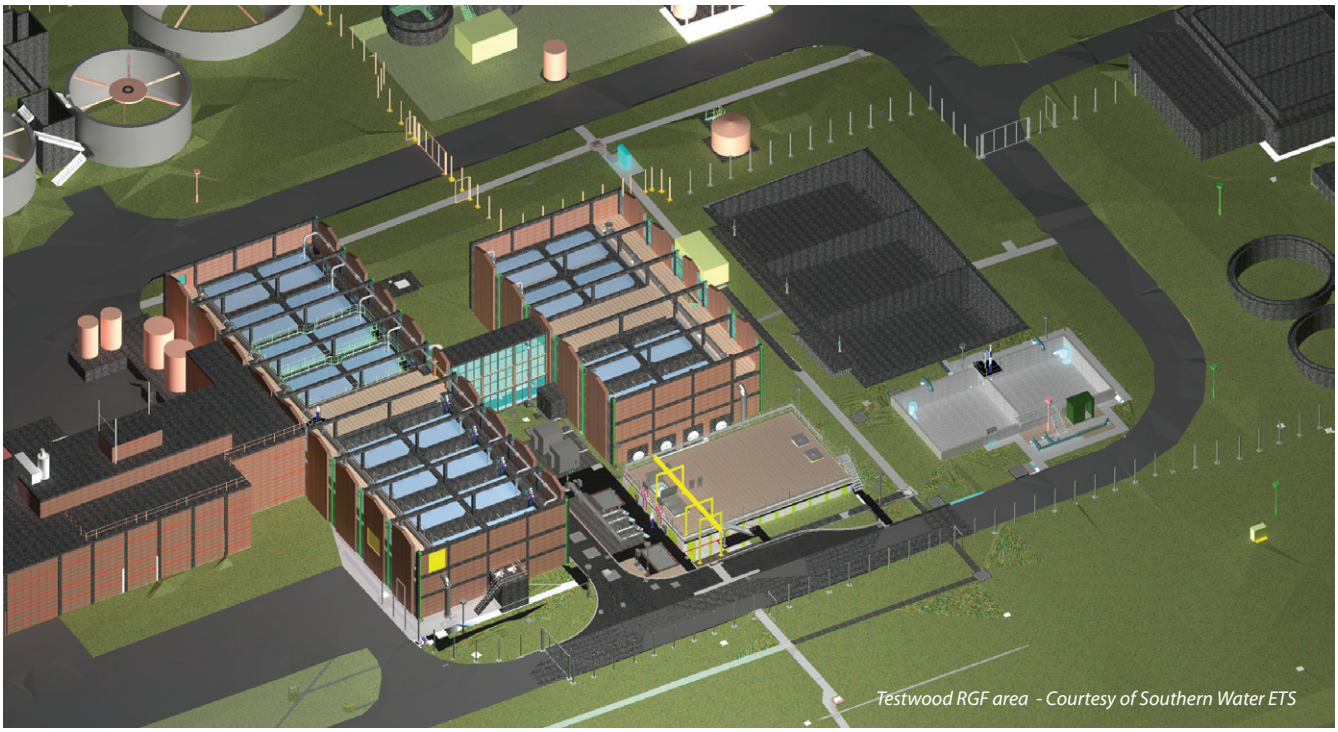
Testwood Water Supply Works Phase 1

capital improvement scheme to increase output from 70Mld to 91Mld and improve the resilience of supplies to Hampshire and the Isle of Wight

by Paria Sadeghy & Laurent Wallis

Testwood WSW is a surface water supply works with existing capacity of 70Ml/d located west of Southampton, which receives water from the River Test and one of the Testwood Lakes during certain conditions. Testwood WSW supplies water to Totton, Waterside, Southampton and the Isle of Wight. The main water treatment processes are clarification, filtration and disinfection prior to supply. The existing water supply works comprises of three separate clarification streams, identified as stages I, II and III. These separate streams (stages) run in parallel. Stage I, with an original design flow of 45Ml/d, was constructed between 1963 and 1967, Stage II, with a further 20Ml/d, was completed in 1973 and Stage III adding a further 40Ml/d in 1980. The rapid gravity filters (RGFs) are divided into two streams - Stage I & II clarifiers feed RGFs 1 to 12 and Stage III clarifiers feed RGFs 13 to 14.



Testwood RGF area - Courtesy of Southern Water ETS

Scheme objectives

The primary driver for the scheme is to increase the supply output of the works from 70Mld to 91Mld, resulting in improved supply resilience in the network area.

The team has selected refurbishment of existing assets instead of replacement, where practicable, to deliver the best value for money for the customer and also reducing environmental impact by avoiding demolition and new construction and associated CO_2 generation.

These refurbished assets will be more tolerant of river water condition changes, increasing resilience in low flow and high flow events and contributing to improved network resilience of supply. Improving the treatment process to deliver water above regulatory standards for taste and odour will ensure continued provision of high-quality drinking water to the customer. Recovery of washwater will improve process efficiency and reduce discharge quantities.

Project scope

Rapid Gravity Filters 1-12 and associated structures: Design, supply, construction, installation, testing and commissioning of following structures and systems to refurbish RGFs 1-12:

- Refurbishment of the existing RGF 1-12 building and structure to increase operational lifetime, including replacement of existing roof covering with an insulated Protan roofing system, remedial works to the roof soffit and a new ventilation system to control condensation levels.
- Existing RGFs are being upgraded to meet the current Southern Water standard requiring increased filter contact time, improvements to the combined air and water backwash system and an automated run-to-waste system. To increase the contact time combined media depth has increased to 1000m and the backwash weir level to be raised by 500mm. To improve filtration and combined backwash air and water distribution across the filters the existing underdrain systems are to be replaced with the Leopold XA underdrain system. The existing backwash pipework is to be refurbished and utilised for the automated run-to-waste system. To facilitate this work the RGF penstocks, valves, actuators, differential pressure and turbidity instrumentation and access platforms are being replaced.
- As the existing combined air and water backwash systems are at design capacity new combined air and water

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backwash systems are to be provided. The new air scour system consists of 75kW blowers delivering low pressure air through a new pipeline with flow and pressure monitoring to the Leopold floor air headers. The new backwash system consists of a partially buried dual cell 1000m^3 backwash tank, submersible pumps and DN600 delivery pipe system feeding the RGF outlet valve manifolds with flow and pressure instrumentation.

- The automated run-to-waste system consists of new pipe connection and flow meter to a new dual cell 500m^3 run-to-waste tank, with facility for a return to head-of-works pumping station and water quality instrumentation.
- A new motor control centre controlling the combined air water backwash system will be integrated with the existing site control system.

Rapid Gravity Filters 13 & 14: Design, supply, construction, installation, testing and commissioning of the following systems to refurbish RGFs 13 & 14:

- RGFs 13 – 14 from Stage III are different in design to filters 1-12 from Stage I & II. Each filter of RGFs 13-14 accommodates 88 individual filter compartments and each consists of water permeable base, referred to as the 'biscuit base'. Media which includes sand and anthracite layers are placed on top of the biscuit base, each roughly 0.25m deep. Each filter is individually backwashed by the travelling bridge system.
- RGFs 13-14 existing arrangement had the inlet channel open to atmosphere which, whilst acceptable when installed, is not current best practice. To bring the installation up to current best practice for the remainder of the filters' planned operational lifetime a temporary building was installed over the RGF 13/14 structure including lighting, ventilation and lightning protection. The existing rubber seal lining on the backwash travelling bridge system was replaced and a new flap valve installed on the backwash outlet pipework.
- Following completion of the works to enclose the filters, refurbishment of the filters commenced. This included the design, supply, construction, installation, testing and commissioning of a replacement system for the 'biscuit base' underdrain system and replacement of the sand and anthracite filter media which had been identified as a possible reason for poor filter performance.
- With the different backwash method only a manual run-to-waste system is required when bringing the RGFs into service at start-up flows of up to 6Ml/d. A temporary run-to-waste overpumping system has been provided so a permanent system could be designed and installed as part of the refurbishment works.
- The temporary building was completed in March 2018 and the refurbishment of RGF 13 was completed in Spring 2019.

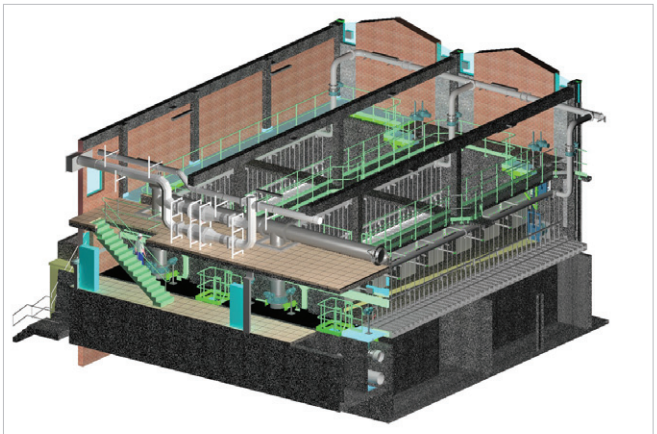
Chemical dosing packages

Trant Engineering Ltd provided design resources to collaborate with the Southern Water design team (ETS) to complete the optioneering, outline design and detail design to determine the replacement/refurbishment of the site's chemical dosing packages.

New coagulant and polyelectrolyte dosing and makeup systems are to be built offline and housed within a new building complete with a new delivery area and chemical storage facility. All dosing lines are to be replaced between the pumps and the existing point of application.

Sodium hypochlorite dosing system will be replaced, including feed pipework, day tank, dosing pumps and associated valves, instruments, pipework and electrical power/control requirements.

Testwood overall site plan - Courtesy of Southern Water ETS



RGF 1 & 2: New arrangement - Courtesy of Southern Water ETS

RGFs 13 & 14: Prior to building install - Courtesy of Trant Engineering Ltd

RGFs 13 & 14: Inside the new building - Courtesy of Trant Engineering Ltd

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6 Granary Wharf, Wetmore Road
Burton upon Trent
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01283 740 216
info@franklynyates.com

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All dosing lines will be replaced between the pumps and the existing point of application.

Orthophosphoric works will comprise the design, construction and commissioning of a modified chemical delivery area including a chemical interception chamber which will be isolated using a key interlock system to ensure that in the event of catastrophic failure of the tanker or tanker hose, any spillage can be isolated and prevented from draining to outfall.

Increase of the PAC dosing rate of 7mg/l to 15mg/l including upgrades to the motive water system, dosing skid, pumps and control panels. Dosing lines will be replaced with a larger size between the pumps and existing points of application.

Auto coagulation system

The quality of raw water is currently monitored by an ABB Aztec 1000 auto-coagulation system in each individual clarification stream and these controllers extrapolate from these readings what the required dose rates for coagulant (currently ferric chloride) should be. To improve process performance Southern Water decided to replace these systems. The updated version of the ABB coagulant dose predictor (CDP) system is made up of a RVG200 controller and an AV412 UV dissolved organics analyser was selected to be trialled. During the trial period the existing system will continue to control the coagulation process.

The scope of the trial includes supply, installation and commissioning of a coagulant dose predictors on each of the three process streams. Over the six-month trial period the CDP will provide coagulant demand (mg/l) and coagulant dose rates (l/min) which will be assessed against data collected via jar sampling on site. The information from both the existing and trial systems have been made available on the site SCADA system. A six month period has been selected so a comprehensive range of inlet conditions can be monitored and on successful completion of the trail the auto-coagulation process control will be transferred to the new system.

Project phases

To ensure the site meets demand throughout the refurbishment a phasing plan has been developed to ensure that both existing processes and new processes and connections can be run in tandem until the final phase when the existing system will be decommissioned. The initial phases begin with refurbishment of pairs of filters moving on to refurbishing four filters in the final phase.

Conclusion

Design works commenced early 2017, with outline design being undertaken by Southern Water's Engineering and Technical Solutions. Construction phase began in Autumn 2017, with Trant Engineering Ltd carrying out works to the RGF13 & 14, final water sample points and commencing the enabling and investigations phase for the RGF building refurbishments. At the end of Spring 2019 phase A of RGF 1-12 is well underway, refurbishment of RGF 13 has been completed and completion planned for all phases by 2022.

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RGFs 1-12: Refurbishment phasing plan
Courtesy of Southern Water ETS