Durdham Down Combined Main

providing resilience to 150,000 people in central Bristol through the installation of a new pipeline

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The Durdham Down Combined main (DDCM) is a 10.2km, 700mm diameter, potable water main running from Harry Stoke in the North of Bristol to Victoria Reservoir, Clifton. This 2.5 year project is part of a £22m investment by Bristol Water to increase resilience and provide for growth in North Bristol. The pipeline is routed into the heart of Bristol and with this came a number of key constraints. A major constraint and theme running through the project has been stakeholder engagement, recognised by everyone as one of the most important features in getting this project completed successfully. This paper discusses the many complexities encountered over the project duration and outlines how these were overcome in a sustainable way with minimal disruption, given the project scope.

Pipelaying on Granny Downs - Courtesy of May Gurney

Route selection and design

The initial route selection was done using a GIS mapping tool developed by Black & Veatch called PROM (pipeline route optimisation methodology), which generates route alternatives and scores them using predefined weightings. Fine tuning of routes can be done as and when other constraints come to light.

The DDCM is a combination of two pipelines, one to provide for growth in north Bristol; one to provide for resilience in Bristol city centre. In the initial route optimisation stage the design team realised that by combining the two routes, one pipeline with two purposes could be developed. This decision substantially shortened the length of pipe and reduced the associated costs.

As the design progressed, it became clear there were some sections of the pipeline that were going to take longer than others to design as a result of a number of constraints. For this reason the pipe route was split into 18 sections.

Four of these sections were progressed to early completion so that May Gurney could begin work, and to avoid deviating too far from the planned programme. The remainder of these sections were completed in two parts with a stepped handover.

Early contractor involvement during the design and route selection greatly aided buildability and ensured a full buy-in from all parties. This meant a smooth transition between design and construction.

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Construction

The construction programme on this project has been 22 months. Due to the staged start approach, construction work started steadily and ramped up towards the end of the project. It was extremely important to Bristol Water that they met their regulatory deadline and the team stepped up to this challenge.

At the peak of the scheme May Gurney had 16 pipe laying gangs working on the project. At one stage there were 5 pipe laying gangs working within 200m of each other. Most of this work was in the highway, primarily residential streets. For this reason, stakeholder liaison was incredibly important. Initially over 35,000 customer letters were sent out; a large number of community meetings were held and an exclusive website was developed to update stakeholders on progress. Customers living along the pipe route were sent letters six weeks in advance, and seven days prior to work commencing, followed by ongoing update letters. Special allowances and changes to the programme were made in order to minimise disruption to customers. For example: the programme was changed to allow for home removals, allowances made for funerals and parking spaces made available for midwives.

Within every gang there was a designated helper, identified with a 'here to help' helmet sticker. The public were informed through letters to look for this member of the team. These team members would take messages, answer questions where possible, help pedestrians around the works and help anyone that needed assistance.

Key Features & Project Constraints

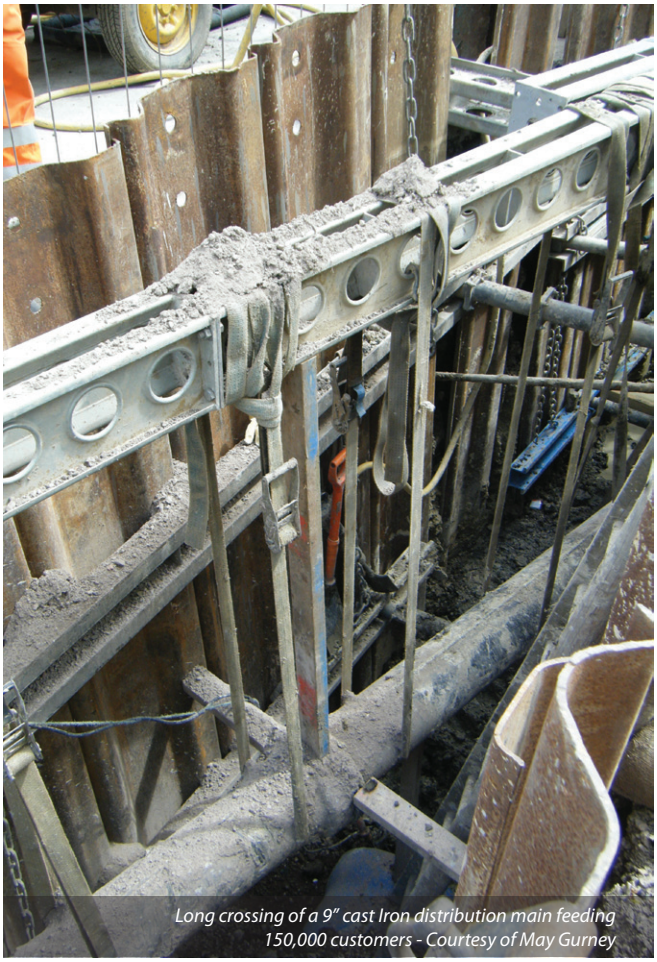
A4174 crossing: The A4174 ring road is one of the main access routes to North Bristol, this road becomes exceptionally busy at times. For this reason the team were not permitted to pipe lay across the dual-carriageway using an open cut method. The ground below the A4174 comprises layers of clay and rock dipping against the line of the proposed drive. A number of no-dig options were considered before a digger shield/pipe jack option was chosen. This 60.5m, 1.2m diameter crossing took 18 days to complete with an additional 13 days to dig the thrust pit and seven days demobilisation.

Village Greens: The initial route planning showed that to keep the pipe route out of the A38, the pipe could be laid alongside the road in Horfield Common for approximately 1km. As the project progressed, it transpired that the common has a 'Village Green' status. This meant the pipe could not be laid in the green and there was no realistic mechanism within law which would enable this to happen. In addition to this there were a number of other constraints that meant it was not simple to carry out this work. In the end, the process became so drawn out that it was necessary to re-route the pipeline.

Railway crossing: The pipe had to cross the Paddington main line railway running N/S through the centre of Bristol. After much consultation with Network Rail, the best option for this crossing was deemed to be through the utilisation of an existing road bridge over the railway. In order to fit the pipe into the deck of this Victorian bridge, the pipe diameter had to be reduced to 500mm for an 80m length over the bridge. Hydraulically, this was not a problem due to the relatively short length of the constriction.

Service crossings: Laying a large pipeline into the centre of Bristol meant laying along numerous residential roads. The age of Bristol's highway network means that the roads are already full of other aging live and abandoned services that have to be negotiated. Varied ground conditions have to be dealt with, whilst all the time working within the confines of an often very tight construction site.

Initially non-intrusive surveys were carried out at every road junction, to provide information on what services were to be



Long crossing of a 9" cast Iron distribution main feeding 150,000 customers - Courtesy of May Gurney

A4174 no-dig crossing thrust pit Courtesy of Black & Veatch

expected. These could be cross referenced with statutory service data from providers and the design team were able to build a more accurate picture of what services existed. This assisted in designing the pipeline so that it theoretically missed every service.

Trial pits were excavated ahead of pipe laying to prove this route, with the line and level of the main re-designed where necessary. Regularly these trial pits identified that the main could not be laid as designed. In these cases the first option was to relocate the main along a different route within the same road. Where this wasn't possible it required a more innovative approach either changing the working method or through bespoke engineering design.

In general, the pipe has been laid in open cut excavations. As a result of the large number of services, the average pipe depth is 2.4m and in some places it is in excess of 4m. In two cases, existing services were laid so densely that specialist tunnelling techniques were used to mine underneath. On another three occasions there were water main crossings exceeding 20m in length. Over the whole length of the project, over 2,200 services have been crossed with a 99.2% success rate.

Working alongside the MoD: The pipeline route passed adjacent to the MoD depot in North Bristol. Due to privacy clauses, full service drawings around the MOD were not available. It was not until excavation began that the team could fully confirm existing services and hence the exact pipe route. It was necessary for the work to be carried out underneath two sets of overhead HV cables and this was made all the more difficult because of the narrow footpath access in which the pipe was being laid. At this point, the ground was made up of fractured, layered rock that required additional care when digging near so many services.

Thrust blocks: Unexpected services sometimes required the position of the pipe to be altered requiring additional bends. Although the pipeline route could be moved slightly, conventional thrust blocks would often not fit in. A number of 'bespoke' thrust blocks had to be designed for this purpose. This included three bespoke reinforced concrete thrust blocks for bends to avoid forces acting on other buried services. It also required a reduction in size of the main in two locations to squeeze between other existing services.

Sustainability: The environmental impact of the scheme has been carefully considered throughout both design and construction with every effort being made to re-use site generated material or imported recycled material. The use of ductile iron pipe has allowed site-won as-dug material to be used as backfill in grassed areas. In the public highway following agreement from Bristol City Council Highways recycled pipe bedding and Type 1 engineering backfill has been used.

Waste management has also been a big consideration. The use of as-dug material has minimised site movements through muck-away and the import of quarried aggregate. In addition, 100% of all surplus excavated material has either been taken off site for recycling into aggregate or for reuse.

Archaeology & Palaeontology: With the pipeline crossing a Roman road and historic mining works on Durdham Downs it was anticipated that this area would be of archaeological importance. The entire length of pipeline laid in unbound surfacing was subject to an archaeological watching brief. Due to the extremely tight pipe laying programme the decision was made to pre-excavate the pipe trench across the Downs allowing sufficient time for any archaeological investigation works to be carried out.

In addition to archaeology, the Clifton area was also important from a Paleontological perspective. The Bristol Dinosaur was found in a quarry near to the pipeline easement in 1860. Through developing a close working relationship with the University of Bristol Palaeontology Department we found that our trench offered a rare insight into the history of this area both through Ice Age and pre-historic deposits. A full time paleontological presence was sponsored during the works to allow the recording and reporting on findings made.

Awards

This project received an excellent standard in a CEEQUAL interim award and is expected to achieve the same in a full project award.

Conclusions

This project was successfully completed by designers Black & Veatch and principal contractor May Gurney and the pipeline was operational by Spring 2013. The success of the project has been as a result of extremely hard work from the whole team and the good working relationship between all parties. Stakeholder liaison has been key throughout this process and reducing the effects felt by all customers has been of upmost importance.

The Editor & Publishers would like to thank Emily Atkin, Civil Engineer with Black & Veatch, and Adrian Parker, Site Agent with May Gurney, for providing the above article for publication.

The project in full swing on Wellington Hill West - Courtesy of Bristol Water