



**Cyfoeth
Naturiol**
Cymru
**Natural
Resources**
Wales

The State of Natural Resources
Report (SoNaRR): Assessment
of the Sustainable Management
of Natural Resources.
Technical Report.
Chapter 7. Towards sustainable
management of natural
resources

Natural Resources Wales

Final Report

About Natural Resources Wales

We look after Wales' environment so that it can look after nature, people and the economy.

Our air, land, water, wildlife, plants and soil – our natural resources - provide us with our basic needs, including food, energy, health and enjoyment.

When cared for in the right way, they can help us to reduce flooding, improve air quality and provide materials for construction. They also provide a home for some rare and beautiful wildlife and iconic landscapes we can enjoy and which boost the economy.

But they are coming under increasing pressure – from climate change, from a growing population and the need for energy production. We aim to find better solutions to these challenges and create a more successful, healthy and resilient Wales.

Evidence at Natural Resources Wales

Natural Resources Wales is an evidence based organisation. We seek to ensure that our strategy, decisions, operations and advice to Welsh Government and others are underpinned by sound and quality-assured evidence. We recognise that it is critically important to have a good understanding of our changing environment.

We will realise this vision by:

- Maintaining and developing the technical specialist skills of our staff;
- Securing our data and information;
- Having a well resourced proactive programme of evidence work;
- Continuing to review and add to our evidence to ensure it is fit for the challenges facing us; and
- Communicating our evidence in an open and transparent way.

The State of Natural Resources Report (SoNaRR) Report Contents

This document is one of eight chapters of the State of Natural Resources Report.

Chapter 1	Introduction to the State of Natural Resources Report (SoNaRR): An assessment of sustainable management of natural resources
Chapter 2	Understanding drivers of change in natural resource use
Chapter 3	Summary of extent, condition and trends of natural resources and ecosystems in Wales
Chapter 4	Resilient Ecosystems
Chapter 5	Well-being in Wales
Chapter 6	Identifying Unsustainable Management
Chapter 7	Towards sustainable management of natural resources
Chapter 8	Assessment of the sustainable management of natural resources
Annex	Technical Annex for Chapter 3
Annex	Technical Annex for Chapter 7 (Part 1)
Annex	Technical Annex for Chapter 7 (Part 2)
Annex	Method for assigning confidence to evidence presented
Annex	Record of confidence assessments
Annex	Acronyms and Glossary of terms

All of the SoNaRR documents can be downloaded from the NRW website:
www.naturalresources.wales/sonarr.

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7. Towards the sustainable management of natural resources

To make the transition to sustainable management possible, we need to move away from the traditional sectoral management of natural resources and focus instead on ecosystem resilience and the wider contribution to well-being that ecosystems can bring.

The previous chapter has set out some of the obstacles to a more integrated approach to, and highlights some of the failings or gaps in, the management of natural resources. It is clear that significant progress is still required if Wales is to optimise the multiple benefits from ecosystems. Some of the issues or gaps in current management may be due to quirks of the regulatory process or to lack of awareness or understanding of the value of ecosystem benefits. What is common is that each one indicates that we need to rethink and redesign our approach.

We also recognise that for every gap or risk there is an opportunity to better manage natural resources in a way which enhances resilience and/or wellbeing. However, SoNaRR is not the place to identify final, fully worked up policy solutions. These need to be developed as part of the National Natural Resource Policy to be produced by Welsh Ministers and in the first set of Area Statements which NRW will be producing. NRW has plenty of experience to offer in helping to design those solutions and we will work with Welsh Government and other stakeholders to take this approach forward.

This chapter pulls the analysis together to inform future planning for the sustainable management of natural resources.

We focus on:

- The identification of key risks to well-being which are set out in a **natural resource and well-being risk register**. This will allow policy makers and other stakeholders to consider the key risks to the resilience of our natural resources and the benefits provided by those resources. This analysis considers in particular the contribution natural resources make to the national well-being goals.
- A recommended approach to help identify **opportunities** to deliver integrated, nature-based solutions by using both cost benefit and spatial analysis. This supplements the risk register by asking, “where are the opportunities to manage our natural resources to deliver multiple benefits?”

These complementary approaches are essential to guide and inform discussion about the opportunities for sustainable management of natural resources. NRW intends to develop both approaches by using them as a basis for engagement, dialogue, and collaboration with stakeholders. This collaboration should help to inform the development by the Welsh Government of the National Natural Resources Policy, and help us to develop Area Statements and the next SoNaRR. The relationship between people and place is an important element of well-being. Going forward, Area Statements will be used to provide the focus for an integrated spatial approach to natural resource management in a way that relates to communities and interests across Wales.

7.1. Identifying key risks to natural resources and well-being.

The purpose of this risk register is to identify the potential risks to well-being that need to be considered, given the current state (extent, condition and trends) of our natural resources and ecosystems, the benefits they provide and the continuation of those benefits for future generations.

Climate change is a key generic risk that will impact upon all broad habitats and potentially could undermine their resilience. It is also important to recognise the interaction between climate risks to natural resources and ecosystems themselves and the risks to business, infrastructure and human health, particularly in relation to flooding, coastal erosion/inundation and water scarcity, which have been identified by the UK Climate Change Risk Assessment (CCRA) as likely to be increased significantly in future¹.

In assessing the extent to which Wales is achieving the sustainable management of natural resources, we first need to recognise that this is not about trying to achieve a specific “steady” state. The objective of the Environment (Wales) Act is to maintain and enhance the resilience of ecosystems and the benefits they provide, utilising best practice and an adaptive management approach. By emphasising the concept of resilience, the Act recognises that ecosystems can adapt.

The achievement of sustainable management is therefore about the resilience of the overall environment. It is not about trying to set targets to determine what the future state of ecosystems should be. The fact that we are dealing with complex, adaptive ecosystems means that our ability to make predictions about future states is limited. This means that we cannot specify in detail, in advance, what sustainable management will look like on the ground. Although it is difficult to define sustainable management in a way that can be easily measured, in the previous chapter we identified some key criteria of **unsustainable** management:

- Natural resources are continuously declining or are being used faster than can be replenished;
- The health and resilience of our ecosystems is being compromised; this includes targets not being met or ‘limits’ in danger of being breached
- The benefits from ecosystems services are not being optimised;
- The contribution to well-being of ecosystem service provision is not meeting our basic needs, or is declining.

Defining unsustainable management in this way allows us to begin to identify and assess how far Wales is moving towards sustainable management by addressing risks. Risks provide a practical way forward for identifying issues which need to be managed or addressed. The use of existing measures or targets can help – as these have generally been set to accepted levels – but do not always give the whole picture. The sustainable management of natural resources will be achieved when

these risks are being adequately managed and the criteria above are eliminated, as far as possible.

To map out the range of existing and potential obstacles Wales faces in doing this, we have drawn up a risk register. The nature of the complex interlocking social, economic and environmental systems we are dealing with, means that a risk based approach is most likely to capture potential problems, even where evidence is limited or probabilities uncertain.

Measurements which inform the risk register include the current suite of indicators available at an all-Wales level. A review of these is set out in Chapter 7 Annex 1 and highlights a number of gaps. This is not surprising as existing indicators are framed to support specific functional policy objectives and are not wholly suited to a focus on ecosystem resilience and the contribution of natural resources to well-being. More work is required in this area to use the indicators to support the assessments made in the risk register.

7.1.1. How to use this risk register

This risk register below can be used as a policy assessment and engagement tool. It can help people to assess whether the possible risks to well-being are being addressed (Box 7.1 and Box 7.2). The evidence supporting the risk assessment is set out in Chapter 7 Annex 2. This also considers what further information on the quality, quantity or spatial distribution of the natural resource or ecosystem may be needed to help us understand its contribution to well-being.

It is appreciated that by presenting these issues as “risks”, the language used is framed in a negative way. We cannot avoid this: it results partly from the approach needed to measure progress and partly from the need to present information to stakeholders about the choices society faces and the consequences of different actions. But this conversation needs to be steered towards, and focus on, the identification of opportunities for sustainable management, asking: “So what can we do about it, to make sure this doesn’t happen, and to optimise the benefits from natural resources?”

Further work needs to be undertaken on the relative impact of risks and the benefits to be secured by tackling them; such work needs to use a method that captures the full value to well-being (see discussion of economic modelling in chapter 8). For this reason, we have not yet assigned levels of likelihood nor assessed impacts to the risks described. At Area Statement level, stakeholder engagement will enable decisions about which risks are most probable given particular circumstances in a locality and which risks would have the greatest impact on well-being.

Many of the issues we face are embedded in social and economic systems where they interact with the wider world in complex ways. It is therefore important **not** to consider solutions for each individual risk in isolation, but to look across the risks to develop **integrated place-based solutions** that maximise contribution across the well-being goals.

To aid these discussions it will be important to consider the risk register alongside a range of spatial information about place (is this happening here?) as well as using economic tools on how best to value the social and economic impacts (what impact will this have on us, our local community, our economy, or the ability of future generations to meet their needs?). This will be an important input to the development of Area Statements.

Box 7.1 Background to ecosystems and resilience assessment

A simple colour shading scheme (dark green = good, medium green = moderate, light green = poor) has been used to imply the general state and prospects for resilience; this is an amalgam of state, trends and implications. Colours were assigned by NRW habitat specialists using expert judgement and are intended to help identify the attributes most likely to be impacting on resilience rather than being a definitive and quantitative assessment. The colours assigned have to be interpreted with care, as it is impossible to represent all the complexities of ecosystems and resilience in this way. For example, an ecosystem may be shaded dark green – good – for a particular aspect of resilience, but there may well be aspects of that attribute, or particular locations, where prospects are moderate or poor.

In most cases the approach to shading should be intuitive, but the way diversity has been treated may need some further explanation. The diversity of ecosystems (particularly those that are made up of semi-natural habitats) is often naturally high, compared to those made up of modified or artificial habitats. The shading emphasises how well diversity has been maintained following historical interventions and therefore how likely it is to continue to support ecosystem resilience.

The main intention is to identify the main factors that affect resilience *within* an ecosystem; it is much harder to make judgements of relative importance *between* ecosystems. For example, it may be impossible to say that factors affecting two ecosystems are of equivalent urgency because of fundamental differences in scale, distribution etc.

The resilience colour shading scheme has been included in the risk register below to help inform Welsh Government's policy response. However the particular risks identified might not be just related to the resilience of ecosystems. There may be unsustainable management practices (as identified in chapter 6 for example) which pose a particular risk to well-being, and we have included them here.

We have integrated risks associated with climate change risks throughout the risk register

For supplementary evidence, please see the technical appendices that accompany the risk register.

Table 7.1 The 2016 natural resources and well-being risk register.

RISKS TO RESILIENCE, BENEFITS AND WELL-BEING										
Resilience assessment					Description of potential risks to benefits					
Broad Habitat	Diversity	Extent	Condition	Connectivity	A resilient Wales	A prosperous Wales	A healthy Wales	An equal Wales	A Wales of cohesive communities	A Wales of vibrant culture and thriving Welsh language
Mountains, moorlands and heaths					<p>If we do not maintain and enhance the resilience of mountains, moorlands and heaths, then there is potentially a risk that we will not be able to capitalise on the opportunities they provide for equitable climate, clean water, hazard protection, wildlife and access and recreation.</p>	<p>If the resilience of mountains, moorlands and heaths declines, there is potentially a risk of increased costs for water treatment, flood and drought management, and carbon capture as well as a potential loss of value from recreation and tourism.</p>	<p>If condition and extent of mountains, moorlands and heaths decline, then there is potentially a risk that they will be less favoured for access and recreation with potential consequences for health.</p>	<p>If these natural resources are not managed in ways that promote hazard regulation (such as flooding), then there is potentially a risk that environmental inequality will be exacerbated.</p>	<p>If these natural resources cannot be managed in a way that contributes to community cohesion (e.g. sustaining local employment opportunities), there is potentially a risk to the viability of rural communities.</p>	<p>If traditional management practices decline, there may be implications for cultural and heritage assets, together with reduced benefits derived from Wales' distinctive landscape, seascapes and historic environment.</p>
Upland heath and grasslands										
Fridd										
Lowland Heath										

RISKS TO RESILIENCE, BENEFITS AND WELL-BEING										
Resilience assessment				Description of potential risks to benefits						
Broad Habitat	Diversity	Extent	Condition	Connectivity	A resilient Wales	A prosperous Wales	A healthy Wales	An equal Wales	A Wales of cohesive communities	A Wales of vibrant culture and thriving Welsh language
Semi-natural grasslands					<p>If we continue to lose semi-natural grasslands, then there is potentially a risk of releasing stored carbon through soil compaction and/or erosion which will also have implications for freshwater environments.</p> <p>Loss of these habitats will lead to a decline in species (such as bees, butterflies and moths) that depend on those habitats.</p>	<p>If we do not manage the decline of our semi-natural grasslands, there is potentially a risk of increased costs for soil restoration and carbon capture.</p>	<p>If the extent and condition of semi natural grasslands declines, there is potentially a risk that they are less favoured for access and recreation with consequences for health.</p>	<p>If these natural resources are not managed in ways that promote hazard regulation (such as flooding), then there is potentially a risk that environmental inequality will be exacerbated</p>	<p>If these natural resources cannot be managed in a way that contributes to community cohesion (e.g. sustaining local employment opportunities), there is potentially a risk to the viability of rural communities.</p>	<p>If traditional management practices decline, it may have implications on cultural and heritage assets.</p> <p>There is a need to conserve and enhance the historic environment including cultural heritage resources, historic buildings and archaeological features and their settings as well as access to Wales' cultural heritage assets.</p>

RISKS TO RESILIENCE, BENEFITS AND WELL-BEING										
Resilience assessment				Description of potential risks to benefits						
Broad Habitat	Diversity	Extent	Condition	Connectivity	A resilient Wales	A prosperous Wales	A healthy Wales	An equal Wales	A Wales of cohesive communities	A Wales of vibrant culture and thriving Welsh language
Enclosed Farmland					<p>If we do not sustainably manage our productive farmland, then there is potentially a risk that we will put further pressures on our ability to sustainably manage other ecosystems to build resilience, adapt to climate change and optimise benefits for well-being.</p> <p>For example, loss of soils and hedgerows could impact on river flows and poorer water quality generally which in turn will damage aquatic flora and fauna.</p> <p>If we do not conserve and enhance soil quality and function, there is potentially a risk to the ability of those ecosystems to continue to deliver important provisioning services such as food.</p> <p>If we continue to lose hedgerows and soils, then there is a potential risk of increased costs of flood risk, drought, and water quality management.</p> <p>If we do not manage emissions (particularly of ammonia and secondary particulate matter), then there is potentially a risk to air and water quality and subsequently to human health.</p> <p>Risk unknown. There is a need to consider the impact of any changes to agricultural systems on well-being issues such as food poverty, even if the change is to support more ecosystem resilience</p> <p>If these natural resources cannot be managed in a way that contributes to community cohesion (e.g. sustaining local employment opportunities), there is potentially a risk to the viability of rural communities.</p> <p>If traditional management practices decline, there may be implications for our cultural heritage.</p>					
Improved grassland										
Arable										
Hedgerows										
Orchards										

RISKS TO RESILIENCE, BENEFITS AND WELL-BEING										
Resilience assessment				Description of potential risks to benefits						
Broad Habitat	Diversity	Extent	Condition	Connectivity	A resilient Wales	A prosperous Wales	A healthy Wales	An equal Wales	A Wales of cohesive communities	A Wales of vibrant culture and thriving Welsh language
Woodlands										
Semi natural broadleaf woodland					If we do not sustainably manage our woodlands to make them capable of adapting to future climatic change & pressure from pests and diseases, then their extent and condition may reduce, with the consequence of a reduction in contribution to well-being.	If we do not create new woodland and bring more woodland into management, there is a risk that we will reduce the productive potential of the Welsh Forest Resource. This would have the consequences of reduced GVA, employment and domestic fibre supply.	If we do not create more attractive and accessible woodland settings close to where people live, then there is a risk that access and recreation opportunities are limited with the consequence of less healthy lifestyles.	If we do not promote opportunities for a range of activities in woodland settings, then there is a risk that we do not offer equality of opportunity with the consequence of sub-optimal enterprise, skills and learning benefits.	If we do not create new woodland and manage existing woodland, then there is a risk of a reduction in community enterprise and participation opportunities with the consequence of reduced regeneration potential from new trees and woodland, and fewer settings for engagement activities and social enterprise initiatives.	If we do not celebrate the cultural heritage of our trees, woodlands, and the historic features they contain, then there is a risk of reduced benefits derived from Wales' distinctive landscapes and historic environment with the consequence of a reduced contribution to Welsh culture.
Planted woodland (Note: native / non-native mixed)										

RISKS TO RESILIENCE, BENEFITS AND WELL-BEING

Resilience assessment					Description of potential risks to benefits					
Broad Habitat	Diversity	Extent	Condition	Connectivity	A resilient Wales	A prosperous Wales	A healthy Wales	An equal Wales	A Wales of cohesive communities	A Wales of vibrant culture and thriving Welsh language
Urban	n/a	n/a	n/a	n/a	<p>If we do not maintain and enhance urban systems for multiple benefits, then there is potentially a risk that our ability to adapt to the impacts of climate change will be hindered.</p> <p>If we continue to lose soil surfaces through compaction and soil sealing, then there is potentially a risk for increased surface water related flooding, as well as other extreme events such as drought.</p> <p>If we do not maintain and enhance urban ecosystems there is potentially a risk to quality of life, health and well-being, local economic investment and desirability of places to live. Areas of particular concern include air quality and green spaces and the connectivity between and within these areas). These risks, and their wider impacts on anti-social behaviour and health, could put added pressure on public services.</p>		<p>If there is a decline in the condition and extent of urban greenspace (including tree canopy cover), there is a potential risk that opportunities to support health and to help mitigate and adapt to impacts of climate change will be lost, with negative consequences for health.</p> <p>If we do not manage emissions (particularly of ammonia and particulate matter), then there is a potential risk that air quality will not improve with subsequent impacts on health.</p> <p>If natural resources are not managed in ways that promote hazard regulation, then there is potentially a risk that environmental inequality will be exacerbated. The potential impacts are greatest in urban environments where the majority of people live. There is a potential risk from a wide range of disbenefits, such as flood and drought risk, heat islands, and from health issues associated with poor air quality, reduced access to green space and noise.</p> <p>There are also potential risks in relation to local environmental quality, and inequalities in access.</p>		<p>If we do not maintain and enhance our urban green spaces, there is potentially a risk that we dilute and potentially remove opportunities for people and communities to create an enhanced sense of place and increase levels of community cohesion. Access to good quality green space can reduce the effects of poverty, health inequalities and it lowers crime rates</p>	<p>If changes in urban areas through growth and development do not make use of cultural assets, including our industrial heritage, there is potentially a risk that existing benefits will be eroded.</p>

RISKS TO RESILIENCE, BENEFITS AND WELL-BEING

Resilience assessment					Description of potential risks to benefits					
Broad Habitat	Diversity	Extent	Condition	Connectivity	A resilient Wales	A prosperous Wales	A healthy Wales	An equal Wales	A Wales of cohesive communities	A Wales of vibrant culture and thriving Welsh language
Freshwaters					<p>If we do not enhance the resilience of freshwater systems, then there is potentially a risk that we will limit our capability to deal with climate change impacts, extreme flows (flood and drought) and subsequent impact on people and aquatic wildlife (such as migratory fish).</p> <p>If we do not manage diffuse pollution (such as nitrates) and point-source pollution (from abandoned mines etc), then there is a potential risk to the resilience and condition of freshwater</p> <p>If we do not sustainably manage our freshwater systems and water use, then there is potentially a risk of increased costs of provision of new water supply, water treatment, and of drought and flood risk management measures.</p> <p>If we do not continue to improve the quality and connectivity of freshwater ecosystems, then there is a potential risk to health through restricted access to water-based recreation, alongside risks of flood and drought events. If we do not continue to protect floodplains, then there is a potential risk for increased flood risk and associated impacts on health/well-being</p> <p>If these natural resources are not managed in ways that promote hazard regulation (such as flooding), then there is a potential risk that environmental inequality will be exacerbated.</p>					
Rivers and streams										
Lakes and standing water										
Floodplains										
Lowland fens and bogs										

RISKS TO RESILIENCE, BENEFITS AND WELL-BEING

Resilience assessment					Description of potential risks to benefits					
Broad Habitat	Diversity	Extent	Condition	Connectivity	A resilient Wales	A prosperous Wales	A healthy Wales	An equal Wales	A Wales of cohesive communities	A Wales of vibrant culture and thriving Welsh language
Coastal margins					<p>If we do not enhance the management of our coastal margins, then there is potentially a risk that they will be more vulnerable to erosion and therefore less effective in both flood protection (putting people and properties at risk) and soil carbon storage and that loss of biodiversity will result.</p> <p>If we do not build resilience into our coastal habitats, there is potentially a risk of increased costs from disruption to transport infrastructure and property damage from coastal flooding.</p> <p>Loss of natural flood protection is likely to increase costs needed to provide coastal flood defences.</p> <p>If we do not make appropriate plans for coastal management, then there is a potential risk to human health from sea-level rise and from coastal erosion. If the condition of coastal margins deteriorates there is a potential risk that they will be less favourable for recreation activities with a potential consequence for health.</p> <p>If coastal margins are not managed in ways that promote hazard regulation (such as flooding), then there is a potential risk that environmental inequality will be exacerbated.</p> <p>If coastal margins cannot be managed in a way that contributes to employment, there is potentially a risk to the viability of coastal communities.</p> <p>If coastal and marine development does not take into account cultural and heritage assets, there is potentially a risk that existing benefits will be eroded, together with reduced benefits derived from Wales' distinctive landscapes and seascapes.</p>	<p>If we do not build resilience into our coastal habitats, there is potentially a risk of increased costs from disruption to transport infrastructure and property damage from coastal flooding.</p> <p>Loss of natural flood protection is likely to increase costs needed to provide coastal flood defences.</p>	<p>If we do not make appropriate plans for coastal management, then there is a potential risk to human health from sea-level rise and from coastal erosion. If the condition of coastal margins deteriorates there is a potential risk that they will be less favourable for recreation activities with a potential consequence for health.</p>	<p>If coastal margins are not managed in ways that promote hazard regulation (such as flooding), then there is a potential risk that environmental inequality will be exacerbated.</p>	<p>If coastal margins cannot be managed in a way that contributes to employment, there is potentially a risk to the viability of coastal communities.</p>	<p>If coastal and marine development does not take into account cultural and heritage assets, there is potentially a risk that existing benefits will be eroded, together with reduced benefits derived from Wales' distinctive landscapes and seascapes.</p>
Saltmarsh										
Sand Dunes										
Sea cliffs										
Shingle										

RISKS TO RESILIENCE, BENEFITS AND WELL-BEING

Resilience assessment					Description of potential risks to benefits					
Broad Habitat	Diversity	Extent	Condition	Connectivity	A resilient Wales	A prosperous Wales	A healthy Wales	An equal Wales	A Wales of cohesive communities	A Wales of vibrant culture and thriving Welsh language
Subtidal					<p>If action is not taken to increase the resilience of marine ecosystems, it will be more challenging to optimise important benefits derived from the marine environment, such as supporting tourism and recreation, sustainable fisheries, and flood protection.</p>	<p>If action is not taken to increase the resilience of marine ecosystems, we will not be able to optimise the opportunities to sustain or increase the economic benefits we get from our seas. For example, poor coastal water quality can have a knock on impact on shell fisheries businesses in Wales as well as on health and well-being of local communities who rely on the resource to support recreation based tourism.</p>	<p>The marine environment is an important source of recreational space. Coastal water quality issues, when they occur, can have a direct impact on the health of recreational visitors.</p> <p>If the condition of the marine environment deteriorates, there is a potential risk that it will be less favourable for recreation activities.</p>	<p>If we do not better understand and optimise the benefits from marine natural resources, then there is a risk that we lose important opportunities to reduce inequality and deprivation within coastal communities</p>	<p>If we do not better understand and optimise the benefits from marine natural resources, such as employment, and health and well-being, then there is a risk we will lose opportunities to support viable coastal communities.</p>	<p>The marine environment is important to the culture and heritage of Wales, including their contribution to Wales' distinctive landscapes and seascapes. Existing benefits could be eroded if we do not sustainably manage marine natural resources.</p>
Intertidal										

Box 7.2 Important information to accompany the risk register

- Much of the evidence presented suggests relationships between natural resources and benefits for well-being. Given the complex range of other factors that apply, not all can be directly attributed, quantified or measured with a high degree of confidence. However, there is some evidence to support all of them (see Chapter 7 Technical Annex 2).
- We have not assigned the probability or scale of impact of the risks at this stage. We intend to work with Welsh Government and other stakeholders on these assessments so as to develop a collaborative and inclusive methodology for use in decision making.
- Ecosystems are not uniform. It is generally assumed that the variation in the diversity, condition, extent and connectivity of ecosystems will significantly impact both on the quality and quantity of the benefit they provide – but this may not always be the case. We need to improve our understanding of the links between the resilience of ecosystems and the benefits they provide.
- The spatial distribution and scale of impact of these risks are not uniform across Wales. Much of this will depend on who or what is affected. Furthermore, the impacts of these risks may be felt in places other than where they are actually occurring – for example, downstream impacts such as flooding or water quality may be exacerbated by a number of upstream catchment issues, and the resilience of both the ecosystems in the wider catchment and the urban ecosystem. We need to improve our understanding of the spatial distribution of our natural resources and ecosystems to help target and prioritise action.
- Responses to these risks and challenges may not necessarily need to be uniform across Wales. Given the range of variables, both in the resilience of ecosystems and the way they deliver benefits, and in the options for their use and management, different responses may be required.
- Recognising that we are dealing with complex, adaptive ecosystems with emergent properties we need to recognise that there is a limit to what we can predict. Some of these risks may never materialise and there will be others that we have missed. The purpose is to take preventative action so that those risks are managed or mitigated. As with any risk register the aim should be to consider the relevance and immediacy of these risks and to decide how to manage or mitigate the risk. New risks can be added at any time, and those no longer considered relevant can be deleted.
- Society will choose what is most important so we need to begin a dialogue with stakeholders about how to prioritise the sustainable management of natural resources to address these risks, build resilience and maximise the contribution that natural resources make across the well-being goals. We can also use economic methods to build on existing knowledge of societies' preferences as a starting point.

To understand how each assessment was made, please refer to Chapter 7 Technical Annex 2 that accompanies this chapter. Further work is needed to help build better evidence around the links between the resilience of ecosystems and the benefits they provide, and the actions that can be taken to manage these risks.

7.1.2. Considering the “Globally Responsible Wales” Goal

It is important to consider the implications of actions in Wales on the rest of the world. However, it is not practicable to develop a risk register by ecosystem in the same way for the “a globally responsible Wales” goal. This would not work for looking at the impact of natural resource use and management in Wales on global ecosystems or for assessing risks to the capability to manage our natural resources to be more globally responsible; it would be too narrowly focused. For example, we could try to assess the potential risks of declining ecosystems in Wales on global ecosystems. If we become unable to produce timber in Wales, what impact might that have on other global ecosystems? But because of the complexity and uncertainty of global markets, that would be a very difficult thing to do piece by piece.

There are other ways we can monitor and assess this, as has been done previously with ecological and resource footprinting (such as food and water footprints). We can also set particular standards on the materials and resources that we demand from overseas. These measures in particular will need to be part of integrated reporting mechanisms (discussed below).

For completeness, and to complement the risk register above, we therefore consider the following more cross-cutting issues in moving towards a globally responsible Wales. The following should be important considerations in developing management responses:

The need to reduce per capita resource use. If we do not reduce per capita resource use, our nation’s ecological footprint will get bigger and will make us less globally responsible.

The need to meet the objectives of the air quality and ambient air quality and cleaner air for Europe Directives. If we do not meet these objectives, we are not being globally responsible. We will risk degrading ecosystems and will lose the ability to deliver other well-being goals.

The need to minimise greenhouse gas emissions as a contribution to climate change. If we do not minimise GHG emissions, we will be exacerbating the effects of climate change.

The need to ensure that emissions and discharges to the environment associated with population growth and development are minimised/mitigated. If we do not mitigate the impacts of population growth and development, we will risk putting further pressure on the resilience of ecosystems and their ability to deliver benefits.

The need to utilise Wales’ natural resources effectively to mitigate and adapt to the effects of climate change. If we do not use our natural resources effectively, we will exacerbate the consequences of climate change in Wales and globally.

The need to minimise waste and promote reuse, recovery and recycling and to minimise the impact of waste generation and management on the natural

resources of Wales. If we do not minimise waste, we will not be able to reduce per capita resource use.

The need to ensure the sustainable extraction of minerals (including marine aggregates), maximise the use of recycled aggregates and to use aggregate material efficiently whilst avoiding adverse effects on Wales' other natural resource assets. If we do not ensure sustainable extraction and efficient use of minerals, we will prevent future generations being able to access the resources that we have or will increase pressure on global resources.

The need to reduce the consumption of non-renewable sources of energy through measures such as improved energy efficiency and enhanced uptake of renewable energy. If we do not reduce our consumption of non-renewables, we will prevent future generations being able to access the resource that we have, will increase pressure on global resources and will not minimise greenhouse gas emissions.

The need to promote a low carbon economy – in particular, the need to promote the efficient, sustainable and proportionate use of natural resources to support economic growth and an increase in GVA from environmental services. If we do not ensure the proportionate use of our natural resources, we will either deplete them, which will prevent future generations being able to access the resources that we have, or put greater pressure on global resources, which will make us less globally responsible. We can do this and support economic growth through promoting a low carbon economy.

The need to meet our duty to reverse the decline in biodiversity, and particularly the need to protect and support the appropriate management and use of designated sites. If we do not apply our biodiversity duty, we will not be undertaking our international obligation to halt the loss of biodiversity.

The need to develop and promote better biosecurity, detection and response actions to tackle invasive non-native species (INNS). If we do not better protect against the threats and impacts that INNS have for marine, terrestrial and freshwater ecosystems then their resilience will be further compromised and the benefits we get from them reduced alongside the additional direct economic and social costs that INNS cause (Box 7.3).

Box 7.3 Risk to resilience and well-being from INNS:

Invasive non-native species (INNS) are a cross-cutting risk for many broad habitat types and for many of the well-being goals. The threat they pose has potentially significant consequences for the resilience of ecosystems pertinent to well-being. Failing to more actively manage the threat and spread of invasive species increases the risks and impacts they have for the Welsh economy as well as the risks to wider ecosystem resilience and the benefits they provide. The 2010 CABI report estimated the annual cost to the Welsh economy from INNS as £125 million².

As INNS are becoming more widespread, their economic, social and ecosystems impacts are expected to increase. There is evidence that long-term cost savings

Box 7.3 Risk to resilience and well-being from INNS:

and securing better ecosystem resilience are possible by taking eradication, containment or control actions as early as possible in the invasion process. We have therefore included a generic risk for INNS

To more comprehensively understand these risks and impacts and to decide how best to deal with them we need to develop more evidence on INNS distributions in Wales and generate more information on the economic, social and environmental costs and risks that existing and future INNS pose to well-being.

There is a need to develop and promote good biosecurity, detection and response actions to reduce the risks posed by (INNS). We need to better protect the benefits we get from marine, terrestrial and freshwater ecosystems through more strategic and collaborative approaches that improve awareness and understanding, help proactively deal with INNS, and avoid the subsequent and more substantial costs and impacts that climate related INNS will cause.

7.1.3. Developing the risk register

The risks outlined in the risk register relate to the functioning of ecosystems (broad habitats) and their ability to continue to deliver benefits for well-being now and in the future.

We recognise that it would be useful to be able to assess which of those risks were more important, or critical, to supporting well-being. This could be done in a number of ways. For example:

- By looking at the significance of the ecosystem in delivering benefits for well-being across the goals. Those that contributed the “most” benefits might be considered more important. This could be achieved by introducing and assigning a high, medium and low significance rating to each risk;
- By looking at the “value” (social, cultural, economic and environmental) of the benefits provided, and assessing the relevant importance of those benefits. These could be assigned scores or ranked against policy objectives, and those with the greatest risk to “value” could be prioritised;
- By looking at the relationship between the condition of the ecosystem and its ability to continue to deliver the benefits. Those benefits that increased alongside the condition of the ecosystem could be prioritised over those where the benefits plateaued.

Each of these approaches would require modelling based on existing evidence where available; however, because of gaps in our evidence, some broad assumptions will be needed about the ways in which those benefits are derived. Assumptions might include information on the area or extent of the ecosystem or the value of the benefit.

Recognising the need for this further work does not prevent highlighting the emerging priority risks to natural resources and ecosystems which are drawn together in the final chapter.

7.2. Managing risks to well-being: Identifying opportunities for nature-based solutions

Building in the information from the risk register, we can also utilise spatial information as a starting point for considering more integrated management of natural resources. The aim is to find more integrated solutions that might provide opportunities to address multiple issues, to deliver multiple benefits and to invest in natural resources.

The sustainable management of natural resources requires an understanding of where benefits are generated (so that these areas are appropriately managed) and where they are received (so that the well-being implications are understood). In areas where land use has changed or habitats have changed, there may also be a series of disbenefits that ‘flow’ from these areas. Using spatially explicit approaches is fundamental to planning more holistic natural resource management.

Using spatial data to better understand the relative importance of each area in terms of provision of benefits will assist with the integrated management of the Welsh environment as a whole, rather than focussing on separate parts taken out of their national context. This requires a systematic assessment of the underpinning evidence. Spatial analysis allows us to bring together a range of different evidence.

The maps presented below are one way of using such evidence to consider this question. The method used, SENSE, is one of a number of available tools assessed and presented on the Ecosystems Knowledge Network website³. This method builds on the JNCC spatial framework for ecosystem services mapping⁴.

A range of maps was prepared as part of a study funded by NRW⁵. The maps show how modelling of existing data provides the starting point to consider opportunities for “nature-based solutions” - green engineering approaches and working with natural processes. Existing datasets are unlikely to be an exact representation of the services being provided, but they do provide a representation using the best currently available data, which can be used as a starting point for a discussion about responses.

A set of maps is presented here as an illustration of how evidence can be analysed to build up a spatial picture of the opportunities for sustainable management. The maps show a range of complementary ecosystem benefits, before showing the opportunities to secure multiple benefits for ecosystems and well-being.

7.2.1. Building a spatial picture:

The maps below model existing natural resources and the benefits they provide using existing data in a three step process. This starts with the collection of relevant data, using proxies where this is limited, and an audit to ensure relevance to the objective of the mapping. Rules (or assumptions) are then drawn up and then different types of map are created:

- Step 1: Stock maps – modelling the extent of existing natural resources
- Step 2: Opportunity maps – suggesting the potential to enhance the provision of ecosystem benefits using nature based solutions
- Step 3: Multi-benefit maps – considering a range of opportunities and showing complementary areas where action could deliver multiple benefits

As an illustration of the approach, the remainder of this chapter shows an analysis of potential opportunities for managing flood risk.

The aim of the first map (Figure 7.1) is to identify areas which are likely to be currently contributing to natural flood management. Natural features can reduce flood risk; these include features such as deep rooting trees slowing water infiltration through the canopy and leading water deep into the soil profile where it is slow to be released. This map shows where the natural features of the catchment, such as soil and woodland, help to retain water, increase infiltration and evaporation, and slow the flow downstream.

Looking at the reverse (Figure 7.2), it is also important to identify areas that due to their characteristics may be contributing to flood risk. These may become opportunity areas - where appropriate management actions could have a positive effect.

The main characteristics considered to be negative for flood risk are topography, land cover and soil type. Steep slopes can generate significant amounts of overland flow, and certain soil types with limited water holding capacity can quickly become saturated and therefore less able to take up any additional water.

The final map (Figure 7.3) looks at where a specified set of interventions could be implemented to reduce flood risk.

Three types of opportunities were considered for this map: bog restoration, wet woodland creation, and tree planting. It should be noted that this list is not exclusive; other opportunities and measures might have been selected for analysis.

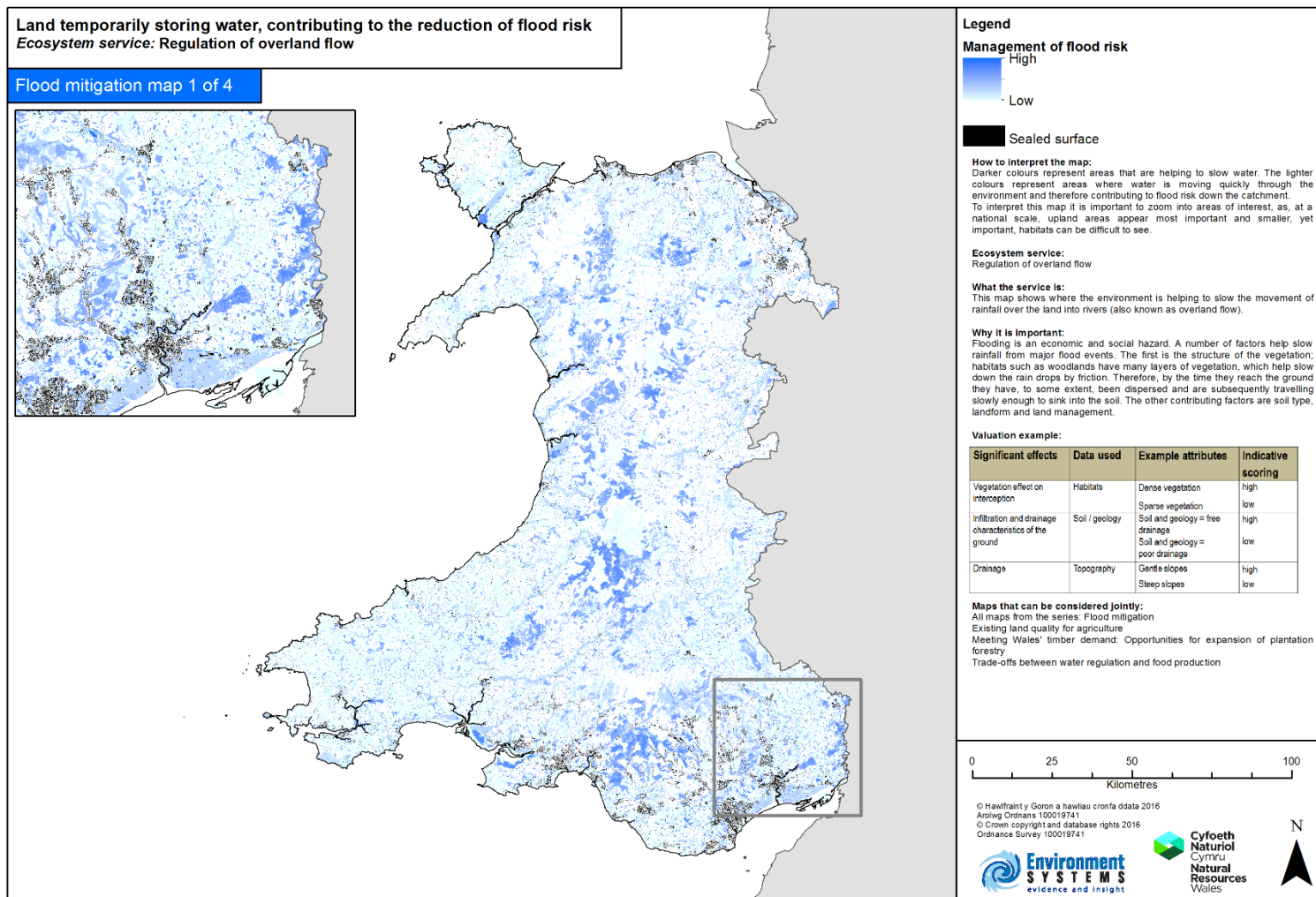


Figure 7.1 Land temporarily storing water, contributing to the reduction of flood risk

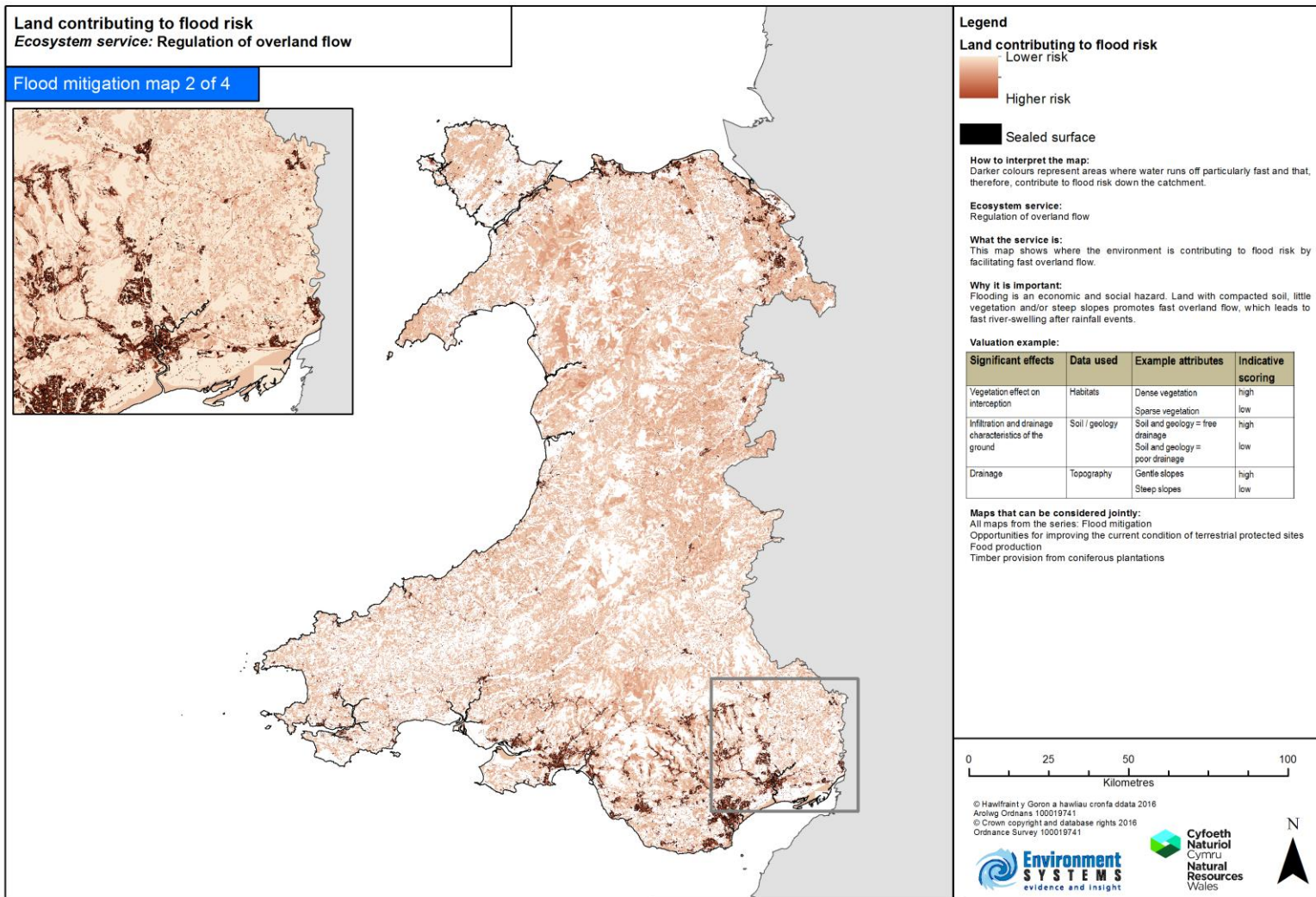


Figure 7.2 Land contributing to flood risk

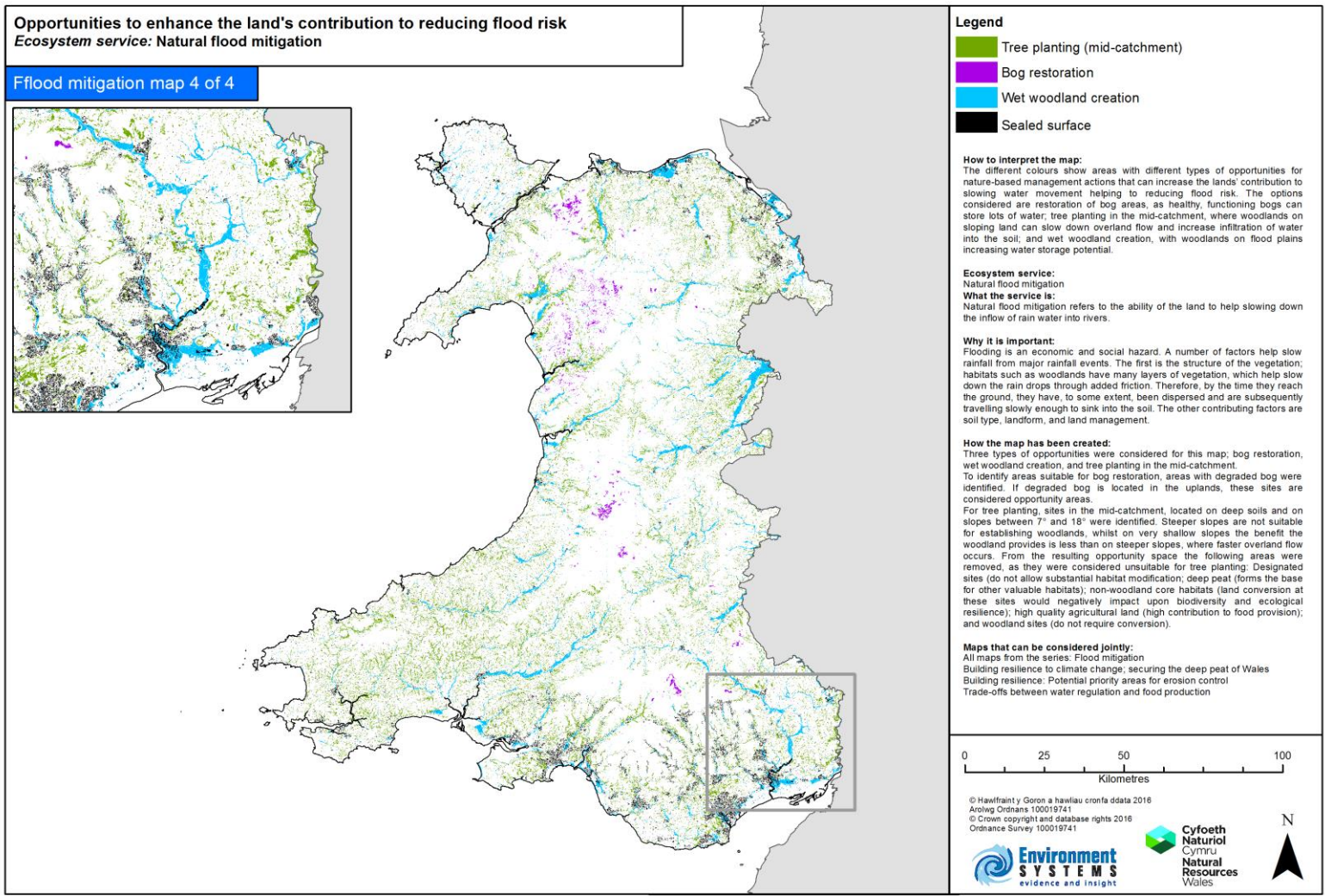


Figure 7.3 Opportunities to enhance the land's contribution to reducing flood risk

The advantage of using a spatial, rather than sectoral, approach is that other ecosystem benefits can easily be added to the analysis, allowing complementary action to be identified as well as highlighting where conflicts may arise between different ecosystem benefits. For example, as well as flood mitigation opportunities, the case study chose to look at additional opportunities for control of soil erosion and maintenance of soil carbon stores (considered below). Other options could include alternative means of maintaining flow levels, maximising the connectivity of a particular habitat, or targeting interventions to maximise benefits for areas at high risk of flooding.

Erosion regulation

Soil erosion can be detrimental to keeping carbon stored in the soil, (important for climate change mitigation) as well as being a risk to water quality and the productivity of agricultural land. Currently, there is very limited monitoring of soil erosion but spatial datasets can identify areas where soil erosion is more likely to be an issue. In the future, it may be possible to use remote sensed data to refine these maps and provide more rapid updates on erosion risk.

Potential opportunities to manage land to help address soil erosion were then mapped (Figure 7.4). The map shows where there is land with properties that are associated with a high risk of soil erosion. Green and orange areas potentially offer little protection to the soil; those that are subject to higher disturbance levels (such as pasture and arable fields) are located on steep slopes.

Maintaining carbon stores

Maintaining carbon storage in the soil is a major mitigating factor for climate change; the more carbon retained in the soil, the less greenhouse gas released to the atmosphere. Soil carbon storage results from interactions of different ecological processes. The amount of organic matter present within the soil profile contributes to this service. Peat based soils contain the most carbon and release significant amounts of carbon to the atmosphere when they are eroding. Soil under undisturbed semi-natural grassland communities is also likely to be a significant carbon store. Carbon is also stored temporarily within vegetation biomass, where the carbon storage value is related to species size and longevity. Figure 7.5 therefore shows how areas of significant soil carbon stocks are currently distributed throughout Wales - the main consideration here being soil type, with organic soils containing a high proportion of carbon. Other attributes such as slope, covering vegetation, peat-lands and bogs have also been considered in the assumptions. As with all the maps, these assumptions can be discussed, agreed and refined further with input data at finer scales from a variety of sources.

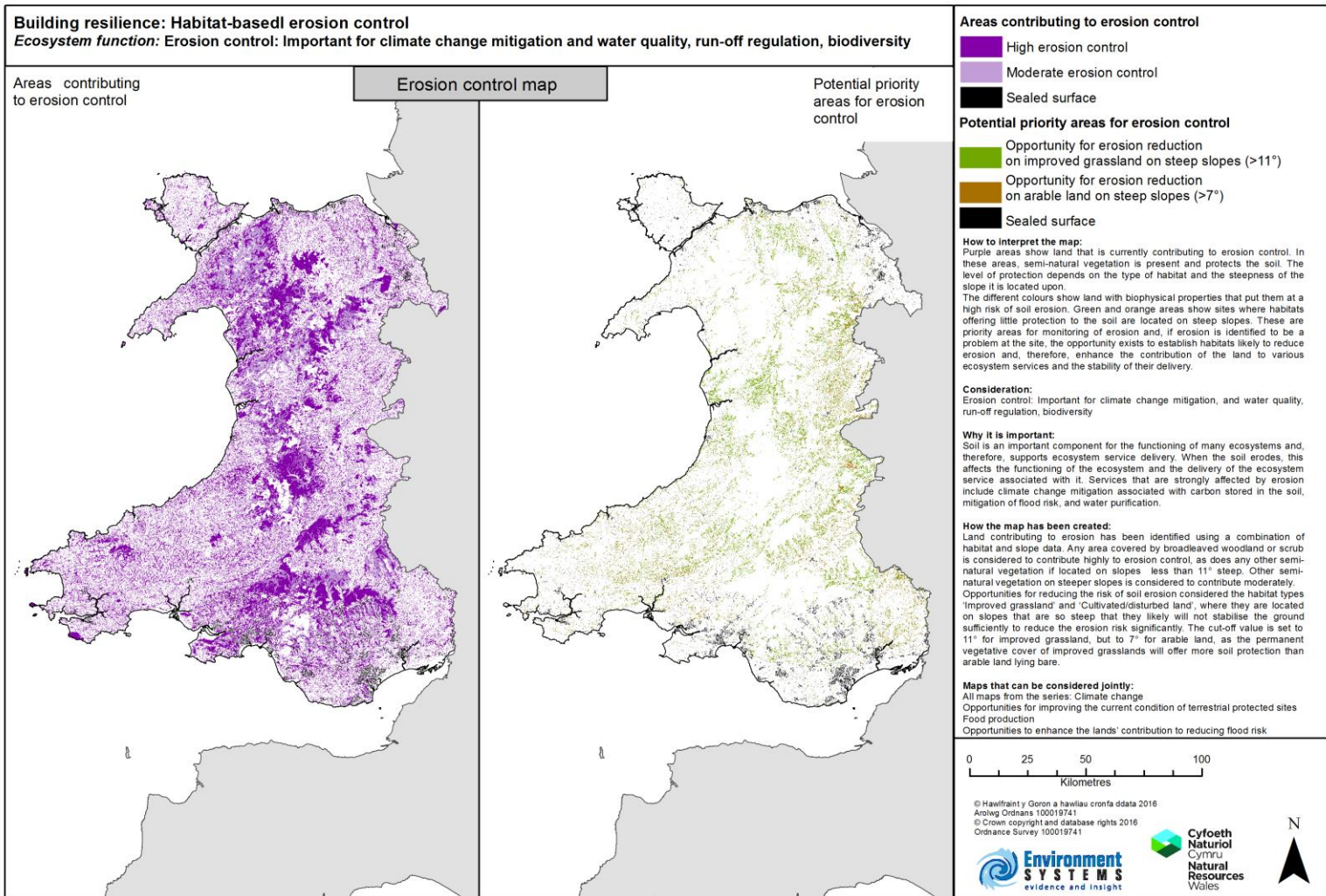


Figure 7.4 Habitat-based erosion control.

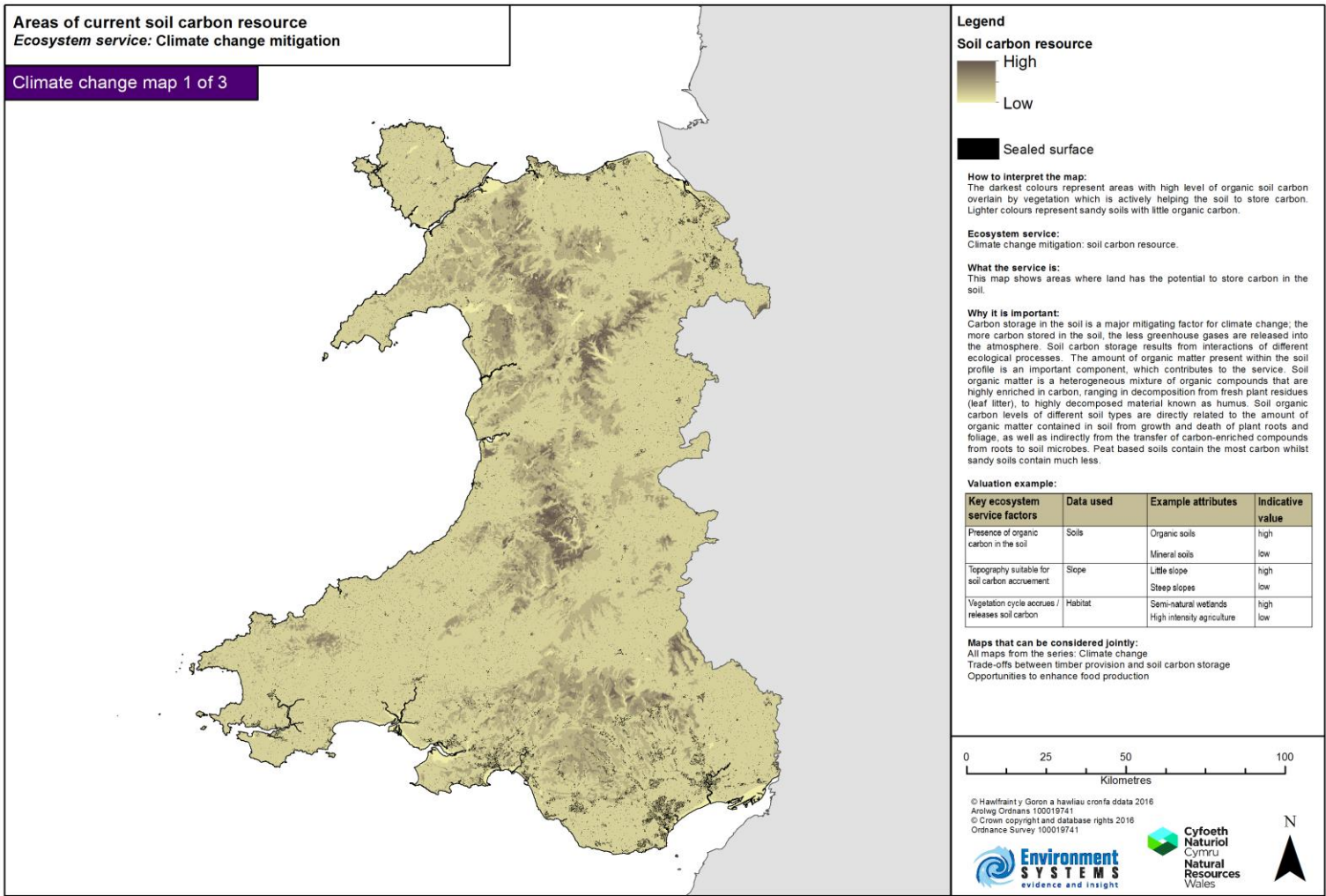


Figure 7.5 Areas of current soil carbon resource

Multi-benefit maps

Multi-benefit maps can identify areas of land or sea where the contribution to a number of ecosystem benefits are in synergy. Such areas could offer multiple benefits in return for changes in management. They may therefore offer an opportunity to test the implementation of integrated policies which aim to deliver across a range of goals and sectors.

Multi-benefits provided by existing natural resources and ecosystems.

This map (Figure 7.6) was created from combining the highest-provisioning areas of the water regulation, erosion control and soil carbon storage stock maps set out above. Where the areas overlap, it is assumed that high levels of multiple services are being provided. The services represented in this map are complementary, meaning that management action for the benefit of one service will be likely to impact the others positively.

Multi-benefits arising from opportunities for ecosystem enhancement

Figure 7.7 shows where there are opportunities to enhance more than one ecosystem benefit. For example, restoration of degraded bog could both decrease soil erosion and increase soil carbon stores by reducing erosion of peat gulleys and promoting colonisation of peat building species.

These types of maps can be used to identify the most significant areas of land in terms of ecosystem benefits and can therefore assist the design of appropriate management interventions.

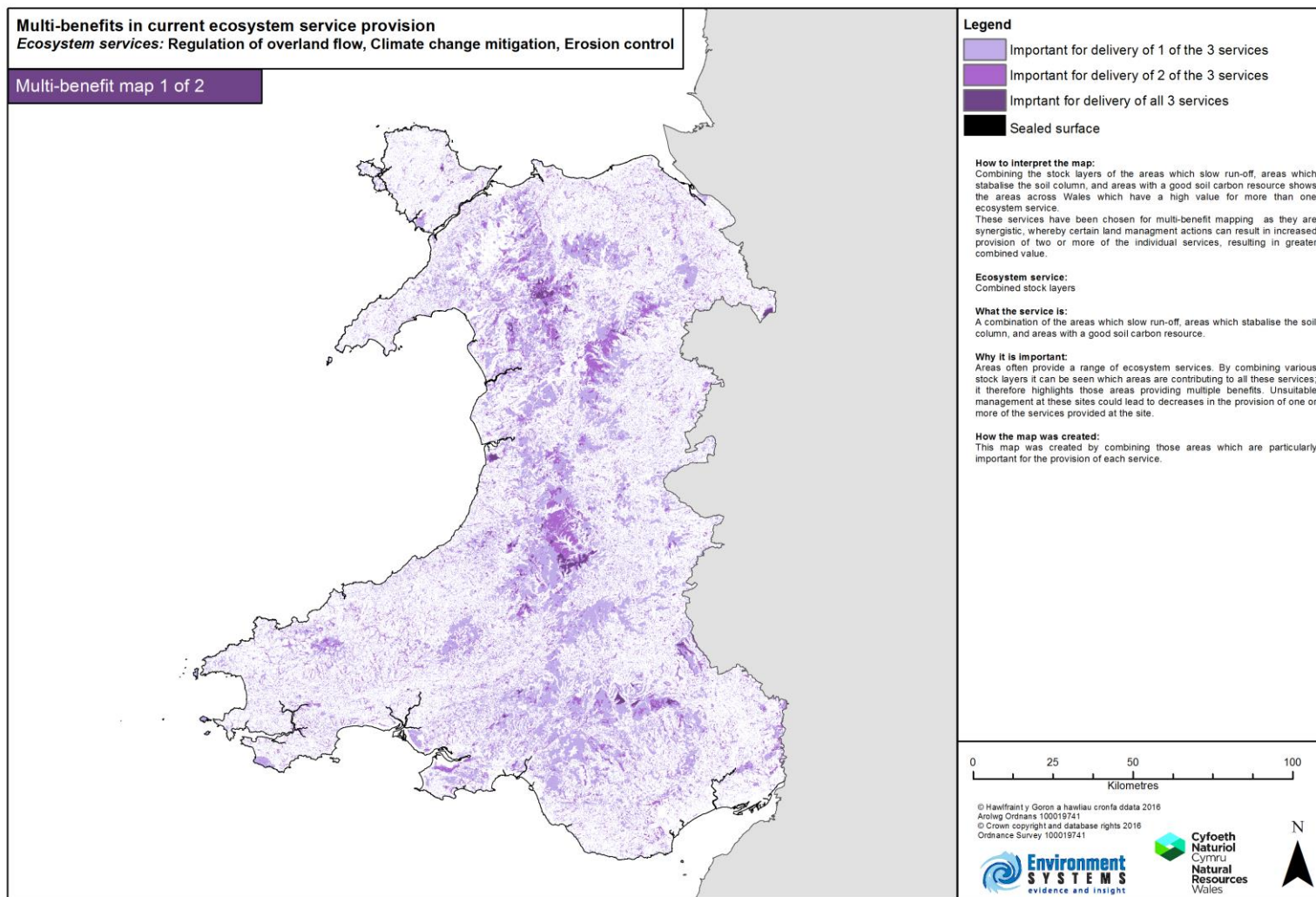


Figure 7.6 Multi-benefits in current ecosystem service provision.

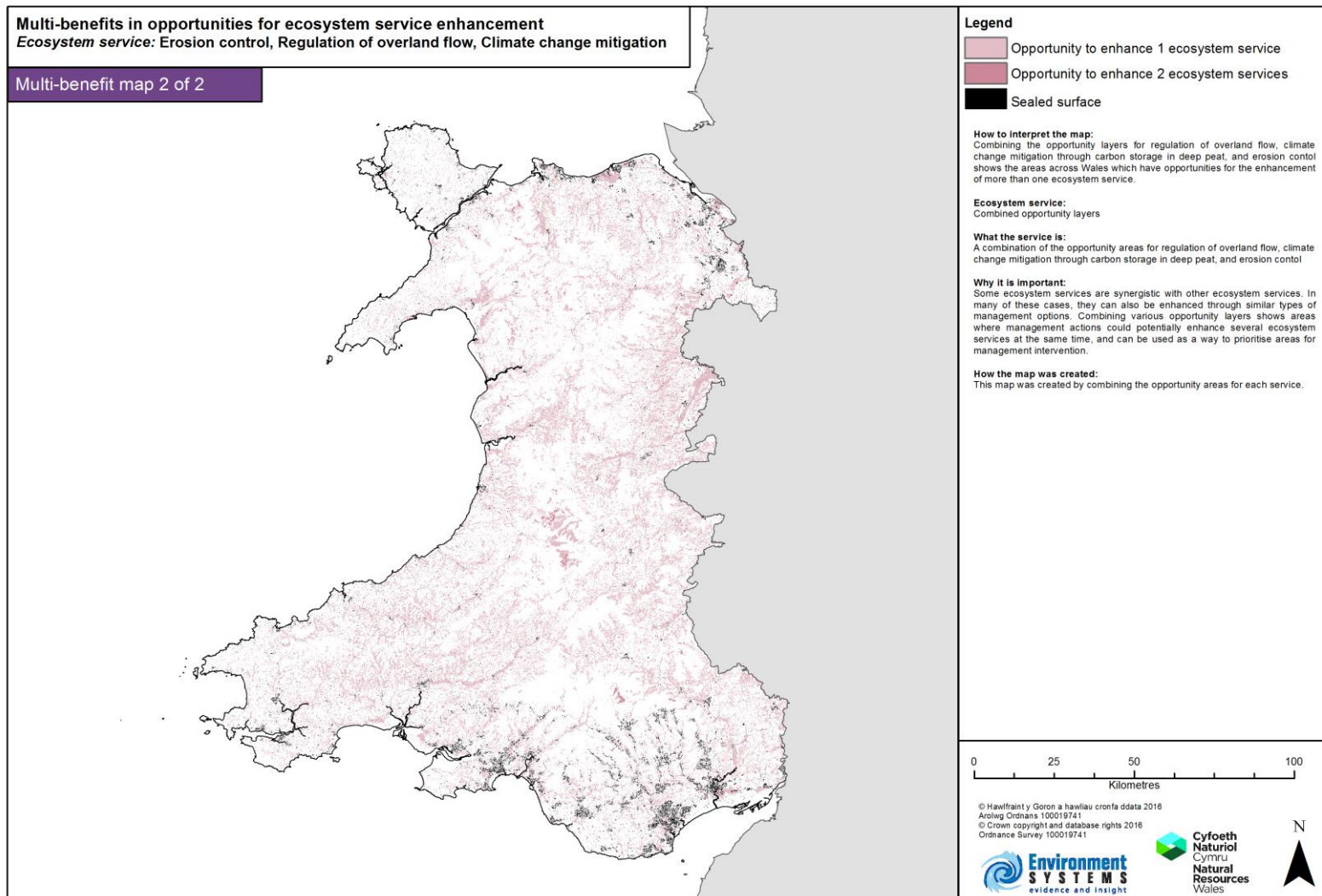


Figure 7.7 Multi-benefits in opportunities for ecosystem service enhancement.

How is this approach different?

Whilst there are many examples of how flood risk schemes can be designed to consider and integrate wider ecosystem benefits, the traditional approach would be to prioritise more narrow, operational issues over other broader considerations.

By thinking more holistically and combining the analysis above with other evidence on risks to resilience, we can see that it is possible to pursue management options that deliver multiple benefits. Starting with the physical components of the ecosystem and looking for optimum management for both resilience and well-being benefits, allows us to start from natural resources themselves and not to be hemmed in by existing functional objectives.

In order to capture the fullest picture of the state of natural resources and the opportunities for their management, it is essential that a range of knowledge is used. The maps above use peer reviewed scientific evidence but this needs to be built on by using a deliberative process which incorporates stakeholders' knowledge so that they are able to inform decision-making. The maps identify potential priority areas to maximise the value for several ecosystem services and bring together ideas on the scale of possible interventions. They are also helpful for guiding discussions between stakeholders and policy makers. This is particularly the case where the policy under discussion is not known to all stakeholders as the maps can guide the eye to the significant features in the most likely place where action could be relevant. The maps have been prepared for SoNaRR with the purpose of informing national policy decisions. Therefore, they should not be thought of as prescriptive tools to guide management on the ground because analysis to enable this would require more detailed datasets combined with local and expert knowledge.

7.3. Conclusion

Filling the gaps in our knowledge

These maps have been produced and presented as an illustration of how spatial information can be used to identify opportunities to manage and mitigate the types of risks outlined in the risk register. Although they are based on what scientific evidence tells us, which is an important starting point, this is not the sum total of human knowledge. Additional local knowledge and community engagement is essential to help ensure that the most appropriate locations are targeted for management interventions and that such interventions support the objectives of a range of different sectors and stakeholders.

We believe these approaches will become critical in dealing with the complexities of natural resources and ecosystems and their contribution to well-being. In particular they can be adapted, discussed, improved and tailored to cope with local variation, uncertainty of evidence and to take account of stakeholder views as part of a deliberative process.

References for Chapter 7

("Accessed" refers to the date the link was last accessed)

¹ Committee on Climate Change. 2016. *UK Climate Change Risk Assessment 2017 Evidence Report, Summary for Wales* [online]. Available from: <https://documents.theccc.org.uk/wp-content/uploads/2016/07/UK-CCRA-2017-Wales-National-Summary.pdf>. [Accessed 29th July 2016].

² Centre for Agriculture and Biosciences International (CABI). 2010. *The Economic Cost of Invasive Non-Native Species on Great Britain*

³ Ecosystems Knowledge Network. 2016. Tool Assessor, Ecosystems Knowledge Network [Online]. Available at: <http://ecosystemsknowledge.net/resources/tools/tool-assessor>. [Accessed 1st August 2016].

⁴ Medcalf K, Small, N, Finch C & Parker J. Spatial framework for assessing evidence needs for operational ecosystem approaches. Available at: <http://jncc.defra.gov.uk/page-6241> [Accessed 1st August 2016].

⁵ Bell G, Pagella T, Naumann E-K & Medcalf K. 2016. Spatial analysis of natural resources for SoNaRR. Rev. No. 1.0. Report for Natural Resources Wales. Environment Systems.