



TAYLOR ENGINEERING, INC.

2018 WEDA ENVIRONMENTAL EXCELLENCE AWARDS Dredging for Navigation

Florida Inland Navigation District
Intracoastal Waterway Deepening
Fort Lauderdale, Broward County, Florida
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Project Summary

Florida Inland Navigation District Intracoastal Waterway Deepening Fort Lauderdale, Broward County, Florida

Project Summary

Taylor Engineering designed, permitted, and provided construction administration for a Florida Inland Navigation District (FIND) project to deepen the Intracoastal Waterway (ICWW) in Fort Lauderdale, Broward County, Florida from -10 feet (ft) Mean Low Water (MLW) to -17 ft MLW. Part of the federally-authorized 403-mile navigation channel along Florida's east coast, the project site lies within a densely populated, highly urbanized area. Marine traffic ranging from small recreational vessels to commercial barges and super yachts creates a difficult working environment. In the 2.9-mile long project area, the federally authorized project depth had become insufficient for safe navigation. This deepening project succeeded because it was carefully planned, well defended, and cost-effectively executed. Throughout the project, the team remained conscious and considerate of all relevant environmental, technical, regulatory, and social aspects that influenced the design, permitting, and construction.

Project phases included

- A conceptual alternatives analysis that considered:
 - Channel footprint and dredging volume
 - Dredging equipment and dewatering practices
 - Long-term maintenance requirements
 - Dredged spoil disposal alternatives
 - Safe off-site material transport from the dredged material management area (DMMA)
 - Benefits of alternative designs to local marine industries and recreational boaters
 - Seagrass and hard coral impacts—direct and indirect
 - Impacts to smalltooth sawfish, manatees, and state and county parks
- Engineering design of the selected alternative
- Effective working relationships with all stakeholders, including private citizens; industries; and local, state, and federal agencies to fit the design within all agency identified constraints while achieving design objectives, maximizing long-term channel design benefits and natural resource impact avoidance, and minimizing unavoidable impacts
- Constructing the project safely and efficiently, within budget and schedule, and modifying the project methods and associated permit conditions as necessary

The project deepened the channel from the previous -10 MLW template to -17 ft MLW (- 15 ft MLW design template plus 2 ft of allowable overdredging) while avoiding environmental impacts and reducing long-term maintenance requirements. The executed design modified the channel to include the best means of protecting and preserving the ecosystem while improving navigation safety.

Environmental Benefits

The ICWW is an artificial channel created at the beginning of the 20th century. Since then, the channel and surrounding open waters have developed a marine / estuarine ecosystem including seagrass, a diverse sessile organism community including sponges and soft and hard corals, and a diverse aquatic community. Seagrass, the foundation of the ecosystem, is a sensitive community that is easily impacted and difficult to restore. The deepening project found the ways to avoid impacts to the seagrasses and corals, also rare and valuable to the system, while deepening the channel to safe navigation depths. Challenges included creating a stable, deeper channel cross section without widening in areas with seagrass along the channel



edge, avoiding impacts to hard corals, and maintaining traffic during project construction. Widening would have required federal project reauthorization. After analyzing safe navigation standards for the vessels using the channel and completing natural resource investigations, the channel design was revised to maintain target depths and avoid seagrass impacts. The redesign narrowed the channel bottom width where necessary in soft sediment locations and made box cuts in limestone areas to obtain the design depth without changing top of bank width. No seagrasses were impacted and the only mitigation was hard coral transplantation within the general project area outside the channel. New limestone exposure created additional habitat for marine sessile organisms. The project also resulted in a better, safer environment for boating of all types and removed contaminated sediments from the system. With the approved overdepth dredging, the channel will require less frequent maintenance; this aspect further reduces the potential for environmental impacts over the long term.

Innovation

Geotechnical. As part of the initial project design development, FIND completed two types of geotechnical explorations for the project. The combined results provided contractors a better means to select the best equipment for the project and avoided construction equipment issues associated with rock hardness. The first investigation, conducted in 2006, included the collection of forty standard penetration test (SPT) borings within the project area. The borings generally encountered weathered limestone below the mudline with relatively low penetration resistance (N-values < 10). An SPT N-value of 10 is approximately equivalent to a relative density of 35 percent and represents the approximate boundary between loose to medium dense sediments for coarse-grained (cohesionless) deposits. However, layers of hard, more competent rock (N values > 10) were encountered at a few borings. For this reason, FIND conducted a second geotechnical exploration in 2014—involving seismic reflection—to better characterize subsurface material, particularly the location of the limestone and other potentially dense, strong materials within the dredging template. The results of the seismic reflection survey correlated well with the results of the previously collected SPT borings and indicated a high likelihood of encountering material with N-values greater than 10 in a large portion of the dredging template. Presentation of both investigations to the prospective bidders (**Figure 1**) allowed them the opportunity to select the best dredging equipment for the project.

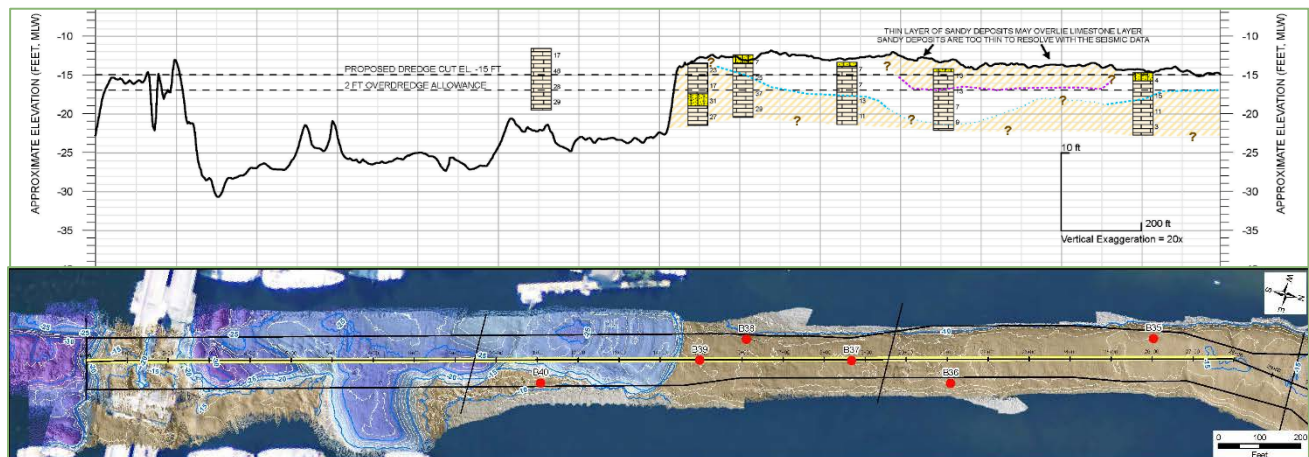


Figure 1. Standard Penetration Test Borings vs. Seismic Reflection Comparison



Maintenance of Upland Traffic.

One year of the seven-year permitting process was strictly dedicated to securing road access via a temporary haul road, to the DMMA located on Port Everglades property without disturbing ongoing port related operations. The 15-ft wide x 1,800-ft long one-way access road required authorization from landowners (Broward County Parks and Recreation and Florida Power & Light), permits from the U.S. Army Corps of Engineers and Broward County, and an individual license from Florida Power & Light that included a fee for use along with design mandates, additional monthly usage fees, and environmental monitoring reports from an independent third party. The contractor was also required to have its upland Maintenance of Traffic Plan and truck haul schedule approved by Port Everglades, Broward County, and Florida Power & Light (**Figure 2**) prior to engaging in any hauling traffic. Over the course of the 11-month long trucking portion of the project, only two complaints were filed by commercial users west of the access road due to a build-up of traffic. The contractor was able to adjust the truck haul schedule to accommodate the adjacent commercial land users and facilitate traffic during peak hour flow.

24-HR TRUCK HAUL TIMEFRAME		MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
12:00 AM	6:00 AM	PORT EVERGLADES (Contractor Collaboration with and approval from Port Operations/Security/Broward Sheriff)						
6:00 AM	8:00 AM	NO HAULING					NE 7TH AVE	
8:00 AM	12:00 PM	NE 7TH AVE						
12:00 PM	4:00 PM							
4:00 PM	6:00 PM	NO HAULING					NE 7TH AVE OR PORT EVERGLADES (Contractor Collaboration with and approval from Port Operations/Security/Broward Sheriff)	
6:00 PM	12:00 AM	PORT EVERGLADES (Contractor Collaboration with and approval from Port Operations/Security/Broward Sheriff)						

Figure 2. Truck Haul Schedule coordinated Before Project Bid

Dredging Over Top of an Active Utility Line.

A Florida Department of Transportation active and unburied cable controls the opening and closing of the Las Olas Boulevard Bridge (**Figure 3**), a major and daily transportation corridor for hundreds of thousands of residents. To avoid a time-consuming and costly Maintenance of Traffic Plan (for bridge closure), the contractor modified the dredging method to work at night (to reduce impact to the marine traffic) with a diver-operated hydraulic dredge around the active, charged line to successfully remove the dredged material and achieve the required project depth.



Figure 3. Nighttime dredging at Las Olas Boulevard



Economic Benefits

The FIND completed the construction (dredging) phase of the project between May 2016 and June 2017, approximately 7 months before the required completion date. Despite the difficult and long permitting process, the construction phase of the project went relatively smoothly due largely to the contractor's attention to detail and support from the project stakeholders. A brief description of the equipment, procedures, and local economic benefit follows.

Equipment and Procedures. The contractor removed material from the bottom of the ICWW with a conventional open bucket (10 CY) excavator and placed it into hopper barges. The 164 ft x 49 ft x 10 ft mechanical dredge—a Liebherr 994 excavator—provided a shallow draft and was powerful enough to break through the weathered limestone material identified in the pre-construction geotechnical borings (**Figure 4**). When filled to capacity, the 2,430-ton capacity hopper barges (230 ft x 43 ft x 11.8 ft) would transport the material from the dredging site to the temporary DMMA located on Port Everglades property approximately three miles south of the southerly project limit. The use of these tools allowed completion of dredging well in advance of the required schedule.



Figure 4. Cashman dredging on the ICWW deepening project in Ft. Lauderdale, Broward County, FL

Once at the DMMA, the contractor tied the loaded barges to fender dolphins and used a long-reach excavator—a Sennebogen 880—and hydraulic clamshell bucket to unload the barges from land. Due to the permit requirement of zero-water discharge directly into the adjacent canal, the contractor used a pump to remove and transfer any freestanding water from the barge into the DMMA. With the excess water removed, the excavator offloaded the dredged material directly into the DMMA. To prevent material from spilling onto the shoreline and protected mangroves, the contractor installed a steel spill plate directly over the shoreline and mangroves to collect and transfer any spilled material to an upland area (**Figure 5**). As the material began to build up at the discharge point, the contractor used a front-end loader to move the material within the DMMA to facilitate dewatering. Once the material was mostly dewatered, the contractor transferred the material into a “stockpile area” located on the north end of the DMMA for final draining and loading into sealed 18-CY dump trucks. Water that collected in the material-settling pond was gravity fed to two corrugated metal pipe flashboard weir risers connected to two



Figure 5. Temporary DMMA at Port Everglades



corrugated metal pipes that discharged into a decanter area. As visible in **Figure 5**, the DMMA design allowed suspended sediments to settle out of the water column by slowing the flow rate through the decanter via interior baffle berms. Water traveled from the decanter area through an elevated drain consisting of a single 2.6-ft corrugated metal pipe and across two trip dams for final discharge into the adjacent canal via an elevated riser and a single 2.6-ft corrugated metal pipe. This process gave sediments time to settle and thus prevented excessive turbidity in the discharge from the DMMA. Before allowing initial discharge of water from the DMMA, the permits required that the contractor collect and test water samples adjacent to the DMMA and in background canal locations for contaminants. The contractor also collected and tested turbidity samples for compliance with the permit turbidity criterion. Once the contractor had obtained passing test results, discharge began.

Local Economy. Broward County residents and the area's vital marine industry have benefited from deeper water and easier navigation following the completion of the ICWW deepening project. Situated in the "Yachting Capital of the World", the project has resulted in significant increased economic benefits while providing for continued operation of the area as a boating destination and international marine hub. To remain competitive with other emerging popular marine destinations, Fort Lauderdale's waterways must remain open and accessible to boats of all sizes. The marine industry's estimated 110,000 marine-related jobs in Broward County contribute one of the largest portions of the industry's estimated \$8.8 billion economic revenue to the County. According to a recent economic study, a similar, recently completed, \$7 million dredging project at the Dania Cut-Off Canal resulted in a \$23 million economic benefit to Broward County in the first year after completion. This financial benefit included \$11 million in additional revenues for boatyards, hotel rooms, restaurants and other local businesses. FIND is currently in the process of completing an economic study for all of Broward County with expected completion by the fall of 2018.



Photograph 6. Ft. Lauderdale Boat Show is located on the northern end of the project study area

Transferability

Key project characteristics and lessons learned transferability for projects with similarly difficult working conditions and significant environmental issues include:

- The importance of a very thorough examination of options that considers all engineering, human, and environmental issues before selecting and developing a constructible design
- Active and frequent communication with the regulatory agencies pre-, during, and post-construction allow for a team-based and permit compliant project
- Avoidance of environmental impacts throughout the entire project duration
 - Design – channel realignment to avoid seagrass and permitting of a one-way access road to avoid mangrove impacts



- Pre-construction – advance coordination with marine boating and industry community and coral relocation to areas outside of the channel
- Construction – excellent turbidity control and dredging practices
- Advanced and thorough geotechnical investigations gage expected material hardness for appropriate equipment selection, thus allowing the contractor to efficiently and effectively dredge, manage, dewater, and truck material for rapid project completion in an urban environment
- Active and frequent communication with the public marine community through outreach meetings and daily reporting of dredge location
- Advanced Maintenance of Traffic plan—coordinated and approved by local governments—to avoid surprises to the local area community by increased truck traffic removing dewatered dredged material

Outreach and Education

The project area includes numerous marine-based industries that required continued access to the ICWW. The dredging contractors 98-ft wide equipment (dredge and adjacent hopper barge), significantly reduced navigable width of the 125-ft wide channel. Prior to project commencement, FIND conducted an outreach meeting with the local industries, U.S. Coast Guard (USCG), Port Everglades, Marine Industries of South Florida (MIASF), and the dredging contractor. The dredging contractor explained the project logistics, including the operation schedule and dredging and offloading operations. To facilitate communication with marine operators, strict vessel movement protocols were put in place and coordinated with Port Everglades. In addition, the contractor provided daily equipment position reports that informed local mariners of dredging location and duration. Within the first two months of dredging eight vessel groundings were reported near the dredge. With alterations of the contractor's proactive communication (e.g., public outreach to local marinas and mariner groups, on-board signage, and daily equipment positions reports), no additional groundings were reported for the duration of the job. Frequent discussions with the regulatory community over the seven-year permitting period and during construction provided them a clear understanding of project aspects that they otherwise would not have known or considered. This had a positive effect on their view of the project, on the permit conditions, and their ability to quickly understand and approve permit modifications.

Summary

On average, the dredging contractor achieved a production rate of approximately 1,300 cy/day over the course of the 160-day working or 870 cy/day over the 232-day total dredging period. With exception of one turbidity exceedance early in the construction period, the project resulted in no environmental permit violations. The contractor achieved the design project depth through most of the project area. Unfortunately, due to the delay in relocating Florida Power & Light and AT&T utility crossings, FIND will eventually need to return to the area to dredge the 5,400 cy of material remaining within the permitted dredging template. By the fall of 2018, FIND will perform an updated economic study to determine the net increase in marine economic output; however, FIND and Broward County private and commercial residents strongly believe the expected economic benefits justify the \$19.5 million construction cost.

Project Team

Engineering Firm Nominee:	Taylor Engineering, Inc.
Project Manager:	Lori Brownell, P.E. (WEDA member)
Dredging Contractor:	Cashman Dredging (WEDA member)
Project Owner:	Florida Inland Navigation District