

Annagher Wastewater Pumping Station

upgrade to reduce spills to Coalisland Canal, providing flood protection to the Coalisland catchment and rejuvenating the Coalisland community

by Keith Bingham BEng Hons IEng MICE

Upgrading the Annagher Pumping Station (PS) involved the construction of a new pumping station on the existing site, as well as supporting pipelines in the region of the Annagher coal mine and the Coalisland Canal on the outskirts of the town of Coalisland, County Tyrone. Northern Ireland (NI) Water invested £2.5m to rationalise and upgrade the existing wastewater collection and transfer systems within Coalisland. Implementation of the scheme has ensured that NI Water is able to meet its strategic customer-oriented targets, compliance with European Wastewater Treatment Directives and protection of water quality in the Coalisland Canal. Implementation of the scheme has also played its part in the regeneration plans for Coalisland.



Coalisland Navigation Canal
Courtesy of AECOM/Alan Lavery Photography

Background

Coalisland is a town and community that historically built up around the local coal industry playing its part in powering the industrial revolution in Ireland. The town owes its development to a favourable combination of mineral resources – coal, industrial clays and glacial sands.

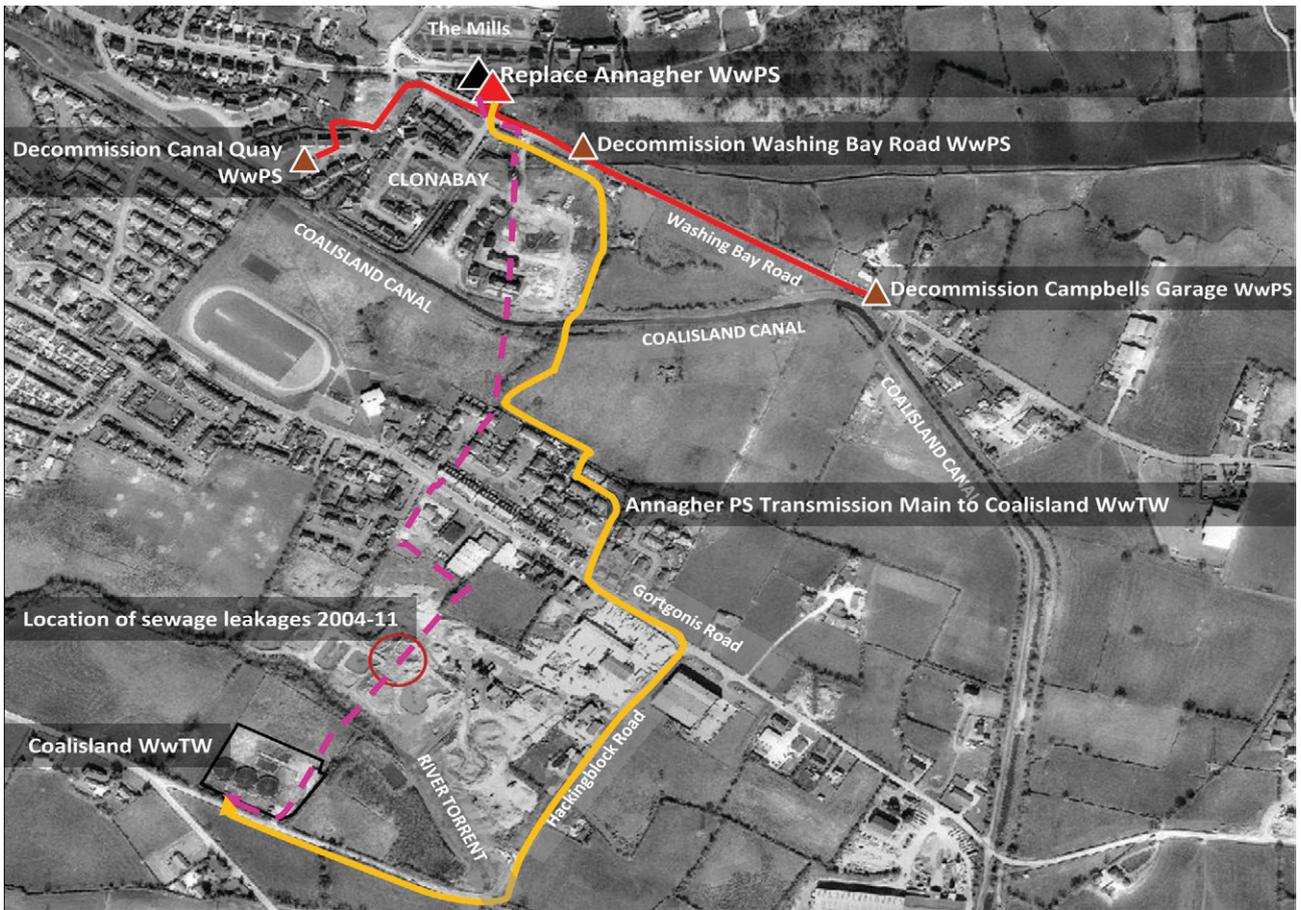
In 1729, the Commissioners of Inland Navigation for Ireland was established and constructed a network of inland canals to supply Dublin and Belfast with coal. Construction of the Coalisland Canal commenced in 1733 and was completed in 1787. The canal served the coal mines and linked the railway network to navigation watercourses. The town developed around the canal basin, resulting in an unusual layout within the town centre.

The canal is an interesting and locally important feature of the town and in combination with the mining of coal, is the underlying reasons for the town's growth and development. The canal therefore represents an important historical feature of Coalisland's heritage, while also supporting local wildlife.

From the earliest asset records it is clear that Coalisland WwTW was located on the present Annagher PS site, close to the site of the Annagher coal mine pit head. Following population expansion in the 1960s, Coalisland Wastewater Treatment Works (WwTW) was relocated out-of-town, requiring the conversion of the old Coalisland WwTW to Annagher PS, a terminal pumping station.

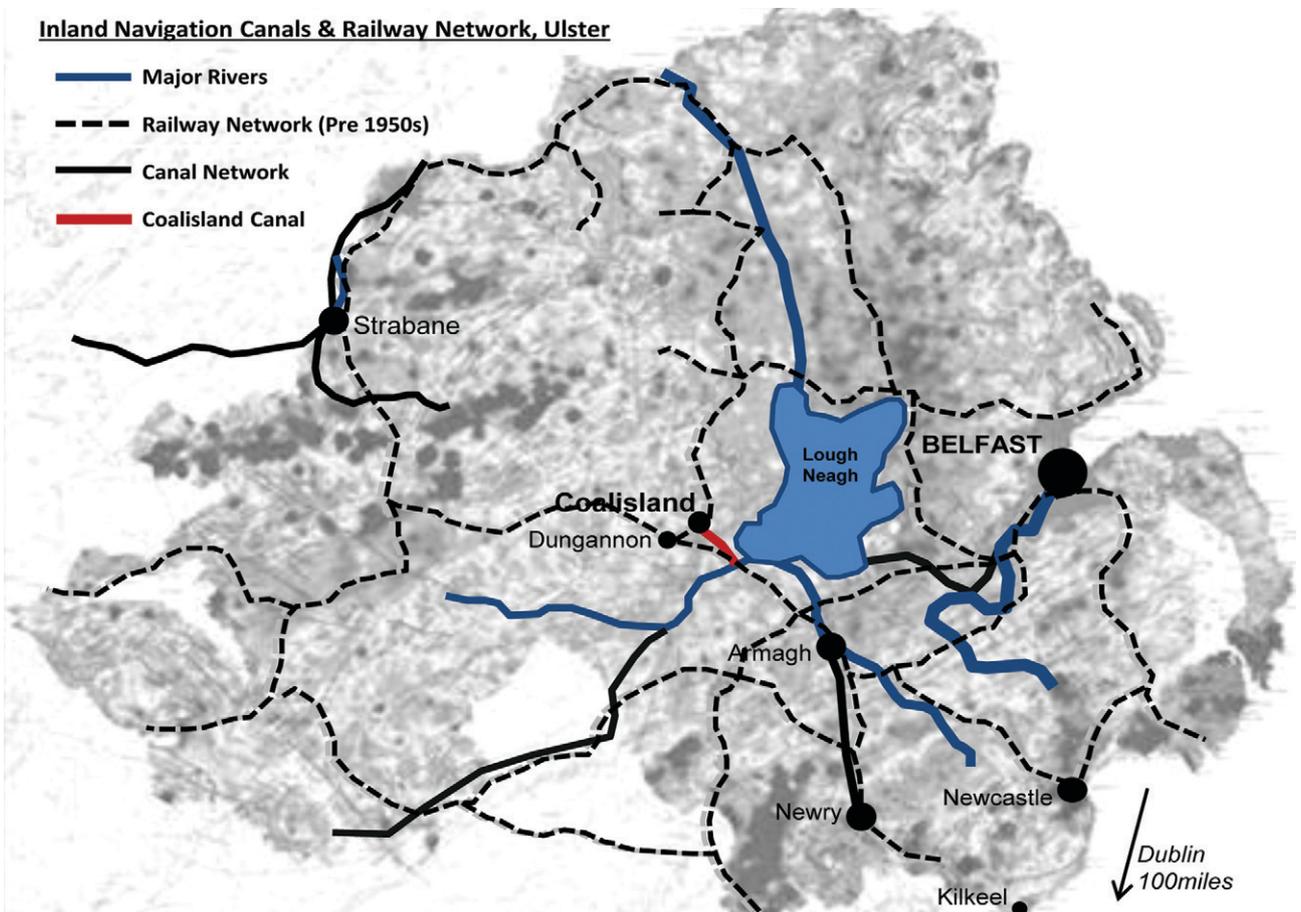
Population growth in Coalisland has resulted in additional flows via the combined network to Annagher PS. With stretched capacity, rainfall storm events and a significant infiltration problem have resulted in frequent spills to the Coalisland Canal and onto Washing Bay Road. These regular spills (and an operational opus mode to extract rags from flows) meant that housing to the boundary of Annagher PS and housing close to the Coalisland Canal became undesirable.

In future, the regeneration of Coalisland may look like the 'Vision for Coalisland 2030' and 'The Concept - Reconnecting Coalisland' with associated links to other towns and cities via the reopened waterways of the Coalisland Canal.



ABOVE: Annagher Pumping Station overview

BELOW: Inland Navigation Canals & Railway Network, Ulster, in the 1800s



Drainage catchment

Coalisland is the second largest settlement in the Dungannon and South Tyrone Borough, west of Lough Neagh, with a population of approximately 6,000. In addition, a number of neighbouring villages are served by local sewerage systems which ultimately pump to the main Coalisland network or gravitate directly to the WwTW. Annagher PS forwards approximately 75% of Coalisland district flows some 2km cross-country to Coalisland WwTW.

The Coalisland Canal dissects the sewerage catchment, requiring pumping stations to transfer flows from north of the catchment, under the canal and on to the WwTW. Similarly, to the west of the catchment, pumping stations are required to forward flows into the gravity network which terminates at Annagher PS.

The existing pumping station passes flows at a rate of 56l/s (less than 'Formula A') to the WwTW. The Coalisland Drainage Area Plan (DAP) undertook hydraulic modelling simulations of the catchment to determine the design criteria for the new PS. The optimum solution required a new PS to pump 142l/s with 670m³ emergency storage provision and associated ancillary sewer upgrades.

Project description

In order to reduce spills to the Canal and to protect the Coalisland catchment from flooding, the Annagher PS scheme involved:

- Replacement of the existing pumping station with a new wastewater pumping station incorporating 670m³ of emergency storage (in addition to dry weather flow capacity).
- Replacement of the existing pressurised transmission rising main (2km) to Coalisland WwTW, including pipeline crossings across the Coalisland Canal and River Torrent.
- Construction of 1km of gravity pipelines through challenging ground conditions.

- Decommissioning of three existing satellite pumping stations, with flows transferred to Annagher PS.
- Upgrade of associated ancillary pipelines to Annagher PS.

Need for the project

- Structural deficiencies were identified with the existing transmission pumping main, the existing superstructures and the existing concrete storm tanks exhibited frequent leakage and regular spills. The existing pumping station wet well was undersized and did not operate efficiently.
- The pumping station equipment was of a vintage nature and the inlet screen (which removed raw screenings) suffered from a number of mechanical failures. Annagher PS is located in a residential location with all stored screenings visible to nearby residents – odour from the screenings handling facility often resulted in complaints to NI Water. Associated necessary frequent repairs, limited pump pass forward flow capabilities and undersized rising main to the WwTW resulted in excessive volumes of unscreened flows being discharged from Annagher PS and also from upstream network overflows.
- The Washing Bay Road is a local school bus-route with collection and drop-off points at the pumping station. There have been numerous occasions where pollution has flowed from the site onto Washing Bay Road, causing significant customer disruption.
- Of potential national consequence were bursts of the existing rising main, occurring within one of the Coalisland sand-washing facilities from where supplies for NI Water's clean water treatment facilities were sourced.

Identified as one of NI Water's most problematic sites, the upgrade of Annagher PS involved the construction of a 15m diameter, 12m deep pumping station, 3km of pipelines and associated infrastructure decommissioning works on the outskirts of

Table 1: Key Drivers for the Replacement of Annagher PS

<i>Drivers</i>	<i>Description</i>	<i>Annagher PS Upgrade Benefits</i>
Environmental protection and Northern Ireland Environment Agency (NIEA) regulation.	Multiple spills into the Coalisland Canal and adjoining roads have caused significant customer disruption. NIEA stipulate that all wastewater pumping stations and combined sewer overflows (CSO) which do not pass forward a minimum of future Formula A and do not have facilities to screen overflows to receiving watercourses be upgraded to meet these minimum standards as stipulated in the Urban Waste Water Treatment Regulations (Northern Ireland) 2007.	Reduction of pollution to the Coalisland Canal and improved water quality. Protection and improvement of the surrounding environment. Ability for NI Water to meet the statutory regulations, thus minimising the risk of prosecution. Water quality improved and improvement to wildlife environment in and around the Coalisland Canal.
Emergency catchment storage	NIEA has advised of requisite emergency storage volumes to be provided prior to overflows.	
Catchment flooding	The DAP model identified areas of predicted 'out-of-sewer' flooding in addition to areas exhibiting historic flooding in the Coalisland catchment.	Reduction of 'out-of-sewer' flooding risk, benefitting local NI Water customers and contributing towards NI Water's strategic aims.
Operation and maintenance	The Coalisland sewerage network is currently operating inefficiently, with inadequate equipment, overloaded by incoming flows, and overworking necessitating excessive maintenance and repair of equipment in situations where the level of health and safety is not satisfactory. The rationalisation of assets includes: <ul style="list-style-type: none"> • Improvement of carbon footprint. • Reduction of current excessive operation and maintenance costs. • Improvement of the level of health and safety for NI Water operational personnel undertaking ongoing inspections and maintenance of assets. 	Reduction in operation and maintenance costs, and improved health and safety conditions for operational personnel.
Unsatisfactory Intermittent Discharge (UID) removal	Several local satellite pumping stations do not have adequate capacity to cope with flows during periods of high rainfall or in an emergency. UIDs occur when large quantities of untreated sewage are discharged to Coalisland Canal and other local watercourses.	Removal of 3 (No.) UIDs through the upgrade of catchment assets, closure of poorly performing assets and provision of screening facilities.

Coalisland. During 2012, NI Water, in conjunction with AECOM as regional project manager, secured funding to deliver the upgrade of the pumping station. A summary of key drivers for the project are outlined in Table 1 (see previous page).

Annagher Pumping Station

The project involved constructing a new wastewater pumping station with separate foul and emergency storage chambers.

Following a comprehensive review process with project stakeholders, including Northern Ireland Members of Local Assembly, Member of Parliament, local councillors, planning authorities, local residents and NI Water customers and network operations staff, it was agreed that the new pumping station should be constructed within the confines of the existing site in order to progress the upgrade with extant land availability.

To minimise the site footprint, the design team proposed the construction of a 15m diameter 12m deep circular shaft. This arrangement enabled the provision of 670m³ of online storage below the invert level of the overflow (set at a level in order to protect the lowest hydraulic level within the catchment), while minimising the land-take of the structure. The proposed hydraulic arrangements provided maximum flood protection to the upstream catchment, while also meeting the spill frequency and volume discharge consent requirements.

The new pumping station has been designed so that all incoming flows discharge to the foul wet well. During dry conditions, foul flows are retained in the foul wet well prior to transfer through a new 450mm diameter rising main to Coalisland WWTW.

The maximum capacity of the three foul pumps is 146l/s (duty/assist/standby). Three low-level lift pumps protect the low lying portions of the catchment and forward to the foul wet well at a rate of 25l/s (duty/assist/standby).

During wet weather, the storage capacity in the foul wet well is utilised prior to spill into the adjacent 'emergency storage' wet well via a 6mm bi-directional static screen. Should the level of the wet wells continue to rise, the pumping station overflows to the watercourse via a new gravity pipeline. Should the level of the wet wells abate, the foul effluent drains back to the foul wet well.

Satellite pumping stations decommissioning

In order to facilitate decommissioning of the pumping stations at Washing Bay Road and Campbells Garage and rationalisation of the existing pumping stations to Annagher PS, new pipelines were constructed along the Washing Bay Road.

All local connections were transferred to the new pipelines and some works to shorten the existing rising main length from Moor Gardens Pumping Station were undertaken, transferring this connection to Annagher Pumping Station by gravity and decommissioning a section of rising main.

Due to the low-lying hydraulic levels of the local satellite catchments, the rationalisation of flows to Annagher PS involved incorporation of a low level lift pumping station to transfer flows to the main inlet which receives flows by gravity from Coalisland. A unidirectional emergency overflow operates via a non-return valve and actuated penstock to protect the low-lying satellite catchments from flooding.

The proposed hydraulic arrangements provided maximum flood protection to upstream catchments yet still meet the spill frequency and volume discharge consent requirements from Annagher PS. The decommissioning works removed the UIDs from the two existing wastewater pumping stations to the historic Coalisland Canal.

Construction methodology

Difficult ground conditions, including significant zones of peat, sand, gravel and a high water table impacted the design and construction of the pumping station shafts and the various pipelines within the catchment.

The design methodology included caisson segmental shafts for the pumping station structure. The construction by caisson method was suited extremely well to the soft ground conditions which allowed the shaft to sink unhindered into the ground, with assistance of hydraulic rams. Retrieving knowledge of the ground conditions by conducting ground investigations was critical during the design process.

The shafts were sunk to a depth of 15m below ground level. At formation level the groundwater became increasingly difficult to control especially during the installation of the structural concrete



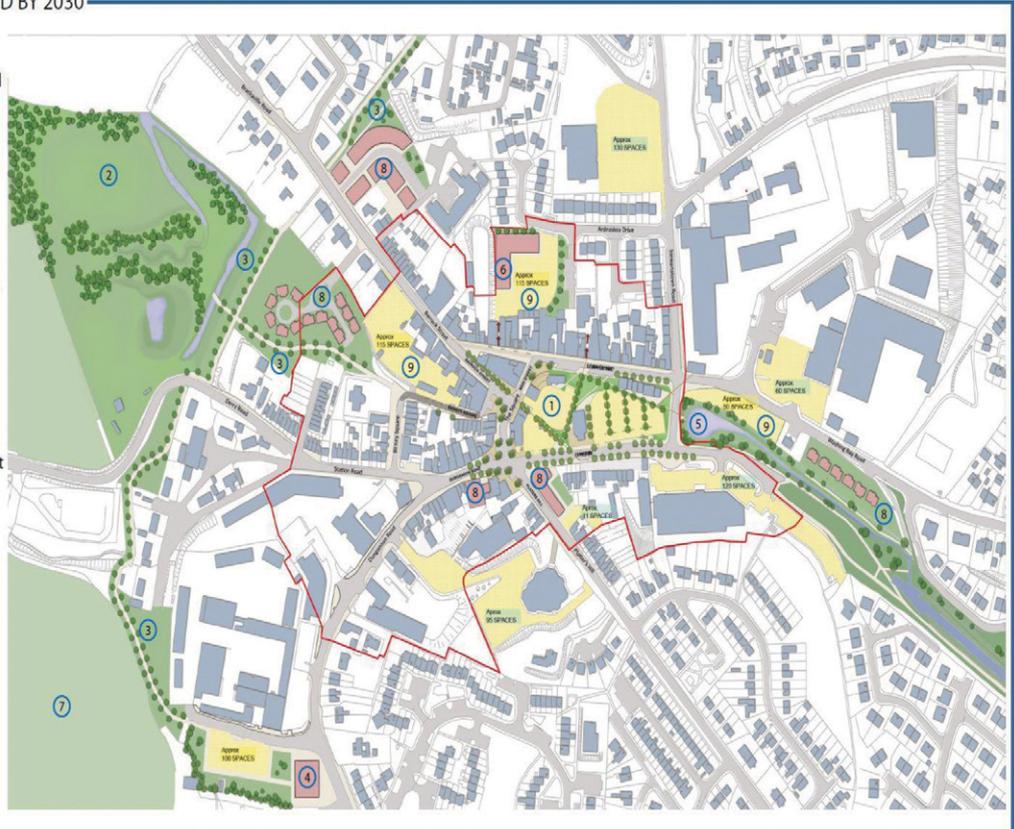
Construction of pipelines to Annagher PS. Trench 'well pointing' dewatering system - Courtesy of AECOM



Annagher PS during commissioning stages
Courtesy of AECOM

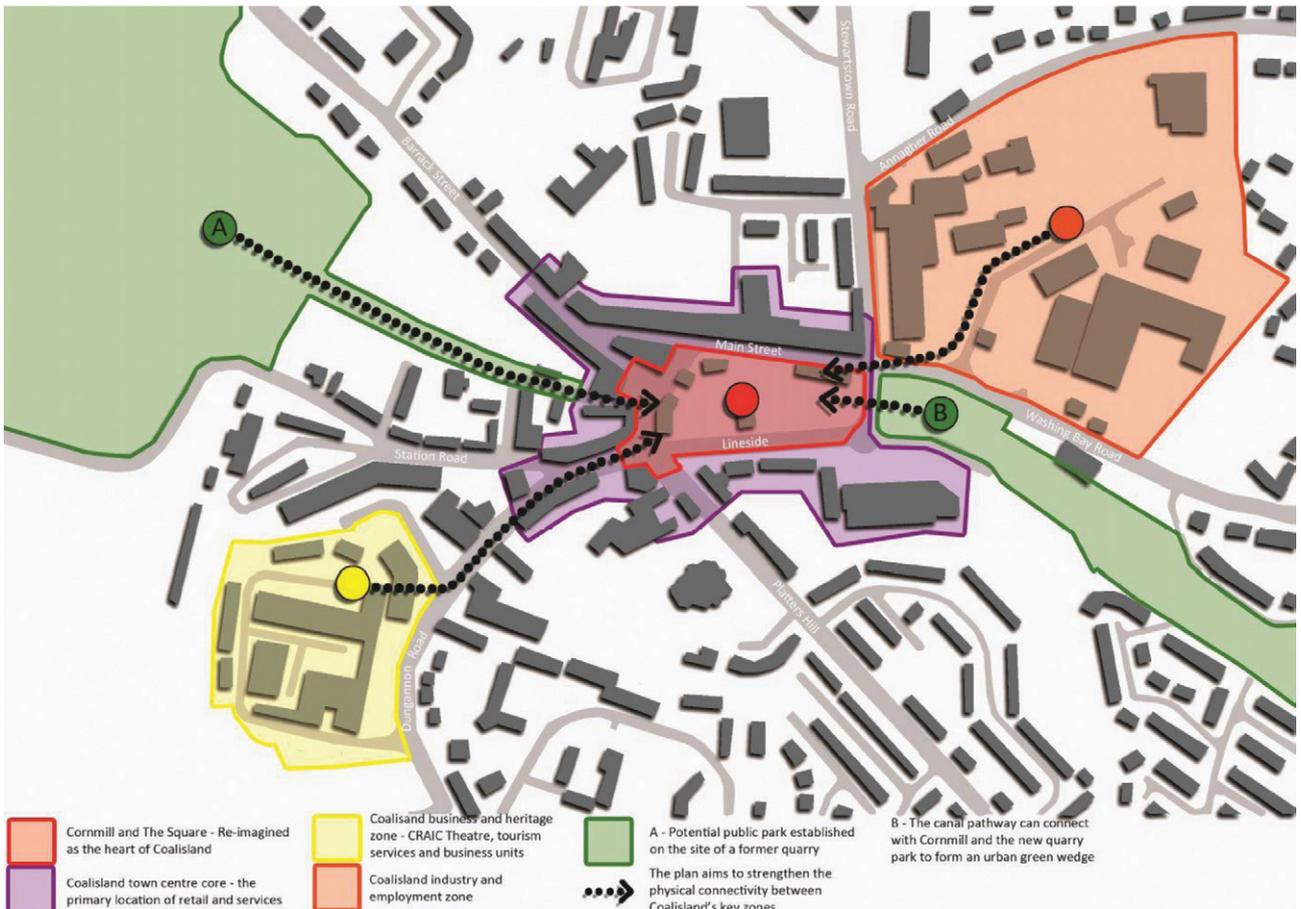
THE VISION FOR COALISLAND BY 2030

- ① Public realm enhancements to focus on the heart of Coalisland (Commill and The Square)
- ② Potential for future restoration of the former clay pits to provide a public park and with recreation and leisure space
- ③ New pedestrian linkages along former railway trackbed and connections to the town centre
- ④ Community hub location
- ⑤ Restoration of the former canal basin for navigation purposes and improvements to surrounding amenity space
- ⑥ Commercial/retail development with additional off street car parking. The development requires pedestrian linkages through the reinstatement of alleyways on the frontage of Main Street
- ⑦ Potential recreational and leisure development. Encourage connection with #2
- ⑧ Additional town centre living accommodation
- ⑨ Improved provision for off street car parking and pedestrian linkages to Main St.



ABOVE: The Vision for Coalisland 2030, Coalisland Town Centre Development Framework - Courtesy of AECOM

BELOW: The Concept – Reconnecting Coalisland, Coalisland Town Centre Development Framework - Courtesy of AECOM





View of jib crane, access covers to pumping station and kiosks
Courtesy of AECOM



Staged-lift pumping station internal
Courtesy of AECOM



MEICA installation and commissioning - Courtesy of AECOM



Annagher PS. View of jib crane, access covers to pumping station and kiosks. The Mills housing development in background
Courtesy of AECOM

base. In order to control the number of deep excavations required, the satellite catchments low-lift pumping station was incorporated within the main Annagher PS structure and compartmentalised accordingly.

All excavations for pipelines required significant dewatering and stabilisation, with pipeline excavations requiring support with trench boxes or sheet piles. In certain circumstances, well pointing was employed to lower the groundwater table.

In the well pointing method, well points are injected into the ground and connected to a pump via ring piping. Silent pumps were utilised in all locations due to the proximity of local residential properties.

Alternative low-dig construction techniques included horizontal directional drilling, guided-auger boring and open-cut trenching excavations. The Coalisland Canal crossing was undertaken using horizontal directional drilling to minimise the impact on the banks and base of the historic canal. The crossing passed 1.5m under the base of the canal and was carefully planned to avoid entry and exit pits close to or on the existing canal towpath. The crossing of the River Torrent was also undertaken using horizontal directional drilling techniques.

With significant dewatering in close proximity to existing dwellings, stakeholder engagement enabled the work programme to be communicated effectively and any effects of the works to be mitigated.

Procurement strategy

Following a period of early contractor engagement, concept civil designs for the wastewater pumping station and pipelines were undertaken in parallel with ground investigation and contractor preparation of initial cost estimates for NI Water gateway approvals.

On confirmation of funding, the main construction contract was let under an NEC3 ECC Option A, Priced Contract with Activity Schedule in order to demonstrate value for money. The project was tendered amongst a select list of design build contractors appointed under NI Water's Integrated Wastewater Framework.

AECOM provided wastewater pumping station outline design, NEC project management, site supervision and stakeholder engagement services for the project. The construction contract was awarded to BSG Civil Engineering in November 2012 and work commenced on site May 2013.

Successful completion

Annagher PS was completed to time and budget in November 2014. Following transfer of flows and completion of the requisite testing and commissioning, the old works was decommissioned, demolished, reinstated and landscaped.

Throughout feasibility, design and construction there has been extensive collaboration and innovation between NI Water, AECOM, CH2M, BSG Civil Engineering, Williams Industrial Services (WIS), PHACE Contracts, the construction supply chain and project stakeholders.

Annagher Pumping Station represents an investment that protects a rich engineering heritage in Coalisland, safeguards the water quality in the Coalisland canal and plays its part in empowering the implementation of the vision for Coalisland for future generations.

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