

Carron Valley A Drinking Water Quality Project

improving water quality in central Scotland

by Martin McLvaney MICE MIWO CEnv

Carron Valley A Regulatory Supply Zone (RSZ) forms part of the Carron Valley Water Operational Area and covers an area of central Scotland including Falkirk, Larbert and Polmont. The water is sourced from Carron Valley Impounding Reservoir and is treated at Carron Valley WTW. The RSZ serves a population of 94,481 and 43,174 properties and contains 500.50km of water mains. The RSZ is divided into five Water Supply Zones (WSZ), namely Little Denny, Woodend, Parkhead, Millhall and Glenhead WSZs. There have historically been issues with Iron and Manganese at the WTW and distribution network.



PU lining in progress - Courtesy of Scottish Water

Background to the project

The Ministerial Objectives of the Scottish Government stated that Scottish Water is to "reduce the number of discoloration incidents and customer complaints by undertaking a prioritised programme of water mains rehabilitation, to be agreed with the Drinking Water Quality Regulator (DWQR), which will minimise the risk of Water Quality being degraded by the condition of the distribution system".

For the Investment Period 2006-2010 (SR06), Scottish Water had produced a programme rules document; *DW5 Water Quality Investigations Methodology*. The principles of the document have been agreed with the DWQR and set out the rules for undertaking the investigation, agreed trigger levels for intervention, selection of the intervention method and post project sampling requirements.

Carron Valley A RSZ was included in the list of 115 regulatory supply zones promoted by the DWQR for possible inclusion in the SR10 Investment Programme (2010-2015). This list of zones required investigation to be undertaken by Scottish Water to prove the existence of Water Quality problems.

This zone had been promoted for investigation as a result of:

- Prescribed concentration value (PCV) and/or threshold limit value (TLV) for iron, manganese or turbidity has been exceeded.
- Greater than 200 water quality related customer contacts.
- Greater than 100 water quality related customer contacts per 10,000 properties.

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Example of corroded 9" cast iron water main - Courtesy of Scottish Water

Scope of investigation

Jacobs Engineering UK Ltd, Belfast, were engaged by Scottish Water in 2007, through their design framework, to undertake the initial investigation into this regulatory supply zone. The objectives of the investigation were:

- To determine the extent and cause of iron and manganese water quality problems that have resulted in PCV exceedances in supply.
- To develop costs for implementing solutions to improve the performance of the mains, in order to minimise the risk of water quality being degraded by these assets.

Investigation of Scottish Water's records showed the network to comprise of:

	Length of mains (km)	% of total mains length
Total	500.50	100%
Unlined Ferrous	340.93	68%
Lined Cast	0.00	0%
Lined Ductile	1.78	<0.1%
HPPE/HDPE	39.99	8%
MDPE	16.24	3%
PVC/uPVC	17.51	3%
Asbestos Cement	39.65	8%
Other	44.39	9%



PU lining rig: Station Road, Falkirk - Courtesy of Scottish Water

Sampling

Analysis of Scottish Water's historical data confirmed the threshold levels at the time of investigation as follows:

	TLV	PCV
Aluminium (ugAl/l)	100	200
Iron (ugFe/l)	100	200
Manganese (ugMn/l)	20	50
Turbidity (NTU)	1	4



Rackfeed borer - Courtesy of Scottish Water

Water quality sampling was planned at WSZ level with water being analysed for aluminium, iron, manganese and turbidity.

The steady state water quality sampling programme for Carron Valley A RSZ was completed in July 2008 and a total of 513 Steady State samples were taken. (Steady state samples are normally taken from customer's taps when the network is calm). The results of this sampling revealed a total of 9 PCV failures for Iron, 4 PCV failures for manganese and 1 PCV failure for turbidity.



Inserting cleaning flail - Courtesy of Scottish Water

Non-steady state sampling was conducted during October 2008 with a total number of 287 samples taken. (Non-steady state samples are normally taken from hydrants and the network is disturbed). The non-steady state samples revealed 223 failures for either iron or manganese i.e. 78% of samples exceeding the PCV. This result suggested the presence of deposits within the water mains which do not cause water quality problems under normal operating conditions, but may cause problems when flows are disturbed by burst or operational activities in the network.

As part of the investigation non-destructive testing (NDT) of water mains has been undertaken within areas where interventions were proposed due to poor water quality. A total of 40 NDTs were taken within the Carron Valley A RSZ with the objective of:

- Confirming pipe size, material and location.
- To identify the structural condition of the main.

For interventions where an NDT has not been taken the rehabilitation technique has been determined by analysis of NDTs taken on similar mains in adjacent areas and from Scottish Water records.

Investigation conclusions

There have historically been some issues with iron and manganese at the water treatment works. Between 2005 and 2007 the following exceedances have been recorded:

Water Treatment Works	Iron	Manganese
Number of TLV Exceedances	1	1
Number of PCV Exceedances	1	2
Distribution System	Iron	Manganese
Number of TLV Exceedances	6	7
Number of PCV Exceedances	-	2

Results of the investigation sampling programme indicated significant numbers of iron and manganese exceedances in various locations throughout the RSZ, both under steady state and non-steady state sampling conditions. Although exceedances have been recorded in the final water from the WTW from 2005 to 2007, the absence of exceedances during 2008 indicates that the WTW is not currently at fault and any build up is no longer occurring. The widespread nature of the exceedances in the distribution network is reflected by customer perception of water quality, with in excess of 13% of those questioned reporting issues in the previous 12 months.

Additionally there is some localised pick of iron from the unlined ferrous mains.

Water quality interventions

In summary, the output of the investigation stage was a recommendation to rehabilitate 84.94km of mains. The rehabilitation techniques agreed with the DWQR in the agreed methodology document were as follows:

- Unlined Ferrous Main: Replace or Surface Coat depending on structural condition
- Preferred Material Main: Clean by flushing or swabbing depending on pipe size.

The rehabilitation techniques recommended comprised of flushing (20.15km) surface coating, 1mm thick spray resin lining applied in-situ (53.16km) pipe replacement (2.13km) and swabbing (9.50km).

Interventions were proposed in the following 15 District Metered Areas (DMAs):

DMA		DMA	
Wallacestone	4,373m	Callendar Park	1,507m
Carronshore	4,542m	Falkirk Westquarter	3,474m
Stenhousemuir	848m	Falkirk Bainsford	7,819m
Camelon	13,014m	Langlees	1,291m
Falkirk Rosebank	8,538m	Falkirk Grahamston	1,345m
Grangemouth Newhouse	2,377m	Falkirk Middlefield	16,922m
Falkirk Windsor Rd	306m	Laurieston	5,182m
Woodlands	13,424m		

Jacobs produced a layout plan drawings detailing the location and lengths of each intervention and construction schedules giving a detailed breakdown of pipe lengths, fittings, pits, surface type etc. for each DMA.



PU lining spin up prior to lining - Courtesy of Scottish Water



Rackfeed Borer - Courtesy of Scottish Water



PU lining spray head - Courtesy of Scottish Water



9" cast iron main after lining - Courtesy of Scottish Water

The construction schedules allowed Scottish Water estimators to produce an initial estimate to complete the project of £4,060,590. The estimate was used by the Scottish Water project team to gain approval at the Capex 2 Governance Gateway.

This approval allowed the project team to engage a construction delivery partner.

Final design and construction phase

Farrans Construction has been engaged as construction delivery partner following their successful tender for Water Infrastructure programme in the Forth & Clyde and Nith & Tay areas of Scotland.

Farrans currently has an agreement in place with Jacobs (Belfast) to provide their water infrastructure design services. This brought an additional benefit of having the same design staff working on the project during the final design and construction phase.

Prior to achieving Capex 3 gateway (i.e. the approval to award the contract), Scottish Water Engineering conducted a detailed review of the project and value challenge. The main highlights of this review and value challenge was the removal of duplication in the construction schedules. For example, the original schedules priced for separate pits for access and for fittings such as valves.

During the review the schedules were amended to specify one pit for access and fittings where appropriate. Another highlight of the value challenge was the improvement in accuracy of specifying the road type. In a lot of instances the previous schedules specified a more expensive road surface type. This value challenge and review contributed to a reduction in estimated project value of £475,598 to a revised project total of £3,585,000.

This value formed the basis of the successful Capex 3 Gateway approval and subsequent formal contract award to Farrans

Construction, who commenced construction on 20 August 2012 in the Falkirk Westquarter DMA. Details of the undertakings includes the following:

- The mains are being cleaned by drag scraping and rackfeed boring. Labour and plant on site currently consists of two PU lining rig squads and one rehabilitation squad.
- The PU lining material being used on this project is Scotchkote 169LV supplied by 3M.
- The lining rigs and the individuals in the lining squads have been certified by WRC-NSF.
- All lining work is being undertaken in accordance with WIS4-02-01: *Operational requirements: In-situ resin lining of water mains.*

Status

Current progress shows approximately 27km of water mains in 10 DMAs have been lined. This, combined with the uncovering of 8,354m of unknown preferred material, equates to approximately 65% of the project completed as of 31 July 2013.

Opportunities encountered have been the aforementioned 8,354m of main that has been found to be preferred material due to Scottish Water records being incorrect. This allows the rehabilitation technique to be down scoped to cleaning i.e. flushing.

Threats encountered have been mainly difficulties in isolating sections of the network due to the same errors in the Scottish Water records.

The project is scheduled to be completed on 4 November 2013.

The Editor & Publishers would like to thank Martin McLvaney, Senior Project Manager with Scottish Water, for providing the above article for publication.



Rackfeed borer cleaning flail entering main - Courtesy of Scottish Water