

Dunoon WwTW

Scottish Water's £34m investment in new sewerage collection, transfer & treatment scheme on the Cowal Peninsula

by Rick Griffin

Situated in beautiful surroundings on the Firth of Clyde, the town of Dunoon was once renowned as the traditional holiday destination for the people of Glasgow. Today, Dunoon and its adjacent environs of Kirn, and Sandbank on the Holy Loch, still attract thousands of visitors every year to this stunning location. However, the existing combined sewer network presently discharges largely untreated wastewater into the Holy Loch and Firth of Clyde, and requires a significant upgrade to comply with the Urban Waste Water Treatment Directive (Scotland) Regulations, and to satisfy Scottish Environmental Protection Agency's (SEPA) guidelines for discharges into recreational waters.



Dunoon WwTW

Courtesy of Black & Veatch

Selecting the location

The challenge for the Project Team and Designers, and ultimately Scottish Water Solutions' (SWS) In-House Delivery Partners (IHDPs), was one of space – where to locate the necessary storage structures and treatment plant along a 10km strip of rocky coastline hugging the Firth of Clyde?

The answer was to purchase Bullwood Quarry, 2km south of Dunoon. However, since the quarry was not big enough to include storm tanks at that location, extensive consultations with Argyll & Bute planners and the local population took place to establish their location preference for a low impact site that was still viable in engineering terms. An area on the promenade immediately south of an existing toilet block was finally selected and this was incorporated into the design.

The current system

- The Dunoon Network is currently served through 21 (No.) sea outfalls (as shown on the map on the next page).
- Outfalls discharge unscreened raw sewage combined with storm flows into what are now designated as recreational Waters (Holy Loch down to Tor na Dee).

Optimised design solution

- A new collection and transfer system is to be installed. Formula "A" flows via a pumped and gravity 10km long "daisy chain" from Broxwood, at the head of the Holy Loch, down through Sandbank and Kirn to West Bay at the southern edge of Dunoon, and from there, a maximum of 107l/s will be pumped forward for treatment at a new WwTW to be constructed in Bullwood Quarry.
- Scope includes the construction of 6 (No.) combined pumping stations/Combined Sewer Overflows; 1 (No.) standalone CSO at Milton Burn, serving a new pumping station at East Bay and the treatment works at Bullwood Quarry. Flows in excess of the pumping stations' capacities are screened and spilled to new outfalls.
- In total, including the discharge into deep waters from the WwTW, 8 (No.) new outfalls will be installed, the largest being the 1,600mm dia from Milton Burn into East Bay.

The project is being managed by SWS, with AECOM designing the scheme. SWS also appointed Professor George Mathieson, consultant to KeyGS, to assess the risk of rock falls in the quarry, and advise on the measures necessary to reduce and manage that risk.

Early works

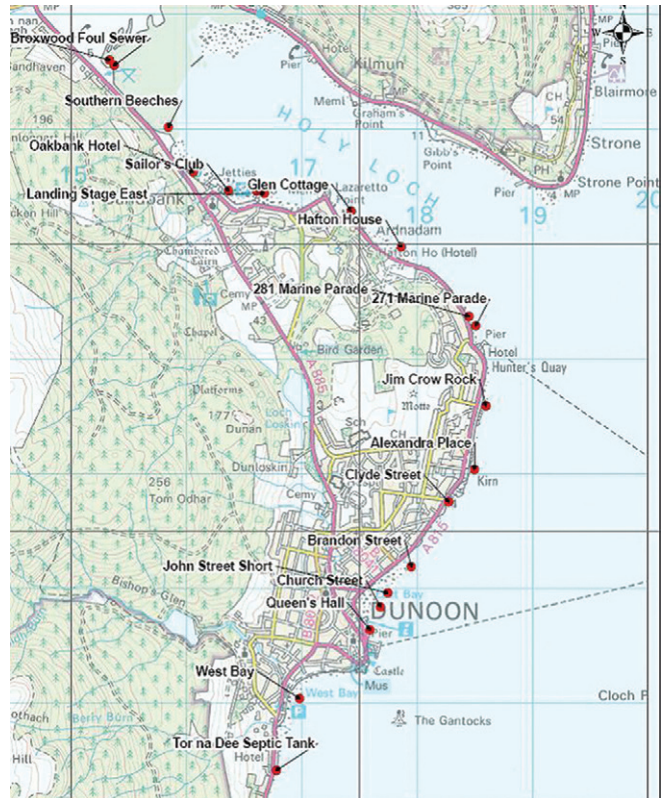
Initially, an enabling contract was let to Black & Veatch to site clear the quarry, and make the slopes safe for both the construction and operational phases of the WwTW. At the same time, GMJV (a joint venture between Galliford Try & Morgan Sindall) were engaged to carry out further site investigations on West Bay, to confirm the design of the storm tanks, while in parallel, agreement was being reached with SEPA on the final design of the proposed new outfalls.

Undertakings

In March 2010, the main contracts were let to the IHDPs. Black & Veatch were awarded the contract for the construction of the new WwTW, while GMJV were awarded the contract for the installation of the 8 (No.) outfalls, as well as the civils and infrastructure contract for the collection and transfer (C&T) sewers. The new system of C&T sewers includes the pumping stations with screened CSOs, and the rising mains that link and collect the various existing sewage outfall streams, to bring them together and transfer them to the new treatment works. Black & Veatch were awarded the mechanical and electrical contract for the C&T.

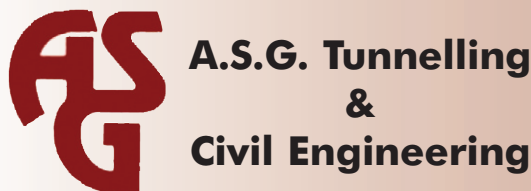
The new Dunoon Sewerage Scheme has been designed for a population equivalent of 14,465, which includes a significant seasonal allowance for visitors. Because of the limited footprint available within the quarry and the nature of the effluent, the treatment process was kept as simple as possible. However, AECOM still had to meet the challenge of shoehorning the plant and equipment into the space available, and Black & Veatch had to devise and implement a construction sequence that aligned with the overall Turn of Flows programme.

GMJV, on the other hand, had to deal with the significant logistic challenge of installing the pipework along the A815, a heavily trafficked, narrow, coastal road, while being flexible enough to re-design onto the beach where the road became too problematic.



Dunoon catchment - Sandhaven to Tor Na Dee
Courtesy of Scottish Water Solutions

The initial process selection for Dunoon WwTW developed from primary treatment only (lamella settling tanks), with space available on the site for a future secondary treatment plant (BAFF). However, the design was challenged for three main reasons:



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- The suitability of lamella primary settlers to deal with high concentrations of fat, oil and grease.
- The relative complex control required for a BAFF plant.
- The requirement for interstage pumping.

The final option of a conventional sewage activated sludge plant was developed as a more robust solution, well proven in the West of Scotland and very familiar to Scottish Water Customer Service Delivery staff.

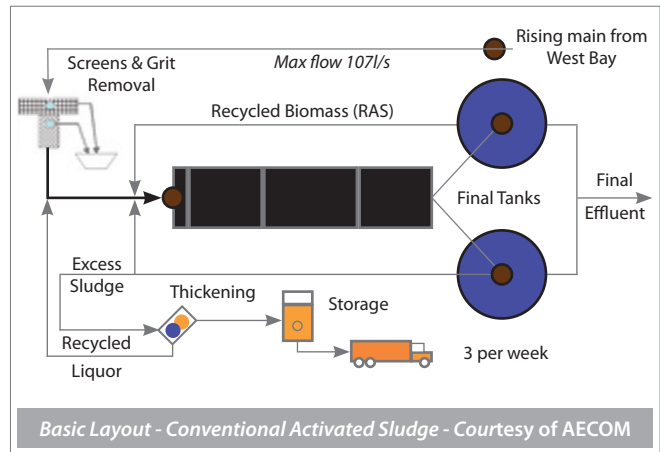
Process description

The compact activated sludge plant is designed to cope with anticipated high levels of fats, oils and greases during Dunoon's tourist season. Metered pumped flows entering the inlet works will be screened by 6mm inclined rotating screens with integral screen washing and compaction bypass. A manually raked screen will provide an emergency bypass.

The screened sewage will then flow through the grit removal plant, which separates and cleans the grit. Washed screenings and grit discharge to skips within an odour controlled enclosure. Odour management was a key condition of obtaining Planning Consent so the process stream is covered and kept under negative pressure. Extracted air will be passed through a catalytic iron filter (CIF) and dry carbon polisher before being discharged through a 20m high stack to atmosphere.

Screened and de-gritted sewage will flow by gravity to a mixed selector zone, where it will be combined with return activated sludge and drainage from process units. It will then gravitate to twin parallel aeration lanes, with three pockets per aeration lane to encourage plug flow conditions. Oxygen levels will be controlled independently in each pocket by air diffusers.

A mechanical mixer will be provided in each final pocket to maintain proper mixing of the mixed liquor, and prevent settlement during periods of low oxygen demand.



Mixed liquor will then gravitate to 2 (No.) final settlement tanks. Dipping scum boxes will remove floating scum before the final effluent spills over circumferential V-notched weirs. Both tank discharges will be combined in a sampling chamber before gravitating to the outfall. Activated sludge will be drawn off from the tanks' central hoppers under gravity, to a collection chamber. The sludge return rate to the selector zone is proportional to the works inlet flow, controlled by actuated hydrostatic valves and in-line ultrasonic flow meters.

Surplus sludge will be periodically withdrawn from the sludge collection chamber via an actuated valve, before being pumped to a sludge buffer tank. The surplus sludge tank will also receive scum from the final settlement tanks, and an internal mixer in this buffer tank will keep the sludge homogeneous. The homogeneous sludge will then be pumped to a sludge thickening plant, comprising polymer dosing pumps, flocculation tanks and drum thickeners. Once thickened to 5% dry solids, sludge will be discharged directly to the thickened sludge holding tank, equipped with a tanker connection to allow off-site treatment and disposal.



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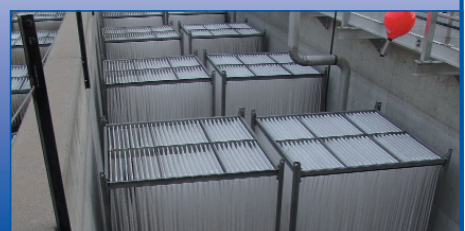
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A final effluent pumping station will supply washwater to the inlet screens, grit removal plant and sludge thickening plant. Pumped potable water will supply wash-down water to hose points within, and adjacent to, the treatment building, the polymer dosing plant, and to the inlet screen heated washing system (provided to counteract fats, oils and grease build up).

Outfalls

ABCO Marine Limited installed 8 (No.) new outfalls for the scheme over a very efficient 9-month programme, which incorporated underwater blasting at Jim Crow, and the installation of the 1,600mm diameter multi-port outfall at Milton Burn from its town centre location out into East Bay.

Storm tanks

Because of the severe shortage of space at Bullwood Quarry the storm tanks for the works were installed at West Bay, giving 2 hours storage under storm conditions while pumping a maximum of 107l/s (3 x Dry weather Flow) to the works for treatment. The pumping station wet well also functions as a storm water balancing tank. The balancing volume is equal to that normally provided at sewage works for that purpose. Any excess inflow over the flow to treatment, is retained in the storage. Prolonged excess inflow, which is sufficient to fully utilise the storage, will spill at high level through screens to a new outfall.

Ward & Burke Construction Ltd, specialist sub-contractors to GMJV, came up with a single, elliptical shaft design, incorporating a dry well, which made efficient use of the limited space available adjacent to the promenade.

The photograph below shows the first segment of the tank being lowered under the control of hydraulic jacks. The piles shown were driven to rock at approx 17 metres depth. Subsequent lifts were poured and lowered every two weeks, giving a 12 week construction programme for the tanks, effectively halving the programme time for the installation of standard bolted Caisson with separate wells.



David Gethin, PM for B&V, Allan King, Agent for GMJV & Rick Griffin, Senior PM for SWS, take a high level view of progress - Courtesy Scottish Water Solutions

Commissioning phase

At the time of writing, July 2011 the project is on programme to enter the dry commissioning phase, with Turn of Flows scheduled for late September, leading to the planned takeover of the works by Scottish Water Operations in December 2011.

The real challenge for this project was to come up with a design that utilised an appropriate level of technology, while situating the pumping stations and treatment works in locations that allowed a realistic chance that all Regulatory Bodies and interested third parties (especially the local residents) would recognise that everything reasonable has been done to mitigate any adverse impact of the works, both during construction and the operation phases.

The Editor & Publishers would like to thank Rick Griffin, Senior Project Manager with Scottish Water Solutions, for preparing the above article for publication. The author would like to thank AECOM, Black & Veatch & GMJV, as well as John Morrison, Scottish Water Solutions Commissioning Manager, for their assistance and input.



Storm Tanks at West Bay

Courtesy of GMJV /Ward & Burke

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