SARASOTA BAY, FLORIDA
Identification of Resource Management Problems and Issues and National Estuary Program Analysis

REPORT to the
U.S. ENVIRONMENTAL PROTECTION AGENCY
Region IV, Atlanta, Georgia and the
FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION
Tallahassee, Florida

by the
MOTE MARINE LABORATORY
Coastal Resources Program
Sarasota, Florida

Ernest D. Estevez, Ph.D.
Senior Scientist

May 24, 1988

MML Technical Report Number 117
EXECUTIVE SUMMARY

Sarasota Bay was identified in Section 317 (National Estuary Program) of the Water Quality Act of 1987 for priority consideration as an estuary of national significance. The bay is the only Florida system so identified and the only subtropical one. It is a very small, relatively clean system which ranks poorly where estuarine area or number of major problems are considered. On the other hand, it ranks highly in terms of preservation need and in terms of its vulnerability because of its small size. It is also distinguished by having more problems resulting from development and overuse than from pollution, especially the many forms of pollution which plague northern estuaries. In this regard, Sarasota Bay represents an excellent setting in which to develop and evaluate management tools focusing on development and overuse impacts. The small size of the bay is an added advantage in such a context. Overall, Sarasota Bay offers the opportunity to address nationally significant problems such as integrated beach/inlet/channel maintenance, nonpoint source control, habitat loss, and sea level rise. Results from a Sarasota Bay study would also be transferable to similar lagoons, bar-built estuaries, and small embayments throughout the gulf and south Atlantic coastlines. Extensive tourism and seasonal residence of northern and midwestern visitors would extend the benefit of a local bay educational program to areas of the nation not involved with the National Estuary Program.

Sarasota Bay is a small, subtropical embayment on the Florida west coast. It is not industrialized but has been affected by development and overuse. It is divided into two counties and two regional planning councils and is affected by several local government comprehensive plans as well as designation by the state as "Outstanding Florida Waters". Part of the bay is also affected by management policies adopted for Charlotte Harbor. These policies and regulations are not presently coordinated, nor do they operate in a larger management framework.

Water quality is good in most of the bay, although nonpoint runoff has reduced nearshore salinity. Tributary basins are urbanized and receive septic tank and sewage plant effluents; however, direct sewage plant effluents to the bay are in the process of being diverted. There are no industrial activities or effluents affecting the bay. On the other hand, the bay's natural habitats have been affected adversely by dredging and filling, especially on beaches, inlets, residential shorelines, and the Intracoastal Waterway.

Native plant communities have declined, particularly seagrass beds, which have been impacted by turbidity and
dredging. Grassbeds near sewage plant discharges have nearly disappeared. Since 1960, seagrass losses have been paralleled by the loss of scallop, hard clam, and oyster fisheries. Loss of these commercial fisheries is believed to be due to seagrass decline, closure of approved shellfish areas, and overharvesting (although the bay could probably support a renewed hard-clam fishery if closed waters were opened). Precipitous declines have occurred in landings of blue crabs, spotted sea trout, red drum and snook, whereas landings of stone crab (claws only) and mullet have increased dramatically. Sarasota Bay supports approximately 1,000 nests of Atlantic loggerhead turtles each year and is a major breeding ground of the bottlenose dolphin. (Dolphin populations in the bay have been studied longer than anywhere else in the world.) Manatees also occupy the bay and use it as a corridor for seasonal migrations.

Sarasota Bay's economic value is a result of its intense recreational use, as well as its indirect effect on waterfront property values. The bay supports about 50 water-dependent industries, institutions, and operations. Recreational uses take many forms, in particular, beach use and saltwater fishing (13 million user events in 1985 alone). The combined expenditures by visitors to the bay area was approximately $1.5 billion in 1987 alone.

Rapid urbanization (mostly since World War II) has placed heavy pressure on the bay's resources, especially in terms of development impacts and overuse resulting from large numbers of people using a relatively small estuary. A preliminary effort to identify problems and management issues facing Sarasota Bay generated a list of 120 concerns -- 14 of a geological nature; 13 hydrological; 20 chemical; 31 biological; 21 cultural; 10 concerning regulation and management; and 20 having to do with education and research. It will be necessary to examine these concerns to determine the validity, data base, course of action, and probability of success for each.

The 120 concerns have been grouped into 14 condensed sets based upon six criteria, namely: 1) their overlap; 2) their role as a cause of other problems; 3) responsiveness to local needs; 4) recognition of MC strengths; 5) geographic specificity vs. national significance; and 6) the probable role of federal, state, and local government involvement.

Four problem sets were identified which would benefit from a significant level of federal participation in addition to state, regional, and local involvement: stormwater runoff; beach/inlet/channel management; habitat creation and restoration; and access. Another four problem sets--monitoring; shellfish sanitation; fisheries assessment-management-restoration; and sea level rise -- are amenable to
solution by state and local governments if addressed in a MC framework. Additionally, five other problem sets could be addressed at more local levels within an MC framework. Overall, Sarasota Bay's problems have nothing to do with toxicants and have only a small bearing on pathogen contamination but do have much in common with problems of eutrophication, habitat loss, changes in living resources, and overuse.

Several reasons have been identified for a Sarasota Bay Management Conference. Rapid urbanization of this vulnerable subtropical system, in which problems of national significance can be meaningfully addressed, represent the primary basis for the MC need. From a management perspective, the bay is moderately regulated but deteriorating because of incomplete management. Moreover, planning efforts that should be addressing bay needs have not begun (local government coordination requirements of state planning law) or are incomplete (water quality planning under federal and state law, especially Section 208 and 303(e) plans). Overall, the bay is seriously threatened by development and overuse impacts -- but not industrial impacts-- and constitutes an excellent microcosm for determining pollution cause-effect relationships and demonstrating success in bay and watershed management plans, with emphasis on those impacts affecting tourism and recreational uses. Finally, the bay falls clearly into the group of national systems for which protective measures outweigh restorative ones as management objectives.

Two aspects of Sarasota Bay's management needs were identified as unique relative to other systems under review by the NEP. One near-term initiative of national significance could be the coordination of federal, state, local and private projects to nourish beaches, maintain inlets and access channels, and the Intracoastal Waterway. These projects are planned and executed without regard for their interactive or cumulative effects on the bay. Over the long term, the bay area's low relief will be affected by drainage projects, hurricanes, rising sea level, and related forces which together constitute serious management problems, but which could be turned to advantage with proper planning (as in the case of contingency plans for land acquisition after major hurricanes).

The likelihood of a successful NEP Conference for Sarasota Bay is high because of previous and ongoing efforts, most of which emphasize a local resource management initiative necessary for successful implementation. A significant level of local matching by city and county governments will be available for the MC, and public support is likely to be significant. Adequate scientific research and technical expertise to address data shortfalls and conduct new studies is available through New College, Mote Marine Laboratory, local governments, and the private sector.
Six preliminary goals have been established for the proposed NEP study of Sarasota Bay:

GOAL I: Improve water transparency in the Sarasota Bay Study Area to the maximum allowable by Gulf of Mexico and local weather conditions.

GOAL II: Reduce the quantity and improve the quality of stormwater runoff to Sarasota Bay.

GOAL III: Eliminate further losses of seagrasses and shoreline habitats and restore lost habitats.

GOAL IV: Coordinate beach/inlet/channel creation and maintenance activities to reduce dredging, eliminate conflicts, and enhance the bay.

GOAL V: Provide increased levels of managed access to Sarasota Bay and its resources.

GOAL VI: Establish a vertically integrated management system for Sarasota Bay.

Objectives have been prepared for each goal, and information is provided on public participation, workshop conference structure, available research support, and political commitment to the management conference project.
PREFACE

Sarasota Bay, Florida was named in Section 317 of the Water Quality Act of 1987 (the Act) to be given priority consideration for inclusion in the National Estuary Program (NEP). Governor Bob Martinez nominated Sarasota Bay to the NEP in a May 19, 1987, letter to Lee Thomas, Administrator of the Environmental Protection Agency (EPA). The language of the Act provides guidelines for documentation required to support a governor's nomination. The types of information the Agency will need to consider includes the need for a management conference, the likelihood of success of the program and information indicating that existing controls of pollution must be supplemented to ensure the attainment or maintenance of water quality. Enhanced water quality should provide for the protection and propagation of a balanced, indigenous population of shellfish, fish and wildlife and allow recreational activities in and on the water.

In 1987 the EPA entered into a cooperative agreement with the Mote Marine Laboratory to assemble information on the environmental status, trends, and environmental problems in Sarasota Bay to support the nomination of the bay to the NEP. The need for an NEP study of the bay, the likelihood of success of the proposed study, and the need for additional controls of pollution to ensure the maintenance or enhancement of water quality in Sarasota Bay were also to be addressed. Toward this end, Mote Marine Laboratory has:

Assessed available information on the status and trends of environmental quality in Sarasota Bay to support the nomination of the bay to the National Estuary Program;

Identified environmental problems in Sarasota Bay and established goals and objectives for the proposed National Estuary Program Study;

Developed information indicating the need for an NEP Study on Sarasota Bay, the likelihood of success of the study and the need for supplements to existing pollution controls to ensure the maintenance or enhancement of water quality in Sarasota Bay.
This report is one product of the research. Another product is a "Bibliography on Sarasota Bay, Its Resources, and Surrounding Areas". The bibliography contains approximately 350 citations, of which approximately 40 were annotated. It accompanies this report, under separate cover (Mote Marine Laboratory Technical Report No. 117b). An earlier draft of this report and the bibliography were presented to a workshop of federal, state, and local government representatives, co-hosted in Sarasota by EPA and MML on March 17, 1988. The Workshop also developed additional information on Sarasota Bay for use in documenting the need for an NEP Study.

Acknowledgements are due to Judy Jones and Greg Blanchard for assistance in literature searches, and Laurie E. Fraser for processing the text of this report and the bibliography. Earl Bozeman (EPA Region IV) and David Worley (Florida Department of Environmental Regulation) provided valuable comments on earlier drafts. Rhonda Evans (Mote Marine Laboratory), Julie Morris (New College of USF) and Robert Weaver (Zorc, Risetto and Weaver, Esq.) contributed data and text on research and local government programs. Greg Blanchard, Robert Dixon, Rhonda Evans and Vicki Wiese provided additional assistance at the Workshop.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>TITLE PAGE</td>
<td>i</td>
</tr>
<tr>
<td>EXECUTIVE SUMMARY</td>
<td></td>
</tr>
<tr>
<td>PREFACE</td>
<td>v</td>
</tr>
<tr>
<td><strong>TABLE OF CONTENTS</strong></td>
<td>vi</td>
</tr>
<tr>
<td>List of Figures</td>
<td></td>
</tr>
<tr>
<td>List of Tables</td>
<td></td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>NATIONAL SIGNIFICANCE</td>
<td></td>
</tr>
<tr>
<td>Definition of Boundary and Resources</td>
<td></td>
</tr>
<tr>
<td>Recreational and Commercial Values</td>
<td></td>
</tr>
<tr>
<td>Importance to Living Resources</td>
<td></td>
</tr>
<tr>
<td>Application of Results to Other Areas</td>
<td></td>
</tr>
<tr>
<td>NEED FOR A MANAGEMENT CONFERENCE</td>
<td></td>
</tr>
<tr>
<td>Economic Importance</td>
<td></td>
</tr>
<tr>
<td>Living Resources</td>
<td></td>
</tr>
<tr>
<td>Restoration of Hard Clam Fishery</td>
<td></td>
</tr>
<tr>
<td>Problem Statement</td>
<td></td>
</tr>
<tr>
<td>Priority Problems</td>
<td></td>
</tr>
<tr>
<td>Cause and Effect Relationships</td>
<td></td>
</tr>
<tr>
<td>Institutional Arrangements</td>
<td></td>
</tr>
<tr>
<td>LIKELIHOOD OF SUCCESS</td>
<td></td>
</tr>
<tr>
<td>Resource Management and Pollution Control History</td>
<td></td>
</tr>
<tr>
<td>Traditional Federal Programs</td>
<td></td>
</tr>
<tr>
<td>New Federal Activities</td>
<td></td>
</tr>
<tr>
<td>State Programs</td>
<td></td>
</tr>
<tr>
<td>Local Government Programs</td>
<td></td>
</tr>
<tr>
<td>1. Wastewater Treatment Improvements</td>
<td></td>
</tr>
<tr>
<td>2. Other Existing Local Programs</td>
<td></td>
</tr>
<tr>
<td>3. Proposed Local Government Programs</td>
<td></td>
</tr>
<tr>
<td>Environmental Quality and Management Goals</td>
<td></td>
</tr>
<tr>
<td>Management Conference Participants</td>
<td></td>
</tr>
<tr>
<td>Public Support</td>
<td></td>
</tr>
<tr>
<td>Research</td>
<td></td>
</tr>
<tr>
<td>Public Participation</td>
<td></td>
</tr>
<tr>
<td>Political Commitment</td>
<td></td>
</tr>
<tr>
<td>Financial Capability</td>
<td></td>
</tr>
<tr>
<td>SUMMARY AND CONCLUSIONS</td>
<td>vii</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

Figure 1. Geographic definition of the Sarasota Bay Study Area.

Figure 2. Mean annual salinity from marina, canal and ditch stations (upper) and pass, mid-bay and nearshore stations (lower) in Sarasota Bay [142].

Figure 3. Relationship between total suspended solids and chlorophyll 'a' in Sarasota Bay [330].

Figure 4. Lines of equal concentration of a sewage tracer, coprostanol, in Sarasota Bay sediments. Units, ng/g dry sediment [219].

Figure 5. Modern distribution and abundance of seagrasses in Sarasota Bay [166].

Figure 6. Sarasota County marine landings, 1953-1981 [109].

Figure 7. Political geography and areas of approved, prohibited and classified shellfish harvesting in Sarasota Bay [110].

Figure 8. Distribution of dolphins in Sarasota Bay June-July 1983 and of female dolphins in Palma Sola Bay 1980-1984 (inset) [332].

Figure 9. Shorelines of Sarasota Bay submerged by a 5 foot rise in sea level [82].

Figure 10. Distribution of grassflats in Sarasota Bay near Whitaker Bayou and near New Pass (inset), 1948 [259].

Figure 11. Distribution of grassflats in Sarasota Bay near Whitaker Bayou and near New Pass (inset), 1979 [259].

Figure 12. Contiguous land development on Longboat Key 1942, 1963 and 1980. By 1980, 73% of the shoreline had been altered by development [1982].
LIST OF TABLES

Table 1. Relation of Tampa and Sarasota Bays and the Gulf of Mexico to important fisheries of Sarasota Bay.

Table 2. Estimated species richness of Sarasota Bay biota. Adapted from Estevez (1984); Tampa BASIS (1985); and Sarasota BASIS (1988).

Table 3. Summary of 1985 Manatee and Sarasota County landings (thousands of pounds) and ex-vessel value (thousands of dollars) for important commercial species in Sarasota Bay.

Table 4. List of resource management problems and issues in Sarasota Bay and surrounding areas.

Table 5. Major problem sets for Sarasota Bay, in order of management complexity.


Table 7. Mote Marine Laboratory studies in Sarasota Bay and adjacent waters.
INTRODUCTION

Sarasota Bay is a small, subtropical embayment on the west coast of peninsular Florida. It is connected to the Gulf of Mexico by numerous inlets, and to the southern end of Tampa Bay via Anna Maria Sound. Like much of coastal Florida, the Sarasota Bay area is experiencing rapid population growth. Barrier islands between the bay and gulf are completely developed as residential, light commercial, and tourist areas. Nearly the entire upland watershed of Sarasota Bay is also developed, mostly as suburban residential and commercial areas. There are no heavy industries in the watershed, and the amount of agricultural land is low and decreasing due to urbanization. The local economy is driven primarily by retirees, tourism, and the services industry which have developed because of the bay, warm climate, and historical circumstances. The bay supports an extensive recreational industry and is showing signs of overuse. For all practical purposes, there has been little more than a century of modern settlement in the bay area, with 3 periods of major development (the Florida land boom of the 1920's; the post World War II boom; and the present period of expansion).

The bay and its watershed are situated in Manatee and Sarasota Counties (Figure 1). The combined population of these counties was 420,500 people in 1986 [50]. Sarasota County ranks 14th in Florida (1986 estimated) population size; Manatee County ranks 17th. Sarasota County's density (427 persons/sq. mile) is 8th statewide and Manatee County's is 16th. Population growth in Manatee County (1970-80) was 53% and growth in Sarasota County was 68% over the same period. Because relative growth is greater in the state's smaller, less populated areas, the Sarasota Bay area ranks 5th (Sarasota County) to 9th (Manatee County) in terms of relative rate, among the state's 20 counties with densest population.

Rapid growth in the bay area has caused land use to change as rapidly. At present, approximately one-fourth of the area's land is in wetland or open water (lakes, canals, etc.), and two-thirds is in farmland and urban use. Although 14% of the land west of I-75 and south of the Manatee River is classified "vacant", there is actually very little vacant land left along the shoreline of Sarasota Bay, except for
Figure 1. SARASOTA BAY AREA
farmland near the village of Cortez. Island and Sarasota County shorelines are nearly all urbanized.

The largest cities --and county seats-- are located near the bay at Bradenton and Sarasota, in Manatee and Sarasota Counties, respectively. Bradenton Beach and the Town of Longboat Key are two small municipalities on the barrier island of Anna Maria and Longboat Key, respectively. Two other islands separate the bay and gulf south of Longboat Key (Lido, Siesta); Lido Key is within the city limits of Sarasota, and Siesta Key is part of unincorporated Sarasota County. Manatee County is in the Tampa Bay Regional Planning Council, whereas Sarasota County is a member of the Southwest Florida Council, meaning that Sarasota Bay is divided across the middle into two separate regional planning bodies. Both counties and the whole bay are within the Southwest Florida Water Management District and the Southwest District of the Florida Department of Environmental Regulation [258].
NATIONAL SIGNIFICANCE

Definition of the Estuary's Boundaries and Resources

Sarasota Bay has been called a lagoon, a neutral estuary, and a bay. It meets CWA's definition of an estuary as "all or part of the mouth of a river or stream or other body of water having unimpaired natural connection with the open sea and within which sea water is measurably diluted with the fresh water from land drainage.". The bay is located between Tampa Bay and Charlotte Harbor, the nation's 17th and 18th largest estuaries, respectively [263]. It exemplifies a number of water bodies along the Florida and gulf coasts by its proximity to open, shallow waters; much greater width than depth; physical dominance by wind and tides rather than tributaries; and recreational uses [85].

For the purposes of the NEP, the boundaries of Sarasota Bay and its drainage basin are presented in Figure 1. Palma Sola Bay, Perico Bayou, and Anna Maria Sound form the northern boundary of the study area, which extends southward to the Albee Road bridge over Blackburn Bay near Nokomis. Additional named waterbodies within the study area are Roberts Bay (landward of Siesta Key) and Little Sarasota Bay. The landward extent of the study area includes: the coastal drainage basins of Perico Bayou, Palma Sola Bay and upper Sarasota Bay; the Bowles Creek, Whitaker Bayou, Hudson Bayou and Phillippi Creek basins; the coastal drainage basins of Little Sarasota Bay and Blackburn Bay; and the barrier islands between the bay and Gulf of Mexico.

The bay area has a mean annual temperature and rainfall of 72.0°F and 54.6 inches of rain per year. Most of the rain (60%) falls between June and September [328]. The bay is approximately 20 miles long and has a mean depth of 5 ft. Deeper portions of the bay's central basin are 8-10 ft deep, and Longboat Pass (between Longboat Key and Anna Maria Island) has a maximum depth of 27 ft. Extensive shallow areas bordering the bay are mudflats, seagrass beds, or wetlands. The bay is subject to a relatively low energy climate [89]. Winds vary to and from the gulf, except during winter frontal systems when northwest winds prevail. Tides are mixed diurnal and semidiurnal, with a mean and extreme range of 1.3
and 2.1 ft, respectively [122, 328]. Average wave heights (on barrier beaches) are about 1 ft, and sediment transport is minimal [89, 138].

Currents in the bay are tide and wind dominated, ranging between 0.3 ft/sec in open bay areas to 1.5 ft/sec within inlets. A nodal area--or zone of little net water movement--crosses the mid bay area in Manatee County [328]. Flushing time for the bay in general is estimated to be 2-15 days, although actual rates depend upon freshwater inflow [63, 65]. Combined peak discharge of nonpoint sources to the bay area are about 13,560 cfs (for a 25 year, 24 hr event over the entire watershed) [99, 118]. Treated wastewater contributes another 15-25 cfs, and there are no industrial discharges of consequence.

Water quality is considered "good" for most parts of the bay1. In fact, all waters of the bay except for two small creek mouths are designated by the state as Outstanding Florida Waters, which provides for strict limits to degradation [108]. Incomplete nutrient and other data suggest a general trend of improvement and a decline in salinity which has been most evident along the mainland shore (Figure 2). Urban stormwater runoff has been implicated as the cause for reduced salinities [142]. The Sarasota Bay area is fully served by separate storm and sanitary sewer systems. Unlike many areas in the northeast and other parts of the country which have combined systems, this area is fortunate in that most if not all sanitary sewage is collected, treated, and then discharged in dedicated systems on a continuous basis, whereas stormwater is collected in separate systems and may or may not be treated. The most heavily urbanized areas are serviced by closed storm sewer systems which consist of inlets, pipes, collector systems and major outfalls. Some major ditches and outfall canals exist in the heavily urbanized areas. In the light urbanized areas or areas of moderate urbanization, stormwater collection is accomplished more through neighborhood ditches, rural sections, and canals. Areas of "fair" water quality include the bayside waters of Longboat Key, Little Sarasota Bay, and Phillippi Creek.

1According to 305b summaries by the Florida Department of Environmental Regulation, using water quality (marine) and trophic state (aquatic) indices.
Whitaker Bayou has fair to "poor" water quality because of stormwater runoff and the City of Sarasota's municipal wastewater treatment plant effluent. An area of about 210 acres in the bay is directly affected by Whitaker Bayou discharges, and the area of indirect effects is probably ten times larger [219, 330] (Figures 3 and 4).

The primary producers of Sarasota Bay are phytoplankton, seagrasses, macroalgae, and wetlands (marshes and mangrove forests) [9]. The system is converting from a phytoplankton-dominated one with significant contributions (of carbon fixation, habitat, etc.) by the other producers, to a more simplified system dominated by phytoplankton without these other producers [167]. Sarasota Bay and nearby waters are regularly affected by naturally occurring dinoflagellate blooms known as red tides. These blooms originate far offshore but may be perpetuated by inshore nutrient enrichment [288]. Red tides defaunate affected areas of the bay and inhibit tourism [132]. During summer months local phytoplankton blooms also kill fish in canals.

There are four seagrass species in the bay; all grow in water less than 6-7 ft deep (Figure 5). Marshes are naturally rare in the bay, but three species of mangroves grow along protected intertidal shorelines instead. Mangrove forests have been ditched for mosquito control and filled for upland development [95]. Approximately 50% of the bay's shoreline has been altered by bulkheads, riprap and destruction of natural vegetation. Shallow, protected waters and once-widespread seagrasses supported an abundance of shellfish, sport and commercial fishes and unique vertebrate species [86]. The shellfish resources of the bay were based on hard clams, oysters, and scallops. Scallops have disappeared from the bay, not having been landed commercially since 1964 [Figure 6; 290]. Oyster landings ended in 1967 and hard clam landings ended in 1971, but both are still present in the bay, and there are probably enough hard clams to support a renewed harvest [88]. Actual harvesting would be limited to 2 areas conditionally approved by the
Figure 1. Relationships Between Total Suspended Solids and Chlorophyll $a$ in Sarasota Bay.
FIGURE Sarasota County Marine Landings, 1953 to 1981
FIGURE MANAGEMENT AREAS OF SARASOTA BAY.
state for adequate sanitation (Palma Sola Bay\textsuperscript{2}; Longboat Key bayside) unless pollution abatement allowed new areas to be opened (Figure 7).

Recreational and Commercial Values

Sarasota Bay's value to the nation results from the extensive recreational opportunities available in the area. These include boating, skiing, diving, surfing, fishing, sightseeing, and nature study. Sailing, especially regatta events, attracts a national field of competitors. In 1985 there were almost 13 million beach use and saltwater fishing "occasions" in Manatee and Sarasota Counties. Such intensive contact and consumptive use represents a strong disincentive for pollution.

Sarasota Bay is an attractive area for recreational pursuits due to the absence of industrial development, good water quality in most areas, spectacular white sand beaches on the barrier islands and proximity to large population areas of Tampa and St. Petersburg.

Importance to Living Resources

Sarasota Bay provides critical habitat for a variety of commercial and recreational fisheries. The estuary serves as a nursery area for juvenile spotted seatrout, mullet and snook and is related to Tampa Bay and the Gulf as a spawning ground or adult habitat (Table 1). However, declining seagrasses, losses of fringing marshes and mangroves, and changing salinity regimes are threatening the suitability of the bay as a fishery nursery ground.

\textsuperscript{2}Palma Sola Bay has been closed since 1981 because of excess coliform from runoff and septic tank leakage.
Table 1. Relation of Tampa and Sarasota Bays and the Gulf of Mexico to important fisheries of Sarasota Bay.

<table>
<thead>
<tr>
<th>Fish</th>
<th>Spawn</th>
<th>Nursery</th>
<th>Adult</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mullet</td>
<td>GM</td>
<td>SB, TB (t)</td>
<td>GM, SB, TB</td>
</tr>
<tr>
<td>Red Drum</td>
<td>GM</td>
<td>GM</td>
<td>GM, SB</td>
</tr>
<tr>
<td>Spotted Sea Trout</td>
<td>SB, TB</td>
<td>SB, TB</td>
<td>SB, TB</td>
</tr>
<tr>
<td>Snook</td>
<td>GM</td>
<td>SB, TB (t)</td>
<td>SB, TB</td>
</tr>
<tr>
<td>Pink Shrimp</td>
<td>GM</td>
<td>SB, TB (t)</td>
<td>SB, TB</td>
</tr>
<tr>
<td>Blue Crab</td>
<td>GM</td>
<td>TB (t)</td>
<td>SB, TB</td>
</tr>
<tr>
<td>Stone Crab</td>
<td>GM, SB</td>
<td>GM, SB</td>
<td>GM, SB</td>
</tr>
<tr>
<td>Hard Clam</td>
<td>SB, TB</td>
<td>SB, TB</td>
<td>SB, TB</td>
</tr>
</tbody>
</table>

GM, Gulf of Mexico  
SB, Sarasota Bay  
TB, Tampa Bay  
(t), Tributaries, usually brackish

Unique or important vertebrates in Sarasota Bay include the Atlantic loggerhead turtle, bottlenose dolphin, and West Indian manatee. Sea turtles use barrier beaches for nesting. In Manatee and Sarasota Counties combined, about 1,000 nests are established per year [186]. Their success depends on storms, natural predators, and beach management practices. Dolphin populations have been studied longer in Sarasota Bay than anywhere else in the world (Figure 8). Dolphins probably use the bay as a breeding ground and their numbers are stable [332], which is in marked contrast to manatees, an endangered species. Manatees occur in Sarasota Bay during summer months and use the bay as a corridor prior to the cold season. Between 25 and 50 manatees are believed to inhabit the bay on this basis [213]. The animals are threatened most by high speed boat traffic.
Application of Results to Other Areas

Sarasota Bay is a very small, relatively clean system which ranks poorly where estuarine area or number of major problems are considered. On the other hand, it ranks highly in terms of preservation need and in terms of its vulnerability because of its small size. It is also distinguished by having more problems resulting from development and overuse than from pollution, especially the many forms of pollution which plague northern estuaries. In this regard, Sarasota Bay represents an excellent setting in which to develop and evaluate management tools focusing on development and overuse impacts. The small size of the bay is an added advantage in such a context. Overall, Sarasota Bay offers the opportunity to address nationally significant problems such as integrated beach/inlet/channel maintenance, nonpoint source control, habitat loss, and sea level rise. Results from a Sarasota Bay study would also be transferable to the large number of similar lagoons, bar-built estuaries, and small embayments throughout the gulf and south Atlantic coastlines. Extensive tourism and seasonal residence of northern and midwestern visitors would extend the benefit of a local bay environmental educational program to areas of the nation not involved with the National Estuary Program.
NEED FOR A MANAGEMENT CONFERENCE

Economic Importance of Sarasota Bay

Sarasota Bay supports or enhances about 50 basic, water-dependent industries, institutions, and operations and about $20 million annually in overall payrolls. This direct benefit is augmented by an undocumented, indirect economic benefit and also by $115 million of economic value in the bay for wastewater and stormwater disposal. In addition, residential waterfront property has an estimated value of $1.9 billion. Close proximity to the bay (less than 2% of the two county land mass) results in property tax equal to more than 19% of the total two county tax base [58].

The Sarasota Bay area's principal commercial interest is tourism, which involves a recreational use of the bay and other natural and cultural resources. Consequently, distinctions between the dollar value of the bay for recreation are difficult to separate from the dollar value of the bay for commercial uses. A tourist development tax in Manatee County indicates growth of tourism in the bay area:

<table>
<thead>
<tr>
<th>Year</th>
<th>Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982</td>
<td>$383,998</td>
</tr>
<tr>
<td>1984</td>
<td>495,363</td>
</tr>
<tr>
<td>1986</td>
<td>628,263</td>
</tr>
<tr>
<td>1988</td>
<td>1,057,936</td>
</tr>
</tbody>
</table>

In 1987 Manatee County had 1.4 million tourists and Sarasota County had 1.3 million tourists. The combined expenditures by visitors to both counties amounted to approximately $1,574,043,000.00 (1-1/2 billion dollars) in 1987 alone.

A 1986 economic impact statement on the designation of Sarasota Bay as an Outstanding Florida Water estimated the total annual economic value of recreational fishing in the bay area to be $38,001,471 (in 1983 dollars) [108]. The economic value of other types of water related recreation (saltwater boat ramp use, beach activities, etc.) was estimated to be $9,949,223 (1983 dollars) [108]. These data indicate the extent to which tourist expenditures depend on Sarasota Bay and its amenities.
Living Resources

Sarasota Bay supports a rich and diverse assemblage of invertebrates, vertebrates, macroalgae and higher marine plants (Table 2). Commercially important species include blue crab, stone crab, (pink) bait shrimp, mullet, red drum and spotted sea trout.

Table 2. Estimated species richness of Sarasota Bay biota. Adapted from Estevez (1984); Tampa BASIS (1985) and Sarasota BASIS (1988).

<table>
<thead>
<tr>
<th>Taxon</th>
<th>No. Species</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INVERTEBRATES</strong></td>
<td></td>
</tr>
<tr>
<td>Mollusca</td>
<td>225</td>
</tr>
<tr>
<td>Annelida</td>
<td>150</td>
</tr>
<tr>
<td>Crustacea</td>
<td>250</td>
</tr>
<tr>
<td>Echinodermata</td>
<td>15</td>
</tr>
<tr>
<td>Others</td>
<td>200</td>
</tr>
<tr>
<td><strong>VERTEBRATES</strong></td>
<td></td>
</tr>
<tr>
<td>Elasmobranchs</td>
<td>21</td>
</tr>
<tr>
<td>Fishes</td>
<td>170</td>
</tr>
<tr>
<td>Reptiles and Amphibians</td>
<td>4</td>
</tr>
<tr>
<td>Breeding Birds</td>
<td>30</td>
</tr>
<tr>
<td>Wintering</td>
<td></td>
</tr>
<tr>
<td>Maritime Birds</td>
<td>50</td>
</tr>
<tr>
<td>Mammals</td>
<td>2</td>
</tr>
<tr>
<td><strong>MACROALGAE</strong></td>
<td></td>
</tr>
<tr>
<td>Green algae</td>
<td>85</td>
</tr>
<tr>
<td>Brown algae</td>
<td>45</td>
</tr>
<tr>
<td>Red algae</td>
<td>140</td>
</tr>
<tr>
<td><strong>HIGHER MARINE PLANTS</strong></td>
<td></td>
</tr>
<tr>
<td>Seagrasses</td>
<td>4</td>
</tr>
<tr>
<td>Intertidal plants</td>
<td>20</td>
</tr>
<tr>
<td><strong>ESTIMATED TOTAL:</strong></td>
<td>1,411</td>
</tr>
</tbody>
</table>

There are 153 commercial blue crab permits and 180 stone crab permits issued for the two county area. Blue crab landings show marked, continual declines from 177,000 lbs/yr in the 1950's to about 30,000
lbs/yr today [290]. Overfishing and habitat loss are believed responsible for the decline. Stone crab landings (of claws only) have increased from 6,400 lbs/yr to 24,000 lbs/yr over the same period due to increased demand. Bait shrimp landings have fallen precipitously, causing some to regard the fishery as completely collapsed -- but this may be an artifact of reporting [290]. Some commercial bait fishing currently occurs in the bay, but new requirements for trip ticket reporting have yet to yield data to evaluate trends.

Sarasota Bay's finfish resources are mullet (commercial only), red drum and spotted seatrout (commercial and sport), and snook (sport only) [71]. Mullet represents the largest fishery, with 2 to 6 million lbs landed annually. Whole fish are sent to local markets and manufacturers of fish products. Mullet roe has become a major byproduct, shipped to oriental markets. There may be some decline in mullet landings, but trends are indefinite. Spotted sea trout landings, however, have fallen six-fold from 300,000 lbs/yr in the 1950's, due to the destruction of seagrasses and probably overfishing [133]. Red drum landings peak at about 200,000 lbs/yr and vary widely. In the 1980's, landings have been near 50,000 lbs/yr. The status of red drum has been declining throughout Florida, and last year seasons were adopted for their protection. Snook is a highly prized sport fish for which there are no landing data, but concern over their diminishing number has caused the adoption of seasons, plus limits to size, gear, and catch. Declines in snook stocks are attributed to nursery habitat loss and overfishing. Table 3 presents a summary of 1985 landings and ex-vessel value for commercially important fisheries in Sarasota Bay.

<table>
<thead>
<tr>
<th>Species</th>
<th>lbs</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Drum</td>
<td>45</td>
<td>32</td>
</tr>
<tr>
<td>Black Mullet</td>
<td>1,441</td>
<td>728</td>
</tr>
<tr>
<td>Spotted Seatrout</td>
<td>70</td>
<td>63</td>
</tr>
<tr>
<td>Blue Crab</td>
<td>17</td>
<td>8</td>
</tr>
<tr>
<td>Stone Crab</td>
<td>36</td>
<td>148</td>
</tr>
<tr>
<td><strong>TOTALS:</strong></td>
<td><strong>2,609</strong></td>
<td><strong>949</strong></td>
</tr>
</tbody>
</table>
Restoration of Hard Clam Fishery

According to marine shellfish landing data, hard clams were landed in Sarasota County until 1971. Ten years of relatively stable landings (1953-1963) averaged 15,015 lbs/year. After 1963 landings were erratic and usually less than 10,000 lbs/yr. The hard clam fishery apparently closed as a result of discontinued effort (the landings were not moved to Cortez, in Manatee County, which was the case for some finfish catches). Whether abandonment was due to water quality declines is uncertain, but the present-day occurrence of unclassified or closed water in the bay has prevented the fishery from reopening.

Assuming that 1953-63 landings were taken entirely from Sarasota Bay (plus Roberts and Little Sarasota Bays) and represent sustainable yield under low to moderate harvesting effort, it is reasonable to consider a renewed annual landing of about 20,000 lbs if and when Sarasota Bay is approved for shellfish harvest. In 1984 the statewide average dockside value of hard clams was $3.53, so recovery of a hard clam fishery in Sarasota Bay could represent approximately $70,600 (1984 dollars) of new products. This estimate does not consider the effect of size-selection and variable price schedules, or of marketable by-catches (sunray venus, cockles, etc.).

Problem Statement

Resource management problems and issues in Sarasota can be identified from historical references, workshop and conference proceedings, local government plans, and other sources. As used here, "problems and issues" are in reference to both the causes of management concerns (such as nutrient enrichment) and also the symptoms or effects such concerns can take (such as algae blooms).

Table 4 tabulates all of the problems and issues which could be identified on Sarasota Bay, its resources, and surrounding areas. Major groupings were used to organize the list, following the outline of previous Sarasota Bay problem summaries. No ranking of items within a group was intended, although the relationship of problems is described later in this section.
Table 4. List of Resource Management Problems and Issues in Sarasota Bay and Surrounding Areas. No priorities are intended by the order of listed items.

A. Geological
1. Increased fine sediments from beach projects.
2. Increased fine sediments from inlet projects.
3. Increased fine sediments from channels and spoils.
4. Increased fine sediments from nonpoint sources and wastewater.
5. Infilling of canals with sediments.
7. Erosion of bay shorelines.
8. Lack of integrated beach and inlet planning.
9. Unused channels, basins and borrow pits.
10. Spoil island and shoal erosion.
11. Migration of dredge spoils from offshore dump sites.
12. Restoration and management of beach dunes.

B. Hydrological
1. Sea level rise.
2. Altered circulation and flushing.
3. Increased wave energy from boat wakes.
4. Increased wave energy from hardened shorelines.
5. Increased runoff from uplands.
6. Altered hydroperiods in upland systems.
7. Declining salinity.
8. Intracoastal Waterway impacts in Lower Sarasota Bay.
10. Operation of reservoirs in Manatee County.
11. Poor flushing of Grand Canal.
12. Impacts of mosquito control ditches.
13. Runoff from barrier islands.

C. Chemical
1. Eutrophication.
2. Nutrient enrichment in canals.
5. Oxygen depletion in canals and tributaries.
6. STP precipitation of CaCO3.
7. Nonpoint source loads of nutrients, metals, biocides.
8. Contaminant accumulation in bay sediments.
10. Oil, grease and toxic paints from boats and marinas.
12. Impacts of mosquito control chemicals.
13. Closure of Palma Sola Bay for shellfishing.
15. Septage wastes from leisure craft.
Table 4. continued.

17. Nutrient enrichment from Tidy Island to Long Bar Point.
18. SKUA effluent into Grand Canal.
19. Aeration test in Bayshore Gardens/Trailer Estate.
20. City of Sarasota STP effluent in Whitaker Bayou.

D. Biological
1. Phytoplankton blooms.
2. Red tides.
3. Macroalgae blooms.
4. Loss and alteration of shallow water habitats.
5. STP effluent and nonpoint discharge impacts to benthic fauna.
6. STP effluent and nonpoint discharge impacts on shellfish areas.
7. Exotic plant species.
8. Uncontrolled predators in rookeries.
11. Declines in specific fisheries.
12. Propeller damage to seagrasses.
13. Fishery allocations to sport vs. commercial users.
14. Unauthorized mangrove trimming.
15. Manatee losses due to collisions.
16. Turtle nest loss to predators and vandalism.
17. Turtle hatchlings loss to predators and disorientation.
18. Harassment of marine turtles, birds, mammals.
20. Loss of tidal creek habitat.
22. Impacts of mosquito control ditches.
23. Abandoned fishing nets and traps.
24. Loss of salt flats and high intertidal habitats.
25. Eutrophication of Grand Canal, Heron Lagoon.
26. Erosion of Bay Isles mangrove bar.
27. Seabird panhandling.
29. Parasitism of fishes in tidal creeks.
30. Bowlees Creek habitat restoration.

E. Cultural
1. STP effluent and nonpoint discharge impacts on recreation.
2. Loss of access points to bay.
3. Boat traffic congestion.
4. Conflicting vessel uses.
5. Unclassified shellfish areas.
6. Post-hurricane contingency plans.
7. Cross bay bridge.
8. Restrictions to scenic access.
Table 4. continued.

9. Beach access.
10. Litter.
12. Erosion of Cortez Village as a cultural resource.
15. Apathy and inexperience regarding hurricanes.
16. Funding of beach nourishment projects.
17. Lack of fishing piers.
18. Use of City Island.
19. Division of bay into 2 regional planning councils.
20. Acquisition of Emerson Point, Riverbay and Perico Island.
21. Scheduled vs. demand bridge openings.

F. Regulation and Management
1. Uncoordinated monitoring programs.
2. Inconsistent tree ordinances.
3. Accumulation of local acts regulating fishing.
4. Lack of goals and objectives.
5. Independent, inconsistent permitting procedures.
6. Inadequate compliance monitoring and enforcement.
7. Lack of a bay management plan.
8. Inconsistent dock permitting procedures.
10. Inadequate coordination between scientists and governments.

G. Education and Research
1. Discharge and loading in tidal creeks.
2. Fine sediment budget for bay.
3. Resource inventory and monitoring.
5. Fishery stock assessments.
7. Bay resource atlas.
8. Signage for turtles, manatees, birds.
11. Stormwater impacts to bay.
12. Relation of groundwaters to surface waters and bay.
15. Lack of bay related educational programs.
17. Poor dissemination of environmental information.
18. Lack of synthesized data base and data outlet.
19. Need for more open-water monitoring stations.
20. North Creek monitoring and trend analysis.
The 120 individual problems and issues listed in Table 4 were condensed into several sets and arranged with respect to management complexity. Criteria used for the sets and arrangements were (1) overlap with other problems; (2) extent to which problem concerns the cause of many other problems; (3) responsiveness to local needs; (4) recognition of MC strengths; (5) the degree to which a problem is unique to the area, or is of national significance but may be easier to address in the Sarasota Bay area because of other circumstances; and (6) the probable role of federal, state and/or local government involvement.

The sets are arranged from most federal involvement to most local involvement in Table 5. Sets are meant to be organizing concepts around which management projects can develop, assimilating a number of specific, related problems in the process. Not all specific problems can be addressed by the sets described below, but refinement of the approach should improve such coverage.

Problem descriptions can only be developed once they are ranked by importance and studied in greater depth. This process is part of a NEP Management Conference but would also occur in a non-federal management initiative. In either case, key questions to address in the process of problem review will include (1) is the perception of the problem accurate; (2) does the problem influence a large part of the estuary; (3) can the likely cause of the problem be identified; and (4) is it feasible to correct the problem? Based on these criteria, four priority problems in Sarasota Bay are identified and discussed in greater detail. Possible causes of these environmental and management related problems and issues are presented and management action plans to address those problems are addressed.
Table 5. Major Problem Sets for Sarasota Bay, in Order of Management Complexity. No priorities are intended by the order of listed items.

A. Federal, state, regional and local participation

These problem sets would benefit from a significant level of federal participation in addition to state, regional and local involvement.

- Stormwater runoff. The watershed is mostly developed and programs to retrofit existing developed areas will be complicated and costly. Stormwater is a serious problem in the bay, but improvements to runoff management systems should be measurable in terms of bay resources and values. Response to runoff projects will be easier to detect than in systems facing multiple stresses. Studies of runoff in tidally affected creeks would be nationally significant.

- Beach/inlet/channel management. At present, beaches are (or can be) nourished by federal or state or local agencies, or private parties. Inlets may be dredged for navigation, beach spoil, or both goals. Approach channels and the Intracoastal Waterway are managed with minimal local role. Impacts of these combined, inter-related activities are significant and tools developed to manage these impacts would be nationally useful. The opportunity to address these problems may be unique to the bay area, if they are not identified as important resource management issues in other priority estuaries named in the Water Quality Act of 1987.

- Habitat creation and restoration. A number of specific problems concern habitat. The status, restoration, and preservation of seagrasses is the most important habitat issue in the bay. The special problem of intertidal habitat in Sarasota Bay is the lack of suitable, naturally occurring sites. Impaired habitat can be restored, but significant habitat gains will be more complicated to justify, design, implement and evaluate. A federal involvement will be needed to develop habitat creation projects in urban settings where potential space is
Table 5. continued.

limited. Such projects would be nationally useful, however, as models for similar situations.

- Access improvements. Taken collectively, problems of scenic, beach, boating, and passive access form a set of significant impediments to full use of the bay. Access builds a popular constituency for the bay which creates support for other management programs but will require state and regional effort to accomplish during initial project stages.

B. State, regional and local participation.

These problem sets are probably amenable to solution by non-federal governments if coordinated in a management conference framework. Federal participation could enhance specific work elements through application of national expertise.

- Coordinated monitoring. This set includes problems of data retrieval, synthesis, and application to management issues, and also adjustments and additions to water quality and other environmental samplings in the bay. A relevant model may be the SWIM\(^3\) data compilation project underway in Tampa Bay.

- Shellfish sanitation. Conditionally approved areas are closed on intermittent or continuing bases. Harvests in other areas are prohibited due to runoff, or prohibited by default because the area has not been evaluated. A program to reopen, open, and study these areas is needed.

- Fisheries assessment, management and restoration. This problem set addresses the unknown status of shellfish and finfish stocks; recreational effort; local laws; allocation disputes; and habitat needs. Protection of stone crabs and bait shrimp, and restoration of scallops deserve special effort.

\(^3\)Surface Water Improvement and Management Act of 1987.
Table 5. continued.

- Sea level rise (SLR). Federal involvement in this issue far outdistances state activity despite Florida's special relation to the sea. The development of a meaningful assessment of SLR impacts for Sarasota Bay would help the area in terms of research and contingency plans and also represent a national demonstration project for community-level participation (Figure 9). The issue is also relevant to turbidity, habitat, stormwater and other major problems.

C. Regional, local and private participation

These sets are probably amenable to solution without extensive commitment of federal or state resources other than their role in providing a management framework. As in the previous case, federal or state involvement would significantly enhance specific work elements.

- Coordinated planning. It does not appear that coordination requirements of state planning laws will be met for Sarasota Bay, much less their codification in capital improvement, land use, or other implementation measures. Emphasis needs to be placed on adjoining governments and specific consistency between regional plans.

- Plans for geographic areas of particular concern (GAPC). This set recognizes the many site-specific management needs occurring around the bay, and would create a mechanism within the larger conference process to develop GAPC plans with goals, plans, studies, etc. tailored to each area's particular needs. The GAPC approach is an approved part of coastal zone management programs at the state level, but has not been used widely at the regional or local level.

- Educational programs. The lack of general and specific educational programs is one of the most often cited problems regarding Sarasota Bay. Educational programs, public participation, and related activities are central to all phases of bay management but can be handled adequately by regional and local governments. One nationally
significant aspect of a Sarasota Bay educational program would be the extensive involvement of tourists and seasonal residents. These persons would return to their northern homes with conservation knowledge applicable to problems in distant neighborhoods.

Boat traffic improvements. This set addresses wake erosion, manatee protection, seagrass signage, multiple uses, bridge operation, marina practices, and related problems. Access and use cannot be formally restricted, so policies and procedures related to boating must be developed to accommodate a growing boater population.

D. Local and private participation

With the incentive and technical support of a management conference, local governments and private citizens should be able to make significant contributions to the health of the bay in several areas.

Shoreline protection and management. A uniform, rational and ecologically beneficial approach is needed by local governments and waterfront landowners to remove seawalls, optimize dockage, enhance native vegetation, and control litter. (This set refers mostly to bay shorelines but could be addressed in conjunction with gulf beach projects.)

Control of exotic tree species. Encroachment of natural, mangrove-vegetated shorelines by Brazilian pepper and Australian pine, and, to a lesser extent, ornamental vegetation can be effectively prevented through a cooperative program involving local governments and citizens.

It is worthwhile to compare the major problem sets to the five priority threats identified as part of the Near Coastal Waters Initiative.

Toxicants -- Sarasota Bay has no industrial effluents or major point sources and dredge spoils are not contaminated. Some contaminants enter the bay as urban runoff, but agricultural runoff is small and diminishing. The absence of toxicants will simplify cause-effect research.
Pathogen Contamination -- Sarasota Bay contains areas closed to shellfishing due to the impact of sewage plant effluent, and shellfish have been identified as a major problem set. Human gastrointestinal diseases traceable to contaminated shellfish have also been reported from the bay area.

Eutrophication -- This threat is addressed in several bay concerns and the major problem set on stormwater runoff. Acute impacts of STP effluent include loss of seagrass beds, but algal blooms and fish kills (unrelated to red tides) are apparently increasing.

Habitat Loss/Modification -- This threat is represented by half of the major problem sets identified for Sarasota Bay and overlaps with "changes in living resources" with respect to many particular bay problems. Some habitat issues are very long term (sea level rise) or complex (urban settings), while others are site-specific or can be addressed at a local level (exotic species control).

Changes in Living Resources -- This threat results most directly from development and overuse which typify Sarasota Bay. Losses of shellfish and finfish are of immediate concern and were identified as major problem sets.

Finally, Sarasota Bay may be threatened by programmatic issues such as uncoordinated or ineffective monitoring, inadequate educational programs, incomplete land use planning, and other institutional shortfalls.

Priority Problems

In the preceding section, 14 major sets of problems were identified which included many of the very specific problems or issues facing the bay. All of the specific and general problem statements are perceived rather than established problems, and it will be an early but important task for the management conference to validate the perceived problems and reduce each to testable, resolvable statements. Likewise, the following presentation of "priority problems" is offered without benefit of detailed scrutiny. No effort has been made, for example, to involve local governments in ranking problems/issues by priority, and priorities reflected in this section will be revisited during the management conference. The "priority problems" are presented to indicate some familiarity with the bay's most probable problems and show that these are nationally significant.
1. Beach/Inlet/Channel Management

One of the innovative aspects of the Sarasota Bay nomination concerns the need and opportunity to develop an integrated program for beach nourishment, inlet maintenance, and waterway maintenance. As previously described, barrier beaches in the Sarasota Bay area are renourished as federal, state, or local government programs or private initiative. Sediment sources include offshore borrow areas, ebb-tidal deltas, and inlets. Inlets are maintained as federal or local programs. Access channels are maintained as local or regional government programs or private initiatives. The Intracoastal Waterway is maintained as a federal project. None of this dredging occurs within a coordinated planning framework, so schedules, permits, funding, and monitoring progress on independent tracks with unknown (but probably adverse) effects on economy, efficiency, and effectiveness.

Direct and indirect effects of dredging and filling have not been evaluated with respect to water quality but are considered serious. Some beaches on all islands have been nourished at least once [323]. Longboat and New Passes have been dredged for navigation purposes. The Intracoastal Waterway definitely caused several areas of bay-bottom to be spoiled [320]; may be responsible for large losses of seagrasses in the north bay due to indirect turbidity effects; and is believed to have caused or enhanced closure of Midnight Pass (in Little Sarasota Bay, between Siesta and Casey Keys) [251]. Major residential and commercial filling projects have been conducted on Bird, Lido, and Longboat Keys and City Island [89, 95]. These combined projects have altered circulation, tidal prisms, fine sediment budgets, inlet stability, bay transparency, and other parameters.

These physical changes are believed to have caused --and continually cause-- significant alterations to Sarasota Bay and adjacent areas by altering beach sediment dynamics, affecting inlet bypassing, impacting tidal deltas and the biota they support, increasing erosion near inlets, changing boundary conditions for the bay (such as tidal prisms and current velocities), introducing fine sediments into the bay system, keeping fine sediments in the system longer, covering productive
areas of bay bottom, increasing turbidity, altering circulation, and affecting the movement of estuarine animals.

For these reasons, there is a need to supplement the existing regulatory and planning process where beach nourishment and management, inlet channel maintenance, and related issues are involved. Assistance in obtaining federal cooperation will be of particular importance, and development of an integrated plan will create an opportunity to address a number of specific bay problems.

2. Stormwater Runoff

Stormwater runoff contributes by far more of the total suspended solids and 30-50% of nutrients, compared to point sources, and the amount of stormwater is expected to increase with urbanization. The impact of stormwater in Sarasota Bay is probably an alteration of transparency and resulting loss of seagrasses, especially when combined with the impact of nutrients from stormwater and STP effluents. Sedimentation and sediment contamination will significantly worsen as the region's population and infrastructure grow.

Control of nonpoint sources in the Sarasota Bay area will require significant advancements beyond previous federal and state regulations and management tools. The watershed is very flat, subject to intense summer rains and flooding, has a high water table, and is close to sea level. Creeks and built drainage systems are tidally influenced over much or all of their respective lengths. Tidal action has seriously confounded efforts to measure loading and impacts and also has been a major design problem for retention systems and other nonpoint controls. It may be possible to link habitat programs to stormwater projects, given the tidal character of the drainage system. Drainageways may be an important resource for habitat creation because of the natural relationship of wetlands to areas of low relief, and because most of these areas are either publicly owned, maintained, or used by easement. Another possibility for long-term habitat improvements may exist in the new inlets, shoals and deltas, beaches, and wetlands that will be created after very strong hurricanes. Contingency plans will be needed in order to take advantage of such events on a timely basis. All of these projects are also related closely to sea level rise because rapid rise of
sea level is certain to affect drainageways, habitat, and the vulnerability of coastal resources to hurricanes.

3. Habitat Loss

Aquatic habitat loss (seagrass beds, mangrove communities, and other nearshore areas) is a serious problem in Sarasota Bay. These habitats are critical feeding and nursery areas for a variety of recreationally and commercially important finfish and shellfish. Between 1948 and 1979 there was a 54% decrease in seagrass cover along the eastern bay; a 65% loss around New Pass; and an 83% loss around Whitaker Bayou [259]. Baywide losses are estimated to be 20-30 percent [166]. Causes of these losses are not definitely known, but mineral turbidity (from beach, inlet and ICW dredging) and organic turbidity (from STP effluents) are suspected (Figures 10 and 11). Seagrass losses have also occurred as a result of boat propeller damage in shallower areas of the bay.

Mangrove forests surrounding Sarasota Bay have been impacted severely by shoreline development, dredge and fill activities and the invasion of exotic species such as Brazilian pepper and Australian pine. Changes in wetland and other shoreline acreages are not presently available for all of Sarasota Bay but such studies by Sarasota County are presently underway. Some areal data are available for Northern Sarasota Bay, however, for the periods 1957 and 1983 (NUS, 1986). Overall, there has been a 16% loss of beaches, mudflats and sandbars and a 17% loss of mangrove forest in the vicinity of Cortez, which is less developed than other areas of Sarasota Bay.

Evans and Evans (1988) evaluated linear shoreline trends for all of Sarasota and Roberts Bays, for 1948, 1978 and 1987 (Table 6). Total shoreline length (excluding gulf beaches) increased 164% from 65.6 miles (1948) to 107.6 miles (1978) due to canal construction. Since 1948, the relative amount of beach decreased 22%, bulkheads and revetments increased by 41%, and mangrove shorelines decreased by 18%. The linear coverage of exotic plants (Australian pines and Brazilian peppers) has doubled since 1948.
Figure  Distribution of Grassflats in Sarasota Bay - 1948

SOURCE: Sauers and Patten, 1981
Figure Distribution of Grassflats in Sarasota Bay - 1979
Table 6. Linear measurements of six shoreline types for the Sarasota County portion of Sarasota Bay for 1948, 1978 and 1987 (Evans and Evans, 1988). Measurements are in miles with the percentage based on total shoreline length for each year in parentheses. Data include Roberts Bay calculations for consistency with boundaries set by conference.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Beach</td>
<td>21.4</td>
<td>17.3</td>
<td>-17%</td>
<td>12.0</td>
<td>-22%</td>
<td>-5%</td>
</tr>
<tr>
<td>Bulkhead</td>
<td>9.3</td>
<td>47.2</td>
<td>+34%*</td>
<td>48.8</td>
<td>+41%*</td>
<td>+2%</td>
</tr>
<tr>
<td>Revetments</td>
<td>*</td>
<td>4.8</td>
<td>(4%)</td>
<td>*</td>
<td>(9%)</td>
<td>*</td>
</tr>
<tr>
<td>Mangroves</td>
<td>32.6</td>
<td>34.0</td>
<td>-18%</td>
<td>33.6</td>
<td>-18%</td>
<td>same</td>
</tr>
<tr>
<td>Other Vegetation</td>
<td>1.6</td>
<td>2.9</td>
<td>+1%</td>
<td>1.2</td>
<td>-1%</td>
<td>-2%</td>
</tr>
<tr>
<td>Australian Pine/</td>
<td>0.7</td>
<td>1.4</td>
<td>same</td>
<td>1.1</td>
<td>same</td>
<td>same</td>
</tr>
<tr>
<td>Brazilian Pepper</td>
<td>(1%)</td>
<td>(1%)</td>
<td>same</td>
<td>(1%)</td>
<td>same</td>
<td>same</td>
</tr>
</tbody>
</table>

* Values for 1948 revetments were included in the bulkhead measurements (Evans et al, 1978). Where noted, the revetment data are included in the bulkhead figures.

TOTAL MILES 65.6 107.6 105.9

4. Lack of Access to Bay Resources

Access concerns visual and physical connection to the bay and its resources. Visual access has been curtailed significantly by waterfront construction, especially of high rise buildings. A lack of bay scenery retards the feeling that it is a central aspect of the community, and hinders development of a public constituency for the bay. Physical access involves parking and pedestrian movement to beaches and shorelines; boat ramps; wet slips; anchorages; and channels. On the one hand, these access opportunities already are below desirable levels of
service and recreational use of the bay is restrained as a result. On the other hand, improvements to access are bound to increase traffic, congestion, accidents, user conflicts, and injury or overuse of limited natural resources (seagrasses, shellfish beds, bird rookeries, manatees, etc.). The rapidly developing bay area must reconcile these conflicts through systematic planning and evaluation. Results of such effort will be very relevant to other coastal sites experiencing rapid population growth.

**Cause and Effect Relationships**

Four major problem sets in Sarasota Bay deserving priority consideration are (a) beach/inlet/channel maintenance (b) stormwater, including urban runoff (c) habitat loss, and (d) lack of access to bay resources. These problem sets touch on Near Coastal Waters Initiative threats of toxicants (b,c); pathogens (b); eutrophication (b,c); habitat loss/modification (c); changes in living resources (c) and other, primarily institutional arrangements (a,c,d).

The management conference includes two milestones relevant to the understanding and correction of priority problems. One milestone is to identify causes of these priority problems, and develop hypotheses to relate the problems to their probable causes. Another milestone is to define the relationships in empirical ways. The latter milestone will be an important component of the stormwater study and --to a lesser extent-- of the habitat and dredging assessments. The extent to which the evaluations can be performed on access-related issues remains to be determined.

Stormwater relationships will benefit from advanced studies performed in Tampa as part of the National Urban Runoff Program (NURP) which, for example, identified tidal water as a complex source of pollutants and as a complication to receiving water models. These effects of tides probably occur in Sarasota Bay's tributaries, as well. Stormwaters in the bay area include runoff from farmland, numerous golf courses, and urbanized areas. Farmland runoff is an area of active study in west-central Florida and these results will benefit bay-area assessments. On the other hand, runoff characteristics of golf courses are very nearly unstudied. Sensitivity and risk assessments will be
needed on this subject, followed by characterization studies, if warranted. The results of such studies could be nationally significant.

There already exists considerable interest among local governments in the concept of combined habitat/stormwater projects. Lack of suitable sites for intertidal habitat is a nationwide impediment to restoration projects in urban areas. Wetlands can, however, be built into retrofitted or new stormwater systems and contribute to water quality improvements of runoff, especially nutrients and sediments. Another major area of habitat improvement is expected in seagrasses, especially with cessation of STP effluent discharges. Definition of the relationship(s) between seagrasses and STP effluent will involve monitoring of naturally occurring and experimentally introduced seagrasses, and water quality, before and after the effluents are removed from the bay. Potential indicators will include transparency, phytoplankton, epiphytic algae, and seagrass growth rates. It may be desirable to consider use of *Caulerpa* (a macroalga) for pioneer or companion plantings during the effort.

Issues to be dealt with regarding beach nourishment and dredging will have to include sediment types and their fine sediment content; effects of nourishment on nearshore turbidity under low energy climates and on turbidity in the bay during storms; alterations of inlet structure on tidal prism, circulation, transparency, and beach stability; and effects of maintenance dredging on seagrasses near the Intracoastal Waterway.

**Institutional Arrangements**

[RESERVE FOR STATE INPUT] ALSO SEE STEVE SAUERS’ SARABASIS MANUSCRIPT]
LIKELIHOOD OF SUCCESS

Resource Management and Pollution Control History

The Sarasota Bay area is urbanized in terms of its actual watershed, but the system is different than older, urbanized ones because it is recently settled and still has large areas of surrounding open space, farm land, and natural areas. The bay and basin have experienced only about 100 years of settlement [191]. The period prior to World War II saw relatively little change in land or bay use, and environmental laws have been in effect for the past 15 years, so significant alterations to the bay and upland occurred primarily during the period 1945-1975. Today extensive areas of the watershed support land uses first put there (except for pasture or open range). This situation means that infrastructure is not as complex, well developed, or permanent as in northern coastal areas, so changes in land use, storm drainage, sewerage, or shoreline conditions will be easier and less expensive to accomplish. The proximity of undeveloped interior lands may also facilitate projects which benefit the bay. Sewage treatment, for example, may be easier to provide at inland sites where gross densities are an order of magnitude lower than along the coast [239].

Today Sarasota Bay is more regulated than it is managed [258]. Regulatory limits to projects with adverse impact exist at the federal and state level, but local regulation can be traced to public outcry in the 1960s over expansion of Bird Key and destruction of mangrove forests on the bay side of Longboat Key by a real estate development company. Local regulations were adopted to limit similar projects and to establish waters in the City of Sarasota as a marine park. Since then, the regional water management district has implemented rules controlling runoff and surface water management projects, and the state has (through the Department of Environmental Regulation - DER) enforced legislative acts addressing nonpoint and wastewater treatment levels. Most recently, in 1985 the Environmental Regulatory Commission designated Sarasota Bay as an "Outstanding Florida Water" (OFW), bringing into play the severest effluent regulations that are currently available in the state. Basically, OFW status requires that the DER issue no permit which
directly lowers existing ambient water quality or indirectly degrades the OFW. The OFW status does not provide a management framework for the waterbody, even where water quality issues are concerned.

[STATE TO EXPAND ON OFW STATUS PER COMMENT FROM OMEP]

Sarasota Bay's management status is similar to most of Florida's coastal waters. Well developed management programs exist only for the state's largest systems (Apalachicola, Tampa, and Biscayne Bays, Charlotte Harbor and the Indian River Lagoon); one national park (Everglades); a national estuarine sanctuary (Rookery Bay); and a national marine sanctuary (Looe Key). More than 40 coastal sites are Florida aquatic preserves or state wild and scenic rivers: these sites have adopted plans or have plans under development which are more limited in scope than the bay management programs.

There have been several steps leading toward a management program for Sarasota Bay. In 1985 the state legislature passed the Local Government Comprehensive Planning and Land Development Regulation Act,

[STATE EXPAND ON LGCPA]

creating a new coastal management section in state law. The law was amended in 1985-86 and requires local governments to address specific plan topics; coordinate plans with neighboring governments; and be consistent with regional plans. Special effort must be made to ensure that "certain bays, estuaries and harbors that fall under the jurisdiction of more than one local government are managed in a consistent and coordinated manner". These requirements may set the stage for bay management, but revised plans alone will not contribute to a

4Program refers to the existence of goals and objectives; a coordination system such as a plan; mechanisms for affecting programs or policies of other governmental units; and other features associated with resource management.

5Apalachicola Bay is also a national estuarine sanctuary.
comprehensive program unless (1) the bay is viewed in its entirety by each plan; (2) the process leads to an institutional advocacy for the bay; and (3) each plan adopts the same language relative to the bay. These final measures are not required by state law, and the extent to which planning efforts will be redirected to achieve them remains to be seen.

Another significant advancement for Sarasota Bay’s management can be traced to the 1982 Tampa Bay Scientific Information Symposium, at which existing knowledge about that bay was reviewed and evaluated for management purposes. The symposium led rapidly to a series of work groups culminating in an Agency on Bay Management within the Tampa Bay Regional Planning Council. The Agency adopted a management plan [297] for Tampa Bay and is in its second year of implementation. Success in the Tampa Bay setting encouraged scientists and resource managers to meet in 1986 to assess the need for a management program for Sarasota Bay. The 1986 workshop recognized the value of such a program and endorsed a public symposium similar to that held for Tampa Bay [81]. The symposium, known locally as SARABASIS6 was held in 1987, and written proceedings will be available in 1988. Material from SARABASIS has been distilled for use by local planning agencies in preparing state-mandated comprehensive plans. Late in 1987 an estuarine seminar was held in Washington, D.C. on Tampa and Sarasota Bays under the sponsorship of the National Oceanic and Atmospheric Administration; SARABASIS materials also aided in preparation for that seminar and this NEP documentation.

Traditional Federal Programs
[STATE TO SUPPLY]

New Federal Activities
[STATE TO SUPPLY]

State Programs
[STATE TO SUPPLY]

---

6for Sarasota Bay Area Scientific Information Symposium.
Local Government Programs

1. Wastewater Treatment Improvements

Manatee County is presently constructing a deep well for use at its southwest regional facility, for use in relieving surplus effluent disposal problems. The plant presently uses golf courses for spray irrigation and private cropland for row irrigation but the well will provide an additional disposal option during wet-weather conditions. The well is being designed and tested for a 14.5 mgd capacity, and is scheduled for completion in October 1988 although final pump installation may not be finished until September 1989.

The City of Sarasota operates a 9.1-13.0 mgd advanced secondary plant which discharges to Whitaker Bayou near U.S. 41. The city is actively pursuing a reuse project in which effluent will be pumped to City-owned storage areas and thence to private farmland for spray irrigation. The project will cost approximately $23 million and will be funded by federal and state grants and local revenue bonds. The City is working closely with the State of Florida to develop wet weather alternatives: one possibility involves advanced treatment which would cost an additional $17 million. The City is also implementing an in-vessel composting system for sludge. Compost will be used as a soil amendment on city parks and will be available for commercial use. Finally, the City is replacing its master pump stations and has recently completed an inflow infiltration correction project for its collections system.

2. Other Existing Local Programs

The following is a summary of existing local government pollution abatement and natural resources management programs.

The City of Sarasota is currently implementing programs aimed at restoration and maintenance of water quality and natural resources for Sarasota Bay:

1) Wastewater treatment reuse system which will result in ultimate removal of the City's sewage treatment discharge from Whitaker Bayou and Sarasota Bay.

2) Stormwater attenuation ordinance to retain stormwater flows on site and limit flows to the Bay.
3) Erosion and sedimentation control measures, including turbidity screening to control nonpoint pollution sources.

4) Marine park district zoning regulating water related nearshore uses includes development plan review.

5) Shoreline protection and management actions for such areas as Bird Key Park and selected beach restoration projects.

6) Exotic tree control for city owned land.

7) Artificial reef program to expand fish resources.

8) Public access maintenance program for beaches, shoreline parks, boat ramps, docks and piers.

9) Sarasota Bay environmental educational programs.

10) Intergovernmental planning participation.

Sarasota County through its Department of Natural Resources and Department of Environmental Services has a significant program and regulatory commitment to Sarasota Bay water quality and natural resources enhancement by providing:

1) Water quality and sewage treatment plant compliance monitoring.

2) Dredge and fill regulation.

3) Coastal construction control line regulation.

4) Beach management planning and nourishment.

5) Navigation channel maintenance project.

6) Wildlife habitat restoration program.

7) Artificial reef construction and derelict vessel removal programs.

Manatee County through its wastewater utility, and planning and building inspection functions has a major program commitment to Sarasota Bay by providing:

1) Water quality monitoring and data collection to define background conditions and identify water quality improvement.

2) Wastewater reuse which consolidated many package plants, some of which discharged to Sarasota Bay.

3) Building inspection and certification program which implements the Federal Flood Insurance Program building requirements.
Collectively, these programs provide a significant initial basis for a successful Sarasota Bay Comprehensive Conservation and Management Program that would provide needed water quality and resource planning and coordinate existing, currently proposed and future programs.

3. Proposed Local Government Programs

The following proposed local government programs will benefit from as well as enhance the activities of a Sarasota Bay NEP Management Conference.

The City of Sarasota is developing a regulatory and structural approach for retaining more stormwater on site and controlling runoff to achieve environmental objectives. It is preparing the following programs for consideration:

1) A land development regulation ordinance requiring the retention and treatment of 40% of a development site's stormwater.

2) A stormwater management program financed by a service fee and including a level of service concept to improve bay water quality through runoff control.

The City and Sarasota County are considering a consolidated stormwater management program.

Sarasota County initiatives under development include the following:

1) A stormwater management program based on water quality and quantity limitations of the bay and streams to assimilate runoff, and also including a level of service approach.

2) Seagrass trend analysis update.

3) Beach management plan preparation.

4) A habitat restoration program.

5) Inlet dredging and maintenance projects.

6) Marine resources guide development addressing natural and manmade resources.

Manatee County is considering proposed programs for the following:

1) An environmental service fee to finance construction of in-stream and off-stream stormwater detection systems to achieve water quality and quantity objectives.
2) Agricultural runoff collection and redirection program.

3) Expanded urban reuse system for treated wastewater.

4) Land development regulations directed to reducing development densities in high hazard coastal areas.

Sarasota Bay has some regulation, but no comprehensive planning or management. These existing and proposed programs presently under consideration need water quality and natural resource planning now lacking for Sarasota Bay to assure their coordinated implementation and determine appropriate additional program needs. Removal of the City of Sarasota's wastewater treatment discharge provides a unique opportunity to determine its impact on the bay and what additional measures are needed to assure water quality, seagrass and other resource restoration.

Environmental Quality and Management Goals

Goal statements specific to Sarasota Bay do not exist at present, which is remarkable in light of the fact that the bay is the largest and most conspicuous landform and natural resource in the two county area. General goals exist in all local government comprehensive plans for tidal water, but most fail to reflect special knowledge or concern for conditions in the bay. Statements of expectations by the public are needed for the bay. These statements should describe bay features that should exist after some period of management effort. Goals should be verifiable, practical and meaningful. Above all, the goals should be formulated in an atmosphere of openness and concern for the wants and rights of all people who have an interest in the bay.

At this stage of pre-planning it is possible to establish five preliminary goals for the proposed National Estuary Program Study of Sarasota Bay:

GOAL I: Improve water transparency in the Sarasota Bay Study Area to the maximum allowable by the Gulf of Mexico and local weather conditions.

GOAL II: Reduce the quantity and improve the quality of stormwater runoff to Sarasota Bay.

GOAL III: Eliminate further losses of seagrasses and shoreline habitats and restore lost habitats.
GOAL IV: Coordinate beach/inlet/channel creation and maintenance activities to reduce dredging, eliminate conflicts, and enhance the bay.

GOAL V: Provide increased levels of managed access to Sarasota Bay and its resources.

GOAL VI: Establish a vertically integrated management system for Sarasota Bay.

Objectives are action statements which operationally define the steps necessary to achieve a goal. In light of existing NEP planning and documentation, the nature of the goals stated for Sarasota Bay, and the need for consistency between the NEP and State and local initiatives, the general objectives we can propose are based upon the seven purposes of NEP management conferences:

To assess trends in water quality, natural resources, and uses of Sarasota Bay;

To collect, characterize, and assess data on toxics, nutrients, and natural resources within Sarasota Bay to identify the causes of environmental problems;

To develop the relationship between the in place loads and point and nonpoint loadings of pollutants to Sarasota Bay and the potential uses of the bay, water quality, and natural resources;

To develop a comprehensive conservation and management plan that recommends priority corrective actions and compliance schedules addressing point and nonpoint sources of pollution to restore and maintain the chemical, physical, and biological integrity of Sarasota Bay, including restoration and maintenance of water quality, a balanced indigenous population of shellfish, fish and wildlife, and recreational activities in the bay, and assure that the designated uses of the bay are protected;

To develop plans for the coordinated implementation of the plan by the states as well as federal and local agencies participating in the conference;

To monitor the effectiveness of actions taken pursuant to the plan; and
To review all federal financial assistance programs and federal development projects in accordance with the requirements of Executive Order 12372, as in effect on September 17, 1983, to determine whether such assistance programs or projects would be consistent with and further the purposes and objectives of the plan prepared under this section.

Objectives which are specific to the stated goals may also be viewed as management actions which are necessary to achieve those goals. The following section identifies specific objectives for each goal statement and benefits from the attainment of the goal.

GOAL STATEMENT 1: Improve water transparency in the Sarasota Bay Study Area to the maximum allowable by Gulf of Mexico and local weather conditions.

Objective 1.1 Eliminate direct (Sarasota; Siesta Key) and indirect (Manatee County-Cortez) STP effluent discharges.

Objective 1.2 Reduce nutrient and suspended sediment loads from existing agricultural, golf-course and urban runoff to levels equal to those from newly-developed lands employing best available stormwater runoff controls.

Objective 1.3 Create intertidal wetlands, replace bulkheads with riprap, and take other similar measures to increase overall intertidal area, improve shoreline retention of suspended particulates and prevent erosion.

Objective 1.4 Design, conduct, monitor and evaluate beach nourishment, inlet maintenance, and channel dredging projects so as to reduce sources of turbidity, minimize resuspension and transport of particulates, and reduce erosion, and enhance the bay.

Benefits:
Significant increases to baywide transparency have direct aesthetic, recreational and ecological value, and relate directly to major problem sets and other perceived problems in the bays as follows:

A. Habitat Issues

Increased transparency will improve the light climate for seagrasses. Seagrass recovery can be expected in shallow areas affected by STP effluents or stormwater, and in deeper water where compensation...
depths would be increased. Also, shoreline projects to increase wetlands and otherwise "soften" hardened shores will help sequester suspended material and simultaneously mitigate previous wetland losses.

B. Fisheries Issues

Increased seagrass coverage would provide additional habitat for shellfish (bait shrimp) and finfish (spotted seatrout). Likewise, increased intertidal wetlands would benefit recruitment and maintenance of valued species, including sea and shore birds.

C. Stormwater Issues

Characterization and control of nutrients and turbidity from nonpoint source runoff will be needed to improve baywide transparency. Light (and its correlated parameters) are quantitative, easy to measure, amenable to modelling, and useful as integrating measures of success in controlling runoff impacts.

D. Beach Nourishment and Dredging Issues

Sediment sources, chronic turbidity, hydrodynamic changes, and other aspects of dredging and filling would be evaluated with respect to the cumulative impacts of many independent projects by using light and light-related parameters as bay-wide indicators of improved management.

E. Access Issues

The aesthetic and recreational value of the bay would be enhanced by significant increases in transparency, either by improving poor transparency in some areas or prolonging good visibility in others (or both). The ability to see well into or under the water enhances boating, wading, fishing, and diving, and also makes seagrass beds, manatees, and other vulnerable living resources easier to see and avoid.

Summary

Light-related parameters (transparency, turbidity, chlorophyll, total suspended solids, etc.) are useful in defining a meaningful, baywide goal that touches on a number of perceived problems. A goal of significantly improving the bay's light climate would seem to unify a number of necessary studies, control programs, and new policies and practices.
GOAL STATEMENT 2: Reduce the quantity and improve the quality of stormwater runoff to Sarasota Bay.

Objective 2.1 Coordinate regional and local stormwater runoff control strategies.

Objective 2.2 Retrofit existing stormwater systems to provide for attenuation and treatment.

Objective 2.3 Reduce impervious areas by using porous pavement when streets and parking lots are constructed or replaced.

Objective 2.4 Provide mechanisms for controlling direct stormwater runoff to bay tributaries.

Objective 2.5 Develop, implement and monitor best management practices for agricultural lands and golf courses.

Benefits:
Control and treatment of stormwater runoff to Sarasota Bay will result in decreased loadings of mineral and organic particulate matter as well as nutrients, heavy metals and hydrocarbons. Natural salinity regimes would be restored; transparency will improve, resulting in benefits to seagrasses; algal blooms will be less common and extensive; and there will be a slower accumulation of toxic materials in sediments.

GOAL STATEMENT 3: Eliminate further losses of seagrasses and shoreline habitats and restore lost habitats.

Objective 3.1 Improve the light climate of the bay so that most bay bottom can support recolonization of seagrasses.

Objective 3.2 Reduce nutrification impacts (algae blooms and epiphyte growth) to seagrasses.

Objective 3.3 Prevent introduction or resuspension of fine mineral sediments from beach nourishment and dredging projects.

Objective 3.4 Monitor recolonization of seagrasses in areas relieved of STP effluents.

Objective 3.5 Conduct experimental plantings of macroalgae and seagrasses to accelerate rates of seagrass colonization.
Objective 3.6 Convert bulkheaded shorelines to riprap or natural grades wherever possible.

Objective 3.7 Link habitat creation projects to stormwater control projects.

Objective 3.8 Adopt contingency plans for acquisition of intertidal habitats after hurricanes.

Objective 3.9 Inventory and acquire or protect low upland areas likely to be flooded by rising sea level.

Benefits:
A reversal in the trend of habitat loss will make it possible for Sarasota Bay to sustain a larger number of users without users experiencing a reduced level of individual benefit (e.g., as more habitat produces a larger stock of spotted seatrout, more fishermen can continue to catch the same number of trout that fishermen today enjoy). The indirect ecological effects of habitat improvement include increased ecological resilience to perturbations such as red tides or oil spills. Aesthetic and recreational benefits include improvements to scenery, enhanced opportunities for nature study, shelling, birding, and bay education.

GOAL STATEMENT 4: Coordinate beach/inlet/channel creation and maintenance activities to reduce dredging, eliminate conflicts, and enhance the bay.

Objective 4.1 Design and implement a coordinated program of beach and inlet management which makes full use of natural sand transport systems and minimal use of structural controls.

Objective 4.2 Incorporate habitat restoration criteria and beach access opportunities in all beach nourishment programs.

Objective 4.3 Evaluate all proposals for beach nourishment, inlet maintenance dredging, or new inlet dredging projects, and the creation or maintenance of navigation channels in the bay (including the Intracoastal Waterway) in terms of their cumulative, interactive and
long-term effects on circulation, flushing, transparency, and beneficial uses.

Objective 4.4 Identify habitat, circulation, sediment transport and other restoration opportunities in the study area and make these components of new beach/inlet/channel projects.

Objective 4.5 Develop and implement a post-hurricane contingency plan for acquisition of high-risk areas, important recreational or environmental resources, and navigation/access areas (Figure 12).

Benefits:
A coordinated dredging program would eliminate the increased erosion of beaches caused by inlet maintenance dredging, one commonplace conflict resulting from coordinated projects presently taking place in the bay. Dredging projects have actually heightened the need for more dredging in some specific cases and pitted some users (boaters) against others (beach users). A coordinated program would eliminate such conflicts; reduce the overall need for dredging; provide a much-needed cumulative impact assessment for dredging projects; prevent ecological and recreational losses; and provide a framework in which restoration projects could occur.

GOAL STATEMENT 5: Provide increased levels of managed access to Sarasota Bay and its resources.

Objective 5.1 Define levels of service for all primary forms of access.

Objective 5.2 Identify existing and potential conflicts and environmental impacts resulting from enhanced access.

Objective 5.3 Evaluate methods to reduce conflicts and impacts through area restrictions, use restrictions, seasons, or other methods.

Objective 5.4 Implement financial programs, educational projects, and controls to optimize access to the bay and resources.
Contiguous land development on Longboat Key: 1942, 1963 and 1980. By 1980, 73% of the shoreline had been altered by land development. In 1981, ownership and zoning of the remaining shorefront suggested that as little as 4% of the shoreline was guaranteed to remain undeveloped in the future.
Benefits:
As previously mentioned, improvements to access are badly needed but pose the risk of worsening conflicts among users and impacts to the resources which attract people to the bay. Improvements could be made for fishing access, for example, by the construction of bayside and gulf-side fishing piers. Waterfront picnic areas could be developed on abandoned spoil islands. Markers near seagrass beds would help boaters avoid running aground and also prevent propeller-dredging. With proper planning, methods for analyzing access issues and developing solutions could become protocols of national usefulness. One particular contribution would be the integration of environmental objectives in planning for access improvements.

GOAL STATEMENT 6: Establish a vertically integrated management system for Sarasota Bay.

Objective 6.1 Cause federal to local governments, plus stakeholders and public representatives, to jointly identify baywide goals, problems, solutions, and implementation strategies.

Objective 6.2 Cause these parties to commit to long-term (20 years, plus) financing, staffing, research, monitoring, enforcement, capital improvements, and other actions necessary to meet bay management goals.

Benefits:
Given the rapid rate of population growth and turnover in government staff and programs, some mechanisms for the perpetuation of bay management projects must be guaranteed. In the past, local (and state) governments have not received the full cooperation of federal agencies in achieving local resource management initiatives. The management conference can remedy this situation by causing federal, state, and local governments to work together throughout the process. In addition, local governments are likely to bear the burdens of long-term financing and implementation but will need funding assistance from federal and state sources, which require considerable lead time and coordination.
Management Conference Structure and Membership

On March 17, 1988 Mote Marine Laboratory and EPA Region IV staff conducted an NEP Preplanning Workshop, part of which was held for the purposes of (1) teaching local government representatives details of management conference structure and (2) soliciting input on the organization of policy, management, and citizen advisory committees. Four small groups evaluated specific committee proposals and decided on modifications which reflected their particular knowledge of local problems, governments, and specialists.

[STATE TO FINISH THIS PART.]

Public Support

There are several citizen groups with specific concerns for Sarasota Bay, such as Save Our Bays, Inc.; Midnight Pass Society; American Littoral Society; Sarasota Shell Club; Manasota 88; Izaak Walton League; Audubon Society; Sierra Club; Organized Fishermen of Florida; Florida League of Anglers; Florida Conservation Association; Manatee-Sarasota Fish and Game Association; Save Our Snook; Sarasota Sailing Squadron; Beach Preservation Associations; and a number of diving, fishing, surfing, and boating clubs.

Citizen involvement in local government activities affecting the bay include eight advisory boards or committees in city and county governments, the Florida Sea Grant Marine Extension Advisory Committee, and the TBRPC Agency on Bay Management (Manatee county only). Other interested groups include neighborhood associations, Chambers of Commerce, Boards of Realty, Leagues of Women Voters, and retiree associations. There is an extensive amount of documentation available on the involvement of citizens in bay-related affairs, including the resolution of multiple use conflicts; clean up projects, long range issues such as sea level rise, oil exploration, and offshore mineral mining; and fishing conflicts.

Sarasota Bay is used heavily for educational programs, including Sarasota County's Comprehensive Environmental Education Program; Sarasota County's High School marine biology courses; New College thesis and
independent study research; adult education programs sponsored by Manatee and Sarasota County School Boards, Mote Marine Laboratory, and others; and marine science summer camps sponsored by Mote Marine Laboratory.

Research

A review of literature on Sarasota Bay, its resources, and surrounding areas produced a bibliography of approximately 350 citations covering most areas of concern for resource management. Citations in the bibliography are divisible by authorship into contributions by government agencies, Mote Marine Laboratory, New College and miscellaneous sources, in decreasing order of output. (Reports by government agencies included a number of engineering and consulting reports performed under contract on a wide range of subjects.)

Mote Marine Laboratory (MML) is an independent, nonprofit institution established in 1955. It is situated directly on Sarasota Bay and has a staff of 65 scientists, specialists, technicians, and administrators, plus a large volunteer corps. The Laboratory conducts research in marine, estuarine, and riverine environments including Sarasota Bay. MML has an annual budget of approximately two million dollars and derives income from grants, contracts, and donations. The Laboratory sponsored the 1986 Sarasota Bay Workshop; cosponsored the 1987 Symposium; coordinates the Sarasota Bay Steering Committees; and is producing the Symposium Proceedings. Contributions by MML to the science and management of Sarasota Bay are available at the Laboratory, appear in the bibliography, and will appear in the SARABASIS Symposium Proceedings. Key among these are pre-nomination documents provided to DER, a Sarasota Bay "White Paper", and this report. Technically, MML has cooperated with federal and state agencies in a number of estuarine environmental assessments along the west coast of Florida (Table 7). These projects span chemical fate and effects, endangered species monitoring, resource inventories, impact assessments, policy analyses, and baseline data collection. MML has federal and state approval for program and project quality assurances and quality controls and has the facilities, staff, experience and management capability to perform a number of multidisciplinary studies on resources of Sarasota Bay.
Table 7. Mote Marine Laboratory studies in Sarasota Bay and adjacent waters.

**Sarasota Bay**

Environmental Evaluations of Sarasota Bay
Benthic Fauna and Phytoplankton Studies in Sarasota Bay
Hydrological and Hydrographical Study of Little Sarasota Bay
Ecological Monitoring of Midnight Pass and Little Sarasota Bay
Assessment of Estuarine Shoreline Alterations in Sarasota County
Sarasota Bay Ichthyoplankton Studies
Sarasota Bay Hydrography Study
Water Quality Survey Near Longboat Pass
Environmental Status of Sarasota Bay, 1980
Sarasota Bay Shellfish Survey
Midnight Pass Plankton Studies
Metals and Pesticides in Oyster Tissues in Phillippi Creek (unpublished data)
Assessment of Effects of Treated Sewer Discharge on the Benthic Infaunal Communities of Whitaker Bayou and Adjoining Sarasota Bay
Mosquito Control Chemicals in Mangroves
Red Tide Studies
Low Level Monitoring - Dolphins
Manatee Aerial Surveys
Marine Mammal Strandings
Wasteload Allocation Data Collection for Sarasota Bay
Grand Canal Ecological Reconnaissance
Analysis and Characterization of Tar Collected in New Pass
Coprostanol Distribution From Sewage Discharge into Sarasota Bay
Planning and Production of SaraBASIS (Sarasota Bay Area Scientific Information Symposium) conference and proceedings

**Tampa Bay**

Plankton Larval Survival Studies
Estuarine Ecological Studies
Thermal Effects of Benthic Communities
Evaluation of Effects of Dredged Material Disposal off Egmont Key, Florida
Surface Water Quality and Hydrology of Lower Tampa Bay
Aquatic Baseline Study in Lower Tampa Bay
Tampa Bay Estuarine Profile
Tampa Bay Ichthyoplankton Studies
Port Manatee Sediment Metals
Wetland Restoration in Tampa Bay
Marine Habitat Research
Table 7. Continued.

**Gulf of Mexico**

- Red Tide Study
- Gulf of Mexico Dump Site Study
- Artificial Reef Invertebrate Study

**Other Nearby Waters**

- Charlotte Harbor Water Quality and Literature Review
- Water Quality Assessment in Phillippi Creek
- Survey of Hydrocarbons in Sediments and Fauna of Charlotte Harbor
- Manatee River Wasteload Allocation Study
- Charlotte Harbor Benthic Survey
- Lower Hillsborough River Water Quality and Hydrography Study
- Manatee River Benthic Faunal Survey
- Lake Manatee Sediment Survey and Bathymetry
- Ringling-MacArthur Reserve Water Quality Studies
- Myakka River Ecological study
- Myakka River Wetlands Assessment
- Port Manatee Environmental Audit

The Mote Marine Laboratory opened a Southwest Florida Coastal Research Center in September 1987 to promote the development and use of scientific information for resource management needs along the Southwest Florida coast. Funded through a "partnership" of individual, corporate and public sources, the Center provides services and technical assistance beyond the scope of individual research projects. The objective of the Center is to bridge the gap between research activities and management needs by: identifying informational needs for regional problems, providing a data base of scientific information on the region's environment, and providing on informational resource managers and the general public.

**New College** is a small liberal arts school operated as the undergraduate honors program of the University of South Florida at Sarasota. The College awards Bachelor of Arts degrees in natural and social sciences, the arts, and environmental studies. All students are required to produce a senior thesis, and many have worked on problems of bay ecology and management. Students are also required to participate in independent study projects, some of which have addressed Sarasota Bay.
Faculty have also conducted research in the bay. Most student and faculty study of the bay has originated in the Division of Natural Sciences and the Environmental Studies Program (ESP). The ESP is an interdisciplinary program which cosponsored the Sarasota Bay Symposium, teaches courses on the local environment, and facilitates student research. Faculty and students from New College have worked closely with scientists at Mote Marine Laboratory on a number of projects.

Since 1967, 133 senior projects at New College have dealt with environmental topics (13 in the Humanities Division; 48 in the Social Sciences Division; and 72 in the Natural Sciences Division). The Campus is located on Sarasota Bay and taking advantage of the bay as a research laboratory, 38 research projects related to Sarasota Bay have been completed by New college students, staff, and faculty. A variety of topics have been addressed: shoreline conditions, mosquito control ditches, sewage and stormwater impacts, recreation, aesthetics, restoration of wetlands and spoil, hazard perception, cultural history, and natural history.

Values, threats and solutions have been addressed in three quarters of these projects. Natural history studies describing shrimp, seagrasses, and fishes of the bay contribute to knowledge of the bay's ecological value. A 1977 study [279] documented the visual quality and aesthetic value of local tidal creeks. A 1982 project [51] examined the changes in primary productivity in a mangrove forest that had been ditched for mosquito control, and several studies have considered the effects of residential canals and seawalls on adjacent estuarine waters [200; 237].

Often projects have contributed to knowledge of values and threats. An example is a 1988 project that included a photoessay of shoreline conditions in Sarasota Bay (values) and a survey documenting the trend of shoreline hardening (threats).

In the area of solutions, a student proposed a waterfront park design for a vacant city-owned waterfront parcel [73] and several students have experimented with artificial habitat construction for young stone crabs, whose nursery habitat has been displaced by seawalls [26;
327]. Others have considered restoration of spoil piles in wetlands (Lee 1988) and the construction of mitigation ponds (Murer, 1988).7

New College has also played a central role in the bay area as a facilitator and sponsor of public involvement in environmental issues. The ESP sponsors seminars, workshops and conferences on wetlands, Sarasota Bay management, inlet management, and a number of other issues. ESP staff and students are used as facilitators in a variety of public participation programs, as well.

Public Participation

The Sarasota Bay Management Conference will require a two-way flow of information between the conference and public in order to succeed. The Citizens Advisory Committee is an integral component of this flow of information, but prior to its establishment, the Policy and Management Committees will assess information on issues and politics of the bay area in order to assist staff in development of a work plan for public participation. The CAC would be asked to review and approve the work plan as one of its early tasks.

Other components of the public participation program will include newsletters, meetings and workshops, slide shows, and local media liaison. A "Bay Day" celebration similar to that held after the Sarasota Bay Symposium could become an annual event. After reviewing the Florida Sea Grant Newsletter (Marine Scene) and communications from Sarasota County's comprehensive environmental education program, a new bulletin on the bay and the NEP is probably justified. A slide show on Sarasota Bay has already been produced by Mote Marine Laboratory's Coastal Research Center, compiled from materials developed on the status, resources, and problems of the bay. The show has been revised based on local government input and could be used as the first in a series of popular lectures.

The public participation program would be effectively administered either by the MML Coastal Research Center or New College Environmental Studies Program, or both. The ESP staff are trained in small group process and meeting facilitation, and both centers have extensive mailing lists. New College already possesses a desktop publishing system. The ESP has sponsored four major conferences (SARABASIS; Crises of Our Beaches; Florida for Floridians; Cumulative Wetland Impacts) and is well-regarded for emphasizing the involvement of participants through the use of surveys and questionnaires, nominal group procedures, and American Assembly techniques. One ESP coordinator chairs the Myakka River Resource Management Coordinating Council, a public advisory group created by the Florida legislature.

The large number of tourists and winter season residents in the bay area pose unique problems and opportunities for public participation programs. Short-term visitors may completely miss infrequent projects but still interact with the bay or its resources in significant ways. Seasonal residents may be fiscal conservatives enjoying the lack of a state income tax, availability of homestead exemption, and lenient estate restrictions. This group may have strong and vocal opinions concerning public expenditures for natural resource management. On the other hand, public participation programs equipped with such insight and adapted to specific types of tourists and visitors could extend the benefits of bay management well beyond the geographic area of Sarasota Bay. In this regard the Sarasota Bay Management Conference has an opportunity to affect residents' attitudes toward resources (and resource management) in the visitors' own communities and states.

**Political Commitment**

Existing and proposed local government programs were reviewed in a previous section (see Likelihood of Success: Local Programs). Local governments are prepared to provide matching funds for and through the state office as required by terms of the NEP Agreement (see Financial Capability, below), and have participated in every phase of SARABASIS and NEP preplanning.
Some very recent developments also indicate the political commitment to bay management. In Manatee County a referendum recently won large popular approval for a bond-issue to acquire sensitive wetlands at the mouth of the Manatee River, near Perico Bayou. The Florida Legislature is likely to pass a bill this year aimed at bolstering fish populations in and around Sarasota Bay by attaching a $300.00 gill net license to commercial fishing permits. Revenue from the fee, which already is collected in Manatee County, will be used for habitat restoration. The fee concept was developed by commercial fishermen and is being implemented at their request.

Financial Capability

[STATE TO PROVIDE]
SUMMARY AND CONCLUSIONS

Sarasota Bay was identified in Section 317 (National Estuary Program) of the Water Quality Act of 1987 for priority consideration as an estuary of national significance. The bay is the only Florida system so identified and the only subtropical one. It is a very small, relatively clean system which ranks poorly where estuarine area or number of major problems are considered. On the other hand, it ranks highly in terms of preservation need and in terms of its vulnerability because of its small size. It is also distinguished by having more problems resulting from development and overuse than from pollution, especially the many forms of pollution which plague northern estuaries. In this regard, Sarasota Bay represents an excellent setting in which to develop and evaluate management tools focusing on development and overuse impacts. The small size of the bay is an added advantage in such a context. Overall, Sarasota Bay offers the opportunity to address nationally significant problems such as integrated beach/inlet/channel maintenance, nonpoint source control, habitat loss, and sea level rise. Results from a Sarasota Bay study would also be transferable to similar lagoons, bar-built estuaries, and small embayments throughout the gulf and south Atlantic coastlines. Extensive tourism and seasonal residence of northern and midwestern visitors would extend the benefit of a local bay educational program to areas of the nation not involved with the National Estuary Program.