LMR Drilling UK Ltd.

Unique Solution for Outfall Construction...

Cornborough Outfall, Devon

LMR Drilling UK Ltd., England's foremost Horizontal Directional Drilling Contractor, expanded its engineering capabilities by using its in-house marine expertise to provide a unique solution to the method of outfall construction for the Main Contractor, Morgan Est, who had been engaged by South West Water to construct a new sewage treatment scheme at Cornborough, Devon.

LMR were engaged by Morgan Est as the Main Contractor for the outfall construction. This involved the installation by Directional Drilling of the outfall pipe, the construction of a 10 port diffuser, and the installation of a pipeline beneath the River Torridge, again by Directional Drilling.

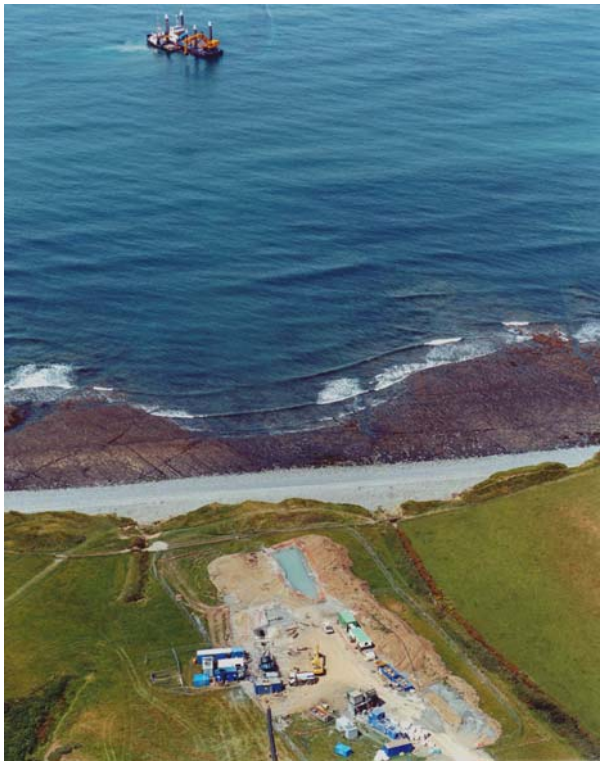
Outfall Site

The size of the polyethylene outfall pipe was 710 mm SDR17 with a PE 100 pressure rating, whilst the size of the pipe for the river crossing was 455 mm SDR17 with a PE 100 rating.

The length of the outfall drilling was 540 metres with a 60 metre long, 10 port diffuser section on the end, and the length of the river crossing was 425 metres long.

Since the successful installation of the longest HPPE pipe installed by Directional Drilling on the River Tamar in 1999, and the fact that LMR had worked for Morgan Est on this project and had built up a working relationship of understanding and trust, they were approached as preferred sub-contractors to bid for the outfall installation.

The successful way in which the contract for the River Tamar had been undertaken by using a risk



Rig Site & Barge

sharing format, formed the basis for this contract, hence the form of the contract used for this work was the Institution of Chemical Engineers Model Form of Conditions for Process Plants suitable for Reimbursable Contracts 2nd Edition, which is similar to the New Engineering and Construction Contract.

The proposed outfall location had been selected in the early stages of the scheme development and was subjected to planning approvals based on environmental and discharge requirements. These approvals defined the position of the diffuser on the seabed and the discharge and dispersal requirements. These requirements were therefore the guidelines for the design of the diffuser.

Due to the fast track programme requirements, discussions with both the marine contractor, Van Oord, and the diffuser designers, Pell Frischmann and Hyder, had to be instigated at an early stage. The design meetings that followed called upon the experience of the various disciplines to ensure the diffuser design could encompass the

requirements of build-ability and construct-ability, taking into account the maximum lift capacity of the crane on the barge, the deck loading, and the facilities at the barge's berth in Appledore dockyard.

Casting of Concrete Diffuser Domes

The stability requirements of the dome protection units for each diffuser port, because of the current and wave action, demanded heavy concrete structures which were firmly embedded onto the rockhead below the seabed. Once the design concept had been agreed, the construction programme was assessed, and the conclusion reached that if the units were factory built, they would not be ready on time for installation. Morgan Est provided a solution to the uncertainty by constructing the units on site, then transporting them to the dock for loading onto the barge.

Prior to the drilling taking place, a seabed survey was conducted at the exit point and along the line of the area where the diffuser was to be positioned.

Confirmation that everything was in order, and that all the method statements, risk assessments, quality plan and environmental procedures had been approved, and that the DEFRA licence was in place, resulted in the mobilisation of the drilling equipment to site.

Rig Site

The drilling rig, and all its associated equipment, arrived on 31st May 2002, the rig was set-up, tested, and drilling of the pilot hole commenced on 8th June 2002.

The drill profile for the majority of its length was required to pass through rock consisting of mudstone, and classified as a Northam Formation. For the initial pilot drilling, a 17½" tungsten carbide insert bit, driven by a 9⅝" mud motor, which had a 1.8° fixed bend was used. Pilot hole drilling went according to plan, and by 14th June was completed to the required distance and ready for the subsequent hole opening operations, which were to be performed by the technique of forward reaming. The pilot hole drilling was taken to a point approximately 40 metres from the punch out position on the seabed, in order to maintain circulation of mud and cuttings back toward the drill site.

Forward reaming with a 28" hole opener began once the pilot assembly was removed. The pilot hole was opened up to 28" for a distance of 500 metres to avoid loss of mud and maintain mud circulation. The drill string was then pulled out of the hole and reaming with the 36" hole opener began.

On 10th July, after reaching a distance of 360.5 metres, it was decided to withdraw the hole opener because of mud losses. A series of cementing operations then took place to seal the end of the hole.

Forward reaming with the 36" hole-opener continued until punchout on the seabed occurred on 24th July.

With Van Oord barge, Abeko Server II, on station at the exit point excavating the exit trench, preparations began for hole opening of the last 40 metre section and the pullback operations.

Abeko Server II at Exit Point

The pullback operation could only commence after the excavation of the trench had been completed, the drilled hole at the exit point was free from obstructions and debris, and the weather and sea-state were suitably calm. This was because the 710 mm diameter HDPE pipeline

had to be pulled from the shore out to sea and towed by tug to a position alongside the barge.

The summer months are generally associated with good weather, but the wind and sea-state were so bad that the barge had to return to its safe haven in Appledore and be on standby for a suitable weather window.

Whilst awaiting a change in the weather, the final stages of hole-opening were completed, but during this procedure some difficulties were experienced with obstructions in the hole and several hole cleaning operations had to be employed to ensure the hole was of adequate size to accept the product pipe.

Everything was set for pullback on 18th August. The barge left Appledore docks in the early hours of the morning, but by the time it reached the exit point and set-up in the appropriate position, the weather was considered to be too rough to launch the pipe, and the pullback was put on hold.

With all the conditions favourable, at first light on 20th August, the pipe was launched into the sea and towed out ready for pullback.

Pullback was completed in the early hours of Wednesday, 21st August.

After a well-earned rest, the crew commenced demobilisation the next day. After the delays due to the weather, the construction programme had become so tight that as the equipment was leaving, the haul roads were being removed.

All that was remaining was the construction of the diffuser on the seabed, which was in itself a major item of construction, consisting of ten individual concrete structures that had to be bedded down onto the rockhead in a 4 metre excavated trench. This construction too was like the pullback of the pipe, subject to weather conditions.

Completion of the marine works enabled the barge, the Abeko Server II, tug and crew to be released on 9th October 2002.

This unique method of outfall construction may well challenge the construction methods of the future and provide a more economical and environmental solution.