



TUNNEL

Secant Piles, Soil Mixing, Ground Freezing

NORRIS CUT TUNNEL

MIAMI, FLORIDA, USA



Owner:

Miami-Dade Water and Sewer Department

Engineer:

Parsons Brinckerhoff

General Contractor:

Nicholson Construction

Subsurface Conditions:

Hard limestone with frequent cavities ranging from 0.1 to 4 inches.

Approximate Key Quantities:

Secant Piles	68 (7,448 LF drilled)
Soil Mixing	75 (6,525 LF drilled)
Ground Freezing	24 pipes

Numerous pipe segments damaged from years of wear and tear were discovered during inspections of an outdated, 1977 wastewater pipeline just south of the Port of Miami. The pipeline’s system included a 54-inch diameter tunnel and force main which ran from Virginia Key Central Wastewater Treatment Plant (CDWWTP), underneath Biscayne Bay Norris Cut, to Fisher Island. The Miami-Dade Water and Sewage Department (MDWASD) decided to replace the system with a new, larger 60-inch diameter tunnel and force main.

PROJECT BACKGROUND

The Norris Cut project is part of a larger, multi-billion dollar initiative to upgrade the region’s aging wastewater and sewage

systems. In 2013, Miami-Dade County, the Florida Department of Environmental Protection and local and state governments, agreed to commit resources for the improvement of the county’s pipes, pump stations, and wastewater treatment plants. Completion of the upgrades is anticipated to take close to 10 years. Nicholson Construction Company operated as general contractor for the Norris Cut wastewater upgrade and was responsible for the design, permitting and construction. To assist with the tunneling phase of this project, Nicholson worked closely with tunnel design firm Arup, sister company and worldwide tunneling contractor Bessac and tunnel boring machine (TBM) manufacturer Herrenknecht AG. Nicholson’s contract



(1) Nicholson Superintendent and Foreman discussing TBM launch operation; (2 & 3) Lowering of Dorsey into the launch shaft at Virginia Key Central Wastewater Treatment Plant

also included the construction of a launch shaft at CDWWTP and a receiving shaft on Fisher Island.

THE WORK

Construction began with the 42-foot diameter secant pile launch shaft on Virginia Key. Once the piles cured and excavation of the middle was performed in the wet. Because of the presence of ground water, Nicholson then utilized the tremie method to install a 6-foot-thick concrete floor. This method includes inserting a waterproof pipe to the base of the shaft, then continuously pumping concrete onto the underwater floor. The concrete displaces the water and is able to achieve full compaction by self-weight. The remaining water was then pumped out to reveal a finished shaft.

Nicholson engineers were concerned that the region's ground conditions would not be able to support the initial launch of the TBM. The geology underneath Biscayne Bay is comprised mainly of Florida's Fort Thompson Formation, hard limestone with

frequent cavities ranging in size from 0.1 to 4 inches, which increases the possibility for cave-ins and/or flooding. To avoid a collapse, Nicholson froze the ground at the mouth of the tunnel by inserting pipes into the rock wall and then pumping the pipes with a continuous salt water solution. Over the next 7 to 8 weeks, the ground water within the wall froze making it easy to carve out a starting point for the TBM.

Several features of the TBM also allowed it to adapt to changing geological conditions with relatively short conversion time. The TBM, given the name "Dorsey" after Miami's first black millionaire who originally owned Fisher Island, boasts features like slurry mode and dual pressure balance which were designed by Bessac, Arup, and Herrenknecht AG.

Dorsey was launched from CDWWTP out of the secant pile shaft, and for 24 hours a day, five days a week – with a shift on Saturday – the TBM dug its way towards Fisher Island. After the launch, Nicholson transported its

equipment to Fisher Island to construct the soil mixing retrieval shaft. This shaft was built using 7-foot diameter soil mixed columns extending to depths of 87 feet and the middle was excavated in the dry.

After 227 days and tunneling 5,280 feet, Dorsey reached its destination and pulled into in the 28-foot diameter soil mixing retrieval shaft.

THE RESULT

The new, updated wastewater pipeline system is fully functional and has an 80 year design life. The successful execution of the Norris Cut Tunnel project is due largely to the collaborative relationship between the Miami-Dade Water and Sewage Department, Nicholson and the other contractors and subcontractors. Under Nicholson's leadership, this design-build project is part of Florida's push to further develop the state's tunneling industry.