

Belfast Sewers Project

£160m project provides modern sewerage system for Belfast

by
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The city of Belfast received a major boost in September 2006 when work began on the construction of a state-of-the-art stormwater tunnel, which will bring major benefits to the city including a cleaner environment and a reduction in the risk of flooding. The tunnel is an integral and final part of Northern Ireland Water's (NI Water) innovative £160m Belfast Sewers Project. The project is one of the biggest and most important infrastructure investments in the city, involving work to upgrade the existing sewer networks and the construction of a large diameter drainage tunnel to increase stormwater capacity.



Interior of the stormwater tunnel

Courtesy of Northern Ireland Water

The need for the project came about as a direct result of the development and expansion of the local area coupled with the fact that Belfast's sewer network dates back to the Victorian era, and was in need of modernisation.

Infrastructure Services Company Morgan Est and Farrans Construction Ltd joined forces to form a fully integrated Joint Venture to carry out the stormwater tunnel construction works part of the project whilst Dawson WAM and McAllister Brothers JV worked alongside John Graham (Dromore) Ltd to complete the substantial programme of rehabilitation works to the existing sewer network.

These Contractors worked closely with Atkins Consultants, the designated Project Managers for the project.

The Belfast Sewers Project has enabled a significant number of the existing combined sewer overflows to be closed and this will reduce the pollutant load from the sewerage system on the River Lagan and its tributaries by 85% from that occurring prior to implementation.

Sewer Rehabilitation Programme

A combination of new technology and innovative environmental methods such as trenchless or 'No-Dig' technology was used where



The Belfast Sewers Project team begin to lower the pump into the shaft of the Terminal Pumping Station (TPS). The pump is one of 6 No. 15 tonne stormwater pumps which have been installed 40m below ground level at Duncrue Street, at the base of the project's TPS

Courtesy of Northern Ireland Water



The pump makes its way down the shaft, 40 meters below ground level. The pumps are crucial elements to the whole project and work to alleviate storm conditions and reduce the risk of flooding in the city

Courtesy of Northern Ireland Water

ever possible to replace or otherwise rehabilitate the outdated sewerage system and at the same time cause as little disruption as possible to city life on what represented one of the biggest infrastructure investments of its type in the UK.

The contract to upgrade the sewer network started in 2005. There are approximately 1,800km of sewers covering a catchment area of 42sq km. The older central area of Belfast is currently served by two large diameter brick sewers dating from 1888, and a third concrete sewer was commissioned in the 1970s.

The construction of a purpose built terminal pumping station

The Terminal Pumping Station (TPS) at the downstream end of the tunnel was the last shaft in a series of 19 located to intercept storm water discharges from Combined Storm Overflows around Belfast. The TPS is capable of pumping up to 4,000 gallons of water per second so even during the heaviest of storms the TPS will effectively and safely cope with the excess stormwater emanating from the sewers. Initial flows arriving at the TPS are pumped to the adjacent Belfast Wastewater Treatment Works in Duncrue Street. Should incoming flows exceed the capacity of the WWTWs, the excess volume is discharged following screening via a diffuser into the Herdman Shipping Channel.

These stormwater management measures will lead to a significant reduction of pollution and ease the burden on the sewer system resolving issues of flooding in Belfast.

The construction of new sewer tunnels

The new Belfast Sewers tunnel weaves its way across the city passing under its commercial heart. The tunnel is approximately ten kilometres in length and up to four metres in diameter and in places it is 30m below the ground. It starts at Cromac Street and ends at the terminal pumping station sited adjacent to the Belfast Wastewater

Treatment Works, Duncrue Street. Tributary tunnels join the main tunnel at various points. These tributary tunnels start at Glenmachan Street, Park Road and Queens Quay, to the west, south and east of the city centre.

A series of vertical shafts were constructed along the route of the tunnel to provide stormwater connections and access to the system for inspection and maintenance.

The shafts range in size from small 1.6 m internal diameter access shafts, to the one that forms the large 37m diameter, 40 deep terminal pumping station underground structure. The main 4m internal diameter tunnel from Duncrue Street to Cromac Street, some 30m below ground, was completed as part of the project in 2008 with the rest of the tunnelling work being completed by September 2009.

Tunnel Boring Machine

2007 saw the arrival of the Belfast Sewers Project's massive 'friendly giant' tunnelling machine in the city. The Tunnel Boring Machine (TBM) is a 90m long colossus which pulls over 250 tonnes of support equipment and machinery as it works its way through the soil.

The business end of the machine is the cutter head. Equipped with ripper teeth and roller cutters it can power through even the toughest of compacted sediment and grind to bits any boulders that get in its path.

Advancing 1.2m at a time the TBM stops so that a ring of tunnel lining can be built. Six precision pre-cast concrete segments fit together to form a 1.2m wide ring with an internal diameter of 4m. The tunnel ring segments are locked and bolted together, and a special grout is added to the cavity to support the tunnel lining and stabilise the soil.

Using a combination of laser guidance and onboard computer controls, the machine shows operators its exact location in a 3D environment, ensuring that the TBM and the Belfast Sewers Project stayed on a safe, precise and steady track.

Challenges

The project was extremely challenging due to the complex nature of Belfast’s geology, which proved to be very variable in geological structure. Dealing with residuals from gas production, when tunnelling through the former gasworks site on the Ormeau Road, also presented challenges particularly when it was found that the contaminants extended through the strata under the River Lagan. Production was therefore slowed as appropriate medical precautions were put into place to protect those working on the project and with having to ensure the spoil was dealt with properly.

November 2009 saw the issue of a hole which suddenly developed in the Cromac Street carriageway, a major city centre traffic route. This resulted in a temporary closure of the road and a lot of media attention. It would appear that when tunnelling through a vein of extremely hard dolerite beneath Cromac Street the dolerite material fractured. Some of the dolerite then formed a barrier which prevented the normal pressure grouting filling fully the void space that formed with the fracturing of the rock.

However, on a project of this scale issues such as these are to be expected and the integrated team of NI Water, Atkins and Morgan Est Farrans worked well together to resolve all that arose and to deliver the benefits of this major project on schedule by December 2009.

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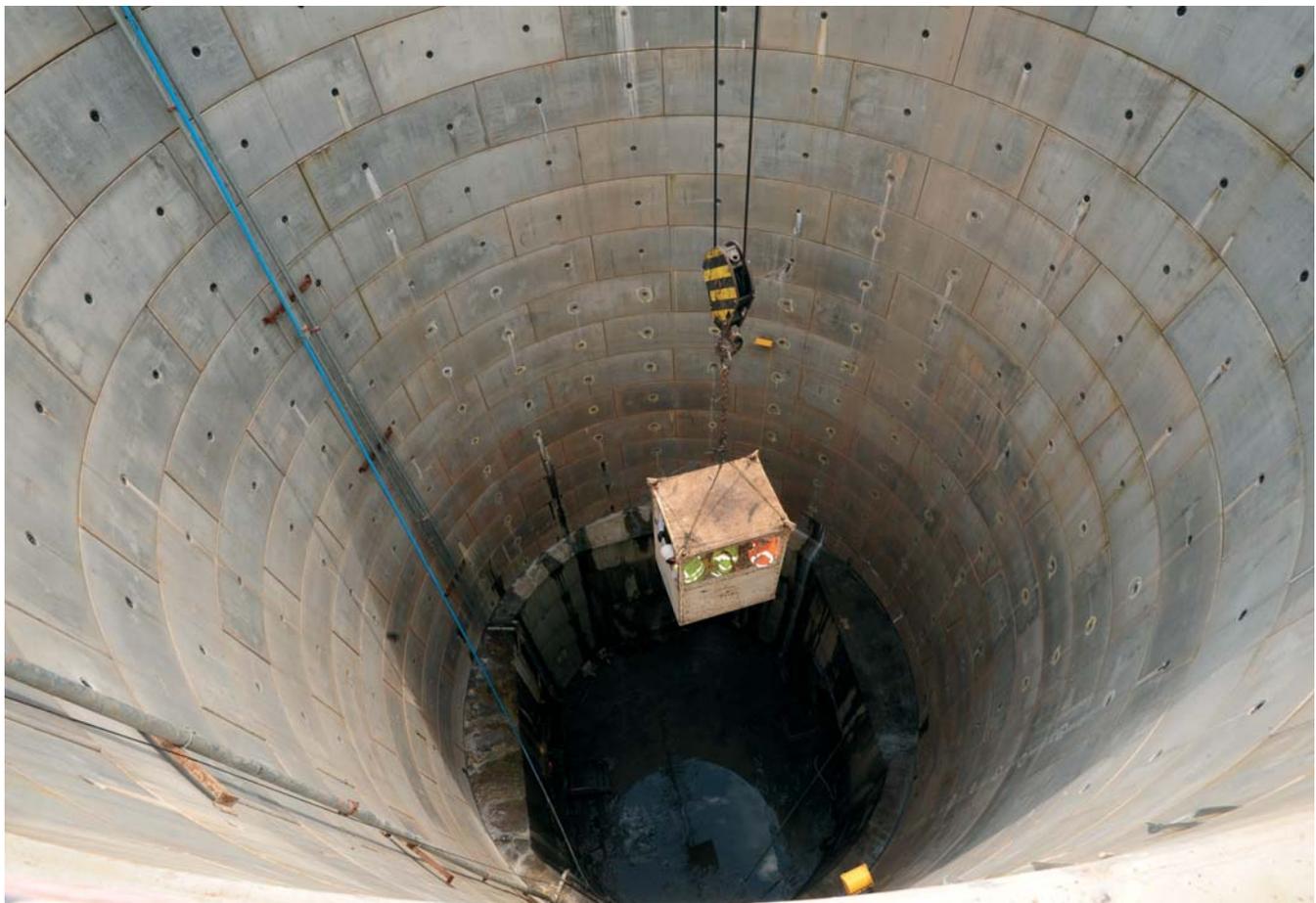
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Visitors are lowered down a shaft approximately 30m metres below ground at Corporation Street, Belfast to view the stormwater tunnel Courtesy of Northern Ireland Water