POST WORKS ASSESSMENT OF THE STREAM RESTORATION PROJECT SITES AT SEVEN HATCHES (R. WYLYE)

Summary of post works assessment following final site visit on 30th April 2009

R. Wylye, Seven Hatches– Pre Scheme

R. Wylye, Seven Hatches – Post Scheme

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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 Wylye at Seven Hatches

The River Wylye at Seven Hatches, just upstream of Wilton had historically been over widened and over deepened. In addition the Seven Hatches sluice structure itself slows the flow, acts as a barrier for fish migration and elevates water levels upstream of it for some distance.

The project objectives were to;

- Modify the operation of Seven Hatches sluices, reducing height by an average of 0.15 metres, thus increasing ecological connectivity between reaches and improving upstream habitat quality;
- Restore the historic bed level and increase the heterogeneity of bed morphology in previously dredged reaches, by the reclamation and re-introduction of excavated gravel/stone bed material;
- Narrow over wide channels where necessary, in order to re-establish a sinuous channel of appropriate cross-sectional area with respect to present day hydrographs;
- 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;
- Break out and remove the tractor bridge footings and replace with a single span bridge. To remove the impounding effect of the structure;
- Enhance the availability and quality of habitat for SAC species and habitats, in particular;
    - Bullhead (increased diversity of hard bed, particularly pools during winter and insertion of large flints in new riffle/fast glides during summer and increased shading / large woody debris particularly for juveniles);
    - Salmon (a more usable migration route, viable spawning sites, and appropriate habitat for fry and parr);
    - 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);
    - Desmoulin's whorl snail (marginal zone enhancement of all channels);
    - The Ranunculus community (by increasing heterogeneity in velocity and bed morphology).

2. Scheme Assessment

2.1 Site Description

The key feature of the project area was the presence of the large modern radial sluices replacing the earlier hatches that gave the site its local name. The impact of these sluices has been significant, with the upstream reach heavily impounded with associated deposition of fine sediment and increased water depth. Despite the presence of a constructed fish pass, the sluices impact on the passage of migrating fish which have been using the main carrier to migrate. Flood berms formed from dredging material were evident along parts of the length of the reach. The dredged material had been used to infill the water meadow channels on the left bank.

Immediately above the hatches, the river splits into two channels, the main Wylye (the "Union") and a carrier, (the "Butcher Stream") and is further sub-divided into a number of channels below this point. One new tributary flows into the Union below the first railway crossing, "Law's Ditch". This perennial chalk spring runs separately from the River Wylye for a mile and a half in total, fed from the base of the chalk escarpment, but as part of the land drainage improvement scheme it was culverted underneath the Butcher and for a further 600 m downstream, effectively blocking upstream access for aquatic species.

The dominant substrate throughout the project area was fine gravel and sand, with bank material generally comprised of fines in addition to dredged gravel. Flow type was dominated by glide with short lengths of run/rapid. Riparian trees and large woody debris are limited over much of the reach. *Ranunculus* growth throughout much of the project reach was poor. Conditions for spawning and juvenile salmonids were generally poor.

Several impoundments including Seven Hatches sluices, the footings of the first railway (upstream) bridge and the footings of a tractor bridge further downstream combined with earlier dredging activities to impact significantly on upstream habitat quality and affect the river's geomorphology.

Past land drainage work has resulted in a reduction of 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.

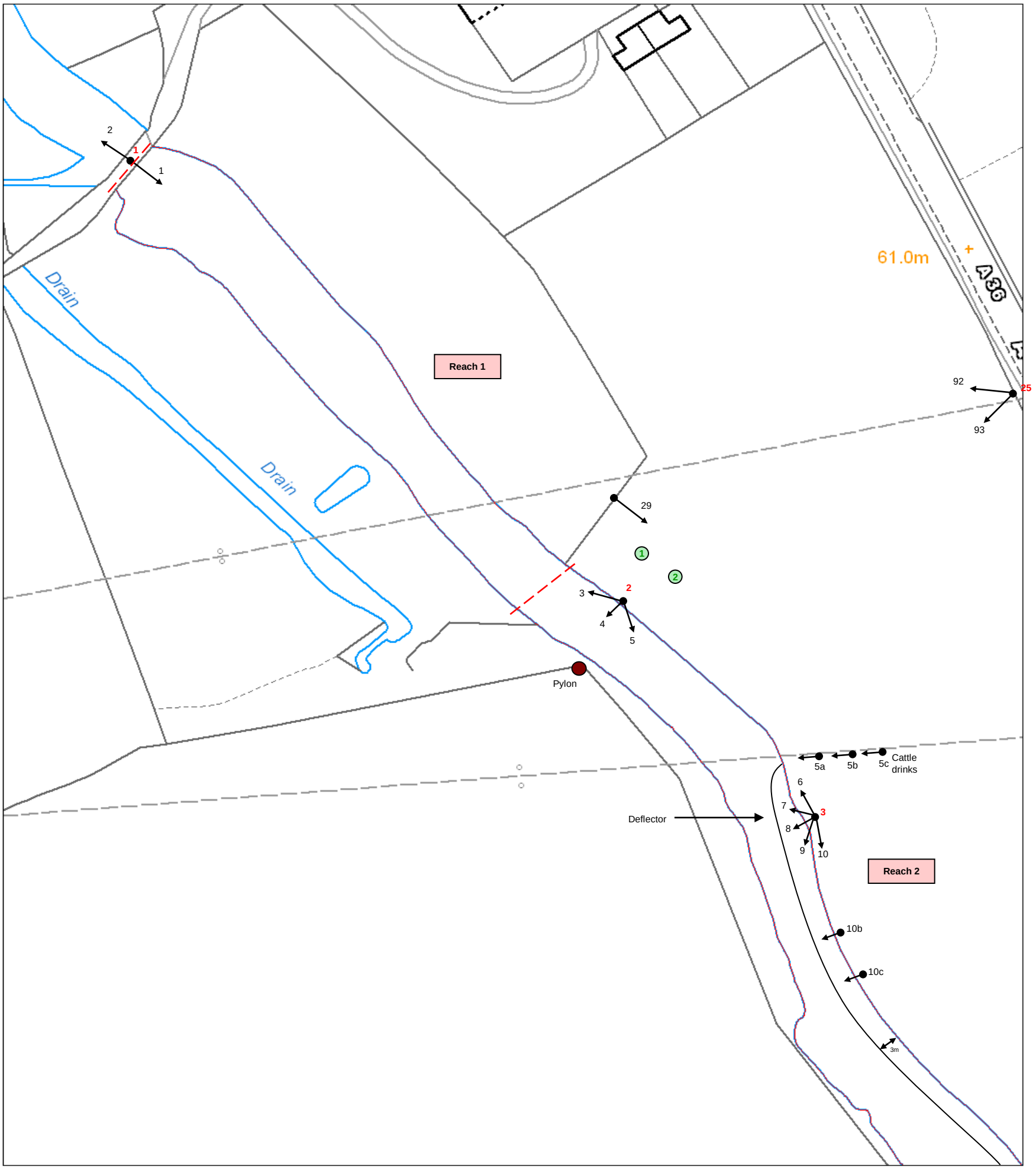
The slower flows and resulting siltation from the impoundments and historical land drainage have damaged favourable status for the *Ranunculus* macrophyte community, and resulted in the absence of salmon spawning. The paucity of large woody debris has reduced the morphological variation present in the river, with an associated reduction in habitat quality and availability for, amongst others, bullhead, Atlantic salmon, brook lamprey and *Ranunculus*. In addition the piping of Laws Ditch reduces ecological connectivity of this watercourse from the River Wylye downstream and agricultural stock pressure has damaged riparian vegetation structure and caused significant erosion of some river lengths.

2.2 Proposed Restoration Works

A range of techniques were proposed, including:

- Modifying the operation of Seven Hatches sluices ;
- Re-grading existing banks to restore/enhance diverse marginal vegetation;
- Narrowing the channel width using staked faggot bundles;
- Breaking out and removing the tractor bridge and central footing from the site and replacing it with a single span bridge;
- Excavating previously deposited river dredgings where present and mechanically screening material on site;
- Re-introducing gravel to river to river bed level;
- Introduce large woody debris using felled/toppled riparian trees;
- Replanting with appropriate tree species;
- Erecting fencing to prevent stock access.

Figure2.1 River Wylye at Seven Hatches Reaches 1 and 2



Scale 1:1250

0 25 50 75m

0 62.5 125 187.5ft.

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Map 1
Drawn By:
Date: 11/9/2006
Ref: su09423298
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Figure 2.2 River Wylye at Seven Hatches Reaches 3 and 4 (upper)

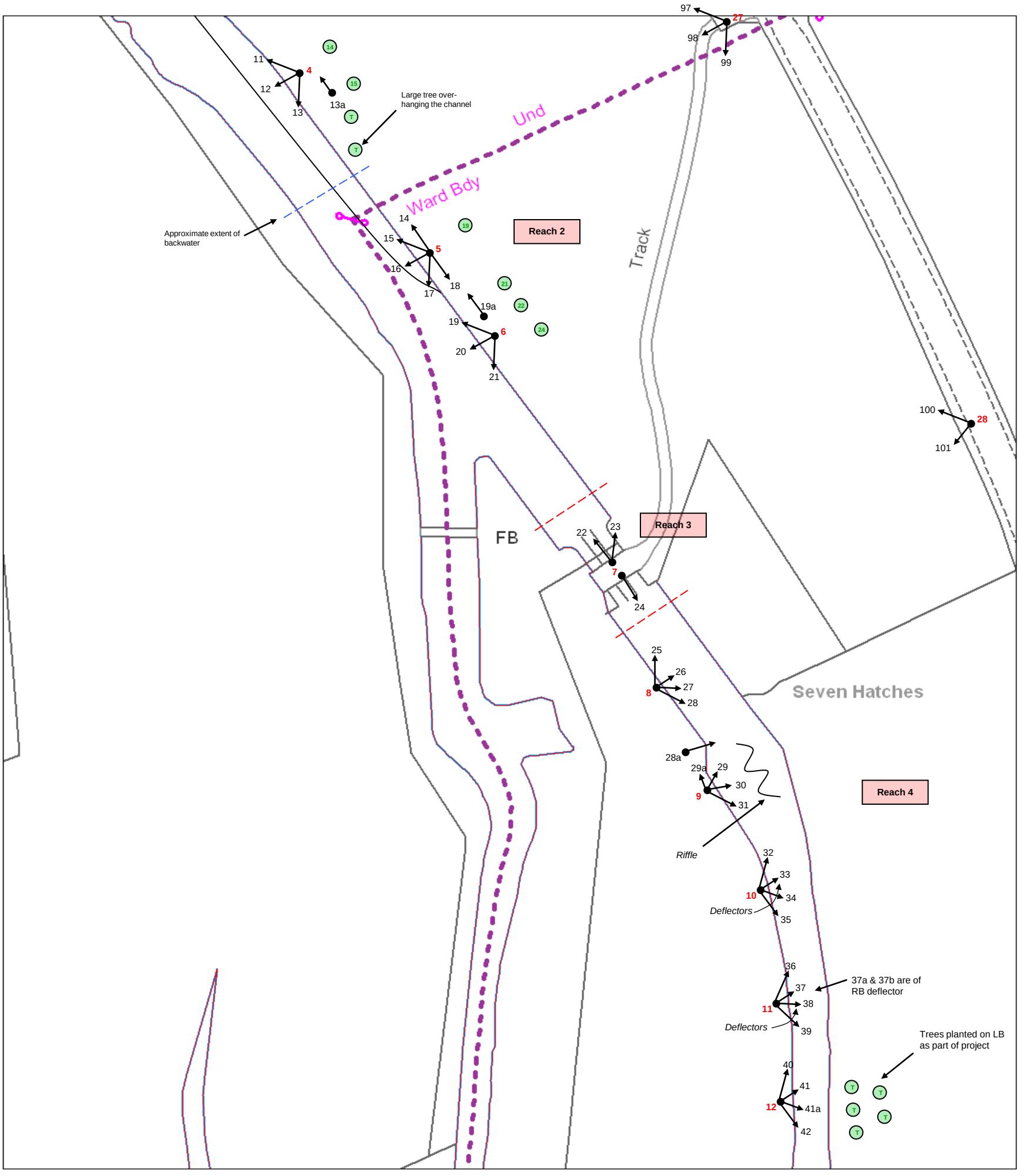

Figure 2.3 River Wylye at Seven Hatches Reach 4 (middle)

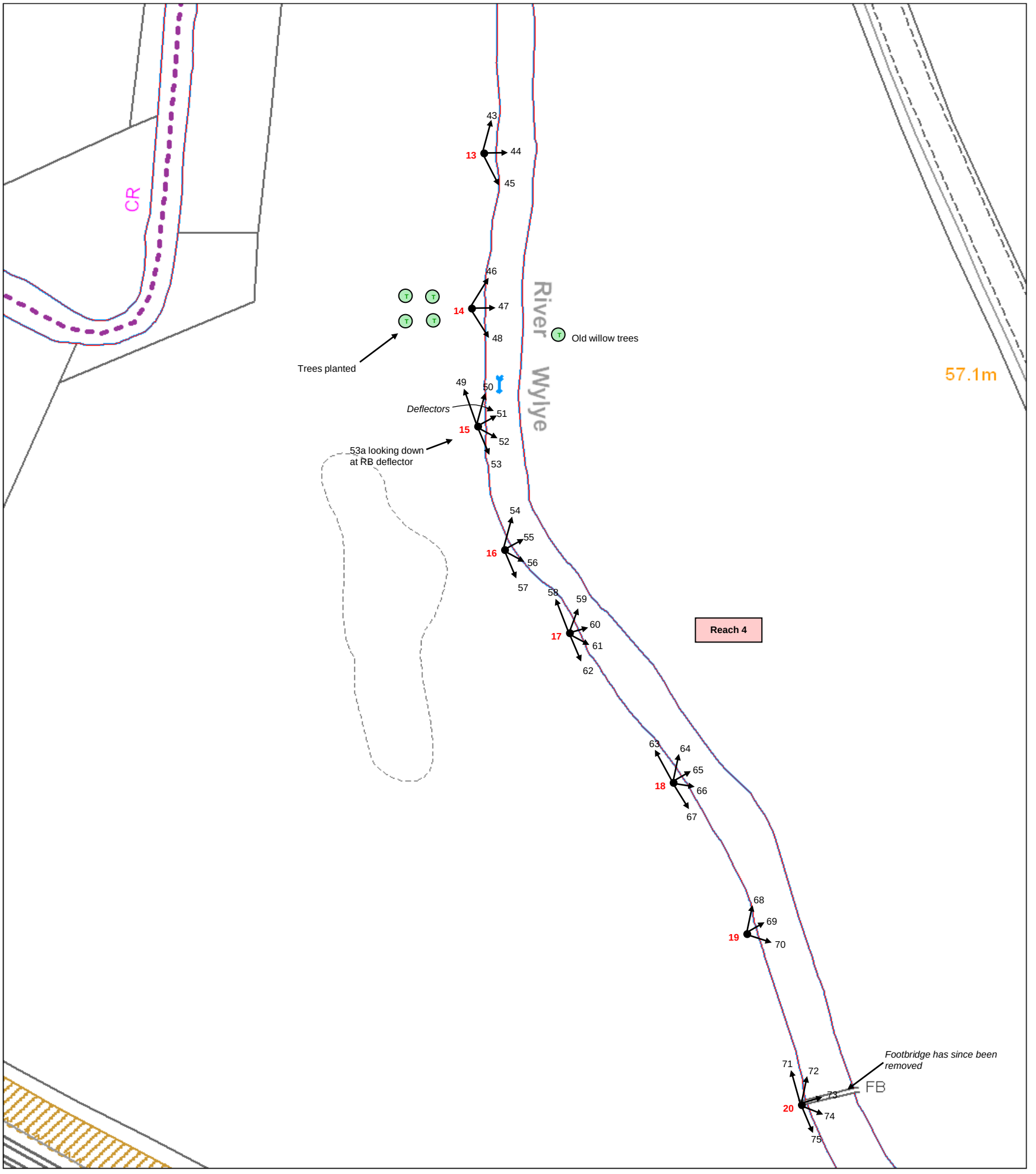

Figure 2.4 River Wylye at Seven Hatches Reach 4 (lower) and 5

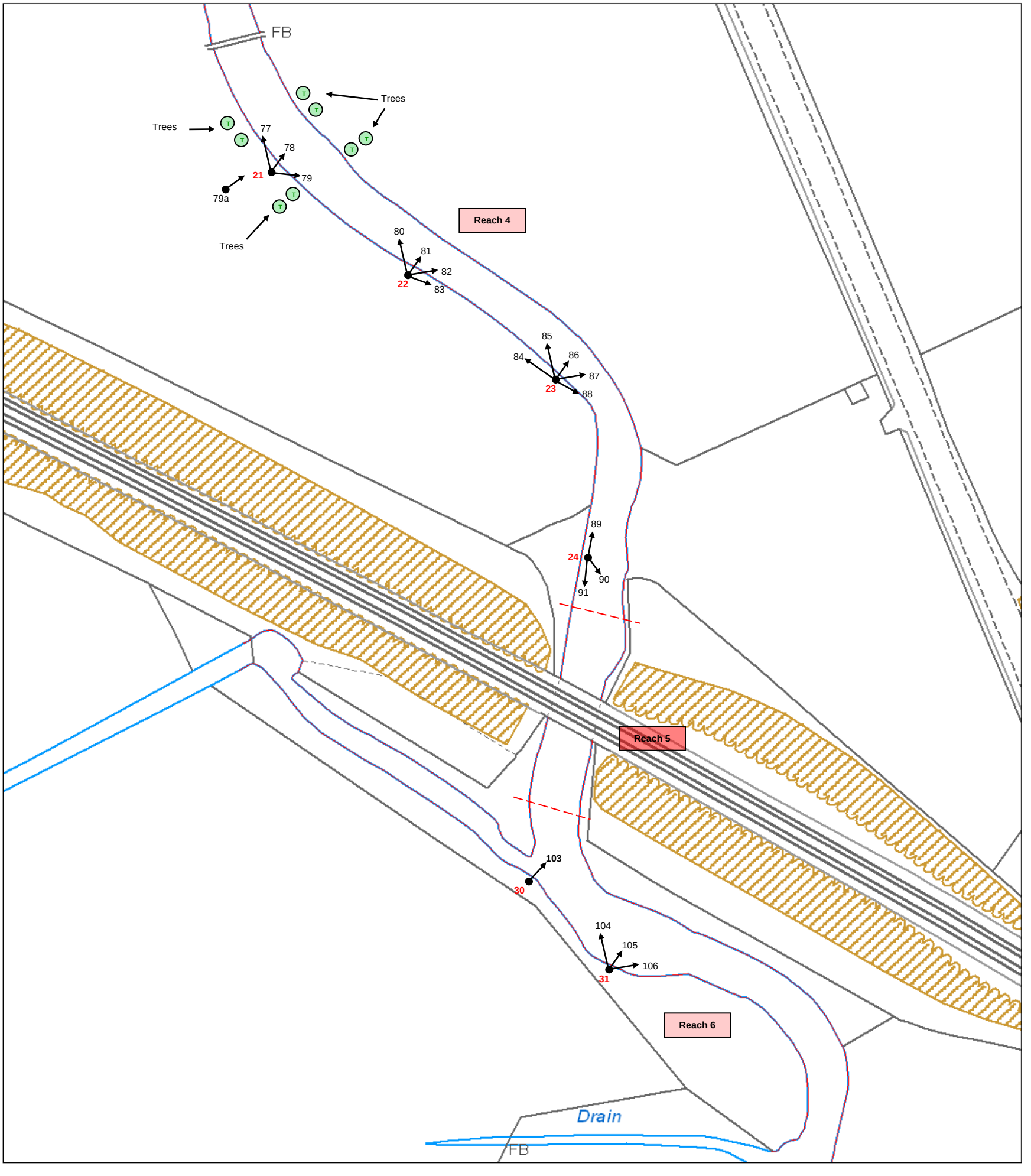

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Figure 2.5 River Wylye at Seven Hatches Reach 5 and 6 (upper)

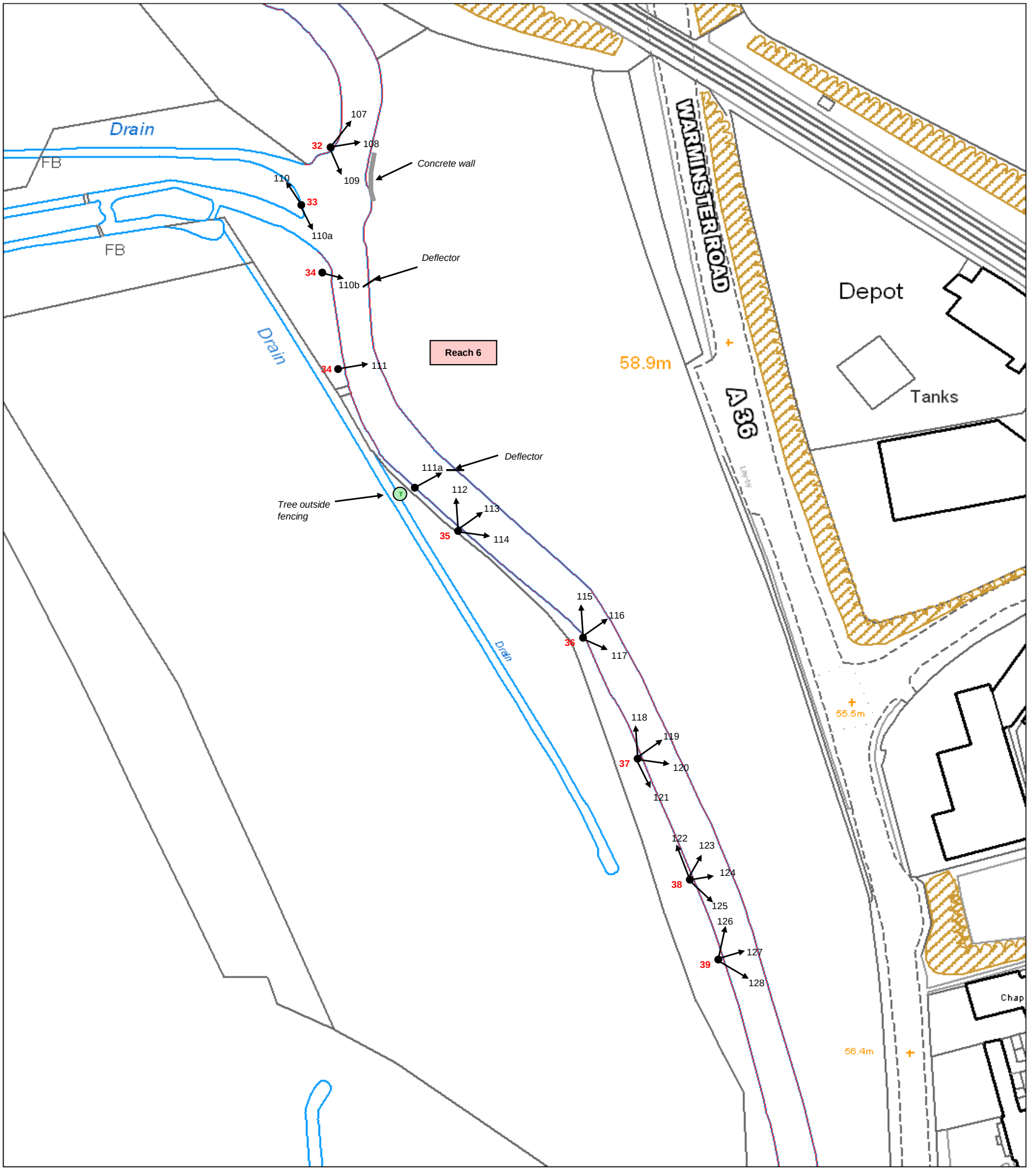

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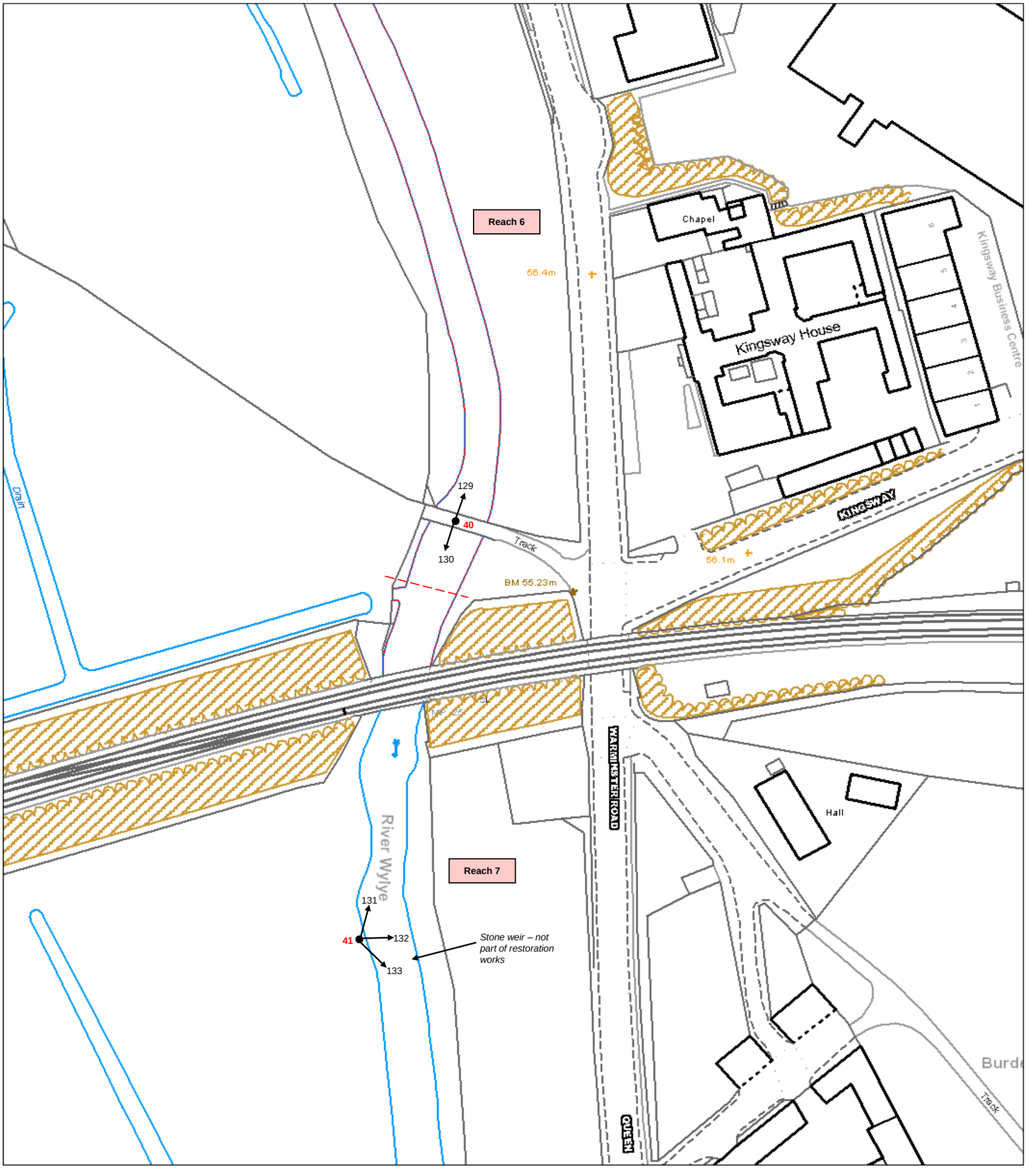
Figure 2.6 River Wylye at Seven Hatches Reach 6 (lower) and 7



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Map 6
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Date: 11/9/2006
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3. Assessment of Proposed Restoration and Likely Outcomes

The restoration works were designed to have a range of positive effects on the river and its ecology. Some of these effects would be visible after the works (restoring bed levels) and some would take years to become apparent (success of habitat enhancement).

The modified operation of the Seven Hatches sluices were expected to improve the quality and availability of upstream habitat for key SAC species, particularly bullhead, salmon and *Ranunculus*, ecological connectivity between contiguous reaches would also improve, particularly for migrating fish.

The restoration of the historic hard bed level was expected to increase habitat for bullhead, spawning brook lamprey, and spawning/juvenile salmonids. Greater heterogeneity in bed morphology was expected to result in re-establishing favourable condition for *Ranunculus* and increased diversity in the *Ranunculus* community while the manipulation of channel structure was also expected to result in redistribution and sorting of fine sediments, increasing habitat diversity for the benefit of SAC target species.

Increased diversity of marginal vegetation would create additional habitat for Desmoulin's whorl snail and brook lamprey larvae and the introduction of woody debris and associated sediment accumulation was designed to promote sorting of bed material and diversity in channel morphology. There should be an associated increase in both available habitat for brook lamprey larvae and the detention time of fine sediment.

Increased hydrological continuity with the floodplain would benefit a range of macrophyte, invertebrate and avian species and the inclusion of riparian meadow in agri-environment schemes was expected to increase the ecological value of this land, with an associated decrease in riparian damage as a result of a reduction in agricultural stock.

It should be noted that the design work was carried out at a time when water levels were below the seasonal average. The post construction visit was carried out at a time of above long term average water levels.

Site visits were carried out on 6th June 2007(pre works), 22nd October 2007(during works), 18th December 2007(post works) and 30th May 2009(post works - 18 months on). The reaches (see map Figures 2.1 to 2.6) can be summarised as;

- Reach 1 - Upstream of Proposed Restoration Section
- Reach 2 - Narrowing with Brushwood
- Reach 3 - Seven Hatches
- Reach 4 - Importing Gravels, Tree Removal and Use of Large Woody Debris as Deflectors
- Reach 5 - Underneath Railway Bridge
- Reach 6 - Downstream of Restoration works – Tree Deflectors Installed
- Reach 7 - Upstream of Second Railway Bridge

Table 3.1 summarises the information in terms of short term and long term effects from the pre works, 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.

3.1 Pre Works

Reach 1: On the pre works site visit Reach 1 was identified as having a straight uniform channel, with trees on both banks, marginal vegetation and no in channel vegetation. The only potential adverse effect of the proposed restoration scheme was the possibility of increased siltation should the channel narrowing cause a backing up of water. No positive impacts were envisaged.

Reach 2: This reach also had a straight uniform channel with large mature trees on the left bank and a few smaller trees on the right bank. Marginal vegetation was in evidence and the banks were grazed by cattle. In the short term negative effects were expected in terms of disturbance of vegetation and visual impact, but both were expected to be low. In the long term the perceived negative impact (low) would be to birds with respect of the removal of trees. Medium long term positive impacts were expected with respect to increasing flow variability, increasing in channel and marginal vegetation and increase in habitat for fish and invertebrates. The felling of trees was expected to have a low positive impact in terms of increasing the views across the valley by tree felling.

Reach 3: This reach comprised of the hatches themselves and a short section upstream and downstream of the structure. Just upstream of the hatches the river splits into two with the Butchers Stream tributary take off on the right bank. Upstream of the hatches the river was impounded and the channel was straight, uniform and deep. It was anticipated that the short and long term negative effects being silt deposition resulting from the upstream works. The siltation may affect the Butchers Stream, depending on the hatch configuration.

Reach 4: Downstream of the hatches in Reach 4 the river is uniform with very low sinuosity, but some depth variation. The marginal vegetation was limited as a result of grazing and cattle poaching was in evidence in some sections. The restoration works were expected to have a negative effect in terms of possible impoundment and disturbance from the works themselves. Positive effects were predicted to be flow diversity, both in the short and long term, as well as increased habitat and improved visual aspect.

Reach 5: This reach demonstrated flow diversity and good bed variation and is thus a good habitat for fish. No works were intended to be carried out in this reach therefore no impact was expected.

Reach 6: This reach lay between the two railway bridges. Both banks, which were steep, were covered in dense stands of nettles. The channel had a gravel substrate but was silted in places. There was some in channel vegetation in evidence and the presence of woody debris was creating flow variability. Numerous holes were observed in the left bank which may well have been made by water voles. The expected negative impacts were disruption to vegetation in the short term only. Long term benefits were expected to be increased vegetation and habitat for fish and invertebrates and localised movement of bed material and the formation of riffles and areas of deposition.

Reach 7: For Reach 7 no works were planned so no impacts, either positive or negative, were envisaged.

3.2 During Construction

Reach 1: During the construction phase no noticeable short term effects were observed.

Reach 2: For Reach 2 very little impact was observed resulting from the works. There was no significant damage to riparian vegetation and the visual impact was not significant.

Reach 3: The visual clarity of the water in this reach was good, but the bed upstream of the hatches was heavily silted.

Reach 4: Downstream of the riffles a significant amount of silt had been deposited. It was also noted that the material used to create the riffles was quite large (approximately 20cm in diameter) this was the base fill that was observed at the time of the site visit rather than the top layer of gravels which were 20-60mm in size.

Reach 5: It was observed that no significant increase in silt deposition had occurred and that brushwood silt traps had been installed just upstream of the railway bridge.

Reach 6: No changes were observed in this reach.

Reach 7: No obvious deposition of sedimentation had occurred in this reach.

3.3 As built

Reach 1: - No effect was observed

Reach 2: - The berm were created by placing large tree trunks perpendicular to the bank with a line of posts along the front edge. Large wood deflectors were also placed so as to protrude further out into the channel (see Plate I). Brushwood was then placed within the structure and the chalky soil which had been excavated out from the cattle drinks was placed on top. The brushwood and soil was then topped off with pre planted coir mats and the whole structure was then cross wired together. The coir mats had been planted with glyceria, water mint, yellow flag, water parsnip, marsh marigold. The deflectors narrowed the channel by 3 to 3.5m. The most downstream end of the berm was within the impoundment effect of the hatches. No negative impacts were observed. Fencing was installed set well back (11m) from bank to protect the establishing marginal fringe. Silt deposition was occurring between the deflectors and this was expected to eventually be colonised by emergent vegetation. Trees were felled according to a carefully planned felling program.

Reach 3: - Silt might have been transported around bypass channel, so is likely to have been deposited throughout reach. There was no change in hatch management which was deemed essential by the fishing club to maintain water levels and flow in Butchers Stream.

Reach 4: - Gravels were imported to create a riffle just downstream of hatches (see Plate II). Further downstream woody debris was pinned into the substrate to create varied flow (see Plate VII). Gravel was collecting around the deflector and the effect of riffle having a medium effect rather than low. Trees were felled according to a carefully planned felling program. The deflectors were protruding 3 to 4m out into the channel.

Reach 5: - No effect was observed

Reach 6: - The deflectors were only having a very localised effect, only two had been installed which were very straight and not whole trees as requested in the original specification, more like large logs.

Reach 7: - No effect was observed

3.4 Post Project

Reach 1: - No effect was observed

Reach 2: The water parsnips did not survive as the water levels were too high and the plants became inundated. On the final site visit the aquatic emergent vegetation growing (water mint *Mentha aquatica*, yellow flag *Iris pseudacorus*, marsh marigold *Caltha palustris, glyceria sp* and *junca sp*s. The resulting narrowed channel was however, still over-wide. No changes were made to the hatch operating regime and as a result the radial gates at still impound water. The fencing is keeping the cattle away from the bank except at the specially built watering places, thus prevent poaching and alleviating the resulting siltation problem.

Reach 3: - no effect

Reach 4: -. Both the riffle creation and the woody debris seem to be working well. The gravel on the riffles are still free of silt and there is evidence of scour on the downstream side of the log deflectors which is creating varied flow regime and mobilising silt from the substrate. On all the riffles large boulders were used to build up the bed level and the gravels were laid on top. The fencing off of cattle has allowed the bankside vegetation to grow and is preventing poaching thus decreasing sedimentation. In addition willow tree saplings have been planted which will create additional habitat in the long term. For this reach the sill underneath the railway bridge and its impounding effect, is the limiting factor with regards to restoration works.

Reach 5: - no effect

Reach 6: - only low impact effect of deflectors since influence is only occurring locally (see Plate VIII)

Reach 7: - no effect

Table 3.1 Summary of the Assessment of Scheme Outcomes from the RRC Rapid Assessment Proformas

	Pre Works (6th June 2007)		During Works (22nd October 2007)		As Built (18th December 2007)		Post Works (30th May 2009)	
	Expected Positive Effects	**Expected Negative Effects**	**Positive Effects**	**Negative Effects**	**Positive Effects**	**Negative Effects**	**Positive Effects**	**Negative Effects**
Reach 1	Very few 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	No noticeable changes were observed	No noticeable changes were observed
Reach 2	The narrowing of the channel with the construction of the D deflectors initially created flow variation and the removal of some of the trees improved the landscape view and the river channel.	The within channel works caused a certain amount of sediment mobilisation. However, this would have settled out downstream at the hatches themselves or in the section upstream of the first railway bridge having little long term negative impact. The removal of selected trees would have reduced bird habitat but only to a minor extent. Long term the avian habitat will improve as the newly planted trees grow and mature	There were no short or long term impacts.	There were some visible impacts but these were not deemed to be significant.	Marginal vegetation had increased because the cattle had been fenced out from the riparian section. Silt deposition occurring between the deflectors narrowing the channel and creating marginal areas in which emergent vegetation was starting to establish. . No trees were removed as was originally intended so there was no loss of bird habitat	No negative impacts were observed	D deflector actively accreting (storing) silt and emergent vegetation growing well in the silt. Greater extent of marginal vegetation. Visual improvement to the previous bare banks. Bankside vegetation improved now that cattle have been fenced off from the river.	No negative effects were observed in this reach
Reach 3	The raising of the radial sluice gates was expected to have a positive effect with by lowering water levels in the impounded section upstream and reconnection the reaches upstream and downstream with respect to fish movement.	The raising of the radial sluice was expected to release a significant amount of silt which would be deposited in the reach downstream (particularly in reach 5).	Whilst the works were in progress the water was observed to be clear indicating minimal silt release. No trees were removed as was originally intended so there was no loss of bird habitat	The bed upstream of the hatches was very silty, though this was likely to have been the case even before the works started given its impounded nature and slow velocity.	No trees were removed so no loss of bird habitat	Silt may have been carried into backwater and as the channel is so large silt is likely to have been deposited throughout the reach. No change to hatch management to maintain water levels in backwater.	No positive effects were observed for this reach	No negative effects were observed in this reach
Reach 4	The import of gravels was expected to increase flow diversity even in the short term and in the long term to increase morphological features which would lead to an increase in fish and aquatic invertebrate habitat. In addition a visual benefit was expected with respect to more open views across the valley as a result of tree removal	It was thought that the importation of gravels could potentially cause a backup of water and that in the short term the works could disturb vegetation and have a detrimental visual impact. In addition the removal of trees would reduce bird habitat	Increased flow diversity and raised bed level	Significant quantities of silt had been deposited mid channel downstream of the riffle structures covering the gravel bed and reducing potential spawning habitat	Increase of flow diversity at riffle. The riffle has actually had a moderate effect on increasing velocity rather than the predicted minor effect. No trees were removed so no loss of bird habitat.	Possible backup of water on the backwater channel which may result in siltation of gravels.	Improved diversity of flow at riffle. New willow planting will create greater habitat in the long term. Evidence of beneficial scour and subsequent gravel bed undulations on the downstream side of logs	No noticeable changes were observed
Reach 5	Not expected to be influenced by the works.	Not expected to experience any negative effects from the restoration works.	There was no significant increase in silt within this reach so gravels have remained clean. Brushwood was installed upstream of the bridge to act as a silt trap	No negative effects were observed for this reach	No noticeable changes were observed	No noticeable changes were observed	No noticeable changes were observed	No noticeable changes were observed
Reach 6	In the long term the installation of tree deflectors was expected to increase geomorphological diversity, increase in-channel vegetation and increase fish and macroinvertebrate habitats.	The installation of tree deflectors was expected to cause disturbance of vegetation and have a visual/social impact in the short term. No long term negative impacts were envisaged.	Tree deflectors had not been installed at the time of the site visit	Tree deflectors had not been installed at the time of the site visit	Effect of deflectors is only minor to negligible rather than moderate though some local changes in flow have occurred	No noticeable changes were observed	Improved diversity of flow resulting from installation of deflectors locally.	No noticeable changes were observed
Reach 7	No positive impacts were envisaged for this section.	Potentially this reach could be impacted by deposition of sediment as a result of the upstream restoration works, however it was already of poor quality in terms of habitat and geomorphological features	No obvious deposition of silt had occurred (as had been suggested as a possible negative impact).	No noticeable changes were observed	No obvious deposition of silt had occurred (as had been suggested as a possible negative impact).	No noticeable changes were observed	No obvious deposition of silt had occurred (as had been suggested as a possible negative impact).	No noticeable changes were observed

	Upstream of restoration reaches
	Restoration reaches
	Downstream of restoration reaches

Figure 3.1 Seven Hatches Restoration Techniques Upper Reaches

Plate I Deflectors Newly installed in Unit 2

Plate II Newly created Riffle Downstream of Seven Hatches

Plate III Brushwood Silt Trap on Upstream Side of Railway Bridge

Plate IV New Willow Saplings Planted in Unit 2

Figure 3.2 Seven Hatches Restoration Techniques Lower Reaches

Plate V Sediment Beginning to Infill the Berm

Plate VI Cattle Watering Location

Plate VII Log Deflectors cut into Substrate in Unit 4

Plate VIII Log Deflector in Unit 6

3.5 Reasons for Changes from Original Planned Works

A number of changes occurred from the original planned works. These changes and the reason for the change are listed in Table 3.2.

Table 3.2 Changes made to Original Plans

Works proposed in bid	Alternative (constructed)	Reason for change
Reclamation of gravel on site, reinstatement in channel to provide spawning areas	Gravel and stone purchased from local supplier, creating 1500m^2 of spawning habitat	Gravel not present on site in the volume/quality needed
Removal and replacement of tractor bridge to reduce impoundment	No action	Topographic survey showed no hydraulic benefit in removing tractor bridge
Re-grading banks and gravel replacement in lower reach	Securing of large woody debris to deflect/vary flow and enhance marginal habitat	Rail bridge controlling slope of reach, therefore very limited hydraulic benefit to be gained in re-instating gravel into channel. Machine access is restricted and practicality/cost of importing material prohibitive.
Felling of entire line of mature polar trees	Identification of selective tree works to balance landscape and river ecology needs.	Felling licence required in order to re-claim gravels. Ecological benefit could be obtained by more selective tree work.
No tree planting planned	Native sapling trees planted	Tree planting included partly to replace felled trees and to comply with planning permission legal obligations
Changes to hatch operation	No significant changed to hatch operation	The hatches control the diversion of water down Butchers Stream. Concerns raised over potential flooding issues in Wilton as raising the hatches would mean less water is diverted down Butchers Stream and the flood risk from the main channel is increased as a result. Butchers Stream is a good environment for salmon in its own right, concerns that changing the flow regime down this channel would be detrimental

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;
- Channel cross section surveys;
- Macrophyte surveys, and;
- Fisheries surveys.

Monitoring at each site was within the restored reach and at a control site some distance away from the restoration site.

For the Seven Hatches site the control reach was upstream of the restoration site at South Newton, and included an impounded section and a re-profile driver channel. Comparisons at the control site were made in 2006 and 2008. One riffle and two glides were recorded within the control site. Comparison with the pre-restoration survey with conditions in 2008 showed that the physical biotopes remained predominantly unchanged. The glide was flowing faster post restoration due to higher flows. In the upper section the channel remained shallower and velocities are greater than further downstream. The extent of channel vegetation decreased since 2006 possibly due to grazing by water fowl. Greater numbers of salmonids were recorded in 2008, but fewer bullhead, brook lamprey or minnows.

The restoration site for Seven Hatches was at Chilhampton Farm, just upstream of the town of Wilton. The introduction of gravel and stone bed material and large woody debris has increased the variability of the bed morphology. Felling of selected trees along the left bank has had a visual impact.

Upstream of Seven Hatches and downstream of the railway bridge the biotopes for pre scheme (2006) and post scheme (2008) are the same. The section immediately downstream of the hatches now has a series of riffles where before the scheme it was a glide. The glide-riffle sequence created by the restoration work has resulted in contrasting localised areas of sediment deposition and transport. The restriction of livestock has removed the influence of poaching reducing fine sediment input into the channel and established riparian and marginal vegetation which is acting as a sediment trap along the channel margins.

Where no restoration work has been carried out the channel cross sections are similar between 2006 and 2008. At the riffle site the channel bed has been raised resulting in shallower depths and decreased bankfull depth. The differences in bed level elevation at the three riffle sites were also in evidence in the long profile. The faster flowing water has meant that in the riffle sections the finer silt has been removed.

There were significant differences between the macrophyte surveys of 2006 and 2008. By 2008 there was a 30% cover of fennel pondweed at one site (one of the deepest sections in the reach). The fencing off of the cattle had allowed marginal and riparian plants to flourish. Overall the

number of taxa observed in 2008 was less than that in 2006 and the reduced number of species was recorded as covering less than 5 % of the channel.

The range and number of fish caught in 2008 was significantly different to those from 2006. The main differences were an increase in the number of salmon, trout and bullhead and a decrease in lamprey and minnows. The increase in salmonids may be due to increased velocities partly due to the restoration work and partly due to higher flow conditions. Lamprey requires shallow water with low velocities and the presence of organic detritus and/or plant material. Minnows prefer shallow waters with sandy or gravely substrate. The high velocities and deeper water experienced in 2008 made habitat conditions for lamprey and minnows less favourable.

In addition to the work by Royal Haskoning, Wessex Water carried out macroinvertebrate sampling at the control site at South Newton upstream of the restoration works and at one of the riffle sites in Reach 4. The sampling was carried out pre scheme (August 2007) and post scheme (August 2008). Table 4.1 shows the various macroinvertebrate scores for two industry standards (British Working Party Monitoring [BMWP] and Lotic-invertebrate Indices for Flow Evaluation [LIFE]) for the two sites pre and post scheme.

The results show that consistently high BMWP scores indicate good water quality at both sites and that the restoration has not affected this either positively or negatively. In 2008 there are higher LIFE scores recorded at both sites for both family and species scores. Indicating that between the two years factors other than the restoration work have increased the scores and any effect on the LIFE scores because of the restoration work has been masked. Overall there was little change in the number of taxa, the pollution scores or the conservation scores at either site. Examination of the taxa reveals a similar community at both sites, both pre- and post restoration. These are only the initial results and further sampling is to take place in 2009.

Table 4.1 Macroinvertebrate Scores Pre and Post Scheme

River	**Wylye**	**Wylye**	**Wylye**	**Wylye**
Site	7 Hatches	7 Hatches	S.Newton	S.Newton
Restoration/Control	Restoration	Restoration	Control	Control
pre/post	pre	post	pre	post
Date	28/08/2007	22/08/2008	28/08/2007	22/08/2008
CCI	20.17	21.75	21.64	23.02
Life score (Species)	6.83	7.40	6.87	7.30
Life score (Family)	6.51	6.98	6.46	6.98
BMWP score	230	229	227	248
Ntaxa	39	39	38	41
ASPT	5.90	5.87	5.97	6.05

5. Assessment of Methods Used

5.1 Berm

Figure 5.1 shows the berm at photograph location 9 (Reach 2). The deflector here has narrowed the river by up to 1.5m. The deflector was infilled from soil excavated when the cattle drink just upstream was excavated. The deflector has completed silted over and the area inside the deflector is completely covered with emergent and marginal vegetation.

Further downstream at photograph location 13 (see Figure 5.2) the berm is only partially silted over, however the narrowing is up to 3.5m. The emergent/marginal vegetation is only sporadic. It is possible that less spoil from the cattle drink excavation was put into the deflector here as it was much further away from the excavation site.

Some of the pre planted coir mat vegetation such as the water parsnip failed to survive possibly because the water levels are now much higher than when the construction work was carried out in 2007 (See note in Section 3).

The berm are currently causing a health and safety concern for the anglers. The wires holding the brash in place are a possible trip hazard as they are hidden at the far extent of the ‘new bank’ below water level. As a result it is planned that coir rolls will be fitted to the front edge of the deflectors to visually mark the point where shallow water becomes deep river.

Figure 5.1 Berm in Reach 2 at Photo Location 9

Plate IX Photo Location 9 Pre Works

Plate X Photo Location 9 During Works

Plate XI Photo Location 9 As Built

Plate XII Photo Location 9 Post Works

Figure 5.2 Berm in Reach 2 at Photo Location 13

Plate XIII Photo Location 13 Pre Works

Plate XIV Photo Location 13 During Works

Plate XV Photo Location 13 As Built

Plate XVI Photo Location 13 Post Works

5.2 Riffle

For Reach 4, large quantities of gravel and stone were imported to create riffles. Originally the gravel was planned to be recovered from the riparian zone whereby a line of mature trees were to be felled and the gravel removed from beneath. However, it transpired that there was little gravel in the area, so the trees remained in place and the gravel was imported from outside the site. As well as the gravel being imported, log deflectors were pinned into the substrate (see Section 5.3). The riffle sections have significantly altered the flow dynamics with shallower and faster flowing water. The wood deflectors create localised flow variability (see Figure 5.3) providing additional habitat diversity across the gravels. Stone was used to build up the river bed and the gravel lain on top. In the lower riffle the blockstone underneath the gravels has now been exposed. Ideally this is not desirable; however it has resulted in an additional habitat type where scour has occurred on the downstream side creating hollows.

Figure 5.3 Riffle in Reach 4 at Photo location 30

Plate XVII Photo Location 30 Pre Works

Plate XVIII Photo Location 30 During works

Plate XIX Photo Location 30 as Built

Plate XX Photo Location 30 Post Works

5.3 Shallow Water Log flow Deflectors

Large logs were pinned into the imported gravel substrate. The gravels had been placed to create a riffle and the logs were installed to increase the flow variability. Figure 5.4 Log Deflectors in Reach 4 at Photo Location 51(Plates XXI to XXIV) shows one of the sites where the logs have been installed. Plate XXIV shows that even when the flows are relatively high the log deflectors are working well and the variation in flow can be seen clearly.

Figure 5.4 Log Deflectors in Reach 4 at Photo Location 51

Plate XXI Photo Location 51 Pre Works

Plate XXII Photo Location 51 During works (prior to log being installed)

Plate XXIII Photo Location 51 as Built

Plate XXIV Photo Location 51 Post Works

5.4 Deep Water Log Flow Deflectors

In Reach 6 two tree deflectors were installed on the left bank. The trees were held in place by vertical wooden stakes. Both deflectors were still in place at the last site visit. The upstream deflector is still protruding out of the water slightly (see Plate XXV and Plate XXVI . The downstream one is fully submerged (see Plate XXVII and Plate XXVIII). Both are creating small areas of flow variability locally.

Figure 5.5 Tree Deflectors in reach 6 at Photo Location 110b and 111a

Plate XXV Photo Location 110b as Built

Plate XXVI Photo Location 110b Post Works

Plate XXVII Photo location 111a as Built

Plate XXVIII Photo Location 111a Post Works

6. Discussion and Recommendations

6.1 Discussion

Part of the original aims for the Seven Hatches site included setting a new hatch operation protocol whereby the radial gates would be raised in order to lower the water levels in Reach 2. However, the local fishing club expressed their reservations about lowering water levels in this reach because of concern over the reduction of flow entering Butchers Stream. It was believed that lower water levels would reduce the inflow into this off-take tributary since this watercourse was reportedly a good habitat for Salmon spawning.

In Reach 4, the method of introduction of gravels and the creation of riffles was largely successful in that increased heterogeneity in flow types was achieved. Additionally, the downstream riffle had large woody debris pinned into the substrate. This increased the flow variability locally and there was evidence of scour taking place on the downstream side of the structures. Both riffles showed signs that the gravels were adjusting to changes in flow and that the higher velocities in this reach would be capable of limiting the deposition of silt within the gravel interstices, providing suitable spawning areas in the future. In the long term it is predicted that the turbulence at moderate to high flows generated by the woody debris will help to ensure that the riffles remain free of excessive siltation. Detailed hydraulic modelling was carried out for the works to determine the optimum location for the riffles and the potential flood risk impact of the works.

The macroinvertebrate sampling carried out by Wessex Water was sampled at one of the riffles. Results showed that there was an increase in LIFE scores which indicate faster velocities as a result of the works, though it was not conclusive as only two sets of samples (pre and post scheme) were taken. Further long term sampling of the riffles may give a clearer indication as to the changes in macroinvertebrate assemblages as a result of the works.

The channel narrowing techniques were successful in terms of providing marginal vegetation features. The system of brashings and log deflectors used in Reach 2 trapped silt and sediment. No cross sections were taken in this reach so it is not possible to quantify the effect of the deflectors on the cross section profile. At the request of the local fishing club some adaptive management techniques are to be applied to these deflectors in that coir rolls will be staked to the front of the deflectors to define the front edge of the structure and to further encourage vegetation which will assist in stabilising the newly forming bank edge. The deflectors have improved the heterogeneity of the habitat, providing shallow well vegetated margins close to the existing deeper water. Larger structures would have had a more significant narrowing effect; however this would likely have had an adverse impact on flood flow conveyance.

With respect to the SAC species the silty margins created by the Reach 2 deflectors are good habitat for brook lamprey and for salmonid fry as an area of refuge. In addition the emergent vegetation now colonising the new margin have created good habitat for Desmoulin's whorl snail. The riffles have created new spawning areas for both salmonids and cyprinids. Bullhead juveniles inhabit shallow stony riffles whilst the adults prefer sheltered sections created by large woody debris, tree roots, leaf litter, macrophyte cover and large stones. So as with the salmonid fry and brook lamprey, the additional silty marginal areas and large woody debris have created habitat for the bullhead adults. As stated above much of the river is still over-deep and sluggish

and only the new riffles are creating potential areas for *Ranunculus* colonisation (seen on a subsequent visit in July 2009).

6.2 Lessons Learnt

For this site potential for major restoration was always limited by the existence of the structures, however many such structures exist all along the Avon where they cannot as yet be removed, so demonstrating approaches to best improve the adjacent habitat was necessary.

6.2.1 Reach 2

Changes resulting from this restoration work were further limited by sub-optimal operation of hatches in that the hatches could not be raised and therefore the upstream impounding effect remained the same as before. The planned changes to the hatch operation which would have lowered water levels in this reach were not carried out because of the concerns about reduced flows and the potential effect on salmon in Butchers Stream and flooding downstream in Wilton. This project demonstrates the need to be able to influence flow management through structures. Without the development of the hatch operating protocol the works in Reach 2 are limited in their effect because of the impounding influence of the structure.

The narrowing above the hatches could have been bolder than was actually carried out. The log deflectors could have protruded much further into the channel and the brushwood infill and log stake wet ledge could have then been wider. However, what was installed is developing well.

The result of the planting scheme was not as varied as was originally planned because many of the plants did not survive as a result of water levels being higher than expected due to wet winters and wet summers. However, often planted vegetation takes a number of seasons to establish well, and any 'gaps' are usually colonised by spread from other planted species or through silt and seed deposition of upstream macrophytes. It could be a number of years before the ledge vegetation reaches its full potential, something that is often outside the reporting phase of a 4 year project.

6.2.2 Reach 4

The combination of gravel introduction and log deflectors has improved the flow variability. The combination of the two techniques (gravel augmentation and log deflectors) has improved their individual effectiveness. Between the riffle sections the water is still deep and substrate is silty. Due to the depth of the channel, cost of material and the resulting short distance of overall length of the riffles, the majority of the river remains over-deep and over-wide. Significant benefit could be accrued by this approach but only with a much larger investment of funding.

6.2.3 Reach 6

The tree deflectors needed to be much bigger and protrude into the river much more to have desired more visible and immediate effect. Felling and securing large willows directly in to the river could have been more effective. Localised flow variability has been achieved, and this signifies that the deflectors are likely to have the desired effect, but could take a further 5+ years to gradually begin to re shape the channel through year-on-year deposition and vegetation growth. This has been observed in other silt laden channels where very minor changes in flow velocity by submerged log deflectors have slowly accreted significant vegetated marginal

ledges. . None of the approaches adopted by the project have been wholly inappropriate for the river type, objectives set or the desired outcomes.

6.3 Recommendations

It is suggested that further hydraulic modelling be carried out to determine the optimum level to which the hatches can be raised to allow water levels upstream to be lowered and re-design the inflow to Butchers Stream to facilitate the same split of water between the two channels .The macrophyte and fisheries surveys need further repetition to determine what, longer term effect the restoration work will have. It is suggested that a walkover survey be used to determine if the new riffles in reach 4 are being used as spawning areas, possibly in conjunction with the fishing club. It is further recommended that the macroinvertebrate sampling be continued for at least 5 years at both the upstream control site and the riffle site to determine what effect the restoration work is having on aquatic invertebrate assemblages. Though macroinvertebrates are not the designated interest, they often provide a more reliable indication of river health than more mobile fish populations.

The qualitative monitoring cannot conclude success or failure as the timeframe is too short. This assessment shows that the changes to the river are only just beginning to be visible, and in some case will take many more years to reach the desired end result. The STREAM project has aimed to work with natural riverine processes, altering the channels in small ways rather than large scale engineering works (which are more costly and increase ecological disturbance). This approach is going to require more 'vision' in terms of immediate works versus long term results. It should be noted that another years monitoring will be carried out by Royal Haskoning, repeating the detailed monitoring that was carried out. This is part of the Environment Agency's Water Framework Directive science program.

The key question for future projects involving impoundment structures is "will the structure become obsolete and removable within the period of adjustment that is required for the alternative enhancement works to become fully effective". If the answer is yes then removal at a later date should be the primary goal.

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			

the **RIVER RESTORATION CENTRE**

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:

the **RIVER RESTORATION CENTRE**

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?

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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:

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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)		

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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

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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