The South Cornwall River Improvement Project

A Catchment Restoration Fund Project

IMERYS

Forestry Commission England

Westcountry Rivers Trust

Environment Agency

NATURAL ENGLAND

SOUTH WEST WATER

THE wildlife TRUSTS Cornwall

A clear solution for farmers
CATCHMENT SENSITIVE FARMING

one and all · onen hag oll
CORNWALL COUNCIL

The Lost Gardens of HELIGAN

The South Cornwall River Improvement Project (SCRIP) was a Catchment Restoration Funded Project, which was administered by the Environment Agency. The project was written and delivered by the Westcountry Rivers Trust and steered by its catchment partnership.

The project was delivered over three years (2012-2015), with the primary aim of delivering targeted action to make significant steps towards achieving Water Framework Directive (WFD) waterbody objectives set out in the 2009 River Basin Management Plans.

This report documents the works delivered under the SCRIP and describes how these works were targeted to ensure that efficient on the ground management was delivered effectively throughout the catchment.

Although the SCRIP has completed its final year, the work that has been delivered and the valuable information and data that has been collected will provide a solid foundation to build upon in the future. This not only provides wider benefits to the society and the environment, but also provides a valuable tool to aid in building a sustainable future for the catchment as whole.

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Image: River Warleggan.

The Catchment Restoration Fund

The Department for Environment, Food and Rural Affairs (Defra) created the Catchment Restoration Fund (CRF) in 2012 to help achieve the Water Framework Directive (WFD) status objectives set out for waterbodies in the 2009 River Basin Management Plans (RBMPs).

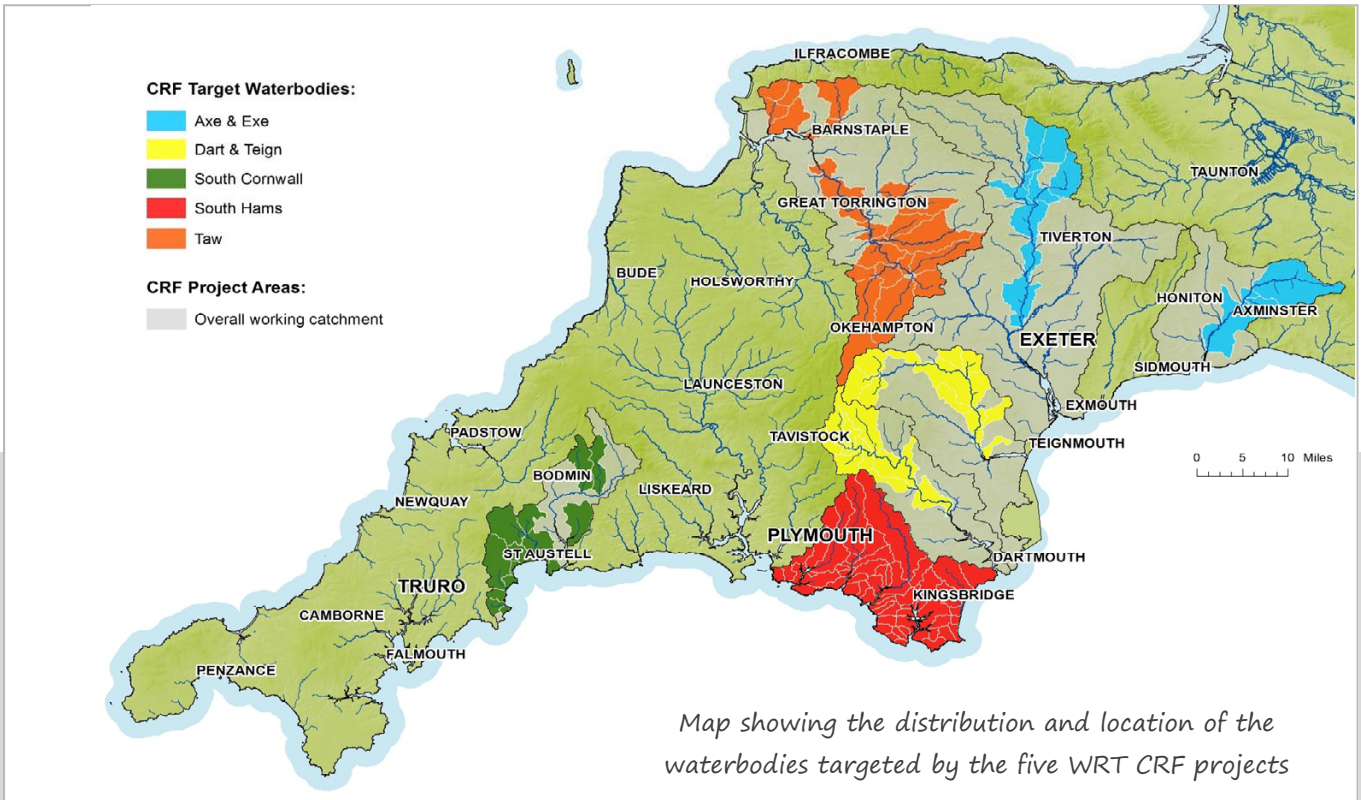
The fund was allocated for projects in England to be delivered in 2012/13, 2013/14 and 2014/15. The CRF was administered by the Environment Agency to support third sector organisations to deliver catchment-level projects designed to fulfil the following objectives:

- Restore natural features in and around watercourses;
- Reduce the impact of man-made structures on wildlife in watercourses;
- Reduce the impact of diffuse pollution that arises from rural and urban land use.

While the South West of England has some of the UK's most iconic and beautiful rivers, many of them are experiencing pressures, both current and historic, that limit their ability to function naturally and which cause them to become ecologically degraded.

In 2012, responding to these problems, the Westcountry Rivers Trust (WRT) secured CRF funding to deliver over £4 million of river restoration and catchment management work over three years on river catchments across the South West. These river and catchment restoration projects have been delivered on the rivers of the South Hams, the Axe and Exe, the Dart and Teign, the Rivers of South Cornwall and the Taw.

These river improvement projects were specifically developed using a rigorous evidence-led, partnership approach to mitigate the pressure acting on these rivers and improve the health of these precious and vital river ecosystems.



Map showing the distribution and location of the waterbodies targeted by the five WRT CRF projects

River Catchment Overview

St Austell Bay Rivers

The majority of these rivers share similar characteristics where the headwaters have been affected by historic and contemporary mining with the lower section channels being modified. The Par catchment rises around Criggan Moors near the villages of Roche and Bugle at an altitude of around 130m.

Many of the St Austell Bay rivers flow through water dependent designated areas including Breney Common SAC/SSSI, Red Moor SSSI and several County Wildlife Sites.

Due to historic engineering the lower section of the Par river is heavily modified and canalised and therefore lacks many features suitable for fish, invertebrates and many other forms of wildlife.

The St Austell River or 'The White River' has an area of approximately 39km and rises near Carthew and discharges at Pentewan Beach. The upper catchment is heavily influenced by historic and contemporary clay extraction which leads to heavy outflows of clay washing from extraction points, which have high suspended sediment and turbidity levels. These discharges have significant affects upon the water quality and ecology of the river. Below St Austell the river becomes heavily modified and straightened consequently reducing habitat diversity, providing few features to encourage fish and other aquatic fauna.

The Mevagissey, Port Mellon and Gorran stream are small coastal catchments. The headwaters are dominated by agriculture which is the main pressure acting on these water bodies. There are also large areas of woodland particularly in the Mevagissey stream. The lower section of the Mevagissey is culverted which is known to prevent the movement of migratory fish. There are also culverts in the upper catchment which restrict the movement of fish. The Mevagissey river failed WFD for fish (poor) although it is thought that the water quality is generally good, which would make re-colonisation possible.

The rivers of the St Austell bay area, although generally small do have a significant effect on bathing water quality, with the beaches Polkerris, Port Mellon and Gorran Haven only just passing the Bathing Water Directive limits).

South Cornwall Rivers	
Catchment Size	426 km^2
St Austell Bay Rivers	Par, St Austell & Portmellion
Fowey Rivers	Warleggan, St Neot & Lerryn
Designations	SSSI, SAC & AONB
Species	Atlantic Salmon, Bullhead, Trout, Otter, Eel, Lamprey
WFD RFF	Fish, Phosphate, Phytobenthos, Metals (Copper & Zinc)

Fowey Rivers

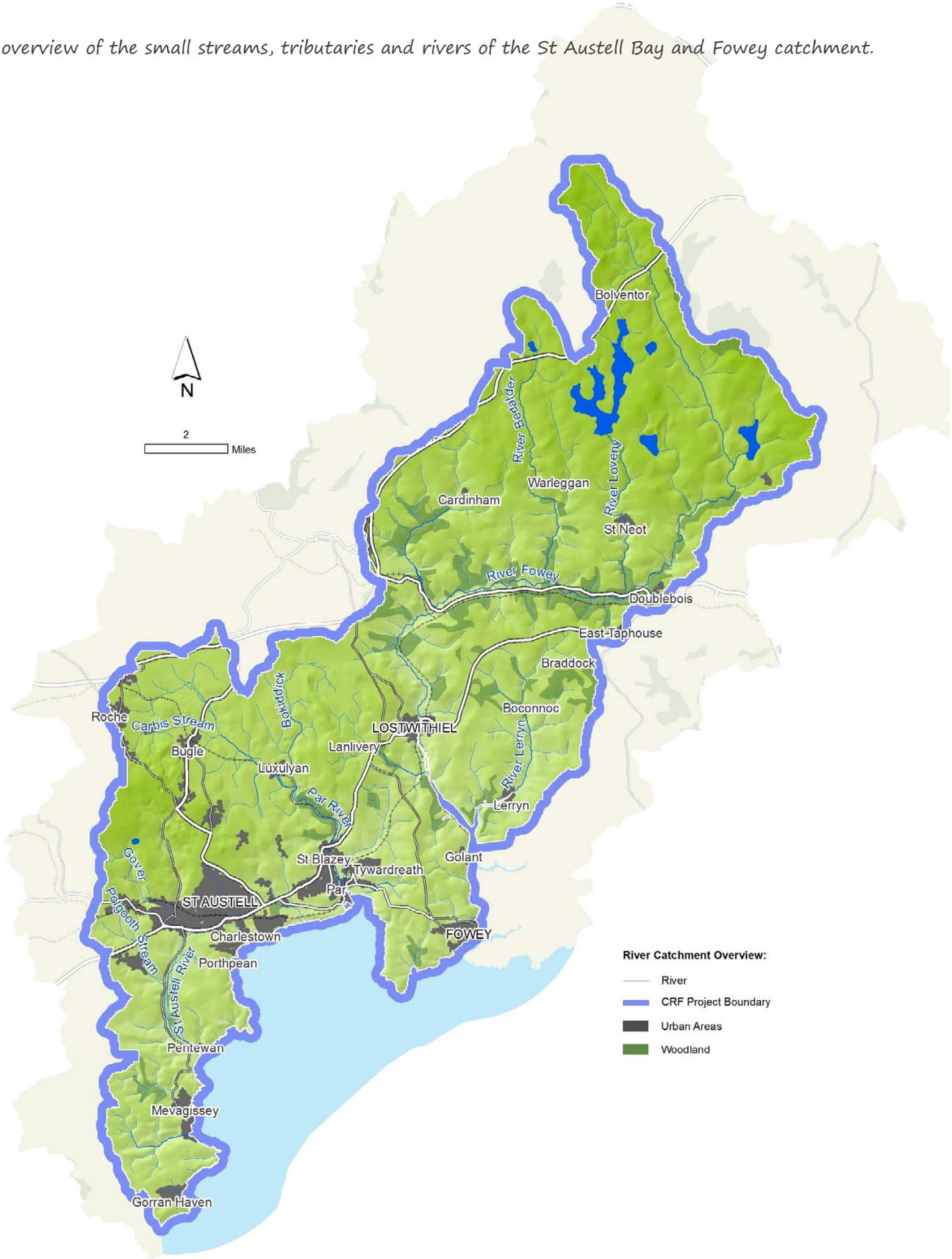
The Warleggan and St Neot rivers rise on Bodmin Moor and are of similar size and topography. Both of these tributaries drain into the main river Fowey which is the largest river catchment in South Cornwall at 177km^2. The headwaters can be considered extensive moorland which is conducive to good water quality, whereas further down the catchment there is more intensive mixed farming including dairy and arable farms.

There are also extensive areas of woodland in the catchment including more natural deciduous woodland and large coniferous plantations. There is no heavy industry in the catchment but there are large areas of historic mining which have left their legacy on the environment, resulting in high levels of copper and zinc in some streams. The Fowey is the principle water abstraction resource for Cornwall and as such is important in the delivery of multiple ecosystem services.

Although similar to the Warleggan in topology, the St. Neot river is impounded by Colliford Lake Reservoir which provides a significant proportion of Cornwall's mains water. This has had a huge effect on the flow regime, as well as affecting the transport of bed-load and penetration of migratory fish upstream. Water is released from the reservoir and transported downstream where it can then be extracted at Restormal on the main river near the tidal limit.

River Catchment Overview

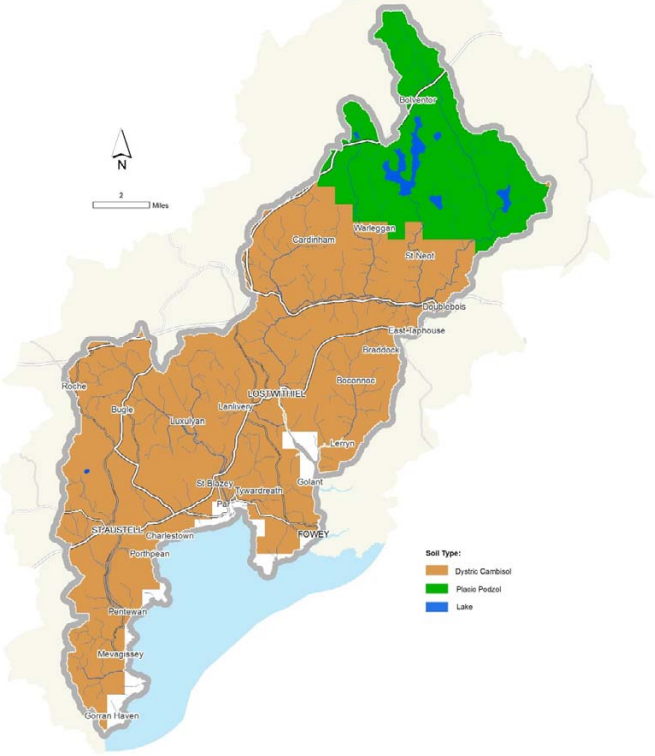
An overview of the small streams, tributaries and rivers of the St Austell Bay and Fowey catchment.



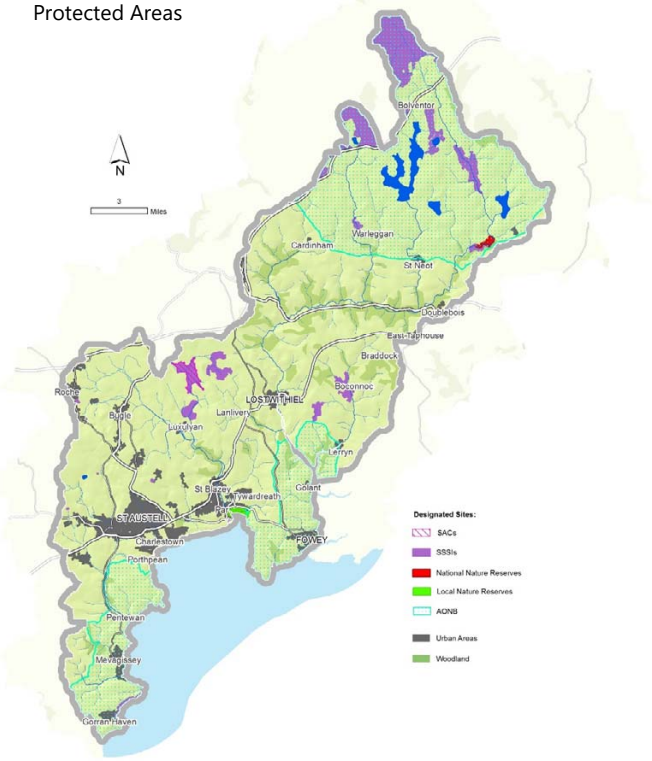
River Catchment Overview

Landscape Characteristics of the Teign & Dart

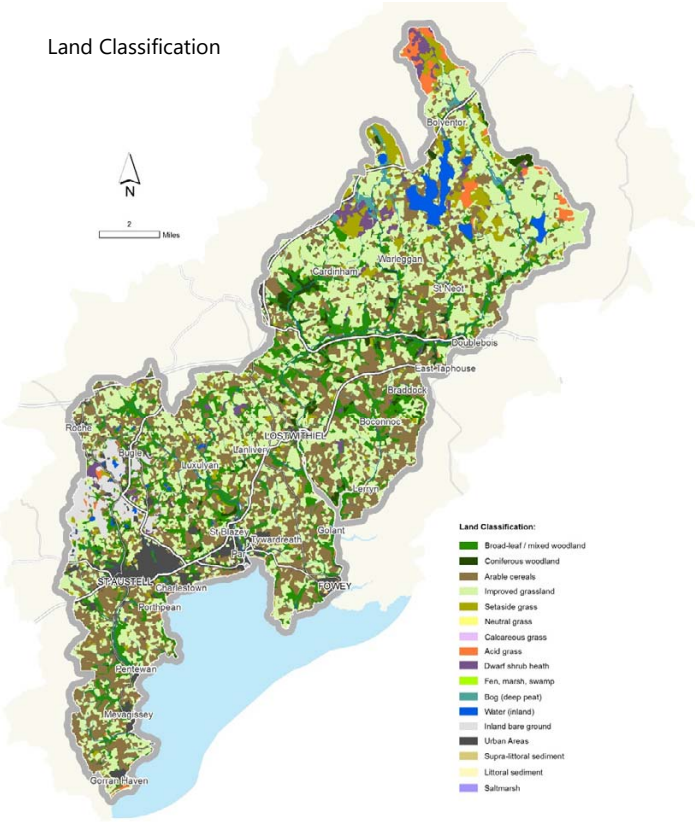
Distribution of soil type



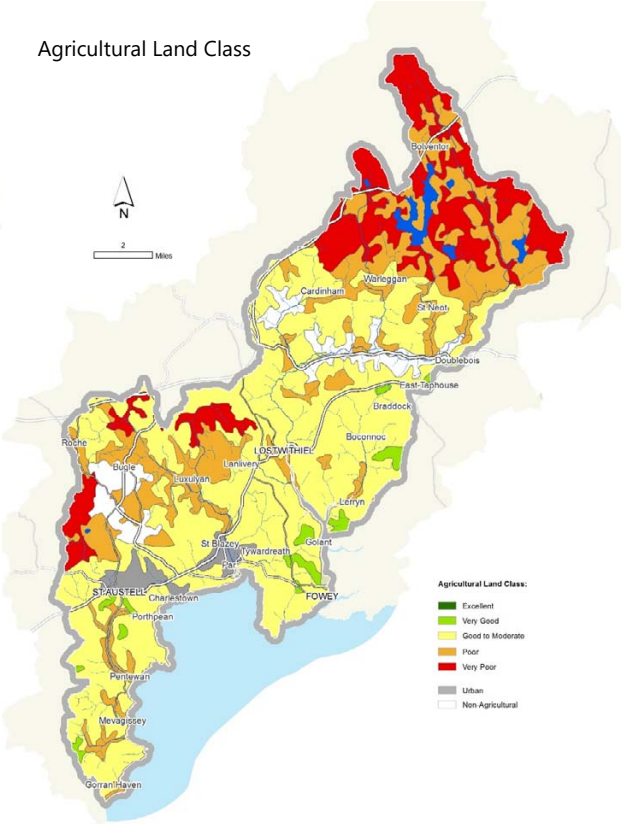
Designated Sites & Protected Areas



Land Classification



Agricultural Land Class



WFD Classification

The most important set of evidence that we can use to assess the condition of the waterbodies in the Teign and Dart river catchments is their Water Framework Directive (WFD) classification. The associated Reason for Failure information collected by the Environment Agency also helps us target interventions to mitigate pressures acting on these waterbodies. This data is shown on the following two pages.

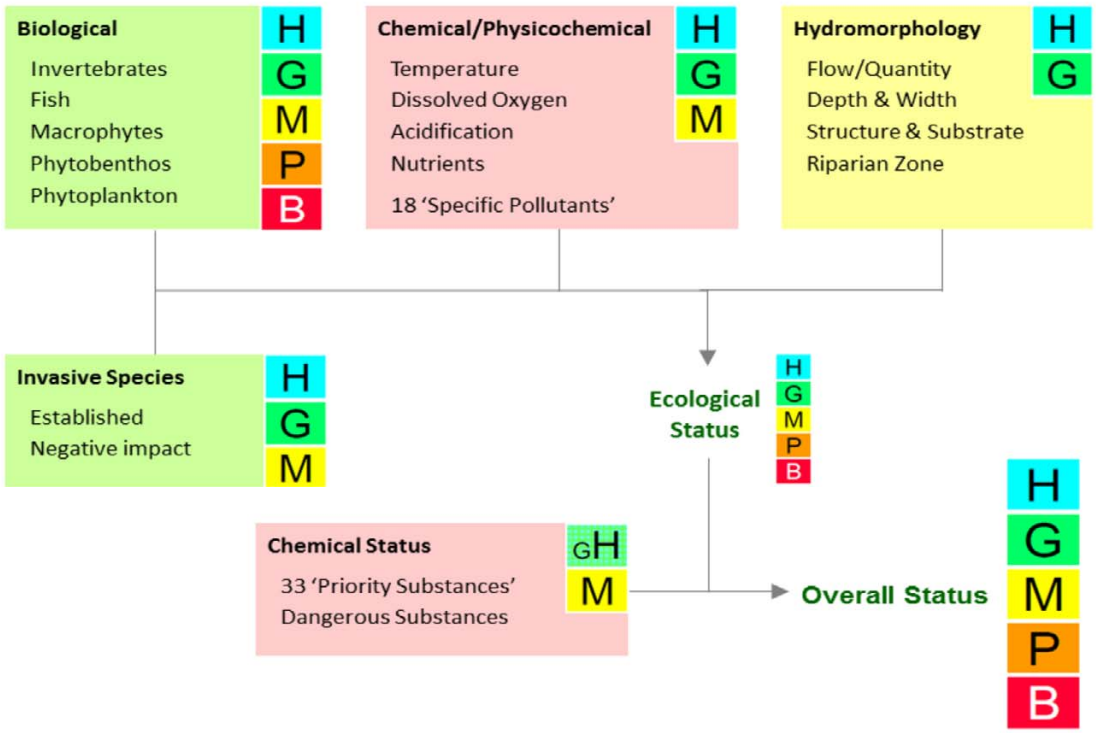
WFD condition assessments are currently undertaken by the Environment Agency using methodologies agreed with the UK Technical Advisory Group (UK TAG) and recommendations for remedial catchment management interventions are made through River Basin Management Plans (RBMPs).

For surface waters, such as rivers and lakes, the 'overall status' of a waterbody is comprised of an ecological and a chemical component. The ecological status of a waterbody is primarily measured using a series of biological parameters and is recorded on the scale high, good, moderate, poor and bad (with moderate or worse being regarded as failure).

To determine a WFD classification the degree of disturbance to each quality element is assessed against a 'reference value or set of values' for that element. A reference value for a biological quality element is a value identified from the range of values the quality element may have when subject to no or only very minor alteration as a result of human disturbance (i.e. when it is in a reference, or high status, condition).

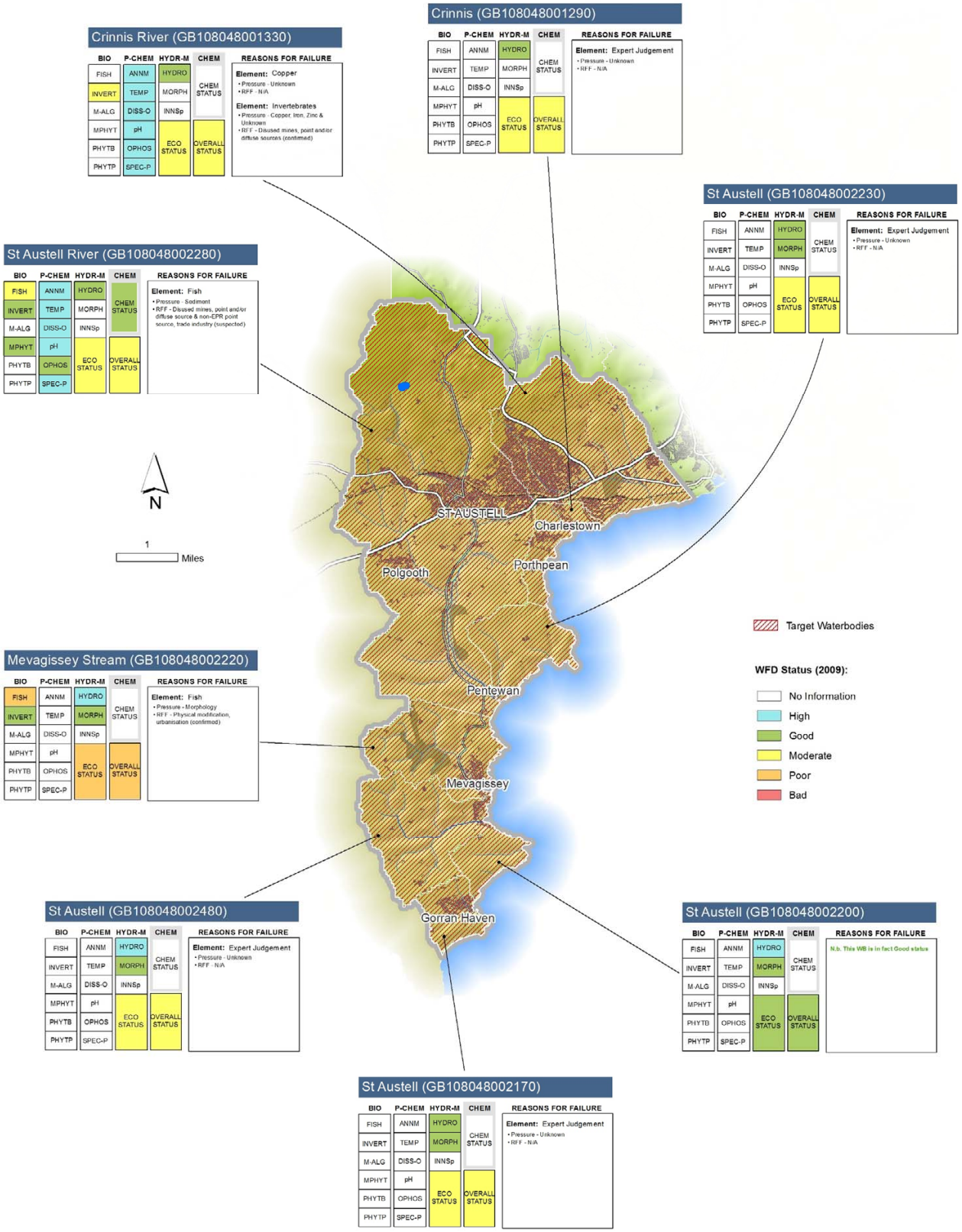
In addition to the biological characterisation of waterbody condition, classifications are also supported by assessments of three further components of the environment: 1) morphology (physical structure); 2) hydrology (flow and water levels), and 3) chemistry (including general water quality, physico-chemistry, and chemical pollutants.). Annex V of the WFD identifies these components as 'elements supporting the biology'.

The schematic below shows how Overall WFD status is determined. Once the individual elements have been assessed the lowest classification recorded for any of the parameters will form the final WFD classification for that waterbody (this is referred to as 'one out, all out').



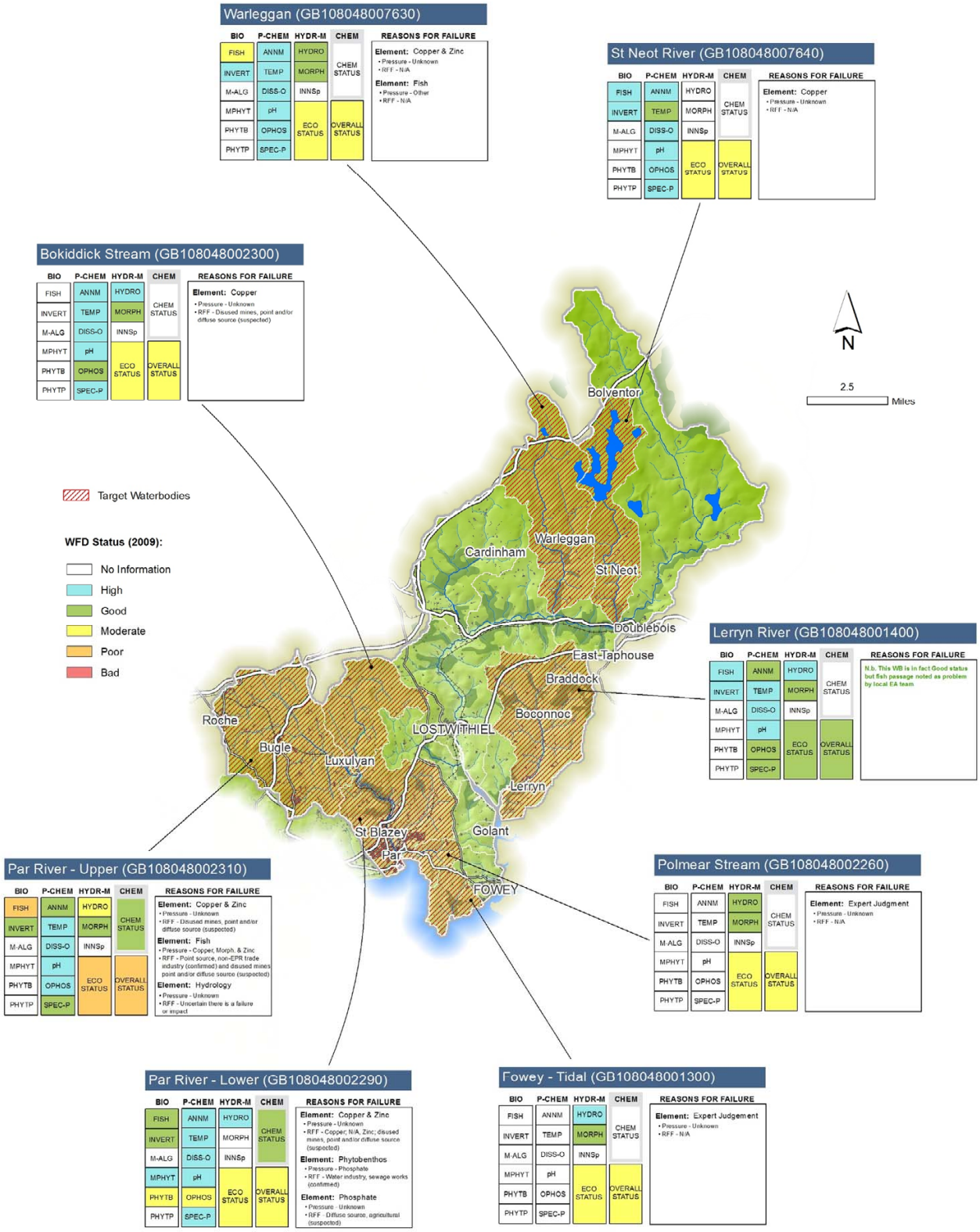
West Catchment Report Card 2009

Map showing 2009 WFD Classifications and Reasons for Failure



East Catchment Report Card 2009

Map Showing 2009 WFD Classifications and Reasons for Failure



The South Cornwall River Improvement Project (SCRIP)

The catchments included within the South Cornwall Rivers Improvement Project (SCRIP) are the St Austell Bay Rivers and the Fowey.

There were a number of pressures that affect the WFD status of the South Cornwall Rivers, many of which have failed to reach good ecological status. The SCRIP aimed to improve the catchment's WFD status by restoring its rivers and riparian habitats though a variety of well monitored and practical methods.

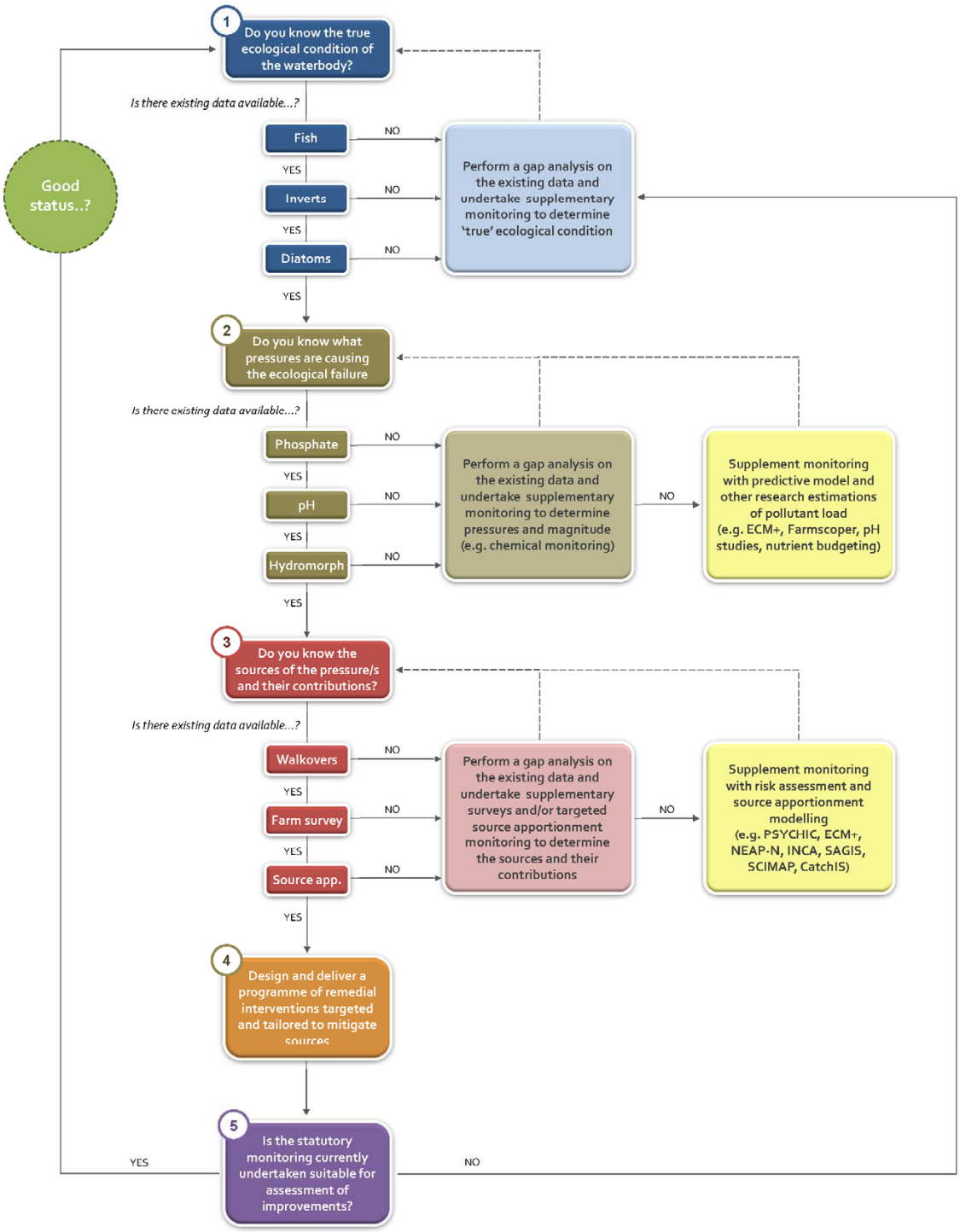
Some benefits of the SCRIP include helping to improve water quality; improve the ecological health and biodiversity of the river and its surrounding habitats; create a better environment for recreation and angling, and conserve and restore fish populations.

The SCRIP was led by the WRT in partnership with IMERYS, The Environment Agency, South West Water, Cornwall Council, The South West Rivers Association, Natural England, Cornwall AONB, Catchment Sensitive Farming, The Fowey Rivers Association, Heligan Gardens and the Forestry Commission.

St Austell China Clay Works by Paul Glendell

This report

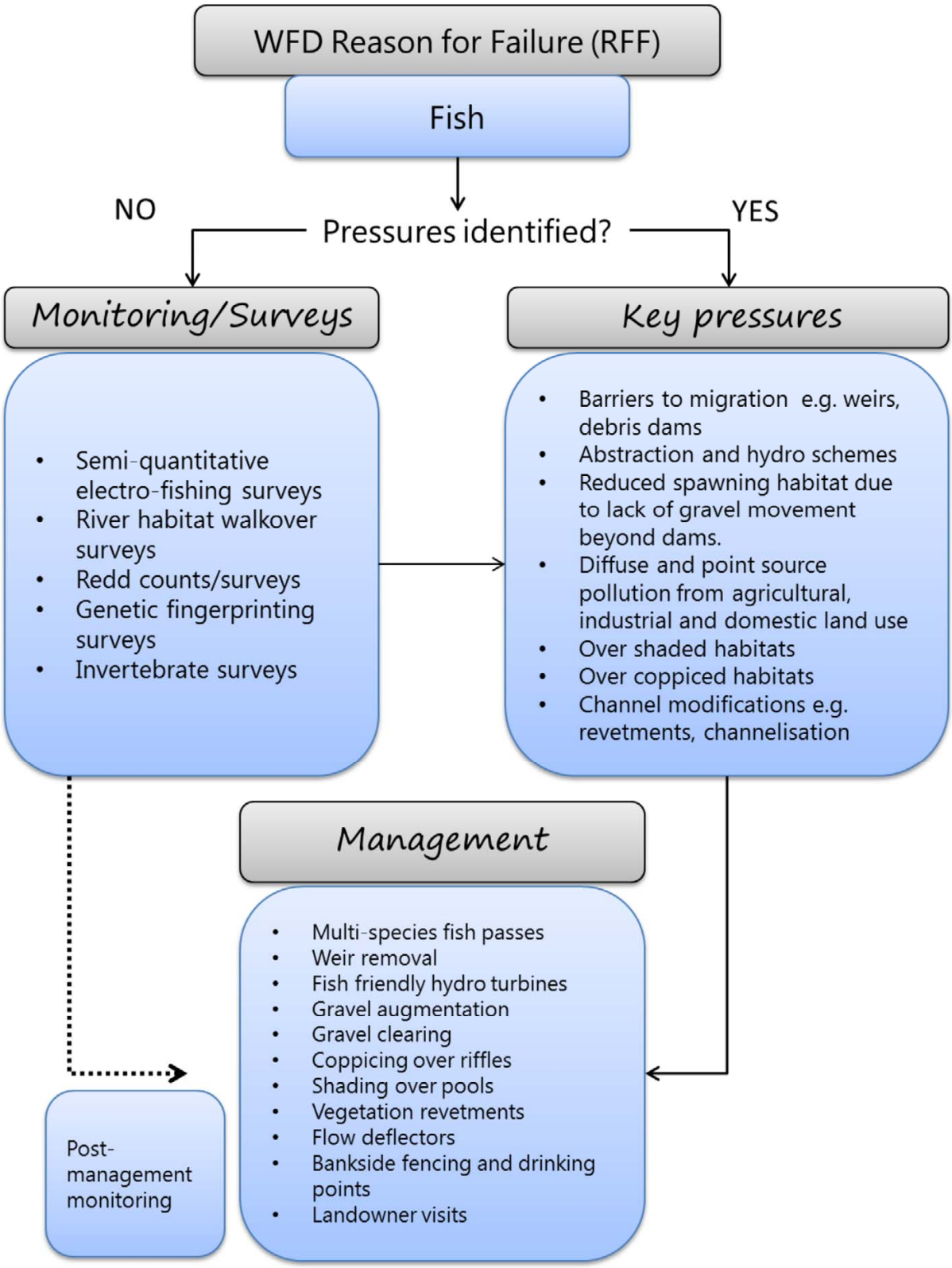
This Catchment Restoration Funded Project report has been written from a WFD Reason for Failure point of view. This is because all of the work conducted within the project was designed to address specific environmental pressures, aiming to restore freshwater habitats to their natural condition and target waterbodies failing to reach good ecological status under the WFD. Therefore the report has been divided into specific chapters relating to each reason for failure, where a full account of the investigations and works conducted to address those failures have been made.




FISH

Targeting interventions for fish

Flow diagram to illustrate how CRF works within the SCRIP were targeted and driven by WFD.



Identification of pressures & Reasons for Failure

Investigative monitoring: a key component of fisheries management

Monitoring is a key component of fisheries management. It is used to investigate the pressures which are causing the failure of a waterbody to reach WFD objectives and it is used throughout a management programme to asses its effectiveness. Monitoring is most effective if it is conducted regularly so that data can be collected even once a management project has ceased, as this ensures future management can be targeted efficiently and effectively.

Electrofishing surveys are the primary method to assess fish population densities, diversity and distribution within a river. Electrofishing is especially effective at monitoring the impact of a barrier on fish movement and the effectiveness of the intervention once the barrier has been removed or mitigated. Redd counting is another survey method which can be very useful in investigating the impacts of barriers and their mitigation.

The biological and physiochemical components of water quality can be measured in a number of ways. Biological methods commonly adopted include diatom, macrophyte and invertebrate sampling, which uses indicator species to assess the levels of nutrient enrichment or pH aberration within a river. In addition to the biological measures of river ecological health, the physical and chemical properties of the water are assessed through the taking and analysis of monthly water samples to determine whether the water is able to support the good ecological health of the river.

Barriers to Migration and Abstraction

Many fish, particularly species that are highly migratory, require different riverine environments for the different phases of their lifecycle. Anadramous species in particular, such as salmon and sea trout, migrate in order to reproduce; therefore barriers to migration such as weirs, culverts and structures related to abstraction (such as hydro-electric machinery) can be significant factors underpinning failures in WFD fish status.

Other barriers, such as dams, not only inhibit migration, but they can also have a negative effect on the morphology of the river and the natural movement of substrate or bed-load material. Where dams are present, rivers downstream can become starved of substrate material and gravel (depletion) and therefore fish spawning potential in this downstream reach is decreased.

Habitat management, such as; weir removal, the installation of multi-species fish passes, fish friendly hydro turbines and the introduction of gravels below dams, are all effective but site specific options to adopt.

These methods, combined with appropriate monitoring, can be highly effective management tools that help to maintain or improve the connectivity within a river and improve the breeding potential for migrating fish.

Management options include:

- Multi-species fish passes
- Weir removal
- Fish friendly hydro-turbines
- Gravel augmentation/ rehabilitation

Lack of habitat management

When rivers have the subject of poor maintenance, there are a number of factors that can negatively affect the its potential to support healthy fish populations.

A healthy river system requires a patchy mosaic of shaded and open areas. Shading stabilises water temperature and provides protection for many fish species from predation. However, there is also a need for open unshaded areas as they play a key role providing sunlight to areas where juveniles fish occur. Light is needed to sustain the benthic community of the river, it encourages epithetic algae to grow which communities of scrapers and grazing invertebrates are reliant on, therefore providing valuable feeding grounds for juvenile fish.

In the past woody debris in the channel was thought to cause negative effects such as flooding and increased bankside erosion. However, if woody debris is secure, correctly sited and does not cause increased potential for erosion or flood risk, it is more commonly accepted to have many ecological and hydrological benefits.

Channel modifications such as revetments and channelisation can have significant negative effects on the river fauna. These homogeneous habitats often lack riparian vegetation; therefore shelter availability is low leading to a loss of suitable habitat to support fish and other aquatic species.

Management options include:

- Coppicing of riparian trees & woody debris management
- Vegetation revetments to protect banks
- Flow deflectors to create heterogeneous flow

Poor land management & diffuse pollution

Land management practices, such as intensive farming, can place pressures on river health through sediment inputs caused by erosion and chemical pressures through the use of pesticides and fertilisers. These pressures can negatively impact macrophyte, invertebrate and fish communities, which, in turn, has a knock-on effect on the health of the whole ecosystem.

Fish populations, especially salmonid species, are extremely dependent on the supply of clean and well oxygenated water. For example, the accumulation of silt in spawning gravels can smother eggs and fry, while also impacting on the invertebrates which they feed on.

Management options include:

- Landowner engagement to give advice & grants
- Bankside fencing & alternative livestock drinking points
- Gravel cleaning

Culvert Mitigation

There are a number of culverts through out the Mevagissey and St Austell river system. Historic culverts can cause delay to or may completely obstruct migrating fish. Some reasons for this are excessive water velocities, inadequate depth or culvert diameter, sudden change of invert level between the culvert and the watercourse, rapid change in stream hydraulics at the upstream inlet, lack of resting places, and debris dams causing a physical blockage or a combination of any of these factors.

Mitigation should therefore focus on removing or improving the above issues, providing works do not reduce the channel capacity or pose a flood risk.

Portmellon Road Culvert

The Portmellon stream road culvert was identified by a walkover survey to be a potential obstruction to migrating fish upstream. The large concrete apron provided extremely shallow water levels, making it very difficult for fish to approach or enter the culvert during all flows.

A wooden baulk was installed to increase the water depth on approach to the culverts. The baulk was made out of untreated hardwood sleepers and was fitted by K. Hill and Partners Ltd.


Completed wooden baulk

Mevagissey Culvert

The Mevagissey culvert originally presented a complete obstruction to migrating fish upstream, the diameter was too small and its invert position was set too high. The culvert was removed under SCRIP and replaced with a large culvert which would allow access to multiple species of fish under all flow regimes.


Before


After: Larger culvert installed

Portmellon Culvert

Sanctuary wood culvert is situated on the Portmellon Stream. Erosion had occurred at the exit of the culvert to such an extent that a 1m height difference had been created thus preventing fish passage. The stream was backfilled with material from the existing banks and the levels raised to so that scour could not occur and fish passage could be reinstated. .


Before


After

Case Study

The South Cornwall
River Improvement Project

Treskilling Stream Habitat Works

The Treskilling Stream is a tributary of the Par. This waterbody is failing for fish and hydromorphology. The reasons for failure are thought to be attributed to diffuse pollution from suspected disused mines and changes to flow heterogeneity from potential historical channelisation.

Long stretches of the Treskilling Stream lack flow heterogeneity which provides a habitat unable to support a diverse range of species. Without a combination of instream features such as course woody debris, vegetated banks, or a change in flow regime many species are unable to thrive. For example, a channelised (straightened) stream would have a slower flow, this can cause reduce oxygen levels in the water. Spawning fish and their young are reliant on fast flowing well oxygenated water to spawn. A channelized stream would also support less invertebrates for fish to feed on and suitable habitat for fish to rest or spawn upon.

Investigation

Recent Environment Agency fisheries survey data suggested that salmonids were absent from the river. WRT also undertook further fisheries surveys in 2013 but found no salmonids at two other survey locations along the river. The conclusion was, therefore, straightforward; with significantly improved water quality (validated through invertebrate and diatom surveys) the main priority on the Polgooth stream is to remove obstacles to migratory species of fish, allowing fish from the main river to access and re-populate the Polgooth.

Delivery

The walkover survey identified four possible barriers to salmonid migration. Two small culverts which served as a river crossing, one weir and a large 35 m culvert which is a total barrier that prevents fish migrating from the St Austell River into the Polgooth Stream. Two of the four barriers were concrete piped culverts which were identified as a priority for removal. Following consultation with the landowners and Cornwall Council, permission was gained to remove the culvert as the crossing was no longer in use (right).

WATERBODY	Treskilling Stream
CATCHMENT	Fowey
WFD STATUS	FISH (POOR)
PRESSURE	Hydromorphology
MANAGEMENT	Flow deflectors
DESIGN	Boulder reintroduction
DATE:	September 2014

Channelised stretch of the Treskilling Stream

Boulders being positioned instream

3 of the 12 boulder deflectors in-situ

Case Study: Treskilling Stream Habitat Works

The South Cornwall
River Improvement Project

Case Study

Treskilling Stream Habitat Works

The river Lerryn rises near East Taphouse and flows through the Boconnoc estate before flowing into the Fowey estuary near Golant. The weir on the river Lerryn at Couch's Mill was noted several years ago as a possible barrier to fish as part of the previous Cornwall River Project, however at the time additional funds were needed to complete the work.

Through the SCRIP, supplemented with some additional match, worked to arrange for the deconstruction of the weir. The weir historically served a leat, however over time the leat has been taken out of use. It was important however, given its history that there was consultation with Cornwall archaeology regarding its archaeology value.

Management

A SNIFFER assessment of the weir was also undertaken (a rapid assessment methodology to assess obstacles to fish migration), which highlighted that the weir is difficult for salmonids to pass in all but very high flows.

As removal is the best way to improve fish passage for all species and is often the cheapest, we were able to undertake a full removal whilst taking note of the design and construction materials originally used during building of the weir.

Minimising barriers to fish migration (up and downstream) can significantly help fish populations and allow adult fish to return to spawning grounds with the minimum of stresses along with allowing maturing smolts to freely move downstream and out to sea. Juvenile salmon have been found during surveys below the weir and it is hoped that this small population can increase given an easier chance to move and spawn further up the catchment.

WATERBODY	River Lerryn
CATCHMENT	Fowey
WFD STATUS	FISH (HIGH)
INVESTIGATION	Barrier Assessment
PRESSURE	Barrier to migration
MANAGEMENT	Barrier easement
DESIGN	Weir removal
DATE:	July 2015


BEFORE: Lerryn Weir in medium flow


BEFORE: Lerryn Weir in low flows. This is when fish would really struggle to migrate upstream.


July 2015


Sept 2015

AFTER: Lerryn Weir removed. Banks have been graded out and vegetation has started to become established encouraging stabilisation

Case Study: Treskilling Stream Habitat Works

Case Study

The South Cornwall
River Improvement Project

Reconnecting the Polgooth Stream

The Polgooth stream is the largest tributary in the catchment where fish failure is caused by the absence of salmonids (both salmon and trout). This was suspected to be linked to point and diffuse inputs of contaminants from historical mining sites, particularly effluent from china clay driers, which reduced the levels of available oxygen in the stream. However, these driers have since been decommissioned, improving the water chemistry conditions. Given that water quality conditions have improved in the number of years since effluent discharge ceased, the continued absence of salmonids was suspected to be linked to physical barriers to fish passage.

Investigation

Recent Environment Agency fisheries survey data suggested that salmonids were absent from the river. WRT also undertook further fisheries surveys in 2013 and found no salmonids at two other survey locations along the river. The proposed intervention was, therefore, clear; with significantly improved water quality (validated through invertebrate and diatom surveys) the main priority on the Polgooth stream is to remove obstacles to migratory species of fish, allowing fish from the main river to access and re-populate the Polgooth.

Delivery

The walkover survey identified four possible barriers to salmonid migration. Two small culverts which served as a river crossing, one weir and a large 35 m culvert which is a total barrier that prevents fish migrating from the St Austell River into the Polgooth Stream.

Two of the four barriers were two concrete piped culverts which were identified as a priority for removal. Following consultation with the landowners and Cornwall Council, permission was gained to remove the culvert as the crossing was no longer in use. (see below).

WATERBODY	Polgooth Stream
CATCHMENT	St Austell River
WFD STATUS	FISH (MODERATE)
INVESTIGATION	Walkover survey and biological monitoring
PRESSURE	Mine drainage & barrier to migration
MANAGEMENT	Barrier easement
DESIGN	Culvert removal
DATE:	2013-2014

The weir identified in the walkover was assessed to be a partial barrier to fish. In order to improve fish passage over the weir a pre-barrage or tail water back up would reduce the face height of the weir, and increase the take off depth aiding upstream migration. However, the large 35m culvert was the main priority barrier to improve under SCRIP, therefore funding was prioritised to improve the culvert and work on the weir would have to wait until future funding came available.

Weir identified upstream of 35m barrier

Future Priorities

Under SCRIP, WRT contracted H20K to design a by-pass channel to allow for upstream migration of all fish species and create new diverse in-river habitat upstream.

Although the EA approved the designs, and the landowners originally agreed to have the works completed, the works had to be postponed as the landowner had unfortunately decided to sell their land. The 35m barrier is now a priority for future works.

Before & After: Culvert removal

35 m long culvert

Restoration Measures: Habitat Improvements

WFD Benefits of Coppicing & Woody Debris

Rivers that have not been managed correctly can negatively affect the river's potential to support fish., consequently reducing its WFD status. A healthy river system requires a patchy mosaic of shaded and open areas. Shading stabilises water temperature and provides protection for many fish species from predation. However, some open sections are equally as important for providing sunlight to areas where juveniles are growing. Light is needed to sustain the river's benthic community, it encourages epithetic algae to grow which communities of scrapers and grazing invertebrates are reliant on, therefore providing valuable feeding grounds for juvenile fish.

Although excessive amounts of loose woody debris in a water coarse can increase the potential for debris dams and flood risk, if managed correctly woody debris can add many ecological benefits to the river system:

- Provides shelter and food for a variety of fish and invertebrate species
- Increases channel diversity through bed scouring and improves spawning gravels
- Provides bank protection, reduces erosion

Action

Sites targeted for action were informed from the local WIPs, habitat walkover surveys and the local Fisheries Associations. Coppicing management was divided into two areas.

1. Fisheries Management—coppicing aimed to improve fisheries habitat
2. Farming management - coppicing conducted prior to fencing being installed and/or aimed to reduce erosion and stabilise banksides, which also indirectly benefits fisheries habitats (see Phytobenthos chapter).

Fisheries coppicing aims to provide a patchy mosaic of shaded and open areas. The contractors were advised by WRT to coppice over highlighted riffle sites, and leave the pools shaded for resting fish. All debris dams were assessed by WRT and removed if they posed a risk to obstruction or flooding. At suitable sites, woody debris was secured into the banksides or river bed to improve habitat diversity and river morphology. All contracts specified that works near or in the watercourse must be complaint with PPG5 and CDM.

Restoration Measures: Coppicing & Woody Debris Management

St Austell River, Pentewan


Before: Heavily shaded stretch of riffle habitat


After: Coppicing has allowed lots of sunlight through to the riffle sites.

COPPICING OUTPUTS		
Waterbodies	**Site**	**Length (km)**
St Austell	Pentewan	0.275
St Austell	Portmellon	0.6
St Austell	Polgooth	0.08
Bokiddick	Breney Common (Upper)	0.27
Bokiddick	Breney Common (Upper)	0.4
Par (Upper)	Upstream Lavrean	0.1
Par (Upper)	Downstream Molinnis	0.05
Total sites *		**17**

Bokiddick Stream 1


Before: Dense vegetation


After: Both banks coppiced

Bokiddick Stream 2


Before: Dense vegetation completely covered the watercourse


After: The river is visible again

Coarse Woody Debris Introduction

The Westcountry Rivers Trust adopted a variety of course woody debris (CWD) introduction methods under SCRIP, where native woody species such as alder, thorn, oak and willow were used as natural bankside revetments. A method known as 'pleaching' or 'hinging' was used where suitable tree species are cut and laid in the flow direction along the river bank, any branches that broke during this process were removed to avoid causing a flood risk. This method not only provides shelter for fish, but also offers bankside protection from erosion.

COARSE WOODY DEBRIS OUTPUTS			
Waterbody	**Site**	**Metres**	**Structure**
St Austell	Pentewan	-	V Flow Deflector
Par (Upper)	Upstream Lavrean	10	
Par (Upper)	Downstream Mollinis	20	
Bokiddick	Breney Common (Lower)	100	
Total (metres)		**130**	

Blackthorn 'pleached' into the bankside, Bokiddick

Other methods of introducing CWD in the river are brash revetments. This is where native tree species such as willow, alder, thorn and hazel are attached to the banks with untreated hardwood stakes. Brash faggots are then wired around the CWD to create habitat diversity for multiple species and strong protection against erosion. Approximately 20m of brash revetments on the Lower St Austell River were planned under SCRIP, but although flood defence consent was granted by the EA, other aspects of the planning process delayed completion of the works. However, all the planning and methods are currently in place and the Pentewan Steam will be made a priority for future works and 10m of bank were fenced off for

A wooden deflector was introduced on the St Austell River at Pentewan (which is categorised as a Heavily Modified Waterbody) to improve flow heterogeneity. The deflector works with existing features to create a meander. This method was adapted from Church (1992) taken from the Environment Agency Restoration of Riverine Salmon Habitats, Technical report 44. Unfortunately, as the river is a flood alleviation channel permission was not granted by the EA to install more than one deflector in case the works would impede flow.

Wooden deflector, St Austell River at Pentewan

Restoration Measures: Gravel Cleaning

Some types of land use management can give rise to physical pressures on the river corridor through sediment input caused by erosion, and chemical pressures such as agriculture and mining. These common pressures can negatively impact macrophytes, invertebrates and fish abundance, which may have a knock-on effect on the whole ecosystem. Fish populations, especially salmonid species are extremely dependent on the supply of clean and well oxygenated water. The accumulation of silt in their spawning gravels, and soil derived pollution that has a toxic effect on the fish directly, or on the invertebrates in which they feed on, are all causes for declines in fish diversity.

At the start of the SCRIP the upper Par catchment had a WFD status of Poor for Fish. Its reason for failure had been linked to diffuse pollution from surrounding clay mines which carry fine sediment with a high heavy metal content. This has caused heavy concretion of gravels and poor spawning potential. Historical electrofishing results (WRT & EA) also indicate that the Par supports a low fry density, despite it being a historically important salmonid spawning stream.

Method

For the above reasons WRT conducted a gravel cleaning programme on the Par River. WRT adopted a variety of non-mechanical gravel cleaning methods tailored for individual sites. Works were conducted downstream to avoid siltation of cleaned areas. All pools were left, and where possible only riffle sites were cleaned. Most works were completed by hand using a mattock and fork to break up the compacted gravels, and rakes to release the fine sediment.


Compacted gravels being loosened by hand

GRAVEL CLEANING SCRIP OUTPUTS

Waterbody	Site	No of Sites *
Upper Par	Downstream of Luxulyan	1
Upper Par	Upstream of Higher Menadew	1
Upper Par	Bokiddick Stream –Thunder Park	1
Upper Par	Bokiddick Stream- Tregantle	1
Total Sites		4

Investigation	Habitat walkover surveys
Pressure	Sediment input and oxidised iron and magnesium causing silted and compacted gravels
Management	Gravel cleaning

Note: 1 site = 20m²


Example of gravels post works


Example of gravels post works

Monitoring

River Habitat Walkover Surveys

Habitat Walkover Surveys use a fast but detailed method to assess the provision of fish habitat in a river system and to determine its condition. Walkover surveys also identify where there are potential threats to the condition of the fish habitats present and where barriers or obstacles exist in the river that may act to stop fish accessing those habitats.

Under SCRIP a total of 58km of habitat walkover surveys were taken on the Polgooth Stream, Crinnis Stream, Bokiddick, Gover, Mevagissey and Portmellon Stream. None of the catchment had been walked previously therefore it was vital to record as much information as possible to get a good baseline.

Information such as habitat type, notes of concern and barrier assessments were collected. This information was not only an important tool to inform on the ground management decisions, but it is also a way of monitoring any changes in the catchment during and/or after the project.

Barrier assessments

Habitat assessments

Electrofishing Surveys

A catchment wide semi-quantitative electrofishing programme was conducted under SCRIP. A total of 15 electrofishing surveys were completed in 2013, and 10 in 2014. Some electrofishing sites were not revisited in 2014 due to some sites being unsuitable.

The only comparable Electrofishing surveys are those that have been carried out by the Environment Agency (EA), who have undertaken a number of fully-quantitative surveys (>30) that date back to around 1998.

The semi-quantitative survey is not intended to replace the existing EA sampling and monitoring programme mentioned above. The strength of this survey is to enable a quick, affordable, baseline semi-quantitative catchment wide view of the fry life stage only. Electrofishing surveys aided as a tool to inform appropriate habitat restoration works, and were also used to assess the effectiveness of those works against the Water Framework Directive (WFD) driven criteria.

As a result of SCRIP's electrofishing programme Signal Crayfish were identified and reported. Following this the EA conducted a crayfish survey in 2014, which identified Signal Crayfish through out the Polgooth Stream.

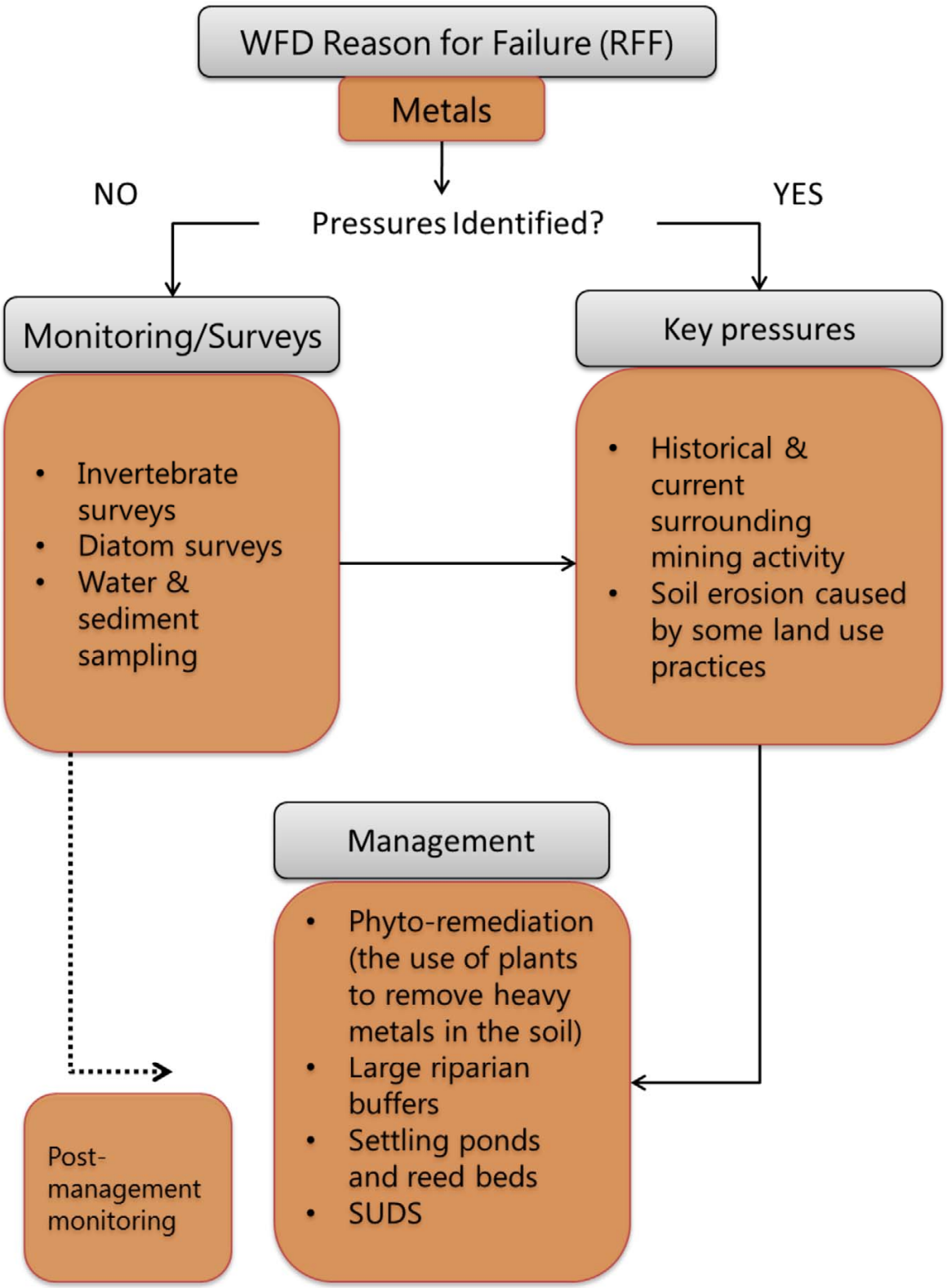
Further Monitoring

Where waterbodies were failing for Fish and/or defaulted to 'moderate' due to lack of data extra monitoring was undertaken. This included extra biological monitoring such as diatoms and invertebrate surveys. As more information was gathered about the catchment, it appeared that water quality, particularly metals, had a significant impact upon trout density. More information on this can be found in the Metals chapter.

Metals

Targeting interventions for pH

Flow diagram to illustrate how CRF works within the SCRIP were targeted and driven by WFD.



Heavy Metals in the Environment

Pressures

Many river basins in England and Wales have been significantly contaminated with metals released from past mining operations. The Water Framework Directive (WFD) River Basin Characterisation exercise in 2005 estimated that 453 surface water bodies in seven of the eleven River Basin Districts were at risk of pollution by abandoned mines (Environment Agency,2008).

In Britain mining for coal, metal ores and other minerals has taken place since the Bronze Age. However, although the mining peak was in the late nineteenth century, pollution still continues to be discharged from many sites. Research indicates that up to 90 per cent of metals are associated with sediment rather than liquid form, and metal contaminants are primarily mobilised and transported downstream, and deposited, by river processes.

Ecological Impact

The impacts of minewater diffuse and point source pollution can be very serious on the freshwater environment. Some impacts include:

- reduced numbers and diversity of invertebrates;
- fish mortalities, particularly of sensitive salmonid species;
- loss of spawning gravels for fish reproduction and nursery streams;
- a reduction in numbers and biodiversity in the river corridor.

The ochre deposited by iron-rich mine waters can decimate freshwater ecology by smothering the river bed with iron hydroxides. Salmonids are particularly sensitive to such pollution as they require well aerated gravels to build redds. The lowered pH can cause damage to their gills, which can have a detrimental effect on the survival of smolts (a young salmonid at the stage when it migrates from freshwater to the sea).

Acidic conditions can also increase the solubility and toxicity of metals such as aluminium, copper, lead, zinc and cadmium. In some areas, particularly upland streams, the natural fish and invertebrate populations are greatly reduced because of minewater pollution. These streams are important as fish-breeding grounds and nursery areas for developing juveniles.

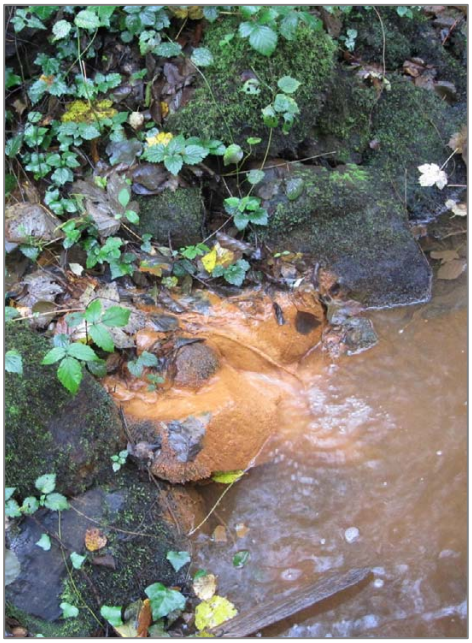
Any changes in the river's ecology can have a knock-on effect on the whole river ecosystem, for example, riverine birds and mammals such as dippers and otters may be unable to feed sufficiently.

Mitigation

Many methods to mitigate against the impacts of mine pollution have been developed and are continually undergoing improvements.

In Cornwall, one of the largest minewater treatment plants in Britain was built to deal with pollution from the Wheal Jane tin mine. This plant prevents 670 tonnes of iron and 150 tonnes of zinc from entering the Restronguet Creek each year (EA, 2008).

The formation of wetlands around mining inputs is another method of mitigation that can work well to retain and remove heavy metals from the environment. By forming a complex matrix of plants and ponds it is possible to engineer the interaction of the metals with microbial and plant communities. These communities can remove metal contaminants from the environment via functions such as filtration, adsorption, precipitation, ionic exchange, microbiological degradation, and biological uptake and prevent transport through the environment (Wang et al 2014).



Monitoring for metals on the Par

Background

The Upper Par was found to be failing under WFD for Iron, Copper and Zinc, due to the historical mining heritage within the catchment. As this could be a contributing factor to the Moderate classification for fish, it was decided that an investigation should be conducted into the locations of these potential metal inputs and to assess whether any mitigation works could be carried out.

Monitoring Methods

Spot samples taken along the River Par indicated that the metal inputs were occurring in the headwaters at Criggan moor. The Criggan moor catchment is complex and highly dendronous, making the determination of potential metal input locations, together with their potential influence, difficult. Due to this and the inaccessible nature of the sites, spot sampling was considered the most effective and cost efficient method to gain an overview of the metals situation in Criggan Moor. Samples were taken above and below tributaries & confluences to assess the potential contributions from each reach and analysed by the National Laboratory Service (NLS).

These results were then analysed using the Biotic Ligand Model. This model takes into account site specific abiotic factors such as DOC, Calcium and pH to assess the bioavailability of these metals at each sampling location.

Results

Results showed that the concentrations of Iron, Copper & Zinc increased progressively upstream with exceedingly high levels being found in the upper headwaters on Criggan Moor.

This suggests that the source of the metal pollution in occurring in the upper headwaters and is being transported downstream via fluvial processes. WRT are currently looking into effective mitigation methods that will retain pollutants and reduce the amount of mining derived pollutants found downstream.

Iron ochre deposits

Samples being collected

Reducing the impact of mining on the St Austell River

The St Austell River in South Cornwall has been failing to achieve good ecological status under the WFD, in part owing to fish failures. Sediment inputs from mining/quarrying sources have been identified as a key pressure underlying these failures in the catchment.

Owing to this, WRT liaised with IMERYS, a key stakeholder in the catchment, and instigated an investigation into mitigations works to reduce sediment inputs to river channels from IMERYS assets. Initial surveys undertaken by WRT identified key areas for targeted mitigation of sediment inputs and, in addition, potential input of iron ochre from a tributary running through IMERYS owned land.

Following this, WRT and IMERYS personnel undertook a joint site visit on 19th June, 2014 to discuss mitigation options.

Reducing sediment inputs

A site visit was undertaken to identify the potential for increasing the sediment retention capacity at the IMERYS site and focused upon an area of existing sediment catch pits. The visit defined the options for improving sediment retention and these were highlighted as:

- Installation of an additional catch pit which will be linked to existing pits via union pipes.
- Increasing the volume of existing catch pits.
- Increased frequency of catch pit cleaning

- Installation of a filter on the current outflow pipe from the final catch pit to reduce the input of fine sediment to the river channel

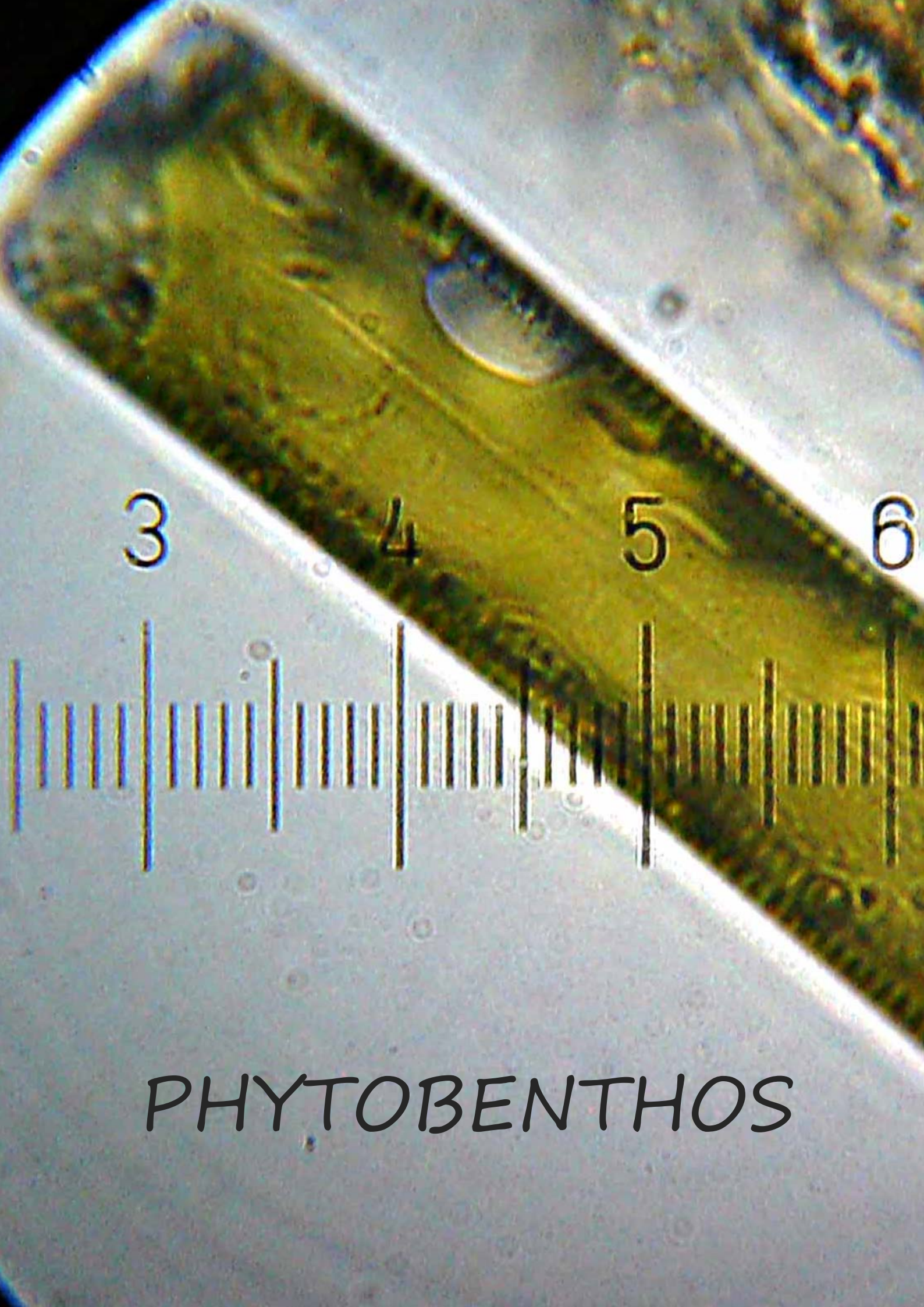
Reducing iron ochre inputs

Initial walkover surveys undertaken by WRT identified that iron ochre was impacting upon a tributary, which runs through the IMERYS site at Lower Ninestones. The tributary enters the St Austell River where the iron ochre is deposited amongst the gravel bed. An invertebrate survey undertaken by WRT in the main river channel below the tributary input, returned low BMWP scores indicative of an impacted river system.

WRT has suggested making improvements to some historic catch pits at the site, which receive inputs from the tributary (and another drainage gully) and were originally designed to retain sediment from the site when it was in use (Figure 3). Although there is established vegetation at the site (Figure 4), WRT has advised that improved management of the area, to include changes to layout and flora, could have potential benefits for iron ochre removal.

Future work

The proposed mitigation methods for reducing sediment inputs are being considered by IMERYS and WRT will assist in further works if they are deemed feasible. WRT is undertaking further investigation with regard to the proposed wetland area involving detailed consideration of the wetland design, which will be informed by expert advice from external parties.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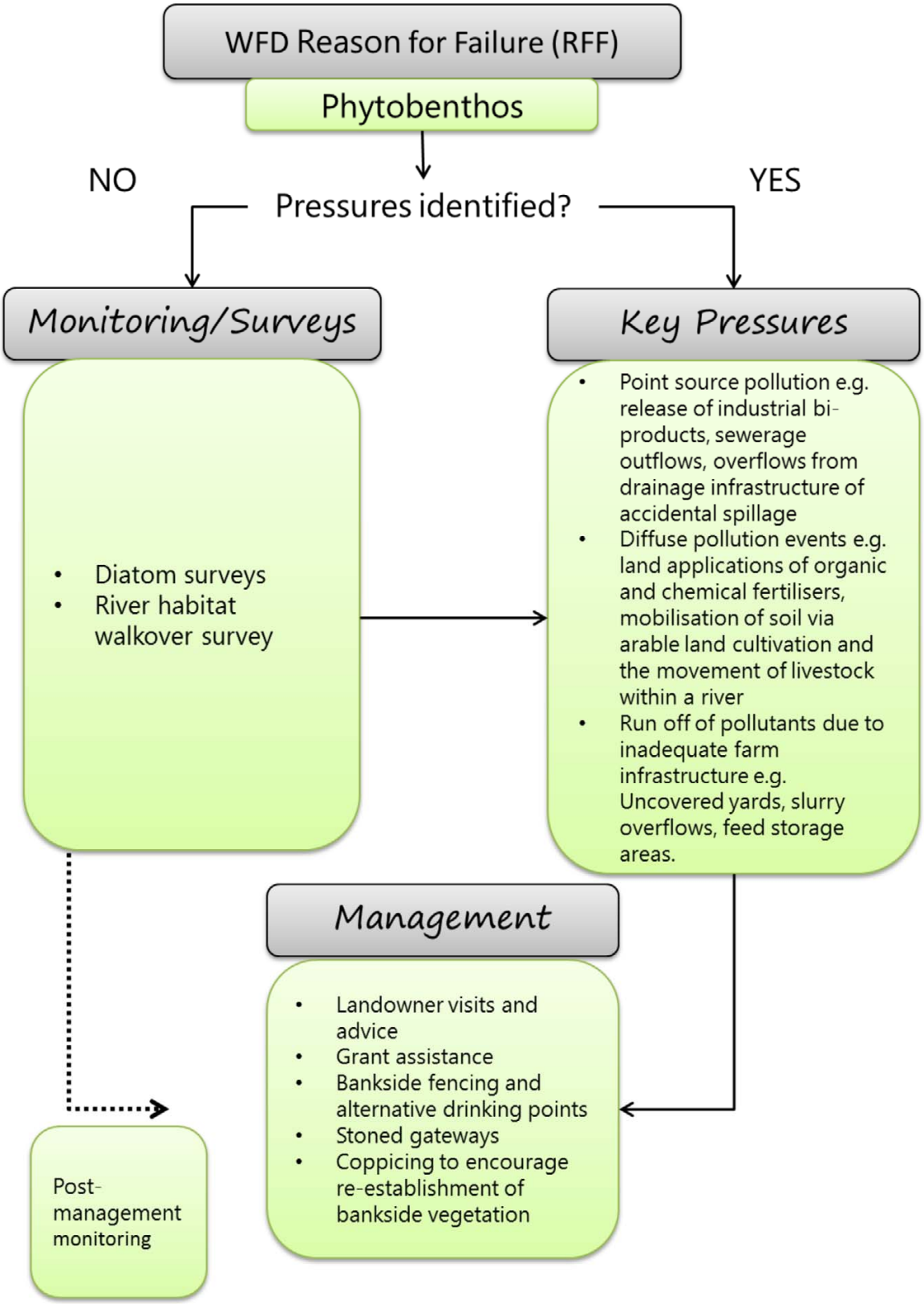
PHYTOBENTHOS

Targeting interventions for Phytobenthos

Flow diagram to illustrate how CRF works within the SCRIP were targeted and driven by WFD.



Phytobenthos

Phytobenthos are a benthic (they live attached to substrates such as rock/stone or large plants) sub-group of diatom algae. Most are unicellular, but they can exist as colonies in the form of filaments or ribbons.

The assessment of phytobenthos in a river is a well-established method for assessing water quality. It is widely accepted that a detailed evaluation of the structure and function of phytobenthic (diatom) communities in a river can provide robust evidence for assessing its ecological condition.

The criteria for the assessment of diatom communities for WFD classification were developed through the Diatoms for Assessing River Ecological Status (DARES) Project. This project assessed diatom assemblages at a series of reference sites and developed a model that allows the composition of the benthic diatom assemblage in a river to be predicted. Comparison of the predicted assemblage with that found through sampling allows the ecological condition of the river to be assessed.

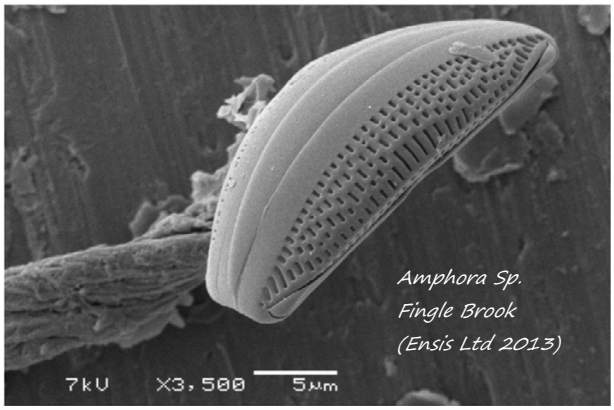
Pressures

Phytobenthic community composition can be affected by a wide array of pressures, but they are particularly sensitive to changes in the pH and nutrient levels in the water and can be used to identify rivers impacted by these types of pollution.

Pollution of this type can be derived at specific locations along a river (point sources) or from the cumulative effects of many small, highly dispersed and often individually insignificant pollution incidents (diffuse sources).

Highly localised point sources of pollution occur when human activities result in pollutants being discharged directly into the aquatic environment. Examples include the release of industrial bi-products, effluent produced through the disposal of sewage, the overflows from drainage infrastructure or accidental spillage.

Diffuse pollution can occur when large amounts of slurry, manure, chemical phosphorous-containing



Amphora Sp.
Fingle Brook
(Ensis Ltd 2013)

fertilisers or agrochemicals are applied to land. If these processes coincide with high rainfall events, it can lead to run off or leaching from the soil and to the subsequent transfer of contaminants into a watercourse.

In addition, the intensive cultivation of land or the over disturbance of soil by livestock (poaching) can mobilise fine sediment, which may transfer to drains and watercourses by water running over the surface. Other diffuse sources include pollutants mobilised from farm infrastructure such as uncovered yards, slurry pits, feed storage areas and dung heaps.

Monitoring

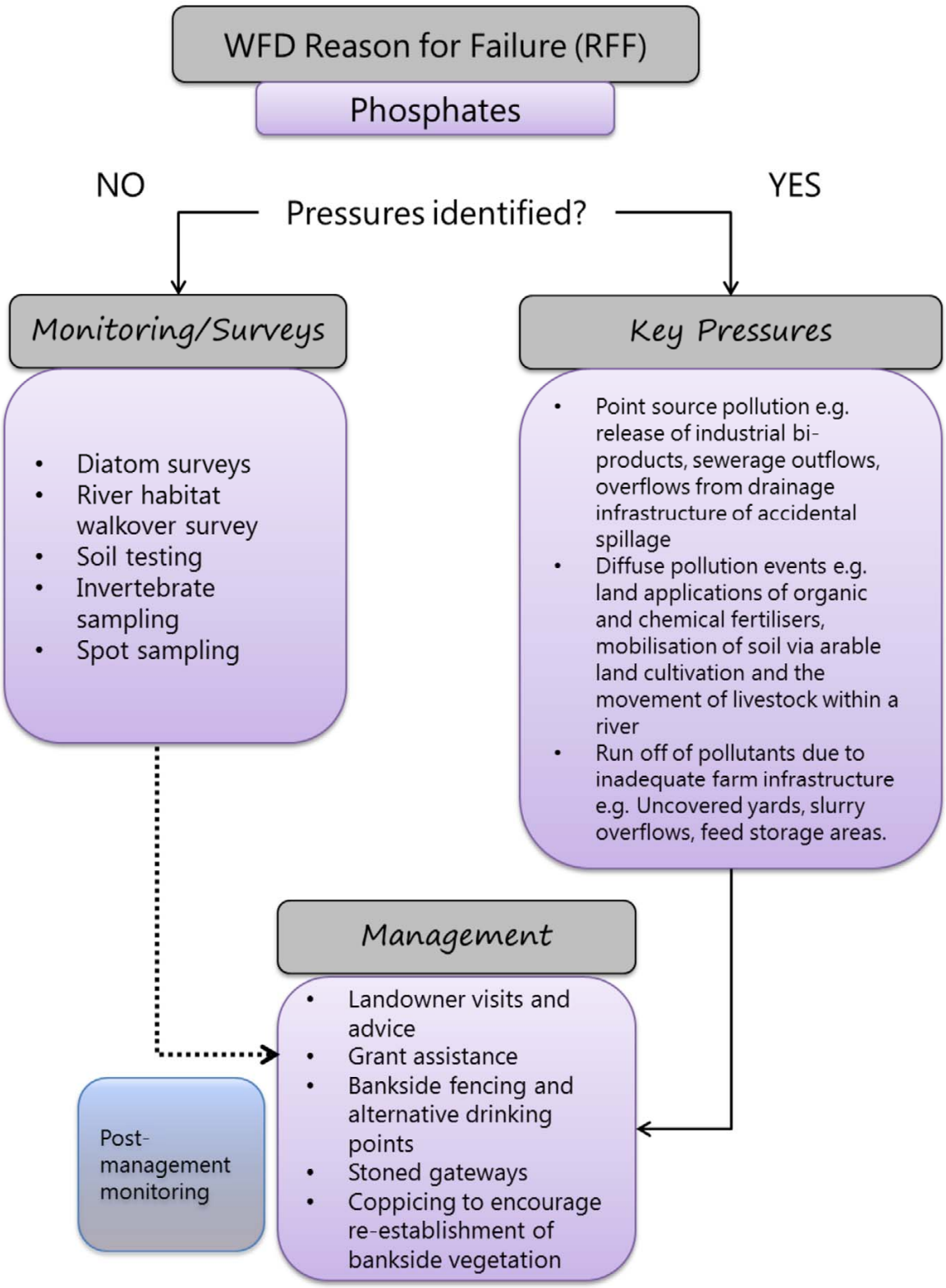
Waterbodies failing to reach good ecological status for Phytobenthos were monitored, and rivers that lacked biological data were investigated with diatom surveys.

SCRIP conducted a catchment wide biannual diatom sampling programme, with surveys carried out in Spring and Autumn. (2012,/13/14). The samples were analysed and reported by APEM and UCL/ENSIS. The diatom results played a vital role informing and targeting the farm advice.


PHOSPHORUS

Targeting interventions for Phosphorus

Flow diagram to illustrate how CRF works within the SCRIP were targeted and driven by WFD.



Phosphorus

Pressures

Numerous waterbodies in the River Taw catchment are currently failing to achieve good overall status, in part, owing to elevated phosphorus (P) concentrations. Phosphorus is often the growth limiting nutrient in freshwater systems such that biologically available forms of P are naturally in short supply and quickly become exhausted by biological uptake.

Freshwater systems are sensitive to changes in the natural balance of available P, which is commonly affected by human inputs, particularly those derived from agricultural practice and sewage treatment works (STWs). In addition, the Taw catchment receives industrial effluent from a dairy processing plant. Diffuse input of P via runoff from agricultural land and direct point source inputs from effluent discharges can potentially increase the bioavailable pool of P (eutrophication), leading to excessive algal growth and associated ecological impacts. In turn, impact upon ecosystem function disrupts the flow of services and benefits to society (such as those associated with recreation and health) and can lead to increased cost of water treatment.

The Water Framework Directive (WFD) (2000/60/EC) has set stringent Environmental Quality Standards (EQS) for 'reactive phosphorus' in surface waters aimed at reducing nutrient enrichment and associated impacts upon biota. Consequently these standards are driving efforts to reduce P inputs to surface waters through appropriate management of agricultural practice and point sources. It, therefore, follows that there will be an overall reduction of P inputs to surface waters. However, because P is strongly associated with sediments, many watercourses may have an historic 'sink' of P in sediment storage zones, which could provide an additional source of bioavailable P if the sediment is re-mobilised and the particle-bound P is released into solution. P cycling in freshwater systems is, therefore, complex and successful management requires a sound understanding of the catchment system on a site-specific basis.

Targeting Phosphorus Sources

The assessment of phosphorus inputs involves, not only the measurement of excess nutrient concentrations, but also the identification of P delivery pathways to the river and the factors which are likely to influence P mobility and availability to biota. This enables mitigation measures to be targeted to prevent P delivery at source and indicates the potential for system recovery.

As part of the Taw River Improvement Project (TRIP), a parallel project to SCRIP, Westcountry Rivers Trust commissioned a scientific panel to undertake rigorous assessment of P dynamics within the Taw catchment with the following principal aims:

1. To assess physicochemical and biological status in relation to nutrient inputs
2. To determine the key sources of phosphorus delivery to the catchment
3. To identify factors which control P cycling and bioavailability
4. To identify areas for mitigation targeting

The field research was carried out by members of WRT, Plymouth University Catchment & River Science Group and Rothamsted Research.

Excess algal growth where phosphorous concentrations have been elevated by agricultural and domestic waste inputs

Management: Phosphorus

Reducing diffuse water pollution from agriculture (DWPA)

Phosphorus concentrations in surface waters can often become elevated above natural background levels owing to inputs from agricultural and domestic waste sources. Diffuse water pollution from agriculture (DWPA) can be responsible for significant P inputs to watercourses and managing such inputs is complex given the difficulty of identifying key source areas.

Diffuse water pollution is likely to be wet-weather driven and inputs of P are often associated with soil loss from agricultural hillslopes under eroding conditions. Agricultural soils can be rich in P owing to the application of fertilsers and manures to improve fertility and consequently soil erosion can result in the loss of particle-bound P to surface waters.

In addition, inputs from slurry stores and farm yards and direct defecation by cattle can also contribute to elevated P concentrations in watercourses. It is, therefore, important for farmers to carry out best practice to minimise soil and nutrient loss, which not only reduces environmental impacts, but also provides financial savings for the farm. With careful planning and changes to land management, this can be achieved to good effect.

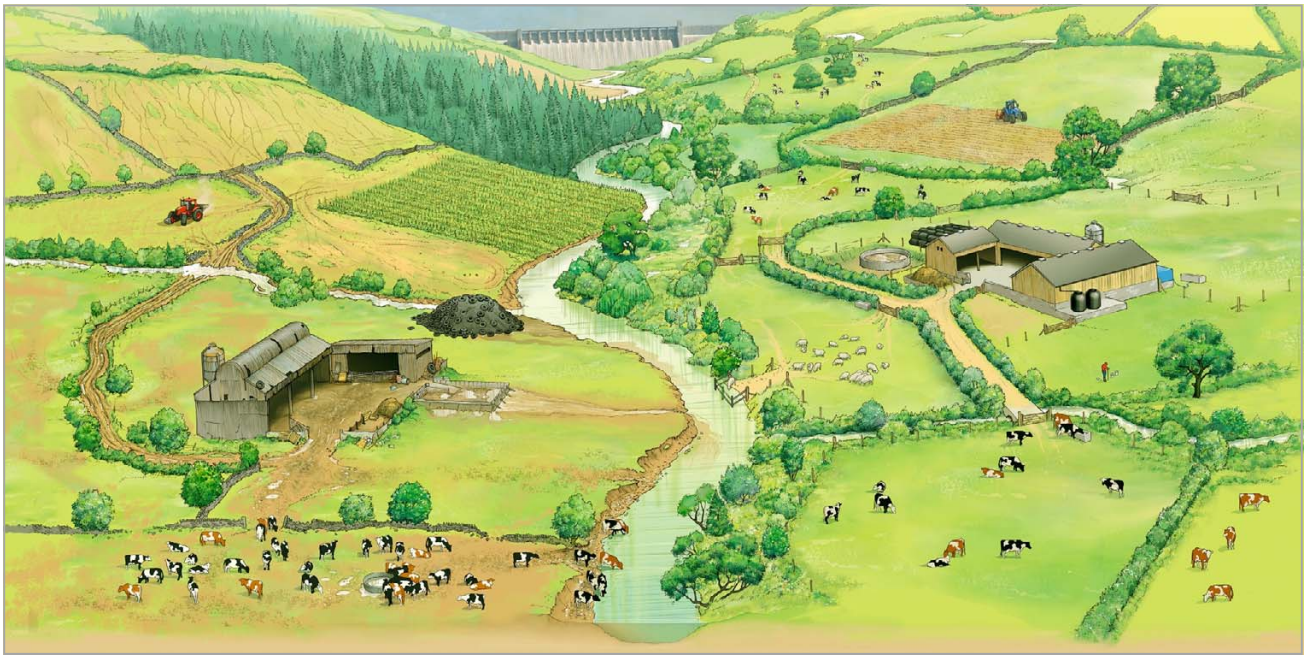
Farm Advice

All waterbodies failing (or indicated to be failing though investigations) to reach good status for Phosphorous and Fish were targeted for farm visits and advice. These integrated land advice packages were delivered by an experienced farm advisor which covered many aspects of a farmers practice. The advisor identified where the adoption of good practice or best practice may minimise the risk that an activity will have a negative impact on the environment, and where it may enhance the provision of a particular ecosystem service and improve WFD

In addition to broad advice on good practice, the advisors also produced a targeted and tailored programme which, through the provision of free soil tests, included specific advice on pesticide, nutrient and soil management on the farm to mitigate any potential environmental impacts (see output map on page 48 for distribution of works).

A proportion of the SCRIP budget was allocated for a farm capital grants scheme. Funds were available to contribute towards 60% of the total cost of advised farm improvements. Works covered by the grant scheme would generally include:

- Riparian fencing and preparatory tree work
- Introducing riparian buffer zones
- Alternative or improved livestock drinking points
- Soil tests
- Culverts
- Farm track improvements (not gravelled)
- Gate relocations



Farm Advice & Delivery: Investigations & Monitoring

Waterbodies failing to reach good ecological status for Phosphorous and Phytobenthos were monitored, and rivers that lacked biological data were investigated with diatom surveys. SCRIP conducted a biannual diatom sampling programme on the Mevagissey, Portmellon, Polmear, Chapel point, Polgooth, Gorran Haven and Fowey tidal waterbodies. The surveys were carried out in Spring and Autumn (2013 & 2014).

The samples were analysed and reported by APEM and UCL/ENSIS. The diatom results played a vital role informing and targeting farm advice .

Farm Advice & Delivery: Grant Assisted Works

Total farming delivery outputs for SCRIP are set out below. In addition to the below tabled outputs, over 100 soil tests were conducted, 64 of which were on the Par. Once the results had been received specific nutrient budgeting advice was provided, this not only raised awareness on nutrient issues but also provided an opportunity for the farmer to save money on unnecessary fertiliser applications.

The below table shows which waterbodies received grant assisted farm improvement works under SCRIP.

FARM WORK OUTPUTS

Waterbody	Waterbody Name	Number of Farms	Fencing (m)	*Coppicing (m)	Drinking Points	Water Pipe (m)	Pappa Pump	Water Pump
GB108048002310	Par River (Upper)	1	1440		2			
GB108048002310	Par River (Upper)	1	710		1			
GB108048002310	Par River (Upper)	1	1260		3			
GB108048002310	Par River (Upper)	1	400					
GB108048002300	Bokiddick Stream	1	925		2			
GB108048002280	St.Austell	1	1800		1			
GB108048002280	St.Austell	1	650		1	20		
GB108048002480	Portmellon Stream	1	1360	450	3	50		
GB108048002480	Portmellon Stream	1	400	750				
GB108048002200	St. Austell (Chapel Point)	1	600		1		1	
GB108048002220	Mevagissey Stream	1	410		3	510		1
GB108048002220	Mevagissey Stream	1	150		1			
GB108048001370	Fowey (Tidal)	1	620		2			
GB108048001370	Fowey (Tidal)	1	300		1			
GB108048001370	Fowey (Tidal)	1	315					
GB108048001300	Fowey Tidal	1	120		1			
Total Outputs WRT		**16**	**11460**	**1200**	**22**	**580**	**1**	**1**

Note: Coppicing conducted as a preparatory measure before the fencing is installed. However, coppicing will always be conducted in way which will provide multiple benefits to the river ecosystem, including fish habitat improvements.

Grant Assisted Works for Phosphorus: Before & After

Before: Poached field and small stream (River Par)

After: Fencing and large buffer strip which encourages re-vegetation (River Par)

Before: Eroded and undercut banksides (River Par)

After: Fenced banksides and evidence of maturing bankside vegetation (River Par)

Before: Eroded field (Par Tributary)

After: Fenced banksides (Par Tributary)

Grant Assisted Works for Phosphorus: Before & After

Before: Poached field and small stream (Menabilly)

After: Fenced watercourse and alternative drinking point provided (Menabilly)

Before: Heavily poached and incised banksides Mevaigissey)

After: Newly fenced watercourse (Mevagissey)

Before: Bare open banksides (Treskilling)

After: Fenced and re-vegetated banksides offering bank stabilisation and improved habitat diversity (Treskilling)

PARTNERSHIP & STAKEHOLDER ENGAGEMENT

Partnership & Stakeholder Engagement

The SCRIP developed an integrated stakeholder-driven assessment of the catchment prior to, and through out the project. This provided a comprehensive understanding of the challenges the catchment faces and, helped develop a strategic, targeted, balanced and therefore cost-effective catchment management intervention plan.

The SCRIP management plan was achieved through engaging with catchment stakeholders by building diverse, and empowered catchment partnerships comprised of environmental practitioners, businesses and community groups.

Once brought together, the partnership developed a shared understanding of the issues in their catchment, which aided in building a consensus about what actions needed to be delivered to achieve this shared vision for their catchment in the future.

Project Partners

The following table lists the SCRIP partners and their representatives.

Organisation	Representative
Westcountry Rivers Trust	Giles Rickard and Matt Healey
Environment Agency	Tom Fletcher, Julian Payne, Rob Wood
Cornwall Council	Natasha Collings, David Watkins, Stephen Blatchford, Martin Eddy, Ann Reynolds, Martin Clemo
IMERYS	Stewart Vale, Bob Alyward
Catchment Sensitive Farming (CSF)	Rebecca Hughes
Natural England	David Hazlehurst
South West Water	Lewis Jones
Forestry Comission	Garin Linnington
Cheryl Marriot	Cornwall Wildlife Trust
Jim Briggs	Heligan Gardens

Meetings

Over the three year project the SCRIP developed a strong partnership that helped steer the project forward in a positive and effective direction. Every six months the SCRIP held a Partnership Advisory Group Meeting (PAG) where each project officer would present a project progress update. This offered an opportunity for all the project partners to ask questions, provide feedback and agree any changes to the original bid.

Date of SCRIP PAG Meetings	Venue
30th October 2012	Wheal Martyn Museum
21st March 2013	Wheal Martyn Museum
18th September 2013	Eden Project
21st march 2014	Wheal Martyn Museum
3rd November 2014	Wheal Martyn Museum
13th March 2015	Wheal Martyn Museum

In order to ensure the partnership were regularly updated a project newsletter was sent every few months, these provided brief concise updates on project progress and what was planned for the following months ahead. Alongside the regular PAGs, other specific meetings were held which followed on from specific PAG agenda items or meetings to discuss particular project works. All of which have been documented and archived.

Volunteering & Stakeholder Involvement

During SCRIP some of the habitat walkover surveys were conducted by volunteers, where some members of the local community were given training by the SCRIP catchment officer. This provided both awareness on assessing riparian habitat, and involved members of the community in active catchment management.

Some stakeholders were involved in the physical delivery of the project. For example, Catchment Sensitive Farming (CSF) and SCRIP joint funded the delivery of improvement works on the Chapel Point Stream. Pulling together skills and resources meant that works were delivered efficiently and effectively.

Another example of positive stakeholder engagement involved working with Cornwall Council. Similarly to all the CRF projects SCRIP was successful in highlighting the importance of watercourse management. In this case SCRIP was able to provide details on how watercourses can be managed to benefit fisheries and wildlife, this information was then successfully added to Cornwall Council's policy document on the 'Condition Standards for Watercourse Inspections'.

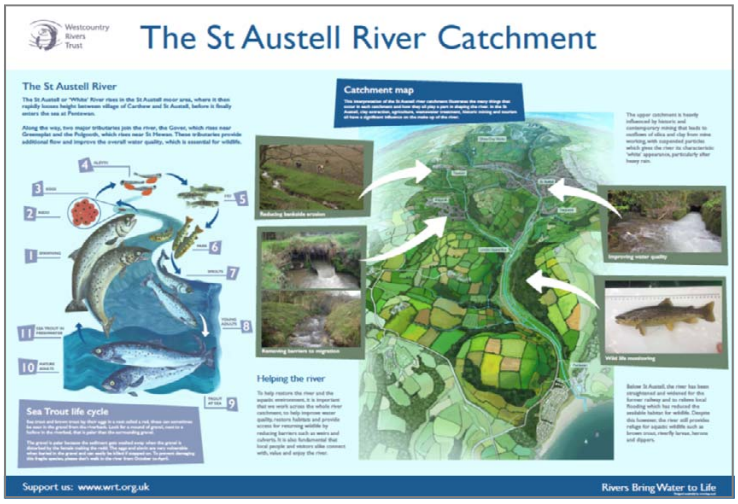
Community Engagement

In order to inform and involve the wider community about the importance of catchment management and the role of the SCRIP, awareness was raised through some of the following ways:

- ***St Austell re-meander walk:*** On the 21st August 2013 SCRIP held an event for local South West Water the EA, local interest groups and Cornwall Council to walk along a section of the St Austell River. This stretch was highlighted as a potential site which could potentially be re-meandered to provide additional wetland habitat and flood retention.
- ***School Visit:*** On the 12th September 2014 SCRIP officers visited a school on Bodmin Moor to educate children on the water cycle, catchment management and wildlife, such as invertebrate identification.
- ***Interpretation Boards:*** 3 x interpretation boards containing catchment wide information on the St Austell River have been installed along a riparian public footpath. The information provides an opportunity for people walking along the river to learn about the local wildlife, environmental pressures and ways you can help the river.

Educational school visits

An example of one of the interpretation boards installed on the St Austell River



WRT Pinpoint Farm Advisory Training 2013

Project Summary

Overall the SCRIP has been extremely successful in its delivery. All works within each failing WFD waterbody have been informed through sounds science and investigation prior and post delivery. This not only ensures that a more accurate ecological condition of each water body is identified, but it ensures that all works delivered are both efficient and effective.

Although it is evident that the three year SCRIP project has been successful in its delivery, three years is a relatively short period to expect significant improvements of water quality. However, we can safely be reassured that works such as barrier easements will improve the rivers connectivity for migrating fish species, and farm works such as fencing will most definitely prevent damage caused by livestock entering the river, and reduces pressure such as bankside erosion. Although these delivery outputs have a small positive impact individually, the cumulative impact though out the catchment will be significant.

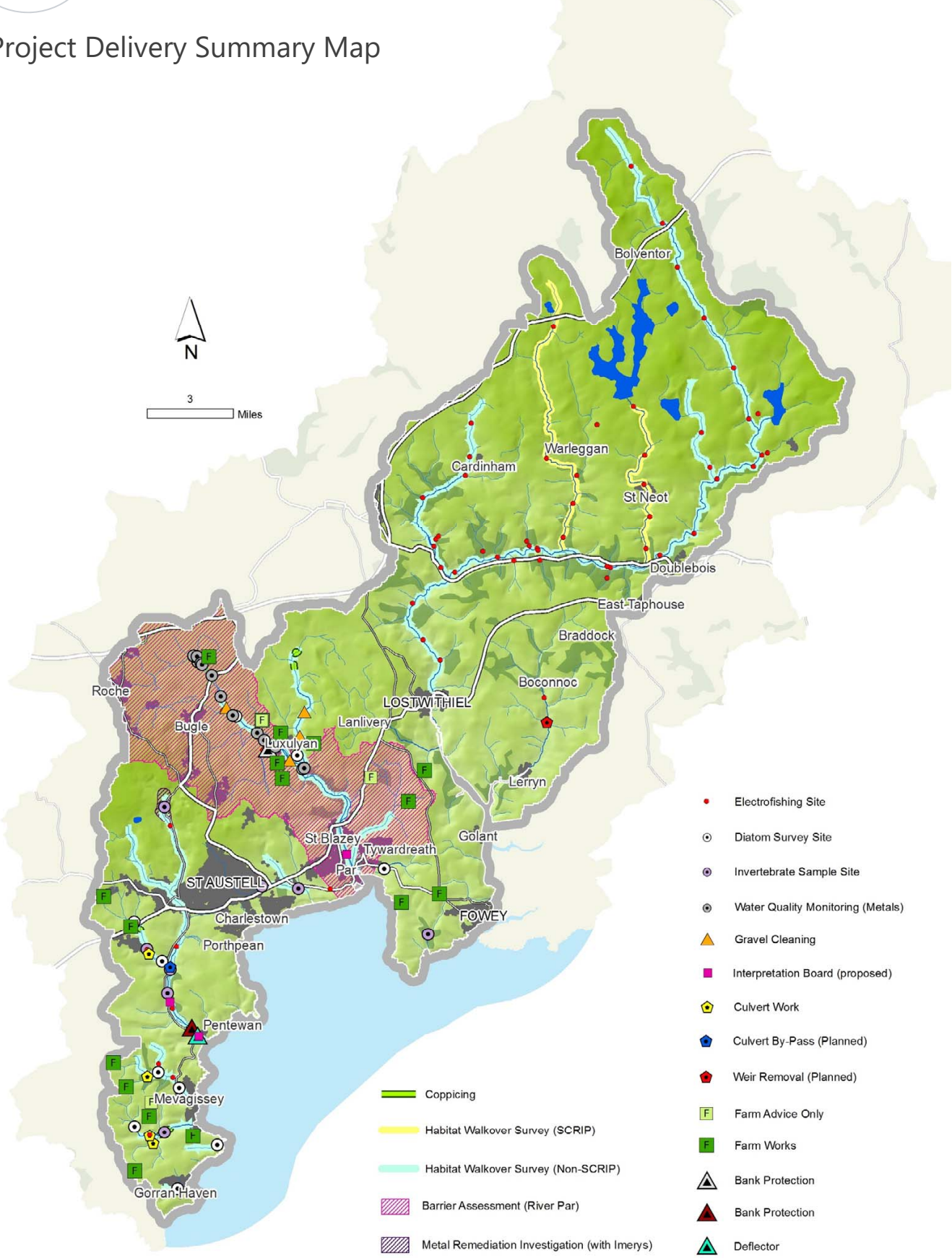
The project has provided a strong baseline to continue working from. We have conducted many investigations and works, all of which have provided valuable information on the current condition of the river, and pinpointed the locations of some specific pressures that still need to be targeted within South Cornwall's catchment. It is therefore crucial that this work is continued into the future, not only to ensure that the funds provided under the CRF have been spent efficiently, but also because SCRIP has provided a management foundation, which if built upon will ultimately provide a sustainable future for the catchment.

Summary of SCRIP Project Achievements

In the original project application a number of targets were proposed. The table is a summary of these targets giving an indication of whether each outcome was achieved within the SCRIP Project (Green = complete, yellow = partly complete, red = not complete). These outputs are also summarised on the map over the page:-

Project Targets	Target Reached?	Comments
Creation of in-river features		A wooden deflector and in-stream boulders to improve flow heterogeneity and habitat diversity have been installed.
3 x culvert mitigation		5 culverts have either been successfully removed or improved on different waterbodies within the SCRIP catchment (1 x portmellon, 2x Mevagissey, 2 x Polgooth). However, the large 34 m culvert on the Polgooth could not be mitigated under SCRIP, this was due to last minute land ownership issues and is now a priority for future works.
Fish translocation		A translocation of bullheads above an obstruction on the Warleggan waterbody was originally proposed. After consultation with the EA is was decided that this was not a suitable option due to concerns of causing a potential genetic bottleneck, however, some bullheads were introduced above the Warleggan and so the action was completed.
Electrofishing		Surveys complete
Obstacle/barrier assessment		Barrier assessments completed during habitat walkover surveys. This information played a vital role when targeting works under SCRIP.
Coppicing		1.775km of fisheries management coppicing complete and 1.2 km of fencing preparatory coppicing complete.
12.5km of fencing		11.46km of fencing complete (90%). After reviewing walkovers not all fencing as envisaged in the project application was necessary. Therefore these resources were reallocated to tackle the removal of the Lerryn weir
3 x Interpretation boards		Design and build complete, installation also now complete.
18 x Alternative drinkers		22 alternative drinking points have been installed
Diatom Monitoring		Diatom programme complete. However, further surveys would be advised.
Work with Imerys		The proposed mitigation methods for reducing sediment inputs are being considered by IMERYS and WRT will assist in further works if they are deemed feasible.
100 x Soil tests		Over 100 soil tests conducted.

Project Delivery Summary Map



Future Works

Future works on the South Cornwall catchment which have been planned by WRT following the completion of SCRIP.

Monitoring

- An annual semi-quantitative catchment wide electro-fishing programme is hoping to be continued. However, this is dependent on funding.
- WRT will pursue funding to continue an annual diatom programme.
- The SCRIP's monitoring and investigation programme has already contributed some valuable data. This contribution not only adds data to an already detailed archive, but it has also provided data on some waterbodies which are completely data deficient. WRT will endeavour to continue as much monitoring as possible into the future beyond CRF.

Physical Works

- WRT have engaged with Imerys with regards to improving water quality and conducted a number of site visits and made recommendations for specific works such as increasing the number of catch pits at the head of the St Austell River, and creating a wetland to improve impacts form Iron Ochre and heavy metal contamination.
- WRT will continue to seek funding to complete the mitigation works on the 34m Polgooth culvert. All planning consents have been obtained.
- Through the cooperation of existing catchment partners , such as the local fisheries associations, it is hoped that future Catchment Fisheries Plans will be develop improved fisheries management on South Cornwall's rivers.
- The five year Upstream Thinking 2 Project on the Fowey catchment starts in April 2015. This will deliver extensive work to target water quality issues within the catchment and build upon the work already delivered under the SCRIP.
- The metal monitoring results on the par indicate that there would be significant scope for metal remediation in the Upper Par catchment. Therefore funding to pursue this will be made a priority.

The South Cornwall River Improvement Project (SCRIP) is a Catchment Restoration Funded Project, which was administered by the Environment Agency. The project was written and delivered by the Westcountry Rivers Trust, and steered by its catchment partnership.

The project was delivered over three years (2012-2015), with the primary aim of delivering targeted action to make significant steps towards achieving Water Framework Directive (WFD) waterbody objectives set out in the 2009 River Basin management Plans.

This report documents the works delivered under the SCRIP and describes how these works were targeted to ensure that efficient on the ground management was delivered effectively throughout the catchment.

Although the SCRIP has completed its final year, the work that has been delivered and the valuable information and data that has been collected will provide a solid foundation to build upon in the future. This not only provides wider benefits to the society and the environment, but also provides a valuable tool to aid in building a sustainable future for the catchment as whole.

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