Walton-le-Dale WwTW

a major upgrade to an existing works, with a particularly complex construction & commissioning sequence

by David Morgan & Richard Watts

Walton-le-Dale WwTW is located near the town of Walton-le-Dale to the south east of Preston in Lancashire. The domestic population for the catchment is forecast to increase from 49,486 to 59,237 by the project's 2031 design horizon, with the population equivalent (PE) increasing from 64,721 to 74,472. The consented dry weather flow (DWF) will therefore increase from 13,000m^3/day to 14,281m^3/day. The consented FTFT will increase from 30,200m^3/day to 53,542m^3/day. There was be no change to the current Environment Agency consent limits of 30mg/l BOD, 45mg/l SS, 10mg/l ammonia, on a 95%ile (spot) basis. With an approved budget of £23.5m to upgrade the works and a host of technical and logistical issues to address, it was soon recognised that this scheme was expected to be one of the most demanding on the United Utilities AMP5 programme.

Aerial view with civil construction significantly complete - Courtesy of KMI

Existing assets

The assets at the WwTW consisted of preliminary screening, grit removal, primary settlement, mineral media trickling filters and humus tanks, with final effluent discharged to the River Ribble. Co-settled raw sludge was stored on-site and then transferred via tankers to Blackburn WwTW for further treatment. There was an odour control plant that treated foul air from the sludge tanks. Flows greater than FTFT were diverted to storm tanks, which overflowed to the River Ribble when full.

The new AMP5 consent required UV disinfection on the continuous final effluent discharge and that overflows from the storm tanks shall not be greater than 10 (No.) per annum on average over a 10 year period. The UV plant shall be capable of delivering a minimum dose of 35mJ/cm^2 at maximum flow and at a calculated UV transmittance of 30%.

Proposed works

The principal elements of the scheme included:

- Diversion of 5 (No.) existing inlet sewers.
- Inlet works with 3 (No.) automatic band screens, 2 (No.) bypass screens, screenings handling and 2 (No.) 8.0m diameter detritors.
- 2,500m^3 storm tank including storm return pumping station.

- Modifications to existing primary settlement tanks and distribution chamber.
- Filters feed pumping station.
- 4 (No.) 33.7m diameter trickling filters.
- 2 (No.) 25.8m diameter humus tanks.
- Final effluent UV disinfection plant and building.
- Outfall pumping station.
- 2 (No.) 450m^3 sludge storage tanks with air mixing plant.
- Odour control plant.
- Flood protection bund and flood compensation area.

The project formed part of the United Utilities AMP5 capital programme with a consent date of 30 June 2014. The initial design of the scheme was undertaken by an integrated United Utilities and MWH team, with the latter acting as Engineering Service Provider.

Construction was undertaken by framework contractor KMI (a joint venture of Kier, Murphy and Interserve), with detailed design services being provided by GHA Livigunn and Interserve.

Engineering development

The existing site provided some considerable challenges in developing a solution; the land to the south east is designated as Ancient Woodland and a Site of Biological Interest (SBI). The field to the south west contained areas of marshy grassland that were deemed to be of biodiversity value and were overlooked by residential properties.

To the north of the works any proposed development would encroach on the 1:100 flood plain of the river Ribble. Naturally there was a need to minimise land take and integrate the new plant with the existing facility.

A process of elimination led to the northern option being developed. Developing the land to the north of the works impacted on the 1:100 year flood plain of the river Ribble. Following a detailed Flood Risk Assessment and extensive liaison with the Environment Agency(EA), the following key criteria were identified:

- The new works should be protected by a bund whose level was determined from the 1:100 flood level, freeboard and an allowance for climate change.
- As a result of negotiations with the EA, a flood compensation volume of 3,000m^3 in the field to the south-west was agreed as an offset for construction within the flood plain. This volume was realised by a reduction in ground levels in the field and a number of short culverts through the bund that supports the Western Sewer that flows to the works.

With a public footpath just to the north of the works to be diverted, screening was also a key element of the scheme.

Technical challenges

With existing and new assets intermingled and the obvious necessity to maintain the existing facility until the new plant came on line, some particularly challenging problems were faced:

Inlet sewers: The original works were fed by 5 (No.) sewers which were up to 1,000mm in diameter. These were all to be diverted into the new inlet works. To achieve this a short section of the new inlet works channel was built, with the diverted flows brought to this. The new section was then stanked off and cross-connected back into the old inlet works, which ultimately allowed flows to be sent through the new or old facility.

Primary tanks: The initial design included for the provision of 2 (No.) new tanks. Following detailed process analysis, the team proposed modifications to the existing tanks which would obviate the need for the additional tanks. These included:

New detritors and FTFT channel leading to the existing PSTs - Courtesy of KMI

- Reviewing the surface loading rate.
- Raising the top water level and outlet weirs.
- Replacing the diffuser drums.
- Repositioning the scum scraper blades and scum box.

This allowed the project to move forward with the existing units, thus realising significant savings. It was noted that the flow distribution to the existing tanks was not balanced and the construction of a new chamber was simply impractical. This time the team used CFD modelling to assess the disparity in flow split and loads and in doing so, understand how those could be addressed should operational concerns be realised; by means of adding baffles, for example.

Trickling filters: The 4 (No.) 33.7m diameter trickling filters were initially developed using a conventional peripheral weir. As the overall plant design was progressed it became clear that, despite the significant volume of material required for the new bund, there would still be a surplus of excavated material.

By changing the filters to an internal collection channel a further 10,000$m^3$of material could be retained on site.

UV plant: The Shellfish Wares Directive of 200cfu faecal coliforms/100ml needed careful consideration. To achieve the preferred solution of UV disinfection, a pilot plant was established on site to accurately assess performance. This also allowed detailed discussions with the EA to take place with actual data.

This led to the adoption of a three channel system with 3 (No.) D/A/S lamps in series and a minimum dose consented at 35mJ/cm^2.

Outfall pumping station: Under normal conditions the plant flows by gravity to the nearby river Ribble. Under flood conditions the plant is unable to forward flows to the river, resulting in flooding at the works. Whilst this clearly has major ramifications for Operations staff, it was noted this could potentially disrupt construction work too. With 2012 presenting the wettest summer on record this risk was realised twice as can be seen in the top left photograph on the next page.

With the new bund in place the future works would be protected from overland flows, but not from backflow in the outlet main. In order to overcome this an outfall pumping station was developed.

Normal flows post UV plant gravitate out to river. The provision of a new chamber on the final effluent and storm pipelines allows these flows to be intercepted and directed to the canister pumps in the station. From here flows gravitate out to river.

Construction

A period of detailed planning by KMI prior to commencing work on site was fundamental to understanding the complex nature and sequencing of the works, not least the need to keep the existing plant fully operational whilst building a new facility around the existing with Operations staff engulfed within it.

Work on site commenced in November 2011 with diversions of overhead and buried HV lines, followed by sequential diversions of the inlet sewers. In August 2013 flows were diverted through the new inlet works, with seeding of the new filter media the following month. This lead onto commissioning of the UV plant in November.

By April 2014 KMI had amassed a total of 377,237 manhours without a RIDDOR, a period of 882 days. This is particularly impressive when noting that some 68 (No.) sub-contractors have been engaged on the scheme.

Commissioning

Throughout the construction process 19 (No.) key outages were identified on a schedule. These helped to form a detailed

Reduced level excavation for the humus tanks following pile installation - Courtesy of KMI

The reception chamber for the new inlet works with the existing facility and PSTs under water in the background - Courtesy of United Utilities

Visualisations were key to minimising the impact of the project Courtesy of MWH & United Utilities

construction programme that allowed the contractor to gain a thorough understanding of the demanding nature and criticality of the sequencing.

Commissioning of the new process was particularly challenging. With 12 (No.) existing and 4 (No.) new filters it would not be possible to define the performance of the new units with a blended flow, noting also it would take some time for the filters to seed and reach their optimum performance levels.

To achieve this the flow from the new trickling filters was directed to the new humus tanks. This flow was then cross connected to the outlet from the primary tanks to allow a re-circulation facility to be provided within the existing process.

At such time as the filter performance reached the desired levels the flows from the two humus facility outlets were combined and directed to the UV plant. This provided flexibility in allowing flows to alternate between the existing and new process as the commissioning phase developed.

Conclusions

The new works at Walton- le-Dale were brought into service on 12 September 2013. The EA regulatory output date and S&D output was achieved some five months ahead of the regulatory date on 27 January 2014 and within the budget of £23.5m.

With a scheme that continued to grow in its complexity throughout its life the teamwork & commitment of all those involved was fundamental in achieving a successful outcome.

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