1947 RIVER LEE FLOODS

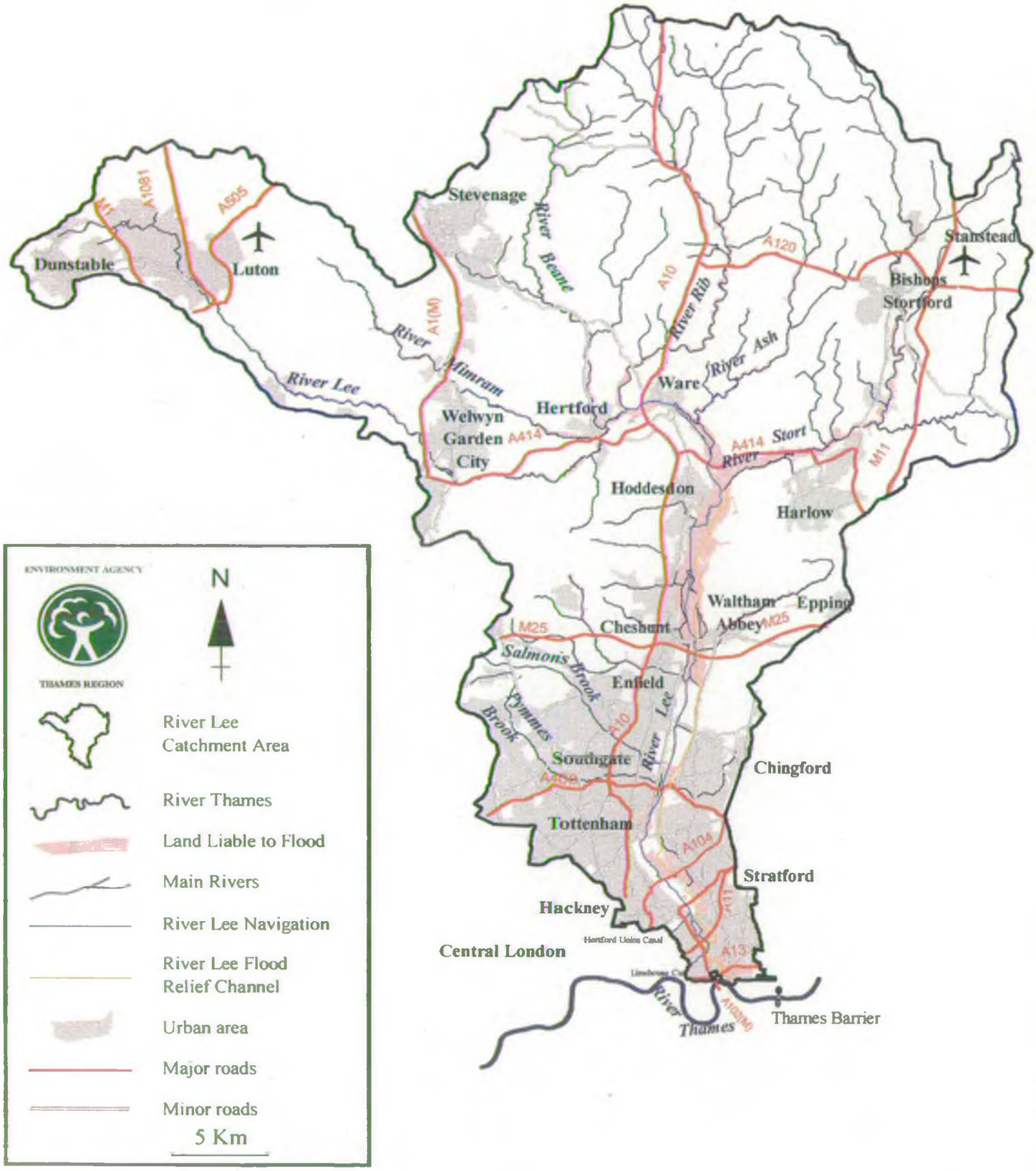
50

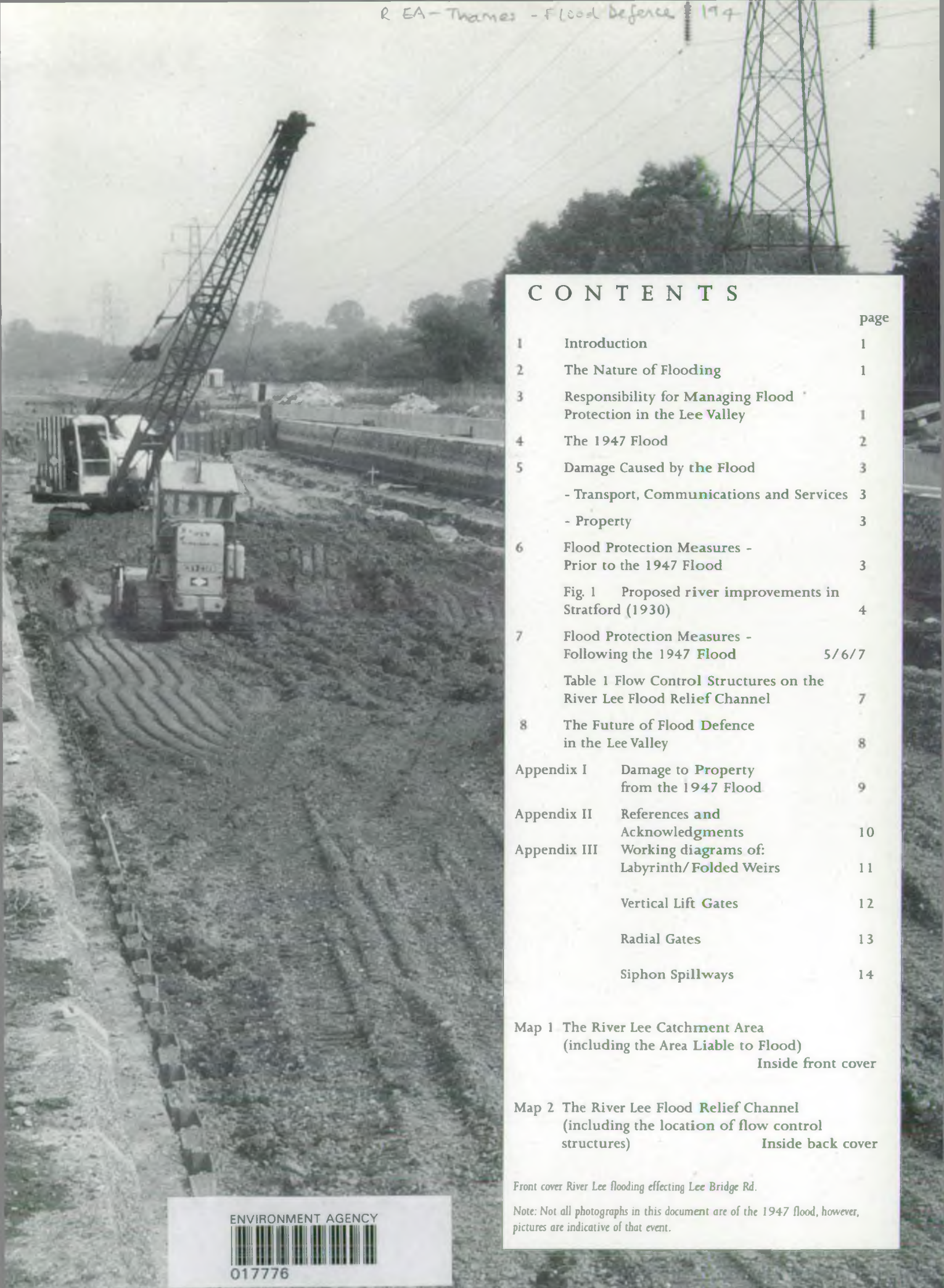
YEARS ON

ENVIRONMENT AGENCY

MAP 1

River Lee Catchment Area Showing Land Liable To Flood (based on extent of 1947 flooding)





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Map 1 The River Lee Catchment Area (including the Area Liable to Flood) Inside front cover

Map 2 The River Lee Flood Relief Channel (including the location of flow control structures) Inside back cover

Front cover River Lee flooding effecting Lee Bridge Rd.

Note: Not all photographs in this document are of the 1947 flood, however, pictures are indicative of that event.

1 INTRODUCTION

1997 marks the 50th anniversary of one of the River Lee's most damaging floods. At the time it was recorded as being the Lee's worst flood in living memory. This booklet describes what happened, the damage that was caused and what has since been done to alleviate the effects of flooding. The booklet also contains historical and reference material regarding the nature of flooding generally, the River Lee's flood history specifically, who has been responsible for managing the river and the future of flood management issues in the Lee Valley. The booklet is illustrated by maps, photographs and diagrams which illustrate aspects of flooding and flood management in the Lee Valley.

The booklet is aimed at providing information for people interested in the subject of flooding history and flood management of the River Lee. The Environment Agency hope that it will be useful to the general public, students studying for GCSE or higher level qualifications and teachers of other pupils.

2 THE NATURE OF FLOODING

The river network carries surplus surface water, ie rainfall, from land to the sea as part of the hydrological cycle. In lowland watercourses, such as the River Lee, flooding results from prolonged periods of rainfall, thunderstorms or rapid snowmelt. Watercourses have a limited capacity. When this capacity is exceeded, flooding occurs and water flows over the river banks and into the floodplain. The floodplain is as much a part of the river system as the channel which carries normal flows. It consists of low lying land adjacent to the river channel. The capacity to store and carry flood water is reduced if significant areas of floodplain have been raised, embanked, or built upon.

Flooding is a natural occurrence and reports of major floods in the Lee Valley date back to the 1800s with notable occasions being:

1839 (undated)
October/November 1857
August 1892
6th November 1894
7th February 1897
18th February 1900
17th June 1903
19th January 1918
18th February 1919
30th April 1919
7th June 1928

Tottenham Marshes flooded up to the London-Cambridge railway line (1892)

In the past the flooding had not been such a big issue because most of the riverside land was grazed and people knew not to build too close to rivers. Indeed periodic flooding actually improved the agricultural value of fields by leaving deposits of rich river sediments on the land. However with the coming of the industrial revolution and the rapid expansion of London, the pressure on land increased. This meant that roads, houses and factories were constructed on open land and fields and, consequently, in places which were prone to flooding.

3 RESPONSIBILITY FOR FLOOD PROTECTION IN THE LEE VALLEY

The River Lee Trust erected this marker after the 1839 flood.

The River Lee has had a very long history of management by a variety of organisations. In 1425 Parliament granted a 'Commission of Conservancy' to look after the River Lee. This was known, in its later years at least, as The River Lee Trust and was the first such organisation in England. In 1868 the 'Lee Conservancy Act' set up the Lee Conservancy Board (LCB) to oversee Flooding, Navigation and later, pollution of the River Lee.

The LCB was replaced by the Lee Conservancy Catchment Board (LCCB) under the Lee Conservancy Catchment Board Act 1930. The LCCB carried on the LCB's work although the Navigation role was transferred to the Transport Commission in 1948 and later to British Waterways Board, which was created in 1963 specifically to manage Navigation Transport.

The course of the River Lee was hugely altered by the need to provide drinking water to London. The New River Company abstracted water from Amwell and supplied London via the New River which was constructed in the early 1600s. Later, from the mid 1800s through to the middle of this century the Lee Valley reservoirs were constructed to store water for London. The Lee supplies around one sixth of London's drinking water. The reservoirs are all constructed in the natural floodplain of the River Lee and the river was diverted around them.

The LCCB was replaced by the creation of Thames Water Authority (TWA) in 1974. TWA also incorporated the whole of the water supply and sewage disposal industry. This meant that one organisation was responsible for both monitoring and regulating the river, in terms of flooding, pollution and protection of water resources and was responsible for abstracting water and discharging sewage effluent back into rivers. There was a potential for conflict of interest here as TWA could be seen as "both poacher and gamekeeper". For example, TWA were one of the largest abstractors of water (principally for water supply), whilst at the same time being the organisation responsible for the granting of abstraction licences.

In 1989 the water industry was privatised and the regulatory functions, including Flood Defence, were vested in the newly created National Rivers Authority (NRA). This period of time also saw the rise of widespread environmental awareness. The NRA was widely regarded as the most powerful environmental protection agency in Europe. The NRA continued to manage flood defences for the Lee Valley although no major flooding took place during its existence.

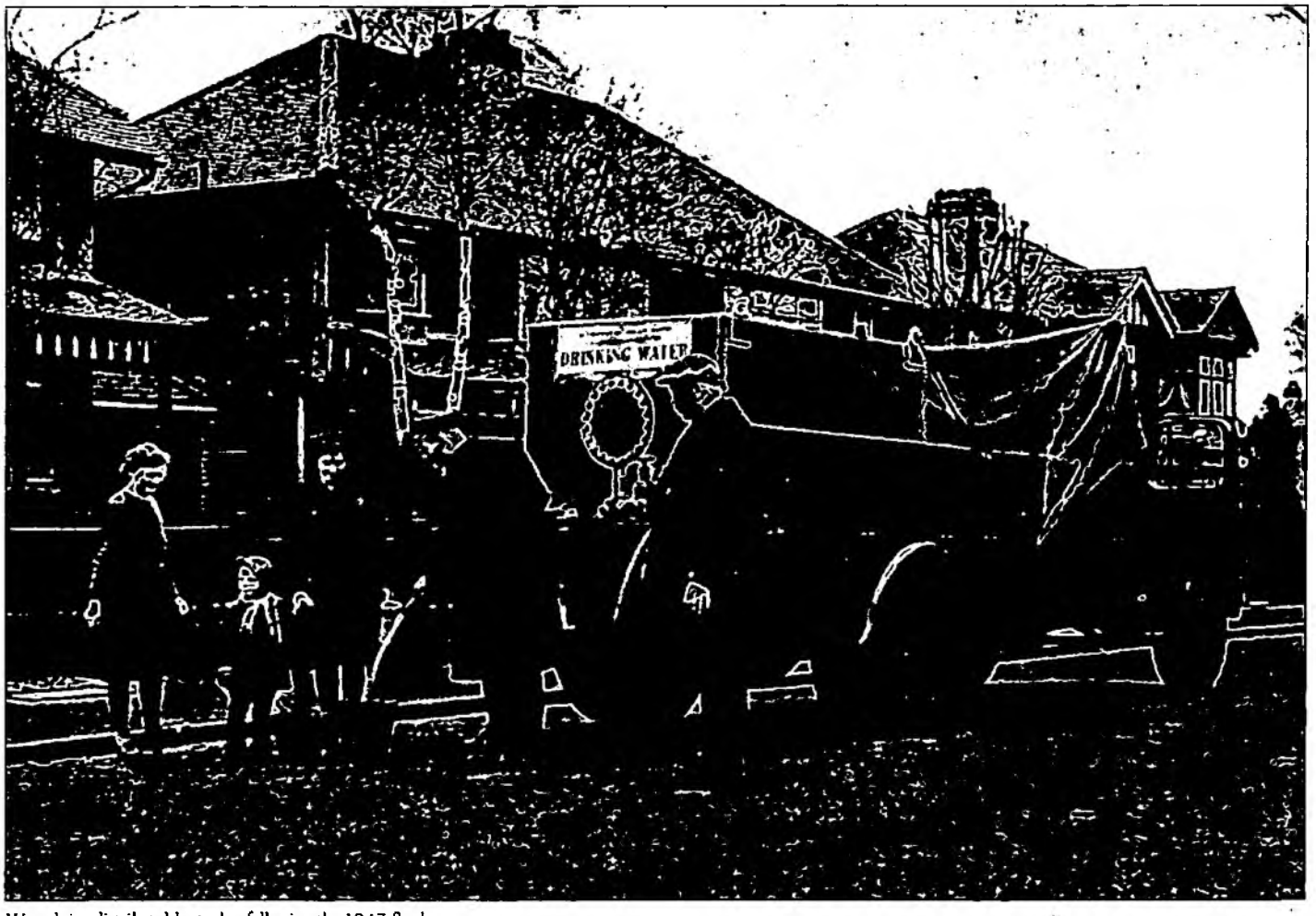
In April 1996 the NRA joined forces with Her Majesty's Inspectorate of Pollution and the waste regulation authorities to form the Environment Agency (The Agency). The Agency is responsible for a wide range of environmental issues including the water environment, waste regulation and emissions from certain industrial processes. Today, responsibility for flood defence on the River Lee rests with the Environment Agency.

4 THE 1947 FLOOD

The winter of 1946/7 was bitterly cold; indeed the sea froze over along parts of the English Channel coast. In the early part of 1947 heavy and continuous falls of snow occurred which settled to form a thick blanket of snow (estimated to be 140mm thick (5.5 inches)). The freezing conditions saw the bulk of this snow remain on the ground in rural areas. A general thaw, triggered by rainfall, set in around 12th March. The result was a very rapid melting of the snow and subsequently an extremely high rate of water run-off. Water levels began to rise firstly in the tributaries and then in the main River Lee.

During the evening of the 18th water levels again began to drop steadily. By the evening of the 19th, nearly a week after the first reports of flooding, water levels were at last back to normal.

Flow levels recorded at Feildes Weir, Hoddesdon, were estimated at 114 cubic metres (m^3) per second although the gauging station here was overrun. Measurements at Lee Bridge record the maximum figure as being 156 m^3 per second. This is over half a million tonnes of water (or 7 million baths) per hour! The average dry weather flow is around 7.5 m^3 per second; therefore the flood water was around 20 times greater than the normal flow.



Water being distributed by tanker following the 1947 flood.

By midday on 13th March all sluice gates on the river were fully raised to allow water to pass as freely as possible. However, the rise of water levels continued at such a rate that the water could no longer be controlled. It was around this time that widespread flooding began to occur. Water levels continued to rise until the morning of Saturday 15th March when they reached their peak. During this period it was also raining; a total of 38mm (1.5 inches) of rain fell.

From the afternoon of the 15th to the evening of the 17th water levels dropped slowly. However by the night of the 17th the additional rainfall was also having an impact as it drained off the land and into the rivers. Water levels started to rise again and on the afternoon of the 18th another peak in river flows was reached. This flooded many areas for a second time.

KEY POINTS – Pages 1 & 2

- 1947 flood was the worst in living memory
- River Lee has a long history of flooding
- River Lee has a long history of flood management
- 1947 flood caused by rapid snowmelt
- Flooding is a natural occurrence
- River flow 20 times greater than normal

5 DAMAGE CAUSED BY THE FLOOD

The total amount of land flooded covers an area of some 2960 hectares (7312 acres), that is over 4000 football pitches. The damage and disruption that this caused was considerable.

Transport, Communications and Services

Many forms of communications were affected. The River Lee Navigation was still heavily used by commercial traffic at the time of the flood. Barge traffic was stopped on 11th March when it was realised that major flooding could occur. Breaches of the banks and damage to the canal occurred at several places. These included Waltham Common Lock, Stanstead Cut between Hardmead and Stanstead Locks, Rye House near Hoddesdon, Dobbs Weir, Kings Weir, Enfield Lock, Picketts Lock and two very large breaches near Stonebridge Lock, Tottenham.

This damage meant that when the flood water subsided, the Navigation was opened on 21st March but only as far north as Tottenham. Emergency work then began to repair breaches and remove debris and shoals of sediment that had been deposited further upstream. The Lee Conservancy Catchment Board used their own labour force along with three firms of contractors and three gangs of Prisoners of War in order to complete the work as quickly as possible.

By 31st March the repairs to Enfield Lock, Picketts Lock and Stonebridge Lock were complete and traffic was able to get to Waltham Abbey. By 1st May the rest of the Lee Navigation to Hertford was open but the River Stort Navigation was not fully navigable until 16th June, three months after the flooding occurred.

Many roads were flooded throughout the valley. The Lea Bridge Road was closed as flood waters rose to a depth of nearly 1 metre. The main railway line through Tottenham Hale was flooded and railway services were suspended between 14th and 20th March. Telephones were also affected as underground cables were flooded.

Flood water severely disrupted the Lee Bridge Waterworks putting some pumps out of action and leaving thousands of homes without water. Over 1000 tankers were used to distribute 14 million gallons of drinking water around north and north east London. River water had also flooded the filter beds at the waterworks. This meant that people in a much wider area had to boil their water because of the possibility of contamination. Full water supply was not restored until 2nd April. An estimated population of 1.25 million people were affected in this way.

Property

Appendix I contains a table which details the losses of local businesses due to the flooding. Many hundreds of homes were flooded right along the Lee Valley from Hertford down to Hackney. Some of the worst hit areas were in the middle reaches of the Valley around Broxbourne, Nazeing and Dobbs Weir. Many people had to be evacuated, some were rescued by boat and others were left stranded for several days.

The effects of the flood on private dwellings appears to have been such that no full account has ever been made of the amount of damage that actually occurred.

6 FLOOD PROTECTION MEASURES - Works Prior to the 1947 Floods

As described in Section 2, the River Lee has had a long history of flooding. This was recognised as a problem in the Stratford and Bow areas in the early 1900s as these areas were already heavily urbanised. Flood alleviation works were constructed under the powers granted in the River Lee (Flood Relief etc) Act 1930. This enabled the construction of a 100ft (30m) wide drainage channel from Carpenters Road to Three Mills along the route of Waterworks River, which was previously a much smaller channel. Works were also carried out to the Old River Lee, Three Mills River, City Mill River and Bow Back River.

The mills at Three Mills represented a restriction to river flows. The river was used to power the mills but at times of very high flows this could become a flooding problem. A new channel was constructed to bypass the mills; this was called the Prescott Channel after the then Chairman of the Lee Conservancy Catchment Board, Major Sir William Prescott. The extent of these works are shown in Figure 1.

These works were carried out by the Lee Conservancy Catchment Board and the West Ham Corporation and were completed at a cost of £800 000 in 1936. The Report on the 1947 flood states that;

"The value of this scheme has been proved beyond doubt. During the recent abnormal conditions, no flooding occurred in the Stratford area."

Some local works in the Tottenham Area were also constructed in the early 1930s to alleviate localised flooding. These concentrated on the River Lee New Cut around Ferry Lane.

The Lee Conservancy Catchment Board Act 1938 authorised the Board to widen 2.5km (1.5 miles) of the existing River Lee between Carpenters Road, Stratford and a place known as "The Friends" (see Map 2). Furthermore that 6km (3.75 miles) of entirely new flood channel be constructed from "The Friends" north along the line of Dagenham Brook to join the River Lee Diversion at Chalk Bridge, Tottenham. This channel was to be designed to intercept 75% of the flood water from the upstream catchment area, which entered the Lee Navigation below Tottenham Lock, and led to flooding around Tottenham and Lea Bridge.

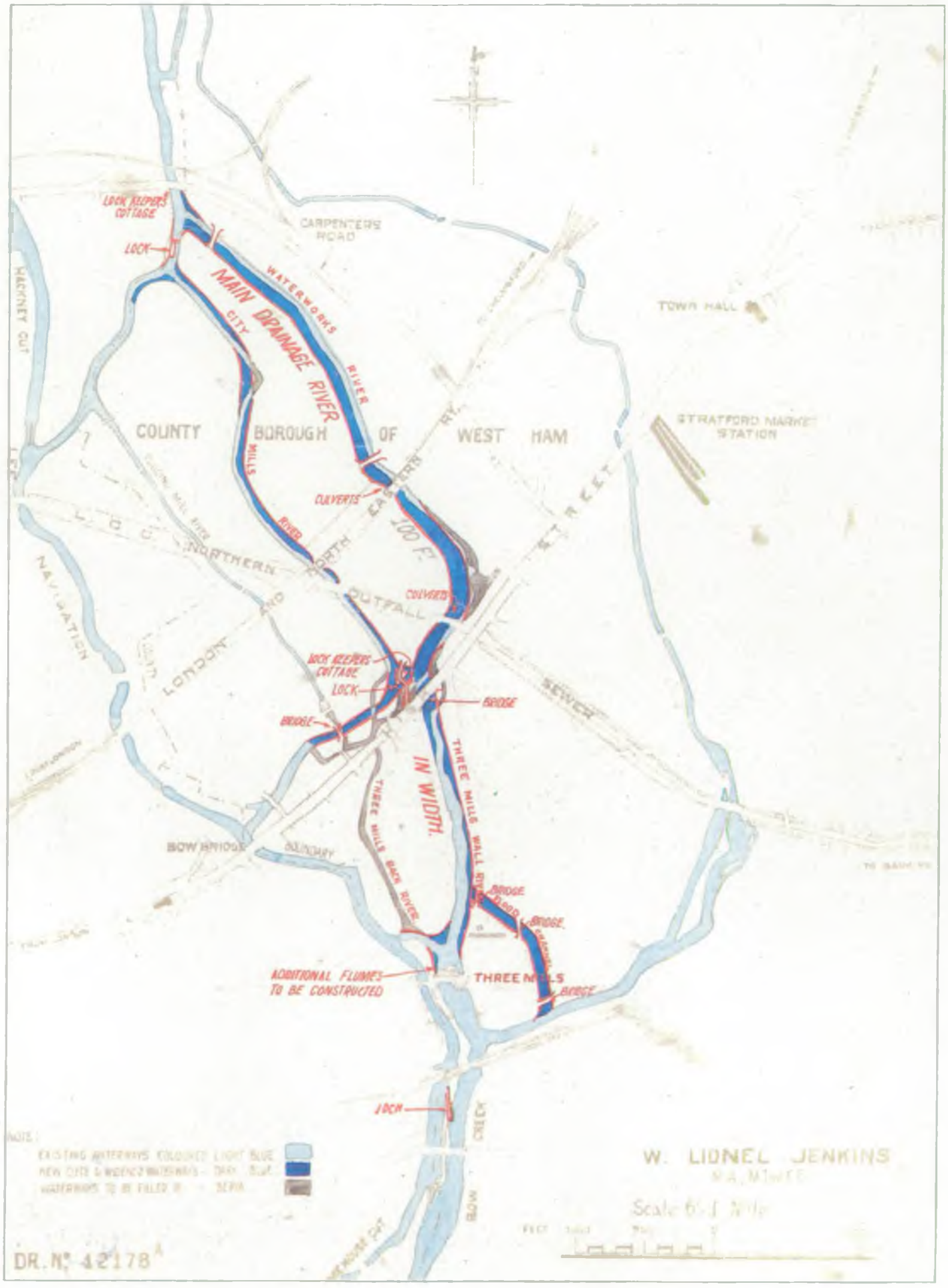
These works passed through heavily built up areas where the size of the channel meant that many other civil engineering projects had to be incorporated into the overall scheme. These included new road bridges to carry Carpenters Road, Eastway, Lea Bridge Road and Ferry Lane as well as four new railway bridges. The project also necessitated the demolition of houses in Elmfield Road, Walthamstow. The Lee Conservancy Catchment board constructed 35 houses at Lee Close, Walthamstow to replace the demolished houses.

Land negotiations and design work commenced on this project in 1938; however, due to the outbreak of World War II, the project was suspended. Therefore this project did not ease flooding in the Tottenham and Lea Bridge areas in 1947. Work resumed just after the war and construction continued into the 1950s.

KEY POINTS – Pages 3 & 4

- 1947 flood caused widespread damage and disruption
- Flood alleviation works protected some areas

FIGURE 1 1930 Plan of river improvements around Stratford



7 FLOOD PROTECTION MEASURES - Works following the 1947 Flood

The Flood Report for the March 1947 event contained some recommendations for further flood relief works. These were: firstly to complete the works already started under the 1938 Act and secondly to increase channel capacities north of Chalk Bridge, Tottenham. These works included widening of river channels through the Royal Small Arms Factory at Enfield Lock, increased capacity through some weirs and a new flood channel through Waltham Marshes to avoid the complicated waterways of the Royal Gunpowder Factory at Waltham Abbey.

There was a realisation that there would be widespread urban development of the upper parts of the Lee catchment area as part of the post war plans to rebuild London and clear its remaining slums. This included the expansion of Hertford, Luton and Dunstable and the creation of the New Towns of Harlow, Hatfield, Welwyn Garden City and Stevenage during the 1960s and 1970s. Urbanisation on this scale would significantly alter the rate at which surface water, ie rainfall, would enter rivers. On open rural land much rainfall is intercepted by vegetation and trees, forms puddles and ponds on the ground, soaks into the ground or works its way through small ditches and into streams before entering rivers. During all of these stages there is time for rainfall to evaporate back into the atmosphere. It also means that the time of travel into rivers varies greatly for different areas thereby dispersing the peak flows which cause flooding.

When open countryside is turned into agricultural land the drainage process can be speeded up somewhat by the straightening and clearance of ditches. However, when land is built upon and a formal drainage system introduced, this process is speeded up considerably. Collectively, this all means that rainwater enters rivers at a very much quicker rate than it would do naturally and that there is less opportunity for evaporation. The result is an increased risk of flooding.

The planning of widespread urban development, combined with the 1947 flooding, led to pressure for a more comprehensive flood alleviation scheme north of Chalk Bridge, Tottenham. In 1963 the Ministry of Agriculture, Fisheries and Food gave the go ahead for work to commence on the Lee Valley Chalk Bridge (Tottenham) to Ware Scheme.

The scheme was estimated at £3.2 million (1958 prices) and was to contain a flood of the same magnitude as the 1947 flood. In the built up area between Tottenham and Enfield land availability was limited, and therefore the channel had to be constructed in concrete with vertical walls in order to achieve sufficient capacity and speed of flow. The speed of flow was designed to be 3m/second (about 7mph, which is somewhat faster than average walking pace which is 3-4mph).

North of Enfield the channel was designed to be predominantly constructed with reinforced natural earth bed and banks. Here land was available to make a channel which was visually more pleasing and some pioneering construction techniques were used. The large scale use of Gabion Baskets was one example. Gabion Baskets are essentially steel mesh cages filled with rocks. They are strong and durable like concrete. However the gaps between the rocks can be filled with soil so that plants could grow from them without damaging the structural stability of the Baskets.

Elmfield Road. The houses shown in the foreground of this picture have been demolished to make way for the River Lee Flood Relief Channel

KEY POINTS – Page 5

- Urban development can increase flood risk
- Flood relief works up to Ware were approved in 1963
- Innovative construction techniques were used

LCCB replacement housing at Lee Close, Walthamstow as new (1954)

Area between King George's Reservoir and Waltham Abbey BEFORE construction of River Lee Flood Relief Channel (Cattlegate Channel).

Area between King George's Reservoir and Waltham Abbey AFTER construction of River Lee Flood Relief Channel (Cattlegate Channel).

Another pioneering technique was the use of a geotextile called Terram. This material allows water to flow through it whilst stabilising soil beneath it. Therefore earth in vulnerable positions, for example river banks, is prevented from being washed away.

In order to maintain water levels in the Flood Relief Channel and to ensure a supply of water for the Lee Navigation, a series of sluices and weirs were also constructed. These maintain a constant level of water in the channel and associated lakes, but enable flood water to be discharged downstream towards the Thames when necessary. These structures are detailed in Table 1, illustrated in Appendix III and located on Map 2.

Between Waltham Abbey and Feildes Weir the Flood Relief Channel was directed through a series of worked out gravel pits. These can act as storage for some of the flood water thereby reducing the capacity needed to contain the floods further downstream.

The Feildes Weir to Ware section of the Flood Relief Channel consists mainly of widening the River Lee Navigation. Clearly the locks on this stretch, namely Stanstead and Hardmead, present an obstruction to flow. Therefore by-pass channels with radial gates were constructed around the locks. The bypass to Stanstead lock is 350 metres long and the one at Hardmead is 200 metres.

The Chalk Bridge - Ware Flood Alleviation Scheme was extended during its construction to include the Ware - Hertford reach of the Lee. The works here also consisted mainly of widening the River Lee Navigation Channel and were completed in 1976. With the completion of the Ware - Hertford works, the River Lee had a comprehensive flood protection system running from Hertford to the River Thames through some highly urbanised areas. Although the scheme was conceived as a number of individual projects with the earliest parts being constructed in the 1930s, it now functions as an integrated system.

TABLE 1: Flow control Structures along the River Lee (See Map 2 for locations)

NAME	TYPE	COMMENTS
Newmans Sluices	4 Vertical Lift Gates	Gates respond automatically to variations in flow but maintain a constant upstream water level in the Flood Relief Channel.
Rammey Marsh Sluices	3 Vertical Lift Gates	Retains water levels in the Flood Relief Channel upstream.
David Stoker Radial Gates	2 Radial Gates	These gates are self regulating using flotation tanks and maintain water levels upstream in the Flood Relief Channel. Originally called Edmonsey Sluices, they were renamed in memory of David Stoker who for many years was a dedicated and admired employee of Thames Water Authority and then the National Rivers Authority. Sadly, David died of cancer in 1995.
Holyfield Weir	Fixed Crest Weir 172m in length	This weir retains water levels in Holyfield Lake.
Kiora Radial Gates	2 Radial Gates	These retain water levels in the Nazeing Channel.
Nazeing Weir	Labyrinth (or Folded) Weir	Retains water in Nazeing Lake.
Kings Weir	Labyrinth Weir	Takes excess flow from the Lee Navigation and discharges it into the Flood Relief Channel via the Old River Lee.
Meadgate Sluices	3 Vertical Lift Gates	Retains water in Meadgate Lake.
Richard White Radial Gates	2 Radial gates	Retains water levels in the Flood Relief Channel upstream of Dobbs Weir Road. Originally called Netherhall Sluices this structure was renamed in memory of Richard White who was a long standing and well respected employee of Thames Water Authority who had much knowledge of the development of the Flood Relief Channel.
Feildes Weir	1 28m fixed crest weir 2 Large vertical lift gates 1 Small vertical lift gate	Here flow from the Upper Lee catchment and River Stort Catchment meet. The flow is split between the Lee Navigation and the Flood Relief Channel.
Stanstead Radial Gate	1 Radial gate	Retains water in the Navigation channel whilst allowing the discharge of flood water through a lock bypass channel. Stanstead Lock would otherwise be a severe obstruction to flow.
Hardmead Radial Gate	1 Radial gate	Retains water in the Navigation channel whilst allowing the discharge of flood water through a lock bypass channel. Hardmead Lock would otherwise be a severe obstruction to flow.
Amwell Magna Weirs	1 Fixed crest weir with a fishpass 1 Labyrinth weir	Controls water levels within Amwell Magna Fishery which is home to the oldest angling club in the country, Amwell Magna Angling Club, formed in 1831.
Ware Weir/Syphon	1 Fixed Crest Weir 1 Single Barrel Syphon	Retains water in Lee Navigation whilst allowing some flood flows into Amwell Magna Fishery.
Ware Lock Weir/Syphon	1 Fixed Crest Weir 3 Barrel Syphon	Retains water in Lee Navigation whilst allowing flood flows past the lock and old Mill Stream.
Lee Tidal Barrier	3 Vertical Lift Gates	These gates used to stand across Bow Creek, near the confluence of the Lee and the Thames. They were designed to prevent high tides from causing flooding in the East End. They became obsolete and were subsequently removed following the construction of the Thames Barrier.
Chalk Bridge Sluices	2 Vertical Lift Gates (now welded into a fixed position)	The gates were fitted as part of flood defences in the Tottenham area before the Chalk Bridge - Ware Flood Alleviation Scheme. They are now fixed in a semi closed position to divert flood flows along the Lee Flood Relief Channel whilst allowing some flow along the River Lee (New Cut). Originally they were known as Green Gates Sluices.

8 THE FUTURE OF FLOOD DEFENCE IN THE LEE VALLEY

During the planning and construction stages of the River Lee Flood Relief Channel there were a number of flooding incidents, particular years include; 1949 and 1968. However since the completion of the scheme in 1976 there has been no major flooding in the Lee Valley. This demonstrates the value of the Flood Relief Channel. It should, however, be remembered that flooding is a natural phenomenon and that the risk of it occurring can only ever be reduced and not eliminated. It is therefore possible that very extreme weather conditions could still lead to widespread flooding. Near misses in recent years include the storms of October 1987 and October 1993 when the Flood Relief Channel was almost full. Some localised flooding of tributary rivers has also occurred.

Although the Lee Flood Relief Channel is complete, the Channel itself and the flow control structures along it all need continual inspection and maintenance. This currently accounts for an average of £160 000 per year of the Environment Agency's budget. In addition to the annual maintenance, some of the structures have required major refurbishment and repairs over the last five years. This has amounted to further expenditure in excess of £2 million.

Without such expenditure the system may be prone to failure or breakdown at the times when it is needed most, namely during heavy rainfall.

The River Lee Flood Relief Channel performs its function very well. However the job it does is to satisfy human demands, ie the protection of people and property from flooding. It is not the way that nature intended the river to behave. The River Lee would naturally flood into its floodplain. The floodplain area supports a rich variety of wildlife and much of this has been lost due to the operation of the flood channel and the encroachment of urban development. Old flood meadows are drying out. This changes the ecology, usually for the worse, by reducing the biodiversity of the habitat. Biodiversity means the range of animals, plants and insects that live in a particular area. Another impact is that archaeological remains that were preserved in the waterlogged ground are in danger of drying out and decaying.

Therefore there are arguments to suggest that we should let more land flood during times of high rainfall to mimic the natural situation. The problem is that much of the River Lee's floodplain, and that of many other rivers too, is now built upon. It would be unacceptable to allow such areas to flood regularly because of the damage to property and the safety risk that this would present. Instead we must seek to prevent the remaining floodplain from being built upon. The Environment Agency does not have the power to do this directly and relies on influencing local councils when they make decisions regarding planning applications to build on the floodplain.

The level of protection that the River Lee Flood Relief Channel offers may also have changed. Originally it was designed to cope with a flood of the scale experienced in 1947, a flood which could be expected roughly once in 70 years. However since its design the development of roads, houses, shops and other urban land uses has continued apace. This will have changed the rain water run-off patterns and may mean that a flood of 1947 proportions or larger could happen more often.

In order to assess this situation the Environment Agency is preparing a detailed computer model of the River Lee and its tributaries to establish how much flood protection is currently being provided.

Whatever happens the Environment Agency will continue to place protection from flooding as a top priority for the Lee Valley.

For more information contact:

The Environment Agency
Apollo Court,
2 Bishop Square,
St Albans Road West
Hatfield
Hertfordshire AL10 9EX
Tel: 01707 632500

For 24 hour information and advice on flood warnings in England and Wales, call;

ENVIRONMENT AGENCY FLOOD CALL 0645 88 11 88

KEY POINTS – Pages 7 & 8

- The Flood Alleviation Works extended to Hertford
- All works completed in 1976
- The Lee Flood Relief Channel requires constant maintenance
- The Works have changed the nature of the Lee Valley

Lea Bridge Road, Clapton showing Lee Bridge Water Works

Nb. People using boats for transport

APPENDIX I
DAMAGE TO PROPERTY IN THE 1947 FLOOD

Taken from the Report on the Flooding in the Lee Valley during March 1947, published by the Lee Conservancy Catchment Board, 18th July 1947.

FACTORIES, ETC., FLOODED

FIRM	ESTIMATED LOSS (£s 1947 prices)
Lea Bridge and Tottenham area	
James Latham, Ltd.	
Plywood and Veneer	1,000
Timber	250
Lea Valley Laundry	
Motors re-wound	350
Messrs. John Clark & Co, Piano Frame Manufacturers.	
Out of action for one month	
John Dickinson & Co., Ltd., Paper Mills	300
The Mills Equipment Co., Ltd. (Pumping)	50
Gestetner, Ltd. (Pumping)	300
Ferry Lane Wharf. Small Clients	500
Timber and Paper Control	Substantial
Keith Blackman Ltd. Plus 2.5 days' Production Loss	7,000
Atlas Emery Works	6;000
Northmet Transformer Station, Edmonton	400
Supersuites, Ltd.	300
Andrew Austin, Ltd.(Cleaning Powder Manufacturers)	980
Gospo, Ltd	800
F. Coals, Ltd., Experimental Engineers.	
(Machine Tool Manufacturers)	7,000
The Century Glass Works, Ltd. (Also loss of 1_ shifts)	1,000
Fred. Liebetruth, Ltd. Box Manufacturers	1,800
Luxram Electric, Ltd., (Electrical Manufacturers)	1,000
E. Turner, Ltd., (Furniture Manufacturers)	4,000
Leyton area	
D. Smith & Sons Ltd., Lee Bridge Road.	5,000
Messers. H. Darby & Son, Lee Bridge Road	80
British Celilynd, Ltd.,	300
H. Young & Co., Ltd., and	
Powers & Dean, Ransomes Ltd., Burwell Road	20
L. Hyams, Ltd., Argall Avenue.	400
S. E. Porter & Sons, Ltd., Argall Avenue	No figure.
I. & R. Morley, Ltd., Argall Avenue	Estimated at thousands, but not divulged.
Walkers, Dyers & Cleaners, Argall Avenue	Not ascertained.
W. Saper, Ltd., Argall Avenue	5,000
S. Kaye & Sons, Ltd.	800
Fred. G. Johns & Co., Ltd., Argall Avenue	4,000

FIRM	ESTIMATED LOSS (£s 1947 prices)
Leyton area continued	
Lewden Metal Products, Ltd., Argall Avenue	No figure.
Spurdens, Ltd., Argall Avenue	60
Andrew Arnold, Ltd., and	
Bowes, Salters & Co., Ltd Argall Avenue	500
Thos. E. Evans, Ltd., Argall Avenue	20
Super Metal Stampings, Ltd.,, Argall Avenue	4,000
C. E.Jones & Sons, Argall Avenue	750
Hobbs Hart & Co., Ltd., Staffa Road	500
Commercial Structures, Ltd., Staffa Road	600
Caribonum, Ltd., Eltoe Road	200
Lea Bridge District Gas Co.	93
Edmonton area	
Austin Veneer & Panel Co., Ltd	10,000
Metal Structures, Ltd.,	3,000
Times Veneer Co., Ltd.,	100
Atlas Lamp Works, Ltd.,	800
Ever Ready Co. (Great Britain), Ltd.,	5,000
Harris Lebus	10,000
L. Hall (Edmonton), Ltd	4,000
Cheshunt area	
Cheshunt Householders' losses	4,000
Broxbourne and St. Margaret's area	
Ministry of Supply	128
Henry Page & Co., Ltd.	400
Ware area	
Ware Urban District Council	40
Ware Rural District Council.	
Damage to pumping plant, vehicles, etc	
Henry Page & Co., Ltd.	400
A.B. Swain & Co., Ltd	1,000
C. Albany 7 Son, Ltd.,	750
Hertford area	
Hertford Corporation (Council property only)	1,500

APPENDIX II
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Consulting Engineers Report on River Lee Watershed (Flood Prevention) Act, 1920
Lee Conservancy Board, 1920

Lower Lee Catchment Management Plan - Action Plan
National Rivers Authority, November 1995

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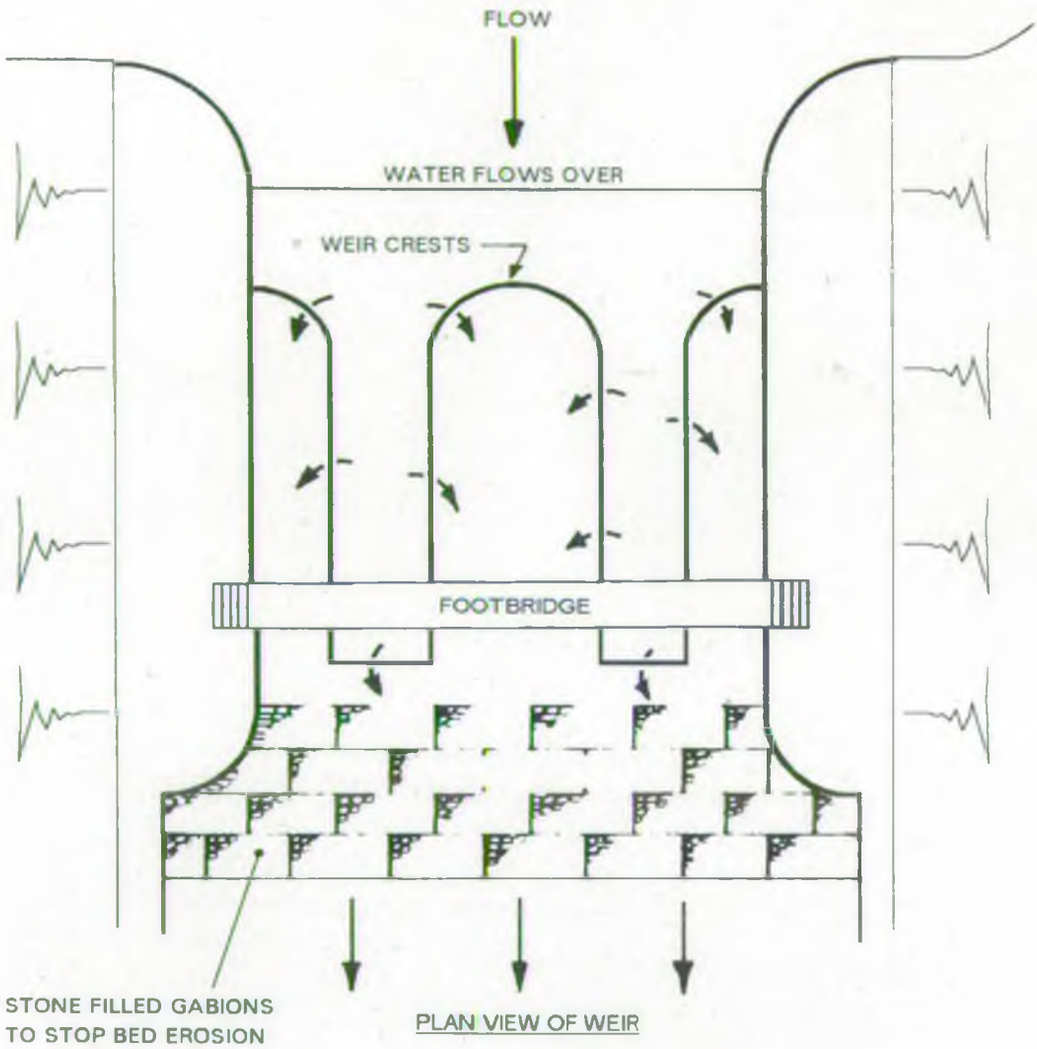
Cheshunt Library, *Crossbrook Street, Cheshunt, Herts.*

Stanstead Radial Gate Structure (looking upstream)

APPENDIX III

LABYRINTH OR FOLD WEIRS

A labyrinth weir is characterised by its folded appearance. The weir is shaped in this way to allow a longer length of weir for the water to flow over compared to a traditional straight weir occupying the same space. With more weir length available, more water is able to pass therefore keeping water levels upstream lower than they would be with a straight weir. This affect is beneficial in locations where river banks are relatively low upstream of the weir.



The principle of a folded weir is that it can discharge very high flow for a relatively narrow channel. If the weir was straight in plan it would be 2-3 times wider.

LABYRINTH OR FOLDED WEIR

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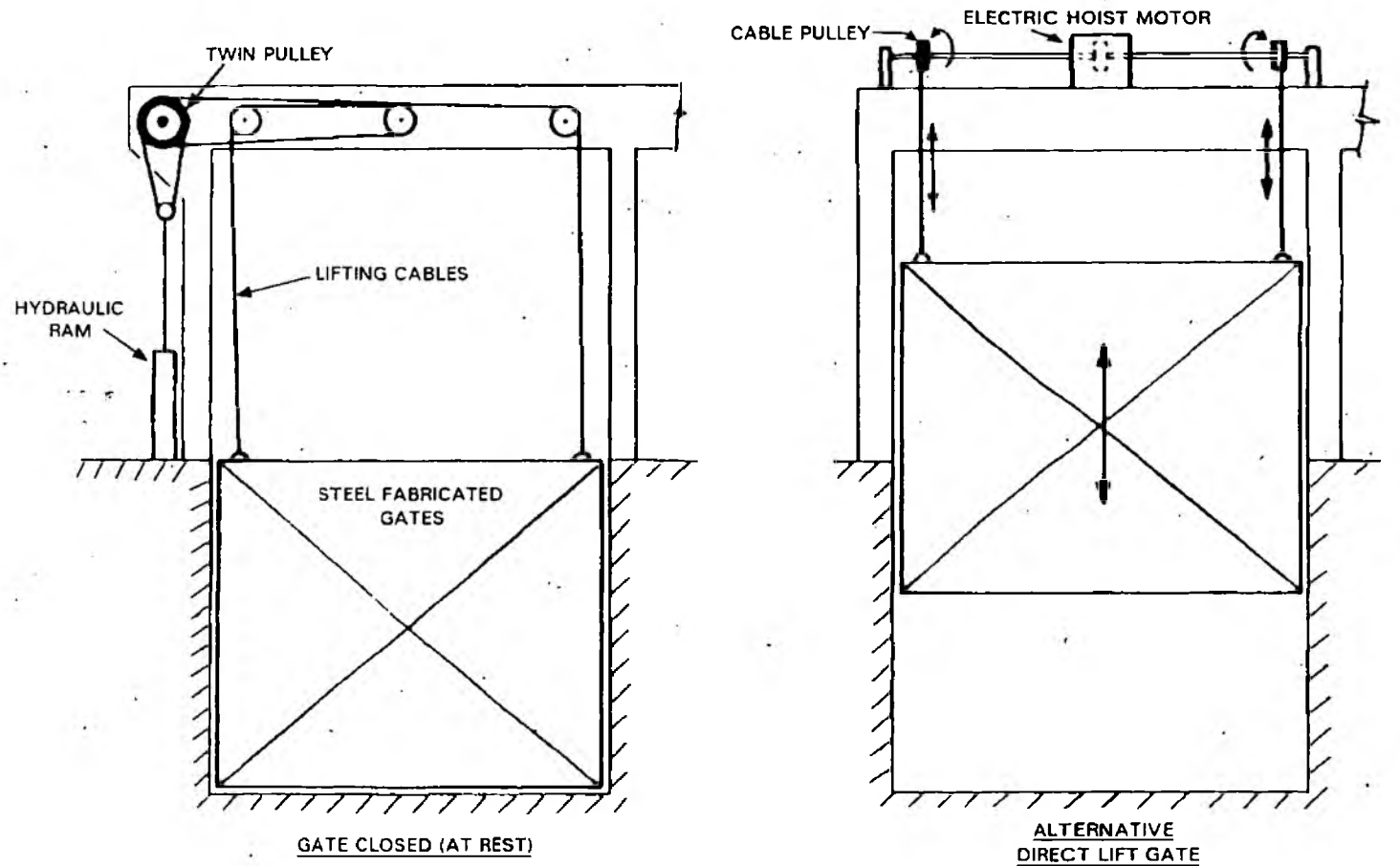
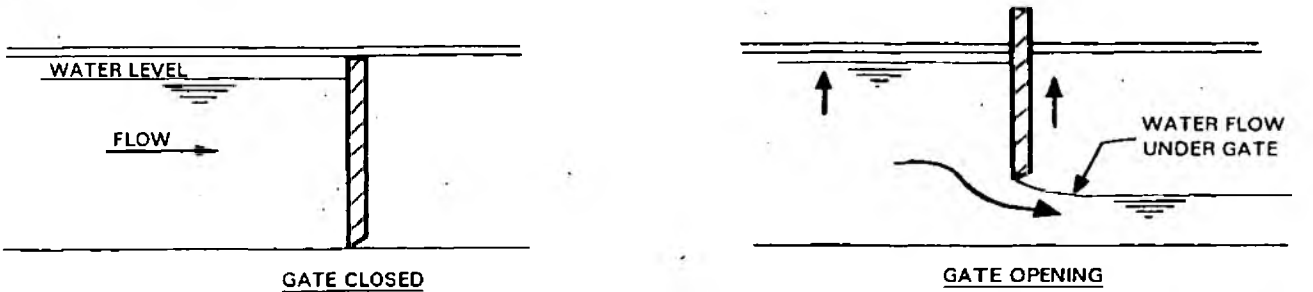
VERTICAL LIFT GATES

Vertical lift gates are used to maintain upstream water levels. The gates operate automatically and are controlled by the changing water levels. In times of high flow the gates rise allowing water to pass thus reducing the risk of flooding upstream.



VERTICAL LIFT GATE - PULLEY OPERATED



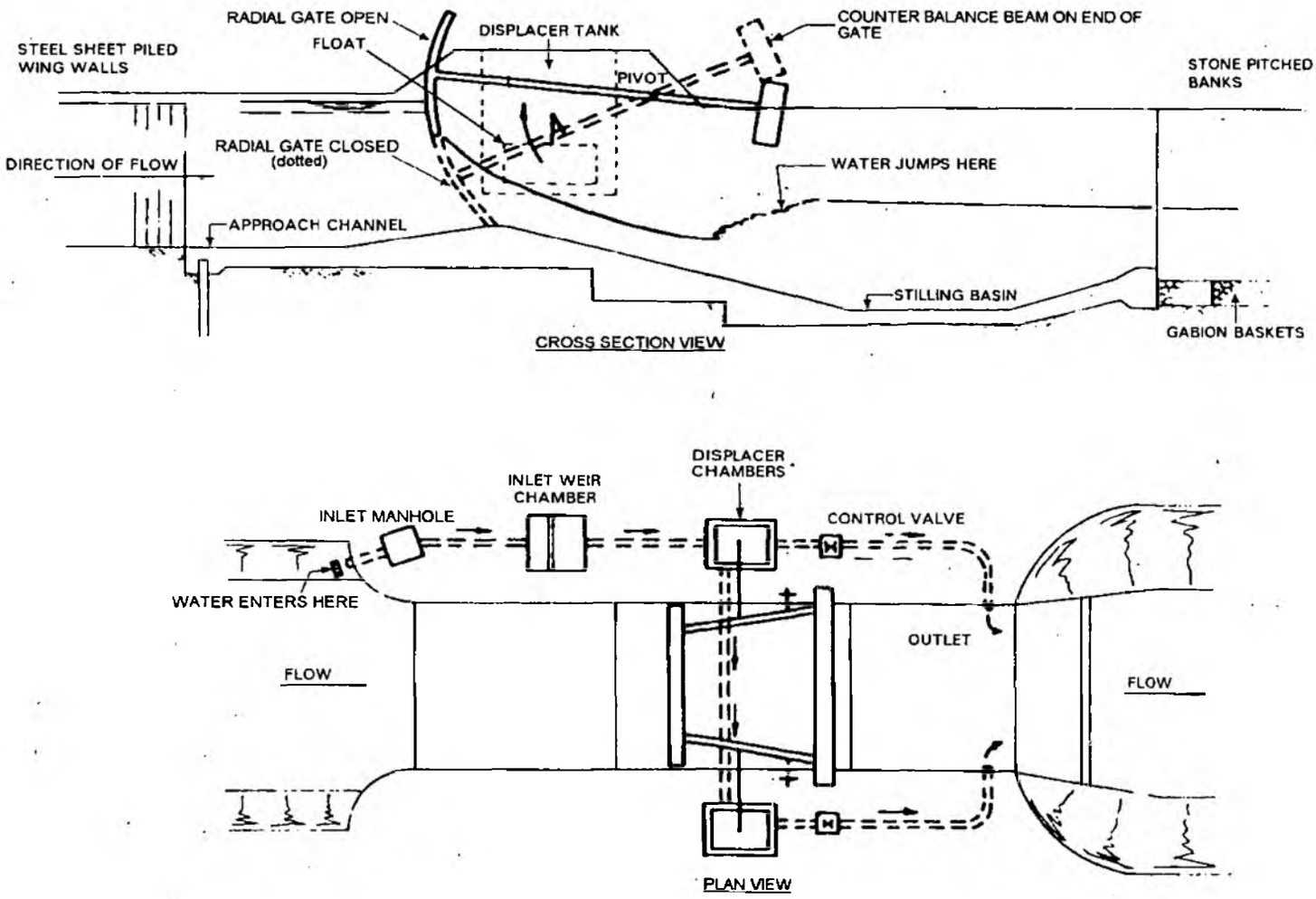
NOTE

THE GATE OPENING ie. MOVEMENT OF HYDRAULIC RAMS IS GOVERNED BY UPSTREAM WATER LEVEL RECORDED BY FLOAT METHOD. THE GATE OPENS AND CLOSES BY A FLOAT CONNECTED TO THE HYDRAULIC LIFTING SYSTEM.

RADIAL GATES WITH DISPLACER SYSTEM

Radial gates are used to control water levels in the Flood Channel. When closed the gates allow no flow to pass. As water levels upstream of the gate rise the gates automatically open allowing water to pass through.

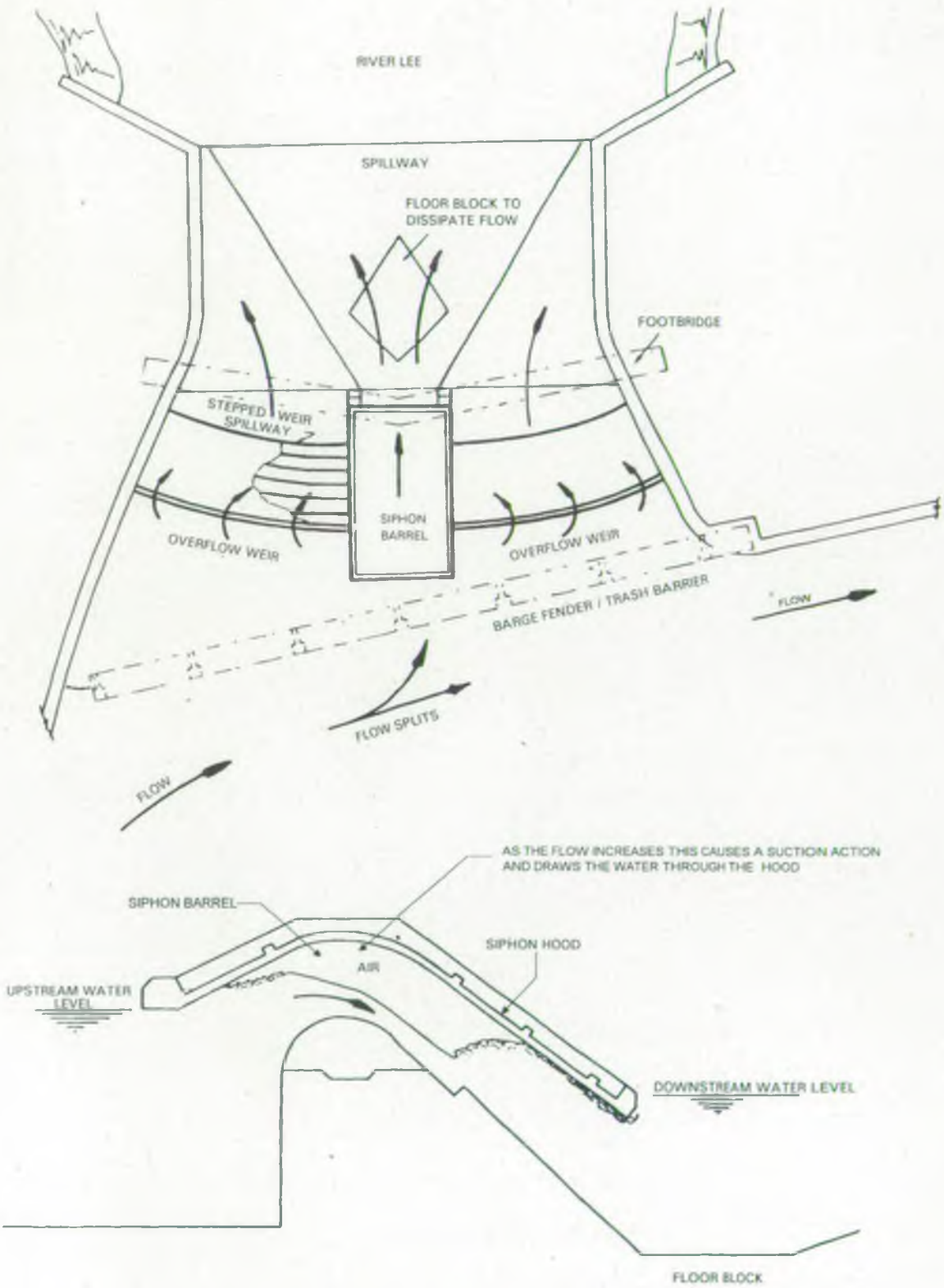
Radial gates have displacer chambers containing large steel floats. The floats are connected to the radial gates. In times of high flow the chambers become flooded lifting the floats which raise the radial gates. The amount the gate opens is dependent on the rise in water levels upstream. As the gate opening increases more water is passed through the gate reducing the risk of flooding upstream.



AUTOMATIC DISPLACER - OPERATED RADIAL GATES

SIPHON SPILLWAYS

As water rises upstream of the structure the level of water over the weir is higher than that of the top of the inverted "u bend" within the siphon structure. This condition creates a siphon which sucks water through from upstream. The amount of water able to pass through the siphon is greater than that of a conventional weir of the same width.



CROSS SECTION VIEW THROUGH SIPHON

AIR REGULATED SIPHON

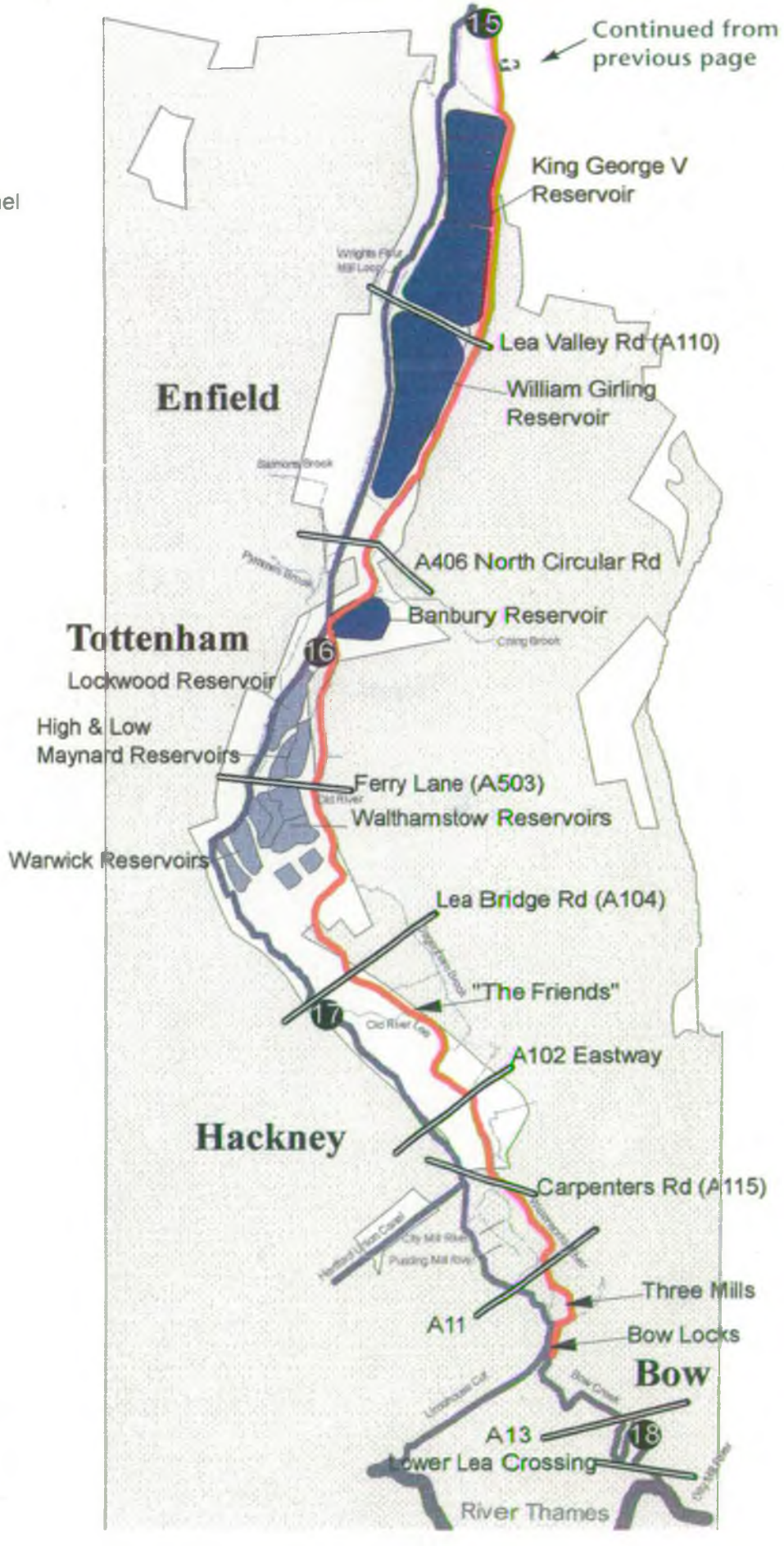
sponsored by HALCROW

Map 2 Flow Control Structures

along the River Lee Flood Relief Channel

KEY

- River Lee Flood Relief Channel
- Main Navigation Channel
- Flood Relief & Navigation Channel
- Other rivers
- 1 Key river structures
- Open waterbodies
- Road crossing
- Urban area



List of Structures

Ware Lock
Ware Weir/syphon
Amwell Magna Sluices
Hardmead Radial Gate
Stanstead Radial Gate
Feildes Weir
Richard White Radial Gates
Meadgate Sluices
Nazeing Weir
Kiora Radial Gates
Kings Weir
Holyfield Weir
David Stoker Radial Gates
Rammey Marsh Sluices
Newmans Sluices
Green Gates/Chalk Bridge Sluices
Lea Bridge Weir
Lea Tidal Barrier (site of)

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The Environment Agency delivers a service to its customers, with the emphasis on authority and accountability at the most local level possible. It aims to be cost-effective and efficient and to offer the best service and value for money.

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