

Maghera WwTW & Dungiven WwTWs

NI Water experience of large diameter rotating biological contactors (RBCs) to achieve challenging treated effluent standards

by Gabriella Giuffre, Angela Torrens and Michael Donnelly

Maghera Wastewater Treatment Works (WwTW) and Dungiven WwTW are two medium sized works located in county Londonderry, Northern Ireland. Maghera WwTW was overloaded while Dungiven WwTW was an ageing works, and neither would have been unable to meet the revised consent standards set by the Northern Ireland Environment Agency (NIEA) that had to be achieved by June 2011. To meet the sites quality drivers and predicted growth in their respective catchments, Northern Ireland Water (NI Water) incorporated upgrading the two facilities in their capital works investment programme.

Main Photograph courtesy of MWH
Maghera WwTW

Inset photographs courtesy of BSG Civil Engineering
(Left & right) Dungiven WwTW (Middle) Maghera WwTW



Maghera WwTW

Located in the town of Maghera, the works serves a population equivalent (PE) of approximately 6,898 estimated to rise to 7,169 by 2017. The treatment works processes before the facility was upgraded consisted of screening, primary settlement, biological filtration (trickling filters), final settlement (humus tanks) and pumping the treated final effluent to the Moyola River by means of a dedicated final effluent pumping station.

Maghera WwTW was overloaded and unable to consistently achieve the new consent to discharge standard set by the Northern Ireland Environment Agency (NIEA) of 30:50:10 that had to be achieved by June 2011.

Dungiven WwTW

This works serves a PE of approximately 4,743 in the town of Dungiven, estimated to rise to 5,742 by 2017. Prior to the upgrade the WwTW processes comprised screening, primary settlement, biological treatment (trickling filters), final settlement (humus tanks) prior to discharge to the River Roe. The existing WwTW

also included a side stream (extended aeration) which treated a proportion of the screened raw sewage and then blended it with final effluent from the main treatment stream prior to discharge to the River Roe.

Dungiven WwTW was an ageing works built in the late 1960s that would have been unable to meet the revised consent of 30:50:5 set by the NIEA that had to be achieved by June 2011.

Solution identification and procurement

NI Water carried out a high level assessment of options to upgrade each site and determined that the solution for each site should include:

- **Maghera WwTW** – new inlet screens, strengthening the existing side stream by installing a new side secondary treatment stream consisting of RBCs and humus tank.
- **Dungiven WwTW** – new inlet screens, storm tanks (reusing existing assets), new secondary treatment stream (RBCs) and new humus tanks.

Outline design

Having identified the preferred treatment solution at both sites, NI Water, through the Integrated Wastewater Framework, engaged the services of MWH-RPS JV to develop the sites outline design, generate tender documents to procure the WwTW upgrade under a design and build contract.

MWH-RPS JV's brief included developing a solution that not only met regulatory standards, but also maximised reuse of existing assets, achieved the lowest whole life cost, and considered NI Water Operations process experience and expertise with rotating biological contactors (RBCs). Having assessed other potential treatment processes in line with NI Water strategy, MWH-RPS JV ultimately developed an outline design for solutions that involved the use of large diameter (RBCs) at both sites.

Rotating biological contactors

The decision to select RBCs was informed by field data provided by NI Water Operations from several sites across Northern Ireland, which demonstrated that existing RBC plants were consistently achieving excellent final effluent quality with ammonia standards as low as 2mg/l with minimal levels of operating costs. The challenge for the MWH-RPS JV and NI Water teams was to ensure that these levels of performance would be maintained by large diameter RBCs (4.5m), which in practical terms were the only viable RBC option for larger works such as Maghera and Dungiven.

This required development of specifications that would not only ensure process performance but also reliability, low maintenance costs and overall low whole life costs. This was achieved by working in close collaboration with NI Water Operations team, involvement of RBCs suppliers, consultation with other water companies and through MWH-RPS JV process expertise.

Large diameter RBCs for Maghera and Dungiven WwTW upgrade not only provided NI Water with a cost effective solution, it also provided NI Water operations with a process they were familiar with and in which they had confidence.

Specifications

The outline design and specifications development phase of the projects confirmed the following:

- **For Maghera:** The solution consisted of providing 2 (No.) new inlet screens (duty/standby), side stream RBCs; 3 (No.) 4.5m diameter, 1 (No.) new humus tank, new MCC and kiosk and various minor site works.
- **For Dungiven:** The solution consisted of new inlet screen (duty only), storm tanks (blind and flow through tank) re-using existing assets, refurbishment of the existing primary settlement tank, 6 (No.) new RBCs (4.5m diameter), 2 (No.) new humus tanks, new MCC and kiosk, new sludge return pumping station, refurbishment of various site assets.

Undertakings

On completion of the tender documents, the design and build contract for each site was competitively tendered within a restricted list of contractors. Following the tendering period and an in-depth review of tender returns, MWH-RPS JV and NI Water determined that the most advantageous tender was the one submitted by the consortium BSG-Williams Industrial Services (WIS)-Doran Consulting.

Following approval of the tender reviewing team recommendations by NI Water Capital Investment Panel (CIP), the consortium was appointed as the design and build contractor for the upgrade of both Dungiven and Maghera WwTWs in July 2009.

The design and build consortium proposed that the specialist process contractor supplying the large diameter RBCs at both sites be KEE Process Ltd.

Detail design and construction

To meet the statutory obligations set by the NIEA, the projects had to be completed and treatment processes in beneficial use at each site by June 2011.

This timescale meant that the project team had to complete detail design and move to construction within a relatively short period from appointment of the design and build contractor. Both projects had to be delivered with no detriment to the sites ability to maintain the existing final effluent quality standards.

These challenges were met by a close and integrated team comprising MWH-RPS JV, BSG-WIS-Doran Consulting, NI Water Operations and NI Water Engineering Procurement. The integrated team worked closely to finalise detail design, resolve issues arising, agree release of process plant and phased return to service of refurbished/new assets. The teamwork was supported by regular communications, regular design and commissioning meetings, and consultation with the key stakeholders throughout the project.

Challenges

The projects presented significant construction challenges due to the extensive reuse of existing assets at each site and overall site complexities. This resulted in phased construction, testing and commissioning of assets at both sites.

As an example of the challenges, at Maghera the existing screens and inlet works had to be kept operational whilst the new screens chamber was built, the new screens fitted and commissioned. While at Dungiven, the refurbishment of the primary tank had its challenges as the existing works had only one primary settlement tank and releasing the tank for refurbishment required careful planning to ensure that all foreseeable risks associated with operating the site without this key treatment process, were identified and successfully managed.



Dungiven WwTW - Courtesy of MWH

The integrated team approach worked well, and facilitated resolution of issues and challenges in a positive, constructive, non-confrontational environment.

Process commissioning and performance

Maghera WwTW side-stream RBC configuration was such that commissioning of the RBCs and the new humus tank could be done off line. When the new processes achieved an acceptable standard, the new stream was returned to service and the site acceptance tests completed for the site as a whole.

Maghera RBC commissioning began in Q3 of 2010. Initially the RBCs were filled and the effluent recirculated around the RBCs to facilitate biomass growth. To ensure that an adequate source of food would be available to support gradual biomass growth on the RBCs media, the flows would be replenished with "fresh" effluent at appropriate frequencies.

After the initial commissioning period, when the biomass on the RBCs media was established, the new RBCs and humus tank stream effluent was gradually returned to the inlet works until the new side stream was able to achieve the consent standard successfully. The 28-day site tests began in January 2011 and after successful completion, the site was handed over to Operations in March 2011 in advance of the compliance deadline and within budget.

At Dungiven WwTW construction proceeded broadly in two phases, inlet area and then RBCs and humus tanks. The inlet screen and new storm water treatment facilities were constructed, installed, tested and commissioned first to ensure the appropriate quantity and quality of effluent reached the new RBCs and humus tanks.

Once inlet works facilities were commissioned and operational, the RBCs and humus tanks commissioning began. The RBCs were commissioned following the same process as at Maghera WwTW.

The biomass on the Dungiven RBCs was established within a relatively short amount of time and the overall RBCs/humus tanks process stabilised to a point that NI Water Operations having reviewed site quality data, had gained enough confidence that agreed de-commissioning the old trickling filters and humus tanks and bring the new secondary treatment process stream on line.

Once the site performance stabilised, following a detailed planning meeting, NI Water Operations agreed to release the primary settlement tank to allow replacement of the tank scraper bridge and carry out minor tank repairs. The refurbishment of the tank was successfully completed within programme in late January 2011 and after a final proving period, the site acceptance tests began in late February 2011. The site acceptance tests were successfully complete in late March 2011 and the site successfully handed over to NI Water Operations in May 2011 in advance of the compliance date and within budget.

Conclusions

Maghera and Dungiven WwTWs treatment capacities were upgraded adopting large diameter RBCs. NI Water's decision to use this technology is based on operational knowledge and experience of using RBCs across Northern Ireland. Based on such experience, as well as extensive field data, NI Water decided to endorse use of large diameter RBCs not only for larger sites but also to meet challenging final effluent conditions.

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