Carbarns WwTW

project to provide growth, quality & capital maintenance improvements

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Carbarns Wastewater Treatment Works (WwTW) is located in Wishaw to the north east of Glasgow, within the Clyde river valley. The site is a key strategic asset for Scottish Water and is part of the 'Clyde 7' group of treatment facilities. This is a group of large sewage treatment works that have a combined influence on the River Clyde water environment. A treatment facility has been in place at the Carbarns site since 1856, and the process has undergone various upgrades and improvements as the flows from the contributing catchment has grown and the consented discharge parameters have developed over the years. The current works dates from the early 1970s.

Image of Existing ASP surface aerators *Courtesy of Grontmij*

Ravenscraig

The WwTW formerly treated the waste flows from the Ravenscraig steel mill that was located within the catchment until closure of the mill in 1992. Now one of the largest regeneration projects in Europe, the Ravenscraig site is currently being redeveloped into Scotland's first new town in more than 50 years. The first phase of the new town development is complete, and included the relocation of Motherwell College to a new campus, and construction of a multi-million pound Regional Sports Facility. Phase two of the development is underway and will include the construction of new homes and a new town centre. Carbarns WwTW is the local facility that has been identified to treat the flows from the new town.

Project drivers

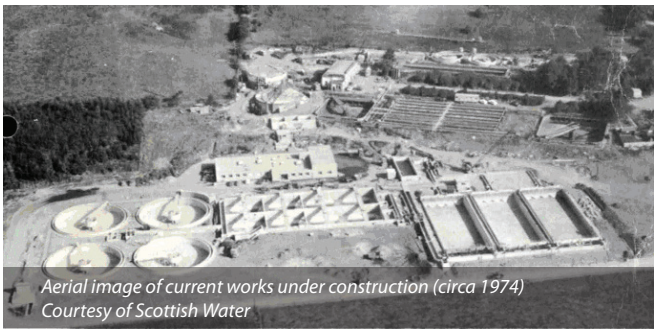
The 2001 census returned a contributing population of 37,228 for the Carbarns WwTW catchment. The current (2010) estimate of contributing population equivalent (PE) is 43,370, which includes the catchment growth from the first phase of the Ravenscraig development. By the end of 2018, further growth of 10,665 PE is expected, increasing the total contributing population equivalent of the site to 54,035.

Whilst growth is a significant factor to the continued operability of the works, the site is also designated for further quality improvements in response to EC01A Urban Wastewater Treatment Directive (941/271/EEC), EC04A Freshwater Fish Directive (78/659/EEC) and EC10A Water Framework Directive (2000/60/EC). The ammonia (95 percentile ceiling) is to be tightened from 10 to 2mg NH_3/l, and there will be a first time total phosphorus limit (annual mean) of 2mg/l.

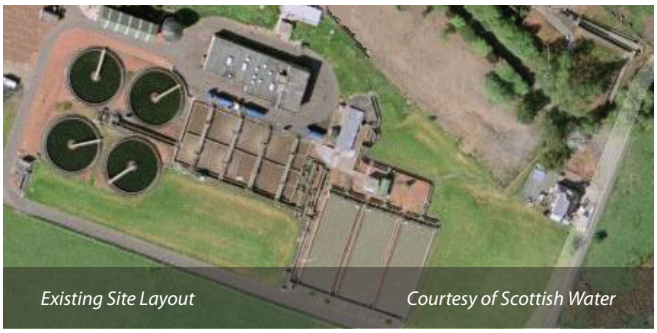
Existing process & needs

The current site configuration dates from the late 1960s, and the process consists of inlet screening and grit removal, primary settlement, secondary treatment by activated sludge with surface aeration and final settlement.

To address the growth and quality needs at the site, it is proposed to upgrade the works through augmentation and improvement of the secondary treatment process. Capital maintenance improvements are also required to ensure the continued good operation of the primary and final settlement sludge draw off systems, and inlet screening arrangements for the full 2018 design horizon.



Aerial image of current works under construction (circa 1974)
Courtesy of Scottish Water



Existing Site Layout *Courtesy of Scottish Water*

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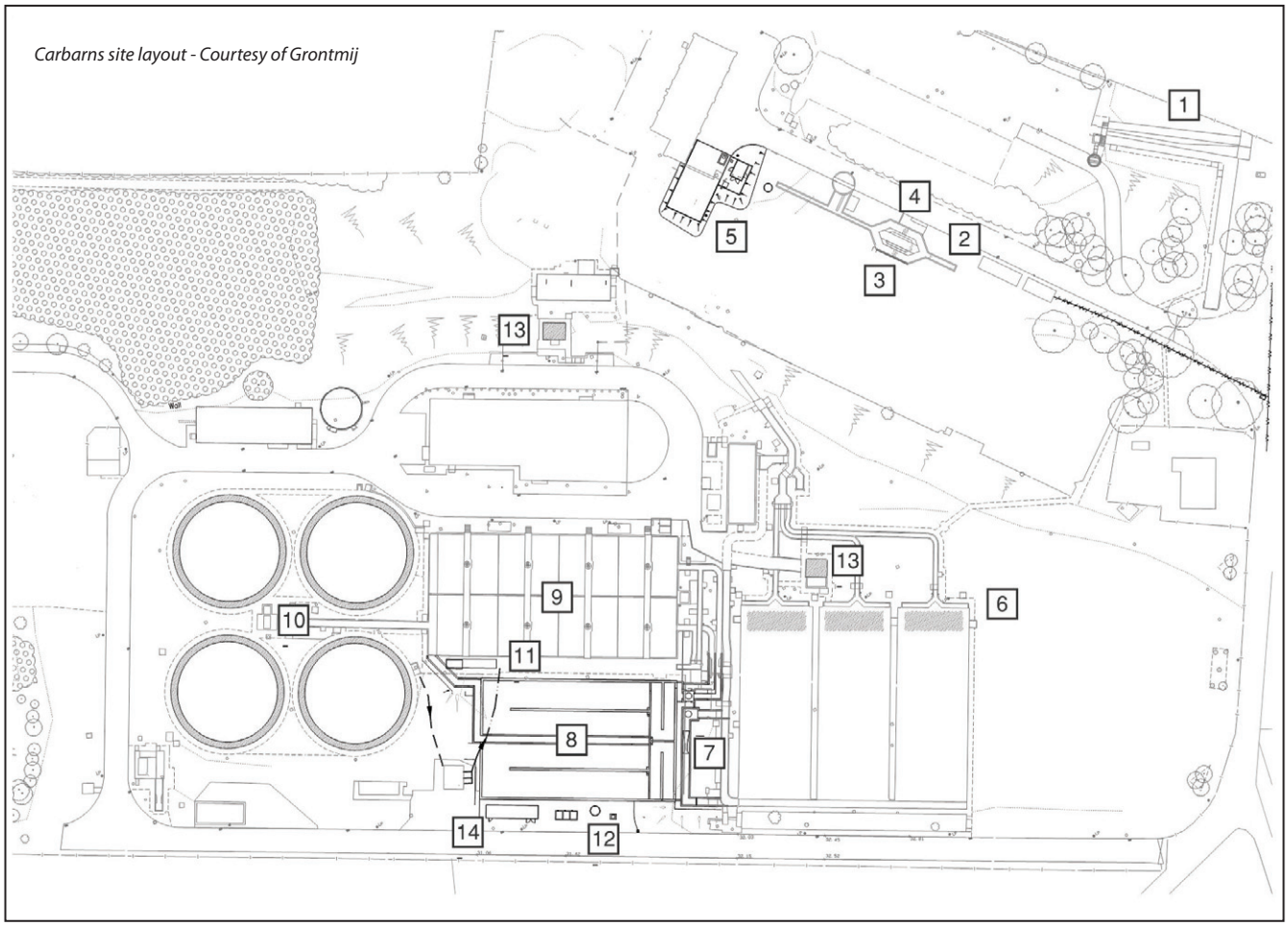


Carbarns site layout - Courtesy of Grontmij

ASP construction: Base Slab Construction February 2011 Courtesy of Expanded

Existing storm weir and spill channel *Courtesy of Grontmij*

Design

Grontmij has been responsible for the design development since inception of the upgrade project in 2008. Design services provided by Grontmij have included process & hydraulic design, MEICA design, civil and structural design and geo-environmental investigations. Grontmij was originally contracted to Scottish Water Capital Investment Delivery (CID) to develop the design to Capex 3 approval stage. Grontmij are now currently progressing the final construction stage design on behalf of Scottish Water Solutions (SWS), who were allocated delivery of the project in 2009.

In 2008 a flow and composition survey was undertaken to establish the current population equivalent, chemical composition and levels of underlying infiltration within the wastewater flows arriving at the WwTW. Through this, the existing works' capacity was assessed and process options for the management of future growth and consent tightening were investigated. A value engineering workshop was undertaken early in the feasibility stage project, to define a preferred outline solution that was aligned with project drivers and investment programme allowances. The project team worked closely with the various stakeholders within Scottish Water to further jointly develop the solution. Third party stakeholders, including North Lanarkshire Local Authority Planners and SEPA, were also consulted throughout. Given the pace of development at the Ravenscraig site, and the significance of the WwTW, a project steering group was initiated that acted to ensure that the design gained staged approval timeously and with advanced buy-in.

Project Scope

The final design approved for construction consists of the following *(numbers relate to the site layout diagram above):*

1. Resetting of control weirs to suit new design flows: With the future anticipated growth, consented 6DWF will increase from 564l/s to

697l/s and 3DWF will increase from 380l/s to 423l/s. In order to pass the future design flows, it is necessary to raise the level of both the storm and 3DWF overflow weirs. This will be facilitated by installation of new stainless steel weir plates. New control flumes are also required at each location and new stainless steel flumes have been specified.

2. Installation of a Coarse Screen: The works has previously experienced large debris being passed forward during storm conditions, which impacted upon the fine screens. A bespoke, wide spacing (100mm) bar screen and associated lifting mechanism is to be installed.

3. Fine Screen Panel Replacement: The existing screens are duty/assist band screens. The existing screening panels are subject to excessive wear due to the levels of grit experienced in the incoming sewage flows. Replacement of the 6mm fine screen panels with a higher density material is proposed to remediate these units.

4. Bypass Screen Access Modifications: The current bypass screen access arrangement for removal of screenings is unsafe and inadequate. Provision of a screenings launder, removable handrailing, and general metalwork modifications, are proposed to improve access and maintenance in this area of the works.

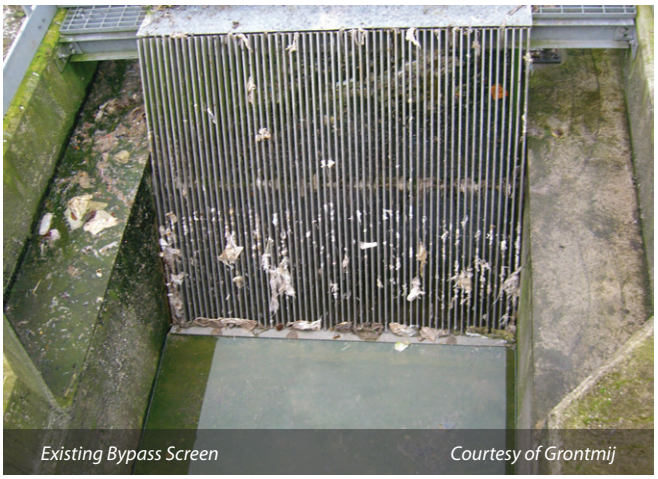
5. Installation of a Ferric Dosing System: Provision of a ferric dosing system is required to meet future consent requirements. The dosing system proposed is a containerised system provided by Siemens Water Technologies. This will require modification of the existing potable washwater system, including pump replacement, and provision of new bylaws-compliant washwater pipework. Extension and localised widening of the existing access road is also required to provide safe access for chemical deliveries.

6. Primary Settlement Tank (PST) Sludge Draw Off System Refurbishment: Primary settlement is achieved via three rectangular tanks, that operate as combined primary/storm tanks. Sludge on the site is co-settled in the PSTs. To ensure continued operation throughout the design horizon the PST scrapers, airvac and de-sludge system will be refurbished.

7. Construction of a New Activated Sludge Plant (ASP) Inlet Channel and Flow Distribution Chamber: A new flow distribution chamber is required to equally split both RAS and settled sewage flows equally between the existing and new ASPs. This includes the construction of an inverted siphon. In order to allow the distribution chamber to be constructed off-line and at the maximum distance from existing structures, a new approach channel is also proposed. The new feed channel/distribution arrangement will ensure adequate mixing of flows and stable flow conditions prior to flow splitting. The flow split between the new and exiting ASP is designed to have 50:50 ratio to allow a simple hydraulic flow split.

8. Construction of a New Activated Sludge Plant with Fine Bubble Diffused Air (FBDA): A new tank of approximate 5,845m^3 operational volume will be constructed to augment the aeration volume of the existing secondary system. This new tank will be a two lane, two pass configuration and will include an anoxic zone (with submersible mixers) prior to aeration. Aeration will be provided via a Fine Bubble Diffused Air (FBDA) system provided by Suprafilt. Construction of a new outlet channel with tie-in to the existing ASP outlet channel is also required.

9. Upgrade of the Existing ASP: The existing ASP is a two-lane tank with an approximate operational volume of 5,260m^3. Each lane is subdivided into 4 (No.) pockets. A new anoxic zone with mixers will be constructed within the first pocket of each lane. The existing tank is aerated via 6 (No.) surface aerators and a 'drop-in' FBDA grid at the front end of each lane. This will be replaced by a Suprafilt fixed FBDA system, that will re-use the existing FBDA blowers.



Existing Bypass Screen *Courtesy of Grontmij*

Clean down of a PST lane prior to mechanical refurbishment *Courtesy of Expanded*

FBDA diffusers *Courtesy of Suprafilt*

FBDA bubble pattern *Courtesy of Suprafilt*

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* Source: Global Environment Outlook: environment for development (GEO-4)

10. Final Settlement Tanks (FST) Sludge Scraper Refurbishment: There are four circular radial flow secondary settlement tanks, which are adequately sized for future design flows/population, but require refurbishment of their scraper blades to ensure continued operation throughout the design horizon.

11. Diversion and Extension of Return Activated Sludge (RAS) Pipework: To facilitate construction of the new ASP, it is necessary to demolish the existing RAS channel serving the works. The RAS flows also have to be diverted to the new flow distribution chamber. A new 500mm diameter rising main extension is therefore proposed to divert RAS flows around the new ASP.

12. Construction of a New Surplus Activated Sludge (SAS) Pumping Station: A New SAS pumping station is required as the existing station will become land locked once the New ASP is constructed and will also be starved of flow once the RAS line is diverted. A new submersible pumping station operating on a duty/standby basis, and fed via an actuated valve on a timer basis, will be constructed.

13. Thickened and Co-settled Sludge Pump Replacements: In conjunction with the refurbishment of the PST and FST sludge draw off systems, the associated sludge pumps are proposed for replacement to ensure continued operation throughout the design horizon. The 2 (No.) PST (drywell centrifugal) co-settled sludge pumps and the 2 (No.) thickened sludge (progressive cavity) pumps will therefore be replaced. Pumps will be supplied by KSB.

14. New Motor Control Centres (MCCs): 2 (No.) New MCCs within a new kiosk will be provided for the new equipment. The MCC will be supplied by Boultings. Modification works are also required on the existing MCCs to integrate the new works with the existing, and will also include the integration of new packaged plant programmable logic controllers (PLCs) onto the existing PLC 'Profi-bus' network.

Conclusion

The project gained Capex 3 approval (the green light for development and implementation) in July 2010 and construction commenced in November. Construction is being undertaken by the SWS in-house delivery partners, Expanded and Jacobs LES. Total investment at the site will be in the region of £10m. The construction of the new ASP tank was completed in May 2011, which constituted the main civils works at the site. Construction of the associated channels and access arrangements is ongoing, as is refurbishment of the PST sludge system. M&E installation of new equipment is expected from July 2011 onwards. The project is currently on programme and is forecast to complete in April 2012.

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Drained down FST prior to scraper refurbishment Courtesy of Expanded

Flow distribution inverted siphon construction Courtesy of Expanded

Flow distribution inverted siphon construction Courtesy of Expanded

ASP construction: Base Tank Nearing completion as of April 2011 Courtesy of Expanded

Image of RAS outlet manifold, modified during temporary diversion of flows - Courtesy of Expanded