

Carmarthenshire Nutrient Management Strategy

Achieving Nutrient Neutrality & Beyond

MARCH 2024



Carmarthenshire County Council – Nutrient Management Strategy

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Glossary

Abbreviations

Abbreviation	Meaning	Abbreviation	Meaning
BBNP	Bannau Brycheiniog (Brecon Beacons) National Park	NMB	Nutrient Management Board
BGI	Blue Green Infrastructure	NRW	Natural Resources Wales
CeCC	Ceredigion County Council	PAC	Pre – Application Consultation
CSO	Combined Storm Overflows	PE	Population Equivalent
CTW	Constructed Treatment Wetlands	PCC	Pembrokeshire County Council
DCWW	Dŵr Cymru Welsh Water	PPW	Planning Policy Wales
EA	Environment Agency	PRoW	Public Rights of Way
EIA	Environmental Impact Assessment	PTP	Package Treatment Plant
FCERM	Flood and Coastal Erosion Risk Management	rLDP	Revised Local Development Plan
GI	Green Infrastructure	SAB	SuDS Approving Body
HRA	Habitats Regulations Assessment	SAC	Special Area of Conservation
IAP	Interim Action Plan	SAGIS	Source Apportionment Geographical Information System
IUCN	International Union for Conservation of Nature	SPA	Special Protection Areas
JNCC	Joint Nature Conservation Committee	SuDS	Sustainable Drainage Systems
LDP	Local Development Plan	TANs	Technical Advice Notes
LLFA	Lead Local Flood Authority	The Council	Carmarthenshire County Council
NBB	Net Benefits for Biodiversity	TP	Total Phosphorus
NbS	Nature based Solutions	WFD	Water Framework Directive
NCUK	National Committee for the UK	WG	Welsh Government
NE	Natural England	WwTW	Wastewater treatment works

Definitions

Word	Meaning
Attribute	A piece of information which determines the properties of an environmental feature.
Benefit	The benefits to people obtained from ecosystem services or their wider environment.
Biodiversity	Biodiversity is defined by the UN Convention on Biological Diversity (CBD) as the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species and of their functions.
Blue Green Infrastructure	Blue Green Infrastructure (BGI) is defined by the European Commission as 'strategically planned networks of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem service'.
Ecosystem	A dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit.
Ecosystem asset	The stock of nature which provides ecosystem services and benefits to people. In this report broad habitats are used to define the ecosystem assets. Geodiversity is also considered as a natural asset supporting abiotic and ecosystem services.
Ecosystem services	The flow of benefits people obtain from ecosystems, which includes timber, fibre, crop pollination, water regulation, climate regulation, recreation, and physical health.
Ecosystem collapse	Refers to a situation where an ecosystem suffers a drastic, possibly permanent, reduction in carrying capacity for all organisms, often resulting in mass extinction.
Environmental Net Gain ENG	ENG means achieving Net Benefit for Biodiversity first, and then going further to achieve net increases in the capacity of affected natural capital to deliver ecosystem services.
Eutrophication	<p>Eutrophication is a process that occurs in bodies of water when there is an excessive amount of nutrients, such as nitrogen and phosphorus, in the water. When these nutrients enter a body of water, they cause an overgrowth of plants and algae, called algal blooms.</p> <p>This eventually can result in a depletion of oxygen levels, known as hypoxia, which can harm or kill fish and other organisms that depend on oxygen to survive.</p> <p>Additionally, the excessive growth of plants and algae can block sunlight from reaching the deeper parts of the water, preventing other aquatic plants from growing and reducing biodiversity. This has negative impacts on the overall health of the ecosystem.</p>

Word	Meaning
Green Blue Infrastructure	Green Blue Infrastructure (GBI) is an effective way to complement the built environment whilst alleviating various social, economic, and environmental challenges that are pertinent to delivering sustainable development. In essence, it is focused on actualising the benefits of public goods, ecosystem services, and natural resources whilst also safeguarding the environment for the enjoyment of future generations.
Grey Infrastructure	Grey infrastructure refers to structures such as dams, seawalls, roads, pipes or water treatment plants.
Impacts	Arise when a company or project operations significantly affect ecosystem function quantity or quality.
Indicator	A non-quantitative measure of an environmental property.
Metric	Quantitative measure of an indicator, including the units used.
Natural Capital	The stock of renewable and non-renewable natural resources on earth (e.g., plants, animals, air, water, soils, minerals) that combine to yield a flow of benefits or 'services' to people. These flows can be ecosystem services or goods and benefits, which provide value to business and wider society.
Nature-based Solutions	Nature-based Solutions (NbS) are actions to address societal challenges through the protection, sustainable management and restoration of ecosystems, benefiting both biodiversity and human well-being delivering ecosystem services and adding value to natural capital assets.
Net Benefit for Biodiversity	Net Benefit for Biodiversity (NBB) is defined as, 'the concept that development should leave biodiversity and ecosystems in a better state. Following completion of a project the biodiversity, natural capital or ecosystem services associated with the project is greater than the previous baseline values.
Nitrogen	Nitrates are a class of compounds containing the element nitrogen, an essential nutrient for life. Nitrates are found in human and animal waste and are heavily used by agriculture in crop fertilisers and animal feed. Excess nitrate levels can severely damage a water body's quality and ecology by encouraging excess algae growth.
Phosphates	Phosphates are a class of compounds containing the element phosphorous, which like nitrates are essential biological nutrients to drive plant growth. They are heavily used in agriculture and in sewage. Phosphorous from agriculture and water industries can enter water bodies in similar ways to nitrates, through surface run-off and sewage discharges. Similar to nitrates, if phosphate accumulate in waterbodies, they can encourage excess algae growth and damage the chemical and ecological quality of the water environment. Conversely, the world's reserves of high-grade rock phosphate are considered a "finite" resource.

Word	Meaning
Population Equivalent	The average amount of water, or another component, produced by one person, during one day.
SuDS	Sustainable drainage systems (SuDS) are a collection of water management practices that aim to align modern drainage systems with natural water processes. SuDS efforts make urban drainage systems more compatible with components of the natural water cycle such as storm exceedance runoff, soil percolation, and bio-filtration.
Total Phosphorus	Total phosphorus (TP) is a measure of all phosphorus found in a sample, whether that phosphorus is dissolved or particulate.
Value	The value that people place on the well-being benefits obtained from ecosystem services, which can be expressed in both monetary and non-monetary terms.

Executive Summary

This Nutrient Management Strategy (hereby referred to as ‘the Strategy’) has been prepared to bring together an integrated response to the challenges of delivering nutrient neutrality, and the growing impact this is having on Carmarthenshire’s environment, economy, health, and wellbeing. The Strategy forms part of a wider package of support from the Carmarthenshire County Council (Council) that will facilitate the Local Development Plan (LDP) and sets out a holistic approach to delivering broader benefits, with a particular focus on Nature-based Solutions (NbS) and wider environmental improvements. It also reflects the leading and proactive role Carmarthenshire has adopted in responding to the challenges posed by nutrients in our protected rivers both to their environmental quality and the consequential social and economic impacts. This Strategy presents the current status of the Riverine Special Areas of Conservation (SAC) in Carmarthenshire, what has been done to date by the Council, the statutory bodies and partners, what mitigation opportunities are available and how they could be implemented.

In January 2021, Natural Resources Wales (NRW) published a report presenting an assessment of phosphorus levels within Welsh SAC rivers against [revised water quality targets](#). This found that over 60% of the rivers and streams assessed in Wales fail to meet the revised water quality targets for phosphorus. At least a portion of five of the nine riverine SAC catchments within Wales can be found within the Carmarthenshire County boundary and therefore the Council has a statutory duty to protect these SAC.

There are currently no known phosphorus failures in the Afon Tywi SAC, despite this, it is important to consider the effects of increased phosphorus generated from any new development. In doing so, provided there is sufficient headroom capacity at the respective Wastewater Treatment Works (WwTW) to treat additional wastewater from the proposed development within the revised environmental permit limits, the proposed development would generally satisfy the Habitats Regulations Assessment requirements in line with [NRW Advice to Planning Authorities](#). However, the Afon Teifi has known failures and so a nutrient neutrality approach is required, as per [NRW nutrient neutrality principles](#).

The key aims of the strategy are;

- 1) To Maintain or Restore the Conservation Status of Carmarthenshire’s Riverine SAC,
- 2) To Join Up The Approach,
- 3) To Enable Sustainable Development.

The Council has been a leader in producing a number of tools and guidance documents, which have set the foundations to allow for nutrient neutral development planning and implementation in all SAC catchments within West Wales. Significant work has been undertaken to date to explore potential mitigation opportunities at national and local scales.

The ‘[Teifi Demonstrator Catchment](#)’ project has been launched as a cross-sectoral collaboration supported by Welsh Government aimed at improving water management in the Teifi catchment. It will be an important project in driving the holistic approach which CCC are targeting to improve water quality and deliver wider benefits. Key partners include the Rivers Trusts, Dŵr Cymru Welsh Water, the Farming Unions and Local Authorities. Lessons learned from this project will be shared throughout Welsh catchments.

NbS offer opportunities to reduce nutrient pollution whilst also delivering a wide range of additional benefits such as amenity and biodiversity benefits. There is also huge value in finding collaboration opportunities, and avoiding working in silos, wherein multiple strategy targets can be resolved simultaneously. NbS differentiate from traditional drainage and treatment solutions because they can also provide water quality improvements by reducing sediment and contaminants from discharges through settlement and/or biological breakdown of pollutants. This can improve the water quality of downstream waterbodies such as streams, rivers, lakes,

bathing or shellfish waters. Therefore, such benefits have the potential to be captured in the form of nutrient credits and other credits, as part of green financing initiatives.

It is important to take a more complete and holistic ecosystem approach to ensure that the most appropriate suite of actions can be implemented at any given location. By taking this approach, wider expertise can be brought in, additional funding made available and shared objectives more readily realised.

Successful delivery of the Strategy will provide the means for delivering nature-based solutions (NbS) as well as sustainable development aspirations, in the right place, for the right reasons and ensure that a collaborative and a systems approach to improving Carmarthenshire's environment, economy and health & wellbeing.

1 Introduction

This Nutrient Management Strategy (hereby referred to as 'the Strategy') seeks to reflect the significant contextual changes that have emerged in relation nutrient pollution in Carmarthenshire's protected sensitive rivers. In particular the Strategy seeks to address issues arising from the publication Natural Resources Wales (NRW) guidance on Phosphate levels in riverine Special Areas of Conservation (SAC). Critically, the strategy aims to explore a holistic, integrated, and coordinated response to what are a complex set of challenges with wide ranging implications.

This is particularly pertinent given the impacts not only on our environment, but also on the communities in affected areas and their social and economic worth and opportunities. This Strategy will form an important step in recognising those impacts and setting them within the context of a need for a holistic approach, which connects with and integrates the Carmarthenshire County Council's (Council's) corporate objectives and its plans and strategies.

The impact of nutrient pollution has far reaching consequences for the economic and social health of Carmarthenshire. The adverse biological and ecological effects of nutrient pollution can result in economic losses across multiple industries and economic sectors. In order to address this issue, legislation dictates that essential home building and development be put on hold until nutrient mitigations are in place or secured. This delay in supplying appropriate mitigations has a knock-on effect on economic growth and the availability of housing within the County. It is therefore of paramount importance for the social and economic wellbeing of Carmarthenshire that an all-encompassing Strategy addresses the issue of nutrient pollution in a cohesive way and sets out ways of attaining and implementing suitable mitigation measures. Thereby, allowing our County to prosper and maintain itself as an attractive and affordable place to live and work.

Carmarthenshire has a rich and diverse natural environment. Within the County boundary, at least a portion of five of the nine riverine SAC catchments within Wales can be found. In addition, the Carmarthenshire Bay and Estuaries SAC encompasses the estuaries of the Rivers Loughor, Taf, Tywi and Gwendraeth providing extensive areas of intertidal mudflats and sandflats, with UK wide significance in terms of resident species.

The natural environment is vital to the social, economic and cultural well-being of people living in Carmarthenshire today and the generations to come. The need to manage and protect these natural resources sustainably is important now more than ever. Natural resources that are healthy and thriving are also healthier for people, their communities and for the economy. These precious environments form an important part of Wales's landscape and natural heritage. Of the Riverine SAC in Carmarthenshire, the Afonydd Cleddau, Afon Teifi, Afon Tywi, Afon Wysg (River Usk) and Afon Gwy (River Wye) support some of the most special wildlife to be found in Wales, including Atlantic salmon, freshwater pearl mussel, white-clawed crayfish and floating water-plantain. Figure 1-1 provides an overview of the five phosphorus sensitive riverine SAC in Carmarthenshire.

The benefits afforded by these areas to both communities and nature are significant. They support tourism, health and wellbeing, biodiversity, carbon sequestration, rural-economies, water supply and more. Unfortunately, these vital environments are under pressure and amongst the biggest issues faced is nutrient pollution from phosphorus and nitrogen. A healthy natural environment is a vital part of a sustainable, resilient and distinct Carmarthenshire. Naturally by improving the health of rivers and the way land is managed, we can create a more prosperous society. Thereby connecting social and environmental justice.

Excess nitrogen and phosphorus in water leads to eutrophication that ultimately causes overgrowth of algae and plants, resulting in stimulation of certain plant species, toxic algal blooms and decreasing oxygen levels. This causes direct mortality in animals and reduces overall biodiversity by favouring fast growing species.

New developments such as housing or agricultural enterprises can lead to increased amounts of nutrients entering the water environment, threatening their long-term health.

In January 2021, NRW published a report presenting an assessment of phosphorus levels within Welsh SAC rivers against **revised water quality targets**. This found that over 60% of the rivers and streams assessed fail to meet the revised water quality targets for phosphorus. The sources of phosphorus depend on the catchment, for example for Afon Teifi is largely driven by WwTW discharge (**67% of the daily load**) while the Afon Tywi is largely driven by agricultural inputs (**over 85%**).

Hughes et al. (2008) estimated that the largest sources of nitrogen pollution in Welsh watercourse were agriculture (contributing 60%) and sewage leaks and discharges (contributing 17%). New developments such as housing or agricultural enterprises can lead to increased amounts of nutrients entering the water environment, threatening their long-term health.

The Welsh Government and the Council has a statutory duty to protect these SACs through regulation of activities for which they are responsible via the **Conservation of Habitat's and Species Regulations 2017, as amended** (Habs Regs). This has resulted in the **Control of Agricultural Pollution (Wales) Regulations 2021**, that restricts the use of nitrogen and enforces nutrient management.

The **guidance published by NRW** clarified the requirements with regards to the revised water quality targets for phosphorus within Welsh riverine SACs, new developments that add people to the catchment have potential to harm these environments without mitigation. **The Environment (Wales) Act 2016** requires a new, more integrated approach to managing our natural resources in order to achieve long-term sustainability. It widens the responsibility from SAC compliance with the Habs Regs, to the duty that public authorities must *“seek to maintain and enhance biodiversity and promote the resilience of ecosystems”* In response, the Council has had to consider the demonstration of nutrient neutrality when considering planning applications and indeed its own proposals within the revised Local Development Plan (rLDP).

1.1 Nutrient Neutrality

Nutrient neutrality is an approach for managing new development and water discharge permit proposals to prevent them from causing any net increase in nutrients for the duration of the authorisation. According to latest **NRW guidance**:

“In SAC catchments failing to meet phosphorus targets, it is possible that new developments can be authorised if it can be demonstrated they will not lead to further deterioration of water quality in the SAC water bodies failing to meet water quality targets and will not undermine the ability for the SAC to meet its conservation objectives.

This may be achieved if:

- *developments are not a source of phosphorus or*
- *developments are a source of phosphorus but there is no pathway for it to enter the SAC river environment or*
- *measures associated with a given development are put in place so that nutrient neutrality can be achieved and that development does not lead to a net increase in phosphorus entering the SAC river environment.*

In SAC catchments meeting phosphorus targets, it is possible that new developments can be authorised if it can be demonstrated they will not lead to an adverse effect on site integrity (i.e. will not undermine the ability for the SAC to meet its conservation objectives)”

In other words, new developments must demonstrate that they are not contributing any additional nutrient load into the receiving environment if drain to the failing riverine SAC catchments. This has had severe impact across Wales, bringing Local Development Plan (LDP) housing allocations and already permitted housing development to a standstill, and raising the question of how to deliver the housing needs of the future whilst protecting the natural environment.

Within Carmarthenshire, the riverine SACs currently requiring nutrient neutrality for new applicable developments are the Afon Teifi, Afonydd Cleddau, River Usk and River Wye (further discussion in 2.1.1).

1.2 Aims

This Strategy sets out a framework for the Council and its stakeholders to collaboratively secure the long-term health of Carmarthenshire’s most sensitive rivers whilst enabling sustainable growth. The three core aims of this Strategy are described below.

To Maintain or Restore the Conservation Status of Carmarthenshire’s Riverine SACs

The Council is committed to ensuring the environmental targets and conservation objectives required for these riverine SACs are met. This means ensuring there is a strategic plan in place to meet nutrient neutrality for the rLDP whilst also exploring additional opportunities for environmental improvement works across the catchments, adding headroom for future development and securing long-term river health.

To Join Up the Approach

Meeting this challenge requires holistic systems thinking. The Strategy will focus on how we bring stakeholders together to identify shared objectives, underpinning a vision that will unlock collaborative working. This will recognise the role of the Nutrient Management Boards as a mechanism to bring together local authorities and stakeholders to co-deliver cross-border solutions. The strategy will also seek to link up other local strategies, such as the Council’s tree strategy or flood risk strategy which could have positive impacts on water quality.

To Facilitate Sustainable Development

Core to this Strategy is ensuring that development is able to take place within Carmarthenshire, but crucially that this development is sustainable. This means finding smart, value for money solutions to the issue of nutrient pollution and deliver wider benefits where possible. The Strategy will consider both short and long-term aspirations in terms of nutrient management to secure a solid platform for housing development within the County.

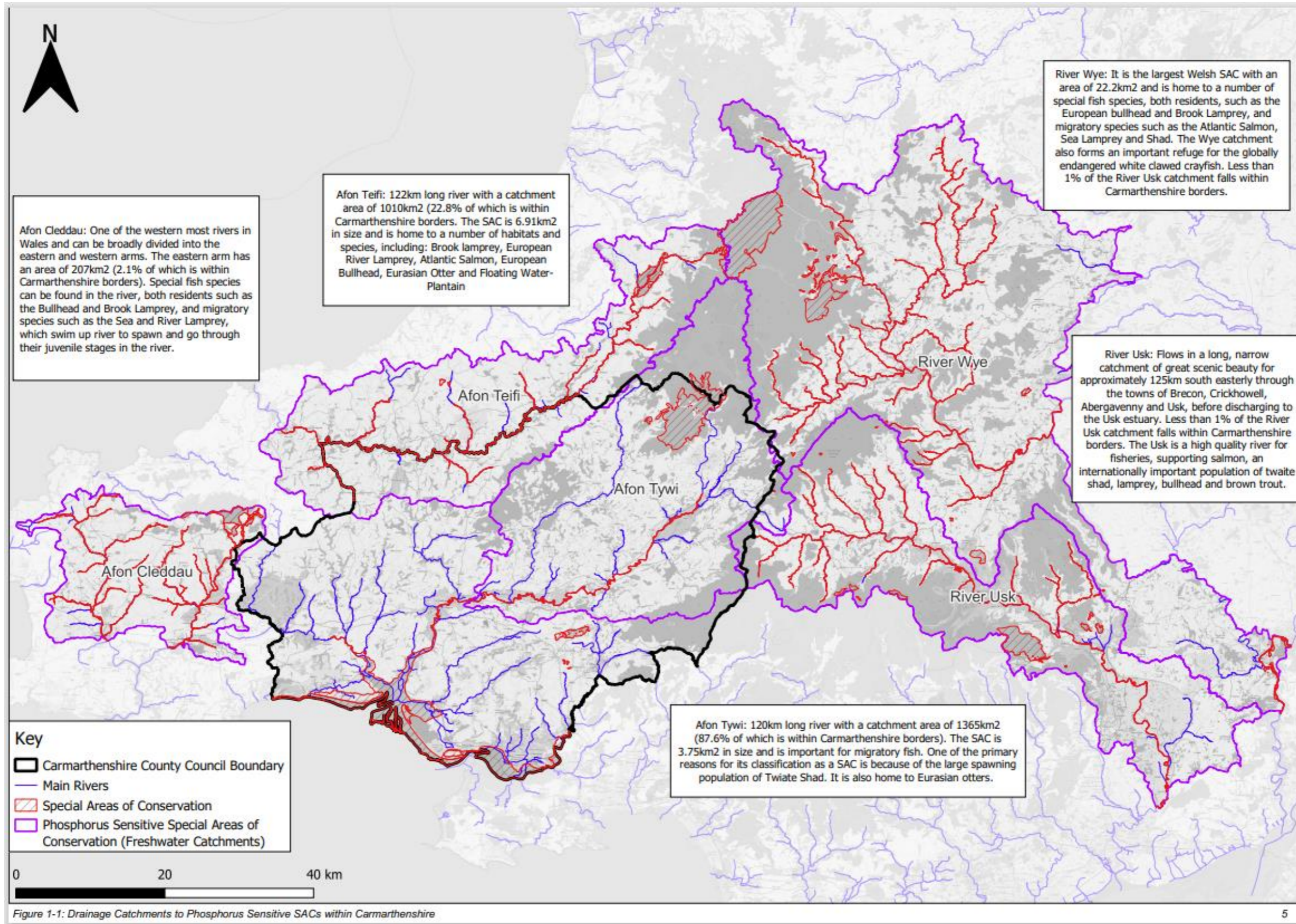


Figure 1-1: Drainage Catchments to Phosphorus Sensitive SACs within Carmarthenshire

Figure 1-1: Drainage Catchments to Phosphorus Sensitive SAC within Carmarthenshire

2 Current Status

This section of the Strategy will highlight the current status regarding nutrients within the Carmarthenshire SACs, helping to establish current understanding of the existing conditions and the scale of the challenge. It will also summarise key responses to date from key stakeholders.

2.1.1 Riverine SAC phosphorus compliance

All five riverine SACs within Carmarthenshire were assessed as part of the NRW compliance study against revised phosphorus targets. To assess each SAC, the catchments were broken down into sub-catchments based on available monitoring data and given a pass or fail rating. Table 2-1 provides a summary of the most recent results (November 2022). Since the publication of this report, data for an additional sampling point in the upper Tywi waterbody was found, which indicated that the upper Tywi waterbody (GB10060036350) is compliant with the [Water Framework Directive, 2017](#) (WFD) targets for phosphorus. Therefore Table 2-1 has been updated to account for this.

Table 2-1: Summary of SAC river phosphorus compliance results for the five SAC Rivers in Carmarthenshire.

SAC River	Total waterbodies	Passing waterbodies	Failing waterbodies	Unassessed
Afon Tywi	3	3 (100%)	0 (0%)	0 (0%)
Afon Teifi	18	8 (~44%)	8 (~44%)	2 (~11%)
Afonydd Cleddau	19	5 (~26%)	10 (~53%)	4 (~21%)
River Usk	45	14 (~31%)	29 (~64%)	2 (~4%)
River Wye	24	2 (~8%)	15 (~63%)	7 (~29%)

There are known failures on in some of the upper catchments of the River Usk and River Wye which border Carmarthenshire. The eastern arm of the Afonydd Cleddau, which borders Carmarthenshire is broadly passing its phosphorus targets. Given the very small percentage that the Rivers Usk, Wye and Afonydd Cleddau phosphorus sensitive SAC catchments account for within Carmarthenshire's boundary (see Figure 1-1), and that there is no new housing proposed in these catchments under the rLDP, this Strategy will focus on the Afon Tywi and Afon Teifi. However, it is important to note that the discussion throughout this Strategy broadly applies to other SACs too.

As shown in Table 2-1, there are currently no known phosphorus failures in the Afon Tywi. Despite this, it is important to consider the effects of increased phosphorus generated from any new development. For example, The Council's rLDP has 7 sites (104 dwellings) within the Tywi catchment. Further work on the application of [nutrient neutrality principles](#) to the Tywi SAC in relation to meeting the requirements of the Habitat Regulations has been conducted by [DTA Ecology](#). It states that the Habitats Regulations should only constrain development proposals which represent a threat to the integrity of a SAC. Development proposals affecting Tywi catchment will not represent such a risk until the waterbody approaches a nutrient target such that a risk of exceedance arises. Despite this, a simpler headroom checking or monitoring approach could be considered by the Council and stakeholders if deemed necessary to ensure that there is no imminent risk of exceedance due to the planned development.

The Afon Teifi has known failures and so a nutrient neutrality approach is required, as per NRW guidance. As a result, nutrient neutrality would apply in across this SAC catchment. Within the Council's rLDP, 14 sites (total of 172 dwellings) are planned within the Teifi catchment and strategic solutions to unlock this new development would be required. As shown in Figure 2-1, the majority of the failing waterbodies are in the lower catchment, near to urban areas like Newcastle Emlyn and Llechryd.

2.1.2 Additional considerations

NRW is the statutory government body with key responsibilities for the implementation and management of the Habitats Regulations and the WFD in Wales. Despite the current focus being on the management of phosphorus entering the SAC, the environmental targets and conservation objectives of the riverine SAC, as well as the contributing tributaries should still be considered. This is to ensure that all SAC rivers and contributing tributaries are maintained or restored back to favourable condition status, meeting their designated requirements. Nutrients such as nitrate, nitrite and ammonia could pose future risks to the status of these waterbodies. Careful consideration around the location and type of mitigation implemented across the catchment is also required to ensure that nutrient neutrality approaches do not compromise or disrupt the achievements of WFD restoration objectives.

2.1.3 Future Considerations

Whilst eutrophication has mostly been a freshwater issue, there is **new evidence** that there are effects on marine margins, and even in the much longer term, oceans. Details of content and release date of the Marine SAC guidance with regards to nutrients have not been specified by NRW. However, it is understood that modelling has been completed and that Marine SAC guidance will be issued pending legal consultations.

These may include incorporation of nutrient budgeting with phosphate and/or nitrate targets has been the case with phosphates guidance. The areas that will be affected by any new guidelines will be coastal and estuarine river catchments. This will likely affect inland areas of Carmarthenshire as far as Ammanford, Llanelli, and Carmarthen town.

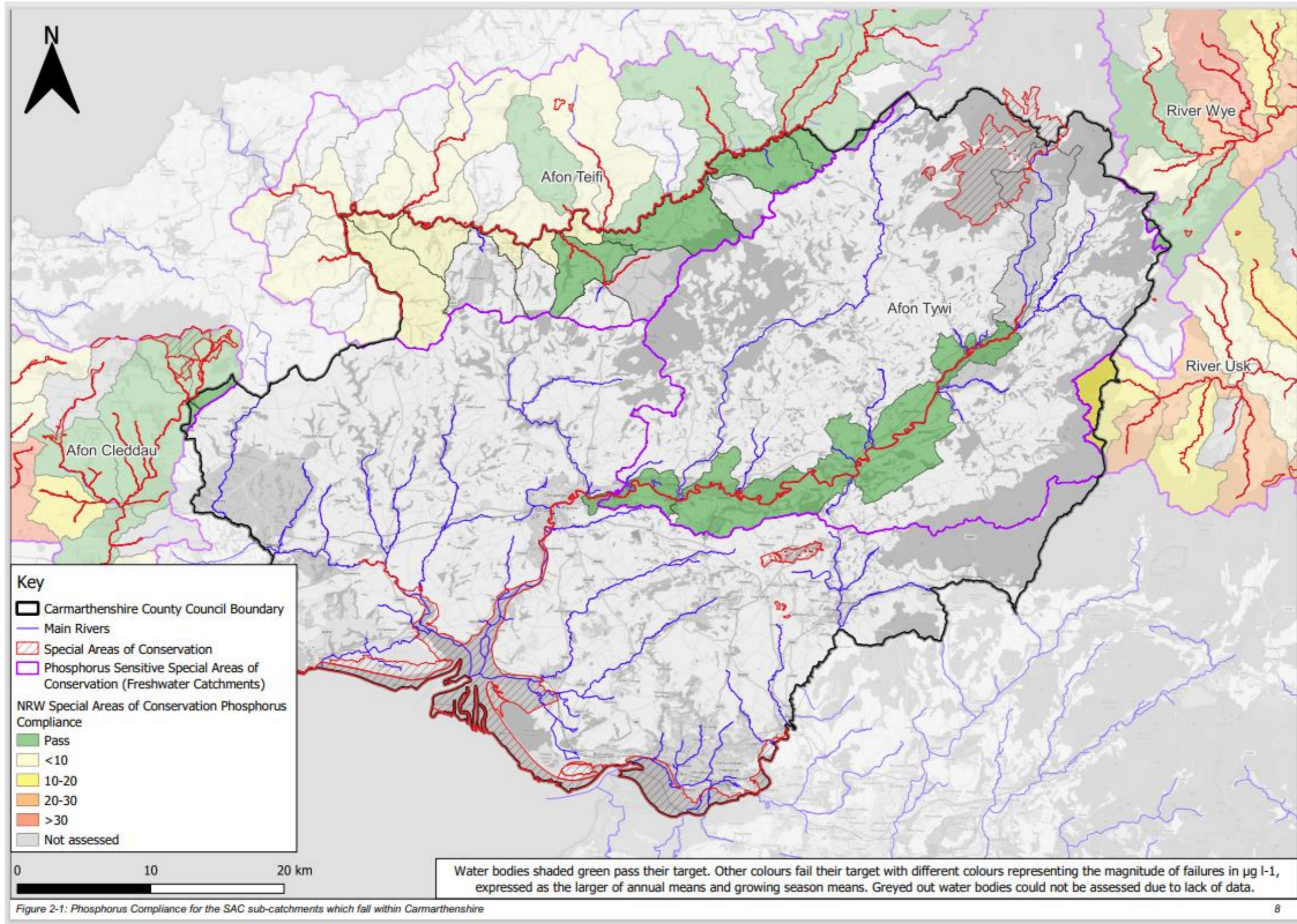


Figure 2-1 Phosphorus Compliance for the SAC sub-catchments which fall within Carmarthenshire.

2.2 What has been done?

To date, the starting point for assessing the action required to reduce pollution to the updated targets has been to establish what the required proportional reductions are, in line with each sector's contribution to the overall load of a pollutant. This is in line with UK Government's general policy principles around '**polluter pays**' and '**fair share**'. The expectation is that each sector will reduce their phosphate inputs in proportion to their contributions, so every sector has to make reductions in phosphate entering the catchment.

However, these principles are complicated in the case of nutrient pollution. Many years of excess nutrient pollution from agriculture, industry and aging wastewater infrastructure have led to the current situation. Untangling these historic exports to the natural environment is not easily done, and whilst some work has been carried out to better understand the present day sources of nutrient pollution, this does not easily translate to an apportionment of legal responsibility for implementing mitigation.

Competing pressures of population growth, demand for affordable food, housing supply, urban creep and climate change are society wide factors. Tackling the issue of nutrient pollution has therefore required all parties to consider their potential to positively address the situation and initiate change.

2.2.1 Carmarthenshire County Council Response

The Council has recognised the potential for additional housing, job and employment creation and other developments (brought forward under the rLDP and through planning applications) to increase phosphate export into these SAC. Conversely it also recognised early on the impacts this would have on the socio and economic futures of communities within affected catchments. It has therefore been proactive in tackling the present need to demonstrate nutrient neutrality compliance. The Council has taken a leading role in developing a range of tools, guidelines, technical notes and strategy documents all focusing on tackling the issues around nutrient neutrality. Carmarthenshire's original Nutrient Budget Calculator, the first formal one in Wales, has been developed to form the West Wales Nutrient Budget Calculator. This calculator was an important first step in allowing nutrient neutral development to proceed, initially in Carmarthenshire and subsequently in all catchments within West Wales. The soon to be published All-Wales Nutrient Budget Calculator will largely be derived from the original Carmarthenshire Nutrient Budget Calculator now **West Wales Calculator**. CCC were also instrumental in setting up the Tywi, Teifi and Cleddau NMBs, and the Regional Stakeholder Technical Advisory Group Figure 2-2 captures the breadth of the Council's response to nutrient neutrality and its efforts to improve SAC status.



Figure 2-2 The Carmarthenshire County Council's response to Nutrient Neutrality

An **Interim Action Plan (IAP)** was developed for the rLDP which has made clear recommendations as to the way ahead, providing a clear indication of how the rLDP can be brought forward to adoption in line with NRW's advice. The IAP was accompanied by a **Habitats Regulations Assessment (HRA) addendum report** which assessed the potential impact of phosphates, in addition to the site screening amendments made to the rLDP to minimise impact of phosphates since the publication of the original **HRA report in 2019**.

Further to the work on the IAP and HRA addendum report, it was concluded that for the rLDP to satisfy the HRA compliance assessment, the in-combination impacts of planned new developments that discharge to the Teifi SAC from the adjacent Ceredigion County Council (CeCC) and Pembrokeshire County Council (PCC) would need to be accounted for. As such, an additional study was commissioned that further details the estimated nutrient budgets and assesses potential constructed wetland opportunities within CeCC and PCC to address in-combination impacts.

The IAP has been developed into an Action Plan, whereby the nutrient budget calculations for the current rLDP allocations and commitments have been updated in line with the All-Wales Nutrient Budget calculator. Strategic scale solutions to mitigate the revised nutrient budget of the proposed developments will be considered alongside site scale solutions where appropriate.

The purpose of this Strategy is to set out a collaborative approach to support the Council's response to issues of nutrients in our protected rivers. It also supports the development and implementation of the **Council's rLDP**, and to meet the requirements of the Conservation of Habitats and Species Regulations (**as amended 2017**).

As part of the preparation of the rLDP and a reflection of the cross-county nature of riverine SAC catchments a Statement of Common Ground (SoCG) between Local Authorities, NRW, Dŵr Cymru Welsh Water (DCWW) and Bannau Brycheiniog (Brecon Beacons) National Park (BBNP) is being developed to address the legislative need for nutrient neutrality or betterment for the delivery of the Councils rLDP. The SoCG informs the inspectors of the **agreed position of Local Planning Authorities**, NRW, and DCWW relating to the requirement that **any development within the Afon Teifi and Afonydd Cleddau SAC must not contribute further nutrient input**.

2.2.2 Dŵr Cymru Welsh Water Response

To understand DCWW's contribution to the phosphorus load to the rivers, and to assess any improvements DCWW would need to make to their WwTW discharges, DCWW have updated and re-calibrated their water quality models using the regulator and industry standard tool known as SAGIS (Source Apportionment Geographical Information System). SAGIS has been used to identify where DCWW should remove additional phosphorus from the WwTW discharges to meet its 'fair share' of the water quality improvements needed. This informs DCWW where they should prioritise and reduce the amount of phosphorus entering the SAC to help restore favourable status in the river. SAGIS modelling has informed the Review of Permits (RoP) process outlined in Section 2.2.3.

DCWW have published key documents on their website relating to this modelling work and outlined the approach to investment DCWW is planning to take, which will support the collaborative efforts for implementing suitable cost-effective solutions to restore the SAC rivers to favourable conservation status whilst supporting the economic development needs in Wales.

The results of the SAGIS modelling provide a detailed summary of the amount of phosphorus discharged to these SAC on a daily basis, quantified at the downstream modelled extent. It also provides a breakdown of the main contributing source of phosphorus at a sub catchment level within each SAC. This is important because it provides an opportunity to target the source of phosphorus in those catchments with appropriate mitigation measures. A summary of the SAC Phosphorus Load Overview Maps for the Afon Teifi, Afonydd Cleddau, River Usk and River Wye can be found in Appendix A. The Afon Tywi SAC Phosphorus Load Overview Map is due to be published at the end of 2023.

DCWW's SAC phosphorus permit programme is expected to be completed by 2032, during Asset Management Plan 9 (AMP9). As part of the programme, every DCWW WwTW discharging over 20m³ /day to a SAC, or non-designated waterbody draining to a SAC, will meet a phosphorus permit condition by 2032. Where a reduction in phosphorus load is not required, DCWW will agree a new 'backstop' permit limit (5mg TP/litre) to prevent deterioration in the waterbody. Investment will be prioritised to tackle the largest phosphorus contributing sites first with the smaller sites later in the programme.

DCWW have also provided an overview of where collaboration opportunities for constructed treatment wetlands (CTW) could be available for any interested parties. Such CTWs provide extra polishing to the treated wastewater effluent by passing it through a series of interconnected shallow holding areas planted with native wetland species such as iris, sedges, rush, reeds, marsh marigold and watercress. CTWs are engineered to mimic the physical, chemical, and biological processes occurring in natural wetlands. Not only do the wetlands have a practical water quality benefit, but they provide a huge biodiversity asset and create a valuable habitat for local wildlife.

Each WwTW has been screened into a category (A, B, C or D) to highlight the different opportunities available. It is important to understand that the investment programme is a major undertaking, both logistically and financially, and as such will need to be delivered over several investment 5 yearly or AMP periods. Figure 2-3 shows the AMP cycles over the period of the rLDP. Over these AMP cycles, DCWW will be investing in several assets which will directly impact the rLDP. This allows for a more coordinated approach across Carmarthenshire when it comes to locating mitigation measures. This is explored further in Section 4 Joining up the Approach.

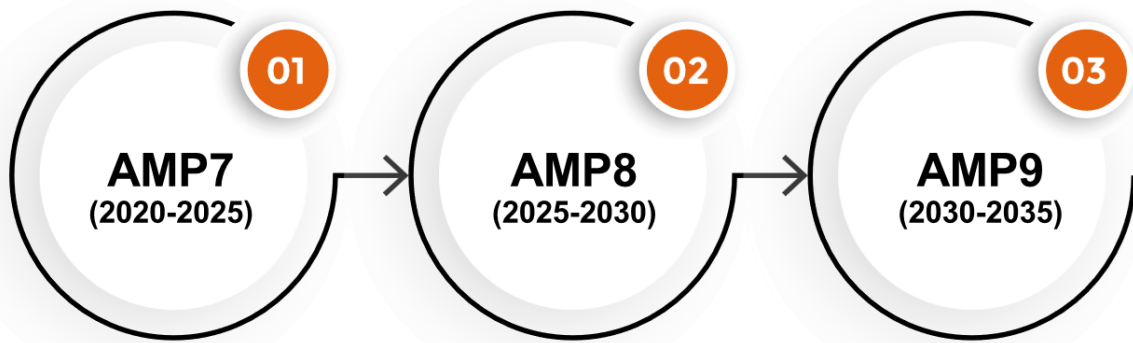


Figure 2-3 DCWW AMP Periods

2.2.3 NRW & Welsh Government Response

Following on from the Joint Nature Conservation Committee (JNCC) report, and subsequent NRW planning advice and RoP, a number of frameworks, action plans and guidance documents have been developed to help tackle excess nutrients entering Welsh catchments. This section consolidates some of the key supporting frameworks and guidance documents that will be applicable to the Council, stakeholders, developers and locals.

The river pollution summits convened by the First Minister, jointly chaired by the Minister for Rural Affairs and the Minister for Climate Change, have discussed the need to move at speed, strip away complexity and provide certainty in messaging across the different challenges.

The [Welsh Government \(WG\) Relieving pressures on SAC river catchments to support delivery of affordable housing Action Plan \(2022\)](#) sets out clear actions, timescales, and responsibilities to tackle pollution in SAC river catchments and address planning constraints. Whilst the action plan mainly focuses on the issue of unlocking development across Wales, certain themes are applicable to returning the SAC rivers to favourable conditions, and delivering wider benefits, via the menu of mitigation measures.

The [‘Teifi Demonstrator Catchment’](#) project was launched in late November 2023. This is a cross-sectoral collaboration project supported by Welsh Government and aimed at improving water management in the Teifi catchment. The launch of the project was marked by a stakeholder engagement event convened by NRW Chair Sir David Henshaw and attended by key partners including the Rivers Trusts, Dŵr Cymru Welsh Water, the Farming Unions and Local Authorities. The Teifi Demonstrator Catchment project will form part of the wider holistic approach we are taking to improve water quality. The work in the Teifi will be used to develop a ‘best practice’ model which can subsequently be replicated across all of Wales’ catchments.

As part of the Welsh Government’s First Minister’s Action Plan there was an action for NRW to produce a ‘menu of mitigating measures’. CCC first produced mitigation measures for the SW Wales NMBs that was then further developed by NRW. This [Mitigation Measures Menu](#) is a list of potential options for phosphorus mitigation using the best available evidence. The purpose of the menu is to acknowledge measures which have been identified through available evidence as having the potential to reduce nutrient input into freshwater environments. NRW and WG will provide a clear direction on the role and function of the NMB, as well as work together to provide sufficient levels of funding for 2023-24 and 2024-25 and then to explore future funding options.

To date the Welsh Government have made available almost £1.5 million of funding to enable the NMBs to produce Nutrient Management Plans. These plans, and their implementation, provide the mechanism by which NMBs progress action to improve water quality so we can restore and conserve favourable condition

status on our SAC rivers, whilst also allowing development to continue within these catchments without increasing the phosphorus loading. This will address the pressing need to enable the construction of more affordable housing now, while at the same time, making progress on improving river health and achieving favourable conservation status.

It is anticipated that NMBs will develop plans which identify measures which will make a difference in the short, medium and long term. These will provide the foundation for longer-term improvements with the aim of achieving and maintaining SAC compliance, but with early priority given initiatives to unlock affordable housing over the next two years. In the future, the Welsh Government expects the NMBs will play a continuing role in supporting the Welsh Government and Natural Resources Wales in promoting and delivering their longer-term ambitions in relation to water quality. Locally led bodies, underpinned by the democratic accountability of Local Authorities, have the best chance of finding solutions which will work and will stick.

The All-Wales Nutrient Calculator is due to be released in due course and will be a unified nutrient calculator to directly aid planning decisions on nutrient neutrality and will have the ability to take account of catchment-level data, local features and needs. The All-Wales Nutrient Calculator builds on the Carmarthenshire Nutrient Budget Calculator and subsequent West Wales Nutrient Budget Calculator, both developed by the Council.

A Task and Finish (T&F) nutrient credit trading group has been established to look at the structures and evidence base that would be required to enable nutrient offsetting in SAC river catchments. The T&F Group will also look at possible mechanisms for nutrient trading in the future.

As discussed in Section 2.2.2, each WwTW has been allocated a 'collaboration category' by DCWW. Where CTWs are possible, NRW have published a [Policy on constructed wetlands \(October 2023\)](#) which clarifies NRW's position on what CTWs NRW will support. This policy assists in making an informed decision on the use of CTWs for various purposes. The Policy covers CTWs, wetlands designed and created for a specific purpose. Naturally occurring wetland habitats (including bogs, marshes, fens, ponds, lakes and rivers) are excluded from this Policy. It should also be noted that NRW endorse the use of [Natural England's \(NE\) Framework Approach for Responding to Wetland Mitigation Proposals](#), which provides a detailed guide on undertaking feasibility studies for CTW, designing and implementing the CTW.

3 Mitigation Opportunities

This section seeks to outline the solutions available to tackle the issue of nutrient neutrality. Significant work has been undertaken to date to explore potential mitigation opportunities at national and local scales. Carmarthenshire has been proactive in identifying strategic solutions to mitigate phosphate exports generated by its rLDP, some of which are discussed within this document. In many instances, Nature-based solutions (NbS) offer opportunities to reduce nutrient pollution whilst also delivering a wide range of additional benefits.

3.1 Nutrient management opportunities

3.1.1 Options

Management of nutrient levels is typically achieved through nutrient capture, although reductions in nutrient release can also be effective (e.g., through changes in agricultural practices such as reduced use of fertilisers). Under [Planning Policy Wales \(PPW\)](#), development proposals in sewered areas must connect foul drainage to the main sewer and the use of new private WwTW is not permitted where public WwTW are available. Nutrient capture can be achieved through the use of enhanced process treatment technology at wastewater treatment works, however, this is largely only an option to water utility companies or their regulators at present.

In contrast, the use of NbS is an effective means of capturing nutrients and it is an option available to all. NbS refers to the use of natural and semi-natural habitats to deliver some kind of benefit. A common example of a NbS is the use of trees to sequester carbon. NbS can be used for wide range of purposes and at a wide range of scales, making them a very versatile option. Figure 3-1 overleaf shows the wide range of intervention measures available to support nutrient management. A detailed summary of each measure, the advantages and disadvantages can be found in Table B-5-1 in Appendix B.

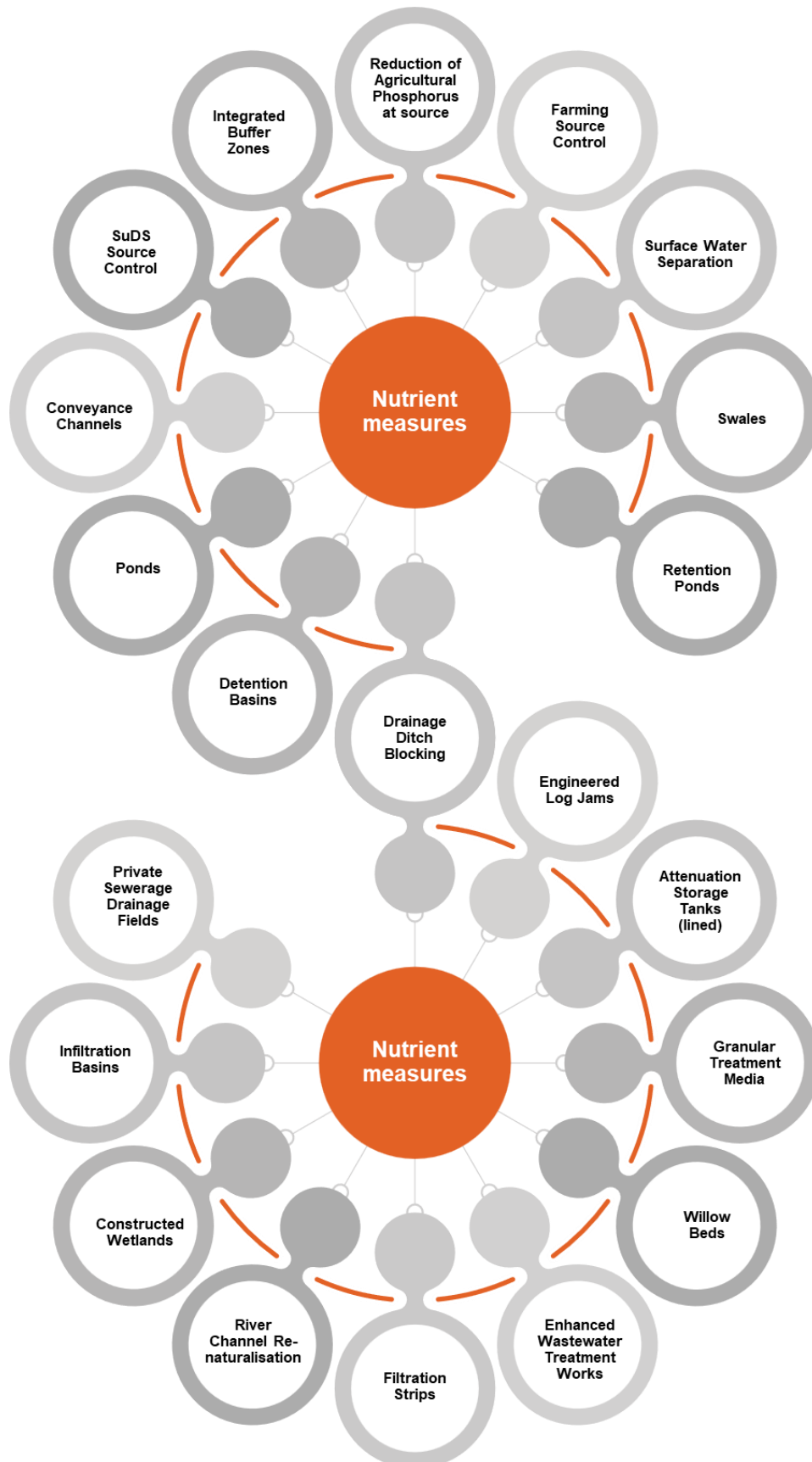


Figure 3-1 Nutrient Management Interventions

The main focus on this Strategy is on NbS, but also included are sustainable land management practices and grey infrastructure solutions. Included under the umbrella of NbS are suitable Sustainable Drainage Systems (SuDS) for simplicity although they may contain engineered solutions such as permeable paving, infiltration trenches, soakaways and suitable proprietary products. Therefore, SuDS is an umbrella term itself for a range of green, blue and grey infrastructure derived methods of managing surface water, typically in an urban environment. SuDS mimic natural drainage processes to reduce the effect on the quality and quantity of runoff from developments whilst maximising wider benefits such as amenity and biodiversity, further discussed in 3.2. These features can be very effective measures within often space-constrained urban environments.

The multiple types of intervention have been included to demonstrate the range of options available. Table B-5-1 in Appendix B provides an overview of the ever-growing body of evidence that can guide decision making around selection of nature-based solutions. Information is presented on the following topics to provide guidance regarding which of these options is likely to be most appropriate:

- Advantages and disadvantages
- Potential delivery partners
- Feasibility
- Effectiveness
- Maintenance requirements
- Wider benefits
- Case Studies

When selecting nutrient management interventions, it is important to consider the scale of nutrient load being offset. For example, wetlands offer a solution to large nutrient loads but may be impractical and prohibitively expensive options for implementing at smaller scale developments to manage their impacts. Guidance on assessing a proposed developments nutrient impact can be found on the Council's [website](#).

3.2 Wider benefits of NbS

3.2.1 Multiple benefits

One of the key advantages of NbS over grey infrastructure is their delivery of additional benefits (i.e., beyond the capture of nutrients) in addition to their inherent resilience and ability to respond to changing needs. When considering the potential uses of NbS for improving water quality, as opposed to more traditional forms of water management with grey infrastructure, it is important to take into account the following benefits that can be achieved from their correct implementation and management:

- Improved cost-benefit ratios obtained from NbS when compared to grey infrastructure (further discussed in 5.3).
- Interest from collaborators or funders in supporting the delivery of additional benefits from NbS.
- Can contribute to the delivery of wider local or national targets.
- Can help in addressing non-legislative targets (e.g., organisational or stakeholder internal targets).

Wider environmental benefits from NbS include enhanced biodiversity and wildlife habitats, as well as socioeconomic benefits such as community involvement and amenity value (Figure 3-2). Table B-5-1 in Appendix B includes examples of some of the wider benefits typically delivered by each intervention, with one such being wetlands. Wetlands that are implemented for the purpose of capturing nutrients can also deliver benefits relating to biodiversity, aesthetic value, recreation, carbon sequestration and natural flood mitigation, among others.



Figure 3-2: Indicative wider benefits of NbS

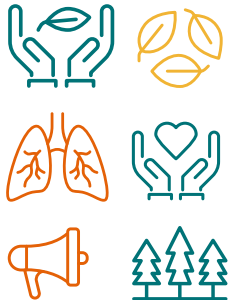

3.2.2 How additionality could be achieved through NbS

As an important type of NbS for water quality, several SuDS measures can mimic natural drainage processes to reduce the effect on the quality and quantity of runoff from developments and provide wider environmental benefits, such as amenity and biodiversity benefits. They differentiate from traditional drainage and treatment solutions because they can provide water quality improvements by reducing sediment and contaminants from runoff through settlement and/or biological breakdown of pollutants. This can improve the water quality of downstream waterbodies such as streams, rivers, lakes, bathing or shellfish waters. Such benefits have the potential to be captured in the form of credits which are additional to obtaining nutrient credits. The credits that can be obtained ultimately depend on which NbS has been implemented.

For example, the use of willow beds to help improve the reduction of excess nutrients in water can also create biodiversity and carbon sequestration benefits to name a few. These could translate into attaining carbon credits and the potential for creating **net benefits for biodiversity**, providing that these are proven to be additional to acquiring nutrient credits. In order to achieve these extra credits, additionality rules must be adhered to when implementing any NbS. Currently in Wales, guidelines for claiming additionality on nutrient neutrality solutions have not been published, however the **woodland carbon guidance** reemphasises the necessity for claimed credits clearly being additional to the project purpose, which should also be considered when claiming any additional credits for nutrient neutrality projects.

Table 3-1 presents some examples of how the additional benefits shown in Figure 3-2 can be achieved through varies NbS. A complete list of interventions and their benefits can be found in Table B-5-1 in Appendix B.

Table 3-1 Examples of additionality through NbS

Intervention	Discussion	Benefits
Integrated Buffer Zones	<p>A solution involving increasing grassland, floodplain grassland, beetle banks, woodland and hedgerows.</p> <p>+ Advantages: Good capability for capture of pollutants and wider environmental benefits.</p> <p>- Disadvantages: Reduced productive area under agriculture may release nutrients during non-growing season. Risk of increasing emissions of nitrous oxide and methane (greenhouse gases)</p>	
Willow Beds	<p>Willow beds can be designed to treat stormwater from low/medium risk surfaces of small catchments. They allow capturing, attenuation, and evapotranspiration of captured flows.</p> <p>+ Advantages: Capture, attenuation and evapotranspiration of all flows so no discharge occurs. Uptake of phosphorus by the willow. Harvesting willow can be a valuable resource. If built as part of a closed systems, it is effective immediately.</p> <p>- Disadvantages: Not commonly used in the UK, and where they are, they tend to be for private sewage treatment installations. To have optimal TP removal performance harvesting of willow will be required. Harvesting of willow is a valuable resource but the process is of harvesting it is onerous. Some sediment removal is required at the inlet and any suspended sediment may have to be removed periodically. Little information available currently regarding regulations on their implementation of water treatment. Effective only during the willow growing season.</p>	

3.2.3 Contribution to wider legislative and non-legislative targets

NbS could contribute to the delivery of other existing legislation targets and strategies from the WG and the Council in addition to delivering water nutrient pollution targets. Section 4 of this report details such strategies that demonstrate potential for cross-strategy collaboration when implementing NbS for achieving nutrient neutrality.

Moreover, the use of NbS may result in additional partners or funders collaborating with the Council who may be interested in supporting the delivery of wider benefits. Several case studies of multistakeholder projects with additional benefits are illustrated in Table C-5-2 in Appendix C, however one notable example is DCWW funding the **Upper Tywi Restoration Project**. DCWW awarded funding to the project in order for the Carmarthenshire Rivers Trust to prevent further deterioration of the fisheries within the area. The proposed methods included the use of lime dosing to decrease levels of acidification and creating habitat and wildlife improvements. Although bettering the water quality was the main aim of the project, additional community benefits were hoped to be gained through the community participation organised throughout the project.

Non-legislative internal targets set by various organisations and developers that are centred on biodiversity or net zero commitments may be achieved partly through additional benefits of NbS. **NRW's recent corporate plan** consists of goals to be achieved by 2030, including various wellbeing objectives. Most notably, the 'Nature is recovering' objective has a strong focus on restoring nature which includes:

“scaling up nature-based solutions in urban and rural areas to build connectivity between habitats, securing multiple benefits for nature and people through working with planners and developers to embed in developments”

The exact steps NRW aims to take to reach this objective are detailed in their [corporate plan](#) online, and they further outline how these NbS goals are interconnected with woodlands, flood and drought risk, and potential societal benefits. Similar targets in other organisations may present the Council with potential opportunities to deliver NbS by working alongside other stakeholders through collaborative and productive relationships.

3.3 Implementation of NbS

3.3.1 Potential delivery partners

It is important to consider potential delivery partners and funding sources when selecting interventions as these can have a significant impact on the feasibility and cost effectiveness of interventions. Typical organisations for each intervention type are included in Table B-5-1 in Appendix B. Further guidance on potential delivery partners is presented in Figure 4-1 and funding sources are included within Section 5.4.

3.3.2 Feasibility

Table B-5-1 in Appendix B presents a range of intervention measures and avoidance measures which could be implemented to capture nutrients. Each intervention measure provides a breakdown of its effectiveness, feasibility, maintenance and additional wider benefits beyond reducing Total Phosphorus (TP) concentrations. For all the intervention measures presented below, improved water quality in terms of phosphate is an assumed benefit. Only interventions approved by DCWW and NRW have been included within the Table B-5-1 in Appendix B.

3.3.3 Effectiveness

To support this decision making, typical advantages and disadvantages of each option has been presented. Further, RAG (red, amber, green) ratings are included regarding the typical feasibility, maintenance requirements and effectiveness (in terms of nutrient management) of each of the interventions. These are colour coded, with green being the most advantageous options (i.e. those that are readily feasible, have low maintenance requirements and are highly effective). It is important to consider the local context, as this will have an impact on the relative merits of each intervention, feasibility, maintenance requirements and effectiveness.

3.3.4 Adoption and support

DCWW and NRW (see NRW Mitigation Measures Menu) have both expressed their position on what intervention measures they will and will not support for SAC mitigation. NRW have published their final [Policy on Constructed Wetlands in October 2023](#). Additionally, NRW have recently shared their [‘live’ mitigation menu](#) with WG and the NMBs, which was developed from the CCC Nutrient Mitigation Options Technical Review. The document outlines various nutrient mitigation measures and the evidence underpinning their ability to reduce nutrient levels in water. As this is a live document, it is expected to be updated as further evidence for the effectiveness for various mitigation measures becomes available.

For DCWW, wetlands for use on their WwTW sites must meet specific [requirements](#). Currently, these include ensuring that treatment works that have a Population Equivalent (PE) of less than 2,000 to minimise wetland surface area footprint, have a high enough permit limit to warrant wetland construction and whether the trade effluent contains damaging chemicals to wetlands. It should also be considered that different criteria will be

applied for collaboration wetland opportunities. For example, if the wetlands are implemented on third party land for further tertiary treatment as part of Nutrient Neutrality purposes, using DCWW WwTW treated effluent where collaboration opportunities exist.

Therefore, it will be necessary to consider both NRW's and DCWW's latest positions on constructed treatment wetlands when assessing whether they can be used as a mitigation measure to reduce water nutrient pollution. The Council has issued **guidance** on types of mitigation that could be an effective solution within Carmarthenshire.

3.3.5 Potential Challenges

The implementation of NbS can involve a range of challenges, some of these general and some context specific. One of the key general challenges is achieving 'buy-in' from stakeholders. Underneath this umbrella, underlying challenges include:

- Cost/benefit analysis
 - Demonstrating that NbS can deliver greater benefits for a lower cost than grey infrastructure solutions.
- Timeframes
 - Demonstrating the NbS can deliver solutions within the timeframe required. Often NbS take more time to realise benefits than grey infrastructure solutions.
- Is it the right solution?
 - Working with stakeholders to ensure that the solution is the right one in the right place.

The achievement of this buy in is critical to securing the long-term funding and delivery partners key to the management and monitoring of NbS, without which the interventions may fail in the long-term.

The successful implementation of NbS often requires cross-disciplinary work, with input required from ecologists, engineers, hydrologists, planning specialists and delivery partners. It can be challenging to coordinate these various different parties, but doing so can result in more robust overall schemes. Further challenges are discussed in section 5.5 which focuses on implementation risks.

3.4 Case studies

Several NbS, which can provide nutrient mitigation have been successfully implemented across Wales. NbS have been widely implemented through various funded and research-based projects throughout Wales, often having a strong focus on the additional benefits it could provide in the local context and significant community or local stakeholder involvement. Several case studies present existing and potential opportunities for further collaboration with regards to Carmarthenshire's nutrient management strategy. Table C-5-2 in Appendix C outlines a more complete list of case studies and signposts several additional benefits achieved by these schemes.

Four Rivers for LIFE

The Four Rivers for LIFE, is a large river restoration project across four river SAC rivers (Teifi, Tywi, Cleddau and the Usk), which will run for 5 years. This is partly European Union funded, with match funding from WG, DCWW, BBNP Authority, Woodland Trust, etc. Totalling a £9.1 million investment.



The project aims to significantly improve the conservation status of multiple habitats and species on four SAC Rivers in mid and South Wales.

As a holistic river restoration project, it will take a nature-based approach to address multiple pressures across the catchments of the four SAC.

The methods used for this project, and the learning and knowledge, will be shared with other river restoration and fisheries communities across the UK and Europe. The project will also work with the International Union for Conservation of Nature (IUCN) National Committee for the UK (NCUK) River Restoration and Biodiversity group. The project will also support the development of a conservation strategy for all other SAC rivers in Wales based on the techniques, approaches and principles developed during the project and compliments the existing [LIFE Dee River project](#). This presents a potential collaboration opportunity for addressing nutrient neutrality in Carmarthenshire.

Rainscape



DCWW have invested £115 million across Llanelli and Gowerton between 2012 and 2020 to manage surface water and reduce sewer flooding. The main approaches used in this project include various SuDS such as swales and porous paving. They have planted nearly 10,000 street trees and created attenuation like this on opposite Parkview Terrace. Many of the projects involved engaging the local community and local schools.

Dairy Project

NRW's "Dairy Project", completed in March 2023, aimed to reduce agricultural pollution, officers visited over **900** dairy farms in Wales. The officers have carried out pollution control visits offering advice and guidance to dairy farmers, helping ensure they are compliant with legislation and reduce the risk of pollution. Face to face meetings have been excellent for engagement and relationship building. For each farm a report was produced

detailing improvement measures required to reduce the risk of pollution. Farm improvements include increasing slurry storage capacity, separating clean water from slurry and achieving reductions in livestock nitrogen loading to land. The scheme context and their advice can be viewed on their You Tube channel [here](#). This presents a potential collaboration model for reducing nutrient pollution within SAC from agricultural sources in Carmarthenshire.



Teifi SAC Catchment Phosphate Reduction and Mitigation Project (PRAM Project)

Ceredigion County Council is leading this project, which will evaluate the feasibility for the planning and development of constructed treatment wetlands for reducing phosphates, including two wetlands on the Teifi. It will also implement phosphate reduction interventions on the ground, which will include 9km of riparian fencing and tree planting in the most severely livestock damaged areas. In addition, small SuDS schemes will be implemented in the main towns on the Teifi.

The project has received £500,000 from the WG Nature Networks Fund to “directly improve the condition of this SAC through reducing phosphate inputs, improving water quality and reversing decline in nature”.

A list and description of other case studies of NbS applications for water management projects can be found in Table C-5-2 in Appendix C.

Coleg Sir Gâr Gelli Aur College Farm Solid Waste Project

Coleg Sir Gâr Gelli Aur college farm in Carmarthenshire has been turning slurry into solid agricultural fertiliser that is cheaper than imported counterparts. The technology also filters the slurry to the point where it can become used by the farm as a clean water source. After five years in development, the process is ready to be rolled out commercially on farms across Wales. As well as reducing pollution it could reduce abstraction requirements. This could be an important Category 2 measure for delivering wider benefits for the SACs and increasing potential headroom for development.



3.5 Catchment wide projects

Figure 3-3 shows the variety of projects which will all have a direct impact on restoring the riverine SAC back to favourable conditions. Further mapping of planned / ongoing restoration works within the catchment could be brought into a database / web viewer to provide a single source of understanding on NbS within Carmarthenshire.

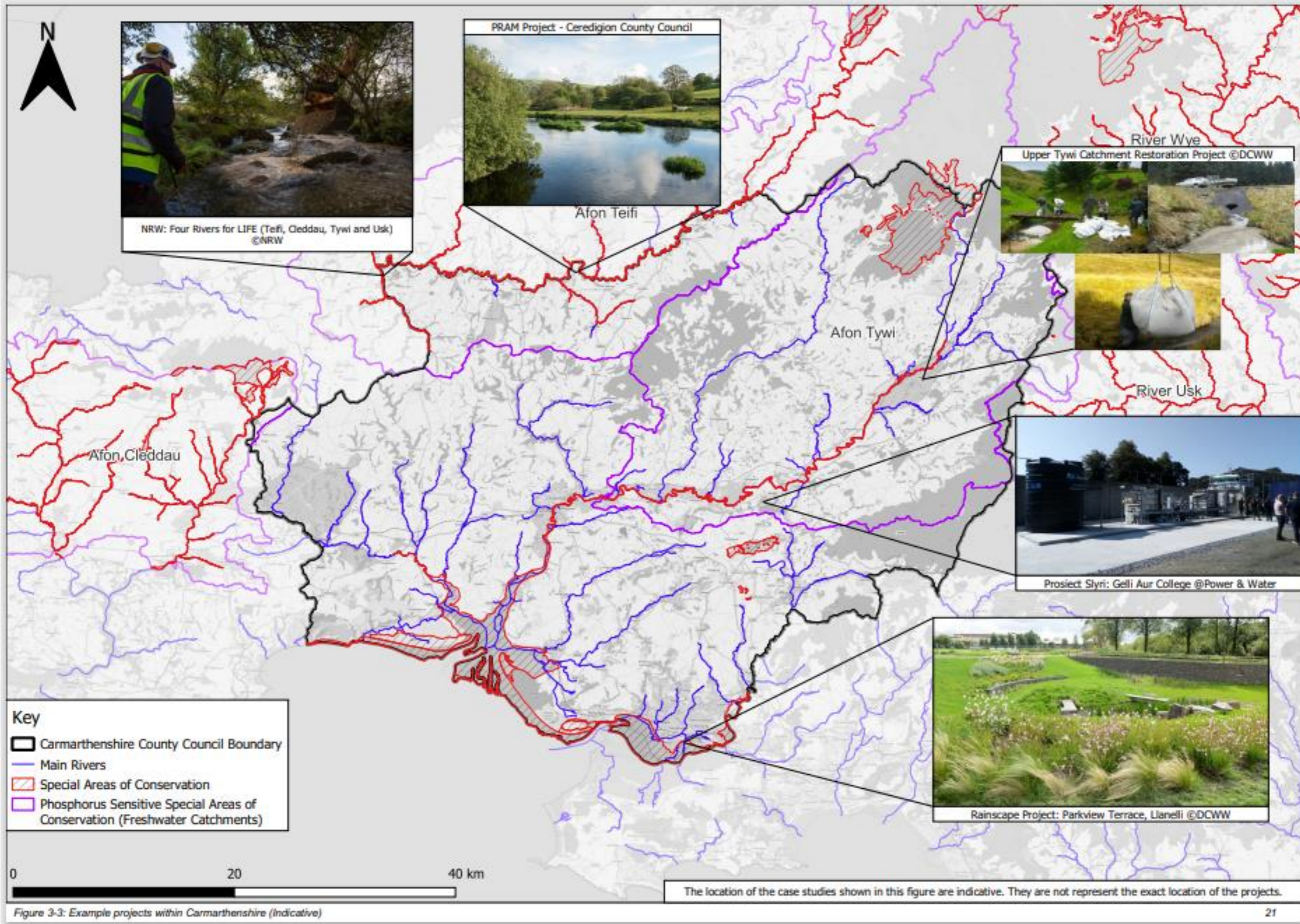


Figure 3-3: Example projects within Carmarthenshire (Indicative)

Figure 3-3 Example projects within Carmarthenshire (Indicative)

4 Joining up the approach

This Strategy has so far demonstrated an understanding of the challenges ahead, but also shown that solutions are known and there several examples of work already undertaken within the catchments to positively impact reducing nutrient levels. What is clear is that several key organisations and stakeholders are already making great strides to tackle nutrient pollution, and that many of the NbS being employed offer benefits that stretch beyond nutrient mitigation. As a result, there is huge value in finding collaboration opportunities, and avoiding working in silos. This section aims to summarise how stakeholders can [join up the approach](#) to achieve nutrient neutrality and wider benefits including supporting the response to the climate and nature emergencies and delivering opportunities for regeneration, provision of affordable homes and jobs within Carmarthenshire's impacted communities.

4.1 Synergies

It is important to take a complete ecosystem approach to ensure that the most appropriate suite of actions can be implemented at any given location. By taking this holistic approach, wider benefits can be achieved, additional funding made available and shared objectives more readily realised.

Section 4 highlights a range of national and local policies, strategies and guidance documents that can drive the selection, design and implementation of nutrient capture measures, as outlined in Section 3. There is a particular focus to understand how the strategy links with broader objectives around the regeneration and the climate and nature emergencies and to which local policies and strategies are aimed at supporting, or implementing NbS, as this would help outline potential investment opportunities from third parties seeking to invest in NbS.

The relevance of local strategies produced by the Council and its partners for achieving nutrient neutrality allow for opportunities for collaboration through identifying areas wherein multiple strategy targets can be resolved simultaneously. Some of the key local policies and targets for Carmarthenshire are described in Section 4.1.1. Often, through addressing local strategies and policies, specific interventions can contribute to achieving strategies and policies on a national scale, as local strategies often use national targets as the basis or to inform local-scale targets. Such national policies and strategies are outlined in Table D and Table D-5-4 in Appendix D, respectively.

An example of a local strategy aligns with corporate objectives such as the climate and nature emergencies and has connections to nutrient neutrality is [Carmarthenshire's Strategy for Trees and Woodlands 2023-2028 Draft](#). It presents ample opportunities to implement NbS to effectively address both nutrient neutrality and the Council's Draft Strategy for Trees and Woodlands 2023-2028 simultaneously. This is in addition to contributing to the national targets set out by the [Environment \(Wales\) Act 2016 \(as amended\)](#) which directly informs biodiversity targets established by local authorities. For instance, one of the targets of the Council's Draft Strategy for Trees and Woodlands 2023-2028 is exploring how extra trees can be planted in the County. Specifically, the draft has a set target of increasing woodland cover on the Council's land from 5.34% to 19% by 2050, in line with the UK target of 17-19% woodland cover across the UK to achieve carbon neutral by 2050. This will require the Council to plant 33ha of woodland every year between 2023 and 2050. Therefore, this could partly be addressed through the application of willow beds, wet woodlands and buffer strips.

The application of NbS as part of a cross-strategy approach could help to attract stakeholders with the technical knowledge to implement these solutions and align with the targets of both strategies. This includes stakeholders who provide funding to various schemes, or working groups that facilitate knowledge sharing on various environmental topics, such as the [Wales Water Management Forum](#).

Figure 4-1 below outlines several other examples of stakeholders who could become involved in nutrient neutrality solutions for different stages of implementing potential solutions.

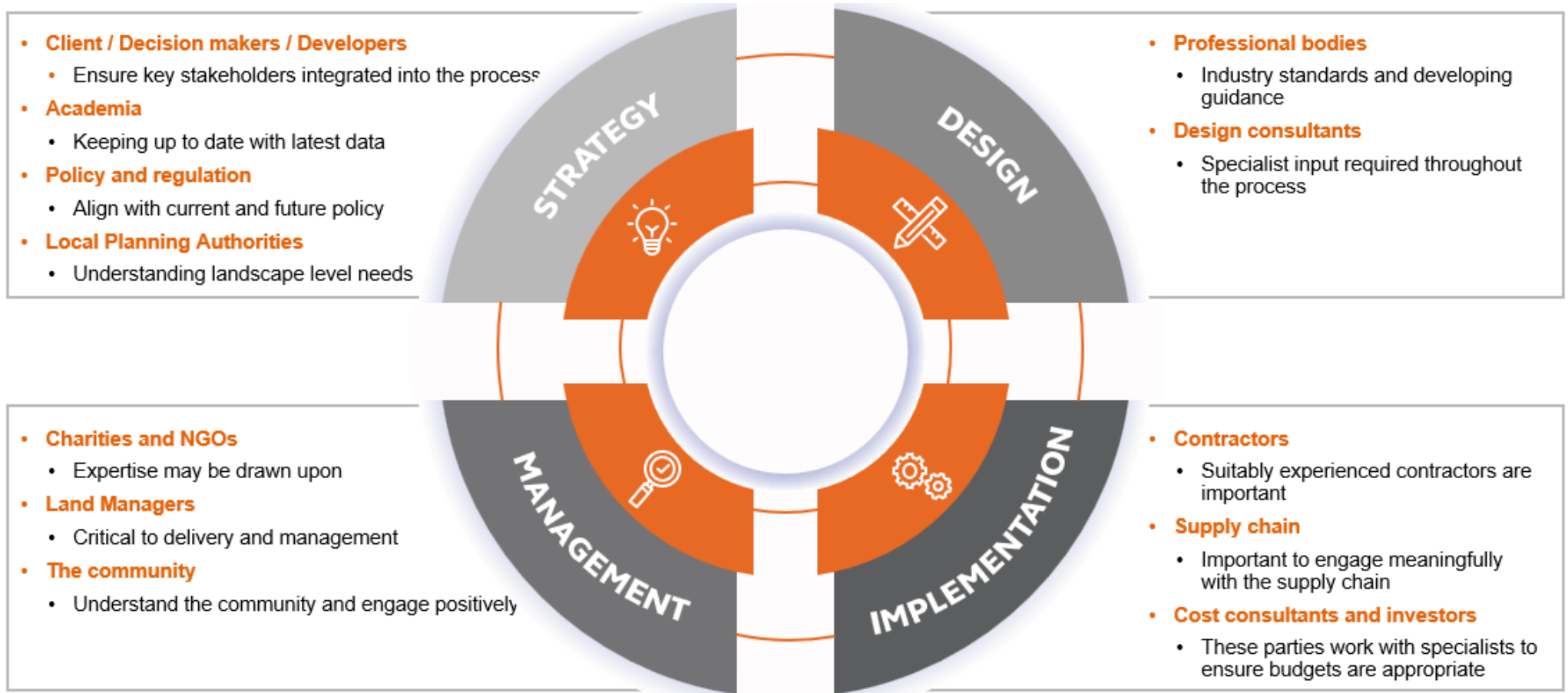


Figure 4-1: Potential collaborators who may influence the achievement of nutrient neutrality.

4.1.1 National and Local Policies

Local policy can also be a key driver of the implementation of nutrient capture measures, with many stemming directly from national policies and strategies.

The **Planning and Compulsory Purchase Act 2004** introduced the LDP system to Wales, The Council has a statutory duty to produce an LDP for their area. The Council has been producing a rLDP (2018-2033) to outline the location and quantity of development within Carmarthenshire for a 15-year period between 2018 and 2033, and will replace the existing adopted LDP. The LDP is required to be in conformity with National Policies and Strategies, such as **Future Wales – the National Plan 2040**, which can be found in Table D and Table D-5-4 in Appendix D, respectively.

The rLDP Policies recently were revised, which included several key local policies relevant to phosphorus and their impacts on water quality. Of relevance to the HRA regarding phosphate reduction, these policies were Policy **CCH4**: Water Quality and Protection of Water Resources and Policy **INF5**: Rural Allocations outside Public Sewerage System Catchments.

4.1.2 Local Strategies and guidance

Beyond policy, local strategies (Figure 4-2) can also provide useful guidance regarding priorities, which can inform the selection and design of nutrient capture measures.

Table 4-1 below summarises a few key strategies, with a more detailed list of strategies and guidance documents can be found in Table E in Appendix E.

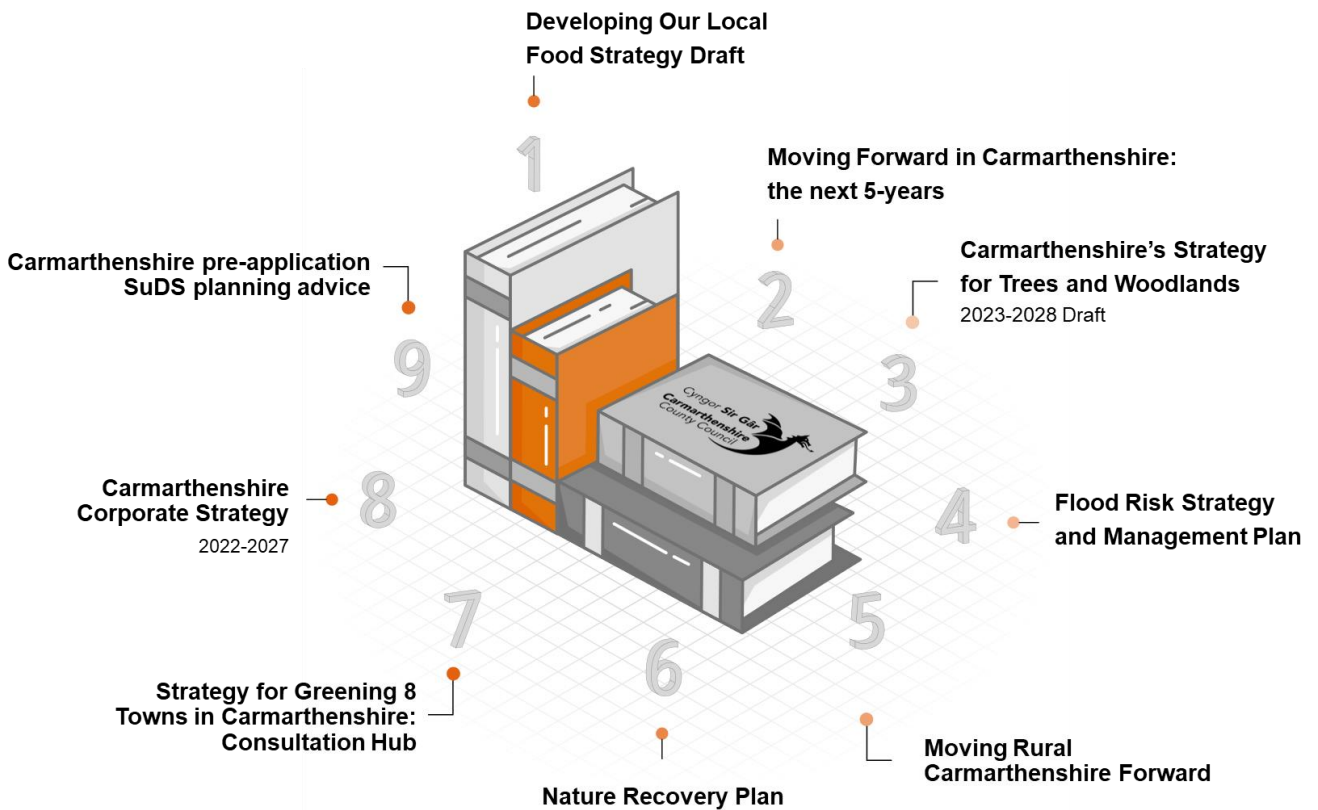


Figure 4-2 Local Strategies

Table 4-1: Key pieces of local strategies and guidance related to phosphate mitigation

No.	Guidance / Policy / Initiative	Overview	Detail	Implementation	Joining up the approach	Actions	Funding Sources
1.	Developing Our Local Food Strategy Draft Carmarthenshire Public Service Board (PBS)	This strategy aims to take a holistic approach to developing the Local Food System in Carmarthenshire, inclusive from production, processing, provision, distribution and waste. Through tackling priority areas such as production and provision (demand and supply) simultaneously to maximise the economic, environmental and social benefit.	The strategy sets clear targets through Food Goals (long term), those of relevance to the nutrient management strategy are listed below; 3. Net Zero Food System 4. Farming for Nature and Climate 5. Sustainable Food Procurement. The importance of agroecology is highlighted within the strategy.	Several short-term actions are proposed under the plan including auditing current environmental impact of farming practices, further impact assessments, developing costed plans to deliver / develop a Rural Land Map and Use Framework (amongst several other programmes / initiatives).	Strategic actions such as the creation of a rural land map could help to identify opportunities for agroecological practices such as agroforestry or use of buffer strips along field boundaries. These measures would align closely with the objectives of the food strategy whilst forming category 2 measures to reduce nutrient pollution.	Liaise with Carmarthenshire PBS to understand when strategy will be finalised and align any strategic actions to the shared objectives and common benefits of the nutrient management strategy	Whilst details of the Sustainable Farming Scheme (SFS) in Wales are yet to be confirmed, this would offer a means for farmers to be paid for agroecological practices that support a range of benefits including phosphate reduction. The council could look to work closely with farmers to establish schemes that would qualify under SFS and deliver against the aims of the nutrient management strategy.
2.	Moving Forward in Carmarthenshire: the next 5-years Carmarthenshire County Council	Carmarthenshire identified around 100 priority projects, schemes or services that they aim to deliver over the next five years, as part of the plan. Carmarthenshire aim to invest in key areas to improve economic, environmental, social and cultural well-being in the County.	Actions include: 23. Promote a tree strategy to improve the environment and mitigate the effects of air and noise pollution 24. Work with stakeholders to improve sewerage capacity within the County 45. Establish a Local Housing Trading Company to increase levels of affordable housing	The planning document is high-level and suggests implementation will be outlined in more detailed reports and recommendation for specific projects. (some of which are detailed in this table).	Action 23 has relevance to nutrient management when considering mitigation measures such as wet woodlands, or riparian buffer strips. Action 24 will help ensure future development can be served by adequate sewage treatment works. Action 45 could assist delivery of mitigation when bringing forward affordable housing.	Whilst specifics under the plan are limited, the strategic direction is clear and there are shared objectives between this plan and the nutrient management strategy which should be explored with councillors as more details emerge.	Not made clear in the document but expected to be a broad mix of funding sources, likely similar to those outlined in Section 5.4, further highlighting the need to combine efforts.
3.	Carmarthenshire's Strategy for Trees and Woodlands 2023-2028 Draft Carmarthenshire County Council (note: linked to action 23 under no.2 in this table)	This strategy aims for Carmarthenshire to deliver tree and woodland management in response to both the Nature Emergency and the Climate Change Emergency which it and WG have declared. To achieve 19% woodland cover in line with Woodland Trust's recommendation (2021) the council would need to plant 33ha per annum.	Action TWS/2A3: Develop and demonstrate an integrated approach to delivery of tree and woodland planting across CCC projects which will deliver against several agendas: Green and Blue Infrastructure, SUDS, carbon sequestration, nature recovery, ash dieback, landscape, and amenity, reduction in phosphates, and improving air quality (Responsibility: Rural Conservation Manager)	CCC's strategic Land Use Review is reviewing landholdings and assessing where there are opportunities to plant new trees. Reducing phosphate pollution levels in watercourses is already recognised as a shared benefit. Ambition to identify 6 new planting schemes on CCC managed land.	Tree planting has potential to reduce nutrient pollution when implemented in targeted areas such as along agricultural field boundaries, or along riparian corridors. Work has been done to identify the scale of opportunity for such measures and should be shared with the key stakeholders delivering Carmarthenshire's strategy for trees and woodlands.	Engage with the Carmarthenshire Nature Partnership, Rural Conservation Manager and CCC woodland officer to understand current progress against plan and identify areas of mutual / shared benefit.	The plan outlines the role of CCC woodland officer in identifying funding for implementation of plans. However, there are specific mentions of Green Infrastructure grants and Welsh Government Grants.
4.	Flood Risk Strategy and Management Plan Carmarthenshire County Council	As the Lead Local Flood Authority (LLFA) CCC has responsibility to develop, maintain, apply and monitor a strategy for local flood risk management including surface run-off, groundwater, and ordinary watercourses.	Proposed measures for local flood risk management include: M31 – Protection: Natural Flood Management to slow the flow. M34 – Protection: surface water management including SuDS.	Actions were identified in May 2019, and so may already be complete or in progress. Long-term intervention (2021 onwards) highlighted as needing further investment, costs had not been estimated as of May 2019.	Actions M31 and M34 have potential to reduce nutrient pollution downstream, particularly for diffuse pollution sources. SuDS can reduce pressure on combined sewers, reducing incidence and severity of CSOs.	Information sharing to find common areas where nature-based solutions have been identified to protect against flooding and reduce nutrient pollution from diffuse sources.	Welsh Government - £75m investment 23/24 (announced April 23) inc. ambition to expand NFM approaches. Funding to deliver such measures could be shared between workstreams.

No.	Guidance / Policy / Initiative	Overview	Detail	Implementation	Joining up the approach	Actions	Funding Sources
5.	Moving Rural Carmarthenshire Forward	This strategy focusses on the development of rural towns and communities within Carmarthenshire. It has a strong focus on agriculture, the Welsh language and rural regeneration.	The strategy outlines recommendations on a variety of different topics relevant to rural Carmarthenshire. Of particular relevance to nutrient management are; agriculture and food, and environment and waste.	The predominant role of the task group responsible for the strategy is stakeholder engagement, lobbying and awareness raising.	The task group would be a useful stakeholder in the development of mitigation measures focussed on tackling diffuse sources of pollution in rural areas. This could explore opportunities for land managers to deliver nature-based solutions.	Liaise with the task group to understand progress against this strategy and gain insight into means of delivering nature-based solutions in rural areas of Carmarthenshire.	No funding sources of direct relevance to the nutrient management plan, however, engagement via this policy could be an important gateway to implementing reduction measures with stakeholders. Wider, grants and funds discussed in this report will be relevant.
6.	Nature Recovery Plan	Delivered by the Carmarthenshire Nature Partnership, the recovery plan sets out a wide range of actions at small and large scales which has potential to reverse the decline of nature in Carmarthenshire.	Delivered in four parts, the plan outlines its key stakeholders, specific actions individuals and landowners can take and outlines more strategic actions that can be explored by the partnership. Of particular relevance to the nutrient management plan, objective 4, which looks to tackle key pressures on species and habitats and objective 5 which looks to improve evidence, understanding and monitoring have direct links to the work underway in response to nutrient management.	Individual projects are brought forward and supported by the partnership, with funding sourced from many of those funds discussed in this document.	A great deal of work has been carried out by the partnership exploring innovative funding mechanisms and means of delivering against their objectives. There may be significant lessons to learn by joining up the aspirations for nutrient management with the objectives of the nature recovery plan, particularly in considering land owner engagement and means of delivering mitigation.	Liaise with the recovery partnership to explore opportunities to share resources, lessons learned and maximise opportunities to deliver nutrient mitigation whilst boosting biodiversity and delivering benefits for nature.	Many of the funding mechanisms identified in this document which could be used to deliver nutrient management will be of relevance to the nature recovery plan also. Joining up the approach may be crucial to ensure Carmarthenshire is not “competing” for funding on measures which have mutual / shared benefits. Could also be a source of co-delivery partners and shared funding.
7.	Strategy for Greening Towns in Carmarthenshire: Consultation Hub	The strategy focuses on 8 towns in Carmarthenshire and looks to improve understanding of existing green-blue infrastructure and develop opportunities to expand and improve connectivity of the network.	The strategy focusses on three themes, people, places and nature. Several phases of the work have direct relevance to the work currently being identified by CCC and the West Wales NMB.	The work will be delivered in several phases, including; <ul style="list-style-type: none"> 1. Baseline analysis and data collection 2. Stakeholder engagement 3. Opportunity identification 4. Mapping opportunities 5. Introducing actions plans for each of the 8 settlements 6. Finalise strategy and digital report 	Green-blue infrastructure has potential to improve nutrient management within Carmarthenshire and so this work is of direct relevance. Working alongside the group delivering this strategy could unlock opportunities to better understand proposed interventions whilst also looking at opportunities to maximise impact on improving nutrient management.	Liaise with the strategy group, identify shared objectives and align strategic mitigation interventions with proposals. It may be that funding sources and resource could be shared across the workstreams, saving the council money in avoiding duplicated effort when looking at urban interventions to tackle nutrient pollution.	No direct funding sources cited, however, the interactive map of Carmarthenshire, the online Consultation Hub and the proposed Final Strategy Mapping could be a useful resource to align NbS nutrient reduction opportunities.
8.	Carmarthenshire Corporate Strategy	A wide ranging covering all aspects of the council's operations. Core values include working as a unified team and ensuring resources within the council are used as effectively as possible.	4 well-being objectives are set by the council, objective 3 has perhaps most direct relevance to Carmarthenshire's nutrient management strategy as this focusses on environmental health.	Implementation of this strategy is not necessarily focussed on actions but guiding principals in how the council delivers its services and roles / duties.	Several areas discussed in the corporate strategy are relevant to the aims of the nutrient management strategy including the role of planning in delivering positive outcomes for nature. The strategy has clear focus too on use of resource efficiently within the council, something this	To liaise with the council leaders and highlight the opportunities for closer collaboration between the strategies listed in this table to gain senior buy-in on the need to work closely and secure mechanisms to achieve that.	Funding here could be directly from council budgets, finding means of sharing resource and common project outcomes effectively, but also seeking funding jointly between the different strategic projects and initiatives that will result from this strategy and the many others being delivered by the council.

No.	Guidance / Policy / Initiative	Overview	Detail	Implementation	Joining up the approach	Actions	Funding Sources
					section is looking to directly address.		
9.	Carmarthenshire Pre-Application SuDS Planning Advice	Wide ranging documentation around the planning requirements of delivering SuDS.	Sets out means of submitting planning applications for SuDS, and the legal requirements when delivering SuDS on new developments.	Implementation via the Sustainable Drainage Approval Board (SAB) and following Section 17 of Schedule 3 (flood and water management act)	<p>Whilst this guidance does not mention specific projects, it's clear that all new developments will require SuDS which do have potential to reduce nutrient impacts.</p> <p>There may be opportunities to better define the benefits of SuDS for nutrient mitigation for developers / planners, which could lead to more expansive adoption across a development (to meet neutrality) over and above the required minimums.</p>	<p>Importance of SuDS in mitigation nutrient impacts of development is recognised – internal engagement with council staff with responsibility on the SAB would aid discussions on how to maximise the positive benefits of SuDS when reviewing developments through the planning system. For example, there may be opportunities to recommend certain types of SuDS with greatest phosphate removal potential in failing SAC/WFD catchments.</p>	<p>Most SuDS would be delivered by developers and not funded by the local authority. However, strategic projects considering things like rural SuDS, or retrofit SuDS could be explored in collaboration with the SAB and flood risk team within CCC.</p>

5 Implementation

When taking forward NbS with delivery partners, there are key considerations to develop any project. Figure 5-1 sets out an example of the process that can be followed when developing NbS, however, each project will have its own nuances, so this should be treated as a guide only. It should be noted that this is not a strict linear process and there might be a need to revisit some of steps and refine the solution where necessary. In some instance, the NbS selection, stakeholder benefit mapping and delivery partners may already have been identified, which therefore bypasses steps 1-6. Further details on some of the stages are discussed in more detail below.

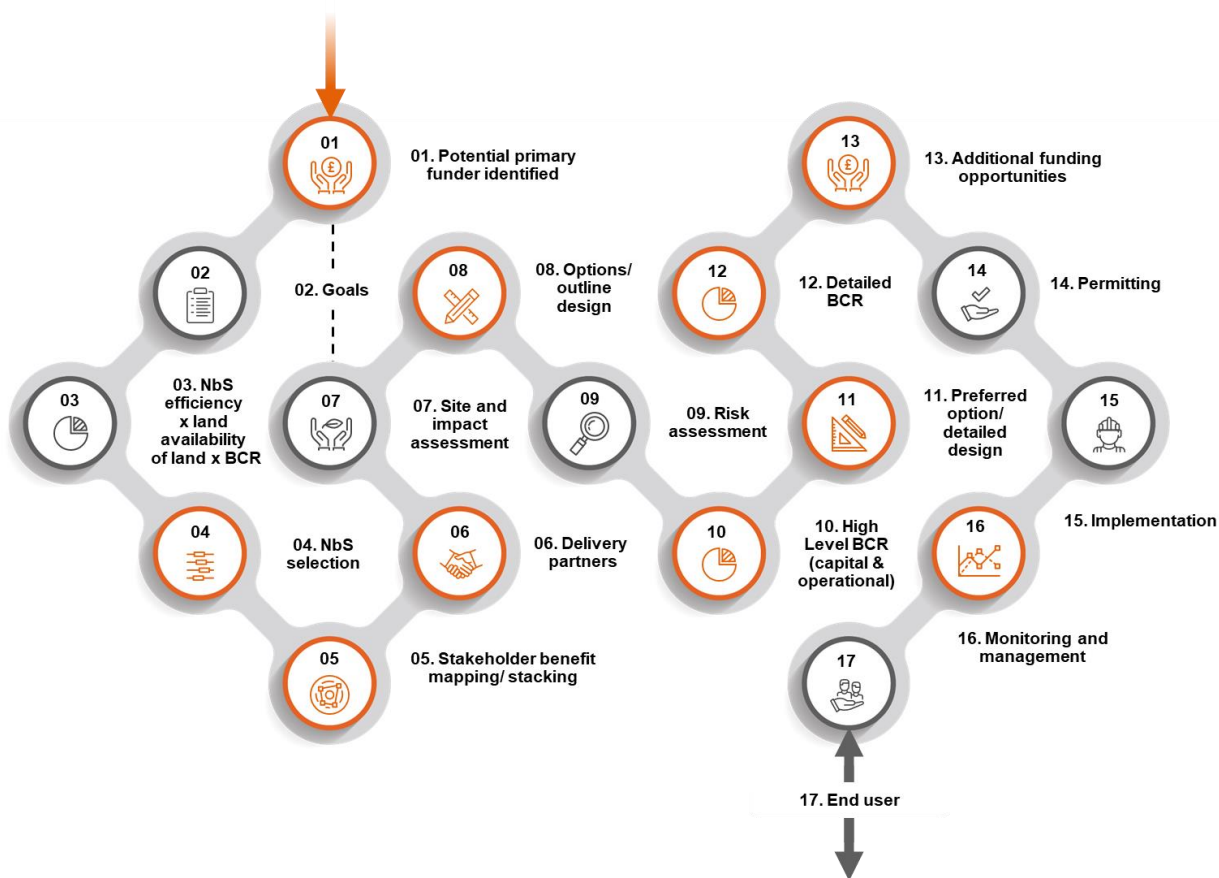


Figure 5-1: Example process for implementing NbS

5.1.1 Consideration of stakeholders

Ricardo has recently provided guidance on the use of NbS to deliver nutrient neutrality and the wider benefits that could be attained. It suggests a process for completing a nutrient mitigation stocktake, beginning with steering groups to identify the mitigation solution to implement, and finishing with determining the potential additionality from these solutions suggested. Stakeholder engagement is prioritised throughout the entirety of this process, which only further helps the identification of the most appropriate form of NbS that is required. This may be an important consideration for the steps required to meet the targets for developing multiple strategies in a way that all stakeholders have their needs taken into account.

5.1.2 Design

Appropriate NbS design requires clearly defined objectives, i.e. what is the NbS designed to achieve? Usually the design objectives, within the context of Nutrient Neutrality, will relate to a water quality parameter, such as a removal of TP. However, there may be other considerations within the objectives, for instance the potential to provide wider benefits to society, such as through reducing flood risk, increasing biodiversity benefits or enhancing recreational opportunities. Outline designs must be undertaken to inform the preferred options and detailed design, supported by relevant investigations and appraisals. Design and Engineering consultancies may be helpful in ensuring the design is in line with industry best practice standards.

5.1.3 Permitting

Some NbS interventions may require planning permission and/or other types of consents and each scheme would need to be assessed against the relevant legislation, based on its own design attributes, to determine whether planning permission might be required. Specialist guidance should be sought to determine what (if any) planning or permitting approvals are required.

The suite of documentation that may be required as part of a planning application should be discussed and confirmed with the Council as part of a pre-application consultation. Design and Engineering consultancies may be helpful in pulling together the various documentation required to produce the planning application which could include; Environmental Impact Assessment (EIA) Screening, Planning Statements, Drainage Strategies, Flood Consequence Assessments, Archaeology Studies etc.

Other consents required might include: Ecological licences, Section 278 agreement and Public Right of Way diversion orders, Forestry Licence, Abstraction Licence, Bespoke waste permit, Ordinary Watercourse consent under section 23 of the Land Drainage Act 1991 as amended by the Flood & Water Management Act 2010, and Environmental permit for flood risk activities.

5.1.4 Implementation

The NMB is responsible for identifying and delivering a Nutrient Management Plan and associated actions that achieve the phosphorus favourable conservation target of a river that is designated as a SAC, whilst also meeting socio economic needs of its surrounding communities. To this end, three NMBs were formed in March 2022 in West Wales; the Afon Tywi NMB, the Afon Cleddau NMB and the Afon Teifi NMB.

Carmarthenshire have been instrumental in the development of solutions to date and will continue to work positively as a member of the three boards to develop and implement a collaborative approach to the nutrient management across these SAC so that the benefits of the implemented measures can be maximised.

The currently identified high level opportunities for developing CCC's strategic nutrient mitigation schemes have been detailed in the Action Plan that has been published alongside the rLDP. This will help inform the Nutrient Management Plan (NMP) being developed for the Tywi NMB and Teifi NMB. which will promote and ensure that there is a collaborative approach between the partners to develop and implement such strategic schemes. These Plans will be supported by the NMB Members and provide the steps needed to implement strategic catchment scale interventions to maintain favourable conservation status of the SACs.

5.1.5 Consultation

As discussed in Section 2.2.1, a Statement of Common Ground (SoCG) is being prepared between the Council, NRW, DCWW and neighbouring LPAs to support the rLDP in the intervening period. This sets out partner understanding for the approach to the rLDP existing and future collaboration. This Strategy aims beyond nutrient neutrality, focussing on a wide range of NbS and other solutions that can provide nutrient reduction and wider benefits. Not all of the measures may necessarily qualify for 'nutrient credits' for

prospective developers, with collaborative efforts of the Council and its stakeholders, SAC, community and economic benefits can be delivered.

5.1.6 Monitoring and management

For a NbS and other solutions to provide necessary effective treatment in perpetuity (current guidance suggests that mitigation measures must remain in place for 80 to 125 years) however there is likely to be a declining future baseline for nutrient levels in the SACs in line with the raft of legislation and policies to reduced nutrient pollution and the planned AMP upgrades from DCWW. Maintaining levels of nutrients at the required levels will require a robust monitoring and management plan that includes the routine operation and maintenance of the NbS and identifies additional occasional measures if required.

Monitoring and evaluation is essential to determine whether implemented NbS and other solutions respond effectively to the challenges identified. It also facilitates an understanding of how NbS performance and impacts evolve with time, and provides insights into their respective potential for up-scaling and replication according to stakeholder needs and the local context (environmental, social, and economic conditions).

Monitoring and evaluation of NbS is essential, not only to measure the “success” of individual NbS projects, but to inform further actions and provide evidence to support effective land use planning and management, and policy-making.

5.2 Indicative capital costings

The costs of implementing nutrient management interventions (NbS and grey infrastructure solutions) vary depending on a range of factors, as presented in Figure 5-2.

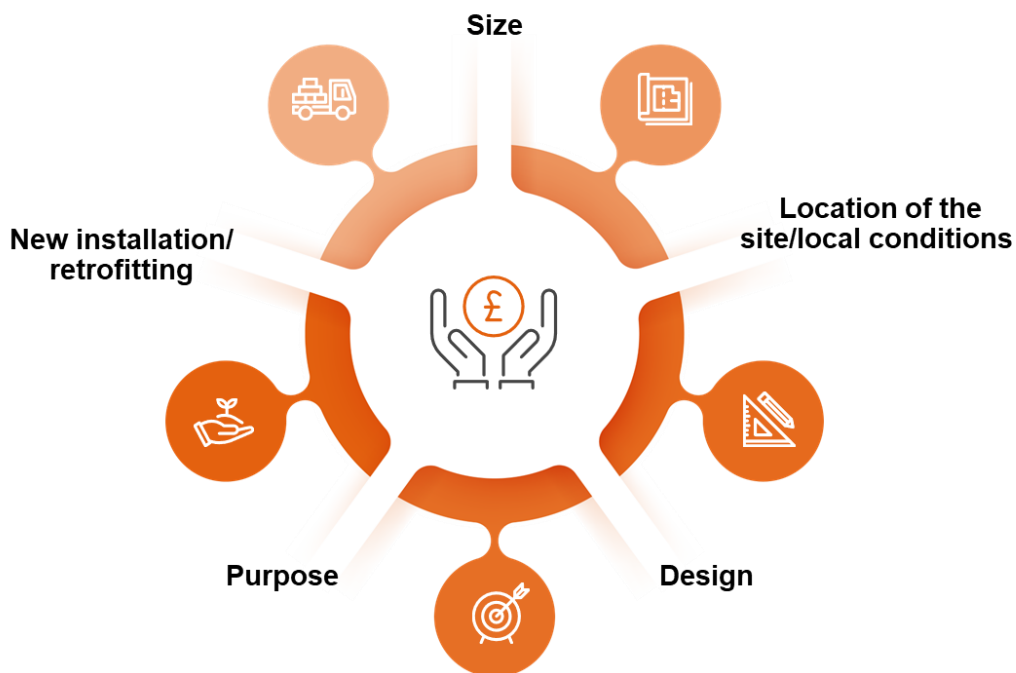


Figure 5-2 Capital Costings Factors

However, there are general trends regarding which interventions tend to be cheaper or more expensive. Table 5-1 sets out indicative costings for some of the more common intervention types. Due to the impact of the factors listed above, these should be used as a guide only, rather than for precise budgeting. These costings only include the costs of the interventions themselves and not any of the advanced design work that will be

required. Inflation has been factored into the indicative capital costings based on the date specified in Table 5-1.

Table 5-1: Indicative costs (inflation adjusted) for nutrient management interventions.

Intervention	Indicative capital costings	Sources
Rainwater / stormwater capture	£5,149 per residential property	Environment Agency, 2015 (costs from 2005)
Green roofs	£142 per m ² to £66.99 per m ²	Environment Agency, 2015 / Susdrain, 2017 (costs from 2015)
Swales	£20 per m ³ or £426.87 per m	Environment Agency, 2015 (costs from 2005) / Susdrain, 2017 (costs from 2015)
Detention basins	£20 per m ³ to £64.36 per m ³	Environment Agency, 2015 (costs from 2007) / Susdrain, 2017 (costs from 2015)
Retention basins	£16 per m ³ to £64.36 per m ³	Environment Agency, 2015 (costs from 2007) / Susdrain, 2017 (costs from 2015)
Ponds	£16 per m ³ to £64.36 per m ³	Environment Agency, 2015 (costs from 2007) / Susdrain, 2017 (costs from 2015)
Bioretention zone/rain gardens	£460 per m ²	Susdrain, 2013 (costs from 2013)
Tree pits	£2,197 per tree pit / ~£2955.28 (small hornbeam) to £11,659.04 (large oak) per tree pit	Arcadis, 2020 / ACD environmental 2017 (costs from 2015)
Filter strips	£4.80 per m ²	Environment Agency, 2015 (costs from 2007)
Filter drains	£120 per m ³ stored volume	Environment Agency, 2015 (costs from 2007)
Permeable paving	£62 per m ² to £131.35 per m ²	Environment Agency, 2015 (costs from 2007) / Susdrain, 2017 (costs from 2015)

Intervention	Indicative capital costings	Sources
Willow beds	£2,000 per ha	Woodland Trust, 2023 (costs from 2023)
Granular treatment media	£0.45 per 1000 gallons of water*	Based on professional experience
Soakaway - attenuation storage tank with permeable liner (with upstream catchpit)	>£160 per m ³ stored volume	Environment Agency, 2015 (costs from 2007)
Attenuation storage tanks (lined)	£775 per m ³	Environment Agency, 2015 (costs from 2007)
Wetlands	£44.82 per m ³ to £72.24 per m ³ treated volume	Environment Agency, 2015 (costs from 2007) / Susdrain, 2017 (costs from 2015)

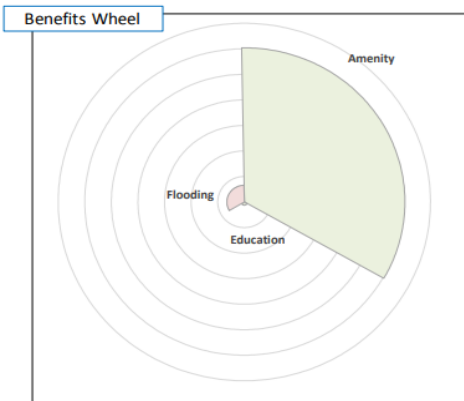
*Converted from dollars to pounds sterling

5.3 Cost-benefit analysis of wider benefits

Several tools exist to aid landowners and decision makers with quantifying certain changes to the land, including the application of NbS and SuDS. This can aid cost-benefit analyses to assess where NbS implementation could reduce costs. Research conducted by Interpave in 2019 into a [case study in Lamb Drove, Cambridgeshire](#) explored the cost of SuDS when compared to traditional forms of grey infrastructure. In particular, the case study focussed on the application of various SuDS techniques, including but not limited to swales, filter strips, detention basins, and retention ponds. The results demonstrated that there were capital cost savings of £341 per home and also a potential 20-25% reduction in maintenance costs for SuDS usage than traditional drainage when compared to a control site. Wider benefits including enhanced well-being, biodiversity and amenity were also noted to have improved. This aligns with Arcadis' findings from the North West Bicester development, which delivered [£750 of benefits per household per annum from SuDS](#).

CIRIA (Construction Industry Research and Information Association) has produced a [Benefits Estimation Tool](#) in order to assess the benefits of Blue Green Infrastructure (BGI) which could be applied to NbS. The tool guides the user through various structured methods and the confidence level which contributes to the output of a value assigned to the benefits in the context of the project. The tool is useful in quantifying the financial value of these benefits and is useful to use for cost-benefit analysis of NbS usage. Therefore, not only could the application of NbS produce significantly greater benefits for water quality, but from an economic perspective, the costs of managing issues beyond water quality may be reduced in the long-term if NbS are carefully implemented where appropriate. The benefits from two case studies, using B&EST 2019, are shown below. It should be noted that there is a tool has been updated (2021) into the [Benefits of SuDS Tool \(BeST\)](#).

Natural Flood Management in the Royal Borough of Greenwich



Description

Installation of natural flood management (NFM) to create a wet woodland, including targeted and specific maintenance of the Wickham Valley Watercourse. NFM measures and a watercourse diversion to include leaky dams, 186m length of 0.4m high berms, 664m³ of attenuation storage over a 0.33ha flooded area, and the creation of 130m of watercourse.

Project Cost:

£74,900

Results:

BEST shows that the option provides a total PV benefit of £0.34m (before confidence) and £0.19m (post confidence). The benefit cost ratio (post confidence) is **4.6** (range of 0.4 to 13.7).



Glasgow City Centre Surface Water Management Plan

Description

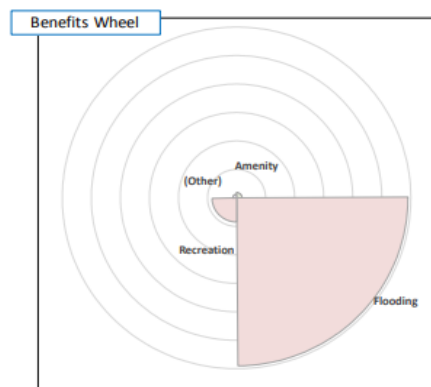
The proposed option assessed using BEST was to 'implement SuDS with other surface water management measures'. It included several retrofit measures that could form part of the city's redevelopment plan, including green roofs, swales, permeable paving, a pond/wetland and exceedance management measures. The proposed option was compared to a baseline 'do nothing' case.

Project Cost:

£26,833,659

Results:

BEST shows that the option provides a total present value (PV) benefit of £70.6m (before confidence) and £63.1m (post confidence). The benefit cost ratio (post confidence) is **2.4** (range of 0.2 to 3.7).



The **Wildfowl and Wetlands Trust (WWT)** create and maintain thousands of hectares of wetland habitats. WWT have a number of projects which show that there is potential to create wetlands to help improve water quality, with the benefits far outweighing the costs. **Environment Agency analysis** shows that achieving the Government's 'good status' 75% target generates benefits of around **£22.5bn for costs of £17.5bn**. The **Natural Capital Committee (NCC)** notes that reducing this to less costly interventions improves this to £20bn benefits for £12bn costs.

Research by WWT is showing that being around wetlands and their wildlife can help us regain a sense of peace and provide us with a place to recuperate and escape life’s daily stresses. **WWT Steart Marshes** project is expected to deliver health benefits worth up to £3.5 million in the next 10 years. In addition to the health benefits, it is estimated that WWT Steart Marshes produces between half and £1 million worth of additional goods and services every year.

5.4 Nutrient management funding

The funding for nutrient management comes from a range of sources. Typically, the primary funder will be the organisation that is required to or wants to deliver the nutrient management solution. However, there are often opportunities to bring in additional sources of funding through collaborations, grants and partnerships. Relevant bodies typically include water companies, governmental bodies, charities and private businesses.

Table 5-2 sets out some of the most relevant such organisations. This is not an exhaustive list but provides guidance to some of the organisations that are most likely to be relevant. Details of specific funds are also listed. These are included to provide an indication of the range of funding potentially available, rather than being a complete list of all potential options.

When seeking multiple funding sources, care should be taken to ensure that they are compatible, and one does not result in ‘double funding’ with two parties funding the same action. Examples could include funding to take agricultural land out of intensive agriculture and funding to plant trees, or funding for outcomes, such as funding for nutrient capture and carbon credits. Guidance should be sought from the relevant funding bodies to understand any limitations and requirements that come with funding.

The Nutrient Credit Trading Scheme & Toolkit Feasibility Study was commissioned by the South West Wales region (Carmarthenshire, Neath Port Talbot, Swansea and Pembrokeshire Councils) funded through the EARTH programme. Building upon this a Nutrient Credit Trading system is being developed, as discussed in Section 2.2.3, along with the development of a ‘toolkit’ to identify best practice, information sharing and the creation of added value.

There are a number of different legal mechanisms that can be used to secure the delivery of interventions, with context being key to which is most appropriate. Options include (but are not limited to):

- Section 106 Agreements
 - These are essentially legal agreements between the local authority and a developer or landowner to and may require financial contributions to mitigate the impact arising from a particular development. These are also often known as planning obligations.
- Conservation Covenants
 - These are private, voluntary agreements to conserve the natural or heritage features of the land.
- Bespoke Contracts
 - A method of dealing with more complex issues or bespoke requirements.

When dealing with interventions located outside of a development (e.g. a created wetland on third party land), options include the purchase or renting of suitable land.

Table 5-2: Sample of potential funding sources

Fund	Details
Welsh Government	

Fund	Details
Welsh Government Spending Commitments	<ul style="list-style-type: none"> • Funding of up to £415k being made available in 2022-23 to nutrient management boards with additional provision in 2023-24 and 2024-25. • £40 million of funding over the next three years to address water quality problems across Wales. • £10 million to directly support on-farm infrastructure investment in 2021 to enhance nutrient management and help farmers reach compliance with the Control of Agricultural Pollution Regulations. • A package of support for farmers, foresters, land managers and food businesses worth over £227 million over the next three years to support the resilience of the rural economy, which includes supporting actions to tackle agricultural pollution.
Basic Payment Scheme, Sustainable Farming Scheme (SFS) and Glastir Advanced, Commons and Organic contracts scheme	<p>The Basic Payment Scheme provides funding to farmers to manage their land in a way that aligns with good environmental practices. The SFS (due to be launched in 2025) is expected to provide funding for similar actions. One of the schemes focuses is to “maintain and enhance the resilience of ecosystems and the benefits they provide”. The Glastir Advanced, Commons and Organic contracts scheme will provide interim support during the transition to the Sustainable Farming Scheme.</p>
National Forest for Wales	<p>The National Forest for Wales aims to:</p> <ul style="list-style-type: none"> • Create areas of new woodland. • Help to restore and maintain some of our irreplaceable ancient woodlands. <p>In time it will form a connected network of woodlands throughout Wales. This will bring social, economic and environmental benefits.</p>
Additional resources	<p>The WG have numerous schemes and guidance to reduce the level of nutrients at source including the Nature Networks Fund and considerable guidance on SuDS design. These measures have considerable potential to reduce impacts at source. There are significant opportunities to strategically direct this funding towards nutrient reductions across the catchment.</p>
DCWW	
DCWW Spending Commitments	<ul style="list-style-type: none"> • Investing significantly to improve storm overflows with £140m being invested between 2020-2025 with a further £420m planned from 2025 to 2030. • Investing an additional £60m specifically to reduce phosphorus in the five failing SAC rivers in our operating area.

Fund	Details
	<ul style="list-style-type: none"> Delivering a comprehensive programme of upgrades to treatment works that will remove 90% of its phosphorus releases by 2030. DCWW's business operating model has allowed them to bring forward over £100m additional investment in its wastewater infrastructure accelerating investment that will have a direct benefit in improving rivers in Wales by 2025.
Existing and planned WwTW Upgrades in AMP7	DCWW has outlined proposals to invest an extra £100m before the end of 2025 to reduce Phosphate discharges from its wastewater treatment works and to reduce the impact of Combined Storm Overflows (CSOs). This is in addition to the £836m already budgeted in its Business Plan for 2020-2025.
Rivers in Wales Environmental Investment	<p>DCWW is committing to the following:</p> <ul style="list-style-type: none"> Investing £133m to eliminate 90% of the harm caused by Phosphorus in WwTW outflows in SAC by 2030 and 100% by 2032. Developing catchment permitting and nature-based solution approaches (e.g. RainScape in Llanelli) to achieve what is needed at smaller, more rural sites where the conventional, carbon intensive, WwTW phosphorus removal process is likely to be sub-optimal.
DCWW community fund	<p>DCWW fund for non-profit organisations' projects serving local communities. Applicants can receive up to £5,000 of funding per project. DCWW are seeking to fund projects focussing on a range of areas, including:</p> <ul style="list-style-type: none"> Improvements to the environment or local community initiatives promoting health, wellbeing and environmental objectives. Activities undertaken by registered community groups - specifically with health, wellbeing, environmental objectives. Improving and supporting local education activity for example water efficiency, environmental and innovation benefits. The delivery of the project must be completed within 12 months of the application being approved and funding being provided.
DCWW Water Framework Directive Fund	Funding scheme that provides financial contributions to not-for-profit organisations for projects that will deliver improvements to Welsh rivers, lakes and waterways.
NRW	
Four Rivers four Life	Between 2022 and 2027, over £9 million will be used to support the Four Rivers for LIFE Project, a collaboration between EU's LIFE

Fund	Details
	<p>Programme the WG and DCWW to protect, enhance and help restore the Rivers Teifi, Tywi, Cleddau and Usk. Further details are included in Table C-5-2 in Appendix C</p>
<p>Sustainable Drainage Feasibility Grant</p>	<p>The grant aims to support the development of small, local SuDS in Wales on existing sites. A fund of £450,000 is available for feasibility development grants between £25,000 - £40,000. The sustainable drainage feasibility grant will enable individuals, community groups and others undertake feasibility studies with the potential to develop small-scale schemes via a future competitive grant stage.</p>
<p>Ofwat</p>	
<p>Innovation Fund, Water Breakthrough Challenge and Water Discovery Challenge</p>	<p>Through their Innovation Fund, Ofwat are delivering a series of innovation competitions that water companies, in partnerships with others, can enter. The current scheme is expected to run until 2025, and Ofwat are currently consulting on a proposal to continue the Fund until 2030. This scheme includes £40 million in funding available in the upcoming Water Breakthrough Challenge. The Water Discovery Challenge is a £4 million competition that aims to accelerate the discovery, development and adoption of promising innovations by the water sector.</p>
<p>Local Councils</p>	
<p>Carmarthenshire County Council</p>	<p>There may be opportunity to collaborate with the Council (or other Local Planning Authorities) in the delivery of nature-based solutions. There may be existing Council led funding/support schemes, but in cases where there are not, engaging with the Council may still be of benefit.</p> <p>The Council will give further consideration to the use of s106 agreements from developments where there is a need arising from that development. These may be used as a means of contributing to funding however, regard will need to be had to other corporate objectives and issues of development viability in determining any financial contribution sought.</p>
<p>Charitable organisations</p>	
<p>Heritage Lottery Fund</p>	<p>Three levels of funding (£3,000 to £10 million) are available for projects that seek to, among other focuses, (1) improve habitats or conserve species, as well as helping people to connect to nature in their daily lives or (2) large-scale rural projects that help improve landscapes for people and nature by, for example, restoring habitats and celebrating the cultural traditions of the land. As discussed in</p>

Fund	Details
	Section 3.4, the PRAM Project in Ceredigion is funded by the Nature Networks Programme and it is being delivered by the Heritage Fund, on behalf of the WG.
Esmee Fairburn Foundation	The Esmee Fairburn Foundation has aims that include restoring freshwater environments from pollution and damaged ecosystem restoration. The organisation has previously supported freshwater projects in Wales, providing grants of £10,000 to £60,000 to support organisations.
BASC Wildlife Fund	The BASC Wildlife Fund is a sustainable shooting organisation Provides financial support for hands-on conservation initiatives and sustainable land management. Grant funding has previously been awarded for the creation of wetland habitat in Gloucestershire and Humber, targeting biodiversity improvements.
Private funding	
Private funding	There may be opportunities for collaboration with private funding through the stacking of benefits. For example, delivery of biodiversity or carbon capture (in addition to nutrient capture), on behalf of developers seeking off-site seeking such benefits.

5.5 Project Risks

When developing nutrient management opportunities, as with any project, there are inherent risks that will need to be managed. This section provides an overview of the key risk categories that are likely to be encountered and typical risk reduction measures. These are set out in Table 5-3.

Table 5-3: Key potential risks and reduction strategies

Project stage	Risk	Mitigation
Funding	Failing to suitably identify funders or quantify benefits can lead to a risk failing to secure funding and delivery good value for money.	<ul style="list-style-type: none"> • Carry out cost/benefit analysis throughout process. • Capture wider benefits (e.g., biodiversity, noise attenuation etc). • Factor uncertainties into budget. • Early engagement with potential funders. • Secure funding and binding commitment for implementation of management and monitoring plans.
Scoping	Failing to scope the project effectively in terms of its technical feasibility, the stakeholders involved and the availability of land and resource to delivery all put the project at risk.	<ul style="list-style-type: none"> • Early engagement with landowners and stakeholders. • For breaking laws protecting wildlife - Early consideration of potential receptors, surveys and consideration throughout the design process. • HRA consideration at outset (staged approach). • Consider/review evidence base for decisions e.g., Water quality data, modelling etc. • Technical feasibility should include consideration of WwTW locations, position within catchment e.g., further upstream means positive impact on larger downstream area, implement desk study at scoping stage, followed by site specific assessment, as required. • Achieve 'buy in' throughout process – take relevant bodies on journey with you.
Design	Failing to consider design constraints and potential project risks including any	<ul style="list-style-type: none"> • Collaborative design process with consideration of local conditions.

Project stage	Risk	Mitigation
	<p>planning constraints (e.g., environmental protections) poses a risk to delivery. Failing to line up the necessary surveys / design works can also impact the overall success of the project.</p>	<ul style="list-style-type: none"> • Design based on primary purpose, then add wider benefits such as biodiversity enhancements. • Consider management and monitoring plan. • Consider wider benefits throughout process so output is robust to changing requirements by delivering a range of benefits. • Engagement with key local stakeholders. • Engage with appropriate specialists, as required.
<p>Permitting</p>	<p>Failure to secure appropriate permits or legal approval resulting in legal implications and/or reputational damage.</p>	<ul style="list-style-type: none"> • Early engagement with suitable specialists that can advise on permitting/legal requirements.
<p>Implementation</p>	<p>Failure of habitat to establish resulting in requirements to re-implement the habitat.</p> <p>Habitat failure can be caused by negative human impacts (including vandalism), inappropriate designs or force majeure.</p> <p>Higher than expected costs</p>	<ul style="list-style-type: none"> • Consideration of the implementation process at the outset – staged design. • Allocate budget for replanting/reseeding etc. • Implementation ideas considered at outset – staged design. • Continue to engage with local stakeholders.
<p>Management</p>	<p>Failure of habitat due to lack of or inappropriate on-going management, negative human impacts (including vandalism), climate change or force majeure.</p>	<ul style="list-style-type: none"> • Negative human impacts managed by fencing, strategic locations away from public areas, signage. • Create management and monitoring plans for defined period of time. • Secure funding and binding commitment for implementation of management and monitoring plans. • Engage with stakeholder when land not under direct control (e.g., rain gardens installed in new build housing). • Incorporate climate adaptability into the designs.








Appendix A











Special Areas of Conservation Phosphorus Load Overview Maps















Appendix B














Intervention Measures Matrix




















Table B-5-1 Intervention Measures Matrix











Intervention	Discussion	Benefits	Feasibility	Maintenance	Effectiveness	Case Studies
Reduction of Agricultural Phosphorus at source	<p>This solution focusses on changing farming practices.</p> <p>Advantages: Removes P at source, thus reducing pressure on traditional WwTW and nature-based solutions. Increases sustainability of soil. Associated pre-treated sludge biosolid spreading by DCWW as a single accredited stakeholder.</p> <p>Disadvantages: Multiple stakeholders required to change long standing practices. Difficult to manage / monitor. Legacy P requires consideration i.e., 20years of continued P export needs to be considered in the land use change.</p> <p>Delivery Partners: Landowners, WG, The Council, NRW, NFU Cymru, DCWW, Env. NGOs</p>	 Increased biodiversity from reduction in nutrient enrichment and in soil  Aesthetic value  Carbon sequestration	Low	Medium	High	Dairy Project Wales Land Management Forum Wales Water Management Forum Rivers Trust of Wales (Welsh Rivers Trust) Afonydd Cymru The West Wales Rivers Trust Taclo'r Tywi Initiative
Farming Source Control	<p>Farm improvement works to prevent Phosphorus from entering watercourses, which can include fencing.</p> <p>Advantages: A simple scheme that increases farm value and there is already an existing grant scheme, which can last a long time (50+ years)</p> <p>Disadvantages: Multiple stakeholders which may create long term management difficulties and requires seasonal vegetation management.</p> <p>Delivery Partners: DCWW, NRW, NFU Cymru, Landowners/land managers, The Council, WG: WG Spending Commitments, Basic Payment Scheme, SFS, Glastir Advanced, Commons and Organic contracts scheme, National Forest for Wales, Food accreditation scheme, Farm Business Grant Scheme post 2024</p>	 Increased biodiversity in watercourse habitats from a reduction in nutrient enrichment and in soil  Aesthetic value	High	Medium	High	Dairy Project Wales Land Management Forum Wales Water Management Forum Rivers Trust of Wales (Welsh Rivers Trust) Afonydd Cymru The West Wales Rivers Trust Taclo'r Tywi Initiative
Surface Water Separation	<p>This solution focuses on separating wastewater flows from new and existing developments to capture stormwater.</p> <p>Advantages: Already normal practice for new developments, leads to reduced CSO discharges into the watercourse and reduced sewage treatment costs. Similar compensatory surface water removal approach already in place for Carmarthen Bay and Estuaries European Marine site.</p> <p>Disadvantages: Costly to retrofit in urban areas, limited reduction in Phosphorus unless effective SuDS are incorporated, long term effectiveness depends on operating practices at WwTWs.</p> <p>Delivery Partners: Developers, The Council, DCWW, Wales Green Infrastructure Forum</p>	 Increased Capacity and efficiencies at WwTW	High	Low	Low	Wales Land Management Forum Wales Water Management Forum Rivers Trust of Wales (Welsh Rivers Trust) Afonydd Cymru The West Wales Rivers Trust Taclo'r Tywi Initiative
Enhanced Wastewater Treatment Works	<p>Increasing the ability of WwTWs to remove Phosphate.</p> <p>Advantages: Increase headroom for new development, clear delivery mechanisms within DCWW. Opportunity to explore developer contributions.</p> <p>Disadvantages: Requires long term investment and long lead times. May transfer issues to biosolid spreading which would require extra controls.</p> <p>Delivery Partners: DCWW: Existing and new WWTW funding, Spending commitments. Developers, NRW, Ofwat, NFU Cymru, WG Spending Commitments.</p>	 Improved Water Efficiency and water quality	Medium	High	High	Wales Land Management Forum Wales Water Management Forum Rivers Trust of Wales (Welsh Rivers Trust) Afonydd Cymru The West Wales Rivers Trust Taclo'r Tywi Initiative













Intervention	Discussion	Benefits	Feasibility	Maintenance	Effectiveness	Case Studies
SuDS Source Control	<p>Permeable paving</p> <p>Advantages: Reduces peak flows and enhance water quality treatment. Dual use of the landscape, prevents ponding, can be used in high density developments</p> <p>Disadvantages: Not compatible with large sediment loads, only suitable for low traffic volume areas, maintenance to minimise silt clogging.</p> <p>Delivery Partners: Developers, The Council.</p>	<p> Natural Flood mitigations</p> <p> Temperature Regulation</p>	Medium	Low	High	<p>RainScape National Surface Water Management and SuDS Group Members Teifi SAC Catchment Phosphate Reduction and Mitigation Project Natural Flood management plus in the Cadoxton catchment Four Rivers for LIFE National Surface Water Management and SuDS Group Members Rivers Trust of Wales (Welsh Rivers Trust) Afonydd Cymru The West Wales Rivers Trust Taclo'r Tywi Initiative</p>
	<p>Green roofs</p> <p>Advantages: Reduced peak waste water flows and enhanced water quality treatment along with reduced storm water overloading and CSO discharges, Mimics predevelopment state of water flows, can be retrofitted (site dependant), no additional land, can provide a return on investment from energy savings.</p> <p>Disadvantages: High cost compared to conventional roof, not appropriate for all sites and limited retrofitting abilities, requires high maintenance as any damage to roof membrane is more critical as water is encouraged to remain on the roof, limited impact of phosphate removal.</p> <p>Delivery Partners: Developers, The Council, DCWW, Business Improvements Districts for retrofits.</p>	<p> Increased Biodiversity</p> <p> Aesthetic value</p> <p> Thermal attenuation</p> <p> Climate resilience</p> <p> Water efficiency</p> <p> Noise Attenuation</p> <p> Air Quality improvements</p> <p> Health and wellbeing if accessible</p> <p>Increased longevity of roofs</p>				










Intervention	Discussion	Benefits	Feasibility	Maintenance	Effectiveness	Case Studies
Swales	<p>Shallow broad and vegetated channels designs to store and convey runoff to remove pollutants.</p> <p>Advantages: Easy to incorporate into landscaping, good removal of urban pollutants, reduces runoff rates and volumes and low capital cost. Maintenance can be incorporated into general landscape management, pollution and blockages are visible and easily dealt with.</p> <p>Disadvantages: Not suitable for steep areas with roadside parking, limits the opportunities to use trees for landscaping, risks of blockages in existing pipework.</p> <p>Delivery Partners: Developers, The Council, Local Highways Agencies, WG, National Surface Water Management and SuDS Group, Ofwat, Innovation Fund, Water Breakthrough Challenge, Water Discovery Challenge, NRW, Four Rivers for Life, Sustainable Drainage Feasibility Grant, DCWW: Spending Commitments, Rivers in Wales Environmental Investment, DCWW Community Fund, Wales Green Infrastructure Forum, Living Streets Cymru, Active Travel and Safe Routes in Communities (SRiC) schemes, Heritage Lottery Fund, Esmee Fairburn Foundation</p>	 Biodiversity  Amenity  Aesthetic value  Passive cooling	Medium	Low	Medium	RainScape National Surface Water Management and SuDS Group Members Telfi SAC Catchment Phosphate Reduction and Mitigation Project Four Rivers for LIFE National Surface Water Management and SuDS Group Members Rivers Trust of Wales (Welsh Rivers Trust) Afonydd Cymru The West Wales Rivers Trust Taclo'r Tywi Initiative
Conveyance Channels	<p>Channels and rills are open surface water channels with hard edges that can be planted with vegetation.</p> <p>Advantages: Effective water and pollution treatment, can act as pre-treatment to remove silt before water is conveyed into further SuDS features, easy to construct.</p> <p>Disadvantages: Incorrect planting can cause silt build up, need to give careful consideration to crossings, routine maintenance to remove litter/debris, large maintenance required every 5 years.</p> <p>Delivery Partners: Same as Swales</p>	 Biodiversity Increase  Amenity  Aesthetic value  Passive cooling	Medium	Medium	Medium	Four Rivers for LIFE National Surface Water Management and SuDS Group Members Rivers Trust of Wales (Welsh Rivers Trust) Afonydd Cymru The West Wales Rivers Trust Taclo'r Tywi Initiative
Filtration Strips	<p>Filter strips of gently sloping grass and street trees</p> <p>Advantages: Well suited to implementation in areas with heavy traffic, encourages evaporation, infiltration and interception. Easy to construct and low construction cost, effective pre-treatment option</p> <p>Disadvantages: Not suitable for all locations. No significant attenuation or reduction of extreme flows.</p> <p>Delivery Partners: Same as Swales</p>	 Biodiversity  Amenity  Aesthetic value  Health and wellbeing Can encourage active transport	Medium	Medium	Medium	Four Rivers for LIFE National Surface Water Management and SuDS Group Members Rivers Trust of Wales (Welsh Rivers Trust) Afonydd Cymru The West Wales Rivers Trust Taclo'r Tywi Initiative
	<p>Filter drains are stone filled trenched with underdrains alongside roads, paths or rail lines.</p> <p>Advantages: They can capture specific pollutants if there is a layer of treatment media included (the amount removed will depend on the treatment media used). Large ability for treatment since they are often created to be in parallel to the length of roads and paths.</p> <p>Disadvantages: It does not capture pollutants directly if treatment media is not added, No vegetation, Depending on the soil conditions and/or pollutant loads, there is risk of filter drains enabling phosphate pollution migration into the underlying ground water, Flow exceedance could lead to temporary flooding.</p> <p>Delivery Partners: Same as Swales</p>	 Biodiversity (microorganisms, insects and amphibians)  Amenity Can filter out fine sediments, metals and hydrocarbons (depending on filter media used) Encourage adsorption and biodegradation process	Medium	Low	Medium	Four Rivers for LIFE National Surface Water Management and SuDS Group Members Rivers Trust of Wales (Welsh Rivers Trust) Afonydd Cymru The West Wales Rivers Trust Taclo'r Tywi Initiative


Intervention	Discussion	Benefits	Feasibility	Maintenance	Effectiveness	Case Studies
	<p>Shallow landscaped areas with engineered soils, enhanced vegetation and filtration, which can also include trees.</p> <p>Advantages: Very effective in removing urban pollutants which can also reduce volume and runoff rates. Flexible layout to fit into landscape. Well-suited for installation in highly impervious areas, Good retrofit capability and when lined, can be used to manage surface water runoff from areas with high groundwater pollution risks.</p> <p>Disadvantages: Requires landscaping and management. Susceptible to clogging if surrounding landscape is not managed. Not suitable for areas with steep slope. Should be used in conjunction with other SuDS components</p> <p>Delivery Partners: Same as Swales</p>	 Biodiversity  Amenity / Aesthetic value	Medium	Low	High	Four Rivers for LIFE National Surface Water Management and SuDS Group Members Rivers Trust of Wales (Welsh Rivers Trust) Afonydd Cymru The West Wales Rivers Trust Taclo'r Tywi Initiative
Infiltration Basins	<p>A solution based around, rain gardens, infiltration trenches and basins, soakaways, tree pits.</p> <p>Advantages:</p> <p>Rain gardens – Small and easy to retrofit, minimal land take, easy to maintain, flexible layout to fit into landscape and can be installed in impervious areas if designed correctly.</p> <p>Soakaways – Particulate P removal through sedimentation of solids upstream of soakaway and infiltration in the soakaway. Can reduce rate of run off and some volume reduction</p> <p>Tree pits – Can enhance the performance of other green infrastructure technologies.</p> <p>Disadvantages:</p> <p>Rain gardens – As they are often small, their impact can be limited, requires landscaping and management, susceptible to clogging if surrounding landscape is not managed. Not suitable for areas with steep slopes or impermeable soils.</p> <p>Soakaways – Phosphorus removal highly dependent on infiltration rate and if there is an overflow.</p> <p>Tree pits – Nutrients can be cascaded downstream in extreme events.</p> <p>Delivery Partners: Same as Swales</p>	 Biodiversity  Amenity / Aesthetic value  Natural flood mitigation  Can reduce the risk of waterborne diseases	Medium	Medium	Medium	Natural Flood management plus in the Cadoxton catchment Four Rivers for LIFE National Surface Water Management and SuDS Group Members Rivers Trust of Wales (Welsh Rivers Trust) Afonydd Cymru The West Wales Rivers Trust Taclo'r Tywi Initiative
Retention Ponds	<p>Building of ponds to retain water (retention ponds)</p> <p>Advantages: Can cater for all storms and has good removal capability of urban pollutants. Can be used where groundwater is vulnerable, if lined.</p> <p>Disadvantages: No reduction in runoff volume. Anaerobic conditions can occur without regular inflow. Land take may limit use in high density sites. May not be suitable for steep sites, due to requirement for high embankments. Colonisation by invasive species could increase maintenance. Perceived health & safety risks may result in fencing and isolation of the pond.</p> <p>Delivery Partners: Same as Swales</p>	 Biodiversity  Thermal attenuation  Climate resilience  Amenity  Aesthetic value  Recreation  Natural flood mitigation	Medium	Medium	High	Natural Flood management plus in the Cadoxton catchment Four Rivers for LIFE National Surface Water Management and SuDS Group Members Rivers Trust of Wales (Welsh Rivers Trust) Afonydd Cymru The West Wales Rivers Trust Taclo'r Tywi Initiative

Intervention	Discussion	Benefits	Feasibility	Maintenance	Effectiveness	Case Studies
Detention Basins	<p>Detention basins are shallow vegetated areas which retain water at times.</p> <p>Advantages: Can cater for a wide range of rainfall events and can be used where groundwater is vulnerable, if lined. Simple to design and construct with a potential for dual land use. Easy to maintain. Safe and visible capture of accidental spillages.</p> <p>Disadvantages: Little reduction in runoff volume. Detention depths may be constrained by system inlet and outlet levels</p> <p>Delivery Partners: Same as Swales</p>	 Biodiversity  Amenity  Aesthetic value  Health and wellbeing can double up as play and recreation areas  Natural flood mitigation	High	Low	Medium	Natural Flood management plus in the Cadoxton catchment Four Rivers for LIFE National Surface Water Management and SuDS Group Members Rivers Trust of Wales (Welsh Rivers Trust) Afonydd Cymru The West Wales Rivers Trust Taclo'r Tywi Initiative
Ponds	<p>Larger bodies of standing water. Water is moved in out of the pond through runoff and flow. Can be surrounded by vegetation, grass, hard landscapes, and other surroundings</p> <p>Advantages: Uptake of phosphate by plants and aquatic flora. Phosphate can also sediment out onto the base of the pond</p> <p>Disadvantages: Good practice for construction must be followed as badly designed ponds can act as exporters of dissolved phosphate. Minimal direct infiltration potential. Cannot manage large inputs of water or exceedance flows</p> <p>Development Partners: Developers, The Council, Local Highways Agencies, WG, WG Spending Commitments, Basic Payment Scheme, SFS, National Surface Water Management and SuDS Group, DCWW Spending Commitments, Rivers in Wales Environmental Investment, DCWW Community Fund, NRW, Sustainable Drainage Feasibility Grant, Four Rivers for Life, Wales Green Infrastructure Forum</p>	 Biodiversity  Amenity  Aesthetic value  Recreation  Thermal attenuation	Medium	Medium	Medium	Four Rivers for LIFE National Surface Water Management and SuDS Group Members Rivers Trust of Wales (Welsh Rivers Trust) Afonydd Cymru The West Wales Rivers Trust Taclo'r Tywi Initiative
Constructed Wetlands	<p>Wetland creation designed and maintained specifically for maximising P reduction from both storm and foul water discharges. Plant roots can absorb nutrients and incorporate them into the plant structure. Can provide for tertiary treatment after effective primary and secondary foul treatment processes.</p> <p>Advantages: Good removal capability for pollutants and can trap large volumes of sediments. If lined, can be used where groundwater is vulnerable. Large wider environmental benefits and high longevity for functioning effectively (50+ years), Reed bed systems can be incorporated into wetlands which can further enhance biodiversity.</p> <p>Disadvantages: Land take is high. Requires maintaining sufficient baseflows in dry periods and there is limited depth range for flow attenuation. May release nutrients during non-growing season, which must be mitigated by good design and maintenance. Little reduction in runoff volume and less effective for steep sites and will require significant earthworks. Colonisation by invasive species could increase maintenance. Performance vulnerable to high sediment inflows. P will be bound in sludge which may require disposal and will require extra pre-treatment with solar drying and well managed biosolid spreading to satisfy crop need. Desludging could be every 10 years but depends on the wetland design. May need to replace bed material if it is saturated with nutrients if artificial bed material is used. Seasonal vegetation removal and management. Potential mosquito habitat.</p> <p>Development Partners: Developers, The Council, Welsh Rivers Trust, DCWW Spending Commitments, Rivers in Wales Environmental Investment, DCWW Community Fund, NRW, Sustainable Drainage Feasibility Grant, Four Rivers for Life, NFU Cymru, Local Nature Partnership for North East Wales, United Utilities, DCWW, WG, WG Spending Commitments, Basic Payment Scheme, SFS, Heritage Lottery Fund, Esmee Fairburn Foundation Ofwat Innovation Fund, Water Breakthrough Challenge, Water Discovery Challenge.</p>	 Biodiversity  Amenity  Aesthetic value  Recreation  Thermal attenuation/temperature regulation  Climate resilience  Carbon sequestration  Natural flood mitigation  Potential for water reuse	Medium	Medium	High	Upper Tywi Restoration Project The Wetlands Project The Pontbren Project Four Rivers for LIFE National Surface Water Management and SuDS Group Members Wales Water Management Forum Rivers Trust of Wales (Welsh Rivers Trust) Afonydd Cymru The West Wales Rivers Trust Taclo'r Tywi Initiative Teifi SAC Catchment Phosphate Reduction and Mitigation Project

Intervention	Discussion	Benefits	Feasibility	Maintenance	Effectiveness	Case Studies
Integrated Buffer Zones	<p>A solution involving increasing grassland, floodplain grassland, beetle banks, woodland and hedgerows.</p> <p>Advantages: Good capability for capture of pollutants and wider environmental benefits.</p> <p>Disadvantages: Reduced productive area under agriculture may release nutrients during non-growing season. Risk of increasing emissions of nitrous oxide and methane (greenhouse gases)</p> <p>Development Partners: Developers, The Council, Welsh Rivers Trust, DCWW, Rivers in Wales Environmental Investment, DCWW Community Fund, NRW, Sustainable Drainage Feasibility Grant, Four Rivers for Life, NFU Cymru, Cities for Trees, Local Nature Partnership Carmarthenshire, United Utilities, Salmon and Trout Conservation, WG, WG Spending Commitments, Basic Payment Scheme, SFS, Glastir Small Grant Scheme, Heritage Lottery Fund, Woodlands for Wales</p>	 Biodiversity	Medium	Medium	High	<p>The Pontbren Project Four Rivers for LIFE National Surface Water Management and SuDS Group Members Wales Water Management Forum Rivers Trust of Wales (Welsh Rivers Trust) Afonydd Cymru The West Wales Rivers Trust Taclo'r Tywi Initiative Teifi SAC Catchment Phosphate Reduction and Mitigation Project</p>
		 Climate resilience				
		 Air quality				
		 Health and Wellbeing				
		 Educational				
		 Pest control				
		 Noise attenuation				
 Amenity						
 Aesthetic value						
Private Sewerage Drainage Fields	<p>Network of discharge pipes from septic tank or Package Treatment Plant (PTP) laid in trenches under the ground surface so that effluent can be discharged to the ground. Effluent percolates through soil. Sediment bound P is immobilised and soluble P is bound to soils and sediments.</p> <p>Advantages: Likely to be less costly than a wetland system with less maintenance for same P removal performance. Can be delivered up to medium spatial scale (<100 units / <2.0 ha)</p> <p>Disadvantages: Longevity of scheme anticipated to be low (10-20 years). Increased usage of the drainage field with time can result in the soils or filter materials sorption capacity being reached. Fields where ground water flood risk is high or water table is within 2.0 m of ground surface are unsuitable. Provides no additional environmental benefits.</p> <p>Development Partners: Developers, DCWW Spending Commitments, NFU Cymru, The Council.</p>	 Efficiency and increased capacity at WwTW	Medium	Low	High	<p>National Surface Water Management and SuDS Group Members Wales Water Management Forum Rivers Trust of Wales (Welsh Rivers Trust) Afonydd Cymru The West Wales Rivers Trust Taclo'r Tywi Initiative</p>

Intervention	Discussion	Benefits	Feasibility	Maintenance	Effectiveness	Case Studies	
River Channel Re-naturalisation	<p>Works to return rivers to a more 'natural state' including: re-meandering, creating berms, pool-riffle systems, riparian planting and reconnecting channel to floodplain.</p> <p>Advantages: Good capability for capture of pollutants and wider environmental benefits. Can have high longevity for functioning effectively (50+ years). Minimal maintenance required during the establishment phase of the river channel.</p> <p>Disadvantages: Currently no industry standard regarding the design of larger scale river and floodplain re-naturalisation schemes to support the achievement of nutrient removal. Baseline and longer-term monitoring will be required prior to and following the implementation of a scheme in order to determine how much P the scheme is removing. P absorption to sediments is primary process of nutrient removal, however, the process is reversible with desorption occurring if P concentration of water drops below a threshold. Threshold is dynamic as the sorption capacity of sediments changes over time. Management regime may depend on the local context and degree of re-naturalisation. Potentially will be over a year until additional benefits are realised.</p> <p>Development Partners: The Council, DCWW Spending Commitments, Rivers in Wales Environmental Investment, DCWW Community Fund, Welsh Rivers Trust , Salmon and Trout Conservation', Land owners / land managers, NRW, Sustainable Drainage Feasibility Grant, Four Rivers for Life, WG, WG Spending Commitments, Basic Payment Scheme, SFS, Heritage Lottery Fund, Ofwat, Innovation Fund, Water Breakthrough Challenge, Water Discovery Challenge</p>	       	<p>Natural flood mitigation</p> <p>Biodiversity</p> <p>Amenity</p> <p>Aesthetic value</p> <p>Carbon sequestration</p> <p>Additional pollutant removal</p> <p>Health and well being</p> <p>Air quality</p> <p>Climate resilience</p>	High	Low	Medium	<p>Natural Flood management plus in the Cadoxton catchment</p> <p>Four Rivers for LIFE National Surface Water Management and SuDS Group Members</p> <p>Wales Water Management Forum</p> <p>Rivers Trust of Wales (Welsh Rivers Trust)</p> <p>Afonydd Cymru</p> <p>The West Wales Rivers Trust</p> <p>Taclo'r Tywi Initiative</p>
Drainage Ditch Blocking	<p>Placing of barriers across ditches to slow the flow, increase residence times and prevent downstream transport of sediments.</p> <p>Advantages: Easy to construct, low construction cost and low maintenance (mainly visual inspections needed).</p> <p>Disadvantages: Low predictability / certainty of success, and low removal performance. Lack of UK based evidence for effectiveness; baseline and long-term monitoring is recommended pre-and post-implementation and may result in localised flooding during heavy rainfall events. Dam failure would have implications for P removal efficiency. Limited research currently available on the effectiveness of this method for nutrient removal.</p> <p>Development Partners: Land owners / land managers, DCWW, DCWW Spending Commitments, Rivers in Wales Environmental Investment, DCWW Community Fund, The Council, NFU Cymru, Environmental NGOs, NRW, Sustainable Drainage Feasibility Grant, WG.</p>	   	<p>Natural flood mitigation</p> <p>Biodiversity</p> <p>Additional pollutant removal</p> <p>Carbon sequestration</p>	Medium	Low	Low	<p>Natural Flood management plus in the Cadoxton catchment</p> <p>Four Rivers for LIFE National Surface Water Management and SuDS Group Members</p> <p>Rivers Trust of Wales (Welsh Rivers Trust)</p> <p>Afonydd Cymru</p> <p>The West Wales Rivers Trust</p> <p>Taclo'r Tywi Initiative</p>

Intervention	Discussion	Benefits	Feasibility	Maintenance	Effectiveness	Case Studies
Engineered log Jams	<p>Leaky dams made of woody debris constructed to mimic beaver dams and slow flows and re-naturalise river reaches.</p> <p>Advantages: P removal achieved through sedimentation, chemicals sorption and biomass assimilation. Well-designed schemes will require little maintenance and could serve up to 100 units.</p> <p>Disadvantages: Risk being washed away in flood events – best suited to small watercourses < 2m wide. Lack of research for engineered log jams / beaver dams to confirm potential nutrient removal estimates; monitoring will be required pre/post scheme introduction to determine effectiveness. Potential for increased localised flooding. Adaptive management needed in case repairs are needed. Possibility that P removal may be short-term and that nutrients could be remobilised during floods.</p> <p>Development Partners: The Council, NRW, Sustainable Drainage Feasibility Grant, Four Rivers for Life, DCWW, DCWW Spending Commitments, Rivers in Wales Environmental Investment, DCWW Community Fund, Welsh Rivers Trust, Salmon and Trout Conservation, Landowners / land managers, WG, WG Spending Commitments, Basic Payment Scheme, SFS, Heritage Lottery Fund, Esmee Fairburn Foundation, Ofwat, Innovation Fund, Water Breakthrough Challenge, Water Discovery Challenge</p>	 Natural flood mitigation  Biodiversity  Carbon sequestration Additional pollutant removal	Medium	Low	Low	Natural Flood management plus in the Cadoxton catchment Four Rivers for LIFE National Surface Water Management and SuDS Group Members Wales Water Management Forum Rivers Trust of Wales (Welsh Rivers Trust) Afonydd Cymru The West Wales Rivers Trust Taclo'r Tywi Initiative
Granular Treatment Media	<p>Granular treatment media that has been designed to treat various pollutants. There are phosphorus specific granular treatment media.</p> <p>Advantages: Up to 100% TP removal (if infiltration possible and depending on the manufacturer)</p> <p>Disadvantaged: P removal highly dependent on manufacturer and how well assets are maintained. Filter media will need to be changed periodically.</p> <p>Development Partners: Landowners / land managers, The Council, NRW, Sustainable Drainage Feasibility Grant, Developers, Local Highways Agencies, National Surface Water Management and SuDS Group, Living Streets Cymru.</p>	 Potential for grey water recycling  May reduce unpleasant odours	Medium	Medium	Medium	Wales Water Management Forum National Surface Water Management and SuDS Group Members Rivers Trust of Wales (Welsh Rivers Trust) Afonydd Cymru The West Wales Rivers Trust Taclo'r Tywi Initiative.
Willow Beds	<p>Willow beds can be designed to treat stormwater from low/medium risk surfaces of small catchments. They allow capturing, attenuation, and evapotranspiration of captured flows.</p> <p>Advantages: Capture, attenuation and evapotranspiration of all flows so no discharge occurs. Uptake of P by the willow. Harvesting willow can be a valuable resource. If built as part of a closed systems, it is effective immediately.</p> <p>Disadvantages: Not commonly used in the UK, and where they are, they tend to be for private sewage treatment installations. To have optimal TP removal performance harvesting of willow will be required. Harvesting of willow is a valuable resource but the process is of harvesting it is onerous. Some sediment removal is required at the inlet and any suspended sediment may have to be removed periodically. Little information available currently regarding regulations on their implementation of water treatment. Effective only during the willow growing season.</p> <p>Development Partners: Landowners / land managers, The Council, NRW, Sustainable Drainage Feasibility Grant, Four Rivers for Life, DCWW, DCWW Spending Commitments, Rivers in Wales Environmental Investment, DCWW Community Fund, Developers: Could help to deliver Net Benefit for Biodiversity, DCWW, WG, WG Spending Commitments, Basic Payment Scheme, SFS, Heritage Lottery Fund, Ofwat, Innovation Fund, Water Breakthrough Challenge, Water Discovery Challenge.</p>	 Biodiversity  Natural flood mitigation  Aesthetic value Amenity value  Carbon sequestration Can harvest the willow which could then be sold (offsets some of the maintenance costs)	Medium	Low	High	The Pontbren Project Natural Flood management plus in the Cadoxton catchment Four Rivers for LIFE National Surface Water Management and SuDS Group Members Rivers Trust of Wales (Welsh Rivers Trust) Afonydd Cymru The West Wales Rivers Trust Taclo'r Tywi Initiative

Intervention	Discussion	Benefits	Feasibility	Maintenance	Effectiveness	Case Studies
Attenuation storage tanks (lined)	<p>Lined cellular/crated or other storage below ground (no infiltration).</p> <p>Advantages: Particulate P removal through sedimentation of solids upstream of attenuation tank.</p> <p>Disadvantages: Attenuation tank is not designed to provide any P removal on its own. P removal highly dependent on upstream features and how well assets are maintained. Filters need changing every few years.</p> <p>Development Partners: Landowners / land managers, The Council, NRW, DCWW, DCWW Spending Commitments, Developers: Could help to deliver Net Benefit for Biodiversity, DCWW, WG, WG Spending Commitments, Basic Payment Scheme</p>	 <p>Natural flood mitigation</p>	Medium	High	High	<p>Natural Flood management plus in the Cadoxton catchment</p> <p>Wales Water Management Forum</p> <p>Rivers Trust of Wales (Welsh Rivers Trust)</p> <p>Afonydd Cymru</p> <p>The West Wales Rivers Trust</p> <p>Taclo'r Tywi Initiative</p>

Appendix C

NbS and other Solutions Case Studies

Table C-5-2: NbS Case Studies

Case Study	Description
<p>LIFE Dee River project</p> <p>NRW</p>	<p>This £6.8 million project aimed to restore the River Dee and the wider catchment through enhancing biodiversity and encouraging the population numbers of various protected species (including salmon, lamprey and freshwater pearl mussels). Specific activities of the project include:</p> <ul style="list-style-type: none"> • removing the constraints to fish migration and wider ecological connectivity • restoring or improving natural riverine physical processes, features and habitats • improving agricultural / forestry land management to reduce nutrient / sediment input to the SAC • conservation management for critically endangered freshwater pearl mussel • building long-term positive relationships with key stakeholders
<p>Upper Tywi Restoration Project</p> <p>DCWW</p>	<p>DCWW awarded funding to the Upper Tywi Catchment Restoration Project in order for the Carmarthenshire Rivers Trust to prevent further deterioration of the fisheries within the area. The proposed methods of achieving this was through the use of lime dosing to decrease levels of acidification and improving the local river ecology through habitat and wildlife improvements.</p> <p>Additional community benefits were hoped to be gained as a result, through encouraging community involvement with the improvements itself and for the project to encourage outdoor recreation on its completion.</p>
<p>The Pontbren Project</p>	<p>A Woodland management and tree planting project led by a group of neighbouring farmers in mid-Wales. The aim of the project was for the changes to woodland management would result in increased efficiency of upland livestock farming. The project was funded by the WG and involved planting 120,000 new trees, 16.5km of hedge creation or restoration and approximately across 10 years. No loss of agricultural productivity was reported during this 10 year period, with the farmers planning on continuing tree and hedgerow planting and managing the woodland.</p> <p>Scientific data was collected from application of tree planting as a flood reduction strategy, which is being used to investigate the impacts of land use within flood-prone catchments.</p>
<p>Teifi SAC Catchment Phosphate Reduction and</p>	<p>Ceredigion County Council is leading this project, which will evaluate the feasibility for the planning and development of constructed treatment wetlands for reducing phosphates. It will also implement phosphate reduction interventions on the ground, which will include 9km of riparian fencing and tree planting in the most severely</p>

Case Study	Description
Mitigation Project (PRAM Project)	<p>livestock damaged areas. In addition, small SuDS schemes will be implemented in the main towns on the Teifi.</p> <p>The project has received £500,000 from the WG Nature Networks Fund to “directly improve the condition of this SAC through reducing phosphate inputs, improving water quality and reversing decline in nature”.</p>
The Wetlands Project DCWW	<p>DCWW will shortly start construction of two wetlands on the River Lugg, to reduce phosphate levels in the river, whilst at the same time significantly improving local biodiversity. This project is a partnership with the Local Authority, local developers, the Wye and Usk Foundation, and our Regulators.</p>
Natural flood management plus in the Cadoxton catchment NRW	<p>Heavy rainfall and flooding in Dinas Powys resulted in significant damage to roads, gardens, homes and other infrastructure. In the face of climate change, NRW explored alternative flood alleviation measures to traditional grey infrastructure approaches to manage this. This includes the use of NbS with feedback and involvement from the local community. The WG has provided funding for this work.</p>
River Restoration Programme NRW	<p>NRW are developing a River Restoration programme across Wales, looking at interventions to reduce diffuse pollution, and improve water quality. This programme includes the SAC rivers. NRW has secured WG capital funding for river restoration works for some of the SAC rivers, including developing a river restoration plan on parts of the Cleddau, Teifi, Tywi and Usk SAC. These could be opportunities to align potential mitigation measures in Carmarthenshire to align with or complement this wider scheme.</p>
Salmon and sea trout plan of action for Wales 2020 NRW	<p>This is an NRW led plan to improve salmonid populations, the following elements support improvements in water quality:</p> <ul style="list-style-type: none"> • Tackling Physical habitat constraints in the freshwater environment via Fish Habitat Restoration Plans • Safeguarding water quality and quantity
Wales Land Management Forum	<p>This forum is an agriculture sub group tasked with undertaking root cause analysis to achieve a common understanding of the causes of agricultural pollution and the ways in which these are currently addressed through the investigation, agreement, reporting and delivery on potential solutions, taking an integrated approach, working across organisations. Their main areas of focus are:</p> <ul style="list-style-type: none"> • A robust regulatory regime • Developing a voluntary, farmer-led approach to nutrient management • Ensuring better advice and guidance is provided and can be taken up by farmers • Improving the range of investment opportunities • Identifying and promoting innovation

Case Study	Description
<p>Wales Water Management Forum</p>	<p>The purpose is to provide an opportunity for membership organisations to share evidence and explore opportunities for working together collaboratively towards the sustainable management of water in Wales. There could be an opportunity for Carmarthenshire to collaborate with other councils and organisations in terms of sharing ideas and potentially aligning strategies more broadly to address nutrient pollution in water.</p>
<p>Wales Fisheries Forum</p>	<p>This forum represents a range of stakeholders with an interest in the freshwater and diadromous fisheries resources of Wales and the work of NRW and others to maintain, improve and develop migratory and freshwater fisheries in Wales.</p>
<p>National Surface Water Management and SuDS Group Members</p>	<p>The main objectives from this group are to provide a source of expertise in the field of surface water management and to encourage collaborative working, especially when identifying where benefits can be maximised. They also aim to provide support to LLFA for the implementation of SuDS and in the development of Flood Risk Management Plans. This is in addition to providing advice and signpost to stakeholders to facilitate the necessary skills and expertise for surface water and SuDS management.</p>
<p>Rivers Trust of Wales (Welsh Rivers Trust) Afonydd Cymru</p>	<p>The Rivers Trust of Wales, Afonydd Cymru, formed in 2008 as an umbrella organisation to represent member Rivers Trusts across Wales, they represent the regional Rivers Trusts with NRW and WG and they champion Wales’ thirty-three rivers, and the many lakes and smaller watercourses. Their aims include restoring Welsh rivers to good ecological status, reduce the high levels of water pollution, and influence the relevant policies and practice to protect Wales’ freshwater environment.</p> <p>They have a number of projects working with partners and directly with farmers across a number of catchments in West Wales. These include the River Restoration Project and the AC DC: The Nutrient and Soil Management Project.</p>
<p>The West Wales Rivers Trust</p>	<p>The West Wales Rivers Trust was formed in 2017 with the aim of restoring and safeguarding the rivers, lakes and wetlands of Pembrokeshire, Carmarthenshire and Ceredigion. The objectives of the Trust include promoting awareness of environmental issues and best practice, encouraging recreational enjoyment of rivers, lakes and wetlands, and undertaking research into restoring damaged habitats.</p>
<p>Gelli Aur Project (Afon Tywi) - Prosiect Slyri</p>	<p>The dairy enterprise at Gelli Aur is a 211 hectare college farm consisting of a herd of up to 600 cows with two distinct Spring and Autumn calving periods, with a focus on producing milk from forage. This project will innovatively reduce farm waste and help safeguard the environment and address the agricultural industry's impact on the environment by developing a dewatering and purification system to manage slurry on farms. This Project has received funding through the WG’s Rural Communities Rural</p>

Case Study	Description
	Development Programme 2014-2020, which is funded by the European Agricultural Fund for rural Development and the WG.
<p>Taclo'r Tywi Initiative (Afon Tywi)</p>	<p>The initiative aims to engage with all interested parties and through this partnership approach have a practical plan for the future management of the Afon Tywi. The initiative aims to promote better water quality, improved biodiversity, natural flood management, greater support for farmers and agriculture, and better protection for local wildlife amongst other aims.</p>
<p>Carmarthenshire Fisherman's Federation</p>	<p>Represents the interests of angling clubs and fishery owners of Carmarthenshire. They piloted a scheme in 2018 called 'Adopt a Tributary', which then commenced in 2019. This community-led project is ongoing and aims to protect the tributaries of the Afon Tywi in Carmarthenshire.</p>
<p>Carmarthenshire Nature Partnership</p>	<p>The Carmarthenshire Nature Partnership involves organisations including the Council, government, and non-government wildlife bodies, wildlife charities and voluntary groups. They focus on actions that seeks to maintain and enhance biodiversity within Carmarthenshire either through the management of land, or action to help specific species.</p>

Appendix D

Key pieces of national legislation, policies and strategies related to phosphate mitigation

Table D-5-3: Key pieces of national legislation related to phosphate mitigation.

Policy	Overview
Planning and Compulsory Purchase Act 2004	<p>Although national legislation, the Council has a statutory duty to produce a LDP. The Planning and Compulsory Purchase Act 2004 introduced the LDP system to Wales, Local Planning Authorities have a duty to produce an LDP for their area. A plan-led approach is the most effective way to secure sustainable development through the planning system.</p>
Future Wales – the National Plan 2040	<p>Future Wales – the National Plan 2040, sets the strategy for addressing key national priorities through the planning system. It is a spatial plan, setting a direction for where WG and key stakeholders should be investing in infrastructure and development for Wales. As the national development framework, Future Wales is the highest tier of development plan. Strategic (none commenced) and LDP are required to be in conformity with Future Wales.</p> <p>In making decisions about where to invest in infrastructure, such as may be required to address phosphorus pollution in Wales, WG and key stakeholders will have regard to Future Wales, and the national growth areas as a material consideration. There will of course be other competing priorities but nonetheless, growth areas are considerations.</p>
Planning Policy Wales	<p>PPW Edition 11 sets out the land use planning policies of the WG. It is supplemented by a series of Technical Advice Notes (TANs), WG Circulars, and policy clarification letters, which together with PPW provide the national planning policy framework for Wales. PPW contains a framework of National Sustainable Placemaking Outcomes considered to be optimal for development plans and individual developments.</p> <p>Key outcomes for this strategy include: Maximising Environmental Protection and Limiting Environmental Impact; Growing our Economy in a Sustainable Manner and Making best Use of Resources; Infrastructure; Housing; and Environment.</p> <p>A Heads of Planning Letter Dated 11 October 2023: Addressing the Nature Emergency through the Planning System: Updated National Planning Policy for Chapter 6 of Planning Policy Wales brings into policy the updates to the chapter in advance of the publication of a consolidated new PPW.</p>
Environment (Wales) Act 2016 (as amended)	<p>The duty for public authorities in the exercise of functions in relation to sustainable management of natural resources – enables Wales’s resources to be managed in a more proactive, sustainable and joined-up way.</p>

Policy	Overview
Well-being of Future Generations (Wales) Act 2015 (as amended)	In this Act “sustainable development” means the process of improving the economic, social, environmental and cultural well-being of Wales by taking action, in accordance with the sustainable development principle, aimed at achieving the well-being goals. The seven well-being goals (‘the goals’) are available in the associated weblink.
Planning (Wales) Act 2015 (as amended)	The Planning (Wales) Act 2015 also made a series of changes with the aim of modernising planning enforcement that could be potentially useful when strengthening the existing planning policies and incorporating suitable planning conditions (including their proper enforcement) for implementing suitable onsite and offsite interventions that are related to this strategy.
The Flood and Water Management Act 2010 (as amended)	A UK Act of Parliament relating to the management of the risk concerning flooding and coastal erosion. The Act aims to reduce the flood risk associated with extreme weather, compounded by climate change. It created the role of Lead Local Flood Authority, which is the local government authority responsible for managing flood risk in the local government area. The Act gave new powers to local authorities, the Welsh Ministers and water companies.
The Conservation of Habitats and Species Regulations 2017 (as amended)	These Regulations makes provision for selecting, designating, registration and notification of European sites (SAC and Special Protection Areas (SPAs)). Additionally, these Regulations include the protection of species, additional protection of habitats and wild animals and plants and assessment of plans and projects having a potential effect on European sites.
Environmental Permitting (England and Wales) Regulations 2016	Regulations for the obligations of periodic reviews of permits in this case by NRW. It aims to maintain environmental permitting and compliance to various and activities outlined in the act.
The Water Resources Act 1991	An Act of Parliament that regulates water resources, water quality and pollution, and flood defence. Could be used to enhance water protection to a greater extent for reducing sources of pollution.
The Water Resources (Control of Agricultural Pollution) (Wales) Regulations 2021	Regulatory measures to address agricultural pollution in Wales. It focuses on farmers there the environmental risk from poor manure management is greatest.
The Water Environment (Water Framework Directive) (England and	This regulation imposes duties on the Secretary of State, Welsh Ministers, the EA and NRW to carry out certain functions so as to ensure compliance with the EU directives, in particular when deciding whether to grant, vary or revoke certain permits and licences which affect water quality.

Policy	Overview
Wales) Regulations 2017	
Agriculture (Wales) Bill	Has set up a support framework which can accommodate the development of agriculture and forestry within Wales for the next fifteen to twenty years. The Bill’s policy framework is a response to the legislative framework established by the Well-being of Future Generations (Wales) Act 2015 and the Environment (Wales) Act 2016. It will create a new system of farm payments that “rewards farmers for their response to the climate and nature emergencies” and supports them to produce food sustainably (Sustainable Farming Scheme).
The Environment (Air Quality and Soundscapes) (Wales) Bill	The new Bill is part of a package of measures to improve the quality of the air environment in Wales. It will give powers to WG to introduce new long-term targets for air quality under a national framework taking account of the latest scientific knowledge including the World Health Organisation Air Quality Guidelines

Table D-5-4: Other national strategies and guidance

Piece/Organisation	Details
Woodlands for Wales WG	<p>This strategy was produced in 2001 to set out the plan for Welsh forestry for the following 20 years. The strategy was reviewed in 2018, wherein the vision for the next 50 years remains the same as what was outlined in 2001. The strategy identifies six key outcomes to strengthen woodlands and trees in Wales, to ensure that it will be fit to meet the needs of Wales for the next 50 years:</p> <ul style="list-style-type: none"> • More woodlands and trees are managed sustainably. • Woodland ecosystems are healthy and resilient. • Woodlands are better adapted to deliver a full range of benefits. • Woodland cover in Wales increases. • The management of woodland and trees is more closely related to that of other land uses. • Urban woodlands and trees deliver a full range of benefits.
Innovation Strategy for Wales WG	<p>New innovation strategy sets out aspiration for Wales to be a leading, innovation-based nation. The ‘Climate and nature’ focus will involve optimising our natural resources for the protection and strengthening of climate and nature resilience. We will focus the innovation efforts of the ecosystem on tackling the climate and nature crises simultaneously, ensuring a just transition to a wellbeing economy.</p>

Piece/Organisation	Details
<p>Flood and Coastal Erosion Risk Management</p> <p>WG</p>	<p>Flood and Coastal Erosion Risk Management (FCERM) in Wales involves a number of organisations, including 28 Risk Management Authorities (RMAs), who have a duty to work together and co-operate on FCERM activity, including schemes and reporting. These key organisations include NRW, 22 Local Authorities as LLFA, water companies operating in Wales, and the WG.</p> <p>A key aspect of this strategy is creating long-term sustainable resilience in the context of the climate emergency. This goes beyond improving flood defences but into changes of land and water management and building community resilience.</p>
<p>Our corporate plan to 2030 – Nature and People Thriving Together</p> <p>NRW</p>	<p>The strategy has three key aims by 2030:</p> <ul style="list-style-type: none"> • nature is recovering • communities are resilient to climate change • pollution is minimised
<p>Making time for nature 2020</p> <p>DCWW</p>	<p>Working toward the statutory objectives of seeking to maintain and enhance biodiversity in the fulfilment of our functions as well as promoting the resilience of ecosystems in the exercise of our functions.</p>
<p>Clean Air Plan for Wales: Healthy Air, Healthy Wales</p> <p>WG</p>	<p>The central aim of this strategy is to improve air quality in Wales in order to decrease negative impacts of poor air quality on human health, biodiversity, the wider natural environment and the Welsh economy. The plan contributes to the delivery of the wider national strategy ‘Prosperity for All’ by ‘reducing emissions and delivering vital improvements in air quality’ to support ‘healthier communities and better environments’.</p>
<p>Working Together for a Healthier Wales: Long-Term Strategy 2023 to 2035</p> <p>Public Health Wales</p>	<p>This Long-Term Strategy sets out our vision for achieving a healthier future for people in Wales by 2035. Key priorities include: Influencing the wider determinants of health, Promoting mental and social well-being and Tackling the public health effects of climate change.</p>
<p>Prosperity for All</p> <p>WG</p>	<p>The Well-being Statement, sets out how the WG have set well-being objectives in line with their statutory duty under the Well-being of Future Generations (Wales) Act 2015 (the Act). Key objectives include: ‘Build a stronger, greener economy as we make maximum progress towards decarbonisation’ and ‘Embed our response to the climate and nature emergency in everything we do’.</p>
<p>Green Growth Wales: Investing in the Future</p>	<p>The prospectus sets out how the sustainable use of Welsh natural resources can create a new economic model that will deliver sustainable wealth creation and economic growth. It sets out our key offers around:</p>

Piece/Organisation	Details
WG	<ul style="list-style-type: none"> • Our wealth of natural resources • A flexible and committed Government • Practical and customised support for business
<p>Marine Strategy Part Three: UK programme of measures</p> <p>UK Marine Strategy</p> <p>DEFRA</p>	<p>The Marine Strategy is a requirement of the Marine Strategy Regulations 2010, with 3 key aims:</p> <ul style="list-style-type: none"> • protecting the marine environment • preventing its decline • restoring it where practical • using marine resources sustainably <p>Part three of the strategy details existing measures to address set targets in the strategy, including reduced nutrient inputs arising from sewage treatment works, which may involve the waste that enters rivers.</p>
<p>Environmental regulation of overflows: action plan</p> <p>WG</p>	<p>The actions being taken forward within this workstream are all aligned to the WG Programme for Government 2021-26 and the Wellbeing goals of:</p> <ul style="list-style-type: none"> • Building a stronger, greener economy as we make maximum progress towards decarbonisation. • Make our cities, towns, and villages even better places in which to live and work. • Embed our response to the climate and nature emergency in everything we do. • Begin to designate Wales's inland waters for recreation, strengthening water quality monitoring.

Appendix E

Key pieces of local strategies and guidance related to phosphate mitigation

Table E-1-5: Key pieces of local strategies and guidance related to phosphate mitigation

Guidance	Detail
Carmarthenshire Corporate Strategy 2022-2027	Sets out the strategy for addressing the key challenges and development areas facing Carmarthenshire, with a longer-term view to improving the social, economic, environmental and cultural well-being of the residents and communities of Carmarthenshire.
Carmarthenshire Cabinet Vision Statement (2022)	Outlines the key themes and issues facing Carmarthenshire and the Councils ambitions over the next five years to address them. This includes working with partners to strengthen the economy, increase prosperity, and invest in housing, education, culture, infrastructure, and the environment.
Carmarthenshire pre application SuDS planning advice Carmarthenshire County Council	Outlines the requirements provided by WG for the sole purpose of submitting information to the SuDS Approving Body (SAB) in accordance with the legislation detailed in the planning advice document and other relevant items of primary and subordinate legislation.
Carmarthenshire Revised Local Development Plan (rLDP) 2018 - 2033: Green Infrastructure assessment (2020) Carmarthenshire County Council	Supports the rLDP and provides an assessment of the GI across Carmarthenshire.
Statutory National Standards for Sustainable Drainage Systems WG	They are for the design, construction, operation and maintenance of SuDS serving new developments in urban or rural areas of more than one dwelling or where the area covered by construction work equals or exceeds 100 metres squared. They provide information for designers, property developers, local authorities and other interested parties, such as sewerage undertakers and NRW. They also contain links to additional supporting information relating to SuDS.
Growing Together Campaign NFU Cymru	Members of the Senedd have been planting an oak tree, kindly supplied by Coed Cadw – The Woodland Trust in Wales, as part of NFU Cymru's recently launched #GrowingTogether strategy for tree planting in Wales.

Guidance	Detail
	<p>This is part of a wider effort to encourage increased tree planting in Wales whilst incorporating it into integrated farming systems.</p>
<p>Flood Risk Strategy and Management Plan Carmarthenshire County Council</p>	<p>Under the Flood and Water Management Act 2010, the council became the Lead Local Flood Authority (LLFA) and have responsibility to develop, maintain, apply and monitor a strategy for local flood risk management including surface run-off, groundwater, and ordinary watercourses. In creating the strategy, Carmarthenshire considered the socioeconomic and environmental needs of the local area and communities to create more effective risk management. Although the natural flood mitigation measures implemented are not designed for nutrient removal, they may contribute to sediment capture further up the catchment.</p>
<p>Moving Rural Carmarthenshire Forward Carmarthenshire County Council</p>	<p>First wide-ranging strategy developed to regenerate rural communities in Carmarthenshire. The Task Group have identified a number of key areas that influence the issues facing rural communities in Carmarthenshire. These include environment and waste, agriculture and food, education and skills, tourism, and economic development among many others.</p>
<p>Carmarthenshire County Council Moving Forward in Carmarthenshire: the next 5-years Carmarthenshire County Council</p>	<p>Carmarthenshire identified around 100 priority projects, schemes or services that they aim to deliver over the next five years, as part of the plan Moving Forward in Carmarthenshire.</p> <p>Carmarthenshire aim to invest in key areas to improve economic, environmental, social and cultural well-being in the County. They will produce reports and recommendations on specific process.</p> <p>Potential opportunities for linking nature-based solutions to environment aims and community-focused aims could be possible.</p>
<p>Transformations: A strategic regeneration plan for Carmarthenshire 2015-2030 Carmarthenshire County Council</p>	<p>As part of the Swansea Bay City Region, the strategy focuses on regeneration of specific towns and targeted growth zones in multiple ways. This includes economic growth, tourism, infrastructure, education, and the environment, among others.</p>
<p>Strategy for Greening 8 Towns in Carmarthenshire: Consultation Hub Carmarthenshire County Council</p>	<p>Land Use Consultants is working together with Carmarthenshire to deliver a Strategy which sets out how Green and Blue Infrastructure will be enhanced in 8 'focus towns' in the County. The goal of the strategy is to identify the existing green and blue infrastructure in Carmarthenshire, the challenges each town faces and the opportunities to improve the network around them. These opportunities will be taken forward by a range of partners across the County.</p>

Guidance	Detail
<p>Carmarthenshire’s Strategy for Trees and Woodlands 2023-2028 Draft</p> <p>Carmarthenshire County Council</p>	<p>This strategy aims for Carmarthenshire to deliver tree and woodland management in response to both the Nature Emergency and the Climate Change Emergency which it and WG have declared.</p> <p>In addition, this strategy has been prepared in response to item 23 of Carmarthenshire County Council Moving Forward in Carmarthenshire: the next 5 years (2017 – 2022). Recent information about plans for Carmarthenshire to replant yearly have been reported here.</p>
<p>Net Zero Carbon Action Plan, Project Zero Sir Gâr 2021</p> <p>Carmarthenshire County Council</p>	<p>Approach set out the route for Carmarthenshire to become a net zero carbon local authority by 2030. This not only focuses on the carbon emissions that are currently measured by the council, but also the flexibility needed to account for unexpected changes. The main carbon emission sources being targeted by the strategy include non-domestic buildings, street lighting, fleet mileage and business mileage.</p>
<p>Environment Act: Forward Plan for Environment</p> <p>Carmarthenshire County Council</p>	<p>This plan has been published to comply with the Authority’s legal obligation within the Environment (Wales) Act 2016. Under this Act all public bodies ‘must seek to maintain and enhance biodiversity in the proper exercise of their functions and in doing so promote the resilience of ecosystems’. The Authority is required to prepare and publish a plan on how they intend to comply with this Biodiversity and Resilience of Ecosystems Duty.</p>
<p>Nature Recovery Plan</p> <p>Carmarthenshire County Council</p>	<p>The entire plan is written in four parts. Part 1 outlines the plan and its purpose, Part 2 outlines how others can take action, Part 3 focuses on the local priorities in relation to the national objectives of the Wales Nature Recovery Action Plan, and Part 4 contains references, appendices and technical information. It is planned to be a straightforward document that is dynamic and updated as needed, whilst signposting to further information and organisations.</p>
<p>Waste and Resource Management Strategy</p> <p>Carmarthenshire County Council</p>	<p>The strategy is based upon WG’s current waste strategy document (‘Towards Zero Waste’) wherein outlines the high-level targets, policies and aims for local authorities. Carmarthenshire aim is to work towards achieving the statutory targets set within the WG strategy, ensuring that we do our bit to achieve ‘Zero Waste’ by 2050. Carmarthenshire will align with the policies and targets set within the WG strategies with a clear focus on a circular economy, net zero carbon pledge, cleaner environment, and a strategy to further develop the good work already achieved by Wales and our standing as third best recyclers in the world.</p>
<p>Tree Management Strategy</p>	<p>Where the Council owns land, it has a responsibility under the Occupiers’ Liability Act 1957 and 1984 and the Health and Safety at</p>

Guidance	Detail
Carmarthenshire County Council	Work Act 1974 to manage its trees responsibly and to minimise or prevent the risk of personal injury or damage to property. All trees on Council owned and managed land are therefore to be subject to regular inspections to assess their condition.
<p data-bbox="145 595 520 663">A framework for managing our land for pollinators</p> <p data-bbox="145 685 549 719">Carmarthenshire County Council</p>	This strategic plan sets out the Council's commitment to contributing to the action being carried out across Wales to address the decline in pollinators. This includes action to contribute to the development of local environments that will be rich in habitats that help support sustainable pollinator populations. This will also contribute to making places more attractive for people to live and work in. Solutions to nutrient neutrality such as riparian buffer strips could directly support this work.

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