Test & Itchen
River Restoration Strategy
Management Report
Environment Agency

5th April 2013

ATKINS

Plan Design Enable

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1. Introduction

1.1. Why do we need to restore the Test and Itchen SSSI?

The Rivers Test and Itchen in Hampshire are two of the best examples of Chalk Rivers in England, supporting diverse plant and wildlife species. As such, both rivers and many of their tributaries, are designated as Sites of Special Scientific Interest (SSSIs). In addition to this, the River Itchen is also deemed to be internationally important for its wildlife and is designated as a Special Area of Conservation (SAC) under the EC Habitats Directive.

These rivers are designated for both habitats and species, providing important examples of Chalk river and lowland, low gradient river habitats, with other notable features including fen meadow, flood pasture and swamp and fen habitats. Vegetation is also an important feature of the SSSIs with in-channel vegetation being dominated by *Ranunculus* species (Figure 1, Photo (f)). Important species present include: Southern damselfly (*Coenagrion mercurial)* (Figure 1, Photo (a) - Itchen only)*;* White-clawed crayfish (*Austropotamobius pallipes)* (Figure 1, Photo (e) - one of the few remaining populations in southern England)*;* Otter (*Lutra lutra)* (Figure 1, Photo (c)); Water vole (*Arvicola terrestris);* Bullhead (C*ottius gobo)* (Figure 1, Photo (d))*;* Brook lamprey (*Lampetra planeri)* (Figure 1, Photo (b))*;* and Atlantic salmon (S*almo salar)* (Figure 1, Photo (g))*.*

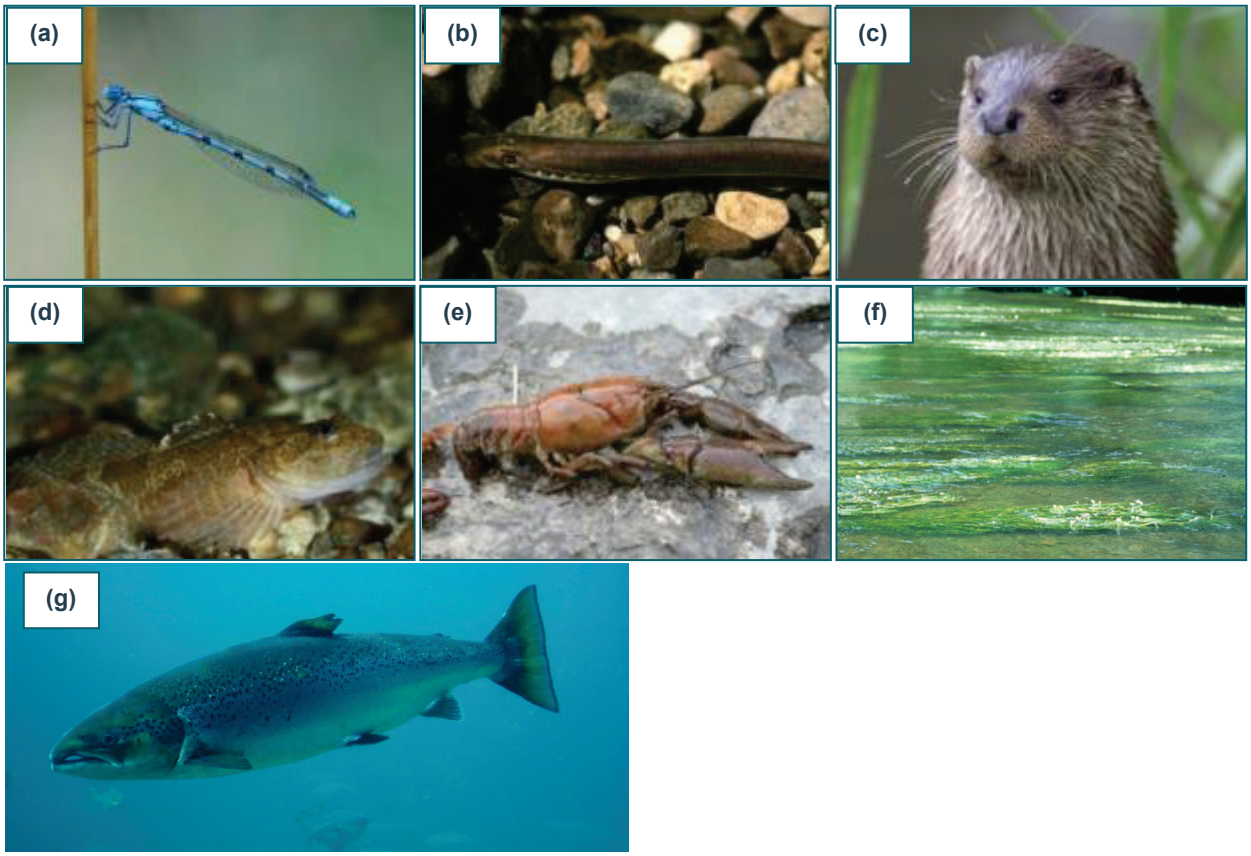


Figure 1: Important species and habitats present in the Rivers Test and Itchen

There are 14 SSSI riverine units on the Test and Itchen; eight on the Test and six on the Itchen. Natural England undertook a condition assessment of the riverine SSSI units in March 2006 on the Test and March 2010 on the Itchen. The assessment showed that the riverine units within both SSSIs are in unfavourable condition. The riverine sections of the SSSIs are in unfavourable condition for a number of reasons, including historical modifications to the physical structure of the channels, banks and riparian zone. Many of the causes behind these changes lie in the historical and commercial use of the rivers, which in various cases are outdated and no longer used in modern times. The evidence of these historic practices remains, leaving a legacy of inappropriate river and land management that now needs to be addressed.

Over the last decade, many projects have sought to address the various causes of unfavourable condition within the sites and the focus of this particular project is on in-channel and riparian restoration, looking at the

quality of habitat available and whether the river provides the natural and unconstrained physical conditions required to support the flora and fauna expected in a river of its type.

This programme of work needs to be implemented to achieve the SSSI favourable condition to fulfil the requirements of the Wildlife and Countryside Act, Habitats Directive, and Good Ecological Status to achieve the objectives of the Water Framework Directive. It will also support in the getting the Itchen SAC towards favourable condition.

Aside from simply achieving these legislative targets, it is also important to ensure these rivers are restored and enhanced as much as is possible and practicable, which will increase their resilience to climate change and extremes of flow as well as supporting their wider commercial and amenity value and the ecosystem services that they provide.

1.1.1. What is River Restoration?

River restoration refers to river improvement measures that are designed to return the physical form (morphology) of the river and the subsequent ecological features present, back towards their natural condition. Restoration in its broadest sense is a wide ranging activity. It can take the form of complete restoration changing the course of the river with features designed to replicate the natural unconstrained conditions, to in-channel works to improve local diversity, or enhancement of specific sections by improved management practices. River restoration in the context of this project does not, necessarily, mean returning the river to its natural course within the floodplain.

This project considers the past modifications to the river channel and floodplain, including weir construction, over widening and deepening for flood defence purposes, land use change and agricultural impacts. All these activities have led to a progressive reduction in the natural habitat available and subsequently a decrease in the biodiversity value expected of a natural Chalk river of this type. Where such impacts are evident, the restoration activities proposed herein aim to restore the river to a form more closely resembling its natural state. This will provide a greater length of suitable habitat for the expected biodiversity to develop over time.

It is recognised that there are many other issues that need to be addressed within the catchment to achieve the desired vision of a more natural river system, including water quality and abstraction pressures. This project seeks to address the physical form of the rivers only, and recognises that there are parallel programmes of work ongoing to address these other pressures over different timescales. It is however expected that by restoring the rivers the resilience of the river systems to other pressures will improve. This includes resilience to more extreme high and low flows expected in future as a result of climate change, the added pressures on resources from population increase and water quality issues by helping to address inappropriate flow velocities.

1.2. Legislative Drivers

Both the River Test and Itchen, and many of their tributaries, are designated as Sites of Special Scientific Interest (SSSIs) under Section 28 of the Wildlife and Countryside Act, 1981 (as amended and inserted by section 75 and Schedule 9 of the Countryside and Rights of Way Act 2000), Section 17 of the Water Resources Act, 1991 and Section 4 of the Water Industry Act, 1991.

As well as its SSSI status, the River Itchen is also deemed to be internationally important for its wildlife and habitats and is designated as a Special Area of Conservation (SAC) under the European Commission (EC) Habitats Directive, and is also designated under the Water Framework Directive (WFD) as a Protected Area. The additional SAC designation recognises the wildlife and habitats on the Itchen are of particular value in a European context.

Current condition assessments on both SSSIs undertaken by Natural England (March 2006 on the Test and March 2010 on the Itchen) indicate that both SSSIs are in unfavourable condition. The objectives of this project are to set out the restoration measures required to bring the sites into favourable physical habitat condition and achieve good ecological status.

1.2.1. “Favourable Condition” and “Good Ecological Status”

“Favourable Condition” refers to the condition of the features for which the SSSI has been designated. If at this condition, it means that all of the targets for the mandatory attributes (e.g. flow, water quality, population size, habitat) used to assess a feature have been met.

"Good Ecological Status" is the general objective of the WFD and means the achievement of both "Good Ecological Status" and "Good Chemical Status". Good Ecological Status refers to rivers showing ecological characteristics with only a slight deviation from the 'reference conditions'. In such a situation the biological, chemical and physico-chemical and hydromorphological conditions are associated with limited or no human pressures.

This project addresses the hydromorphological component of these objectives, and is therefore an important part of achieving favourable condition for the SSSIs and Good Ecological Status under the Water Framework Directive. For more information on the Water Framework Directive follow the Environment Agency website:

What's in your backyard (Environment Agency, 2012a): http://maps.environment-agency.gov.uk/wiyby/wiybyController?x=357683.0&y=355134.0&scale=1&layerGroups=default&ep=map&textonly=off&lang=_e&topic=wfd_rivers

1.3. Aim and objectives of the restoration plan

The aim of this project is to appraise the geomorphological condition of the rivers, identifying the condition of the rivers relative to their 'natural' benchmark. From this starting point river restoration, rehabilitation and conservation/enhancement actions are identified that could be put in place to restore the SSSI and SAC and bring it into favourable (recovering) condition. This includes the following specific objectives:

1. Determine the impacts of physical modifications on the geomorphology and ecology of the river
2. Provide an outline restoration plan for the river on a reach by reach basis
3. Identify potential delivery mechanisms to help achieve this

The focus of this restoration project is on ensuring the condition of habitats rather than the preservation of species directly, with the principle being that habitats that are characteristic, natural and unconstrained are more likely to support the characteristic flora and fauna.

Although this project is primarily aimed at in-river and riparian characteristics, it is also recognised that the land management adjacent to these river channels has the potential to affect the quality of the in-river habitat and as such, has been given due consideration throughout this project.

The objective is to restore the rivers to a condition such that they can support the biodiversity that is characteristic of their river type, and thereby achieve favourable condition and Good Ecological Status. In modifying the geomorphological condition, the physical form and functioning of the river, the in-channel features within the river will be able to adapt naturally over time to reach the required status. It is intended that this plan will provide a framework for the improvement of both the SSSIs and SAC over the next 20 to 30 years.

1.4. Stakeholder involvement

The actions set out in this restoration plan need to be undertaken to achieve favourable condition in the SSSIs. This restoration plan is seen as the framework for the improvement of both the Rivers Test and Itchen SSSIs. As a result, the strategy will inform future decision making by Natural England and the Environment Agency with respect to prioritisation and funding of measures and the suitability of management actions proposed on the two rivers.

It is widely recognised that successful implementation of any plan such as this requires positive engagement with landowners, land managers, river managers and key stakeholders, and this is even more critical with these two rivers given their local commercial and political and emotional importance.

To facilitate the involvement of key stakeholders, the project has taken a proactive and inclusive approach to stakeholder engagement, by taking the following steps:

1. Distributing a newsletter to stakeholders to introduce the project, the people working on it, and the opportunities to be involved (October 2012)

2. Establishing a Test and Itchen River Restoration website, with information and contact details available to the public (October 2012)

3. Undertaking ad hoc stakeholder engagement throughout the initial site visits (October/November 2012)

4. Holding a stakeholder consultation evening to present the project and gather views and concerns from stakeholders at the start of the project to help guide the direction of the strategy and promote an inclusive approach to stakeholder engagement (November 2012)

5. Publishing the draft Restoration Plan on the project website (February 2013)

6. Running a follow up stakeholder consultation event to gather feedback and answer questions following publication of the draft Restoration Plan (March 2013)

The first consultation event was held on the evening of 12th November in Sparsholt College, Hampshire. The Environment Agency invited all landowners, river keepers and potential stakeholders to the event and subsequently approximately 60 people attended, representing landowners, estates, river managers and key interest groups.

The evening was chaired by Tom Davis of the Test and Itchen Association who gave an introductory speech outlining his positive experiences of his involvement in the River Avon Restoration Plan. An initial presentation was then given by Heb Leman of the Environment Agency that introduced the project, outlined what it seeks to achieve and the timeframes involved. Atkins, as the environmental consultants working on the project, gave a further presentation that outlined the technical process involved and showcased some examples of successful restoration actions on other rivers undertaken as part of similar projects.

Following this, the presentation panel, consisting of representatives from the Environment Agency, Natural England and Atkins, took questions from the audience lasting approximately 1.5 hours.

This evening provided an excellent opportunity for those who could potentially benefit from the project to raise any questions or concerns to representatives of the Environment Agency, and to meet other landowners and stakeholders to gauge a balanced viewpoint on the project. The opportunity to do this in advance of the production of the draft restoration plan has provided the option for these viewpoints to help shape the direction of the Plan.

The follow up meeting on 4th March 2013 was also held in Sparsholt College, Hampshire. Tom Davis of the Test and Itchen Association chaired the session. Firstly, Heb Leman of the Environment Agency provided a recap of the restoration strategy. Atkins followed by giving a presentation on the findings of their study. Finally, Jenny Wheeldon of Natural England gave a presentation on how other similar strategies on other SSSI rivers have been implemented around the country.

The final plan will be published on the project website in April/ May 2013. Following on from this, the Environment Agency and Natural England will work with stakeholders to agree how best to deliver the Test and Itchen River Restoration Plan. The approach to implementation of the various measures within the plan will vary depending on the location and complexity of the actions, and there are also a number of different delivery mechanisms that can be used to help deliver these actions. As such, it is envisaged that an inclusive approach to stakeholder consultation will be required throughout the lifecycle of the project, with the successful restoration of both rivers relying heavily on the co-operation of the key stakeholders.

2. The Test and Itchen SSSI

2.1. Overview

The Test SSSI is approximately 142 km in length and comprises the River Test from Overton to the Lower Test Valley SSSI at Testwood and the River Dever from Wonston to its confluence with the Test at Bransbury Common SSSI. The Itchen SSSI is approximately 89km in length and includes branches in the headwaters from Cheriton Stream from the south, New Alresford to the west (River Arle) and Abbotstone from the north (Candover Stream). The individual streams all converge to form the main River Itchen between New Alresford and Itchen Stoke. From this point the river flows west towards Winchester and then broadly in a south-westerly direction to its confluence with the Itchen Estuary SSSI.

There are 14 SSSI riverine units on the Test and Itchen; eight on the Test and six on the Itchen. On the River Test five of the eight riverine SSSI units assessed are in unfavourable-declining condition and three assessed as unfavourable-no change. On the River Itchen all of the riverine SSSI units are assessed as unfavourable-no change.

2.2. Geology and topography

Chalk covers the majority of both the Test and Itchen catchments, estimated at 90% and 80% coverage, respectively. In the lower valleys to the south of the catchments, clays and sands overlie the Chalk. These areas in the south of the catchment are relatively impermeable. This causes rapid run off into the Test and Itchen and their tributaries in these areas (Environment Agency, 2012b).

Ground elevations largely reflect the underlying geology, peaking at 290 m on the northern Chalk boundary. The eastern areas of Chalk are covered with Clay-with-Flints and form a high and flat plateau (Environment Agency, 2012b). The southern area of the catchment is flatter and more heavily urbanised.

2.3. Channel changes and past practices

There have been numerous, primarily human, impacts within both catchments which have had significant effect upon the form and function of the channel. Many of these modifications date back to the Domesday Book of 1086, or before and still have present day impacts on the current functioning of the river.

The river system has been modified over centuries by the construction of sluices, artificial channels for water meadows, mills and navigation. Many reaches have also been re-aligned and/or deepened for land drainage. Based on maps from 1803 (Oldmapsonline, 2010), the majority of the channel planform was significantly altered, even at this time. This historic modification resulted in multiple, often straightened watercourses, rather than the braided channel characteristic of a Chalk river.

The present day number of structures on the Test and Itchen is 670 and 379, respectively (all structures recorded by NFCDD including weirs, sluices, culverts, bridges, fords and outfalls) - See Appendix A1 and A2 for location map).

2.4. Hydrology

The River Test main channel is approximately 50km in length and the surface catchment is estimated at 1260 km^2 (Environment Agency, 2010). The Itchen main channel is approximately 45 km in length with a surface catchment of around 470km^2.

The Rivers Test and Itchen gain their water from the Chalk aquifer, which supplies most of the streams and rivers in the area as well as most of the water abstracted in the area (Environment Agency, 2012b). Chalk rivers are characterised by a flow regime dominated by input from groundwater: meaning rainfall infiltrates slowly from the aquifer, providing a steady flow regime. Chalk rivers start to show a rise in water levels and river flow from mid to late winter following the onset of winter rains, until March or April. From this point flows start to decline over summer and autumn, reaching minimum flows in October until the rains begins again (Atkins, 2012).

2.5. Ecology

The Test and Itchen are typical Chalk rivers and exceptionally species-rich, with over 100 plant species recorded. The majority of these plants are present throughout the system on the Itchen, with a greater transition on the Test with the most diverse communities being found in the lower reaches where the substrate is more varied.

Tree cover varies considerably along the extent of both rivers. Trees are a key feature of a naturally functioning riparian corridor; bank side roots provide important habitat for fish, crayfish and aquatic insects. Adult white clawed crayfish utilise tree roots and rocks in the banks to provide shelter, whilst juveniles shelter in vegetation and grass growing out of the river banks (Jacobs, 2012b). Overhanging boughs provide cover for fish and also produce a diversity of water temperatures. In addition fallen trees provide a source of woody debris, which can assist in restoring a more natural flow regime to previously modified reaches of the river.

Bed substrate is dominated by coarse gravels in the faster flowing sections, with silt deposits generally occurring upstream of structures and in slower flowing, modified reaches. A coarse substrate alongside in-

channel vegetation provides valuable habitat niches for bullhead (*Cottus gobio*), a key reason for SSSI and SAC designation.

Both rivers are world renowned for game fishing, largely provided by brown trout, and to a lesser extent salmon and sea trout. The rivers are managed for trout, with fishing for sea trout and Atlantic salmon also taking place. In the middle to uppermost reaches of both rivers native populations of brown trout are believed to persist, and bullhead and brook lamprey are notable elements of the natural fish fauna.

The species and habitats that qualify the River Itchen for SAC designation are given in Table 1 below. All of the qualifying species and habitats for SAC designation are also reasons for SSSI notification of both water bodies (along with other key species). The requirements of these species reflect the geomorphological characteristics of lowland rivers such as the Test and Itchen.

Table 1: The habitat requirements of qualifying species found within the Itchen SAC

Reason for site selection	Habitat or Species	Habitat requirements
Annex I habitats that are a primary reason for selection of this site	Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation	The vegetation grows on gravel riffles where flow is in relatively swift and shallow (ideally 0.3-0.5 m/s). It requires good light for photosynthesis so is sensitive to siltation and shade and does not occur in deep slow flowing areas. There needs to be at least 5 cm of water over riffles in summer (when flows are lower).
Annex II species that are a primary reason for selection of this site	Southern damselfly *Coenagrion mercuriale*	This has specialised habitat requirements as it is confined to shallow, well-vegetated, base-rich runnels and flushes in open areas or small side-channels of Chalk rivers. Most sites are on wet heath.
	Bullhead *Cottus gobio*	This is a small bottom-living fish that inhabits a variety of rivers, streams and stony lakes. It appears to favour fast-flowing, clear shallow water with a hard substrate (gravel/cobble/pebble) and is frequently found in the headwaters of upland streams. However, it also occurs in lowland situations on softer substrates so long as the water is well-oxygenated and there is sufficient cover. It is not found in badly polluted rivers.
Annex II species present as a qualifying feature, but not a primary reason for site selection	White-clawed (or Atlantic stream) crayfish *Austropotamobius pallipes*	The crayfish lives in a diverse variety of clean aquatic habitats but favours hard-water streams and rivers. Non-native species of crayfish are a major threat to the native white-clawed crayfish. White-clawed crayfish habitat includes crevices in rocks, submerged plants and tree roots or features which provide shelter from predators. They feed on all manner of live and dead organic matter (fallen leaves, vegetation, worms, insect larvae, small fish and other crayfish).
	Brook lamprey *Lampetra planeri*	This fish requires clean gravel beds for spawning and soft marginal silt or sand for the ammocoete larvae. It spawns mostly in parts of the river where the current is not too strong.
	Atlantic salmon *Salmo salar*	Spawning requires shallow gravelly areas in clean rivers where the water flows swiftly. Atlantic salmon also require sufficient depth and an unobstructed channel to migrate downstream as a smolt and upstream as an adult to spawning grounds. Appropriate nursery habitat is also an important requirement.

Reason for site selection	Habitat or Species	Habitat requirements
	Otter *Lutra lutra*	The otter is a semi-aquatic mammal, which occurs in a wide range of freshwater and coastal areas. Inland populations utilise a range of running and standing freshwaters. Suitable habitat includes vegetated river banks, islands, reed beds and woodland (used for foraging, breeding and resting).

*Source: Jacobs 2012b and JNCC 2012

3. Pressures and Impacts

3.1. Condition assessment

Natural England assesses the condition of SSSI land in England based on physical, hydrological, ecological and water quality elements for both habitats and species. SSSI condition is classified as follows:

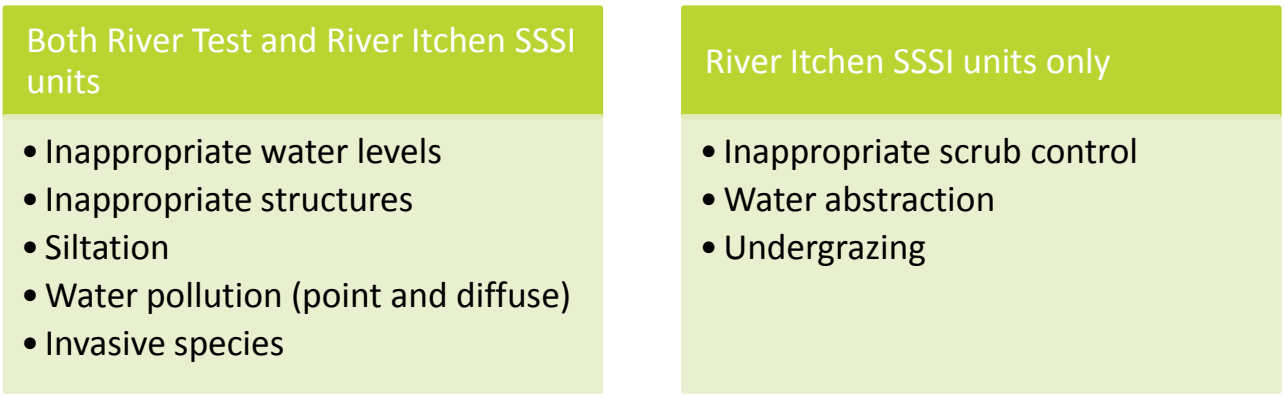
- **Unfavourable no change** or **unfavourable declining**; implies that enhancement works or improved management is required to restore and maintain a SSSI to favourable condition.
- **Unfavourable recovering;** implies that whilst the site does not meet all the targets, actions or response of the river are in place and the site is improving.
- **Favourable condition;** means that special habitats and features are in a healthy state and are being conserved by appropriate sustainable management practices where necessary.

Unfavourable recovering and eventually favourable condition is the target for all SSSIs.

The two River Test and River Itchen SSSIs are divided into 14 riverine units (eight on the Test and six on the Itchen (See Figure 3 and Figure 4). The condition status of the River SSSI units and reasons for adverse condition are summarised in Table 2 and Table 3.

Based on condition assessment data from 2006 and 2010 all riverine units are in unfavourable no change or unfavourable declining condition. Physical, hydrological, ecological and water quality elements are all considered to be contributing to this unfavourable condition status. From examining the individual condition assessment comments, physical habitat (particularly channel and bank habitat structure) may be of more concern on the Test than on the Itchen. Analysis of Table 2 and Table 3 'reason for adverse condition status' matrices suggests that the main issues are as shown in Figure 2.

Figure 2: Summary of main pressures on the Rivers Test and Itchen



The River Basin Management Plan (Environment Agency, 2009) identifies WFD pressures on the river system that prevent the achievement of Good Ecological Status. The WFD targets are to achieve Good Ecological Status in those water bodies not designated as heavily modified or artificial and to achieve Good Ecological Potential for channels designated as heavily modified or artificial. Where the identified measures are technically feasible and cost effective, the timescale for meeting the WFD objective is 2015. The targets for the WFD water bodies are complementary to the SSSI favourable condition targets and the delivery of the strategic restoration plan should contribute to achieving both.

Figure 3: Figure SSSI Units on the River Test

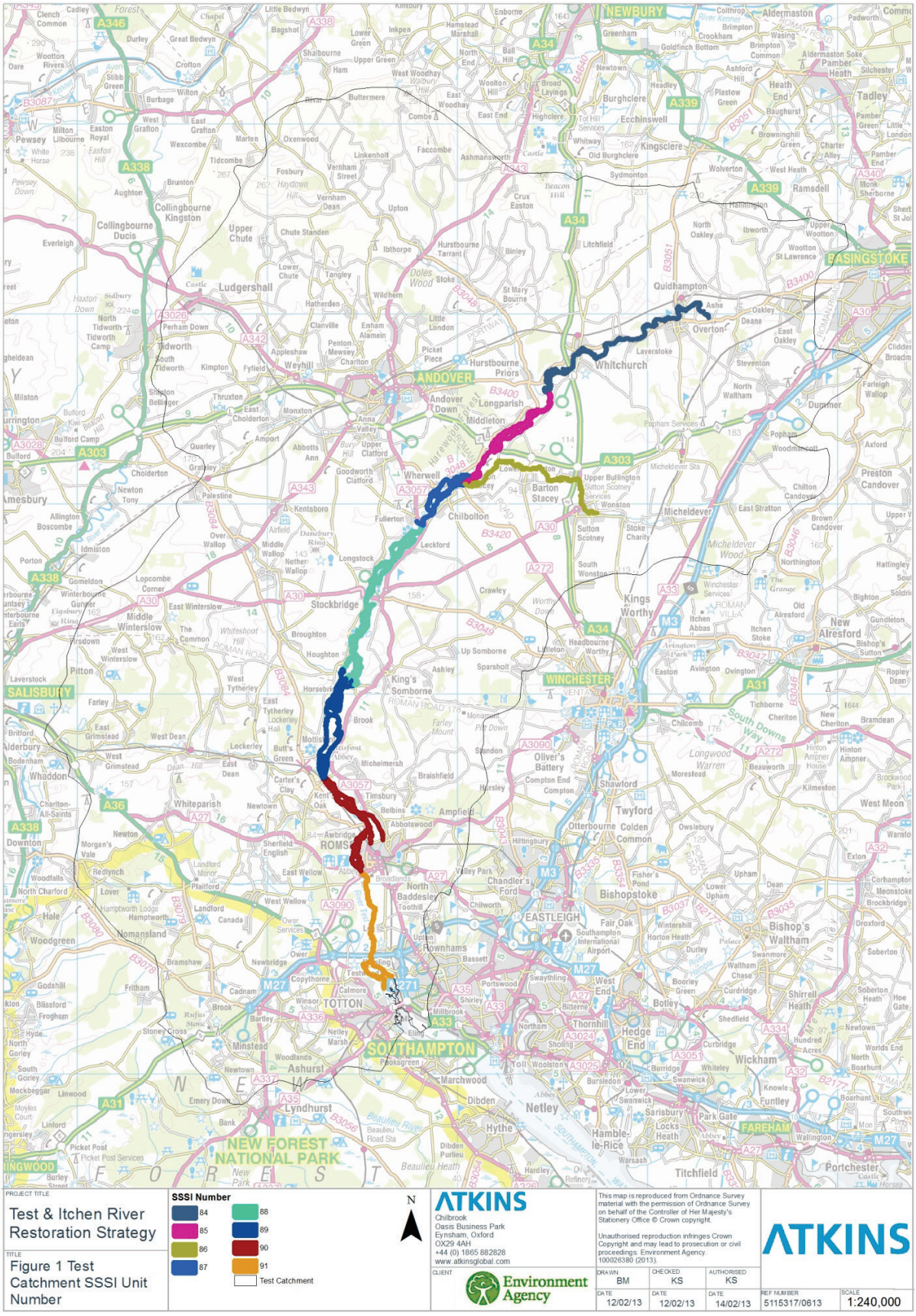


Figure 4: SSSI Units on the River Itchen

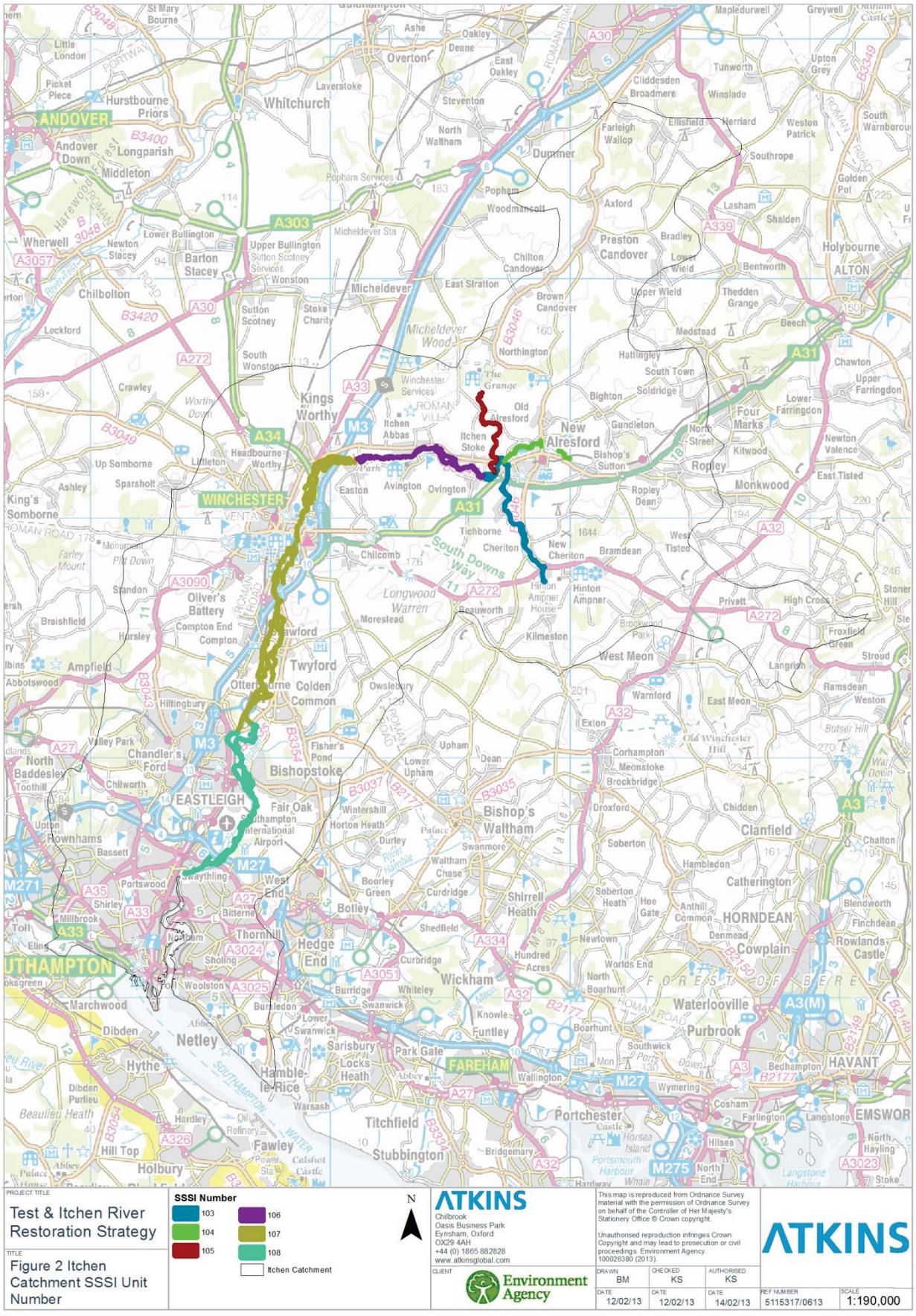


Table 2: River Test SSSI units and condition status – and reasons for adverse conditions

River Test SSSI units	Length (km)	Area	Unit cover type	Condition status	Reasons for adverse conditions status										
					Inappropriate cutting/mowing	Inappropriate scrub control	inappropriate water levels	Inappropriate weirs dams and other structures,	Inappropriate weed control	Invasive freshwater species	Siltation	Water abstraction	Undergrazing	Water pollution agriculture/run off	Water pollution discharge
84: Source to Bourne	21.43	30.48	Rivers and streams	Unfavourable Declining			X	X		X	X			X	X
85: Bourne to Dever	18.99	28.69	Rivers and streams	Unfavourable Declining			X	X		X	X			X	X
86: Dever	4.65	4.68	Rivers and streams	Unfavourable No Change			X	X			X			X	X
87: Dever to Anton	14.71	18.79	Neutral grassland and river	Unfavourable No Change			X	X			X			X	X
88: Anton to Wallop	8.27		Neutral grassland and river	Unfavourable Declining			X	X			X			X	X
89: Wallop to Dun	20.40	33.54	Rivers and streams	Unfavourable Declining			X	X			X			X	X
90: Dun to Romsey	20.80	29.00	Rivers and streams	Unfavourable Declining			X	X			X			X	X
91: Romsey to Estuary	10.73	21.72	Rivers and streams– overlap with Lower Test Valley (SSSI)	Unfavourable No Change Lower Test Favourable condition)			X	X		X	X	X		X	X
Total	**119.98**	**166.9**													

*Source: Geodata, 2010

Table 3: River Itchen SSSI units and condition status – and reasons for adverse conditions

River Itchen SSSI units	Length (km)	Area	Unit cover type	Condition status	Reasons for adverse conditions status										
					Inappropriate cutting/mowing	Inappropriate scrub control	inappropriate water levels	Inappropriate weirs dams and other structures,	Inappropriate weed control	Invasive freshwater species	Siltation	Water abstraction	Undergrazing	Water pollution agriculture/run off	Water pollution discharge
103: Cheriton Stream	12.65	8.99	Rivers and streams	Unfavourable No Change		X	X	X			X		X	X	X
104: River Alre (sic)	2.95	2.83	Rivers and streams	Unfavourable No Change	X	X	X	X			X		X	X	X
105: Candover Brook	5.30	3.19	Rivers and streams	Unfavourable No Change			X					X		X	X
106: Upper Itchen (Itchen Stoke to Easton)	9.35	11.9	Rivers and streams	Unfavourable No Change		X	X	X		X	X	X		X	X
107: Middle Itchen (Easton to Highbridge)	39.47	48.13	Rivers and streams	Unfavourable No Change		X	X	X	X	X	X	X		X	X
108: Lower Itchen (Highbridge to Wood Mill)	19.00	24.86	Rivers and streams	Unfavourable No Change			X	X		X				X	X
Total	**88.72**	**99.9**													

*Source: Geodata, 2010

3.2. Field survey

The Natural England condition assessment summarised in section 3.1 was undertaken at 14 representative locations along the Rivers Test and Itchen (one per each riverine SSSI unit). To gain a more complete picture of the condition of the geomorphology and ecology of the channel a walkover survey of the full length of the two River Test and River Itchen SSSIs was undertaken. The fieldwork was completed in two parts:

1. Between 2009 and 2012 Geodata undertook a geomorphological survey and ecological interpretation for approximately 67% of the riverine SSSI unit reach lengths. The bulk of this work was done between 2009 and 2010. Land access was difficult in some units and reaches were only assessed where permission had been granted. Full assessments could therefore not be carried out for any of the 14 SSSI units as a whole during this time.

2. During 2012 Atkins were commissioned to complete the remainder of the walkover survey which was conducted during two separate weeks in October and November 2012 (22nd – 26th October and 5th – 7th November). The majority of the remaining 30% of the SSSI unit reach lengths were assessed for the geomorphology and ecological interpretation. The assessment involved working downstream from the headwaters of the two rivers and assessing all reaches (within the SSSI Units) that had not previously been assessed and for which the Environment Agency had obtained access. There remained a few short sections of channel where access was not granted. Key issues associated with theses reaches has thus been identified from a desk study only. A future walkover survey would need to be undertaken to assess these reaches and identify opportunities in full.

The Geodata survey work involved taking hard copy notes out on site and transferring the information into a database. Atkins completed their fieldwork assessments with the aid of mobile mappers to note key gemorphological features and supporting information. The information on different processes and forms noted was used to determine the contemporary geomorphological status of the river for each reach within the SSSI units. The reach number classification system developed by Geodata was integrated within the Atkins work for transparency. The data from Geodata was interpreted for use by Atkins in assessing pressures and in developing reach based management actions. Appendix B highlights which reaches were surveyed by Geodata and which were surveyed by Atkins. Common management actions were developed and applied between the two different surveys to ensure consistency in the interpretation.

Features noted within the field survey cover the following broad areas:

- Survey details – broad survey information and details for each particular reach defined
- Bank features – description of bank material and associated features such as riparian vegetation and shading
- Riparian zone and flood plain – evidence of flood plain connectivity.
- Bed features – description of bed material, vegetation cover, presence of ranunculus and marginal silts
- Channel geometry – planform and cross-sectional description
- Channel flow types – summary of flow types observed
- Geomorphological process - evidence of incision, aggradation and stability
- Photograph locations – location and direction of photographs undertaken in each reach
- Sediment dynamics – marking of sediment sources and sinks at a point or line scale
- Presence of woody debris
- Presence of invasive species
- Locations of structures – including weirs, bridges, sluices, outfalls etc and their dimensions and impacts on the channel
- Presence of bank protection, embankments, erosion, management activities
- Management option type – “Restore”, “Rehabilitate”, or “Conserve and enhance”
- Restoration options at specific locations or along whole reaches

As discussed by Geodata in the ‘River Test and Itchen SSSI River Restoration Strategy’ (2010) summary document; two types of river community type (JNCC, 2005) are present:

River Community Type I: Lowland, low gradient rivers, naturally eutrophic (high in nutrients) rivers with a high base flow where they flow over the clay dominated reaches – these occur in the lower reaches of the Test and Itchen. The channel may be dominated by sand and silty beds over gravels and have a meandering course with more active channel movement.

River Community Type IIIb: Chalk rivers: base rich, low energy, lowland rivers and streams, generally with a stable flow regime that occur over most of the Test and the Itchen channels and tributaries, typically with a high groundwater flow, and stable flow regime. These channels typically have a meandering course and may have multi-thread channels, with clean gravel beds but with infrequent bars and riffles. These channels have a rich and diverse in-channel vegetation and fauna and marginal vegetation.

Mainstone (2007) describes the Test and Itchen Rivers as key examples of River Community Type III rivers. The characteristics of this type of river that might be expected with limited human impact are summarised in Table 4. The reaches which are more similar to River Community Type I are significantly less in extent. Characteristics are similar but as mentioned above the channels are more active and there is a predominance of finer sediments over gravels. Localised gravel habitat is important for a variety of invertebrates and fish but different species dominate the more ponded and silty reaches. This baseline is what the field observations were assessed against during the walkover survey to help determine restoration opportunities.

The River Test and River Itchen have historically undergone physical habitat modifications for water meadows, milling, fisheries and flood risk management. As noted by Geodata (2010) the types of features that would therefore be expected within a Chalk river now in favourable condition would be:

- Low levels of artificial impoundment with minimal interruption to the long profile of the river and movement of sediment and fauna.
- Natural and un-modified planform, cross-channel profiles, and channel dimensions typical of river type and adjusted to natural river flow conditions.
- Natural river bed of clean river gravels with low fine sediment content and unconstrained by artificial bank materials and protection.
- Channel and flow diversity creating varied habitats and ecological niches that sustain diverse plants and animal communities.
- A natural bank side vegetation cover with shallow marginal vegetation and riparian tree cover.
- A river channel connected to its floodplain.

Table 4: Characteristics of chalk River Community Type III rivers (based on Mainstone, 2007)

Feature	Description	Ecological significance
Bed	Distinct Chalk bed channels, extensive gravel substrates, infrequent gravel shoals and exposed riverine substrates. Finer substrates become more dominant in the lower reaches.	A mosaic of beds of submerged plants and gravels is typically created. There is enhanced scour between the plant beds generating gravel beds low in silt. Gravel and in-channel vegetation provide a refugia for invertebrate fauna, including mayfly (*Ephemeroptera*), caddis fly (*Trichoptera*) and also gastropod mollusc species. Species shifts from the upper reaches to the lower reaches are evident; according to reductions in current velocity and progressive fining of bed substrates. The submerged plant cover is also important for the fish community as a refuge and feeding habitat. Finer silty substrates (either in the lower reaches or such as created behind log jams) are important to fish species such as lampreys Highly biologically active hyporheic zone including within the gravel substrate.

Feature	Description	Ecological significance
Flow types	Low longitudinal frequency of riffles and pools (dominated by glides). Natural structures (such as log jams) are present with increasing frequency downstream. Chalk rivers are winterbournes and so often the head of the river migrates during drier periods.	Shallow cross sectional profile and low scouring energy of the river leads to abundance of plants: in-channel specialists including water-crowfoots (*Ranunculus spp.*) and starworts (*Callitriche spp.*). The fish community shows a longitudinal transition dependent largely on current velocity and substrate types. Salmonids dominate the upper reaches and middle reaches, using gravels for spawning and the growth of juveniles. Downstream rheophilic cyprinids (including dace and chub) are more predominant. These also use the gravels for spawning. Winterbournes constitute a distinctive habitat hosting plant and animal species resistant to drying out.
Planform and banks	Sinuous channel form and shallow cross sections.	Shallow banks (particularly the inside of meander bends) allow a zone of transition for plant species.
Riparian zone	Marginal vegetation characteristically encroaches into the channel as flows recede from Spring through Summer, thereby reducing effective channel width and maintaining current velocities in the channel. Over winter this vegetation is scoured out and the process begins again in Spring. Semi-continuous lining of the channel by riparian trees.	Active marginal vegetation including water-cress (*Rorippa nasturtium-aquatica*), brookline (*Veronica beccabunga*) and water forget-me-nots (*Myosotis spp.*). The marginal vegetation provides important habitat for the invertebrate fauna, as mentioned above. Riparian trees are a vital habitat component generating submerges exposed root systems that provide in channel habitat for fish and invertebrates such as white clawed crayfish (*Austropotamobius pallipes*). A potential holt and resting space for otters (*Lutra lutra*) and a source of woody debris and leaf litter for the channel. Trees also vary the light and temperature regime adding to the habitat diversity. Other riparian plants also provide habitat for otter and bird species such as warblers and reed bunting. The co-occurrence of wooded and open margins allows diurnal movement of several invertebrate species between the two habitats. Highly biologically active hyporheic zone including lateral connectivity into the riparian zone.

3.3. Key findings

Within the River Test and River Itchen there were a variety of different pressures (see Table 5) identified which affects the physical form and functioning of the channels which in turn determines the associated ecological functioning of these rivers. Principal pressures include:

Riparian Zone

- Modified by land use pressures leading to a reduction in tree cover in total area and width of riparian strip.
- Degradation of buffer strip leading to a reduction in complexity of the riparian corridor.

Banks

- Uniform banks due to historic re-sectioning of the channel leading to near vertical sides in places and an abrupt transition between marginal and bank side habitats.
- Limited complexity of marginal strip due to management of marginal vegetation practices.

- Heavily poached in places leading to accelerated fine sediment input into the river. This is related to livestock pressure as well as humans and dog access.

Bed

- Reduction in habitat diversity due to dredging, weed cutting practices and removal of coarse woody debris.
- Over-widening leading to significant lengths of channel which are prone to deposition.

Planform

- Channel straightening and re-sectioning has led to a reduction in longitudinal and lateral habitat complexity.
- Both rivers are perched in places with embankments on either side due to historical legacy of mills, water meadows, fish farms and watercress beds.

Flow (types and velocity variability)

- Both rivers are low energy systems but flow variability is reduced due to historic modifications affecting channel planform (straightening, widening and re-sectioning) and longitudinal connectivity (impoundments and deepening).
- The lack of coarse woody debris within the rivers reduces flow and velocity variability.

The pressures exist throughout the two rivers and across the various SSSI units. A summary of how these are geographically distributed is detailed in Table 6. An assessment of the scale of the pressure on each SSSI unit is also made to determine whether it was a) present (<10%), b) localised (>10–<60%) and c) Extensive (>60%) on the various reaches within the SSSI units**.**

Table 5: Pressures caused by human activity and their impact on the River Test and Itchen SSSI/SAC

Feature	Description of impact	Consequences	Example
Bed	**Lack of morphological diversity as a result of channel engineering** Historic engineering of the channel including deepening (dredging), re-sectioning to improve water conveyance and land drainage, and water control structures, can lead to uniform flows and a bed with little variation in composition.	Uniform flow reduces habitats associated with different velocities and depths. For example slow glides can result an increase in emergent vegetation, which can choke the channel.	 An over deepened, ponded section of channel with a silty bed on the Test (Geodata, 2010).
	Lack of morphological diversity as a result of maintenance Channel maintenance is observed to influence the character of the bed material; annual in channel and vegetation cutting, largely reduces the encroachment of marginal vegetation. This in turn prevents the development of marginal silts and a more natural flow regime, responsible for a more natural bed structure.	Channel maintenance again reduces flow diversity and the development of marginal silts, meaning the establishment of marginal vegetation will be limited.	
	Sediment Input The control structures and their associated tributaries, often associated with historic management of the river for water meadows, are a cause of accelerated sediment input.	Accelerated sediment input to the channel can lead to increased siltation downstream, and reduced spawning habitat for salmon.	
Banks	**Lack of morphological diversity as a result of channel engineering** Banks are relatively uniform as a result of historic straightening or re-sectioning of the channel. Banks are characterised by steep, often vertical, sides. These steep banks often give the channel a symmetrical cross section, which is uncharacteristic of a lowland river.	Steep sided banks lead to an abrupt transition between the marginal and bank side habitats, reducing the habitat availability along both banks. For example reduced habitat for vegetation as well as cover for fish and otter.	 Uniform cross-section with steep-sided banks on the Test.
	Bank poaching Accelerated bank collapse due to poaching from livestock.	An accelerated rate of bank erosion increases the supply of sediment to the channel, which can lead to increased siltation downstream. Bank poaching destroys existing bank side habitat, further decreasing habitat availability.	
Riparian zone	**Degraded riparian zone due to land-use pressures** The riparian zone has been extensively modified due to land use pressures, with many sections of the river lacking trees and riparian vegetation altogether.	A degraded riparian zone reduces habitat availability, such as wet-woodland. Drainage of the floodplain and an increase in cultivated land leads to increased surface-water run-off reaching the channel, increasing sediment input and flood risk.	 Lack of riparian zone on the Itchen.
	Lack of riparian vegetation due to land-use pressures and current maintenance strategies Bank maintenance consists of intensive cutting/mowing of riparian vegetation to leave either a minimal or no riparian strip. In addition trees are often scarce due to land use pressures and fisheries management. In a few reaches on the Test and Itchen there is a continuous line of trees and in these instances selective thinning may be appropriate.	Intensive cutting leads to reduced habitat availability including a lack of cover for fish and habitat for fly-life. Reduced trees results in a reduced supply of woody debris to the channel and reduced shading.	

Feature	Description of impact	Consequences	Example
Flow	**Uniform flows due to re-sectioning** Historic engineering of the channel: deepening (dredging), re-sectioning to improve water conveyance and land drainage, can lead to uniform flows.	Uniform flows reduce habitats associated with different velocities and depths.	 Uniform flow caused by a downstream impoundment on the Test.
	Impoundment of flow due to water control structures Structures cause slow, uniform, generally smooth flow and increased sediment deposition.	Structures cause uniform flows reducing habitats associated with different velocities and depths. In addition increased sediment deposition reduces habitat diversity.	
	Embankments and over-deepening Embankments and over-deepening increase the volume of water the channel can carry and reduces its connectivity with the surrounding floodplain.	A reduction in floodplain inundation means silt that would otherwise be deposited on the floodplain remains in the channel, increasing siltation and reducing habitat availability.	
Planform	**Lack of morphological diversity as a result of channel engineering** The realignment of the river channel into a straighter course is often associated with land use or attempts to improve flow conveyance.	Reduced habitat diversity due to a reduced variation in flow type, associated with more sinuous channels, characteristic of lowland rivers. Straight channels are also associated with a uniform cross-section and steep-sided banks. This further decreases habitat availability and diversity due to a lack of transitional macrophyte habitat.	 A straightened section of channel on the Itchen

Table 6: Summary of key pressures on the various SSSI riverine units

River	SSSI Unit	Key Pressure									
		Bed		Banks		Riparian Zone		Flow		Planform	
		Reduction in bed diversity through dredging, weed cutting and removal of course woody debris	Over-widening	Uniform banks	Poached channel	Reduced Tree cover	Degradation of buffer strip	Limited flow variability due to historic modifications	Lack of Coarse Woody Debris	Channel straightening and re-sectioning	Perched channels with embankments
Itchen											
Itchen	103	L	L	L	L	**E**	L	L	L	L	L
Arle (Itchen)	104	L	**E**	L	L	L	L	L	L	L	L
Candover (Itchen)	105	**E**	L	L	L	L	L	L	L	L	L
Itchen	106	**E**	**E**	**E**	P	**E**	**E**	**E**	**E**	**E**	**E**
Itchen	107	**E**	**E**	**E**	L	**E**	**E**	**E**	**E**	**E**	**E**
Itchen	108	L	L	L	L	L	**E**	L	L	L	**E**
Test											
Test	84	**E**	**E**	**E**	-	L	**E**	**E**	**E**	**E**	**E**
Test	85	**E**	**E**		**E**	**E**	**E**	L	L	**E**	**E**
Dever (Test)	86	L	L	L	-	-	L	L	L	L	L
Test	87	**E**	**E**	L	L	**E**	**E**	L	L	L	L
Test	88	**E**	L	L	P	**E**	**E**	L	L	L	L
Test	89	**E**	L	L		L	**E**	L	L	L	L
Test	90	**E**	L	L	P	P	**E**	L	P	L	L
Test	91	P	P	P	-	P	P	-	P	P	L

KEY – P : Present (<10%), L: Localised (>10%<60%), **E** : Extensive (>60%) and '-' Not present

4. Potential Solutions

4.1. Selecting restoration solutions

The pressures identified along the River Test and Itchen reflect the historical legacy of the previous management of these rivers alongside existing management operations. These practices have contributed to the unfavourable status of the SSSI. The adjacent floodplain to the river has been used for a variety of purposes that include agriculture, water meadows, grazing land and water cress beds. The river itself has been impacted by mills, sluices (for water meadows) and fish farms. The immediate riparian corridor, alongside the river has been heavily impacted by intensive fisheries management which has in places, left limited riparian strip or little to no marginal vegetation. Impacts to the river channel include:

- Woodland clearance
- Land drainage
- Channel straightening
- Impoundments
- Deepening
- Over-widening
- Creation of new side channels

The River Test and Itchen, in comparison to other UK rivers, are classified as being of low energy. This means that river is largely unable to adjust its' planform to naturally recover a more meandering form. Adjustment, through the process of erosion does occur, but it tends to be localised and occurs at a slow rate. Far more prevalent in the two catchments are adjustments through channel narrowing as the channel responds to an over-wide channel width through deposition and marginal vegetation encroachment. This process tends to lead to narrowing of the channel which in turn creates faster moving water which can mobilise fine sediment from the bed of the channel and keep valuable spawning gravels clear of fine sediment. Good examples of this process are illustrated in Figure 5.

Figure 5: Natural adjustment through deposition and marginal vegetation encroachment (examples from the Test and Itchen)

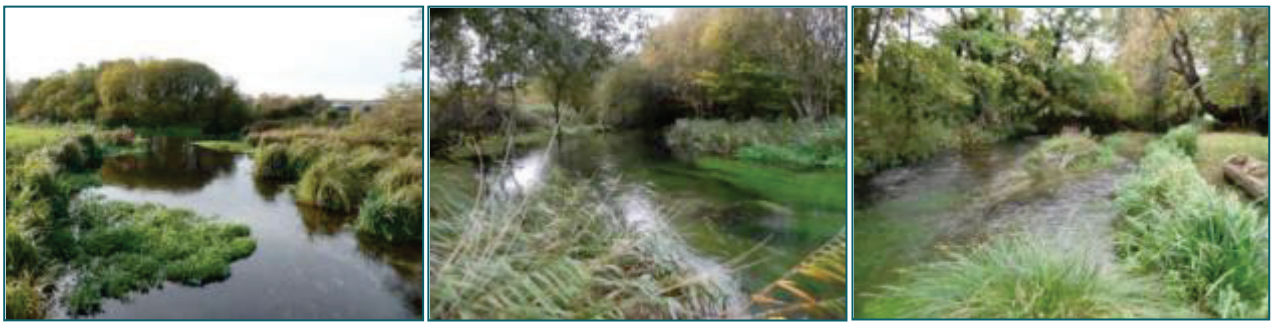
Natural adjustment of the River Test and Itchen can only have a limited benefit and is most suited to free flowing channels that have been over-widened, where narrowing to a more natural width and depth would be beneficial. To significantly improve the channel in other reaches of the two rivers, more intervention is required. Restoration or rehabilitation of the channel may be required to address the longitudinal (upstream to downstream) and lateral connectivity (across the channel and out to the connecting floodplain). Restoring longitudinal connectivity needs modifications to structures or sluices to improve connectivity for water, sediment and ecology. Lateral connectivity needs to focus on addressing pressures both across the bed, banks, the riparian corridor (alongside the bank edge) and connections to the adjacent floodplain. A channel that is in favourable condition on the Test and Itchen should ideally have the following key characteristics:

- Low level of impoundments
- Natural, unmodified planform and cross-sectional profiles that are typical of the channel type
- Natural clean river beds with a low amount of fine sediment
- Channel and flow diversity creating mosaic habitats to sustain population for a diverse range of species

- Natural bankside vegetation cover with a mixture of riparian vegetation and shade provided by trees
- Channel that is connected to its floodplain in times of higher flow

Figure 6 shows some good examples of channels of this type that possess good habitat in both lateral and longitudinal directions.

Figure 6: Good free flowing sections of river with high quality habitat across the bed, banks and riparian zone (examples from the Test and Itchen)



4.2. Creation of a restoration vision

By combining the understanding of the behaviour of classic Chalk river systems along with the information gained from the walkover surveys it has been possible to develop a vision for the Rivers Test and Itchen (see Tables 9 and 10). The vision reflects how the natural geomorphological and ecological functioning of the system would be if the various restoration and management actions are implemented.

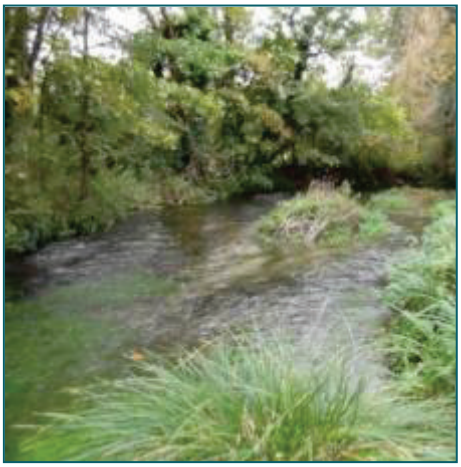
As the Test and Itchen have similar geomorphological characteristics, one restoration vision has been developed to reflect both rivers. Despite the highly modified nature of both channels, there are reaches along both water bodies that include sections that are largely naturalised and meet the requirements of favourable condition. These locations have been used as reference sites to help illustrate the intended outcomes of restoration measures. A restoration vision for the Itchen Navigation has also been developed.

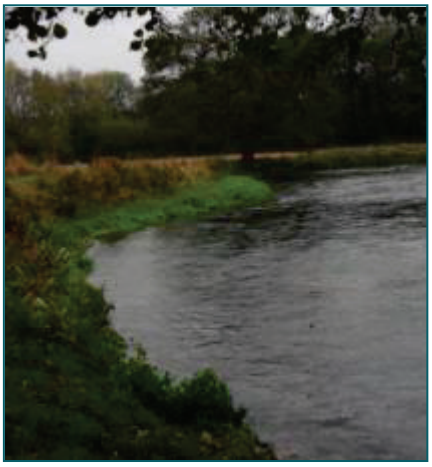
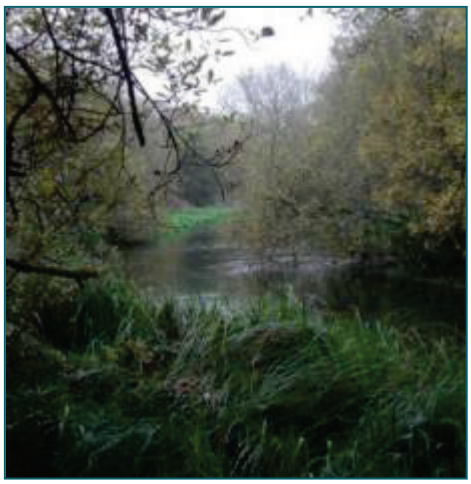
The aim of implementing the restoration visions is to increase the extent of channel with characteristics comparable to the reference sites, making these conditions more dominant across both rivers. As a result, the diversity and availability of habitat and flow type will increase, making the channel more resilient to current and future pressures, such as extreme flows and temperatures, and potentially water pollution and siltation.

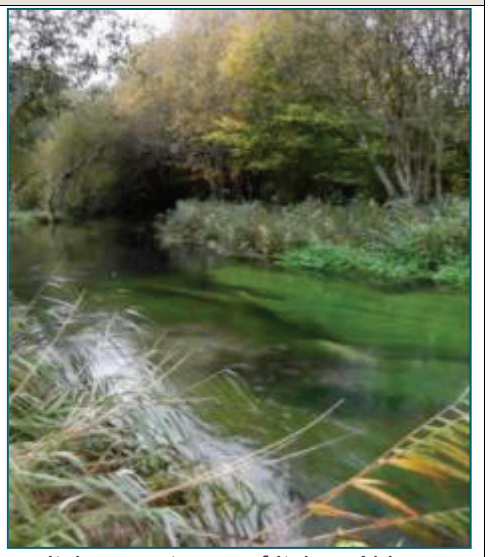
4.2.1. The Rivers Test and Itchen

Both the Test and Itchen are classic Chalk rivers, meaning they are base rich, low energy, lowland rivers that do not change greatly in position over time. These channels typically have a meandering course with clean gravel beds, and few bars and riffles. Banks are generally fine grained and cohesive, making them resistant to erosion. Based on these typical characteristics of a Chalk river, the features that would support Favourable condition are summarised in Table 7 overleaf.

Table 7: Characteristics of features which would contribute to Favourable condition on the Test and Itchen

Feature and characteristics	Ecological benefit	Illustration
Planform Active channel recovery leading to a more sinuous channel planform.	Variations in channel cross-section associated with planform adjustment, contributing to habitat diversity.	 Reach upstream of the M27 bordering High Wood, Itchen
Diverse bed and flow types Varied bed with shallow, fast flowing (riffle) sections with clean coarse gravels, characteristic of a Chalk river. Deeper sections with glides and pools, with fine sediments and areas of exposed gravels and marginal silts.	A diversity of bed and flow types should ensure suitable habitat for all life stages of characteristic species This would include **a** varied invertebrate community relying on a diversity of bed material and flow types., Specific species include: Water crowfoot and water starwort: grow on gravel riffles where flow is relatively swift and shallow. Bullhead favour fast-flowing, clear shallow water with a hard substrate or softer substrates so long as the water is well oxygenated and there is sufficient cover. White clawed crayfish: make up of crevices in rocks, submerged plants and tree roots or features which provide shelter from predators. Brook lamprey: requires clean gravel for spawning and marginal silts for larvae. Atlantic salmon: requires clean gravels with swift flow for spawning.	 Itchen downstream of Shawford

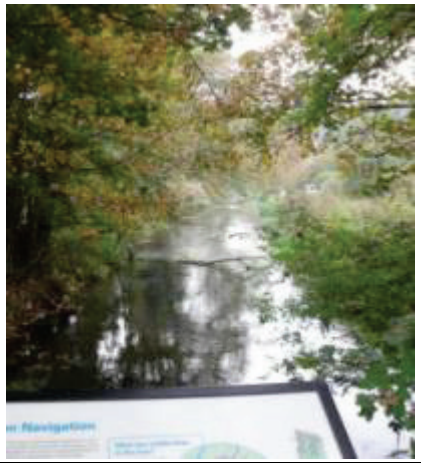
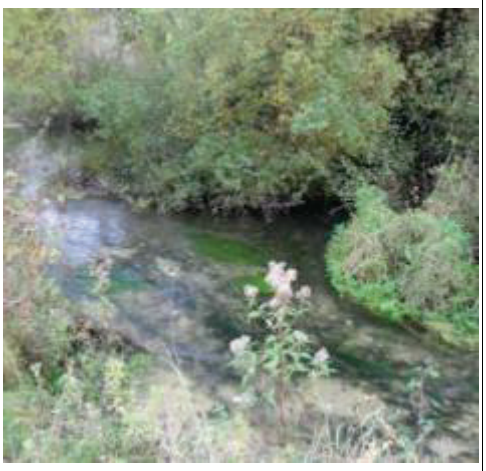
Feature and characteristics	Ecological benefit	Illustration
Varied bank profiles Under natural conditions bank profiles would be asymmetrical and correspond to a meandering planform.	Banks that are varied with a shallow gradient lead to a more gradual transition from aquatic to terrestrial habitats, with marginal species such as watercress and water forget me not, to wetland species such as canary grass, leading to more terrestrial rushes and finally grasses.	 Kimbridge, River Test
Bank materials Bank materials of fine sediment are characteristic with some occurrences of tufa and further south in the catchment flint deposits occurring where the underlying geology shifts.	The benefit of softer bank materials, leads to sloping banks and a more gradual transition from the aquatic to terrestrial environments, with a range of habitats.	
Undisturbed bank and riparian vegetation Encompassing a mosaic of different habitats bank side vegetation ranges from grasses, to tall herbs, bushes and trees. These all provide different habitats. Trees are a vital component as their root systems provide cover for fish and otter and they provide a source of woody debris for the channel, creating flow variation.	Submerged root systems provide a habitat for fish, particularly bull-head, white clawed crayfish and invertebrates. Trees provide woody debris and leaf litter to the channel, providing a source of food for invertebrates and contributing to flow variation. Tree lining provides diversity in channel cover, further adding to habitat diversity and a habitat used by otters. Riparian scrub provides an important habitat for bird species, water voles and otter.	 Paper Mill Estate, River Test

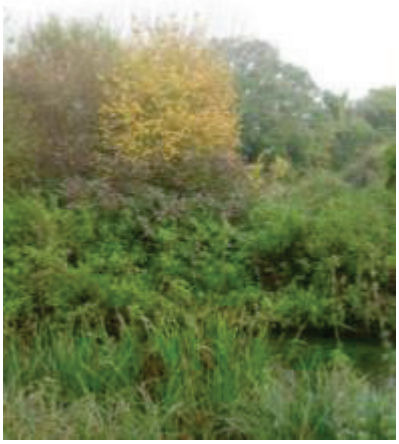
Feature and characteristics	Ecological benefit	Illustration
In-channel vegetation Chalk rivers characteristically have a rich and diverse in-channel vegetation and fauna and marginal vegetation.	Water voles thrive in emergent vegetation. Insect fauna depend on a wetland margin for hatching, resting, feeding and mating, and a refuge during times of high flow. Invertebrates A diversity of bed and flow types should ensure suitable habitat for all life stages of characteristic species. This would include **a** varied invertebrate community relying on a diversity of bed material and flow types. Refuge and cover for fish, and clean spawning gravel between stands of vegetation. Specific species include: Southern damselfly: require well-vegetated, base-rich runnels and flushes in open areas or small side-channels of chalk rivers. White clawed crayfish: require shelter from submerged plants and tree and feed on live and dead organic matter including fallen leaves and vegetation. Otter: use reed beds for foraging, breeding and resting. Water-crowfoot and water-starwort: they may modify water flow, promote fine sediment deposition, and provide shelter and food for fish and invertebrate animals.	 Itchen upstream of Itchen Abbas

4.2.2. Itchen Navigation

The Itchen Navigation channel is also part of the SSSI and in addition to this is partially designated as a SAC. It is a perched, artificial channel covering approximately 17 km between Winchester and Eastleigh. The Navigation is artificially straight throughout its length resulting in limited options to change the planform. In-channel restoration work has already been undertaken by the Itchen Navigation Heritage Trail Project to improve the SSSI and this has led to significant habitat improvements in some sections. Despite this, there are a range of measures that could preserve and improve the remaining features on the channel, helping the waterway to meet the favourable condition status for its SSSI status (Table 8).

Table 8: Characteristics which would contribute to Favourable condition on the Itchen Navigation

Feature and characteristics	Ecological benefit	Illustration
Planform The Itchen Navigation is a perched, artificial channel and flows through urban areas. Measures to restore the channel planform have thus not been recommended.	NA	
Diverse bed and flow types Despite this being an artificial channel, measures to increase the bed and flow variation would be of benefit, creating sections of riffle, pool, glide, with both silt and gravel substrate.	A diversity of bed and flow types should ensure suitable habitat for all life stages of characteristic species for which the river was designated, including: Water crowfoot and water starwort: grow on gravel riffles where flow is relatively swift and shallow. Bullhead favour fast-flowing, clear shallow water with a hard substrate or softer substrates so long as the water is well oxygenated and there is sufficient cover. White clawed crayfish: habitat includes crevices in rocks, submerged plants and tree roots or features which provide shelter from predators. Brook lamprey: requires clean gravel for spawning and marginal silts for larvae. Atlantic salmon: requires clean gravels with swift flow for spawning.	
Varied bank profiles As an artificial channel the cross-section is largely symmetrical, however measures to increase asymmetry, creating a cross-section with a variety of bank gradients, are recommended.	Banks that are varied with a shallow gradient lead to a more gradual transition from aquatic to terrestrial habitats, with marginal species such as water cress and water forget me not, to wetland species such as canary grass, leading to more terrestrial rushes and finally grasses.	

Feature and characteristics	Ecological benefit	Illustration
Bank materials Bank materials are unlikely to reflect the underlying geology due to the artificial nature of the channel. However cohesive sediment banks, in which the majority of the Navigation is made from, are of ecological benefit.	Vertical cliffs of cohesive sediment provide a nesting habitat for kingfisher and sand martins, white-clawed crayfish and water voles. In addition vertical cliffs provide a nesting habitat for a range of insects.	
Undisturbed bank and riparian vegetation The straight and artificial planform of Navigation limits the width of riparian vegetation. However, the channel has the potential to encompass a mosaic of different habitats. Habitats could include bank side vegetation ranging from grasses, to tall herbs, bushes and trees. In addition, trees are a vital component as their root systems provide cover for fish and otter and they provide a source of woody debris for the channel, creating flow variation.	Submerged root systems provide a habitat for fish, particularly bull-head, white clawed crayfish and invertebrates. Trees provide woody debris and leaf litter to the channel, providing a source of food for invertebrates and contributing to flow variation. Tree lining provides diversity in channel cover, further adding to habitat diversity and is a habitat used by otters. Riparian scrub provides an important habitat for bird species, water voles and **otter**.	
In-channel vegetation Despite being an artificial channel the Navigation has the potential for a rich and diverse in channel vegetation and fauna and marginal vegetation.	Insect fauna depends on a wetland margin for hatching, resting, feeding and mating, and a refuge during times of high flow. Invertebrates Water voles thrive in emergent vegetation. Southern damselfly: require well-vegetated, base-rich runnels and flushes in open areas or small side-channels of Chalk rivers. White clawed crayfish: require shelter from submerged plants and trees and feed on live and dead organic matter including fallen leaves and vegetation. Otter: use reed beds for foraging, breeding and resting. Water-crowfoot and water-starwort: they may modify water flow, promote fine sediment deposition, and provide shelter and food for fish and invertebrate animals.	

4.3. Restoration measures

With the aspiration to meet the restoration visions set out in section 4.2 a number of restoration actions can be undertaken. These actions fall into three categories: restore, rehabilitate and conserve and enhance.

Restore – This category of restoration encompasses those reaches which have degraded and do not show evidence of the potential to naturally re-adjust and recover. These reaches require fundamental restoration measures to meet favourable condition. Restoration measures can include the removal/lowering of structures and the re-naturalisation of planform. The latter option may require re-notification action to ensure that new alignments have statutory protection (Geodata, 2010).

Rehabilitate – This category covers those reaches where the channel shows evidence of adjustment to a more natural form, or potential to adjust, following historic modification. However pressures remain that affect the in-channel and riparian habitats, which will prevent the river from recovering to support favourable condition. Typically, measures to rehabilitate the river are focused around in-channel measures such as the addition of woody debris to narrow the channel or bed raising, which will assist the river in establishing more natural features. In instances where the riparian zone has been significantly degraded, measures associated with vegetation management are suggested. Improving the condition of the riparian zone will again assist channel recovery by providing a supply of wood to the channel and marginal vegetation, which will create variations in flow and lead to a more varied channel morphology.

Conserve and enhance – The category represents reaches where restoration works are the least significant. In these reaches actions to restore the morphology of the channel were deemed unnecessary. However despite a good morphology there is opportunity to make further improvements involving the management of the river. Management actions such as control structure management and vegetation management would fall under this restoration activity, helping to mitigate failure to achieve Favourable condition and prevent deterioration in water body status (adapted from Geodata, 2010).

The specific actions which fall under these categories are listed in Table 9 and further details including a description of each action and its potential benefits are included below in section 4.3.1. It should be noted that some actions fall under either the ‘rehabilitation’ or the ‘conserve and enhance’ categories depending on the scale of the restoration improvement in terms of either spatial extent or magnitude of impact it is considered likely to have on the channel.

Table 9: Categorisation of restoration actions

<table>
<tr><th>Restore</th><th>Rehabilitate</th><th>Conserve and enhance</th></tr>
<tr><td>Restore channel continuity
(i.e. weir, sluice, bridge)
• Removal
• Partial removal/lowering
• Change sluice control to restore channel</td><td colspan="2">Rehabilitate or conserve and enhance riparian zone
• Riparian planting
• Vegetation management by reducing mowing/cutting regime
• Reduce tree shading
• Increase tree shading
• Create riparian corridor along channel
• Tackle invasive species</td></tr>
<tr><td>Restore channel planform</td><td>Rehabilitate channel
• Bank re-profiling
• Channel narrowing by marginal planting
• Channel narrowing by in channel measures e.g. deflectors or adding woody debris
• Bed level raising
• Create riffles
• Create backwater
• Remove bank protection</td><td>Modify channel maintenance operations
• Reduce dredging
• Alter weed cutting management practices
• Conserve woody debris features
• Remove some woody debris where channel is choked
• Remove trash</td></tr>
<tr><td>Restore connectivity with the floodplain
• set back embankments
• lower embankment</td><td colspan="2">Reduce poaching pressure
• Grazing pressure management (reduce livestock)
• Install fencing to prevent livestock access
• Install fencing to reduce dog/human access to channel</td></tr>
<tr><td>Restore old channel</td><td colspan="2">De-silt particular reach</td></tr>
<tr><td rowspan="2">Other</td><td colspan="2">Modify hatch control operations to enhance channel</td></tr>
<tr><td colspan="2">Other</td></tr>
</table>

The overarching restoration categories are presented on a reach by reach basis in Appendices A3 and A4.

4.3.1. Overview of restoration categories and actions selected for the Test and Itchen reaches

Restore channel continuity (weirs and sluices)	**Category: Restore** **Sub – options:** • Removal • Partial removal/lowering • Change sluice control to restore channel
Description: Weirs, sluices and bridges influence hydraulics of the river system and can alter the flows and downstream transportation of sediments. They can also cause localised bank erosion and scour pools to develop in the vicinity of the structure. They can also interfere with the passage of migratory fish and other fauna. Channel continuity can be restored by either removing the structure in full (such as head and wing walls and sills) or in part (for example lowering the sill levels). If a structure is important to flood or flow control and is operable (such as a penstock sluice) there is the potential to alter its operating regime to improve channel continuity. Once channel continuity is restored by removal of part or complete structures, the rivers will often adapt naturally over time with bed levels settling and riparian margins restoring naturally. In some cases, further work may be required to restore the channel planform and floodplain connectivity following structure removal.	**Illustrations:** **Sluice Management Example: River Nadder – Fovant on Nadder.**  Sluices on the River Nadder - impoundment effects (above)  Resulting in sluggish flow with siltation and *sparganium* (eel grass) (above)  Post project: hatches were raised and the channel modified to produce a reach with clean gravels present and *Ranunculus* community starting to establish.

Potential benefits

Removal or alteration of structures alleviates the morphological effects of impoundments, allowing a more natural habitat to develop including a better range of depths and velocities, and riffle habitats that are characteristic of a more natural system. Restoring these aspects of the river then reduces siltation associated with impoundments and clears gravel substrates. Removal of such structures also allows for easier passage for migratory fish species and fauna which is important for the ecological 'naturalness' of the river and for ensuring sustainability of certain migratory species.

Potential constraints and other considerations

Flood risk management may pose a constraint in some areas, particularly around urban areas and riparian properties.

There is a risk that sediment that has been deposited behind the structure would be released downstream on removal. The main risks are that it could smother spawning gravels or be contaminated.

Water Level Management will also be a constraint in some cases, especially on the Itchen, where structures are needed to control flows into different floodplain SSSI compartments for habitat and biodiversity benefits. Weir removal especially can alter water levels upstream and this effect can extend a reasonable distance which can affect upstream off-take structures and render them ineffective.

Depending on the weir, its function and the degree of removal/alteration, there may be further requirements for restoration actions to re-profile banks and margins if the river is not likely or able to adapt naturally over time.

Restore channel planform/old channel course

Category: Restore

Description:

Where the planform of the channel has been artificially influenced, for example through dredging or flood defence works, the structure of the modified channel can result in a channel with very uniform depths and flows and potentially in a different location on the floodplain. This kind of modified channel is far removed from the structure and characteristics expected of a natural Chalk river that would have varying depths, berms, riffles and a high diversity of flow patterns.

The key objective of this restoration action is the creation of a new channel planform with areas of different depths and asymmetrical form and subsequently a higher diversity of flows and velocities across and along the cross-sectional forms.

This restoration action involves cutting a new river planform to mimic a more natural channel and install comparable features such as pools and riffles, marginal planting or introduction of large woody debris. It is likely that in a Chalk system such as these rivers, the margins would develop naturally and rapidly over the course of the first year as flow patterns develop and sediment is deposited in a more natural form.

Illustrations:

River Wensum SSSI - Restoration of Great Ryburgh Loop

During Construction

1 year on

Potential benefits

Restoring the river to a more natural planform will allow more natural sediment processes to occur (such as deposition on the inside of the bend) and establish increased flow variability. It will create the form required for a better variety of marginal habitats to develop which helps to increase macrophyte assemblages and will also create the diversity in flow patterns within the river. These areas of fast and slow flow are important for many reasons including sediment movement, creation of clean spawning gravels, fish refuge and macro-invertebrate habitat.

Further to these benefits, ensuring the river has a more natural planform will also help increase its resilience to changing flows throughout the year. A channel with a more natural structure is better equipped to adapt to lower flows by establishing a planform with a deeper, narrower, sinuous low flow channel through the middle. This helps to ensure that during low flows the available water is not spread across the channel which can lead to a shallow, wide, uniform channel. In doing so, this helps reduce the number of isolated sections in low flows, reduces solar heating of the water and helps to maintain fine sediment transfer, minimising siltation. Both of these are important aspects to fish health, particularly the migratory species important to the Test and Itchen. This is an important consideration with future climate change and projections for fish population increases for the catchments.

Potential constraints and other considerations

Works can be disruptive to fishing activities, for a short period of time, and for other amenity values of the river whilst the bank and bed re-establish.

Any material introduced to the river, for example gravels, should be suitable for the Chalk river environment (e.g. use of chalk and flint material for instance).

Restore connectivity with the floodplain

Category: Restore

Sub – options:

- **Lower embankments**
- **Remove embankments**

Description:

The objective of this type of restoration action is to ensure the river is connected with the floodplain and is operating in a natural manner such that flooding is progressive as river levels increase.

This action can include:

- Removal of embankments along the river edge including bank protection measures.
- Set back of embankments.
- Wetland habitat creation to facilitate connectivity.

Undertaking these actions encourages a more natural relationship between the river and the floodplain to develop which in turn helps to alleviate widespread flood impacts downstream.

Illustrations:

River Itchen: Localised removal of embankment

Potential benefits

Increasing the connectivity with the floodplain provides the following benefits:

- Progressive flooding of the floodplain as levels rise and subsequent alleviation of flood impacts downstream and reducing the effect of a river 'bursting its banks'.
- Reduced wash out of in-channel features during high flows.
- Sediment deposition on the floodplain during high flows rather than in the channel.
- Improved drainage of floodplain after periods of high flows.
- More natural banks provide better habitat than artificial or modified banks.
- Where connectivity is restored by removal of bank protection or bank re-profiling, other benefits are realised for the channel such as with channel planform and marginal habitat creation.

Potential constraints and other considerations

Constraints to removal of bank protection include flood defence and other users of the floodplain, such as for agricultural grazing land. Fishing and other amenity users may be impacted where embankments are lowered or removed.

When bank protection is removed, there will be a period where the risk of bank erosion is greater, until marginal vegetation is re-established. Marginal planting could be considered as part of this measure in high risk cases.

Rehabilitate channel

Category: Rehabilitate

Sub – options:

- Bank re-profiling
- Channel narrowing by marginal planting
- Channel narrowing by in channel measures e.g. deflectors or adding woody debris
- Bed level raising
- Create riffles
- Create backwater
- Remove bank protection

Description:

- Bank re-profiling is necessary where banks have been steepened through channel deepening or straightening. Re-profiling makes them less steep and allows marginal vegetation to develop, effectively narrowing the channel.
- Channel narrowing can be achieved through localised planting on the channel banks and/or margins to reduce the local width. Bioengineering techniques can be used to support planting e.g. berm features can be created and stabilised by using wooden stakes.
- Narrowing the channel can be achieved by a variety of different techniques such as the addition of wooden hurdle flow deflectors, log weirs, addition of coarse woody debris into the channel at specific locations to cause a partial log jam or pushing high banks in.
- Bed raising by the addition of gravel to the bed material to create local flow variation (comparable to riffle features during low flows) is also a potential mechanism to rehabilitate the channel. This measure is particularly useful where the channel has been dredged and is therefore over-deepened.
- Creating riffles has a similar effect to bed raising, but involves the addition of gravel to a single location which can lead to high velocities within the channel and increased spawning area and in-channel diversity.
- Backwaters can be created by partially blocking off a redundant tributary channel using gravel and or woody debris. This would create slower flows along the section and lead to sediment being deposited and marginal habitat encroachment over time.

Potential benefits

Actions to rehabilitate the channel act to increase in-channel diversity along the reach by either reducing the channel width or depth. Locally they will increase the diversity in flows, and velocities, and provide an improved width depth ratio. This is extremely important during low flows. Faster flowing sections are important for fish spawning and pools for juveniles. Bed raising, by gravel addition, also reconnects the channel to the floodplain, by locally raising water levels, and provides the appropriate morphology and functioning for wet woodland and grassland communities to establish. The addition of woody debris leads to a more natural channel structure and the creation of niche habitats. Often a mix of these techniques can be used to maximise morphological improvements.

Illustrations:

Itchen Navigation - Bank stabilisation by marginal planting

River Avon – Wood deflectors used to create local flow variation

River Itchen – Bed raising

Potential constraints and other considerations

- Bank re-profiling may lead to some erosion during the time period it takes for vegetation to re-establish. Seeding the ground and planting of shrubs and trees can be undertaken to help stabilise the bank. A change in management of the riparian zone may be required e.g. fencing installed to prevent disturbance until the bank has stabilised.
- In some locations (such as an urban area) elevating the bed may not be desirable as it could lead to localised flood risk. A feasibility study may be required.
- Woody debris should not be located immediately upstream of structures to reduce the risk of movement at high flows and potential risk of blockage. Woody debris can be pinned into position to prevent movement.

River Wensum SSSI – localised narrowing through bank re-profiling

Rehabilitate or conserve and enhance the riparian zone

Category: Rehabilitate or Conserve and enhance

Sub – options:

- Riparian planting
- Vegetation management by reducing mowing/cutting regime
- Reduce tree shading
- Increase tree shading
- Create riparian corridor along channel
- Tackle invasive species

Description:

The riparian fringe of a river along with the marginal corridor can be impacted by a variety of different features. To maximise habitat heterogeneity there is often a balance needed of light and shade which enables sufficient light penetration to encourage the growth of marginal vegetation but sufficient shade (through cover) to ensure that this does not become too dominant. Cover helps keep water cooler in summertime which is critical for cold water fish species, such as salmon and trout. Over grazing (through livestock), heavy visitor pressure or poor management can also lead to a significant impact on bank cover and accelerated input of fine sediment into the channel. Thus planting, reduction in grazing pressure and fencing can all be appropriate management options under the correct settings.

Potential benefits

- A riparian fringe can provide a valuable buffer to agricultural drainage into a river system and reduce water quality issues.
- Vegetation, through trees, shrubs and marginal vegetation are in themselves valuable habitat attributes to a range of species.
- Trees can provide a valuable source of coarse woody debris and more generally carbon into the river systems.
- Trees and marginal vegetation can provide valuable shade to the river, cooling the temperature in summertime which is critical for cool water fish species.

Illustrations:

River Itchen: Well established riparian corridor

Potential constraints and other considerations

- Creating a riparian zone would require a land take and thus may need a localised change in land use, appropriately incentivised.
- Limited grazing to the bank edge can be preferable to the installation of fencing as it is sometimes be deemed to be advantageous to some bank side species diversity.
- There needs to be a balance between the need for fencing to reduce livestock and visitor pressure against the need to have access to the river edge but some form of management is likely to be required.

Reduce poaching pressure	**Category: Rehabilitate or Conserve and enhance** **Sub – options:** • Grazing pressure management (reduce livestock) • Install fencing to prevent livestock access • Install fencing to reduce dog/human access to channel
Description: Accelerated erosion of channel banks can be caused by poaching. This is the trampling of vegetation on the bank by livestock in rural areas or by humans/dogs in areas where there is a public right of way adjacent to the watercourse. There is also an issue with swans accessing the channel where there is a mown grass bank which provides easy access to the watercourse. To lessen this pressure in rural areas livestock access to the river can be controlled in the first instance by working in conjunction with the landowner and reducing the number of livestock in the riparian zone, or by the installing of fencing accompanied with cattle access points. For areas where public access to the riparian zone is a posing a pressure, fencing can be put in place to prevent access. This is particularly important when marginal and riparian planting has been undertaken. It is often beneficial to put up notice boards to explain why access is the watercourse is being deterred.	**Illustrations:** **River Test – Reach has been fenced off and cattle access provided** 

Potential benefits

Reducing the poaching pressure will lead to an improved riparian and marginal vegetation community and an improved marginal and aquatic invertebrate community. The reduction in erosion will lead to less fine sediment input to the channel.

Access to the channel (through fencing) by a limited number of livestock is sometimes considered to be a preferred approach to reducing poaching pressure because it prevents a large poached area from forming and instead a small, more controlled area access is formed instead. Appropriate livestock at the correct stocking density can have beneficial effects on bank side vegetation in terms of diversity, 'health' and coverage. In some areas of the Itchen floodplain, stocking regime is an important aspect of conservation of the Southern Blue Damselfly. Therefore any poaching/fencing/grazing actions need to be discussed carefully with landowner and NE to ensure outcomes. Should fencing be installed, a vegetation management plan may also be required to ensure that bank side species diversity is maintained.

River Itchen: Fencing showing the impact of livestock pressure

Itchen Navigation – Marginal habitat has been temporarily fenced off to prevent human and dog access whilst it stabilises

Itchen Navigation – Marginal habitat planting to stabilise the bank has been temporarily fenced off to prevent human and dog access whilst it stabilises.

Potential constraints and other considerations

- Landowners may be reluctant to reduce the number of livestock so fencing may be a preferred option at some locations.
- Where public access to the riparian zone is prevented notice boards are suggested to improve understanding of the reasoning for the action.
- If fenced, a vegetation management regime inside the fence line may need to be agreed to ensure species diversity maintained.
- Some form of bank side management will be required if poaching has been identified as an issue.

De-silting	**Category: Rehabilitate or Conserve and enhance**
Description: De-silting can be undertaken in reaches where there is a significant volume of fine sediment build up in the channel. This option should be restricted to locations where modifications have caused this build up (such as weirs) which are now being removed or where localised de-silting can help reduce localised flood risk and enable drainage channels to flow freely into the main channels.	**Illustrations:**
Potential benefits • Reduce localised source of fine sediment • Reduce localised flood risk	
Potential constraints and other considerations • There is a general presumption against the dredging of channels in the Water Framework Directive due to the impact that the operation has on the riverine habitat. • The sediment dredged may need to be disposed of off-site if it is deemed to be contaminated. • De-silting should only be undertaken for flood risk or water quality reasons. More sustainable measures should be put in place for the longer term.	

Modify hatch control operations to enhance the channel	**Category: Rehabilitate or Conserve and enhance**
Description: This option is similar to that of the restoration option for 'changing sluice control to restore channel' but the scale of effects are less. This rehabilitate/conserve and enhance option refers to modifying hatch operation such that the channel adjusts naturally over time and the adjustments are small scale and is more of a case of making minimal adjustments to hatch operation to obtain the desired results. The option can be an informal agreement on how to operate a structure or could take the form of a 'hatch operating protocol' to formalise the agreement more, as has been previously used on Water Level Management Plans on both of these rivers.	**Illustrations:** 
Potential benefits Alteration of structure operation can help increase connectivity between channels and can alleviate effects of impoundments. Rehabilitating channels in this way can allow a more natural habitat to develop that includes cleaner gravels, less siltation and a better range of depths and velocities that are more characteristic of a natural chalk system. It can also help with fish passage.	
Potential constraints and other considerations • Changing operation of such structures sometimes takes a lot of trials before the optimum balance is reached and this can take time to achieve where historic management practices need changing. Hatch Operating Protocols that clearly set out aims and objectives can help the appropriate balance to be achieved. • Benefits of any alteration can take a while to be realised. However, it is also an easy option where a structure operation is causing a negative effect.	

Modify channel maintenance operations	**Category: Conserve and enhance** **Sub – options:** • Reduce dredging • Alter weed and marginal vegetation management practices • Conserve woody debris features • Remove some woody debris where channel is choked • Remove trash
Description: This option covers a range of actions and involves changing management behaviours that can have detrimental effect on riverine habitats. Many of the actions relate to less intensive management of the river, e.g. reduced dredging, allowing woody debris to remain in place and not 'putting the river to bed' by undertaking a winter vegetation cut of the bank, or by leaving weed to grow in summer to maintain water levels. Other options include more management, such as removing trash and unblocking sections that are choked with debris to reinstate flow and reduce impoundment effects.	**Illustrations:** 
Potential benefits There are many benefits of actions involving a reduced management intensity: • Reducing the cutting of marginal vegetation can provide an increased degree of bank protection throughout the winter, reducing erosion and increasing bank stability. Established marginal vegetation also provides better habitat for marginal species and helps by providing shade throughout the winter months. • Reducing the cutting of marginal vegetation can help narrow over-widened channels leading to the removal of fine sediment in the centre of the channel through locally increasing velocities. The marginal vegetation also provides valuable habitat. • Reducing maintenance practices can lead to reduced management costs. • Removing blockages from the rivers helps reduce impoundments and siltation, but also help reduce flood risk.	
Potential constraints and other considerations Often the constraints to implementing these options are linked to existing, long established practices, within river management rather than any technical requirement. These actions themselves often take less effort as they involve leaving the river to adjust to a more natural channel width reducing maintenance costs while achieving habitat benefits.	

5. Reach scale restoration options

5.1. Organisation of the options

The fieldwork undertaken on each of the Rivers Test and Itchen was used to identify the pressures that exist on each of the reaches and identify a variety of actions that may be required to return them back into favourable status. The reaches were grouped into the classes of Restore, Rehabilitate and Conserve and Enhance as outlined in Section 4. The classification largely was made by the types of operation that were required and the scale of intervention at which an action was necessary to improve the reach to a more favourable state. Appendix A3 and A4 shows maps that illustrate the location of each of the reaches across the SSSIs on both the Test and Itchen and reach class as whether it was in need of being restored, rehabilitated or conserved and enhanced. In the appendices a further set of maps (Appendix A: A5 and A6) and a table (Appendix B: B1 and B2) for the Test and Itchen were constructed to show, at a reach scale, individual actions that would need to be undertaken to improve each of the reaches to enable them to move towards a favourable status. This does not mean that the measure identified for a particular reach will be undertaken along the whole reach just that parts of this reach would benefit from this specific management action. The details would need to be determined at a project level. A summary of guiding principles for each of the classes of intervention are outlined below. In addition, a summary of the main river characteristics and actions required for each of the SSSI units is detailed in Table 10 and Table 11.

5.2. Reach scale options

5.2.1. Reaches for conservation and enhancement

Reaches that have been classed as being in need of conservation or enhancement are already broadly in a state consistent with a good morphology and ecology. In these reaches actions to restore the morphology of the channel were deemed unnecessary. However despite a good morphology there is opportunity to make further improvements that often involve the management of the river. This will help enhance the habitat within the river system which can then help to maintain a natural self-sustaining fisheries within a particular reach. It is also important to ensure that there is no further deterioration of the water body for the Water Framework Directive legislation. Guiding principles that should be followed include:

- Retain, and manage, riparian and marginal vegetation to provide a good balance of light and shade into the channel.
- Ensure any vegetation management is aligned to good management practices.
- Preserve and enhance volume of coarse woody debris in the channel, where it is not a flood risk, to enhance the in-channel diversity.
- Maintain free flowing channel and ensure that no further large impounding structures are added into the channel.
- Do not dredge the channel unless it is locally deemed to be a flood risk.
- Reduce grazing pressure, or add fencing where poaching (from livestock or visitor pressure) is an issue.
- Modify hatch control operations to further enhance the channel where appropriate.

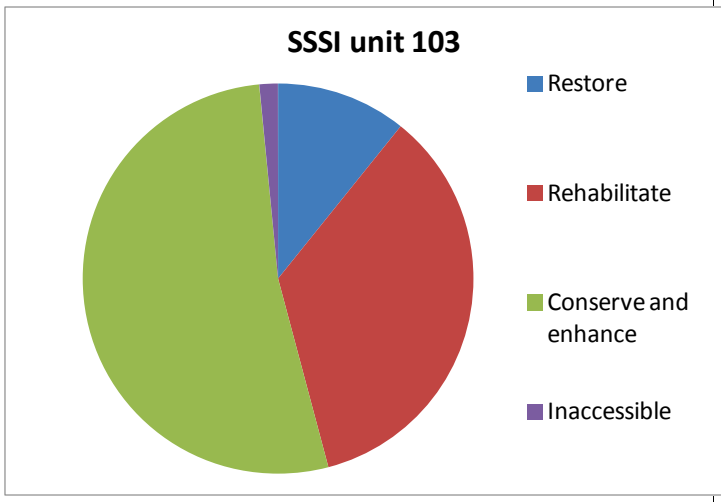
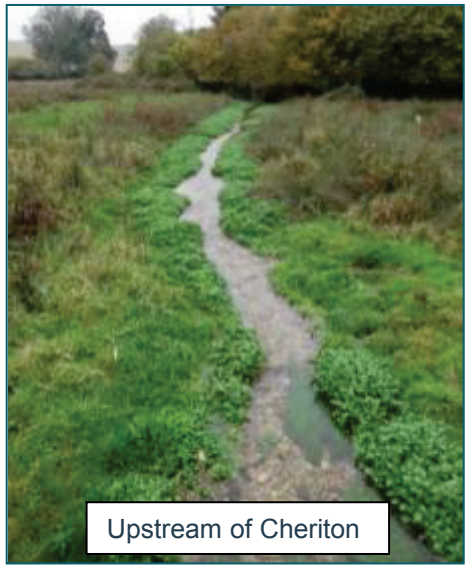
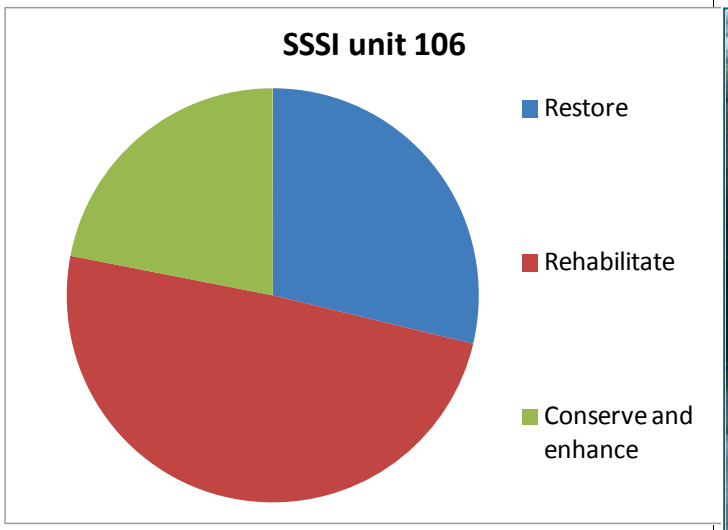
These principles should be adopted for the reaches identified in need of conserving and enhancing but are equally applicable to all the other reaches within the SSSI once other pressures have been addressed.

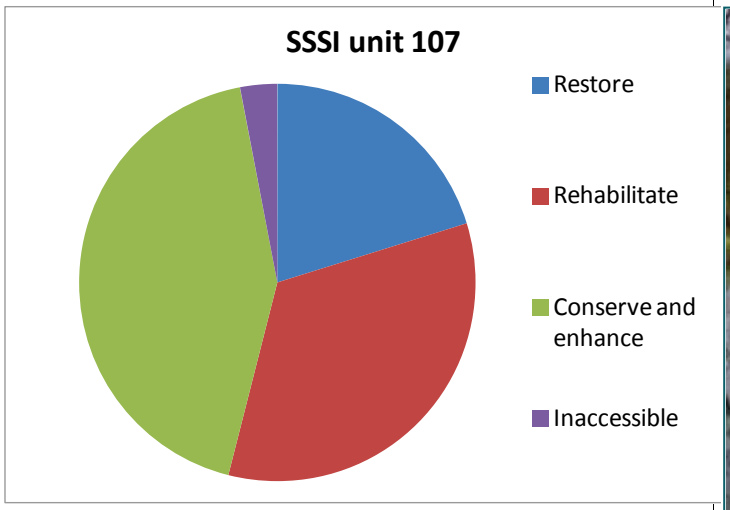
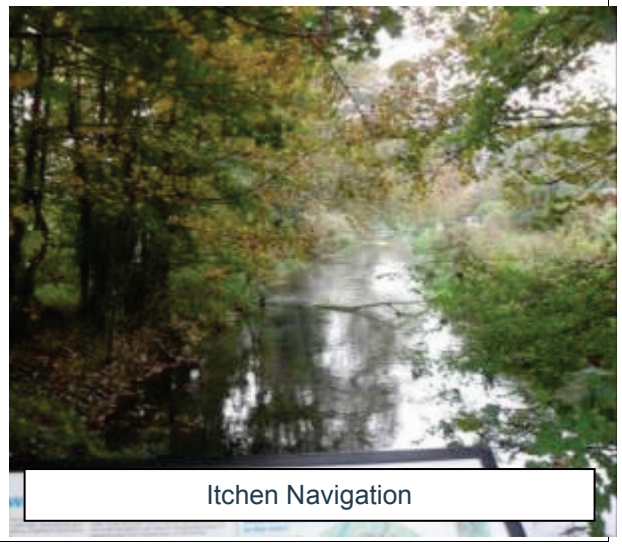
5.2.2. Reaches for rehabilitation and physical restoration

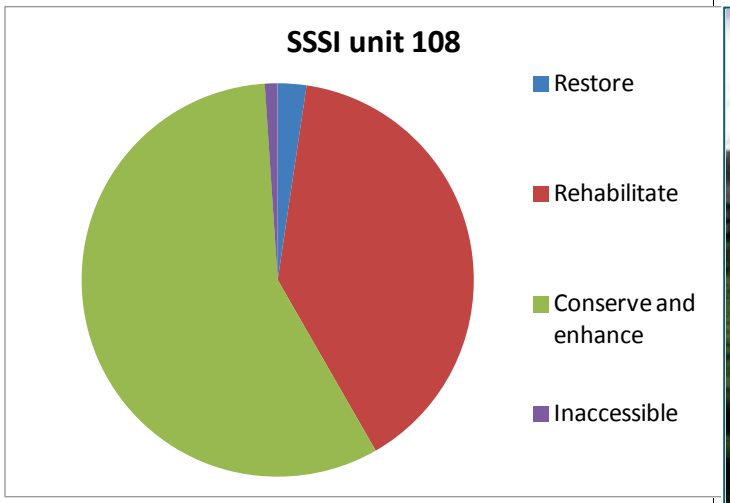
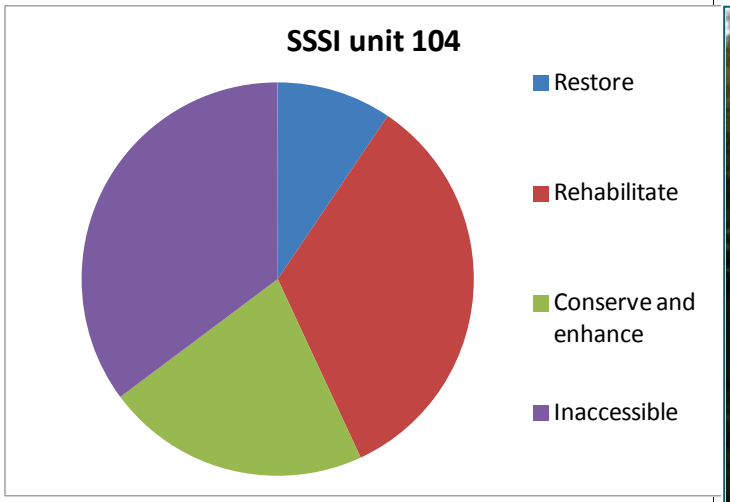
Reaches that have been classed as those requiring rehabilitation or restoration encompass river sections needing direct intervention in order to enable recovery towards ‘favourable conditions.’ Historic legacies or recent management activities have degraded these channels to such an extent that they do not have the potential to naturally re-adjust. The differences between the class of restoration or rehabilitation fundamentally depend on the scale of intervention necessary to enable the reach to move towards a favourable condition. Restoration actions are more significant both in terms of scale and often cost. For example restoration actions include the removal/lowering of structures and the re-naturalisation of planform. Reaches classed as requiring rehabilitation covers those reaches where the channel shows evidence of adjustment to a more natural form, or potential to adjust, following historic modification. However pressures remain, affecting the in-channel and riparian habitats, which in turn will prevent the river from recovering to support favourable condition. Typically measures to rehabilitate the river are focused around in-channel measures, such as the addition of woody debris, to narrow the channel or bed raising, which will assist the

river in establishing more diverse morphology. In instances where the riparian zone has been significantly degraded, measures associated with vegetation management are suggested.

Table 10: Summary of the river characteristics and actions required (based on approximate unit length) along each SSSI unit on the Itchen

Description and conservation actions	Restoration categories	Photographs
103: Cheriton Stream - Unfavourable No Change Unit 103 is the Cheriton stream, beginning south of the Itchen at Cheriton and flowing north meeting units 104 and 105 east of Alresford. The majority of this reach has been given the restoration action 'Conserve and enhance', reflecting the need for : -Vegetation management by reducing mowing/cutting regime in the upper sections of this reach. -Undertake grazing pressure management/fencing where grazed (e.g. downstream of Cheriton). -Reduce tree shading in lower section. 'Rehabilitation' is associated with actions in the lower half of the unit, to: -Modify hatch control operations to enhance the channel and those running alongside it. - Narrow the channel where the reach is too wide. -Reduce grazing pressure.		
106: Upper Itchen (Itchen Stoke to Easton) - Unfavourable No Change Unit 106 flows from east of Alresford and through the Itchen Valley. The majority of this reach falls under the restoration action 'Rehabilitate', due to straightening and impoundments. The following measures have been suggested: -Change sluice control to restore channel (reach I35). The following 'Rehabilitation' measures are recommended interspersed throughout the unit: -Vegetation management by reducing mowing/cutting regime. -Riparian Planting. -Channel narrowing through in channel measures.		

Description and conservation actions	Restoration categories	Photographs
107: Middle Itchen (Easton to Highbridge) - Unfavourable No Change Unit 107 begins at Easton and flows southwards through Winchester, past Compton and Otterbourne, to meet unit 108 just north of Eastleigh. This reach covers a significant proportion of the Itchen and with the greatest extent falling under the category 'Conserve and enhance'. The majority of the reaches in this category have the restoration action to 'leave alone'. Rehabilitation measures include (reaches I61, I54, I58, I59, I74): -Change sluice control to restore channel. -Vegetation management by reduced mowing/ cutting regime. -Riparian planting. To restore the channel: -Weir removal or partial removal/lowering of structure (I42, I43).		
107: Middle Itchen (Easton to Highbridge) - Unfavourable No Change (Itchen Navigation) On the Itchen Navigation the following measures are recommended: -Channel narrowing by adding woody debris. -Channel narrowing by marginal planting and also riparian planting. - Install fencing to reduce dog/human access to more extensive lengths of the channel. -Locally reduce tree shading or increase riparian planting.	**(See above)**	

Description and conservation actions	Restoration categories	Photographs
108: Lower Itchen (Highbridge to Wood Mill) - Unfavourable No Change Unit 108 begins just north of Eastleigh and flows in a southerly direction to its confluence with Southampton water. This reach covers a significant proportion of the Itchen with the greatest extent falling under the action 'Conserve and enhance', with largely 'no action' necessary. For reaches with the restoration action 'Rehabilitate', the key actions include: -Lower embankments (reach I81). -Reduce poaching pressure by installing fencing to prevent livestock access (reaches I79, I81, I83, and I89). - Riparian planting (I62 and I79).		 Itchen Valley Country Park
104: River Arle (sic) - Unfavourable No Change Unit 104 flows eastwards north of Alresford. The majority of this reach falls under the restoration action 'Rehabilitate', with the associated actions: -Vegetation management by reducing cutting /mowing regime. -Creating riparian corridor along the channel. -Reduce tree shading. -Channel narrowing by marginal planting and in channel measures e.g. deflectors or adding woody debris. Options to 'Restore' the channel include: -Removal/ lowering of the weir structure at Keepers Cottage. -Restore continuity by re-meandering channel from Drove Lane to confluence with the Itchen.		 Downstream of weir at Keepers Cottage

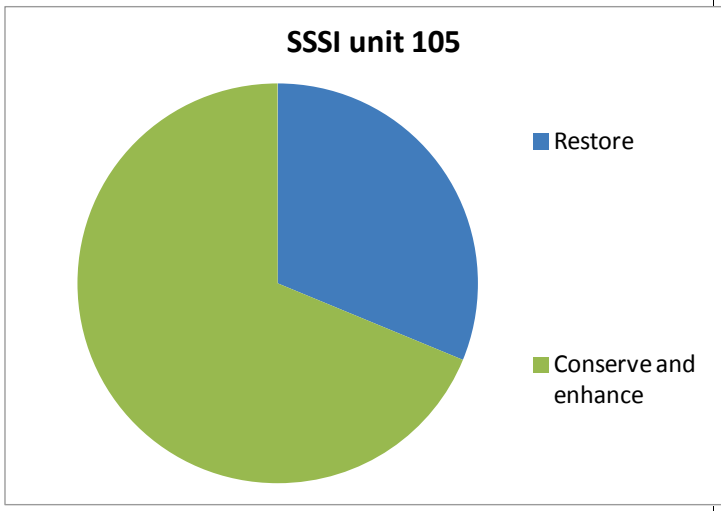
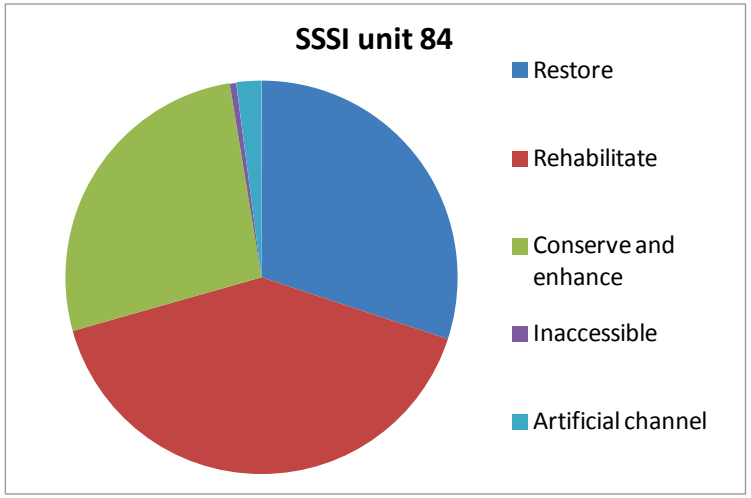
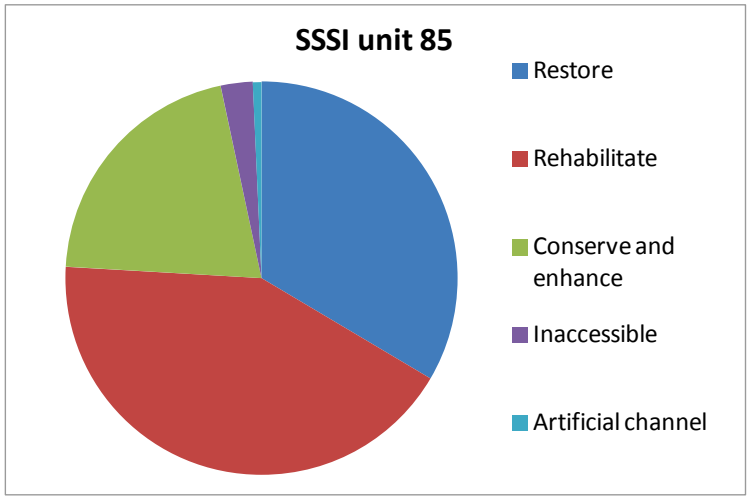
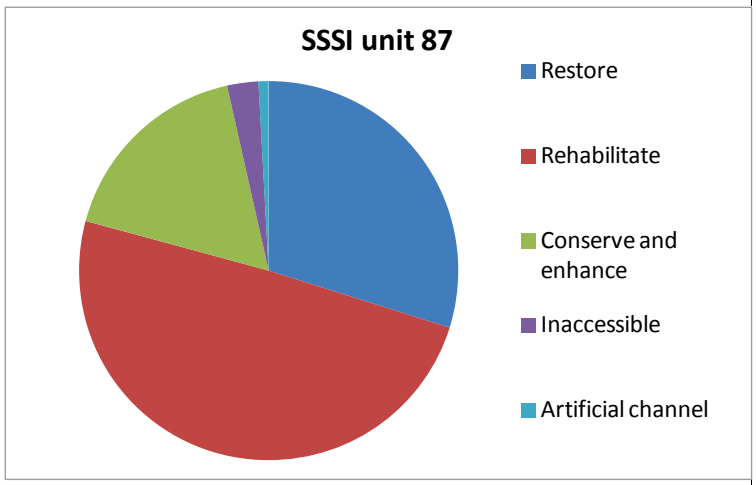
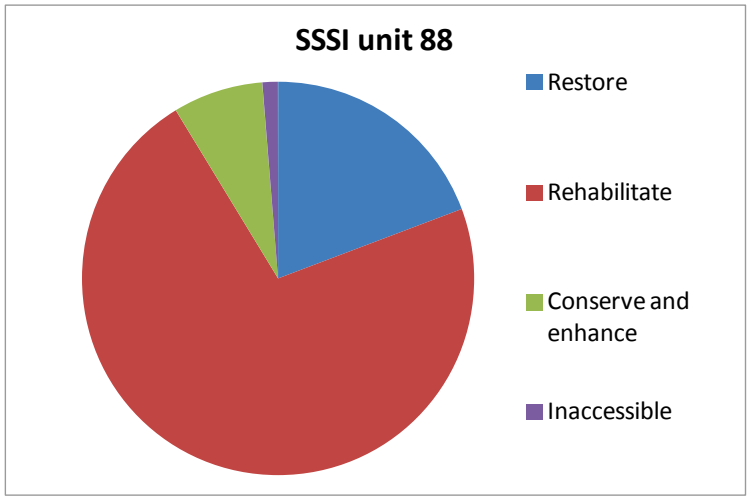
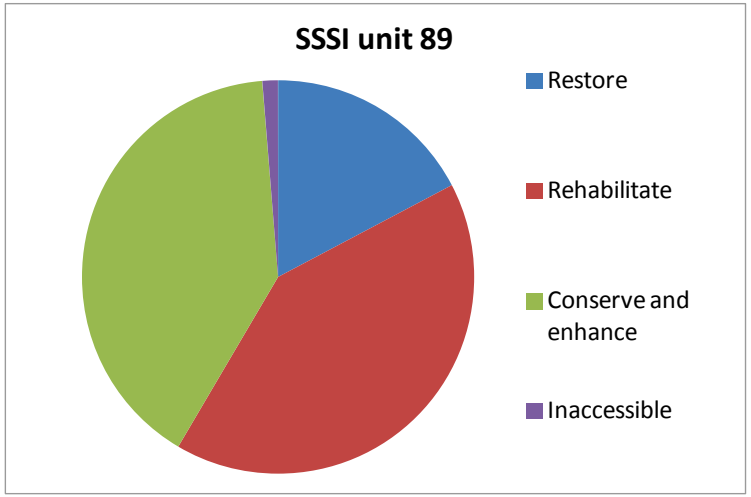
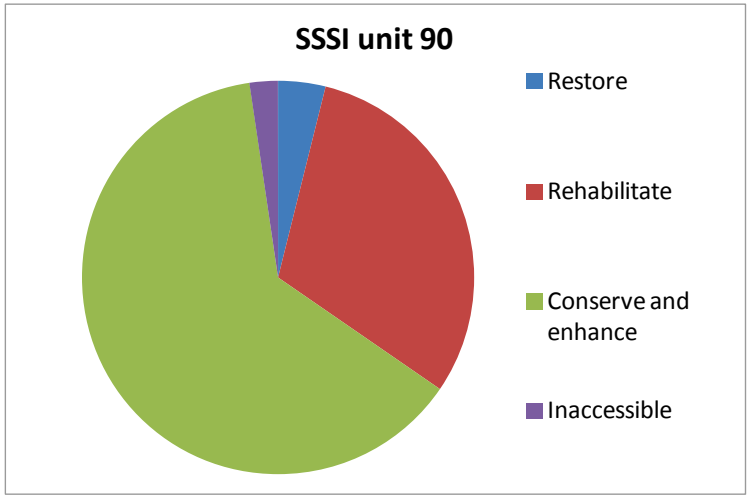
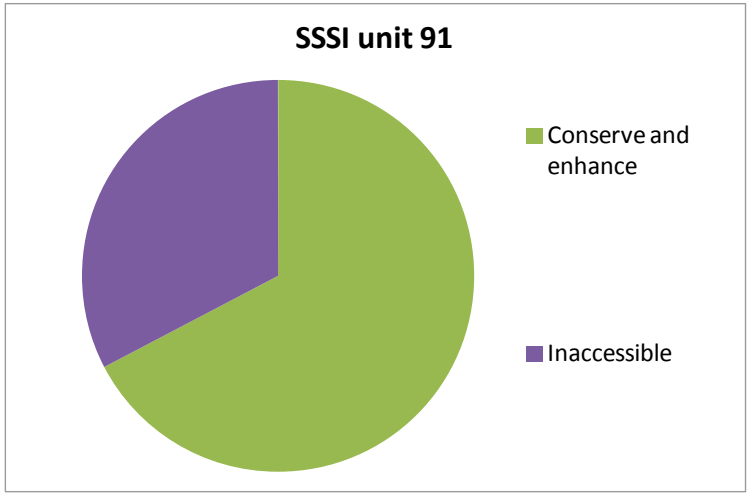
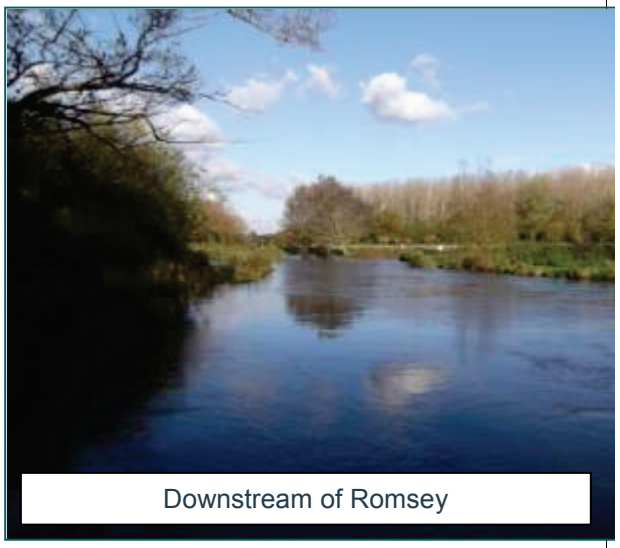
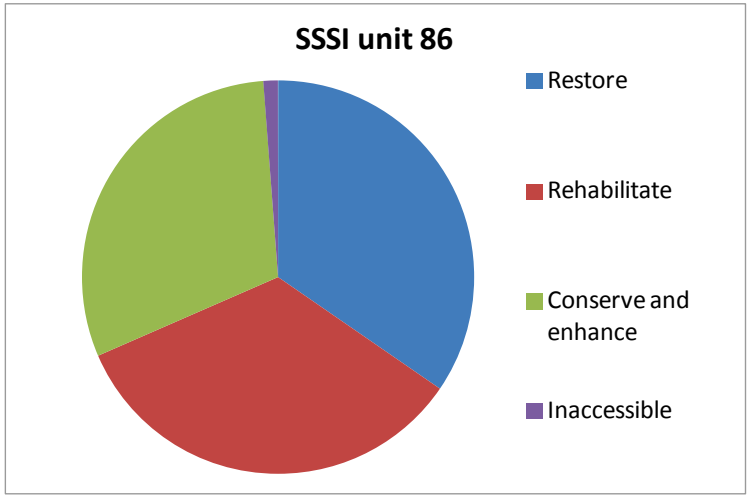
Description and conservation actions	Restoration categories	Photographs
105: Candover Brook - Unfavourable No Change Unit 105 comprises the Candover Brook, beginning at the northern source of the Itchen and flowing southwards past Itchen Stoke and Ovington. Measures to 'Conserve and enhance' the channel include: - Install fencing to prevent livestock access (C07). -Reduce poaching pressure by grazing pressure management (C07). Riparian planting (C01). - Modify hatch control operations to enhance channel (C04). -Localised channel narrowing (C06). Measures to restore the channel include: - Restore an old channel planform and put all the water back into a restored channel in the centre of the floodplain (C03, C02). - Restore an old channel planform (C05). - Remove channel embankments (C05).		

Table 11: Summary of the river characteristics and actions required (based on approximate unit length) along each SSSI unit on the Test

Description and conservation actions	Restoration categories	Photographs
84: Source to Bourne - Unfavourable Declining Unit 84 begins at the source of the Test, west of Overton and flows eastwards through Whitchurch, meeting unit 85 at Hurstbourne Priory. The majority of this reach falls under the restoration action 'Rehabilitate', reflecting the need for significant in channel measures to enable the channel to re-adjust, with the following key measures: -Channel narrowing by in-channel measures (reaches T003, T004, T005, T015, T019, T020 and T027). -Vegetation management through reducing mowing/cutting regime (reaches T003, T010, T011, T014, T016, T019, and T025). Action to restore the channel in this section is always associated with 'weir removal/lowering and/or changing sluice control' (reaches T019, T023, T026, T027, T030 and T034).		
85: Bourne to Dever - Unfavourable Declining Unit 85 flows from south of Hurstbourne Priory through Longparish to join unit 86, north of Wherwell, where the Dever reaches the Test. This unit is dominated by actions to 'Restore', and 'Rehabilitate'. Largely, where 'Conserve and enhance' has been recommended no actions are required. Key measures to 'Rehabilitate' the channel are: -Localised bed raising (reaches T048 and T043). -Vegetation management through the reducing mowing/cutting regime in appropriate locations (reaches T044 and T047). Key measures to 'Restore' the channel include: -Structure removal or partial removal/lowering (reaches T039, T040, T037 and T049). -Channel narrowing through in-channel measures		

Description and conservation actions	Restoration categories	Photographs
(reaches T039, T041,T037, T044 and T049)		
87: Dever to Anton - Unfavourable No change Unit 87 is a section with multiple channels, flowing through Wherwell and Chilbolton to join unit 88 upstream of the Leckford estate. The majority of this unit comes under 'Rehabilitate', reflecting the need for measures such as: -Riparian Planting (interspersed throughout this unit). -Vegetation management through reducing mowing/cutting regime (interspersed throughout this unit). -Bed level raising (reaches T053 and T055). Where 'Restore has been recommended this is usually associated with partial removal/lowering of weirs or a change to sluice control (reaches T055, T060 and T059).		
88: Anton to Wallop - Unfavourable Declining Unit 88 covers a significant proportion of the Test through Leckford, Stockbridge, Houghton meeting unit 89 at Bossington. The majority of this unit comes under 'Rehabilitate', reflecting the need for significant in channel measures to enable a largely modified channel to re-adjust. Measures to 'Rehabilitate' this section include: -Vegetation management by reducing mowing/cutting regime. -Channel narrowing through in-channel measures. -Riparian planting. Measures to 'Restore' the channel include: -Structure removal or partial removal/lowering (T076). -Channel narrowing. - Restore channel planform (T097).		

Description and conservation actions	Restoration categories	Photographs
89: Wallop to Dun - Unfavourable Declining Unit 89 flows from Bossington past Mottisfont to unit 90. This majority of this unit is split between 'Conserve and enhance and 'Rehabilitate', with a relatively sinuous section of channel downstream of the Compton estate. The measure 'Vegetation management by reducing the mowing/cutting regime' is recommended throughout most of this unit, alongside the following specific measures to 'Rehabilitate' the channel: -Bed level raising (reaches T112, T119). -Channel narrowing by in-channel measures (T119).		
90: Dun to Romsey - Unfavourable Declining Unit 90 flows from Kimbridge to the final unit, 91, at Romsey. This majority of this unit comes under 'Conserve and enhance', in part due to the appropriate management techniques employed downstream of Kimbridge. The key measure falling under the categories of both 'Conserve and enhance' and 'Rehabilitate' is 'vegetation management by reducing mowing/cutting regime'. In addition the following measures are recommended: -Install fencing to prevent livestock access (reaches T134 and T148). -Weir removal (reaches T142 and T143).		

Description and conservation actions	Restoration categories	Photographs
91: Romsey to Estuary - Unfavourable No change (Lower Test Favourable condition) Unit 91 flows from Romsey to Totton at the Lower Test Nature Reserve. All of the reaches that were able to be accessed fell into the restoration category 'Conserve and enhance', reflecting the appropriate management undertaken in this section of channel. However the following measures are recommended to assist the channel in the establishment of more natural features: -Vegetation management by reducing mowing/cutting regime. Rehabilitate the channel locally by: - Channel narrowing by adding woody debris. - Removing bank protection.		
86: Dever – Unfavourable No change Unit 86 is on the Dever and flows from the west of Wonston through Bullington to its confluence with the Test. This unit is approximately 12.5 km in length and split relatively equally between Restore and Rehabilitate, due to the following recommended measures: -Vegetation management by reducing mowing/cutting regime (reach D14, D10). -In-channel narrowing by in-channel measures (reach D10). -Reduce dredging (reach D14). Action to restore the channel in this section is usually associated with 'weir removal/lowering and/or changing sluice control' (reaches D06, D13, D15 and D03).		

Reach specific restoration measures are presented in Appendices A5 and A6

6. Implementing the plan

6.1. Working with landowners and land managers

The rivers Test and Itchen are a significant part of the Hampshire landscape, economy and people's lives. A substantial amount of effort is already invested in the everyday management of these rivers by landowners, land managers, river keepers and interest groups. Therefore, for a restoration strategy to be successfully developed and implemented, the Environment Agency and Natural England recognise the need to work positively alongside key stakeholders to bring about improvements to the rivers.

This inclusive approach has already started, with early communication of this particular phase of the project disseminated via a newsletter, a project website and an initial consultation event to present the strategy aims, objectives and associated timescales and gather initial feedback from stakeholders. Further to this, site visits undertaken along both rivers through October and November 2012 included a good degree of landowner and river keeper engagement, which has also captured viewpoints of the people involved. Included in this information is a consideration of the potential constraints to restoration, gained from the site visits, desk based data reviews and more critically through this positive engagement with the various landowners, river keepers and other key stakeholders on the project. Earlier work from undertaken by Geodata also included extensive consultation with landowners and river keepers.

The main constraints that have been raised are categorised as follows:

- **Land drainage and flood risk:** the restoration plan may be constrained by concerns over increased flood risk in some areas as a result of establishing connectivity between the river and floodplain by removing embankments or revetments. This could affect the land drainage capabilities for agricultural practises and also have an impact on accessibility for fishing, hunting, agriculture and the general amenity value associated particularly with private riparian ownership.

- **Water level management:** removal or alteration of structures, or other significant in-channel restoration measures such as bed raising or narrowing, have the potential to significantly alter water levels through long sections of the river. This effect would be of local benefit; however there are concerns about upstream and downstream effects, and subsequent impacts on floodplain connectivity. For example, significant water level changes resulting from removal of a structure could affect nearby off-take structures that feed other terrestrial and riverine units of the SSSI, thereby potentially impacting the floodplain SSSI and SAC status. Other amenity uses, such as fishing and riparian ownership preferences, could also be impacted while levels and margins settle. There may therefore be restoration constraints requiring careful consultation with landowners outside the immediate reach where restoration action is undertaken.

- **Fishing:** concerns have been raised about restoration activities that either temporarily disrupts fishing, but more crucially any actions that would lead to a significant change in the nature of the fishery and thus its customer base. In many cases there is a fear of the unknown effects and how that might affect customer perceptions and hence repeat rods secured for the following years.

- **Agriculture:** restoration measures that for example block river access for cattle (to stop poaching) or otherwise disrupt arable or pastoral farming practices by re-establishing river/floodplain connectivity raise concerns associated with potential changes in farming practices but also financial concerns over who pays for fencing and bridges that may need to be installed as a result of any restoration activities. Any restoration activities that result in significant land use change will bring additional concerns and constraints. This is not anticipated to be a widespread result in the catchments because of the extent to which the floodplain is already restored and existing widespread Environmental Stewardship uptake in both floodplains, and the level to which farming practices especially are already established with floodplains in operation. However, it will need to be carefully considered on a case by case basis as the strategy is taken forward. Particularly important to these constraints is the support of Environmental Stewardship schemes, which is considered a relevant funding mechanism.

- **Amenity and Visual:** restoration measures may be constrained in some locations where they impact on amenity or visual aspects of the river. This includes changes to landscape character that affect private landowners (such as private gardens and landowner preference for how they manage their riparian

character) and other riparian ownership where access is important. In taking restoration actions forward to implementation, it will be important to consider and balance the various values and amenity emphasis the different involved parties may have on the river.

- **Historic Landscape:** The Test and Itchen catchments are important in terms of historic landscape and cultural heritage. Particularly important on the River Itchen is the historic value of the water meadow system and associated structures. Restoration will therefore have to consider any constraints presented by these cultural factors, particularly when suggesting any removal of structures or changes to landscape features in the water meadows that have significance within the historic landscape of the catchment. In some cases, structures and features may need to be preserved for their historic value and restoration implementation will have to find a compromise to balance all interests.

- **Protected species and habitats:** The River Test and Itchen and their accompanying floodplains have a variety of protected species and habitats. The species and habitats and their requirements would need to be assessed when any actions are considered as part of the strategy.

- **Other Businesses:** There are a variety of businesses along the River Test and Itchen that use the rivers. These include fish farms and water cress producers as well as commercial fisheries as noted earlier. Requirements of these businesses would need to be considered when actions are taken forward.

It is not appropriate at a strategy level such as this to remove potential restoration actions from a restoration plan based on these constraints. However the constraints identified are all valid, and have been captured at this stage for further investigation and consideration at a project specific basis as the restoration strategy is implemented.

In taking the strategy forwards, the Environment Agency and Natural England intend to build upon the positive work already being undertaken to restore other areas of the rivers. For many of these proposals to be implemented it will be necessary to work closely with landowners, managers and key stakeholders, with everyone playing an important role in developing these proposals. In some cases it will be appropriate for stakeholders to take ownership of implementing the improvement measures, with the Environment Agency and Natural England providing guidance in the technical implementation of actions.

In doing so, it is important to consider both the financial (that is the initial capital layout as well as the ongoing operational and maintenance costs) and manpower resources that will be required to implement restoration actions. There is currently a mosaic of different delivery mechanisms already in place to support these activities, depending on the particular restoration measure, the geographical extent at which it applies and the priority and timing of any potential works, and these are discussed in Section 6.4.

6.2. An opportunity

The restoration strategy also presents a range of opportunities for the restoration of the floodplains, particularly important with the Itchen Floodplain SSSI. Examples of this include:

- Removal of significant embankments and restoration of a more natural river cross section and planform under the restoration strategy can help reduce the severity of naturally occurring flood events by allowing a progressive inundation of the floodplain rather than sudden flooding associated with a river breaching embankments (causing sudden unwanted flooding, damage to agricultural land and animals, and disruption to amenity value of the floodplain). Conversely, removing embankments allows faster draining of water back into the river once water levels have dropped off again.
- Reduction in poaching and/or establishment of a wider riparian zone through restoration can help disrupt the pathway of land run-off, thereby reducing the riverine impacts such as from sediment inputs and water quality issues. Measures such as this also help to achieve the objectives of various land based plans such as farm Soil Management Plans, the catchment Diffuse Water Pollution Plan, Higher Level Stewardship and Nutrient Management Plans objectives.
- Some restoration actions will serve to positively affect water levels in the floodplain habitats. This is particularly relevant to the Itchen SSSI where the previously implemented Water Level Management Plan identified several WLMP remedies that require river restoration actions in channel to fulfil water level requirements in the floodplain. Consideration of these issues in implementing the plan can mean one measure fulfils the riverine and floodplain SSSI habitat objectives.

Most crucially to these rivers, carefully thought out and implemented restoration actions can also provide excellent opportunities to mitigate any potential current and future effects of abstractions and discharges. For example, river restoration actions (such as channel narrowing, bed raising, in-channel measures, marginal planting, shading) implemented on any potentially depleted reaches downstream of an abstraction can help establish a more natural riverine system in terms of flows, velocities and riverine character that is also more resilient to future water level and velocity regimes as a result of abstraction and climate change pressures. Similarly, restoration actions such as these can serve to increase velocities locally which can help mitigate the water quality effects of discharges.

For opportunities such as these to be exploited, consultation between involved parties, the Environment Agency and Natural England is even more critical if the sustainability of outcomes is to be realised on these rivers.

6.3. Shaping the options – the process

The purpose of a Strategy such as this is to consider the restoration potential of the entire river(s), regardless of the potential constraints. It therefore sets out the long term 'strategic restoration vision' for the entire SSSI Rivers over the next 20 to 30 years. Constraints to implementing of some measures inevitably exist and these have been captured for consideration; however they are not sufficient to remove potential restoration actions from a strategy of this type.

The strategic nature of this plan thus sets out a restoration vision with each measure/group of measures to then be taken forward initially into a series of individual feasibility and outline design projects. Through doing this, it will be possible to more accurately cost and visualise the restoration projects and likely outcomes, allowing clear thinking on the likely costs and benefits of taking restoration forward. It will also allow more effective consultation with stakeholders and any affected parties.

Following on from feasibility and outline design stages, a detailed design phase would be undertaken, the outputs of which are to be used to consult with stakeholders and the Environment Agency and Natural England to secure the required consents to implement the actions. They will also be used to plan and cost implementation and secure any possible funding via supporting delivery mechanisms.

Once designed and consented, the projects can be implemented. Depending on the scale and nature of the works and funding streams this could be undertaken by the Environment Agency, Natural England, local wildlife groups, landowners, river keepers, fishing groups or private individuals.

The degree to which this process will need to be followed will depend on the details of each restoration action/project, the outcomes of consultation, the project lead responsible for implementation and the source of funding.

It is important to note that inclusion in the strategy will be helpful in agreeing ways forward, and ultimately to be eligible for some of the potential support and funding mechanisms that may available in the future to support implementation

For those actions taken forward, long term cooperation and engagement will be needed post-implementation to ensure restoration outcomes are sustained in the long-term. For example, post implementation monitoring to understand success of certain measures and combinations of measures will be important and with some restoration activities, particularly where an innovative method/design are implemented or where future natural processes may need managing so as to not jeopardise restoration actions. In taking projects forward it will be important to consider and communicate the long term management needs, for example:

- Ongoing management of naturally occurring in-channel processes such as woody debris;
- Management of trees – including living bank side trees and shrubs but also fallen trees in order to prevent local bank erosion or over-shading;
- Management of weed cut activities – both in-channel and marginal/riparian cutting.

Summary examples of the next steps required to implement the suggested measures are show in Table 12.

Table 12: Summary examples of next steps required to take the suggested measures forward and develop designs to accurately cost and implement each measure

Measures	Feasibility/Consultation	Design
Restore channel continuity (i.e. weir, sluice, bridge) • Removal • Partial removal/lowering • Change sluice control to restore channel	Understand the potential impacts on upstream and downstream environments, the ecological constraints and opportunities, to include EIA scoping. Also important with this measure is consideration of the flood management risks and impacts on floodplain. Historic value to the structures should be evaluated. Any alterations may need to be in keeping with the structure or alternatively the structures may need to be preserved. Another consideration is the water level management requirements of the floodplain and additional investigations may be needed to understand the effects structure removal/changes may have on water levels in the floodplain once bed levels have re settled. Consultation will be required with landowners, and upstream/downstream owners/keepers/fishing groups. This could include introduction of the concept of a Hatch Operating Protocol.	Produce specification for the removal or modification of structure, including design drawings and any appropriate method statements including site access plans, schedule of environmental constraints and checks/mitigation measures. Consultation will be undertaken as part of the Flood Defence Consent process but early engagement between landowners, stakeholders, N.E. and the E.A. is advantageous. In some cases, Hatch Operating Protocols will need to be agreed. Post implementation monitoring will be important to understand the outcomes and success factors.
Restore channel planform	Understand the local environmental constraints, any potential seasonal constraints on works (either to do with access or ecological disturbance). Consideration must also be given to disposal of spoil if there is going to be any material that can't be re-profiled either in-river or on the floodplain. Consult with any stakeholders likely to be disturbed during or after the works. Feasibility needs to consider potential delivery mechanisms and constraints and	Develop a site specific plan with drawings of current and required plan form and cross-sections. Produce a method statement including site access plans and schedule of environmental constraints/mitigation measures. Consultation will be undertaken as part of the Flood Defence Consent process but early engagement between landowners, stakeholders, NE and the EA is advantageous. Post implementation monitoring will be important

Measures	Feasibility/Consultation	Design
	opportunities presented by other plans/projects being implemented or previously implemented.	to understand the outcomes and success factors.
Restore continuity with the floodplain • set back embankments • lower embankment	Aside from any environmental constraints, feasibility assessments will need to consider the increased risk of flooding by removing an embankment. Riparian access and fishing requirements will also need to be carefully considered so as to not affect amenity value of the reaches. As part of this, early consultation between stakeholders, the EA and Natural England will be required.	Produce specification for removal of bank protection including before and after illustrations. Produce site access plans, environmental constraints and mitigation measures.
Restore old channel • De silt particular reach	This depends on the cause of the siltation (there may be little point in de silting without fixing the cause if for example it is related to an impoundment/structure operation downstream. Feasibility will also need to consider the extent of the reach that needs de silting and the environmental conditions in the reach itself and downstream. It may be that there are more suitable methods for dealing with high volumes of sediment on the bed of a channel. Consideration needs to be taken for any potential downstream effects of de silting and what to do with the spoil. Aside from this, there will need to be the usual consideration of practicalities and timing of any potential operation.	Specific design requirements depend on outputs of feasibility study.
Rehabilitate channel: • Bank re-profiling • Channel narrowing by marginal planting • Channel narrowing by in	As with implementation of other measures, feasibility assessments need to include a review of the works required, the potential environmental and flooding risks involved and then	Varied requirements depending on exact nature of the measure, but can include the production of a site specific plan that can include scaled drawings specifying

Measures	Feasibility/Consultation	Design
channel measures e.g. deflectors or adding woody debris • Bed level raising • Create riffles • Create backwater • Remove bank protection	also any upstream/downstream consultation that may be required.	bank slopes or bed levels for example, or illustrated drawings that set out where planting, deflectors and in-channel measures will be undertaken. Irrespective of the nature of the measure, environmental constraints and mitigation measures need to be set out for the duration of the works.
Rehabilitate by reducing poaching pressure: • Grazing pressure management (reduce livestock) • Install fencing to prevent livestock access • Install fencing to reduce dog/human access to channel	Feasibility investigations should include discussions with landowner/tenant (in the case of agricultural poaching pressures) to understand the animal access/drinking requirements. The exact location and extent of fencing needs to be determined to provide the maximum benefit – especially in cases where fencing is coupled with other restoration measures e.g. marginal planting or channel narrowing measures. Consultation will be needed with Natural England to understand the riparian access requirements of some reaches to support marginal trampling for Southern Damselfly habitat for example.	Limited design requirements with fencing.
Rehabilitate channel by modifying hatch operation to enhance channel	Discussions will be needed with affected landowners, river keepers and fishing interests, and potentially with downstream interests. In the case of large structures, the Environment Agency water licensing team need to be consulted to understand and take account of any historic agreements/rights to water that need to be adhered to. The potential for changes in flood risk will also need to be considered.	There may be some modification requirements to existing structures. Hatch Operating Protocols would be beneficial, setting out seasonal hatch operation requirements, especially where there may be complicated networks of channels.

Measures	Feasibility/Consultation	Design
Rehabilitate or conserve and enhance riparian zone • Riparian planting • Vegetation management by reducing mowing/cutting regime • Reduce tree shading • Increase tree shading • Create riparian corridor along channel • Tackle invasive species	Varied requirements including discussions with river keepers/managers to understand current practices throughout the year, and a common agreement of riparian zone objectives for the reach.	Agreement on actions with interested parties. There is likely to be little design requirements with these actions.

6.4. Delivery mechanisms and sources of funding

Implementation of river restoration strategies on this scale requires careful coordination and multi partner approach to implementation. These two rivers are a significant part of the commercial and political landscape of Hampshire and much work has already been undertaken to improve the habitats they provide. It is important to build upon this in an all-inclusive approach when planning the implementation of measures.

It is important to remember that some actions are inexpensive and easily implemented, such as those that are about changing the way things are currently done (e.g. a reduced approach to vegetation management) or simple measures that can be done by volunteers and fisheries supported by River Trusts. Larger actions, requiring more financial or resource support will mostly require funding mechanisms.

There is no single source of funding for this type of restoration activity but various funding mechanisms are available to different groups leading on the implementation of restoration measures. The sources of this funding depend on the nature and timeframe of the measures and who is undertaking the improvements. In seeking funding, it is important to consider not only the initial capital layout, but also the ongoing operational and maintenance responsibility, often applicable over decades. Depending on these timescales, a mosaic of funding mechanisms may be required for current and future implementation of measures.

Some sources of funding are more established than others and available long-term, for example the Environmental Stewardship Schemes implemented by Natural England (Higher Level Stewardship (HLS) and Entry Level Stewardship (ELS)), the Environment Agency's Flood and Coastal Risk Management (FCRM) capital and maintenance budgets and Catchment Restoration Funds.

Less established funding mechanisms include opportunistic bidding opportunities to funds such as those under European Restoration Programmes (such as the EU LIFE Programme) as well as special projects being undertaken by NGOs such as Wildlife groups and Rivers Trusts.

Different funding and delivery mechanisms will be available depending on the particular restoration measure, the geographical extent at which is applies, the priority and timing of any potential works and the lead party involved in implementation. The latter aspect will be vital in identifying the primary funding source. The range of groups involved in implementation could therefore include:

- The Test and Itchen Association;
- Salmon and Trout Association
- Angling clubs and syndicates;
- Private landowners and river keepers;
- National Farmers Union;
- Country Land and Business Association (CLA);
- Hampshire and Isle of Wight Wildlife Trust;
- Natural England; and
- The Environment Agency.

The following sections outline the key delivery mechanisms currently in place that could be considered when taking the strategy forwards into implementation.

6.4.1. Water Framework Directive Improvement Fund

In April 2011, the Secretary of State announced the allocation of £92 million over four years with the specific objective to improve the health of our rivers, lakes and estuaries by addressing water quality issues, removing barriers to fish migration and removing invasive non native species in order to help achieve our aims under the Water Framework Directive. This money will be allocated to projects that contribute towards WFD outcomes and are implemented between 2011 and 2015. Projects considered for funding include those that: remove invasive non native species; clear up pollution; and remove barriers to fish migration.

6.4.2. Catchment Restoration Fund

£28m of funding has been allocated by DEFRA over three years (from 2012/13) to the Catchment Restoration Fund (CRF) to civil society groups for implementation of water body improvement projects. These projects will contribute to bringing water bodies to Good Status and are over and above measures in River Basin Management Plans.

http://www.defra.gov.uk/environment/quality/water/legislation/water-framework-directive/

The CRF opens up the funding to bids from third sector organisations in the hope to encourage businesses, local authorities and community groups to join forces with charitable organisations in order to secure funding for improvement ideas on rivers.

Administered by the Environment Agency, the CRF encourages charities, communities and interest groups to apply for a share of the CRF to tackle local water issues including poor water quality, habitat restoration and fish passage. £10m has been promised to the fund each year to 2015, to be allocated to projects that deliver between 2012 and 2015 and support the following outcomes:

- Restore more natural features in and around waters;
- Reduce the impact of manmade structures on wildlife in waters; or
- Reduce the impact of diffuse sources of pollution arsing from rural or urban land use.

The Fund will also help to deliver the Government's commitments in the Natural Environment White Paper to restore nature in our rivers and water bodies. (www.defra.gov.uk/environment/natural/whitepaper/)

In order to apply to the CRF for funding, the lead applicant must be from a recognised organisation with "charitable, benevolent or philanthropic purposes". Bids are assessed by a national panel led by the Environment Agency, involving DEFRA and Natural England and advised by the River Restoration Centre. The full process and examples of successful bids are available on the Environment Agency's CRF website: http://www.environment-agency.gov.uk/research/planning/136182.aspx

The Environment Agency has provided signposts to additional funding (http://www.environment-agency.gov.uk/research/planning/33106.aspx) and also publishes guidance on preparation of bids (http://a0768b4a8a31e106d8b0-50dc802554eb38a24458b98ff72d550b.r19.cf3.rackcdn.com/geho0612buqq-e-e.pdf)

The CRF is currently closed to bids for 2013- see http://www.environment-agency.gov.uk/research/planning/136182.aspx for the latest information on the fund.

6.4.3. Planning Control and Developers Contributions

Section 106 of the Town and Country Planning Act (1990) requires developers seeking planning permission to incorporate within their proposals supplementary plans that help meet the needs of the community by securing contributions towards community infrastructure. This can include financial contributions to community facilities such as open spaces, which can include riparian land.

This mechanism could be used to deliver some restoration enhancements along each river, and would require consultation with Test Valley, Eastleigh District and Winchester City Planning Departments.

6.4.4. European Funding

The European Commission fund a number of other large scale programmes, including: LIFE+; Regional Convergence; Competitiveness and Cooperation (including INTERREG); and Framework Programme.

http://ec.europa.eu/environment/funding/intro_en.htm

Funding is available through the European Regional Development Fund (ERDF) for Water Management projects that;

- Improve the quality of water supply and treatment, including cooperation in the field of water management;
- Support integrated, sustainable and participatory approaches to management of inland and marine waters, including waterway infrastructure;
- Adapting to climate change effects related to water management.

Under this European funding umbrella, the LIFE programme is the EU's funding mechanism for the environmental improvement initiatives, with the overall objective being to contribute to the implementation, updating and development of EU environmental policy and legislation by co-financing pilot or demonstration projects with European added value.

LIFE began in 1992 to date there have been three complete phases of the programme (LIFE I: 1992-1995, LIFE II: 1996-1999 and LIFE III: 2000-2006). The funding has been used for restoration projects in the past across the EU to address issues such as urban wastewater management, industrial wastewater treatment, river basin monitoring and improving groundwater quality. LIFE has provided financial support to approximately 3014 environmental projects across the EU, some €2.2 billion providing a vital funding mechanism for restoration actions.

http://ec.europa.eu/environment/life/about/index.htm

6.4.5. Environmental Stewardship Schemes

The Environmental Stewardship Schemes (ESS) is part of the Rural Development Programme for England (RDPE). Administered by Natural England, it aims to provide support to land managers to maintain the land in a certain way that benefits the landscape, biodiversity or habitats. There are several levels of ESS:

- Entry Level Stewardship (ELS);
- Organic Entry Level Stewardship (OELS);
- Upland Entry Level Stewardship (UELS); and
- Higher Level Stewardship (HLS).

The two current schemes that are particularly relevant to supporting this strategy are the Entry Level Stewardship and the Higher Level Stewardship.

The current ELS scheme is open to all and provides support to land managers for schemes that benefit the environment. Higher Level Stewardship (HLS) provides additional support for land management actions that are more relevant to the river restoration strategy, such as significant land use change, livestock management, fencing of water courses, wide riparian buffer strips, improved wetland riparian zones, scrub clearance and management, water level control structure operation, reinstatement of floodplain carriers and floodplain culverts and watercourse crossings. Additionally, HLS is only available in areas of higher environmental value, such as SSSIs – including the Test and Itchen floodplains. The scheme requires land owners/managers to work with Natural England to establish a combination of measures appropriate to the land character, specific environmental objectives/problems and formulate a plan that is committed to for a five year period. Although some capital funding can be sourced through this scheme, such as for covering the initial financial layout for fencing and water meadow culverts/bridges etc, this source of funding is also important in supporting long term operational and maintenance needs of restoration activities. This delivery mechanism will be important to consider as it seeks to change the long term practices to those that are more suited to improving the quality and sustainability of existing wildlife habitats, whilst also creating new habitats where required. It should be noted that the current Rural Development Programme ends in December 2013 and the new programme is expected to start from January 2015 onwards.

http://www.naturalengland.org.uk/ourwork/farming/funding/default.aspx

6.4.6. England Catchment Sensitive Farming Delivery Initiative

The England Catchment Sensitive Farming Delivery Initiative (ECSFDI) is also funded through the Rural Development Programme for England, overseen by DEFRA, and implemented by a partnership between the Environment Agency and Natural England. Targeted to certain priority areas (which the Test and Itchen are considered to be), the ECSFDI is specifically focused on reducing diffuse pollution from agricultural practices through delivering advice to farmers and financial support for capital schemes. Advice is delivered through Catchment Sensitive Farming Officers (CSFOs) who visit famers and offer advice on the various funding mechanisms and advise on the incentives that exist to help address environmental issues arising from farming practices. It should be noted that the current Rural Development Programme ends in December 2013 and the new programme is expected to start from January 2015 onwards.

http://www.naturalengland.org.uk/ourwork/farming/csf/default.aspx

6.4.7. Environment Agency Flood Risk Management

The Environment Agency budgets are set annually for flood risk management capital expenditure and maintenance budgets. There is the potential to fund some restoration activities through these budgets where the objectives are in line with the Flood Risk Management strategy. Actions here could include altering or removing major impounding structures and unblocking blocked channels and removing obstructions to flow.

6.4.8. Environment Agency Fisheries and Biodiversity

The EA fisheries and biodiversity team has a yearly budget to help undertake works on the rivers including restoration enhancements. Budget is variable between years, fairly limited and needs to be focused and prioritised carefully.

6.4.9. Natural England SSSI Funding

A small amount of money is available each year from Natural England for works within SSSIs. This includes funding through the Conservation and Enhancement Scheme which affords discretionary payments to fund costs of specific management to deliver favourable condition of the nature conservation interest on land of outstanding scientific interest. The mechanism can fund both capital works and management programmes (over a five year agreement period). This is a useful fund to consider where other sources of funding are not available e.g. outside HLS areas but it is important to note that 50% match funding is required for public bodies and some organisations.

http://www.naturalengland.org.uk/grantsfunding/findagrant/conservationandenhancementscheme.aspx

6.4.10. Test and Itchen association

The Test and Itchen (T&I) Association is the body which regulates fishing and related matters on the two rivers under powers delegated from the Environment Agency. Support can be found through this route, either in the form of advice, sharing lessons from others, manpower support to implement actions and sometimes financial support.

6.4.11. Forestry Commission English Woodland Grant scheme

The English Woodland Grant Scheme provides financial support for establishment and maintenance of woodland schemes. Funding could be available for establishment of riparian woodland or other land-based planting schemes that serve to disrupt the pathway of sediment run off for example. Grants available are targeted at both improving existing woodland but also creating new woodland. This mechanism could be important in achieving the appropriate level of shading required for Good Ecological Status.
http://www.forestry.gov.uk/ewgs

6.4.12. Heritage Lottery Fund (HLF)

The Heritage Lottery Fund (HLF) uses money raised through the National Lottery to provide funding for projects that have “a lasting impact on people and places”. Administered through the National Heritage Memorial Fund (NHMF), funding of approximately £375million is available each year to be invested in a wide range of projects including the natural environment. This funding mechanism was used to deliver some of the works undertaken as part of the Itchen Navigation Heritage Trail project.

6.5. Combining different delivery routes

Table 13 shows examples of how the different delivery routes discussed above can be combined to implement the various types of restoration works being proposed within the Strategy (please note this is indicative only, outlining the types of measures that could be considered through different mechanisms).

Over the proposed lifetime of the Strategy, these mechanisms may change, however if restoration actions are set out in the Strategy and priorities are defined thereafter within projects, momentum can be gained such that mechanisms can be taken advantage of when they emerge.

Table 13: Potential delivery routes and implementation mechanisms (subject to change)

Scale of works (in order of increasing scale)	Restore / Rehabilitate / Conserve & Enhance	Action	Delivery Mechanism (N.B. Can include provision of advice only, not just funding)												
			WFD Improvements / Catchment Restoration Fund	Planning Control and Developers Contributions	European Funding	Environmental Stewardship	Catchment Sensitive Farming	EA Flood Risk Management Capital	EA Flood Risk Management Maintenance	EA Fisheries & Biodiversity	N.E Conservation & Enhancement Scheme	Test & Itchen Association	FC English Woodland Grant Scheme	Heritage Lottery Fund	Private funding / trusts
	Rehabilitate / Conserve & enhance riparian zone	Riparian Planting		*	*	*				*	*			*	*
		Vegetation Management by reducing mowing / cutting regime		*		*			*						*
		Reduce tree shading				*			*	*				*	*
		Increase tree shading				*				*			*	*	*
		Create riparian corridor along channel		*		*				*				*	*
		Tackle invasive species	*	*	*	*				*				*	*
	Conserve & Enhance channel plan form by modifying channel maintenance operations	Reduce dredging					*		*	*		*			*
		Alter weed cutting practises								*		*			*
		Conserve woody debris features	*						*	*		*			*
		Remove some woody debris where channel is choked	*						*			*			*
		Remove trash	*						*			*			*
	Rehabilitate / Conserve & Enhance continuity with floodplain by reducing poaching pressure	Grazing pressure management (reduce livestock)				*	*								*
		Install fencing to prevent livestock access	*			*	*								*
		Install fencing to reduce dog / human access to channel	*			*	*								*
	Rehabilitate channel planform	Bank reprofiling	*	*	*			*		*	*	*		*	*
		Channel narrowing by marginal planting	*	*	*					*	*	*		*	*
		Channel narrowing by in-channel measures e.g. Deflectors or adding woody debris	*	*	*			*		*	*	*		*	*
		Bed level raising	*	*	*			*		*	*	*		*	*
		Create riffles	*	*	*					*	*	*		*	*
		Create backwater	*	*	*					*	*	*		*	*
		Remove bank protection	*	*	*			*		*	*	*			*
	Restore old channel	De silt particular reach	*		*	*	*		*		*				*
	Restore continuity with floodplain	Set back embankments	*	*	*			*			*				*
		Lower embankments	*	*	*			*			*				*
	Restore channel continuity (i.e. Weir, bridge, sluice)	Structure removal	*	*	*			*		*		*		*	*
		Partial removal / lowering	*	*	*			*		*		*		*	*
		Changing sluice control to restore channel	*			*		*	*	*		*		*	*

7. Other plans and programmes

The following sections outline some of the other key programmes of work that are underway or planned on both rivers. In taking the restoration strategy forwards it will be important to consider any potential conflicts the restoration actions may have on these programmes, or vice versa.

7.1. River Basin Management Plan

Ten WFD water bodies within the Test catchment and eight WFD water bodies within the Itchen catchment correspond to the SSSI reaches surveyed. These WFD water bodies have been assigned measures that are to be implemented in order to bring the water bodies into good ecological status for WFD. Although the implementation of the restoration strategy should contribute towards good ecological status in the context of morphology, consideration needs to be given to the measures assigned to each water body in order to ensure there are no conflicts that jeopardise attainment of WFD objectives over the timeframes set out in the River Basin Management Plan, and particularly no deterioration of any quality elements as a result.

7.2. Itchen Navigation Heritage Trail Project

Restoration works have already been carried out as part of the Itchen Navigation Heritage Trail Project (led by the Hampshire and Isle of Wight Wildlife Trust). A number of works were carried out which included: embankment stabilisation by hard and soft engineering techniques; marginal planting; fencing put in place to discourage dog access and therefore reduce poaching of the bank; and footpath improvements. All actions planned for this programme have already been completed and are largely complementary to the aims of the restoration strategy, but in taking the restoration strategy forwards consideration should be taken to the works already undertaken by the Navigation project to avoid conflicting objectives.

7.3. Water Level Management Plans

Over the last 10 years, the Environment Agency and Natural England have been addressing the issue of inappropriate water level management within the SSSIs through implementation of Water Level Management Plans (WLMP) on both the River Itchen (which has been completed) and the River Test. A WLMP identifies areas where the biodiversity of the SSSI is in unfavourable condition due to either a lack of water, or too much water, and proposes actions to remedy this. These actions could range from simple un-blocking of water meadow ditches and implementing hatch operating protocols for off-take structures, to constructing new main river off-take structures to provide water to a SSSI unit, all with the aim of better redistribution of water across the SSSI.

A careful balance between river and floodplain is needed when progressing the River Restoration strategy alongside the WLMP, particularly with any conflicting objectives between the river and floodplain and managing the dwindling water resources. The two projects have the potential to compliment or constrain each other and so it is imperative that the restoration project takes account of implemented WLMP actions, and liaises on planned future WLMP works. Additionally, where actions have been identified under river restoration that can be delivered in parallel with the WLMP, there may be opportunities for both projects to benefit.

7.4. National Environment Programme Investigations

Over the last two years, the Lower Test has been subject to a National Environment Programme (NEP) Water Resource Investigation. Undertaken by Southern Water, with a Steering Group that also comprised the Environment Agency and Natural England, this project has focused on understanding the potential effects of Southern Water's Testwood abstraction on the hydrology and ecology of the Lower Test (including the River Test SSSI and Test Valley SSSI). This study has looked at available hydrology and ecology data to understand if the historical abstraction regime at Testwood has had any detectable effects on the hydro-ecology of the river including fish populations, and additionally whether there are likely to be any further effects if Southern Water were to utilise the current

abstraction licence in full. The focus has therefore been mainly on the reach of the Great Test downstream of the Testwood abstraction.

The technical scope of this project included quantifying potential flow effects for a range of abstraction scenarios and the development of a hydraulic model to look at the interaction between river flows, channel management and river structures on the flow regime (i.e. water depths and velocities) in the Great Test. It also examined the potential impact of abstraction and other river management issues on fish migration, habitats (including the floodplain habitat (to a certain degree) and other species and the potential benefits of some river management and abstraction interventions.

There does seem to be potential for benefits to be realised in this area with river restoration interventions, which may help to increase the resilience of the river in general, including greater resilience against periods of low flows, whether influenced by abstraction or not. This should be kept in mind when taking the Strategy forwards into implementation. The work of the River Restoration strategy is clearly distinguishable and separate from that needed to mitigate the impacts of the abstraction.

7.5. River Test and Itchen Shading Strategy

The Environment Agency, in partnership with Natural England has produced a Climate Change Strategy for the rivers' Test & Itchen, with specific reference to shading from trees. Conceived in 2010, LIDAR and aerial photography has since been used to document the existing extent of tree shading and identify areas where tree planting could be considered. The ultimate aim of the project is to undertake tree planting where practical, and appropriate, to provide the maximum amount of shade to help reduce solar heating of the water. This would benefit salmonid species that are not tolerant to rising water temperatures, primarily salmon and brown trout. The next stages of this project will be to incorporate the climate change mapping into the Test & Itchen River Restoration Strategy. This will ensure the objectives of the two work programmes are suitably aligned.

In addition to this, the Environment Agency has also been producing guidance to support tree planting activities for riparian shading, written to explain the benefits of riparian shade and provide consistent advice on creating riparian shade to support the Environment Agency's initiative on Keeping Rivers Cool.

7.6. Diffuse Water Pollution Plan

Natural England and the Environment Agency are currently consulting on the Diffuse Water Pollution Plans (DWPP) for the Test and Itchen (started 2010). SSSI units covered within this Plan include: The River Test, SSSI units 84-91; the River Itchen SSSI units 103-108; and Alresford Pond SSSI unit 1.

The Plan seeks to identify where diffuse pollution is preventing SSSIs from achieving favourable condition and furthermore it identifies remedies, potential delivery mechanisms, timeframes involved and evidence gaps to address.

As diffuse pollution is a significant issue on both rivers, and more specifically sedimentation is a primary concern in the context of geomorphology pressures, it is important that any River Restoration strategy actions being taken forward consider the objectives and aspirations of the DWPP. There may be opportunities for mutual benefits to be realised between the two work programmes.

7.7. Review of Consents

The Environment Agency has completed a Habitats Directive Stage 4 review of consents are part of its assessment of the licensed abstractions from the River Itchen SAC. This highlighted the need for modifications to several licences for public water supply so that the volume of water abstracted from the SAC is limited during summer months. Furthermore, the EA has imposed a "hands off flow" that means all abstraction needs to stop when the flows fall below a certain critical level with the specific purpose being to protect the environment during low flows.

7.8. Restoring Sustainable Abstraction

In addition to the Review of Consents programme on the Itchen SAC, the Environment Agency is also looking at all licensed abstractions as part of the Restoring Sustainable Abstraction (RSA) programme. The purpose of this is to review existing abstraction licences and the potential effects these may be having on the environment.

The EA then work with abstractors to review the licence conditions and requirements of abstractors to find a balance between their requirements, the downstream requirements of people, businesses and industry and the needs of the environment so that a sustainable level of abstraction is ensured into the future.

Licences are currently being reviewed on both rivers and it will be important to keep this in mind when taking the restoration strategy forwards and working with landowners whose licences may be under review or recently altered.

7.9. Other improvement programmes

At the initial Test & Itchen River Restoration Strategy Steering Group, a mini workshop task was undertaken to identify, at a high level, known works being undertaken, planned or recently completed on both rivers. These include:

- Rivers Test and Itchen weed management review
- Works undertaken or planned by the Test & Itchen Association
- Test & Itchen Catchment Flood Management Plan actions
- Test & Itchen Catchment Abstraction Management Strategy
- Your Test Valley Plan
- Removal of obstructions to fish passage presented by EA gauging weirs
- Monitoring the vegetation on the River Itchen
- WWF Rivers on the Edge
- River Anton Enhancement Strategy
- Stockbridge River Restoration Strategy
- Romsey's Waterways and Wetlands Enhancement Strategy
- Mottisfont restoration works
- Winnall Moors Restoration Project
- Fulling Mill and Abbots Worthy restoration actions
- Itchen Valley Grazing Project
- Southern Chalkstreams project

When taking the Restoration Strategy forwards, consideration needs to be made of the other improvement programmes that have been undertaken (or are planned). In some cases, these programmes may present potential conflicting objectives, and in others there may be opportunities for mutual benefits to be realised (either ecological or in terms of funding mechanism).

(Please note: it is recognised that the above list may not contain all actions past, underway or planned. It simply captures some of the examples highlighted during the Steering Group meeting in September 2012. When the restoration strategy is taken forwards, a more thorough assessment of other projects should be undertaken).

8. Prioritisation and Costs

8.1. Prioritisation

Some restoration actions can be implemented immediately with no need for lengthy planning, consultation or consenting phases and little or no external funding being required. This could include, for example, a reduced approach to vegetation management or slight alteration in the operation of an existing flow control structure. Within the restoration strategy, most of the common actions defined for many reaches include some degree of altered vegetation management and so changes such as these can be made immediately with existing advice and support from the Environment Agency and Natural England and could continue on into the future. The benefits of these actions for the SSSI would also be realised very quickly and are considered the “quick wins”, although it is understood that some consultation will be required between stakeholders such as fishing groups.

Larger scale actions will inevitably require feasibility and design stages, more planning and consultation and a higher level of support financially and these may take longer to bring about, particularly if there is uncertainty in the funding environment. Actions in this category could include alterations or removal of larger structures and long term land use change.

Table 14 presents the restoration actions included in this strategy, the likely cost to implement and the timeframes over which they could be implemented (assuming funding is readily available). Please note these timeframes are indicative only, showing relative differences in timeframes for the various restoration actions.

Other important considerations in planning restoration activities (aside from scale of the works, likely cost and timeframes for funding mechanisms) are the following:

- Consenting process – Environment Agency Flood Risk Consent, Natural England SAC/SSSI consenting, consents related to transfer of water (Water Resource License), heritage consents and planning permissions etc.
- Post implementation monitoring

The lead in time for consents will largely depend on the scale of the works, the ecological and flood risks involved, and the level of stakeholder and statutory consultation required.

As an indication, Table 15 below shows the time constraints posed by some of the designated species present in the SSSIs. Other species will also need to be considered in particular locations, such as the Southern Damselfly. These represent guidelines only and if planning works it is best to talk to the Environment Agency and Natural England as appropriate since the type and scale of works undertaken will influence what mitigation measures may be necessary.

Table 14 : Prioritisation of works

Scale of works (increasing)	Restore / Rehabilitate / Conserve & Enhance	Action	Cost to implement	Timescale (years)						
				0	1	2	3	4	5 to 10	10 to 30
	Rehabilitate / Conserve & enhance riparian zone	Riparian Planting	Low							
		Vegetation Management by reducing mowing / cutting regime	Saving							
		Reduce tree shading	Low							
		Increase tree shading	Low							
		Create riparian corridor along channel	Low							
		Tackle invasive species	Low							
	Conserve & Enhance channel plan form by modifying channel maintenance operations	Reduce dredging	Saving							
		Alter weed cutting practises	Low							
		Conserve woody debris features	Saving							
		Remove some woody debris where channel is choked	Low							
		Remove trash	Low							
	Rehabilitate / Conserve & Enhance continuity with floodplain by reducing poaching pressure	Grazing pressure management (reduce livestock)	Medium							
		Install fencing to prevent livestock access	Low							
		Install fencing to reduce dog / human access to channel	Low							
	Rehabilitate channel planform	Bank reprofiling								
		Channel narrowing by marginal planting	Low							
		Channel narrowing by in-channel measures e.g. Deflectors or adding woody debris	Low							
		Bed level raising	Medium							
		Create riffles	Medium							
		Create backwater	Medium							
		Remove bank protection	Medium / High							
	Restore old channel	De silt particular reach	Medium / High							
	Restore continuity with floodplain	Set back embankments	Medium / High							
		Lower embankments	Medium / High							
	Restore channel continuity (i.e. Weir, bridge, sluice)	Structure removal	High							
		Partial removal / lowering	High							
		Changing sluice control to restore channel	Low / Medium							

Table 15: Designated species survey and mitigation requirements

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Birds	Survey	Winter birds		Breeding birds/migrant species			Breeding birds		Breeding birds/migrant species			Winter birds	
	Mitigation	Tree clearance works may be conducted but must stop if nexting birds are found		Bird nesting season. No clearance or construction works						Tree clearance works may be conducted but must stop immediately if nesting birds are found			
Badgers	Survey	All survey methods - best time is in spring and early autumn/winter											
	Mitigation	No disturbance of existing sets						Stopping up or destruction of existing sets permitted					No disturbance of existing sets
Bats	Survey	Inspection of hibernation, tree and building roosts			No surveys	Activity surveys and inspection of building roosts. Emergence counts					No surveys	Inspection of hibernation, tree and building roosts	
	Mitigation	Works on maternity roosts		Works on maternity roosts until mid May. Works on hibernation roosts from mid March			Works on hibernation roosts only			Least disturbance to breeding and hibernating roosts			Works on maternity roosts only
Otters	Survey	Surveys for otters can potentially be conducted all year round, though vegetation cover and weather conditions may limit success											
	Mitigation	Work can be carried out in any month, but it is likely to be restricted where otters are found to be breeding which can be in any month of the year											
Water Voles	Survey	Reduced activity	Initial surveys possible	All survey methods can be used though vegetation cover and weather conditions may limit success. Optimum time is March to June								Initial surveys possible	Reduced activity
	Mitigation	Works in water vole habitat possible		Works in water vole habitat must be undertaken with appropriate mitigation measures								Works in water vole habitat possible	
White Clawed Crayfish	Survey	Reduced activity			Surveys can be undertaken	Avoid surveys as females are releasing young		Optimum survey time				Reduced activity	
	Mitigation	Avoid capture programmes. Low activity may lead to animals being easily missed			Exclusion of crayfish from construction areas	Avoid capture programmes		Exclusion of crayfish from construction areas				Avoid capture programmes. Low activity may lead to animals being easily missed	
Fish	Survey	The timing of surveys will depend on the migration pattern of the species concerned. Where surveys require information on breeding, the timing of surveys will need to coincide with the breeding period, which may be summer or winter months depending on the species. Advice should be sought from the EA fisheries team											
	Mitigation	Protection of water courses is required at all times of the year. Work will need to be timed so as to avoid the breeding season of the species present. This varies from species to species											
	Survey	The timing of surveys will depend on the migration pattern of the species concerned. Where surveys require information on breeding, the timing of surveys will need to coincide with the breeding period, which may be summer or winter months depending on the species. Advice should be sought from the EA fisheries team											
	Mitigation	No in-channel works in spawning areas				Works in spawning areas permitted						No in-channel works in spawning areas	

8.2. Costs

Costs to deliver the river restoration strategy have been developed and are outline in Table 16 and Table 17 Assumptions for the calculations are shown in Table 18. The costs have been developed on the assumption that all the measures identified in the reach scale restoration options will be required at the length outlined on the plans to get each of the reaches, and then the subsequent SSSI into favourable condition. The cost is therefore likely to be an over estimate of the fund necessary to deliver each of the SSSI towards favourable condition. The costs derived for each SSSI unit and the measures required in Table 16 and Table 17. A high and low estimate for the cost for delivering the Test and Itchen river restoration strategies was calculated based on a 20% variance above and below the cost estimated. Potential funding streams to deliver the actions and the prioritisation of them are detailed in Section 6.4 and Section 8.1, respectively.

Table 16: Cost for delivering the River Test river restoration strategy

SSSI Unit	Action	Total Cost £ (Nearest Thousand)	Low Cost £ (-20%)	High Cost £ (+20%)
84	Alter weed cutting management practices	7000		
	Change sluice control to restore channel	0		
	Channel narrowing by instream measures	782000		
	Channel narrowing by planting	4000		
	De-silting	24000		
	Modify hatch/sluice control	26000		
	Removal or partial removal/lowering of structure	9000		
	Remove bank protection	316000		
	Remove weirs	4000		
	Vegetation management	43000		
84 Total		**1,215,000**	**972,000**	**1,458,000**
85	Bed level raising	563000		
	Change sluice control to restore channel	0		
	Channel narrowing by instream measures	681000		
	Fencing - Livestock	24000		
	Grazing pressure management	0		
	Reduce dredging	-138000		
	Removal or partial removal/lowering of structure	11000		
	Remove bank protection	148000		
	Riparian planting	87000		
	Tackle invasive species	12000		
	Vegetation management	34000		
85 Total		**1,422,000**	**1,137,600**	**1,706,400**
87	Alter weed cutting management practices	31000		
	Bed level raising	736000		
	Change sluice control to restore channel	0		
	Channel narrowing by instream measures	51000		
	Fencing - Livestock	4000		
	Grazing pressure management	0		
	Reduce dredging	-455000		
	Removal or partial removal/lowering of structure	4000		
	Riparian planting	488000		
	Vegetation management	55000		
87 Total		**916,000**	**732,800**	**1,099,200**
88	Bed level raising	3712000		
	Change sluice control to restore channel	0		
	Channel narrowing by instream measures	1234000		
	Create backwater	434000		
	De-silting	537000		
	Fencing - Humans/dogs	20000		
	Fencing - Livestock	23000		
	Modify hatch/sluice control	53000		
	Reduce tree shading	10000		
	Removal or partial removal/lowering of structure	2000		
	Restore channel planform	206000		

	Restore continuity with floodplain	486000		
	Riparian planting	1061000		
	Vegetation management	105000		
88 Total		**7,882,000**	**6,305,600**	**9,458,400**
89	Bed level raising	2261000		
	Change sluice control to restore channel	0		
	Channel narrowing by instream measures	615000		
	De-silting	982000		
	Reduce tree shading	7000		
	Removal or partial removal/lowering of structure	6000		
	Remove weirs	9000		
	Riparian planting	39000		
	Vegetation management	34000		
89 Total		**3,955,000**	**3,164,000**	**4,746,000**
90	Bed level raising	502000		
	Channel narrowing by instream measures	187000		
	Create backwater	882000		
	Create riffles	1149000		
	Fencing - Livestock	42000		
	Removal or partial removal/lowering of structure	4000		
	Re-profiling channel banks	108000		
	Restore continuity with floodplain	198000		
	Riparian planting	79000		
	Vegetation management	28000		
90 Total		**3,179,000**	**2,543,200**	**3,814,800**
91	Channel narrowing by instream measures	86000		
	Remove bank protection	20000		
	Riparian planting	15000		
	Tackle invasive species	26000		
	Vegetation management	26000		
91 Total		173000		
	Test Total (Units 84, 85, 87, 88, 89, 90 and 91)	**18,741,000**	**14,992,800**	**22,489,200**
86	Alter weed cutting management practices	28000		
	Change sluice control to restore channel	0		
	Channel narrowing by instream measures	303000		
	De-silting	57000		
	Reduce dredging	-256000		
	Reduce tree shading	14000		
	Removal or partial removal/lowering of structure	6000		
	Remove bank protection	164000		
	Restore channel planform	90000		
	Riparian planting	18000		
	Vegetation management	29000		
86 Total	**Dever Total**	454000	363200	544800
	Overall Total	**19,195,000**	**15,356,000**	**23,034,000**

Table 17: Cost for delivering the River Itchen river restoration strategy

SSSI Unit	Action	Total Cost (Nearest Thousand)	Low Cost (-20%)	High Cost (+20%)
103	Channel narrowing by instream measures	143000		
	Fencing - Livestock	37000		
	Grazing pressure management	0		
	Modify hatch/sluice control	31000		
	Reduce tree shading	1000		
	Vegetation management	3000		
103 Total		**215,000**	**172,000**	**258,000**
105	Grazing pressure management	0		
105 Total		**0**		
106	Change sluice control to restore channel	0		
	Channel narrowing by instream measures	299000		
	Create riffles	297000		
	Fencing - Livestock	9000		
	Remove bank protection	56000		
	Riparian planting	55000		
	Vegetation management	7000		
106 Total		**723,000**	**578,400**	**867,600**
107	Bed level raising	1707000		
	Channel narrowing by instream measures	501000		
	Channel narrowing by marginal planting	134000		
	De-silting	1057000		
	Fencing - Humans/dogs	13000		
	Fencing - Livestock	23000		
	Grazing pressure management	0		
	Modify hatch/sluice control	88000		
	Removal or partial removal/lowering of structure	10000		
	Riparian planting	395000		
	Vegetation management	35000		
107 Total		**3,963,000**	**3,170,400**	**4,755,600**
108	Channel narrowing by instream measures	219000		
	De-silting	361000		
	Fencing - Humans/dogs	9000		
	Fencing - Livestock	58000		
	Install fencing to reduce erosion	18000		
	Reduce tree shading	2000		
	Restore continuity with floodplain	41000		
	Riparian planting	174000		
	Vegetation management	21000		
108 Total		**903,000**	**722,400**	**1,083,600**
	Itchen Total (Units 103, 105, 106, 107 and 108)	**5,809,000**	**4,647,200**	**6,970,800**
105	Channel narrowing by instream measures	63000		
	Fencing - Livestock	14000		
	Grazing pressure management	0		
	Restore channel planform	298000		
	Restore continuity with floodplain	162000		

	Riparian planting	33000		
105 Total	**Candover Stream Total**	**569,000**	**455,200**	**682,800**
104	Channel narrowing by instream measures	57000		
	Channel narrowing by planting	14000		
	Create riparian corridor	9000		
	Fencing - Humans/dogs	7000		
	Reduce tree shading	5000		
	Restore channel planform	46000		
	Riparian planting	33000		
	Vegetation management	2000		
	Fencing - Livestock	4000		
104 Total	**Arle Total**	**177000**		
	Overall Total	**6,551,000**	**5,240,800**	**7,861,200**

Table 18: Cost assumptions for various proposed measures on the Test and Itchen

ID	Action	Unit description	Rate used: £/m	Comments/assumptions
1	Add soft bank protection	m	88	Faggot work narrowing 1 bank
2	Alter weed cutting management practices	m	-10	Boat + excav + boom: 1/2 costs
3	Bed level raising	m	270	Wensum* glide - no fine gravel
4	Change sluice control to restore channel	m	0	No change in costs
5	Channel narrowing by instream measures	m	88	Faggot work narrowing 1 bank
6	Channel narrowing by planting	m	60	Sub faggots for planted coir
7	Create backwater	m	416	Wensum *backwater cost
8	Create riffles	m	476	Wensum * glide
9	De-silting	m	145	Dredging cost
10	Fencing - Humans/dogs	m	16	Plain wire fencing
11	Fencing - Livestock	m	20	Sheep fencing
12	Fencing - Erosion	m	18	Barbed wire fencing
13	Grazing pressure management	m	0	No change as management time remains same
14	Modify hatch/sluice control	per m of control width	4400	Replace with penstock with civils work
15	Reduce dredging	m	-145	1/2 of re-calculated costs
16	Reduce tree shading	m	11	Wensum * tree trimming
17	Remove bank protection	m	156	Halcrow *derived cost
18	Remove weirs	per m of control width	720	Cost is per m river width
19	Removal or partial removal/lowering of structure	per m of control width	360	Cost is per m river width
20	Removal of trash blockages	per item	1285	Cost is per blockage
21	Re-profiling channel banks	m	58	Wensum * channel re-section
22	Restore channel planform	m	163	Wensum * channel realign
23	Restore continuity with floodplain	m	160	Wensum * remove spoil bank and add swale
24	Riparian planting	m	60	as per channel narrowing planting
25	Tackle invasive species	m	5	same as vegetation management
26	Weed screen removal/management	m	180	Cost is per m river width
27	Vegetation management	m	5	Hand work: 1/2 boat cost

*Note: Figures in relation to the River Wensum are based on the experience of implementing the River Wensum SSSI strategy on the ground with our partners the Environment Agency and Natural England. Halcrow refers to the spreadsheet on river restoration costings developed by Halcrow for the Environment Agency (Environment Agency, 2008).

8.3. Strategy implementation

This management report and the accompanying technical report together form the restoration strategy/vision for the Test and Itchen which sets out the restoration aspirations over the next 20 to 30 years and the types of restoration measures that could be carried out to achieve favourable condition in the SSSIs/SAC. This document will be used in future to support decision making and prioritisation of work on both rivers. However, it is important to note that the types of measures contained herein are not definitive and do not obligate landowners/land managers/stakeholders to the specific actions. It is recognised that a lot of work needs to be done to bring about the changes set out within the strategy, and that this will require further feasibility investigations alongside effective, proactive and positive stakeholder engagement with landowners, land managers and other stakeholders. As the strategy progresses it will also be advisable that good practice actions and evidence of successful measures be shared around interested parties in the two catchments. This will ensure that learning lessons can be maximised and an evidence base for improvement measures be developed.

Further work needs to be undertaken to understand the specific constraints on the various restoration actions at a site level, such as those posed by commercial interests (such as fishing and farming) land use, flood risk, development, infrastructure and cultural heritage.

Following publication of the final plan, Natural England and the Environment Agency will work with stakeholders to take forward the actions within the plan. Whilst some options will be able to be implemented relatively quickly over the next few years, other measures will take longer to develop. This plan is a long-term restoration strategy likely to be realised over the next 20 to 30 years.

9. References

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Appendix A. Figures

THE FOLLOWING APPENDIX A. FIGURES HAVE NOT BEEN INCLUDED IN THE MAIN TEST AND ITCHEN RESTORATION STRATEGY DOCUMENT. THEY ARE PROVIDED WITHIN AN ACCOMPANYING APPENDIX A FOLDER.

A.1. Structures along the River Test

A.2. Structures along the River Itchen

A.3. Restoration category per reach – Test

A.4. Restoration category per reach – Itchen

A.5. Restoration actions per reach – Test

A.6. Restoration actions per reach – Itchen

Appendix B. Summary of restoration potential per reach

B.1. Summary of restoration potential per reach on the River Test

B.2. Summary of restoration potential per reach on the River Itchen

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