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Part 16: Design Elements VII: Water Supply

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16 Design Elements VII: Water Supply

16.1 Introduction

16.1.1 The supply of water to the Chesterfield Canal was the subject of a Water Resources Study commissioned from British Waterways (2002) (see Volume Two: Supporting Reports). The report examined the water supply along the entire Chesterfield to Kiveton Park length.

16.1.2 The Chesterfield Canal between Killamarsh to Kiveton Park straddles the watershed between the hydrological catchments of the River Rother and the River Ryton and its tributaries. The Water Resources Study concluded that sufficient water did exist within both hydrological catchments to permit the filling and maintenance of the proposed restoration. The hydrology of the area is described in more detail in Part Six, above.

16.1.3 The Killamarsh Town, Killamarsh East and Norwood lengths lie entirely within the Rother catchment. The watershed is along the crest of the coal measure escarpment which in this area is occupied by the line of the M1 motorway. The Wales length to the west of the M1 Motorway lies in the Rother catchment – the Wales length to the east in the Ryton catchment. The Kiveton Park section, and the restored canal to the east, is within the Ryton catchment.

16.1.4 The Environment Agency requires the separation of catchment waters wherever practicable. To that end the water supply to the Killamarsh to Kiveton Park length is to be sub-divided into two: That to the west (Rother Catchment) of the M1 Motorway and that to the east (Ryton Catchment).

16.2 Water Supply West of the M1 (Rother Catchment)

16.2.1 Water for the Killamarsh Town Section will reach it via the restored canal from Chesterfield (see *Next Navigation West*). Ultimately this water will have been extracted from the River Rother at St.Helena's Floodgate in Chesterfield.

16.2.2 The Water Resources Study (2002) examined the water quality and ecology of the River Rother and proposed an upper limit on extraction at St.Helena's Floodgate of 5 MLD to reduce possible adverse effects on water quality in the river. On the basis of current predictions of the numbers of boat movements (and hence the number of lock operations and volume of water used) following through reconnection (i.e. after the Killamarsh to Kiveton Park link is completed) it is proposed to take no more than 2 MLD. This provides a reasonable margin for special events or unexpected activity.

16.2.3 The capacity of the River Rother to supply the Killamarsh Town Section will be augmented and buffered by the provision of additional reservoir capacity on the Chesterfield to Staveley length. Such capacity will be added by the provision of new (non-navigable) wetlands on the former Staveley Iron and Chemical works site between Hollingwood and Mill Green. These wetlands are integral to the emerging Chesterfield Borough Council masterplan for the site (CBC 2009). Additional

reservoirs will ensure continuity of flow and, under current climate change models, limit navigation failure to less than one year in every ten.

16.2.4 Other water inflows to the Killamarsh Town length will be negligible and come from field & storm drains. The majority of these inflows are ephemeral and situated on the off-bank. The potential chemical and sediment impact of these inflows will be reduced by the presence of reed beds and reed shelves on the off-banks which will act as bio-filters.

16.2.5 All water abstracted from the River Rother which is not lost to either bed leakage or evapotranspiration is ultimately returned to the river via Nethermoor Lake.

16.2.6 Water for the Killamarsh East and Norwood Sections will be supplied from the reinstatement of the Killamarsh and Woodall Ponds and the feeder leat which brought water from both reservoirs and the County Dike to the head of the Norwood Flight (see below, section 10.15).

16.2.7 When the canal opened in 1777 the Norwood Flight was fed by water from the summit pound of the canal. The summit pound was fed by the Broad Bridge Dike which brought water from the Harthill and Pebbly Reservoirs to the south west of Harthill village.

16.2.8 The supply from Harthill proved insufficient to feed both the Norwood Flight and the long sequence of locks down to Turnerwood Feeder Lock (No.38) where the Brancliffe Feeder enters the canal. In consequence in march 1785 plans for new reservoirs at Norwood were approved by Managing Committee of the Proprietors of the Chesterfield Canal Navigation. The two reservoirs at Killamarsh Pond and Woodall Pond were completed in 1786.

16.2.9 Both ponds Woodall and Killamarsh Ponds occupy shallow valleys and are impounded by earth cored dams. In both cases since abandonment of the Norwood flight the reservoir levels have been lowered (and the spill way modified) from their original operational capacity.

16.2.10 The Killamarsh Pond reservoir has been lowered little, is in good condition and is maintained as a fishing pond. The Woodall reservoir dam wall has been severely slighted and the level is very low. The current owner is seeking to partially re-establish the dam and raise the water levels to create an additional fishing pond. Outline agreement has been reached to reinstate the leat which took water from these ponds to the head of the Norwood Flight and to extract water to feed the restored flight.

16.2.11 Additional water for these sections will come from the ground water which currently drains from the collapsed Norwood Tunnel and from several springs along the canal route. Flow is constant and sufficient, at this time, to maintain the Norwood Flight and the partially restored side ponds in water.

16.2.12 Under full operation the reservoir and ground water supplies will be insufficient to operate the lock flight. It is proposed that back pumping systems be installed on both the Moorhouse and Norwood Flights. Electric pump systems to recycle water have been fitted to locks and lock flights on the Basingstoke, Wey & Arun, Ashby, Kennet & Avon and Erewash Canals with varying degrees of success. Experience of these systems will be used to design the most appropriate and energy efficient

system for the Chesterfield in the light of the restrictions offered by the archaeological investigations.

16.2.13 The Moorhouse Flight will probably employ a single pump to transport water from the base of the flight to the summit in a single lift utilising the Nethermoor lake as the base reservoir and the Norwood pound (including the mooring arm and off-line reserves) as the upper reservoir.

16.2.14 The Norwood Flight will probably employ a series of pumps with shorter pipe runs to transport water from the base of a given lock group to the top of the group. The Intermediate side ponds providing the necessary temporary reservoir capacity.

16.2.15 The length of the Wales section west of the watershed (the M1 motorway) as far as the Coalpit Lane Locks lies above the feed from the reservoirs and hence will need to be entirely fed by back pumping from the pound below. The summit pound and a new side pond on the summit level will be the reservoir. It is envisaged that a single lift relatively-low capacity pump in continuous operation will be the most energy efficient solution to this problem.

16.2.16 Several alternative energy sources for operating the back pumping systems are under consideration. One of the most promising avenues is the potential for using the natural wind exposure of the Coal Measures Escarpment to establish a series of wind turbines. While this is a highly sustainable option (with the potential to generate income from surplus power sales) further work needs to be carried out this concept prior to the detailed design stage.

16.3 Water Supply East of the M1 (Ryton Catchment)

16.3.1 The Canal's internal watershed between the Rother and Ryton catchments will be at the Coalpit Double Locks. These locks will lack conventional byweirs as all excess water from the pound above will be directed to flow westwards down the Norwood flight. Back pumping will be used on this lock pair to recycle descending water and restrict the amount of Rother Water entering the Ryton catchment.

16.3.2 Water supply for the pound between the foot of the Coalpit Double Locks and the head of the Wales Double Locks will come from (1) groundwater sources (identified by Arup in their study), (2) surface water drainage which currently flows into a drainage ditch on the line of the canal and (3) back pumping at the Wales Double Locks.

16.3.3 Water supply for the section from the foot of the Wales Double Locks to the Kiveton Waters Marina will come from (1) drainage water from the colliery tip and surrounding lands which currently flows into a drainage ditch on the line of the canal and (2) water from the Feeder from the Harthill and Pebbly Reservoirs.

16.3.4 The water flow from the drainage ditches will be cleaned up prior to use in the canal by filtration through a reed-bed filter.

16.3.5 The existing feeder from the Harthill and Pebbly Reservoirs - known as the Broad Bridge Dike - crosses the canal route at proposed water level. At present some of this feeder water is diverted to feed the Kiveton Waters ponds while the remainder continues along the Broad Bridge Dike to enter the already restored canal near Kiveton Park (Dog Kennels Bridge). Following reinstatement of the Canal and the

opening up of the Kiveton Waters Ponds into a marina, the Broad Bridge dike will enter the canal via an inlet weir on the south bank. On the opposite bank a take off or side weir will take water down the existing Broad Bridge Dike. This will ensure continuity of flow and provide storm water take off.

16.3.6 Using the existing Board Bridge Dike in this way will remove the need for a conventional byweir on the Hard Lane Treble Locks. This is important in the design of the Hard Lane Locks as these will need to be built in a constricted space and a conventional byweir will have insufficient capacity to cope with major storm events (see 10.15 Locks & Water Control, above).

16.4 Reservoirs and Side Ponds

16.4.1 Harthill and Pebbly Reservoirs are owned and maintained by British Waterways. All matters relating to these reservoirs are, and will remain, the sole concern of British Waterways.

16.4.2 Harthill and Pebbly reservoirs currently feed water into the already restored section at Kiveton Park. The proposed restoration will mean that same water is fed into the canal at the higher Kiveton Waters level. No alteration to the reservoirs is proposed or required.

16.4.3 Killamarsh and Woodall ponds are privately owned. The landowner is sympathetic to the restoration of the canal and has offered to work with the Partnership to bring both ponds back into use as canal feeders.

16.5 Feeders and Leats

16.5.1 Leats, lades or feeders take water from reservoirs and rivers into the canal. Within the Killamarsh to Kiveton Park section the key feeders are those which link the Killamarsh and Woodall Ponds to the head of the Norwood flight

16.5.2 A short leat brought water from a sluice on the Woodall Reservoir Dam (SK477811) to a junction with the Killamarsh leat (SK476811) at around 65m AOD. A second longer leat brought water from a sluice on the Killamarsh Reservoir Dam (SK473809) along the contour to a junction below the Woodall Dam. From the junction a short overflow leat leads to the County Dike.

16.5.3 The combined feeder heads northwest and then follows the contours through the Nor Wood (it is crossed by footbridges at SK472816 and SK470818)) and around the flank of the hill until it is flowing eastwards to reach the summit pound of the Canal above the Norwood Top Quadruple Locks (SK473819). The combined feeder leat is around 1100m long and falls around 5m over its course.

16.5.4 Unsurprisingly, the extant surviving canal feeder resembles a miniature canal in construction – with shallow excavation into the hill side on the up slope flank and the resultant up-cast being used to create a bank on the downslope side. The outer bank varies in width depending upon the underlying slope but is generally 6 to 8ft wide. The bank carries a footpath (to facilitate inspection & repair) for much of its length. Where visible the channel of the combined leat is circa 6 to 8ft wide and 2ft

deep. The outer bank is lined with stone or brick in places to reduce erosion. It is not clear if the channel was fully puddled with clay throughout but his appears likely. Two footbridges (footstones) cross the line.

16.5.5 Excess water from both ponds and the from the leat was discharged in to the County Dike. The Dike itself passes under the canal in a culvert (SK 468 818) and did not ever discharge into the canal. An overflow from a side weir at the foot of the Norwood Flight (SK 4689 8199) discharges into the County Dike below the canal level.

16.6 Groundwater Extraction

16.6.1 Since the cessation of deep mining ground water levels in the area have gradually risen. The replenishment of near surface groundwater reservoirs was noted by Arup who suggested that extraction of groundwater supplies would be a valuable adjunct to the maintenance of water supply on the summit pound.

16.6.2 Initial assessment suggests that ground water extraction may be possible in the vicinity of Coalpit Lane and to the east near Wales Locks.

16.6.3 Small wind pumps would be the most sustainable way of getting water from the ground to the waterway.

16.6.4 Full assessment of the groundwater resources will be made in conjunction with the programme of geotechnical boreholes to be undertaken as part of the detailed design phase. Once potential flow rates have been determined it will then be possible to design an appropriate extraction and treatment regime.

16.7 Water Conservation

16.7.1 Water supply to the new summit section (the Wales section) is limited. It is essential that water is conserved on this section. This will be achieved by:

- Use of a very low leak-rate liner system on the canal channel (Bentomat and concrete block) to minimise water loss.
- Use of a wider and slightly deeper than average canal channel to increase water storage capacity.
- Additional side ponds to provide further water storage and offer off-line nature reserves.
- Use of back-pumping on all locks.

16.7.2 The methods employed to do this are described in the sections on channel construction and on locks.