

Environment Agency, Southern Region

River Medina Improvement Works

Assessment of obstructions and fish passage issues

Final Report



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Front cover picture - a "velocity control weir" constructed for flood defence purposes in the 1960's, just above the tidal limit in Newport. Overall head drop 1.4 m.

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1 INTRODUCTION

This is the final report for the study on fish passage issues in the River Medina. The work was undertaken for the Environment Agency as one of the partners in the Newport River Restoration Group, which aims to improve and enhance the river. The invitation to tender included the following specification for the work:-

We are commissioning an investigation to look at fish passage issues on the Medina between NGR SZ 50122 89394 and SZ 49779 84620. The output from the investigation will include a report which identifies the following:-

- *all structures that may impede fish passage*
- *the constraints they pose to different fish species under various conditions*
- *information on the purpose and current use of such structures*
- *an assessment of the geo-morphological impacts each structure is having upstream and downstream.*

It is also important to assess flood risk as a result of implementation of these options,

The report should present options to improve fish passage to all freshwater fish on the Medina, together with a recommended methodology on delivery of these options. The methodology should include outline designs, estimated costs and any permissions required. We would also expect the report to identify any opportunities for enhancement of fish habitat or areas that have spawning potential both now and after any improvements have been made.

It was recognised from the outset that addressing fish passage issues provides an important opportunity to provide other habitat enhancements to reduce the impact of earlier insensitive engineering works. There has been much channel alteration, with considerable straightening and hard engineering of banks, and much of the natural head loss has been concentrated into weirs and other retaining structures. Not only does this represent an obstruction to fish passage, it also represents a considerable loss and degradation of habitat. The riverine habitat was assessed as a separate investigation carried-out by Vaughan Lewis of Windrush Consultants.

The study area, defined in the terms of reference, runs from the tidal river landwards of the confluence with the Lukely Brook upstream for about 5 km to Highwood Lane Bridge (Figure 1.1).

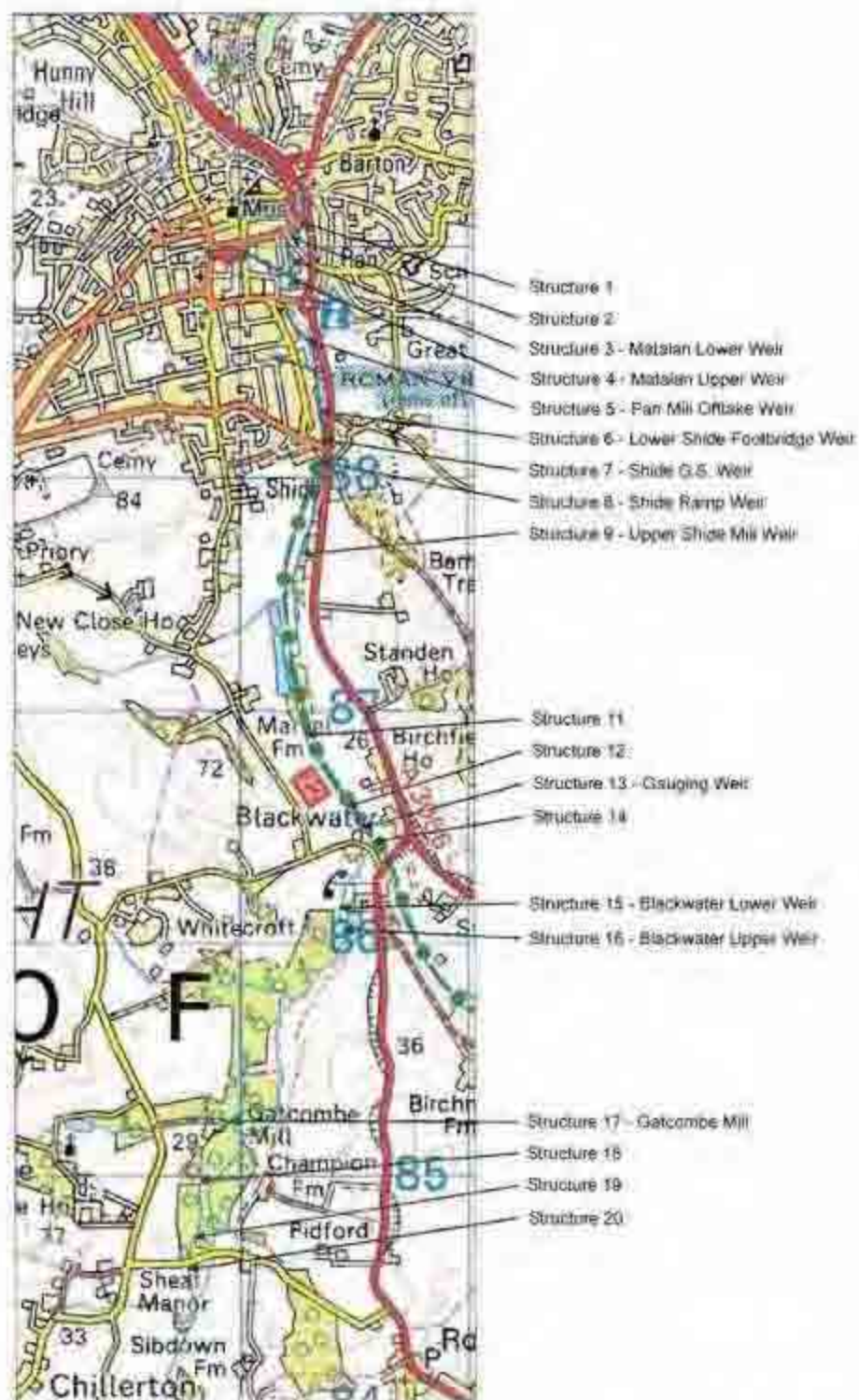


Figure 1.1. The study area, showing the location of the structures discussed in this report. The blue grid lines are at 1 km intervals. © Crown Copyright. All rights reserved. Environment Agency, 100026380, (2009).

2 DESCRIPTION OF THE RIVER MEDINA

2.1 Overview

The River Medina has a catchment area of 29.8 km² to the gauging station at Shide road bridge, about 1 km from the tidal limit. A summary of flow statistics is given in Appendix 1. The upper reaches are groundwater-fed from chalk and greensand, and the river flows across gault clay, carstone and ferruginous sands. It then crosses greensand and chalk once more before reaching the estuary at Newport. Thus the catchment geology is predominantly permeable but the river does receive a fair amount of surface run-off in rainfall events. The water is generally rather turbid, with visibility restricted to the order of 30 cm.

Throughout much of the course of the river the channel has been heavily modified by straightening (especially downstream of Blackwater, originally for railway construction) and by construction of head-retaining structures. A total of 20 structures have been identified downstream of the upper limit of the project area at Highwood Lane Bridge, including two in the tidal river that retain head only at low water. This has resulted in a large-scale loss of natural channel features such as pools, riffles, and meanders, and has significantly affected fish passage.

2.2 Mills and milling

In the past hundred years there have been six mills impounding water on the Medina in the study area, with several more in the more distant past; for example, the Domesday book lists seven water mills in the Shide area alone.

The lowermost of the six recent mills was Ford Mill (NGR SZ 503 891) in Newport. This was demolished in 1962 and the site of the mill itself lies under the ring road bridge opposite the end of Pyle Street (Figures 2.1 and 2.2). A plan of the site is shown in Figure 2.3. Although not a tide mill it represented the tidal limit and its headpond stretched back to Pan Mill outfall (Major 1970). Since its removal the tide now penetrates a further few hundred metres to a weir at SZ 50233 88941.



Figures 2.1. and 2.2. Looking upstream to the site of Ford Mill, Newport, at low tide on July 24 2008 (left), and near high tide on August 4 2008 (right). The mill was situated where the bridge in the distance is located, and it formed the tidal limit. The tide now penetrates a few hundred metres further to a large weir.

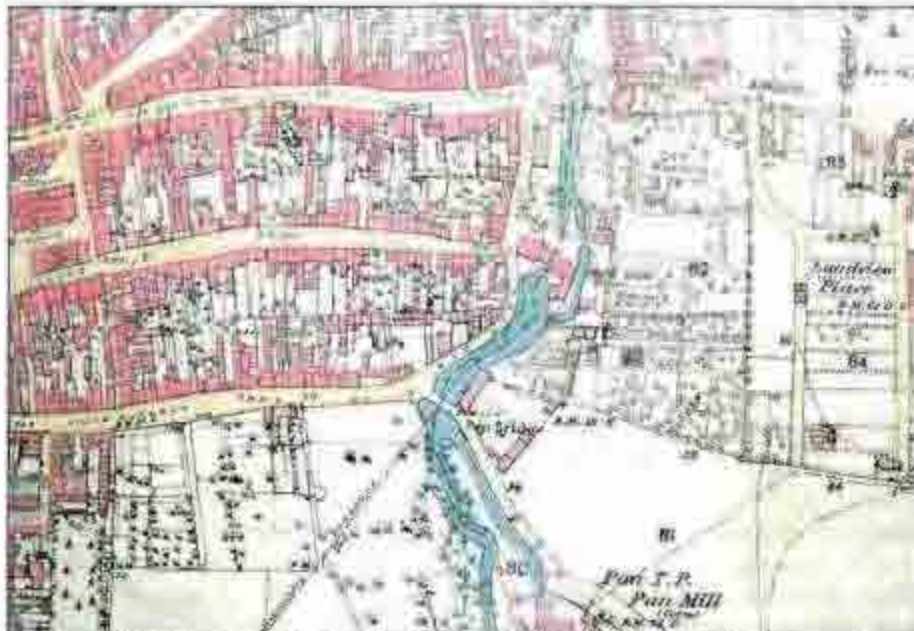


Figure 2.3. OS 25" map of 1862 showing the layout at Ford Mill, Newport. The approximate line of the existing river channel is shown by the green dashed line.

The buildings of Pan Mill are still well preserved at SZ 503 889 but the stream now bypasses the site. The headpond was formed by damming the stream, with an overflow structure to the side (Figure 2.4). There has been considerable realignment of the channel here in recent years.



Figure 2.4. OS 25" map of 1862 showing the layout at Pan Mill, Newport. The approximate line of the existing river channel is shown by the green dashed line.

The site of Shide Lower Mill (SZ 504 882) has also been bypassed by the river in recent years; the site of the mill and its headpond now lie beneath the A3020 St Georges Way north of Shide road bridge. The layout of the mill and its associated waterways is shown in Figure 2.5.



Figure 2.7. OS 25" map of 1862 showing the layout at Blackwater Mill. The approximate line of the existing river channel is shown by the green dashed line. The millpond remains as a landscape feature. Note the parish boundary indicating part of an earlier course of the river.



Figure 2.8. OS 25" map of 1862 showing Gatecombe Mill. The present channel is indicated. A new weir has been constructed across the lower part of the millpond, so that the channel bypasses the mill. Again, the parish boundary indicates the original main course of the river.

The buildings at Blackwater Mill (SZ 505 862) are still there and the millpond (Figure 2.7) has been made into an ornamental lake. The stream now bypasses the mill but the retained head above a major weir maintains the level in the lake.

The uppermost mill within the study area is at Gatcombe (SZ 499 85202 – Figure 2.8). There has been a mill here since Domesday and the mill building is still there complete with mill wheel, but does not operate. The Annual Report for the Isle of Wight River Board, year ending March 31st 1955, contains the following:-

"The weir destroyed by flood water in 1951 at Gatcombe Mill Pond, SZ 499 853, on the River Medina was replaced by a mass-concrete dam with a central fixed weir, 15 feet wide. (See Figure 4.20). The crest level of the new weir is four feet lower than the level of the former mill weir. The effect is that the obstruction due to the mill has been eliminated whilst the high velocity apparent in the river since the destruction of the mill weir has been reduced to within reasonable limits."

The elimination of the "obstruction" referred to was presumably in terms of flood prevention only as this site remains impassable to fish (see Section 4.4). One wonders what was unreasonable about the high velocities which presumably prevailed between 1951 and 1955.

2.3 Channel straightening

Straightening and removal of meanders has taken place over hundreds of years for agricultural and milling purposes. Evidence of pre-railway removal of a meander is apparent in Figure 2.6.



Figure 2.9 Extract from OS 25" map north of Blackwater at the time of construction of the railway in the 1860's. The original winding course of the river is superimposed with the straightened channels either side of the line of the railway.

However, it was the construction of the Isle of Wight Central Railway in the 1860's that had the greatest effect upon the lower part of the River Medina. It was constructed to run in the bottom of the valley from Blackwater to Newport (a distance of about 3 km) and for much of its course the river was moved into a straight channel, presumably to save on bridge costs. Two examples are shown in Figures 2.9 and 2.10. Figure 2.9 shows the OS map of 1862 for a few hundred metres downstream of Blackwater Bridge.

The straight lines of the railway and the modified channel have been superimposed on the original winding course of the river. In Figure 2.10 the original meandering course of the river near Marvell Farm (a few hundred metres downstream of the location in the previous figure) is shown compared to the straightened course after the railway was completed.

Considerable channel straightening was also involved in the flood relief works in the 1960's, including "35 chains" (about 700 m), the whole of the river between Pan Mill and Lower Shide Mill. More detail of this work is given in Section 2.4.

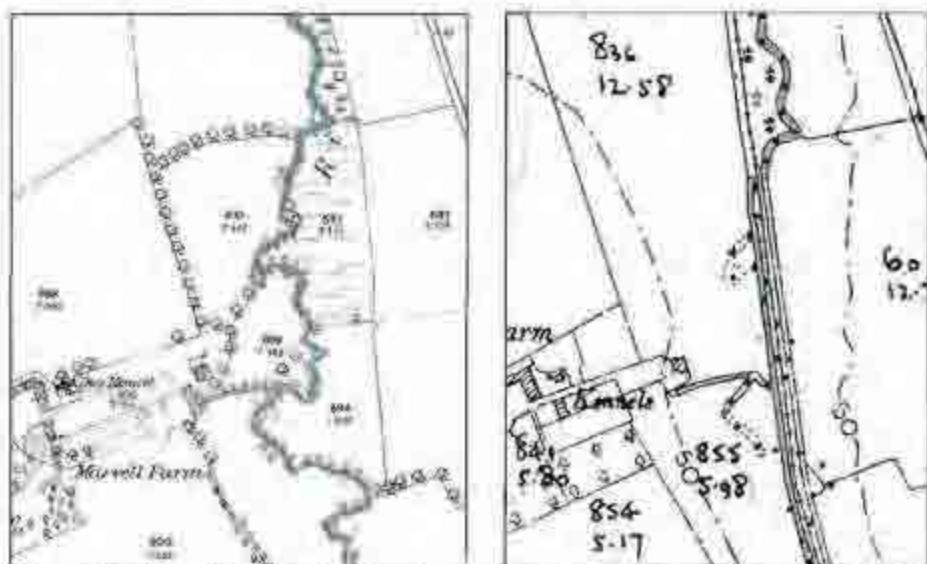


Figure 2.10 Channel straightening for railway construction near Marvell Farm. Left, the OS 25" map of 1862 showing meanders. Right, map of 1909 showing straightened channel alongside the railway.

2.4 Flood defence works

Major flood defence work was undertaken by the Isle of Wight River Board (later River Authority) between 1963 and 1974 to reduce flooding between Blackwater and Newport. Details are hard to find but there are some descriptions in the Authority's Annual Reports:-

"As a result of extensive damage to domestic, shop and industrial property caused by the major floods of October 1st 1960, and January 29-30th 1961, the Board resolved to advance its programme of flood relief works on the lower reaches of the River Medina between the village of Blackwater and the town of Newport, a distance of about two miles. By resolution of the Board in November, 1960, the investigation into the causes

of the flooding was commenced. It soon became clear that, owing to the partially built-up nature of the area along the lower reaches of the river, together with the obstructions in the form of mills and bridges, the Board would be forced for economic reasons to carry out the work in stages. The first stage of the comprehensive scheme is known as River Medina Improvement Scheme No. 2. By resolution of the Board on 30th November, 1962, the Engineer's design and estimate of cost were approved." (Annual Report for year ending March 31st 1963).

"The Authority continued the programme of flood relief works on the lower reaches of the river Medina between the village of Blackwater and the town of Newport, a distance of about two miles. The first stage of this comprehensive scheme, known as "the river Medina Improvement Scheme No. 2" was completed by direct labour during the year". (Annual Report for the year ending March 31st 1966).

From the description of the later stages of the scheme it would appear that this first stage involved work around the recently-demolished Ford Mill, and Pan Mill.

"The Authority approved the second stage of the flood relief works on the lower reaches of the river Medina upstream of the first stage of the River Medina Improvement scheme No. 2 referred to in our first annual report. The second stage comprises the improvement and re-alignment of 35 chains of the river between Pan Mills, Newport and Shide. The estimated cost is £17,380 which was approved by the Ministry of Agriculture, Fisheries and Food for the purposes of a grant. It was intended to proceed with this scheme during the year but negotiations for the purchase of the necessary land proved unexpectedly protracted and this was not therefore possible". (Annual Report for year ending March 31st 1967).

The second stage (Scheme No.4) of the comprehensive flood relief scheme on the River Medina was completed. It covered the reach between Pan Mill, Newport, and Lower Mill, Shide, a distance of half a mile and the work included four velocity-control weirs, substantial re-alignment (designed with tree preservation in mind) and a new channel to preserve the mill rights of the Pan Water Mill. The actual cost of the work was £20,500. It was carried out by direct labour." (Annual Report for the year ending March 31st 1971).

The design and estimate of cost (£19,000) of the third stage (Scheme No.5) of the same flood relief scheme were submitted to the Minister of Agriculture with an application for a grant. The scheme covered the reach of the Medina between Lower Mill, Shide, and Blackwater Road, Shide, a distance of a quarter of a mile, and the work included two velocity-control weirs and retaining walls along the restricted section north of Highway A 3056. The design paid particular regard to amenity. The construction of the bridge on A 3056 has already been completed by the Isle of Wight County Council in exchange for additional river works to be carried out by the Authority." (Annual Report for the year ending March 31st 1971).

"Work was completed on the third stage (Scheme No.5) on the River Medina. The design and estimates of cost, £18,000, were approved for the fourth and final stage (Scheme No.6) of the same flood relief scheme and the design is in progress. This stage covers the reach of the Medina between Blackwater Road, Shide and Blackwater Village a distance of one and three quarter miles." Annual Report for the year ending March 31st 1974).

3 FISH STOCKS IN THE RIVER MEDINA

The Medina has never been known for the quality of its fish stocks and fishing. The 1928 edition of the guide "Where to fish" (Sheringham 1928) has the following entry:-

"Gatcombe. Few trout, dace and eels follow the stream down to Blackwater and Shide. Permission from landowners".

By the 1955-56 edition (Eaton 1955) this faint praise has been reduced to :-

"Medina from Newport to Chale; few fish."

More (1860) stated that roach and dace occurred "plentifully" in the Eastern Yar and Medina. He recorded bullheads as being present in the Eastern Yar but not in the Medina. "Common trout" occurred in a few streams in "West Medina"; it is uncertain if this includes the Medina itself or is referring to streams in the western half of the island. Three spined sticklebacks were also recorded for the river.

In recent years a number of electric fishing surveys have been undertaken by and on behalf of the Environment Agency and its predecessors. Generally these have involved catch-depletion population estimates over short reaches (typically 100m) or a single fishing sample over a longer reach. The species recorded in each survey at each site are shown in Table 3.1.

Eels appear to be present in good numbers throughout most of the river. Some idea of trends in numbers can be obtained from the results of the 1993, 1997 and 2007 semi-quantitative surveys. No numbers are available from the 1980 survey. In 1993 there were 243 eels per km of river recorded in catch one of the three 100 m sections fished. In 1997 there was an average of 40.3 eels per km recorded in the single fishing of the 3600 m length. In 2007 the single fishing produced 99 eels per km from the 905 metres fished. Thus what was viewed as a significant decline at the time of the 1997 survey appears to have been arrested and indeed reversed over the last ten years.

Dace are the dominant coarse fish species present, with an upstream limit between Highwood Lane bridge and Gatcombe Mill. It is surprising that they were not recorded as being present in the river in the 1980 survey, as they were said to be in the river in 1925 and before (see above) and have been recorded at all sites below Highwood Lane Bridge in all surveys since then. The ages of the fish captured in the 1993 survey were established by scale reading and the growth rate was concluded to be faster than on the Dorset Stour, and equal to those on the Frome (Welton *et al* 1993) and is well above the growth curve standard described by Hickley and Dexter (1979). Longley (2007) comments on the impressive size and condition of dace in the Medina. Good numbers of cyprinid fry were seen in the margins of the lower river in July 2008 and these were presumed to be dace.

Carp show up in many surveys in the lower river and these are probably the result of escapes from streamside ponds, or unauthorised stocking. James Kingswell, keeper on the Gatcombe Mill Estate, recalls catching carp to 10 lbs by angling in the impounded reach above Blackwater Mill some years ago.

4 ASSESSMENT OF OBSTRUCTIONS

4.1 Introduction

As already noted, there are a considerable number of weirs on the river between the estuary and the top of the project area at Highwood Lane. An incomplete list was supplied by the Environment Agency (see Table 4.1). A preliminary inspection of most of the project area was made on July 24 208, with a follow-up visit to some on August 4. This allowed a complete list to be prepared (Table 1).

Table 4.1 Structures in the River Medina between Newport and Highwood Lane bridge.

#	NGR	Distance in m		Description	Details from Environment Agency list	
		From last	From TL		#	Description
1	50166 89237	0	-220	Small structure in tidal channel		Not listed
2	50237 89064	70	-150	Small weir beneath road bridge tidal		Not listed
3	50233 88941	150	0	Head drop c. 95 cm. Tidal limit		Not listed
4	50224 88793	120	120	Two-stage weir, head drop 68 cm upper stage, 70 cm lower stage.		Not listed
5	50310 88616	250	370	Site of head structure for mill. Head drop 44 cm		Not listed
6	50341 88258	350	720	On private ground, head drop not measured.	13	Single drop concrete weir with counter. Has dropboard grooves to side. Head loss across weir 0.75m.
7	50360 88133	110	830	Concrete weir with a measured head drop of 13 cm. Notch in centre.	14	Single drop concrete weir with gauge. Head loss 0.45m. Gauge station is telemetry and gaugeboard under(?)
8	50360 88092	50	880	Old sloping stone weir with girders for sail boards.	15	Single drop weir with timber drop board, head loss across weir approx. 0.3m.
9	50234 87661	500	1380	Three-stage weir, oblique to stream. Head drop not measured	16	Stepped concrete weir with counter. Total headloss approx. 1m.
10	50267 87326			Not inspected	17	Dismantled weir – land has been reclaimed and turned into nature area – banks have been supported with gabions.
11	50294 86915	900	2280	Low-head (10 cm) weir under farm bridge, merges with riffle downstream	18	Single drop concrete weir. Head loss approx. 0.2m.
12	50558 86500			Small board weir (head c.20cm) for irrigation pump.	19	Single stop dropboard weir. Head loss 0.2m.
13	50573 86463	500	2780	Gauging flume at intake	20	Flat concrete weir with raised s-shaped longitudinal profile. Head loss 0.5 m. Pumping station on left bank.
14	50614 86420			Diversion sluice	21	Masonry weir, with sluice gate to one side.
15	50448 86133	450	3230	Masonry weir with slots for sail boards.		Not listed
16	50552 86015	150	3380	Blackwater Mill weir. Head drop 176 cm plus fall from apron.	9	Double drop concrete weir with counter. 1.5 m head loss. Timber drop boards on top with winch.
17	49912 85202	1300	4680	Gatcombe Mill Weir. Head drop 190 cm plus secondary drop of c. 30 cm.	11	Weir- single drop concrete weir and counter, with 1.5 m head loss.
18	49818 84986			Not inspected	12	Single drop concrete weir with 0.4 m head loss.
19	49812 84728			Not inspected.	10	Concrete weir with timber dropboard at outflow. Total drop 0.3 m.
20	49761 84601	760	5380	Gauging structure	7	Weir with gauge – single drop weir with gauge.

During the period September 2-4 2008 a detailed survey was made of all structures that were considered to be an impediment to fish movement and which justified some remedial work. A description of each of the 20 structures identified is given below.

4.2 Tidal waters to St Georges Way Bridge

Structure 1. SZ 50166 89237. A low-head weir in the tidal channel (Figure 4.1). Its function would appear to be to provide bed stability. As it is drowned-out at high tide it represents no obstacle to fish movement, and it was not surveyed in detail.



Figure 4.1. Structure 1 at low tide (July 24 2008) and near high tide (August 4 2008).

Structure 2. SZ 50237 89064. A low head weir with apron, beneath Pan Bridge (Figure 4.2). Function unknown; this may have been one of the "velocity control weirs" constructed as part of the second stage of the Flood Relief Scheme in the 1960's (Section 2.4). As it is drowned-out at high tide it represents no impediment to fish passage, and it was not surveyed in detail.



Figure 4.2. Structure 2 at low tide (July 24 2008) and near high tide (August 4 2008).

Structure 3. Matalan Lower Weir, SZ 50233 88941. This is a weir with apron with a head loss of about 0.95 m (varying with the tide) in a single fall, set between vertical blockwork banks (Figures 4.3 and 4.4). It now represents the tidal limit, and has effectively replaced the head drop at Ford Mill. This is likely to have been one of the "velocity control weirs" constructed as part of the second stage of the flood relief Scheme in the 1960's. It would appear to be a significant impediment to upstream migration, at least at low tide levels.

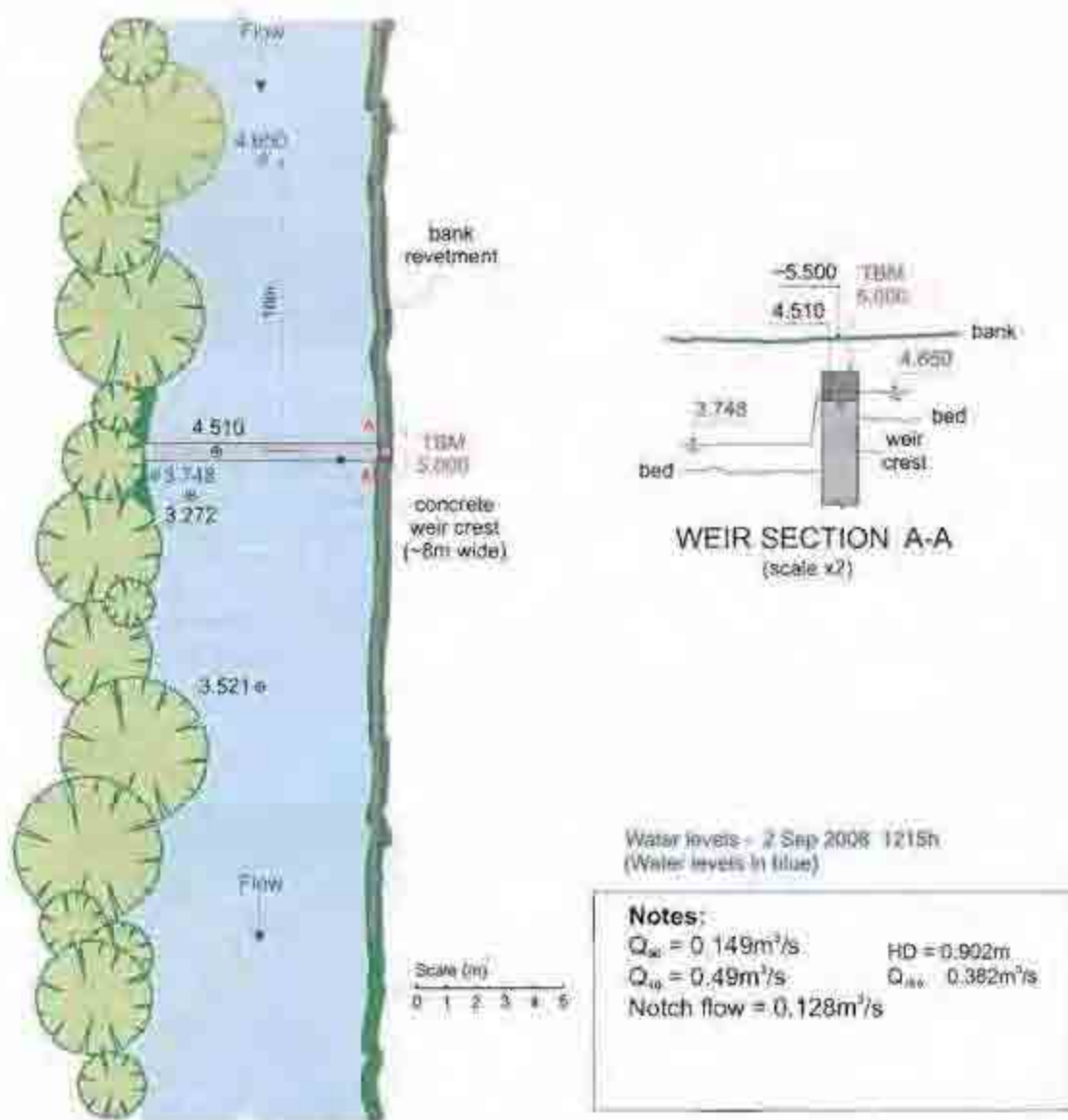


Figure 4.3 Plan of Matalan Lower Weir as surveyed.

In order to check to what extent tides reduced the head drop across this structure, recording depth-sensors were deployed upstream and downstream of the structure from September 3 to November 23 2008. Neap tides had no effect on the downstream level, and spring tides lifted the level by up to 0.4 m at peak. Even then this would leave a head drop of the order of 0.5 m. Thus while this weir could be passable by active swimmers such as sea trout under certain limited conditions, for most of the time it would be a serious impediment to migration. It is of little significance to freshwater fish as there is minimal freshwater habitat downstream.



Figures 4.4 and 4.5. Structures 3 (left) and 4 (right), February 6 2007.

Structure 4. Matalan Upper Weir, SZ 50224 88793. This is a two-stage weir with a total head loss of 1.295 m (September 2 2008), and an apron to the lower stage, set between vertical blockwork banks (Figures 4.5, 4.8 and front cover). It is located about 120 m upstream of structure 3. This structure effectively replaces most of the head drop at Pan Mill, which is now bypassed, and almost certainly represents one or two of the “velocity control weirs” from the 1960’s flood relief scheme. It is a major impediment to upstream migration. It is of only minor significance to freshwater fish as there is only a short reach of freshwater river downstream of here, albeit good riverine habitat.

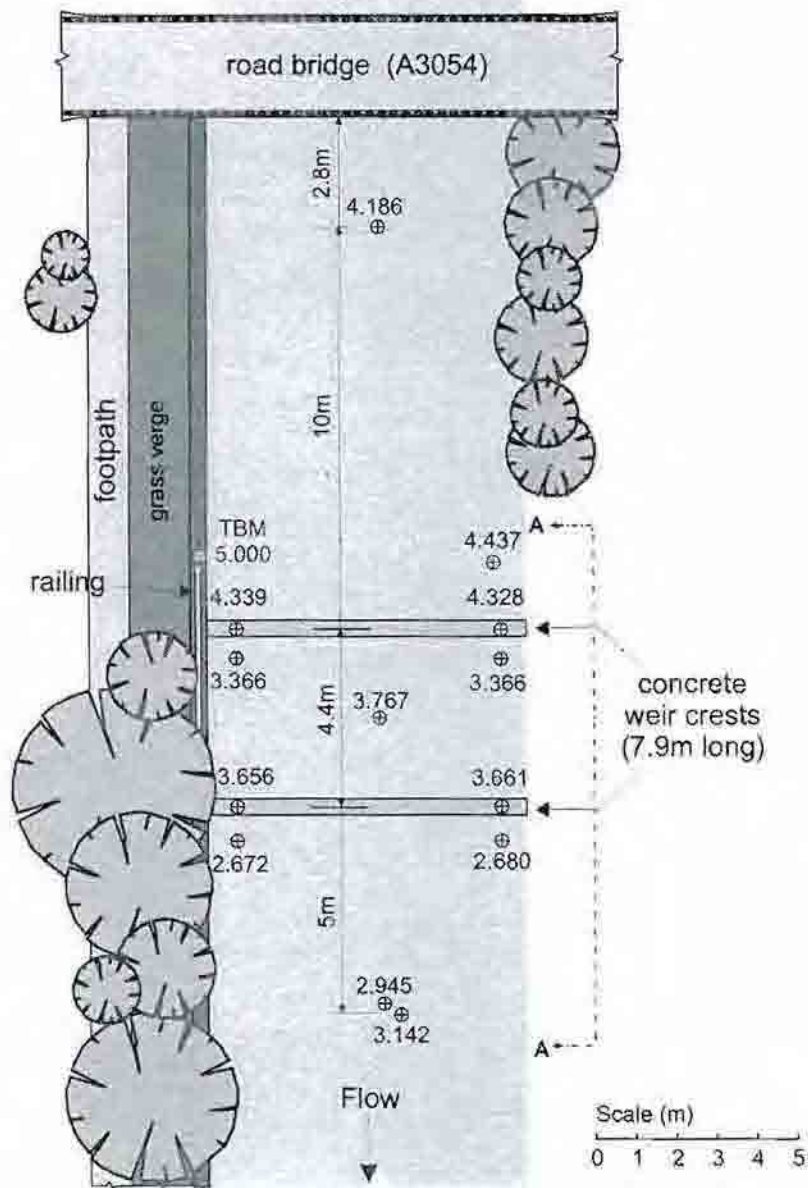
4.3 St Georges Way Bridge to Shide Bridge



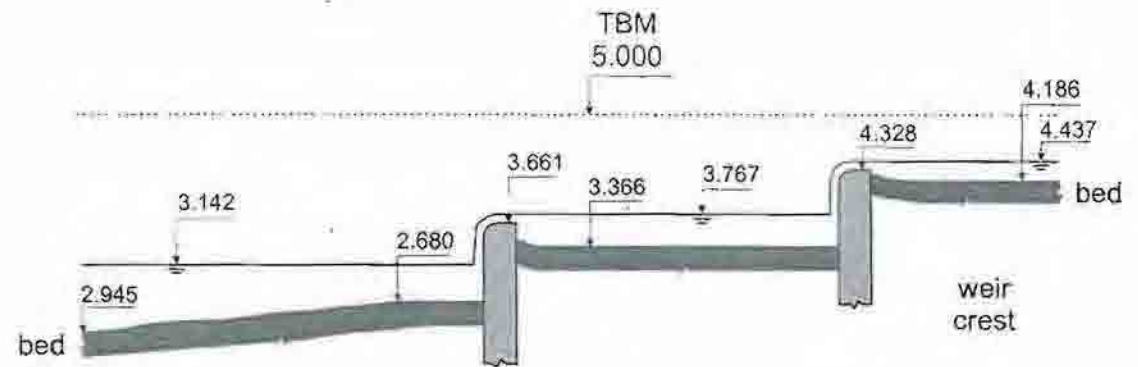
Figures 4.6 and 4.7. Structures 5 (left) and 6 (right) in July 2008.

Structure 5. Pan Mill Offtake weir, SZ 50341 88258. A concrete weir with apron with a head drop of the order of 0.45 m (Figure 4.6). This is one of the “velocity control weirs” that was constructed as part of the 1960’s flood relief scheme. It also provides the head for an offtake channel to Pan Mill. This channel was created during the construction of the flood relief scheme to maintain the water rights of the mill. The weir represents a significant impediment to movement at low flows due to the shallow water on the apron but may be less of an obstruction at high flows. This weir was surveyed and drawings could be produced without a further site visit.

Structure 6. Lower Shide Footbridge weir, SZ 50341 88258. Another concrete weir with apron (Figures 4.7 and 4.9); the head drop was 0.7 m on September 2 2008.



(4A) MATALAN UPPER WEIR



WEIR SECTION A-A
(Scale x2)

Water levels - 2 Sep 2008 1315h
(Water levels in blue)

Notes:
 HD = 1.295m
 $Q_{64.3} = 0.186 \text{ m}^3/\text{s}$

Figure 4.8. Plan of Matalan Upper Weir, as surveyed

is situated. The weir has a central notch and is unlikely to be a serious impediment to the migration of any species. This site was surveyed and detailed drawings could be produced without a further site visit.



Figures 4.10 and 4.11. Structures 7 (left, February 2007) and 8 (right, July 2008). The design of the works shown in Figure 4.10 was said to have "paid particular regard to amenity"!

4.4 Shide Bridge to Blackwater Bridge

Structure 8 Shide Ramp Weir, SZ 50360 88092. A low, gently sloping stone weir with a head loss of the order of 0.3 m, and provision for stop boards to increase the head (Figure 4.11). The original function is unclear but it is an attractive feature and probably not a serious impediment to migration at higher flows; at times of low flow (as when the photograph in Figure 4.8 was taken) there is just a few centimetres of water over the face of the weir.

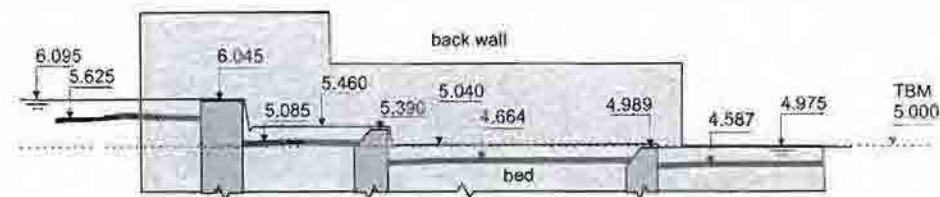
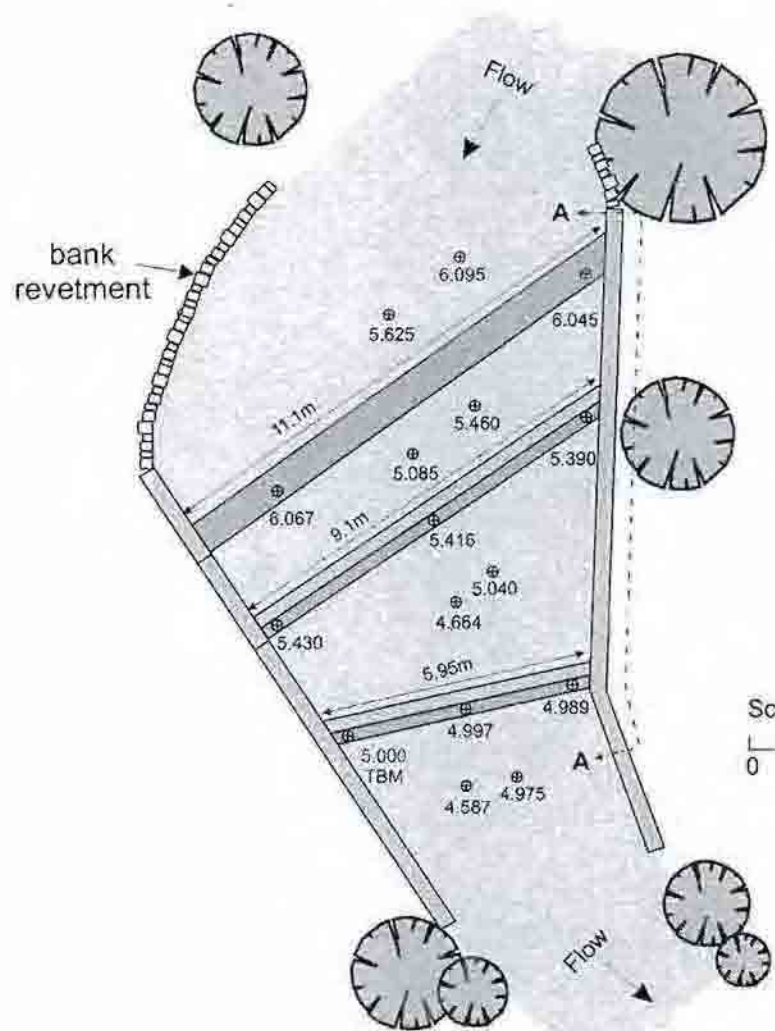
Structure 9 Upper Shide Mill Weir, SZ 50254 87661. This is a three-stage concrete weir set at an oblique angle to the stream, and with a total head loss of about 1.1 m (Figures 4.12 and 4.14). Clearly a "velocity control weir" from the flood relief scheme it effectively retains the head that was maintained by Shide Upper Mill. This is likely to be a major impediment to fish movement.

Structure 10 SZ 50267 87326. A derelict weir no longer on the channel line, included here because it is on the Environment Agency list. Not inspected.

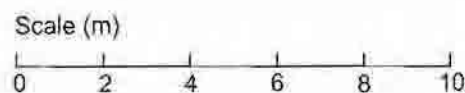
Structure 11 SZ 50294 86915. A very low head (0.1 m) structure beneath a farm bridge (Figure 4.13). No impediment to fish movement.



Figures 4.12 and 4.13. Structures 9 (left) and 11 (right) in July 2008.



SECTION - VIEW ON A-A



(9A) UPPER SHIDE MILL WEIR
(Layout Diagram)

Figure 4.14. Plan of Upper Shide Mill Weir, as surveyed

Water levels - 3 Sep 2008 1000h
(Water levels in blue)

Notes:

HD = 1,12mm

$Q_{62.2} = 0.191 \text{ m}^3/\text{s}$

Structure 12 SZ 50558 86509. A low-head (0.2 m) board weir creating depth for an irrigation pump (Figure 4.15). Not a significant impediment to fish movement.

Structure 13 SZ 50573 86463. A flat Vee flow gauging flume with a head loss of the order of 0.4-0.5 m (Figure 4.16). Likely to be an impediment to the movement of small fish.



Figures 4.15 and 4.16. Structures 12 in July 2008 (left) and 13 (right) in September 2008.

Structure 14 SZ 50614 86240. A diversion sluice controlling flow into a side channel. It is included here because it is in the list of structures produced by the Environment Agency. As it does not impinge on the main channel it is not considered further here.

4.5 Blackwater Bridge to Highwood Lane

Structure 15 Blackwater Lower Weir, SZ 50448 86133. A wide-crested masonry weir with a head drop of the order of 0.4 m, with provision for oversail boards. (Figure 4.17). The function of this structure is unknown but the oversail board provision suggests that it once had a level management function, either to do with the mill or for amenity purposes. Likely to be an impediment to migration at low flows, requires assessing in higher flows.



Figures 4.17 and 4.18. Structures 15 (left) and 16 (right) on July 24 2008.

Structure 16 Blackwater Upper Weir, SZ50552 86013. This large structure (Figures 4.18 and 4.23) effectively retains the head for Blackwater Mill, though it has been constructed since the mill ceased using water power.

It therefore currently has the function of maintaining the upstream level for feeding the mill pond, which is retained as a landscape feature in a large garden. The overall head loss from the retained upper level to the surface on the long shallow cill was 1.76 m on July 24 2008 and 1.86 on September 2 2008, of which about half was due to stop boards in slots above the concrete structure. It is a formidable obstruction for upstream passage of all species.

Structure 17 Gatcombe Mill Weir, SZ 49912 85202. This concrete dam (Figure 4.19) was erected about 1954 to replace the Gatcombe Mill dam that had been destroyed in a flood in 1951. Its crest is about four feet lower than the original, isolating the mill wheel from its water supply (Figure 4.20). It is a major impediment to upstream migration.



Figures 4.19 and 4.20. Gatcombe Mill pond dam and waterwheel, July 24 2008.

Structure 18 SZ 49818 84986. A weir with a head of about 0.4 m, on the branch of the river feeding the mill pond (Figure 4.21). Not surveyed in detail.

Structure 19 SZ 49812 84728. A diversion weir feeding a second channel that rejoins the outfall from the millpond on a right-angle bend (See figure 2.6). The weir itself was not inspected, but at the time of the site visit on July 24 2008 approaching half of the flow was passing down this channel. If the weir can be adjusted to take a greater proportion of the flow then this may allow access to the area above Gatcombe Mill without having to overcome the massive concrete weir there.



Figures 4.21 and 4.22. Left; structure 18. Right: structure 20, looking upstream.

deep hole

3.019

2.850

6.8m

3.177

3.177

3.257

1.28m

3.627

0.75m

3.638

3.975

4.887

4.879

4.871

4.48m

4.931

3.732

grass verge

bank revetment

TBM 5.000

Sleeper Weir (6x15cm high)

flap gate control to lake

footbridge

Flow

4.931

4.887

TBM 5.000

3.732

3.975

3.638

3.627

3.257

3.177

3.177

2.850

3.089

bed

RH bank revetment

bed

WEIR SECTION A-A

Scale (m)

0 1 2 3 4 5

Water levels - 3 Sep 2008 1200h
(Water levels in blue)

Water levels - 3 Sep 2008 1200h
(Water levels in blue)

Notes:
HD = 1.862m
Q_{out} = 0.186m³/s

Structure 20 Highwood Lane Gauge, SZ 49761 84601. Said by Environment Agency to be a weir with gauge, but inspection failed to reveal any significant head-drop structure (Figure 4.22). In any event there appeared to be little habitat upstream of here suitable for anything but smaller species and eels, so regarding this as the upper limit of the project area appears appropriate.

4.6 Summary of obstruction issues

A summary of the assessment of the level of impediment to movement of trout and dace is shown in Table 4.1.

Trout occur, perhaps only on an intermittent basis, in the Shide area of the stream. There is likely to be some gravel suitable for spawning in this area but the main areas suitable for spawning and rearing lie upstream of here, especially between Blackwater Mill and the top of the study area. There would appear to have been no trout in this area for many years, and this area is cut-off from the Shide area by at least two major obstructions.

Dace occur throughout most of the study area between the tidal limit and Highwood Lane bridge, but it is likely that there is little upstream movement past several major obstructions. It is probable that this situation has prevailed for the past thousand years, since mills were erected on the river. It is possible that some upstream migration can take place during floods. Some downstream movement of fry and young fish will have occurred, allowing at least a one-way transfer of genetic material.

Eels are well-known for their ability to ascend obstacles where a “damp” route through weeds, moss and debris exists (Solomon and Beach, 2004 a and b). While many of the obstructions appear formidable with respect to eel passage the fact is that the species is well-distributed throughout the catchment, and many are succeeding in ascending or bypassing all the structures being considered here. Figure 4.24 shows the wetted area at the side of Structure 3 which is likely to allow passage of elvers and small eels. Gauging weirs (Crump section and flat Vee) are often major impediments by virtue of their clean lines and smooth concrete faces. However, the flat Vee below Blackwater Bridge (Structure 13) would appear to be passable by small eels by virtue of growth of moss at the edge of the wetted area (Figure 4.25), possibly encouraged by the stable low-flow regime during the summer. It is recommended that the operators of this weir are requested not to clean it unless the plant growth significantly affects its gauging function. Two weirs (Structures 16 and 17) appear particularly difficult for eel passage but in both cases there are alternative routes for passage. Suggestions are made in Section 5 for improved access by eels if this is deemed necessary.

Bullheads are generally considered to be poor at overcoming weirs and other structures, but they are one of the most sedentary of British freshwater fish species, with measured migrations of just tens of metres compared to tens of kilometres for many cyprinids (Peter 1988). They are well-distributed throughout the catchment despite the presence of obstructions in the form of mills having been in place for many hundreds of years. Almost nothing is known of effective ways to allow passage on this species over obstructions.



Figure 4.24 (left). Growth of wet moss and liverworts at the side of Structure 3 which probably allows ascent by elvers. Figure 25 (right). Moss growing in the very shallow edge of Structure 13 which is likely to allow ascent of small eels.

Table 4.1. Assessment of the level of obstruction for different species represented by structures in the River Medina.

#	Bullhead	Dace	Trout	Eel	Distance from TL (m)
1	n/a	n/a	0	0	-220
2	n/a	n/a	0	0	-150
3	n/a	n/a	2	1	0
4	2	2	2	1	120
5	2	2	2?	1	370
6	2	2	2?	1	720
7	2	1	1	0	830
8	1	1	1	0	880
9	2	2	2	1	1380
10	0	0	0	0	1700
11	1	0	0	0	2280
12	1	0	0	0	2500
13	2	1	1	1	2780
14	0	0	0	0	2880
15	2	2	2	1	3230
16	2	2	2	2	3380
17	2	2	2	2	4880
18	2	2	1	1	
19	?	?	?		
20	0	0	0	0	5580

n/a = not applicable – only tidal water downstream. 0 = little or no impediment to migration; 1 = some impediment at all times or likely to be impassable at times; 2 = appears impassable. TL = tidal limit.

5 THE WAY AHEAD

5.1 Introduction

Although this investigation has focussed on fish passage issues, it is important that any future plans for remedial action for fish passage are integrated into an overall plan for the catchment and takes account of other factors that will impinge on fish stocks. For example there is no point in providing passage facilities for migratory trout if there is little or no gravel in a fit state for spawning or if there are major water quality issues.

In the first instance the requirements for opening up the river for sea trout will be considered. However, before significant expenditure is committed to this it would be prudent to ensure that water quality and habitat quality are suitable. The fact that there are no trout in the upper part of the study area indicates that conditions have not been suitable at some stage in the past, if not today. A careful scrutiny of available water quality records is strongly advised, along with an assessment of the suitability of the gravel bed for trout spawning. An alternative approach to both these issues would be to stock the area from Blackwater Mill to Highwood Lane with juvenile brown trout and to follow their progress for a year or two by electric fishing survey and visual observation.

In the following sections, remedial options for each significant obstruction are considered, starting at the tidal limit and working upstream. In some cases more than one option is discussed. It must be stressed that the proposals and drawings are based upon brief surveys and are not engineering plans for construction. Further, the suggested costs are indicative only and are based upon experience elsewhere. Local factors such as site access, problem ground or floods can have a major influence upon installation costs. The method of construction of the pre-weirs that are suggested at some sites will also have a major impact on costs. River diversion during construction is likely to be very expensive, whereas dewatering only part of the channel at any time using sandbags should be much less so. An alternative could be the use of large natural blockstone laid on the river bed; this would not require channel dewatering, but would require access for suitable lifting equipment.

Complete removal of obstructions, or significant lowering, is an attractive option as not only would it facilitate fish movement but could also recover some of the natural gradient of the stream, to the benefit of habitat in general. However, in some cases the retained head serves a purpose (eg at Blackwater, where it maintains the level in the millpond, now an ornamental lake, and retains the level in a managed withy bed upstream). In other cases there may be issues regarding structural integrity of upstream structures (such as St Georges Way bridge immediately upstream of Structure 4). Finally, removal will cause the channel to erode upstream as the river cuts back to form a lower bed, and may lead to bank failure. This is especially the case in the lowermost reaches where major weirs dissipate most of the head drop in a reach of steep gradient which was realigned in the 1960s-70s (see Section 2.4) and these structures may be integral to the channel stability. For a similar range of reasons structure removal is rarely used as a remedial technique in the UK, and would not appear to be a viable option for most of the structures under consideration here.

One of the main problems for fish passage is that many of the structures have shallow aprons, which do not provide an adequate depth of water for ascending fish to "take-

off'. It is possible that some engineering such as cutting a notch in the crest and providing a deeper channel through the apron will allow passage without the need for a formal fish pass. Where this is proposed the suggestion is that the notch should be sized to run full at the Q95 flow; this indicates a notch of the order of 0.6 m wide and 0.25 m deep in the lower river. In some cases it may be possible to build-up the tailwater level with a pre-barrage, thus increasing the depth below the weir, and spreading the head drop into more than one fall.

5.2 Sea trout

Much of the habitat suitable for spawning, rearing and adult holding of sea trout lies between Blackwater Mill and the upstream limit of the study area at Highwood Lane. Even including all this reach the total area suitable is limited, so it is assumed that access throughout the study area will be required for a viable programme. One exception is the area upstream of Gatcombe Mill on the mill channel: there is a limited area which is basically poorly suited for spawning and rearing. Much better conditions prevail on the more easterly channel.

Opening up this area would involve attention to seven structures which are considered to be generally impassable for trout (Table 4.1). These are now considered in turn.

The first major obstruction is the Lower Matalan weir, which forms the tidal limit (Structure 3, Section 4.2). Although this may be passable at times of high spring tides, for most of the time it is a serious impediment to movement. This is a site where one or two notched pre-barrages constructed downstream, with a notch also cut into the existing structure, is probably the most cost-effective solution; the indicative cost is £30 k, depending on whether one or two pre barrages were needed. This proposal is indicated in Figure 5.1

The second major obstruction is Matalan Upper Weir (Structure 4, Section 4.2). Two remedial options have been considered here. The first involves the installation of a Larinier fish pass (Armstrong *et al* 2004) within the right bank of the river (Figure 5.3). This would cost of the order of £90,000 and would provide good migration conditions for both trout and cyprinids. A much cheaper option would be to cut notches in the two existing weirs (Figure 5.3). This would not significantly reduce the head drops across each stage of the weir but would provide a much easier route of ascent for strong swimmers such as adult sea trout. It is unlikely to aid passage for cyprinids and eels, though as already discussed the former are hardly an issue this far down stream.

The third significant obstruction is Pan Mill Offtake weir (Structure 5, Section 4.3). The problem here is not the retained head (of the order of 0.45 m) but the shallow water below and the flat top of the weir. This can most simply be addressed by cutting a notch in the weir, at an indicative cost of £10k. This would allow passage of sea trout but would probably not aid migration by cyprinids and eels.

The next major obstruction is the Lower Shide Footbridge weir (Structure 6, Section 4.3), which has a head drop of the order of 0.9 m. The proposal here is to cut a notch in the top weir, raise the lower weir crest and install a notch, and construct an intermediate notched weir between the two existing ones (Figure 5.2). This would cost

of the order of £35k and would greatly assist the passage of sea trout. It is unlikely to aid the passage of cyprinids and eels.

The fifth major obstruction is the Upper Shide Mill Weir (Structure 9, Section 4.4), a three-stage construction with an overall head drop of about 1.1 m.

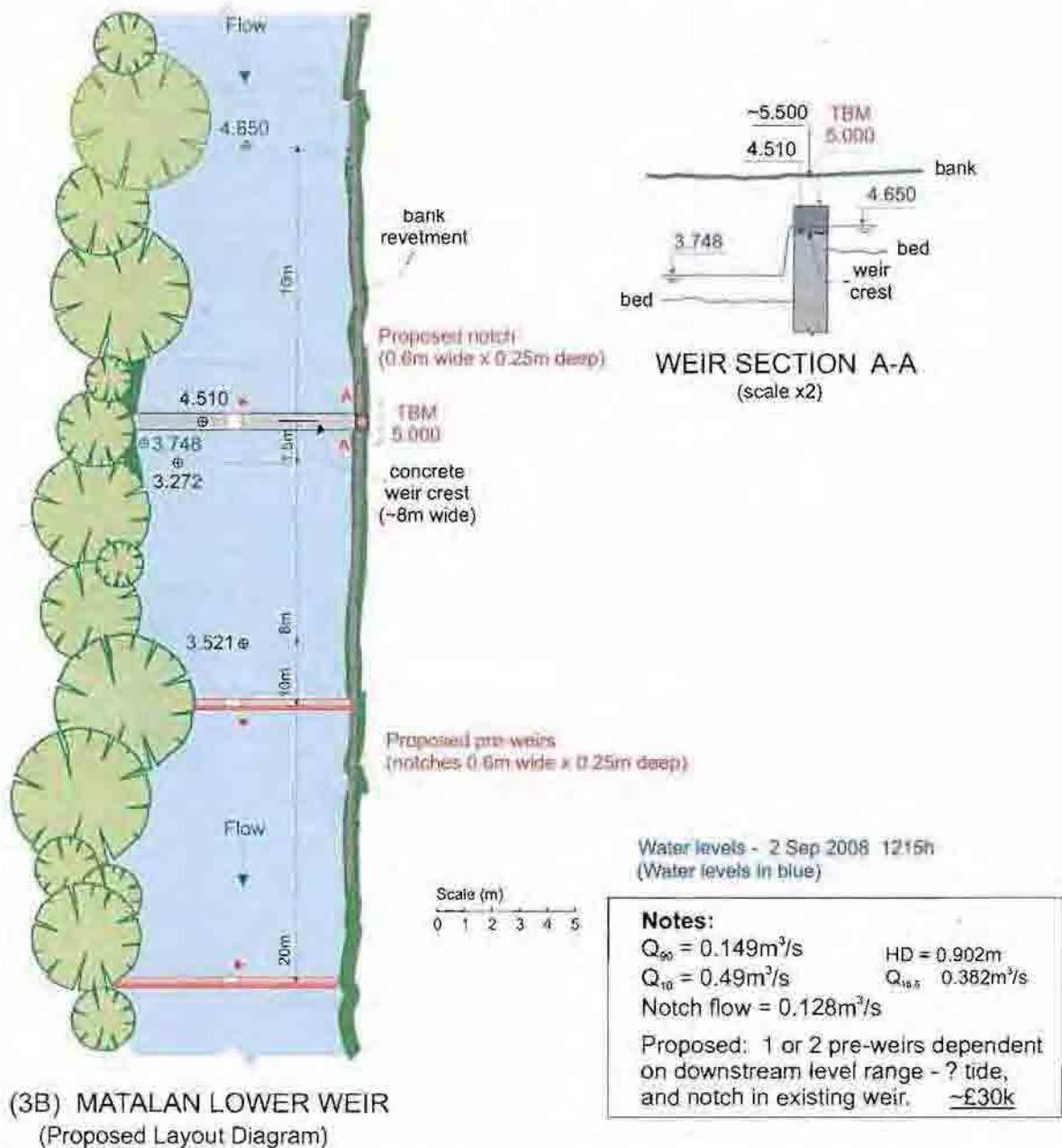


Figure 5.1. Plan of Matalan Lower Weir, showing proposed works

The proposal here is to notch all three weirs and provide a new fourth notched weir a short distance downstream (Figure 5.4). This would cost of the order of £35k. This would allow the free passage of sea trout but would not aid the passage of cyprinids and eels.

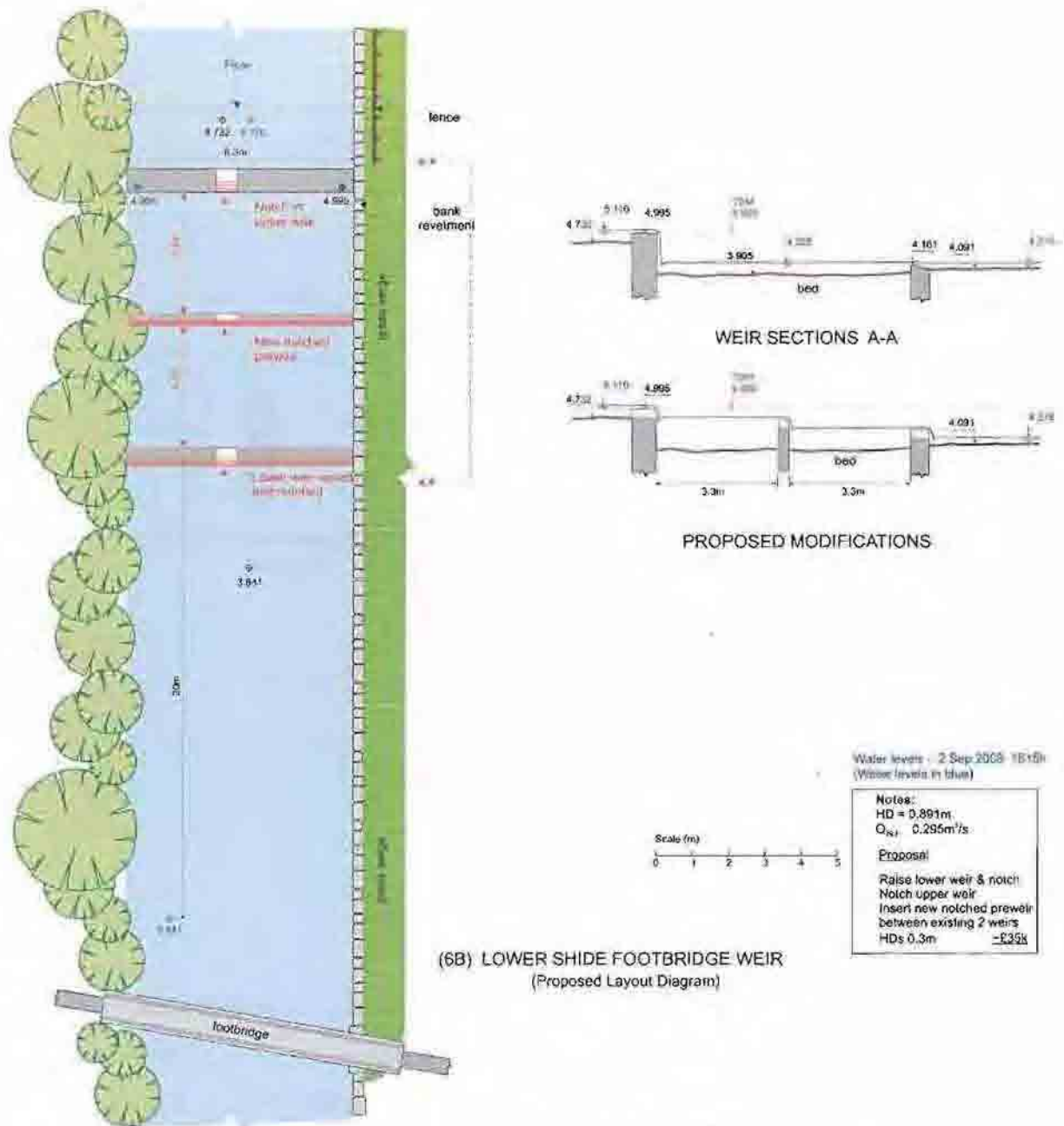
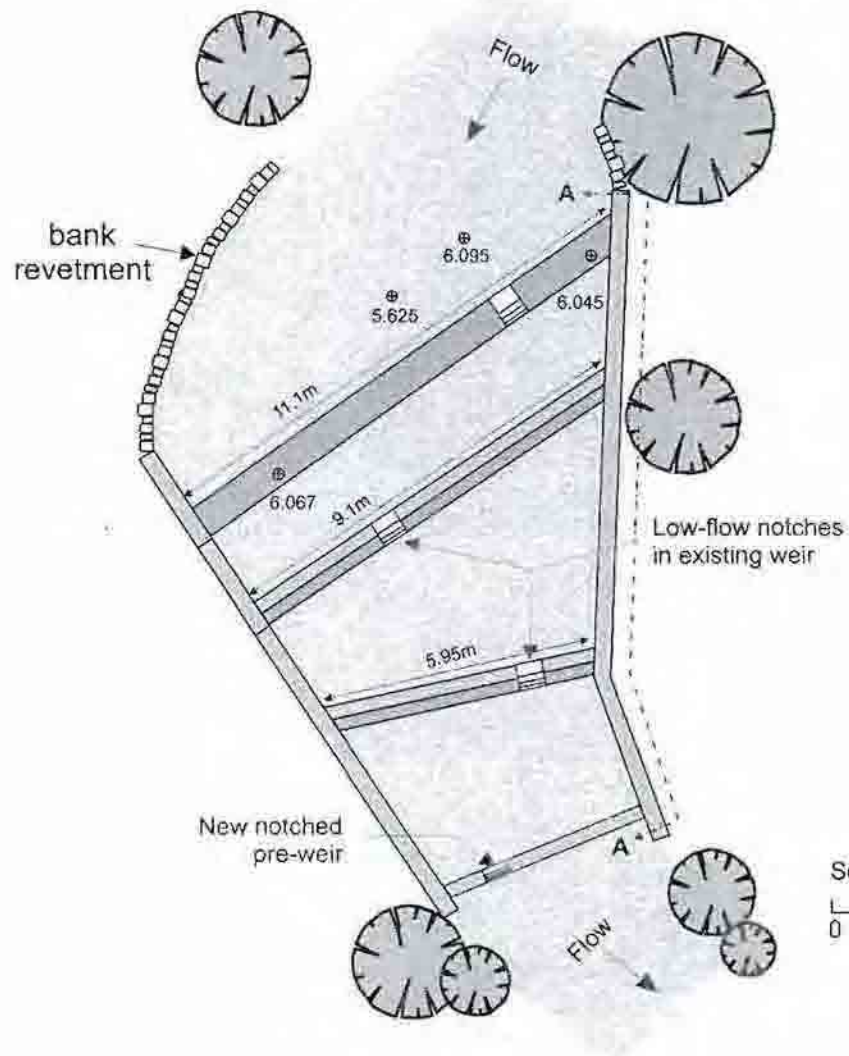


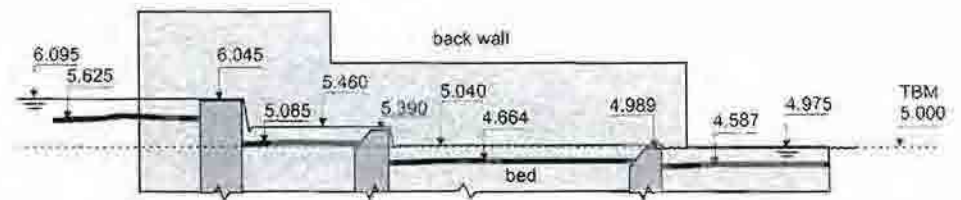
Figure 5.2. Plan of Lower Shide footbridge weir, showing proposed works.

The next significant obstruction is Blackwater Lower Weir (Structure 15, Section 4.5), which has a head drop of the order of 0.45 m and a long flat crest. No specific remedial action is presented here because of the alternative suggestion of bypassing both this and the next obstruction with a "new" channel. If this alternative proposal is not acted upon it is likely that a notch cut into the weir would allow passage of sea trout.

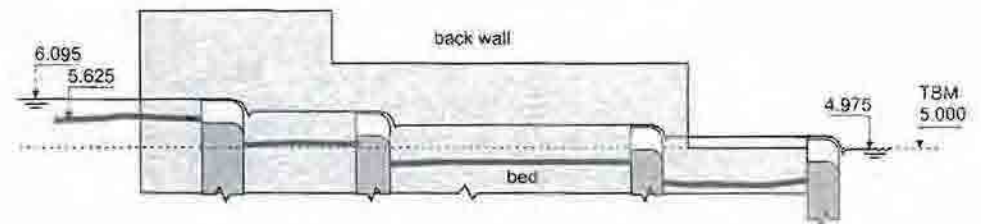
The seventh major obstruction is Blackwater Mill Weir (Structure 16, Section 4.5), which is the most formidable on the river with a head drop of the order of 1.86 m. Two specific solutions were considered here, that of a Larinier pass in the left bank, and a pool and traverse pass constructed within the existing channel (Figure 5.5).



UPPER SHIDE MILL WEIR
(Proposed Layout Diagram)



SECTION - VIEW ON A-A



PROPOSED SECTION - VIEW ON A-A

Scale (m)



Water levels - 3 Sep 2008 1000h
(Water levels in blue)

Notes:

HD = 1.12m

$Q_{62.2} = 0.191 \text{ m}^3/\text{s}$

Proposals

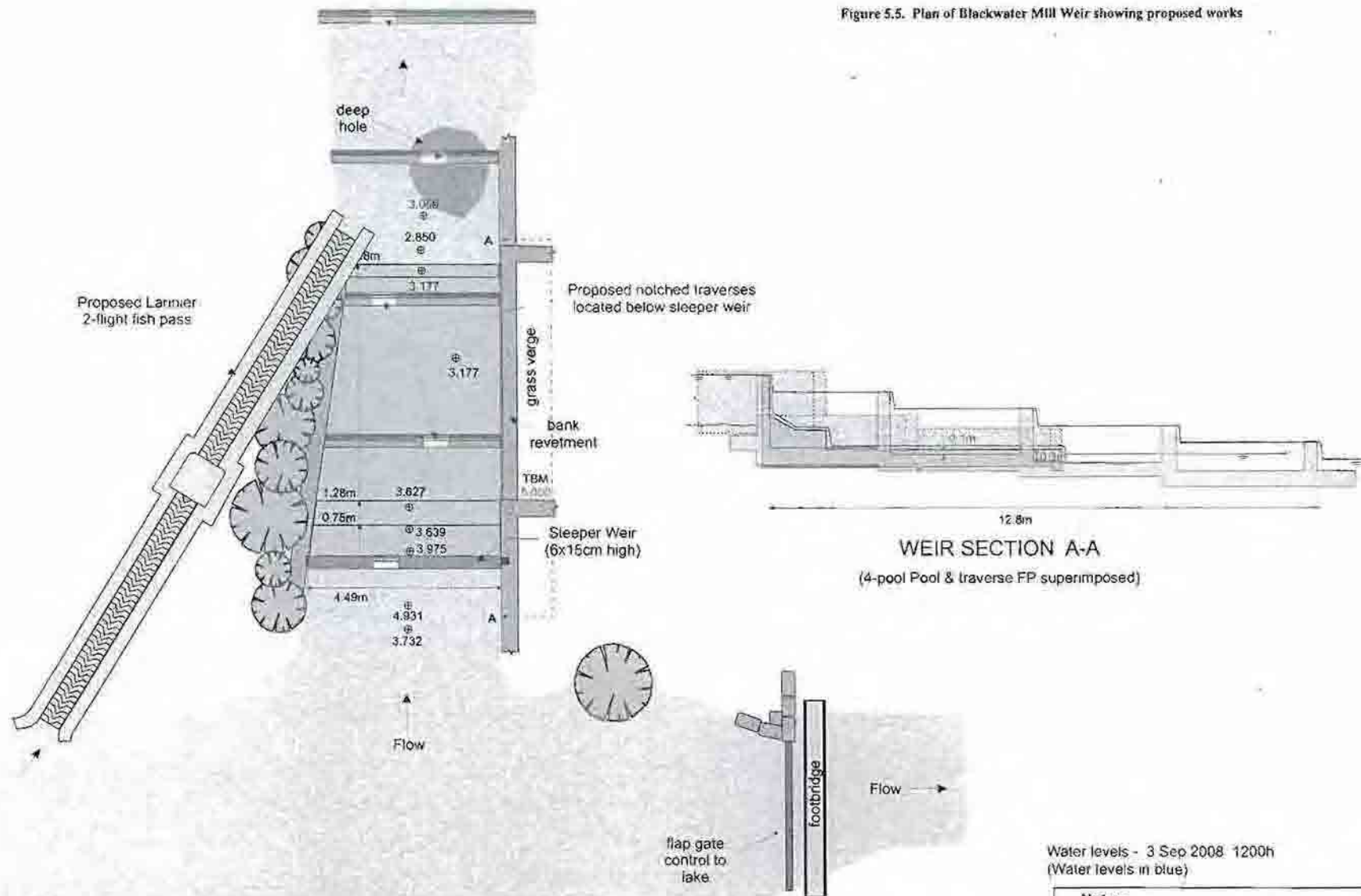
Low-flow notches in
existing weirs.

New notched pre-weir.

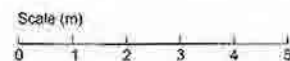
New weirs HDs 0.28m ~£35k

Figure 5.4. Plan of Upper Shide Mill Weir, showing proposed works

Figure 5.5. Plan of Blackwater Mill Weir showing proposed works



(16B) BLACKWATER MILL WEIR
(Layout Diagram)



Water levels - 3 Sep 2008 1200h
(Water levels in blue)

Notes:
HD = 1.862m
 $Q_{50,2} = 0.186 \text{ m}^3/\text{s}$

Proposals

1. Laminar in RHS bank ~12.4m long. ~£120k
2. P&T FP within existing channel ~£60k (as shown). Upper pool 2.5m long to reduce FP length, lower 3 pools 3m long to reduce depth.

figure of £100k is suggested. A major advantage of this option are that it would re-create an additional 300 m or so of stream with a steep gradient which would support considerable channel diversity and create significant additional habitat potentially suitable for salmonid spawning and rearing. It could also represent an effective passage for, and additional habitat, for cyprinids and eels. It may be prudent to maintain the existing channel in good order so that it can be used for conveyance of flood flows. Overall, this represents an exciting opportunity for habitat recovery. It is strongly recommended that this option be actively explored further. Issues that would need to be addressed include:-

- ownership of all the land and stream that would be affected, and seeking agreement of these owners;
- identification of the exact location the original channel and a survey to establish the course, gradient and the form of the channel and original bed;
- design of the structure at the offtake from the existing channel to ensure level control for feeding the lake;
- the provision of a small sweetening flow down the bypassed part of the current channel to ensure its continued availability for conveyance of flood flows;
- access for plant and machinery;
- plans for disposal of the material excavated from the old channel;
- design of any training walls, head loss structures and other engineering of the refurbished channel.

Gatcombe Mill weir is effectively impassable but no remedy is proposed here as the available length of stream between here and the study-area boundary at Highwood Lane is short, has most of the gradient taken away by the weir, and is not ideal trout spawning and nursery ground. In contrast, the eastern channel which bypasses the mill weir is potentially good habitat and it is suggested that a greater proportion of the dry-weather flow is directed down this arm. This would require some adjustment and possibly modification of the structure at the point where the two channels separate, but this location was not found or surveyed in this investigation. It is worthy of note that the fact that the parish boundary follows this eastern channel indicates that it was the original course of the river.

5.3 Cyprinids

Dace is the dominant cyprinid species present, although there are also small numbers of roach and chub downstream of Blackwater. As dace are a small species (growing to about 25 cm in length in the Medina) they are used here as a model for other species.

The swimming ability of dace is less than that of sea trout largely by virtue of their smaller size. It is unlikely that the simple expedient of cutting notches in the Medina weirs, or adding intermediate or downstream weirs to reduce head drops to around 0.4 m which will provide passage for sea trout, will assist the passage of dace. On the other hand, Larinier passes with a gradient of up to 15° have been shown to allow passage of remarkably small fish (G Armstrong, pers. Comm.). It is considered likely that the Larinier pass options considered here will allow passage of dace and other cyprinids, at least at times. If dace passage is considered essential then consideration

could be given to provision of Larinier passes at all obstructions with a head difference of 0.3 m or more.

However, such considerable expense is not, it is suggested, justified. Dace are present in satisfactorily-self-sustained sub-populations in the several separate reaches of the river. Even if upstream movement of genetic material has not taken place for some hundreds of years, some downstream movement will have occurred and the populations do not appear to have suffered. If some genetic redistribution is deemed desirable then consideration should be given to moving some fish from the lower reaches to the upper reaches every several years. However, it is suggested that there are many more pressing fisheries issues justifying action.

5.4 Eels

From the presence of eels in fair numbers throughout and upstream of the study area it appears that some elvers and small eels can ascend all the obstructions at times. The potential re-opening of the old channel at Blackwater should allow easier upstream migration, but notching of weirs and provision of additional weir steps will probably not. If it is deemed desirable to improve upstream passage for eels consideration could be given to a simple facility providing a substrate in the "corner" of each weir; a piece of discarded trawl netting could be anchored to a block upstream and draped over the weir cill; see Solomon and Beach (2004) for an example of this approach. The cost is minimal, and the material is easily deployed and removed as required. Alternatively, consideration could be given to stocking the upper river with elvers. This latter approach is currently being explored nationally as an input to eel management plans.

5.5 Flood risk

There have been serious floods from high fluvial flows in the Medina, notably in October 1960 and January 1961. These events were the catalyst for the flood alleviation work undertaken on the channel in the 1960's, which is described in Section 2.4. It is clearly imperative that any remedial work for fisheries does not increase flood risk in any way.

With this in mind, the majority of the options proposed in Section 5.2 have been specified in a manner that increases or at least maintains the flood capacity of the channel. Possible exceptions are some of the suggested options at Structures 3, 6, 9 and 16 which involve construction of intermediate or downstream weirs. While it is believed that these would not materially affect flood risk, this must be examined at the detailed planning stage if these suggestions are to be taken forward. It must be borne in mind that, at the time of the serious flooding in 1960, Ford Mill and its millpond were still a major feature on the river in Newport and their removal must have made a significant difference to flood risk.

5.6 Summary of recommendations

The actions that are recommended in order to open the river up to sea trout are summarised in Table 5.1. It is again stressed that the costs provided are indicative only.

It is stressed that further examination of the river to check its suitability for sea trout, in terms of water quality and gravel quality, should be undertaken before commitment to further significant expenditure is made (see Section 5.1). More detailed plans and proposals for each site will then be required. It is recommended that detailed plans for sites 3, 4, 5, 6 and 9 are prepared. It is recommended that the proposal for reinstating the original channel at Blackwater Mill, including specifying a control structure at the upstream end, be commissioned.

Table 5.1 Summary of recommendations and indicative costs of provisions for sea trout migration.

Site	Site #	Recommendation	Indicative cost
Matalan lower weir	3	One or two pre weirs, notch cut in existing weir	£30k
Matalan upper weir	4	Larinier fish pass	£90k
Pan mill offtake weir	5	Cut notch in weir	£10k
Lower Shide footbridge weir	6	Cut notch in upper weir, raise lower weir, add intermediate notched weir.	£35
Upper Shide Mill weir	9	Notch all three weirs, add fourth downstream	£35k
Blackwater Mill lower weir	15	Bypass using original channel	Included below
Blackwater Mill upper weir	16	Bypass using original channel	£100k
Total			£300k

If free access for cyprinids is required throughout the river then significant additional facilities would be required. Providing Larinier passes at each of the first five sites would cost of the order of £400k, plus the £100k for the Blackwater bypass channel. It is suggested that such a provision is not necessary for the health of the stream and of the cyprinid populations.

6 REFERENCES.

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7 APPENDIX A. HYDROMETRIC STATISTICS FOR THE UPPER SHIDE GAUGING STATION.

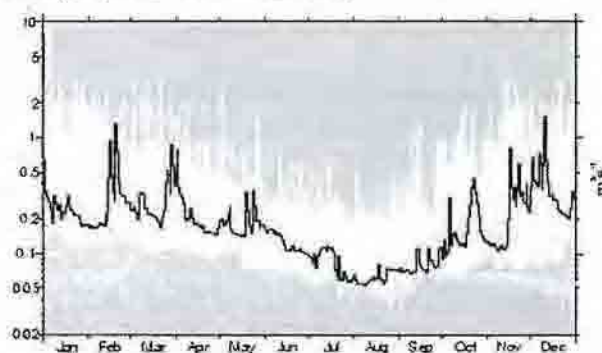
Taken from the National River Flow Archive website, and from Hydrological Data UK.

Grid Reference: 40 (SZ) 504 881
 Operator: EA
 Local number: 53001001
 Catchment Area: 29.8 km²
 Level of Station: 10.4 mOD
 Max. Altitude: 167.0 mOD
 Mean flow: 0.29 m³s⁻¹
 95% exceedance (Q95): 0.084 m³s⁻¹
 10% exceedance (Q10): 0.526 m³s⁻¹
 61-90 Av. Ann. Rainfall: 839 mm

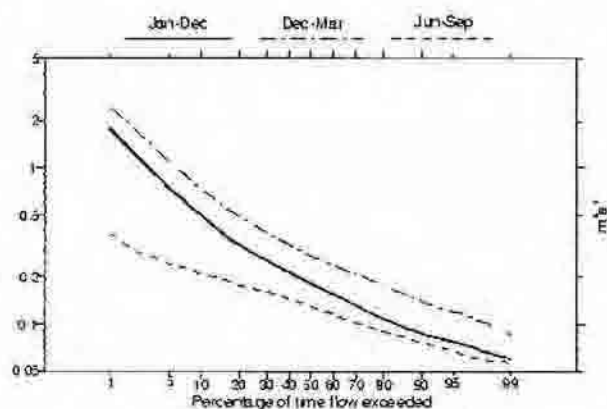


Sample Hydrograph of Gauged Daily Flows

Max. and min. daily mean flows from 1965 to 2006 excluding those for the featured year (2006: mean flow: 0.20 m³s⁻¹)



Flow Duration Curve for Gauged Daily Flows



Station Description

Ultrasonic station (at road bridge) installed in 1996 (no data Sep-Dec 96). Superseded trapezoidal critical depth flume, width 2.4m (with broad-crested c/m rated overflow weir for stages > 0.6m). Nov. 2000 peak under review. Small abstractions for irrigation. Flow reduced in 1985 by gw pumping tests. From 1989, low flows augmented by IoW Conjunctive Use Scheme; also transfers to the Eastern Yar.

Catchment Description

Entirely rural, arable catchment. Fairly steep slopes in southern headwaters. Predominantly permeable: Chalk and Lower Greensand with some Gault Clay.

Factors Affecting Runoff

- Runoff influenced by groundwater abstraction/recharge.
- Runoff reduced by industrial/agricultural abstraction.

River Flow and Catchment Rainfall on the National River Flow Archive

Gauged Daily Flows (gdf): 1965 to 2006

Monthly Catchment Rainfall (mm): 1965 to 2006

Datatype	1960s	1970s	1980s	1990s	2000s
gdf					
mif					

For many stations monthly peak flows are also archived. When daily flow data are not available monthly mean flows may be held on the National River Flow Archive. See Data Holdings for further information.

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HYDROLOGICAL DATA: 1986-90

101002			Period	Rainfall (mm)	Runoff (mm)	Mean flow (m ³ /s)	Peak flow (m ³ /s)	Date of peak	Min. daily flow (m ³ /s)	Date of min.	10 Percentile (m ³ /s)	50 Percentile (m ³ /s)	95 Percentile (m ³ /s)
4 A. NRA S	Medina at Upper Shide	CA	65.85	275	0.26	73.3	01/04	0.03	02/09	0.4	0.16	0.07	
7 A.R. CI	Level 10m BFI Ex	Local Number: 3300150 Station: 109					1984						
			1985	324.08	314	0.29	6.5	02/01	0.06	16/09	0.5	0.19	0.08
			1987	324.94	313	0.30	4.9	11/11	0.10	20/09	0.5	0.21	0.11
			1988	323.31	313	0.31	6.5	05/01	0.11	16/09	0.6	0.18	0.13
			1989	324.82	309	0.19	3.1	20/12	0.04	07/08	0.3	0.11	0.06
			1990	325.82	272	0.20	6.4	08/02	0.05	14/08	0.4	0.10	0.06

Comment: Truncoidal cross-section flume, width 2.4m, intentionally filled with broad-leaved aquatic macrophytes to allow wet for slopes greater than 0.0m/1.14 m/s. Small adjustments for vegetation have reduced in 1985 by plant-water pumping tests and, from 1983, by the use of Wright Conveyance Use Scales.

* Entry from catchment. Agriculture is mainly timber. Fairly steep slopes in the southern headwaters. Geology is predominantly lower Gneiss and with some local Clay and Crakle.

