Culmore WwTW

upgrade to meet treatment & new discharge regulations

Culmore Waste Water Treatment Works, constructed in 1979, serves a population and local industry in the City of Derry area. It is located at Culmore to the north east of the city on the west bank of the Foyle. The site location is adjacent to the Foyle estuary and four residential properties, with a playing field also adjacent. The Culmore WwTW population equivalent is approximately 150,000. The works has a Dry Weather Flow (DWF) of 305 l/s and a Full Flow to Treatment (FFT) of 810 l/s.

The existing treatment process consists of the following elements:

* storm separation;
* inlet pumping;
* preliminary treatment (screenings & grit removal);
* primary settlement;
* marine outfall pipe;
* sludge storage and dewatering.

Contract procurement

Water Service identified that the existing works required upgrading to meet the Urban Waste Water Treatment Regulations (Northern Ireland) 1995 and revised discharge standards set by the Environment and Heritage Service (EHS). *McAdam Design,* on behalf of Water Service, Project Managed the Tendering process (May 2003 – December 2003), the Preferred Bidder Stage (February 2004 – July 2004), the Detailed Design (July 2004 – September 2004), Construction (July 2004 – December 2005) and subsequent commissioning of the refurbishment of the Culmore Works with operational support concluding May 2007.

Following the selection of preferred tenderer *Black & Veatch/Dawson Wam Joint Venture (JV)* supported by *Hyder Consulting* for civil and structural design, attended a series of design development and partnering meetings with Water Service and *McAdam.* Discussions centred on risk and value engineering to develop the Actual Target Cost. Once a figure had been agreed the contract was duly awarded under the Engineering Construction Contract Option C. *Hyder Consulting* providing services under the Option C Professional Services Agreement.

The evolving detailed design was based on the flows and loads for the design year of 2025 given in the Tender Documents. Supplementary information was obtained during the Preferred Bidder Stage and incorporated into the design, ensuring that the plant can be operating effectively from the date of commissioning to the design horizon date.

Process appreciation

The process design provided preliminary treatment reusing the existing inlet works and pumping station, including installation of new screw pumps in existing channels, supplemented by a standby submersible pump, which pass forward Formula A flow.The flow is then screened to 6mm in two directions using four band screens, which were installed in the existing comminutor channels with minor modifications of the structure. Four of the existing primary settlement tanks are used to settle the sewage reducing the load to the secondary biological process, allowing a smaller biological process volume and reduced aeration requirements. After primary treatment the settled sewage then gravitates to the inter-stage pumping station which then passes the flow forward to the activated sludge plant. The inter-stage pumping station was incorporated into the design to allow the new activated sludge process to be incorporated into the constraints of the existing hydraulic profile between the fixed levels of the existing primary tanks and existing final effluent outfall.

The activated sludge process utilises a step feed arrangement which was chosen after the analysis of three different options. It was selected as it provided the most effective solution for producing the final effluent total nitrogen of 10mg/l, flexible operation and uniform oxygen demand. However, this process required a more sophisticated inlet arrangement, which required a detailed hydraulic analysis and close liaison with the civil structures designers to achieve the required reinforced concrete inlet channel arrangement. After the aeration tank the mixed liquor gravitates to the final settlement tank distribution chamber where it is split into six final settlement tanks. Final effluent overflows peripheral weirs while the mixed liquors settle to the bottom of the tank and are scraped to a central hopper utilising a half bridge scraper.

The collected sludge is then passed to the sludge treatment plant where primary and secondary sludges are stored separately and blended prior to dewatering to produce a sludge cake with 27% dry solids content as a 95%ile. Imported sludge is screened and blended

with indigenous sludge. During detailed design several methods of handling the sludge were discussed. The final arrangement provides an area for 4 large skips with appropriate access within the site for vehicle movement.

Additionally, storm water storage capacity has been set to retain storm flows of approximately three times dry weather flow for a period of two hours to meet the EHS requirements.

The process stream for Culmore WwTW is given in the Process Block Diagram, see facing page.

The following table provides a summary of the consent requirements to which the new works will be required to conform.

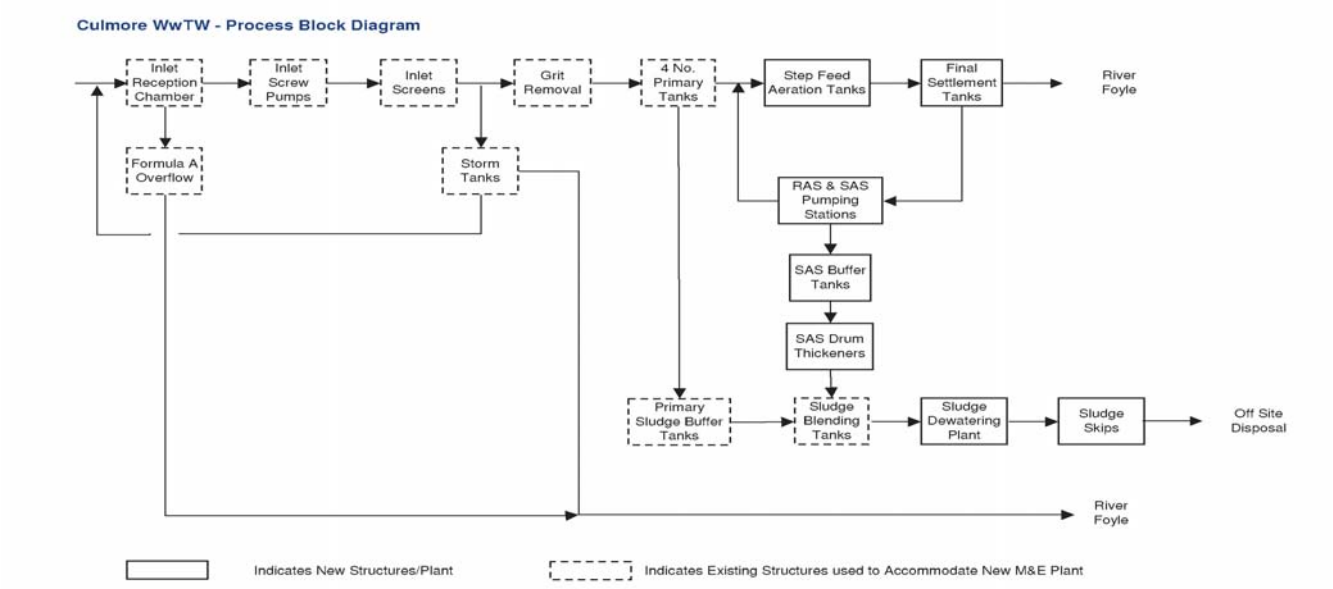
Urban Wastewater Treatment Standards

Parameter	95%ile	Upper Tier	Annual Avge
BOD	25mg/l or 70% reduction	50mg/l	N/A
COD	125mg/l or 75% reduction	250mg/l	N/A
Total Nitrogen	N/A	N/A	10mg/l

Standard compliance

The Urban Wastewater Treatment standard compliance is monitored by 24 hour composite samples of raw influent and treated effliuent.

The annual number of samples is 24. The 95%ile compliance is based on a look-up table, which for 24 samples allows 3 sample failures on each parameter in a calendar year. No failures are permitted against the upper tier.



Environment & Heritage Service (EHS) Registered Discharge Standards.

Parameter	95%ile	Upper Tier	Annual Avge
BOD	30mg/l	60mg/l	N/A
TSS	50mg/l	125mg/l	N/A
Total Nitrogen	N/A	N//A	10mg/l

Standard Compliance

The EHS standard compliance is monitored by spot samples. The annual number of samples is 52. The 95%ile compliance is based on the look-up table which for 52 samples allows up to 5 sample failures on each paramater in any calendar year. No failures are permitted against the upper tier.

General site layout

The detailed design solution was developed in accordance with the Tender Submission and parameters identified in the concept Planning Drawings and Landscaping drawings issued with the Tender document. In parallel, the orientation of the process elements were developed to provide maximum accessibility for operational staff, delivery of chemicals to treatment areas and removal of waste products off site from the skip handling areas, whilst minimising the overall plant footprint. Thus, minimising the amount of new road, maximising the use of the existing road and reducing cross site interconnecting pipework. The storm and foul drainage reflected the requirements of the Tender documents, which required positive drainage to the site system upgraded.

Principal elements of the civil & structural design included:

* detailed review & assessment of existing structures incorporated into the new works (inlet works, primary tanks & sludge tanks};
* modifications to existing inlet works, including civils works associated with the installation of new screw pumps and screens installed into existing channels;
* activated sludge plant consisting of 78m wide by 65m long and 5.5m deep reinforced concrete structure with 6 lanes;
* six 23m dia 3.5m deep final settlement tanks & distribution chambers;
* 2 interconnected storm tanks total length 94m x 32m wide & 4m deep;
* sludge dewatering building, 41m long x18m wide, steel, pitched portal frame building with lean-to MCC room supported on raft slab;
* inlet MCC masonry building 9.2m x 4.3m Ring main building to accommodate electricity supply company's metering equipment 6m x 4m;
* generator, transformer & blower - masonry building 31m x 8 x 3.7m high;
* road layout; pipelines; storm & foul site drainage; service ducts and cable duct layouts and longitudinal sections.

Re-use of existing assets

The JV designers fully embraced the philosophy of the Client in re-using existing assets including the incorporation of existing inlet works and re-using 4 primary settlement tanks, all 4 of the picket thickeners tanks and associated pumping station structure.

MCC, Generator, & Blower Area

In keeping with the appearance of the aeration lanes, the MCC and Generator area has been presented as being part of the above structure. The building constructed from fair faced bloc-work with features to match architectural details as specified for new buildings. The height of the building blends with the coping of the aeration lanes. It has also been located centrally on the site to assist in controlling noise levels at the boundary.

De-watering building

The De-watering building designed as a steel portal frame building with a "lean-to" steel frame housing the MCC, minimises the visual impact of the construction of a larger building. This structure reflects the requirements of the concept planning application drawing and facilitates process requirements. Optimising the Mechanical and Electrical plant layout within the building envelope and sludge area resulted in several iterations to ensure all Client requirements were attained.

Landscaping

The specification will ensure a high standard of landscaping and the detailed design utilises all excavated material to form landscaping bunds and the ground is reprofiled around the aeration lane structures, storm tanks and final settlement tanks. minimising the visual impact of these large reinforced concrete structures.

Progress and Programme

A significant amount of civil/structural refurbishment and construction has been completed, including the aeration tanks and final settlement tanks. As this article is written (April 2005) overall progress to date is 58% with the anticipation that the works will be producing compliant effluent by December 2005. ■

Note: *The Editor & Publishers thank Water Service, Northern Ireland and Hyder Consulting, for the above article & illustrations.*