The population of Lincolnshire is growing and responsibility for providing a clean, safe and sustainable water supply to Lincolnshire falls to Anglian Water Services. It was identified in Anglian Water’s AMP5 business plan that additional resources were needed to meet the forecast water requirements for the growing town of Boston and the surrounding area. There was also a need to provide resilience to the West Pinchbeck Water Treatment Works (WTW).

The 200 acre reservoir and water treatment works at Covenham has ample capacity to serve the local population’s requirements and other areas of the county. Anglian Water’s business plan solution was to provide a new pipeline with the capacity to transfer 27 million litres of treated water per day (MLD) from Covenham WTW, near Louth, in the north of the county, to Minningsby Reservoir in central Lincolnshire and then on to the town of Boston in the south of the county. The estimated cost of delivering the scheme was £40 million.

**COVENHAM TO BOSTON SCHEME**

A £40 million scheme by Anglian Water utilised GPS Excel piping to ensure security of supply to homes and businesses in Lincolnshire.

Application  Potable Water
Customer       Anglian Water
Contractor     J N Bentley
Product        450mm Excel pipe in various SDRs
Date           Aug 2012

**CASE STUDY INFORMATION**

Application  Potable Water
Customer       Anglian Water
Contractor     J N Bentley
Product        450mm Excel pipe in various SDRs
Date           Aug 2012
Tough Targets
As part of its Special Projects framework, Anglian Water has set challenging targets for reducing the capital costs, embodied CO2 emissions and operational CO2 emissions for this project. The project brief aligns with Anglian Water’s ‘Love Every Drop’ campaign, a leadership platform designed to highlight the importance water plays in all our lives.

From the start, the joint project team comprising contractor JN Bentley, consultant Mott MacDonald and client Anglian Water embraced the challenge. Initially they focused on meeting the targets by utilising existing assets where possible. The Business Plan solution envisaged a new 60km of 600mm pipeline supplying all the additional water needs direct from Covenham WTW. Analysis of the existing water supply network identified some unused capacity and opportunities to deliver more water to Boston, from the south, without a significant impact on how the current system operates. Through Anglian Water’s Risk & Value process and operational field trials the use of existing assets was adopted; resulting in the flow required from Covenham reducing to 15 MLD and the pipeline diameter reducing to 400mm. This lowered the embodied carbon by 1/3; however the solution did not reduce the operational carbon impact as this solution required an intermediate booster pumping station in addition to a new pumping station at Covenham WTW.

Not satisfied, the project team revisited the solution to see if operational carbon could also be reduced. They realised that by removing the booster pumping station the operational carbon target could be achieved, but this slightly increased the embodied carbon as the pipe diameter increased to 450mm.

To mitigate the slight increase in embodied carbon due to the 450mm diameter pipeline, the team, using the construction expertise of the scheme’s project partner J N Bentley, started to look for construction innovations to reduce the embodied carbon and started with pipeline material selection. Under consideration was ductile iron, steel and plastic. They not only considered the technical suitability of each material for transferring potable water and their embodied carbon, but also the ease and method of installation including; the size of pipe trench, the pipe jointing and bedding materials; the management of the necessary materials and machinery along the easement; methods for crossing rivers, roads and railways; and the final commissioning of the completed pipeline.

The final solution is to pump a reduced amount of water (15.6 million litres per day) from a new pumping station, located within the existing works at Covenham, via a 40km pipeline to the existing Minningsby service reservoir which will provide storage for the Boston system. The water will gravitate through the second 20km section of the pipeline to Boston. The remaining 11.4 million litres per day required for resilience to West Pinchbeck will be transferred from the Wing WTW, near Rutland Water through existing infrastructure, which will gain some enhancements.
Delivering Carbon Reductions

The project team’s starting point was to consider the embodied carbon of the various materials needed to carry out the project. They challenged traditional designs and needs for items such as wash outs and air valves; they reviewed pipe specifications and the need for bed and surround to the pipework. They concluded that minimising the requirement for concrete across the installation would have the most significant impact on carbon reduction. The majority concrete components were replaced with less CO2 hungry alternatives.

This CO2 material comparison methodology was a factor in the decision to specify polyethylene pipe and Pipe supplier, GPS PE Pipe Systems, worked closely with the project team to help respond to the carbon challenge. The selected pipeline material was Excel New Blue high performance PE100 pipework, a new PE pipe from GPS PE Pipe Systems which combines a blue outer pipe with a black PE core.

Jon Briafield, GPS Product Manager explains: “PE pipe offers improved embodied CO2 if compared to traditional pipe materials due to the reduced energy consumption required for its manufacture, its longer service life and its ease of recycling. The use of PE piping also reduces the cost of the pipe by varying the pipe thickness of the pipeline in line with the pressure profile required at specific points. As a result the amount of raw material is reduced still further, which brings about savings in both capital outlay and embodied CO2.”

Further carbon reductions were achieved by:

- Manufacturing longer (18m) lengths to reduce the number of deliveries required by 30%. This also reduces the number of joints required which in turn reduces the construction programme for the welding machine and therefore the energy needed to run it.
- Using ‘as-dug’ material, where possible to reduce installation cost and environmental impact of importing and exporting material, which in turn reduces vehicle movement, quarry activity and waste.
- Utilising the flexibility of the PE pipe to follow the natural terrain, avoiding the need for any extra joints to accommodate bends or local route diversions and minimising the number of thrust blocks.

The final solution reduced the embodied carbon from a business plan impact of 28,950 tonnes of CO2 to 12,644 tonnes of CO2. The forecast capital cost of the scheme has also been reduced, demonstrating that reducing carbon delivers capital efficiencies.

The team has adopted the Lean principle of collaborative programming and has involved the supply chain as soon as possible. As a result, the scheme has scored a provisional ‘Excellent’ rating from the CEEQUAL assessment scheme (the evidence-based sustainability assessment and awards scheme for civil engineering) for the design phase of the project. The site team is challenged to reduce its carbon impact further. They are using additional lean tools and CEEQUAL process to focus their environmental delivery of this project.
Keeping to Schedule

The installation process involved the provision of a 30m construction corridor, which narrowed to 10m near hedges and road locations, for the full length of the pipeline. Top soil stripping was done at a 28m width to mitigate the impact of the excavation on soil structure and ensure that the land can be returned back to its original state. After preconstruction land drainage was installed, welded pipe strings were laid out along the easement. The pipeline is being laid in an open trench installation, as the route passes largely through farmland. Excavation is being carried out using a rock trenching machine converted to operate in clay and the trencher’s cutting teeth and guidance mechanism have been modified to give optimum graded backfill for immediate reuse. This has allowed up to 650m of trench excavation, pipe installation and backfill to be completed in a day.

Where it has been necessary to lay sections using a trenchless method for safety or environmental reasons or to meet the requirements of statutory authorities, directional drilling has also been used. Excavation of the pipe trench began in May and the installation continued at an average rate of 1500m/week, which was slower than originally envisaged due to the combination of heavy clay soil conditions and unseasonably wet weather throughout the spring and summer.

Long-term Legacy

The project team expects to have completed the first 40km section of pipeline by the end of 2012, compared with the original target of autumn 2013. The shorter second 20km section will be installed directly afterwards with the first water arriving in Boston taps from Covenham WTW early in 2014.

Ian Turner concludes: “Once the project has been completed there will be little evidence above ground that anything has changed. However, there will be a substantial increase in drinking water availability and resilience to our customers in Boston.”