

Using the Ecosystem Approach – A Framework for Natural Resources Wales

Foreword

The establishment of Natural Resources Wales (NRW) provides Wales with a unique opportunity to take a more joined-up approach to managing and caring for our environment and its natural resources.

This joined-up approach is often referred to as the ecosystem approach. But what does this mean? Ultimately it's about planning a sustainable future for ourselves – our environment, economy and communities. It's all about managing our natural resources in a way that enhances the health of the environment, whilst also providing better benefits for society and businesses.

This is not a new appraisal mechanism - it is a way of considering existing assessments, plans and projects in a different way. It is framework to encourage the identification of common purpose. The aim is to work with other colleagues and interested communities from the start in order to establish common aims and objectives for a given activity or location.

Much of this thinking is not new and many of you have worked in this way over the years, providing a strong foundation which we can build on. This framework provides a common basis and some first steps from which we in Natural Resources Wales, can approach our work from this broader perspective. It is a way of helping us all find multiple wins in everything we do, and will enable us take a more integrated approach across all of our work from the start.

So, as we continue to make use of our traditional range of tools to protect the environment, we must also look to build in new ones which will help us achieve even more. The ecosystem approach demands that alongside biological diversity and ecological resilience, we give full consideration to the community and the economy as an integral part of managing the environment. As such, stakeholder engagement and the use of economic measures are growing in importance in making the links and dependencies on our natural resources clear to all.

The application of the ecosystem approach is an evolving area of work which will be further developed by NRW working in partnership with Welsh Government which is developing its policy on natural resource management. Further guidance will be produced over time with greater detail and instructions. Training and example case studies will also be made available.

Rhagair

Mae sefydlu Cyfoeth Naturiol Cymru yn rhoi cyfle unigryw i Gymru roi dull mwy cydgysylltiedig ar waith ar gyfer rheoli a gwarchod ein hamgylchedd a'i adnoddau naturiol.

Yn aml, cyfeirir at y dull cydgysylltiedig hwn fel 'dull yr ecosystem'. Ond beth mae hyn yn ei olygu? Yn y pen draw, mae'n golygu cynllunio dyfodol cynaliadwy i ni'n hunain – ein hamgylchedd, ein heconomi a'n cymunedau. Rheoli ein hadnoddau naturiol mewn ffordd a fydd yn gwella iechyd yr amgylchedd, gan arwain at well manteision i'r gymdeithas a hefyd i fusnesau.

Nid dull gwerthuso newydd mo hwn. Mae'n ffordd o ystyried asesiadau, cynlluniau a phrosiectau sy'n bodoli'n barod mewn ffyrdd gwahanol. Fframwaith ydyw ar gyfer ceisio dod o hyd i bwrpas cyffredin. Y nod yw gweithio gyda chydweithwyr a chymunedau â buddiant o'r cychwyn cyntaf i bennu nodau ac amcanion cyffredin ar gyfer gweithgareddau neu leoliadau arbennig.

Nid syniadau newydd yw'r rhain, ac mae nifer ohonoch wedi gweithio yn y ffordd yma ers blyneddau, gan gynnig sylfaen gref y gallwn adeiladu arni. Mae'r fframwaith hwn yn cynnig sylfaen gyffredin a rhywfaint o gamau cychwynnol y gallwn ni yng Nghyfoeth Naturiol Cymru eu rhoi ar waith o'r safbwynt mwy cyffredinol hwn. Bydd yn ein helpu i fod ar ein hennill ym mhopeth a wnawn, a bydd yn ein galluogi i weithio mewn modd mwy integredig o'r cychwyn cyntaf.

Felly, wrth inni barhau i ddefnyddio ein hoffer traddodiadol i ddiogelu'r amgylchedd, rhaid inni hefyd geisio cynnwys dulliau newydd a fydd yn ein helpu i gyflawni mwy fyth. Ochr yn ochr ag amrywiaeth fiolegol a chydnerthedd ecolegol, mae dull yr ecosystem yn ei gwneud yn ofynnol inni roi ystyriaeth lawn i'r gymuned a'r economi fel rhan hollbwysig o reoli'r amgylchedd. O'r herwydd, mae ymgysylltu â rhanddeiliaid a defnyddio mesurau economaidd yn dod yn fwyfwy pwysig o ran gwneud y cysylltiadau a'r ddibyniaeth ar ein hadnoddau naturiol yn glir inni.

Mae'r dasg o roi dull yr ecosystem ar waith yn dal i esblygu, a bydd yn cael ei datblygu ymhellach gan Gyfoeth Naturiol Cymru mewn partneriaeth â Llywodraeth Cymru sy'n datblygu eu polisi eu hunain ar reoli adnoddau naturiol. Ymhen amser bydd canllawiau pellach, a fydd yn cynnwys mwy o fanylion a mwy o gyfarwyddiadau, yn cael eu llunio. Ymhellach, bydd hyfforddiant ac enghreifftiau o astudiaethau achos ar gael.

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Introduction - purpose and key features

The ecosystem approach is about managing the environment so that its different components are considered together, including its natural systems and the benefits that people get from it. Most importantly, it emphasises that people themselves are part of ecosystems and must be involved in decision making. The ecosystem approach is not a rigid methodology, but a way of thinking that should help us develop and implement our plans, projects and assessments in a more integrated and joined up way.

This framework is aimed at all staff in Natural Resources Wales (NRW). Its purpose is to help us understand what the ecosystem approach is about, and to start to apply it in our everyday work. It is not a detailed manual, but an introductory guide setting out:

- a set of core principles;
- an understanding of ecosystems and the services they provide;
- some key steps which can be applied to a range of activities from projects and programmes to plans and policies; and
- a range of resources available to assist in decision making.

This framework has been based on a review of what other organisations are doing, in the UK and around the world, and has drawn out the common features and best practice from these examples. As well as being a useful resource for us in NRW, this guide should also be of interest to partners and the information can be adapted to suit a range of audiences.

The Ecosystem Approach

The term 'ecosystem approach' originally comes from the Convention on Biological Diversity (CBD), where it is described as "a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way"¹.

An ecosystem is made up of living organisms (from microorganisms, through fungi, plants, animals to people), their non-living surroundings (rocks, soils, air, sea, water etc.), and all the diverse and complex interactions that take place between them (from soil formation, through predator-prey relationships, to growing a potato crop). Everything we need to live, function and enjoy life in some way comes from our ecosystems, and these benefits from nature have become known as 'ecosystem services'. However, it has been all too easy for the natural environment to be over-exploited, so that not only does its natural value suffer, so too do the services it provides and eventually people as well. It is therefore essential that we recognise the value of our ecosystems, and that we manage our natural resources so that our underlying ecosystems are sustained in a healthy, functioning way. It is this feedback and balance between use and maintenance of the natural environment that is at the heart of the ecosystem approach.

The ecosystem approach encourages the engagement of the whole range of people with an interest in a particular place or activity, to agree a set of shared outcomes we can all work towards. It suggests a broad view of the natural environment, the ecosystem services provided and the issues associated with environmental change. Working in this way we can improve the environmental, social and economic

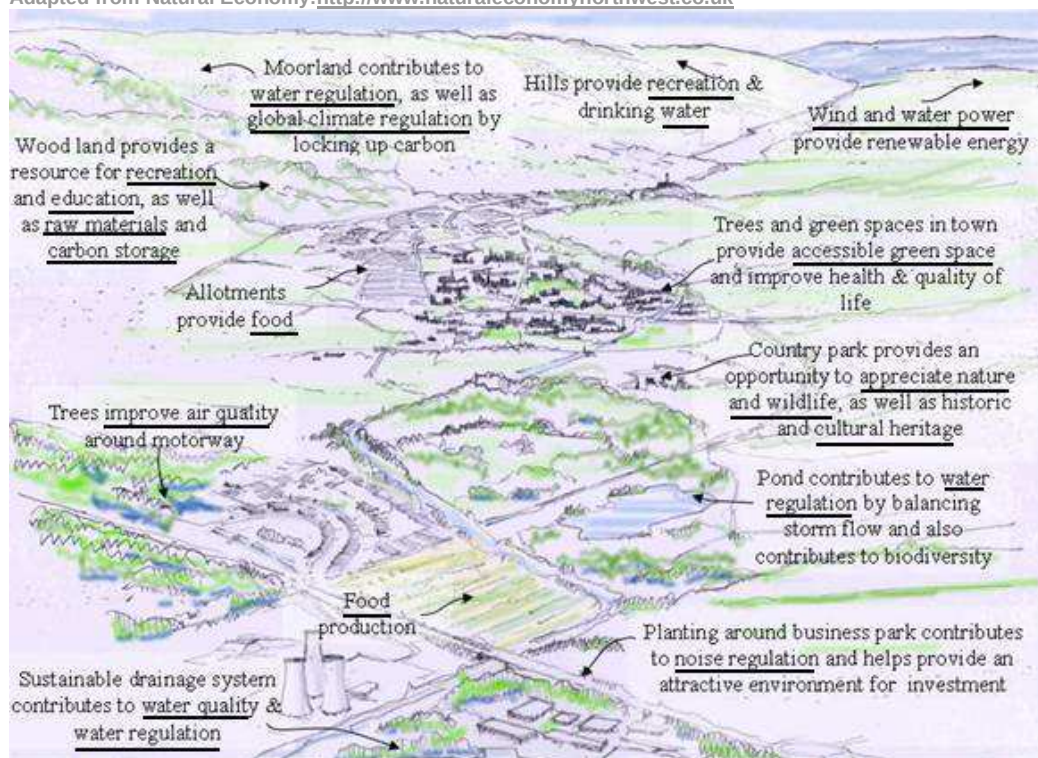
¹ CBD (2004) Secretariat of the Convention on Biological Diversity, The Ecosystem Approach, (CBD Guidelines) Montreal.

outcomes, pursuing sustainable development and working with the natural environment to increase its resilience whilst managing the supply of ecosystem services, or benefits we get from nature. For NRW, this will mean carrying out our work in a more integrated way, be it flood defence, forest design planning, biodiversity conservation, marine management, promoting recreation, or running our corporate business.

Figure 1 illustrates some of the ecosystem services provided by a terrestrial landscape. The services are underlined in the annotations and general information on them can be found in [Section 2](#). In each case, the services are a product of the underlying ecosystems. Sustainable delivery of the services requires that the ecosystems are in good condition, well managed, and with sufficient natural diversity to be resilient and to be able to adapt to change.

Figure 1: some of the ecosystem services provided by a terrestrial landscape.

Adapted from Natural Economy: <http://www.naturaleconomynorthwest.co.uk>



Why the ecosystem approach?

Our present environmental regulations, designations and controls have successfully conserved Wales' highest quality landscapes and transformed the quality of our urban environments and many of our rivers and streams. However, some environmental problems remain more intractable, largely where they are rooted in a complex series of underlying or interacting factors. Our failure to meet our 2010 Biodiversity targets and recent evidence from the UK National Ecosystem Assessment² that around a third of all services we get from ecosystems are in decline, led in January 2012 to the Welsh Government Green paper *Sustaining a Living Wales* which called for a fresh approach to natural resource management.

² UK National Ecosystem Assessment (2011). The UK National Ecosystem Assessment: Synthesis of the Key Findings. UNEP-WCMC, Cambridge

In Wales we recognise that our nature, land, water and air are our ultimate resource and are critical for our economy and well-being. With increasing demands placed on this resource and the uncertainties of climate change, we can no longer afford to manage our environment as a separate entity or 'add on'. The ecosystem approach is a recognised framework for sustainable natural resource management which Welsh Government has adopted as part of its overall vision and delivery of sustainable development in Wales.

Developing and embedding the ecosystem approach including associated demonstration projects is an essential component of the Welsh Government's Natural Resource Management Programme which has been created to deliver the policy commitments set out in the Green Paper. This includes delivering the Environment Bill and setting the strategic policy framework and national priorities for natural resource management in Wales.

What does this mean for you?

The breadth of experience and expertise of staff and our partners is our greatest asset as the ecosystem approach emphasises collaborative and multi-disciplinary approaches to problem solving. While many of us already work in this way, in NRW there will be a stronger emphasis on:

- Embedding the principles of the ecosystem approach in your work.
- Working more collaboratively across teams.
- Routinely assessing the positive and negative impacts of options for our activities on ecosystems, their services and associated benefits.
- Looking for 'win win' opportunities and innovative solutions.
- Developing a shared vision and clear ecosystem based objectives for our activities and monitoring them.
- Supporting better decisions with a wider evidence base and ensuring that lessons learned are captured to improve the way we manage natural resources in the future.
- To whom, what and where the benefits or impacts fall.

Ecosystem Approach Framework for Natural Resources Wales

The framework should be used in a proportionate way for the activity, from helping to guide simple in-house decisions to the management of more complex projects or processes, e.g. Strategic Environmental Assessment (SEA), and the development of strategic plans and corporate policies. It can also be used in providing advice to Welsh Government, determining monitoring requirements and responding to consultations.

It is intended to be used in any situation where the natural environment is affected or managed and can be applied at different scales:

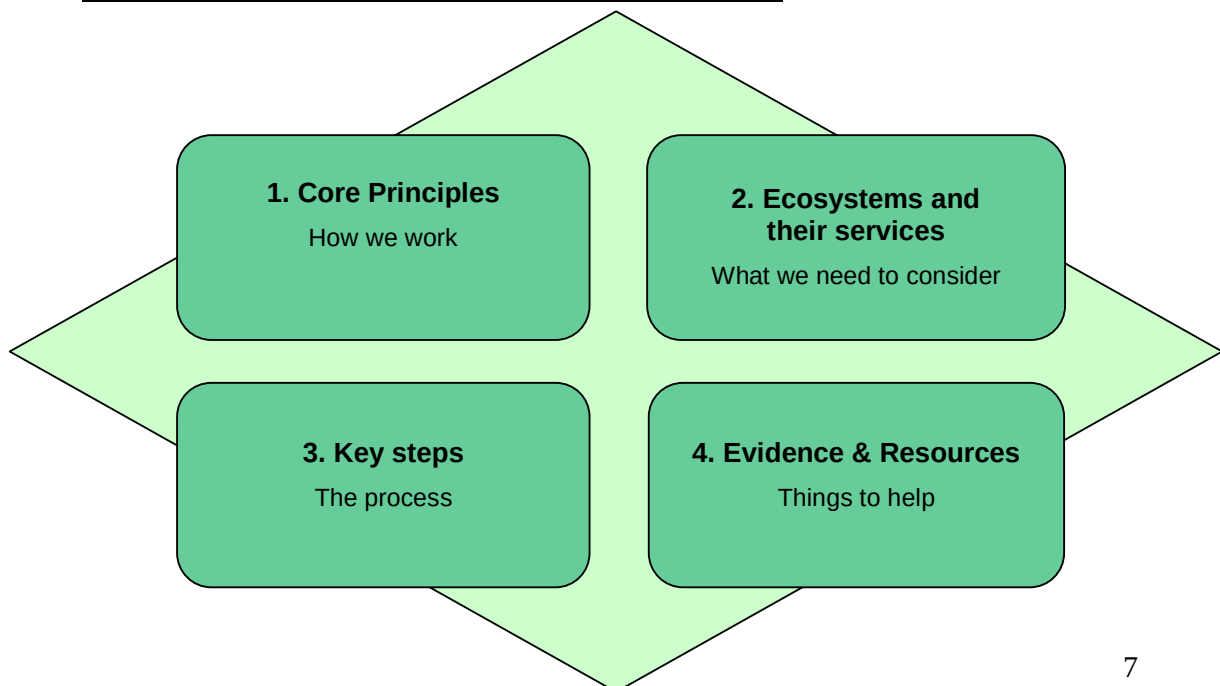
- **At a local scale**, e.g. a plan for a new housing development, a windfarm, a forest design plan, a Sustainable Urban Drainage Scheme, a marine Natura site, a fishery, a local nature reserve.
- **At a regional scale**, e.g. a National Park, a river catchment, a development plan, a renewable energy strategy.
- **At a national scale**, e.g. a national planning framework, a climate change mitigation and adaptation framework, Rural Development Plan.
- **At an international scale**, e.g. Irish Sea fisheries plan.

The framework is not a separate ‘tick-box exercise’, rather it is a set of principles and a way of working that will become an integral part of NRW activities and the way we make decisions.

How do we embed the ecosystem approach?

The framework is set out in 4 sections, with a boxed summary explanation of key tasks. The [first section](#) describes the core principles of the ecosystem approach and how they can be used to inform our work. The [second section](#) explains what is meant by ecosystems and their services and provides a reference list of services and the [third](#) sets out a series of key steps that can be embedded into our activities. The [final section](#) provides the key evidence and resources needed to use the approach.

Figure 2: The ecosystem approach framework outline



1. Core Principles – How we work

Welsh Government has adopted the definition of the ecosystem approach, as endorsed by the United Nations' Convention on Biological Diversity (CBD). Our work will be guided by these principles and the United Nations Operational Guidance for the Ecosystem Approach³. For the purposes of this framework we present the 12 principles in a more simplified way in table 2. See **Annex 1** for a fuller description.

Table 2. Our core 12 Principles (See Annex 1 for a full explanation).

CBD Principle	Topic	Brief description (CBD⁴)
Principle 1	Societal Choice	The objectives of management of land, water and living resources are a matter of societal choices
Principle 2	Localised Decisions	Management should be decentralized to the lowest appropriate level
Principle 3	Adjacent Effects	Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems
Principle 4	Economic Drivers	Recognizing potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context. Any such ecosystem-management programme should: • Reduce those market distortions that adversely affect biological diversity • Align incentives to promote biodiversity conservation and sustainable use • Internalize costs and benefits in the given ecosystem to the extent feasible
Principle 5	Ecosystem Resilience	Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach
Principle 6	Environmental Limits	Ecosystem must be managed within the limits of their functioning
Principle 7	Spatial and Temporal Scale	The ecosystem approach should be undertaken at the appropriate spatial and temporal scales
Principle 8	Long Term Approach	Recognizing the varying temporal scales and lag-effects that characterize ecosystem processes, objectives for ecosystem management should be set for the long term
Principle 9	Managing Change	Management must recognize that change is inevitable
Principle 10	Biological Diversity*	The ecosystem approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity. Biological diversity is critical both for its intrinsic value and because of the key role it plays in providing the ecosystem and other services upon which we all ultimately depend
Principle 11	Evidence	The ecosystem approach should consider all forms of relevant information including scientific and local knowledge, innovations and practices
Principle 12	Stakeholder Engagement	The ecosystem approach should involve all relevant sectors of society and scientific disciplines

³ CBD (2004) Secretariat of the Convention on Biological Diversity, The Ecosystem Approach, (CBD Guidelines) Montreal.

⁴ <http://www.cbd.int/ecosystem/principles.shtml>

*Biological Diversity. In Wales we recognise that **geodiversity** is also critical and underpins the ecosystem approach.

Using the Principles

It will be important to demonstrate our understanding and use of the 12 core principles by embedding them into the way we work.

- Read and understand how these principles can be applied in your area of work.
- Apply these principles at the earliest opportunity to an activity, process or decision.
- At key decision stages you should record how these principles have informed your thinking. This should be proportionate to the task.

Annex 1 provides the full version of the CBD principles, plus some simple questions to help **explain what they mean** in the context of our work.

2. Ecosystems and their Services - What do we need to consider?

What are ecosystems?

Ecosystems are communities of living organisms (including everything from microorganisms, through fungi, plants, animals to people), their non-living surroundings (rocks, soils, air, sea, water etc.), and all the interactions that take place between them. These interactions are highly complex, including nutrient cycles, energy flows, ecological interactions, and geophysical and climatic processes. Human activities are part of ecosystems and can have a strong influence on them. The underlying diversity of ecosystems, from the genetics within species to the structural variation within landscapes is a critical resource, as it provides the capacity to deal with disturbance to adapt to change.

Ecosystems can be recognised at numerous scales from the very small (e.g. a community of microbes on a single leaf, or the invertebrates that live beneath a rock in a stream) to the very large (e.g. the Welsh uplands, or the Irish Sea). All, of course, are linked in some way and are part of the biosphere that encompasses all life on Earth. The scale that is considered will depend very much on the issue in-hand. Often, consideration at the scale of habitats will be appropriate as it corresponds well to the scale at which management is carried out (e.g. grazing on a heathland, or thinning in woodland). But many ecosystem processes (e.g. water cycles, deer population dynamics) are likely to operate at a broader scale, and it may be better to think in terms of landscape units such as river catchments, coastal zones or forest districts⁵.

⁵ Welsh Government (WG) (2011b). Natural Environment Framework Ecosystem Scale. Welsh Government Paper.
<http://wales.gov.uk/topics/environmentcountryside/consmanagement/nef/publications/evidence/ecosystemsscale/?lang=en>

What are Ecosystem Services?

The United Nations defines ecosystem services as “the benefits that people obtain from ecosystems”⁶.

They can be divided into 4 categories:

- **Supporting system and services** necessary for the production of all other ecosystem services, such as soil formation, nutrients cycling and primary production
- **Provisioning services** such as crops, fish, timber and genetic material.
- **Regulating services** such as water purification, biological control mechanisms, carbon sequestration, pollination of commercially valuable crops etc.
- **Cultural services** providing a source of aesthetic, spiritual, religious, recreational or scientific enrichment.

The importance of ecosystem services

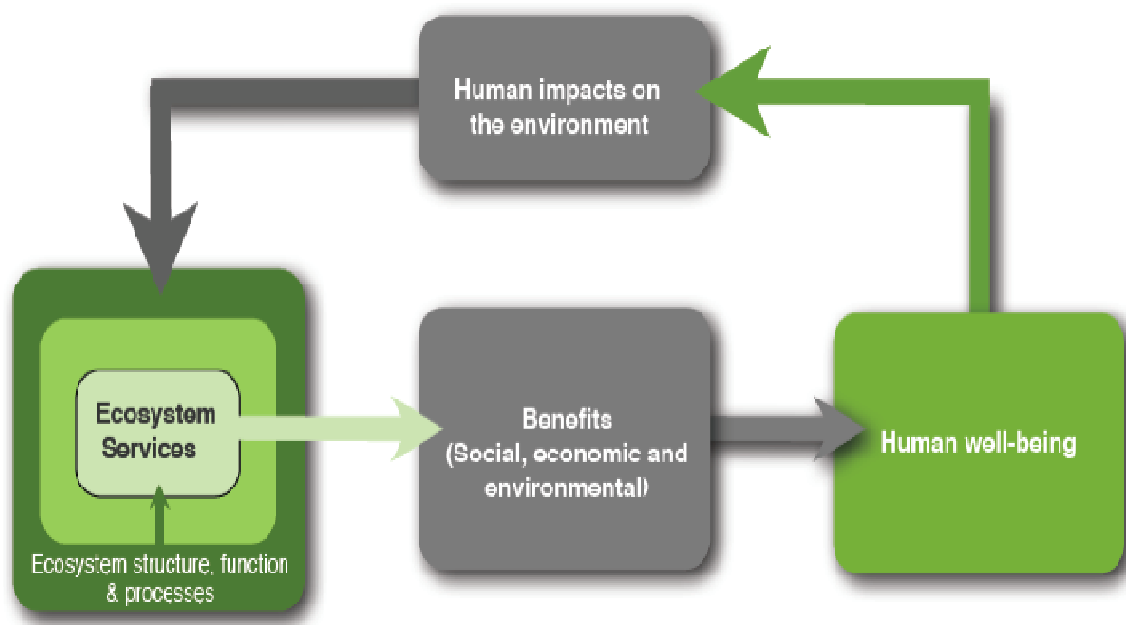
The **UK National Ecosystem Assessment, 2011**⁷ (UK NEA) was the first analysis of the UK's natural environment in terms of the benefits it provides to society and continuing economic prosperity. It states that *‘our wealth as a nation and our individual well-being depend critically upon the natural environment. It provides us with the soil, food, water and air that are essential for life and with the minerals and raw materials for our industry and consumption. Less obviously, it provides the processes that purify air and water, and which sequester or break down wastes. It is also in our environment where we find recreation, health and solace, and in which our culture finds its roots and sense of place. Scientists refer to these services that our environment provides as ‘ecosystem services’ recognising that it is the interaction between the living and physical environments that deliver these necessities.’*

All ecological processes are the product of interactions between different groups of organisms and are dependent on there being a range of these present. In this sense, biodiversity – the variety and variability of living organisms – ultimately underpins the functioning of all ecosystems and thereby the delivery of all ecosystem services.

⁶ Millennium Ecosystem Assessment, 2005. *Ecosystems and Human Well-being: Synthesis*. Island Press, Washington, DC Copyright © 2005 World Resources Institute
<http://www.maweb.org/en/index.aspx>

⁷ UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Synthesis of the Key Findings*. UNEP-WCMC, Cambridge.

Figure 3: Ecosystem Services link to human wellbeing (adapted from⁸)



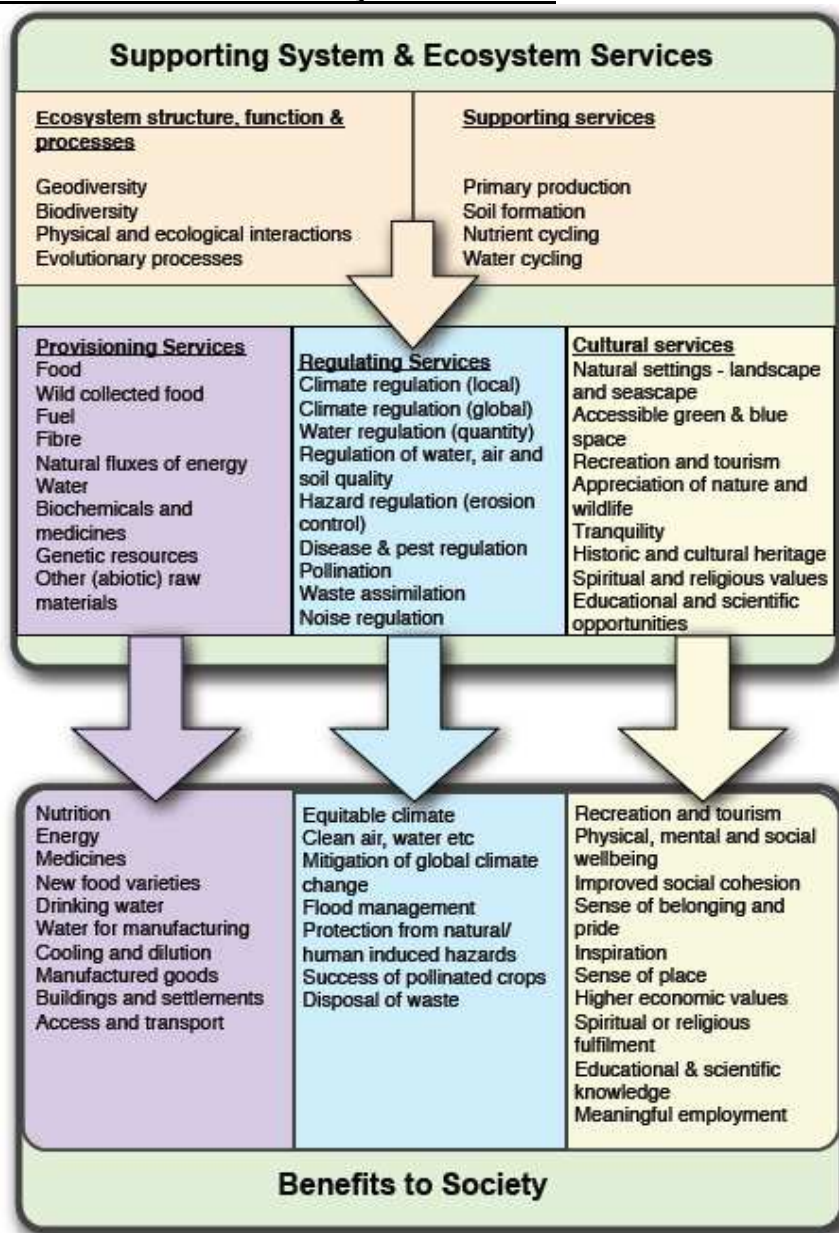
Defining Ecosystem Services in Our Work

The list of services provided here should be thought of as a framework to facilitate a more consistent approach to the application and reporting of an ecosystem approach. It should not however be a 'strait-jacket', particularly where local, or stakeholder derived services can provide added value. The list is a compilation of the most consistent features of the many lists and frameworks that have been produced around the world, and includes services considered most relevant to Wales. It is not intended to be exhaustive, and a degree of overlap is inevitable. It is the overall approach of capturing the services and benefits that matters rather than the details of placement.

The ecosystem services in **Figure 4** can be used as an organising framework or reference list to help manage information about key ecosystem and ecosystem service, issues and opportunities, much in the way that scoping matrices or topic areas do in project Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA). **See step 4 of the key steps section of the Framework in the next section.**

⁸ UK National Ecosystem Assessment (2011) The UK National Ecosystem Assessment: Technical Report. UNEP-WCMC, Cambridge.

Figure 4: A Reference List of Ecosystem Services



For a more detailed description of the ecosystem services presented above please see Annex 2.

An essential step in the framework process is to understand the ecosystem services and underlying processes relevant to the activity or place. This can be done in a number of ways⁹:

- o **A service led approach** – starts with the ecosystem services and looks at how different landscapes or contexts provide each, based on factors such as geology; soils; land cover; biodiversity and management (sea-bed characteristics etc for

⁹ Adapted from: England's Terrestrial Ecosystem Services and the rationale for an Ecosystem Approach. Technical Report to Defra by Haines- Young, R and M. Potschin (2008)

marine). This approach lends itself to regional/national scale mapping using GIS tools – e.g. linking carbon sequestration to soils, topography and land cover. A potential drawback of this approach is that as this tends to look at services individually it can easily miss links between services. This makes it harder, for example, to identify situations where improving one service can have positive or negative impacts on other services. **Section 4 of this framework – Evidence and Resources, provides links to data and GIS approaches to show how this can be done.**

- o **A habitat based approach** – describes the services provided by each habitat present within the area of interest. There are a number of different classification systems for habitats in the marine and terrestrial environments, including a broad habitat classification system for Welsh habitats developed through the NEF work¹⁰, and more detailed levels of habitat and biotope classification developed over decades to support conservation work. The scale at which this is applied will depend on the issue or problem being tackled. This approach can be good for communicating with land managers and in helping to understand the multifunctional characteristics of landscapes. However, it can miss the links between habitats and ecosystem service provision across wider landscapes, and the value of finer scaled habitats. **Section 4 of this framework – Evidence and Resources, provides links to data and GIS approaches to show how this can be done. There is also a link to the evidence base of ecosystem service provision by the habitat type.**
- o **A place based approach** – As environmental decision making often involves specific geographic areas, this approach encourages people to think about how different ecosystem services inter-relate around a place. Essentially this approach combines the habitat and service-led approach and builds on the strengths of both. This is a good ‘arena’ for stakeholder participation in the identification and valuation of ecosystem services and for cross-sectoral collaboration. Because it allows for comparison between services on a landscape scale, it can also be used to start identifying areas where synergies between services exist or where trade-offs need to be made.

In practice a combination of all of these approaches is likely to be valid for any given situation. The importance of stakeholder participation in the identification of relevant ecosystem services and issues should not be underestimated.

Understanding Ecosystem Resilience and Limits

Provisioning, regulating and cultural ecosystem services are ultimately based on supporting systems and services that result from the interactions of biodiversity, geodiversity, the atmosphere and physical processes. For our approach to natural resource management to be sustainable, these systems and services need to be in good condition and have the capacity to adapt to continue to provide the services we need, and those we may need in the future. An essential part of an ecosystem approach therefore is to manage the feedback between human drivers and impacts

¹⁰ Welsh Government (WG) (2011b). Natural Environment Framework Ecosystem Scale. Welsh Government Paper. (http://wales.gov.uk/topics/environmentcountryside/consmanagement/neff/publications/?view=Search+results&lang=en&gf_subcategory_select=5727463&gf_freesearch=&image.x=43&image.y=10)

and the supporting system to ensure that a sustainable balance is achieved and maintained.

Welsh ecosystems are, however, often highly modified, in terms of their scale and condition. Around a third of the services delivered by Welsh habitats are in decline, many others are in a reduced or degraded state, including marine fisheries, wild species diversity and some of the services provided by soils. Reductions in ecosystem services are associated with declines in habitat extent or condition and changes in biodiversity, although few of the underlying relationships are well understood.

The *resilience* of an ecosystem is its ability to absorb, or recover from, disturbance, although the term is often used more broadly to refer to the general sustainability of the system. Factors to be considered in building resilience include:

- Extent (so that the full range of biodiversity is present and larger scale processes can operate).
- Condition (through good management and reduction of damaging external influences).
- Connectivity (both *ecological*, to reverse the effects of fragmentation so that natural dynamics are restored and to provide some mitigation against climate change impacts, and *functional*, so that linkages are restored between ecosystems).
- Diversity (including biological, landscape and socioeconomic, to have the capacity to adapt to change).

Ecosystem Services

The list of ecosystem services provided in Figure 4 and described in detail in Annex 2 are provided as a guide for users to explore ecosystems and ecosystem services as part of the process described in section 3 of this framework.

- Use any of the above approaches (service led, habitat led or place led) or a combination to describe the ecosystem and their services – both existing and potential relevant to the NRW activity concerned.
- It may be easier to start the assessment with the provisioning, regulating or cultural services and work back to the supporting system and services
- Base the assessment of the supporting system/services on known baseline/trends in areas such as soils, ecosystem structure, function and biodiversity/geodiversity – linked specifically to the ecosystem service issues identified earlier.

Prioritising and Valuing Ecosystem Services

- The approach to prioritising and determining the relative value of ecosystem services will be based on a combination of available science and expert judgement, and will be informed by stakeholder opinion.
- The approach will be tiered, with most cases seeking to rank/prioritise services relative to each other, at least as an initial step.
- In other cases it may be useful to gain an understanding of the broad magnitude of monetary value, perhaps to scope out opportunities for Payments for Ecosystem Services (PES).
- A number of valuation tools are available (see references in section 4 of this document) to better understand the detailed costs and benefits of ecosystem services, however there is still considerable debate about the application of these

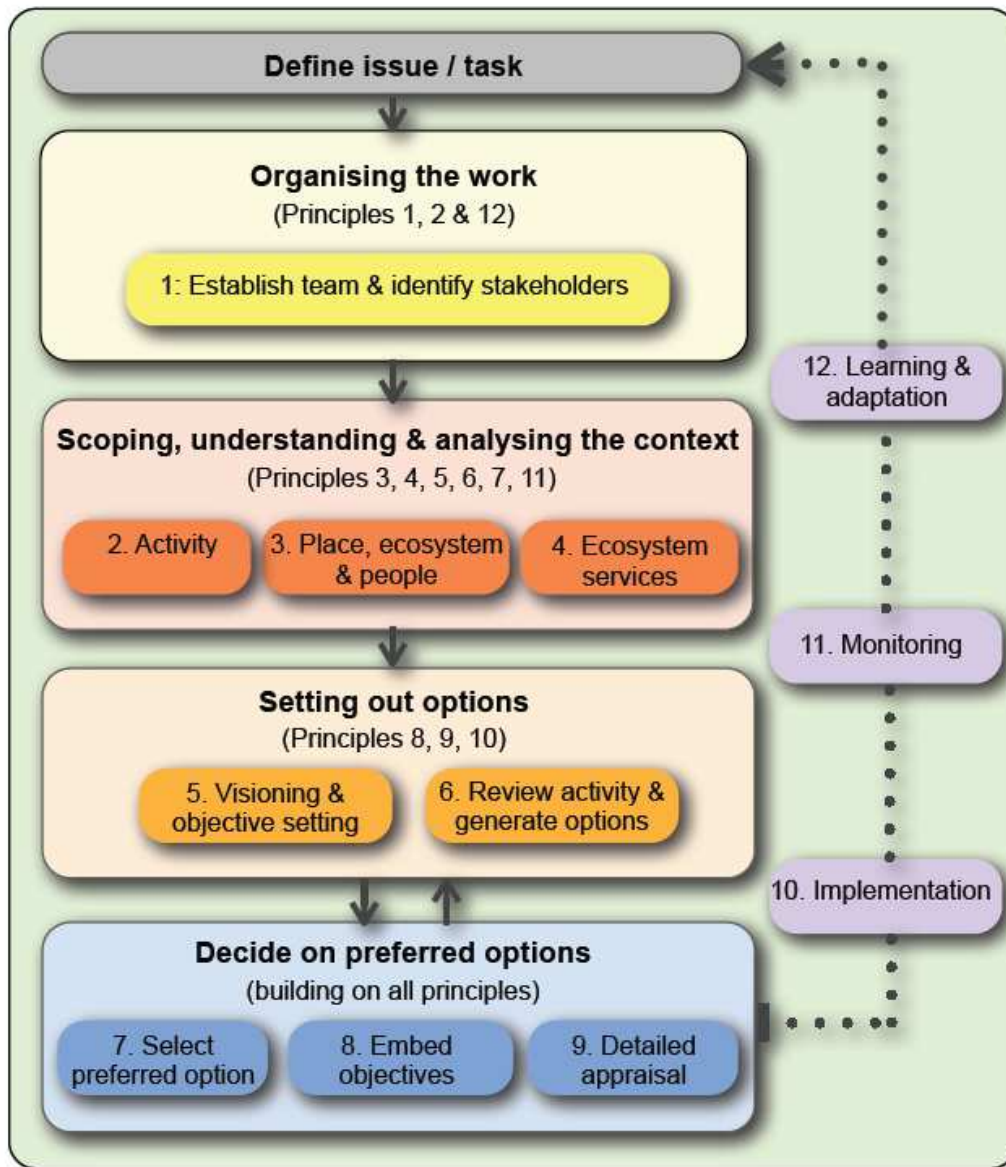
As recognised in principle 4, economics can help understand why the value of an ecosystem service is not fully recognised. In economic terms this is often due to the problem of 'public goods' such as water quality or biodiversity being exploited or degraded because their true value is not recognised in markets. It will be important to recognise what type of market or regulatory failure is occurring so that a suitable remedy can be applied. This could range from the provision of better information, establishment of suitable partnerships, consideration of subsidies and incentives, or payment for ecosystem services, through to the use of regulation and designations.

3. Key Steps – the process

Central to this framework are 12 steps, set out in **Figure 5** below, which will help us integrate the ecosystem approach principles into our work. The principles numbered relate to those presented in table 3 above. The suggested activity for each stage is described in a box **at the end of this section**. Where appropriate these boxes include hyperlinks to the useful resources presented in [section 4](#).

The greatest benefit from using this approach will come from using it at the start of any activity, before proposals are formed, positions taken, or applications made. However, it is recognised that NRW may often be dealing with proposals made by others, where such an approach has not been applied. In these cases, value can be added by discussing earlier stages and wider ecosystem solutions with third parties. It is also recognised that wider policy changes are needed to move the ecosystem approach onto a firmer footing with external organisations.

Figure 5: Key steps in applying the ecosystem approach



For a more detailed description of the key steps and potential issues to consider presented above see the box at the end of this section.

The level of detail or relevance of each step will need to be proportionate and reflect the influence and entry point of NRW staff. While a NRW led activity can cover all of the steps at an appropriate level of detail, responding to a consent application or third party consultation is likely to require less detail and a focus on the steps that can be influenced, usually in the latter stages of the process.

The idea is that users will recognise where these stages sit within their current activities, and embed them as part of that activity. In reality NRW will often only be able to influence later stages, particularly where third parties are involved, or where significant work has already taken place. However the overall approach should provide a firm basis for discussion and re-visiting certain aspects as well as a clear approach for new activities or where the activities are within the control of the organisation

While it is easier to present this as a linear process, it should be remembered that like all such processes, it is of course iterative. Earlier stages will sometimes have to be re-visited in the light of new information, and parts of an activity (or, sometimes all of it), having to be re-thought or re-designed.

The bullets and questions in the boxes below are not exhaustive, prescriptive or necessarily sequential. They are designed as prompts for the sorts of questions or actions we should be considering at each key stage to embed a wider understanding of ecosystems and their services

Key steps

1. Establish Project Team and/or identify key stakeholders:

- ⇒ For large or complex activities, establish a multidisciplinary project team (including external partners where required) with a mix of skills to cover both the prime objectives of the activity and the mix of likely ecosystem issues which need to be considered
- ⇒ Identify key stakeholders and involve them from the start and throughout. Additional or different stakeholders may be identified as we progress through these steps.
- ⇒ Ensure the project manager or lead has the right skills to facilitate and enable wider multidisciplinary and cross sector collaboration
- ⇒ Even for apparently simple/minor pieces of work, it should be possible to identify stakeholders (any person or body who could affect or be affected by that decision or process)
- ⇒ Recognise the importance of partnerships and being part of wider networks – be a key stakeholder for third party activities.
- ⇒ The language relating to the ecosystem approach can become a barrier. Fit the language to the audience by just saying what the services are e.g. reduction in flooding rather than water regulation.

2. Understand the activity:

- ⇒ What is the activity?
- ⇒ What is its purpose and specific objectives (policy context, need etc)?
- ⇒ Who will benefit and how?
- ⇒ What uncertainties exist with regard to the activity (now and into the future)?
- ⇒ What are its spatial and temporal dimensions and why have the locations and timings been proposed?
- ⇒ What are the likely environmental impacts (and benefits) of the activity - their nature, magnitude, timing, duration and frequency?
- ⇒ Are there potential cumulative impacts alongside other activities?
- ⇒ What are the impacts on adjacent areas?
- ⇒ What are the key interdependencies (e.g. customers; suppliers; raw materials; finance)?
- ⇒ Are there any Legislative or Regulatory requirements and/or implications for the activity?
- ⇒ Will the activity change because of the consequences of climate change?

3. Understand the Place, ecosystems and people: key drivers, issues and opportunities:

- ⇒ What is the spatial scale and extent of the place/places relevant to this activity?
- ⇒ What ecosystems, habitats and species are present? (including status, condition and trend etc).
- ⇒ What geodiversity issues are present which could impact on the activity?
- ⇒ What ecosystem processes are taking place and how do they relate to other areas? (e.g. river flow, grazing systems, combinations of habitats)
- ⇒ How is the place managed and regulated? (e.g. designations; Local Development Plans; Glastir etc)
- ⇒ What are the key drivers for change?
- ⇒ What social, economic and other environmental features or issues (relevant to the activity) are present?
- ⇒ How might the place and the factors identified above change without the activity (e.g. in response to climate change)?
- ⇒ What are the known environmental/regulatory limits?
- ⇒ How does the place contribute to ecological networks and resilience?
- ⇒ What is fixed and what can be changed?
- ⇒ Will the activity be vulnerable to climate change e.g. precipitation changes?
- ⇒ What are the connections and dependencies across this place and its wider context

4. Understand the ecosystem services relevant to the activity and place:

- ⇒ Use the list of services presented in part 2 of this framework as a guide
- ⇒ What ecosystem services and benefits are currently provided by this place, and what is the appropriate scale at which to consider them?
- ⇒ What are their current state, condition and trends?
- ⇒ How valuable are these services and to whom?
- ⇒ What are the dependencies of the activity (i.e. services required by the activity)
- ⇒ Who are the main beneficiaries and/or those impacted for these services and where are they located?
- ⇒ How is this place linked to the wider landscape in providing these services and benefits?
- ⇒ How vulnerable are the ecosystems and their services and how might they change over time due to drivers such as climate change, pollution, energy use, consumption etc?
- ⇒ How could service provision and benefits be enhanced?
- ⇒ How could the management of the natural environment support climate change adaptation?
- ⇒ What additional services could potentially be provided?
- ⇒ What are the likely impacts of the activity on each service and the system?
- ⇒ What are the Interdependencies between the services
- ⇒ Are any of the services more or less important than their state/condition imply (e.g. an apparently low value service may be critical to a local economy or to the survival of particular species)?
- ⇒ How can the ecosystem be more resilient?

5. Visioning and objective setting based on the above

- ⇒ Based on the issues and opportunities identified from steps 3 and 4, bring the stakeholders (with their range of relevant skills and experiences) together to work creatively (based on evidence) to generate a shared vision for the activity or place.
- ⇒ Participants should be encouraged to use open creative thinking to identify alternative opportunities and solutions for addressing issues.
- ⇒ Given the wider issues and opportunities identified, what are the key objectives needed to address these and to deliver the shared vision for the activity or place? For example if the above analysis includes the need to alleviate downstream flooding/pollution, address health inequalities or biodiversity issues, how can these requirements be built into our work – incorporation of wetlands, footpaths/cycle paths, habitat creating landscaping etc.
- ⇒ How can these new objectives inform or change the original objectives of the activity?
- ⇒ Focus on 'win wins' and opportunities to enhance ecosystem service provision and multiple social economic and environmental benefits.
- ⇒ Explore opportunities for incentive schemes for ecosystem services, such as Payments for Ecosystem Services (PES)

- ⇒ How can we restore as well as just maintain ecosystems, so that they develop ecological resilience (e.g. climate change impacts and the drivers identified in 3 above)?
- ⇒ What collaborative opportunities exist (e.g. to deliver other people's objectives, wider benefits or regulatory requirements)?
- ⇒ Has this activity been undertaken in a similar place before, what worked well, what lessons can be applied to this activity?

6. Review activity and generate options

- ⇒ Does the original activity deliver against the objectives identified above?
- ⇒ Where are the key tensions and synergies (e.g. impacts and opportunities)?
- ⇒ How can the original objectives of the activity be informed or changed by the wider ecosystem evidence to deliver its original purpose (e.g. is there enough water?)?
- ⇒ Is the activity still relevant, and are the benefits and impacts out-weighed by wider ecosystem service benefits? Should the activity go ahead?
- ⇒ Could aspects of the activity be changed (e.g. location and timing)?
- ⇒ What alternative ways are there to deliver/address the activity/issue?
- ⇒ Involving key stakeholders, generate a 'long list' of options which deliver the original purpose and address the key ecosystem approach objectives.
- ⇒ Is the evidence likely to be available within time and cost constraints?

7. Select preferred option(s)

- ⇒ How effective is each option at the delivery of the original purposes and objectives of the activity?
- ⇒ How does each perform against the wider vision and ecosystem approach objectives (from step 5 above)?
- ⇒ Impacts on supporting ecosystem and processes?
- ⇒ Impacts on wider ecosystem services, benefits and beneficiaries?
- ⇒ Opportunities for multiple and enhanced ecosystem services
- ⇒ Opportunities for restoration and enhancement of ecosystems.
- ⇒ Resilience to climate change and other man-made or natural challenges.
- ⇒ Priority or value of services and benefits- see note on prioritization/valuation below.
- ⇒ What are the risks associated with each option for ecosystems, economy & people?
- ⇒ How does the precautionary principle apply and what opportunities are there for adaptive management?
- ⇒ Is monitoring in place to ensure the activity achieves its objectives?

Depending on the scale, timing and resource constraints for an activity, an (initial) option appraisal can be 'light touch' based perhaps on expert judgment and stakeholder knowledge. For statutory processes such as SEA; EIA etc, these 'assessment of alternatives' would have to be underpinned by a more detailed appraisal with more robust evidence.

Assessing options to identify those to go forward for more detailed assessment is a standard project/environmental management approach, particularly for large or complex activities. This iteration can involve options on a range of factors, including design; location and timing of an activity or its components and can be repeated throughout the key stages in its development (from inception; concept and outline stages to detailed design and delivery). This is also reflected in the iterative nature of EIA; SEA and Sustainability Appraisal for project, programme, plan and policy assessment/appraisal and development.

8. Embed ecosystem approach objectives into the design and development of the preferred option

- ⇒ Embed ecosystem approach objectives, reflecting those into detailed design, timings, location etc of activity and its components, throughout the development of the activity.
- ⇒ Develop a suite of ecosystem approach based outcomes or targets to compliment activity specific outcomes/targets.

9. Detailed appraisal

- ⇒ Before implementation or delivery, test the design/final detail of the activity against the vision and objectives agreed in Step 5 above.

10. Implementation

- ⇒ Depending on the nature and scale of the activity, ensure that the ecosystem approach objectives and targets are built into any project or environmental management system for the delivery of the activity (e.g. policy; plan; programme or project).

11. Monitor activity against ecosystem objectives and outcomes

- ⇒ Agree a proportionate monitoring protocol.
- ⇒ Build into reporting system for Natural Resources Wales and Welsh Government.

12. Learning and adaptation

Ensure that lessons learned are fed back to modify or inform current or future activity. This is an extremely important and often overlooked step which given our limited experience of embedding the ecosystem approach will be particularly important to record.

4. Evidence and Resources: things to help

This section of the framework outlines the evidence and resources available to help you to implement the ecosystem approach in your work. It is not intended to provide a comprehensive list of all resources available, or indeed to provide all the answers. Instead it is intended to serve as a starting point and direct you to key documents and web sites. This area of work will develop over time as additional, or more accurate, data or tools and reports become available.

Possibly the most important step to take is setting up a multidisciplinary team – talk to those with different areas of expertise as this will almost certainly lead to new ideas and new perspectives that could improve the outcome of your work.

This section is mainly framed around 3 main headings of ecosystems, people and value. There are also useful guides from the Convention on Biological Diversity that set out how to apply the ecosystem approach to a project or issue:

Beginners guide: <http://www.cbd.int/ecosystem/sourcebook/beginner-guide/>

Advanced users guide: <http://www.cbd.int/ecosystem/sourcebook/advanced-guide/>

1. Ecosystems

Understanding ecosystems and service provision

As described in section 2 ecosystems services are the ‘benefits that people obtain from ecosystems’. An essential step in the framework process is to understand the ecosystem services and underlying processes relevant to the activity or place. This can be done using a service, habitat or place based approach. In order to help NRW staff to do this a report has been published aimed at providing an overview of the baseline evidence for the provision of services by Welsh ecosystems.

Providing evidence on all the ecosystem services listed in figure 4 for terrestrial, freshwater and marine environments is an enormous task. Hence this report is the first stage of gathering the evidence base and identifying some of the key evidence gaps for NRW. The information on the current baseline in the report is also presented in a matrix. Where possible, references are given to enable staff to get further information for a particular subject area. An example of the matrix for upland habitats only is given in Annex 3. A similar matrix is available for heath & grasslands; arable farmlands; woodlands; urban; freshwater & wetlands; coastal margins; and marine intertidal, inshore and offshore.

See – [Provision of Ecosystem Services by Welsh Ecosystems: An Evidence Base](#). Pagella, T. , Thomas, Rh., Latham, J., Lindenbaum, K. (2013). LWP report.

The following may also be of interest;

- *Scientific research in Wales*¹¹ - summary of current research in Wales on delivery of ecosystem services or the application of the ecosystem approach in practice.

¹¹ Russell, S. (2012). Scientific research in Wales on ecosystem services.

- *Review of evidence gaps*¹² - An initial review of the ecosystem approach evidence needs and gaps.
- Former [CCW green space toolkit](#)¹³
- [UK National Environment Assessment](#)¹⁴
- [Ecosystem services: A guide for decision makers](#)¹⁵
- [Nature in performance: Initial recommendations for integrating ecosystem services into Business Performance Systems](#)¹⁶
- Wildlife Trusts Good Practice Guidance¹⁷ – '[Planning for a healthy environment: good practice for green infrastructure and biodiversity](#)'.

Data and mapping

(i) Key datasets for mapping ecosystem services

The creation of NRW brings together large datasets held, licenced or owned by the three legacy bodies. This gives an opportunity to review the datasets in relation to their applicability to support implementation of the ecosystem approach. A preliminary assessment of the relevance of NRW datasets to ecosystem services (figure 4) has been undertaken as is published in the report below.

Some examples of the maps available are:

- Supporting systems and services – designated sites (e.g. SSSIs, SACs), habitats (e.g. Phase I terrestrial, Marine Intertidal Phase I) and species (e.g. RSPB birds data, National Fisheries Monitoring Programme);
- Provisioning services – forestry (e.g. FC land, National Forest Inventory), flood risk management (e.g. flood storage areas, historic flood map) and energy (e.g. windfarms);
- Regulating services – water regulation (e.g. WFD, Bathing Waters and Shellfish Waters data), local climate regulation (e.g. former CCW weather stations, met office rain gauges) and air regulation (e.g. UK critical loads);
- Cultural services – landscapes and seascapes (e.g. LANDMAP, CADW maps), recreation (e.g. Rights of Way, public forests) and designated sites (e.g. NNRs, LNRs, AONBs).

See – [Existing Ecosystem Approach Datasets for Natural Resources Wales](#). Thomas, Rh. (2013). LWP report. And supporting [spreadsheet](#).

Data from the [National Biodiversity Network](#), Local Record Centres data and [GeoConservationUK](#) may also be of interest.

(ii) Spatial Mapping Tools

To implement an ecosystem approach spatial tools can help in visualising the area affected by a particular existing or proposed activity and in decision making. A variety of tools developed by the legacy bodies can help with, for example,

¹² Pagella, T., Thomas, Rh, Latham, J. & Lindenbaum, K. (2013). [A preliminary review of the relevance of research questions identified during consultations on the application of the ecosystem approach in Wales](#).

¹³ <http://intranet.ccw.gov.uk/portal/page/portal30/home/recreation-access/urban-green-spaces>

¹⁴ <http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx>

¹⁵ World Resources Institute (2008). Ecosystem services: A guide for decision makers. http://pdf.wri.org/ecosystem_services_guide_for_decisionmakers.pdf

¹⁶ World Resources Institute (2011). Nature in performance: Initial recommendations for integrating ecosystem services into Business Performance Systems. http://pdf.wri.org/nature_in_performance.pdf

¹⁷ The Wildlife Trusts (2012). Planning for a healthy environment: good practice for green infrastructure and biodiversity

stakeholder engagement, assessing sensitivities and mapping ecosystem services. This report outlines some of the spatial tools which are currently available to staff in NRW and can be used to help in the implementation of the ecosystem approach. Some of the tools are summarised in the report may be useful in mapping habitat connectivity, ecosystem services, marine sensitivities, peatland and cultural areas.

See - [Spatial Tools to Support the Ecosystem Approach for Natural Resources Wales](#). Thomas, Rh., Elliott, J., Latham, J., Rothwell, J., Aron, H., Smith, K. & Davies, G. (2013). LWP Report.

(ii) Resilience

An ecosystem's resilience is its ability to survive, adapt and recover from disturbance. Resilient ecosystems will therefore also more reliably provide ecosystem services. To be resilient, ecosystems need to be well managed, and have sufficient extent and connectivity. Diversity (both natural and socio-economic) is also a vital element, as it provides the underlying resources to allow ecosystems to adapt to change. A key part of the ecosystem approach is to consider the feedback between disturbance (including use of ecosystem services) and an ecosystem's resilience. Many of NRW's activities already relate to this, for example through work on monitoring, condition assessment and environmental limits. But there is a need to develop and coordinate these to provide a more thorough and practical understanding of our ecosystem's resilience. A paper is available which reviews the concept of resilience and its application to Welsh ecosystems. It is hoped that it will stimulate discussion on its practical application and measurement, and inform the development of the concept by NRW, WG and partners in the future.

See – **Ecosystem Resilience: a discussion paper on the use of the concept for Natural Resources Wales**. Latham, J., Spode, S., & Thomas, Rh. (2013). LWP Report.

2. People

Engagement

- Former [CCW Stakeholder toolkit](#)¹⁸ is available to staff as a guide to stakeholder and community engagement.

Following may also be of interest;

- *Defra Guides* - Defra has published a guide for '[participatory and deliberative techniques to embed an ecosystem approach into decision making](#)'¹⁹. This gives advice on how to begin building participation into decision making when taking an ecosystem approach. Also published is '[What nature can do for you: A practical introduction to making the most of natural services, assets and resources in decision making](#)'²⁰.
- [Participation Cymru](#) specialises in public and community engagement.

¹⁸ <http://intranet.ccw.gov.uk/portal/page/portal30/home/external-communications/external-relationships/stakeholder>

¹⁹ Fish, R., Burgess, J., Chilvers, J. Footitt, A., Haines-Young, R. Russel, D., Winter, D.M. (2011) Participatory and Deliberative Techniques to embed an Ecosystems Approach into Decision Making: an introductory Guide. (Defra Project Code: NR0124).

²⁰ Defra (2010); What nature can do for you A practical introduction to making the most of natural services, assets and resources in policy and decision making.

- *Stakeholder engagement* – [guidance on stakeholder engagement](#) is available. The [biodiversity toolkit](#)²¹ may help in landscape scale issues.

Health

- ["Health Maps Wales"](#)²², developed by NHS Wales, show a number of health indicators and can be useful for targeting areas for health related projects.
- Former [CCW commissioned](#) a review of evidence relating to health, wellbeing and the natural environment²³. It gives suggestions for how health and well-being is incorporated into the work of organisations with a traditionally 'environmental' remit.
- Defra funded Ecosystems Knowledge Network has outlined ways to [incorporate public health goals into ecosystem management](#)²⁴. There is evidence on the links between [nature and health](#) (e.g. [Forest Research evidence](#)²⁵), as well as practical examples of projects (e.g. [Let'sWalkCymru](#), FC Scotland [Branching Out](#) for mental health, [NHS Forest](#), [Green Gyms](#)).
- [Wales Health Impact Assessment: A Practical Guide](#)²⁶ - on how to consider the health and well-being of a population that may be affected by a proposed action, policy or project.

3. Value

Valuing ecosystem services is a useful tool but it's important that it does not dominate project delivery and discussions. Valuation is not all about prices. However, if appropriate, the following resources may be useful in considering valuing ecosystem services:

- Defra guide - [An introductory guide to valuing ecosystem services](#)²⁷;
- Defra PES Guide - [Payments for ecosystem services: a short introduction](#)²⁸,
- [Valuing environmental impacts: Practical guidelines for the use of value transfer in policy and project appraisal](#)²⁹.

Case Studies

In addition to the above a range of case studies are being undertaken within the legacy bodies. These will be made available to NRW staff as examples of good practice in implementing the ecosystem approach.

²¹ <http://www.biodiversityplanningtoolkit.com/biodiversity.asp>

²² <http://www.infoandstats.wales.nhs.uk/page.cfm?orgid=869&pid=40976>

²³ Institute of Rural Health (2008). Natural Heritage: A Pathway to Health. CCW Policy Research Report No. 07/20. www.irh.ac.uk/pdfs/publications/NaturalHeritage.pdf

²⁴ <http://ekn.defra.gov.uk/resources/tools-guidelines/health/>

²⁵ Forest Research Trees and Woodlands: Nature's Health Service report. <http://www.forestry.gov.uk/fr/INFD-5ZBBG5>

²⁶ <http://www.wales.nhs.uk/sites3/page.cfm?orgid=522&pid=63782>

²⁷ Defra (2007). An introductory guide to valuing ecosystem services.

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69192/pb12852-eco-valuing-071205.pdf

²⁸ Defra (2010). Payments for ecosystem services: A short introduction.

<http://archive.defra.gov.uk/environment/policy/natural-environ/documents/payments-ecosystem.pdf>

²⁹ efttec (2010). Valuing Environmental Impacts: Practical Guidelines for the Use of Value Transfer in Policy and Project Appraisal. Case Study 5 – The Benefits of Designation of Marine Conservation Sites.

<http://archive.defra.gov.uk/environment/policy/natural-environ/using/valuation/documents/case-study5.pdf>

Evidence & Resources

The evidence and resources listed in this section are provided to help you implement the ecosystem approach in your work. For ecosystems, resources are provided to guide you on the evidence base of the ecosystem services provided by habitats, spatial modelling tools and useful datasets for mapping to assist in implementing the ecosystem approach. Useful aids to help with stakeholder engagement and assessing health/recreation benefits of an activity are also given above along with links to guides for valuing services where appropriate.

The resources provided are not an exhaustive list and there may be others which you may find useful. Indeed a major part of testing this framework will be to develop further tools and resources.

Setting up a multidisciplinary team is an important resource - by talking to those with different areas of expertise as this will almost certainly lead to new ideas and perspectives.

ANNEX 1: The 12 Principles for an Ecosystem Approach and Operational Guidance for the Application of an Ecosystem Approach

Societal Choice

Principle 1: The objectives of management of land, water and living resources are a matter of societal choices.

Different sectors of society view ecosystems in terms of their own economic, cultural and society needs. Both cultural and biological diversity are central components of the ecosystem approach, and management should take this into account. Societal choices should be expressed as clearly as possible. Ecosystems should be managed for their intrinsic values and for the tangible or intangible benefits for humans, in a fair and equitable way.

Questions to consider:

- Who are the stakeholders that need to be consulted?
- What measures can be put into place to ensure stakeholders are involved at all relevant stages of the process in an equitable way?
- How do we best manage conflicts of interest? What mechanisms can we put in place to manage negotiations, trade-offs and conflicts between different stakeholder groups?
- How do we ensure that the process is transparent to everyone concerned?

Localised Decisions

Principle 2: Management should be decentralized to the lowest appropriate level.

Decentralized systems may lead to greater efficiency, effectiveness and equity. Management should involve all stakeholders and balance local interests with the wider public interest. The closer management is to the ecosystem, the greater the responsibility, ownership, accountability, participation, and use of local knowledge.

Questions to consider:

- What is the wider context for this work? For example, consider how the work fits in with existing government policies or local authority and 3rd sector initiatives.
- What can be done to ensure good communication between the different interests, at local regional and national levels and between these scales?
- What mechanisms can be used to maintain an appropriate balance among different interests?

Adjacent Effects

Principle 3: Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems.

Management interventions in ecosystems often have unknown or unpredictable effects on other ecosystems; therefore, possible impacts need careful consideration and analysis. This may require new arrangements or ways of organization for

institutions involved in decision-making to make, if necessary, appropriate compromises.

Questions to consider:

- Who and what else may be affected by the activity? I.e. what are the effects on adjacent and other ecosystems?
- How do we work around not knowing what the likely impact of an activity will be? Local stakeholder knowledge for example may be valuable for getting a better idea of potential wider impacts, whereas putting in place a monitoring system can be a useful way to assess actual impacts over the longer term.
- Is there evidence of impacts from research or case studies within or outside of Wales?
- Are there ways in which negative impacts can be minimised?

Economic Drivers

Principle 4: Recognizing potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context. Any such ecosystem-management programme should:

- o Reduce those market distortions that adversely affect biological diversity;
- o Align incentives to promote biodiversity conservation and sustainable use;
- o Internalize costs and benefits in the given ecosystem to the extent feasible.

The greatest threat to biological diversity lies in its replacement by alternative land use. This often arises by undervaluing natural systems and populations.

Often those who benefit from conservation do not pay the costs associated with conservation and, similarly, those who generate environmental costs (e.g. pollution) escape responsibility. Alignment of incentives allows those who control the resource to benefit and ensures that those who generate environmental costs will pay.

Questions to consider:

- Have you considered the economic context of the issue you are dealing with in terms of:
 - o The distribution of economic gains & losses from any proposed action?
 - o The opportunity to follow the polluter pays principle and internalise costs within businesses?
 - o Whether economic opportunities will be reduced now or in the future?

Ecosystem Resilience

Principle 5: Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a **priority target** of the ecosystem approach.

Ecosystem functioning and resilience depends on dynamic relationships within species, among species and between species and their abiotic environment, as well as the physical and chemical interactions within the environment. The conservation and, where appropriate, restoration of these interactions and processes is of greater significance for the long-term maintenance of biological diversity than simply protection of individual species.

Questions to consider:

- What are the critical thresholds in Welsh ecosystems, beyond which the systems fail?
- What extent and arrangement of habitats are required for ecosystems to be resilient?
- How can we link environmental limits and monitoring in a coordinated way to measure resilience?

Environmental Limits

Principle 6: Ecosystem must be managed within the limits of their functioning.

In considering the likelihood or ease of attaining the management objectives, attention should be given to the environmental conditions that limit natural productivity, ecosystem structure, functioning and diversity. The limits to ecosystem functioning may be affected to different degrees by temporary, unpredictable or artificially maintained conditions and, accordingly, management should be appropriately cautious.

Questions to consider:

- Have cumulative effects (both in time and space) been assessed when considering ecosystem limits?
- What mechanisms can be put in place to work around our gaps in knowledge about the actual limits (thresholds for change) in different ecosystems? For example, should a monitoring process be encouraged?
- With so many uncertainties in managing ecosystems, we must be proactive about learning from experience and adapting our approach. A systematic method of monitoring the effects of management and implementing lessons learnt is needed.

Spatial and Temporal Scale

Principle 7: The ecosystem approach should be undertaken at the appropriate spatial and temporal scales.

Appropriate spatial and temporal scales should be used to address the problem identified. The ecosystem approach can be applied to issues of any scale. The approach recommends the scale of analysis and action should be set by the problem that is being addressed.

The time taken for ecosystems to respond to management changes (positively and negatively) need to be taken into account in any actions taken.

Connectivity between areas should be promoted where it is necessary to address the problem encountered.

Questions to consider:

- Have you considered the most appropriate spatial and temporal scale for this work, taking into account:
 - o The wider environmental/ecological links that may influence the objectives of the work.
 - o The wider socio-economic context that may influence the objectives of the work.
 - o Time constraints and temporal cycles of relevant management frameworks.

Long Term Approach

Principle 8: Recognising the varying temporal scales and lag-effects that characterize ecosystem processes, objectives for ecosystem management should be set for the long term.

Time needs to be considered explicitly in formulating management plans, and in longer-scale processes need to be especially considered and planned for because these are otherwise often neglected.

Management systems tend to operate at relatively short time scales, much shorter than the timescales for change in ecosystem processes. Long-term ecological processes are therefore likely to be poorly accommodated in management systems, unless these are explicitly and carefully designed to address long-term issues.

Questions to consider:

- Are short term trends masking long term trends that should really be the focus of this work?
- Is it likely that there will be a significant time lag between delivering this work and achieving the expected outcome? If so, how can expectations be managed?

Managing Change

Principle 9: Management must recognize that change is inevitable.

Change in ecosystems is both natural and inevitable, and therefore management should adapt to these changes. Objectives should not be construed as fixed outcomes but rather focus on the maintenance of natural ecological processes, which drive changes.

This focus on processes needs a management approach that is flexible and adaptive, both as a response to changing circumstances and to take account of new knowledge and understanding. The ecosystem approach must utilize **adaptive management** in order to anticipate and cater for such changes and events and

should be cautious in making any decision that may foreclose options, but, at the same time, consider mitigating actions to cope with long-term changes such as climate change.

Adaptive management should generate new knowledge and reduce uncertainties, thereby allowing the manager to anticipate and cater for change. Ecosystem management must therefore involve a learning process that will help to adapt methods and practices to improve the ways in which these systems are being managed and monitored. Flexibility is also needed in policy-making and implementation. Long-term, inflexible decisions are likely to be ineffective or detrimental.

Questions to consider:

- Have we built in steps to ensure we can adapt this work in the light of further information or future change?
- How can we ensure lessons learnt here inform future work within this organisation and that of relevant partners?
- How much do we understand about natural variability of the issue/area we are working on? Can we reflect this in our approach?

Biological Diversity

Principle 10: The ecosystem approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity. Biological diversity is critical both for its intrinsic value and because of the key role it plays in providing the ecosystem and other services upon which we all ultimately depend.

There has been a tendency in the past to manage components of biological diversity either as protected or non-protected. There is a need for a shift to more flexible situations, where conservation and use are seen in context and the full range of measures is applied in a continuum from strictly protected to human-made ecosystems.

In Wales we recognise that geodiversity is also critical and underpins the ecosystem approach and suggest this is considered under principle 10 with biological diversity.

Questions to consider:

- How could this work promote integration of environmental, social and economic objectives?
- How does this work help to achieve an appropriate balance between conservation and use of biological diversity?

Evidence

Principle 11: The ecosystem approach should consider all forms of relevant information including scientific and local knowledge, innovations and practices.

Ecosystems can be viewed at various scales and from different perspectives, each yielding unique information and insights. Good management should therefore consider all relevant information; it depends on maximising the information inputs, carefully assessing their accuracy and relevance, and integrating the information into decision-making and management. Ongoing support for understanding and

Questions to consider:

- What different forms of information might be available to help inform this work?
- Has the information been shared with other stakeholders?
- Have we considered alternative approaches to delivering this work? Could alternative approaches be developed through stakeholder engagement?

information (e.g. research, monitoring, indicators, assessments, etc) is required.

Stakeholder Engagement

Principle 12: The ecosystem approach should involve all relevant sectors of society and scientific disciplines.

Most problems of biological-diversity management are complex, with many interactions, side-effects and implications, and therefore should involve the necessary expertise and stakeholders at the local, national, regional and international level, as appropriate.

The management of biodiversity, because of its complexity, and the significance of human impact, requires a wide range of scientific and management skills, including those located in sectors that have not traditionally been involved in biodiversity conservation or management.

Adopting the principles of the ecosystem approach provides a framework for fostering greater involvement of all relevant stakeholders and technical expertise in planning and carrying out coordinated activities, sharing management of resources or simply exchanging information

Questions to consider:

- Have we given appropriate emphasis on stakeholder engagement in developing and delivering this work?

ANNEX 2: Detailed Descriptions of the Ecosystem Services

SUPPORTING SYSTEM AND SERVICES

Supporting services are those that are necessary for the production of all other ecosystem services. They differ from provisioning, regulating and cultural services in that their impacts on people are often indirect or occur over a very long time. It is important to recognise the impact that people have on supporting services, often as consequence of using other services. An awareness of this, and the necessity to strike a suitable balance, is central to the ecosystem approach.

Ecosystem Structure Function and Processes

- Geo-diversity – e.g. geomorphology, landscape, topography, bedrock geology
- Biodiversity – All organisms
- Physical and Ecological Interactions - e.g. weathering, sediment transfer
- Evolutionary processes

Supporting Services (From UK NEA²²)

- Primary production and photosynthesis: The assimilation or accumulation of energy and nutrients by organisms. Photosynthesis which drives this produces oxygen which is necessary for most living organisms.
- Soil formation: Because many provisioning services depend on soil fertility, the rate of soil formation influences human wellbeing in many ways.
- Nutrient cycling: Approximately 20 nutrients essential for life, including nitrogen and phosphorus, cycle through marine and terrestrial ecosystems.
- Water cycling: Water is cycled through ecosystems and is essential for living organisms.

Adapted from *Millennium Ecosystem Assessment Ecosystems*³⁰ and UK NEA³¹.

Provisioning Services

These are the products obtained from ecosystems including:

- **Food (agriculture and aquaculture):** A vast range of food products are derived from plants, fish, animals and microbes.
- **Wild collected food:** This includes fish, shellfish, game, wild fungi, and plant products such as nuts and berries, and marine algae.
- **Fuel:** such as wood and other biological materials serve as sources of energy.
- **Fibre:** derived from materials such as wood jute, cotton, hemp, silk and wool.
- **Natural fluxes of energy:** Wind, water, wave, and tidal, are natural flows of energy provided from ecosystems which can be harnessed to a greater or lesser extent to provide renewable energy. Other important sources of renewable energy include geothermal and solar which come from the wider natural environment.
- **Water:** People obtain freshwater from ecosystems and therefore the supply of freshwater can be considered a provisioning service. This can be from

³⁰ Millennium Ecosystem Assessment, 2005. *Ecosystems and Human Well-being: Synthesis*. Island Press, Washington, DC Copyright © 2005 World Resources Institute

<http://www.maweb.org/en/index.aspx>

³¹ UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Synthesis of the Key Findings*. UNEP-WCMC, Cambridge

reservoirs, rivers, aquifers and groundwater. Water is also important for a variety of other uses, such as manufacturing, cooling, dilution, etc.

- **Bio-chemicals and medicines:** Many medicines, biocides, food additives such as alginates and biological materials are derived from ecosystems.
- **Genetic resources:** This covers the genes and genetic information used for animal and plant breeding and biotechnology
- **Other (abiotic) raw materials:** such as salt, stone, metal ores, aggregate, oil and minerals (e.g. coal, ores, sand and gravel).

Examples of benefits to human wellbeing: Food and nutrition; drinking water; water for manufacturing; cooling and dilution; new crop/livestock varieties; renewable energy; the source of manufactured products; medicines; locations and materials for buildings and settlement locations, including industrial development and communication routes.

Regulating Services

These are the benefits obtained from the regulation of ecosystem processes, including:

- **Climate regulation (local):** Ecosystems influence local climate for example changes in land cover can affect both temperature and precipitation, and can moderate urban heat island effects.
- **Climate regulation (global):** Ecosystems play an important role in global climate regulation through for example the 'locking up' of carbon in vegetation; soils and the oceans.
- **Water regulation:** The timing and magnitude of run-off, flooding (including coastal flooding) and aquifer recharge can be strongly influenced by changes in land cover and management.
- **Water, Air and Soil quality regulation:** Ecological processes (biochemical and physical) play a vital role in filtering and purifying water, air and soils. For example, the mitigation of air pollution in urban areas by trees and vegetation, or the role of wetlands or marine species (e.g. filter feeders such as mussels and oysters) in cleaning water.
- **Hazard Regulation – erosion control:** Vegetative cover plays an important role in soil retention and the prevention of landslides. Coastal ecosystems such as salt marsh and sand dunes can also help protect coastal areas from the sea.
- **Disease and pest regulation:** Ecosystem changes affect the prevalence of crop and livestock pests and diseases, and the ability of non-native species to prosper at a given location. Diverse ecosystems can be more resilient to pests and disease and the introduction of non-native species.
- **Pollination:** Ecosystem changes affect the distribution, abundance and effectiveness of pollinators, which in turn impact on the viability of the ecosystem itself and pollination dependent crops – mainly fruit in the UK.
- **Waste assimilation:** Ecosystems filter out and decompose organic wastes introduced into inland waters and marine ecosystems. They can also assimilate and detoxify compounds through soil and sub-soil processes (including processes within marine sediments).
- **Noise regulation:** the physical presence of vegetation can be very effective in absorbing noise, particularly alongside roads and in urban environments.

Examples of benefits to human wellbeing: include equitable climate – moderation of heat; drought etc; breathable air; clean water etc; mitigation of potentially calamitous climate change; climate change adaptation and resilience; avoidance of flooding; protection from natural and human induced hazards; success of pollination dependent crops, human and other wastes rendered safe.

Cultural Services

These are the non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation and aesthetic experiences, including:

- **Natural settings- landscape and seascape:** Many people find beauty, tranquillity or aesthetic value in various aspects of ecosystems, as reflected in the support for parks and scenic drives and in the selection of housing locations.
- **Accessible green space:** The natural environment provides an important setting for a huge range of outdoor social and recreational activities, many of which are beneficial for physical and mental health. For example the stress relieving effects of simply being in green surroundings is now well proven.
- **Recreation and tourism:** People often choose to spend their leisure time based in natural or cultivated landscapes, such as coastal landscapes or National Parks.
- **Nature and wildlife (appreciation of):** This includes the intrinsic value of nature to humans. The interest and fascination people have with the natural world, particularly the more charismatic species and attractive habitats, is demonstrated by the popularity of natural history programmes and the growing membership of wildlife organisations such as the Wildlife Trusts; RSPB and the National Trust for example.
- **Tranquillity:** There are psychological benefits of being in a tranquil environment which allows individuals to take respite from the periods of sustained stress that characterise modern living.
- **Historic and cultural heritage:** Many communities place high value on the maintenance of historically or culturally important places. Furthermore, ecosystems and the natural environment can influence and help define the cultural identity of communities.
- **Spiritual and religious values:** Many people attach spiritual or religious values to ecosystems or their components.
- **Educational and scientific opportunities:** The natural environment provides an 'outdoor classroom and laboratory' for the study and teaching of a diverse range of subject areas from ecology, geology, agriculture, maths and physics to the arts and crafts.

Examples of benefits to human wellbeing: include income and wellbeing benefits of recreation and tourism; physical, mental and social wellbeing; improved social cohesion; a sense of belonging and pride; inspiration (e.g. art, folklore and design); sense of place (better places to live work and invest in); higher property values; spiritual or religious fulfilment; educational and scientific knowledge; employment and voluntary work.

ANNEX 3: Provision of Ecosystem Services by Welsh Ecosystems – Upland example ³²

See the report for the references which are coded as letters in this matrix and for further information on the evidence base. This is an example for upland habitats. A similar matrix is available for heath & grasslands; arable farmlands; woodlands; urban; freshwater & wetlands; coastal margins; and marine intertidal, inshore and offshore.

Ecosystem services category	Ecosystem service	B- Upland								
		Dry Heath; Wet Heath	Upland Grassland	Bracken	Blanket Bog, Valley Mire, Flush	Rock; Scree	Upland Conifer plantation	Scrub	Upland Lakes	Upland Rivers
Provisioning Services	Food	B	D,C	BE	B					
	Wild collected food	B								
	Fuel				B		E			
	Fibre						E			
	Natural fluxes of energy	B	B	B	B		B	B	B	B
	Water						EC	EC	B	B
	Biochemicals and medicines	B								
	Genetic resources									
	Abiotic Raw Materials									
Regulating Services	Climate regulation - Local						E			
	Climate regulation - Global	AB1BB	AB, BB, CB	AB,BB	AB,BB		AB,EB		AB,FB	AB,FB
	Water regulation		C		GC		EC	EC	G	F
	Regulation of water, air and soil quality		C	BE	GC		E	EC	GC, F	F
	Hazard (Erosion) regulation		C				EC	E	F	F
	Disease and Pest regulation									
	Pollination						E			
	Waste assimilation						E		F	F
	Noise regulation									
Cultural services	Natural settings -Landscape and seascape	AD	AD	AD	AD	AD	AD	AD	AD	AD
	Accessible Green Space						ED	ED		
	Recreation & tourism	BD	BD	BD			ED		FD	FD
	Nature and Wildlife appreciation	B	B	B	B	B	E,B		B	B
	Tranquillity	AD	AD	AD	AD	AD	AD	AD	AD	AD
	Historic and cultural heritage	B	B	B	B	B	ED		B	B
	Spiritual and religious value									
	Education and scientific opportunity	B	B	B	B	B	B	B	B	B

Key

Published evidence (high confidence)

Published evidence (low confidence)

Expert opinion/assumed service

Unknown

Not applicable

³² Provision of Ecosystem Services by Welsh Ecosystems: An Evidence Base. Pagella, T. , Thomas, Rh., Latham, J., Lindenbaum, K. (2013). LWP report.