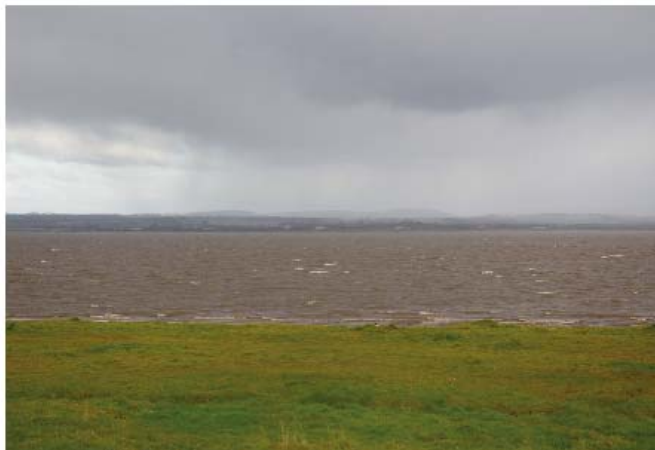


Bowness on Solway Cluster

constructing a new WwT scheme in a highly sensitive AONB requires environmental vigilance

by
Peter M Taylor, MICE and David Barker I.Eng, ACIWEM

The purpose of this United Utilities project was to comply with the new discharge consents for the short sea outfall at Drumburgh, Port Carlisle and Bowness-on-Solway, and for the minor water course discharge at Glasson. The site was located on the Solway Firth approximately 20km to the north west of Carlisle extending from Bowness to Drumburgh. The nearby villages of Port Carlisle and Glasson were also affected by the pipelaying operations and increased construction traffic. This highly sensitive £10.8m project was delivered by a partnership between United Utilities, MWH and KMI+.



Views across the Solway Firth and saltmarshes

Courtesy of KMI+

The works were bounded to the south by the B5307 coastal road and to the north by marshland adjacent to the Solway Firth, with much of the area classified as a SSSI. The sites comprised relatively flat grassed areas which were subject to periodic tidal flooding occasionally covering the coastal road. The inferred line of Hadrian's Wall crosses close to the site area (making the area a World Heritage Site). The Area is also a designated AONB (Area of Outstanding Natural Beauty).

Principal Elements of Scheme

The Scheme consists of the provision of a new wastewater treatment works (WwTW) at Glasson to treat the combined flows from four villages and discharge the treated effluent to the existing Glasson outfall. New pumping stations located at Bowness on Solway, Port Carlisle and Drumburgh will transfer the untreated flows from the villages via new rising mains to the new Glasson WwTW. At Glasson the existing outfall pumping station was removed but the existing outfall was retained for emergency storm overflows.

Design Requirements

During the early stages of design it became clear that the preferred option was to treat flows at a single central Wastewater Treatment Works (WwTW) to be located on a new green field site.

The continuous discharges from the Bowness on Solway, Port Carlisle, Glasson and Drumburgh outfalls were to comply a 60:40 consent (40 mg/l BOD and 60 mg/l suspended solids). The Environment Agency (EA) originally identified an indicative standard of 500 mg/l suspended solids for all four discharges to meet the requirements of the urban waste water directive. Subsequent modelling of the existing Bowness on Solway and Port Carlisle outfalls confirmed that the EA dispersion and dilution criteria could not be met without extending the outfalls. Extension of the outfalls would be costly and difficult due to the numerous environmental designations and the shifting nature of the estuary channel, which could result in the outfalls silting up.



Bowness

Courtesy of KMI+

The EA reassessed their requirements and amended the consent to a minimum of secondary treatment at all four sites.

Environmental Constraints

At this point the true enormity of the environmental constraints for the internationally recognised habitat area of the Solway Firth quickly became apparent. All aspects of the design would be challenged by these constraints.

The Upper Solway's flats and marshes are a Ramsar site and seals, dolphins and porpoises have been sighted offshore. Glasson Moss National Nature Reserve is part of the largest undamaged area of lowland raised mire in Britain.

The falling tides along the Solway Coast expose wide sand stretches, intertidal mud-flats and, higher upstream, saltmarsh and peat moss providing rich feeding grounds for a variety of wildlife. The saltmarsh is a coastal grassland habitat that has evolved and is now able to survive in salty conditions and would be virtually impossible to reinstate if excavated.

The Solway estuary provides an overwintering ground for huge numbers of wildfowl and in recent years it has become apparent that the Solway is a major migration route for seabirds.

Construction work on the Solway estuary area (Rising Main from Bowness to Port Carlisle and Port Carlisle Pump Station) must not impact on the winter bird migrations and hence could only be undertaken from May to September.

The route of Hadrian's Wall and its associated Vallum (ditch) runs all along the Solway Coast area with the route not defined, being mainly a suggested alignment only. All sites and pipeline routes had to be designed to avoid these suggested/actual locations if possible and, where unavoidable, extensively investigated with English Heritage.



Drumborough & Glasson (L) and Port Carlisle (R)

Solution Design

The design was undertaken by United Utilities and MWH, then detailed design and construction by KMI+ (a Kier, Murphy, Interserve Joint Venture) working in partnership with United Utilities.

The site for the WwTW, with a design flow to full treatment of 15 litres p/sec, had to be identified; initially an inland site near to Glasson was considered, discharging into a minor river. The dilution effect was minimal and would have required an enhanced treatment standard. The watercourse would have had to be enlarged to the Solway across the salt-marsh and all flows would need pumping to this site. The environmental damage to the saltmarsh made this inland WwTW unacceptable.

The WwTW site finally identified was on agricultural land adjacent to the saltmarsh near to Glasson and was located centrally within the project. The outfall pipeline from this WwTW site posed a key environmental problem as it had to cross the saltmarsh to reach the Solway.

The pumping station locations at Drumburgh and Port Carlisle were defined by the existing sewer infrastructure with the Glasson flows gravitating to the proposed WwTW. Due to visual and environmental problems the Solway pumping station had to be positioned some 120 metres along the coast on agricultural land. This required a gravity interceptor sewer and storm overflow constructed along the beach area passing flows to a 5 metre deep pumping shaft.

The Port Carlisle pumping station was on the headland and, for visual reasons, had to be entirely below ground. The control kiosk building and substation were hence sited some 80 metres remote from the pump shaft on the edge of a recreation ground.

Due to the severe environmental constraints, some elements of the scheme could not proceed. A booster pumping station part way from Bowness on Solway was deleted and it was not possible to site storm storage tanks at any of the locations.

The raising main pipeline route from Bowness-on-Solway to Glasson WwTW was mainly located in the B5307 coast road which is subject to flooding. Tidal flooding of the entire estuarial area occurs, under severe high tides, and the sewerage system needs to continue to function at all times.

KMI+ Construction

To preserve the surrounding environment, 2,700 metres of pipeline had to be laid in the highway between Bowness-on-Solway and Glasson. A road closure and diversion was necessary but it was decided that the short term inconvenience was acceptable to avoid any environmental impact to the saltmarsh and surrounding area. The pipeline route still involved four crossings of Hadrian's Wall and each location had to be hand dug with English Heritage supervision to identify the exact route.



photo supplied by KMI+



Pipeline under construction

Courtesy of KMI+

The scope specified an open cut technique with a replacement pipeline backfill of foamed concrete between Port Carlisle and Glasson (approx 1,300m). This required the removal of approx 3,500 tonnes of excavated material to landfill.

KMI+ considered ways to reduce the amount of traffic to take excavated material to landfill and investigated the viability of remediating the spoil to comply with current guidelines for use as backfilling in highways instead of foam concrete.

A Cost Benefit Analysis was undertaken to investigate the viability of recovering the spoil to make it acceptable for use as backfill in line with current guidelines. The project team employed a consultant to take samples of the existing material within the roadway and carry out laboratory testing to ascertain if it could be re-used for backfill. The results were very positive and it was deemed that the soils could be re-engineered to an acceptable consistency for roadway construction by adding 3% lime and 3% cement to the existing as - dug material. In addition the highways department had expressed some concern at the use of foam concrete in the highway, in particular on the stretches of road subject to tidal flooding. A no-fines, lightweight concrete was chosen for its porous qualities to allow the seawater to drain back through.

Approvals for the changes to the scope were sought and granted from both the Roads Authority and the Senior Project Manager and ongoing plate bearing testing were undertaken as the pipeline progressed to ensure its integrity.

The ensuing environmental and financial benefits were:

- 175 lorry trips to landfill site were avoided;

- The landfill site was 18 miles away, so 6,300 miles of road journeys were saved;
- 3,500 tonnes of quarried material were not required;
- 291 concrete truck visits to site were unnecessary, saving 5,800 miles of road journeys;
- Savings of nearly £108,000 in transport and landfill costs were achieved.

An additional 3,400 tonnes of spoil was destined for landfill but KMI+ looked for alternative disposal options. The local site team found that a farmer had permission to build a yard adjacent to his farm buildings. This required approximately 7,000 tonnes of fill material to merge with existing ground levels.

Consequently, a paragraph 19 Waste Exemption was applied for and permission was granted by the EA allowing the import of inert soils for the construction of the yard. This allowed KMI to transport as-dug materials from the locations of the new treatment works, pump stations and pipeline to this site. The ensuing benefits were 350 lorry trips to landfill were avoided, 12,600 miles of road journeys were saved (the landfill site being 18 miles away), and savings of £30,000 were achieved.

Saltmarsh

All the work on the Saltmarsh / Mud flats had to be undertaken between April and September so as not to disturb the overwintering birds on the salt-marsh. These works consisted of:

- storm overflow/outfall pipeline from the WwTW;
- repairs to the outfall pipeline structures at Port Carlisle and Solway;
- the pumping station at Port Carlisle;
- interceptor pipelines at Bowness on Solway.



Work in progress

Courtesy of KMI+

To progress the work through the SSSI protected saltmarsh around 250 individual one metre-square sections of this unique landscape needed to be temporarily moved while the pipe laying took place. Each metre-square section was meticulously documented and labelled so that it could be replaced in the exact spot from where it was removed. A special digger bucket had to be manufactured to precise requirements and the wooden boxes, used to house the turf temporarily, specially made. The boxes and their precious contents then had to be tended on a daily basis between May and August to make sure it thrived. The turf had to be back in place by September for the start of the bird migration season.

Work on the outfall pipe sections across the saltmarsh / mud flats required ground protection mats to be laid on top of geotextile to allow the machines (using biodegradable oil) to travel on the salt marsh. Turves in these areas were lifted and placed on plywood sheeting adjacent to the excavation for immediate replacement back in their original position as soon as pipe laying and backfilling was complete. Since the mats were only allowed to remain in one place for five consecutive days and the replaced saltmarsh had to be given five days to recover, this painstaking procedure was repeated over two months until all the outfall pipe work was completed.

The final piece of environmental vigilance came in the form of the use of an Eco generator using bio-fuel while over-pumping at Port Carlisle Pumping Station. This ensured that if a spillage did occur into the watercourse there would be no significant damage to the unique habitat.



Saltmarsh turf storage

photo supplied by KMI+

An innovative and collaborative approach by the partners involved made sure that the project was delivered successfully within such tight environmental constraints.

Note: The Editor and Publishers wish to thank Peter M Taylor, Lead Civil Engineer with MWH, and David Barker, KMI+ Site Manager, for preparing the above article for publication. ■