POST WORKS ASSESSMENT OF THE STREAM RESTORATION PROJECT SITES AT HALE

(R. AVON)

Summary of post works assessment following final site visit on 1st May 2009

R. Avon, Hale– Pre Scheme

R. Avon, Hale – Post Scheme

Report by

the River Restoration Centre

RRC, Cranfield. MK43 0AL

rrc@theRRC.co.uk

Prepared by

Dr Di Hammond, Dr. Jenny Mant, Martin Janes & Alice Fellick (now at Thames21)

"Demonstrating Strategic Restoration and Management (STREAM) is supported by the European Commission's LIFE-Nature programme, Natural England, Environment Agency, Wiltshire Wildlife Trust, Hampshire and Isle of Wight Wildlife, Trust, and Wessex Water"

Document Revisions

No.	Details	Date
1	Draft Report	August 2009
2	Final Report	September 2009

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1. Introduction

Introduction

The majority of the perennial River Avon catchment and part of one of the winterbournes (River Till) in Hampshire is designated as a Special Area of Conservation (SAC). The River Avon is one of the UK's most bio diverse, with over 180 species of aquatic plants, 37 species of fish and a wide range of aquatic invertebrates. The headwaters of the main river are a network of clay streams fed by chalk springs. These converge to form a chalk river, which is then joined by the main tributaries around Salisbury developing into a large calcareous river. It then flows over more acid sands and clay as it passes the New Forest and the Dorset Heaths. The SAC also includes the Dockens Water, a largely unmodified acid stream draining New Forest heathlands.

The River Avon has a high baseflow input from the chalk aquifer. In the upper reaches of the system, the rivers support outstanding chalk stream fisheries, and the surrounding land is mainly grazed or arable. In the lower reaches of the Avon, the river is known for its coarse fishery and the floodplain is of international importance for wintering wildfowl and waders. The river is highly valued throughout for its flora and fauna, and is the subject of a range of conservation, fishery and agricultural initiatives.

The SAC designation is due to the inherent richness of flora and fauna of the River Avon. Specifically the reviser is designated for the following internationally rare or vulnerable species and habitat underpin the designation.

- Water courses of plain to montane levels with *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation (classic chalk stream habitat)
- Population of Atlantic salmon (*Salmo salar*)
- Population of bullhead (*Cottus gobio*)
- Population of brook lamprey (*Lampetra planeri*) and sea lamprey (*Petromyzon marinus*)
- The river and adjoining land a habitat for populations of Desmoulin's whorl snail (*Vertigo moulinsiana*)

The River Avon SAC is subject to a water level management plan, and an action plan for the SSSI's restoration needs was completed as part of the Environment Agency (EA) assessment of the cost to meet the Public Service Agreement (PSA) target for river morphology (EA 2008).

1.1 STREAM Project Background

1.1.1 Project Specification

The STREAM project was a £1 million four-year conservation project centered on the River Avon and the Avon Valley in Wiltshire and Hampshire. The River Avon and its main tributaries are designated as a Special Area of Conservation (SAC), and the Avon Valley is designated as a Special Protection Area (SPA) for birds. The STREAM project has undertaken strategic river restoration activities and linked management of the river and valley to benefit the river habitat including water crowfoot and populations of Atlantic salmon, brook and sea lamprey, bullhead, Desmoulin's whorl snail, gadwall and Bewick's swan.

A Conservation Strategy for the River Avon Special Area on Conservation (2003) identified the main issues affecting the ecological health of the River Avon *SAC*, and agreed on a range of actions required to address them. It also highlighted the complex relationship between the river and the Avon valley.

In December 2002, work began on securing substantial new funding to do the following:

- Restore, to favourable condition, the River Avon Special Area of Conservation/Special Site of Scientific Interest (SSSI) and the Avon Valley Special Protection Area/SSSI.
- Tackle wider biodiversity issues outside the European protected sites including additional priority species and associated habitats, and
- Improve public access, awareness and support for the natural heritage importance of the river and valley.

The project identified 6 sites where conservation-led restoration of the watercourse habitat is required, and which could subsequently be used to demonstrate techniques and disseminate knowledge and experience of this work. For the application submission, an outline design for each site has been drawn up.

1.1.2 Restoration

The approach to the restoration works is to reinstate the physical form and diversity of the river channel, creating dynamic habitats that are sustained by the river's natural flow regime. The aim of the works was to demonstrate novel and appropriate restoration techniques for the chalk river types within the River Avon SAC, but the approach should be applicable to other rivers supporting *Ranunculion fluitantis /Callitricho-Batrachion* communities.

Works included bank re-profiling to a more natural slope, non-native tree felling and native tree planting, reconnecting the river to its floodplain, and enhance currently poor marginal habitat, which is known to be critical to fish and invertebrates in lowland rivers.

The key objective of the restoration work was to demonstrate a range of bio-engineering techniques useful for the narrowing of river channels. The range of techniques should then provide a 'tool-box' that fishing clubs could carry out themselves to help integrate the needs of riparian ecology with fishery management.

1.2 Monitoring Requirements

The project bid identified a number of actions which were identified. These fell into a number of categories including;

- Preparatory actions (Actions A)
- Purchase/lease of land and/or rights (Actions B)
- Non-recurring management (Actions C)
- Recurring management (Actions D)
- Public Awareness and dissemination of results (Actions E)
- Overall project operation and monitoring (Actions F)

Of the overall project operation and monitoring actions (see Table 1.1), action F8 relates to monitoring.

Table 1.1 Overall project Operation and Monitoring Actions

Code	Title and Actions	Objectives
F1	Appointment of Project Management Team	Set up an effective LIFE project team
F2	Project Management, including management of Project Staff	Ensure all project actions are executed to fulfil the objectives of the LIFE project within the allocated budget
F3	Project Reporting	Reporting progress of project to the EU
F4	Management of the Project actions and budget by Project Working and Steering Group	To provide overall direction to the project.
F5	Purchase equipment	To equip the LIFE team so they can effectively carry out the project
F6	Purchase car	Allow the LIFE team to travel around the catchment and liaise with key stakeholders
F7	Project Initiation Workshop	To launch the project and facilitate a good working relationships between all partners.
F8	Monitoring Programme	To monitor success of the river restoration work and disseminate findings.
F9	Assessment of River Restoration Sites	Compare the River Restoration project outcomes with the original objectives
F10	Production of After-LIFE Conservation Plan	To set out future conservation management continuing and developing the actions in this Project

1.2.1 Detailed Monitoring

Royal Haskoning were commissioned by Natural England to undertake physical and biological monitoring at each of the restoration sites. A monitoring protocol was developed for the river restoration works. This combined detailed monitoring at a limited number of sites, with a more rapid assessment of the remainder. The full detailed monitoring was carried out and Upper Woodford and Seven Hatches sites. At Fovant and Hale only the rapid assessment was carried out, but was also conducted at Upper Woodford and Seven Hatches. The rationale behind this was to minimise costs while ensuring basic assessment of the effects of the range of restoration techniques carried out by the Project.

All sites were monitored pre and post restoration. Detailed monitoring was carried out on two restoration sites, each with a control site. The control sites had comparable physical characteristics to the restoration sites prior to the works; however, no restoration works were carried out on the control sites. The remaining restoration sites were subject to a less detailed monitoring assessment. Field mapping was converted into a suitable digital GIS format to allow calculation of the areas of habitats within the reaches from which it was possible to monitor change following repeat surveys. The GIS recorded physical and ecological features, sample and cross-section locations and any other spatial data collected in the field.

The pre-restoration surveys were intended to establish a record of biological and physical conditions at the site prior to restoration. The post-restoration surveys were to record modifications to the channel after restoration. The surveys both provided snapshots pre- and post-restoration. It should however be recognised that there is a limitation to the comparisons

that can be made over this short duration and it was not possible to draw any conclusions regarding changes in conditions at a site pre / post-restoration. The relationship between physical and biological conditions were analysed at each site and comparisons drawn concerning the relationships identified at each site at the time of survey, taking into account other factors and processes that might have influenced relationships.

The detailed monitoring comprised the following techniques;

- Geomorphological and habitat baseline surveys;
- Cross section surveys;
- In channel macrophyte survey;
- Fisheries surveys;
- Fixed point photography.

Geomorphological and Habitat Baseline

Geomorphological and Habitat Baseline survey included the river bed, banks and a riparian zone not less than 5 m from the bank edge (subject to the nature of the adjacent habitats). Thus the mapping extended beyond 5m where an adjacent habitat is specifically a riverine wetland or where the restoration works restore connections between the floodplain and the channel.

Geomorphological mapping was at a suitable scale, and covered the detail of the channel geomorphology, evidence of geomorphological processes, bed materials and vegetation cover. Habitat mapping included the vegetation structure and species composition recorded in a way that allows comparative assessment in subsequent years following colonisation of the restored or modified reaches**.**

Cross-section Survey

Cross-section surveys will be undertaken through each reach at a maximum spacing of three bankfull channel widths for a maximum length of 1000m. Survey within each cross-section will seek to capture habitat boundaries and morphologically defined features in addition to water surface elevation.

In-channel Macrophyte Survey

A Macrophyte survey (to include *Ranunculus spp, Callitriche spp* and associated community) was undertaken with relevant spatial data presented in GIS formats. This will include;

- Cross sectional survey of vegetation cover (%);
- Species quadrats at 5 cross-sections at each site ;
- Reach-based overview maps.

Fish Survey

Fishery survey for *Salmo salar, Petromyzon marinus, Lampetra planeri* and *Cottus gobio* were undertaken within the restored and control reaches. The survey design will reflect the complexity of the riverine environment, with sampling from within different habitats within the watercourse. The sampling framework will be based on the habitat mapping.

It is intended that any fish survey would be undertaken completely within the field, with no specimens taken and all material returned to the river. Species and size classes will be identified.

Fixed Point Photography

Repeat photography was undertaken at each reach from fixed point locations. These survey points needed be re-locatable and were thus be recorded by a 12 figure grid reference together with the bearing of the view established by a Geographical Positioning System (GPS). Such data was provided as a GIS point layer with an appropriate file structure to allow for hot-linking within a GIS.

As well as the detailed mapping, rapid assessment techniques were also employed at all the sites. The rapid assessment of the remaining restoration sites will use the following techniques;

- Feature inventory survey;
- Basic habitat mapping;
- Fixed point photography.

Feature Inventory Survey

The remaining restoration sites were audited using a standard feature inventory form. This approach was been developed and deployed on the River Cole restoration project and used to estimate physical habitat diversity (Sear *et al*. 1998). A tally of all physical habitat features within the channel (pool, riffle, eroding cliff etc.) is recorded. This survey was undertaken at the same time as the main monitoring programme during the autumn when vegetation has died back.

Basic Habitat Mapping

The watercourse habitat and surrounding terrestrial habitats were mapped using UK biodiversity habitat types.

Fixed point photography

Fixed Point photography was undertaken as for the detailed monitoring sites.

1.2.2 Rapid Assessment Surveys

In addition to the Royal Haskoning monitoring, the River Restoration Centre (RRC) also carried out a series of rapid assessment surveys. The surveys were planned to be carried out pre, during, just after (as built) and post the restoration works. Examples of the RPPA forms can be seen in Appendix A. The project was divided into physically distinct reaches each of which was assessed separately. The reaches include one or more upstream of the restoration (recording upstream impact) and one or more downstream of the restoration (again recording any subsequent impact). Repeat photography was also carried out and a set of maps showing the location of the photographs is produced (see Section 2).

The pre project assessment includes a précis of the objectives and background information, the reach characteristics including width, depth, bank and bed material, vegetation, land use and quality of ecological habitat along with the short and long term potential impacts of the restoration work.

The ‘during construction’ proforma includes information about the contractor and a technical site plan. The form also includes a summary of predicted short and long term impacts (both

positive and negative). There are then a number of questions relating to the construction programme and costs and a section related to changes to the original design.

The post and as-built assessment forms additionally an inventory of restoration techniques and an assessment of the number of different aspects of the project including;

- Visual and social elements;
- Physical characteristics;
- Vegetation;
- Fish & Aquatic Invertebrates, and;
- Mammals, terrestrial invertebrates and birds

The potential changes, both short (recovery from the physical works) and long (beyond the lifetime of the project) term, are then identified and an appraisal of the techniques used is carried out. The overall project was then assessed and future improvements and management requirements identified along with the potential for adaptive management and future restoration opportunities.

Rationale for Expert Judgment Rapid Assessment Techniques

The RRC has produced a rapid assessment methodology for assessing the potential, actual and possible future effects of the restoration work. This is a relatively new, expert judgment based tool to assess multi-disciplinary objectives and determine a project's successes and failings. The methodology allows the incorporation of any additional quantitative or qualitative analysis undertaken for particular elements. It also requires a subjective assessment of likely future success and identifies adaptive management potential whereby future phases of the current project and future new projects can utilize the results and lessons learnt from the current scheme. It should be noted that the repeat photographs are an important part of this process as they give a visual record of the works and their success and or failure as well as allowing a comparison between before and after restoration to be made. The method is cost affective and helps to deliver LIFE requirements for monitoring and assessment within the often short timescales associated with such projects. The assessment also highlights changes that have occurred between the design stage of the project and the works which were actually carried out and why these adjustments were necessary to implement the scheme.

1.3 Aims and Objectives for the River Avon at Hale

The main channel has generally been over-widened and deepened, due to past dredging, with deposited spoil creating a bund on right and left banks. The bed was dominated by poorly sorted fine gravel and sand, with very limited spawning and juvenile habitat for salmonid species. Submerged macrophytes including un-branched bur-reed (*Sparganium emersum)* and starwort (*Callitriche* spp) are relatively abundant. Growth of water crowfoot (*Ranunculus spp)* was generally poor throughout the reach. Due to the lack of riparian shrubs and trees there was very little large woody debris present in the reach, which should be characteristic of the river at this location.

The objective of the restoration were to;

- 'Re-energise' the reach by providing variations in flow characteristics and channel dimensions;

- Increase both the heterogeneity of bed morphology and margins in previously dredged reaches;
- Promote localised sediment transport;
- Increase the availability of suitable spawning habitat for salmon, bullhead and rook lamprey;
- Increase the amount of large woody debris in the channel in order to increase both the availability of this habitat type and morphological diversity of the channel and;
- Enhance the availability and quality of habitat for, in particular;
    - Bullhead (increased diversity of hard bed, particularly pools during winter and riffle/fast glides during summer and increased large woody debris for, particularly, juveniles ;
    - Brook lamprey (increased availability of well sorted, fine sediment in shaded, marginal areas with large woody debris for ammocoetes and gravel/sand dominated shallows <40cm deep for spawning adults);
    - Salmon parr (increased availability of coarse substrate, with overhead cover and woody debris lodged in the channel);
    - Desmoulin's whorl snail in the marginal zone of the channel;
    - The *Ranunculus* community as a result of increased heterogeneity in velocity and bed morphology.

2. Scheme Assessment

2.1 Site Description

The River Avon at Hale is a fast flowing with very little flow variability within the channel. Historically land drainage works on the River Avon at Hale(south of Salisbury) has resulted in a deeper bed level, loss of hard bed substrate, over-widening of the channel and the creation of raised flood banks, with an associated loss of hydrological connectivity with the floodplain over much of the project reach.

Grazing by cattle and sheep has slowed the development of a community of marginal vegetation which would facilitate a 'natural' and stable narrowing of the channel. In addition the river has a poor submerged macrophyte diversity being mostly water- crowfoot (*Ranunculus penicillatus*).

As a result of past dredging there is a severe lack of suitable gravel substrate for migratory salmonids to spawn on. There is a need for a shift from silt and sand domination to gravel and pebbles.

The river has very little in the way of riparian tree cover and the resulting lack of large woody debris has reduced the physical habitat diversity present in the river, with an associated reduction in habitat quality and availability for, amongst others, bullhead (*Cottus gobio*), Atlantic salmon *(Salmo salar),* brook lamprey *(Lampetra planeri)* Desmoulin's whorl snail *(Vertigo moulinsiana)* and water crowfoot (*Ranunculus spp).*

2.2 Proposed Restoration Works

A range of techniques will be used, including;

- The creation / rehabilitation of two or three 30-40m spawning riffles using a combination of existing and imported gravels;
- The construction of upstream facing current deflectors.;
- The introduction of large woody debris into the channel.;
- The planting of isolated groups of native trees and shrubs protected by temporary electric or other fencing.

Figure 2.1 River Avon at Hale Reach 1

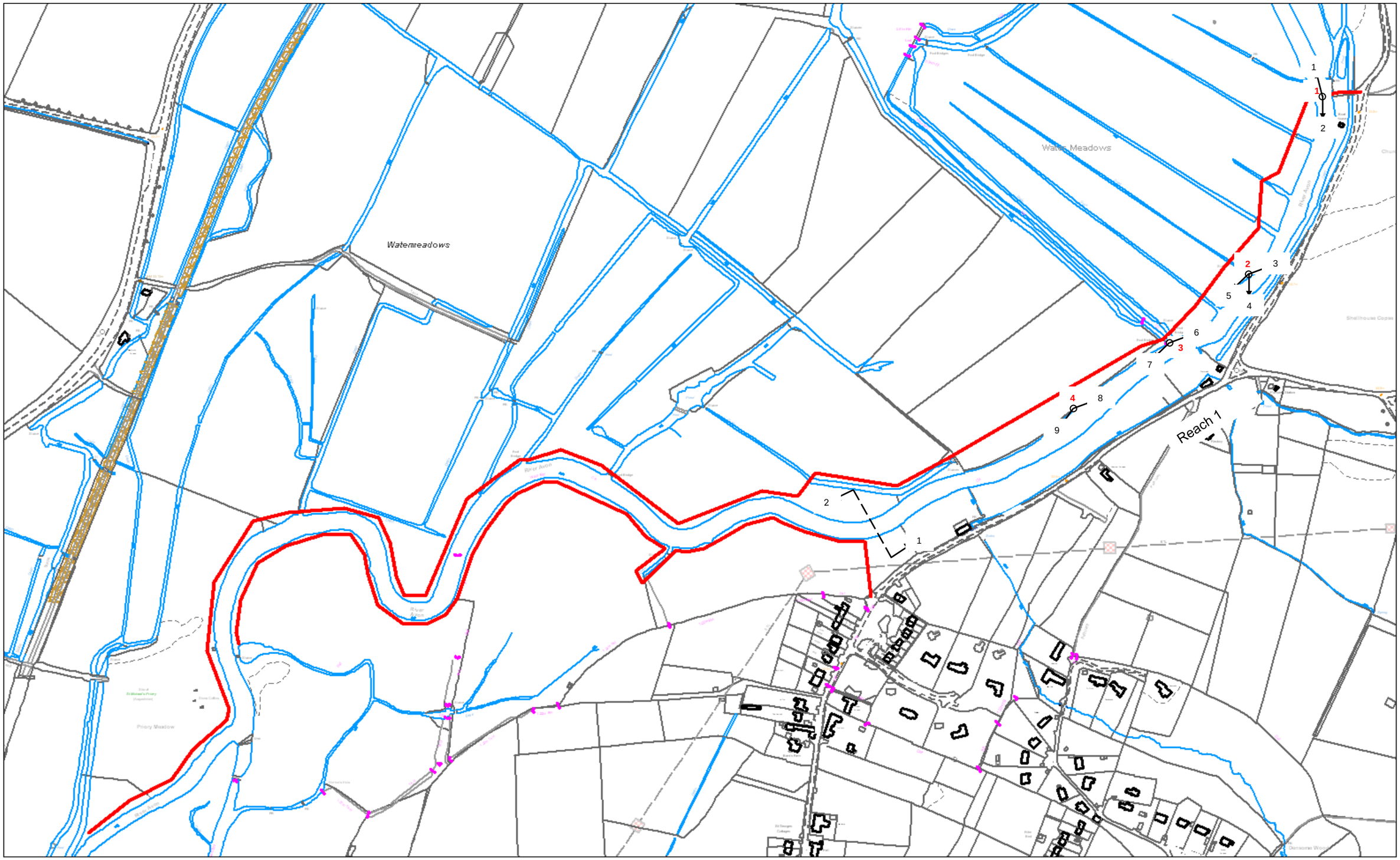


Figure 2.2 River Avon at Hale Reaches 2 and 3

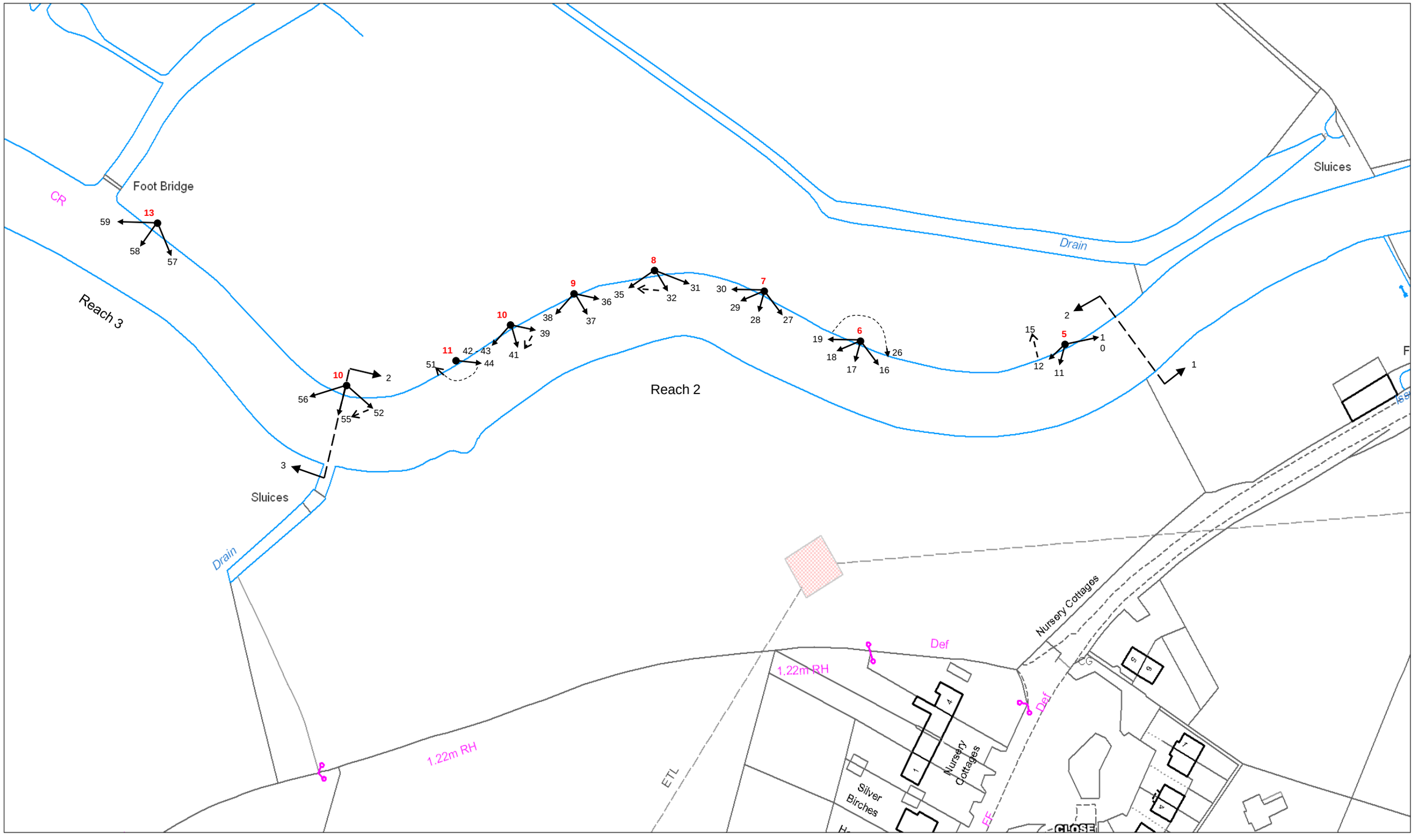
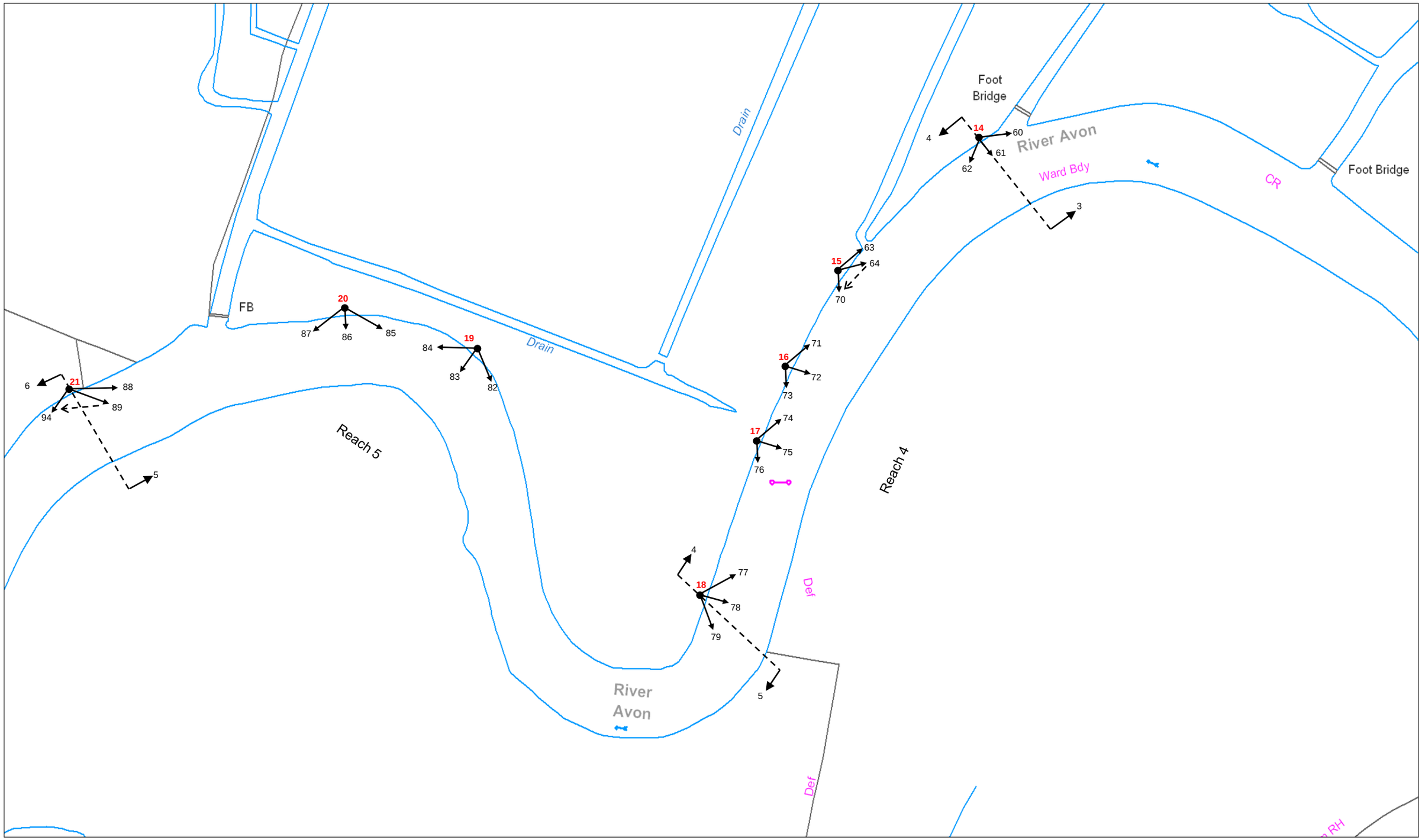


Figure 2.3 River Avon at hale reaches 4 and 5



Scale 1:1250 Map 1 of 1

0 25 50 75m
0 62.5 125 187.5ft.

Drawn by: Jenny Wheeldon
Date: 20/6/2007
Ref: -3888-3888
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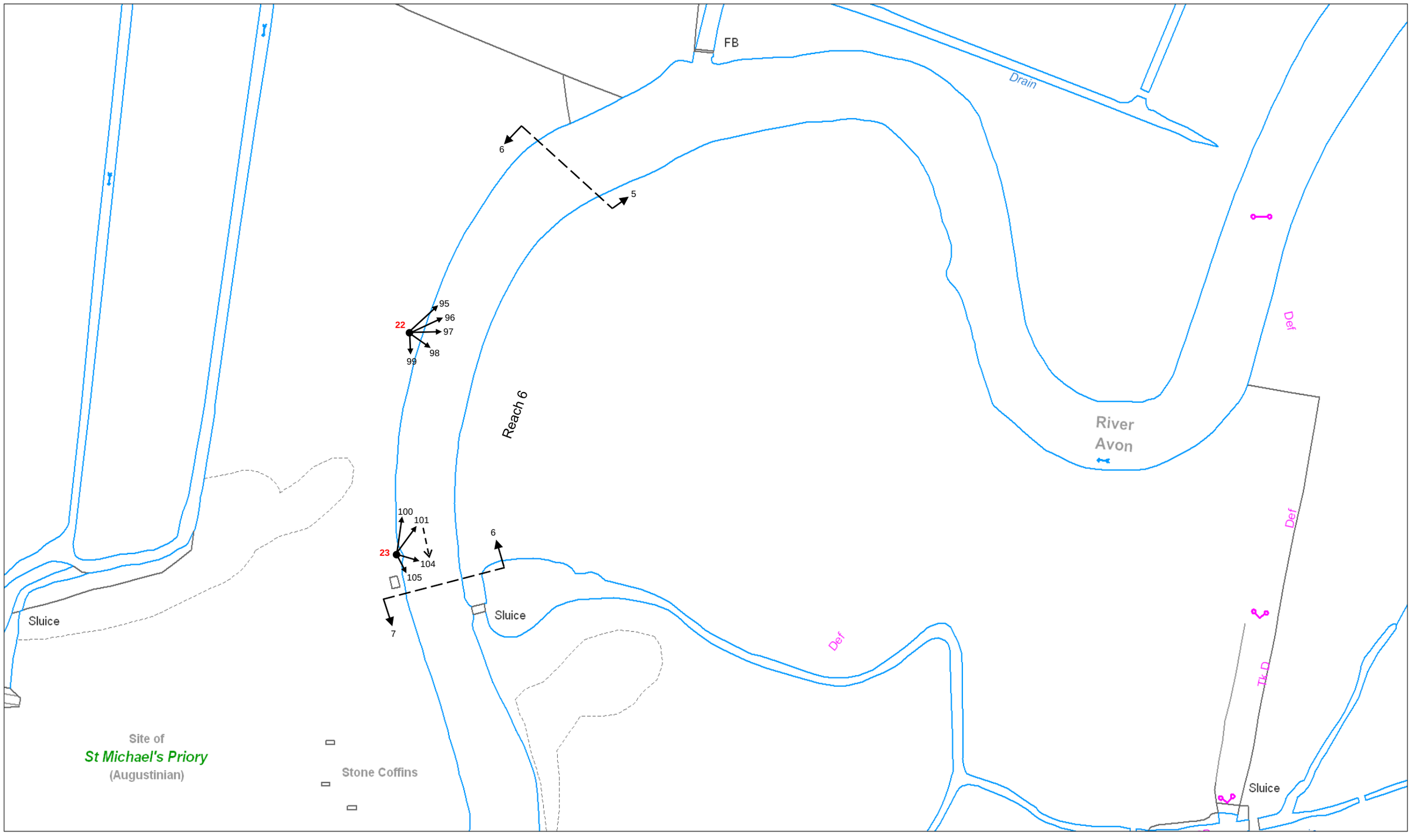
Grid North

Natural England

Figure 2.4 River Avon at Hale Reach 6



Scale 1:1250 Map 1 of 1

0 25 50 75m
0 62.5 125 187.5ft.

Drawn by: Jenny Wheeldon
Date: 20/6/2007
Ref: -3888-3888
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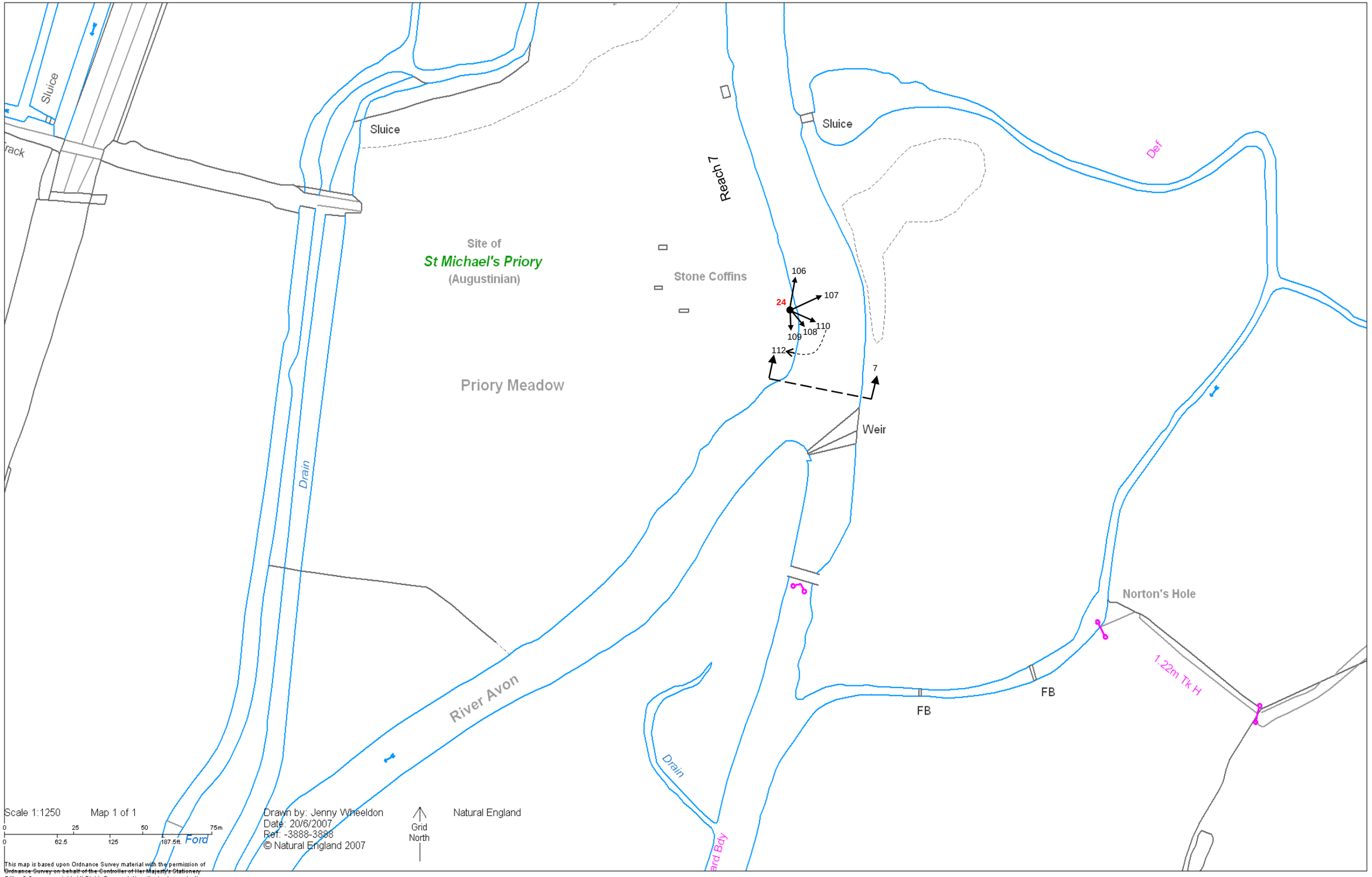
Figure 2.5 River Avon at Hale Reach 7



3. Assessment of Proposed Restoration and Likely Outcomes

It was proposed that the creation / rehabilitation of two or three 30-40m spawning riffles using a combination of existing and imported gravels be carried out. Existing gravels would be reshaped/stabilised using to create a stable crest for each riffle. Gravels would then be placed on top and below the crest of each riffle to raise profile of bed and provide a suitable depth of spawning substrate for salmonids to spawn on. Where suitable gravel was not available, aggregate would need to be imported in from local quarries;

For construction of upstream facing current deflectors was proposed to install upstream facing deflectors. Large tree limbs will be securely set at angles between 30^0 and 60^0 upstream to the flow and be approximately 12-15m each in length, varying flow and narrowing the channel. This technique would introduce significant amounts of large woody debris habitat, adding further sinuosity and narrowing of the channel;

The planting of isolated groups of native trees and shrubs protected by temporary electric or other fencing was also proposed. Groups of trees would be planted at locations typically associated with pool habitat. This would provide valuable habitat for nesting birds and a future input of large woody debris into the channel.

The expected positive effects resulting from the restoration works included increasing the variety of water velocities by re-shaping the channel bed. In addition changes in bed profile over the length of the channel to the benefit of a range of key species, especially bullhead, salmon and *Ranunculus*

The riffle creation was expected to 're-energise' the reach resulting in localised sediment transport promoting and changing the substratum composition from sand and silt domination to gravel and pebbles. This in turn should promote growth of submerged macrophytes, particularly *Ranunculus.*

The creation and rehabilitation of spawning riffles was expected to create a suitable spawning ground for salmon which would compliment efforts to restore a sustainable population of salmon in the catchment.

The tree planting and ultimate source of large woody debris would benefit geomorphological processes in general and would offer increased habitat opportunities for brook lamprey in particular. In addition the improvements to the vegetated margins would facilitate the complete development of watercourse habitat suitable for Desmoulin's whorl snail.

Site visits were carried out on 2nd July 2007(pre works), 12th October 2007(during works) and 1st May 2009(post works - 18 months on). The reaches (see map Figures 2.1 to 2.5) can be summarised as;

- Reach 1 - Upstream of Proposed Restoration Section
- Reach 2 –Riffle Creation and tree planting
- Reach 3 – coppice/pollard existing trees to provide instream woody debris
- Reach 4 – Shape gravel and install deflector to create a riffle, coppice/pollard existing trees to provide instream woody debris

- Reach 5 - coppice/pollard existing trees to provide instream woody debris
- Reach 6 – coppice/pollard existing trees to provide instream woody debris, deflectors on left bank
- Reach 7 – downstream of restoration works

Table 3.1 summarised the information in terms of long term and short term effects from the pre, during construction, as built and post works assessment sheets. The following sections give a more detailed account of the findings and assessments from the RRC rapid assessment proformas.

3.1 Pre Works

Reach 1: - This reach was upstream of any proposed restoration works. On the day of the site visit high flows made it impossible to see the river bed, so it was not possible to make observations about the bed material or in-channel macrophytes. It was assumed, from previous observations and known characteristics of this river, that the bed material was predominantly gravel. The channel was over-deepened with vertical sides and an extensive floodplain. Good marginal and bank vegetation was observed, though the riparian vegetation was limited. The floodplain habitat was varied and thought to be good for terrestrial invertebrates as well as aquatic species in the numerous ditches which criss-cross the flood plain. No impacts, either positive or negative were expected for this reach.

Reach 2: - Within this reach the river was over-deep and fairly uniform, though some width variation was observed. There were very few trees lining the river. The expected short term effect for the works for this reach were *Ranunculus* growth as the gravels are lain, general disturbance by the machinery and the planting may also effect terrestrial invertebrates but only in a very minor way. No long term negative impacts were envisaged. For the positive impacts in the long term there was expected to be increase flow diversity, improved salmon spawning, increase the growth of *Ranunculus* and aquatic marginal plants. The tree planting was expected to increase habitat for terrestrial invertebrates and nesting places for birds.

Reach 3: - This reach had more trees on both banks and good connection to the flood plain. Within Reach 3 no works were planned and it was not expected that the works upstream or downstream would have any effect either positive or negative.

Reach 4: -Reach 4 was similar in character to Reach 3. The gravel rearranging was expected in t he short term to suspend silt into the water column, remove any in channel vegetation and create turbidity all of which were negative effects. In the long term the positive benefits were expected to be the creation of flow variability, increased Ranunculus and increased spawning habitat.

Reach 5: - Reach 5 is particularly deep reach and at the time of the site visit the channel bed was not visible. No works were planned for this reach. The only expected impact was potentially the increase of silt from the upstream works. No long term positive or negative impacts were envisaged.

Reach 6: - Within Reach 6 it was planned to install large woody debris deflectors. These were expected to crease flow variability locally, increase Ranunculus growth and create habitat for

brook lamprey by the formation of silty margins. In the short term there was expected to be a general disturbance as a result of the works themselves both here and upstream.

Reach 7: - The main influence on Reach 7 was the weir and sluice structure at Breamore Mill. No works were planned for this reach and no impacts, either positive or negative were expected.

3.2 During Construction

3.3 As built

No as built site visit was carried out

3.4 Post Project

Reach 1: - No positive or negative effects observed.

Reach 2: Tree planting was not in evidence when the post project site visit was carried out. Very few trees exist along the river banks, and there was a comment from a local angler (Marie Bennett) about the amount of weed growth in the river which makes fishing difficult.

The newly created riffle (see Plate II) was working well in that it was creating fast flowing areas and a diversity of flow. Barble were reported spawning on the new riffle in June. It is hoped that salmon will use the riffle to spawn later in the year.

Reach 3: - No restoration work was carried out in this reach which has a very uniform flow.

Reach 4: - The re-arranged gravels in Reach 3 were creating diverse flows as expected both where the gravels had been moved and downstream. This reach is generally fast flowing with no pools and therefore no areas of refuge.

Reach 5: - A tree kicker was installed in this reach (see Plate I) which is creating localised flow variability and areas of refugia on the downstream side. Other areas of the reach have uniform fast flowing water.

Reach 6: - Deflectors were installed on the left bank. For the post project assessment site visit the river was accessed exclusively from the right bank. The deflectors were not visible from the right bank so no comment is possible other than that there was no obvious flow variability visible from the right bank

Reach 7: - No positive or negative effects observed.

Figure 3.1 Restoration Works

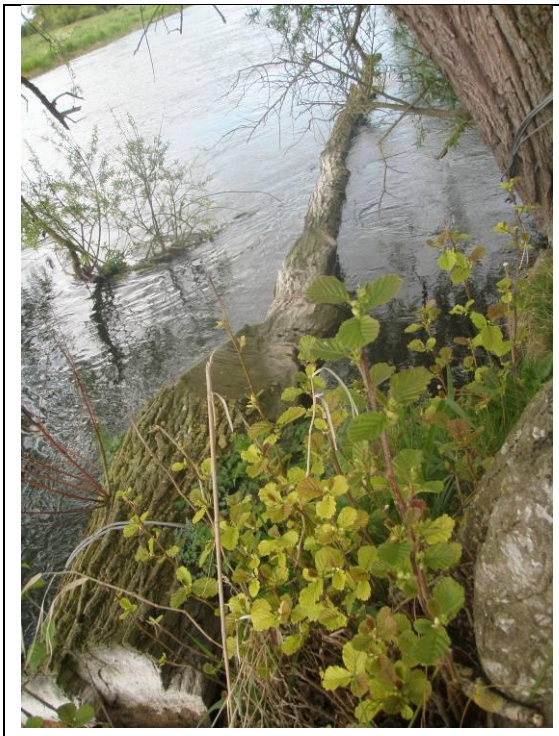


Plate I Tree Kicker

Plate II Newly created Riffle (during works)

Table 3.1 Summary of the Assessment of Scheme Outcomes

	Pre Works – 2nd July 2007		During Works – 12th October 2007		Post Works- 1st May 2009	
	Expected Positive Effects	**Expected Negative Effects**	**Positive Effects**	**Negative Effects**	**Positive Effects**	**Negative Effects**
Reach 1	Very little positive effects were expected for the reach upstream of the construction works.	No negative effects were expected for this reach.	No noticeable changes were observed	No noticeable changes were observed	No noticeable changes were observed	No noticeable changes were observed
Reach 2	Increased diversity of flow, improved fish spawning, increased habitat for nesting birds once trees have grown	The within channel works could cause a certain disturbance to plant community (ranunculus and starwort) and some movement of silt. Planting may affect habitat locally. Long term the avian habitat will improve as the newly planted trees grow and mature	No reported impact during construction works	No reported impact during construction works	Flow diversity created by riffle. No tree planting in evidence	No noticeable changes were observed
Reach 3	No impact expected	No impact Expected	No impact expected	No impact Expected	No trees were removed so no loss of bird habitat	No negative impacts
Reach 4	Increased flow diversity. Creation of spawning gravels	The within channel works could cause a certain disturbance to plant community (ranunculus and starwort) and some movement of silt.	Increased flow diversity. Creation of spawning gravels	Movement of Silt and disturbance of in stream vegetation.	Increase of flow diversity at riffle. Riffle has only had a low effect	No negative impacts
Reach 5	No impact expected	Possible siltation from works upstream.	There as no significant increase in silt within this reach. A tree kicker was installed in this reach as opposed to the	No negative effects occurred in this reach	Minor localised flow variation at tree kicker	No noticeable changes were observed
Reach 6	In the short and long term increased diversity of flow and gravels exposed to potentially increase spawning areas. Long term silty margins created for lamprey	Short term disturbance from upstream works	Deflectors could not be seen from right bank, so no evidence of improvement observed	Deflectors could not be seen from right bank, so no evidence of negative effect observed	Effect of deflectors on left bank is only Low to negligible rather than moderate though possibly some local changes in flow but could not be seen from right bank. Right bank coppicing did not seem to have been done	No noticeable changes were observed
Reach 7	No impact expected	No impact expected	No impact expected	No impact expected	No noticeable changes were observed	No noticeable changes were observed

3.5 Reasons for Changes from Original Planned Works

The final works differed from those proposed in the original bid as shown in the table below. The changes made during the design process ensured that the objectives of the works as proposed in the bid document were met, and the optimum environmental benefit-cost mix obtained. Since the original bid was written the New Forest National Park has come into being. The establishment of this National Park emphasises that in addition to ecological sensitivities, the restoration site is in a nationally important area in terms of landscape and archaeology. Any works in the area are therefore subject to strong planning legislation.

Table 3.2 Changes to Planned Works

Works proposed in bid	Alternative (constructed)	Reason for change
Reclamation of existing gravel, no import of materials	Gravel imported for top riffle, but existing in-channel gravel used for lower riffle. 2125m^2 of spawning habitat created	Gravel not present on site in the volume/quality needed
Riffle locations	Riffle location moved. Amount of riffle habitat not changed. Better for demonstration purposes, as the various techniques are closer together.	No practical access route for importing gravel and access would have damaged landscape/archaeologically sensitive water meadows
Excavation of marginal shelves adjacent to riffles (for flood risk management and habitat enhancement)	River bank profile softened as consequence of machines working along banks.	No need to re-grade banks to achieve improvements in spawning habitat or for flood risk management. Excavation and subsequent removal of material off site not cost beneficial, and damaging to water meadows.

The work was carried out by the Environment Agency's own workforce, building on the experience they gained at Fovant in 2006**.**

A key aspect of planning the works was consideration of the potential impact on flood risk. The Environment Agency did not require a formal assessment for consenting purposes, however the extensive summer floods in the UK meant that local residents were particularly concerned about flood risk issues. A simple conveyance estimation was undertaken, which was felt to be proportionate to the potential impacts, and the results circulated to residents. In cases where the impact of restoration works is likely to be low, conveyance estimation is a simple, cost effective approach

4. Pre and Post Project Monitoring

Royal Haskoning were commissioned by Natural England to record physical and biological conditions pre and post restoration at each of the sites. The surveys were designed to document physical changes that occurred as a result of the restoration works and provide a baseline for further monitoring. The monitoring included reach-scale mapping using Physical Biotope Mapping and River Corridor Survey. The surveys were carried out at on the River Avon near Hale and Breamore. The upstream boundary of the site was located at the bridge between Church Copse and the adjacent water meadows. The downstream boundary of the site was near St Michael's Priory just upstream of the weir and near the Mill pond. Comparisons were made between 2006 and 2008.

The dominant physical biotope in 2008, as in 2006, is a glide that becomes deeper and faster flowing towards the downstream limit of the reach. At the time of the 2008 survey, discharge and water levels were particularly high and this is likely to have "drowned out" much of the localised diversity of physical biotopes that may have resulted from in- channel restoration structures. Areas of upwelling occur naturally within areas of high flow velocity as a result of three-dimensional flow dynamics. The two areas of upwelling observed may be related to creation of the large riffle upstream of the first area and the large woody debris deflectors installed within the second area downstream.

Similar fine sediment sources were observed, although increased marginal vegetation, and in one location exclusion of livestock through fencing, have reduced bank erosion at meander bends. Several deflectors and a gravel riffle have been installed as part of the restoration works and it is likely that they are having a localised impact on the sediment regime through the trapping of fine sediment. Due to the high water levels however, it was not possible to ascertain whether the restoration measures have resulted in altered patterns of sediment deposition on the channel bed.

Vegetation structure and species diversity appears generally similar to the 2006 survey. There was, however, no evidence of horned pondweed during the 2008 survey.

Summary of physical and biological relationships;

- The cross-sectional profile of the channel remains over sized and flow conditions were deep and largely uniform in physical biotope. Localised diversity may be evident at lower flows as a result of the in-channel restoration works that have been undertaken, but were not observed at the time of survey;
- Livestock poaching, natural depositional features and installed vegetated berms are providing habitat diversity by modifying the profile of channel margins and water depths in places. These are associated with the establishment of marginal vegetation species;
- Increased growth of marginal vegetation is likely to be related to sustained higher water levels within 2007 and 2008;
- Landuse practices are still limiting the width of the riparian zone; and allowing livestock access to the channel is increasing localised fine sediment supply. At one location, however, fencing has been successfully used to reduce poaching;
- The fluvial bank erosion observed is localised and reflects lateral planform change through meander development.

5. Assessment of Methods Used

5.1 Riffle Creation in Reach 2

Plates III to V (Figure 6.1) show the site of the riffle which was installed in Reach 2. The flow variability is evident and the riffle is working well since Barbel have been reported spawning on it. It is hoped that salmon will spawn on the riffle in future.

Figure 5.1 Riffle Site Photo location 27

Plate III Newly created Riffle

Plate IV Photo Location 27 During Works

Plate V Photo Location 27 Post works

5.2 Reach 3 Gravel Re-working

Figure 6.2 shows the site where the gravels have been re-worked. The central channel exhibited much faster flow and generally the flow diversity was greater. There are very few bankside trees along this reach, so very little shading is in evidence.

Figure 5.2 Gravel Reworking at Location 70

Plate VI Photo Location 70 Pre Post works

Plate VII Photo 7Location 70 During Works

Plate VIII Photo Location 70 Post Works

5.3 Reach 5 Tree Kicker

Plates IX to XII show the site where the tree kicker was installed. The effect of the kicker is localised but areas of refugia are in evidence on the downstream side (see Plate I).

Figure 5.3 Tree Kicker at Photo location 84

Plate IX Photo Location 84 Pre Works

Plate X Photo Location 84 During works

Plate XI Photo Location 84 Post Works

5.4 Reach 6 – Deflectors

Several 60 degree upward facing deflectors were installed on the left bank. No evidence of them could be seen from the right bank, so any effect with respect to flow variability was only on a very local scale.

6. Discussion and Recommendations

6.1 Discussion

The Avon at Hale is the most downstream of the Avon and Avon tributary sites. The river meanders within a wide floodplain over 2 km across. Flows are much higher in this part of the Avon than the upstream sites, thus the nature of the river here is much different in that the watercourse is very much a chalk *river* rather than a small chalk *stream.* The potential for restoration at this site is therefore very different from the opportunities at the upstream sites (Fovant, Upper Woodford, Amesbury and Seven Hatches).

The river has historically been dredged making it over-deep with vertical bank sides. The fast flowing water means there is little in the way of refuge areas for fish fry and the generally open aspect of the banks means that *Ranunculus* and other in channel vegetation is prolific. The main opportunities for restoration work at this site were therefore bed-raising by introducing gravels and the introduction of large woody debris to create localised slower flowing water which would act as refuge areas for fish fry.

The open aspect of the river bank could further be enhanced by the planting of native trees which would afford some additional shade to the channel and increase the habitat for birds. However, this may be contradictory to the requirements of the SPA breeding waders as they may obstruct flight lines and create p for corvids. So any planting needs to be considered carefully with respect to the tree species choice and future maintenance and the benefits to one SAC species weighed up against the potential dis-benefits to another.

For the SAC species the introduction of gravels to create a riffle would increase the habitat for lamprey, salmon and bullhead spawning. The introduction of large woody debris was essential to provide refuge areas for fish fry of all these species. The fast flowing nature of the river at this site makes it more suited to salmon than the other fish SAC species.

6.2 Lessons Learnt

6.2.1 Reach 2

The tree planting was not carried out on this reach. The river bank from Reaches 2 to 5 has very little tree cover on either bank and Reaches 6 and 7 have very few trees on the right bank. *Ranunculus* growth in all of the reaches has been prolific this year and in areas, particularly Reaches 6 and 7 where the river is a carpet of white *Ranunculus* flowers from bank to bank.

6.2.2 Reach 3

The new riffle was performing well and fish are now using it to spawn. However, the river is still over widened here and more flow variability would create a more varied habitat. There are no pools in this reach and generally a lack of areas of refuge.

6.2.3 Reach 4

The re-arranged gravel riffle is performing well creating flow diversity. This reach generally has uniform flow and a lack of pools which would act as refuge areas.

6.2.4 Reach 5

The tree kicker which was installed was not large enough. It was creating flow variability but only on a very local scale.

6.2.5 Reach 6

Deflectors were only creating very localised flow variability. They probably needed to be larger and protrude out into the river more. At the time of the post works site visits flows were high. A follow up visit at low flows might reveal the effect of the deflectors.

6.3 Recommendations

The restoration work has had a significant effect locally. The new riffle site in reach 2 has created variable flow regime locally. The riffle site in reach 4 where the gravels were re-worked has also created flow variability but it is less pronounced. Generally the river is still over-wide and overdeep. The proposed tree planting was not seem to have been carried out and both banks particularly in Reaches 2 to 6 are devoid of tree cover and therefore the opportunity for woody debris to develop. A small amount of planting was done after the main works had been carried out, but only in the fenced area adjacent to the riffle in Reach 3.

More gravel riffles and larger wood debris and tree kickers need to be installed to create more flow variability and potentially create areas of slack water suitable for fish fry to take refuge in.

7. References

Environment Agency, Estimating costs of delivering the river restoration element of the SSSI PSA target, 2008.

Natural England, Physical and biological monitoring of STREAM restoration projects – Year Three Report, April 2009.

Natural England, STREAM 4th Annual Report, Dec 2008

Natural England, River Avon SAC STREAM Interim Report, June 2008.

Wessex Water, Short term effects on aquatic macroinvertebrates, 2008.

Appendix A
River Restoration Rapid Assessment Forms

the **RIVER RESTORATION CENTRE**

Project Assessment Form – Pre works Section 1:
Project Objectives and Background information

NOTES: This Project Assessment should be completed in conjunction with photographic monitoring through fixed point photography, the location and orientation of each fixed point photograph should be marked on a site map.

This section (page 1) of the assessment form should be completed prior to going on site.

Objectives

Please outline each of the project objectives for this site and state the category into which they fall:
HG – Hydro geomorphology; V – Vegetation; FA - Fish & Aquatic Invertebrates; M – Mammals; T- Terrestrial Invertebrates; B - Birds; VS – Visual & Social

Objective category	Objective

Background information

	Any survey information?	Any indicator species present? - specify	Any species specific objectives? - specify
Hydro geomorphology			
Vegetation			
Fish			
Aquatic invertebrates			
Mammals			
Terrestrial invertebrates			
Birds			

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Project Assessment Form – Pre works Section 2:
Unit description, reach, vegetation and landuse characteristics[1]

NOTE: An assessment needs to be completed for each 'assessment unit' - identified according to geomorphological features, changes in riparian landuse, vegetation & floodplain characteristics. The location of each unit must be marked on a site map.

Date: Surveyor: GPS point:

River name: Assessment Unit: Weather conditions:

Unit description

Reach Characteristics

Code: LB - Left Bank; RB-Right Bank; Cl – Clay; H-High; M-Medium; L-Low; NF-No perceivable Flow; Y-Yes; N-No

Bankful width (m) Bankful depth (m) Bank slope range (°) LB RB

Av. riffle water depth (m) Av. pool water depth (m) Av. water depth (m) - no pool/riffle sequence

Bank Material (LB) – D= dominant, tick others:	Cobble	Gravel	Cl	Sand	Silt	Artificial
Bank Material (RB) – D= dominant, tick others:	Cobble	Gravel	Cl	Sand	Silt	Artificial
Bed Material– 'D'= dominant, tick others:	Cobble	Gravel	Cl	Sand	Silt	Artificial

If there is any artificial bank or bed material please state the % and provide brief details:

% LB % RB % Bed Details:

Has it got any geomorphological features? Please note, and estimate spacing for pool / riffle sequence.

Sinuosity (H/M/L) Bars (Y/N) Bed variation (Y/N) Width variation (Y/N)

Deposition (Y/N) Bank Erosion (Y/N) Pools / riffles (Y/N) Approx. spacing (m):

Is there any variation in flow? (Y/N) What is the average stream power? (H/M/L/NF)

Please sketch the typical reach X-section, labelling LB and RB. Include main features, floodplain characteristics & flow conditions.

Vegetation

Av. in-channel cover (%): Av. Marginal cover (%): Av. Bank cover (%): LB RB

Av. tree cover (%): LB RB Is the vegetation typical / native to the river? (Y/N):

Are there any invasive species present (Y/N) Specify……

Landuse

Please tick main type of landuse – for 'Farmland' please delete arable or grazing as appropriate

LB	RB		LB	RB		LB	RB		LB	RB	
		Urban			Industrial			Parkland			Farmland: arable/grazing
		Private garden			Wetland			Woodland			Other……

[1]'Reach Characteristics', 'Vegetation' & 'Landuse' have been adapted from 'Geomorphological Sensitivity Assessment Sheet', *Detailed Catchment Baseline Review,* Environment Agency & University of Southampton, 2000.

Project Assessment Form – Pre works Section 3: Assessments of ecological habitats & Section 4: Potential Impacts of restoration works

Please comment on the quality of the ecological habitat:

Vegetation: Is there diversity in veg. types - In-channel: emergent, marginal, floating & submerged; Bankside: bryophytes, herbs or grasses, scrubs or shrubs & trees; and Riparian?

Fish & Aquatic Invertebrates: Is there sufficient flow & diversity in flow types? Is there a diverse river bed (substrate and structure)? Is there adequate cover, shelter & shading? Is there clear fish passage? Is there lateral diversity between the river & floodplain? Are there food sources?

Mammals: Is there cover & shelter? Is there sufficient flow & diversity of flow? Is there lateral diversity between river & floodplain? Are there food sources?

Terrestrial Invertebrates: Is there suitable diversity in emergent, bankside & riparian vegetation? Is there lateral diversity between the river & floodplain?

Birds: Is there adequate cover, shelter & shading? Is there lateral diversity between the river & floodplain? Are there food sources?

Project Assessment Form – Pre works Section 4: Potential Impacts of restoration works

Comment on potential impacts of restoration works & identify perceived degree of impact – High, Medium, Low, Negligible.

Short Term

	+ve	H/M/L/N	-ve	H/M/L/N
Hydro geomorphology				
Vegetation				
Fish & Aquatic Invert's.				
Mammals				
Terrestrial Invertebrates				
Birds				
Visual & Social				

Long Term

	+ve	H/M/L/N	-ve	H/M/L/N
Hydro geomorphology				
Vegetation				
Fish & Aquatic Invert's.				
Mammals				
Terrestrial Invertebrates				
Birds				
Visual & Social				

Additional notes:

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Project Assessment Form – During construction Section 1: Contractor's information, Budget, Site plans and Summary of Predicted Impacts

NOTES: This Project Assessment should be completed in conjunction with photographic monitoring through fixed point photography, the location and orientation of each fixed point photograph should match those taken as part of the 'Pre works assessment'. Any additional fixed point photographs considered to be necessary should be marked on a site map.

This section (page 1) of the assessment form should be completed prior to going on site.

Contractor

Company name | Name of Foreman:

Contact details:

Budget

What is the budget for this project?

Technical site plans

Have sites plans been supplied? (Y/N)

Any other technical specification details:

Summary of Predicted Impacts (from 'Pre works' assessment)

Short Term

	+ve	H/M/L/N	-ve	H/M/L/N
Hydro geomorphology				
Vegetation				
Fish & Aquatic Invert's.				
Mammals				
Terrestrial Invertebrates				
Birds				
Visual & Social				

Long Term

	+ve	H/M/L/N	-ve	H/M/L/N
Hydro geomorphology				
Vegetation				
Fish & Aquatic Invert's.				
Mammals				
Terrestrial Invertebrates				
Birds				
Visual & Social				

Project Assessment Form – During construction Section 2: Project implementation

Project implementation – site overview

Weather conditions:

Is the project running to the predicted time schedule? (Y/N)

If no, what are the reasons for the changes?

Is the project running to budget? (Y/N) If no is it expected to be: Under Over By how much?

What are the reasons for the changes to the expenditure?

Have there been any problems encountered whilst implementing the project – please provide details?

If any problems have been encountered how have they been overcome? Have there been any changes made to the original design?

the **RIVER RESTORATION CENTRE**

Project Assessment Form – Pre works Section 3:
Unit description and Potential Impacts of restoration works

NOTE: An assessment needs to be completed for each 'assessment unit' - identified in the 'Pre works assessment' according to geomorphological features, changes in riparian landuse, vegetation & floodplain characteristics. The location of each unit must be marked on a site map.

Date:		Surveyor:		GPS point:	
River name:		Assessment Unit:			

Unit description

Potential Impacts of restoration works

Refer to predicted impacts from 'Pre Works assessment' (summarised on page 1 of this document) and comment on any changes to these predictions that have occurred as a result of the on-site works, for each identify the perceived degree of impact – High, Medium, Low, Negligible.

Short Term

	+ve	H/M/L/N	-ve	H/M/L/N
Hydro geomorphology				
Vegetation				
Fish & Aquatic Invert's.				
Mammals				
Terrestrial Invertebrates				
Birds				
Visual & Social				

Long Term

	+ve	H/M/L/N	-ve	H/M/L/N
Hydro geomorphology				
Vegetation				
Fish & Aquatic Invert's.				
Mammals				
Terrestrial Invertebrates				
Birds				
Visual & Social				

Additional notes:

the **RIVER RESTORATION CENTRE**

Project Assessment Form[1] – Post works section 1:
Basic Project details, Project Objectives, Background information and Inventory of River Restoration Techniques used

NOTES: This section (pages 1 and 2) of the assessment form should be completed prior to going on site.

Basic Project details

Project name:

Start date: Finish date: Length (km):

Catchment type: Urban / Rural, Upland / Lowland (delete as applicable) Catchment Geology:

Objectives

Please outline each of the project objectives for this site and state the category into which they fall:
HG – Hydro geomorphology; V – Vegetation; FA - Fish & Aquatic Invertebrates; M – Mammals; T- Terrestrial Invertebrates; B - Birds; VS – Visual & Social

Objective category	Objective

Background: Pre and post project information

	Any survey information? (Yes/No)		Any indicator species present? - specify		Any fixed point photography? (Yes/No)	
	Pre	Post	Pre	Post	Pre	Post
Hydro geomorphology						
Vegetation						
Fish						
Aquatic invertebrates						
Mammals						
Terrestrial invertebrates						
Birds						

[1] Sections 1, 2 and 4 of this Project Assessment form were adapted from L. de Smith, Post-River Restoration Assessment (PRRA), ***The development of the 'post river restoration assessment' for evaluating river restoration pro****jects*, 2005.

Inventory of River Restoration Techniques

Which of the following river restoration techniques were implemented within the project - please tick.

* (MAJOR: the main/primary focus of the project; MINOR: secondary consideration/incidental)

		MAJOR*	MINOR*
	Rehabilitation of watercourse features		
1	Reach re-meandered (>500m)		
2	Reach re-meandered (<500m)		
3	Culverted reach re-opened (state approximate length)		
4	X-sectional habitat enhancement (>500m) – two–stage channel profiles etc		
5	Long section habitat enhancement (>500m) – pool/riffle sequences etc. restored		
6	River narrowing due to depleted flows or previous over-widening		
7	Backwaters and pools established/reconnected with watercourse		
8	Bank re-profiling to restore lost habitat type and structure/armouring removed		
9	Boulder etc. imported for habitat enhancement		
10	Gravel and other sediments imported/managed for habitat enhancement		
11	Fish cover established by other means		
12	Current deflectors/concentrators to create habitat and flow diversity		
13	Sand, gravel and other sediment traps to benefit wildlife		
14	Tree/shrub planting along bankside (only if covers >500m of bank or >0.5ha)		
15	Artificial bed/bank removal and replaced by softer material (>100m)		
16	Establishment of vegetation for structure/revetment (e.g. use of willows)		
17	Eradication of alien species		
18	Provision of habitat especially for individual species – otter, kingfisher etc		
19	Fencing along river banks; fencing floodplain habitats for management		
20	Aquatic/marginal planting		
21	Removal of floodbanks		
22	Other (please specify)		
	Restoration of free passage between reaches		
23	Obstructing structure replaced by riffle		
24	Obstructing structure replaced by meander		
25	Obstructing structure modified/removed to enable fish migration		
26	Obstructing structure retained, but riffle/meander structure established alongside		
27	Culverted reach re-opened/daylightened		
28	Obstruction within culvert (e.g. lack of depth, vertical fall) redresses		
29	Dried river reach has flow restored		
30	Other measures taken to restore free animal passage		
31	Other (please specify)		
	River floodplain restoration		
32	Water table levels raised or increased flooding achieved by		
33	Unspecified means/rationalised control		
34	Watercourse re-meandering		
35	Raised river bed level		
36	Weirs established specifically to increase floodplain flooding/water-table		
37	Termination of field drains to watercourse		
38	Feeding floodplain with water (Sluice feeds, water meadow restoration)		
39	Narrowing watercourse specifically to increase floodplain wetting		
40	Lakes, ponds, wetlands established (maybe flood storage areas)		
41	Lakes, ponds, wetlands, old river channels restored/revitalised)		
42	Vegetation management in floodplain		
43	Riparian zone removed from cultivation		
44	Substantial floodplain tree/shrub planting		
45	Other (please specify)		

the **RIVER RESTORATION CENTRE**

Project Assessment Form[1] – Post works Section 2: Assessment of visual elements and social value, physical characteristics and ecological characteristics

NOTE: An assessment needs to be completed for each 'assessment unit' - identified according to geomorphological features, changes in riparian landuse, vegetation & floodplain characteristics. The location of each unit must be marked on a site map.

Date:		Surveyor:		GPS point:	
River name:		Assessment Unit:		Weather conditions:	

Unit description

Part 1: Assessment of visual elements and social value in this unit

Landuse 'Landuse' assessment table adapted from Geomorphological Sensitivity Assessment, *Detailed Catchment Baseline Review* Environment Agency & University of Southampton, 2000

Code: LB - Left Bank; RB-Right Bank

Please tick main type of landuse – for 'Farmland' please delete arable or grazing as appropriate

LB	RB		LB	RB		LB	RB		LB	RB	
		Urban			Industrial			Parkland			Farmland: arable/grazing
		Private garden			Wetland			Woodland			Other……

Please also consider the following questions:

	Y/N
Is the visual appearance of the river harmonizing with the locations surroundings?(e.g. urban/rural)	
Are the river restoration techniques or practices still visible?	
If Yes, do they blend in with the natural environment?	
Is there a need for monitoring?	
Is there visual evidence of the following:	
Unnatural features to the river or bankside? (e.g. sudden changes in bank slope, sharp corners etc.)	
Hard engineering/man made materials? (e.g. concrete, steel, etc.)	
Litter or unsightly objects? (e.g. trolleys, tyres, sewage pipes etc.)	
Vandalism or graffiti?	
Is there sufficient public access to the river site? (e.g. footpaths, bridges, gates etc.)	
Is there any evidence of public use? (e.g. dog walkers, cyclists etc.)	
Has the project incorporated recreational opportunities & educational interest? (e.g. playground, paths, display boards, maps)	
Are there any safety considerations or health hazards, which have not been identified? (e.g. steep bank sides, hard material)	

Any other comments on the visual elements and social value:

Overall score of Section 2 Part 1:	**1 - Poor**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10 - Excellent**

Level of confidence in Answers for Section 2 Part 1:	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100 %**

Part 2: Assessment of physical characteristics in this unit

Reach Characteristics 'Reach Characteristics' assessment tables adapted from Geomorphological Sensitivity Assessment, *Detailed Catchment Baseline Review* Environment Agency & University of Southampton, 2000

Code: LB - Left Bank; RB-Right Bank; Cl – Clay; H-High; M-Medium; L-Low; NF-No perceivable Flow; Y-Yes; N-No

Bankful width (m) ☐ Bankful depth (m) ☐ Bank slope range (°) ☐ LB ☐ RB

Av. riffle water depth (m) ☐ Av. pool water depth (m) ☐ Av. water depth (m) - no pool/riffle sequence ☐

Bank Material (LB) – D= dominant, tick others:	☐	Cobble	☐	Gravel	☐	Cl	☐	Sand	☐	Silt	☐ Artificial
Bank Material (RB) – D= dominant, tick others:	☐	Cobble	☐	Gravel	☐	Cl	☐	Sand	☐	Silt	☐ Artificial
Bed Material– 'D'= dominant, tick others:	☐	Cobble	☐	Gravel	☐	Cl	☐	Sand	☐	Silt	☐ Artificial

If there is any artificial bank or bed material please state the % and provide brief details:

☐ % LB ☐ % RB ☐ % Bed Details:

Has it got any geomorphological features? Please note, and estimate spacing for pool / riffle sequence.

☐ Sinuosity (H/M/L) ☐ Bars (Y/N) ☐ Bed variation (Y/N) ☐ Width variation (Y/N)

☐ Deposition (Y/N) ☐ Bank Erosion (Y/N) ☐ Pools / riffles (Y/N) Approx. spacing (m): ☐

Is there any variation in flow? (Y/N) ☐ What is the average stream power? (H/M/L/NF) ☐

Please sketch the typical reach X-section, labelling LB and RB. Include main features, floodplain characteristics & flow conditions.

Please also consider the following questions:

	Y/N
Does the river experience High flows?	
If Yes, does the river channel pose a flood risk? (e.g. low flood banks, close proximity to housing, choked channel etc.)	
Does the river experience Low/Depleted flows?	
If Yes, does the river have a distinct low flow channel?	
Are the bank profiles structurally diverse?	
Are the bank profiles performing naturally as accustomed to the river catchment type? (compared to u/s and d/s river reaches of same order in the same ecoregion)	
Is the substrate conventional to the river catchment type?	
Is there diversity of in-channel features?	

Any other comments on the physical characteristics:

Overall score of Section 2 Part 2:	**1 - Poor**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10 - Excellent**

Level of confidence in Answers for Section 2 Part 2:	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100 %**

Part 3a: Assessment of ecological characteristics in this unit - Vegetation

Vegetation 'Vegetation' assessment tables adapted from Geomorphological Sensitivity Assessment Sheet, *Detailed Catchment Baseline Review* Environment Agency & University of Southampton, 2000

Av. in-channel cover (%): ☐ Av. Marginal cover (%): ☐ Av. Bank cover (%): ☐ LB ☐ RB

Av. tree cover (%): ☐ LB ☐ RB Are there any invasive species present (Y/N) ☐ Specify……

Please also consider the following questions:

	Y/N
Is there diversity of vegetation types:	
In-channel? (e.g. emergent, marginal, floating and submerged)	
Bankside? (e.g. bryophytes, short herbs, tall herbs or grasses, scrubs or shrubs and trees)	
Riparian? (e.g. mixed woodland, coniferous plantation, orchard, heath, scrub, pasture, wetland and urban development)	
Is the vegetation native/natural/? (compared to u/s and d/s or river reaches of same order in the same ecoregion)	
Is there a need for monitoring/maintenance?	
Has there been any planting or seeding?	
If Yes, has it taken well?	

Any other comments on the ecological vegetation characteristics:

Overall score of Section 2 Part 3a:	**1 - Poor**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10 - Excellent**

Level of confidence in Answers for Section 2 Part 3a:	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100 %**

Part 3b: Assessment of ecological characteristics in this unit - Fish & Aquatic Invertebrates

Please consider the following questions:

	Y/N
Are the following habitat characteristics present:	
Diversity of flow types?	
Diverse river bed? (substrate and structure)	
Stream cover, shelter and shading?	
Resting places and refuge?	
Clear fish passage and habitat connectivity between u/s and d/s?	
Lateral diversity between the river and floodplain?	
Food sources? (e.g. bankside trees, bushes and scrub – a source of terrestrial invertebrates)	
Was an improvement in fisheries part of the initial aim of the river restoration project?	
If No, has the river restoration project been beneficial to fisheries?	
Is there any evidence of fish using the habitat?	

Any other comments on the ecological Fish and Aquatic Invertebrate habitat:

Overall score of Section 2 Part 3b:	**1 - Poor**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10 - Excellent**

Level of confidence in Answers for Section 2 Part 3b:	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100 %**

Part 3c: Assessment of ecological characteristics in this unit – Mammals, Terrestrial invertebrates, Birds

Please consider the following questions:	Y/N
Was an improvement in a particular mammal habitat part of the main objectives of the river restoration project?	
Was an improvement in a particular terrestrial invertebrate habitat part of the main objectives of the river restoration project?	
Was an improvement in a particular mammal bird part of the main objectives of the river restoration project?	
Are the following habitat characteristics present:	
Shelter and cover? (e.g. bankside trees, bushes and scrub)	
Diversity in emergent, bankside & riparian vegetation?	
Lateral diversity between the river and floodplain?	

Any other comments on the ecological habitat for mammals, terrestrial invertebrates and birds:

Overall score of Section 2 Part 3c:	**1 - Poor**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10 - Excellent**

Level of confidence in Answers for Section 2 Part 3c:	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100 %**

Project Assessment Form – Post works Section 3: Identification of Potential Impacts of the restoration works

Comment on potential impacts of works on this unit & identify perceived degree of impact (High, Medium, Low, Negligible)

Short Term

	+ve	**H/M/L/N**	**-ve**	**H/M/L/N**
Hydro geomorphology				
Vegetation				
Fish & Aquatic Invert's.				
Mammals				
Terrestrial Invertebrates				
Birds				
Visual & Social				

Long Term

	+ve	**H/M/L/N**	**-ve**	**H/M/L/N**
Hydro geomorphology				
Vegetation				
Fish & Aquatic Invert's.				
Mammals				
Terrestrial Invertebrates				
Birds				
Visual & Social				

Level of confidence in Answers for Section 3:	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100 %**

Project Assessment Form[1] – Post works Section 4: Appraisal of Techniques and Overall evaluation of the project

Appraisal of Techniques

Please take a photograph of each technique or change implemented, wherever possible; and for each of the 'ticked' practices, please consider the following questions on-site:

	Technique number - taken from table on page 2												
Is the technique: (Y/N)													
Still in place?													
Functioning as intended/producing the desired effect?													
Working with natural processes?													
Appropriate to the river type?													
Score 1-10 (1 = Poor, 10 = Excellent)													

With hindsight, were any of the techniques unnecessary or avoidable? In your view, are there any alternative techniques, which should have been implemented? Please comment:

Overall evaluation of the project

Please consider the following questions for evaluating the project on the basis of your evaluations in Sections 2 & 3:

Overall, is the river restoration project proceeding in the right direction to achieve its objectives?

Is there any evidence of unexpected negative outcomes of the project?

Has the project gained any other benefits?

Are there any areas of the project where further work or regular maintenance may be required?

Overall score for the project[2]:	**1 - Poor**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10 - Excellent**

Level of confidence in Answers for Section 4:	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100 %**

[2] Please consider scores awarded in Section 2 of this assessment when deciding upon the overall score of the project

the **RIVER RESTORATION CENTRE**

Project Assessment Form – Post works Section 5:
Future improvements and management

Please tick all the issues that still apply to this site:

Artificial banks	☐	Over wide	☐
Artificial bed	☐	Over deep	☐
Choked channel – urban and natural debris	☐	Overgrown riparian trees – too much shade	☐
Culvert blockage	☐	Straightened	☐
CSO or drains present/water quality issue	☐	Unacceptable bank erosion	☐
No amenity value – river cut off from urban area	☐	Unacceptable siltation	☐
No in channel features	☐	Urban debris	☐
No in channel vegetation	☐	In-channel obstruction (e.g. weir)	☐
No tree cover	☐	Other – specify or use to expand on key issues	

Does the river pose a serious flood risk in this location? (Y/N) ☐ If Yes provide details:…….
……...

Potential for adaptive management and future restoration

Please tick all that apply, if you wish to expand on the key potential 'technique' please do so in Additional Comments box

Artificial bank removal – LB	☐	Plant riparian vegetation	☐
Artificial bank removal – RB	☐	Raise bed level e.g. substrate enhancement, woody debris	☐
Artificial bed removal	☐	Re-meander	☐
Fencing	☐	Riparian vegetation management	☐
In channel feature enhancement – pools / riffles	☐	Re-profile banks	☐
Increased in-channel sinuosity (current location)	☐	SUDS or further investigation re. water quality	☐
Local community gain[3] - specify in 'other' box	☐	Urban debris management (local community)	☐
Narrow	☐	Weir removal/lowering	☐
'Natural' bank protection	☐	Flood storage e.g. floodplain re-connection	☐
Plant marginal vegetation	☐	Other – specify	

Additional Comments

Level of confidence in Answers for Section 5:	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100 %**

[3] Such restoration techniques might include improving access by installing bridges and dipping platforms, removing bankside vegetation etc. many of these 'techniques' can be specified under already identified 'techniques', additional suggestions should be specified in the 'Other' box