

CASE STUDY

Mersey Gateway Project, UK. Marine geotechnical investigation for Halton Borough Council



Techniques and methods adopted on this project

- A dual approach to investigation:
 - An in-house jackup platform for accessing boreholes in deeper water
 - A spud barge with ramps to access boreholes on an intertidal sandbank
- 28 boreholes up to 55 m deep
- In situ tests:
 - Packer permeability testing
 - High-pressure rock dilatometer testing
 - Geologging

Specialist access kit utilised

- Jackup platform
- Spud barge with ramps
- 400-m temporary trackway
- Low-bearing-pressure, tracked dump trucks and a loader crane
- Hovercraft
- Helicopter
- Flotation tyres



Background

Structural Soils' contract was the 10th procured by Halton Borough Council for providing information to assist in designing and constructing a strategic, new six-lane bridge crossing of the River Mersey estuary approximately 1 km upstream of the existing Runcorn bridge.

As the second and main marine investigation for this development, the aim was to provide a detailed profile of the geology and the geotechnical properties of the superficial soil and bedrock at each of the three potential tower locations within the estuary by drilling boreholes.

The borehole sequence was phased. The initial batch of eight boreholes was drilled at locations predetermined by Ramboll, the engineer. Subsequent borehole locations were selected after consultation with the three international consortiums bidding to build the new bridge and taking into account the findings of the initial boreholes and the specific design criteria required by the bidding parties.

The site is a 1-km-wide tidal estuary with a wide lenticular sandbank in the centre and deeper water channels by either bank. The sandbank is completely submerged by spring tides, and currents of up to six knots occur on large incoming tides that take the form of a bore. The riverbank on both sides is salt flats and the nearest significant harbour or quay is some 20 km down river.

Services provided

In its biggest logistical challenge to date, Structural Soils applied a multidisciplinary approach to overcoming the challenging intertidal conditions that dominate this site. We used our in-house jackup platform to drill the boreholes in the deepwater channels, as we could to move the platform as necessary during all stages of the tidal cycle. We drilled the boreholes through the sandbank directly from the surface of the sandbank using equipment mobilised on a spud-legged barge. This barge also acted as an island, or refuge, for returning plant to during incoming tides.

The investigation involved 28 boreholes, all drilled to competent rockhead at between 10 and 27 m depth using cable percussion methods. Each borehole was then extended to penetrate between 10 and 30 m into the rockhead.

In many boreholes, we undertook in situ, high-pressure rock dilatometer testing incrementally as the boreholes progressed. On completion, double packer permeability testing and geophysical logging, including optical and acoustic logging, were undertaken in several of the boreholes.

The high-profile element of this contract in conjunction with the short programme time in the lead up to main project award meant there was much interest in the drilling operations. During our time on-site, we hosted visits from the BBC and the local newspaper, and multiple visits from the consortiums bidding to build the bridge.

The fieldwork element of the investigation was followed by an extensive phase of laboratory testing that culminated in a factual report. The bidding consortiums also took the opportunity to visit our in-house laboratories to inspect samples during this period.

Additional services

As part of this contract, we were required to provide and supply several services outside the normal remit of even a challenging site investigation. Some of these we sourced from specialist and, where available, local contractors, including port and tug services, cranes and geologging. However, many of the services not part of a normal structural investigation package used resources from our parent company, RSK, including

- project management
- CDM – principal contractor
- surveying
- noise monitoring
- marine plant and drilling platform
- hovercraft
- specialist laboratory testing.

Challenges faced

The site environment and its isolated position provided many challenges to overcome for this project to succeed.

Getting the heavy drilling kit to site necessitated a 20-km journey up river from the nearest dock over uncharted ground, so we commissioned local contractors with knowledge of the river and access to very low draught vessels. Journeys up river had to be in the four-day window each month when the high spring tides provided enough depth of water to clear the treacherous sandbanks.

The apparently simple operation of getting drilling crews and engineers the short distance from the shore across to the sandbank and then to the drilling platform became our biggest challenge when the fluvial channel of the River Mersey silted up and made a shallow-draught boat with an outboard motor unusable. At such times, a hovercraft or a helicopter was used to maintain safe access for staff in all conditions.

The highly weathered state of the bedrock initially resulted in significant core loss, which had to be improved. Using larger-diameter equipment, changing the flush medium and using specialist non-hazardous polymers greatly improved core recovery.



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