

Dunbar WwTW

a new treatment works for a historic coastal town

by Charlie Bull and Alan Knowles

Dunbar is a historic seaside town located approximately 30km South East of Edinburgh, and its need for improved treatment - to comply with the Shellfish Waters Directive and Bathing Water Directive - was first identified by East of Scotland Water in 1998. At that time sewerage from Dunbar was de-gritted, screened and pumped to sea from West Barns PS via a long sea outfall, The project was inherited by Scottish Water and subsequently awarded to Scottish Water Solutions for delivery as part of their Q&S11 framework agreement. The benefits of using a single partner for both design and construction have been highlighted at Dunbar, where construction times have been reduced and operational benefits introduced.



Dunbar is recognised as a centre of good practice visited by other process teams

photo courtesy Scottish Water

Considerable optioneering in terms of process options and location for the new treatment plant resulted in the preferred option of a MBR plant at a new green field site at Beltonford being selected. The Beltonford site is located some 1.5km north of the West Barns PS.

Following resolution of planning, land, trader flows and process footprint issues, Scottish Water Solutions awarded Black & Veatch a design and construct project with an overall budget (inclusive of Client and historical costs) of £9.9m in November 2006.

The principal elements of the new treatment scheme comprise:

- * Provision of 750m³ of storm storage (by means of a Tank sewer, and completed under advance contract).
- * Modifications at the existing West Barns outfall pumping station through installation of transfer pumps. These pumps would then pass forward an FFT of 99.9l/s to the new WwTW site at Beltonford.
- * New MCC.
- * Installation of storm screening facilities at West Barns for flows greater than 99.9l/s. Storm flows would continue to be discharged at West Barns via the existing long sea outfall.
- * New rising main, 1.5km in length, through prime agricultural

land to transfer flow for treatment to new WwTW at Beltonford. (see photo 2)

New treatment works at Beltonford comprising

- * **Inlet works with 6mm screening.**
- * **Degritting and screenings handling.**
- * **Second stage 3mm inlet screening.**
- * **Interstage pumping.**
- * **4-cell membrane (MBR) plant.**
- * **Sludge storage.**
- * **Membrane sludge thickening plant.**
- * **New outfall to Biel water, located 450m away.**
- * **New MCC, Control and mess buildings, associated roads, landscaping.**

Dunbar WwTW is among the first projects to be delivered using Black & Veatch's enhanced in-house design, construction and commissioning model. The integration of design and construction disciplines enabled Black & Veatch to deliver the project successfully ahead of programme and under budget.

Buildability incorporated as early as possible into the design phase is

The bigger picture



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Screens in the foreground & MBR cells in background

courtesy Black & Veatch Water Europe

essential for successful delivery of projects, and early review of the proposed site layout, resulted in construction professionals optimising the site footprint to enable simultaneous working in several locations, reducing the construction programme by 6 weeks. Steel tubular piling sections were selected in preference to precast concrete sections to minimise piling risk in the poor subsoil ground conditions, and their advantageous delivery also reduced the lead time and programme by a further four weeks.

Further buildability inputs which considerably assisted the operational aspects of the works were implemented. Some examples included:

- * Improved rag management, removing manhandling of rags by introducing an extended trough arrangement at the hand raked screen with rags being returned into the main flow channel, captured at the main screens and into the skip;
- * Anti-slip finish to concrete at Inlet Works.
- * Access to the Interstage Pumping Station (IPS) controls required step overs over pipework located 1m above floor level.
At a cost saving to the project, an open area of the IPS was covered, and pump controls were installed at easily accessible location.
- * Bauer couplings were added to all 4 cell drainage pipework to allow the flexibility of one tank being drained down without affecting the operation of the other three.

The close working relationship between design and construction professionals, both formal and informal, ensured that a steady flow of required information was received by the site teams as the construction phase progressed. Construction professionals were given the opportunity to influence the design at all stages of its development, ensuring a high level of constructability was incorporated into the final design.

Design professionals played a valuable and active role in the selection and procurement of M & E packages and subcontractors. This strategy ensured that the correct kit was procured and subsequently installed to the exact requirements of the design, greatly increasing efficiency and reducing the need for remedial work following installation.

The project was awarded a Considerate Constructors Silver Award in April 2008.

Due to the significant issues associated with this project, Black & Veatch were faced with a challenging timescale for delivery. A SEPA enforcement notice was in place which required the new WwTW to produce compliant effluent from by the end of April 2008. The main criteria for successful delivery were therefore as follows:

- * The new WwTW was to provide compliant effluent by the end of April 2008 thereby removing the risk of prosecution from SEPA and the subsequent damage to Scottish Water's reputation.

- * The design and construct element of the project had to be delivered to the target cost.

Due to the high profile nature of the project and the potential for significant reputational damage to all stakeholders, it was necessary to implement the undernoted specific project controls.

The earned value analysis required disciplined, consistent and regular reporting on both programme and commercial performance from the project team. This discipline, to ensure accurate and constant reporting, imposed a culture at all levels within the project team of ensuring that short, medium and long term programmes were produced, monitored closely, successfully delivered and reported upon for inclusion in the EVA matrix.

The project stakeholders adopted a pro-active strategy to the identification assessment and mitigation of risk. This strategy was vital due to the tight commercial and programme constraints inherited by the delivery team. A single integrated project risk register allocating risk to all stakeholders was developed agreed upon and maintained. The approach adopted by the delivery team was to allocate risk to the stakeholder best placed to manage that risk. Regular, specific stakeholder meetings were held to update the register and agree actions plans to mitigate current and future risk.

One example of success of risk management on the project can be demonstrated by the network Flows and Loads sampling undertaken during the construction phase. This identified a number of issues with the properties of the sewage in the Dunbar network, which can be summarised as follows:

- * BOD concentrations and loading within the network significantly higher than the design loading of the plant.
- * High chlorine levels within the network sewage.

The additional industrial BOD loading being discharged into the network was approximately equivalent to an additional domestic population of 10,000, almost 50% of the original design capacity of the new WwTW. In order to mitigate the risk from excessive BOD a two phased approach was developed and put in place.

- * 1: SW liaised pro-actively with the local trader management to identify, separate and remove high strength waste streams for treatment at separate locations.
- * 2. Following a number of discussions Black & Veatch installed temporary pre-treatment at the new WwTW to reduce the BOD loading prior to entering the main process.

The above approach enabled the project to be successfully completed and commissioned, while the trader developed a sustainable, long term strategy for managing their waste. MBR processes are extremely susceptible to changes in chloride levels. The Dunbar network, due to its coastal location, was at particular risk to abrupt

changes to conductivity levels. Sampling within the network indicated that peak chloride levels were very high, with the base chloride level some 3 times above the design envelope of the process at Dunbar. To reduce chloride back to acceptable levels, the following strategy was agreed:

- * 1: Black & Veatch undertook extensive surveys into the Dunbar network to identify the main sources of high conductivity readings.
- * 2: Maintenance to the network was carried out by Black & Veatch in early 2008 at strategic locations to reduce the volume of saline intrusion back to acceptable levels.
- * 3: Discussions with traders into their process maintenance procedures were instigated, to ensure the traders developed a sustainable, long term strategy for managing their waste.
- * 4: A 'real time' saline monitoring & pump control system was designed and installed at the West Barns transfer pumping station. This system would inhibit the West Barns transfer pumps during times of high saline.

The above operation has been successful to date, greatly reducing process risk prior to commissioning.

High conductivity has been recorded as a result of the above saline intrusion issue, and has also resulted as a consequence of industrial discharges from traders. Real time conductivity monitoring has been installed at West Barns PS to protect the MBR process.

The success of the delivery of the Dunbar WwTW project can be attributed to the following key factors:

- * Strong focussed Management Team;
- * A committed and motivated stakeholder network;
- * Pro-active strategy to risk management implemented by the stakeholders.
- * Increased efficiency of delivery as a result of the integrated Black & Veatch project team.
- * Disciplined, consistent project controls and reporting.

The Dunbar WwTW project has become recognised as a centre of good practice and has been visited by other project teams in order that the standards of management, design and construction observed at Dunbar can be applied to other projects within the respective stakeholders businesses. The new WwTW began discharging compliant effluent on 28th April 2008.

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*Final effluent (permeate) gallery prior to pipe insulation being fitted
photo courtesy Black & Veatch Water Europe*