



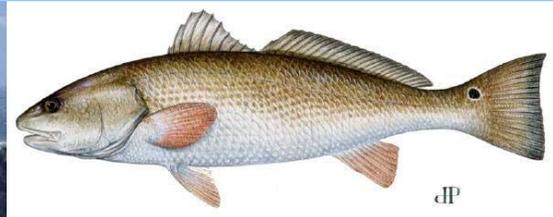
Tampa Bay Estuary Program
Technical Publication # 04-05

TAMPA BAY DREDGED HOLE HABITAT ASSESSMENT PROJECT

FINAL REPORT

April 2005

Tampa Bay Dredged Hole Habitat Assessment Project



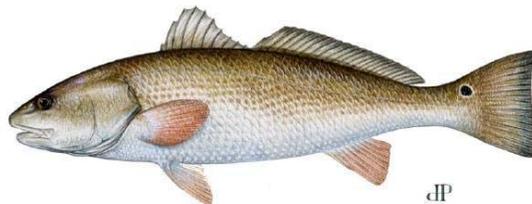
Final Report
April 2005

A report to the
U.S. Environmental Protection Agency, Region 4
By the Tampa Bay Dredged Hole
Habitat Assessment Advisory Team

Tampa Bay Dredged Hole Habitat Assessment Project

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Habitat Assessment Advisory Team

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Project Summary

Man-made dredged holes have been a feature of Tampa Bay, Florida's underwater landscape since the 1950s. Prior to the Dredged Hole Habitat Assessment Project, little was known about the existing habitat value of the numerous holes within the bay. In order to make informed management decisions about what to do with dredged holes in the bay, a group was convened to study several of the holes for physical and biological characteristics, along with the habitat value they provide for fish and invertebrates. The goal of the Dredged Hole Habitat Assessment Team was to assess the existing habitat value of some of Tampa Bay's dredged holes and make management recommendations addressing those holes.

Many factors influence management decisions about dredged holes in Tampa Bay. For example, the water and sediment quality is important for supporting aquatic species, from microscopic organisms to large fish. The type and number of fish and invertebrates inhabiting dredged holes and surrounding areas may be indicators of the habitat value provided. Scientists hope to understand where the "best" habitats are for aquatic organisms so that they can be protected and managed appropriately. Likewise, dredged holes with "poor" habitat value may present an opportunity for benefiting the bay by restoring natural conditions that may enhance their ability to function as aquatic habitats.

This document provides the results of a two-year program studying the habitat value of 11 dredged holes in Tampa Bay and suggests management recommendations for the holes. It is intended to help scientists, managers, and citizens understand more about the habitats of Tampa Bay, particularly its relatively unstudied dredged holes.



Source: T. Shively

Organization of Document: Background information is presented on dredged holes and the project, along with a description of the scientific tasks and data collection efforts. General results from the project precede the detailed individual results—a summary of habitat characteristics and management recommendations—for each of the 11 dredged holes. Technical reports and appendices are included on the accompanying CD.

This report was funded by a wetlands development grant from U.S. Environmental Protection Agency, Region 4 (Rhonda Evans, U.S. EPA, Region 4 Project Manager to the Tampa Bay Estuary Program).

For additional copies or for more information, contact Holly Greening at hgreening@tbep.org

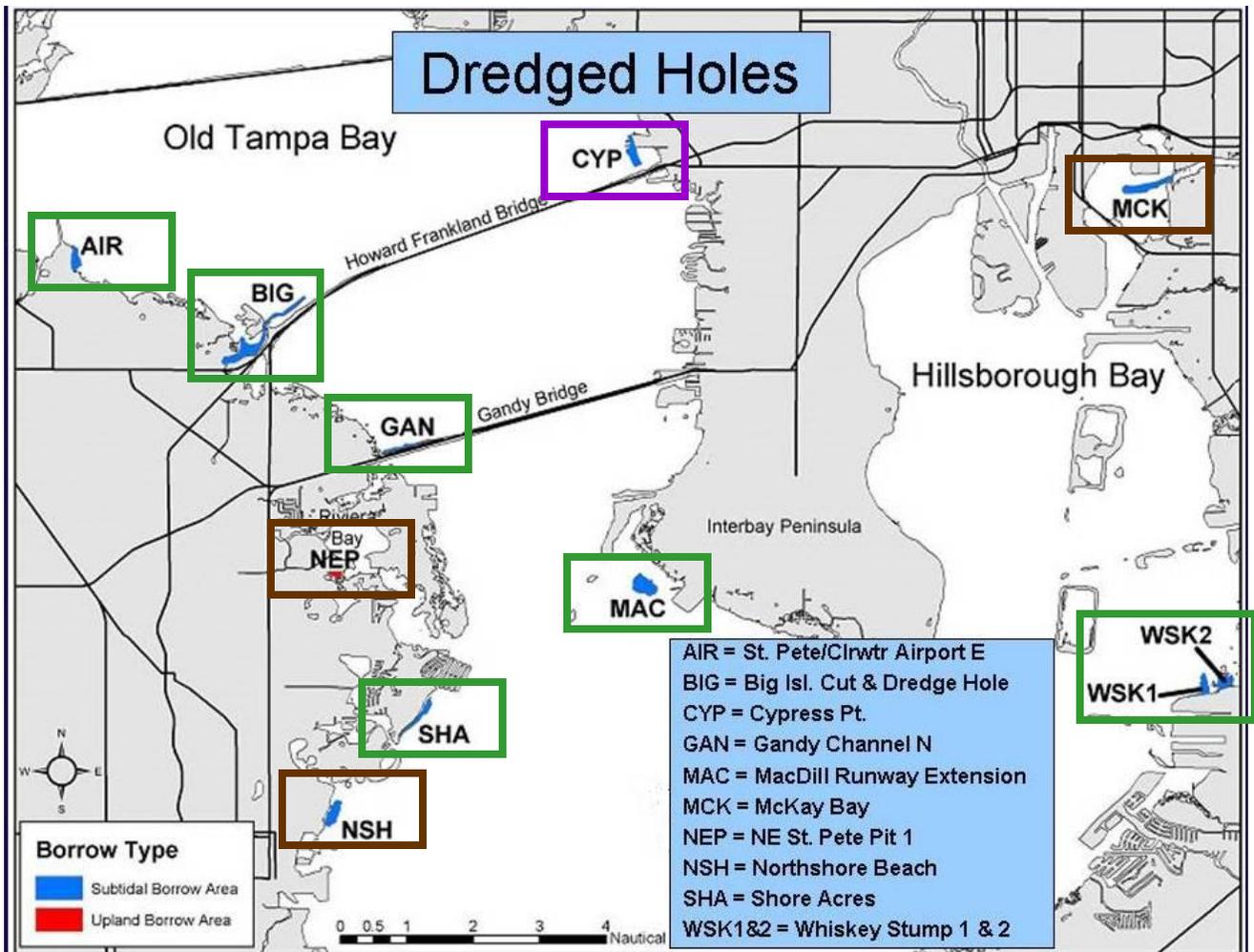
Major Findings and Recommendations

- While there were some similarities between holes, each of the 11 holes was unique. Even holes that are spatially close to one another, such as Northshore Beach and Shore Acres, have different physical and biological characteristics.
- Fisheries resources tend to be more speciose and numerically abundant within the dredged holes compared to adjacent outside areas (considering trawl results only).
- Blue crab and pink shrimp contributed the most to these differences with both tending to be more abundant inside the dredged holes than in adjacent outside areas.
- Seine samples collected outside the dredged holes in shallow areas tended to contain smaller baitfish, although many larval forms of economically important species also were collected.
- Commercial and/or recreational fishers appeared to be utilizing the dredged holes to varying degrees. Several economically important species were collected/targeted by fishers within the dredged holes.
- The benthic quality for most holes was similar to other polyhaline (salinities between 18-30 ppt) mud habitats throughout the bay.
- Near-bottom dissolved oxygen (DO) concentrations were generally greater than 4 mg/L; hypoxia (less than 2 mg/L) was only observed at the McKay Bay holes during the October 2002 survey date.
- Some degree of sediment contamination was noted for each of the 11 holes. Anthropogenic enrichment was most often observed for cadmium and lead.
- In general, benthic communities were more diverse during the spring 2003 sampling period than in the fall 2003 period.
- Due to the unique characteristics of each hole, results from the 11 holes included in this study may not be comparable to other holes within the bay. Therefore, before management recommendations can be made for other holes within the bay, sampling and data collection are necessary for each hole.

Recommendations: Seven of the 11 studied holes are providing suitable habitat for aquatic animals and should remain in their current conditions. However, restoration of the bay bottom to more natural conditions, through complete or partial filling, could enhance the habitat value at four holes. The planting of intertidal or aquatic vegetation may also be encouraged as part of restoration. Further study of the remaining dredged holes in Tampa Bay should be completed prior to developing management recommendations for additional holes.

Summary of Management Recommendations

The Tampa Bay Dredged Hole Habitat Assessment Advisory Group has recommended the following management strategies for 11 dredged holes within Tampa Bay. The project, design, results, and management recommendations are described in detail in this document.



Management Recommendations Key:

Fill Hole to Surrounding Depth (Intertidal shelves may be developed to facilitate the planting of saltmarsh, mangroves, and/or seagrass).

- McKay Bay, Northeast St. Petersburg Borrow Pit #1, and Northshore Beach dredged holes

Partial Filling to Stabilize Shoreline (May be used to combat erosion problems).

- Cypress Point dredged hole

Do Not Fill – Keep Hole As Is (Hole provides favorable habitat to fisheries and/or benthos).

- St. Petersburg/Clearwater Airport East, Big Island Cut, Whiskey Stump Key 1, MacDill Air Force Runway Extension, Whiskey Stump Key 2, Gandy Channel North and Shore Acres dredged holes

Tampa Bay Dredged Hole Habitat Assessment Project

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

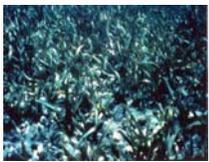
Possible Management Recommendations: The possible management options for each of the 11 dredged holes included in the Tampa Bay project include, but are not limited to: not disturbing a hole, completely filling a hole to potentially restore seagrass habitat, partially filling a hole to decrease hypoxic conditions and cap contaminated sediments, or enhancing a hole by placing artificial materials or reefs in the bottom.



No Change: The dredged hole provides important habitat for fisheries and benthic species and should not be filled.



Partial Filling: Dredged hole may be filled to a prescribed depth in order to decrease hypoxic conditions and cap contaminated sediments. Some deep areas and/or shelves may be retained.



Complete Filling and Restoration of Seagrasses:

Dredged hole may be filled completely with dredged material. Restoration efforts may

focus on recruiting or restoring seagrass habitat.



Artificial Reefs: Artificial reefs or oyster balls may be installed in the bottom of dredged holes to enhance the existing habitat.

Principal Investigators: The following individuals were the lead persons involved in the Tampa Bay dredged hole habitat assessment project. Additional participants are listed under their respective task(s) on the following pages.



Holly Greening, Project Manager;
Lindsay Griffen, Coordinator,
Tampa Bay Estuary Program (TBEP)



US Army Corps of Engineers

Tracy Leaser, Principal Investigator, *U.S. Army Corps of Engineers (USACOE)*



Steve Grabe, Principal Investigator, *Environmental Protection Commission of Hillsborough County (EPCHC)*



Ed Sherwood, Quality Assurance Officer;
Bob McMichael, Principal Investigator, *Florida Fish & Wildlife Conservation Commission, Fish & Wildlife Research Institute (FWC, FWRI)*



Jan Platt, Angler, *Hillsborough County Board of County Commissioners (HCB OCC)*

Tasks and Principal Investigators

1 Complete and obtain EPA approval of a Quality Assurance Project Plan (QAPP), including specific water and sediment quality collection, laboratory, and statistical analyses methods.

Steve Grabe, David Karlen & Christina Holden: EPCHC (S. Grabe now at Janicki Environmental, Inc.)

Ed Sherwood: FWC, FWRI (E. Sherwood now at EPCHC)

Holly Greening: TBEP

2 Conduct a preliminary “screening level” of each candidate dredged hole, utilizing aerial photography, current uses, and on-site reconnaissance visits.

Ed Sherwood: FWC, FWRI

Steve Grabe: EPCHC

Bill Fonferek & Tim Murphy: USACOE

3 Develop and apply a prioritization process to rank dredged holes for further evaluation. Examine existing habitat value, existing use by commercial or recreational fishermen, size of the hole, potential restoration options, distance from dredging locations, distance from other important habitats, potential permitting issues, and potential for long-term sustainability.

Holly Greening & Nanette Holland: TBEP

Jan Platt: HCBOCC (J. Platt now retired)

4 Conduct field sampling and evaluation in priority dredged holes, following protocols as approved in the QAPP.

Physical Characteristics: Conduct hydrographic surveys to obtain surface elevations of the dredged hole bottoms and surrounding areas, side slopes, and volumes of material required to fill the holes.

Bill Fonferek, Tim Murphy, & Tracy Leeser: USACOE

Water Quality, Sediment Quality, and Benthos: Collect sediment samples from dredged holes and analyze for sediment contaminants and benthic community structure. Also take water column profiles, including temperature, dissolved oxygen, salinity, and pH.

Stephen Grabe, David Karlen, Christina Holden, Barbara Goetting, Sara Markham & Thomas Dix: EPCHC

Fisheries Resources: Use multiple gears to sample animal populations directly and analyze data for composition, abundance, and size distribution. Include physiographic parameters, such as salinity, dissolved oxygen, temperature, conductivity, and pH. Assess commercial and recreational fishing effort, based on targeted angler interviews and angler surveys.

Ed Sherwood, Bob McMichael, Marin Greenwood, Tim McDonald & Ed Matheson: FWC, FWRI

5 Data collation, analyses, and interpretation. Develop a Draft Report on existing conditions and potential future enhancements for each priority dredged hole.

Ed Sherwood & Bob McMichael: FWC, FWRI

Tom Cardinale & Steve Grabe: EPCHC (T. Cardinale now retired)

Holly Greening: TBEP

6 Develop final implementation plans for priority dredged holes and distribute information to citizens, scientists, and managers.

Lindsay Griffen & Holly Greening: TBEP

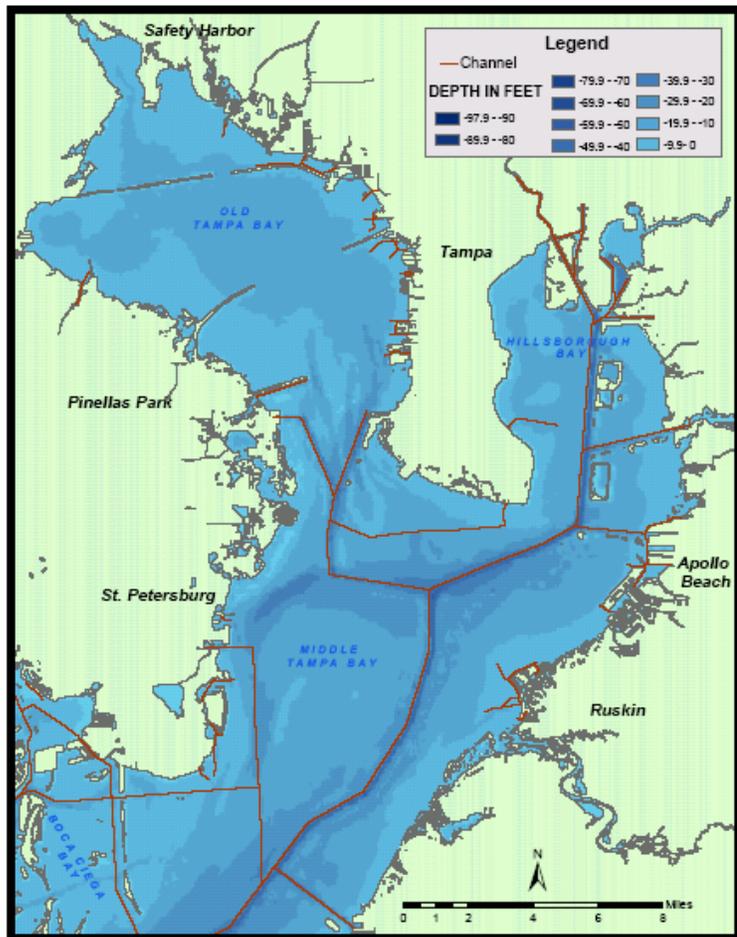
Dredging in Tampa Bay

Dredging, or digging up submerged material, is used to deepen waterways to facilitate navigation and historically, as source material for the development of upland areas. While there are multiple reasons for dredging, it is primarily used in Tampa Bay to aid in navigation. Tampa Bay harbors three major sea-ports, the largest being the Port of Tampa. In addition, utilities, industries, and commercial and recreational boaters depend on the bay for transportation. Tampa Bay is 12 feet deep on average, with many areas considerably more shallow. Near the shores of Tampa Bay, some areas may even be exposed at mean low tide. Dredging materials from the bottom of the bay increases the depth in certain areas, which allows for improved navigation. Within Tampa Bay, a series of channels have been dredged to accommodate both commercial and recreational uses.

Dredged channels need to be periodically re-dredged, as settling and erosion can fill in the deepened channels.



The Tampa Bay region is located in western Florida on the Gulf of Mexico. The map on the right illustrates the “bathymetry” or water depth throughout Tampa Bay. The areas in light blue are more shallow, while the dark blue areas are deeper. The dredged navigation channels have been highlighted in red.



Source: J. Tustison, FWC, FWRI

Historical Dredge and Fill for Land Development

Although little dredging for new land development has occurred since the 1980s, long, straight, and narrow “finger-fill canals” were historically created by dredging in low-lying, wet areas. After the areas were dredged, the “dredged material” was used for other purposes. Low-lying areas in between the canals were filled with dredged material to increase the elevation and make it suitable for development. Over the last 50 years, entire subdivisions and commercial areas were created by using the material to fill in submerged or wet areas. The properties located on finger-fill canals were often created in this manner.



*A new spoil island created using dredged material, circa 1950.
Source: FWC, FWRI*



*A historic residential development created with dredged material.
Source: FWC, FWRI*



*Finger-fill canals near the Shore Acres dredged hole.
Source: FWC, FWRI*

Current Dredging for Navigational Support: The Port of Tampa

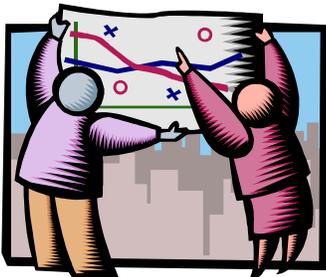
The Port of Tampa is Florida’s largest port and one of the most important in the nation. Shipping has occurred in this region for more than 120 years and the Port has expanded to meet the needs of a growing population. The Port of Tampa currently receives 50 million tons of cargo each year, directly or indirectly employs 54,000 Hillsborough County residents, and brings \$13 billion into the local economy. In order to access this port, a 43-foot-deep, 40-mile-long shipping channel was created. Settling, which occurs as a result of boat traffic and natural processes, continually fills the channel; therefore, regular maintenance dredging is required to ensure an adequate depth for large cargo and cruise ships. Material that is dredged from the channel area may be used for enhancing shorelines or may have other beneficial uses, described on the following pages.



The Port of Tampa

Tampa Bay Dredging and Dredged Material Management Strategy

Tampa Bay Dredging and Dredged Material Management Strategy:



The Tampa Bay region was the first in the nation to develop a plan specifically to address the issues of dredging and dredged material. This plan, a joint project of the Army Corps of Engineers and the Tampa Bay Estuary Program (as part of the Comprehensive Conservation and Management Plan), was designed to identify current dredging projects, determine beneficial uses of the material, and assess the environmental impacts of these

actions. Currently, dredging to maintain the bay's navigational channels generates more than a million cubic yards of material each year, enough to fill Raymond James Stadium 10 times. Most of the dredging is performed to maintain federal channels — those constructed and maintained with the assistance of the Army Corps of Engineers. The remaining maintenance dredging is in non-federal channels, berthing areas, and private channels. Additionally, new projects may require that channels be dredged. Over the next 25 years, the Corps estimates that more than 40 million cubic yards of dredged material will be generated.



Source: ACOE

Once material has been dredged from the bay bottom, the thick slurry has to be placed in an alternate location. Much of the sediment dredged during maintenance activities is deposited on two manmade spoil islands in Hillsborough Bay. The islands, constructed in the late 1960s, are labeled CMDA 2D and CMDA 3D. Island 2D is about 500 acres and 3D is about 400 acres. Nearly 20 million cubic yards of material will be placed on these spoil islands combined by the year 2030, at which time the islands will reach capacity. Material may also be deposited offshore (about 12 million cubic yards over 25 years), used to “renourish” eroding beach areas or deposited elsewhere for other beneficial purposes.

*Spoil islands
CMDA 2D and
CMDA 3D,
located in
Hillsborough*



Source: USGS

The Army Corps of Engineers has a strong commitment to finding alternative options for the disposal of dredged material, such as stabilizing shoreline areas, re-filling abandoned pits, re-creating longshore bars to aid in seagrass recovery, and possibly, filling dredged holes identified as part of this project. The Dredged Material Management Plan is updated annually, and beneficial, cost-effective alternatives are explored. This management plan, which is available on the TBEP website (www.tbep.org), was a driving force behind the dredged hole habitat assessment project.

Beneficial Uses

The U.S. Army Corps of Engineers defines “beneficial” uses of dredged material as those that incorporate ecological concepts and engineering designs with biological, economic, and social feasibility. Numerous construction and engineering activities can utilize dredged material. In addition to creating residential areas, some urban landscapes can be enhanced with dredged material. For example, flat areas can be contoured to help direct the flow of rainwater away from homes and businesses. Additionally, clean sand can be placed on recreational beaches in a process called “beach renourishment” that replaces sand lost through erosion. By utilizing dredged material, coastal communities can continue to provide quality recreational beach areas.

Maintenance dredging of canals and channels can supply a large quantity of suitable fill material. In the 1950s and 1960s, however, new development required higher quality material or a greater quantity of material than was available from permitted or maintenance projects. Therefore, to meet the demand for dredged material at that time, the Army Corps of Engineers determined areas in Tampa Bay that were targeted for materials collection. This activity led to the creation of “dredged holes” or “borrow pits” throughout the bay.



Source: ACOE

Dredging near Egmont Key, Lower Tampa Bay.

Beneficial uses cannot be found for all dredged material, especially material that is contaminated with various pollutants. In these instances, appropriate disposal options must be explored.



Unloading dredged material at a new location.



Source: G. Morrison, EPCHC

Spoil islands such as CMDA 2D and 3D have been created using dredged materials. These islands provide important habitat for beach-nesting birds such as gulls and terns. American oystercatchers (shown on the left) also nest on these islands.

In a summary document provided for this project, the U.S. Army Corps of Engineers identified the following potential ecological effects in dredged holes.

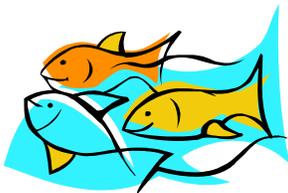


Water Quality: Dissolved oxygen (DO) is essential to aquatic invertebrates and fish. The DO levels in dredged holes may be depleted in a number of different ways: the shape and depth of dredged holes often prevents or restricts water circulation; the breakdown of organic matter by microbes depletes DO; and the lack of light penetration in deeper portions of dredged holes reduces plant photosynthesis (a process that produces oxygen). Therefore, DO used by biological processes, such as the breakdown of organic matter by microbes or the respiration of fish and invertebrates, is not readily replaced. In deep dredged holes, thermal stratification (temperature layers) can form. Although colder water typically contains more DO, stratification can reduce the exchange of oxygen throughout the water column. If the DO content decreases greatly, organisms may experience physiological stress or even death. Holes with reduced oxygen concentrations are labeled **hypoxic** (< 2 mg/L) while those with little or no oxygen are **anoxic** (no DO). Even short periods of hypoxia or anoxia can weaken or eliminate some organisms.



Sedimentation and Sediment Quality: Soil particles suspended in the water column are deposited in a process called **sedimentation**. In areas with decreased currents or flows, such as over a deep dredged hole, the water velocity decreases, allowing particles to settle out of suspension. Deep holes with retarded flow may quickly fill in with particles, possibly altering the bottom habitat conditions in the dredged holes. This becomes especially problematic when the materials that settle out differ in size and quality from those naturally in and around the dredged hole. Just as terrestrial organisms have specific habitat requirements, so do aquatic organisms. The substrate, therefore, can determine the composition and structure of the **benthic** (bottom dwelling) community. In general, filter-feeding organisms such as clams prefer coarser, sandier sediments. Conversely, fine, muddy sediments attract burrowing organisms and surface-feeding animals such as worms. Substrate type is also important in determining which predators inhabit an area. Thus, if sediments settling into dredged holes are either coarser or finer than those in the surrounding area, different communities of organisms will probably be found inside versus outside of the dredged holes.

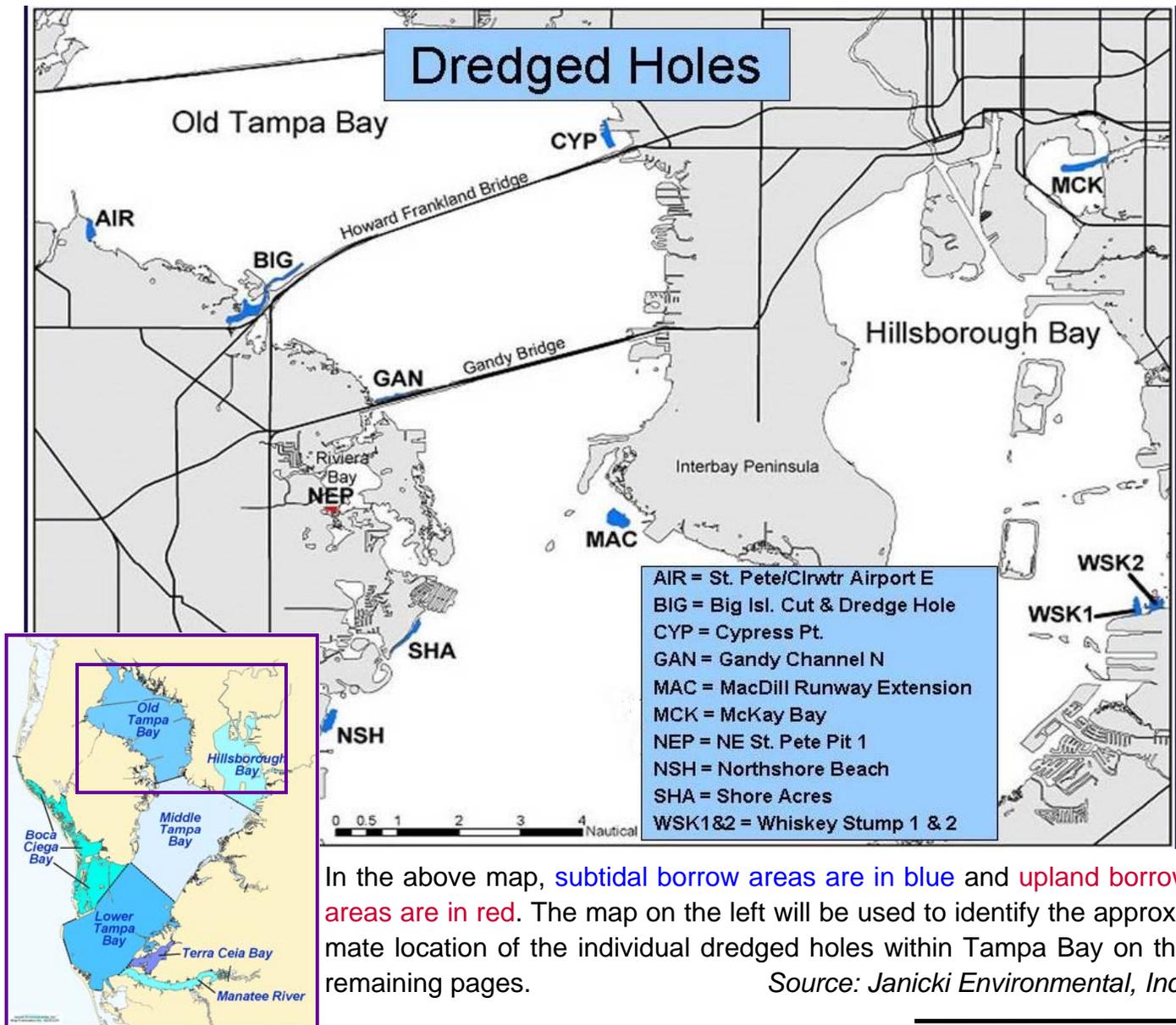
The initial dredging of a hole may destroy or modify the benthic community, and recovery, if possible, may require several years. The type of substrate and the dimensions of the hole affect the recovery rate, with shallower holes recovering faster.



Occupation by Fishes and Large Invertebrates (Nekton): One goal of the dredged hole assessment project was to ascertain the use of dredged holes by nekton, including fish and large macroinvertebrates such as shrimps and crabs. Although anecdotal evidence suggested that dredged holes provide important, albeit different, habitat for nekton, few scientific studies had been conducted to support or refute this theory. It was hypothesized that some holes may provide valuable habitat, especially during specific seasons. During winter months, the deeper water in the bottom of some holes may provide refuge from the cold due to thermal stratification and warmer waters in deeper areas. However, thermal stratification may lead to hypoxia or anoxia which can kill nekton or force them to abandon the hole. Also, low DO may modify the benthic community and thus affect the food supply for nekton. Some nekton may be attracted to the holes because of the changes in bathymetry, preferring steep slopes. Finally, some nekton may take advantage of the slower currents encountered in deeper holes.

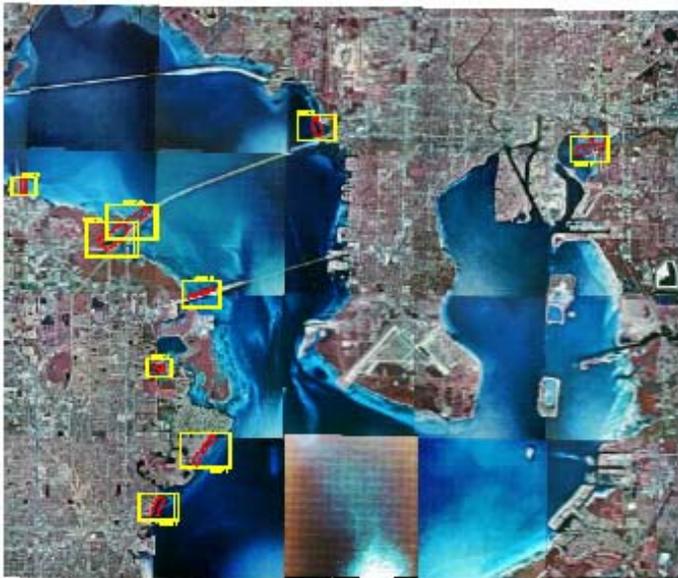
Location of Dredged Holes in Tampa Bay

Numerous dredged holes exist within Tampa Bay. During Tasks 2 and 3 of the Tampa Bay Dredged Hole Habitat Assessment Project, more than 20 dredged holes were subject to a preliminary “screening” process, which included information-gathering, aerial photography, and site visits. The dredged holes were then prioritized or ranked according to their location, proximity to available fill material, perceived habitat value, proximity to other important habitats, current use by commercial and recreational fishermen, and the feasibility of restoration, and narrowed down to 11. Fisheries surveys, benthos collections, and water and sediment quality samplings were conducted on these 11 dredged holes throughout the 2-year study period. Ancillary water and sediment quality samples were collected from an additional five holes. These data are included on the Technical CD. The locations of the 11 studied holes are depicted on the partial map of Tampa Bay below, which includes Hillsborough Bay and portions of Middle and Old Tampa Bay.

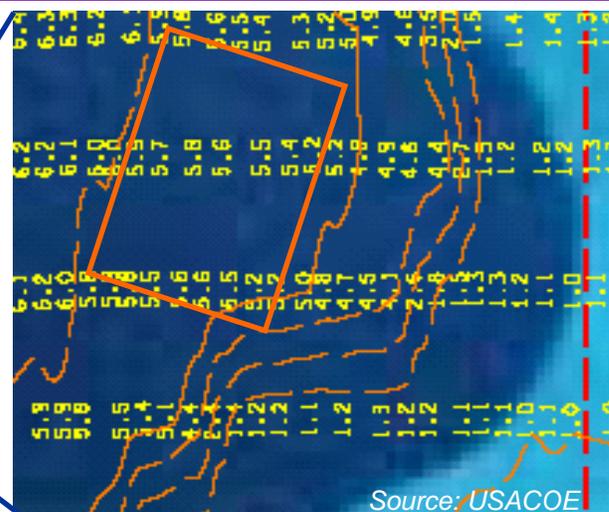
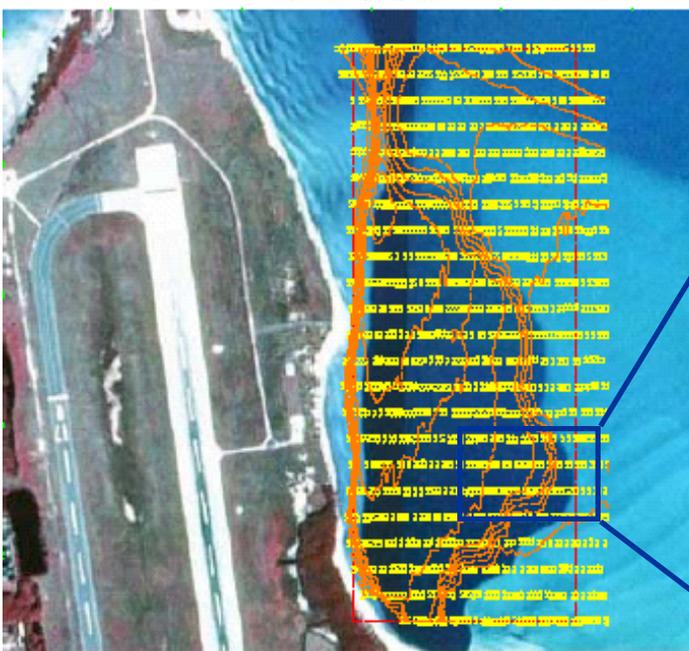


Surveying the Dredged Holes

Physical characteristics, such as depth and volume, of each dredged hole were determined using hydrographic surveys, specifically multibeam sounding technology. Sound signals were sent to the seafloor and received by computer-aided instruments. The depth was determined by calculating the time for the sound signal to be sent to the seafloor and then returned to the instrument. These sounding depths were then plotted on a bathymetric map, or graphic representation for each hole. The Army Corps of Engineers spent considerable effort mapping the bathymetry of the 11 dredged holes. The data consists of the surface elevations (hole bottoms, sides, and areas surrounding the holes), side slopes, and volumes of material required to fill the holes (volumes of the holes). This information will allow scientists and managers to determine the exact depth and volume of each hole, which is important if filling is a recommended management strategy.



This baywide map represents the dredged holes that were hydrographically surveyed by the Army Corps of Engineers. For each hole, a separate map was created with detailed elevations and contour lines. The St. Petersburg/Clearwater Airport East dredged hole is used as an example to demonstrate the extent of the survey information. The aerial photograph to the left outlines the dredged hole and the elevations along a series of transect lines. The individual bottom surface elevations are shown in yellow. The orange contour lines represent a change of 1 foot in bottom surface elevation. For example, the highlighted boxed area in orange has a depth between 5 and 6 feet, lying between the 5-foot and 6-foot contour lines. Hydrographic surveys for all the studied holes are included on the Technical CD.

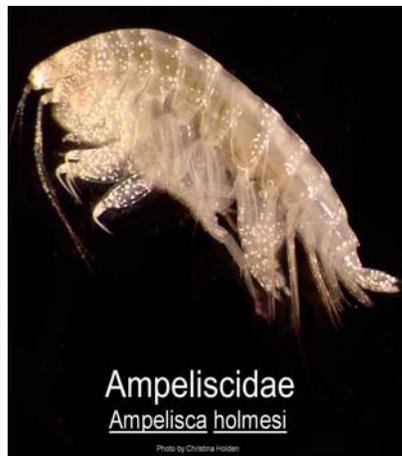


Source: USACOE

Spotlight on Benthic Organisms: Benthic organisms, or benthos, are aquatic animals that live on or in bottom sediments or hard substrate on the floor of a body of water. Invertebrates make up the majority of all marine species. While some are free-moving along the seafloor, others live in the sediments and are relatively immobile creatures. They are typically very small, ranging from microscopic to a foot in length. Some benthos, such as tube-building worms, construct tunnels in the sediments; others, such as clams, rest on the sediments or hard substrates and filter water to remove organic food materials; and still others, such as shrimps, move independently. Benthic organisms are important because they serve as a food source for small fishes, crustaceans, and other nekton. They may also help to reduce the amount of sediment in the water column by filtering the water.

Tampa Bay dredged holes support many different benthic organisms. The type of benthos varies depending on the substrate, the salinity, and the percent silt+clay of the sediment. The following list provides information about some of the most abundant benthos in the 11 dredged holes.

Crustaceans have segmented bodies and a tough exterior carapace. They are bilaterally symmetrical, have a shrimp-like appearance and are characterized by antennae and large eyes. These are burrowing organisms, although most can swim and crawl. They typically feed on detritus, using antennae as filters and are up to a half-inch in length. They include amphipods, cumaceans, crabs, and shrimps.



Examples:

- Ampelisca holmesii* (shown)
- Ampelisca abdita*
- Ampelisca vadorum*
- Metharpinia floridana*
- Rudilemboides naglei*

Annelids are cylindrical, segmented worms with a compound head. Many have lateral appendages. Free-moving and sedentary forms exist; both forms are capable of burrowing. They may be herbivores, omnivores, scavengers, or browsers. They include polychaetes and oligochaetes.



Examples:

- Paraprionospio pinnata* (shown)
- Gyptis crypta*
- Kinbergonuphis simoni*
- Paramphinome* sp. B
- Stenoninereis martini*

Mollusks have a shell that completely encloses the body. A large foot protrudes from the shell and is attached via the mantle. Some are burrowing organisms that feed on phytoplankton by filtering the water; others feed on organic material in or on the bottom sediments. They include bivalves (e.g., clams) and gastropods (e.g., snails).



Examples:

- Mysella planulata* (shown)
- Cyrtopleura costata*
- Dosinia discus*
- Macoma tenta*

Source: C. Holden, EPCHC

Explanation of Benthic and Sediment Characteristics

Many factors influence the kinds and abundance of benthic organisms present in a given area. Scientists sampled the dredged holes for a number of physical characteristics including salinity, sediment type, temperature, dissolved oxygen, and presence of excess nutrients and/or toxic contaminants. These parameters can also help determine the status of the dredged hole in relation to its ability to support benthos and nekton. Results for the 16 sampled holes are on the Technical CD.

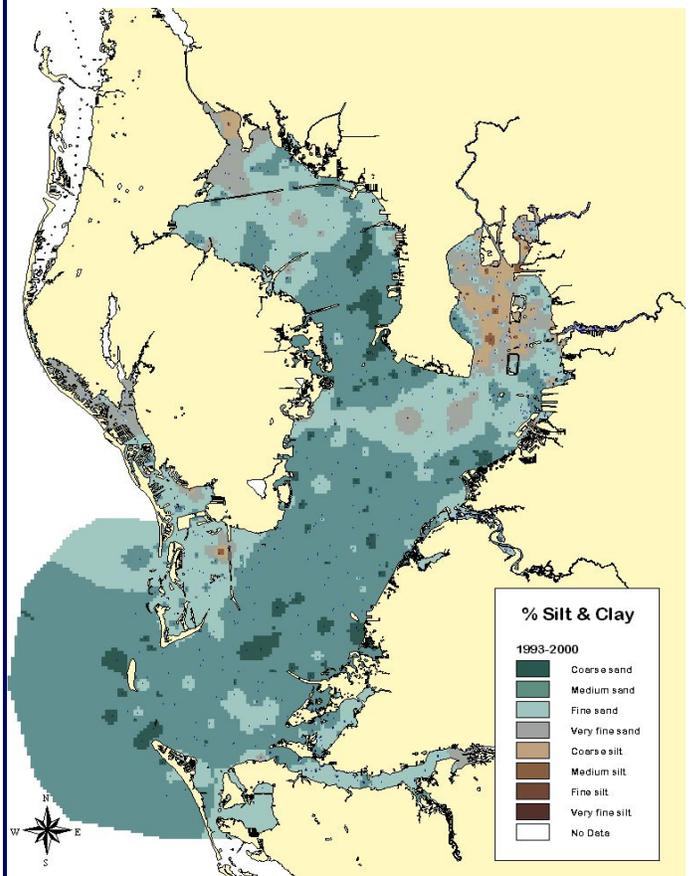
Salinity: Salinity, or the quantity of dissolved salts in the water, is measured in parts per thousand. Salinity can be an important factor in determining stratification of the water column and generally increases at greater depth. At the mouth of fresh-water rivers the salinity can be near zero; however, as the bay empties into the Gulf of Mexico, the salinity can be as high as ocean water, about 35 ppt. Salinities are grouped into ranges, shown in the table. All surveyed holes were in the polyhaline range.

| Benthic Habitat | Salinity Range (ppt) |
|-------------------|----------------------|
| Tidal Freshwater | 0-0.5 |
| Oligohaline | 0.5-5 |
| Low Mesohaline | 5-12 |
| High Mesohaline | 12-18 |
| Polyhaline | 18-30 |
| Euhaline | >30 |

Stratification: Water bodies, particularly deeper ones, can develop distinct layers of water as a result of differing water mass densities. This is usually a result of physical differences (i.e., salinity and temperature) between water masses and can indicate poor flushing or mixing of the water column. This can lead to diminished water quality, such as a reduction of dissolved oxygen in the deeper layers. The degree of stratification is determined by comparing surface and bottom physical water quality measurements.

Dissolved Oxygen: The quantity of dissolved oxygen (DO) is measured as milligrams of oxygen per liter of sampled water (mg/L). A low DO concentration can stress benthic organisms and **hypoxic** (less than 2 mg/L DO) or **anoxic** (no DO) periods can limit their survival. Scientists measured DO at the surface and near the bottom of each dredged hole. If DO levels were below 4 mg/L at the time of sampling, the duration of time that the hole was hypoxic was measured by placing monitors in the hole for a 24-hour period.

% Silt+Clay: The percent silt + clay (% SC) is defined as the contribution of fine-grained sediment (< 63 microns) to a sediment sample. What is not silt and clay is usually sand-sized (larger) particles, although some shell fragments may also be present. If the % SC is greater than or equal to 26 ($\geq 26\%$) in Tampa Bay, it is classified as mud. In general, the lower the % SC value, the coarser the sediments. Sediment type is an important determinant of the benthic community. How coarse or fine the sediment is, can influence which species inhabit an area. In general, very fine sediments such as muds support fewer benthos.



Source: S. Grabe, EPCHC

Explanation of Benthic and Sediment Characteristics

Sediment Contaminants: Anthropogenic (human-caused) pollution can result in the contamination of aquatic sediments with various dangerous chemicals and heavy metals. As polluted water enters a waterbody, metals and other chemicals may adsorb or attach to suspended solids in the water column. These solids eventually sink to the bottom and integrate into the existing sediments. Toxicological studies have shown that many of these substances can affect the growth and survival of benthic organisms by causing deformities or even death. Sediments were sampled and concentrations recorded for a variety of contaminants, including:

- 8 heavy metals (e.g., lead and chromium)
- 19 organochloride pesticides (e.g., Lindane)
- polyaromatic hydrocarbons (PAHs)
- polychlorinated biphenyls (PCBs).

Regulatory standards have not been established for many of these substances, although the guidelines on concentration at which adverse effects are noted have been developed. For each sampled contaminant, threshold levels have been determined that indicate possible effects. Two threshold levels are defined as the Probable Effects Level and the Threshold Effects Level.

The Probable Effects Level (PEL) is the level above which toxic effects to the biota are considered likely.

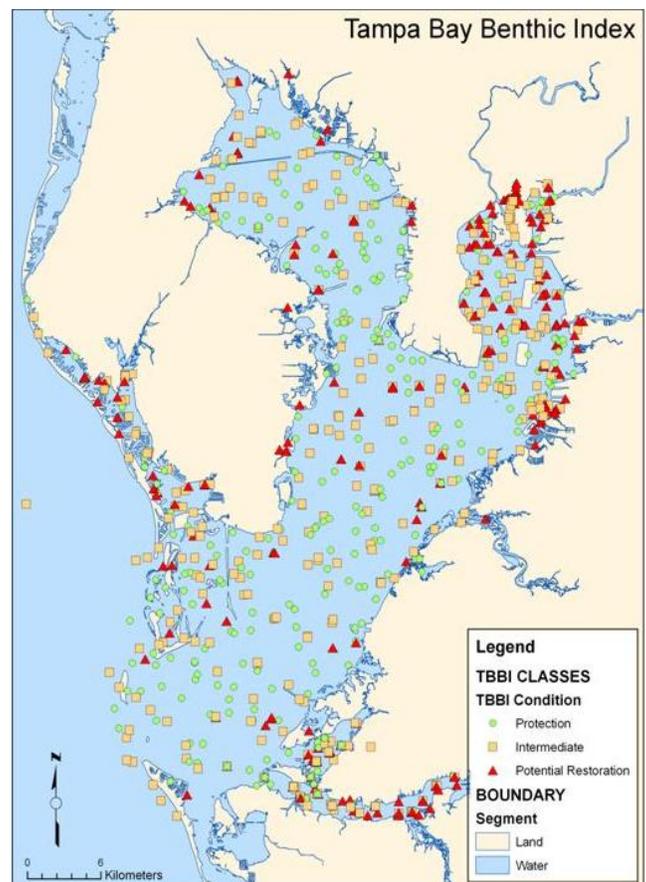
The Threshold Effects Level (TEL) is the level below which toxic effects to the biota are less likely.

Tampa Bay Benthic Index: The Tampa Bay Benthic Index (TBBI) is a combination of benthic invertebrate variables that determines the health of the benthic community in a sampled area. The index uses a complex mathematical equation that calculates the number of benthic species counted compared to the number of species expected for the salinity in that sample area. In general, you would expect more species in higher salinity areas. Benthic samples taken and analyzed throughout the entire bay have been used to suggest the following benthic management conditions, shown on the TBBI map to the right.

Protection Areas have a TBBI score greater than 87. These areas have a relatively high number and diversity of benthic species.

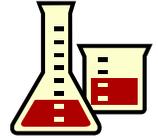
Intermediate Areas have a TBBI score between 73 and 87. These areas have a moderate number and diversity of benthic species.

Potential Restoration Areas have a TBBI score lower than 73. These areas have a low number and diversity of benthic species.



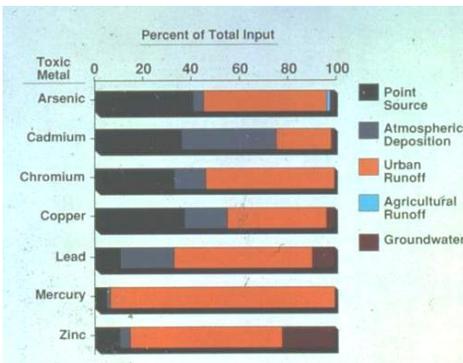
Source: Malloy et al. 2005

Chemical Contaminants



Heavy metals and other chemicals, such as pesticide compounds and industrial solvents, can adversely affect aquatic organisms, including benthic invertebrates and fishes. Since sediment quality is an important component of a healthy aquatic environment, contaminants of concern have been identified and included in sampling protocols. While many contaminants of concern have been identified in Tampa Bay, the following list provides information only on those chemicals detected above PEL or TEL levels in the 11 dredged holes. Acute toxicity signifies that adverse effects were noted following short-term exposure to the chemical, while chronic effects are long-term adverse effects. Carcinogenic compounds may cause cancer; mutagenic compounds may mutate genetic structure.

| <u>Element or Compound of Concern</u> | <u>Potential Impacts</u> | <u>Possible Sources</u> |
|---|---|---|
| Cadmium | Acute toxicity | Electroplating, plastics, batteries, sewage |
| Chromium | Acute toxicity | Atmospheric deposition, alloys, coal combustion, electroplating/metal finishing, wastewater, urban runoff, phosphate fertilizers |
| Copper | Acute toxicity | Oil/fuel combustion, antifouling paints, metal cleaning, plating, pigments and dyes, sewage |
| Lead | Acute toxicity Chronic Effects Human Health Effects | Atmospheric (from gasoline additive), batteries, paints, sewage |
| Nickel | Acute & chronic toxicity Carcinogen | Coal and fossil fuel combustion, mining, refining, incineration, municipal wastewater, urban runoff |
| Zinc | Acute toxicity | Metal coatings, batteries, tires, municipal waste water, sludge, industrial discharges, urban runoff |
| Polyaromatic Hydrocarbons (PAHs) | Acute toxicity Carcinogen/mutagenic | Crude oil, petroleum products, combustion byproducts, stormwater, atmospheric deposition, spills, leaks, refinery fly ash, maritime accidents, marinas, drilling fluids |



Primary Sources of Heavy Metals: This table depicts the potential sources of heavy metals into Tampa Bay, including five of those detected in the dredged holes and two additional metals. **Urban runoff** is the largest source of heavy metals in the Tampa Bay watershed, especially for arsenic, chromium, lead, mercury, and zinc. Other significant contributors of heavy metal pollutant loading are **point sources** and **atmospheric deposition**. **Agricultural runoff** is a primary source for arsenic and **groundwater** is a source of both lead and zinc.

Source: Frithsen et al. 1995

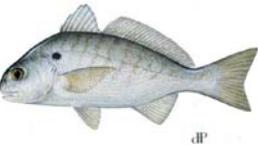
Fisheries Resources of Dredged Holes in Tampa Bay

The Tampa Bay dredged holes provide habitat for many important nekton species. While each species plays an important role in the ecology of the dredged holes, some are also important economically. Below are examples and descriptions of 18 nekton species collected in the dredged holes. The numbered species are the 12 most abundant species, with #1 being the most abundant. The 16 species with dollar signs (\$\$) are targeted by commercial and/or recreational fishers.

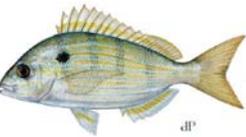
1) Bay Anchovy, *Anchoa mitchilli*: Most abundant fish in Tampa Bay; entire life cycle within the bay. Small planktivore; important in diets of larger fish. Up to 4 inches; common at 2 inches or less.



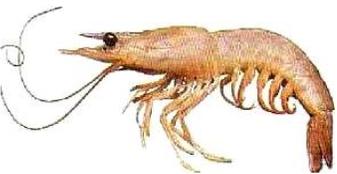
2) \$\$ Spot, *Leiostomus xanthurus*: Uses Tampa Bay as nursery area but spawns offshore. Feeds on benthic organisms and serves as prey for larger fish. Also a popular pan fish. Up to 14 inches.



3) Pinfish, *Lagodon rhomboides*: Juveniles abundant in Tampa Bay, especially seagrass beds; spawns on continental shelf. Feeds on vegetation and invertebrates; important prey for larger fish. Up to 14 inches.



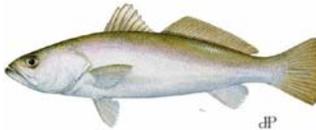
4) \$\$ Pink Shrimp, *Farfantepenaeus duorarum*: Uses Tampa Bay as nursery area; spawns over continental shelf. Feeds at night on small invertebrates; prominent in the diet of predators such as spotted seatrout. Second most valuable commercial fishery in Florida in 2003. To more than 8 inches.



5) \$\$ Blue Crab, *Callinectes sapidus*: Spends much of life in Tampa Bay; spawns over continental shelf. Feeds on wide variety of plants and animals; important in diet of many fishes. Fifth most valuable commercial fishery in Florida in 2003. Width to nearly 10 inches.



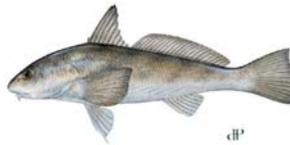
6) \$\$ Sand Seatrout, *Cynoscion arenarius*: Can spend entire life within Tampa Bay; juveniles abundant in tidal rivers. Feeds on invertebrates and various fish species, especially bay anchovy. Some commercial value; common in recreational harvest. To 20 inches, but generally less than 12 inches.



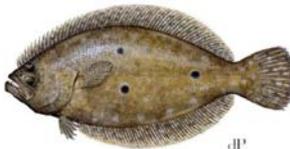
7) Silver Jenny, *Eucinostomus gula*: Uses Tampa Bay as nursery area; spawns in nearshore marine waters. Feeds on benthic invertebrates; consumed by predatory fishes. Up to 8 inches, but usually less than 5 inches in Tampa Bay.



8) \$\$ Southern Kingfish, *Menticirrhus americanus*: Uses Tampa Bay as nursery area but spawns offshore. Feeds on small invertebrates and fishes. Valuable in both commercial and recreational fisheries. To more than 16 inches, but usually smaller in Tampa Bay.



9) \$\$ Gulf Flounder, *Paralichthys albigutta*: Uses Tampa Bay as nursery area; spawns in nearshore marine waters. Feeds on fishes and some invertebrates. Valuable in both commercial and recreational fisheries. To 28 inches, but more commonly less than 17 inches.



 Most illustrations provided by Diane Rome Peebles.

Fisheries Resources of Dredged Holes in Tampa Bay

10) \$\$ Spotted Seatrout, *Cynoscion nebulosus*:



Entire life cycle within Tampa Bay. Feeds on fish and crustaceans, especially pink shrimp. One of the most important recreational gamefish in Florida. To more than 28 inches.

11) \$\$ Red Drum, *Sciaenops ocellatus*:



Uses Tampa Bay as nursery area; spawns in nearshore marine waters. Feeds on polychaete worms, crustaceans, and fish. One of the

most important recreational gamefish in Florida. To more than 40 inches.

12) \$\$ Sheepshead, *Archosargus probatocephalus*:



Uses Tampa Bay as nursery but spawns offshore. Feeds on a variety of invertebrates plus fish and some plant material. Valuable in both recreational and commercial fisheries. To more than 24 inches.

\$\$ Snook, *Centropomus undecimalis*:



Widespread resident (i.e., spends its entire life in the estuary) in Tampa Bay and associated tidal rivers, especially along

mangrove shorelines. Spawns near the mouth of estuaries and may return to same spot each year to spawn. Feeds on other fish, shrimps, and crabs. One of Florida's most popular recreational gamefish. Up to 50 inches.

\$\$ Stone crab, *Menippe spp.*:



Occurs in shoreline areas of Tampa Bay, but most commercial fishery takes place in deeper waters offshore. Benthic species that feed on mollusks such as conchs and scallops. Important

commercial species. Only the claws are harvested; live crab is returned to water and able to regenerate claws. Body up to 5 inches in width.

\$\$ Cobia, *Rachycentron canadum*:



Adults and juveniles sometimes enter Tampa Bay to feed on fish, squid, and crustaceans.

Strong, aggressive feeders. Valuable as a recreational fish. Up to 72 inches.

\$\$ Gray snapper, *Lutjanus griseus*:



Uses Tampa Bay as a nursery area. Adults generally associated with reefs. Feeds on fish, shrimp, and crabs. Taken in both commercial and recreational fisheries, with the majority of landings by recreational anglers. Up to 30 inches.

\$\$ Lane snapper, *Lutjanus synagris*:



Occasionally found around various types of structure, man-made and natural, in Tampa Bay; most common in southern portions of the bay.

Feeds on fish and shrimp. Taken in both commercial and recreational fisheries, with the majority of landings by recreational anglers. Up to 19 inches.

\$\$ Atlantic croaker, *Micropogonias undulatus*:



Uses Tampa Bay and associated tidal rivers as a nursery and feeding ground, but occurrence is sporadic. Adults found in estuaries and offshore marine habitats. Feeds on crustaceans, mollusks, and fish. Serves as prey for larger

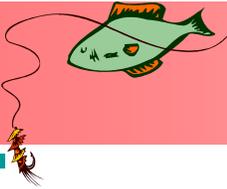
fish, such as spotted seatrout and red drum. Taken in both commercial and recreational fisheries, with majority of landings by recreational anglers. Often taken as bycatch in commercial shrimp fisheries. Up to 20 inches.

\$\$ Ladyfish, *Elops saurus*:



Uses Tampa Bay and associated tidal rivers as a nursery area. Adults reside in the bay and nearshore marine areas. Feeds mostly

on fish and crabs. Frequently caught, but not usually harvested by recreational fishers; most of the harvest in Florida is by commercial fishers. Up to 39 inches.



The Importance of Anglers



Input from local anglers was a very valuable component of the dredged hole management study. Tampa Bay is a popular location for both commercial and recreational fishing and many anglers believed that the dredged holes provided high fisheries potential. Specifically, many holes were valued as important refuge for some fish species during the colder winter months. In order to examine the recreational value of the dredged holes, an angler survey was developed to involve local anglers in the research effort.

In addition to the extensive sampling of the dredged holes by the FWC, many anglers volunteered to record their catch. This information was valuable to area scientists and managers and helped to strengthen the Fisheries Independent data. Anglers were recruited through flyers at bait shops and at local fishing expos. Of the approximately 95 recreational fisherman and commercial guides who were given data sheets, 11 anglers reported their catch information for the study. Additionally, other anglers were interviewed or observed on weekdays during the sampling period (November 2002-March 2004). In total, 87 recreational and 24 commercial fishers were observed. Although no real trends could be established from the angler observations and reports, eight economically important species were caught by anglers in the dredged holes, including blue crab, sand seatrout, spotted seatrout, ladyfish, striped mullet, Gulf flounder, cobia, and red drum.

Researchers also conducted hook-and-line sampling at 26 sample sites throughout Tampa Bay between August, 2003 and March, 2004. In total, 230 animals were collected, including 11 economically important species. Although ladyfish was the dominant species caught by hook and line inside the dredged holes, red drum, sand seatrout, hardhead catfish, and Atlantic stingrays also were collected.



Many bay area anglers volunteered to fish the dredged holes and record valuable data about their catch.

WANTED:

**ANGLERS
TO FISH
TAMPA BAY
DREDGE
HOLES**



If you regularly fish dredge holes in Tampa Bay, your catch information could lead to improved fishing!

Please see bait shop owner for additional details on the dredge hole research project and for a sign-up sheet.





Beyond Hook-and-Line

Scientists and anglers hypothesized that many of the dredged holes in Tampa Bay were providing unique habitat for aquatic species, including some economically important species. To test this theory, monitoring programs were designed to determine the species, number, and size of fishes and invertebrates living in and around the dredged holes.

Fish monitoring included both the assessment of animal populations by directly sampling the dredged holes, and the assessment of rates and fishing pressures by recreational anglers and commercial fishers. The Fish & Wildlife Research Institute staff designed a Fisheries-Independent Survey to collect information on fish utilization of the selected dredged holes compared with other areas throughout the bay, by sampling within the holes and also in the surrounding areas. Since the dredged holes represent potentially unique habitats in Tampa Bay, it was possible that the number and type of animals would differ within and outside of the holes.

A multi-gear sampling approach was used to collect samples inside and outside of the dredged holes. Both trawl and seine nets were employed, depending on the depth of the hole and surrounding areas. In general, both seines and trawls collected primarily juvenile and small fishes. Although similar species were collected using both gears, catch data using seines and trawls cannot be directly compared. Aquatic animals sampled ranged in size from less than an inch (a small shrimp) to almost two feet (a large fish). Sample sites within the dredged holes were randomly selected and two sample sites were visited each month within the October 2002-March 2004 study period. The list and photos on the right provide more information about the gears used in the Fisheries-Independent Survey.

For each gear, the number of fish was counted and the catch data were converted to a number per 100 square meters (100m²). All species were identified and length measurements were recorded for a portion of the catch of each species. Water quality measurements (temperature, dissolved oxygen, salinity, pH) and general habitat and weather conditions were also noted.



Source: FWC, FWRI

6.1-meter Otter Trawl:

The 6.1-meter otter trawl is used in waters ranging from 1.8-7.6 meters in depth. It is used primarily for catching epibenthic fish and macrocrustaceans in deeper waters. This gear was used to sample animals both inside and outside the dredged holes where water depths preclude the use of seines.



Source: FWC, FWRI

21.3-meter Bag Seine:

The 21.3-meter bag seine is used to sample estuarine areas less than 1.5 meters in depth. For this reason, the bag seine was only used to sample areas outside of the dredged holes. It is used to collect small fish and macrocrustacean species. Seine sampling could not be performed at Northeast St. Petersburg Borrow Pit 1 and Big Island Cut dredged hole sites.

Dredged Hole Characteristics and Management Strategies



The following pages provide information, locations, and photographs specific to each of the 11 sampled dredged holes.

Background Information explains the historical reason for dredging the hole, along with a description of the surrounding area, the ownership status, and the feasibility for delivery of fill material by the U.S. Army Corps of Engineers (USACOE).

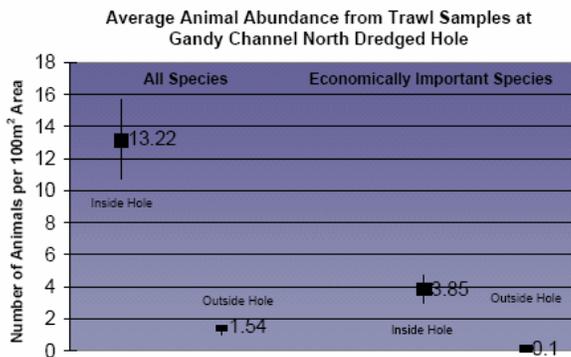


Location: The location of the dredged hole is outlined on the Tampa Bay map, along with an aerial photograph of the dredged hole. The general location, including the county, is also noted.

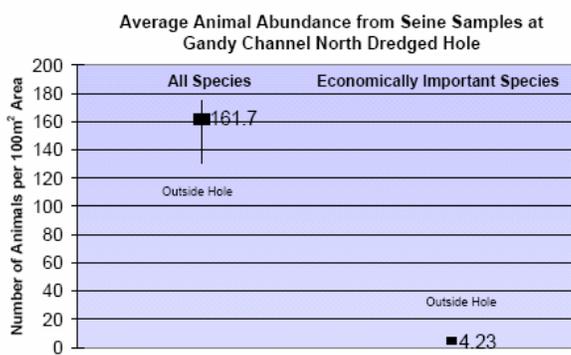


Fast Fish Facts lists the total number of animals caught inside the hole during Fisheries-Independent Monitoring, the dominant species, and the economically important species. The overall FIM ranking is also listed.

Fast Facts lists important physical and biological characteristics of the hole taken through hydrographic surveys and benthic sampling, including the dominant benthos collected in each hole.



Fisheries Graphs are used to illustrate the average abundance of animal species collected inside and outside the dredged holes using trawl and seine samples. While the total number of animals collected is important, it may not be the most accurate way to interpret habitat values of the dredged holes.



The average abundance, or density, represents the number of animals that were collected in a 100 square meter area. Scientists determined this by adding the total number of animals collected, dividing by the number of samples, and then dividing by the sampling area. This allows scientists to compare fisheries data, even when sampling effort is different. “Economically important species” include the 16 species described in “Fisheries Resources of Dredged Holes of Tampa Bay,” pages 18-19.

The black box on the graph is the average value. The lines that extend from the box represent the standard deviation or how spread out the data are. This signifies that, although there was an average density value for all samples combined, the individual collection results varied.

Results from trawl samples and seine samples cannot be directly compared because the sampling gear is different; therefore, two graphs are used to illustrate the data. Also, note that the scale of the graphs (the vertical axis) varies, depending on the range of data.

Dredged Hole Characteristics and Management Strategies

| Nekton Species | Common Name | Number Collected | % of Total Trawl Catch |
|---|-------------|------------------|------------------------|
|  | Bay Anchovy | 286 | 13% |
|  | Blue Crab | 273 | 12% |
|  | Code Goby | 217 | 10% |
|  | Pinfish | 203 | 9% |
|  | Pink Shrimp | 144 | 7% |

Dominant Fishery Species collected inside the dredged hole. The top five species, in terms of total numbers caught and the percentage of the total trawl catch, are listed in a table. In this example, bay anchovy was the most abundant species collected, followed by blue crab, code goby, pinfish, and pink shrimp.

Management Recommendation: A critical part of the following pages is the recommended management strategy for each hole. Using information from fisheries, benthic, and hydrographic sampling, along with angler input and relevant background information, scientists and managers have recommended management strategies for each hole based on its existing utilization by fish and invertebrates.

Overall Ranking of Dredged Holes: Scientists used the Fisheries-Independent Monitoring (FIM) data, along with benthic and sediment data to rank the dredged holes. For all ranking scenarios, #1 represents the “best” habitat value. The FIM Rank compares nekton caught inside the dredged holes with those caught in the surrounding areas. A hole receives a higher rank (lower number) if the fisheries resources inside the hole are better than outside the hole. The Benthic Rank assesses the habitat value of the hole for benthic organisms and includes parameters such as benthic diversity, DO, and sediment contamination. Detailed explanations about these rankings and the selection criteria are included in the Technical Appendix. Scientists also observed use of each dredged hole by recreational anglers and commercial fishers during their sampling visits.

| Dredged hole | FIM rank | Benthic rank |
|--------------------|------------|--------------|
| Shore Acres | 1 | 2 |
| Whiskey Stump 1 | 2 | 7 |
| Whiskey Stump 2 | 3 | 5 |
| Gandy North | 4 | 1 |
| MacDill Runway | 5 | 3 |
| Cypress Point | 6 | 9 |
| St. Petersburg Air | 7 | 4 |
| Northshore | 8 | 8 |
| McKay Bay | 9 | 11 |
| Big Island Cut | Not ranked | 6 |
| NE St. Petersburg | Not ranked | 10 |

This table represents the FIM and Benthic rankings for the dredged holes. The Big Island Cut and Northeast St. Petersburg holes were not assigned a FIM rank because external trawling could not be conducted.

| Recreational Anglers | # Observed | Rank | Commercial Fishers | # Observed | Rank |
|----------------------|------------|----------|---------------------|------------|----------|
| Whiskey Stump 1&2 | 35 | 1 | Big Island Cut | 9 | 1 |
| Big Island Cut | 15 | 2 | St. Petersburg Air | 5 | 2 |
| NE St. Petersburg | 8 | 3 (tied) | Cypress Point | 3 | 3 |
| Gandy Channel North | 8 | 3 (tied) | Shore Acres | 2 | 4 (tied) |
| St. Petersburg Air | 7 | 5 | Gandy Channel North | 2 | 4 (tied) |
| Cypress Point | 5 | 6 (tied) | Northshore | 1 | 6 (tied) |
| McKay Bay | 5 | 6 (tied) | NE St. Petersburg | 1 | 6 (tied) |
| Shore Acres | 2 | 8 (tied) | MacDill Runway | 1 | 6 (tied) |
| Northshore | 2 | 8 (tied) | Whiskey Stump 1&2 | 0 | 9 (tied) |
| MacDill Runway | 0 | n/a | McKay Bay | 0 | 9 (tied) |
| Total Observed | 87 | | | 24 | |

This table depicts the observed use of the holes by recreational anglers and commercial fishers in Tampa Bay. At the MacDill Runway hole, recreational access was restricted for security reasons.

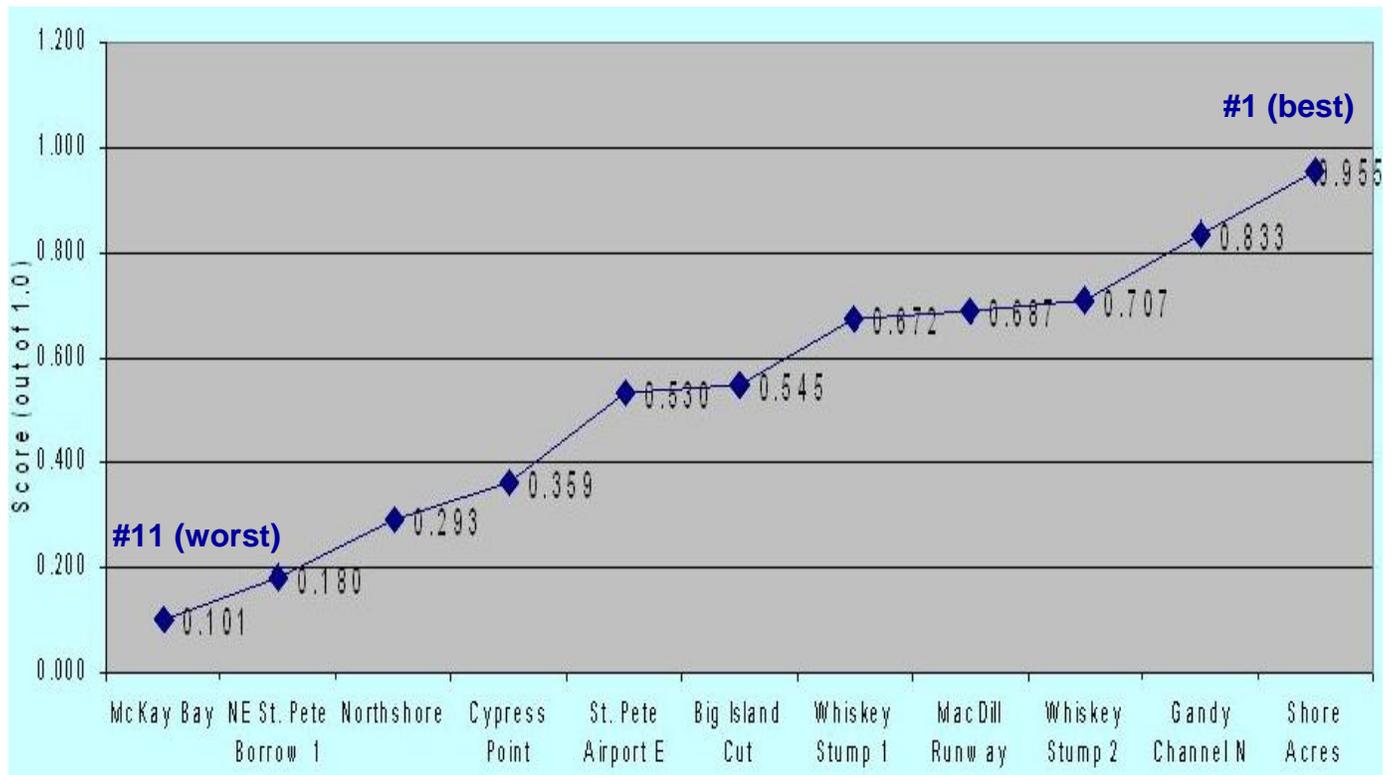
Development of Management Recommendations

The Principal Investigators developed four different options (or methods) for combining the FIM and Benthic Ranks to determine management recommendations for the 11 holes. The first two options divided the holes into “high,” “medium,” and “low” categories and then used a combined qualitative rank to determine the management recommendation. Options three and four utilized the numerical rankings (#1-11) of the holes and entered them into a mathematical formula to determine the combined value.

Following examination of all four options (see the complete description and mathematical formulas in the Technical Appendix), the Dredged Hole Habitat Assessment Advisory Team selected Option 3, with fisheries and benthic rankings weighted equally.

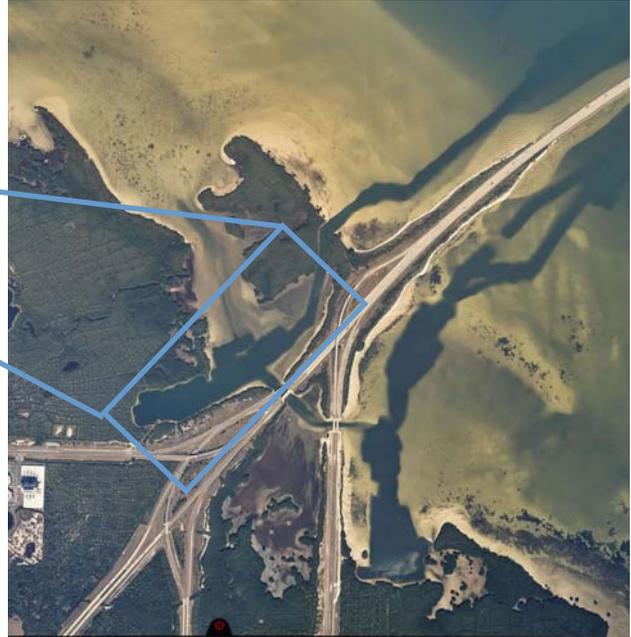
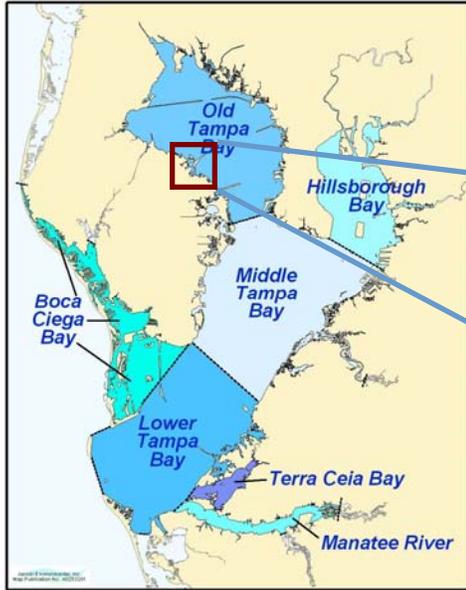
The following graph illustrates the combined values and overall ranking of the dredged holes based on their ecological habitat value.

Combined Values and Overall Ranking of Dredged Holes



Management recommendations are based only on the present ecological habitat value of the dredged holes. Other factors, such as the feasibility of filling the holes, were not included in the ranking criteria for this project.

Big Island Cut Dredged Hole



Location: Pinellas County, north of the Howard Frankland Bridge causeway

Background Information: The Big Island Cut dredged hole was dredged to construct the Howard Frankland Bridge Causeway and the 4th Street interchange. The hole is flanked by a sand/mud flat with patchy seagrass/algae and a mangrove shoreline.

The Big Island Cut hole is under the ownership of the State of Florida.

Feasibility for USACOE material delivery is low.

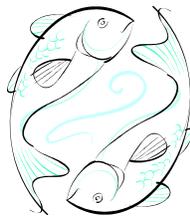
Fast Fish Facts:

FIM Ranking: not ranked
(external trawling not possible)

Total Animals Caught Inside:
7,530

Dominant Species Inside the Dredged Hole:
bay anchovy (68% total catch), spot, sand seatrout, pink shrimp, and blue crab

Economically Important Species: spot, sand seatrout, pink shrimp, blue crab, southern kingfish, gulf flounder, sheepshead, spotted seatrout, Atlantic croaker, red drum, stone crab, snook



Fast Facts:

Approximate Size: 106.5 acres

Maximum Depth: 20.7 feet

Surrounding Area Depth: 2.0 feet

Fill Volume: 3 feet: 841,736 yards³, 4 feet: 712,136 yards³, 5 feet: 595,408 yards³

Habitat Type: Polyhaline Mud

Stratification: None

Dissolved Oxygen: Fall: 2.6 mg/L; Spring: 3.1 mg/L

DO < 4 mg/L: 24-hour Data Not Collected

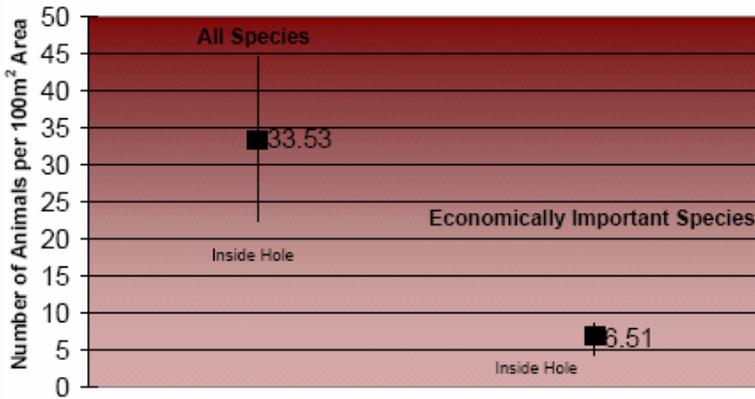
Hypoxia: 24-hour Data Not Collected

Sediment Quality: Marginal; Exceeded TEL values for Cadmium, Chromium, and Nickel

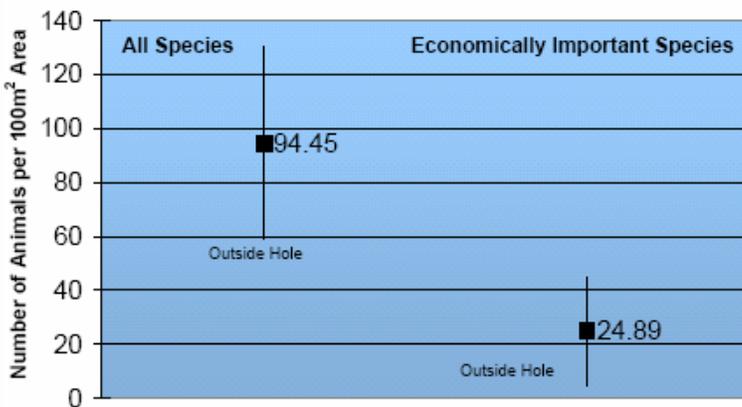
Benthic Index: Fall: 58=Potential Restoration; Spring: 73=Intermediate

Dominant Benthos: Fall: Polychaete *Stenoninereis martini* (100%); Spring: Amphipod *Ampelisca vadorum* (46%); Oligochaete *Tubificoides wasselli* (6%)

Average Animal Abundance from Trawl Samples at Big Island Cut Dredged Hole



Average Animal Abundance from Seine Samples at Big Island Cut Dredged Hole



Interpretation of Graphs:

A total of 12,026 animals was collected from 70 samples inside and outside of the dredged hole. Trawl sampling did not occur outside the dredged hole because the water depth was not great enough. Of the total animals collected, 7,530 animals were collected inside the dredged hole, while 4,496 animals were collected outside. Of the 44 taxa collected inside the hole, 12 were of economic importance and 19 were unique to inside the hole. Of the 35 taxa collected outside the dredged hole, only seven were of economic importance. While the dominant species collected both inside and outside was the bay anchovy, the other dominant species varied. Pink shrimp, sand seatrout, and blue crab were dominant inside the dredged hole, whereas red drum was dominant only outside the hole.

Interpretation of Physical Characteristics— Benthic Ranking: # 6 of 11

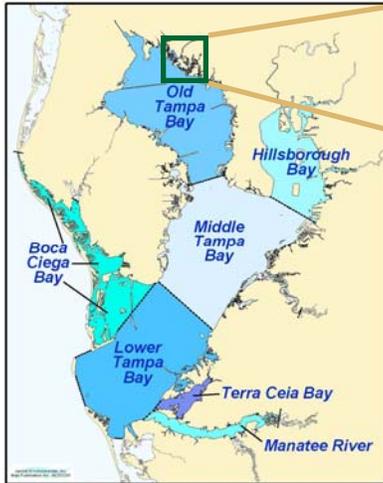
The Big Island Cut dredged hole showed a lower degree of density stratification, but similar sediment contaminant levels and benthic community metrics to comparable polyhaline mud habitats in Tampa Bay.

While the DO concentrations were similar to other habitats in the bay, they were almost hypoxic during both sampling events and were among the lowest sampled in all holes. The benthic community improved slightly during the spring 2003 sampling from “potential restoration” to “intermediate.”

| Nekton Species | Common Name | Number Collected | % of Total Trawl Catch |
|---|---------------|------------------|------------------------|
|  | Bay Anchovy | 5,106 | 68% |
|  | Spot | 768 | 10% |
|  | Sand Seatrout | 336 | 5% |
|  | Pink Shrimp | 254 | 3% |
|  | Blue Crab | 232 | 3% |

Overall Rank: #6; Management Recommendation: Keep Hole As Is— Do Not Fill.

Cypress Point Dredged Hole



Location: Hillsborough County, eastern shoreline of Old Tampa Bay, north of the Howard Frankland Bridge causeway

Background Information: The Cypress Point hole was dredged for fill material to facilitate upland development north of the Howard Frankland Bridge, including the Westshore Mall. The surrounding area is beach and sand flat with patchy seagrass/algae coverage.

The hole is under the ownership of the Tampa Port Authority.

Feasibility for USACOE material delivery is low.

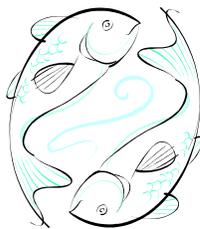
Fast Fish Facts:

FIM Ranking: #6 of 9

Total Animals Caught Inside: 2,673

Dominant Fish Species Inside: bay anchovy (54% total catch), spot, sand seatrout, blue crab, and pink shrimp

Economically Important Species: spot, sand seatrout, blue crab, pink shrimp, southern kingfish, Gulf flounder, sheepshead, spotted seatrout, Atlantic croaker, stone crab, cobia



Fast Facts:

Approximate Size: 39.5 acres

Maximum Depth: 11.9 feet

Surrounding Area Depth: 2.5 feet

Fill Capacity: 3 feet: 449,851 yards³, 4 feet: 358,658 yards³, 5 feet: 279,336 yards³

Habitat Type: Polyhaline Mud

Stratification: None

Dissolved Oxygen: Fall: 6.1 mg/L; Spring: 6.1 mg/L

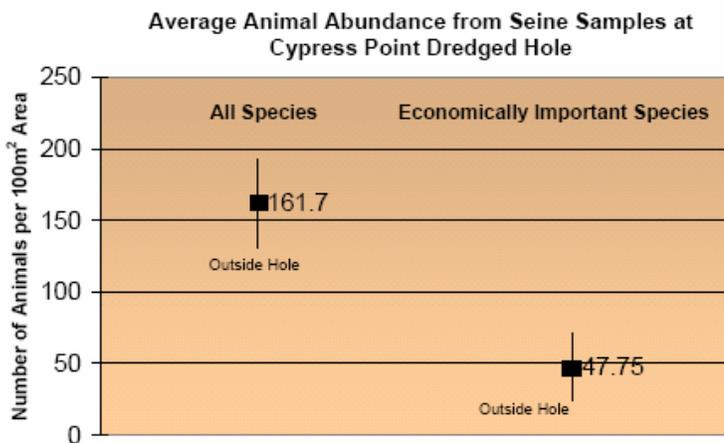
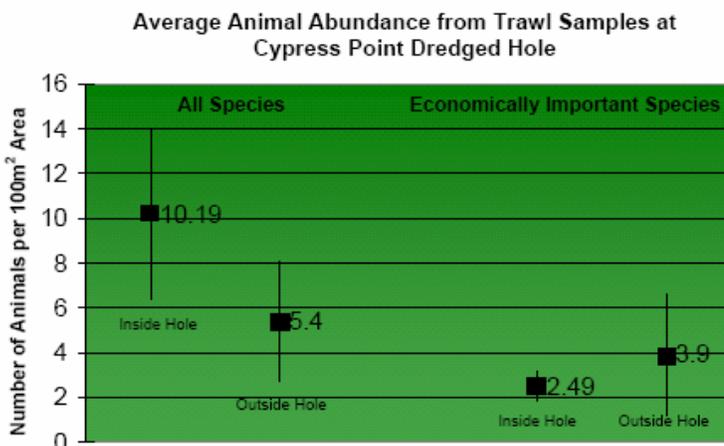
DO < 4 mg/L: DO did not fall below 4 mg/L

Hypoxia: Spring: 1.75 hours

Sediment Quality: Marginal; Exceeded TEL values for Cadmium, Chromium, Copper, Nickel, Lead, and high molecular weight PAHs

Benthic Index: Fall: 53=Potential Restoration (empty sample); Spring: 73=Intermediate

Dominant Benthos: Fall: no animals present; Spring: Amphipod *Ampelisca vadorum* (89%)



Interpretation of Graphs:

A total of 11,812 animals was collected from 106 samples in and around the Cypress Point dredged hole. Of those, 2,673 animals were collected inside the dredged hole from 36 trawl samples. Sampling outside the dredged hole collected 1,442 animals from 36 trawl samples and 7,697 animals from 34 seine samples.

A greater abundance of animals was collected inside the dredged hole from trawl samples; however, a greater density of economically important species was collected outside.

Eleven economically important species were collected inside the hole. Six economically important species were collected outside in trawls samples and 11 in seines.

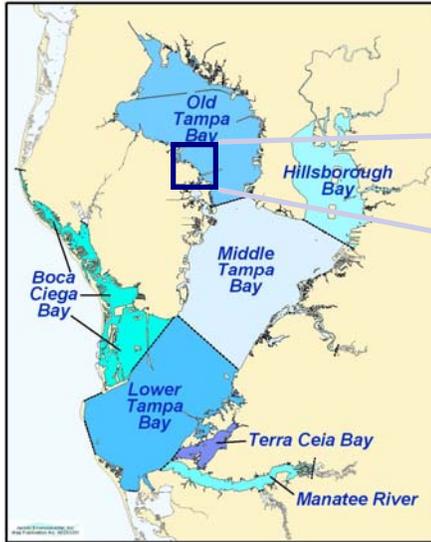
Interpretation of Physical Characteristics— Benthic Ranking: # 9 of 11

The values for DO were better than those generally observed in polyhaline mud habitats elsewhere in the bay. There was evidence of at least moderate levels of sediment contamination. While this level of contamination is consistent with that observed in similar habitats, the Cypress Point dredged hole was the only sampled hole that exceeded the TEL values for polyaromatic hydrocarbons (PAHs). The benthic community was defaunated during the fall 2002 survey and, although the benthic community rebounded in the spring, the species richness and diversity remained low.

| Nekton Species | Common Name | Number Collected | % of Total Trawl Catch |
|---|---------------|------------------|------------------------|
|  | Bay Anchovy | 1,452 | 54% |
|  | Spot | 165 | 6% |
|  | Sand Seatrout | 161 | 6% |
|  | Blue Crab | 156 | 6% |
|  | Pink Shrimp | 95 | 4% |

Overall Rank: #8; Management Recommendation: Partially fill hole to stabilize the shoreline and reduce erosion. Fill to various depths, including to the photic zone.

Gandy Channel North Dredged Hole



Location: Pinellas County, north of the Gandy Bridge causeway

Background Information: The Gandy Channel North dredged hole was dredged to construct the Gandy Bridge causeway. The hole is surrounded by a sand flat with patchy seagrass/algae coverage.

The Gandy Channel North dredged hole is under the ownership of the State of Florida.

Feasibility for USACOE material delivery is low.

Fast Facts:

Approximate Size: 16.1 acres

Maximum Depth: 8.0 feet

Surrounding Area Depth: 1.0 feet

Fill Volume: 3 feet: 43,146 yards³, 4 feet: 25,298 yards³, 5 feet: 13,736 yards³

Sediment Type: Fall: Polyhaline Medium Sands; Spring: Polyhaline Mud

Stratification: None

Dissolved Oxygen: Fall: 5.2 mg/L; Spring: 4.7 mg/L

DO < 4mg/L: Fall: 0.75 hours; Spring: 11.5 hours

Hypoxia: No Hypoxia

Sediment Quality: Marginal; Exceeded TEL value for Cadmium

Benthic Index: Fall: 88=Protection; Spring: 80=Intermediate

Dominant Benthos: Fall: Amphipod *Rudilemboides naglei* (19%); Spring: Amphipod *Ampeplisca vadorum* (64%)

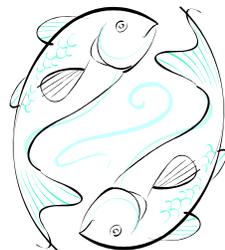
Fast Fish Facts:

FIM Ranking: #4 of 9

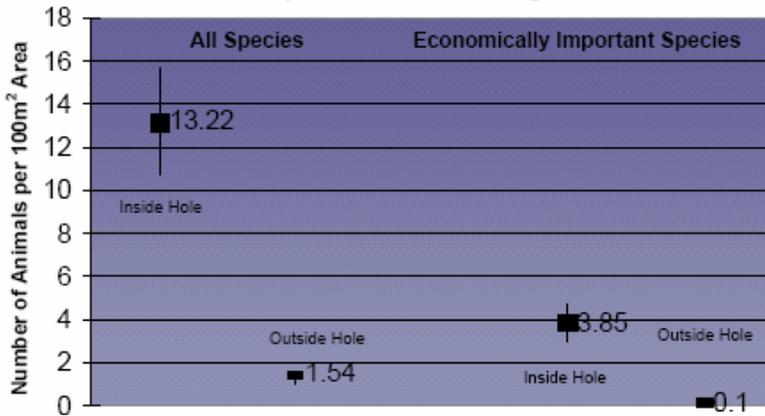
Total Animals Caught Inside: 2,194

Dominant Species Inside: bay anchovy (13% total catch), blue crab, code goby, pinfish, and pink shrimp

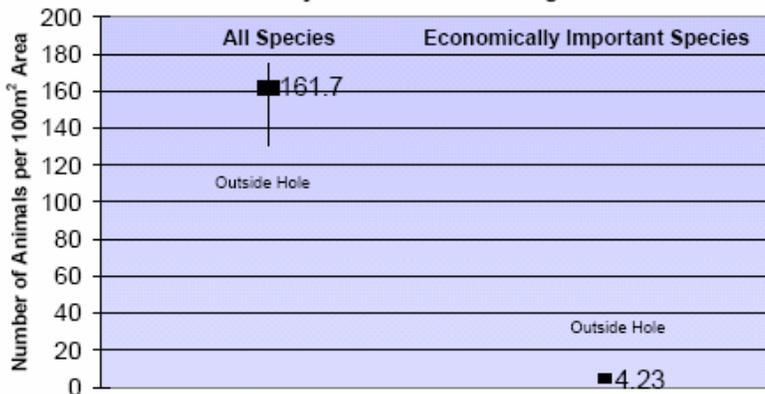
Economically Important Species: blue crab, pink shrimp, spot, spotted seatrout, Gulf flounder, red drum, sand seatrout, southern kingfish, sheepshead, stone crab, lady fish, gray snapper



Average Animal Abundance from Trawl Samples at Gandy Channel North Dredged Hole



Average Animal Abundance from Seine Samples at Gandy Channel North Dredged Hole



Interpretation of Graphs:

A total of 6,769 animals was collected from 79 samples in and around the Gandy Channel North dredged hole. Of those, 2,194 animals were collected inside the dredged hole from 26 samples. Sampling outside the dredged hole collected 221 animals from 27 trawl samples and 4,354 animals from seine samples.

A greater abundance of species was collected inside the dredged hole from trawl samples than outside. A greater abundance of economically important species also was collected inside the hole.

There were 12 economically important species collected inside the hole. Eight economically important species were collected outside in trawls and eight in seines.

Interpretation of Physical Characteristics—Benthic Ranking: # 1 of 11

The sampled habitats in the Gandy Channel dredged hole differed between the two seasons because of differences in sediment type. While the benthos were numerically dominated by peracarid crustaceans during both sampling periods, the fall 2002 assemblage was unusually speciose and diverse. The DO levels were considerably poorer results in the spring 2003. The hole showed a comparable degree of density stratification, similar DO concentrations, and slightly higher sediment contaminant levels compared to similar habitats in the bay.

| Nekton Species | Common Name | Number Collected | % of Total Trawl Catch |
|---|-------------|------------------|------------------------|
|  | Bay Anchovy | 286 | 13% |
|  | Blue Crab | 273 | 12% |
|  | Code Goby | 217 | 10% |
|  | Pinfish | 203 | 9% |
|  | Pink Shrimp | 144 | 7% |

Overall Rank: #2; Management Recommendation: Keep Hole As Is—Do Not Fill.

MacDill Air Force Base Runway Extension Dredged Hole



Fast Facts:

Approximate Size: 60.5 acres

Maximum Depth: 9.8 feet

Surrounding Area Depth: 3.0 feet

Fill Volume: 3 feet: 426,221 yards³, 4 feet: 311,293 yards³, 5 feet: 202,651 yards³

Habitat Type: Polyhaline Mud

Stratification: None

Dissolved Oxygen: Good; Fall: 6.6 mg/L; Spring: 5.6 mg/L

DO < 4 mg/L: 24-hour Data Not Collected

Hypoxia: 24-hour Data Not Collected

Sediment Quality: Marginal; Exceeded TEL values for Cadmium, Chromium, and Nickel

Benthic Index: Fall: 79=Intermediate; Spring: 77=Intermediate

Dominant Benthos: Fall: Decapod *Pinnixa* spp. (15%), Bivalve *Macoma tenta* and Hemichordate *Enteropneusta*- genera undetermined (9%); Spring: Bivalve *Cyrtopleura costata* (27%) and Polychaete *Paramphinome* sp. (14%)



Location: Hillsborough County, southwest of the Interbay peninsula

Background Information: The MacDill Air Force Base runway extension dredged hole was created when the base lengthened its main runway out into Tampa Bay. The fill material for the extension was dredged from a nearby seagrass flat. The hole was partially filled by the ACOE in 2000. The surrounding area is sand flat with patchy seagrass.

The hole is under the ownership of the Tampa Port Authority.

Feasibility for USACOE material delivery is high.

Fast Fish Facts:

FIM Ranking: #5 of 9

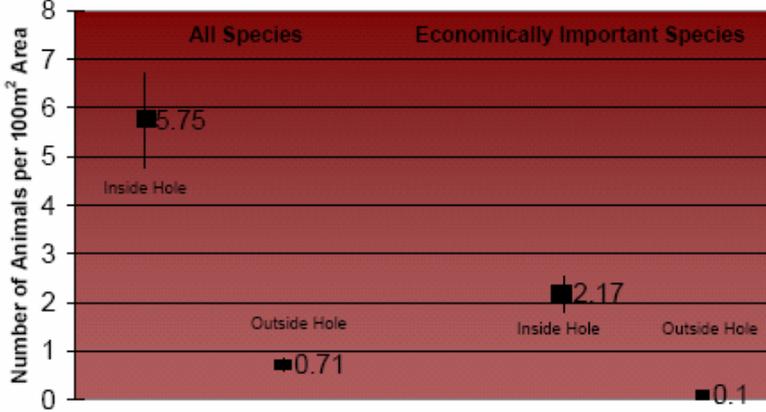
Total Animals Caught Inside: 1,151

Dominant Species Inside: pink shrimp (20% total catch), bay anchovy, leopard searobin, blue crab, and inshore lizardfish

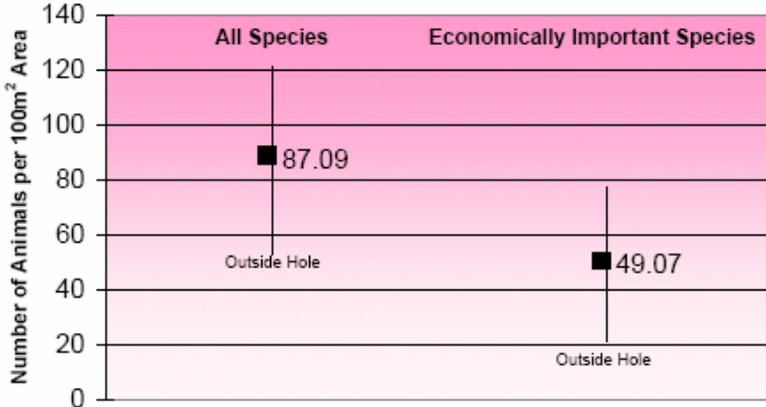
Economically Important Species: pink shrimp, blue crab, southern kingfish, sand seatrout, gulf flounder, spot, spotted seatrout, red drum



Average Animal Abundance at MacDill Air Force Base Runway Extension Dredged Hole



Average Animal Abundance from Seine Samples at MacDill Air Force Base Runway Extension Dredged Hole



Interpretation of Graphs:

A total of 4,468 animals was collected from 82 samples in and around the MacDill Air Force Base Runway Extension dredged hole. Of those, 1,151 animals were collected inside the dredged hole from 28 trawl samples. Sampling outside the dredged hole collected 147 animals from 28 trawl samples and 3,170 animals from 26 seine samples.

A greater abundance of species was collected inside the dredged hole from trawl samples than outside using trawls. A low abundance of economically important species was collected inside and outside using trawls; however, there was a large abundance from outside seine samples.

There were eight economically important species collected inside the hole. Five economically important species were collected outside in trawls and nine in seines.

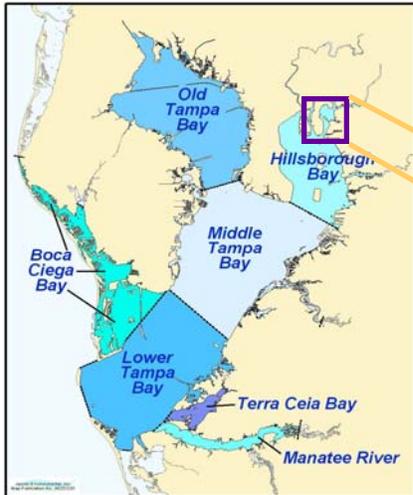
Interpretation of Physical Characteristics—Benthic Ranking: # 3 of 11

The MacDill Air Force Base Runway Extension dredged hole was generally better in terms of DO than other similar habitats in the bay. There was evidence of moderate levels of sediment contaminants, notably three metals. The fall benthic community was more speciose, more diverse, and somewhat more abundant than Tampa Bay polyhaline mud habitats in general. Unlike most sampled holes the spring benthic assemblage was lower in taxa and standing crop than the fall assemblage.

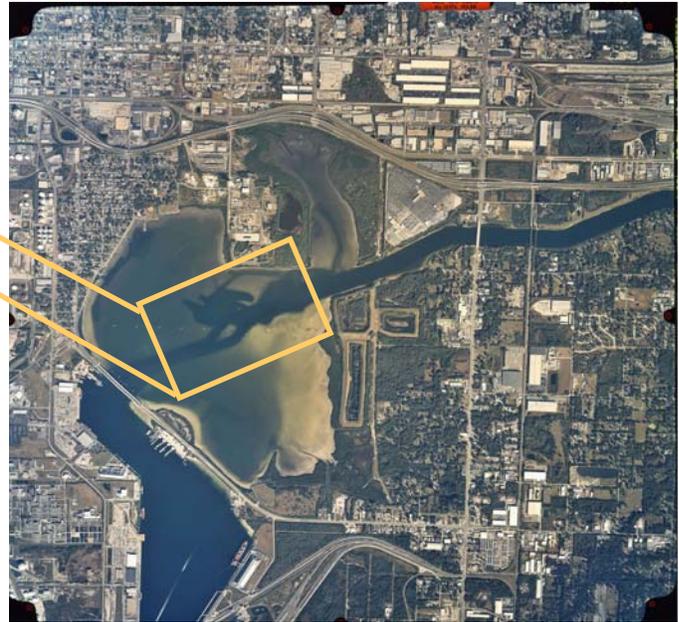
| Nekton Species | Common Name | Number Collected | % of Total Trawl Catch |
|---|--------------------|------------------|------------------------|
|  | Pink Shrimp | 227 | 20% |
|  | Bay Anchovy | 162 | 14% |
|  | Leopard Seabrobin | 149 | 13% |
|  | Blue Crab | 141 | 12% |
|  | Inshore Lizardfish | 51 | 4% |

Overall Rank: #4; Management Recommendation: Keep Hole As Is—Do Not Fill.

McKay Bay Dredged Hole



Location: Hillsborough County, northeast of Hillsborough Bay



Background Information: The McKay Bay hole was dredged for construction activities. Large subtidal dredged channels were excavated to allow construction equipment to access the Palm River and Tampa Bypass Canal for major drainage improvements.

The area is surrounded by mud/sand flats.

The hole is under the ownership of the Tampa Port Authority.

Feasibility for USACOE material delivery is high.

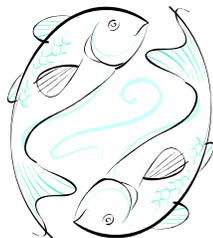
Fast Fish Facts:

FIM Ranking: #9 of 9, worst

Total Animals Caught Inside: 5,844

Dominant Species Inside: bay anchovy (41% total catch), spot, sand seatrout, pink shrimp, and Atlantic croaker

Economically Important Species: spot, sand seatrout, pink shrimp, Atlantic croaker, southern kingfish, blue crab, Gulf flounder, stone crab



Fast Facts:

Approximate Size: 58.8 acres

Maximum Depth: 16.2 feet

Surrounding Area Depth: 2.0 feet

Fill Volume: 3 feet: 891,582 yards³, 4 feet: 48,363 yards³, 5 feet: 617,368 yards³

Habitat Type: Polyhaline Mud

Stratification: Highly Stratified especially in Fall

Dissolved Oxygen: Fall: 1.2 mg/L; Spring: 4.2 mg/L

DO <4 mg/L: Fall: 18.75 hours; Spring: 7 hours

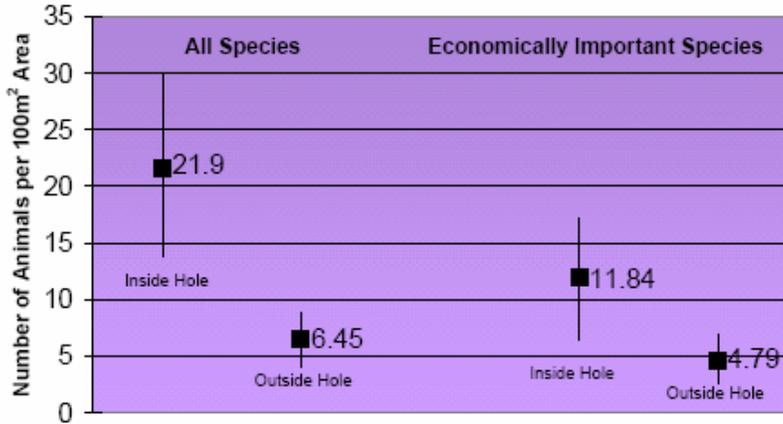
Hypoxia: Fall: 11.25 hours

Sediment Quality: Degraded; Exceeded TEL values for Cadmium, Chromium, Copper, Nickel, Lead, Zinc, and pesticide Lindane

Benthic Index: Fall: 56=Potential Restoration; Spring: 45= Potential Restoration

Dominant Benthos: Fall: Bivalve *Dosinia discus* (100%); Spring: Polychaete *Streblospio gynobranchiata* (100%)

Average Animal Abundance from Trawl Samples at McKay Bay Dredged Hole



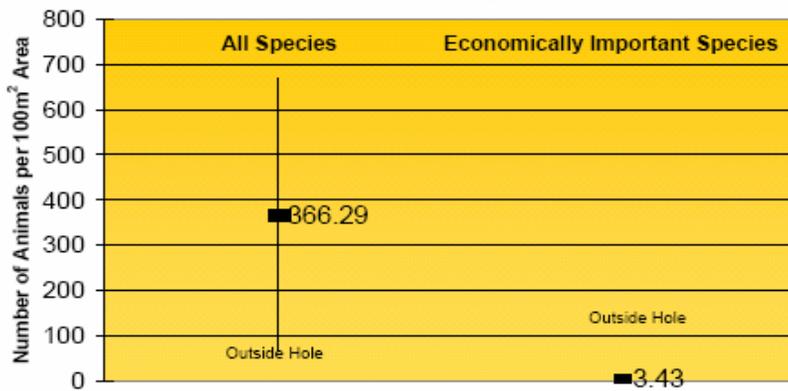
Interpretation of Graphs:

A total of 26,026 animals was collected from 108 samples in and around the McKay Bay dredged hole. Of those, 5,844 animals were collected inside the dredged hole from trawls samples. Sampling outside the dredged hole collected 1,721 animals from 36 trawl samples and 18,461 animals from 36 seine samples.

A greater abundance of species was collected inside the dredged hole from trawl samples than outside using trawls. The abundance of economically important species was slightly higher inside the hole than outside, using trawls.

There were eight economically important species collected inside the hole. Six economically important species were collected outside in either trawls and seven in seines.

Average Animal Abundance from Seine Samples at McKay Bay Dredged Hole



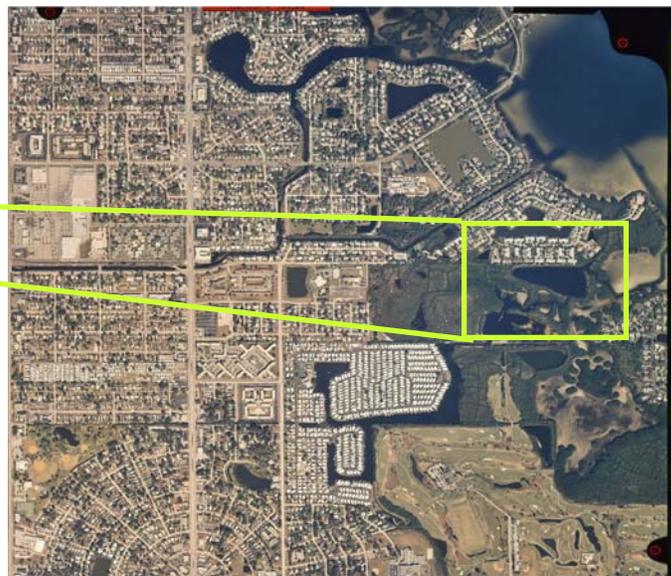
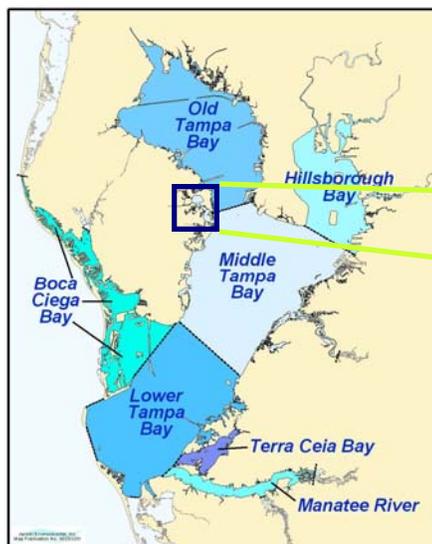
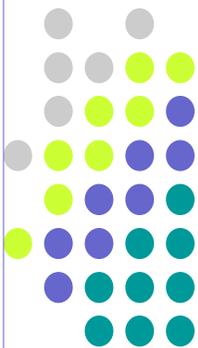
Interpretation of Physical Characteristics—Benthic Ranking: # 11 of 11

There was extensive stress from hypoxia during the fall sampling period and some stress from low DO during the spring. Six metals and the pesticide Lindane contributed to a relatively high PEL Quotient compared to the other dredged holes, although it is consistent with the surrounding area in McKay Bay. The benthic community in the McKay Bay dredged hole showed the highest similarity between seasons of any of the dredge holes, probably because it was the most impoverished of the 11 holes during each sampling period.

| Nekton Species | Common Name | Number Collected | % of Total Trawl Catch |
|---|------------------|------------------|------------------------|
|  | Bay Anchovy | 2,396 | 41% |
|  | Spot | 2,269 | 39% |
|  | Sand Seatrout | 469 | 8% |
|  | Pink Shrimp | 191 | 3% |
|  | Atlantic Croaker | 90 | 2% |

Overall Rank: #11; Management Recommendation: Fill Hole to Surrounding Depth.

Northeast St. Petersburg Borrow Pit 1



Location: Pinellas County, Upland site southwest of Riviera Bay

Background Information: The Northeast St. Petersburg Borrow Pit 1 is located adjacent to the Pinellas County Aquatic Preserve in northeast St. Petersburg. The hole was dredged to provide fill for the Mangrove Bay Golf Course, a large mobile home park, and adjacent residential areas. Several small-scale restoration projects have been completed in the vicinity, including using excavated fill from a marsh restoration project to partially fill other borrow pits and to re-contour a portion of the golf course shoreline.

The hole is under the ownership of the City of St. Petersburg.

Feasibility for USACOE material delivery is high.

Fast Facts:

Approximate Size: 10.9 acres

Maximum Depth: 24.4 feet

Surrounding Area Depth: 3.0 feet

Fill Volume: 3 feet: 201,249 yards³, 4 feet: 187,563 yards³, 5 feet: 173,940 yards³

Habitat Type: Polyhaline Mud

Stratification: Stratified in Spring

Dissolved Oxygen: Hypoxic (Spring); Fall: 3.1 mg/L; Spring: 0.1 mg/L

DO < 4 mg/L: 24-hour Data Not Collected

Hypoxia: 24-hour Data Not Collected

Sediment Quality: Marginal; Exceeded TEL values for Cadmium, Chromium, Copper, Nickel, and Lead

Benthic Index: Fall: 53=Potential Restoration (empty sample); Spring: 62=Potential Restoration

Dominant Benthos: Fall: No animals collected; Spring: Polychaete *Kinbergonuphis simoni*, Oligochaete *Thalassodriloides ineri*, and Amphipods *Ampelisca* spp. and *Ampelisca abdita* (All 25%)

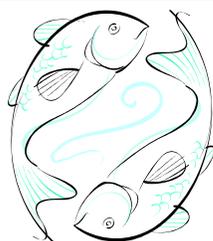
Fast Fish Facts:

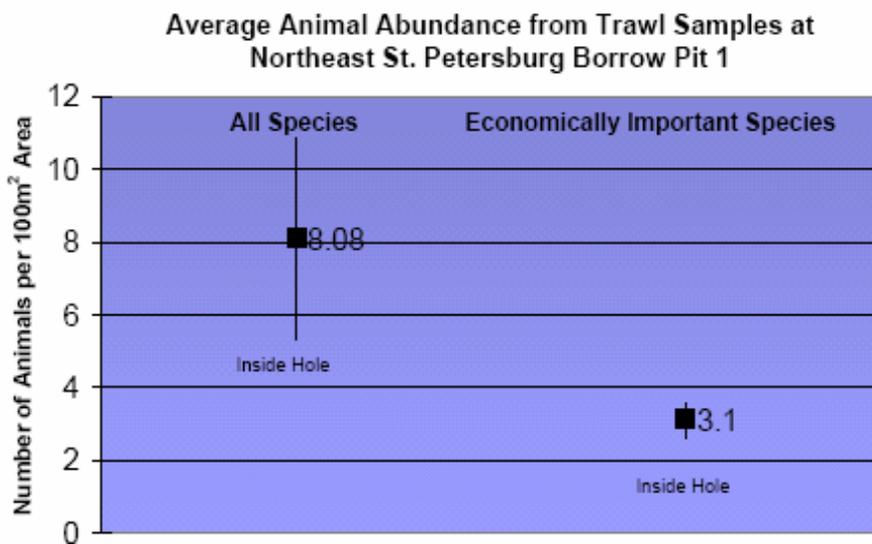
FIM Ranking: Not ranked (no external sampling)

Total Animals Caught Inside: 2,157

Dominant Species Inside: bay anchovy (38% total catch), blue crab, unidentified mojarras, sand seatrout, and southern kingfish

Economically Important Species: blue crab, sand seatrout, southern kingfish, pink shrimp, red drum, spot, sheepshead, spotted seatrout, Gulf flounder





Note: Since the Northeast St. Petersburg Borrow Pit 1 is an upland site, no fish samples were taken outside of the borrow pit.

Interpretation of Graphs:

A total of 2,157 animals representing 34 taxa was collected from 36 samples inside the Northeast St. Petersburg Borrow Pit 1 dredged hole. Of the taxa collected, nine were of economic importance. While comparisons cannot be made using samples collected outside the dredged hole, the total number of animals, number of taxa, and species of economic importance are similar to other

Interpretation of Physical Characteristics—Benthic Ranking: #10 of 11

The Northeast St. Petersburg Borrow Pit 1 showed well developed stratification during spring 2003. The borrow pit exhibited low DO and was anoxic during the spring 2003 sampling. Five metals exceeded their TEL values.

The benthic assemblage was also noticeably degraded. Very few organisms and taxa were found in the samples and the fall 2002 samples were azoic (had no living organisms). Because the benthic habitats were so degraded, there was a high similarity between the seasonal surveys.

| Nekton Species | Common Name | Number Collected | % of Total Trawl Catch |
|---|----------------------|------------------|------------------------|
|  | Bay Anchovy | 810 | 37% |
|  | Blue Crab | 258 | 12% |
|  | Unidentified Mojarra | 220 | 10% |
|  | Sand Seatrout | 168 | 8% |
|  | Southern Kingfish | 124 | 6% |

Overall Rank: # 10; Management Recommendation: Shallow up hole to between - 10 feet and + 3 feet to address hypoxia. Develop intertidal planting shelves with the potential for saltmarsh, mangroves, and intertidal oyster growth.



Northshore Beach Dredged Hole



Location: Pinellas County, middle-west Tampa Bay

Background Information: The Northshore Beach hole was dredged to create the recreational beach and portions of North Shore Park in St. Petersburg. The large offshore dredged hole could potentially create a public safety hazard as people wade offshore and into rapidly increasing water depth. The area is surrounded by a deep sand flat with patchy seagrass and algae.

The hole is under the ownership of the City of St. Petersburg and the State of Florida.

Feasibility for USACOE material delivery is high.

Fast Facts:

Approximate Size: 41 acres

Maximum Depth: 17.7 feet

Surrounding Area Depth: 1.5 feet

Fill Volume: 3 feet: 440,795 yards³, 4 feet: 384,119 yards³, 5 feet: 331,078 yards³

Habitat Type: Polyhaline Mud

Stratification: None

Dissolved Oxygen: Fall: 5.2 mg/L; Spring: 5.1 mg/L

DO < 4 mg/L: 24-hour Data Not Collected

Hypoxia: 24-hour Data Not Collected

Sediment Quality: Marginal: Exceeded TEL values for Cadmium, Copper, Chromium, Nickel, Lead, and Zinc

Benthic Index: Fall: 60=Potential Restoration; Spring: 71=Potential Restoration

Dominant Benthos: Fall: Polychaete *Stenoninereis martini* (100%); Spring: Amphipod *Ampelisca vadorum* (86%)

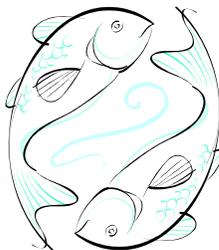
Fast Fish Facts:

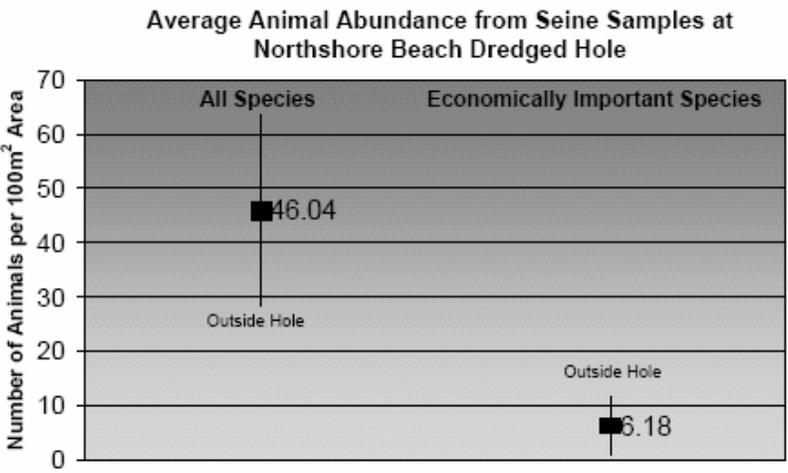
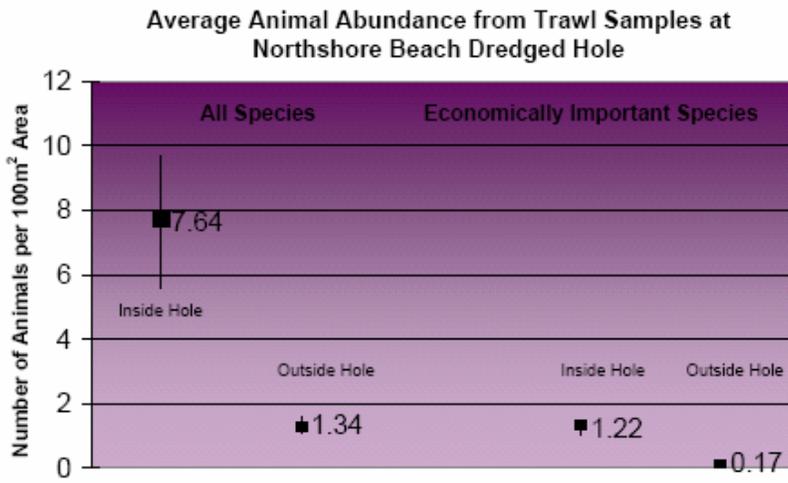
FIM Ranking: #8 of 9

Total Animals Caught Inside: 1,270

Dominant Fish Species Inside: pinfish (20% total catch), unidentified mojarras, silver perch, pink shrimp, and silver jenny

Economically Important Species: pink shrimp, blue crab, Gulf flounder, spot, southern kingfish, sand seatrout, sheepshead, Atlantic croaker, spotted seatrout, lane snapper, red drum





Interpretation of Graphs: A total of 3,224 animals was collected from 82 samples in and around the Northshore Beach dredged hole. Of those, 1,270 animals were collected inside the dredged hole from trawl samples. Sampling outside the dredged hole collected 278 animals from 28 trawl samples and 1,676 animals were from seine samples.

A significantly greater abundance of all species and economically important species was collected inside the hole from trawl samples than from outside trawl samples.

There were 11 economically important species collected inside the hole. Seven economically important species were collected outside in trawls and 11 in seines.

Interpretation of Physical Characteristics—Benthic Ranking: #8 of 11

The Northshore Beach Dredged Hole had adequate DO conditions, although sediment quality was poor. The concentrations of six metals exceeded their TEL values. The benthic community was depauperate during both the fall 2002 and spring 2003 surveys. The dredged hole showed less evidence of density stratification and higher DO levels than comparable habitats in Tampa Bay, and while the benthic community was impoverished, it was not unlike other polyhaline mud habitats in the bay.

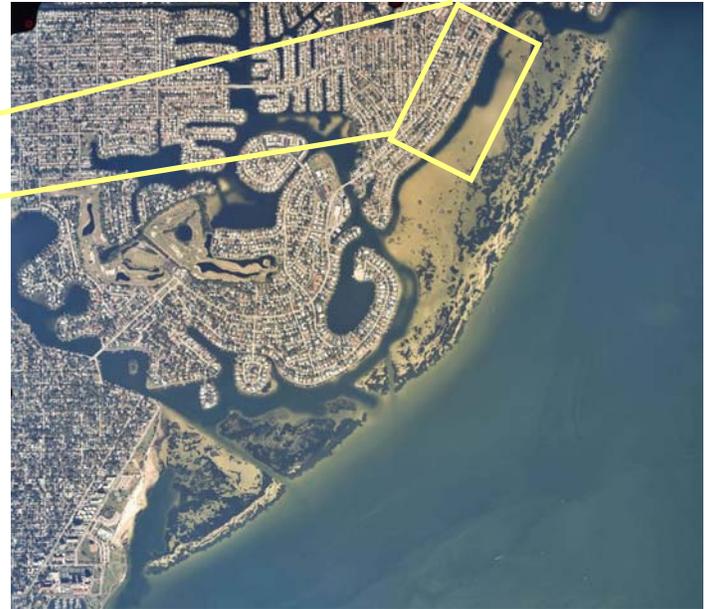
| Nekton Species | Common Name | Number Collected | % of Total Trawl Catch |
|---|----------------------|------------------|------------------------|
|  | Pinfish | 245 | 20% |
|  | Unidentified Mojarra | 211 | 17% |
|  | Silver Perch | 137 | 11% |
|  | Pink Shrimp | 103 | 8% |
|  | Silver Jenny | 63 | 5% |

Overall Rank: #9; Management Recommendation: Fill Hole to Surrounding Depth to encourage expansion of seagrasses.

Shore Acres Dredged Hole



Location: Pinellas County, middle-west Tampa Bay



Fast Facts:

Approximate Size: 30.4 acres

Maximum Depth: 15.4 feet

Surrounding Area Depth: 1.5 feet

Fill Volume: 3 feet: 312,233 yards³, 4 feet: 265,110 yards³, 5 feet: 221,737 yards³

Habitat Type: Polyhaline very-fine sands to mud

Stratification: None; Fall: 0.9; Spring: 0.7

Dissolved Oxygen: Fall: 5.4 mg/L; Spring: 5.3 mg/L

DO < 4 ppm: Spring: 5 hours

Hypoxia: No Hypoxia

Sediment Quality: Marginal; Exceeded TEL value for Cadmium

Benthic Index: Fall: 73=Intermediate; Spring: 88=Protection

Dominant Benthos: Fall: Amphipod *Metharpinia floridana* (25%); Spring: Amphipod *Ampelisca vadorum* (67%)

Background Information: The Shore Acres Dredged Hole was created to aid in the construction of residential areas. Fill material from the bay bottom was cast behind a seawall, creating a higher, filled area. The dredged hole is currently used as a small boat channel and is flanked by a sandy flat with patchy seagrass/algae cover, along with seawall and dock shorelines.

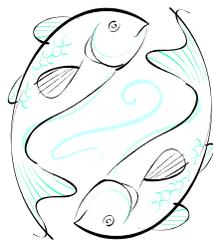
The hole is under the ownership of the State of Florida.

Feasibility for USACOE material delivery is high.

Fast Fish Facts:

FIM Ranking: #1 of 9, best

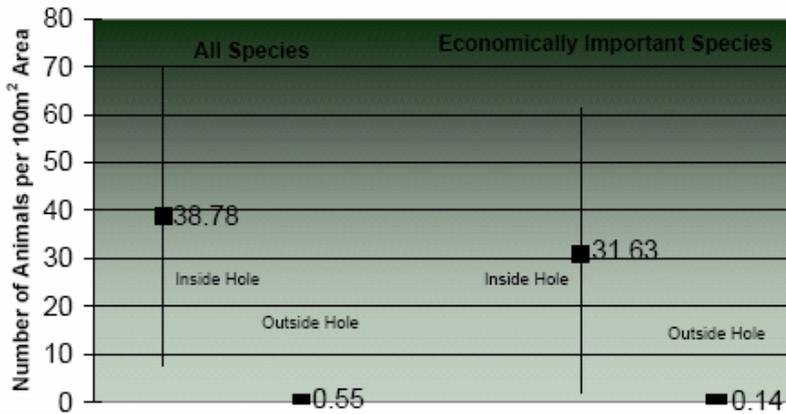
Total Animals Caught Inside: 7,924



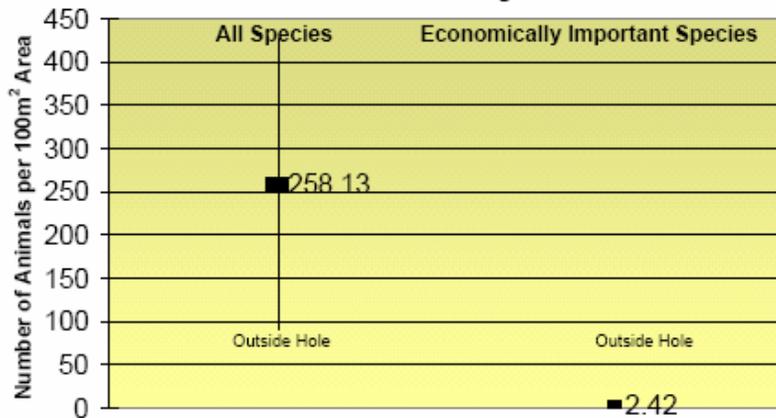
Dominant Species Inside: spot (78% total catch), pinfish, silver perch, blue crab, and pink shrimp

Economically Important Species: spot, blue crab, pink shrimp, southern kingfish, spotted seatrout, Gulf flounder, sheepshead, stone crab, sand seatrout, red drum, lane snapper

Average Animal Abundance from Trawl Samples at Shore Acres Dredged Hole



Average Animal Abundance from Seine Samples at Shore Acres Dredged Hole



Interpretation of Graphs:

A total of 17,433 animals was collected from 82 samples in and around the dredged hole. Of those, 7,924 animals were collected inside the dredged hole from 28 trawl samples. Sampling outside the dredged hole collected 113 animals from 28 trawl samples and 9,396 animals from 26 seine samples.

A greater abundance of species was collected inside the hole from the trawl samples than outside. The trawl samples taken inside the Shore Acres dredged hole were the highest of all holes sampled in taxa, economic importance, and uniqueness.

There were 11 economically important species collected inside the hole. Five economically important species were collected outside in trawls and eight in seines.

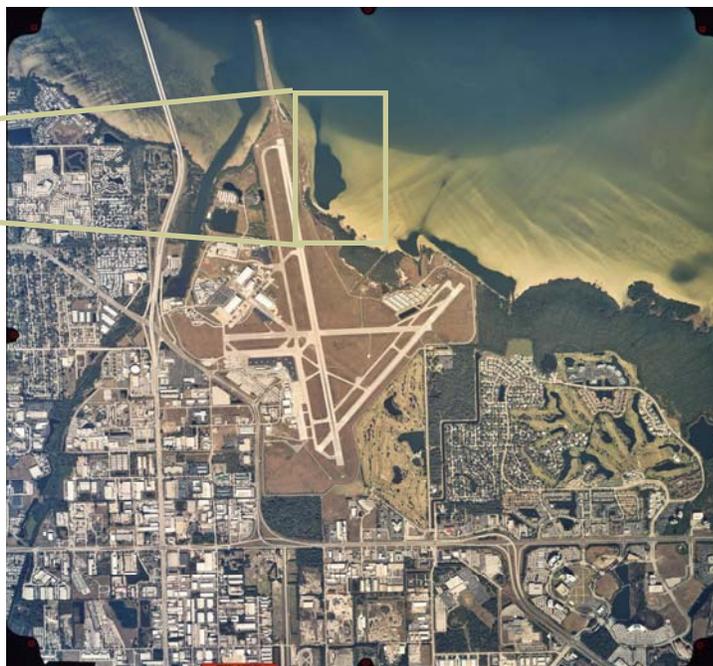
Interpretation of Physical Characteristics—Benthic Ranking: # 2 of 11

The Shore Acres dredged hole was one of the least impacted holes sampled. Sediment contamination was relatively low, with TEL values being exceeded only for Cadmium. Although there was a 5-hour period in spring 2003 when DO concentration was less than 4 ppm, the DO concentrations were generally acceptable. Shore Acres was the only dredged hole that had sand-sized sediments during both survey periods. The benthic community was also relatively diverse.

| Nekton Species | Common Name | Number Collected | % of Total Trawl Catch |
|---|--------------|------------------|------------------------|
|  | Spot | 6,138 | 78% |
|  | Pinfish | 298 | 4% |
|  | Silver Perch | 198 | 3% |
|  | Blue Crab | 182 | 2% |
|  | Pink Shrimp | 158 | 2% |

Overall Rank: #1; Management Recommendation: Keep Hole As Is—Do Not Fill.

St. Petersburg-Clearwater Airport East Dredged Hole



Location: Pinellas County, southwest Old Tampa Bay

Background Information: The St. Petersburg-Clearwater Airport East dredged hole was originally constructed to extend the airport runway and taxiway into Old Tampa Bay. The hole is flanked by a sand/mud flat and a mangrove/rip rap shoreline.

The hole is under the ownership of the State of Florida.

Feasibility for USACOE material delivery is low.

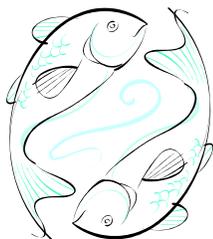
Fast Fish Facts:

FIM Ranking: # 7 of 9

Total Animals Caught Inside: 3,757

Dominant Species Inside the Dredged Hole: pinfish (37% total catch), spot, bay anchovy, blue crab, and sand seatrout

Economically Important Species: spot, blue crab, sand seatrout, southern kingfish, pink shrimp, Gulf flounder, Atlantic croaker, spotted seatrout



Fast Facts:

Approximate Size: 29.2 acres

Maximum Depth: 9.5 feet;

Surrounding Area Depth: 1.5 feet

Fill Volume: 3 feet: 141,380 yards³, 4 feet: 101,332 yards³, 5 feet: 65,893 yards³

Habitat Type: Polyhaline very-fine sand and mud

Stratification: None

Dissolved Oxygen: Fall: 4.1 mg/L; Spring: 4.0 mg/L

DO < 4 mg/L: Spring: 13 hours

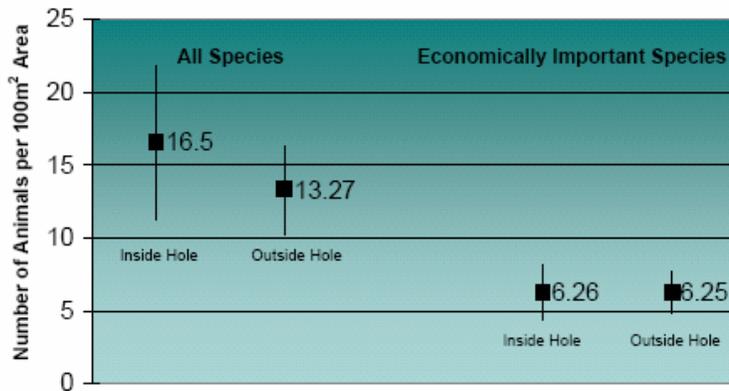
Hypoxia: No Hypoxia

Sediment Quality: Marginal; Exceeded TEL values for Cadmium, Chromium, and Nickel

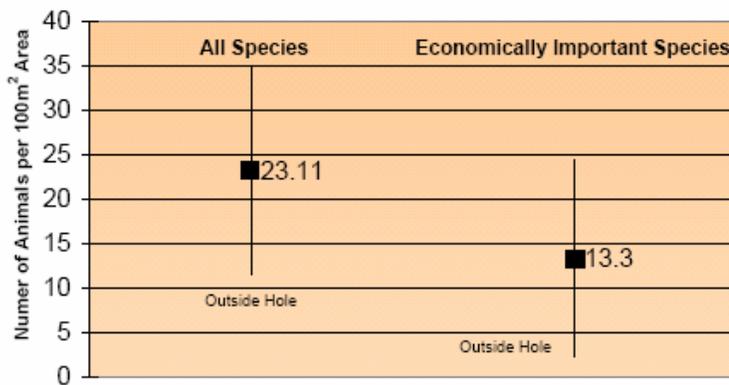
Benthic Index: Fall: 70=Potential Restoration; Spring: 73=Intermediate

Dominant Benthos: Fall: Amphipod (*Ampelisca vadorum*, 45%) and Polychaete (*Gyptis crypta*, 39%); Spring: Polychaete (*Prionospio perkinsi*, 23%) and Amphipod (*Ampelisca holmesii*, 16%)

Average Animal Abundance from Trawl Samples at St. Petersburg/Clearwater Airport East Dredged Hole



Average Animal Abundance from Seine Samples at St. Petersburg/Clearwater Airport East Dredged Hole

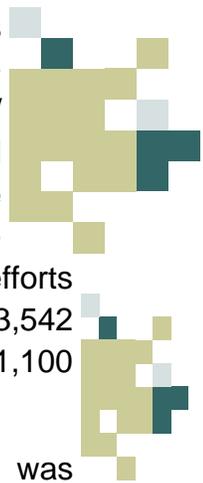


Interpretation of Graphs:

A total of 8,399 animals was collected from 106 samples inside and outside of the St. Petersburg/Clearwater Airport East dredged hole. Of those, 3,757 animals were collected inside the dredged hole from 36 trawl samples. Sampling efforts outside the dredged hole collected 3,542 animals from 36 trawl samples and 1,100 animals from 34 seine samples.

A greater abundance of animals was collected inside the dredged hole from trawl samples than from outside trawl samples. The density of economically important species from trawl samples inside and outside was comparable.

There were eight economically important taxa collected inside the hole. Nine economically important species were collected outside in trawls and eight in seines.



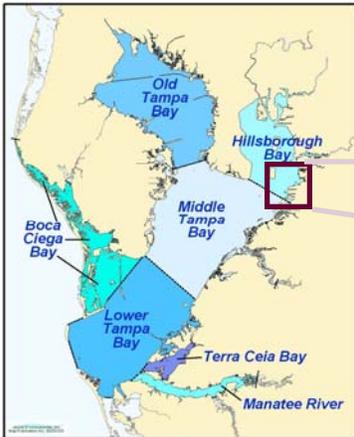
Interpretation of Physical Characteristics— Benthic Ranking: # 4 of 11

Sediment levels at the St. Petersburg/Clearwater Airport East dredged hole were at the high end of the “moderately contaminated” range. There was also a prolonged period of subnominal DO (>13 hours) during the spring 2003 sampling period. The fall 2002 benthic community was noticeably poorer than the Spring 2003 assemblage. Overall, the dredged hole had higher DO, a similar PEL quotient, and a similar benthic community composition to bay-wide polyhaline mud habitats.

| Nekton Species | Common Name | Number Collected | % of Total Trawl Catch |
|---|---------------|------------------|------------------------|
|  | Pinfish | 1,376 | 37% |
|  | Spot | 470 | 13% |
|  | Bay Anchovy | 624 | 17% |
|  | Blue Crab | 310 | 8% |
|  | Sand Seatrout | 291 | 8% |

Overall Rank: #7; Management Recommendation: Keep Hole As Is—Do Not Fill.

Whiskey Stump Key Dredged Hole 1



Location: Hillsborough County, southeastern Hillsborough Bay

Background Information: The Whiskey Stump Key Hole 1 was dredged to serve as a settling area for spoil material that was released over a berm in the “Kitchen” area of Tampa Bay. Dredging and filling activities at Port Redwing created excess dredged material that could not be contained within the original berm. The dredged hole is surrounded by a sand flat.

The hole is under the ownership of the Tampa Port Authority.

Feasibility for USACOE material delivery is high.



Fast Facts:

Approximate Size: 28.2 acres

Maximum Depth: 11.4 feet

Surrounding Area Depth: 1.5 feet

Fill Volume: 3 feet: 206,672 yards³, 4 feet: 171,231 yards³, 5 feet: 137,386 yards³

Habitat Type: Polyhaline Mud

Stratification: None

Dissolved Oxygen: Fall: 5.2 mg/L; Spring: 5.9 mg/L

DO < 4 mg/L: 24-hour Data Not Collected

Hypoxia: 24-hour Data Not Collected

Sediment Quality: Marginal; Exceeded TEL values for Cadmium, Chromium, Copper, Nickel, and pesticide Lindane

Benthic Index: Fall: 58=Potential Restoration; Spring: 83=Intermediate

Dominant Benthos: Fall: Polychaetes *Stenoninereis martini* (40%) and *Polydora cornuta* (19%), Cumacean *Cyclaspis varians* (19%) and Amphipod *Baeta catharinensis* (19%); Spring: Amphipod *Ampelisca vadorum* (82%) and Bivalve *Mysella planulata* (10%)

Fast Fish Facts:

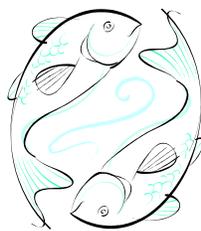
FIM Ranking: #2 of 9

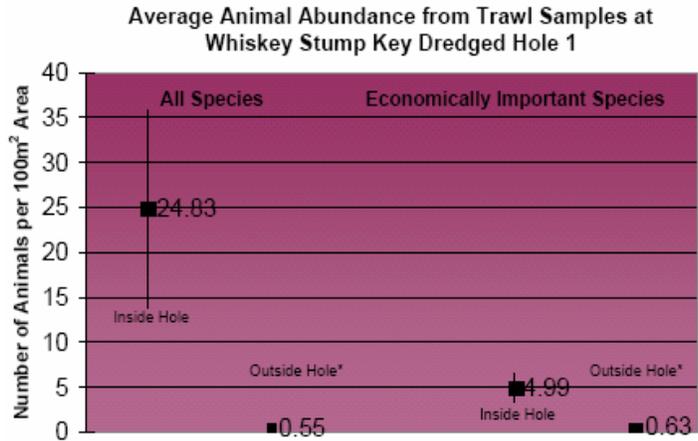
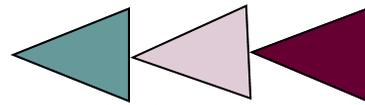
Total Animals Caught Inside: 5,663

Dominant Species Inside:

bay anchovy (54% total catch), pink shrimp, pinfish, silver perch, and silver jenny

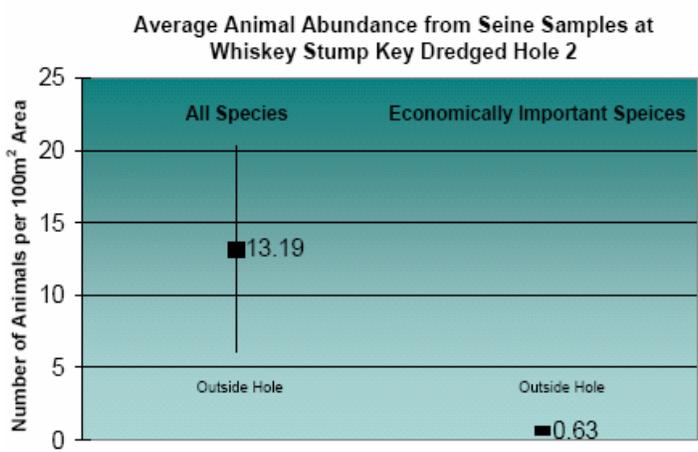
Economically Important Species: pink shrimp, blue crab, sand seatrout, spot, southern kingfish, red drum, Gulf flounder, sheep-head, spotted seatrout, Atlantic croaker





Interpretation of Graphs :

A total of 6,977 animals was collected from 154 samples in and around the Whiskey Stump Key dredged hole 1. Of those, 5,663 animals were collected inside the dredged hole from 33 trawl samples. Sampling outside the dredged hole collected 686 animals from 36 trawl samples (* combined with WSK2) and 628 animals from 60 seine samples.



There was a significantly greater abundance of all species from inside trawl samples, although the abundance of economically important species was relatively low both inside and outside of the dredged hole using trawl samples.

There were 10 economically important species collected inside the hole. Nine economically important species were collected outside in trawls* and seven in seines.

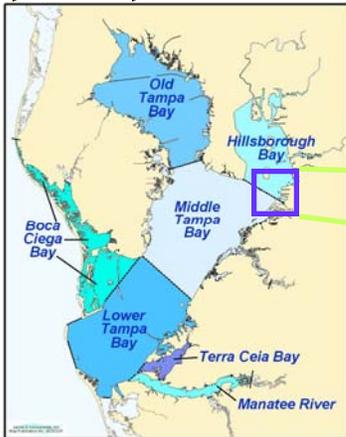
Interpretation of Physical Characteristics— Benthic Ranking: # 7 of 11

The Whiskey Stump Key dredged hole 1 showed less evidence of stratification and higher DO levels than comparable polyhaline mud habitats in Tampa Bay. While the dredged hole was sparsely populated with benthic organisms during the fall 2002 sampling, this condition is not unusual in polyhaline mud habitats throughout the bay. Sediment contamination was noted for four metals and the pesticide Lindane.

| Nekton Species | Common Name | Number Collected | % of Total Trawl Catch |
|---|--------------|------------------|------------------------|
|  | Bay Anchovy | 3,044 | 54% |
|  | Pink Shrimp | 693 | 12% |
|  | Pinfish | 482 | 9% |
|  | Silver Jenny | 356 | 6% |
|  | Blue Crab | 250 | 4% |

Overall Rank: #5, Management Recommendation: Keep Hole As Is— Do Not Fill.

Whiskey Stump Key Dredged Hole 2



Location: Hillsborough County, southeastern Hillsborough Bay

Background Information: The Whiskey Stump Key Hole 2 was also dredged to serve as a settling area for spoil material that was released over a berm in the “Kitchen” area of Tampa Bay. Dredging and filling activities at Port Redwing created excess dredged material that could not be contained within the original berm. The dredged hole is surrounded by a sand flat with sparse, patch seagrass/algae coverage.

The hole is under the ownership of the Tampa Port Authority.

Feasibility for USACOE material delivery is high.

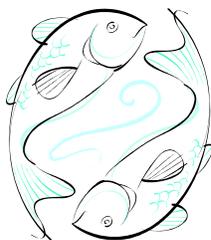
Fast Fish Facts:

FIM Ranking: #3 of 9

Total Animals Caught Inside: 1,917

Dominant Species Inside: silver perch (19% total catch), silver jenny, pinfish, bay anchovy, and pink shrimp

Economically Important Species: pink shrimp, blue crab, sand seatrout, spot, sheepshead, southern kingfish, spotted seatrout, Gulf flounder, gray snapper



Fast Facts:

Approximate Size: 31.4 acres

Maximum Depth: 14.9 feet

Surrounding Area Depth: 2.0 feet

Fill Volume: 3 feet: 244,776 yards³, 4 feet: 200,542 yards³, 5 feet: 158,116 yards³

Habitat Type: Polyhaline Mud

Stratification: Weak in Spring

Dissolved Oxygen: Fall: 6.1 mg/L; Spring: 4.1 mg/L

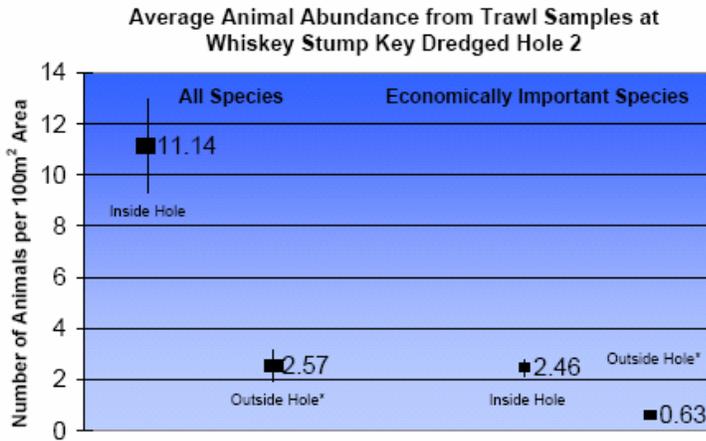
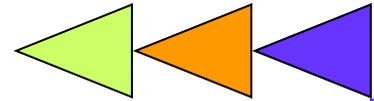
DO < 4 mg/L: DO Did not fall below 4 mg/L

Hypoxia: No Hypoxia

Sediment Quality: Marginal; Exceeded TEL values for Cadmium, Chromium, Copper and Nickel

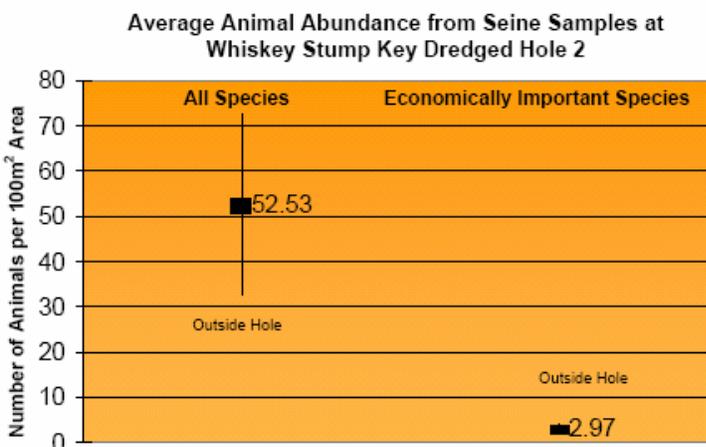
Benthic Index: Fall: 62=Potential Restoration; Spring: 85=Intermediate

Dominant Benthos: Fall: Polychaete *Stenoninereis martini* (36%), Cumacean *Cyclaspis varians* (24.6%) and Amphipod *Ampelisca vadorum* (24.6%); Spring: Amphipod *Ampelisca vadorum* (76%)



Interpretation of Graphs:

A total of 4,515 animals was collected from 154 samples in and around the dredged hole. Of those, 1,917 were collected inside the dredged hole from 25 trawl samples. Sampling outside the dredged hole collected 686 animals from 36 samples (* combined with WSK1) and 1,912 animals from 60 seine samples.



There was a greater abundance of all species, as well as economically important species, from inside trawl samples than from outside trawls.

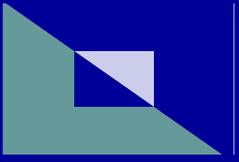
There were nine economically important species collected inside the hole. Nine economically important species were collected outside the hole in trawls* and eight in seines.

Interpretation of Physical Characteristics—Benthic Ranking: # 5 of 11

The Whiskey Stump Key dredged hole 2 showed mild stratification during the spring 2003 survey. The DO concentration was better than similar polyhaline mud habits in the bay. While the dredged hole was sparsely populated by benthic macroinvertebrates in the fall 2002, the standing crop and numbers of taxa increased dramatically in spring 2003.

| Nekton Species | Common Name | Number Collected | % of Total Trawl Catch |
|---|--------------|------------------|------------------------|
|  | Silver Perch | 359 | 19% |
|  | Silver Jenny | 325 | 17% |
|  | Pinfish | 199 | 10% |
|  | Bay Anchovy | 175 | 9% |
|  | Pink Shrimp | 167 | 9% |

Overall Rank: #3; Management Recommendation: Keep Hole As Is—Do Not Fill.



Additional Comments

Statement from the Jacksonville District, US Army Corps of Engineers:

"The Jacksonville District, US Army Corps of Engineers has participated in this study undertaken by the Tampa Bay Estuary Program. The District provided bathymetry and technical assistance for the holes studied. While we applaud this effort to gain new information on aquatic habitats within Tampa Bay, we cannot support recommendations for management of the holes studied. In accordance with the National Environmental Policy Act implementing regulations, any federal action requiring a decision must take into consideration a wide variety of information. This study was limited to water quality, benthic data, fisheries information and recreational fishing data.

We will gladly incorporate this information into our decision-making process regarding the restoration of Tampa Bay bottom along with other pertinent information such as safety, historic and cultural information, wildlife including birds, and seagrasses."

Additional Comments from Bill Fonferek, ACOE:

1. Fisheries surveys were made inside and outside of the holes, which is not a valid comparison. In order to compare similar habitats, fisheries comparisons should have been made between the holes and other edge habitat in the near vicinity.
2. A standard should have been created by which holes could be compared to one another and to other (unstudied) dredged holes in the bay.
3. Use of the word "marginal" in the document is misleading, as most holes exhibited "marginal" characteristics for some parameters. Instead, a different standard should have been used.
4. The recreational fishing data is not appropriate. It is to be expected that people will fish the holes; to artificially assign values on what was observed does not seem validated.

Response to Fonferek comments from Ed Sherwood, EPCHC and Steve Grabe, Janicki Environmental, Inc.:

1. The design of the fisheries trawl surveys was to compare the dredged holes to similar depth habitats outside the dredged holes in the immediate vicinity. The dredged holes represent deep water habitat with an associated edge; the FIM program arbitrarily selected areas outside of the holes with similar depths to make fisheries comparisons. Some of the arbitrarily selected areas outside the holes may also have contained edge habitat from shoal areas. It should be recognized that the sampling within the holes did not focus on "edges" of the dredged holes and, consequently, sampling outside the dredged holes did not focus on the "edges" of shoals areas either. The random selection of sample sites inside and outside the dredged holes was not constrained or stratified to "edge" habitat.

If a strict comparison was to be made of the value of the edge habitat of a dredged hole vs. the edge habitat of a shoal area, then the trawl surveys should have focused on the edges of each. However, the original scope of the project was only to "characterize the dredged holes." The FIM program believes that they adequately showed that deeper water areas outside the dredged holes are different from deeper areas inside the holes, which are different from shallow areas adjacent to the holes. All of these habitats are unique and contain unique compositions of fish, albeit the dredged holes appeared to have more species at a higher abundance than adjacent deeper areas.

Additional Comments

Response to Fonferek comments, continued:

2. We agree that comparing the dredged holes with other comparable habitats is probably more appropriate than comparing the holes to each other. The fisheries index was an attempt to make such comparison and the FIM index (used to rank the holes) was an attempt to create a fisheries standard. The problem is that there are no other reference areas with which to compare. There is currently no fish standard for similar "dredged hole-type habitat" in Tampa Bay.

Comments by Robin Lewis, Lewis Environmental, Inc.:

Although Robin Lewis was not a dredged hole advisory member, his comments have been noted:

It is my understanding that none of the "outside the holes sampling stations" were placed in seagrass beds, even if these were located in the vicinity. If this is incorrect, I would request that someone clarify that issue. If it is correct, it should be mentioned in the final report. If a dredged hole is never filled back to grade, there is no chance it will ever support seagrasses in the future. If it is filled back to grade, there is a chance that it will support seagrasses in the future. In particular, a filled dredged hole will naturally have shallower depths over which waves will be more attenuated. The mere presence of a dredged hole may alter the hydrology in the immediate vicinity, and filling it may make the future possibility of seagrass colonizing a hole better, or seagrasses colonizing adjacent shoals more likely

In particular, the Whiskey Stump Key holes have a very good possibility of supporting seagrass growth. At various times in the past I have observed shoal grass meadows close to the edges of these holes, and these beds have come and gone over the years. We have successfully transplanted seagrasses to the area in front of Whiskey Stump Key, although I do not believe there are seagrasses there now. I believe the City of Tampa Bay Study Group has done similar work. The dredged hole at Lassing Park was successfully filled and planted with seagrasses, and persists today as an example of a restored seagrass bed in Tampa Bay that would never have become a reality without filling a dredged hole.

In my professional opinion, the lack of sampling in seagrass beds, and lack of discussion in general about the possibility of restoring seagrass beds over filled dredged holes, and the lack of acknowledgment that only by filling some of the holes do we preserve the possibility of true restoration of seagrass beds in certain areas in the future, is a fatal flaw in the study. This is not meant as a criticism of FWRI and their fish study. I have the utmost respect for their ability to do a good job of what they are instructed to do, or to develop a scientifically valid sampling program to meet the requirements presented. It is just that the far reaching view that I have of restoring seagrasses to the "Kitchen" and other areas with dredged holes was obviously not shared by others, even when the reality of the work at Lassing Park is there for all to see.

Response to Lewis comments from FWC, FWRI:

The locations of samples "outside the holes" were randomly selected, and included seagrass beds (and areas without seagrass beds). The locations of sampling sites are included in the Fisheries Assessment Final Report (available on the Technical CD). Seagrass beds were sampled for Shore Acres, Gandy Channel North, Northshore, and Whiskey Stump Key 2 dredged holes.

Background Information on Dredging Process and Project Development

Ecology of Bathymetric Depressions in Estuarine and Coastal Waters

Prepared by the U.S. Army Corps of Engineers Research and Development Center.
October 2002.

Final Quality Assurance Project Plan for Implementation of the Tampa Bay Dredged Material Management Strategy: Beneficial Uses for In-bay Habitat Restoration (Dredged Hole Assessment Project)

Prepared by the Tampa Bay Dredged Hole Habitat Assessment Advisory Team.
January 2003.

Final Reports for Physical, Benthic, and Fisheries Sampling

Tampa Harbor, Tampa Bay, Hillsborough Bay, Florida Dredge Hole Assessment Project:
Bathymetric Results

Prepared by the U.S. Army Corps of Engineers, Jacksonville District.
August 2003.

Ecological Assessment of Selected Dredge Holes in Tampa Bay: Hydrographic Conditions, Sediment Contamination and Benthic Macroinvertebrates

Prepared by Stephen A. Grabe, David J. Karlen, Christina Holden, Barbara Goetting, Sara Markham and Thomas Dix—Environmental Protection Commission of Hillsborough County.
February 2005.

Tampa Bay Dredge Hole Assessment Project: Fisheries Assessment Final Report

Prepared by Edward T. Sherwood—Fisheries-Independent Monitoring Program, Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission.
April 2004.

Determination of Management Recommendations (Technical Appendices)

Selection Criteria and Rankings for Fisheries-Independent Monitoring, Benthic and Sediment Sampling, and Physical Characteristics

Determination of Management Recommendations: An Explanation of Ranking Options and Final Management Recommendations

Prepared by Lindsay Griffen, Tampa Bay Estuary Program.
January 2005.

References Used in Document

Frithsen, J., Schreiner, S., Strelbel, D., Laljani, R., Logan, D., and Zarbock, H. 1995. Chemical Contaminants in the Tampa Bay Estuary: A Summary of Distributions and Inputs. Tampa Bay Estuary Program Technical Publication #01-95.

Malloy, K., Wade, D., Janicki, T., and Grabe, S. 2005. Development of a Benthic Index to Establish Sediment Quality Targets for the Tampa Bay Estuary. Technical Report to the Tampa Bay Estuary Program.

Tampa Bay Dredged Hole Habitat Assessment Project funded by a grant from the

U.S. Environmental Protection Agency Region 4



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