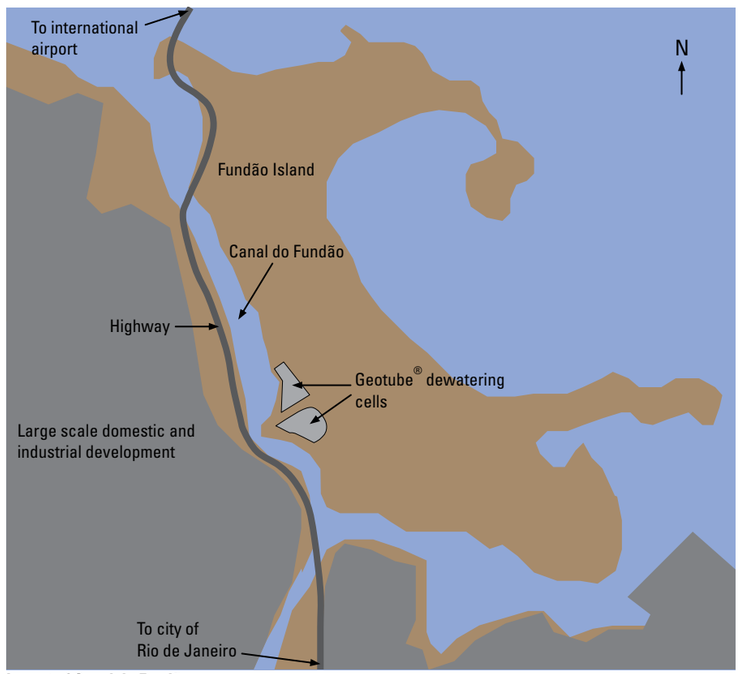
Estuarial and coastal: Canal do Fundão remediation, Rio de Janeiro, Brazil

Canal do Fundão is a 6 km long artificial estuary formed in the early 1950's when the Brazilian federal oil company (Petrobrás) conducted a large land reclamation project to connect 8 near-shore islands adjacent to the Eastern shore of Guanabara Bay in the state of Rio de Janeiro to form Fundão Island. Over time sediment has built up in the canal and it has not been able to self-flush for the last 20 years.

Since the formation of Canal do Fundão a number of favalas have evolved near the shoreline to the West and raw sewage began to collect in the canal. Also, local industrial development has discharged unprocessed waste into the canal with the result that the sediments in the canal were highly contaminated with domestic and industrial waste, trash and other garbage. Consequently, the canal had been identified as a major environmental concern impacting health and life. Compounding this problem, the canal lies alongside the major highway linking the city of Rio de Janeiro with its international airport. With the country hosting the FIFA World Cup in 2014 and the city hosting the Olympics in 2016 arriving tourists could not be subjected to the eyesore and the bad odour on arriving in Rio de Janeiro, hence the decision was made to remediate Canal do Fundão.

A plan was developed to deepen the canal by dredging the contaminated sediments and to narrow it by re-establishing shallow mangroves on the margins in efforts to remediate Canal do Fundão environmentally. To complete the solution, a sewage collection and treatment system would be constructed for all of the surrounding residential and industrial areas that had been contributing to the canal contamination.

A comprehensive testing program for contaminant types and concentrations was carried out along the length of the canal. At specific locations along the canal contaminants ranged from heavy metals (cadmium, copper, chromium, mercury, lead, zinc and arsenic) to aromatic organics (PAH's and PCB's) to raw sewage, phosphates and nitrates. High levels of trash were found along the whole length of the canal.



Layout of Canal do Fundão

To make the canal self-flushing required the dredging of 2 milliom m^3 of sediments. Of this, 600,000 m^3 was considered to be contaminated and would be dredged and then dewatered in special cells on Fundão Island. The remaining 1.4 milliom m^3 of sediments was considered to be uncontaminated and were dredged and transported to an offshore dumpsite for disposal.

It was decided to dewater the dredged contaminated sediments in specially designed cells using Geotube® dewatering containers. Once the dewatering was completed the cells would be capped and vegetated and become part of the natural landscape of Fundão Island including bike and jogging trails. The dewatering cells were designed in an identical manner to landfill containment units with geomembrane composite barrier systems in both the bases and the caps of the cells.

Numerous small scale Geotube® dewatering tests were carried out to determine the correct type of chemical dewatering accelerant to be used and its dosage rate. The results of this testing program demonstrated that a final minimum solids concentration of 55% could be attained within 30 days. Further, solids retention within the Geotube® containers was in excess of 99% and the effluent quality was such that it could be returned directly to the canal. Also, it was demonstrated that odour was effectively subdued once the sediment was fully contained within the Geotube® test unit.

The dewatering cells were constructed using a composite base liner over which was placed a 200 mm thick gravel drainage blanket. The dredged contaminated sediments were pumped to the designated dewatering cells where it was distributed to the Geotube® dewatering containers by means of a manifold system. The Geotube® containers installed had a circumference of 36.6 m with lengths varying to fit the geometry of the dewatering cells. The chemical dewatering accelerant was injected into the manifold system with the dosage rate managed by a computer control system.

The control filling height of the Geotube® dewatering containers was 2.4 m. When the control filling height was reached, filling would be discontinued and the Geotube® dewatering unit allowed to drawdown under gravity flow. The incoming slurry stream would then be diverted to fill other Geotube® dewatering units through management of the manifold valve system. This filling and drawdown cycle was repeated a number of times until a final dewatered filled height of 2.1 m was obtained. The operation was conducted 24 hours per day, 6 days per week. The effluent from the Geotube® units was collected in the under-drain system of each of the dewatering cells and discharged directly into Canal do Fundão. Effluent quality was continuously monitored to ensure that it met Brazilian Federal discharge standards. Each dewatering cell finally contained three Geotube® layers to handle the dewatering of the contaminated sediments volume.

Once the dewatering of the contaminated sediments was completed each dewatering cell was capped with an earth covering and then a barrier system was constructed over the top of each cell. Finally, the capped mounds were vegetated and they now form part of the natural landscape of Fundão Island.

Client: State of Rio de Janeiro Ministry of Environment, Brazil.

Consultant and dewatering contractor: Allonda Geossinteticos Ambientais Ltda, São Paulo, Brazil.

Dredging Contractor: Queiros Galvão SA, Rio de Janeiro, Brazil.

Dredging contaminated sediments in Canal do Fundão

Geotube® dewatering platform

One of the Geotube® dewatering cells

Capping a Geotube® dewatering cell

Capped and vegetated dewatering cell