Atlantic University. 2004. *Regional Shift: South Florida in Transition.*

Florida Department of Community Affairs. 2003. *Preparing a Boating Facility Siting Plan: Best Management Practices for Marina Siting.*

Florida Department of Environmental Protection. 2004. www.dep.state.fl.us/southeast/ps1/wapp.wapp.htm

Palm Beach County Manatee Protection Plan

Florida Department of Environmental Protection. 2003a. Basin Status Report, St. Lucie and Loxahatchee. FDEP Division of Water Resource Management. February, 2003. 172 pp.

Florida Department of Environmental Protection. 2003b. Water Quality Status Report, Lake Worth Lagoon – Palm Beach Coast. FDEP Division of Water Resource Management. July, 2003. 126 pp.

Florida Department of Highway Safety and Motor Vehicles. 1996-1998, 2001-2002 Boat Registration Statistics for 2002. Available online at <http://www.hsmv.state.fl.us/html/safety.html>.

Florida Department of Natural Resources. 1989. Recommendations to Improve Boating Safety and Manatee Protection for Florida Waterways. Final Report resented at the request of the Governor and Cabinet.

Florida Fish and Wildlife Conservation Commission. 2005. *Fish! Southeast Florida Canals: Angler's Guide to Loxachatchee Slough Canal (C-18)*. Available online at <http://www.floridaconservation.org/fishing/docum/loxslough.html>.

Florida Fish and Wildlife Conservation Commission. 2005. Manatee Synoptic Surveys. Available online at http://research.myfwc.com/features/view_article.asp?id=15246

Florida Fish and Wildlife Conservation Commission Division of Habitat and Species Conservation, Imperiled Species Management Section. June 2004. Draft: Manatee Protection Plan Guidelines.

Florida Fish and Wildlife Conservation Commission. 2003. Manatee mortality database, 1976-2003. Available online at <http://www.floridamarine.org>

Florida Fish and Wildlife Conservation Commission. 2003. Addendum to the 2002 Final Biological Status Review of the Florida Manatee (*Trichechus manatus latirostris*).

Florida Fish and Wildlife Conservation Commission. 2001. Boating and angling guide to Lake Worth Lagoon. Florida Marine Research Institute, St. Petersburg, FL.

Florida Fish and Wildlife Conservation Commission, Bureau of Protected Species Management. 2000. Boat Facility Siting Guide.

Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute. 2000. Atlas of Marine Resources, R.O. Flamm, L.I. Ward, and M. White, eds., Version 1.3.

Florida Fish and Wildlife Research Institute. 2001. Information available online at http://www.floridamarine.org/features/view_article.asp?id=15246

Florida Power and Light Company. 2004. Florida Manatee.

Florida Office of Economic and Demographic Research, The Florida Legislature. Florida Population, Components and Change (1950-2000), (last modified March 27, 2001) <http://www.state.fl.us/edr/index.html>

Palm Beach County Manatee Protection Plan

- Gorzelany, J. 1998. Evaluation of Boat Traffic Patterns and Boater Compliance in Lee County, Florida. Final Report for the Florida Fish and Wildlife Conservation Commission (formerly the Department of Environmental Protection Bureau of Protected Species).
- Haddad, K.D. 2002. Final Biological Status Review for the Florida Manatee (*Trichechus manatus latirostris*). Florida Fish and Wildlife Conservation Commission, Florida.
- Harris, B., K.D. Haddad, R.A. Steindinger, and J.A. Huff. 1983. Assessment of fisheries habitat: Charlotte Harbor and Lake Worth. Florida Department of Natural Resources.
- Hartman, D.S. 1979. Ecology and behavior of the manatee (*Trichechus manatus*) in Florida. The American Society of Mammalogists, Special Publication No. 5. 153pp.
- Hurst, L.A., and C.A. Beck. 1988. Microhistological characteristics of selected aquatic plants of Florida with techniques for the study of manatee food habits. U.S. Fish and Wildlife Service. Biological Report 88(18):145
- Husar, S.L. 1977. The West Indian manatee (*Trichechus manatus*). U.S. Fish and Wildlife Service Report 7. U.S. Government Printing Office, Washington D.C. 22 pp.
- Irvine, A.B., J.E. Caffin, and H.I. Kochman. 1982. Aerial Surveys for Manatees and Dolphins in Western Peninsular Florida. Fishery Bulletin 80: 621-630.
- Irvine, A.B. 1983. Manatee metabolism and its influence on distribution in Florida. Biological Conservation 25:315-334.
- Ledder, D.A. 1986. Food habits of the West Indian manatee, *Trichechus manatus latirostris*, in South Florida, M.S. thesis, University of Miami, Coral Gables. 114 pp.
- Langtimm, C.A. and C.A. Beck. 2001. Lower Survival Probabilities for Adult Florida Manatees in Years with Intense Coastal Storms. Ecological Applications. 13(1), 2003, pp. 257-268.
- Langtimm, C.A., T.J. O'Shea, R. Pradel; and C.A. Beck. 1998. Estimates of Annual Survival Probabilities for Adult Florida Manatees (*Trichechus manatus latirostris*). *Ecology* 79(3):981-997.
- Lefebvre, L.W., M. Marmontel, J.P. Reid, G.B. Rathbun and D.P. Domning. 2001. Status and Biogeography of the West Indian Manatee. Biogeography of the West Indies Patterns and Perspectives Second Edition. CRC Press. Boca Raton.
- Lefebvre, L.W., J.P. Reid, W.J. Kenworthy, and J.A. Powell. 2000. Characterizing Manatee Habitat Use and Seagrass Grazing in Florida and Puerto Rico: Implications for Conservation and Management. Pacific Conservation Biology 5(4):289-298.
- Lefebvre, L.W., B.B. Ackerman, K.M. Portier, and K.H. Pollock. 1995. Aerial Survey as a Technique for Estimating Trends in Manatee Population Size – Problems and Prospects. Pages 63-74 *In*: T.J. O'Shea, B.B. Ackerman, and H.F. Percival (eds.). Population Biology of the Florida Manatee. National Biological Service, Information and Technology Report No. 1. Washington, DC.

Palm Beach County Manatee Protection Plan

Lefebvre, L.W., T.J. O’Shea. Florida Manatees. <http://biology.usgs.gov/s+t/frame/m4044.htm>

Limpus, Colin J., K. J. Currie and J. Haines. 2003. Marine Wildlife Stranding and Mortality Database Annual Report 2002. Queensland Government Environmental Protection Agency. Volume 2003 Number 1.

Manatee Population Status Working Group, 2001. Appendix A and D: Recommendation of Population Benchmarks to Help Measure Recovery. Florida Manatee Recovery Plan, (*Trichechus manatus latirostris*), Third Revision. U.S. Fish and Wildlife Service. Atlanta, Georgia. 144pp.+ appendices.

Marine Industries Association of Palm Beach County. 2005. Boating Industry is a Major Economic Source in Florida.

Marine Mammal Commission. 1988. Preliminary Assessment of Habitat Protection Needs for West Indian Manatees on the East Coast of Florida and Georgia. Document No. PB89-162002, National Technical Information Service. Silver Spring, Maryland.

Marine Mammal Commission. 1988. Protection of West Indian Manatees (*Trichechus manatus*) in Florida. Prepared for the Marine Mammal Commission, Washington D.C. by Eckerd College under PB88-222922.

Marine Research Institute. 2005. FWC Conducts Biological Status Review of the Florida Manatee Available on the web at: http://www.floridamarine.org/features/view_article.asp?id=19173

Marmontel, M., S.R. Humphrey, and T.J. O’Shea. 1997. Population Viability Analysis of the Florida Manatee (*Trichechus manatus latirostris*), 1976-1991. *Conservation Biology*. 11(2):467-481.

Milleson, J.T. 1987. Vegetation changes in the Lake Okeechobee littoral zone 1972-1982. Technical Publication No. 87-3. South Florida Water Management District, West Palm Beach, Florida.

Murray, T.J. 2002. Economic Activity Associated with the 17th Annual Palm Beach Boat Show. Yachting Association and Marine Industries Association of Palm Beach County.

Murray, T.J. and Associates. 2005. Economic Impact of the Recreational Marine Industry: Broward, Dade and Palm Beach Counties, Florida—2005. Marine Industries Association of South Florida. Fort Lauderdale, Florida. Report cited in “Palm Beach County marine industry No. 2 in Florida,” *Palm Beach Post*, Feb. 28, 2006. Available online at http://www.palmbeachpost.com/business/content/business/epaper/2006/02/28/a1d_marine_0228.html.

O’Shea, T.J., L.W. Lefebvre and C.A. Beck. 2001. Florida Manatee: Perspectives on Populations, Pain and Protection. CRC Handbook of Marine Mammal Medicine Second Edition. Boca Raton, Florida.

O’Shea, T.J., and H.I. Kochman. 1990. Florida manatees: distribution, geographically referenced data sets, and ecological and behavioral aspects of habitat use. Pgs. 11-22 in J.E. Reynolds, III, and K.D. Haddad. Report of the Workshop on Geographic Information Systems as an Aid to Managing Habitat for West Indian Manatees in Florida and Georgia. Florida Marine Research Publications 49:1-57.

Palm Beach County Manatee Protection Plan

- O'Shea, T.J. 1988. The Past, Present, and Future of Manatees in the Southeastern United States: Realities, Misunderstandings, and Enigmas. Pages 184-204 in Odum, R.R., K.A. Riddleberger and J.C. Ozier (eds). Proceedings of the Third Southeastern Nongame and Endangered Wildlife Symposium. Georgia Department of Natural Resources. Social Circle, Georgia.
- O'Shea, T.J. 1986. Mast foraging by West Indian Manatees (*Trichechus manatus*). Journal of Mammology 67(1): 183-185.
- O'Shea, T.J., C.A. Beck, R.K. Bonde, H.I. Kochman, and D.K. Odell. 1985. An Analysis of Manatee Mortality Patterns in Florida 1976-1981. Journal of Wildlife Management. 49:1-11.
- O'Shea, T.J., and S.H. Shane. 1985. Female-offspring behavior in West Indian manatees. Abstracts. Fourth International Theriological Congress, Edmonton, Canada. August, 1985.
- O'Shea, T.J., B.B. Ackerman, and H.F. Percival (eds.). Population Biology of the Florida Manatee. National Biological Service, Information and Technology Report No. 1. Washington, D.C.
- Packard, J.M., R.K. Frohlich, J.E. Reynolds III, and R.R. Wilcox. 1989. Manatee Response to Interruption of a Thermal Effluent. Journal of Wildlife Mgmt. 53:692-700.
- Packard, J.M. 1981. Abundance, distribution, and feeding habits of manatees (*Trichechus manatus*) wintering between St. Lucie and Palm Beach inlets, Florida. FWS Contract Report No. 14-16-004-80-105. 142 pp.
- Palm Beach County Comprehensive Plan. 1989. As amended in October 2002 (Ordinance 2002-51) and December 2004 (Text Amendment Staff Report, Amendment Round 04-2).
- Palm Beach County Department of Environmental Resources Management. 2004. www.co.palm-beach.fl.us/erm/home.htm
- Palm Beach County Department of Environmental Resources Management and Florida Department of Environmental Protection. 2003. Lake Worth Lagoon Monitoring Project. DEP Agreement No. WAP028. PBC No. R2001-0401. Revised November 2003. 67 pp.
- Palm Beach County Department of Environmental Resources Management and Florida Department of Environmental Protection. 1998. Lake Worth Lagoon Management Plan. August 1998. 257 pages
- Palm Beach County Department of Environmental Resources Management. 1992. Estuarine natural resources inventory and resource enhancement study. 223 pp.
- Palm Beach County Department of Planning, Zoning and Building. 2003 Population Allocation Model. Palm Beach County Population Projections by MPO Sectors. Available online at <http://www.co.palm-beach.fl.us/pzb/Planning/populationproj.htm>.
- Palm Beach County Parks and Recreation Department. 2002. Palm Beach County Public Boating Needs Assessment. October 2002.

Palm Beach County Manatee Protection Plan

- Perkins, Winifred. 2004. Personal Communications.
- Pittman, Craig. February 2004. Fury Over a Gentle Giant. *Smithsonian*.
- Port of Palm Beach. 2004. Port of Palm Beach website, <http://www.Portofpalmbeach.com>.
- Post, Buckley, Schuh, and Jernigan, Inc. 1995. Port of Palm Beach Master Plan Update. April 1995.
- Powell, J.A., and G.B. Rathbun. 1984. Distribution and abundance of manatees along the northern coast of the Gulf of Mexico. *Northeast Gulf Science* 7(1):1-28.
- Reid, J.P., G.B. Rathbun, and J.R. Wilcox. 1991. Distribution Patterns of Individually Identifiable West Indian Manatees (*Trichechus manatus*) in Florida. *Marine Mammal Science* 7:180-190.
- Revenge, C. and Y. Kura. 2003. Status and Trends of Biodiversity of Inland Water Ecosystems. Secretariat of the Convention on Biological Diversity, Montreal, Technical Series no. 11.
- Reynolds, J.E. III. 2003a. Distribution and Abundance of Florida Manatees (*Trichechus manatus latirostris*) Around Selected Power Plants Following Winter Cold Fronts: 2002-2003. Prepared for Florida Power and Light Company – Order Number 4500074487. Juno Beach, Florida.
- Reynolds, J.E. III. 2003b. Distribution and abundance of Florida manatees (*Trichechus manatus latirostris*) around selected power plants following winter cold fronts: 2002-2003. Mote Marine Laboratory Technical Report No. 890. 48 pp.
- Reynolds, J.E. III. 1994. Distribution and Abundance of Florida Manatees (*Trichechus manatus latirostris*) Around Selected Power Plants Following Winter Cold Fronts: 1993-1994. Prepared for Florida Power and Light Company – Order Number B93135-00139. Juno Beach, Florida.
- Reynolds III, J.E. and J.R. Wilcox. 1994. Observations of Florida Manatees (*Trichechus manatus latirostris*) Around Selected Power Plants in Winter. *Marine Mammal Science* 10(2): pp 143-177.
- Reynolds, J.E. III. 1993. Distribution and Abundance of Florida Manatees (*Trichechus manatus latirostris*) Around Selected Power Plants Following Winter Cold Fronts: 1992-1993. Prepared for Florida Power and Light Company – Order Number B91135-00073 Juno Beach, Florida.
- Reynolds III, J.E. and D.K. Odell. 1991. Manatees and Dugongs. Facts On File. Inc. New York, NY. ISBN 0-8160-2436-7. 192 pp.
- Runge, Michael. Atlantic Coast Manatee Population Study.
http://northflorida.fws.gov/Manatee/Documents/MMPARules/FinalEIS/Appendices/AppI_ITModelFEISApproval
- Shultz, Ronald R. 1996. Boating Activity Study for St. Lucie and Martin Counties. Final Report prepared for the Bureau of Protected Species Management Division of Marine Resources Florida Department of Environmental Protection (currently the Florida Fish and Wildlife Conservation Commission's Imperiled Species Management Section).

Palm Beach County Manatee Protection Plan

Smith, S.K. and Nogle, J.M. 2002. Projections of Florida Population by County, 2001-2030. Bureau of Economic and Business Research Florida Population Studies, 35(2), Bulletin 132. University of Florida.

SFWMD (South Florida Water Management District). 2004. Submerged aquatic vegetation report card for the Lake Okeechobee Protection Program (LOPP). www.sfwmd.org
Stout. 2004. Personal communication.

Treasure Coast Regional Planning Council. 1995. Draft Boat facility siting plan for Palm Beach County.

U.S. Army Corps of Engineers (USACE). August 1996. Manatee Protection Plan at Selected Navigation & Water Control Structures (Part II) In Central and Southern Florida Draft Integrated Project Modification Report and Environmental Assessment.

USACE. 1999. Final Environmental Impact Statement for Lake Okeechobee Regulation Schedule Study. November 1999. USACE, Jacksonville, Florida.

USACE. 2003. Unpublished data, Lock Tender Logs. USACE Operations Office, Clewiston, Florida.

U.S. Fish and Wildlife Service. 2001a. Florida Manatee Recovery Plan, (*Trichechus manatus latirostris*), Third Revision. Atlanta, Georgia. 144 pp. + appendices.

U.S. Fish and Wildlife Service. 2001b. Florida Manatee Recovery Accomplishments 2001 Annual Report. Jacksonville, Florida.

U.S. Fish and Wildlife Service. 1996. Florida Manatee Recovery Plan, (*Trichechus manatus latirostris*), Second Revision. U.S. Fish and Wildlife Service, Atlanta, GA. 160 pp.

U.S. Fish and Wildlife Service. 1989. Florida Manatee (*Trichechus manatus latirostris*) Recovery Plan. Prepared by the Florida Manatee Recovery Team for the U.S. Fish and Wildlife Service, Atlanta, Georgia. 98pp.

Van Meter, Victoria Brook. 2001. The Florida Manatee. Originally written for Florida Power and Light. Available online at <http://www.floridaconservation.org/psm/manatee/manatee%20booklet.pdf>.

Venezia, Dr. William A. and Dr. Richard E. Dodge. 1999. Waterway Expert Traffic System. Final Report, Documents Development of a Toll for Coastal Zone Management. Submitted to the Florida Department of Environmental Protection by Nova Southeastern University Oceanographic Center.

Warm Water Task Force. 2004. Draft recommendations for future manatee warm-water habitat. Unpublished Report. September 17, 2004.

Worthy, Graham A.J. 2000. When is it too cold for a manatee? Save the Manatee Club, The Manatee Zone, p.4.

Zoodsma, B.J. 1991. Distribution and behavioral ecology of manatees in southern Georgia. M.S. Thesis, University of Florida, Gainesville 202 pp.

Palm Beach County Manatee Protection Plan

Other County Manatee Protection Plans

Brevard

Citrus

Duval

Lee

Martin

Miami-Dade

Sarasota

St. Lucie

Volusia

Definitions, Florida Statutes, and Florida Administrative Code references:

Palm Beach County Speed Zones: The Florida Manatee Sanctuary Act. Chapter 68C-22.010, Florida Statutes.

Florida Fish and Wildlife Conservation Commission, Imperiled Species Management Section (formerly the Bureau of Protected Species Management). November 2000. Attachment K – Manatee Protection Plan Guidelines.

Florida Administrative Code, §§68C-22.009 – Palm Beach County Manatee Protection Speed Zones, and 68D-24.017 – Boat Safety Speed Zones. Florida Statutes, Ch. 370 - Natural Resources; Conservation, Reclamation, and Use, and §370.12 - Marine animals; regulation (2) Protection of manatees or sea cows.

APPENDICES

Palm Beach County Manatee Protection Plan

APPENDIX A – ATTACHMENT K: MANATEE PROTECTION PLAN GUIDELINES AND FWC BOAT FACILITY SITING GUIDE

A.1 ATTACHMENT K: MANATEE PROTECTION PLAN GUIDELINES

Area-specific manatee protection plans need to be developed by all counties in which manatees regularly occur to ensure the long-range protection of the species and its habitat. The objective of manatee protection plans are: to reduce the number of boat-related manatee mortalities; to achieve an optimal sustainable manatee population (the goal of the Marine Mammal Protection Act); to protect manatee habitat; to promote boating safety; and to increase public awareness of the need to protect manatees and their environment. These plans will address manatee-human interactions, land use (including boat facility siting), and the protection of suitable habitat (including water quality, thermal refugia, freshwater sources, and grass beds). The information needed to prepare manatee protection plans will include manatee studies, habitat assessments, and, if available, boating studies to evaluate boater use patterns and activities.

Boat facility siting elements are necessary components of area-specific manatee protection plans. Boat facility siting must address marinas with wet slips and dry storage, and boat ramps. The objectives of boat facility siting plans are: to determine appropriate dock densities for particular areas; and to develop criteria for designating special use areas (i.e., for water skiing, jet skiing, and commercial fishing).

Necessary components of a manatee protection plan are:

An Information Base

- a. location and capacity of all marina facilities (including dry storage) in the county (proposed and existing);
- b. location of all boat ramps in the county (proposed and existing);
- c. boating activity patterns, including travel routes and major destination areas;
- d. manatee sighting information for the county;
- e. manatee mortality information for the county;
- f. any aquatic preserves; Outstanding Florida Waters or other refuge/reserve information;
- g. port facility information;
- h. location of significant habitat resources, such as grass beds, warm water discharges and fresh water sources;
- i. location of manatee protection and boating safety speed zones in the county (proposed and existing);
- j. location of manatee information displays; and
- k. other relevant data as determined by the Department of Natural Resources.

Recommendations—with an Accompanying Implementation Schedule—to Increase Manatee Protection in the County

- a. boating expansion criteria;
- b. identification of recommended areas for water-related activities requiring high boat speeds, such as water skiing, boat races and certain types of commercial fishing;
- c. a plan for marking navigation channels in currently unmarked waterways used by manatees;

Palm Beach County Manatee Protection Plan

- d. new or expanded speed zones, refuges or sanctuaries for the regulation of boat speeds in critical manatee areas;
- e. installation of manatee educational displays at all boating facilities;
- f. development and dissemination of a pamphlet to county boaters describing manatee protection and boating safety speed zones in the area, and recommendations for boaters on how to avoid hitting manatees;
- g. inclusion of manatee and marine habitat educational material in the county school board's elementary, middle school and high school curricula;
- h. development of appropriate aquatic plant control methods in manatee areas;
- i. identification of land acquisition projects to increase refuges, reserves and preserves for manatee protection; and
- j. other actions as specified by the Department of Natural Resources.

A.2 FWC BOAT FACILITY SITING GUIDE (August 2000)

DEFINITION

A boat facility siting plan can be defined as a Commission-approved, county-wide plan for the development of boat facilities (docks, piers, dry storage areas, marinas and boat ramps) which specifies preferred locations for boat facility development based on an evaluation of natural resources, manatee protection needs, and recreation and economic demands. The boat facility siting plan is one component of the Manatee Protection Plan (MPP). It should include, but is not limited to, the following:

1. An inventory of existing boat facilities and natural resources;
2. An evaluation of boat use and traffic patterns;
3. Criteria on which proposed sites will be screened;
4. A list and map of preferred locations, unacceptable locations, and locations which are acceptable with specific conditions;
5. Appropriate dock densities; and
6. Boat facility siting policies including a policy for the expansion of existing boat facilities.

The main goal of the resulting boat facility siting criteria will be to minimize the amount of interaction between manatees and boats. Part of this goal is also to evaluate impacts of boat facility developments on manatee habitats. The resulting criteria should be based on certain baseline information general to all Florida waterways and then tailored to fit the specifics of each county. While the primary concern of BPSM is manatee protection, we recognize that counties will need to consider recreational uses, economic factors and other marine and coastal resource needs. Much of the analysis of water-dependent facilities required by this boat facility siting plan will aid other county planning efforts.

INFORMATION TO BE ASSESSED

The following information should be collected in order to select areas appropriate for boat facility development.

Palm Beach County Manatee Protection Plan

1. The boating activity study should provide a detailed overview of boat traffic patterns for the county waterways. It should describe traffic routes (points of origin and destination), the volume and types of boats, seasonal variations of boating patterns, and the types and distribution of boating activities. It should also include inventories of marina facilities, boat ramps and port facilities. Boating studies will vary from county to county depending on the nature of each county's waterways and how they are used locally.
2. Manatee use patterns of county waters should be studied so that when evaluating locations for further water-dependent development, impacts to manatees and their habitats can be minimized. With the assistance of FWC, each county should determine sites of preferred manatee use and aggregation. The location of travel corridors, freshwater outfalls and warm water refuges should be determined. Seasonal variations of use patterns should be described and mortality information should be analyzed. Most of this information is available from FWC, USFWS and various other entities depending on the county. Manatee use information should be compared and overlaid with the boating patterns information in order to understand how boats and manatees currently interact. Then problem areas can be identified and measures can be developed that will minimize and eliminate problems.
3. Habitat inventories should be done for the location of seagrass beds, freshwater, submerged vegetation, shellfish areas, existing water depths, and water circulation patterns. This information will give details about habitat quality and location, as well as insight into manatee usage of these areas. Some of this information may already exist for some counties and may only need to be checked and updated.
4. Specially-designated areas should be identified, such as Outstanding Florida Waters, aquatic preserves, federal, state and local parks, sanctuaries and research reserves, wildlife refuges, and any other lands set aside for preservation and open space. Some of these areas are not available for boating facility development or have certain restrictions. The process of identifying the locations of these areas will narrow down areas that will need to be screened for potential boat facility development.
5. Existing upland zoning appropriate for marina and boat facility development should be located and displayed on maps. Counties need to consider whether future land use zoning changes will be allowed to change the location of acceptable boat facility sites. If changes will be allowed, counties need to determine and specify how the areas will be evaluated for such changes. Criteria will need to be developed for these changes. Counties may choose not to allow zoning changes that would alter locations where boating facilities may be sited once the MPP is approved. By collecting this information, counties will reduce the number of sites that need detailed evaluation and can direct their efforts toward sites that are available for development of boat facilities. This process should minimize the amount of areas that will need to be studied in depth.
6. An inventory of the location of existing multi-family residential docking facilities should be shown on maps of the county waters. The Department of Environmental Protection's (DEP) Division of State Lands issues submerged land leases for residential docking facilities and marinas. The division defines multi-slip docks as moorings of three or more vessels. The DEP requires permits for dock construction on both private and sovereign submerged lands. Counties should also consider developing a threshold for residential multi-slip dock densities. Some of the more urban counties may have already reached their threshold in many areas because all available lands have already been developed.

Palm Beach County Manatee Protection Plan

7. The location of all existing marinas and boating facilities should be determined and exhibited on maps. A table for existing marinas should be compiled that will show the number of slips (both wet and dry), a break down of boat types (power vs. sail) and sizes, the percent occupancy (and any seasonal variations), the distance to the nearest inlet, the proximity of existing speed zones and the distance to popular boating destinations. Also, it should be noted if there are any plans for expansion of the current facilities. Much of this information is often obtained in conjunction with the boating study.

8. An inventory of all the boat ramps in the county should be conducted and the locations should be depicted on a map. Information concerning each ramp should be collected such as the number of ramps, the amount of parking (on and off site), and the number of boats launched (with seasonal and weekday/weekend use variations identified). The ramp's proximity to inlets, the ICW and popular boating destinations should be determined. Again, this information should be available from the boating study.

9. An inventory and map showing the locations of port facilities, freight terminals, fuel and transient docks, and boat yards should also be completed for each county. A description of the activities occurring at each of the different types of facilities should be provided. This will be useful when developing criteria for each type of facility that will guarantee appropriate protection for manatees and their habitats. Our office is developing a proposed rule that will address wharf bumpers and fenders. (Please request an update from our office on the status of this rule.)

10. For all of the inventoried information described in points 1-9 above, the information should be exhibited on maps. This will facilitate the spatial analysis that is needed for evaluating areas for boat facility development. For ease of analysis, similar scale maps should be used so that information can be overlaid. The use of a Geographic Information System (GIS), if available, will enhance the mapping process. All of the inventoried information should be considered before choosing a particular scale, especially if GIS is unavailable. Maps for the final boat facility component of the MPP will need to be legible and easy to interpret so that the process of evaluation can be clearly understood.

EVALUATION OF DATA

Once all the information above is compiled, the focus of the detailed analysis can be narrowed by removing lands that are unavailable for boating facilities. Examples may be public wildlife refuges, or areas with conflicting upland land use zoning. The remaining areas will be the focus of the boat facility siting plan.

Next, a search should be made for areas where manatee use patterns and boat use patterns overlap. Areas should be identified where boat use patterns show minimal overlap with manatee use patterns and these should be examined further to evaluate them as preferred marina site locations. It should be determined whether boating activities and facilities located in these areas will affect manatees and their habitats in a negative way and to what degree, if any. Through this evaluation it can be decided whether these areas would be the preferred locations for boating facilities.

In locations where boat/manatee use patterns converge significantly, an assessment should be made of the degree of overlap. Once identified, these locations should be scrutinized carefully to determine if additional boat facilities will significantly impact manatees. The siting plan should specify areas where different types of facilities would be allowed. Additionally, the type of facility proposed

Palm Beach County Manatee Protection Plan

(ramp, dry storage, marina, etc.) may be restricted by physical, environmental or operational factors - or by land use. In creating the specific criteria for each area, the local baseline information should be used. The criteria should be customized for each area and be written to allow the size or type of facility that would be best in the area (if allowed at all). For example, certain sized marinas may be allowed in areas with moderate manatee use if seagrasses are not present, dredging is not required, appropriate speed zones are in place and boat slips are limited in number. In areas where seagrasses are present but manatee usage is low, dry storage or ramp facilities may be more appropriate. Counties should consider whether to assign density thresholds for specific areas. For example, several counties have used the 1:100' ratio of power boat slips to amount of linear shoreline owned for areas deemed as essential manatee habitat.

Some general factors to consider in selecting marina and boat facility sites include:

- proximity to inlets and/or the ICW,
- existing water depths adequate for clearance beneath vessels,
- presence of seagrass beds, and/or shellfish harvesting areas (Class 11 waters),
- proximity to popular boating destinations,
- amount of manatee use, and
- distances of boat/manatee use pattern overlap.

Criteria should also be developed for marina expansions. Some areas may not warrant expansion. Some expansion might be considered under specific circumstances. The expansion of existing facilities in some areas may also be the preference over new boat facility development. The percent occupancy of marinas in the adjacent area should be considered when evaluating requests for marina expansions. While demand for boat slips must be addressed by county officials, existing marinas should be used to their fullest capacity before expansions and new marinas are permitted.

Some general criteria to be considered for siting of marina facilities are:

- Expansion of existing facilities may be preferred over new facilities if environmentally sound
- There should be no impact to seagrass,
- Mitigation for seagrass destruction should not be allowed,
- Areas with adequate depth and good flushing which require no new dredging are preferable,
- Locations near inlets and popular boating destinations are preferable,
- Piling construction is preferred over dredge and fill techniques,
- Marinas should not be sited in essential manatee habitats, and
- Marinas should not be situated in areas with high manatee mortality occurrence.

There are also some special considerations for port and associated facilities. Port facilities, freight terminals, fuel and transient docks, and boat yards should require wharf fenders on all new facilities located in manatee habitat areas and require retro-fitting of existing facilities on an established time table if these facilities do not provide adequate clearance through an open-face pier design. Prop guards for tug boats and other large vessels regularly using manatee inhabited waters should be considered once an operationally functional and efficient design is developed. Expansion of port facilities or the development of new facilities should not impact seagrass beds.

Palm Beach County Manatee Protection Plan

The boat facility siting plan should describe the process and discuss the criteria used to evaluate and identify where and how boating facilities would be allowed. It should be clear why certain areas were determined to be unavailable for boating facilities. The whole process of screening and layering mapped resources and areas using specific criteria should be clearly stated in this boat facility siting plan.

A list of references is attached. The staff of BPSM are available to provide assistance to county staff. Please call Mary Morris, Terri Calleson, or Kelly Schratwieser at (850) 922-4330 or SC 292-4330.

BOAT FACILITY SITING REFERENCES

Bell, Frederick W., 1990. Economic Impact of Bluebelting Incentives on the Marina Industry in Florida.

Cato, James C., 1983. Blue Ribbon Marina Committee, Final Report.

DNR, 1985. Toward a Proactive Statewide Marina Siting Program.

DNR, 1989. Recommendations to Improve Boating Safety and Manatee Protection for Florida Waterways, presented at the request of the Governor and the Cabinet, October 24, 1989, Final Report.

EPA, 1984. Coastal Marinas Assessment Guidance Handbook.

Hillsborough County City-County Planning Commission, 1985. Understanding the Hillsborough, Searching for Answers on River Resource Management.

Malony, Frank E., Bram D. E. Canter and Richard G. Hamann, 1980. Legal Aspects of Recreational Marina Siting in Florida, Florida Sea Grant College, Report Number 36.

Milon, J. Walter and Pamela H. Riddle, 1983. Employment and Sales Characteristics of Florida's Recreational Boating Industry, Florida Sea Grant College, Report Number 52.

Milon, J. Walter, Gary H. Wilkowske and George L. Brinkman, 1983. Financial Structure and Performance of Florida's Recreational Marinas and Boatyards, Florida Sea Grant College, Report Number 53.

Milon J. Walter and Charles M. Adams, 1985. The Economic Impact of Florida's Recreational Boating Industry in 1985, Florida Sea Grant College, Technical Paper No. 50.

Samples, Jay, 1983. Guidelines for Facility.

Southwest Florida Regional Planning Council, 1984. Marina Siting Survey Southwest Florida.

Southwest Florida Regional Planning Council, 1995. Southwest Florida Marina Siting Survey.

St. Lucie County Community Development, 1991. St. Lucie Co., Florida Marina Siting Report.

Palm Beach County Manatee Protection Plan

Tampa Bay Regional Planning Council, 1984. Tampa Bay Regional Marina Siting Study.

Treasure Coast Regional Planning Council, 1989. Marina Siting Suitability in the Coastal Estuaries of East Central Florida.

USEPA, Region IV - Atlanta, 1984. Coastal Marinas Assessment.

West Florida Regional Planning Council, 1984. Marina Siting Study for West Florida.

Palm Beach County Manatee Protection Plan

APPENDIX B – MANATEE PROTECTION SPEED ZONES

Section 68C-22.009(1), Florida Administrative Code.

For the purpose of regulating the speed and operation of motorboat traffic within the following manatee protection areas between the dates of November 15 and March 31 of each year, paragraphs (b), (d), and (e); year-round but seasonally differentiated, paragraph (g); and year-round, paragraphs (a), (c), and (f), the Palm Beach County manatee protection zones are established as follows, pursuant to Section 68C-22.009(1):

(a) IDLE SPEED ZONE (Year-round)

- 1.** All waters along the westerly side of Lake Worth, bounded to the north by the southern edge of the Port of Palm Beach Turning Basin, and that line representing its westward extension, west to the mainland; bounded to the south by an east-west line one mile south of an east-west line drawn along the southern end of Peanut Island; bounded to the east by the western boundary of the marked channel of the ICW; and bounded to the west by the western shoreline of Lake Worth, unless otherwise designated under (1)(e).
- 2.** All waters within 300 feet of the general contour of the shoreline, including associated backwaters and canals, along the easterly side of Lake Worth from a straight line drawn from Lake Worth Inlet channel flashing red marker "10" through flashing green marker "9" and southeasterly extension thereof, southeasterly to the shore of Palm Beach Island, south to an east-west line one mile south of an east-west line drawn along the southern end of Peanut Island, excluding that partially marked navigation channel south of Lake Worth Inlet along the easterly side of Lake Worth, running from daymark R "2" to daymark R "6" and thence southerly, paralleling the eastern shoreline (except as designated under (1)(b) for seasonal regulation).
- 3.** All waters with a northerly limit being a line drawn perpendicular to the centerline of the ICW at the northerly end of the fender system of the SR 707 Bridge, the easterly limit being a due north line drawn across Jupiter Inlet from the western tip of the jetty at DuBois Park to the southwest corner of Jupiter Island (and including the small water body immediately adjacent to and southerly of said jetty), the westerly limit being a line drawn perpendicular to the channel of the Loxahatchee River at the northwest end of the fender system of the Florida East Coast Railroad Bridge adjacent to the SR 811 (Alternate A-1-A) Bridge, and the southerly limit being a line drawn perpendicular to the channel of the ICW at the southerly end of the fender system of the SR 706 (Indiantown Road) Bridge, including all waters of and tributaries to Sawfish Bay and the Jupiter River, and excluding the main marked channel of the ICW.

(b) IDLE SPEED ZONE (Seasonal)

All waters of Lake Worth bounded to the north by a line drawn from Lake Worth Inlet channel flashing red marker "10" running westerly along the line of channel markers marking the northern edge of the Port of Palm Beach Turning Basin and westerly extension thereof, westward to the mainland; bounded to the northeast by a straight line drawn from flashing red marker "10" through flashing green marker "9" and southeasterly extension thereof, southeasterly to the

Palm Beach County Manatee Protection Plan

shoreline of Palm Beach Island; bounded to the east by the eastern shoreline of Lake Worth; bounded to the west by the western shoreline of Lake Worth; and bounded to the south by an east-west line one mile south of an east-west line drawn along the southern end of Peanut Island, which are not otherwise designated under (1)(e).

(c) SLOW SPEED (Year-round)

- 1.** All waters from a line drawn perpendicular to the centerline of the ICW at the north end of the fender system of the Palmetto Park Road Bridge, southward to the south end of the fender system of the Camino Real Boulevard Bridge southerly of Lake Boca Raton, including all of Lake Boca Raton eastward to the Ocean Avenue (SR A-1-A) Bridge over the Boca Raton Inlet.
- 2.** All waters from marker "56" (lat 26 ° 22" 26.380" N, long 80 ° 04" 25.390" W) in the northerly end of Lake Wyman southward to marker "63" (lat 26 ° 21" 38.240" N, long 80 ° 04" 25.670" W).
- 3.** All waters along the westerly side of Lake Worth, bounded to the north by an east-west line one mile south of an east-west line drawn along the southern end of Peanut Island; bounded to the east by the western boundary of the marked channel of the ICW; bounded to the south by the Flagler Memorial Bridge (A1A); and, bonded to the west by the western shoreline of Lake Worth.
- 4.** All waters within 300 feet of the general contour of the shoreline from an east-west line one mile south of an east-west line drawn along the southern end of Peanut Island south to the Lantana Avenue (SR 812) Bridge in Lantana, including those near shore waters within 300 feet of all islands, whether natural or manmade; excluding:
 - a.** the main marked channel of the ICW, and
 - b.** that partially marked navigation channel south of Lake Worth Inlet along the easterly side of Lake Worth, running from daymark R "2" to daymark R "6" and thence southerly, paralleling the eastern shoreline, south to Flagler Memorial Bridge.
- 5.** All waters within 300 feet of the general contour of the shoreline in the Loxahatchee River, including associated backwaters and canals, from a line drawn perpendicular to the centerline of the Loxahatchee River at the northwest end of the fender system of the Florida East Coast Railroad Bridge adjacent to the SR 811 (Alternate A1A) Bridge westward to the Loxahatchee River Road Bridge (easterly end of the C-18 Canal) on the Southwest Fork, to the Martin County/PBC line on the Northwest Fork, and to the Tequesta Drive Bridge on the North Fork.
- 6.** All waters from the Martin County/PBC line southerly to a line drawn perpendicular to the centerline of the ICW at the northerly end of the fender system of the SR 707 Bridge, excluding the main marked channel of the ICW.
- 7.** All waters within 300 feet of the general contour of the shoreline in the northerly end of Lake Worth from the A1A Bridge south to the Blue Heron Boulevard Bridge, excluding the main marked channel of the ICW, and including all associated backwaters and canals and the shorelines of Munyon Island and Little Munyon Island, and the shorelines of all other islands, whether natural or manmade (unless otherwise designated), and including the additional waters described as follows:
 - a.** All waters bounded: on the northwest by a line from the northerly end of Munyon Island northeasterly to the eastern shore of Lake Worth, measured along a perpendicular to said eastern shore; on the west by the eastern shores of Munyon Island and Little Munyon Island, by a line drawn between them at the shortest distance, and by a line drawn from the southerly end of Little Munyon Island to the westerly extension of Pine Point Road (where said westerly extension intersects the eastern shoreline of Lake Worth); and on the southerly and easterly by the shoreline of Lake Worth including the shallow northerly extension of these waters lying easterly of A-1-A and southerly of Turtle Beach Road.

Palm Beach County Manatee Protection Plan

- b.** All waters northerly of the Blue Heron Boulevard (or Riviera Beach) Bridge, westerly of the marked channel of the Intracoastal Waterway, and southerly of a line drawn from marker "32" (lat 26 ° 47" 44" N, long 80 ° 02" 51.5" W), west to the mainland.
- 8.** All waters within 300 feet of the general contour of the shoreline, including associated backwaters and canals, along the easterly side of Lake Worth from the Blue Heron Boulevard Bridge south to a straight line drawn from Lake Worth Inlet channel flashing red marker "10" through flashing green marker "9" and southeasterly extension thereof, southeasterly to the shore of Palm Beach Island, including those nearshore waters within 300 feet of Peanut Island and all other islands, whether natural or manmade; excluding:
- a.** The Lake Worth Inlet easterly of a line running southward from the southwest corner of Singer Island to the southern shore of the Inlet,
 - b.** the Lake Worth Inlet Channel westerly of said line, and
 - c.** The main marked channel of the ICW.
- 9.** All waters within 300 feet of the general contour of the shoreline (including the shoreline of all islands, whether natural or manmade), excluding the main marked navigation channel of the ICW, and including associated backwaters and canals, on the westerly side of Lake Worth from the Blue Heron Boulevard Bridge south to a line of channel markers marking the northern boundary of the Port of Palm Beach Turning Basin, and westward extension thereof.
- 10.** All waters, including associated backwaters, from the Lantana Avenue Bridge (SR 812) in Lantana south to an east-west line running through flashing red marker "52" approximately 0.6 mile northerly of the East Ocean Avenue Bridge in Boynton Beach, excluding:
- a.** The ICW channel,
 - b.** The area within 300 feet westerly of the western boundary of the ICW channel northerly of an east-west line running through flashing red marker "48",
 - c.** The area within 300 feet east of the eastern boundary of the Intracoastal Waterway channel from 300 feet southerly of the southerly end of Hypoluxo Island to an east-west line drawn along the northern edge of Pine Island (or "Beer Can Island"),
 - d.** The portion of the backwater area to the east of Hypoluxo Island designated under (1)(c)11.g.,
 - e.** The marked east-west channel of Boynton Inlet from its confluence with the Atlantic Ocean west to the marked channel of the ICW.
- 11.** All waters within 50 feet of the general contour of the shoreline, including associated backwaters and canals unless otherwise designated, and excluding the marked navigation channel of the ICW, as follows:
- a.** In Lake Worth Creek from the Indiantown Bridge (SR 706) southward to its confluence with Lake Worth,
 - b.** In Little Lake Worth,
 - c.** From an east-west line running through flashing red marker "52" approximately 0.6 mile northerly of the East Ocean Avenue Bridge in Boynton Beach southward to marker "56" (lat 26 ° 22" 26.380" N, long 80 ° 04" 25.390" W), in the northerly end of Lake Wyman in Boca Raton,
 - d.** From the south end of the fender system of the Camino Real Boulevard Bridge southerly of Lake Boca Raton southward approximately 1.3 miles to the Palm Beach County/Broward County line,
 - e.** Along the northerly (PBC) side of the Hillsboro Canal (separating Palm Beach and Broward counties) from the ICW west to the west side of Military Trail (SR 809),
 - f.** That portion of the El Rio Canal from its intersection with the Hillsboro Canal north to SR 798,

Palm Beach County Manatee Protection Plan

g. Those backwaters east of Hypoluxo Island from the Lantana Avenue Bridge to a line 50 feet northerly of the north end of the island lying easterly of the southerly end of Hypoluxo Island; and,

h. From a line drawn perpendicular to the centerline of the ICW running through marker "63" southward to a line drawn perpendicular to the centerline of the ICW at the north end of the fender system of the Palmetto Park Road (SR 798) Bridge.

12. Waters within the C-18 Canal from the Loxahatchee River Rd Bridge westward to Structure S-46.

13. All backwaters, canals and tributaries off of Lake Worth Creek, including those water bodies known as Jonathan's Landing, Admiral's Cove, and Frenchman's Creek.

14. All waters from the northerly confluence of the North Palm Beach Waterway and Lake Worth Creek (Intracoastal Waterway) southward in the North Palm Beach waterway to its confluence with the C-17 Canal (Earman River), westward in the C-17 Canal to the saltwater intrusion dam (S-44) approximately 4100 feet west of the intersection of the North Palm Beach Waterway and the C-17 Canal, and eastward in the C-17 Canal to its confluence with Lake Worth, inclusive of all connecting waters southerly of the confluence of the North Palm Beach Waterway and the C-17 Canal.

15. All waters within the backwater area northerly of the Spanish River Boulevard Bridge in Boca Raton, westerly of the ICW, and southerly of NE 51st Street and easterly extension thereof.

16. All waters of the North Fork of the Loxahatchee River from the Tequesta Drive Bridge north to the Martin County/Palm Beach County line, excluding the main marked navigation channel.

17. All waters of the West Palm Beach (C-51) Canal easterly of US 1 (Structure S-155) to its confluence with the ICW.

18. All waters of the Boynton (C-16) Canal easterly of US 1 (Structure S-41) to its confluence with the ICW.

19. All waters of the C-15 Canal easterly of US 1 (Structure S-40) to its confluence with the ICW.

(d) SLOW SPEED (Seasonal)

1. All waters southerly of an east-west line parallel to and one mile south of an east-west line drawn along the southern end of Peanut Island and northerly of an east-west line parallel to and 1.75 miles south of an east-west line drawn along the southern end of Peanut Island.

2. All waters of the Loxahatchee River from the northwesterly end of the fender system of the Florida East Coast Railroad Bridge adjacent to the SR 811 (Alternate A1A) Bridge westward up the river and northwesterly to the Palm Beach County/Martin County line, excluding the main (posted) navigation channel to within 1/8 mile westerly of the northwesterly end of the fender system of the Florida East Coast Railroad Bridge.

3. All waters of the North Fork of the Loxahatchee River from its confluence with the Loxahatchee River north to the Tequesta Drive Bridge, excluding the main (posted) navigation channel.

4. All waters of the Southwest Fork of the Loxahatchee River from its confluence with the Loxahatchee River west to the Loxahatchee River Road Bridge.

5. All waters within 100 feet of the general contour of the north and south shores of Jupiter Inlet respectively from a north-south line drawn through the westerly ends of the Jupiter Inlet concrete seawalls, located approximately 600 feet west of the inlet's confluence with the Atlantic Ocean at the southeastern tip of Jupiter Island, westerly to a north-south line drawn from the western tip of the jetty at DuBois Park to the southwest corner of Jupiter Island, excluding those waters lying waterward of each of two east-west lines drawn from the westerly ends of said seawalls westward to their point of intersection with the above-described 100-foot shoreline boundary.

6. All waters of Lake Worth bounded to the north by an east-west line drawn perpendicular to the centerline of the ICW at the north shoreline of Phil Foster Island approximately 650 feet north of the

Palm Beach County Manatee Protection Plan

centerline of the Blue Heron Boulevard (Riviera Beach) Bridge; bounded to the east by the eastern shoreline of Lake Worth; bounded to the west by the western shoreline of Lake Worth; bounded to the south by a line drawn from flashing red marker "10" running westerly along the line of channel markers marking the northern edge of the Port of Palm Beach Turning Basin and westerly extension thereof, westward to the mainland, and bounded to the southeast by a straight line drawn from flashing red marker "10" through flashing green marker "9", and southerly extension thereof, southeasterly to the shore of Palm Beach Island, excluding those waters within the Lake Worth Inlet easterly of a line running southward from the southwest corner of Singer Island to the southern shore of the inlet.

(e) MOTORBOATS PROHIBITED ZONE

All waters lying within Lake Worth, commencing at a point exactly 300 feet north of the northeast corner of the Riviera Power Plant discharge canal, thence easterly to a point 100 feet west of the western boundary of the Intracoastal Waterway channel, lying within Township 42 South and Range 43 East; thence running southerly parallel to and 100 feet west of the western boundary of the Intracoastal Waterway channel for a distance of 700 feet to a point within Township 43 South and Range 43 East; thence westerly to the shoreline to a point 300 feet south of the southeast corner of the discharge canal; thence northerly 300 feet to the southeast corner of the discharge canal; thence westerly 150 feet, northerly 100 feet, and easterly 150 feet to the northeast corner of the discharge canal (inclusive of the entire water-body comprising the Riviera Power Plant discharge canal); thence northerly 300 feet to the point of origin. The precise boundaries and effective period of the zone will be posted each year between November 15 and March 31.

(f) MAXIMUM 25 MPH ZONE (Year-round)

All waters as described below: That portion of the main marked channel of the ICW from the Martin County/Palm Beach County line southerly to a line drawn perpendicular to the centerline of the ICW at the northerly end of the fender system of the SR 707 Bridge.

(g) MAXIMUM 30 MPH ZONE (June 1 through September 30)/MAXIMUM 25 MPH ZONE (Remainder of Year)

All waters as described below, except where otherwise designated or posted for more restrictive regulation for the purpose of manatee protection or boating safety:

- 1.** That portion of the ICW, to within 50 feet of the general contour of the shoreline and including the main marked channel, from a line drawn perpendicular to the centerline of the ICW at the south end of the fender system of the State Road 706 (Indiantown) Bridge southerly to the intersection of Lake Worth Creek and Lake Worth;
- 2.** That portion of the ICW, to within 50 feet of the general contour of the shoreline and including the main marked channel, from an east-west line running through flashing red marker "52" southerly to the Palm Beach County/Broward County line; and
- 3.** That portion of the marked channel of the ICW east of Boynton Canal from an east-west line running through flashing red marker "48" southerly to an east-west line running through flashing red marker "52."

(2). Any races involving power-driven vessels within areas designated for regulation under the provisions of this rule shall be approved by all appropriate permitting agencies including but not limited to the U.S. Coast Guard, and shall receive prior approval from the Commission.

(3). Regulations restricting motorboat speed and operation, as set forth herein, are not intended to supersede any existing regulations duly established by federal, state, or local authority which are more restrictive in nature. Where differing regulations exist, regulatory markers posted shall

Palm Beach County Manatee Protection Plan

reflect the most restrictive requirement. Permitted markers as posted are presumptive evidence of zone boundaries, as intended.

(4) Those waters designated under subparagraphs (1)(a)1. and 2., (1)(b), (1)(c)3., 4., 8. and 9., and (1)(d)1. and 6., wherein protection zones were previously established and enforced (as adopted March 19, 1979), shall remain unaffected by exemption provisions for the purpose of boat/motor testing as set forth under 68C-22.003(7).

APPENDIX C – BOATING SAFETY SPEED ZONES

Section 68D-24.017, Florida Administrative Code.

68D-24.017 Palm Beach County Boating Restricted Areas.

(1) For the purpose of regulating speed and operation of vessel traffic on the Intracoastal Waterway within Palm Beach County, Florida, the following boating restricted areas are established:

(a)1. Jupiter Inlet – An Idle Speed No Wake zone from shoreline to shoreline, in and adjacent to the Florida Intracoastal Waterway, bounded on the north by a line drawn perpendicular to the centerline of the Florida Intracoastal Waterway at the north end of the fender system of the State Road 707 Bridge, on the west by a line drawn perpendicular to the centerline of the Loxahatchee River at the northwest end of the fender system of the Florida East Coast Railroad bridge located adjacent to the State Road 811 (Alternate A-1-A) Bridge, on the south by a line drawn perpendicular to the centerline of the Florida Intracoastal Waterway at the south end of the fender system of the State Road 706 Bridge, on the east by a line drawn due north across the Jupiter Inlet from the western tip of the jetty at DuBois Park to the southwest corner of Jupiter Island, and including all waters of and tributaries to Sawfish Bay and the Jupiter River, as depicted in drawing A.

2. Bert Winters Park – An Idle Speed No Wake zone from shoreline to shoreline, in and adjacent to the Florida Intracoastal Waterway, bounded on the north by a line drawn perpendicular to the centerline of the Florida Intracoastal Waterway 2,700 feet southerly of the Donald Ross Road Bridge (approximately 300 feet north of the boat ramp at Bert Winters Park) and bounded on the south by a line drawn perpendicular to the centerline of the Florida Intracoastal Waterway 3,300 feet south of the said bridge (approximately 300 feet south of the boat ramp at Bert Winters Park), as depicted in drawing B.

3. Juno Park to PGA Boulevard – An Idle Speed No Wake zone from shoreline to shoreline, in and adjacent to the Florida Intracoastal Waterway, bounded on the north by a line drawn perpendicular to the centerline of the Florida Intracoastal Waterway 4,300 feet north of the PGA Boulevard Bridge (approximately 300 feet north of Juno Park) and bounded on the south by a line drawn perpendicular to the centerline of the Florida Intracoastal Waterway 3,000 feet south of the said bridge, as depicted in drawing C.

4. US-1 Bridge – An Idle Speed No Wake zone from shoreline to shoreline, in and adjacent to the Florida Intracoastal Waterway, bounded on the north by a line drawn perpendicular to the centerline of the Florida Intracoastal Waterway at the north end of the fender system of the U.S. Highway 1 (State Road 5) Bridge and on the south by a line drawn perpendicular to the centerline of the Florida Intracoastal Waterway from headland to headland across the mouth of Lake Worth Creek at its southern terminus at Lake Worth, as depicted in drawing D.

5. Peanut Island/Palm Beach Inlet -

a. A Slow Speed Minimum Wake zone from shoreline to shoreline, adjacent to the Florida Intracoastal Waterway including all waters of Lake Worth; bounded on the north by a line drawn perpendicular to the centerline of the Florida Intracoastal Waterway at the north shoreline of Phil Foster Island, from the mainland at Riviera Beach to Singer Island; on the southeast by a line drawn from the southwest corner of Singer Island to the nearest channel marker marking the northern edge of the Lake Worth Inlet Channel and running from channel marker to channel marker along the northern edge of the Lake Worth Inlet Channel and the Port of Palm Beach Turning Basin; and, on the south by a line drawn perpendicular to the centerline of the Florida Intracoastal Waterway, from the westernmost channel marker marking the northern edge of the Port of Palm Beach Turning Basin to the mainland, as depicted in drawing E.

Palm Beach County Manatee Protection Plan

b. Palm Beach County is authorized to create by ordinance within this zone a swim area from which vessels are excluded, in waters east of the right-of-way of the Florida Intracoastal Waterway adjacent to and within 150 feet of the southern shoreline of Phil Foster Park.

6. Flagler Memorial Bridge – A Slow Speed Minimum Wake zone from shoreline to shoreline, in and adjacent to the Florida Intracoastal Waterway, bounded on the north by a line drawn perpendicular to the centerline of the Florida Intracoastal Waterway 2,100 feet north of the Flagler Memorial Bridge and bounded on the south by a line drawn perpendicular to the centerline of the Florida Intracoastal Waterway 1,800 feet south of the said bridge, as depicted in drawing F.

7. Royal Palm Bridge – A Slow Speed Minimum Wake zone from shoreline to shoreline, in and adjacent to the Florida Intracoastal Waterway, bounded on the north by a line drawn perpendicular to the centerline of the Florida Intracoastal Waterway at the north end of the fender system of the Royal Palm (Royal Park, State Road 704) Bridge and bounded on the south by a line drawn perpendicular to the centerline of the Florida Intracoastal Waterway along the northern tip of Everglades Island, as depicted in drawing G.

8. Lantana Avenue Bridge – A Slow Speed Minimum Wake zone from shoreline to shoreline, in and adjacent to the Florida Intracoastal Waterway, bounded on the north by a line drawn perpendicular to the centerline of the Florida Intracoastal Waterway at the north end of Hypoluxo Island and bounded on the south by a line drawn perpendicular to the centerline of the Florida Intracoastal Waterway at the south end of the fender system of the Lantana Avenue (State Road 812) Bridge, as depicted in drawing H.

9. East Ocean Avenue Bridge – An Idle Speed No Wake zone from shoreline to shoreline, in and adjacent to the Florida Intracoastal Waterway, bounded on the north by a line drawn perpendicular to the centerline of the Florida Intracoastal Waterway 650 feet north of the East Ocean Avenue (State Road 804) Bridge in Boynton Beach and bounded on the south by a line drawn perpendicular to the centerline of the Florida Intracoastal Waterway at the south end of the fender system of the said bridge, as depicted in drawing I.

10. Northeast 8th Street Bridge – An Idle Speed No Wake zone from shoreline to shoreline, in and adjacent to the Florida Intracoastal Waterway, bounded on the north by a line drawn perpendicular to the centerline of the Florida Intracoastal Waterway at the north end of the fender system of the Northeast 8th Street Bridge and bounded on the south by a line drawn perpendicular to the centerline of the Florida Intracoastal Waterway 600 feet south of the said bridge, as depicted in drawing J.

11. East Atlantic Avenue Bridge – An Idle Speed No Wake zone from shoreline to shoreline, in and adjacent to the Florida Intracoastal Waterway, bounded on the north by a line drawn perpendicular to the centerline of the Florida Intracoastal Waterway 650 feet north of the East Atlantic Avenue (State Road 806) Bridge in Delray Beach and bounded on the south by a line drawn perpendicular to the centerline of the Florida Intracoastal Waterway 1,700 feet south of the said bridge at the northern terminus of the Linton Boulevard Zone, as depicted in drawing K.

12. Linton Boulevard Bridge Zones -

a. A Slow Speed Minimum Wake zone from shoreline to shoreline, in and adjacent to the Florida Intracoastal Waterway, bounded on the north by a line drawn perpendicular to the centerline of the Florida Intracoastal Waterway 1,700 feet south of the East Atlantic Avenue Bridge at the southern terminus of the East Atlantic Avenue Bridge Zone (approximately one nautical mile north of the Linton Boulevard Bridge) and bounded on the south by a line drawn perpendicular to the centerline of the Florida Intracoastal Waterway 2,700 feet north of the Linton Boulevard Bridge, as depicted in drawing K.

Palm Beach County Manatee Protection Plan

b. An Idle Speed No Wake zone from shoreline to shoreline, in and adjacent to the Florida Intracoastal Waterway, bounded on the north by a line drawn perpendicular to the centerline of the Florida Intracoastal Waterway 2,700 feet north of the Linton Boulevard Bridge and bounded on the south by a line drawn perpendicular to the centerline of the Florida Intracoastal Waterway at the south end of the fender system of the Linton Boulevard (12th Street) Bridge, as depicted in drawing K.

13. Lake Boca Raton -

a. A “Slow Speed Minimum Wake” zone from shoreline to shoreline in and adjacent to the Florida Intracoastal Waterway, 3,750 feet north of the centerline of the Palmetto Park Road (S.R. 798) Bridge, (in the vicinity of marker 63), south to 300 feet south of the centerline of the Camino Real Bridge, bounded on the east by the east end of the fender system of the Ocean Avenue (A-1-A) Bridge over the Boca Raton Inlet, and including all waters of Lake Boca Raton.

b. A “Slow Speed Minimum Wake, Weekends Only 9:00 A.M. – 7:00 P.M.” 300 feet south of the centerline of the Camino Real Bridge south to the Palm Beach/Broward County line, a distance of approximately 3,700 feet, as depicted in drawing L.

(b) Palm Beach County is authorized to install and maintain appropriate regulatory markers as directed by the Division of Law Enforcement within such boating restricted areas and shall install “Resume Normal Safe Operations” markers at the boundaries of such restricted areas, except when such boundaries adjoin manatee protection or other boating restricted areas.

(2) The boating restricted areas described in Rule 68D-24.017, F.A.C. are depicted on the following drawings:

(Editor’s Note: See Figure 42 on page 159, above.)

Palm Beach County Manatee Protection Plan

**APPENDIX D – PALM BEACH COUNTY
SINGLE-FAMILY RESIDENTIAL DOCK SURVEY
(APRIL 2006)**

<u>Water Body</u>	<u>Total Dock Count</u>	<u>Mean Slip/Dock</u>	<u>Total Slips</u>
Loxahatchee River	695	1.8	1,237
ICW North ¹	2,033	1.2	2,497
Lake Worth Lagoon North ²	636	1.7	1,102
Lake Worth Lagoon Central	393	1.2	457
Lake Worth Lagoon South	516	1.3	681
ICW South	2,372	1.2	2,799
Totals	6,645	1.3	8,772

¹Includes Jupiter Sound, Loxahatchee River East of US 1, Lake Worth Creek, and North Palm Beach Waterway

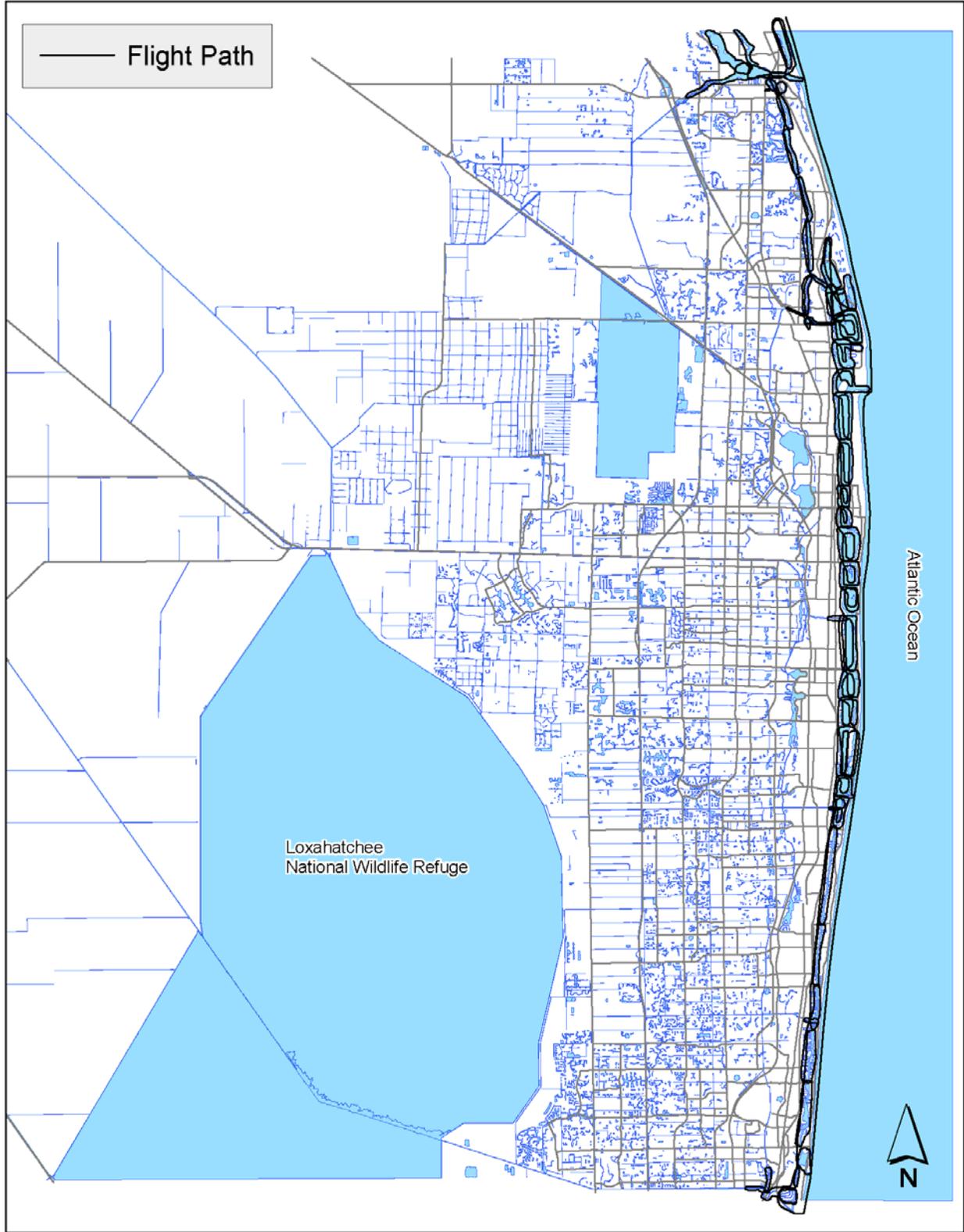
²Includes Little Lake Worth

Note: Survey based on 10% sampling for all segments of Lake Worth Lagoon and Loxahatchee River; 5% for ICW North and ICW South. Interpreted from February 2005 Aerial Photograph. Actual number of slips counted.

APPENDIX E
FIGURES

Palm Beach County Manatee Protection Plan

Figure 4: Typical Aerial Distributional Survey Flight Path, 1990-1993

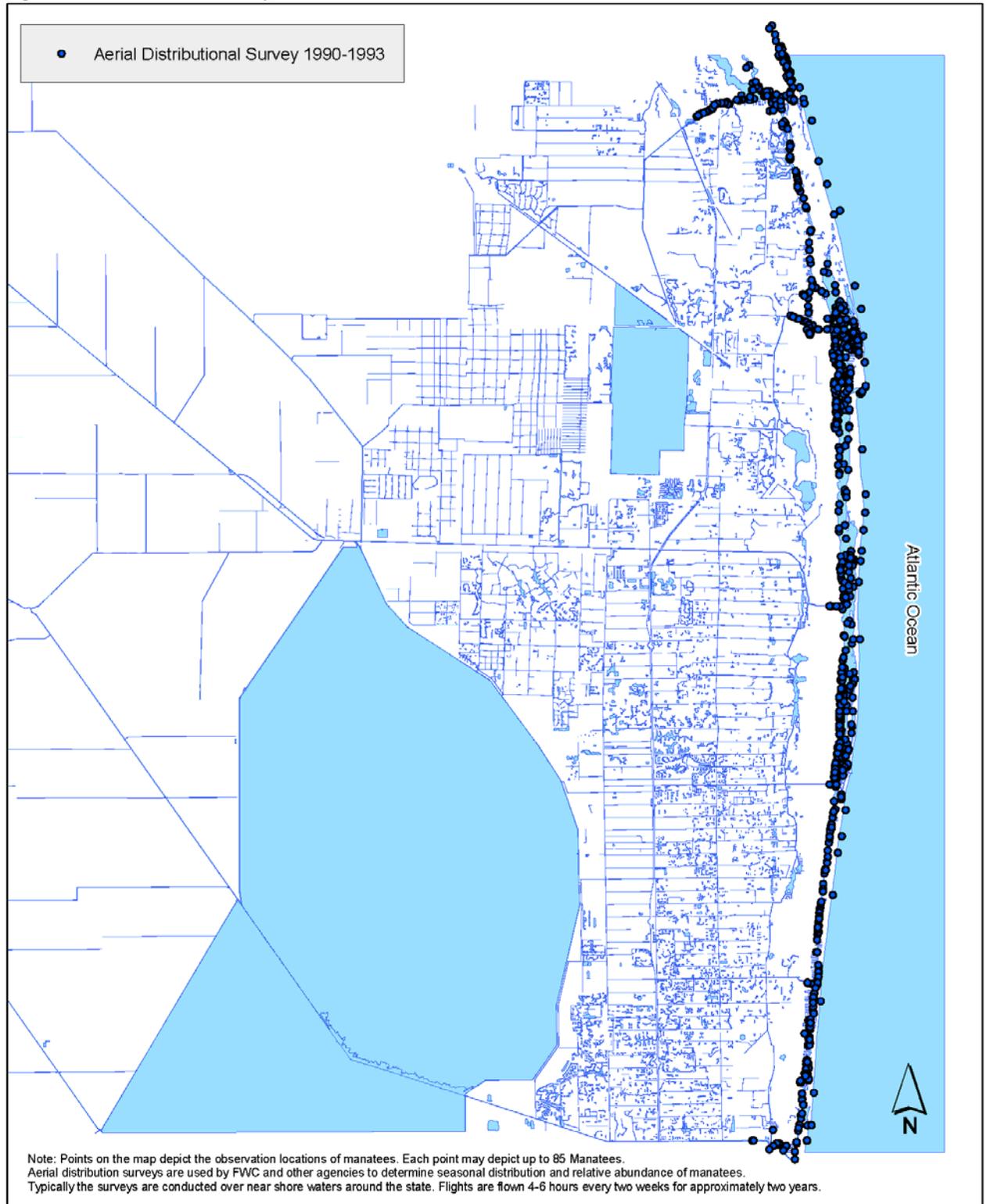


Data Sources: Fish and Wildlife Research Institute, Atlas of Marine Resources 1998 (www.floridamarine.org)
Palm Beach County (www.co.palm-beach.fl.us)
Map Created January 2005 by CUES (www.cuesfau.org)

0 3 6 12 Miles

Palm Beach County Manatee Protection Plan

Figure 5: Aerial Distribution Survey, 1990-1993

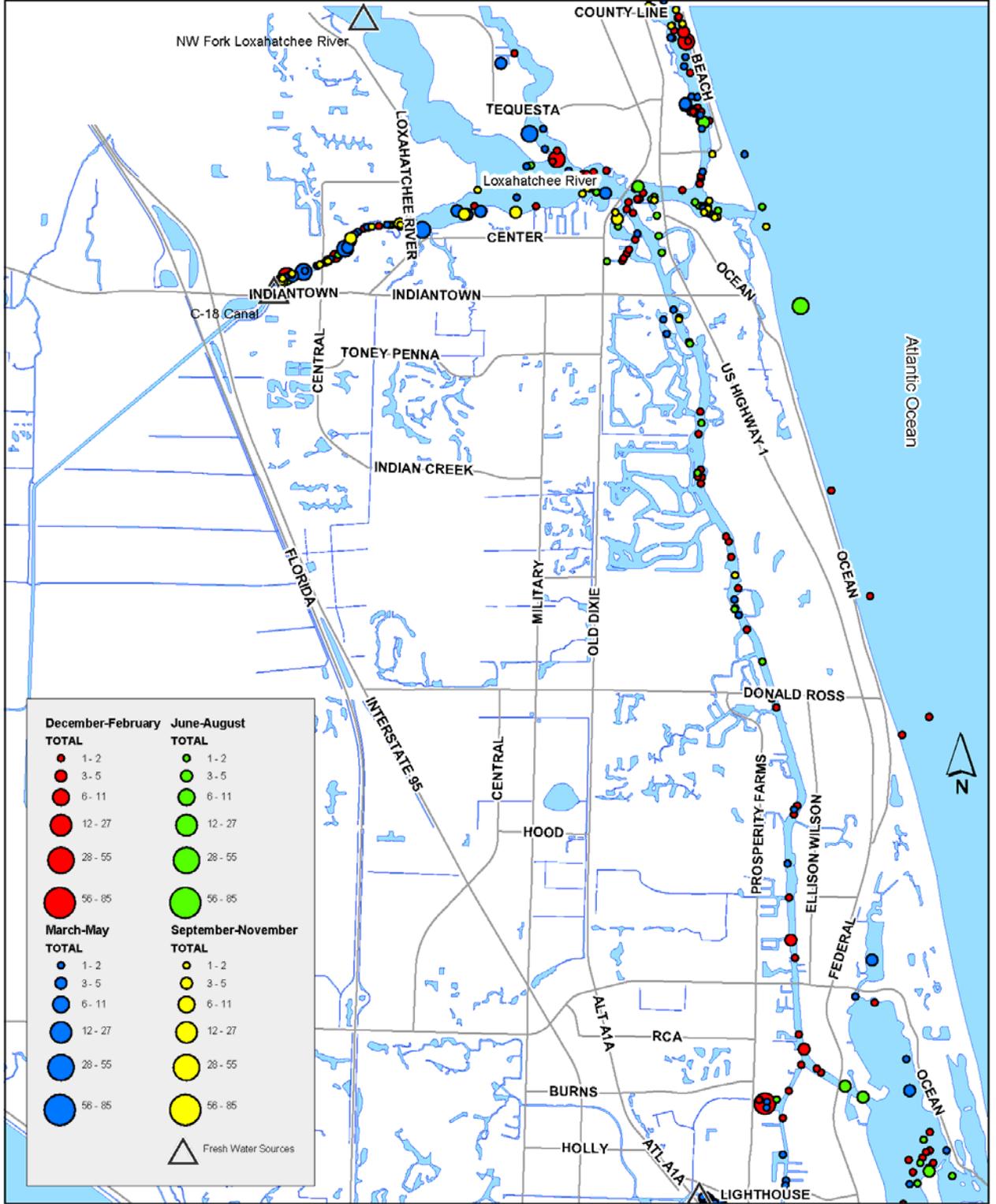


Data Sources: Fish and Wildlife Research Institute. (www.floridamarine.org)
Palm Beach County (www.co.palm-beach.fl.us)
Map created January 2005 by CUES (www.cuesfau.org)

0 3 6 12 Miles

Palm Beach County Manatee Protection Plan

Figure 8a: Aerial Distributional Survey, 1990-1993 by Season, including Counts, Palm Beach North

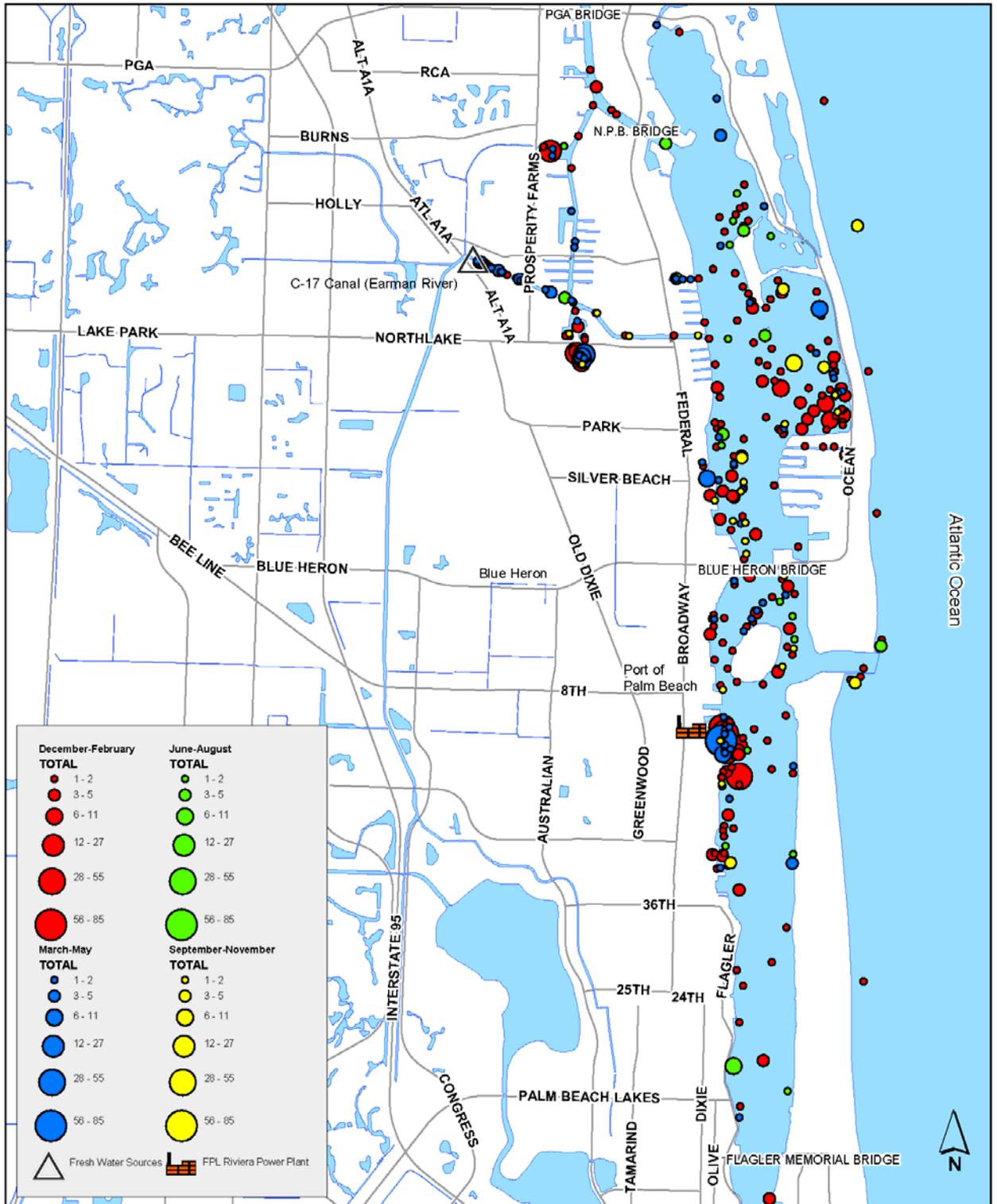


Data Sources: Fish and Wildlife Research Institute. (www.floridamarine.org)
 Palm Beach County (www.co.palm-beach.fl.us)
 Map created December 2004 by CUES (www.cuesfau.org)

Note: Points on the map depict the observation locations of manatees. Each point may depict up to 85 Manatees. Typically the surveys are conducted over near shore waters around the state. Flights are flown 4-6 hours every two weeks for approximately two years.

Palm Beach County Manatee Protection Plan

Figure 8b: Aerial Distributional Survey, 1990-1993 by Season, including Counts, Lake Worth North



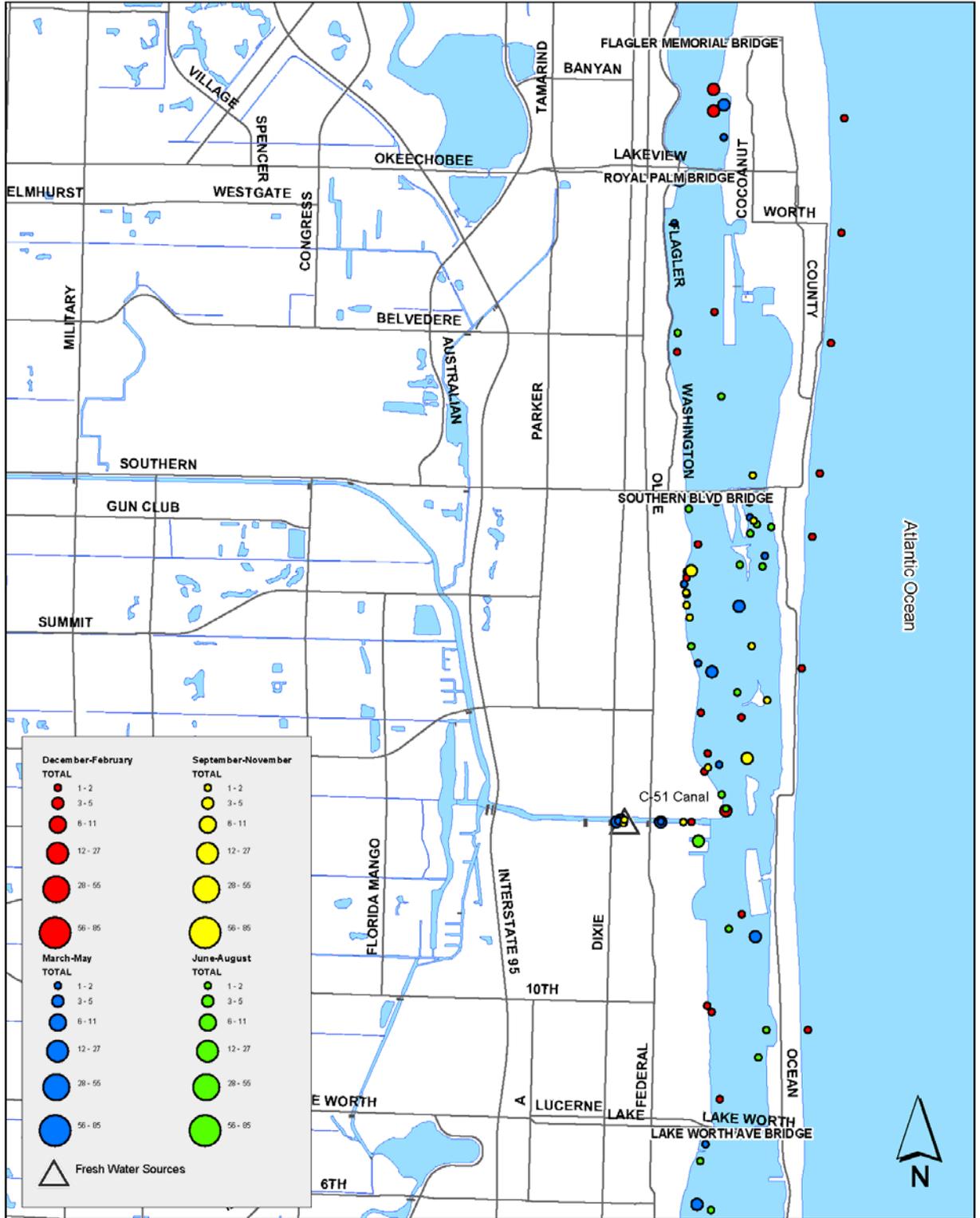
Data Sources: Fish and Wildlife Research Institute. (www.floridamarine.org)
 Palm Beach County (www.co.palm-beach.fl.us)
 Map created December 2004 by CUES (www.cuesfau.org)

Note: Points on the map depict the observation locations of manatees. Each point may depict up to 85 Manatees. Typically the surveys are conducted over near shore waters around the state. Flights are flown 4-6 hours every two weeks for approximately two years.

0 0.25 0.5 1 Miles

Palm Beach County Manatee Protection Plan

Figure 8c: Aerial Distributional Survey, 1990-1993 by Season, including Counts, Lake Worth Central



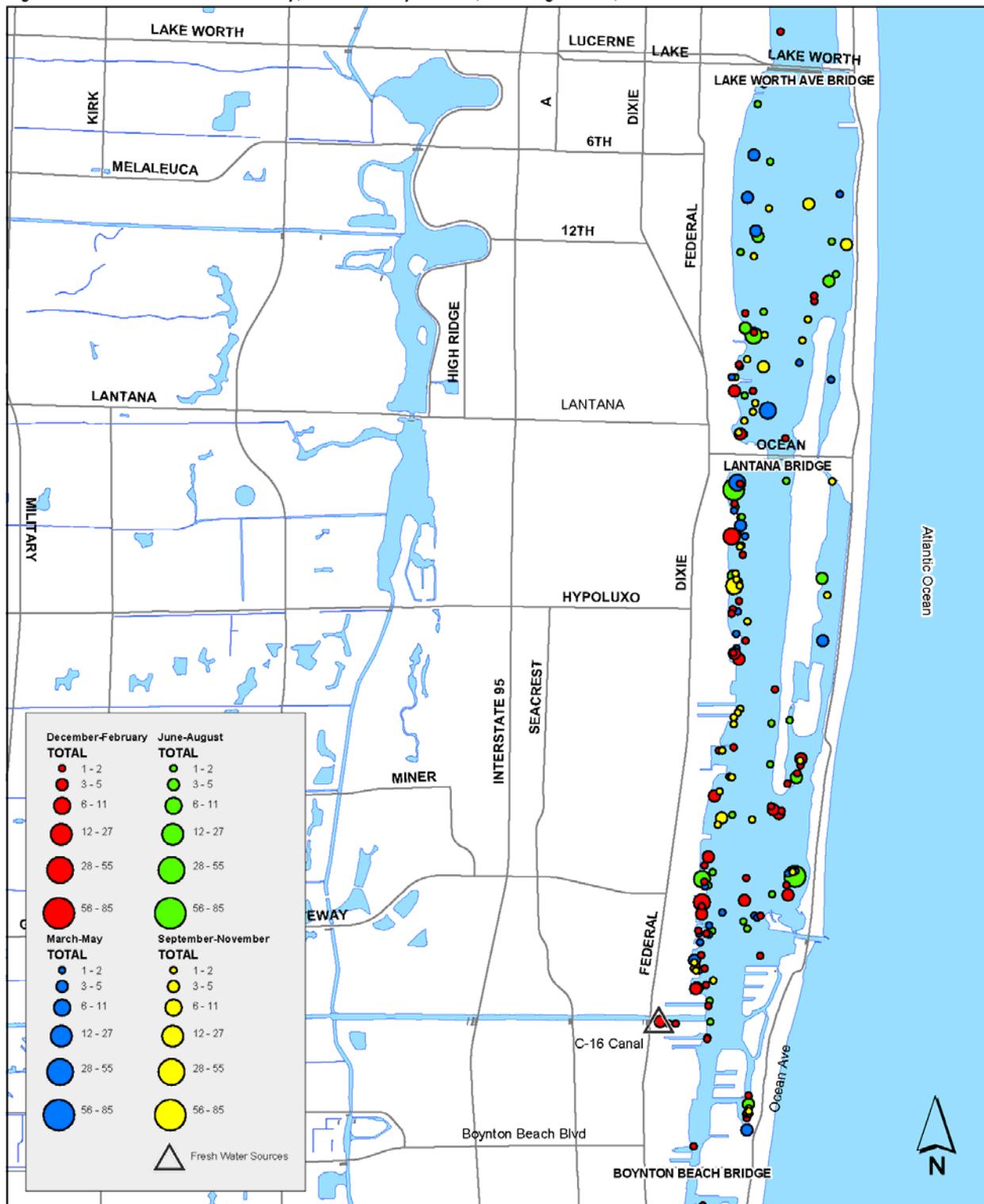
Data Sources: Fish and Wildlife Research Institute (www.floridamarine.org)
 Palm Beach County (www.co.palm-beach.fl.us)
 Map created December 2004 by CUES (www.cuestau.org)

Note: Points on the map depict the observation locations of manatees.
 Each point may depict up to 85 Manatees.
 Typically the surveys are conducted over near shore waters around the state
 Flights are flown 4-6 hours every two weeks for approximately two years.

0 0.3 0.6 1.2 Miles

Palm Beach County Manatee Protection Plan

Figure 8d: Aerial Distributional Survey, 1990-1993 by Season, including Counts, Lake Worth South



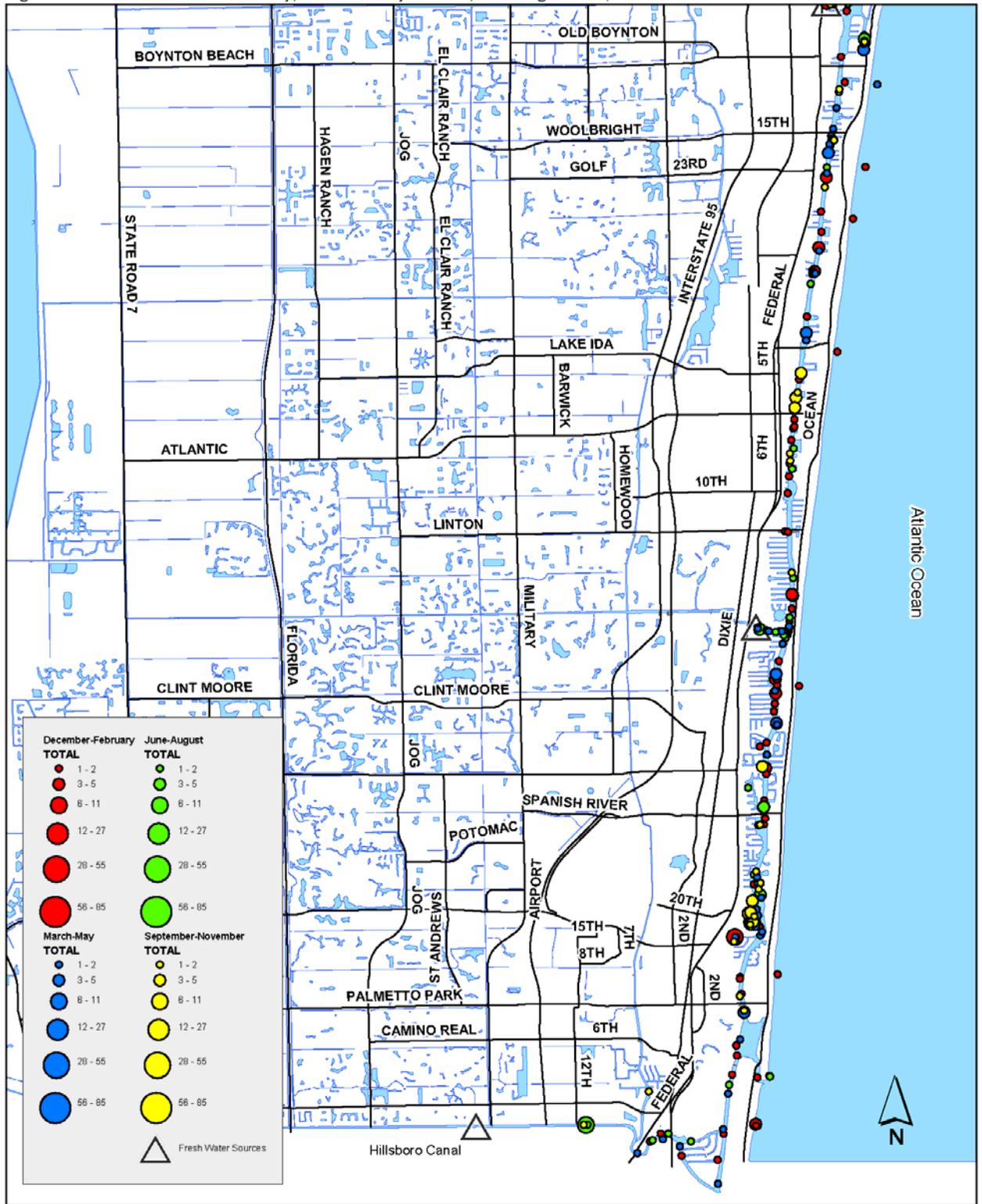
Data Sources: Fish and Wildlife Research Institute. (www.floridamarine.org)
 Palm Beach County (www.co.palm-beach.fl.us)
 Map created December 2004 by CUJES (www.cuesfau.org)

Note: Points on the map depict the observation locations of manatees.
 Each point may depict up to 85 Manatees.
 Typically the surveys are conducted over near shore waters around the state.
 Flights are flown 4-6 hours every two weeks for approximately two years.

0 0.150.3 0.6 Miles

Palm Beach County Manatee Protection Plan

Figure 8e: Aerial Distributional Survey, 1990-1993 by Season, including Counts, Palm Beach South



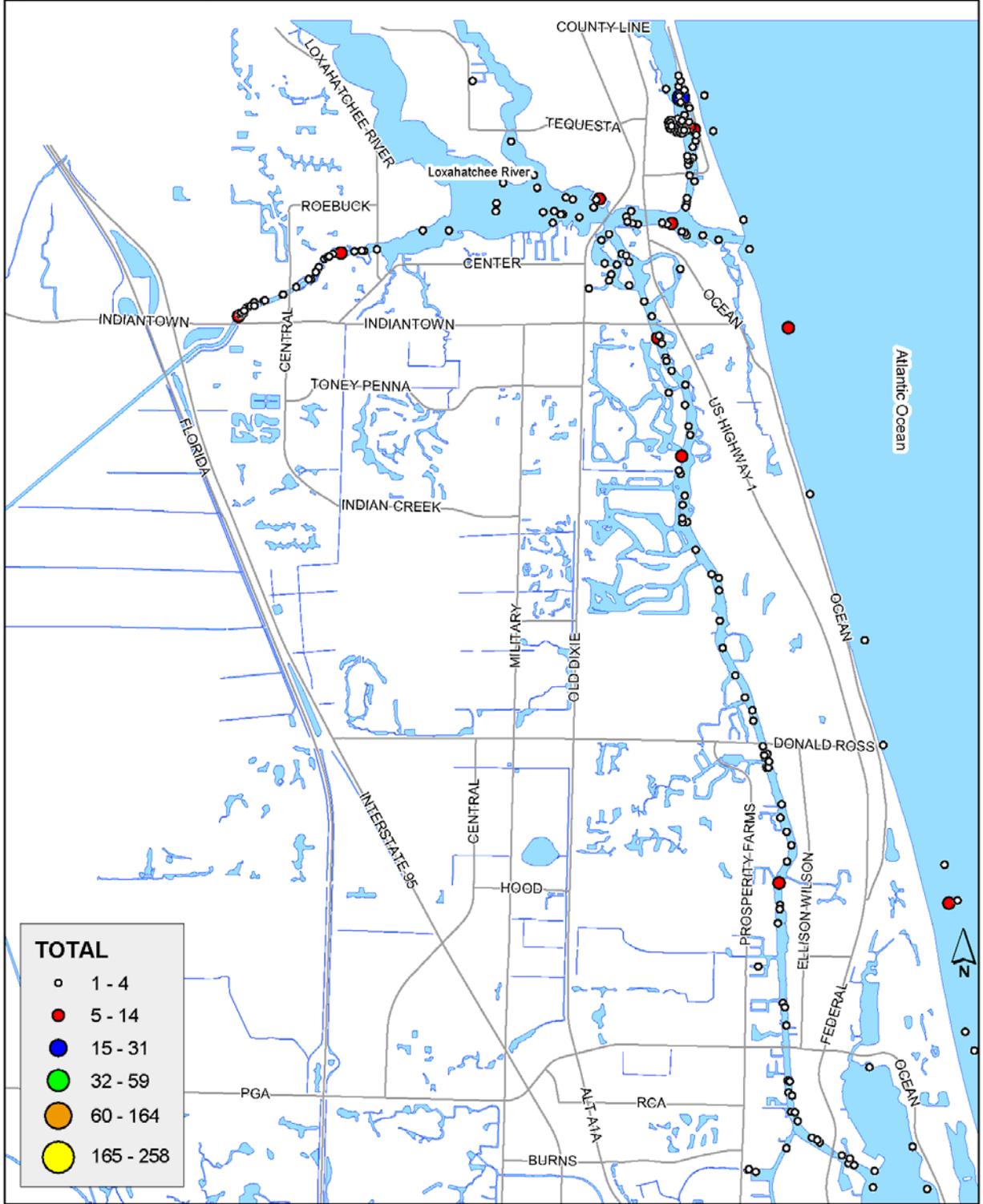
Data Sources: Fish and Wildlife Research Institute. (www.floridamarine.org)
 Palm Beach County (www.co.palm-beach.fl.us)
 Map created December 2004 by CJUES (www.cjuesfau.org)

Note: Points on the map depict the observation locations of manatees.
 Each point may depict up to 85 Manatees.
 Typically the surveys are conducted over near shore waters around the state.
 Flights are flown 4-6 hours every two weeks for approximately two years.

0 0.5 1 2 Miles

Palm Beach County Manatee Protection Plan

Figure 9a: Synoptic Survey Count January-March, 1991-2003, Palm Beach North



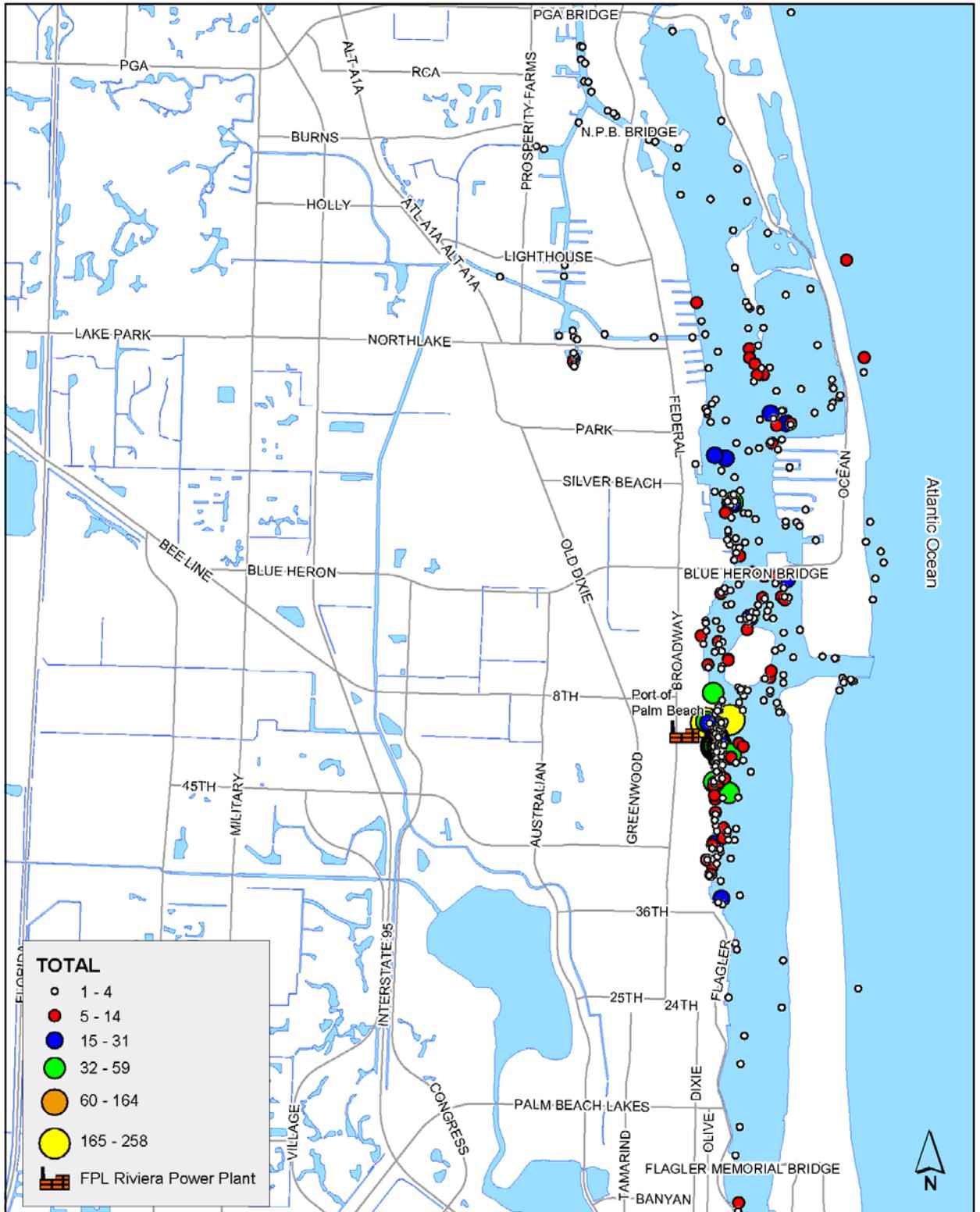
Data Sources: Fish and Wildlife Research Institute. (www.floridamarine.org)
 Palm Beach County (www.co.palm-beach.fl.us)
 Map created September 2004 by CUES (www.cuesfau.org)

Note: Points on the map depict the observed locations of manatee or aggregations of manatees. One point may represent up to 258 animals. Synoptic surveys are normally flown between the months of December and March. Data covers 1991-2003 excluding 1993 and 1994.

0 0.375 0.75 1.5 Miles

Palm Beach County Manatee Protection Plan

Figure 9b: Synoptic Survey Count January-March, 1991-2003, Lake Worth North



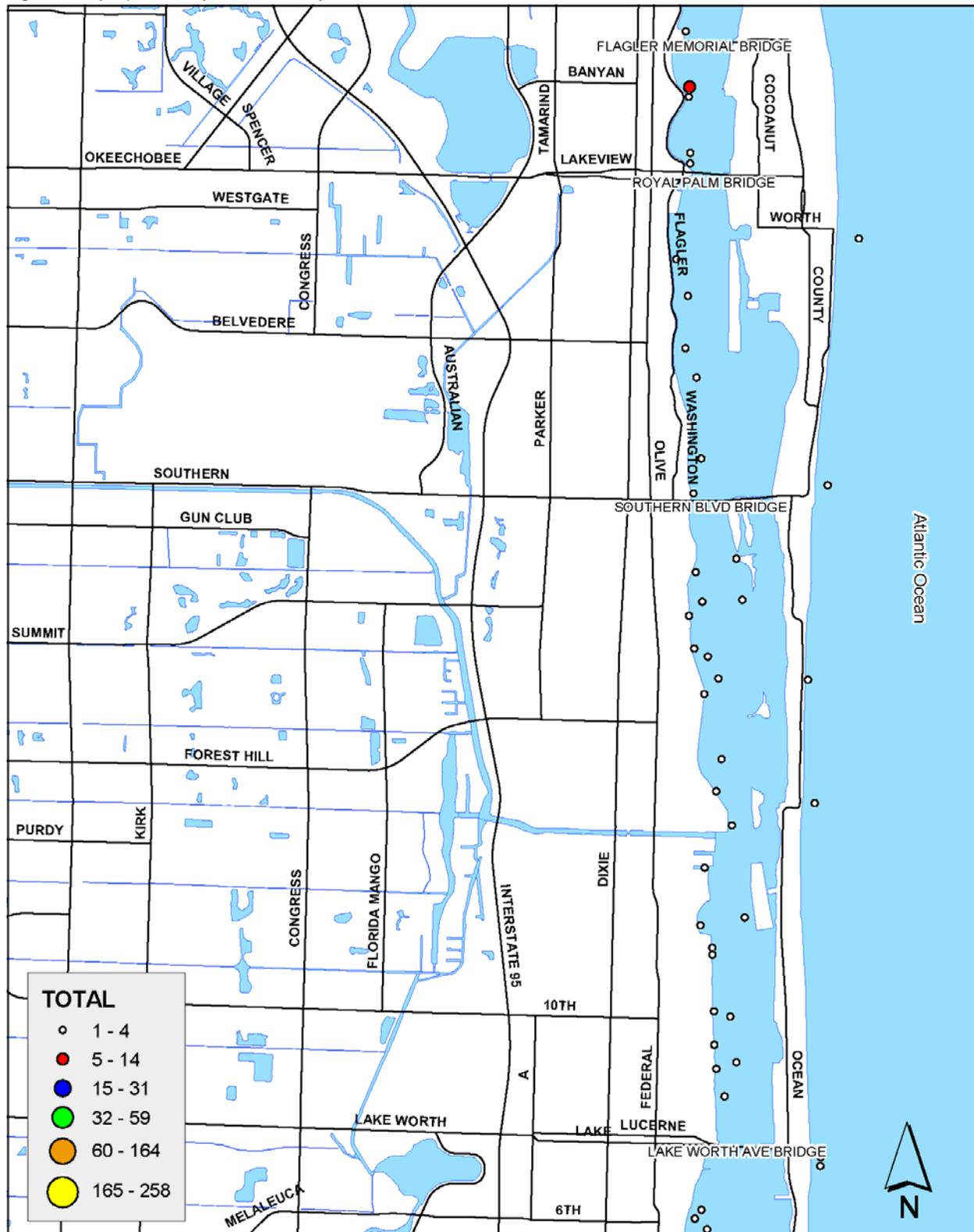
Data Sources: Fish and Wildlife Research Institute (www.floridamarine.org)
 Palm Beach County (www.co.palm-beach.fl.us)
 Map created September 2004 by CUES (www.cuesfau.org)

Note: Points on the map depict the observed locations of manatee or aggregations of manatees. One point may represent up to 258 animals. Synoptic surveys are normally flown between the months of December and March. Data covers 1991-2003 excluding 1993 and 1994.

0 0.5 1 2 Miles

Palm Beach County Manatee Protection Plan

Figure 9c: Synoptic Survey Count January-March, 1991-2003, Lake Worth Central

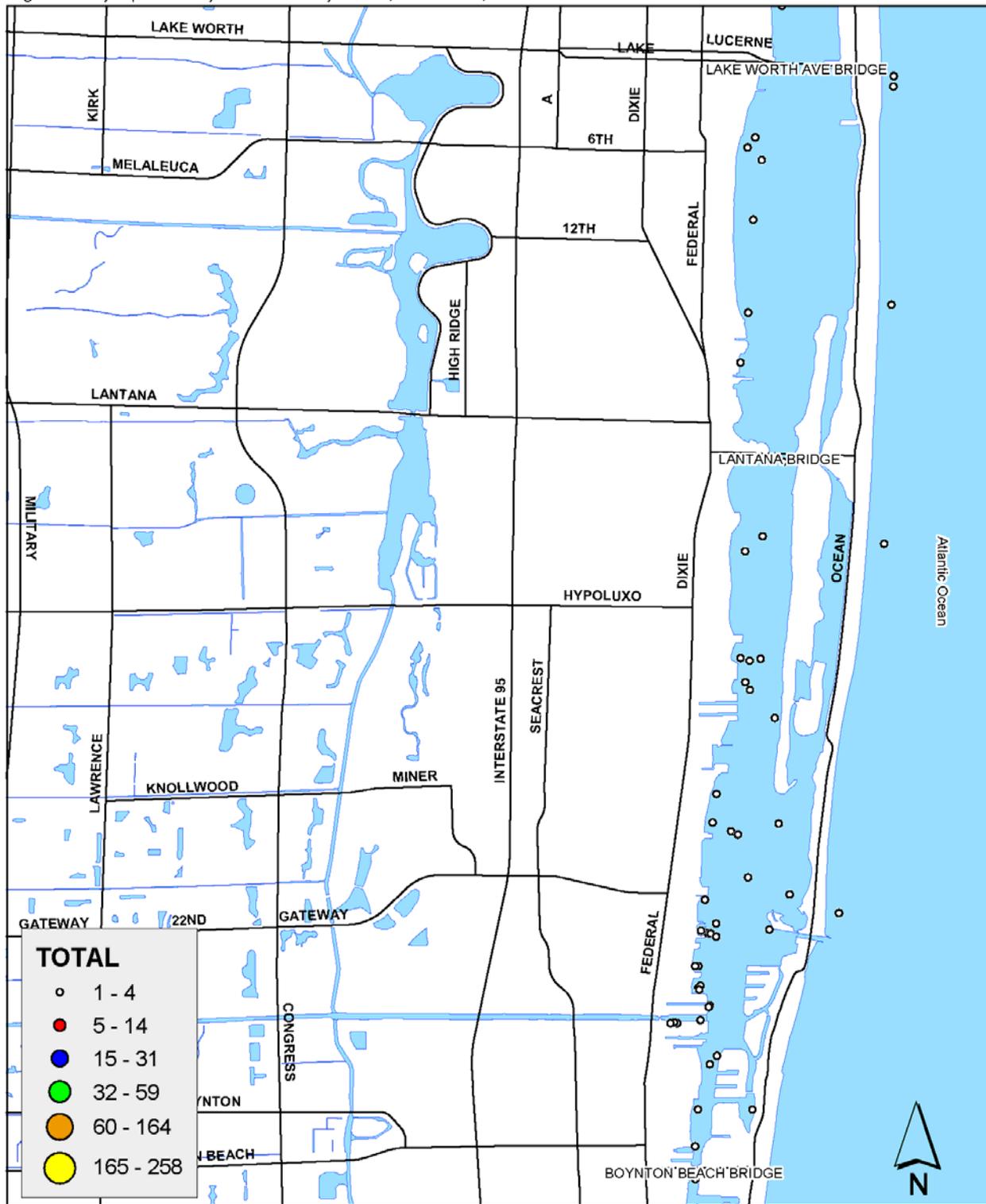


Data Sources: Fish and Wildlife Research Institute. (www.floridamarine.org)
 Palm Beach County (www.co.palm-beach.fl.us)
 Map created September 2004 by CUES (www.cuesfau.org)

Note: Points on the map depict the observed locations of manatee or aggregations of manatees. One point may represent up to 258 animals. Synoptic surveys are normally flown between the months of December and March. Data covers 1991-2003 excluding 1993 and 1994.

Palm Beach County Manatee Protection Plan

Figure 9d: Synoptic Survey Count January-March, 1991-2003, Lake Worth South



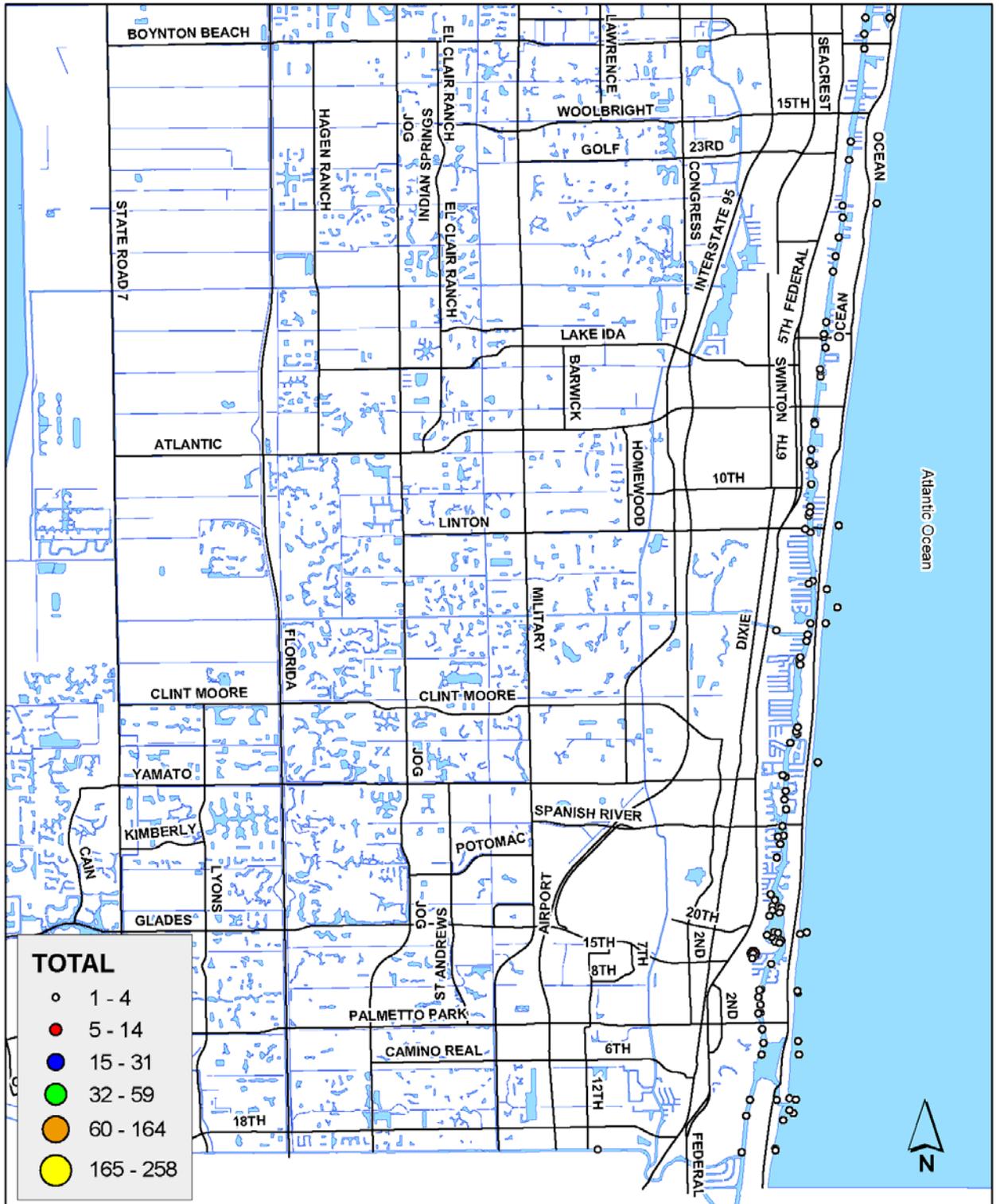
Data Sources: Fish and Wildlife Research Institute (www.floridamarine.org)
 Palm Beach County (www.co.palm-beach.fl.us)
 Map created September 2004 by CUES (www.cuesfau.org)

Note: Points on the map depict the observed locations of manatee or aggregations of manatees. One point may represent up to 258 animals. Synoptic surveys are normally flown between the months of December and March. Data covers 1991-2003 excluding 1993 and 1994.

0 0.25 0.5 1 Miles

Palm Beach County Manatee Protection Plan

Figure 9e: Synoptic Survey Count January-March, 1991-2003, Palm Beach South



Data Sources: Fish and Wildlife Research Institute. (www.floridamarine.org)
 Palm Beach County (www.co.palm-beach.fl.us)
 Map created September 2004 by CUES (www.cuesfau.org)

Note: Points on the map depict the observed locations of manatee or aggregations of manatees. One point may represent up to 258 animals. Synoptic surveys are normally flown between the months of December and March. Data covers 1991-2003 excluding 1993 and 1994.

0 0.5 1 2 Miles

Palm Beach County Manatee Protection Plan

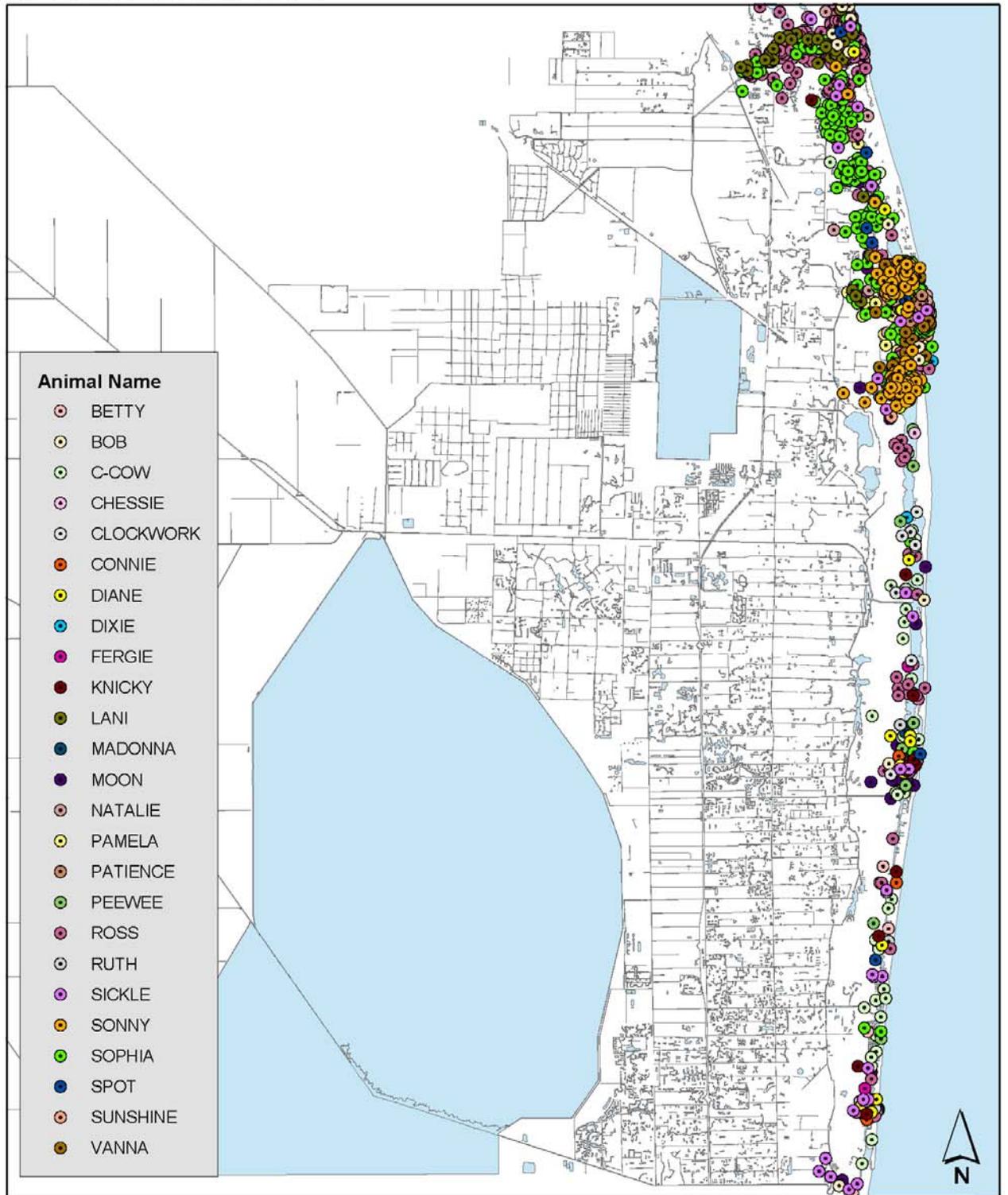
Figure 10: C-Cow Telemetry



Data Sources: Fish and Wildlife Research Institute (www.floridamarine.org) and Palm Beach County (www.co.palm-beach.fl.us); Map created January 2005 by CUES (www.cuestau.org)

Palm Beach County Manatee Protection Plan

Figure 11: Palm Beach County Telemetry



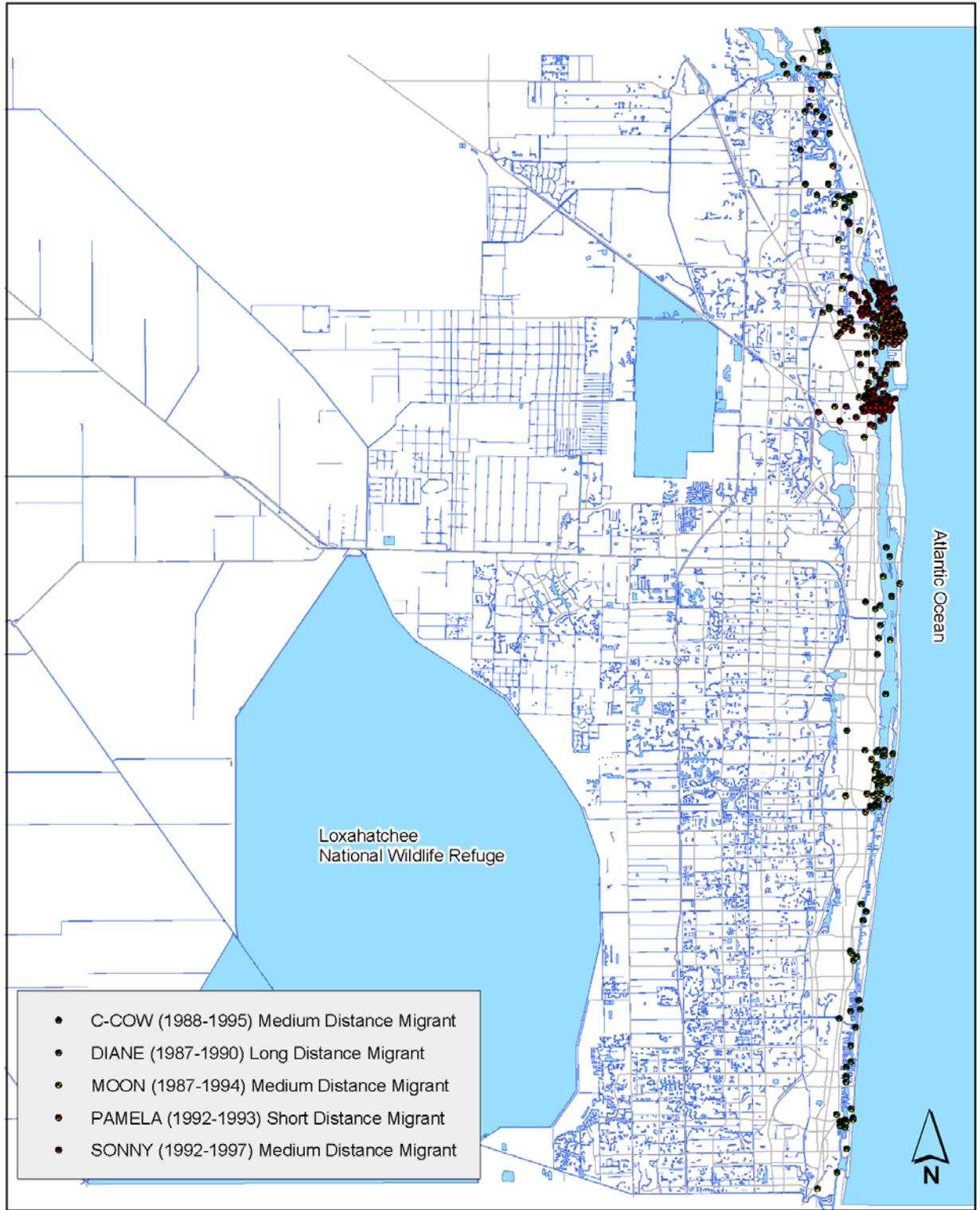
Data Sources: Fish and Wildlife Research Institute (www.floridamarine.org)
 Palm Beach County (www.co.palm-beach.fl.us)
 Map created January 2005 by CUES (www.cuesfau.org)

Note: This map summarizes individual animal movements over a 12-year radio-telemetry study. The dataset has not been edited to reflect adjustments of points that occur over land. *Points on the map depict locations of radio-tagged West Indian manatees within Palm Beach County.

0 4 8 16 Miles

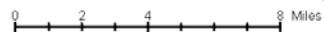
Palm Beach County Manatee Protection Plan

Figure 12: Palm Beach County Telemetry, Selected Animals



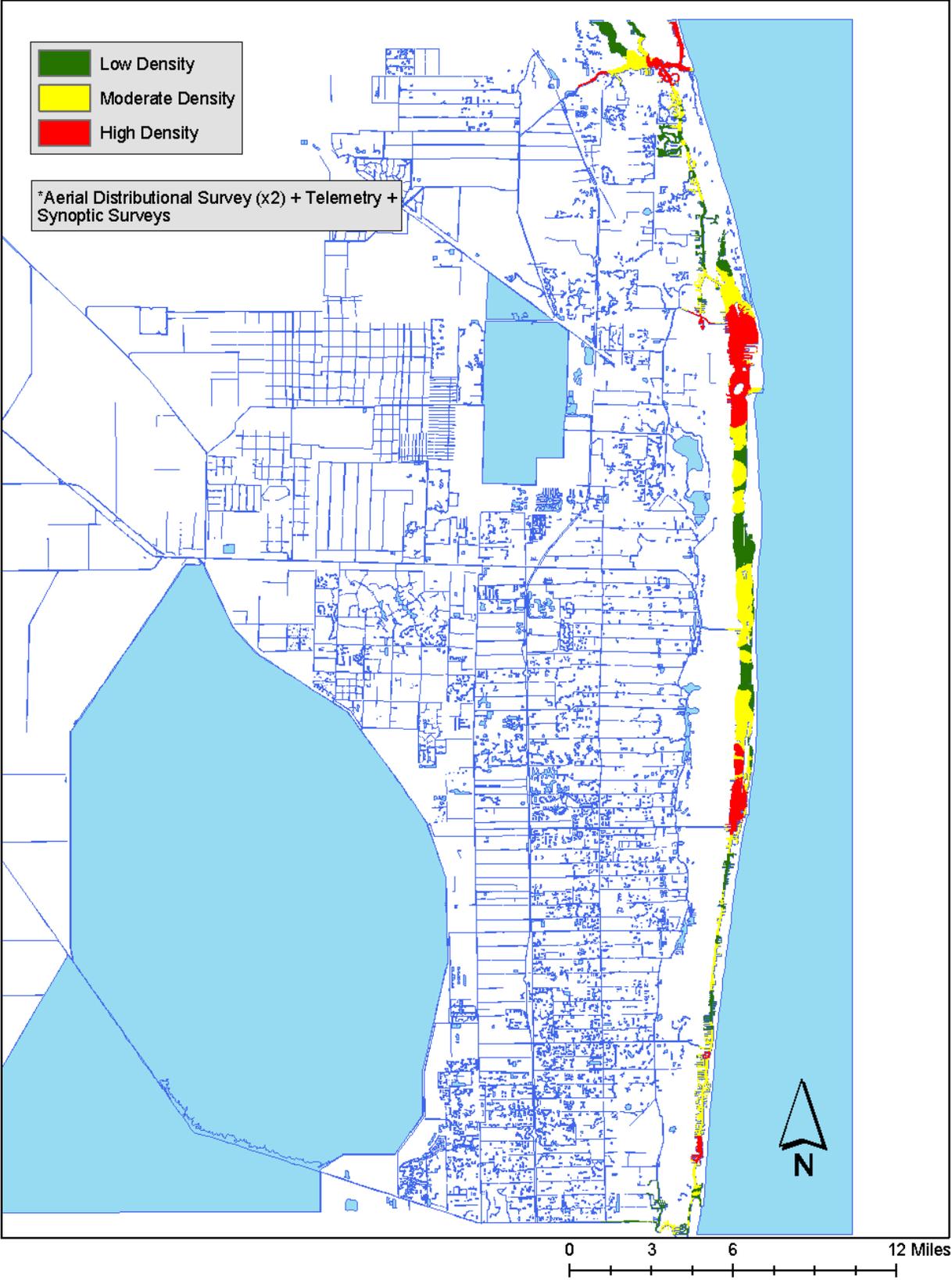
Data Sources: Fish and Wildlife Research Institute (www.floridamarine.org)
 Palm Beach County (www.co.palm-beach.fl.us)
 Map created January 2005 by CUES (www.cuesfau.org)

Note: This map summarizes individual animal movements over a 12-year radio-telemetry study. The dataset has not been edited to reflect adjustments of points that occur over land. *Points on the map depict locations of radio-tagged West Indian manatees within Palm Beach County.



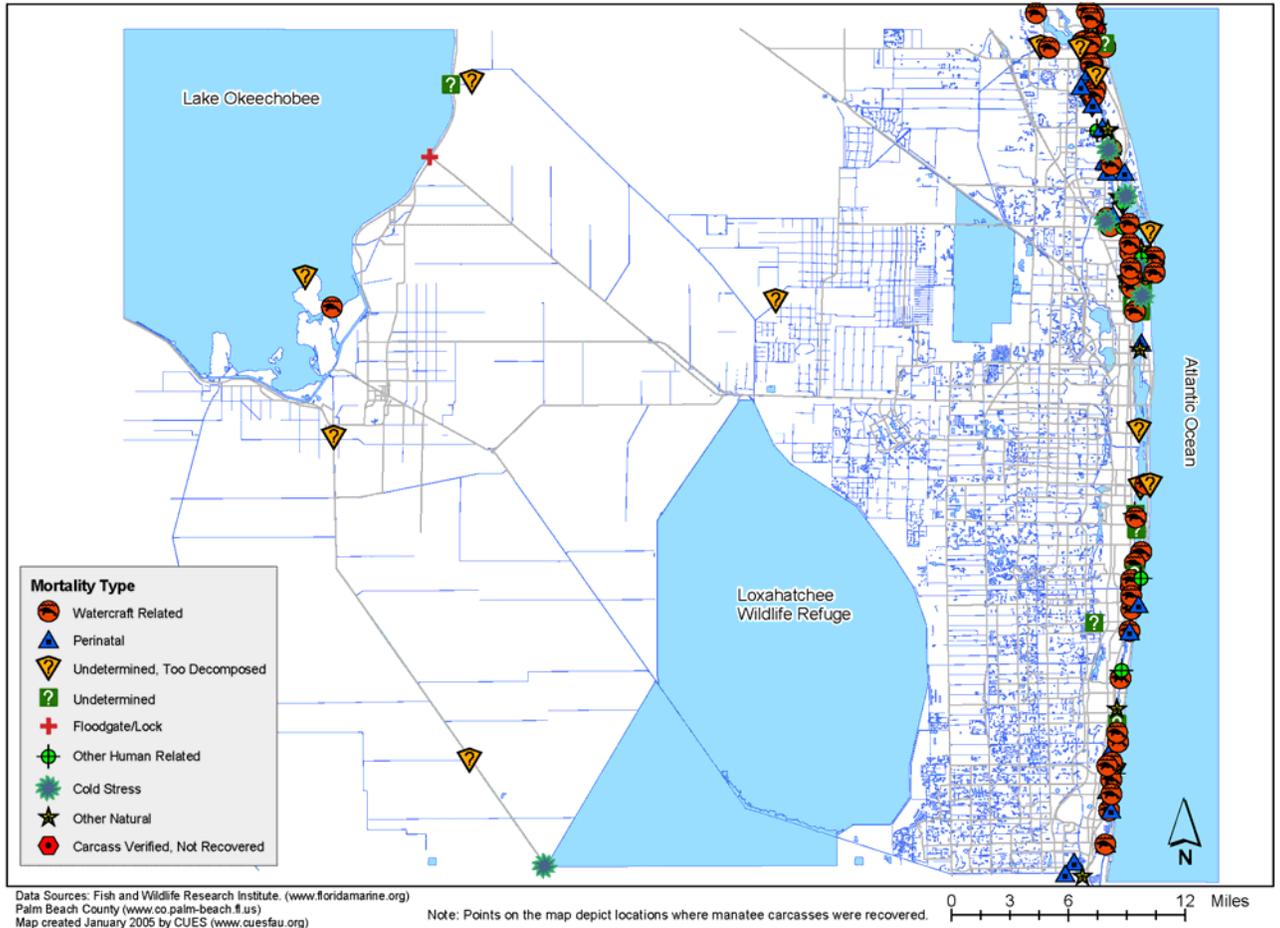
Palm Beach County Manatee Protection Plan

Figure 13. Cumulative Manatee Abundance*



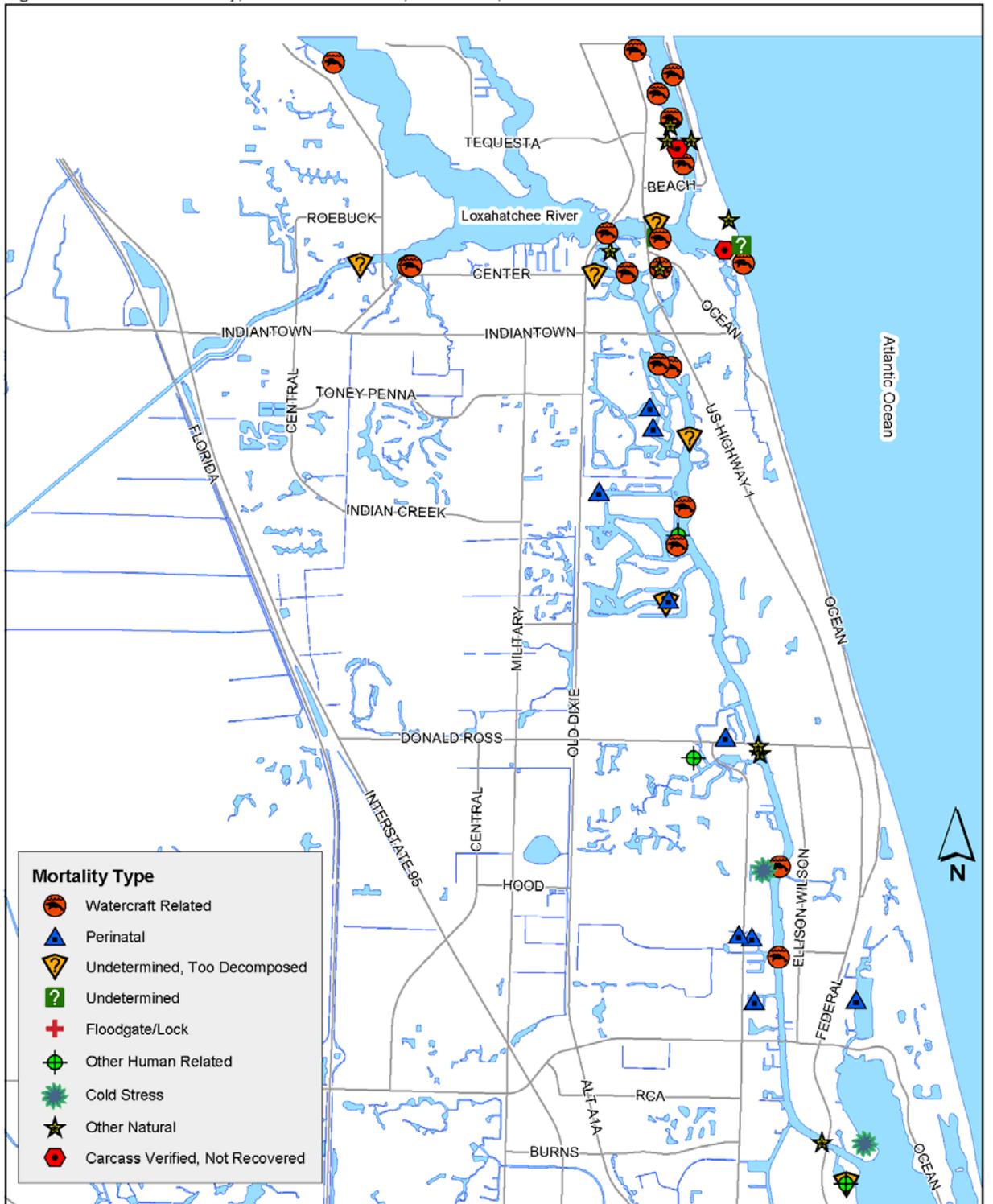
Palm Beach County Manatee Protection Plan

Figure 16: Manatee Mortality, All Causes of Death, 1976-2003, Countywide



Palm Beach County Manatee Protection Plan

Figure 17a: Manatee Mortality, All Causes of Death, 1976-2003, Palm Beach North



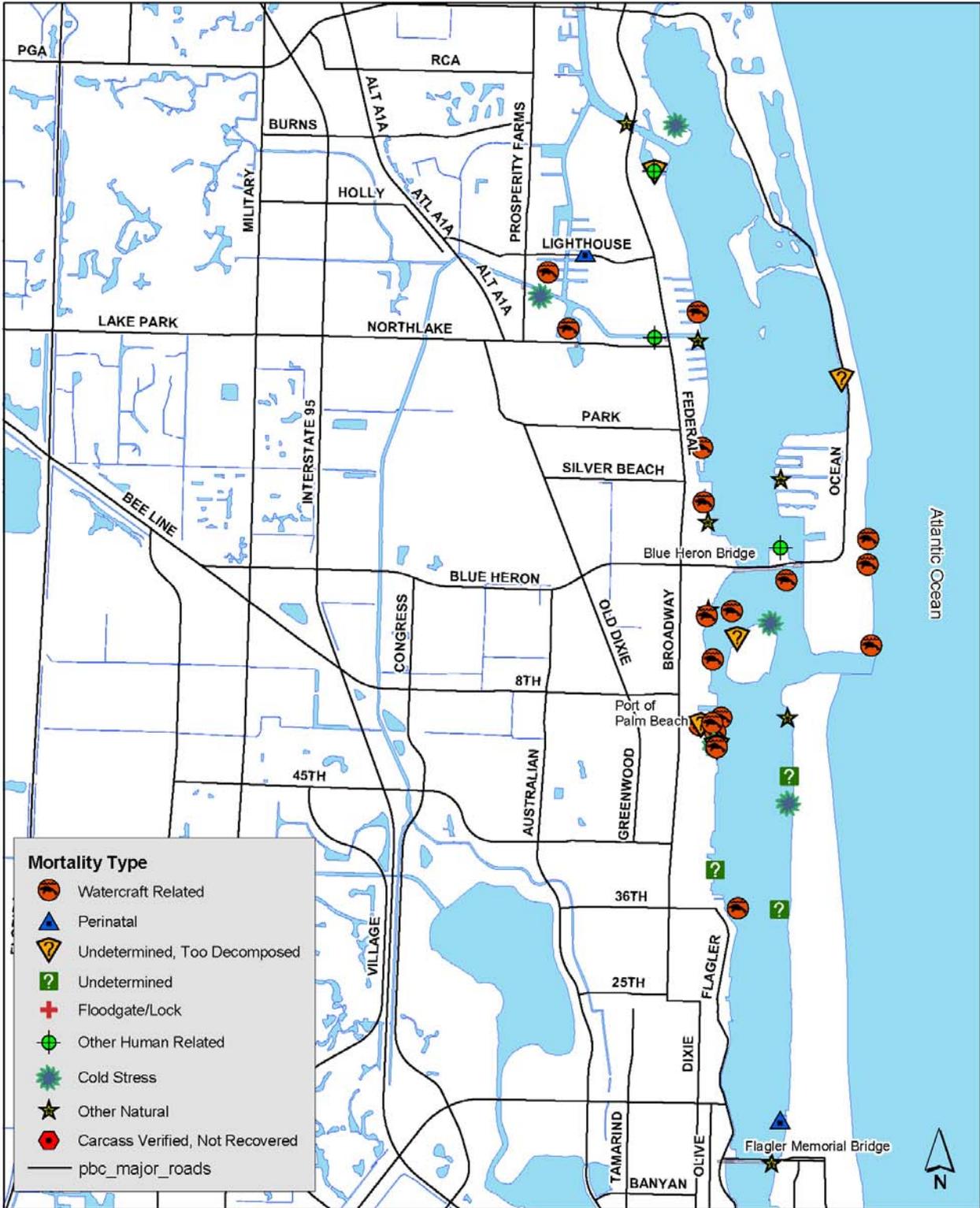
Data Sources: Fish and Wildlife Research Institute. (www.floridamarine.org)
 Palm Beach County (www.co.palm-beach.fl.us)
 Map created September 2004 by CUES (www.cuesfau.org)

Note: Points on the map depict locations where manatee carcasses were recovered.

0 0.5 1 2 Miles

Palm Beach County Manatee Protection Plan

Figure 17b: Manatee Mortality, All Causes of Death, 1976-2003, Lake Worth North



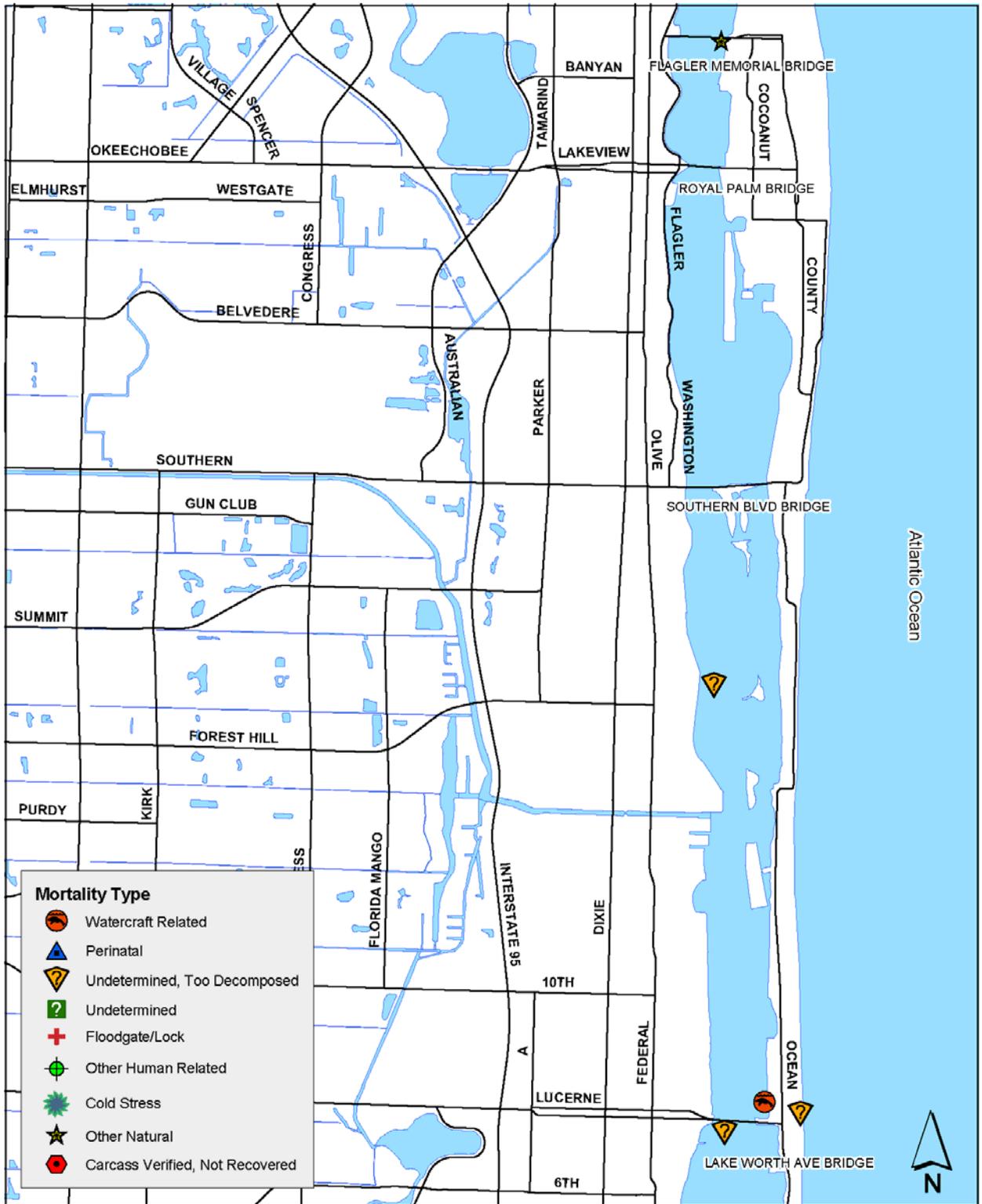
Data Sources: Fish and Wildlife Research Institute. (www.floridamarine.org)
 Palm Beach County (www.co.palm-beach.fl.us)
 Map created September 2004 by CUES (www.cuesfau.org)

Note: Points on the map depict locations where manatee carcasses were recovered.

0 0.5 1 2 Miles

Palm Beach County Manatee Protection Plan

Figure 17c: Manatee Mortality, All Causes of Death, 1976-2003, Lake Worth Central



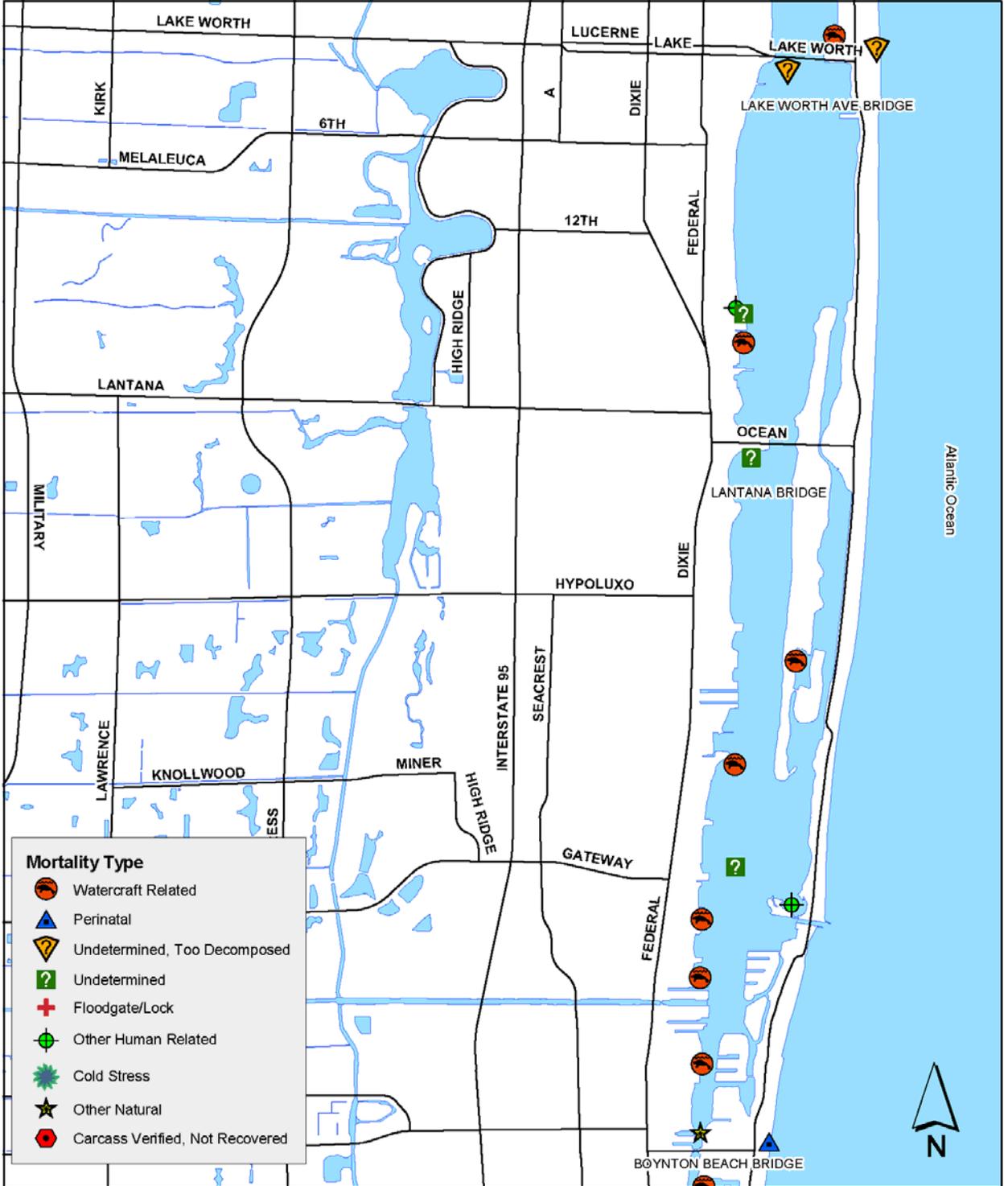
Data Sources: Fish and Wildlife Research Institute. (www.floridamarine.org)
 Palm Beach County (www.co.palm-beach.fl.us)
 Map created September 2004 by CUES (www.cuesfau.org)

Note: Points on the map depict locations where manatee carcasses were recovered.

0 0.4 0.8 1.6 Miles

Palm Beach County Manatee Protection Plan

Figure 17d: Manatee Mortality, All Causes of Death, 1976-2003, Lake Worth South



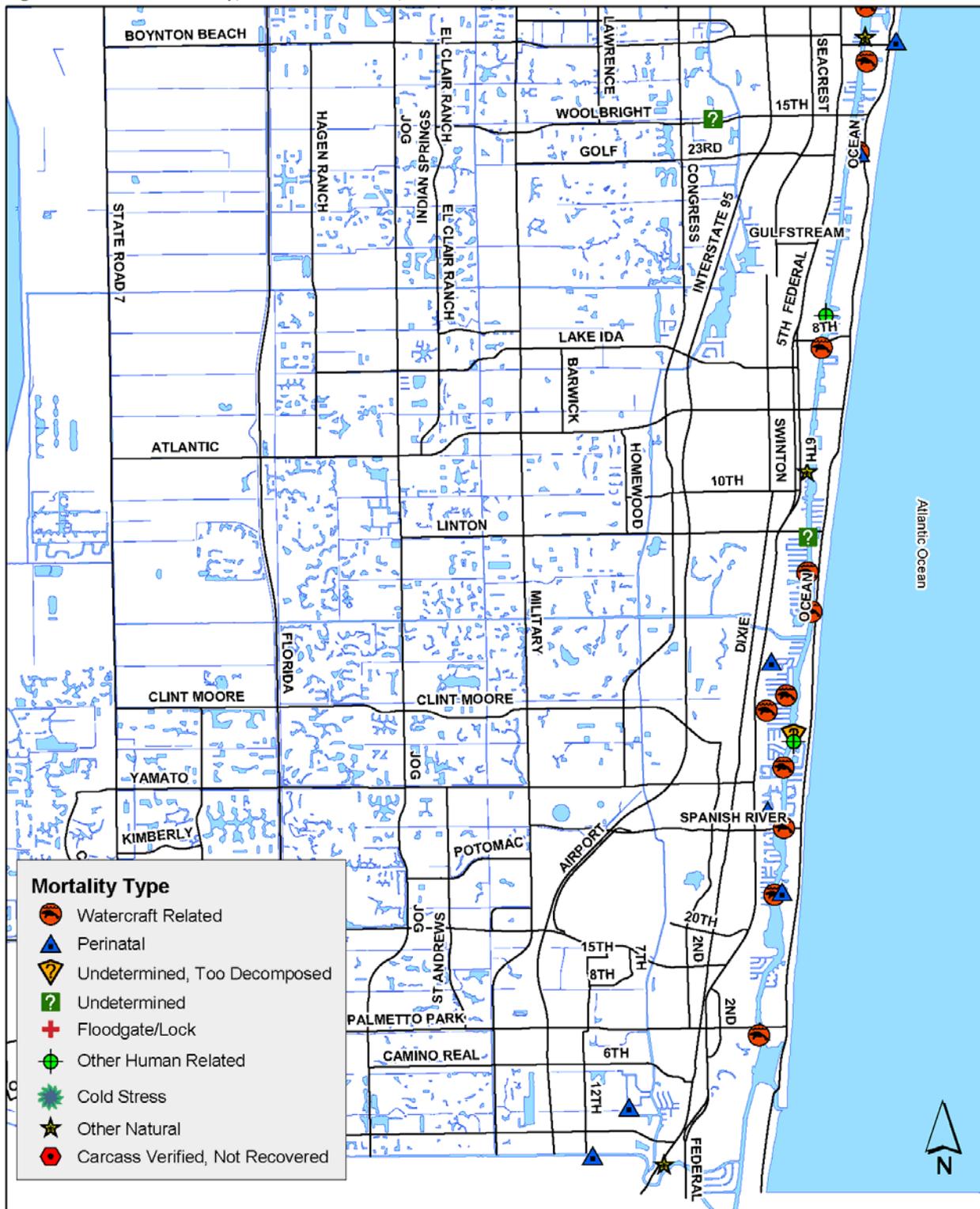
Data Sources: Fish and Wildlife Research Institute. (www.floridamarine.org)
 Palm Beach County (www.co.palm-beach.fl.us)
 Map created September 2004 by CUES (www.cuesfau.org)

Note: Points on the map depict locations where manatee carcasses were recovered.

0 0.25 0.5 1 Miles

Palm Beach County Manatee Protection Plan

Figure 17e: Manatee Mortality, All Causes of Death, 1976-2003, Palm Beach South



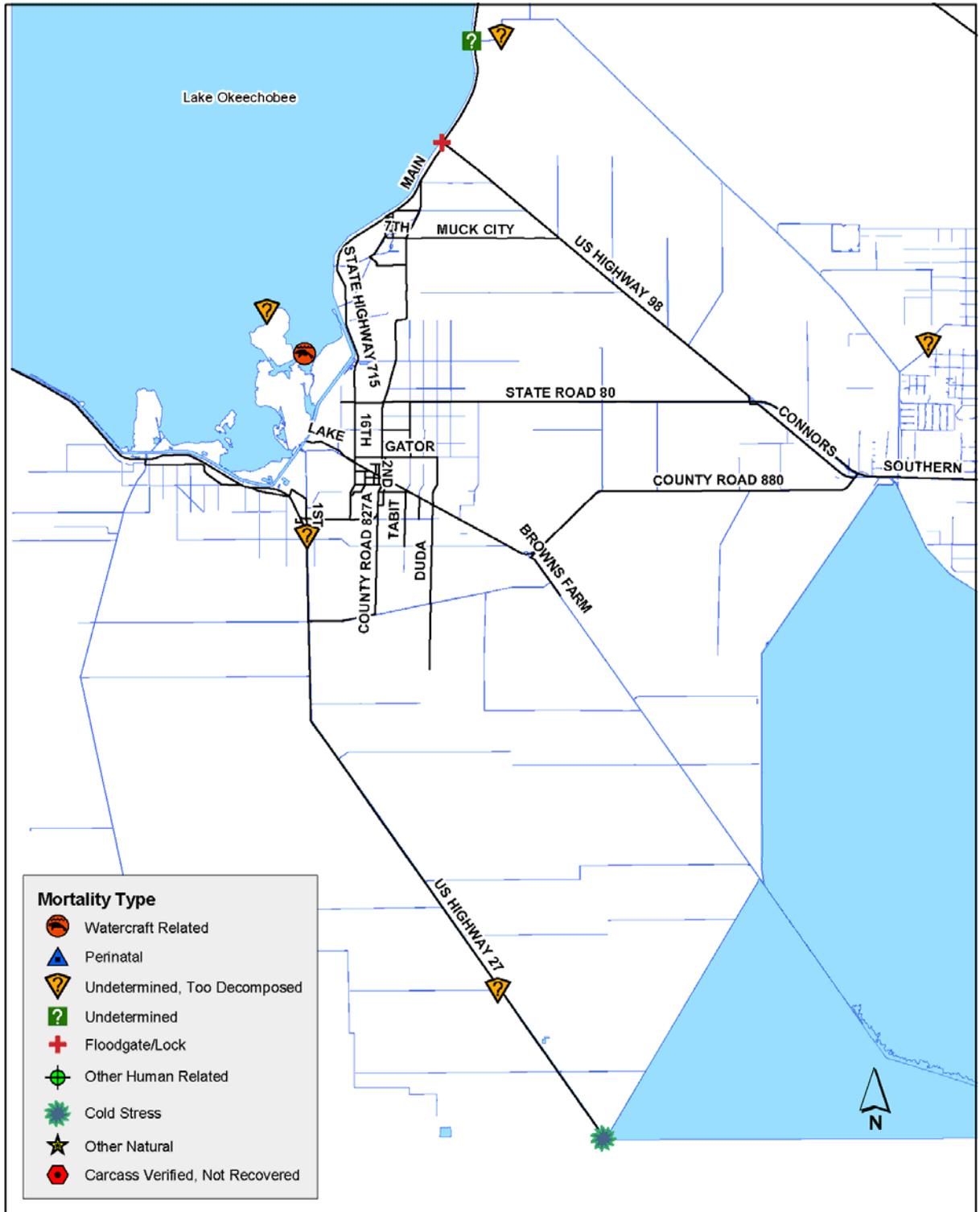
Data Sources: Fish and Wildlife Research Institute. (www.floridamarine.org)
 Palm Beach County (www.co.palm-beach.fl.us)
 Map created September 2004 by CUJES (www.cuesfau.org)

Note: Points on the map depict locations where manatee carcasses were recovered.

0 0.5 1 2 Miles

Palm Beach County Manatee Protection Plan

Figure 17f: Manatee Mortality, All Causes of Death, 1976-2003, Palm Beach West

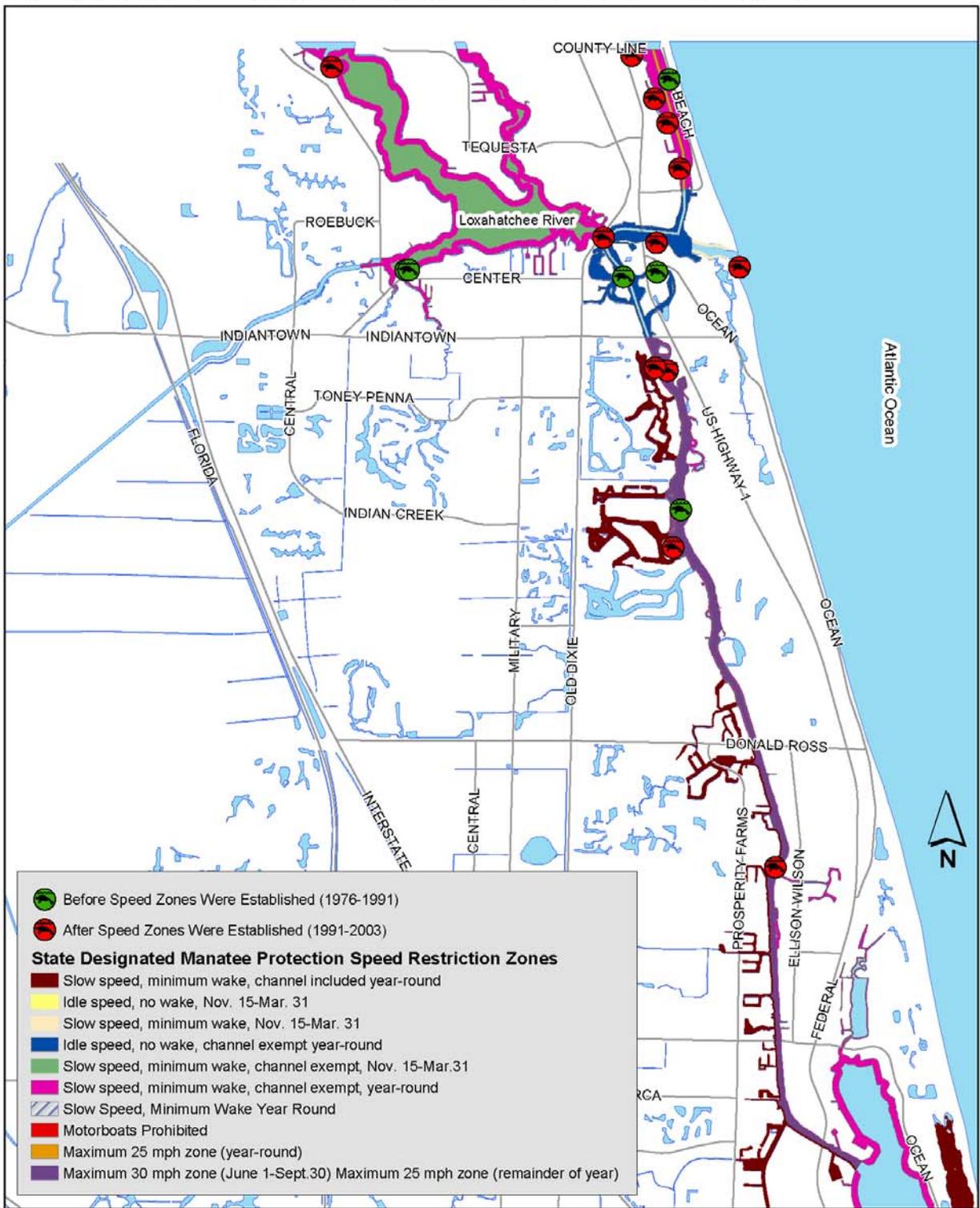


Data Sources: Fish and Wildlife Research Institute. (www.floridamarine.org) Note: Points on the map depict locations where manatee carcasses were recovered.
 Palm Beach County (www.co.palm-beach.fl.us)
 Map created September 2004 by CUES (www.cuesfau.org)

0 2 4 8 Miles

Palm Beach County Manatee Protection Plan

Figure 19a: Watercraft Related Deaths, Before and After Speed Zones were Enacted, Palm Beach North



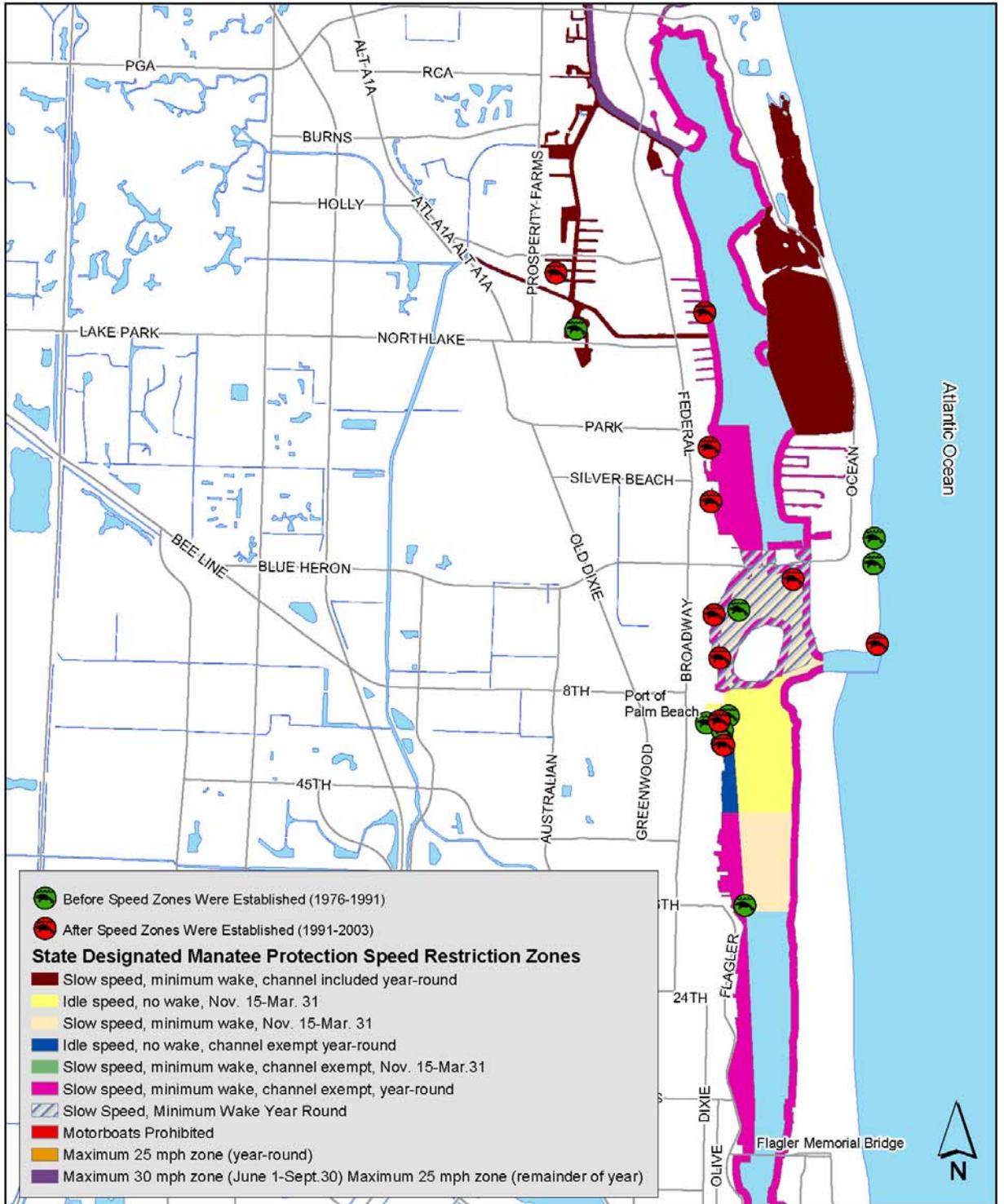
Data Sources: Fish and Wildlife Research Institute. (www.floridamarine.org)
 Palm Beach County (www.co.palm-beach.fl.us)
 Map created December 2004 by CUES (www.cuesfau.org)

Note: Points on the map depict locations where manatee carcasses were recovered.
 Pre-State Designated Manatee Protection Speed Restriction Zones covers 1976-1990
 Post Zones 1991-2003

0 0.5 1 2 Miles

Palm Beach County Manatee Protection Plan

Figure 19b. Watercraft Related Deaths, Before and After Speed Zones were Enacted, Lake Worth North



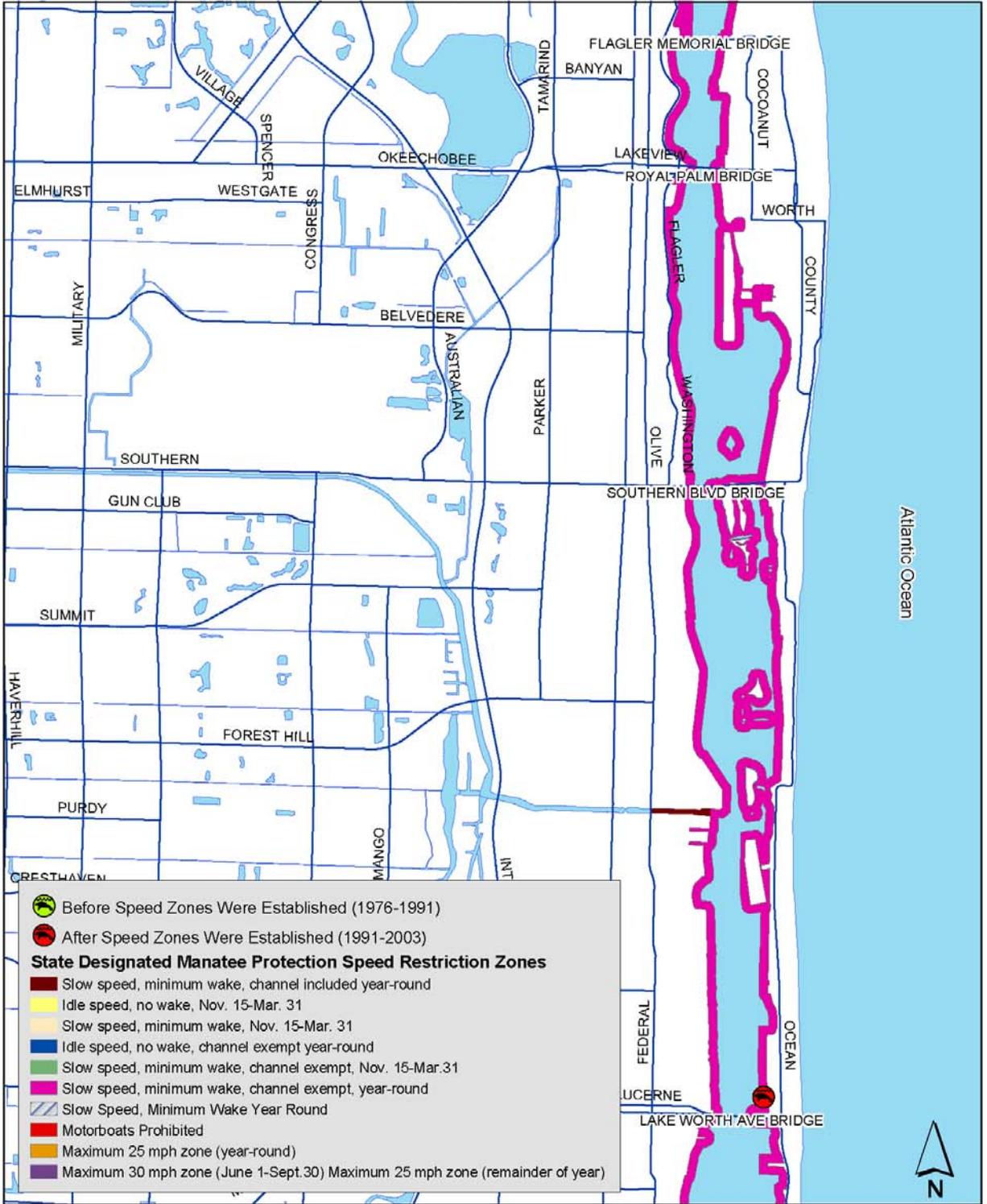
Data Sources: Fish and Wildlife Research Institute. (www.floridamarine.org)
 Palm Beach County (www.co.palm-beach.fl.us)
 Map created December 2004 by CUES (www.cuesfau.org)

Note: Points on the map depict locations where manatee carcasses were recovered.
 Pre-State Designated Manatee Protection Speed Restriction Zones covers 1976-1990
 Post Zones 1991-2003

0 0.375 0.75 1.5 Miles

Palm Beach County Manatee Protection Plan

Figure 19c: Watercraft Related Deaths, Before and After Speed Zones were Enacted, Lake Worth Central



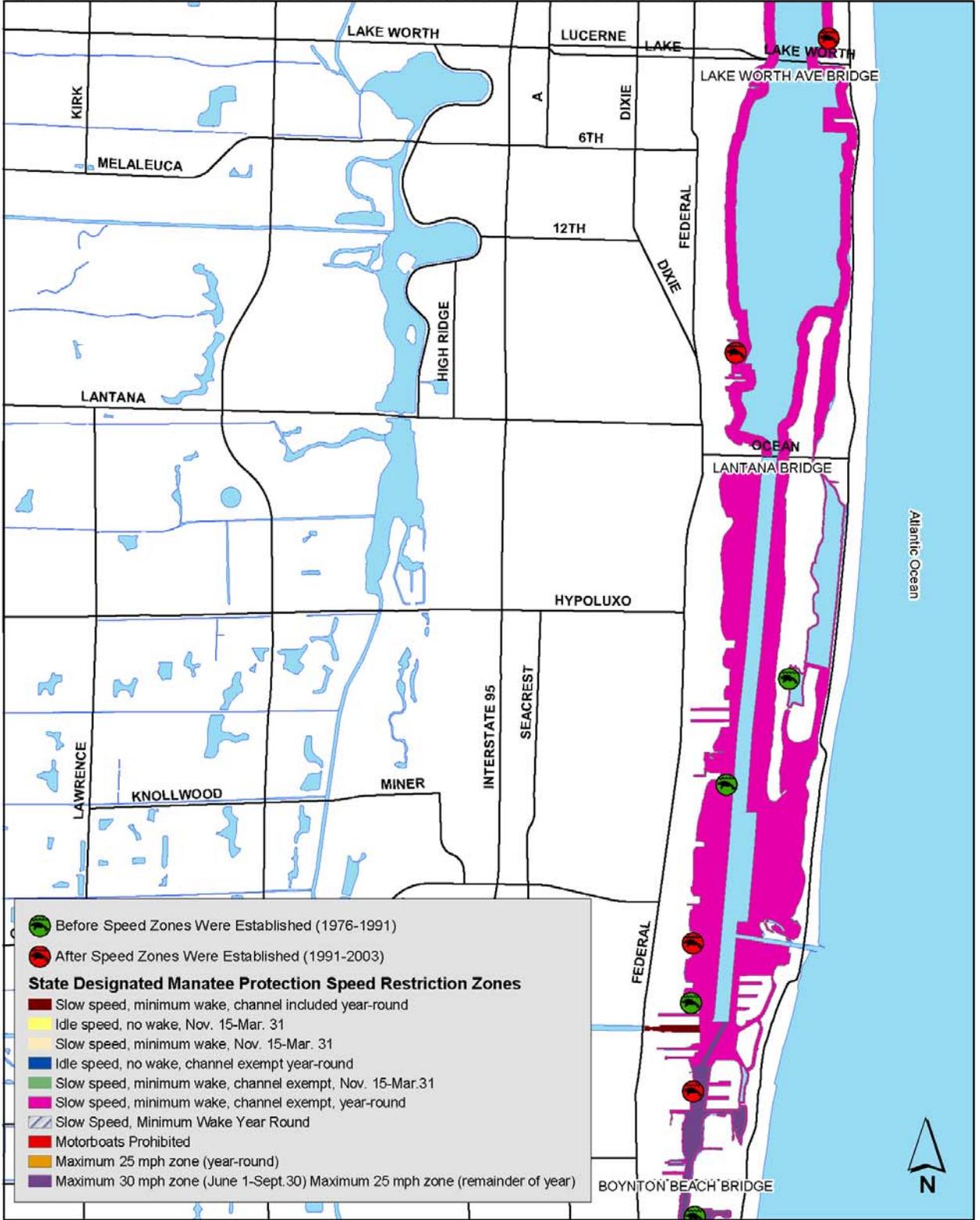
Data Sources: Fish and Wildlife Research Institute. (www.floridamarine.org)
 Palm Beach County (www.co.palm-beach.fl.us)
 Map created December 2004 by CUJES (www.cuesfau.org)

Note: Points on the map depict locations where manatee carcasses were recovered.
 Pre-State Designated Manatee Protection Speed Restriction Zones covers 1976-1990
 Post Zones 1991-2003

0 0.45 0.9 1.8 Miles

Palm Beach County Manatee Protection Plan

Figure 19d: Watercraft Related Deaths, Before and After speed Zones were Enacted, Lake Worth South



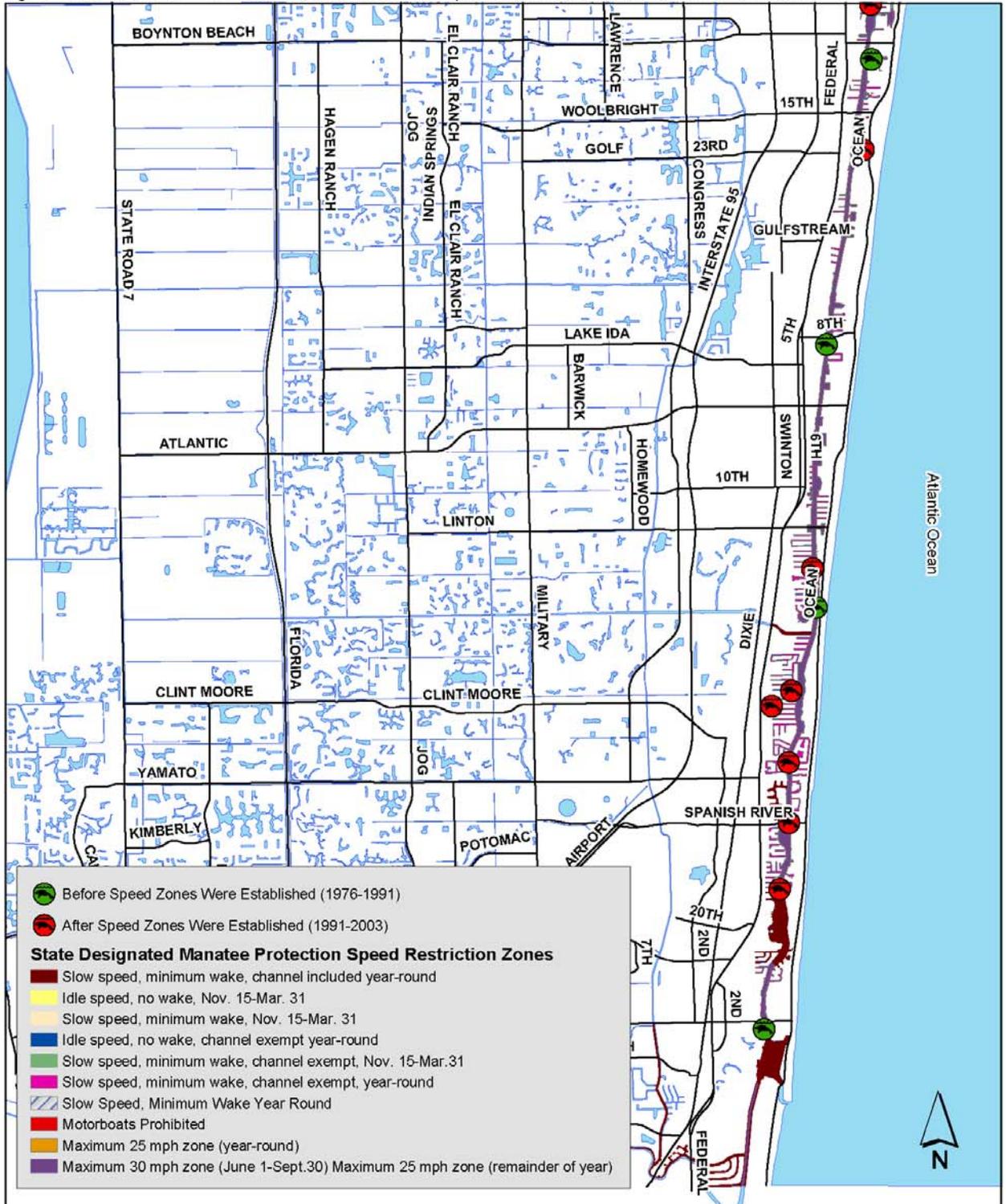
Data Sources: Fish and Wildlife Research Institute. (www.floridamarine.org)
 Palm Beach County (www.co.palm-beach.fl.us)
 Map created December 2004 by CUES (www.cuesfau.org)

Note: Points on the map depict locations where manatee carcasses were recovered.
 Pre-State Designated Manatee Protection Speed Restriction Zones covers 1976-1990
 Post Zones 1991-2003

0 0.5 1 2 Miles

Palm Beach County Manatee Protection Plan

Figure 19e: Watercraft Related Deaths, Before and After speed Zones were Enacted, Palm Beach South



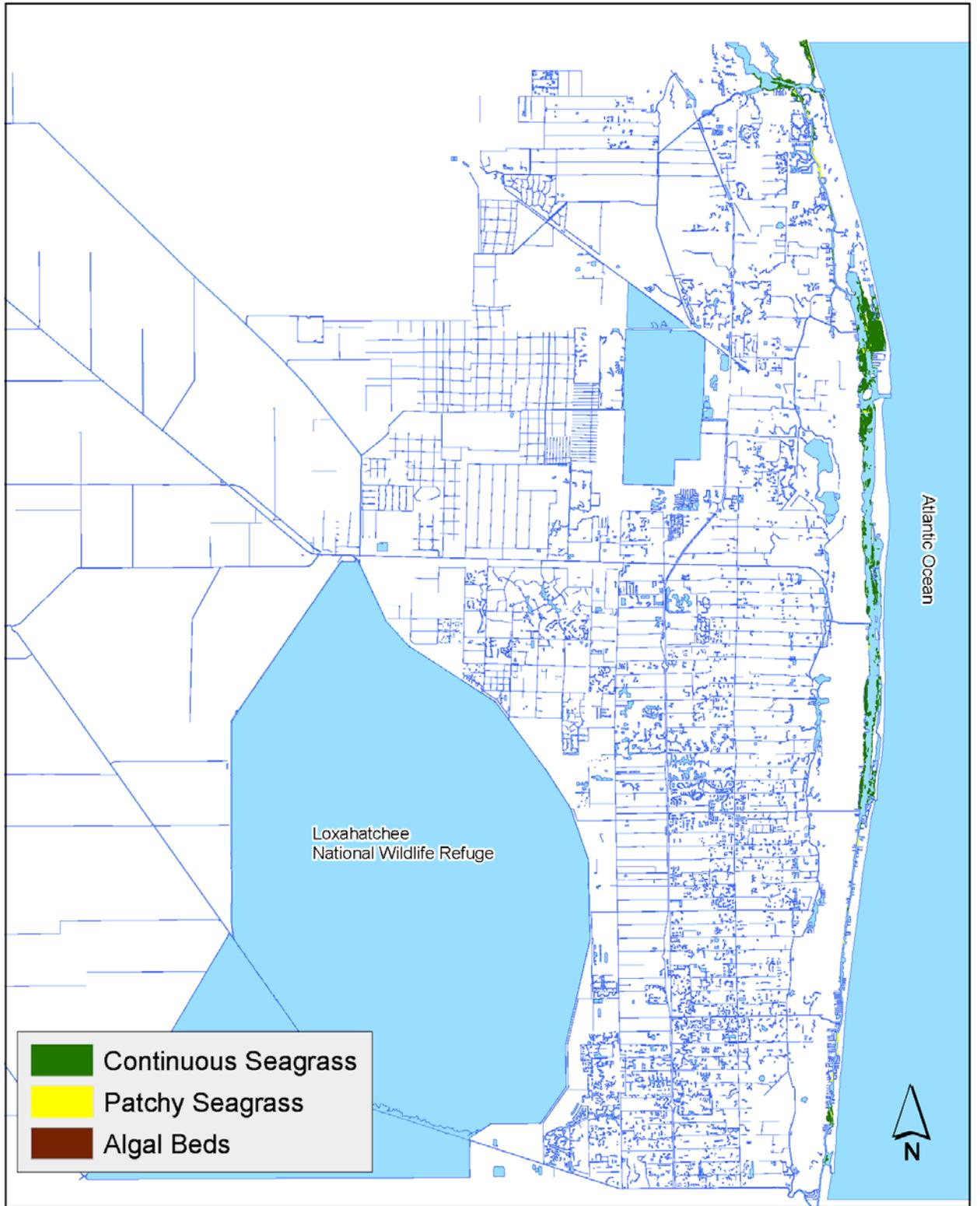
Data Sources: Fish and Wildlife Research Institute. (www.floridamarine.org)
 Palm Beach County (www.co.palm-beach.fl.us)
 Map created December 2004 by CUJES (www.cuesfau.org)

Note: Points on the map depict locations where manatee carcasses were recovered.
 Pre-State Designated Manatee Protection Speed Restriction Zones covers 1976-1990
 Post Zones 1991-2003

0 0.45 0.9 1.8 Miles

Palm Beach County Manatee Protection Plan

Figure 21: Palm Beach County Seagrass

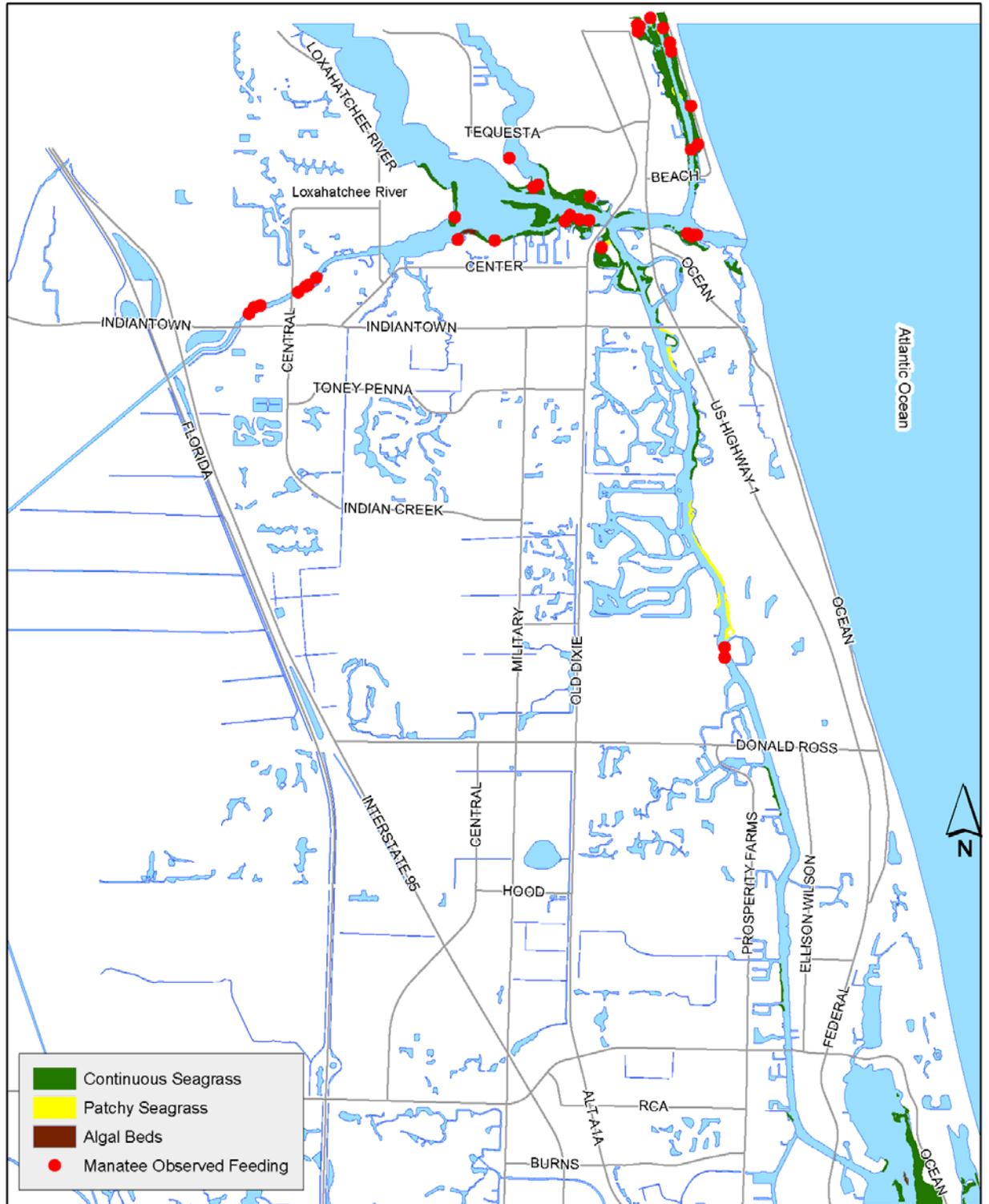


Data Sources: Fish and Wildlife Research Institute. (www.floridamarine.org)
Palm Beach County (www.co.palm-beach.fl.us)
Map created January 2005 by CUES (www.cuesfau.org)

0 3.75 7.5 15 Miles

Palm Beach County Manatee Protection Plan

Figure 22a: Seagrass Feeding, Palm Beach North

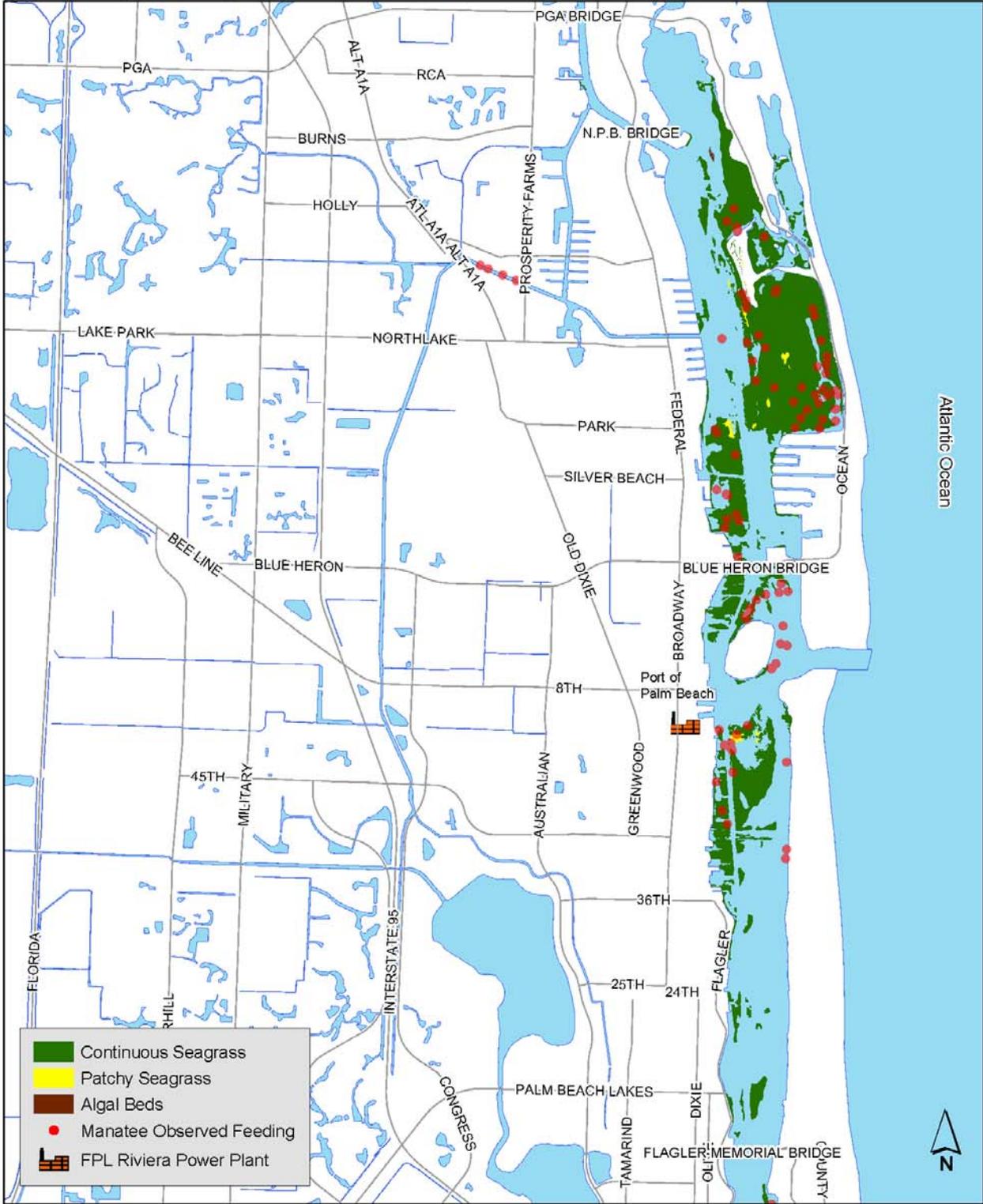


Data Sources: Fish and Wildlife Research Institute. (www.floridamarine.org)
 Palm Beach County (www.co.palm-beach.fl.us)
 Map created September 2004 by CUES (www.cuesfau.org)

0 0.5 1 2 Miles

Palm Beach County Manatee Protection Plan

Figure 22b: Seagrass Feeding, Lake Worth North

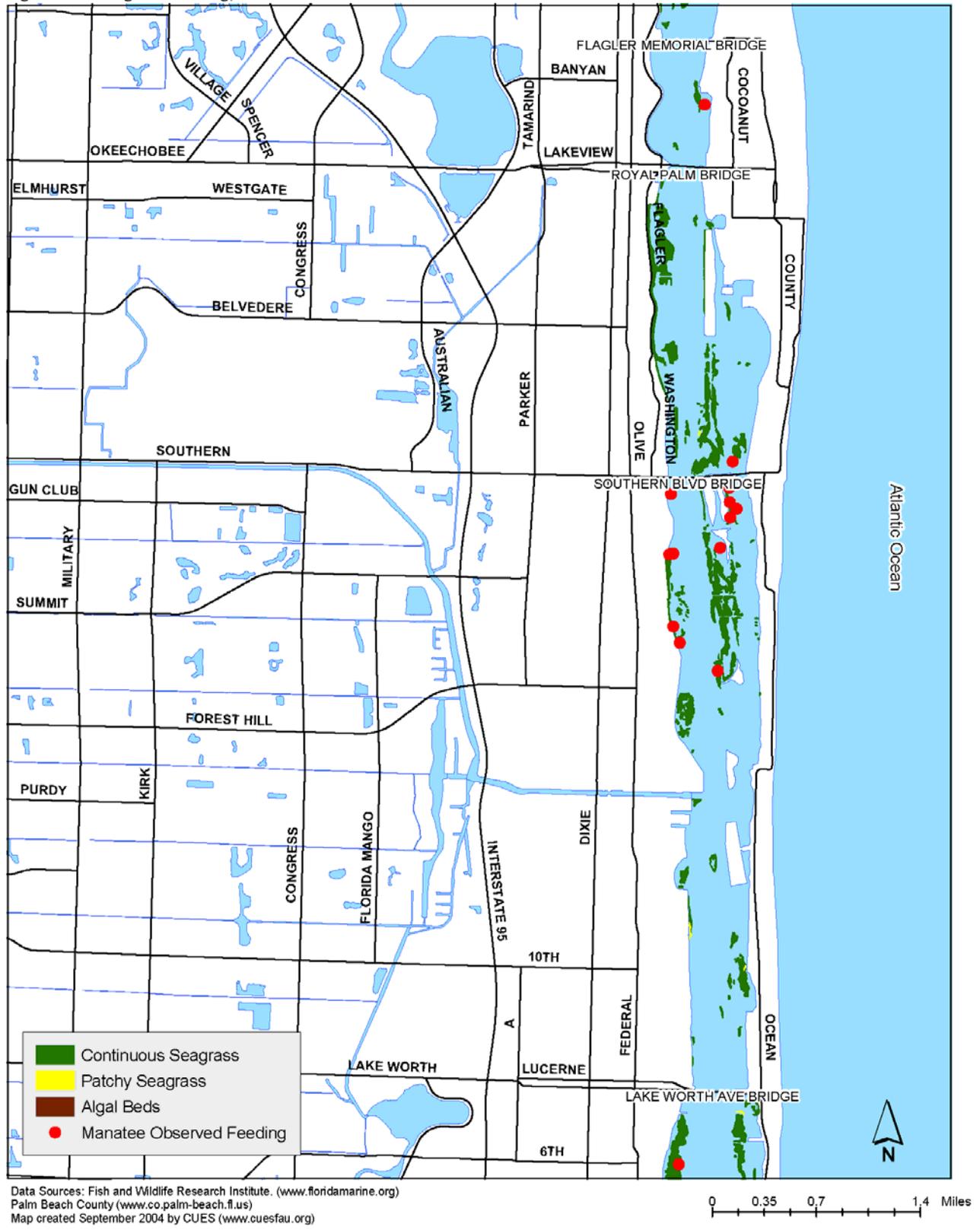


Data Sources: Fish and Wildlife Research Institute (www.floridamanatee.org)
 Palm Beach County (www.co.palm-beach.fl.us)
 Map created September 2004 by CUES (www.cuesfau.org)

0 0.3 0.6 1.2 Miles

Palm Beach County Manatee Protection Plan

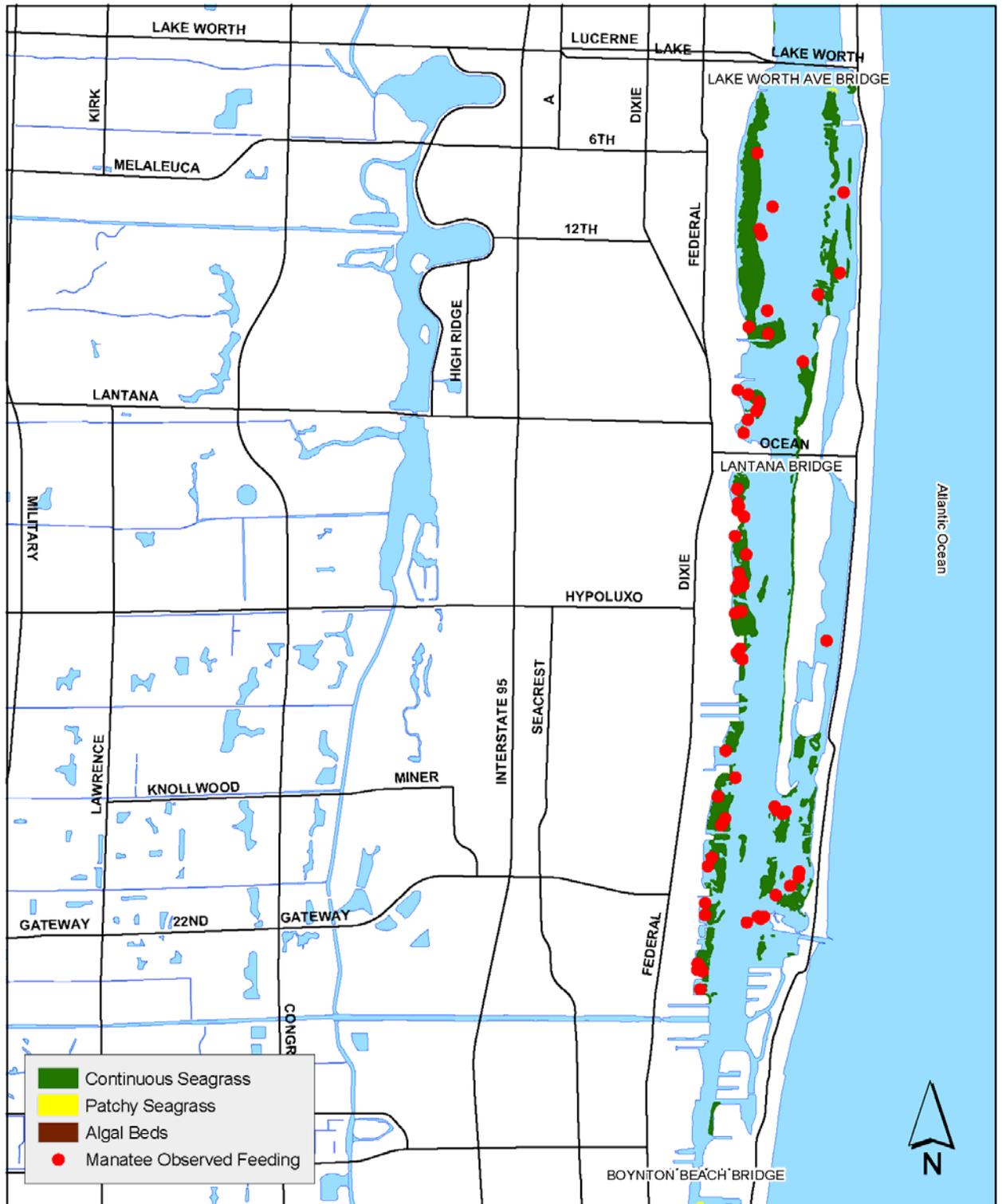
Figure 22c: Seagrass Feeding, Lake Worth Central



Data Sources: Fish and Wildlife Research Institute. (www.floridamarine.org)
 Palm Beach County (www.co.palm-beach.fl.us)
 Map created September 2004 by CUES (www.cuesfau.org)

Palm Beach County Manatee Protection Plan

Figure 22d: Seagrass Feeding, Lake Worth South

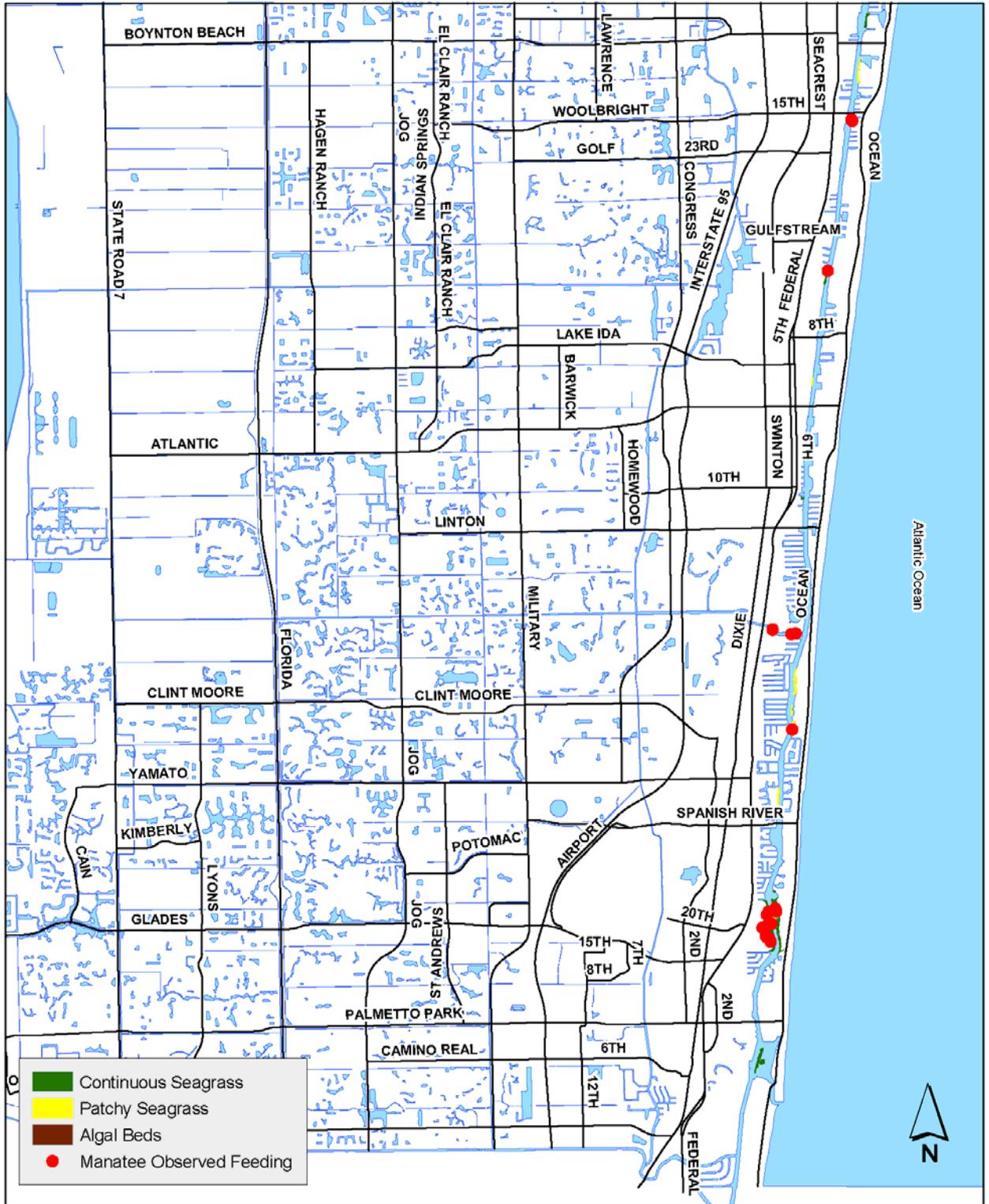


Data Sources: Fish and Wildlife Research Institute. (www.floridamarine.org)
 Palm Beach County (www.co.palm-beach.fl.us)
 Map created September 2004 by CUES (www.cuesfau.org)

0 0.45 0.9 1.8 Miles

Palm Beach County Manatee Protection Plan

Figure 22e: Seagrass Feeding, Palm Beach South

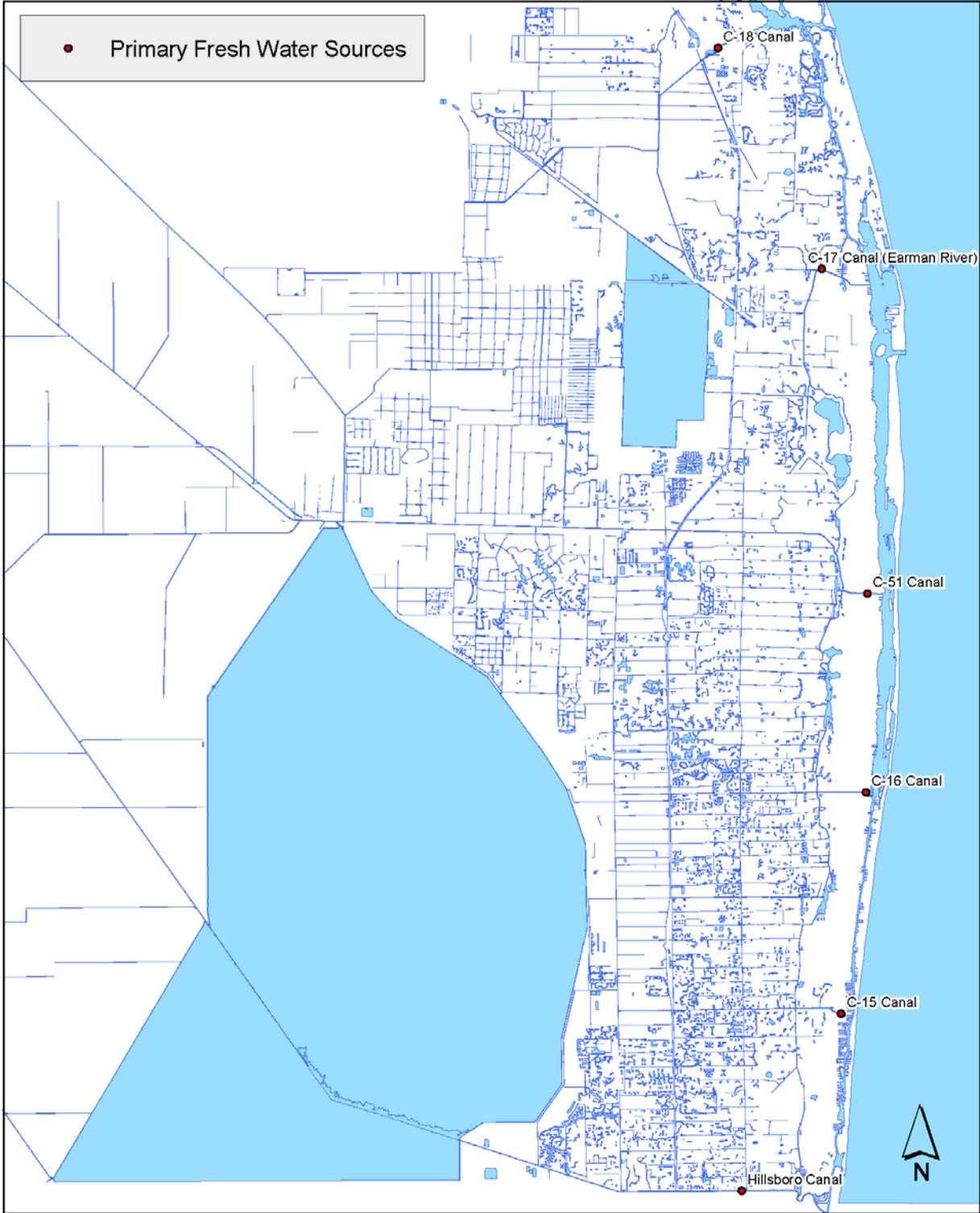


Data Sources: Fish and Wildlife Research Institute. (www.floridamarine.org)
 Palm Beach County (www.co.palm-beach.fl.us)
 Map created September 2004 by CUES (www.cuesfau.org)

0 1.25 2.5 5 Miles

Palm Beach County Manatee Protection Plan

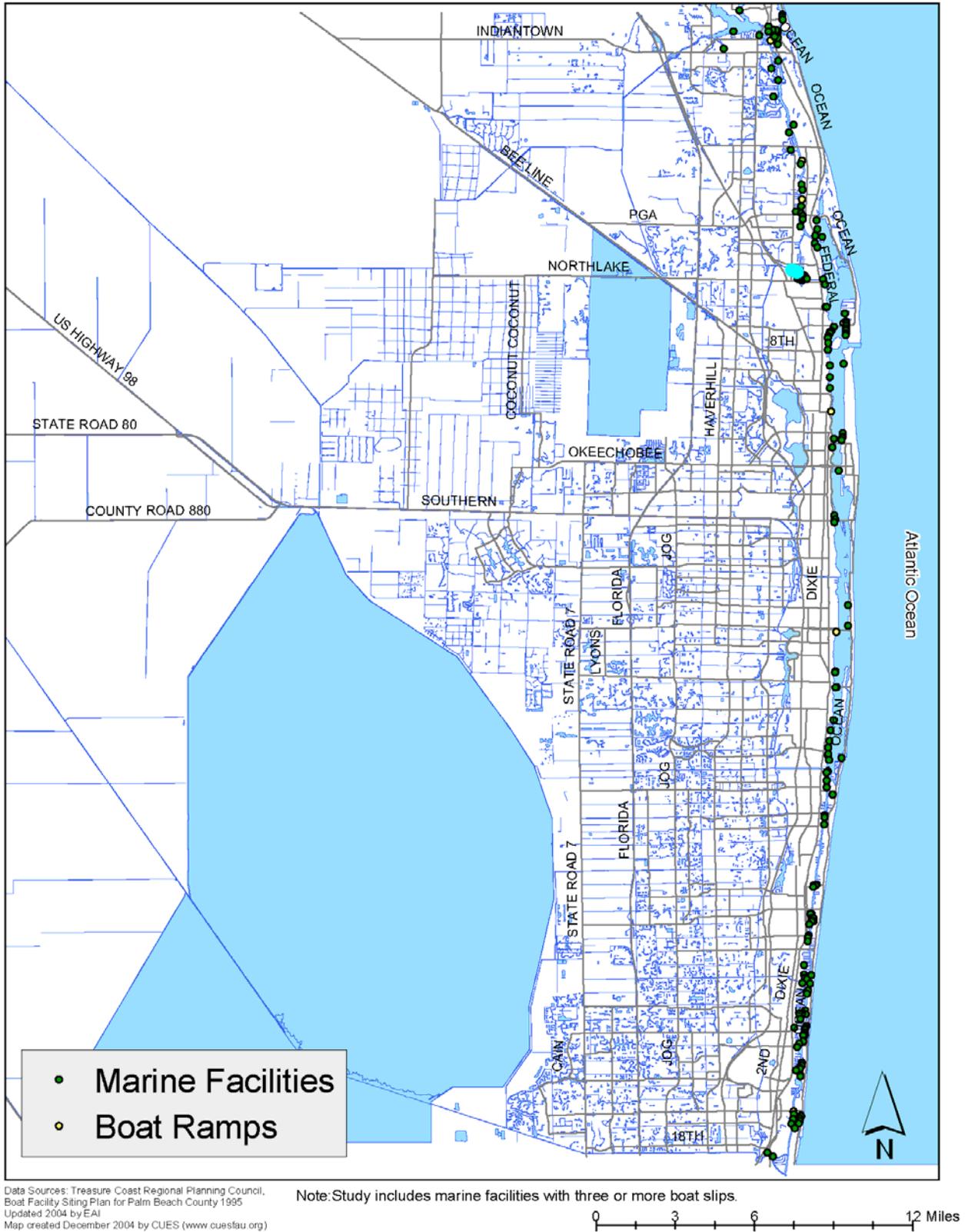
Figure 23: Palm Beach County Fresh Water Sources



Data Sources: Maps and files created by CUES (www.cuesfau.org) and EAI January 2005

Palm Beach County Manatee Protection Plan

Figure 24: Palm Beach County Marine Facilities and Ramps 2004, Countywide

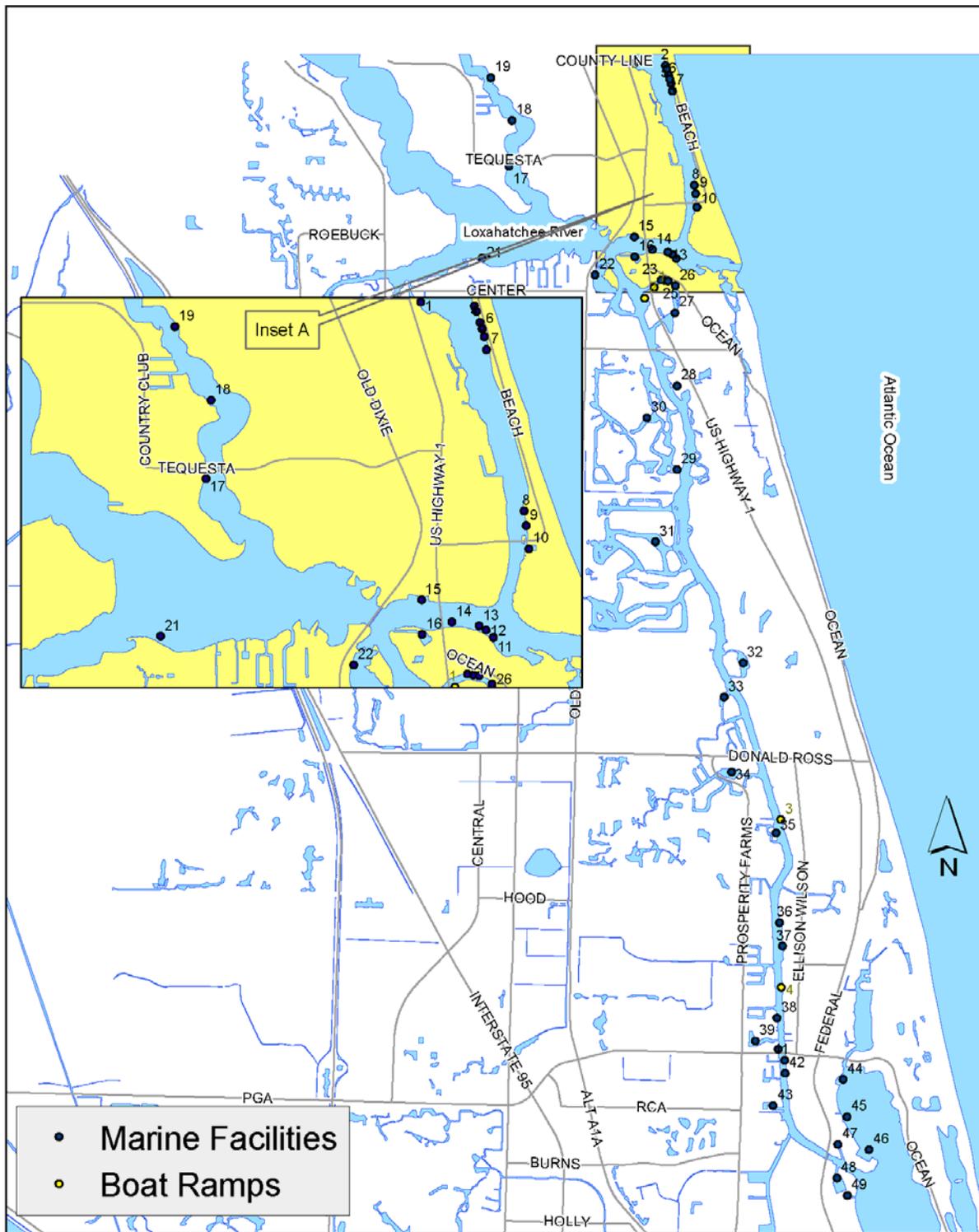


Data Sources: Treasure Coast Regional Planning Council, Boat Facility Siting Plan for Palm Beach County 1995, Updated 2004 by EAI, Map created December 2004 by CUES (www.cuesau.org)

Note: Study includes marine facilities with three or more boat slips.

Palm Beach County Manatee Protection Plan

Figure 25a: Palm Beach County Marine Facilities and Ramps 2004, Palm Beach North



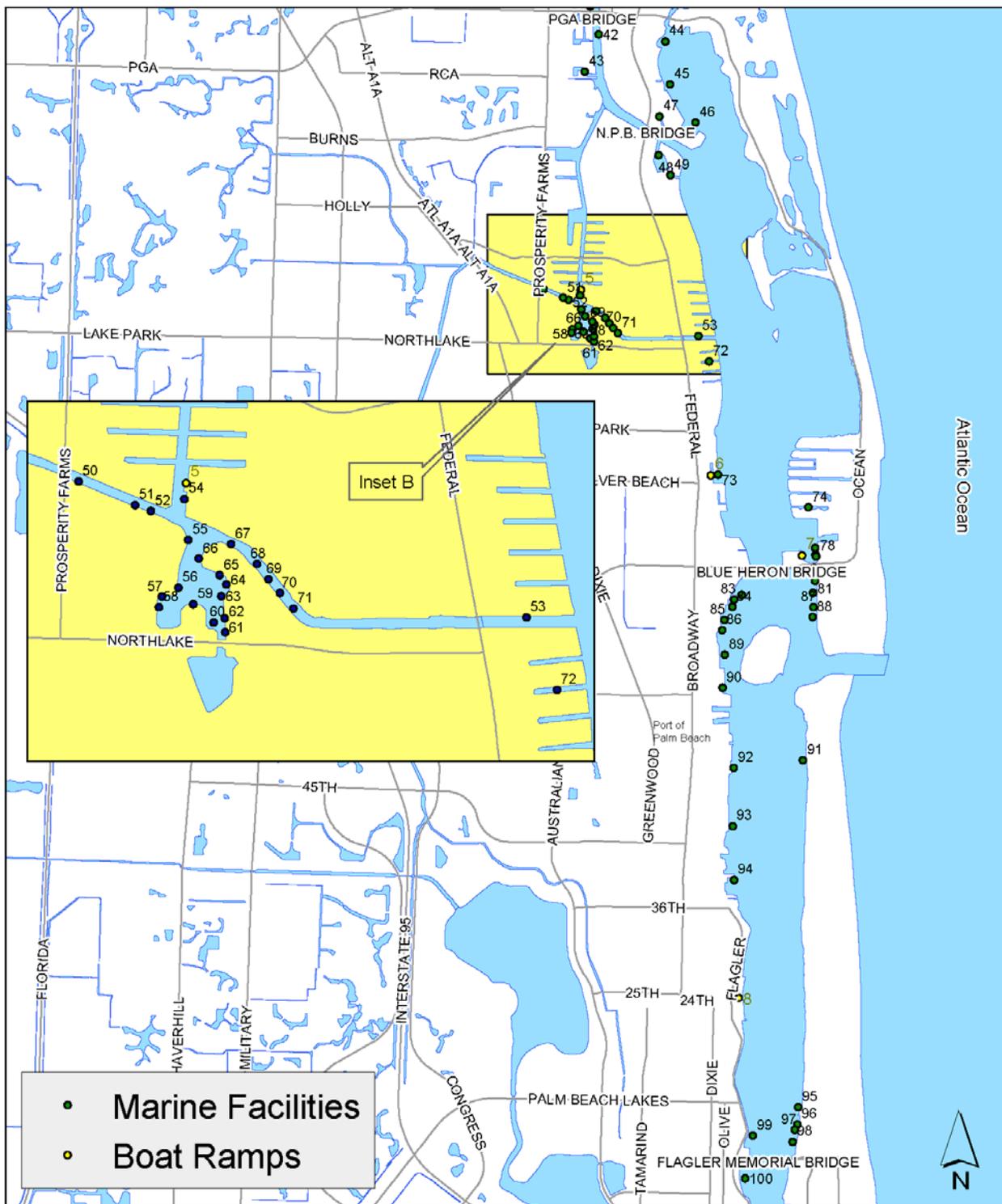
Data Sources: Treasure Coast Regional Planning Council,
Boat Facility Siting Plan for Palm Beach County 1995
Updated 2004 by EAI
Map created December 2004 by CUES (www.cuesfau.org)

Note: Study includes marine facilities with three or more boat slips.

0 0.5 1 2 Miles

Palm Beach County Manatee Protection Plan

Figure 25b: Palm Beach County Marine Facilities and Ramps 2004, Lake Worth North



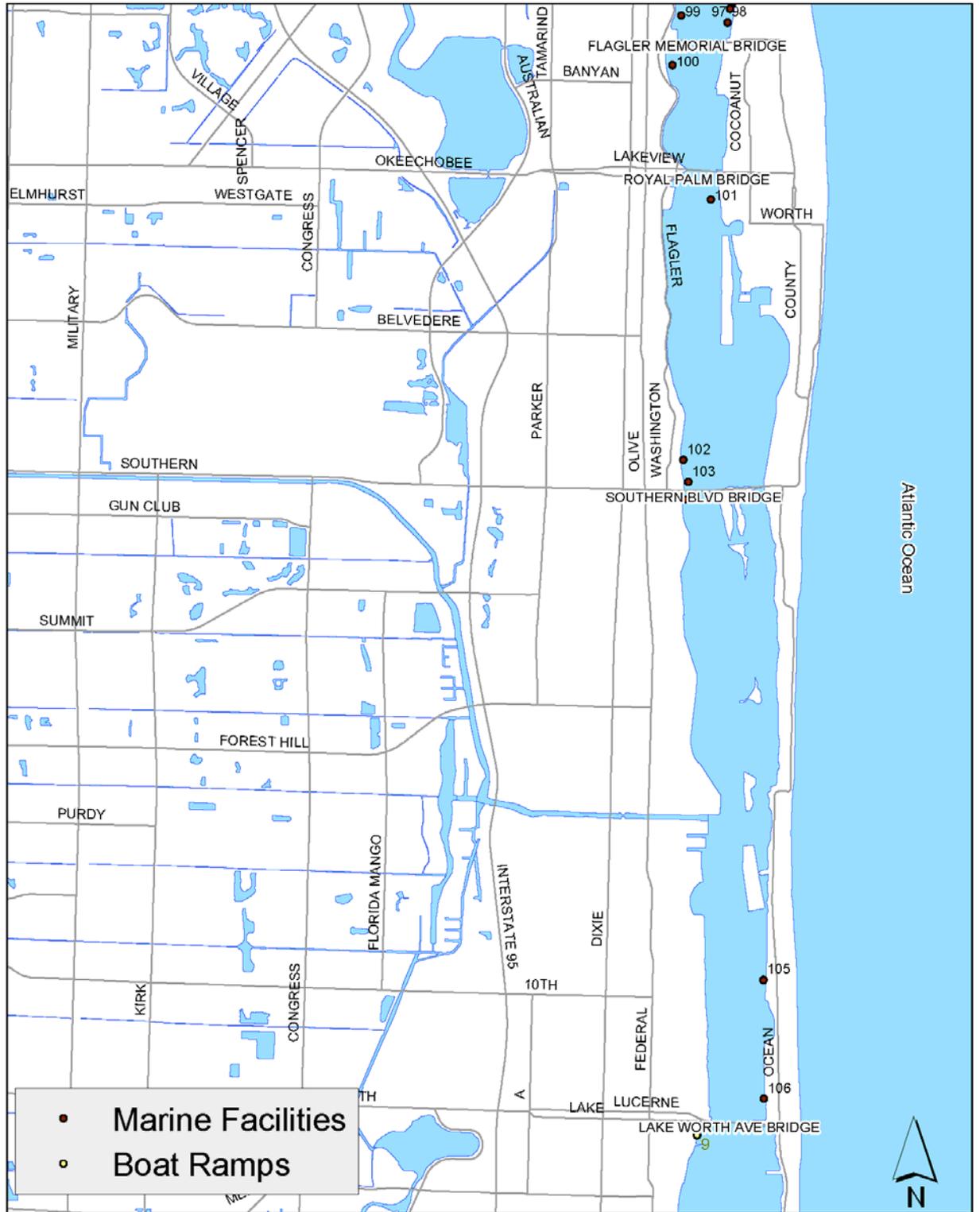
Data Sources: Treasure Coast Regional Planning Council, Boat Facility Siting Plan for Palm Beach County 1995 Updated 2004 by EAI Map created December 2004 by CUES (www.cuesfau.org)

Note: Study includes marine facilities with three or more boat slips.

0 0.5 1 2 Miles

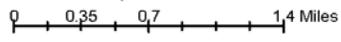
Palm Beach County Manatee Protection Plan

Figure 25c: Palm Beach County Marine Facilities and Ramps 2004, Lake Worth Central



Data Sources: Treasure Coast Regional Planning Council, Boat Facility Siting Plan for Palm Beach County 1995 Updated 2004 by EAI, Map created December 2004 by CUES (www.cuesfau.org)

Note: Study includes marine facilities with three or more boat slips.



Palm Beach County Manatee Protection Plan

Figure 25d: Palm Beach County Marine Facilities and Ramps 2004, Lake Worth South



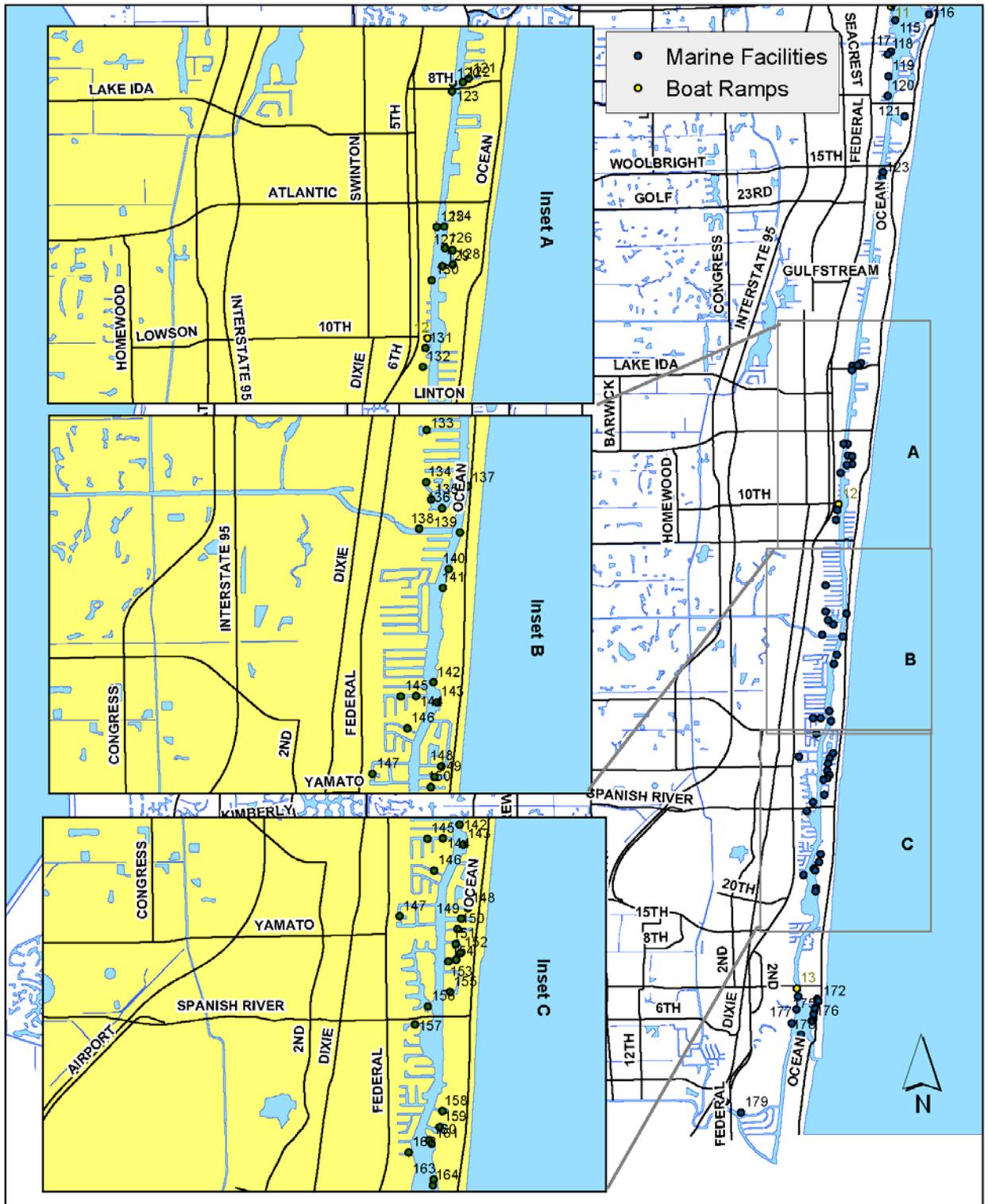
Data Sources: Treasure Coast Regional Planning Council,
 Boat Facility Siting Plan for Palm Beach County 1995 Updated 2004 by EAI
 Map created December 2004 by CUES (www.cuesfau.org)

Note: Study includes marine facilities with three or more boat slips.

0 0.2 0.4 0.8 Miles

Palm Beach County Manatee Protection Plan

Figure 25e: Palm Beach County Marine Facilities and Ramps 2004, Palm Beach South



Data Sources: Treasure Coast Regional Planning Council,
 Boat Facility Siting Plan for Palm Beach County 1995 Updated 2004 by EAI
 Map created December 2004 by CUES (www.cuesfau.org)

0 0.5 1 2 Miles

Palm Beach County Manatee Protection Plan

Figure 27: Marina Facilities Spreadsheet 2004

Palm Beach County Marina Facilities

ID	Facility Name	Facility Type	Wet Slips	Dry Slips	Total Slips	Educational Signage	Method	Jurisdiction	Marina Services	Approx.% Powerboats	Peak Occupancy
1	Scrimshaw on the Bay	Private	20	0	20	N	Field	Palm Beach County			
2	Claridge Condominium	Private	6	0	6	N	Field	Palm Beach County			
3	Beach Sound Condominium	Private	4	0	4	N	Field	Palm Beach County			
4	Ocean Sands Condominium	Private	6	0	6	N	Field	Palm Beach County			
5	The Landfall Condominium	Private	6	0	6	N	Field	Palm Beach County			
6	The Passages Condominium	Private	5	0	5	N	Field	Palm Beach County			
7	Carlyle Condominium	Private	6	0	6	N	Field	Palm Beach County			
8	La Mar Condominium	Private	16	0	16	N	Field	Village of Tequesta			
9	Seamist Condominium	Private	29	0	29	N	Field	Village of Tequesta			
10	Jib Yacht Club and Marina	Commercial	40	0	40	N	Phone	Town of Jupiter Inlet Colony	1,3,5,6	100	Year-round
11	Suni-Sands Mobile Home	Private	16	0	16	N	Field	Town of Jupiter			
12	Captain Paul's Landing	Commercial	10	0	10	N	Field	Town of Jupiter			
13	Jupiter Bay Company	Private	10	0	10	N	Field	Town of Jupiter			
14	Jupiter Seaport Marina	Commercial	50	250	300	Y	Phone	Town of Jupiter	1,2,5,6,7	100	Year-round
15	Jupiter Cove Condominium	Private	55	0	55	N	Field	Town of Jupiter			
16	Jupiter Harbour Condominium	Private	75	0	75	N	Field	Town of Jupiter			
17	Unknown	Private	12	0	12	N	Field	Village of Tequesta			
18	Bermuda Terrace Docks	Private	12	0	12	N	Field	Palm Beach County			
19	Unknown	Private	14	0	14	N	Field	Palm Beach County			
20	Fisherman's Landing	Private	30	0	30	U	Aerial	Town of Jupiter			
21	Jupiter Plantation	Private	26	0	26	N	Field	Town of Jupiter			
22	Unknown	Private	3	0	3	N	Field	Town of Jupiter			
23	Smilin Jack's Marina	Commercial	6	7	13	N	Phone	Palm Beach County	2,5	100	Year-round
24	Pa-Ja Villas and Motel	Private	6	0	6	N	Field	Palm Beach County			
25	Baron's Landing	Private	13	0	13	N	Field	Palm Beach County			
26	Inlet Village Marina	Commercial	13	45	58	N	Field	Palm Beach County			
27	Jupiter River Park Condominium	Private	43	0	43	N	Field	Town of Jupiter			
28	Jupiter Yacht Club	Commercial	79	0	79	Y	Phone	Town of Jupiter	3	95	Winter
29	Jonathan's Landing Marina	Commercial	31	400	431	N	Phone	Palm Beach County	1,2,3,4,5,6	99	Winter
30	Jonathan's Landing	Private	53	0	53	U	Aerial	Palm Beach County			
31	Admiral's Cove Marina	Commercial	74	0	74	Y	Phone	Town of Jupiter	1,3,4,5,6	100	Year-round
32	The Bluff's Marina	Commercial	94	0	94	N	Phone	Town of Jupiter	1,3	83	Winter
33	Cypress Island Marina	Private	72	0	72	N	Field	Palm Beach County			
34	Frenchman's Creek Marina	Commercial	135	0	135	Y	Phone	City of Palm Beach Gardens	1,3,5	78	Winter
35	Unknown	Private	62	0	62	Y	Field	Palm Beach County			
36	Bay Colony Docks	Private	20	0	20	Y	Field	Town of Juno Beach			
37	Oak Harbor Condominium	Private	78	0	78	N	Field	Town of Juno Beach			
38	The Ways	Commercial	9	0	9	N	Phone	Palm Beach County			
39	Soverel Harbor Marina	Commercial	160	0	160	N	Phone	City of Palm Beach Gardens		99	Winter
40	PGA Marina	Commercial	14	400	414	Y	Phone	City of Palm Beach Gardens	1,2,5,6,7	100	Winter
41	Unknown	Private	10	0	10	N	Field	City of Palm Beach Gardens			
42	Unknown	Private	9	0	9	N	Field	Palm Beach County			
43	Harbor Point Marina	Commercial	45	0	45	Y	Phone	Village of North Palm Beach	3	100	Winter
44	Twelve Oaks Condominium	Private	67	0	67	Y	Field	Village of North Palm Beach			
45	Old Port Cove Marina N	Commercial	91	0	91	Y	Phone	Village of North Palm Beach	1,3,4,5,6	90	Winter
46	Old Port Cove Marina S	Commercial	209	0	209	Y	Phone	Village of North Palm Beach	1,3,4,5,6	90	Winter
47	Old Port Cove Condominium	Private	57	0	57	N	Field	Village of North Palm Beach			
48	North Palm Beach Marina	Commercial	113	0	113	Y	Phone	Village of North Palm Beach	1,3,5,6	87	Winter
49	Unknown	Private	17	0	17	N	Field	Village of North Palm Beach			

Palm Beach County Manatee Protection Plan

50	Unknown	Private	6	0	6	U	Aerial	Village of North Palm Beach			
51	Unknown	Private	9	0	9	U	Aerial	Village of North Palm Beach			
52	Unknown	Private	4	0	4	U	Aerial	Village of North Palm Beach			
53	Paradise Villas	Private	63	0	63	N	Field	Village of North Palm Beach			
54	Anchorage Park Marina	Public	32	195	227	N	Field	Village of North Palm Beach			
55	River's Landing Condominium	Private	14	0	14	N	Field	Village of North Palm Beach			
56	Northlake Harbor Condominium	Private	22	0	22	N	Field	Village of North Palm Beach			
57	Northlake Villas	Private	7	0	7	N	Field	Village of North Palm Beach			
58	Westport Condominium	Private	12	0	12	N	Field	Village of North Palm Beach			
59	Northlake Condominium	Private	24	0	24	N	Field	Village of North Palm Beach			
60	Lott Brothers Marina	Commercial	24	0	24	N	Phone	Village of North Palm Beach	1,5,6		100 Year-round
61	Unknown	Private	6	0	6	N	Field	Village of North Palm Beach			
62	Unknown	Private	21	0	21	N	Field	Village of North Palm Beach			
63	Southwind Condominium	Private	16	0	16	N	Field	Village of North Palm Beach			
64	Unknown	Private	9	0	9	N	Field	Village of North Palm Beach			
65	Unknown	Private	5	0	5	N	Field	Village of North Palm Beach			
66	Villa Eden Condominium	Private	6	0	6	N	Field	Village of North Palm Beach			
67	Unknown	Private	24	0	24	N	Field	Village of North Palm Beach			
68	River Edge Condominium	Private	12	0	12	N	Field	Village of North Palm Beach			
69	River Key Condominium	Private	11	0	11	N	Field	Village of North Palm Beach			
70	Marina Apts. of North Palm Beach	Private	3	0	3	N	Field	Village of North Palm Beach			
71	Southwind Apartments	Private	4	0	4	N	Field	Village of North Palm Beach			
72	Condominiums (Multiple)	Private	172	0	172	N	Field	Village of North Palm Beach			
73	Lake Park Marina	Public	75	0	75	Y	Field	Town of Lake Park			
74	Sugar Sands Condominium	Private	77	0	77	N	Field	City of Riviera Beach			
75	Blue Heron Docks	Commercial	23	0	23	N	Field	City of Riviera Beach			
76	Unknown	Private	4	0	4	N	Field	City of Riviera Beach			
77	Bali Condominium	Private	4	0	4	Y	Field	City of Riviera Beach			
78	Unknown	Private	4	0	4	Y	Field	City of Riviera Beach			
79	The Americana Condominium	Private	19	0	19	N	Field	City of Riviera Beach			
80	Captain's Walk Condominium	Private	18	0	18	N	Field	Town of Palm Beach Shores			
81	Cannonsport Marina	Commercial	38	0	38	Y	Phone	Town of Palm Beach Shores	1,5,6		96 Summer/Winter
82	New Port Cove Marine Center	Commercial	45	355	400	Y	Phone	City of Riviera Beach	1,3,5,6		100 Winter
83	Florida Marine	Commercial	24	0	24	N	Phone	City of Riviera Beach	1,2		Fall/Spring
84	Riviera Beach Yacht Center	Commercial	39	0	39	Y	Field	City of Riviera Beach			
85	Unknown	Private	20	0	20	N	Field	City of Riviera Beach			
86	Viking	Commercial	14	0	14	N	Field	City of Riviera Beach			
87	Buccaneer Marina	Commercial	18	0	18	N	Phone	Town of Palm Beach Shores			
88	Sailfish Marina	Commercial	90	0	90	N	Phone	Town of Palm Beach Shores	1,2,4,5,7		97 Winter
89	Riviera Beach Municipal Marina	Public	200	292	492	Y	Phone	City of Riviera Beach	1,3,4,5,6,7		80 Winter
90	Port of Palm Beach	Industrial	25	0	25			City of Riviera Beach			
91	Sailfish Club of Florida	Private	62	0	62	Y	Field	Town of Palm Beach			
92	Unknown	Private	12	0	12	N	Field	City of West Palm Beach			
93	Flotilla Club	Private	13	0	13	Y	Field	City of West Palm Beach			
94	Rybovich Spencer Marina	Commercial	64	0	64	N	Field	City of West Palm Beach			
95	Unknown	Private	11	0	11	N	Field	Town of Palm Beach			
96	Unknown	Private	13	0	13	N	Field	Town of Palm Beach			
97	Unknown	Private	7	0	7	N	Field	Town of Palm Beach			
98	Unknown	Private	20	0	20	N	Field	Town of Palm Beach			
99	Palm Beach Yacht Club Marina	Commercial	45	0	45	N	Field	City of West Palm Beach	1,2,4,5		99 Winter
100	Palm Harbor Marina	Commercial	160	0	160	N	Field	City of West Palm Beach	1,5		70 Winter
101	Town of Palm Beach Docks	Public	87	0	87	N	Field	Town of Palm Beach	3		97 Winter
102	Flagler Yacht Club	Private	23	0	23	N	Field	City of West Palm Beach			

Palm Beach County Manatee Protection Plan

103	Harbor Towers Marina	Private	8	0	8	N	Field	City of West Palm Beach			
104	Unknown	Private	6	0	6	N	Field	City of West Palm Beach			
105	Unknown	Private	10	0	10	N	Field	Town of Palm Beach			
106	Unknown	Private	4	0	4	N	Field	Town of Palm Beach			
107	Gundlach's Marina	Commercial	28	350	378	Y	Phone	Town of Lantana	1,2,5,6	99	Year-round
108	Murrelle Marine	Commercial	34	50	84	Y	Phone	Town of Lantana	2,5	89	Winter
109	Sportsman's Park Marina	Public	11	0	11	N	Field	Town of Lantana			
110	Carefree Cove Condominium	Private	43	0	43	N	Field	Town of Hypoluxo			
111	Palm Beach Yacht Center	Commercial	98	270	368	Y	Phone	Town of Hypoluxo	1,2,3,5,6,7	87	Winter
112	Gateway Marina	Commercial	0	200	200	N	Phone	Town of Hypoluxo	1,2,5,6	100	Year-round
113	Unknown	Private	19	0	19	N	Field	City of Boynton Beach			
114	Unknown	Private	8	0	8	N	Field	City of Boynton Beach			
115	Unknown	Private	24	0	24	N	Field	City of Boynton Beach			
116	Ocean Inlet Marina	Public	24	0	24	U	Aerial	Town of Ocean Ridge			
117	One Waterway North Condominium	Private	106	0	106	Y	Field	City of Boynton Beach			
118	Unknown	Private	10	0	10	U	Aerial	City of Boynton Beach			
119	Unknown	Private	27	0	27	N	Field	City of Boynton Beach			
120	Two Georges Marina	Commercial	22	0	22	N	Phone	City of Boynton Beach	4,7	100	Year-round
121	Pelican Cove Condominium	Private	65	0	65	N	Field	Town of Ocean Ridge			
122	Ocean Ridge Yacht Club	Private	12	0	12	N	Field	Town of Ocean Ridge			
123	Benson Condominium	Private	6	0	6	N	Field	Town of Ocean Ridge			
124	Briny Breezes Mobile Home Marina	Private	66	0	66	N	Field	Town of Briny Breezes			
125	Palm Trail Yacht Club	Private	15	0	15	N	Field	City of Delray Beach			
126	Waterway North Condominium	Private	17	0	17	N	Field	City of Delray Beach			
127	Inlet Cove Condominium	Private	15	0	15	N	Field	City of Delray Beach			
128	Ocean City Marina	Commercial	75	75	150	N	Phone	City of Delray Beach			
129	Delray Beach Yacht Club	Private	60	0	60	N	Field	City of Delray Beach			
130	City of Delray Beach Municipal Marina	Public	24	0	24	U	Phone	City of Delray Beach	3	100	Year-round
131	Seagate Towers Condominium	Private	19	0	19	N	Field	City of Delray Beach			
132	Tahiti Cove Condominium	Private	8	0	8	N	Field	City of Delray Beach			
133	Unknown	Private	4	0	4	N	Field	City of Delray Beach			
134	Seagate Manor Condominium	Private	6	0	6	N	Field	City of Delray Beach			
135	Unknown	Private	4	0	4	N	Field	City of Delray Beach			
136	Delray Harbor Club Marina	Commercial	41	0	41	N	Phone	City of Delray Beach	1,5,6	95	
137	Harbourside Condominium	Private	27	0	27	N	Field	City of Delray Beach			
138	Tropic Bay Condominium	Private	54	0	54	N	Field	City of Delray Beach			
139	Unknown	Private	8	0	8	N	Field	City of Delray Beach			
140	Tropic Harbor Condominium	Private	38	0	38	N	Field	City of Delray Beach			
141	Pelican Harbor Condominium	Private	72	0	72	N	Field	City of Delray Beach			
142	Villa Magna Condominium	Private	19	0	19	N	Field	City of Delray Beach			
143	Captain's Walk Condominium	Private	45	0	45	N	Field	City of Delray Beach			
144	Edgewater Townhouse	Private	10	0	10	N	Field	Town of Highland Beach			
145	Seagate of Highlands Condominium	Private	31	0	31	N	Field	Town of Highland Beach			
146	Coronado Condominium	Private	18	0	18	N	Field	Town of Highland Beach			
147	Regency Highland Club	Private	18	0	18	Y	Field	Town of Highland Beach			
148	Ocean Cove Condominium	Private	23	0	23	Y	Field	Town of Highland Beach			
149	Porto Bella Condominium	Private	56	0	56	N	Field	City of Boca Raton			
150	Unknown	Private	11	0	11	N	Field	City of Boca Raton			
151	Unknown	Private	20	0	20	N	Field	City of Boca Raton			
152	Boca Marina Club	Private	18	0	18	N	Field	City of Boca Raton			
153	Unknown	Private	15	0	15	N	Field	Town of Highland Beach			
154	Unknown	Private	55	0	55	N	Field	Town of Highland Beach			
155	Unknown	Private	47	0	47	N	Field	Town of Highland Beach			

Palm Beach County Manatee Protection Plan

156	Braemar Isle Condominium	Private	53	0	53	N	Field	Town of Highland Beach		
157	Evanton Baye Condominium	Private	14	0	14	N	Field	Town of Highland Beach		
158	Dalton Place Condominium	Private	14	0	14	N	Field	Town of Highland Beach		
159	Aberdeen Arms Condominium	Private	4	0	4	N	Field	Town of Highland Beach		
160	Sea Ranch Club of Boca Raton	Private	88	0	88	N	Field	City of Boca Raton		
161	The Sanctuary	Private	23	0	23	N	Field	City of Boca Raton		
162	Boca House Condominium	Private	11	0	11	N	Field	City of Boca Raton		
163	San Remo Condominium	Private	17	0	17	N	Field	City of Boca Raton		
164	Yacht & Racquet Club of Boca Raton	Private	76	0	76	N	Field	City of Boca Raton		
165	Unknown	Private	6	0	6	N	Field	City of Boca Raton		
166	Unknown	Private	16	0	16	N	Field	City of Boca Raton		
167	Unknown	Private	7	0	7	N	Field	City of Boca Raton		
168	Boca Towers Condominium	Private	6	0	6	N	Field	City of Boca Raton		
169	La Font Condominium	Private	16	0	16	Y	Field	City of Boca Raton		
170	Mizner Court Condominium	Private	24	0	24	Y	Field	City of Boca Raton		
171	Marbella Condominium	Private	10	0	10	N	Field	City of Boca Raton		
172	The Beresford Condominium	Private	7	0	7	N	Field	City of Boca Raton		
173	Chalfonte Condominium	Private	20	0	20	Y	Field	City of Boca Raton		
174	Mizner Tower	Private	8	0	8	Y	Field	City of Boca Raton		
175	Unknown	Private	6	0	6	N	Field	City of Boca Raton		
176	Unknown	Private	7	0	7	N	Field	City of Boca Raton		
177	Boca Raton Resort & Club	Private	32	0	32	Y	Phone	City of Boca Raton	3,4,7	100 Winter
178	Boca Inlet Condominium	Private	30	0	30	N	Field	City of Boca Raton		
179	Royal Palm Yacht and Country Club	Private	52	0	52	N	Field	City of Boca Raton		
180	Boca Bayou Condominium	Private	161	0	161	N	Field	City of Boca Raton		
181	Pahokee Marina & Campground/Everglades Adventure	Commercial	117	0	117	Y	Phone	City of Pahokee	1,3,4,5,6,7	88 Winter
182	Belle Glade Marina & Campground/Slim's Marine	Commercial	50	0	50	N	Phone	City of Belle Glade	1,2,6,7	100 Winter
# of Boat Slips 2004			6170	2889	9059				1=Fuel	
# 1995 BFSP			4878	2769					2=Repair	
									3=Pump-out	
									4=Restaurant	
									5=Marine Supplies	
									6=Bait/Tackle	
									7=Boat Rental	

Palm Beach County Manatee Protection Plan

Figure 28: Palm Beach County Boat Ramps 2004

ID	Location	Jurisdiction	Type	Waterway	Nearest Inlet	Distance (mi)	Ramp Capacity	Trailer Parking
1	Burt Reynolds Park East	Palm Beach Co.	Salt	Lake Worth Creek	Jupiter	1.6	6	117
3	Bert Winters Park	Palm Beach Co.	Salt	Lake Worth Creek	Jupiter	6.4	2	24
4	Juno Park	Palm Beach Co.	Salt	Lake Worth Creek	Jupiter	7.9	1	14
5	Anchorage Park	Anchorage Park	Salt	NPB Waterway	Palm Beach	4.4	2	18
6	Lake Park Marina	Lake Park	Salt	Lake Worth	Palm Beach	2.1	4	60
7	Phil Foster Park	Palm Beach Co.	Salt	Lake Worth	Palm Beach	1.4	4	81
8	Currie Park	West Palm Beach	Salt	Lake Worth	Palm Beach	3.3	6	82
9	Bryant Park	Lake Worth	Salt	Lake Worth	Boynton	5	4	31
10	Sportsman's Park	Lantana	Salt	Lake Worth	Boynton	2.9	4	29
11	Boat Club Park	Boynton Beach	Salt	Lake Worth	Boynton	0.7	6	57
12	Knowles Park	Delray Beach	Salt	ICW	Boca Raton	7.3	2	16
13	Silver Palm Park	Boca Raton	Salt	Lake Boca Raton	Boca Raton	0.7	2	31
14	Canal Point Access	ACOE	Fresh	Lake Okeechobee	N/A	N/A	1	30
15	Pahokee Marina	Pahokee	Fresh	Lake Okeechobee	N/A	N/A	3	30
16	Paul Rardin Park	ACOE	Fresh	Lake Okeechobee	N/A	N/A	1	No defined spaces
17	Belle Glade Marina	Belle Glade	Fresh	Lake Okeechobee	N/A	N/A	7	100
18	City of South Bay Access	South Bay	Fresh	Lake Okeechobee	N/A	N/A	4	20
19	John Stretch Park	ACOE	Fresh	Lake Okeechobee	N/A	N/A	1	59F