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Melton Mowbray flood alleviation scheme

Innovation through partnership



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Melton

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The control structure

Foreword

by Councillor David Wright, Chairman: Rural, Economic and Environmental Affairs Committee, Melton Borough Council

Melton Mowbray residents have been unfortunate to have suffered six serious flooding incidents in the five years since Easter 1998.

164 properties in Melton flooded at Easter 1998, many again the following Christmas day and again just three weeks after that. There have been a number of 'near misses' since.

Melton Borough Council has always attempted to be as constructive as possible, there to help local people, because it is well placed to do so; to help not just during the immediacy of a flood emergency, but also resolving problems and issues for the longer term and wherever possible working in partnership with others.

So much more can be achieved when organisations work together rather than independently. This is exactly the case here. I know it has been hard work, but there is a real sense of achievement for Melton Borough Council in working with, and supporting the work of, the Environment Agency on the Melton Mowbray Flood Alleviation Scheme.

To complete this major flood alleviation scheme from a standing start on a Site of Special Scientific Interest and next to a main railway line, in less than five years is a remarkable achievement which I, for one, and the people of Melton Mowbray, will always be indebted.



Mowbray

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Introduction

The historic market town of Melton Mowbray is situated in the north east of Leicestershire and has a population of over 25,000 people. Melton Mowbray is home to manufacturers, and research and educational institutions of national importance. The town has a long established association with pork pies and Stilton cheese. There is also a long history of flooding.

The town has developed around the confluence of the River Eye, Scalford Brook and Thorpe Brook which join together in the town to form the River Wreake. The River Wreake is the principal tributary of the River Soar, which it joins at Cossington, south-east of Loughborough approximately 24km downstream of Melton Mowbray.



History of flooding

Flooding has occurred frequently in Melton Mowbray and surrounding villages, with records dating back to 1828. On average, flooding has occurred approximately once every five to six years. The worst recorded instances were in 1852, 1875, 1880, 1882, 1897, 1900, 1922, 1932, 1954, 1974, 1975 and 1998.

In November 1852, 2 inches of rain fell in Leicestershire in 24 hours. At Melton Mowbray, 'many sheep and pigs were washed away and at Frisby on the Wreake the flood was greater than any the oldest inhabitant can remember'.

In July 1875, heavy and incessant rain added to already swollen streams in the area. The Scalford Brook and the River Wreake were 'swollen to an extent unsurpassed in the memory of any person living in Melton Mowbray'. 'The rise of water in the Thorpe End was not only such that had never been known before, but was so fearfully sudden as to give no time for preparation. At its highest the water was just up to the Peacock Inn in Sherard Street.

In the houses there, the water rose so high that it swam the ornaments off the chimney pieces in the rooms on the ground floor'.

In August 1922, nearly four inches of rain fell in 24 hours causing extensive flooding. Huge volumes of water flowed through the town. At its height there was reported to be ten feet of water at the lowest part of Burton Street. A relief fund was opened in the town in order to assist some of the poorest sufferers.

In Easter 1998, England and Wales were hit by one of the worst flood events in living memory. The Midlands suffered unusual meteorological conditions and Melton Mowbray was on the northernmost edge of the rainfall. Although the actual rainfall in Melton Mowbray was not as great as in some other areas, 56mm of rainfall in 24 hours was recorded at the Agency's rain gauge at Whissendine, upstream of Melton Mowbray.

This rainfall was not exceptional, but it fell onto land that was already saturated and immediately ran off into rivers and brooks whose flows were already high for the time of year.

The area that flooded was extensive. As well as significant flooding to agricultural land downstream of the town, severe flooding was experienced in Melton Mowbray itself. Here, the flooding was mainly caused by the River Eye spilling out of its banks at the confluence with the Scalford and Thorpe Brooks. Some streets were up to a metre under water and 164 properties were flooded in the town. This flooding has since been categorised as a 1 in 50* year flood event.

The factory units of Pedigree Masterfoods, one of the country's major suppliers of pet foods, were amongst industrial premises flooded. Indeed, had the works not been on a holiday shutdown at the time of the Easter 1998 floods, the financial losses to the company would have been much higher.



Left
Easter 1998

* Floods are categorised by their size and the frequency with which they can be expected to occur. A 1 in 5 year flood is one that has a 20% chance of happening in any year – this is a relatively minor flood. A 1 in 100 year flood has only a 1% chance of happening in any year, but its effects can be enormous.

Previous flood alleviation schemes on the River Wreake

Between 1967 and 1969 the former Trent River Authority carried out pioneer improvement works involving the removal of shoals and tree clearance.

Although the town's historic mills are no longer used and the navigation of the river has long since been abandoned, weirs still remain and the resultant high water levels in the river give rise to poor land drainage conditions and cause frequent flooding of the washland. In the late 1970s, these conditions prompted the former Severn Trent Water Authority to investigate and prepare an improvement scheme for the River Wreake.

However, it was not considered to be economically viable to carry out the full scheme. Subsequently, during the 1980s, some channel dredging and re-sectioning work was carried out as part of a maintenance programme to increase the channel capacity at lower flows and to reduce the frequency of flooding.

In the late 1980s, Frisby balancing lakes were constructed downstream of Melton Mowbray. Here, a series of worked out gravel pits were utilised to provide an off-line water storage area to protect the lower reaches of the River Wreake from frequent flooding. The lake system is designed to contain sufficient water to provide a 1 in 5 year standard of protection to areas downstream of Frisby.

A number of schemes have been carried out on other local watercourses to reduce water levels in Melton Mowbray in minor flood events, eg. Scaford Dam on Scaford Brook which controls the rate of discharge from this watercourse into Melton town centre.

Below
Frisby balancing lake



Background to the scheme

Following the Easter 1998 floods, the Environment Agency started a feasibility study to investigate whether an alleviation scheme to cope with such severe conditions was practical. While this was taking place, the flood warning service for Melton Mowbray was extended so that in times of flood, residents could have a better chance of protecting their property and possessions.

The assessment of flood risk in Melton identified that approximately 400 residential, commercial and industrial properties in the town, (including schools and the railway station) and

over 250 properties downstream on the River Wreake were at risk from a 1 in 100 year flood event.

A computer model was used to identify the key factors affecting flooding and to investigate a variety of options for flood alleviation in Melton Mowbray.

Options investigated included upstream work to control the flow, improvements to weirs and sluices, dredging the channel, floodbanks or walls, relief channels and providing additional capacity at a number of bridges on the river.



Partnerships and funding



The Melton Mowbray Flood Alleviation Scheme was approved and financed by the Regional Flood Defence Committee.

Contributions were made by the Department for Environment, Food and Rural Affairs (Defra) in the form of Grant Aid.

In partnership with Melton Borough Council, the Environment Agency promoted a private funding venture with local businesses to cover a proportion of the construction costs.

Left
The Ham Bridge Silt trap

Consultation

A scheme cannot be developed without considering the effects it may have on the local population, landowners and occupiers and any special interests in the area such as archaeology, nature conservation and recreation.

Detailed consultation with all interested parties took place during the preparation of the scheme. Prior to the scheme, the Agency undertook a programme of public consultation and awareness schemes. This included television and radio features, newspaper articles, exhibitions, leaflets and project progress notices, press releases and direct liaison with interested parties.

Extensive consultations were carried out with a wide range of organisations, groups and individuals including local authorities, Government agencies, public utilities, landowners, wildlife groups, local interest groups, members of the public etc.

The main issues covered during the consultation process were:

- the impact of the scheme on designated environmental sites and existing habitats and species
- water quality, pollution, erosion and siltation issues
- construction impacts on land use, archaeology, traffic management and flood risk
- the potential for environmental enhancement measures.

The Agency also had to apply to Melton Borough Council for planning permission for the scheme.

As part of this process, an Environmental Statement was published for public consultation.



The scheme in detail

As a result of the feasibility study, the chosen option was to construct on-line flood storage upstream of Melton to provide a 1 in 100 year standard of protection for Melton Mowbray.

The scheme involved:

- construction of a dam upstream of Melton Mowbray for the temporary storage of flood water
- railway embankment stabilisation works
- construction of minor floodbanks at Brentingby
- installation of a sediment filter in the floodplain at Ham Bridge
- construction of silt traps in the channel at Ham Bridge on the River Eye and on Burton Brook.



Phase 1

The first step was to construct silt traps at Ham Bridge and adjacent to Sawgate Road on the Burton Brook. These consist of widened sections within the natural river channel, which were designed to reduce the quantity of silt deposited downstream throughout the year. Approximately 13,000m³ of material was excavated from the two sites to create the silt traps. The stockpiled material was used within later phases of the works.

At higher flows when flooding starts in the floodplain, the silt trap at Ham Bridge will work in conjunction with a sediment filter of willow and hazel which has been planted across the full width of the floodplain.

The increased cross section and the planting results in much lower flow velocities which allows suspended silt to settle out. The filter will remove much of the silt carried by the floodwater as it travels across the land.

Previously, the receding water would have dropped this silt into the channel where it smothered insect and plant life in the river. The choking action of the silt was endangering the ability of the river to support the wide diversity of life which contributed to its Site of Special Scientific Interest (SSSI) status.

Isolated pockets of trees have also been planted within the SSSI between Ham Bridge and Brentingby, where flood flows will converge to drain back into the river. These will act as the final silt traps for the receding floodwater.

Work began in December 2000 and was completed on time in July 2001, despite delays caused by unforeseen circumstances such as the Foot and Mouth outbreak.

Melton Mowbray and the River Wreake



Phase 2



The main feature of phase 2 was the construction of a dam and control structure in the River Eye at Brentingby, about 2km upstream of Melton Mowbray.

The purpose of the storage reservoir is to control the downstream flow. A dam constructed just upstream of the railway crossing at Brentingby junction restricts the volume of water allowed to travel down from that point and stores the excess in times of flood. This area will temporarily store all excess water for events categorised as between 1 in 5 years and 1 in 100 years. Extreme flood events greater than 1 in 100 years, will be reduced in magnitude as the flood storage area will store flood water until it is full, when the overflow from the storage will operate, releasing excess flood water back into the River Eye.

The floodwater will then undergo controlled release from the storage area by means of three automatically controlled openings in the dam.

The control structure has been designed to minimise the risk of operational failure, to minimise future maintenance requirements and to satisfy environmental criteria. The need to minimise additional flooding in the storage area led to the choice of a more sophisticated level regulated control, rather than a simple orifice.

The three openings are controlled by electrically operated penstocks (sluice gates). Each is large enough on its own to pass the maximum permitted onward flow when fully open.

The three openings together occupy the full width of the river channel and all remain open in normal use, minimising the impact on the river's flow regime at normal levels. Flow sensors within the dam structure continuously monitor the flow in the river. When the critical flow is reached, the penstocks will automatically operate to prevent excess water from being passed through. A level gauge downstream in Melton will also trigger the penstocks to operate if a critical level is reached. Back up devices have been incorporated into the design and in the event of power failure, all control equipment can be operated manually.

The control structure is housed within a dam so that it ties in with high ground to the east and west. The dam mainly comprises an earth embankment which is retained on the upstream of the left bank by sheet piles in order to minimise the width of the dam.

This minimised the encroachment on the river channel and will protect the dam from erosion. The dam has been designed to retain approximately 3.7 million cubic metres of water to a maximum level of 79 metres above ordnance datum and is a maximum of 4.5 metres high above the floodplain.

The dam is approximately 650 metres long, with a crest 3 metres wide to provide vehicular access for maintenance by the Agency.

In view of the large volume of water that will be temporarily stored in the event of a flood, the flood storage area created had to be designed to satisfy the requirements of the Reservoirs Act 1975. In order to ensure that the safety of communities downstream of the flood storage area was not reduced, the design of the control structure and other engineering works for the storage area had to be approved and supervised by a specialist reservoirs panel engineer.

The main Leicester to Peterborough railway line runs along the river valley and across the flood storage area. The river control structure was constructed separate from, but immediately upstream of, an existing railway bridge across the river. The railway embankment to the east will effectively be surrounded by floodwater when the lake fills. The safety and stability of the railway was therefore, a major design consideration and stabilisation works on 2 kilometres of railway embankment were required.

The channel upstream of the control structure had to be modified in order to direct water in a straight line under the railway. Scour protection works were provided both upstream and immediately downstream of the control structure to reduce erosion during a flood event, particularly where the river runs parallel to the control structure and beneath the railway bridge. Wherever possible, 'soft engineering' bank protection has been used. This consists of geotextiles and pre-seeded coir matting.

Elsewhere, flood defences have been built to protect properties in Brentingby.

Work on the second phase of the scheme commenced in August 2001 and construction was completed in December 2002.

Environmental and archaeological considerations

Upstream of Melton Mowbray, the natural features of the River Eye comprise riffles, pools, small cliffs and meanders providing a range of conditions suitable for the maintenance of rich and diverse plant and animal communities. Downstream of Melton Mowbray, the River Wreake develops a broader floodplain and more pronounced meanders.

The land on which the flood storage area is situated is sited within the River Eye Site of Special Scientific Interest (SSSI). The SSSI is an exceptional example of a semi-natural lowland river, representative of clay streams in central and southern England. It has been designated as such because of the way that the River Eye meanders, the quality of its water and the wide variety of plant and invertebrate life it supports. The protection of the SSSI was one of the key issues in the project and English Nature was fully involved throughout to ensure that the SSSI was not damaged by the scheme.

Prior to the scheme, the integrity of the SSSI was already under threat from excessive silt and phosphate intrusion from surrounding agricultural land (not related to the issue of flooding).

Several features to help manage the water quality were built into the scheme to maintain the SSSI status. These included sediment traps and a sediment filter of dense planting of coppiced willow and hazel. This is a new concept and is the first time that this type of 'green engineering' has been tried in the UK to help control flooding.

The 'green engineering' measures were the first part of the scheme to be installed as the safeguarding of the SSSI was imperative before any major construction works were commenced.

English Nature was brought into the project team from the beginning and continued to be a key part of the team throughout the life of the project. Consultations with English Nature were integral to the option selection and design process from the outset.

The area affected by the scheme was also considered to have high archaeological potential and so English Heritage was involved in the consultation process from the start. There are scheduled ancient monuments at Wyfordby and Stapleford and a significant portion of the site contains ancient ridge and furrow field systems, which are the result of mediaeval farming techniques. The layout of the flood storage area was designed to minimise loss of this important historical feature.

During the construction process, two significant finds were uncovered. The first was a mediaeval ford alongside bridge abutments uncovered in the excavation work for the silt trap on the Burton Brook. The second was a mediaeval villa uncovered near Wyfordby whilst completing the railway stabilisation works. In both cases, a full record of the finds was made and registered.

In order to reduce the visual impact of the control structure, landscape planting has been undertaken. Bank protection works have also incorporated planting which ensures that the banks have a more natural appearance.

The Agency has sought, wherever possible, to adhere to good practice guidelines on sustainability, through consideration of its use of construction materials, re-use of excavated materials, energy sources, social impacts, transport arrangements and waste management arrangements.



How does the scheme work ?

- The structure controls the downstream river flow, restricting it to a volume that can pass through Melton Mowbray without flooding any buildings
- any flow in excess of this will be held back and stored temporarily until upstream flows decline. The water will then be gradually released into the River Eye in a controlled manner
- in the 1 in 100 year event, water will be stored to a depth of up to 4.5 metres above the existing floodplain
- the maximum volume of water that will be temporarily stored in the 1 in 100 year event will be 3.7 million cubic metres (m³). Prior to the scheme, the natural storage of the area was approximately 500,000m³
- the total surface area of water between the control structure and Ham Bridge with the scheme in the 1 in 100 year event will be 2.36 km²
- 'green engineering' techniques protect the SSSI with:
 - upstream sediment traps
 - upstream green sediment filter of densely planted willow coppice to control floodplain flow and encourage sediment to be deposited outside of the SSSI
 - green barriers of willow coppice to control sediment wash-off from the adjacent fields at key locations.



Left
The Control Structure

The future- maintenance and monitoring

Regular river maintenance and monitoring are essential to ensure that the benefits of the improvement works are achieved.

Environment Agency staff are available around the clock to ensure that defences work properly. Regular maintenance will be required including debris removal, clearance of sumps and inspection and maintenance of the penstocks and associated equipment. Sediment will need to be removed from the sump of the silt traps at appropriate intervals.

The sediment filter will require long-term management as willow and hazel coppice, with the vegetation being coppiced on a rotational basis every three to five years, depending on the growth rate after establishment.

A programme of monitoring the environmental aspects of the scheme has been established with English Nature. The following are being monitored to determine the impacts of the scheme and the success of the mitigation measures:

- silt loading in the SSSI post 'green dam' construction
- phosphate levels through the SSSI
- condition of gravel spawning areas over a five year period
- success of the artificial bat roosts in the new control structure
- success of new planting areas
- presence and type of crayfish in the new silt traps.



River facts

The River Wreake and its headwater the River Eye, rise at Bescaby on the fringe of the Vale of Belvoir near the Leicestershire/Lincolnshire border. The width of the floodplain varies from about 70 metres at Melton Mowbray to about 700 metres at Thrussington in the lower reaches. The total catchment area of the Rivers Wreake and Eye is approximately 412km² with the catchment area down to Melton Mowbray being about 207km².

The catchment upstream of Melton is predominately rural with rolling open exposed ridges and valleys with sparse tree cover. Features such as ridge and furrow fields, hedgebanks and enclosures indicate the historical development of the landscape. There are small settlements at Burton Lazars, Brentingby, Wyfordby and Stapleford Park and scattered housing and farms. A flood storage reservoir is located on the Scalford Brook to the north of the town.

The confluence of the River Eye, Thorpe Brook and Scalford Brook occurs at the eastern edge of Melton Mowbray to become the River Wreake, which then flows from east to west through the centre of the town. The river is crossed by a number of road and rail bridges. Adjacent to the confluence is a large pet food factory (Pedigree Masterfoods) with associated historical river control structures (weirs, and sluices) inherited from the site's previous use as a woollen mill.

In the late eighteenth century, the River Wreake was made navigable by the construction of locks from the River Soar at Syston up to Melton Mowbray. The canal was 14 ³/₄ miles long and rose a total of 71 feet by means of 12 broad locks. It enabled carriers to move mainly coal from the Derbyshire coalfields up to Melton Mowbray and later to Oakham when the navigation was further extended. Market produce and wool was carried on the return journey. The 'Wreake Navigation' opened in 1794, but the coming of the railway, which still runs through the valley, caused a severe drop in trade and the canal closed less than 100 years later in 1876. Stone weirs were constructed at the locks to replace the lock gates thereby retaining water levels for the mills. A few traces of the old canal can still be seen in the valley, but the river is no longer navigable.

Left
View from the dam towards
instrumentation building

Key facts

Number of properties protected from a 100 year flood event:	650
Total cost of scheme:	£6.7 million
Scheme commenced:	October 2000
Scheme completed:	May 2003
Length of dam:	650 metres
Width of dam crest:	3 metres
Height of dam above the floodplain:	4.5 metres
Reservoir storage volume when full:	3.7 million ³ (approx)
Area inundated when reservoir full:	2.4 km ² (approx)
Area planted with willow and hazel coppice:	1.3 hectares
Area planted with reedbed:	0.7 hectares
Length of new hedging planted:	1.5 kilometres
Area of other tree planting:	1 hectare
Area of rough grassland established:	5km ²
Area of managed wet pasture:	18 hectares



Consultants and contractors

During the design and construction of the scheme, the following consultants and contractors were engaged (in alphabetical order):

- ADAS
- Arup
- Baker Shephard & Gillespie
- Binnie, Black and Veatch
- Brett Countryside Services Ltd
- Rodney Bridle
- John Chatterton & Associates
- Edmund Nuttall Ltd
- Environmental Services Group Ltd
- Faithful and Gould
- Franklin & Andrews
- GBG Geophysical Surveys
- Posford Haskoning
- Smiths Gore
- G Tomlinson & Sons Ltd

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