

Executive Summary

Midnight Pass Feasibility Study

Introduction to Midnight Pass

Looking at historical events along the coast of Sarasota County provides insight to the dynamic forces which create our physical environment. The coastline is in a constant state of change, yet day-to-day little, if any, is noticed. Over time, however, the cumulative effects of wind, wave, and tides can dramatically change the character of our beaches and barrier islands. Passages between inland waters and the Gulf of Mexico are a vital part of this coastline and a focal point of dynamic forces on these sandy shores. These inlets are closely monitored and evaluated for multiple purposes. In Sarasota, the inlet which has been talked about and studied more than any other is currently closed. This is Midnight Pass and is the focus of this report.

The initial opening of Midnight Pass is not documented, yet records beginning in the late 1800's provide an understanding of its existence. These records include nautical charts, maps, hurricane tracking results, aerial photos, and permit files. A comparison of the charts and aerial photos to known events, such as hurricanes, allows us to correlate the effects of these events on the physical environment in this area.



As a result, a chronology of events and their effects on the shorelines and Midnight Pass has been developed. This history of approximately 100 years shows the results of the forceful dynamics on the barrier islands known as Casey and Siesta Keys and the inlet which separated them.

The first accurate survey of the study area was published in 1888, which reveals a pass located approximately 15,000 feet to the north of Bird Key at a rock outcropping known as Point of Rocks. It is believed this represents the migration of an inlet that advanced northward from Bird Key to Point of Rocks. The record shows that Casey Key paralleled Siesta Key on the west, forming a north/south channel between the two barrier islands.

In 1921, a hurricane opened a pass adjacent to the north end of Bird Key. The new pass was known as Musketeer Pass until around 1924 when it became known as Midnight Pass. The Blind Pass inlet at Point of Rocks gradually closed between 1921 and 1924, forming a long lagoon system from Point of Rocks south to Midnight Pass.

In 1925 and 1926, hurricanes washed over the beach and filled the lagoon approximately 1.5 miles south of the former Blind Pass inlet. This separation created a land-locked northern remnant that became known as Heron Lagoon.



Between 1942 and 1948, Midnight Pass migrated north approximately 1,200 feet, while the north end of Casey Key accreted during this time. In August of 1949, the northern spit of Casey Key was once again breached 1,400 feet south of the 1948 location, threatening private property to the south of the new location. The property owners petitioned the Army Corps of Engineers for permission to add additional groins at the new opening to control erosion.



The pass location remained moderately constant until 1969; although there was considerable shallowing in the northern channel which has been attributed to hurricane Donna (1960) and spoil from the dredging of the Intracoastal Waterway (ICW) in 1963-64.



**Color enhanced aerial photo of
Midnight Pass before Closure in 1983.**

Following 1969, Midnight Pass began a northerly migration that ended in December 1983 when the pass was closed by human intervention. At the time of the closure, the location of the pass had returned to approximately the same location it occupied in 1948. As the migration occurred, the north end of Casey Key accreted and gained vegetation. Since closure in 1983, there has been a significant amount of public interest in the reopening of Midnight Pass.

Background to Project

In 1995, the Sarasota Bay National Estuary Program sponsored a series of mediated forums. Participants were asked to make recommendations to improve water quality and otherwise enhance the ecology of Little Sarasota Bay. The fate of Midnight Pass was singled out as a specific item for discussion and a series of ideas and recommendations were developed.

During the forums, participants heard several presentations about circulation in Little Sarasota Bay, the nursery function on the habitats in the vicinity of the former pass, and plant and animal composition before and after pass closure. When asked to recommend what, if anything, should be done with Midnight Pass, the forum concluded that additional studies should be conducted to determine whether a pass could be reopened that meets a rigid set of physical and environmental criteria.

The recommendations were ultimately forwarded to the Sarasota Board of County Commissioners for their endorsement and financial support. In July 1997, the Board endorsed the recommendations and agreed to fund a study. The guidelines and scope for the study were established as follows.

“Policy Goal

Any pass in the former Midnight Pass area, however reopened, should be a natural pass and the system shall be allowed to respond to natural barrier island processes including shoaling, pass movement, erosion, sea level rise, overwash, etc.

Implementation Recommendations

- 1. Have a comprehensive study conducted by a circulation modeler/coastal engineer which provides for design configurations for non-hardened channels that will result in a reasonably stable pass which requires minimal to no maintenance to keep it open. Identify where the null zones will move to. Look at the nature of sediments in terms of beach erosion.*
- 2. Expand study to consider all circulatory impacts.*
- 3. Determine what biological/topographical changes would be needed to complement a natural pass (for example, but not limited to: removal of exotic vegetation; lowering spoil islands; and, planting mangroves.)*
- 4. The navigability of the pass should not be the major issue in deciding the optimal configuration of the pass.”*

A summary of this feasibility study is presented on the remaining pages.

System Modeling

To implement a comprehensive study about a coastal inlet requires considerable data and numerous calculations. Computer programming can help handle such an evaluation. Recent advancements in coastal engineering and software applications have led to development of computer models which are directly applicable to the assessment of reopening Midnight Pass. The computer modeling performed for this study had three primary goals to achieve:

First, the models had to be established using available reference data, for the purpose of describing the existing physical environment for the area. In achieving this objective, the models can be considered as expanding information in time and space from the data available. The models are established using the existing pre-development bathymetric configuration, and calibrated to reproduce the available historical observations (wave conditions, currents, water levels, littoral drift rates) in the study area.

Second, the models need to accurately determine the stability which can be expected for a range of possible inlet geometries. From this analysis, the more stable inlet configurations can be identified for further study.

Third, the models need to perform a detailed analysis of specific inlet configurations. The current field present in the reopened inlet can be simulated for typical tidal conditions, as well as for a selected storm event where the effect of waves and sand on the flow pattern is included. The impact of the proposed inlet configurations on the shoreline evolution can also be determined.

A depth-integrated hydrodynamic model is the core of the present study, extending from the south of Venice Inlet to the north of Tampa Bay. The model applied is the MIKE21 NHD (Nested Hydrodynamic) module from the Danish Hydraulic Institute's (DHI) suite of applicable computer software. The output of the hydrodynamic modeling includes variations of water level and velocity/flux in time and space.

A regional wave model has also been established to describe the distribution of wave conditions along the Gulf coast. The purpose of this task is to define the inshore wave climates at various locations of interest throughout the area, primarily for the purpose of providing input to the coastal sediment transport tasks. Inshore wave climates are imported directly into the sediment transport model for use in determining the sediment budget and resulting shoreline evolution. The wave model applied is the MIKE21 NSW (Nearshore Spectral Wave) module.

A longshore sediment transport (aka "littoral drift") model has been established, for the purpose of describing the shore-parallel movement of sand resulting from wave forcing. Long-term simulations of the littoral drift rate yield the statistical distribution of beach sediment transport, which will act to close the reopened inlet. The sediment budget (i.e., the gross and net annual littoral drift for a given location of the coast) is determined using the deterministic sediment budget model LITDRIFT.

A full sediment transport analysis has also been completed to:

- (a) quantify the ability of the reopened inlet configuration to remain self-cleansing during typical tidally-dominated conditions, and
- (b) determine two dimensional effects such as the complex wave-driven currents which will occur in the vicinity of the ebb shoal during extreme wave events.

Finally, the complete sediment transport mechanisms present during a storm condition can be evaluated by means of a joint application of the above described models.

Inlet Stability Analysis

The stability of tidal inlets has always been a topic of great public interest, and a source of many problems for coastal authorities. The morphological response of inlets is typically gradual due to forcing from waves and tidal flows under normal conditions, whereas under storm conditions the response may be relatively violent and sudden. This combination of short-term and long-term morphological forcing has always posed a challenge to engineers attempting to predict inlet behavior. Historically such predictions have been made using analytical calculations and empirical relationships. Today, such an inlet stability analysis can be supported by numerical modeling, but the fundamental challenges of predicting such a complex combination of natural mechanisms have largely remained intact.

The stability of an inlet – and it should be made clear that the term “stability” refers to cross-sectional stability and not lateral stability – is a balance between forces tending to infill and those tending to scour or restore the inlet. The primary infilling mechanism is the transport of sand into the inlet by wave-driven littoral drift. The primary scouring mechanism is the transport of sand out of the inlet throat by high velocities occurring at this constriction – such flows are primarily tidally driven.

The approach taken in the present study is to first test a matrix of simplistic inlet geometries in the calibrated MIKE21 model, for the purpose of identifying the tidal prism and maximum velocity corresponding to each cross-section. This information allows for the determination of the critical cross section for a stable reopened pass, assuming a simplistic inlet geometry. From this simplistic inlet geometry, two realistic inlet geometries are identified and studied in detail to determine their ultimate feasibility. The design of these two reopened geometries also take into account the storage capacity required for the inlet to temporarily retain beach material deposited from a severe storm without incurring a reduction of cross-section that would lead to instability.

A total of 22 simplified reopened inlet geometries were evaluated with computer modeling in order to determine the response of the inlet-bay system (in terms of tidal prism and peak cross-sectionally averaged velocity) to a reopened Midnight Pass. Two reference bathymetries were applied, which resulted in conservative and non-conservative estimates of the critical cross-sectional area. The results of this extensive modeling of various geometries generated two configurations for further consideration.

The estimated equilibrium cross-sectional area (300 square meters) was then used to design the two inlet geometries. It is, however, noted from the non-conservative geometry that a clear tendency exists for narrower, deeper channels to be relatively more stable than wider, shallower channels.

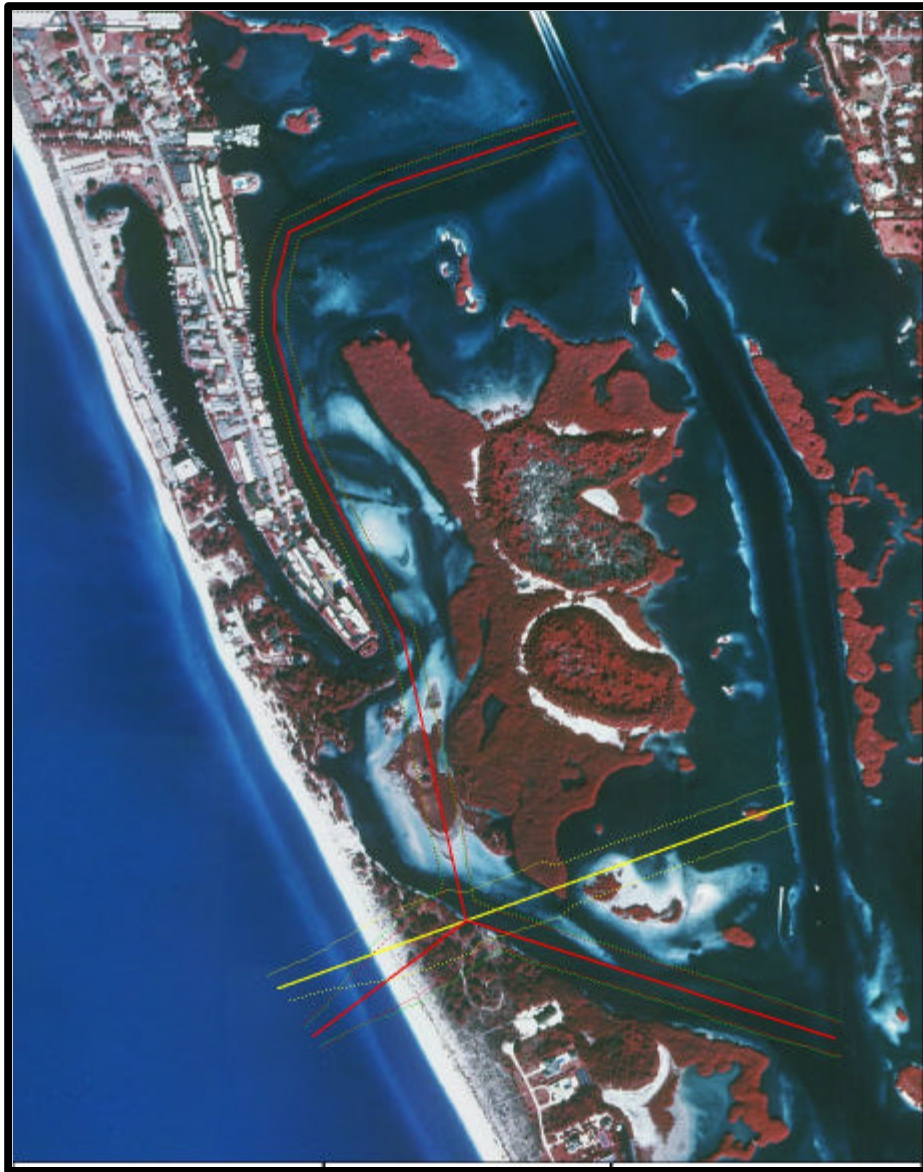
Storage Capacity of Inlet

In order to estimate the amount of sediment deposited in the inlet during storm periods, a simulation of the littoral drift was performed for the period between 1976 and 1995. Within this period, a total of 92 storms of a chosen severity were identified. A statistical analysis showed that a 1% exceedance event for deposition of beach material into Midnight Pass corresponds to 7,000 cubic meters of sand. In other words, over 20 years one storm has exceeded this value.

The cross-shore distribution of sediment transport has shown that the littoral transport exists predominantly in a 100 meter-wide belt adjacent to the shoreline. A storm at the 1% exceedance level could thus impart a cross-sectional reduction of roughly 7,000 cubic meters per 100 meters, or about 70 square meters to the inlet. Further analysis has shown that the self-cleansing ability of the inlet will be sufficient to remove this volume of deposited sand within one typical neap-spring-neap tidal period.

There is a multitude of ways that the specified cross-section of 300 square meters could be applied to the existing coastal geometry. The approach taken here is to define one configuration that is based conceptually upon the geometry of the 1955 pass configuration (similar to the CP&E design, 1989). This configuration is referred to as Layout #1 and includes dredging of the existing channels both north and south of Bird Key, thereby connecting the inlet throat with the ICW.

A second configuration (Layout #2) is defined having a more simple geometry, featuring a linear dredging cut directly from the Gulf to the ICW.



Overlay of proposed Layout #1 (red) and Layout #2 (yellow) on infrared aerial photo 1995.

The reopening of Midnight Pass will affect the distribution of the tidal prism of the Little Sarasota - Blackburn Bay system. While a detailed stability analysis for the nearby inlets is beyond the scope of the present study, a comparison has been made of the integrated tidal prism through the adjacent inlets for the conditions modeled. These results, which were derived from the 14-day long hydrodynamic simulations of each configuration, are shown as follows.

Relative Change in Tidal Prism at Inlets Adjacent to Midnight Pass for Various Situations

Condition	% Change in Tidal Prism, Relative to Existing Condition		
	New Pass	Big Pass	Venice Inlet
Existing	0.0	0.0	0.0
Layout #1	+0.7%	-1.9%	-11.3%
Layout #2	+0.9%	-1.5%	-11.7%

It should be noted that the ICW connection between Dona Bay and Lemon Bay, south of Venice Inlet, is closed in the MIKE21 model at present. Thus, the flows calculated for Venice Inlet do not include any contribution from this water body for any of the layouts. It can be concluded that Venice Inlet will have a reduced tidal prism by the reopening of Midnight Pass, whereas Big Pass and New Pass will be minimally impacted by the specified geometries of Layout #1 and #2.

Assessment of Morphological Evolution After Reopening

Following the reopening of Midnight Pass, morphological changes will occur in front of the inlet and along adjacent beaches. The ebb tidal shoal, which has largely been eroded since the closure in 1983, will develop again; if not initially reconstructed, in response to the new hydrodynamic conditions. The material that is used to restore the ebb tidal shoal will come from adjacent beaches, tidal inlet area and the channel, which connects the inlet and the ICW. The natural restoration of the shoal will continue until it is in dynamic equilibrium with the hydrodynamic regime defined by the tidal currents through the inlet and the wave-driven currents in the vicinity of the inlet mouth.

The calculated transport capacities show that the full gross annual littoral drift will initially be trapped in the inlet area, in the event that the ebb shoal is not constructed in conjunction with the reopening of the inlet. Once the ebb shoal is re-established, significant by-passing of the inlet can be expected via the ebb shoal. Sand dredged during inlet maintenance will be discharged onto the downdrift beach, thus returning the material to the littoral zone.

The ingoing transport capacity is seen to be much larger than what can be supplied by the littoral drift. Although the modeling results show a bayward transport capacity of approximately 200,000 m³/yr, it should be noted that these values are exaggerated due to the fact that the sediment modeled has a constant mean grain size of 0.15mm, which is appropriate for the local beach sand. In practice, the bed will become naturally more protected with coarser sediment that will resist erosion. Additionally, scouring of the seabed will increase the cross-section and reduce the transport rates. It can be said, however, that the model clearly indicates a scouring tendency in the throat of the inlet.

It is possible to create a stable inlet, which will be self cleansing in the inlet area – but the transport potential through the inlet and the channels is large and will lead to fast erosion of the shoreline adjacent to the inlet. The shoreline will quickly re-establish the shape it had 1955, where the shorelines on both sides were bent towards the inlet due to the increasing transport capacity towards the inlet existing during flood flow. In the long term, the ebb shoal will tend to protect the coastline within approximately 200 meters around the inlet. It is, therefore, expected to be beneficial to construct an ebb shoal in conjunction with the reopening of the pass.

Biological Effects of Opening Midnight Pass

Initial dredging impacts to the study area have been evaluated. Within the Midnight Pass study area, field surveys were conducted to evaluate the coverage of existing habitats. A 1995 USGS aerial infrared photograph was used as a base map for delineating habitats. Results of the surveys were entered into a geographic information system (GIS) and layered over the aerial base map. Coverage areas were then calculated for each habitat. The calculated areas impacted by the channel configurations include the actual dredged area as well as the area from the channel to the outer shoulder of the channel. Additional erosional effects cannot be reliably estimated but may be experienced in some area which will be subject to swift water movement.

The straight through configuration would affect the least amount of bay and gulf bottom, approximately 95,610 m² (23.6 acres). The “Y” configuration would affect nearly twice as much, with approximately 183,614 m² (45.37 acres) of bottom impacted. The altered habitats would be converted to sandy or shelly sand clean channel habitat typical of other nearby passes such as New Pass or Big Sarasota Pass. These estimates do not consider the potential deposition of any sandy dredged material being placed in the gulf for beach restoration or ebb delta creation.

Biological considerations of the estuarine system have been assessed. Consideration of the biological implications of reopening Midnight Pass needs to take into account the fundamental effects a pass has on the estuarine fauna. Passes exist to allow freshwater to escape to the sea. Freshwater is toxic to most marine organisms. Paradoxically the mix of seawater with freshwater allows for the highly productive zone known as an estuary, where certain species (mostly of marine origins) have adapted to the depressed salinity to take advantage of a level of nutrients much greater than that found in oceanic waters. Nutrient availability allows for high levels of primary productivity, when in balance provides an abundance of food for consumers. However, excessive levels of nutrients create many problems including suppressed species diversity, alteration of community composition and various levels of eutrophication.

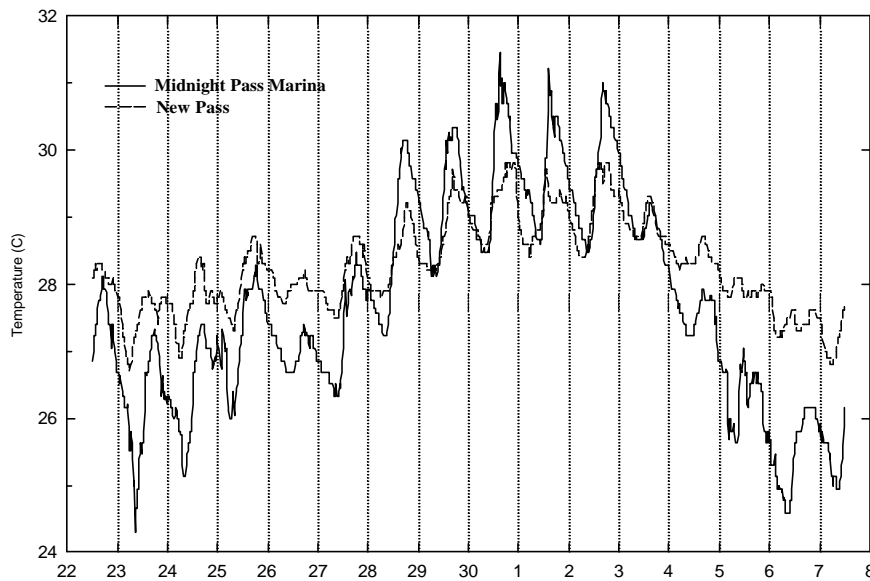
Nutrient levels within the Sarasota Bay system are considered to be excessive (Roat and Alderson 1990). Much of the excess nutrients enter the bay as non-point source pollution, primarily stormwater runoff and atmospheric deposition from the highly urbanized Phillippi Creek drainage basin. Phillippi Creek represented the largest basin draining into Sarasota Bay and drains into the portion of the bay with the poorest flushing and circulation. (From: Sarasota Bay, The Voyage to Reclaimed Paradise).

A water quality trend analysis conducted for Sarasota Bay (Dixon and Heyl 1999) showed that while salinity was generally increasing in the northern portions of the bay (Palma Sola Bay and Anna Maria Sound), it was decreasing in the southern portions of the bay (Lower Sarasota Bay, Little Sarasota Bay, and Blackburn Bay). Total nitrogen showed a strong inverse relationship to salinity although within Little Sarasota Bay total nitrogen showed a declining trend with time. The closure of Midnight Pass has probably contributed to the declining salinity in the southern portions by reducing the flushing rate of that portion of the bay.

In addition to allowing the mixing of freshwater with seawater, passes serve as the focal point for flushing and circulation. Wind generated currents also play a role in estuarine mixing, but in Little Sarasota Bay the effect is generally small compared to tidally induced currents. The physical effect of water movement enhances estuarine communities. Water movement distributes nutrients, allows for dispersion and mixing of oxygen and other dissolved gasses, carries food, removes waste and allows for the transport of eggs and larvae and in the case of broadcast spawners allows for successful fertilization of eggs. Within a contiguous waterbody, stagnant areas are seldom as diverse or productive as areas with circulating water.

The buffering effect of Gulf water entering the bay can be illustrated with a series of temperature measurements taken in September and October 1999. During the collection of supplementary bathymetry data for the modeling effort a thermograph was placed at the Midnight Pass Marina dock, located approximately 1 mile to the north of the former pass on the west side of the bay. The temperature measurements taken at this location were plotted against the temperature measurements recorded at a dock on New Pass. Both lines of data clearly show the tidal effect on temperature. The graph also shows that temperature fluctuations were much greater at the Midnight Pass Marina site. The shallow trapped water in Little Sarasota Bay responds faster to changes in air temperature and solar irradiance. Thus when a cold front pass through the bay water in the vicinity of Midnight Pass drops more rapidly and to a lower temperature than for areas in proximity to a pass. The Gulf waters play an important role in buffering bay water temperatures. Certain fish species such as snook are sensitive to rapid drops in water temperature and may be stunned or killed by rapidly falling temperatures.

Temperature measurements taken at Midnight Pass Marina



The circulation of Gulf water also buffers high bay temperatures. While New Pass temperatures did not exceed 30 degrees Centigrade while at the same time on October 1 temperatures at Midnight Pass Marina were in excess of 31 degrees Centigrade.

In addition to the habitats characterized by the GIS analysis other important components were evaluated based on hypothesized effects of improvements in water quality and circulation.

Non-vegetated Benthos

This habitat comprises a large part of Little Sarasota Bay. Studies of the benthos conducted by Mote Marine Laboratory in August of 1984 (8 months after the pass was closed) and again in 1989 showed a dramatic decrease in species diversity at locations in the vicinity of Midnight Pass. The total number of invertebrate taxa recovered in 1984 was 148. By 1989 the total number of taxa recovered at the same locations had declined to 78, a decline in species richness of 47%. The same trend was observed for the total number of invertebrate individuals recovered in the samples. In 1984 there were 2,480 individuals collected that declined to 1,809 in 1989 for the same sample size, an abundance decline of 27%.

The decline in species diversity and abundance was attributed to declines in salinity and reduced circulation resulting in muddier surficial sediments at the locations that were sampled. A muddier substratum coupled with reduced circulation often results in low dissolved oxygen levels within the substratum. This effect is most pronounced within dredged areas that tend to accumulate fine organic matter. During summer months the production of hydrogen sulfide as a result of anaerobic bacterial respiration can eliminate benthic fauna from dredged holes with poor circulation. Hydrogen sulfide within bottom sediments is common in most of the deeper water areas in the Midnight Pass area.

Bivalve Shellfish

Prior to the closure of the pass edible species of shellfish were abundant in the Midnight Pass area (personal observation). *Mercenaria mercenaria* (quohog) was abundant in the vicinity of the Bird Keys and *Macrocallista nimbosa* (sunray Venus) which is also edible was common. These two species of clams were absent from the area by 1988, as documented by field surveys by the Midnight Pass Society, and by Mote Marine Laboratory in 1989. The Midnight Pass Society survey estimated that large living clams prior to closure were 11,700 per acre.

For many years the only approved shellfish harvest areas have been in the vicinity of passes. An economic and recreational benefit of pass restoration could be the addition of a shellfish harvest area. However, it may take many years for the *Mercenaria* to repopulate the area naturally. It would be a relatively inexpensive project to buy clam seed from commercial sources to jump start the recolonization. A reasonable expectation for *Mercenaria* recolonization in the restored Pass area is 50 % of the pre-closure densities or 5,550 individuals per acre within five years, if seed stock is provided.

Seagrass Communities

Seagrass communities are complex. The physical habitat analysis illustrated that areas which have colonized with *Ruppia* and *Halodule* since the pass was closed will be lost as a result of pass restoration. However, the effect on the other seagrass beds of Little Sarasota Bay and Blackburn Bay will be positive. Water clarity will increase as a result of introduction of Gulf water. The area affected will be proportional to the volume of water that enters the pass. The relationship between seagrass growth and water quality parameters is complex and a prediction of the aerial extent of seagrass improvement is not possible with this qualitative assessment. The seagrass epiphyte load will decrease in areas which experience significant nutrient reductions.

Seagrass expansion within the area influenced by a restored Midnight Pass will depend on the volume of water circulating in and out of the pass as well as a variety of water quality conditions that will manifest as a gradient from the Gulf to the tidal null zones. Most of Little Sarasota Bay and Blackburn Bay is less than 1.83 m deep (-6.0 ft. mllw) consisting of smoothly sloping bottom, bisected by the ICW. This allows for a great deal of potential seagrass expansion if water quality conditions improve even moderately, which was also noted by Kurz and Tamasco (1999).

Incremental calculations of potential increases in seagrass habitat based on light penetration and bottom topography are beyond the scope of this project since additional detailed bathymetry would be necessary. In light of recent seagrass regrowth in other areas of the bay, after improvements in water quality, it is reasonable to expect significant seagrass expansion in Little Sarasota and Blackburn Bays after the restoration of Midnight Pass. The seagrass expansion after pass restoration will easily be an order of magnitude greater than the anticipated loss due to the dredging activity (16.3 acres lost with the 'Y' configuration). The effect on water quality and therefore seagrasses will diminish with increasing distance from the restored pass.

Fisheries

From the time of Pass closure to 1989 area rainfall was below average for every year except 1987. In the summer of 1987 there were heavy rainfall events (14.8 inches in July). During the period after the rainfalls of 1987 the Midnight Pass Society documented a number of fish kills in the area from Stickney Point Bridge south to South Bay (near South Creek) with the majority of fish sighted between point Crisp (Coral Cove) and the Blackburn Point Bridge. This type of fish kill is not uncommon when confined estuarine systems receive excess freshwater runoff.

Like many of the biotic resources of Sarasota Bay the fisheries functions have only been minimally studied. A number of issues remain to be answered including the function of local passes for larval transport/colonization of nearby nursery areas. In fact when Midnight Pass was open, there was more or less direct access to North and South Creeks for the many species that use such areas as nurseries. Generally, these species are spawned in higher salinity waters and use freshwater-driven 'upstream' currents to reach their nurseries. When the pass was closed (and perhaps also when the ICW was built) these migratory routes were completely changed. Now to reach these nurseries, larvae must travel from either Big Pass (8 miles distant) or Venice Inlet (7 miles distant) to these critical areas. Exacerbating the problem is the fact that now a null zone exists near North Creek, so even less water movement occurs. The ICW probably also tends to 'confine' larvae, making it even more difficult to colonize such creeks.

The reports of fish kills and sub-lethal oxygen stress events (slow moving fish at surface gulping air at dawn) have been more frequent since the pass closed. There can be several reasons for water to become oxygen depleted. High primary productivity, induced by excess nutrient levels, create a heavy respiration (consumption of oxygen) at night resulting in pre-dawn oxygen crashes or hypoxic events. In addition to nighttime respiration decay of organic matter, which builds up in poorly circulating areas, consumes oxygen. Freshwater runoff can also stratify the water in an estuary resulting in oxygen depleted high salinity bottom water which can result in large scale die offs of bottom fauna.

A second issue that needs to be addressed is the function of Jim Neville Marine Preserve. Since pass closure the preserve sits within the null zone and one can easily see the stagnation of the waters. Granted, this situation may favor certain species, but generally Sarasota Bay needs habitats for the species that do not thrive in stagnant systems. Every summer, Mote fisheries biologists report spawning congregations of adult snook (*Centropomus undecimalis*) in the Gulf at the former location of Midnight Pass. Snook spawn in the vicinity of estuarine passes and the larvae proceed upstream to tidal creek areas where the larvae develop to juveniles. Larvae have limited swimming ability and rely on tidal transport for entrance into the estuary. Larvae hatched from eggs spawned at the location of the former Midnight Pass presumably perish or have a much-reduced probability of survival since the nearest pass, Venice Inlet, is 7 miles to the south. For a snook larvae spawned at the former location of Midnight Pass it would be a 14-mile trip to the tidal creek habitat of North Creek.

Mangroves

Existing mangrove habitat will be impacted by the restoration of the pass. Most of the mangroves which will be removed are those that colonized the flood tide shoal after closure of the pass. An integrated restoration plan could utilize the planned Bird Keys spoil island restoration (U.S. Army Corps of Engineers) as a way to mitigate this loss. Mangrove habitat in excess of that lost to the pass restoration could be created by removing the spoil placed during the construction of the ICW. In addition mangroves fringing the channel areas may undergo some level of erosion. The effect of the pass opening on the remaining mangroves will largely be neutral in terms of enhanced water quality. Mangroves readily thrive in full seawater as well as estuaries, and therefore mitigation potential for either replanting or planting new mangroves should be considered feasible.

Spoil Island Reclamation

Independent of this project is a program considering restoration of the Bird Keys spoil islands proposed U.S. Army Corps of Engineers. The project is currently in the fact finding stage and there are no design plans for these islands. The opportunity to mesh the potential Midnight Pass reopening and restoration of the Bird Keys is clearly present. While the projects have independent reasons for proceeding, they both address the issue of improvement of bay habitat quality, and a joint venture should be considered. A combined project offers both the ability to increase wetland habitat area and improve circulation within Little Sarasota Bay. By restoring the upland spoil areas of the Bird Keys, the impact of constructing the inlet could be mitigated, as well as realized improvements in water circulation.

Estimated Cost of Reopening Midnight Pass

This study evaluates both implementation and maintenance cost of reopening Midnight Pass in terms of current day pricing. Information was gathered from numerous sources including dredging contractors, recent bids for dredging, the U.S. Army Corps of Engineers, CDM’s cost database, sales representatives, and permitting agencies.

Reopening Midnight Pass will require permitting, engineering, wetland mitigation, dredging, and management administration. There are associated costs with each of these items. Because of the nature and public interest in this project, it is anticipated that the upfront cost will be significant. Environmental agencies and certain sectors of the community will undoubtedly require a significant burden of proof to allow final issuance of the construction permits necessary to reopen Midnight Pass. It is estimated that water quality modeling, additional data collection, administrative hearings and associated legal services, and wetland mitigation will be part of the initial cost for this project.

The estimated capital costs for the two inlet configurations are presented below.

Cost Element	Layout #1 ("Y" Configuration)	Layout #2 (Straight Configuration)
Permitting	\$ 800,000	\$ 800,000
Wetland Mitigation	460,000	300,000
Dredging	4,494,280	3,481,400
Engineering Design/Administration	674,142	522,210
Contingency	449,428	348,140
Total Estimated Capital Cost	\$6,877,850	\$5,451,750

As shown, the estimated costs for constructing Layouts #1 and #2 are \$6.9 million and \$5.5 million, respectively. This amount includes a 10 percent contingency to accommodate unknowns at this point in the project. Such unknowns could include rock excavation, labor disputes, bid protests, and construction claims.

Upon reopening the Pass, the County will be required to maintain and monitor the opening for FDEP permit compliance. This will include maintenance dredging requirements and water quality monitoring. Two options for maintenance dredging have been considered: self-performing and contracting the operation. If the County were to use a dredge rig for other purposes or enter into partnership with the West Coast Inland Navigational District (WCIND), the annual maintenance costs to the County could be reduced. Based on estimates of maintenance dredging, the annual cost for transferring sand is in the range of \$160,000 to \$260,000. Costs could be potentially higher during years with major storm events.

Funding of this public interest project should consider numerous sources such as the WCIND, Sarasota Bay NEP, USACOE, SWFWMD, FDEP, USEPA as well as County funds. In particular, the County should discuss the joint funding of reopening Midnight Pass with the current USACOE restoration program for Sarasota Bay. One of the more important elements of the restoration program includes environmental improvements to Jim Neville Marine Preserve. The projects complement one another and it's feasible that the wetland mitigation program, which will be required for Midnight Pass, can be accomplished by the environmental enhancements to the Jim Neville Marine Preserve. Similarly, if a dynamic water quality model can demonstrate improvements to Little Sarasota Bay, the project may qualify for State grant monies from either FDEP or SWFWMD.

Permitting

In 1989, the County applied for a permit to reopen Midnight Pass; the permit was subsequently denied by FDEP. What is now different which will allow for a permit to be issued? There are several key differences, existing and anticipated, that should allow for State and Federal issuance of permits to reopen Midnight Pass. These differences are:

- A significantly more detailed modeling effort has been commissioned by the County, the results of which demonstrate a stable pass can be built. This hydrodynamic modeling also demonstrates the relationship of the ICW's impact to destabilizing the original Midnight Pass.
- Wetland mitigation and potential integration with restoration plans for Jim Neville Marine Preserve. The original application did not propose wetland mitigation for the initial dredge and fill impacts.
- The commitment of a dynamic water quality model for demonstrating the beneficial relationship of salinity increases (from reopening Midnight Pass) to seagrass improvements within Little Sarasota Bay; this modeling may also be required to perform a nutrient budget for analyzing system eutrophication.
- Since 1989, additional biological and water quality information has been collected to help demonstrate negative impacts resulting from the closure of Midnight Pass.
- The permitting process has been streamlined on a more technical basis of permit issuance and provisions for single point of agency submittals.

A joint effort to a pass maintenance and monitoring program with the County, the NEP and WCIND will help leverage such commitment during the permitting process. A basis of issuance of a joint coastal permit is both demonstrating need and benefit to the public's interest. If these needs and benefits can be demonstrated, then it is deemed permissible.

Conclusions

The feasibility study of reopening Midnight Pass has addressed the inlet stability, biological conditions, permissibility and associated costs. Based on the results of this study, the reopening of Midnight Pass has been found to be feasible. In terms of biological conditions, recreating the inlet is expected to improve the health of the overall natural resources within the affected tidal prism. Coupled with restoration plans within the Neville's Marine Preserve, the project is anticipated to restore environmental conditions to those which existed within the Little Sarasota Bay watershed many years ago.

Layout #2 is recommended as the more feasible configuration for reopening Midnight Pass. This alternative provides the necessary tidal prism for stability and offers lower capital cost and less wetland impacts than the "Y" configuration.

From the standpoint of inlet cross-sectional stability, it is expected that a reopened Midnight Pass is feasible. A maintenance dredging commitment is to be expected for compliance with FDEP permit conditions and following large storm events. Such events may deposit large quantities of sand into the throat of the pass and cause instability. The design configuration has established a storage capacity to absorb such deposition in up to twenty year storm events. It is unlikely to exceed the annual gross littoral drift rate of 30,000 cubic meters per year. Any severe hurricanes, of course, may cause significant change and this study has not predicted the effects of such events.

The state of the art is not, at present, adequate to fully determine the lateral stability of the inlet. An option for lateral stability could be a maintenance dredging program designed to move accumulated sand from the accreted side of the inlet to the eroded side, thereby maintaining inlet location. The manner in which lateral stability can be guaranteed is by hardening the inlet throat. This will also serve the dual purpose of allowing for steeper side slopes in the inlet cross-section, which will contribute to the cross-sectional stability of the inlet. The reopening of the pass will give rise to localized shoreline erosion over a distance of approximately 200 meters on each side of the inlet if the outer portion of the inlet throat is not stabilized.

Following the re-establishment of a dynamic equilibrium including a fully developed ebb shoal, losses from the littoral cell due to the inlet will be small. A sediment sharing dynamic system will develop where exchange of sediment occurs between shoal, inlet, lagoon and adjacent beaches. Any material extracted from this system artificially (such as material dredged from the inlet during maintenance activities) will be placed on adjacent beaches.