

Castor Bay to Belfast Strategic Trunk Main Scheme

a vital new source of water to meet peak period demands in Lisburn and Belfast and help the existing network cope with any future emergency situations

by Martin Gillen & Paul Rodgers

NI Water is committed to improving the water supply infrastructure across Northern Ireland and, as part of its Water Resource Strategy, identified the need to construct a new water pipeline to link its Castor Bay WTW in Craigavon with Lisburn and subsequently Belfast, by connecting into the existing trunk main which transports water to Northern Ireland's largest city with a population of almost 300,000. The £14m project - one of the biggest NI Water pipeline schemes to be undertaken in recent times - will improve the security of the water supply infrastructure for customers in Belfast and Lisburn by providing a vital additional source of water. This will be particularly important during future winter periods, summer droughts and/or emergency situations when the infrastructure may be particularly vulnerable. Having commenced in March 2014, the entire scheme is due for completion in September 2015.



Pipelaying on roads - Courtesy of NI Water

Project aims and drivers

The primary aim of the project is to address the need identified in NI Water's Water Resource Strategy (2002 and 2007) and Final Water Resource Management Plan 2012 for a strategic trunk main link from Castor Bay WTW in Craigavon to Lisburn and Belfast.

The project is urgently required to deliver current and future potable water deficits in the system, provide improved inter-connectivity (security of supply) and aid recovery at key locations during major incidents. The drivers for the project include compliance with the EU Drinking Water Directive 80/778/EEC and subsequent amendments and the Water Supply (Water Quality) Regulations (NI) 2002.

It also contributes to compliance with the Northern Ireland Authority for Utility Regulation (NIAUR) requirements for Interruptions to Supply (DG3) and Restrictions on Use of Water (DG4). The completion of the project also forms part of the actions and undertakings in the NIAUR 2010/11 Freeze Thaw Incident Report to enhance water resources and resilience of the supply network for peak demand.

The project will also ensure additional water resources are available to southern Belfast to offset the abandoned borewell sources and will replace the existing 500mm Castor Bay to Magheraliskmisk pumping main which is in poor condition.



Water

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of pipeline in the
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Pipelaying of the Castor Bay to Belfast Trunk Main through agricultural lands - Courtesy of NI Water



Danescroft Service Reservoir - internal refurbishment
Courtesy of NI Water



Early construction works at the new Sprucefield Pumping Station
Courtesy of NI Water



M1 microtunnel machine - Courtesy of NI Water

Design and operation

The Castor Bay to Belfast Strategic Trunk Main is a design and build project involving the construction of a 30km potable water strategic link between Castor Bay WTW on the eastern shores of Lough Neagh and the 1,300-1,000mm diameter Aquarius Line Trunk Main at Carryduff, Co. Down which is supplied via Drumaroad WTW in south Co. Down.

Several modes of operation have been designed into the system; in essence these modes sequentially extend Castor Bay water eastwards into Drumaroad-supplied areas, reducing the system's demand on Drumaroad WTW, which is an upland source. The design was optimised to utilise gravity-based options where possible, in part depending on the required flow. There is also a mode which can be used in an emergency - for instance, if a Castor Bay supply is unavailable - whereby water from Drumaroad WTW is extended westwards in a reverse flow towards Magheraliskmisk SR.

What the scheme entails

The scheme involves the laying of 30km water pipeline from Castor Bay WTW to south Lisburn, where the pipeline will link into an existing trunk main to transport the water supply further into Belfast. Half the length of the new pipeline will be laid with 700mm epoxy-coated cement-lined, ductile iron, spigot and socket pipe. The remaining 15km will be made up of 600mm with a small amount of 500mm diameter pipe.

The £14m package of improvements also covers several infrastructure upgrades, all of which are linked to the new pipeline. These include the re-commissioning of local service reservoirs that are currently out of operation at Danescroft and St. Andrew's both in Lisburn; the upgrade of the existing Castor Bay Water Pumping Station in Craigavon; the construction of a new water pumping station at Sprucefield (Lisburn) and a new water pumping station at the refurbished St. Andrew's Service Reservoir.

Together the two new pumping stations will have the capacity to deliver 55ML/d while the re-commissioned service reservoirs at Danescroft and St. Andrew's will have a combined capacity of 10ML. Other service reservoirs being refurbished are Poleglass, Carricknaveagh, Duneight and Magheraliskmisk.

Project team

Capita Property & Infrastructure was appointed as NEC Project Manager for the scheme's construction phase and were involved early on during the procurement stage, developing the scope and outline design through to tender documentation, tender assessment and contract award. The company is responsible for contract management and daily administration, together with cost management and site supervision duties. Capita will oversee the 365-day testing period through to a successful project handover to NI Water.

Procurement route

An open tender pre-qualification questionnaire (PQQ) produced a select list for invitation to tender ITT and the contract was awarded to Lagan Construction Group in November 2014. The project is let under NEC ECC Option A: Priced Contract with Activity Schedule.

Construction challenges

The scale of this 30km pipeline scheme posed many challenges for the project team of Capita, Lagan Construction and NI Water. Although the route was designed to go through agricultural land and minor roads as far as possible, going from Craigavon to Lisburn could not be achieved without crossing the M1 and the A1; two of Northern Ireland's busiest arterial routes. In fact there were six major crossings involved in the project. In addition to the M1 motorway and A1 dual carriageway the project team had to design crossings of the Lagan Canal, the Ravarnet River, the Belfast-Dublin railway line and the River Lagan.



M1 Motorway 600mm microtunnel construction
Courtesy of NI Water



Regional Development Minister, Danny Kennedy and NI Water CEO, Sara Venning with some of the 5,798 pipes to be laid - Courtesy of NI Water

Each of these crossings had to be designed to take into account engineering and environmental constraints and was meticulously planned in close liaison with myriad stakeholders. A brief description of how these major crossings were undertaken is laid out below:

Belfast/Lisburn to Newry A1 dual carriageway

The A1 Belfast to Newry dual carriageway was crossed at Sprucefield on the outskirts of Lisburn using a Guided Auger Boring technique. A trenchless solution was chosen due to the complex makeup of the road structure and to minimise traffic disruption on this major route which links Belfast to the Republic of Ireland and primarily Dublin.

A 5m-deep launch pit was constructed in a field adjacent to the carriageway with a 3m-deep reception pit in the verge on the opposite side of the carriageway. Both pits were constructed using sheet piles and the crossing itself undertaken at a depth of 3m below the carriageway extending 68m transversely.

This method involved excavating a tunnel by rotating an auger which is laser guided to accurately drill to a set line and level. The excavated material was then returned to the launch pit and removed. A 960mm diameter steel sleeve was pushed ahead of the auger to support the road and ground above. When the sleeve was complete, the new 600mm watermain was pushed through the steel sleeve and grouted in place.

The carriageway was surveyed prior to commencement of the works to establish baseline level readings and continually monitored for settlement and heave during and after the tunnelling works.

Lagan Canal and River Lagan

Both the Lagan Canal (Aghalee, Co. Antrim) and River Lagan (Mazetown, Co. Down) were crossed using auger boring trenchless techniques. This is similar to guided auger bore except the machine is not laser guided, the line and level are set at the commencement of drilling.



Belfast to Dublin Railway Line 600mm pipe jacking launch pit
Courtesy of NI Water



Lagan River 600mm auger boring launch pit
Courtesy of NI Water



Belfast to Dublin Railway Line 600mm pipe jacking
Courtesy of NI Water

Belfast to Dublin railway line

The Belfast to Dublin railway line under-track crossing (UTX) just outside Mazetown Co. Down was completed using pipe jacking trenchless techniques, primarily to avoid subsidence. From a launch pit, hydraulic jacks pushed 1,200mm diameter concrete pipe sleeve sections through the ground behind a shield at a depth of 2m below the railway line and extending 40m towards a reception pit. A digging machine within the shield excavated a tunnel and the excavated material was returned to the launch pit by a conveyor and removed. Following installation of the sleeves, the new 600mm watermain was pushed through and grouted in place.

Constraints imposed by Northern Ireland Railways meant that the UTX had to be undertaken at weekends. 24-hour working shifts were therefore employed for works immediately below the tracks with drill logs recording the quantities of material excavated.

The railway line was surveyed for a period of two weeks prior to commencement of the works in order to establish baseline level readings via small targets attached to the side of the rails at 3m intervals. For the duration of the works surveys were undertaken three times per day to monitor settlement and heave. The track was monitored for a further two-month period following completion of the UTX.



Microtunnelling of 600mm pipeline under M1 Motorway
Courtesy of NI Water

Belfast to Dungannon M1 motorway

Crossing of the M1 Belfast to Dungannon Motorway at Sprucefield just outside Lisburn, was undertaken using trenchless microtunnelling techniques. Due to the sandy nature of the ground, a tunnel of 95m in length was drilled at a depth of 6.5m below the carriageway requiring a launch pit almost 10m deep. Extensive dewatering was required at the launch pit due to the high water table and the significant depth of dig required.

A rotating laser-guided cutting head excavated the initial tunnel, concrete pipe sleeves of 1,200mm diameter were then jacked in behind the head to support the ground above. The new 600mm watermain was then pushed through the concrete sleeve and grouted in place.

The carriageway was surveyed prior to commencement of the works to establish baseline level readings and continually monitored for settlement and heave during/after completion of tunnelling works.



Project team with NI Water CEO pictured at the laying of the 5000th pipe
Courtesy of NI Water

Environmental challenges

It is perhaps not surprising, given the scale of the project, that the team had to overcome many and varied environmental challenges with the design and build of the new trunk main. These ranged from birds and badgers to fish and Japanese knotweed.

Some of the challenges, such as the annual bird nesting season, were simple to plan around in terms of hedge clearing and topsoil stripping, but others, such as the discovery of two badger setts required a diversion of the original pipeline route, leading to new designs being developed, and fresh wayleaves having to be served.

Managing the environmental challenges so that they didn't impact negatively on the overall programme was a challenge in itself and required forward thinking and excellent communications with key environmental stakeholders.

Programming

The package of work was divided up into sections of pipelaying; construction of pumping stations and refurbishment work with sub-contractors assigned to the various elements to allow different bits of work to be carried out simultaneously to progress the programme. Early communications with landowners, by Lagan Construction's dedicated land liaison officer, allowed timely entry to fields to erect fencing and carry out any hedgerow removal ahead of bird nesting season. Sustained communications with

KEY PROJECT STATISTICS	
5798 pipes altogether	Crossing of River Lagan and Lagan Canal
62 fields crossed	7 designated waterways crossed
Liaison with 60+ landowners	2 new pumping stations
30 roads crossed	5 reservoirs upgraded
Railway line crossed	64,000m ³ excavated material
M1 motorway crossing	189,000 man hours employed to date
A1 crossing	

landowners helped to manage field drainage and plan topsoil stripping and pipelaying at a time best suited to them, as far as was practicably possible.

For roadworks, road closures were planned carefully to ensure that one diversion route wasn't impacted by another road closure and that, where feasible, community events were taken into account in the programming of work.

Public relations

NI Water and the project team were acutely aware of the potential negative impacts arising from such a large-scale pipeline project and from an early stage embarked on a strategic communications strategy to ensure key stakeholders were informed of the works and kept updated throughout.

As part of the public relations programme the project team and NI Water Communications held early briefings with a range of stakeholders including: MLAs and councillors (for roads affected and programme); council staff (bin collections etc); Roads Service (roads impact); Translink (bus routes); Rivers Agency (River Lagan); Lagan Canal Trust (Lagan Canal); landowners; sports clubs (Lisburn Golf Club; Lisburn Rugby Club and Temple Golf Club all within close proximity of works); businesses; social clubs; schools etc.

Letter drops took place in advance of each section of road works and press releases issued to the local media to advise the wider public. Variable message boards were erected on main routes and large-scale project boards helped to convey the huge investment being made by NI Water and the resulting benefits for the public.

NI Water's 24-hour dedicated customer care 'Waterline' number, was issued on all correspondence to the public and displayed on all signage which ensured that any queries about the work were dealt with quickly and effectively.

To minimise the impact to the public while working on main link roads (such as the road between the villages of Aghagallon and Aghalee) 24-hour working was employed to complete the pipelaying in the shortest possible timescale.

Roads were temporarily reopened to accommodate traffic flow for important local events, such as the switch on of village Christmas tree lights, rugby open days and the popular Balmoral Show.

Commissioning and handover

The strong collaborative approach adopted by the project team helped to bring the 700mm diameter pipeline into service much earlier than was programmed, giving the client beneficial use of this new piece of infrastructure.

At the time of writing (July 2015) the pipelaying is almost complete and final connections are being made. The construction and refurbishment works at the pumping station and service reservoir sites are in their final stages.

All elements of the project are on schedule to be completed before September 2015 after which there will be a 365 day contractor-led performance testing period. The project team will continue to liaise with NI Water Operations staff as they work to bring each section of this vast system successfully on line whilst maintaining supplies to the existing network during the commissioning period.

Once testing and commissioning works are complete, NI Water and its customers will reap the benefits of this extensive multi-million project for many years to come.

The Editor & Publishers would like to thank Martin Gillen, Senior Project Manager with NI Water, and Paul Rodgers, Associate Director with Capita Property & Infrastructure, for providing the above article for publication.



Open cut laying on roads of the 700mm pipeline - Courtesy of NI Water