

Date: **1996 - 2000**

Location: **Northwich**



Automating the sluice gates of the River Weaver is just one example of a number of projects that Fairfield Control Systems Ltd have undertaken on behalf of British Waterways and the Environment Agency.

The River Weaver is just over 50 miles long and was originally a shallow tidal stream, mainly used to carry salt away from the Cheshire salt towns. In the 1700's, the expansion of the salt industry gave rise to the increase in demand for the navigation rights of the river. Locks made of timber and sluice gates were introduced and this allowed vessels to navigate, although only at certain tides. The export of salt and import of coal via the new navigation gave the local economy a major boost.

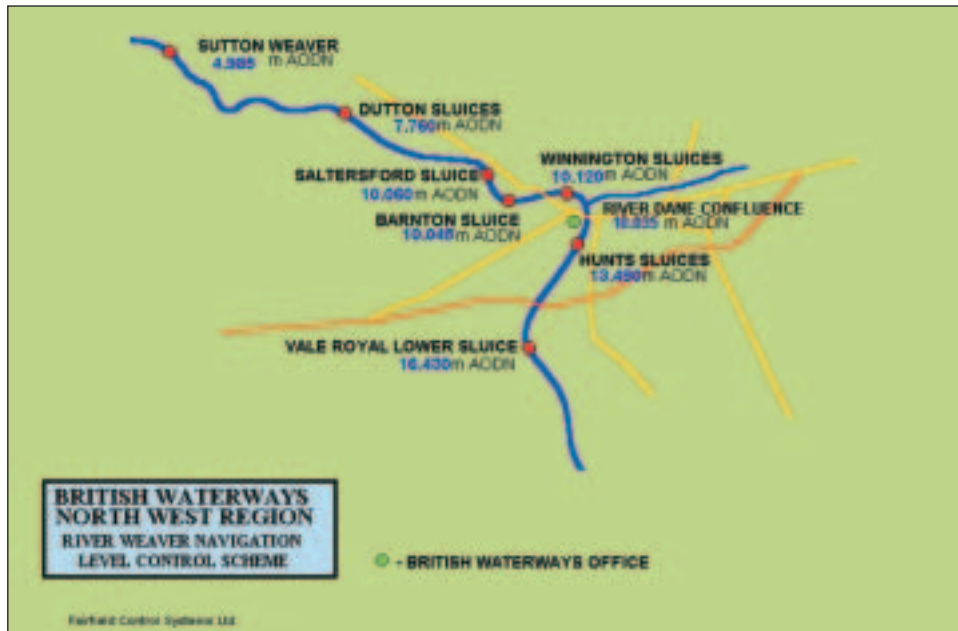
The construction of the Trent and Mersey Canal was driven by the needs of the Staffordshire pottery industry for raw materials and a route to market for the finished goods. When the Trent and Mersey canal was planned in 1765, it was to pass alongside the river but a little way above it. The outcome of this was an increase in traffic along the river, vessels could now enter and leave the river at any state of tide. For information on the connection between the River Weaver and Trent and Mersey see the Anderton Boatlift case study.



In the 1990's the 21 Sluice Gates were refurbished which included electric actuators used to raise and lower the sluice gates. The river level had traditionally been maintained by sluice operators visiting each of the 7 sites and manually setting the sluice gate position. A major part of the scheme was to automate the river level regulation by automatically adjusting the sluice gate positions. The design uses a combination of local feedback control with feed forward control being used from the higher river reaches. Reliability of operation is paramount; the instrumentation performs self checking and voting to exclude failed sensors; the sophisticated PLC software is backed up with simple hardwired circuits and manual overrides.

The level control system keeps the River Weaver Navigable while also performing flood control for the town of Northwich.

Typical of any river level control and flood abatement system, is the need to take measurements and effect co-ordinated control actions over a wide area.



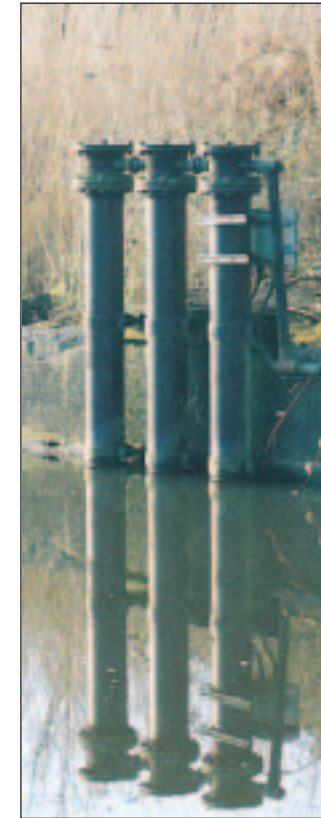
The map shows the geographical area covered by the River Weaver Level Control Scheme. From Vale Royal Lower Sluice to Sutton Weaver is approximately 18 miles, and the hub of the communications network is at the British Waterways offices in Northwich.

On the River Weaver, Fairfield used private wire circuits for communication between the central station and the remote outstation. Alternatives used on similar projects on the River Trent, include radio and dial up PSTN Circuits.

Fairfield developed the unique 'VoiceCall' software for this particular project. Accessing VoiceCall through the appropriate security rights enables British Waterways staff to monitor and interrogate the scheme without having to attend the main offices. Significant alarms and events are reported via spoken messages and text to the operations staff via fixed or mobile telephone equipment. The VoiceCall software also provides facilities for scheduling callout rosters and providing back up contacts should the primary contact fail to respond to the telephone call.

The strength and flexibility of the scheme is made possible by the use of standard Allen Bradley PLC equipment at the outstation for local control and communication via the DH485 protocol using a BT EPS42 network and hub.

Each outstation is located, either at a sluice gate or at a level monitoring site. The water level is controlled by commanding the sluice gates to open or close. The decision to open or close is made by the PLC or backup hardwired circuit in response to the measurements received from three discrete level measuring systems.



Probes and Transducers

To achieve this sophisticated control three level measuring systems are used comprising one set of seven contact probes and two ultrasonic transducers.

River Weaver levels and control conditions monitored are:

- High high water alarm
- High water alarm
- Sluice gate fast open
- Sluice gate normal open
- Sluice gate normal close
- Sluice gate fast close
- Low water alarm

Each measuring device is cross checked with the others and any discrepancy alarmed. In addition a two out of three voting system is used to exclude faulty signals from the control action. In normal operation the PLC logic schedules which of the gates is to open and whether the gates at a remote site should be opened. It also performs signal validation and generates the appropriate alarm flags for reporting via the central station or VoiceCall.

Should the communications with the control station or other outstations be lost the PLC will revert to local control from its own level probes, without reference to any other outstation site. A hardwired watchdog system monitors the PLC and should the PLC fail the sluice gate control is switched to a hardwired logic scheme. Local level signals are then used to control the opening and closing of the sluice gates.

Local manual controls are available on the front of the panel, giving level and gate status information. Control switches are provided to allow manual operation of the gates.



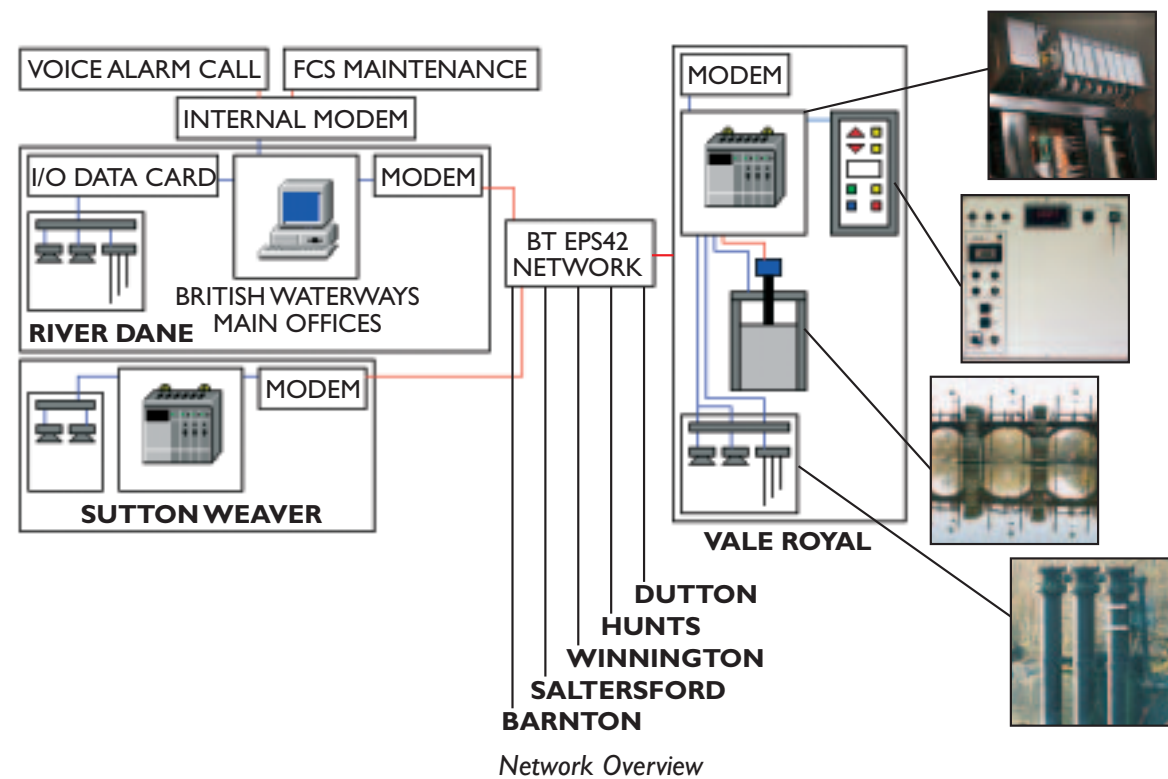
Sluice Gate Actuators





The scheme is designed to be of the highest integrity with fall back control strategies in place to ensure river level regulation continues, whilst failures are immediately reported via the VoiceCall system.

PLC hardware is used because it provides a very high level of fault diagnostics, for hardware, software and communications failures, provides very flexible and versatile logic instructions and has a long and proven track record in industry.



Fairfield Control Systems

The Old Rectory
Main Street
Kirton
Newark
Nottinghamshire
NG22 9LP
Tel: +44(0) 1623 835350
Fax: +44(0) 1623 835375
Email: sales@fairfields.co.uk
www.fairfields.co.uk

