CHAPTER SIX

SPECIAL FEATURES

Chapter 6:

Special Features

6.1 *Introduction*

6.1.1 As required under paragraph 11 (m) of the Terms of Reference this chapter deals with ancient monuments and historic buildings (extended to include conservation areas), and some of the special features and structures mentioned for each waterway in Volume 2 (Descriptions) and indicated in Volume 3 (Maps).

6.1.2 Although the waterways vested in the British Waterways Board were developed, by and large, between the latter part of the 16th century and the middle of the 19th Century the more outstanding and interesting features of the system originate from the achievement of the canal pioneers during the development of wholly artificial canals between about 1760 and 1840. The Board have thus inherited a long established waterway network and as such have responsibility for the upkeep of the system and maintenance of many structures of historical, architectural and engineering interest.

6.2 *Ancient Monuments*

6.2.1 The preservation and protection of ancient monuments is a function of the Department under the Secretary of State for the Environment. The relevant statutes designed to protect ancient monuments are as follows:—

> Ancient Monuments Acts, 1882, 1913 and 1931
> Historic Buildings and Ancient Monuments Act 1953
> Field Monuments Act 1972.

Although the Transfer of Functions Orders, 1969, (Wales) and (Scottish Royal Parks and Ancient Monuments), transferred the responsibility for ancient monuments to the Secretaries of State for Wales and Scotland respectively the responsibility for the detailed executive work of preservation and protection remains with the Department of the Environment.

6.2.2 The definition of the term 'ancient monument' under the foregoing statutes includes virtually all buildings and structures of historical interest and applies, for most purposes, only to uninhabited buildings. Ecclesiastical and other buildings used for religious purposes and dwellings, not occupied by a caretaker and his family, are in general excepted from the powers conferred by the Acts.

6.2.3 Scheduling, which is a duty carried out solely by the Secretaries of State for the Environment, Scotland and Wales, comprises the preparation and publication of lists of monuments whose preservation is considered to be of national importance. Monuments so included are normally recommended to the Secretaries of State by special advisory bodies set up in each of the three countries to deal with such matters. Although the Secretaries of State are bound to schedule all monuments so recommended, they are empowered to schedule additional monuments on their own initiative.

6.2.4 Owners and occupiers of structures which are to be scheduled are notified of the Secretary of State's intention and advised accordingly of their statutory obligation and the restrictions imposed for the preservation and protection of ancient monuments. There is no provision under this legislation for any right of appeal against such notification. The restrictions require the owner and occupier to give the Secretary of State three months notice of any intention on their part to demolish or carry out repairs and alterations or do any work that may affect the character of the monument.

6.2.5 As at December 1974 thirty-nine structures owned by the British Waterways Board had been scheduled as Ancient Monuments and as such placed under the protection of the various statutes outlined above. A detailed list of these is given in Table 6.1 at the end of this chapter.

6.2.6 The factors affecting the Board's operational control of their waterways under this legislation are primarily concerned with administration and finance. Since there is no separate funding for these structures the costs incurred by the Board in complying with the provisions prescribed are met out of their revenue.

6.2.7 The effect of this legislation is particularly evident in the case of preservation whereby the work is required to be carried out in such a way that it will not affect the character of the monument. As these structures are scheduled for their historical and architectural value and are therefore prime examples of early craftsmanship the work of preservation inevitably calls for treatment which by its very nature is expensive, and can only be undertaken by persons or firms equipped with the necessary specialised knowledge and skills. Where the work is carried out by outside firms the Board is involved in a greater administrative effort in the preparation and letting of contracts than that required for normal maintenance.

6.2.8 Notwithstanding the foregoing, the obligation requiring the Board to give three months notice before carrying out alterations and work that would affect the monument could, particularly in an emergency or breakdown situation, delay its repair and if it is an integral part of the system, the re-opening of the waterway. Of the structures scheduled in Table 6.1 six are operational properties whose continuance of operation is essential to the Board in the performance of its duty to provide for navigation under the 1962 and 1968 Transport Acts.

6.2.9 Additionally it can be seen that the work and administrative effort required to comply with this legislation, particularly in the light of the ever increasing number of ancient monuments (seventeen of which were scheduled in 1974), could hamper the Board's maintenance procedure and in time have the effect of delaying essential engineering matters perhaps to the detriment of the whole system.

6.3 *Listed Buildings*

6.3.1 The protection of buildings of special architectural or historic interest is a function of local planning authorities under the Secretaries of State for the Environment, Wales and Scotland. The relevant Acts of Parliament relating to the protection of these buildings are as follows:—

Historic Buildings and Ancient Monuments Act, 1953
Local Authorities (Historic Buildings) Act, 1962
Town and Country Planning Act, 1971
Town and Country Planning (Scotland) Act, 1972
Town and Country Planning (Amendment) Act, 1972

6.3.2 Although listed building legislation was primarily intended to provide protection to buildings not eligible for assistance under the Ancient Monument Acts i.e. buildings which are inhabited or occupied or are still capable of use or occupation, it is apparent that there is no clear demarkation between these two categories; several buildings are listed as both ancient monuments and historic buildings. Listed buildings which are also scheduled as ancient monuments are excluded from the development control provisions of the Town and Country Planning Acts under ancient monument legislation.

6.3.3 The definition of 'building' in the Town and Country Planning Act, 1971 extends the scope of the earlier legislation so as to include a structure or erection and therefore embraces locks, bridges, aqueducts, basins, water-walling and other works necessary in the operation of a waterway. The considerations given when choosing a building for listing are more generally concerned with age, condition, quality and character, particular attention is paid however to special and group value, technological innovation and association with well-known characters or events. Before listing selected buildings are graded to show their relative importance as follows:–

Grade I	–	buildings of outstanding interest
Grade II	–	buildings of special interest which warrant every effort being made to preserve them
Grade II*	–	particularly important buildings in Grade II

The lists, which are constantly under review and form the basis of both local and national conservation policies, are compiled by the Secretaries of State.

6.3.4 The restrictions imposed for the protection and preservation of listed buildings are such that owners, occupiers and developers, who have no right of appeal against listing, are required to obtain listed building consent from the local planning authority or the Secretary of State before they can demolish or carry out alteration work which will affect the character of the building. If a site, occupied by a listed building, is required for redevelopment the applicant would need both listed building consent for the demolition, and planning permission for the new building. If, however, alterations which affect the character of the building and which amount to development are proposed the applicant should obtain planning permission which, in this case, incorporates listed building consent.

6.3.5 In the event of an owner or occupier failing to take reasonable measures to preserve a listed building the Local Authority have the power to acquire it by compulsory purchase. Furthermore, if a listed building is deliberately neglected for the purpose of site redevelopment, the Local Authority is not only entitled to buy the building, but is empowered to do so at a price which excludes the value of the site for redevelopment.

6.3.6 Although listing does not give any automatic entitlement to a grant or loan such facilities are available in certain circumstances both from central government funds and from local authorities. The Secretaries of State for the Environment, Wales and Scotland have the necessary powers to make grants for the repair and maintenance of listed buildings classified Grade I. Local authorities however, have a much wider scope in as much as they can make grants for any building of architectural or historic interest whether it is listed or not. Grants or loans are always made at the discretion of the body giving them.

6.3.7 Under Section 171 of the Town and Country Planning Act, 1971, compensation may be granted where listed building permission for development, normally allowed under the General Development Order, has been refused, if it can be shown that the value of the interest in the Building is less than it would have been had such permission been granted.

6.3.8 A detailed list of the properties owned by the Board which have been placed under architectural or historic building legislation, as at December 1974, is given in Table 6.2 at the end of this chapter.

6.3.9 Of the above approximately 20% are aqueducts, tunnels and locks (operational buildings) whose continuance of operation is essential to the Board in its duty to provide for navigation under the 1962 and 1968 Transport Acts. The upkeep of the greater majority of the remaining 80% is necessary in the performance of the Board's other statutory obligations.

6.3.10 Although local authorities can make discretionary grants for the preservation of any building of architectural or historic interest it would appear, in practice, that such facilities are more readily available in cases where agreements have been made with local authorities for cruising or local amenity on remainder waterways.

6.3.11 The effect of historic building legislation on the Board's control of their system is in essence similar to that discussed for ancient monuments in paragraphs 6.2.7 to 6.2.9 of this chapter.

6.3.12 A further aspect of this legislation concerns the difficulties experienced by the Board when it can be shown that redevelopment would prove more beneficial than the cost of carrying out major repairs to a listed building. It is understood that the Board were faced with this situation fairly recently when it became clear that extensive structural treatment would soon be needed for the preservation of one of their thirteen listed warehouses in Gloucester Dock. Since the warehouse would have only limited usage when repaired the Board decided that it would be more advantageous to demolish this uninhabitable building and redevelop its potentially favourable site. The Board's application for permission to redevelop was refused by the Local Authority. It seems therefore that the Board may not reorganise these docks on a fully operational basis and furthermore there is no return on the money which must be spent to maintain this building in its present unusable state.

6.4 *Conservation Areas*

6.4.1 The preservation, protection and enhancement of conservation areas is a function of local planning authorities under the Secretaries of State for the Environment, Wales and Scotland. The relevant Acts of Parliament providing for the control of development in designated conservation areas are as follows:–

Town and Country Planning Act, 1971
Town and Country Planning (Scotland) Act, 1972
Town and Country Amenities Act, 1974

6.4.2 Under the foregoing statutes, each local planning authority is obliged to notify the Secretary of State which parts of their area, as areas of special architectural or historic interest the character or appearance of which it is desirable to preserve or enhance, have been designated as conservation areas. Areas so designated are registered by the authority in the register of local land changes. Local planning authorities are required to formulate and publish such proposals and review the situation from time to time as directed by the Secretary of State.

6.4.3 The definition of 'building' in the Town and Country Planning Act, 1971 to include a structure or erection embraces locks, bridges, aqueducts, water-walling and other works necessary in the operation of a waterway.

6.4.4 The designation of conservation areas generally extends the provision of development control normally applied to listed buildings (as discussed in paragraphs 6.3.4, 6.3.5 and 6.3.6) to all buildings contained within the area with the exception of ancient monuments, ecclesiastical and other buildings used for religious purposes. Additionally there are provisions under the above legislation for the protection of trees and the enhancement of landscape within designated areas.

6.4.5 As mentioned in paragraph 6.3.7 local authorities have discretionary powers to make grants for any building of architectural or historic interest whose preservation they consider to be of regional or national importance.

6.4.6 A current list of designated canalside conservation areas which are on or within the vicinity of the Board's waterways is given in Table 6.3. at the end of this chapter. Although this list includes all conservation areas within 4 km of the canals it provides some measure of the Board's responsibility under this legislation. It should be noted that Macclesfield Borough Council have recently proposed to designate a 22.5 km length of the Macclesfield Canal as a conservation area.

6.4.7 Under the Town and Country Planning General Development Order, 1973, Class XVIII the Board are empowered to construct or erect, reconstruct, or alter so as to materially affect their character any of their operational buildings, without obtaining local planning authority consent. It would appear however that Section 277A of the Town and Country Amenities Act 1974, which imposes controls on demolition of conservation areas can override the Board's rights under the General Development Order if the work required in carrying out maintenance involves the demolition of a building. It would seem that under this legislation the Board are obliged to obtain permission before reconstructing a lock which has become structurally unsafe if this involves demolition of the existing structure even if the reconstruction is an identical copy. A further and more general example concerns bank protection. New piling is often installed in front of the remains of existing water-walling but in some cases the consequent reduction in waterway dimensions is not acceptable (see Chapter 10) and the old wall must be removed which would apparently require the permission of the planning authority.

6.4.8 It can be seen that the work and administrative effort required in complying with this legislation, particularly in the light of the number of areas already designated, would be considerable and undoubtedly cause delays which would seriously affect the Board's maintenance programmes perhaps to the detriment of the more vital elements of the system.

6.5 *Outstanding Features*

6.5.1 Although a large number of the Board's waterway structures have special historical and architectural interest this Section describes the more outstanding engineering features. The principal examples of these which have been selected as typifying the work of the earliest civil engineers are described under the various headings as follows:—

6.5.2	Aqueducts
6.5.3	Tunnels
6.5.4	Locks
6.5.5	Bridges
6.5.6	Earthworks
6.5.7	Miscellaneous

6.5.2 *Aqueducts:*

a) *Pontcysyllte Aqueduct,* scheduled as an ancient monument in 1958 and undoubtedly the most spectacular example of canal engineering in Britain, carries the Llangollen Branch of the Shropshire Union Canal over the broad valley of the River Dee. Considered to be one of Thomas Telford's most successful works this aqueduct, illustrated in Plate 6.1 below and standing a maximum 38 m high, 307 m in length with nineteen 13.7 m spans, was completed in ten years and opened in 1805.

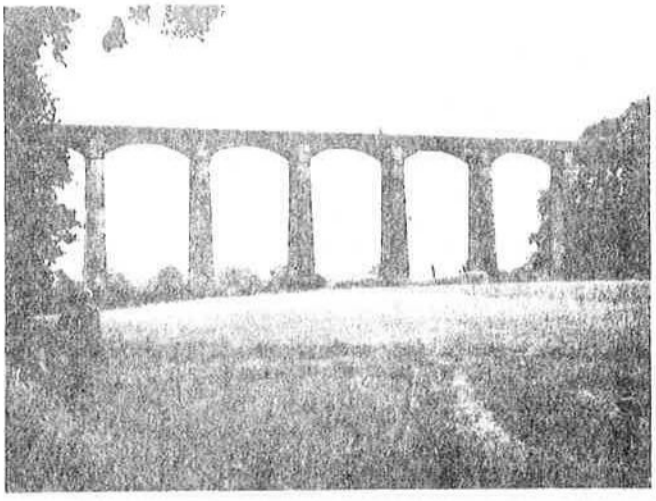


Plate 6.1 *(PFP)*

The construction comprises a cast-iron plated trough supported on four cast-iron rib arches between masonry piers. Although the waterway is 3.6 m wide the width available to craft is only 2.2 m; the remaining 1.4 m is occupied by the towing-path which is carried by one wall of the trough and cast-iron pillars from its base; the towpath is protected by balustrading, there is no such protection on the offside. The stone piers, standing a maximum of 36 m

above normal river level and tapering from 6.1 m x 3.7 m to 4.0 m x 2.3 m at trough level, are of hollow construction with cross walls from 21.3 m upwards. A photograph of the northernmost span of this structure is shown in Plate 6.2 below.

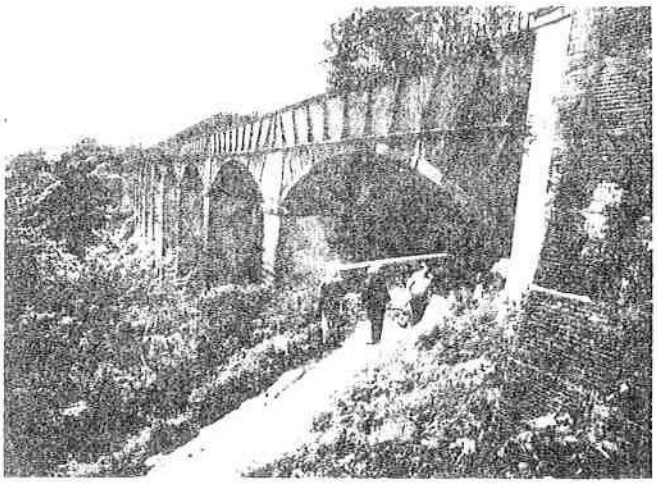


Plate 6.2 *(PFP)*

Although generally in sound condition this magnificent structure was closed to traffic and dewatered in June 1975 when it was observed, during a periodic inspection, that cracks had developed in the rib arches of the southernmost span. This span has suffered a long history of failure and it is on record that in 1866, 61 years after its completion, some damage believed to have been caused by movement of the southern embankment was reported. The Board has called in consulting engineers to investigate and report on the present difficulties.

b) *Chirk Aqueduct,* 5.25 km downstream from Pontycsyllte carries the Llangollen Branch over the valley of the R. Ceiriog. At first glance this splendid 216 m long stone arch structure standing 21.3 m high has the appearance of a railway viaduct or road bridge, for there is little depth of masonry above the piers. Telford achieved this effect by forming the bed of the water channel of cast-iron plates thereby saving the weight of a heavy masonry floor with attendant clay puddling. In addition to reducing weight this form of construction provides a continuous tie between the masonry walls to resist the pressure of the water in the tank. Opened in 1801 and listed as being of architectural or historic interest in 1964, this aqueduct has a waterway width of 3.35 m located centrally across the 6.7 m wide superstructure. A general view of this structure is shown in Plate 6.3 in opposite column.

Although the condition of the aqueduct appears satisfactory it is felt that the channel should be dewatered in order that a thorough inspection can be made of the cast-iron bed plates and bolted connections; it is believed that at the time of our inspection these had not been examined for some years.

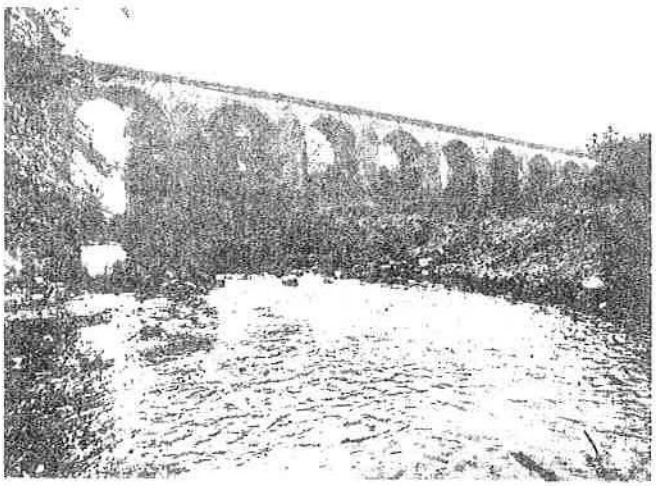


Plate 6.3 *(PFP)*

c) *Stanley Ferry Aqueduct,* a unique cast-iron structure of great interest, carries the Wakefield Branch of the Aire and Calder Navigation over the River Calder. This aqueduct, which has a span of 50 m and a waterway depth and clear width between fendering of 2.6 m and 6.0 m respectively, was engineered by George Leather & Sons, Leeds, and opened in 1839. The structure comprises a cast-iron plated trough, the dimensions of which are 2.9 m deep x 7.4 m wide, supported on cast-iron cross beams which are hung from two cast-iron arches, situated at either end of the cross beams, by wrought iron hangers. The arch springings, bearing on masonry abutments, are located below normal river level. A crescent-shaped break-water, carrying the towpath, was built upstream to protect the aqueduct from damage by waterborne debris brought down the river in flood time. A photograph of this structure is given in Plate 6.4 below.

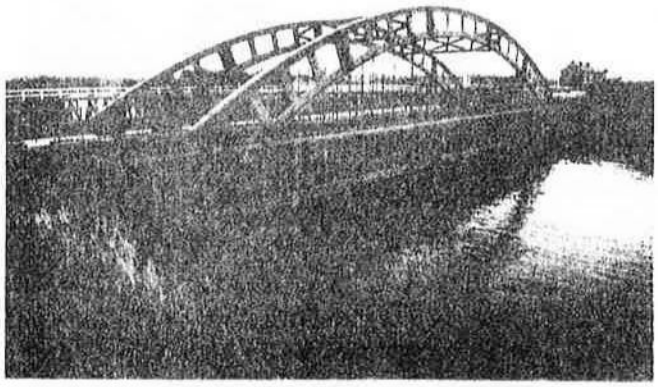


Plate 6.4 *(PFP)*

In 1972 the Board became concerned about the condition of this structure and subsequently commissioned consulting engineers to carry out a thorough investigation. The consultants concluded their report by commenting that the condition of the aqueduct was such that they did not consider it possible to devise an economically justifiable scheme

whereby its strength could be reinstated to a level required for present day operation and recommended that a new aqueduct should be constructed as a matter of urgency; they suggested that the existing structure could remain as a water channel.

d) *Marple Aqueduct,* built in 1800 by Benjamin Outram, carries the newly opened and restored Lower Peak Forest Canal 27m high across the steep-sided valley of the River Goyt near Marple. This 3-span masonry aqueduct, a fine example of Outram's architectural and engineering skill, incorporates a feature, unusual in this type of structure, whereby some reduction in the weight of masonry has been achieved by piercing the spandrel walls. This structure was scheduled as an ancient monument in 1963 and listed as an historic building in 1966 and 1967. In 1963, after a partial collapse, the Board entered into an agreement with the Cheshire County Council whereby they received a contribution of £9,500 towards the cost of the restoration of this historically important structure. The total cost of the works was £45,000.

e) *Almond Aqueduct,* one of the more outstanding structures of the Scottish Waterways, carries the Union Canal over the broad valley of the River Almond near Livingston. This substantial 5-arch masonry aqueduct, 128m in length and standing 23.2 m high was built from local sandstone by Hugh Baird, with advice from Telford, in 1822. The construction comprising 13.4m semicircular arches between tapered piers at 18.3m centres contains the canal in a 4.1 m wide x 2.1 m deep cast-iron trough. The trough is supported longitudinally by intermittent walls and laterally by bolted cast-iron stays bearing on the spandrel walls. This aqueduct which is illustrated In Plate 6.5 below, was scheduled as an ancient monument in 1970.

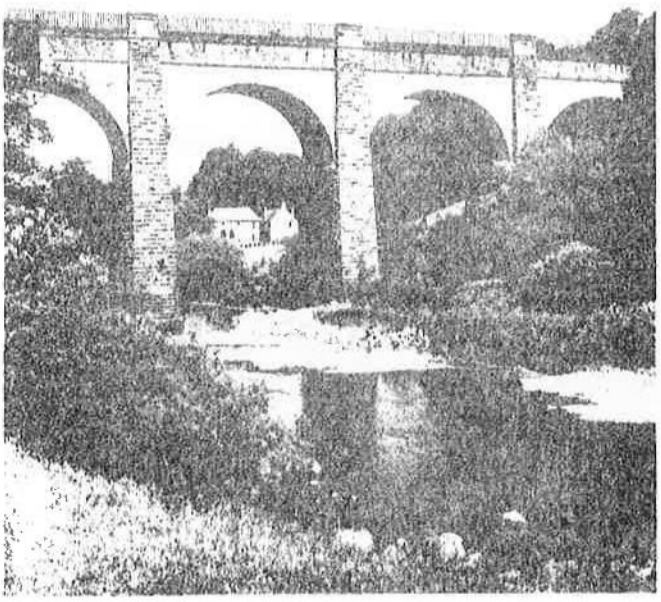


Plate 6.5 *(Photograph by Derek Pratt)*

In 1973 the Board commissioned consulting engineers to carry out detailed structural surveys of this aqueduct and two other Union Canal aqueducts, namely Slateford and Avon. Having given due regard to preservation, structural and other safety considerations the consultants reported that the general structural condition of these was good but recommended that certain works should be undertaken as a matter of urgency and that systematic inspections of these structures should be undertaken. The Consultants estimates of costs, at February 1974 prices, for carrying out the work as detailed were £22,200 for the Almond Aqueduct, £26,200 for Slateford Aqueduct, and £65,200 for the Avon Aqueduct.

f) *Lune Aqueduct,* considered to be John Rennie's most significant achievement and perhaps the finest masonry aqueduct in the country, carries the Lancaster Canal for some 183 m over the River Lune near Lancaster. This monumental stone structure, with five semicircular spans and elegant balustrading, was completed in 1797. The stone used in the construction of this splendid edifice has proved more durable than the Bath stone of his aqueducts carrying the Kennet and Avon Canal over the River Avon. This structure was listed as an historic building in 1953 and 1967.

g) *Salterhebble Aqueduct,* although not in the same class as the foregoing but worthy of mention, carries the Calder and Hebble Navigation over the River Hebble near Halifax. This unique timber aqueduct, spanning 11m, comprises a caulked timber planked trough, 6.7m wide x 1.83m deep, carried on timber framework between masonry abutments. It is reported that the original timber aqueduct, built about 1770, had been renewed in 1930. A general view of the existing aqueduct is shown in Plate 6.6 below.

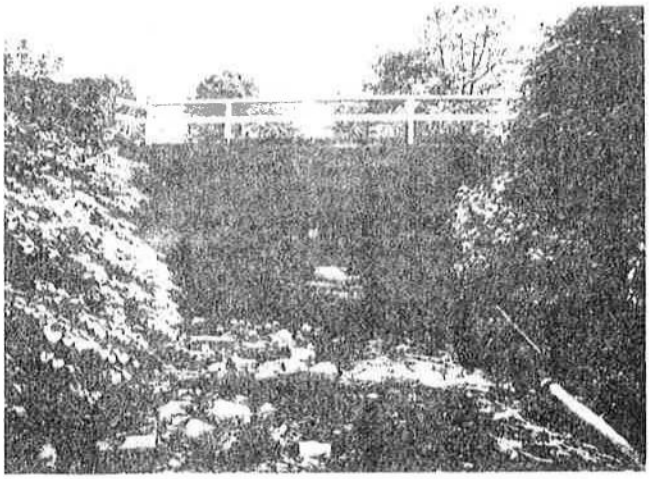


Plate 6.6 *(PFP)*

6.5.3 *Tunnels*

a) *Harecastle 'Old' Tunnel,* the first major canal tunnel in this country, built by James Brindley was completed in 1777 after 11 years work. This tunnel, although now completely abandoned after several roof falls, allowed the passage of moderately laden 2.1 m beamed craft along the summit of the Trent and Mersey Canal some 60m under the highest point of the Harecastle Hill, near Kidsgrove. The construction

of this 2.7 m wide by 3.7 m high tunnel, 2.64 km in length, presented a feat of engineering the scale of which was quite unknown at that time and overcame very difficult ground and working conditions. Brindley overcame the problem of summit water supplies by driving smaller side tunnels to take water from the adjacent colliery workings; today this source supplements the principal feed from the Caldon Canal. The British Railways Board have a licence to discharge water into this bore from their now abandoned tunnel, which runs some 12 m above.

In view of the increased traffic on the canal and the fact that it was a legging tunnel, a passage which took about two hours, it became a bottleneck and the subject of complaint by canal traders using this major trunk route. In 1822 the Trent and Mersey Canal Company sought Thomas Telford's advice, who recommended that a second tunnel be constructed alongside the existing one.

Since the Board have a residual responsibility to accept water from the old railway tunnel and it is in their interest to maximise all available water resources, particularly on the summit of this increasingly popular cruiseway, there is an obligation to maintain a clear passage for water through this partially blocked tunnel.

b) *Harecastle 'New' Tunnel,* another example of Thomas Telford's all round engineering versatility, built a distance of 24 m from the line of Brindley's bore in just over 2 years, was opened to traffic in 1827. A photograph showing the northern portals of these adjacent tunnels is given in Plate 6.7 below; Telford's bore is on the left.

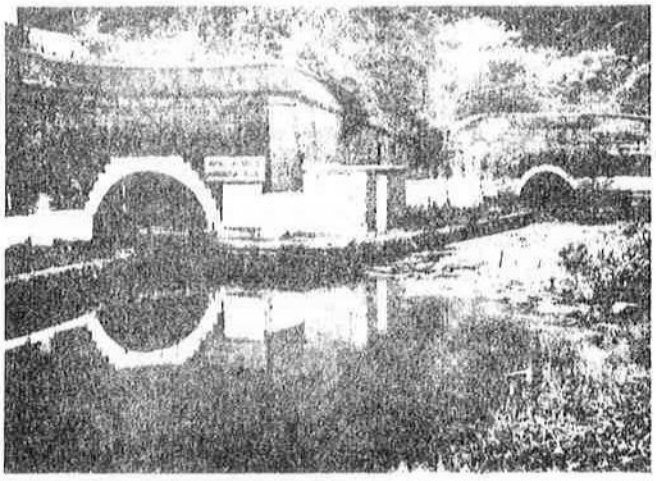


Plate 6.7 *(PFP)*

The tunnel complete with a towpath, effectively making it one way, is 2.68 km in length, its principal dimensions are width 4.27 m and height 4.88 m. The towpath, supported on longitudinal masonry arches, is 1.45 m wide thus leaving a water channel of 2.82 m for the passage of boats. A typical cross-section of this brick lined tunnel is shown in Fig. 6.1 opposite.

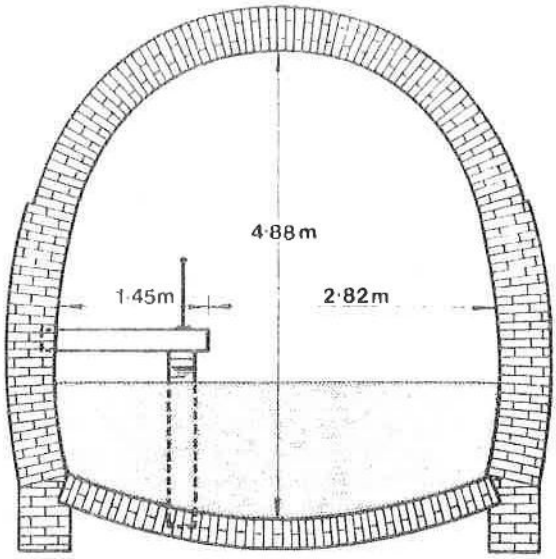


Fig. 6.1

Up until the early 1900's when mining subsidence led to the abandonment of Brindley's bore each tunnel was used one way; southbound traffic continued to be legged through the old bore. In 1914 the North Staffordshire Railway Company, who succeeded the Trent and Mersey Canal Company in 1852, introduced an electric tug to speed up traffic through Telford's tunnel on this important trading route; this service was discontinued in 1954.
At the end of 1973, after two limited roof falls the Board carried out a thorough survey of this tunnel and found that four lengths, totalling 129 m, were a hazard to public safety. The Board immediately closed the tunnel to traffic and called in specialist contractors to help and advise on treatment. It is hoped that the tunnel will be re-opened by the end of this year when the work on these four sections, which has been let under four separate contracts, will have been completed. It will be necessary for the Board to deal with other repairs over the next few years during winter stoppages.

c) *Standedge Tunnel,* almost 5 km long standing on the highest summit level at 200 m A.O.D. is by far the longest canal tunnel in the country and carries the now disused and unnavigable Huddersfield Narrow Canal some 180 m under the Pennine Ridge near Marsden.

The last 300 m at the western end of the tunnel was added at the end of the 19th century by the London and North Western Railway Company to provide a double track crossing at their tunnel entrance; this length of Standedge Tunnel is the maintenance responsibility of the British Railways Board. The canal tunnel provides drainage from this double track tunnel and from the two disused single track tunnels.

The construction of this tunnel through a mixture of coal measures and millstone grit, successively engineered by Benjamin Outram, William Clowes and John Rooth, was completed in 1811 twelve years after the adjacent lengths of canal had been opened.

The tunnel, without a towing path, is lined with brick or brick arches founded on rock for only about two thirds of its length; where unlined not only is the rock surface very rough but the tunnel profile very irregular. At one point the width is reduced to only 2.3 m, in other places where dangerous and weak rock had to be removed large rebates were formed. As originally intended the tunnel was to provide four 5 m wide passing places with a through passage 2.7 m wide by 2.74 m high and a depth of water of 2.44 m.

We were able to make a general inspection of the whole length of this tunnel, which revealed that the condition of the lining, some of which was installed as late as 1945, is fair, but it was found that attention is required in at least two unlined rebates where excessive spalling of the roof has given rise to a potential collapse situation. These falls which are at present blocking the canal should be cleared to provide a clear passage of water through the tunnel.

d) *Dudley Tunnel,* 2.94 km in length on the Dudley Canal, and undoubtedly the most remarkable feature of the Birmingham Canal Network, was finally completed in 1792 and with the Stourbridge Canal provided a shorter and more convenient route between the industrial Black Country and the River Severn via the Staffordshire and Worcestershire Canal.

The first 1.12 km of this tunnel at the northern end and the length of canal connecting with the Wolverhampton Level of the Birmingham Canal at Tipton was built privately for Lord Dudley in 1775 to serve his, and other industrialists', mining and quarrying interests.

Plate 6.8 *(Photograph by Derek Pratt)*

The remaining 1.82 km completed 17 years later, successively engineered by Thomas Dadford Senior and Josiah Clowes, through the limestone ridge which by then had been riddled by old quarry workings proved extremely arduous and difficult. As constructed this legging tunnel with its vast network of mine and quarry branches, totalling in all about 4.5 km, has a height above water level of only 1.75 m and a width of 2.57 m. A view of the northern entrance to the tunnel is shown in Plate 6.8 in previous column.

Although the tunnel, without ventilation shafts, was prohibited to powered craft, and superseded for that reason by the Netherton tunnel in 1858 boats continued to be legged through until the middle of the 20th century when the Parkhead locks below the tunnel became unusable. In 1973 the tunnel was re-opened with the rebuilding of these locks.

e) *Blisworth Tunnel,* the second longest navigable tunnel in Britain at 2.79 km, carries the main line of the Grand Union Canal, formerly the Grand Junction, between Blisworth and Stoke Bruerne. Although work on the tunnel was commenced in 1793 it was not completed until 1805; the delays during construction were caused by very treacherous ground conditions and financial problems experienced by two successive contractors. In the meantime the construction of the canal, with the exception of the tunnel, had proceeded with remarkable speed and it became apparent that some temporary measure would be needed to link the two termini created by the absence of the tunnel.

William Jessop, who was then principal engineer to the Grand Junction Canal Company, recommended that a plate tramway be laid over Blisworth Hill for that purpose; construction, by Benjamin Outram, took only eleven months and allowed the canal to be opened up to traffic in 1800. Without a towpath, the Blisworth Tunnel is wide enough to allow two traditional narrow boats to pass.

f) *Netherton Tunnel,* built between 1855 and 1858 to relieve the restricted Dudley Tunnel, was the last canal tunnel to be constructed in Britain. It runs on a parallel course 2.25 km east of the Dudley Tunnel and with the extension of the Dudley Canal provides a link between the Birmingham Main Line and the Staffordshire and Worcestershire Canal. When opened this generously proportioned and luxurious tunnel provided a towing-path on each side and was equipped with gas lighting which was later converted to electricity. The tunnel as originally constructed is 2.77 km in length, 4.77 m in height and 8.23 m in width with a waterway,5.18 m wide suitable for the passage of two narrow beamed craft.

6.5.4 *Locks*

a) *'Neptune's Staircase',* a flight of eight ship locks situated in unique surroundings at Banavie near Fort William on the Caledonian Canal, and scheduled as an ancient monument in 1974, is probably the most celebrated canal feature in Scotland.

Built by Telford in three years and opened in 1811 this staircase, the largest example of its kind in the

country, raises the canal a height of 19.5 m in a distance of 457 m.

The U-shaped locks, built of masonry 54.86 m long, 12.5 m wide and about 8.6 m high, with a sill depth of 5.18 m are suitable for vessels up to 45.72 m x 10.67 m beam x 4.15 m draught or 48.7 m long x 2.74 m draught. A cross-section of the locks in this staircase, which is typical of all locks on the Caledonian Canal, is shown in Fig. 6.2 below.

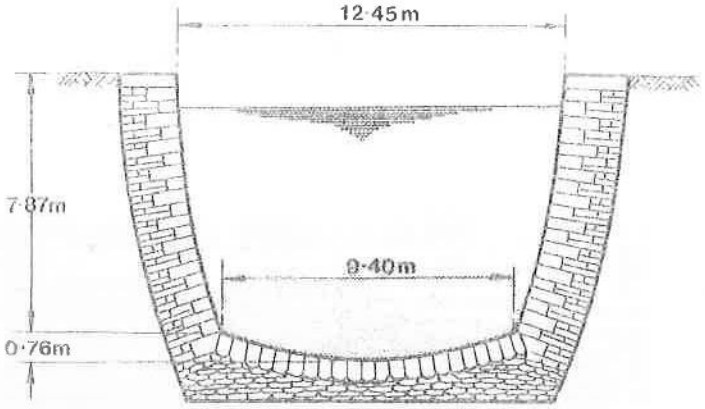


Fig. 6.2

b) *Bingley Five-rise*, a flight of five broad locks in staircase formation, built without side ponds by Longbotham in 1777, raises the Leeds and Liverpool Canal a height of 18.03m, in a distance of less than 100 m, into the 32 km long Gargrave pound. The locks of this notable masonry structure, which was listed as being of architectural or historic interest in 1966, are 19.91 m long and 4.53 m wide with a depth over sill of 1.52 m. A photograph of this flight is given in Plate 6.9 below.

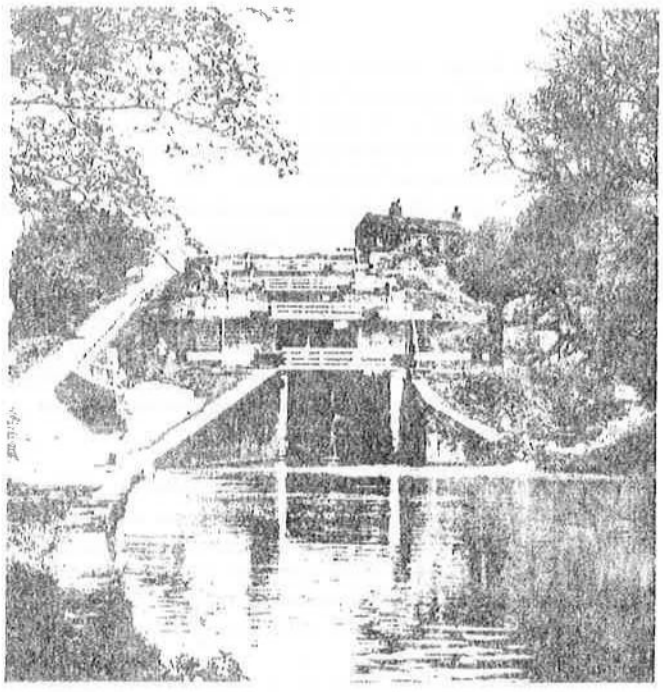


Plate 6.9 *(Photograph by Derek Pratt)*

c) *Devizes Twenty-nine*. Built by Rennie in 1810 and now unusable this flight of twenty-nine broad locks raised the Kennet and Kennet Canal from the 3.2km Sells Green pound up Caen Hill, a height of 72 m, into Devizes.

Longer pounds separate the top six and bottom seven of this long flight but the remaining sixteen, known as the Caen Hill flight, are closely spaced separated only by long transverse pounds terraced in the hillside. Although the lowest locks and some pounds on either side are still in water most of the locks of this once imposing flight are derelict (see Plate 6.10 below). As constructed the locks were all of the same size having the dimensions:-- length 22.36 m, width 4.34 m, depth over sill 1.9 m and rise 2.49 m.

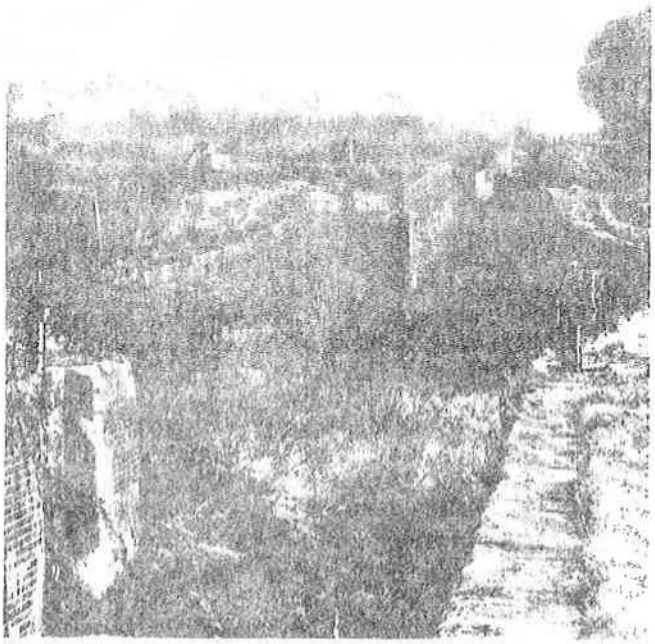


Plate 6.10 *(Photograph by Derek Pratt)*

d) *Tardebigge Locks*. Built without side ponds by John Woodhouse, and opened in 1815, this flight of thirty narrow locks raises the Worcester and Birmingham Canal a height of 66.2 m, over a distance of about 3 km into the 23 km long level summit between Tardebigge and Worcester Bar, Birmingham. Tardebigge top lock, the deepest narrow lock in England with a fall of 4.27 m, is a relic of an experimental vertical boat-lift designed and installed by Woodhouse at the time of construction. Its other dimensions are length 11.46 m, width 2.21 m and depth over sill 1.63 m. The dimensions of the remaining twenty-nine locks of this flight are length 11.46 m, width 2.26 m, depth over sill 1.63 m and rise 2.13 m. A typical view of the locks in this flight is given in Plate 6.11 overleaf.

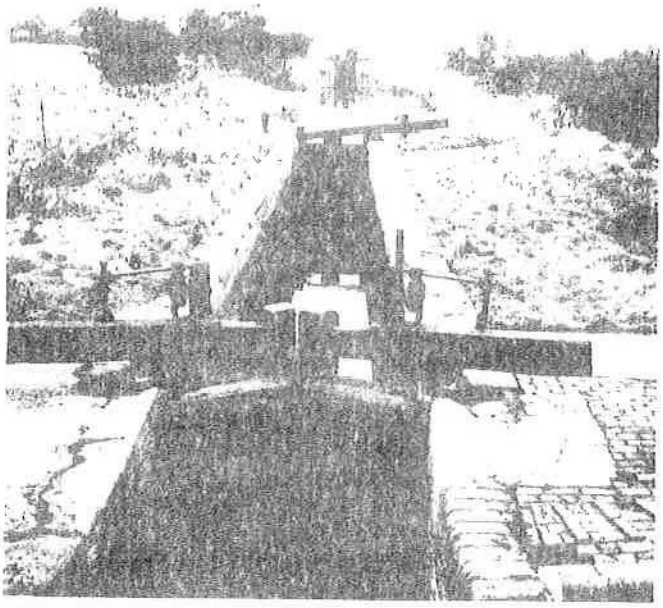


Plate 6.11 *(Photograph by Derek Pratt)*

e) *Hatton Flight,* built by the Grand Union Canal Company between 1932 and 1934 as part of the Grand Union (Warwick Section) Improvement Scheme, raises the Main Line (North) a height of about 45 m in a distance of 3.4 km from Warwick into the 13 km long pound before its final ascent via the five Knowle Locks into the Birmingham Summit Level. The twenty-one broad locks, each 4.6 m wide, 27.7 m long with a 2.1 m rise and a depth over sill of 1.8 m, were built alongside the original twenty-one narrow locks, which they replaced, and were constructed of mass concrete inside a timbered excavation and faced in brick-work on a batter of 1 in 48. Owing to the presence of running sand the lowest lock of this flight was encased in steel piling which was left in. A photograph looking down this flight is shown in Plate 6.12 below.

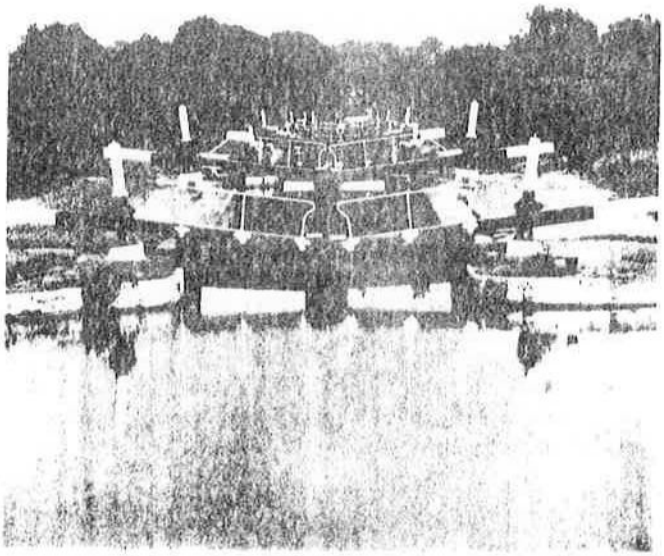


Plate 6.12 *(Photograph by Derek Pratt)*

6.5.5 *Bridges*

a) *Galton Bridge,* built by Thomas Telford in 1829 and hailed as the longest single-span canal bridge in the world, carried Roebuck Lane over the steepsided Smethwick cutting containing the Birmingham Main Line at Oldbury.

This cast-iron arched bridge, which was listed as an historic building in 1972, is supported on masonry abutments and constructed over the 21.6 m deep cutting at its deepest point, with a clear span of 45.7 m. The canal below is 12.3 m wide with a broad towpath on each side. It is believed that this famous bridge, which is illustrated in Plate 6.13 below, is soon to be closed to traffic and preserved as an ancient monument.

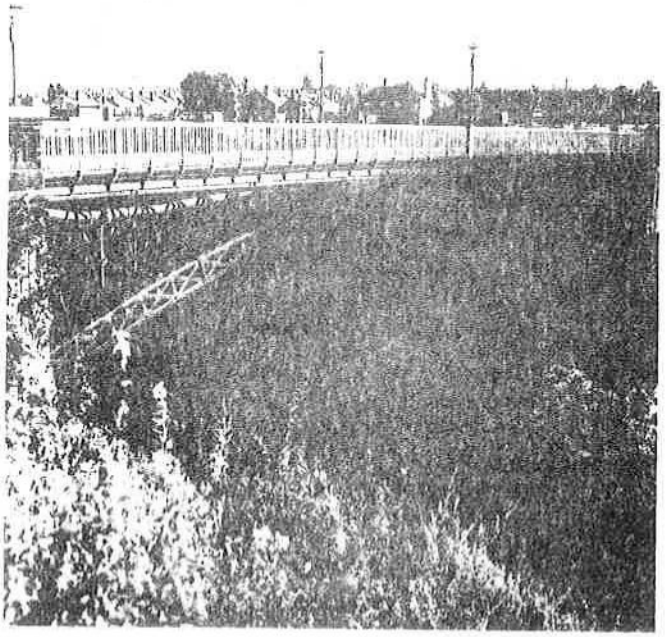


Plate 6.13 *(Photograph by Derek Pratt)*

b) *Moy Bridge,* listed as a building of architectural or historical interest in 1971, is the last of the original accommodation bridges on the Caledonian Canal and one of the more interesting features of the canal system. Built by Telford in about 1812 to accommodate farm traffic, this cast-iron swing bridge comprising two leaves each turned by hand gearing, is opened by the lock-keeper from Gairlochy some 2 km upstream. As access to the gearing on the northern side can only be gained via the bridge, the lock-keeper is obliged to open the southern leaf first and then row across the canal to the other side before opening the northern half. Apart from minor repairs to the timber decking the bridge remains as constructed.

c) *Great Haywood Bridge,* built by Brindley in 1770 and scheduled as both an ancient monument and listed building in 1971 and 1972 respectively, carries the Trent and Mersey Canal towpath over the Staffordshire and Worcestershire Canal at Great Haywood Junction. This graceful brick roving bridge comprising a flat parabolic arch rising 1.8 m with a span of 10.7 m is one of the more interesting features of the canal system.

Work found necessary for strengthening and renovating this structure has recently been carried out by the Board under outside contract, the cost of this work was higher than would normally be expected because of the requirements related to its status as an ancient monument.

d) *Acton Swing Bridge,* illustrated in Plate 6.14 below and one of six electrically operated public road bridges on the Weaver Navigation, carries the busy A49 over the navigation and a river backwater at Acton near Northwich.

Built about forty years ago this tied bow-string girder bridge of built-up rivetted mild steel construction rotates about a central pivot, supported on a submerged circular pontoon which carries approximately three fifths of the 650 tonnes dead weight of the structure. The pontoon, 10.76 m diameter and 7.0 m deep comprising a mild steel shell stiffened with internal bracing, is located in a chamber formed by a steel piled cofferdam, 15.21 m diameter, faced with 1.52 m thick mass concrete walls and a reinforced concrete base founded on Keuper marl. This massive structure, with an overall span of 70.4 m, travelling on a roller path around the top of the chamber, is surprisingly free running and easy of operation; it is attended by two full time bridge keepers.

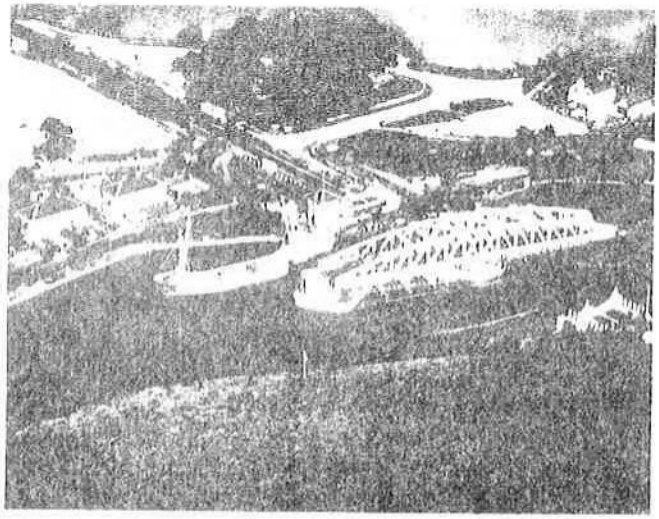


Plate 6.14 *(BWB)*

6.5.6 *Earthworks*

a) *Pontcysyllte Embankments,* constructed by Telford at the approaches to his aqueduct (see paragraph 6.5.2a) and standing a maximum 29.6 m high at the southern end, were acclaimed, at the time of their completion to be the greatest earthworks ever raised. It is not surprising that this fact is now overlooked when it is considered that they form an integral part of perhaps the finest example of canal engineering in Britain.

b) *Shelmore Embankment,* just south of Norbury Junction, carries the Shropshire Union Canal 18.3 m high above the surrounding countryside for a distance of about 1.6 km. Although the construction of this enormous task was started by Thomas Telford in 1829 it was not until March 1835, a year after the rest of the canal had been finished and six months after Telford's death, that the embankment was finally completed by William Cubitt and the canal opened to traffic. The delays during the construction of this great embankment arose from soil stability and compaction problems which gave rise to repeated slips and collapses.

c) *Burnley Embankment,* built by Robert Whitworth between 1796 and 1801, carries the Leeds and Liverpool Canal above part of Burnley. This bank which is 1.2 km long, incorporating an aqueduct over a main road and over 18 m high, presents the canal traveller with an elevated view of one of the most interesting industrial landscapes in the country.

Observations made during our survey on the stability of this embankment are recorded in Chapter 12.

d) *Smethwick Cutting,* a maximum 21.6 m deep, carries the Birmingham Canal Main Line between Smethwick and Spon Lane Junctions, a distance of some 3 km. At its deepest point it is spanned by Galton Bridge (see paragraph 6.5.5a). Completed in 1829, this impressive steep-sided cutting, which cradles the 12.29m wide canal with its two broad towpaths at the Birmingham level, was constructed by Telford on behalf of the Birmingham Canal Company for the purpose of overcoming the problems of water supply and traffic flow experienced by the changes in level of the old line on the Wolverhampton level at Smethwick and Spon Lane Locks.

e) *Tyrley Cutting,* on the Shropshire Union Canal near Market Drayton, was engineered by Thomas Telford and completed by William Cubitt in 1834. Over 2 km in length and rising to a height of 21.4 m above the canal, this long steep-sided cut, which is illustrated in Plate 6.15 below, remains to this day one of the more impressive features of the canal system. Its construction through strata of friable rock alternating with clay made the work of excavation extremely difficult; the clay when wet was particularly treacherous. Delays lasting many months were experienced over the winter periods when the action of frost following rain dislodged and brought down vast quantities of material in the excavation.

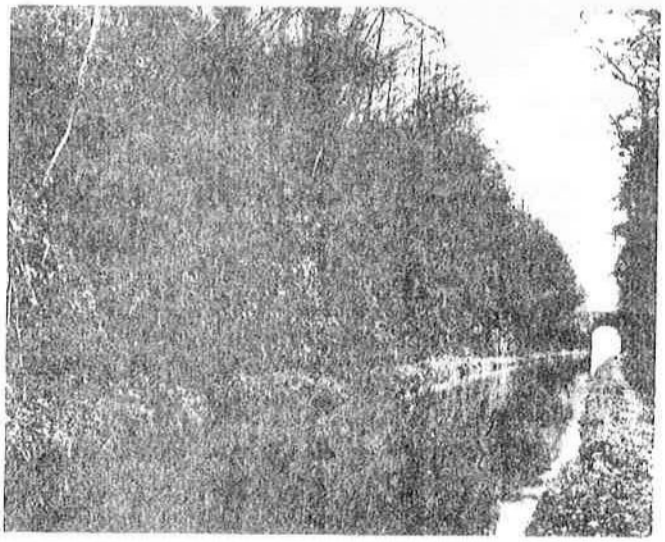


Plate 6.15 *(Photograph by Derek Pratt)*

During our inspection of this cutting it was noted that remedial works will be required in the near future to obviate any risk to navigation arising from bank slippage and overhanging trees.

f) *Clachnaharry Sea-Lock*, marking the eastern end of the Caledonian Canal, was built 365 m beyond the shore line of the gently shelving Beauly Firth so that it could be entered at practically any state of tide. Engineered by Thomas Telford in conjunction with William Jessop between 1806 and 1812 the construction of this sea-lock, the largest lock in the world at the time, represents one of the finest engineering achievements in canal history. The construction of this lock, on 16 m of mud overlying a rock bottom, called for special skill and ingenuity and was achieved by extruding the mud with a clay embankment weighted with stones and then constructing a piled coffer-dam, in the clay apron, within which the masonry lock base and walls were built.

6.5.7 *Miscellaneous*

a) *Anderton Lift*, designed by Edwin Clark and built by Leader Williams in 1875, connects the Trent and Mersey with the Weaver Navigation 14.24m below at Northwich.

This unique lift comprises two counterbalanced caissons, each large enough to take a pair of narrow boats, which travel vertically in an impressive iron structure, as shown in Plate 6.16 below.

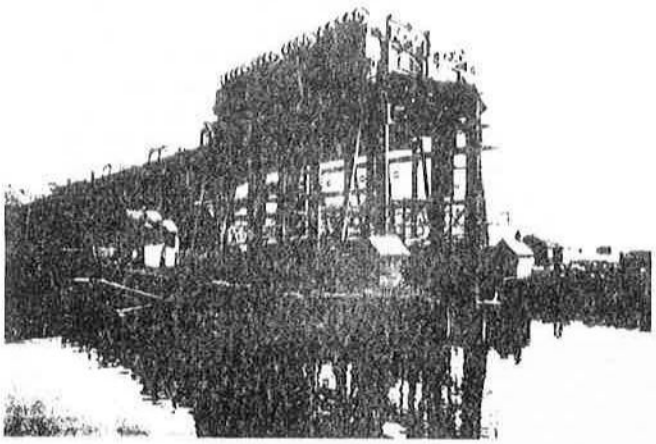


Plate 6.16 *(PFP)*

As originally constructed the tanks which counterbalanced each other were supported by vertical hydraulic rams aided by steam power. By 1908 the rams had corroded so badly that it was decided to change the mode of operation and accordingly the tanks were separately counter-balanced via steel cables passing over a pulley system at the top of the structure; the operation being powered and controlled electrically. A view of the complex gearing arrangement is given in Plate 6.17 in opposite column.

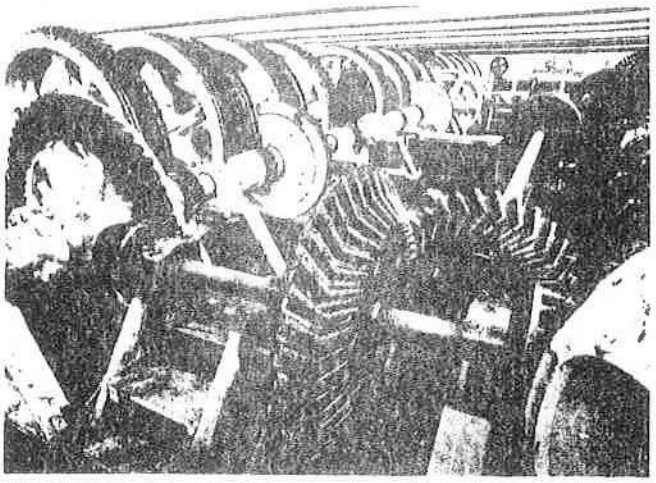


Plate 6.17 *(PFP)*

Following an investigation commissioned by the Board on the structural condition of the lift consulting engineers were appointed to prepare a scheme and supervise an extensive programme of repairs. This work, which started early in 1973, should be completed later this year.

b) *Caldon Canal*, a branch of the Trent and Mersey Canal, was built in 1779 to serve the Caldon limestone quarries near Froghall. It connects Froghall with the Trent and Mersey Canal Summit at Etruria, Stoke. In 1797 a secondary branch was constructed between Leek and the eastern end of the Caldon summit, at Hazlehurst, before the long descent to Froghall, for the purpose of providing a feed from the new Rudyard reservoir to compensate for the large quantities of water consumed by traffic using the busy Froghall terminus. Today the Caldon Canal, fed additionally by Stanley Pool and Knypersley Reservoirs, is the principal feed to the Trent and Mersey Canal.

The construction of the secondary Leek Branch and the later advent of the railway brought about significant changes in the layout of the canal and resulted in the curious "cross-over" junction that now exists at Hazlehurst; this branch is carried over the old Main Line by a brick-arched aqueduct which was listed as being of historic interest in 1967.

c) *Tringford Pumping Station* was built by the Grand Junction Canal Company at a site selected by Thomas Telford on the Wendover Arm, 2.5 km from its junction with the main line at Bulbourne, to overcome the water supply problems experienced at the Tring Summit. The pumping station and its associated works, which included driving headings to the new reservoirs at Tringford and Startopsend and the installation of a Boulton and Watt steam pump, were completed and fully operational in August 1818. It was later enlarged so as to draw from the Wilstone reservoirs also.

The subsequent development of this station, which culminated as recently as 1960/1 when the electrification of the pumping sets was completed, brought about many significant changes and improvements to the pumping layout. As it stands today the

station is equipped with four sets of pumps, each electrically driven, drawing on all the reservoirs and also pumping the Wendover supplies direct from the Wendover Arm into the summit. The original steam pump was eventually removed in 1926. A plan and section of the present pumping arrangements are shown in Figures 6.3 and 6.4, overleaf.

d) *New Junction Canal,* completed in 1905 and the last canal built in this country, was engineered by William H. Bartholamew on behalf of the Aire and Calder and Sheffield and South Yorkshire Navigation Companies to provide a short cut between the two navigations. This artificial commercial waterway through flat countryside is almost 9 km long and quite straight, it comprises one lock at Sykehouse which raises the canal 1.5 m and two major aqueduct crossings over the Rivers Went and Don. The latter has large guillotine gates at either end to protect the canal should the tidal River Don overtop the aqueduct. The Board have recently commissioned a firm of consulting engineers to inspect and report on the condition of all the New Junction Canal aqueducts. A photograph of the Don Aqueduct is given in Plate 6.18 below.

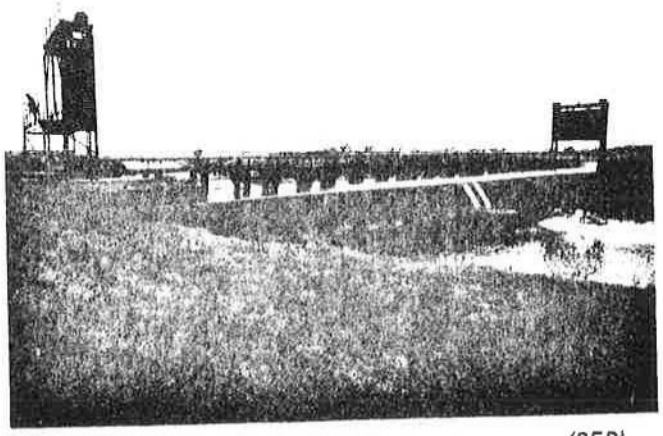
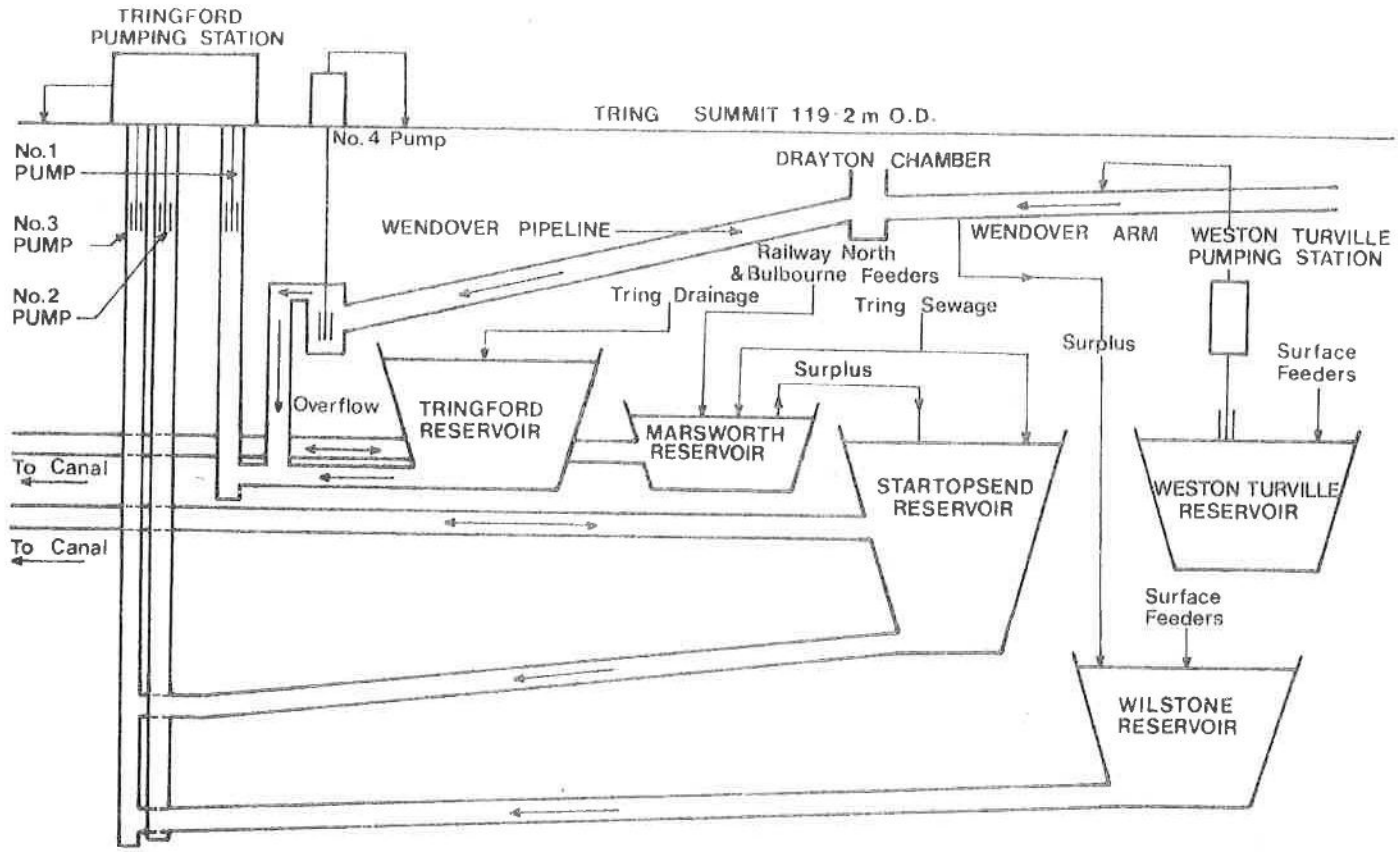


Plate 6.18 *(PFP)*



WESTON TURVILLE RESERVOIR	Receives water from surface feeders and surplus water from the Wendover Stream from whence it is pumped into the Wendover Arm.
WILSTONE RESERVOIR	– Receives water from springs, surface feeders and surplus from the Wendover Arm via the Drayton Feeder, and delivers to Wells 2 & 3 Tringford Pumping Station, via a low level heading, from where it is pumped into the Summit.
TRINGFORD RESERVOIR	– Receives water from the Tring Drainage and overflow from the Wendover Pipeline and delivers, via a high level heading, to Well 1, Tringford Pumping Station whence it is pumped into the Summit.
STARTOPSEND RESERVOIR	– Receives water from Tring Sewage and surplus from Marsworth Reservoir and delivers via a middle level heading to Wells 2 & 3, Tringford Pumping Station, from whence it is pumped into the Summit. In addition the heading from Marsworth Pound (between locks 38 & 39) to the reservoir provides supply when the reservoir is more than 2.3 m under weir level or alternatively feeds the pound when the reservoir is higher than that level.
MARSWORTH RESERVOIR	– Receives water from Tring Sewage and the Bulbourne and Railway North Feeders, and feeds into the canal above the Marsworth Pound from whence it can be used to feed Startopsend Reservoir; surplus water is fed directly to Startopsend Reservoir.
WENDOVER SUPPLIES (including wells, stream and headings at Wendover, together with supplies pumped from Weston Turville Reservoir).	– Water from the Wendover Arm feeds into the chamber at No. 4 Pumphouse from where it is pumped into the summit automatically.

Fig. 6.4 DIAGRAMMATIC SECTION SHOWING TRING RESERVOIRS AND PUMP ARRANGEMENTS

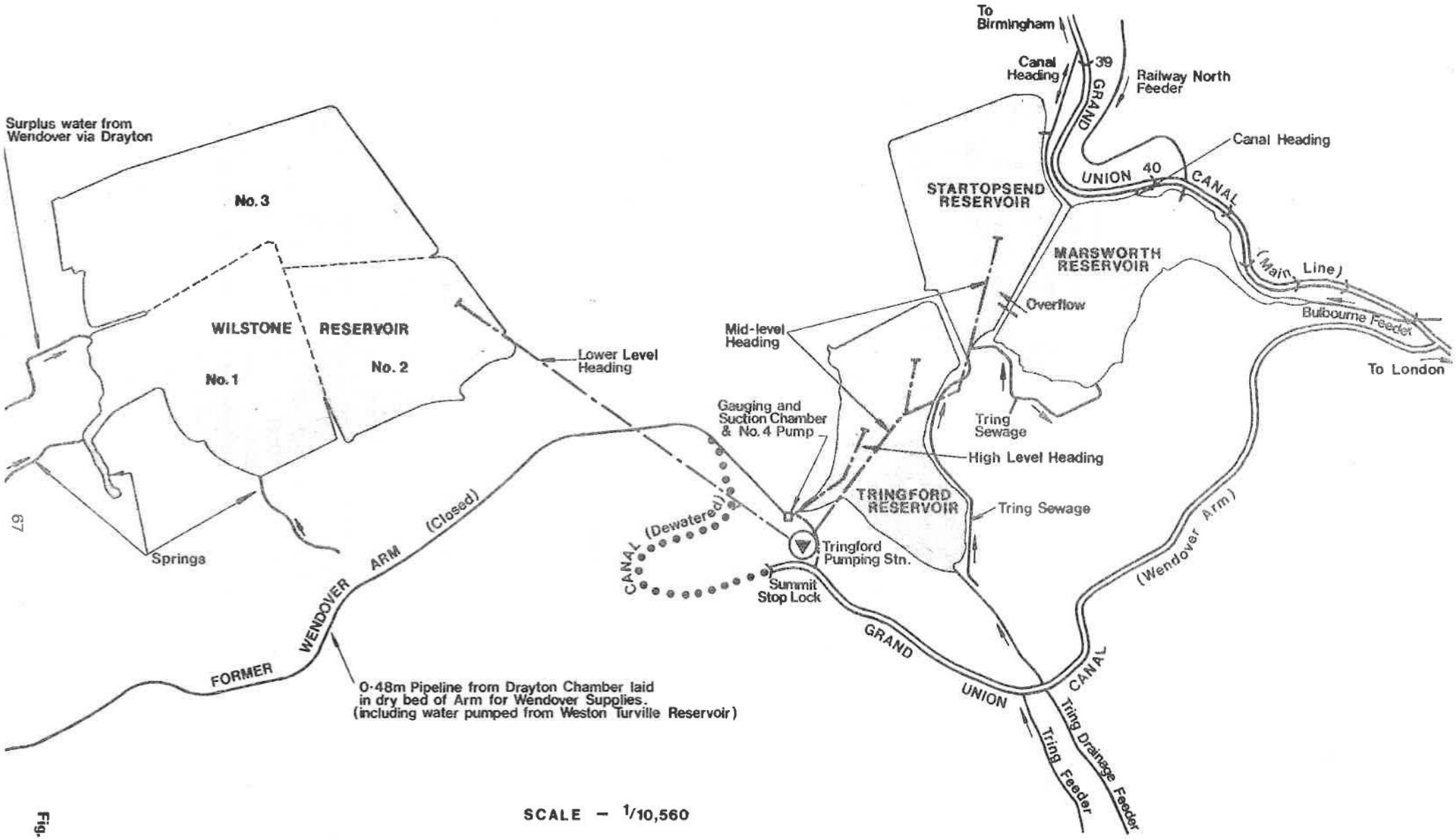


Fig. 6.3

PLAN OF TRING RESERVOIR AND FEEDERS

Table 6.1

BWB'S ANCIENT MONUMENTS

Waterway Ref. No.	Waterway	Description	Location	Date Scheduled
3	Grand Union Canal Main Line (S)	Iron Trunk Aqueduct, Wolverton	Milton Keynes D.C.	13.6.69
		Hanwell Flight of Locks and brick boundary wall of St. Bernards Hospital	Ealing L. B.	12.12.74
5	Leicester Section	*Foxton Inclined Plane (Remains)	Harborough D.C.	24.1.73
7	Stratford on Avon Canal	*Guillotine Lock, Birmingham	Birmingham M.B.	12.3.73
12	Kennet and Avon Canal	Dundas Aqueduct	Wansdyke/West Wilts D.C.'s	16.5.51
18	Staffordshire & Worcester Canal	Great Haywood, Bridge No. 109	Stafford D.C.	29.6.71
20	Birmingham Canal Navigations	Summit Bridge, Warley	Sandwell M.B.	25.6.73
		Engine Arm Aqueduct, Warley	"	21.6.73
21(d)	Llangollen Canal	Pontcysyllte Aqueduct	Glyndwr D.C.	11.9.58
32	Pocklington Canal	Hagg Bridge, Cottingwith	North Wolds D.C.	19.10.73
		Walbut Bridge, Thornton	"	19.10.73
		Coat's Bridge, Bielby	"	19.10.73
		Church Bridge, Thornton	"	19.10.73
40	Peak Forest Canal	Marple Aqueduct	Stockport M.B.	12.3.69
47	Caledonian Canal	Moy Bridge, Kilmallie	Lochaber D.C.	16.8.74
		Neptune's Staircase	"	13.12.74
		Signal Lamp, Gairlochy	"	16.8.74
49	Forth & Clyde Canal	Kelvin Aqueduct, Kelvindale	Glasgow City	22.11.68
		*Antonine Wall, Cadder to Glasgow Road Bridge	Bishopbriggs and Kirkintilloch D.C.'s	30.12.71
		*Antonine Wall, Allendale Cottage to Underwood Pond	Falkirk D.C.	7.7.72
		Drawbridge No. 32, Linnvale	Glasgow City	13.12.74
		Drawbridge No. 37, Ferrydyke	Clydebank D.C.	16.8.74
		Drawbridge No. 38, Bowling	Dumbarton D.C.	16.8.74
		Drawbridge No. 30, Knightswood	Glasgow City	16.8.74
		Locks 9 to 16	Falkirk D.C.	16.8.74
		Aqueduct over Maryhill Road	Glasgow City	16.8.74
		5 Locks at Graving Dock	"	16.8.74
50	Union Canal	Avon Aqueduct, Linlithgow	West Lothian D.C.	19.7.66
		Almond Aqueduct, Kirkliston	Edinburgh City	27.11.70
		Glen High Bridge No. 61	Falkirk D.C.	9.11.73
		Falkirk Tunnel	"	9.11.73
		Footbridge No. 46, Linlithgow	"	9.11.73
		Cottages on Canal, Woodcockdale	"	13.12.74
		Repair Dock at Firdale Cottage	West Lothian D.C.	13.12.74
		Canal Basin, Causewayend	Falkirk D.C.	13.12.74
		Lifting Footbridge, Gilmore Park	Edinburgh City	16.8.74
		Aqueduct near Redall Park	"	16.8.74
		Viewforth Bridge	"	16.8.74
		Aqueduct, South of Kettlestoun Mains, Linlithgow	West Lothian D.C.	16.8.74

*Non-operational property.

Table 6.2

BWB'S LISTED BUILDINGS
(as at December 1974)

Waterway Ref. No.	Waterway	Description	Location	Date Listed
	Grand Union Canal			
2a	Regents Canal	*604, 606 & 608 Commercial Road	Tower Hamlets LB	Provisional
		*Lock Cottage, Hamstead	Camden LB	14.5.74
		*Lock-keepers' Cottage, Camley Street	Camden LB	14.5.74
3	Main Line (S)	Bridge No. 53, Stoke Bruerne	South Northants DC	1.12.51
		Solomans Bridge No. 65 Cosgrave	Milton Keynes DC	1.12.51
		Grove Park Bridge No. 164	Watford DC	15.11.73
		*Toll House (Lock 22), Fenny Stratford	Milton Keynes DC	10.3.70
		Bridge No. 188, Iver Lane, Cowley	Hillingdon LB	16.7.74
		*Cottage (No. 67), 37 Iver Lane, Cowley	Hillingdon LB	6.9.74
5	Leicester Section	Foxton Locks	Harborough DC	7.12.66
8	Coventry Canal	*Canal Warehouse, Leicester Row	Coventry DC	Provisional
		Canal Basin, Leicester Row	Coventry DC	Provisional
11	Oxford Canal (S)	Bridges Nos. 234, 237, 238, 242 & 243	Oxford DC	28.6.72
12	Kennet & Avon Canal	Wharf Bridge, Devizes	Kennet DC	9.4.54
		London Road Bridge, Devizes	Kennet DC	9.4.54
		Park Bridge, Devizes	Kennet DC	9.4.54
		Town Bridge, Devizes	Kennet DC	9.4.54
		Bathampton Bridge, Bathavon	Wansdyke DC	1.2.65
		Ladies Bridge, Wilcot	Kennet DC	27.5.64
		*Nos. 27 & 27a Northgate Street & Boundary Walls & Gates, Devizes	Kennet DC	19.9.72
		Lock No. 13 (Top Lock)	Bath DC	11.8.72
		Lock No. 12 (Second Lock)	Bath DC	11.8.72
		*No. 2 Canal Cottage, Darlington Wharf	Bath DC	11.8.72
		*Top Lock Cottage	Bath DC	11.8.72
		Chimney (Nr Poulteney Gardens Bridge)	Bath DC	11.8.72
		Top Lock Footbridge	Bath DC	11.8.72
		*Engine House	Bath DC	11.8.72
		Lock No. 11 (Abbey View)	Bath DC	11.8.72
		Poulteney Gardens Bridge	Bath DC	11.8.72
		Lock No. 10 (Wash House)	Bath DC	11.8.72
		Wash House Lock Footbridge	Bath DC	11.8.72
		Spring Gardens Bridge	Bath DC	11.8.72
		Sydney Road Tunnel	Bath DC	11.8.72
		Footbridge over Canal (BA 115)	Bath DC	11.8.72
		Bridge over Canal (BA 114)	Bath DC	11.8.72
		Beckford Road Tunnel	Bath DC	11.8.72
		Lock No. 7 (Lower Lock)	Bath DC	11.8.72
		*Weston Lock	Bath DC	11.8.72
		Dolphin Bridge, Weston Cut	Bath DC	11.8.72
		Cottage, 14 From Road, Bradford-upon-Avon	West Wilts DC	23.8.74
14a	Monmouthshire & Brecon Canal	Cefn Brynich Aqueduct	Brecknoch DC	17.1.63
		*The Warehouse, Govilon	Monmouth DC	17.12.73
15	Gloucester & Sharpness Canal	*Llanthony Warehouse	Gloucester DC	14.12.71
		The Docks	Gloucester DC	12.3.73

(Continued on next page)

Table 6.2 Continued

Waterway Ref. No.	Waterway	Description	Location	Date Listed
15	Gloucester & Sharpness Canal (Continued)	*Dock Office	Gloucester DC	12.3.73
		Dry Dock, adjoining Alexandra Warehouse	Gloucester DC	12.3.73
		Dry Dock, The Docks	Gloucester DC	12.3.73
		Gloucester Lock	Gloucester DC	12.3.73
		*Albert Mill Warehouse	Gloucester DC	12.3.73
		*Alexandra Warehouse	Gloucester DC	12.3.73
		*Biddles Warehouse	Gloucester DC	12.3.73
		*Britannia Warehouse	Gloucester DC	12.3.73
		*"G" Warehouse	Gloucester DC	12.3.73
		*Herbert Warehouse	Gloucester DC	12.3.73
		*Kimberley Warehouse	Gloucester DC	12.3.73
		*North Warehouse	Gloucester DC	12.3.73
		*Phillpots Warehouse	Gloucester DC	12.3.73
		*Shiptons Warehouse	Gloucester DC	12.3.73
		*Victoria Warehouse	Gloucester DC	12.3.73
		*Vining Warehouse	Gloucester DC	12.3.73
		*Weighbridge House, Southgate Street	Gloucester DC	12.3.73
		*Mariner's Chapel, The Docks	Gloucester DC	12.3.73
		*Twigg's Box Factory, The Docks	Gloucester DC	12.3.73
		*22 Llanthony Road	Gloucester DC	12.3.73
		*23, 25, 27 & 29 Commercial Road	Gloucester DC	12.3.73
18	Staffordshire & Worcestershire Canal	*2, 3, & 4 Mart Lane, Stourport-on-Severn	Wyre Forest DC	5.7.50
		*Clock Warehouse, Stourport-on-Severn	Wyre-Forest DC	5.7.50
		Canal Basins & Locks, Stourport-on-Severn	Wyre Forest DC	9.11.71
		*4, 5, 6 & 7 Severn Side, Stourport-on-Severn	Wyre Forest DC	9.11.71
		Clayhouse Bridge, Caunsell	Wyre Forest DC	10.12.73
		Aqueduct over River Tixall	Stafford DC	15.1.68
		Gt. Haywood Bridge No. 109	Stafford DC	10.1.72
20a	Birmingham Canal Navigation	Galton Bridge, Warley	Sandwell MB	7.8.72
		Barge Gauging House, Tipton Canal Basin	Dudley MB	22.8.74
	Shropshire Union Canal			
21a	Main Line (S)	Aqueduct, South of Shelmore Wood, Norbury	Stafford DC	15.1.68
		Aqueduct, South of Norbury Junction	Stafford DC	15.1.68
		12 Mile Posts, Norbury Junction	Stafford DC	10.1.72
21b	Main Line (N)	Lock-keepers House, Northgate	Chester DC	23.5.67
		Northgate Locks	Chester DC	23.5.67
		Iron Roving Bridge	Chester DC	23.5.67
		*Dock Office	Ellesmere Port DC	24.2.71
		Locks at Junction with Manchester Ship Canal	Ellesmere Port DC	24.2.71
		Kennison's Bridge	Ellesmere Port DC	24.2.71
		Industrial Building Spanning Canal	Ellesmere Port DC	24.2.71

(Continued on next page)

Table 6.2 Continued

Waterway Ref. No.	Waterway	Description	Location	Date Listed
	Main Line (N) (Continued)	*Lighthouse on Manchester Ship Canal	Ellesmere Port DC	24.2.71
		Warehouse, Raymond Street	Chester DC	10.1.72
21d	Llangollen Branch	Pontcysyllte Aqueduct	Glyndwr DC	7.6.63
		Chirk Aqueduct	Glyndwr DC	30.11.64
		Wrenbury Frith Bridge	Crewe DC	Provisional
		Wrenbury Lift Bridge	Crewe DC	Provisional
		Wrenbury Church Bridge	Crewe DC	Provisional
21f	Newport Branch	Quarry Canal Bridge, Forton	Stafford DC	3.8.71
		Aqueduct over River Meese	Stafford DC	7.3.72
23	Trent & Mersey Canal	Trent Lane Bridge, Colwich	Stafford DC	15.1.68
		Salt Bridge	Stafford DC	15.1.68
		Mile Post, North of Mill Lane, Gt. Haywood	Stafford DC	30.5.73
		*The Neptune Club, Preston Brook	Vale Royal DC	29.10.73
24	Cromford Canal	Bridge, King William St, Ironville	Amber Valley DC	12.12.74
34a	Sheffield & South Yorkshire Navigation	*Canal Wharf Depot	Sheffield MB	28.6.73
		*Bridge Warehouse, Canal Wharf	Sheffield MB	17.7.74
	Aire & Calder Navigation			
35a	Main Line	17/19 Bridge End	Leeds MB	27.5.63
35c	Selby Canal	Brayton Bridge, Brayton	Selby DC	17.11.66
		Tankards Bridge, West Haddlesey	Selby DC	17.11.66
		Paper House Bridge, Chapel Haddlesey	Selby DC	17.11.66
36	Calder & Hebble Navigation	Wakefield Old Lock, Barnsley Road	Wakefield MB	20.3.71
		Thornes Locks	Wakefield MB	30.3.71
		Navigation Warehouse, Thornes	Wakefield MB	30.3.71
39	Ashton Canal	Roving Bridge over Peak Forest Canal	Tameside DC	Provisional
40	Peak Forest Canal	Marple Aqueduct (part)	Stockport MB	29.3.66
		Marple Aqueduct (part)	Stockport MB	20.12.67
		Canal Warehouse, Whaley Bridge	High Peak DC	5.1.73
41	Macclesfield Canal	Palmerston Street Aqueduct	Macclesfield DC	17.3.66
		Gurnett Aqueduct, Sutton over River Bollen	Macclesfield DC	14.4.67
		Roving Bridge No.1	Stockport MB	20.12.67
42	Caldon Canal	Hazlehurst Aqueduct	Staffs & Moorlands MB	3.1.67
		Hazlehurst Iron Bridge	Staffs & Moorlands MB	1.2.67
45	Leeds & Liverpool Canal	Five-Rise Locks, Bingley	Bradford MB	9.8.66
		Seven Arches Aqueduct (part)	Bradford MB	22.11.66
		Seven Arches Aqueduct (part)	Bradford MB	10.1.73
		*Former BWB Office, Lanam Wharf	Blackburn MB	19.4.74
		*Canal House (No. 50)	Blackburn MB	19.4.74
		*Bank Cottage	Blackburn MB	19.4.74
		*Warehouses A, B, C, D & E	Blackburn MB	19.4.74
		*Iron Capstan Base	Blackburn MB	19.4.74
		Linedred Canal Bridge, Briarfield	Blackburn MB	19.4.74
46	Lancaster Canal	Lune Aqueduct (part)	Lancaster DC	22.12.53
		Lune Aqueduct (part)	Lancaster DC	4.10.67

(Continued on next page)

Table 6.2 Continued

Waterway Ref. No.	Waterway	Description	Location	Date Listed
	Lancaster Canal (Continued)	Garstand Aqueduct	Wyre DC	17.4.67
		Keer Aqueduct, Borwick	S. Lakeland DC	4.10.67
		Halton Road Bridge	Lancaster DC	30.11.70
		Basin Bridge	Lancaster DC	30.11.70
		Carr Lane Bridge	Lancaster DC	30.11.70
		*Old Boathouse, Aldcliffe Road Basin	Lancaster DC	30.11.70
47	Caledonian Canal	Dochgarroch Loch, Inverness	Inverness DC	26.1.73
		Bona Lighthouse	Inverness DC	26.1.73
		Five Locks, Fort Augustus	Inverness DC	6.10.72
		Tunnels near Torcastle, Kilmallie	Lochaber DC	15.10.73
		Moy Bridge, Kilmallie	Lochaber DC	2.3.73
		Lighthouse, Gairlochy	Lochaber DC	15.10.71
		*Lock-keeper's House, Gairlochy	Lochaber DC	15.10.71
		Lock Basins & Sluice, Gairlochy	Lochaber DC	15.10.71
		Laggan Locks, Kilmonivaig	Lochaber DC	15.10.71
48	Crinan Canal	*Cottage, Oakfield Bridge, Knapdale	South Argyll DC	23.7.71
49a	Forth & Clyde Canal	Kelvin Aqueduct	Glasgow City	26.4.72
		Canal Buildings, Cadder	Bishopbriggs & Kirkintilloch DCs	12.1.71
50	Union Canal	Avon Aqueduct	West Lothian DC	29.3.71
		Glen High Bridge No. 61	Falkirk DC	15.7.71
		Canal Tunnel, Falkirk	Falkirk DC	15.7.71
		Bridge No. 62, Falkirk.	Falkirk DC	15.7.71
		Feeder Aqueduct, Almondell	West Lothian DC	22.1.71

* Non-operational property

Table 6.3

CANALSIDE CONSERVATION AREAS
(as at July 1975)

Waterway Ref. No.	Waterway	Area	County
1a	River Lee Navigation	Cheshunt, Hoddesdon, Hertford (Centre-Hertfordbury Park)	Hertfordshire
		Waltham Abbey	Essex
		Newham Three Mills, Ponders End, Enfield Flour Mills	Greater London Council
1b	River Stort Navigation	Sawbridgeworth, Bishop's Stortford	Hertfordshire
	Grand Union Canal		
2a	Regents Canal	Regents Park Terraces, Primrose Hill, Keystone Terrace, Barnsley, St. Peter's Wood, Arlington Square, The Three Mills, Bromley-by-Bow	Greater London Council
2b	Hertford Union Canal	Clapton Common	Greater London Council
3	Main Line (S)	Harefield Village, Ickenham Village, Norwood Green, Northolt Green Village, Isleworth Riverside, The Butts (Brentford)	Greater London Council
		Grove Mill	Watford BC
		Aylesbury, Castlethorpe, Eton, Mentmore, Buckland, Denham	Buckinghamshire

(Continued on next page)

Table 6.3 Continued

Waterway Ref. No.	Waterway	Area	County
	Main Line (S) (Continued)	Ivinghoe, Newport Pagnell, Wendover	
		Long Marston, Wilston, Tring, Aldbury	Hertfordshire
		Daventry, Ecton, Ashton, Ashby-St-Ledgers	Northamptonshire
5, 27a	Leicester Section	Buckingham, Padbury	Buckinghamshire
27b		Wicken	Northamptonshire
		Rothley, Old Wood House, Barby, Burton Overy, Cossington, Hoby, Loughborough Rotherby, East Langton, Market Harborough Great Bowden	Leicestershire
6	Main Line (N)	Long Itchington, Offchurch, Leamington Spa, Warwick, Temple Balsall, Barston, Hampton-in-Arden	Warwickshire
7	Stratford-on-Avon Canal	Lapworth, Wooton Wawen, Henley-in-Arden, Bearley, Wilmcote, Shottery, Stratford	Warwickshire
8	Coventry Canal	Atherstone, Mancetter, Brinklow, Rugby (Town Centre)	Warwickshire
9	Ashby Canal	Market Bosworth	Leicestershire
10 & 11	Oxford Canal	Wormleighton, Priors Marston	Warwickshire
		Aynho, Kings Sutton	Northamptonshire
		Oxford, Banbury	Oxfordshire
12	Kennet & Avon Canal	Bath	Bath CBC
		Bathford, Freshford, Monkton Combe	Somerset
		Chilton Foliat, Froxfield, Little Bedwyn, Great Bedwyn, East Grafton, Wooton Rivers, Easton Royal, Milton Lilbourne, Oare, Pewsey, Wilcot, All Cannings, Bishops Cannings, Etchilhampton, Devizes, Potterne, Poulshot, Seend, Melksham, Keevil, Broughton Gifford, Holt, Trowbridge, Bradford-on-Avon, Winsley, Turleigh, Bingley, East Morton, Saltaire, Kildwick, Little London, Yeadon, Horsforth, Pudsey Fulneck.	Wiltshire
		Hungerford, Kintbury, Newbury, (Donnington Crescent, Market Place, Northbrook Street, Pound Lane, Shaw Crescent, Stroud Street), Bognor, Donnington, Shaw, Speen, Aldermaston, Theale	Berkshire
13	Bridgewater & Taunton Canal	North Curry, Taunton, Bridgwater, Bridgwater Docks	Somerset
14a	Monmouthshire & Brecon Canal	Brecon, Crickhowell, Llangattock	Powys
		Llanover, Abergavenny	Gwent
	Swansea Canal	Cilybebyll	Glamorgan
15	Gloucester & Sharpness Canal	Gloucester Docks	Gloucestershire
16	River Severn Navigation	Frampton-upon-Severn, Berkeley	Gloucestershire
		Bewdley, Stourport, Hartlebury, Ombersley, Kempsey, Hanley Castle, Upton-on-Severn Ripple, Worcester (Cathedral & Setting, Brittannik Square, City Area)	Worcestershire
17	Worcester & Birmingham Canal	Worcester (Lansdown & Rainbow Hill)	Worcester CBC
		Crowle, Bromsgrove, Alvechurch	Worcestershire
		Bourneville Village	Birmingham CBC
18	Staffordshire & Worcestershire Canal	Trysull, Wonbourne, Envile, Kinver	Staffordshire
		Tettenhall, Lower Green	Woverhampton CBC
		Stourport, Hartlebury, Bewdley, Wolverley	Worcestershire
	Birmingham Canal Navigations		
20a	Main Lines	St. Peter's Place	Birmingham CBC

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Table 6.3 Continued

Waterway Ref. No.	Waterway	Area	County
	Birmingham Canal Navigations (Continued)		
20b	Birmingham & Fazeley Canal	St Paul's Square-Farmer's Bridge Locks, Whittington, Lichfield, Wall	Staffordshire
20c	Other Lines	Rushall Hall	Walsall CBC
	Shropshire Union Canal		
21a	Main Line (S)	High Offley, Norbury Junction, Gnosall, Church Eaton, Lapley, Brewood, Chillington, Codsall, Oaken	Staffordshire
		Market Drayton	Shropshire
21b	Main Line (N)	Nantwich, Bunbury Higher, Bunbury Lower, Christleton, Church Minshull, Tattenhall Tarporely, Chester City	Cheshire
21d	Llangollen Branch	Llangollen, Trefor, Froncysyllte, Chirk, Garth	Clwyd
		Wrenbury	Cheshire
21e	Montgomery Branch	Welshpool, Berriew, Montgomery, Guilesfield	Montgomeryshire
21f	Newport Branch	Newport	Monmouthshire
22	Weaver Navigation	Daresbury, Aston	Cheshire
23a	Trent & Mersey Canal (W)	Sandbach, Daresbury, Audlem	Cheshire
		Stone, Alrewas, Rugeley, Colton, Rolleston, Tutbury, Mavegsn Ridware, Hanstall Ridware, King's Bromley, Barton-under-Needlewood, Newcastle-under-Lyme, Great Haywood, Ingestre, Tixall, Colwich, Milford, Walton, Longdon, Longport	Staffordshire
23b	Trent & Mersey Canal (E)	King's Newton, Melbourne, Rapton	Derbyshire
24	Cromford Canal	Cromford, Bonsall, Matlock Bath, Riber	Derbyshire
	Grand Union Canal		
27b	River Soar Navigation	Leicester (Castle Gardens & St. Nicholas Church, Cathedral & Guildhall, Town Hall Square, Precinct, New Walk)	Leicester CBC
28	Trent Navigation	Nottingham (Castle Park)	Nottingham CBC
		Alkborough, Burton-upon-Stather	Lincolnshire
29	Grantham Canal	Grantham, Harlaxton,	Lincolnshire
30a	Fossdyke Navigation	Burton	Lindsey
30b	Witham Navigation	Lincoln	Lincoln CBC
31a	Chesterfield Canal	Barlborough, Eckington, Old Whittington, Staveley	Derbyshire
		Worksop, Eastretford	Nottinghamshire
32	Pocklington Canal	Pocklington	Yorkshire
33a	Ripon Canal	Studley Roger, Ripon	Yorkshire
33b	Ure Navigation	Bishop Monkton, Boroughbridge, Roecliffe	Yorkshire
34a	Sheffield & South Yorkshire Navigation	Sprotborough, Thames, Hatfield, Conisborough	Yorkshire
	Aire & Calder Navigation		
35a	Main Line	Snaith, Pontefract	Yorkshire
35b	Selby Canal	Selby, Brayton	Yorkshire
36	Calder & Hebble Navigation	Hebdon Bridge, Luddenden, Horbury, Chapelthorpe, Heath, Hewmillardom	Yorkshire
38	Huddersfield Narrow Canal	Dobcross, Harrop Green, Diglea, Delph, Marsden	Yorkshire
39	Ashton Canal	Droylesdon	Lancashire
		Disley (Moravian Settlement) , Highe Disley	Cheshire

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Table 6.3 Continued

Waterway Ref. No.	Waterway	Area	County
41	Macclesfield	Macclesfield (Town Centre, Park Green and a 22.5 km length of canal)	Macclesfield CBC
		Gawsworth, Kerridge, Prestbury	Cheshire
42	Caldon Canal	Leek, Horton, Cheddleton, Endon, Stanley, Bagnall, Kingsley	Staffordshire
45	Leeds & Liverpool Canal	Worsley, Newburgh, Waterloo	Lancashire
		East Morton	Keighly CBC
		Armley Mills, Rodley, Kirkstall Abbey, Leeds (Canal Basin, Water Lane)	Leeds CBC
		Bradley, Carleton, Cononley, Embsay, Cargrave, Sutton-in-Graven, Thornton-in-Graven, Skipton	Yorkshire
46	Lancaster Canal	Withnelford, Garstang, Borwick, Priest Hutton Warton, Scorton, Churchtown, Over Kellet Abbey Village	Lancashire
		Lancaster (Castle Precinct, Market Square, St. Georges Quay)	Lancaster CBC
		Burton, Milnthorpe	Westmorland
48	Crinan Canal	Lochgilphead	Argylleshire
49a	Forth & Clyde Canal	Kilsyth, Auchinstarry	Stirlingshire
		Linlithgow	West Lothian
		Glasgow (Maryhill Locks, Kelvin Aqueduct)	Glasgow City
49b	Monkland Canal	Cadder	Lanarkshire
50	Union Canal	Ratho, Currie, Mid Calder, Kirknewton	Midlothian

CHAPTER SEVEN

MINING SUBSIDENCE

Chapter 7:

Mining Subsidence

7.1 *Introduction*

7.1.1. Waterways are particularly sensitive to the effects of mining and quarrying for minerals, much more so (for reasons that will be given) than roads and railways. Such operations are to a very large extent in the hands of other parties, with the consequence that the expense to which BWB may be put in providing preventive and remedial measures is for the most part beyond their control. In this respect their liabilities are likely to be more onerous than those discussed in Chapter 6, and less predictable than those under operation "Bridgeguard", to be described in Chapter 10.

7.1.2 The principal minerals in question are coal (by both deep mining and open-cast quarrying), brine (by pumping) and sand and gravel working. In the case of coal, owned and worked by the National Coal Board, it might be thought that the apportionment of costs between two nationalised undertakings is a matter of indifference to the total national economy, but to the individual Boards such apportionment is a matter of concern as the costs have to be passed on to their customers or (in the case of BWB) have to be covered by their income. There is in any case scope for consultation and coordination of activities with a view to minimising the total expense of mining a given quantity of coal.

7.1.3 The position of the BWB differs between the kinds of mineral, however, and the purpose of this chapter is to review the legal situation under each heading, to identify the waterways that are respectively affected and to discuss the factors giving rise to the need for works of a preventive and remedial character. One common factor is the vital necessity of preserving the integrity of the banks and structures of the waterways, when threatened with subsidence or distortion as a result of mining operations, so as to avoid any risk of overtopping, which might lead on to a breach or other danger to the public.

7.2 *Coal Mining*

7.2.1 The great majority of the enabling Acts for the original canals and navigations did not contain general clauses regulating the working of minerals similar to those applying to railways and derived from the Railway Clauses (Consolidation) Act 1845. Some of the earliest Acts indeed predated the beginning of deep coal mining, but most later Acts contain various provisions for defining the respective rights and powers of the waterway authority and the mine owner.

7.2.2 Because of subsequent changes in mining law it is unnecessary to consider the background in any detail but in general a waterway authority would possess one or more of the following kinds of right against a mine owner whose intended workings might threaten the stability of the waterway:—

(a) an express right of support, with compensation already paid to the owner for the loss of value of the coal so sterilised,

(b) an implied right of support, with compensation paid at the time the loss became effective,

(c) a right of warning of approach of workings within a specified distance, with the option to purchase support at that time if so desired.

7.2.3 Statutory rights of support do not, however, completely exclude common law rights and it is now well established that common law rights may still be relied upon outside the limits laid down by statute. In practice the situation was sometimes far from clear, particularly when mine workings were liable to affect waterways having different protective provisions or limits. Then the Coal Mining (Subsidence) Act 1957 made the National Coal Board generally liable for repairing damage caused by subsidence, thus offering to the surface owner a new kind of remedy as an alternative to those he had under statute or at common law.

7.2.4 In 1959 an Agreement was entered into between the British Transport Commission and the National Coal Board which, in effect, took the place of all existing rights of both parties in respect of subsidence and damage. Under this new Agreement (which is subject to six months notice of termination in or after July 1978) the BWB may opt to "sterilise" at 10p per ton any coal they deem it necessary to retain for the support of their system, or alternatively to suffer the damage and then be paid 70% of the cost of consequent remedial works. With recent inflationary trends it is more likely to be cheaper nowadays to sterilise at 10p per ton than to pay 30% of a repair bill.

7.2.5 For this and other reasons the National Coal Board will not be willing to renew the Agreement in 1978 on such terms. On the other hand the BWB have for the time being foregone the statutory benefit they had on several waterways in the north east of England to claim full rights of support, based on the decision in LNWR Co. v Evans (1893) 1 Ch. 16. When the 1959 Agreement was entered into settlement of all outstanding claims was effected and with the working out of many of the older coal fields it may be taken that there are no arrears of maintenance from past workings. All active workings, subsidence, damage, preventive and remedial works are kept under continuous review, as described below, and the Board's liabilities are therefore known and provided for so far as they can be foreseen at present.

7.2.6 The Coal Industry Bill published in January 1975 aims at boosting coal production by giving the NCB wider powers and reducing the ability of surface owners to withhold consent to workings, even if likely to cause widespread subsidence. Until these measures become effective in law it is not possible to say what their effect on the Board's liabilities will be. If it is assumed that the present Agreement will continue for the time being to control relationships with the NCB, the situation will clearly come up for reconsideration in or before 1978 in a completely new context. We are not, therefore, in a position to make any estimate of expenditure to be incurred after that date.

7.2.7 Not all the BWB's waterways are affected by coal mining operations. In the past there was much activity in the Midlands and North of England but many of the former fields have been worked out. Nevertheless some of their legacies in the form of high embankments, resulting from the making up of subsidence, may still be seen on the Birmingham Canals and the Leeds and Liverpool Canal. Some canals had to be

Fig. 7.1 Locations of Mining Activities near Waterways