Creating a Protected Area Network for nature recovery in England

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Project details

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Foreword

Natural England's SSSI Future Reforms project commissioned several 'Think-Pieces' to inform discussion with stakeholders to develop a vision for what we want Sites of Special Scientific Interest (SSSI's) to deliver in future, and how we can best support the 25 Year Environment Plan to achieve 75% of protected sites in favourable condition by 2043, in the face of inevitable change to the natural world due to the Climate Crises. This report is one such think-piece providing a response to the question:

> 'We are interested in your thinking on how an 'Ecologically Connected' network (ECN) of protected sites / areas could work in England, based on the following draft vision:
>
> 'Creating a large and 'Ecologically Connected' Network of Protected Sites / Areas as a key component of 30 x 30 and the Nature Recovery Network, that is actively monitored and adaptively managed to ensure its effectiveness at conserving bio-geodiversity in the face of dynamic change'.

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Executive summary

This think-piece builds on previous work undertaken for Natural England and addresses the range of practical issues involved in creating: “a large and ‘Ecologically Connected’ Network of Protected Sites / Areas as a key component of the 30 x 30 target and the Nature Recovery Network [NRN], that is actively monitored and adaptively managed to ensure its effectiveness at conserving bio-geodiversity in the face of dynamic change”.

The current suite of SSSIs forms an important starting point for the creation of a national Ecologically Connected Network of protected sites/areas, (ECN), foreseen as a key element of the wider Nature Recovery Network (NRN). Whilst Sites of Special Scientific Interest (SSSIs) are spread across England, it has been long recognised that many are too small (especially in the lowlands), and that their distribution is typically fragmented.

Several factors in the legislative and policy landscape mean that there is an opportunity now to address these issues, tackle existing threats, and to begin to create an ECN. Important current opportunities and next steps include:

- Maximising the conservation potential of recent changes to agriculture support mechanisms in England to enhance the management of the wider countryside for nature through Environmental Land Management Scheme (ELMS).
- Using new policy initiatives and powers within the 2021 Environment Act and developing the concepts included in the Nature Recovery Green Paper published in March 2022.
- Using all policy options to enhance ecological connectivity between protected areas and their wider surrounding countryside.
- Further developing monitoring and assessment regimes. A well-established system of monitoring is already in place on SSSIs, and this could be developed further using risk-based approaches.
- Reforming governance and processes through enhancing existing partnerships and forming new ones to ensure the effective management of sites. In particular, this requires closer liaison and joint working with all parts of government and other organisations whose decisions influence land management (especially local authorities with respect to their new obligations under the 2021 Environment Act).
- Move the conceptual basis of the SSSI network and its management from a static approach to a more dynamic, adaptive one, especially given the likely consequences of climate change impacting on protected areas, whilst sustaining existing protection.
- Improve the wider profile and awareness of SSSIs, so as to ensure that protected areas are increasingly valued and supported by the public and stakeholders.

- Network development. Enhance the network concept and level of management with decision makers in all organisations and agencies with responsibility for land management.
- Use of new and existing policy and statutory tools. We note that some of the key building blocks (legislative and policy) needed to create a network are already in place, although others are needed, and that tackling known threats to existing SSSIs remains a priority for action.

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1. Introduction and background

1.1 Global context

The consequences of global climate change are increasing with resultant impacts predicted to increase (IPCC 2022). The recent Conference of the Parties of the Climate Change Convention (CoP 26) strongly emphasised the interlinkage of the twin emergencies of climate change and nature loss. Put simply, climate change impacts cannot be addressed separately from nature recovery. Recognizing the widescale impact on nature and that nature is part of the climate change solution brings into focus the important role that protected areas have in nature recovery, and their potential in both mitigating and adapting to climate change.

The proposed global "30 by 30" target[1] provides a focus for conservation action on protected areas, and on the need for nature recovery more generally. It is clear that if this target is to be met in England, and in other countries, then work needs to begin now to put in place effective conservation action on a large scale, that will begin to "bend the curve" of nature loss (*e.g.,* Tickner *et al.* 2020). Whilst the 30 by 30 target has yet to be formally agreed by countries the current draft states:

"Target 3. Ensure that at least 30 per cent globally of land areas and of sea areas, especially areas of particular importance for biodiversity and its contributions to people, are conserved through effectively and equitably managed, ecologically representative, and well-connected systems of protected areas and other effective area-based conservation measures and integrated into the wider landscapes and seascapes" (See also Section 3.11 below for more detail on the target).

Alongside these global discussions considerable progress on tackling climate change and the loss of nature is being made in England and elsewhere across the UK. The publication of Nature Positive 2030 by the UK nature conservation agencies (Natural England *et al.* 2021), the review of the economics of biodiversity (Dasgupta 2021); significant changes to the English agricultural support regime to help nature; and current and potential legislative changes; all highlight the need to recover nature in its own right and accordingly to help ensure our collective well-being.

For this new and developing agenda to succeed there needs to be a major shift in the scale of ambition for national nature conservation, including significant changes in the way we plan and manage protected areas. Developing a long-term, large-scale, and

[1] of the Convention for Biological Diversity's *Post-2020 Global Biodiversity Framework*

adequately resourced approach will be essential. This change in approach will need to go beyond the “planning” stage and put new approaches into practice in the short-term.

This report has a “real world” focus, and builds on previous work (Galbraith & Stroud 2020, 2021a,b) to provide a practical view of what could be done to underpin a Nature Recovery Network (NRN - a major commitment in government’s 25 Year Environment Plan[2]), that has protected areas, and an Ecologically Connected Network, (ECN) especially of SSSIs at its heart (Annex 4).

Given that the current English SSSI portfolio of 4,127[3] (of which over a quarter are designated for their geology and/or geomorphology) has, until recent years, been developed to provide a representative sample of the main threatened habitats and species across England, enhancing the purpose of this portfolio to become the core of the ECN will be a considerable challenge. This will require a range of innovative approaches, significantly renewed ambition for nature recovery and delivery at scale, engaging stakeholders in an inclusive way. We outline how this could be done, recognising the many uncertainties with such an approach. The initiatives noted above give opportunity to take action now, with added urgency given the speed and scale of current climate change.

1.2. The focus of this work

This report outlines a series of recommendations detailing how the Ecologically Connected Network (ECN) of protected areas including existing protected areas, could be created, and managed to best protect a dynamic natural world in the context of accelerating climate change. To do this, it will be necessary to:

1. Understand the current state of the resource.
2. Clarify what needs to change; and
3. Agree the direction and purpose of that change.

The report considers each of these issues and suggests a means to deliver the Network. We highlight key actions, the decisions required and the issues to resolve at each stage of network design, delivery, and management.

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[2] "We will support nature’s recovery and restore losses suffered over the past 50 years. We will develop a strategy for nature to tackle biodiversity loss, develop a Nature Recovery Network to complement and connect our best wildlife sites, and provide opportunities for species conservation and the reintroduction of native species."

[3] SSSI Feature Condition Summary accessed on 25 October 2022

2. Developing a national network - global learning

The development of national networks of protected areas has been underway in many countries stimulated by international treaties such as the EU Nature Directives, and the Bern and Ramsar Conventions (Stroud & Davidson 2021). However, other than the European Union's Natura 2000 network, rarely has such network building followed systematic approaches (Romão *et al.* 2012).

The following issues and practices seem appropriate here, and have been internationally highlighted (CMS 2014, 2020) as being of particular importance in the design, implementation, and management of ecologically connected site networks:

- "Having a shared vision among cooperating parties, and a clearly expressed purpose.
- Having strong, sufficiently broad, and influential institutional structures, backed by an explicit formal agreement.
- Incorporating (and making the network relevant to) socioeconomic factors.
- Having a well-researched scientific basis; but also making good use of local wisdom.
- Genuinely involving stakeholders (not just consulting them).
- Designing the network according to the functional ecological needs at stake, including both spatial and temporal dimensions.
- Planning according to a recognition that the system overall may only be as strong as the (ecologically) “weakest link in the chain”.
- Designing (where appropriate) in a way that will spread risks, to underpin resilience.
- Where necessary, building a network by joining relevant existing measures together.
- Making appropriate use of “flagship species” to promote wider conservation agendas; and
- Adopting an “adaptive management” approach (adjusting in the light of experience)."

Approaches adopted in other European countries were summarised by Galbraith & Stroud 2021 and reviewed by Romão *et al.* 2012. Approaches adopted vary widely, influenced by cultural, historic, and legislative traditions. Thus, Denmark has no network of nationally important protected areas but rather complements its internationally designated Ramsar and Natura sites with a strong planning system constraining the possible extent of habitat change in the 'wider countryside'. In contrast, eastern European countries, such as Slovakia, have protected area provision based on tiered regional and national networks of national parks – typically derived from long-established cultural traditions of hunting (Hlad

& Skoberne 2001). Common elements to all approaches – at least in theory – is monitoring at both site and national level in order to inform management (typically through a defined management planning process).

Importantly, in developing such a network in England the approaches listed above will need to include terrestrial, freshwater, and marine ecosystems, hence necessarily requiring engagement with a diverse range of stakeholders at an early stage. The following section outlines the key, practical issues that will need consideration.

3. How an ecologically connected network of protected areas could work in England

3.1. Agree the vision and purpose

It is important to agree the vision and purpose of creating the network. The primary purpose therefore is taken as:

“Establish a network of protected areas that will underpin the recovery of nature across England”

In such a network protected areas will be surrounded and connected by other areas of sympathetically managed land and sea, to allow the recovery of nature across the country. "Recovery" is a critical focus – the network needs to do more than sustain the (hugely diminished) *status quo* (Hayhow *et al.* 2019) but needs to 'rewind' and recover from past losses, as well as adapt to future change. To that end, the pro-active management of areas within the network will be essential.

There are important and complex issues to resolve in the creation of an ecologically connected network of protected sites/areas, however, we do see its creation as a major step in developing an effective approach to adapting to climate change. Ideally, sites need to be large with clear ecological links to other areas, surrounded by areas of sympathetically managed land or sea, with a degree of flexibility and responsiveness to change built into the whole network. This flexibility may manifest itself in the interest features held, management techniques being deployed on particular areas, or in the exact shape and size of the site boundaries. Incorporating such flexibility would be a significant change from current practice (Galbraith & Stroud 2021).

Given this vision it seems necessary that there is a renewed overarching “purpose” for SSSIs such that they are seen as the key building blocks for both the ECN and NRN rather than, as currently, part of an essentially representative portfolio of sites distributed across the country[4]. Having such a purpose, ideally consolidated in legislation, would give direction and new impetus for joined-up and targeted conservation action for the recovery of nature. Sites would, in effect, function as ‘nature nuclei’, that, along with sympathetically managed surrounding wider countryside and seascapes as well as underlying geodiversity and geomorphological processes, would facilitate recovery. Alongside this enhancement

[4] Whilst 2003 government policy (below) was that the SSSI series should contain all qualifying sites, in reality the significant administrative overhead of notification has meant that there remain multiple unnotified sites of SSSI quality throughout England.

of ambition could come a simplification of the processes involved and ideally greater stakeholder and public awareness and involvement.

It will be important at the outset to be clear what forms part of the ecologically connected network and why it is included. In summary, ecological connectivity for what? Which features, species, habitats and ecosystems are to be connected? In order to answer these questions this report outlines a possible approach and Section 4 provides a step-by-step guide to the key decisions that would be involved. However, it is important to note here that an element of professional scientific judgement will be required at various stages of the network creation. Taking threatened habitats and species as a starting point (see Annex 1 for habitats) seems logical, with work required to examine the range of practical issues involved in increasing the extent and connectivity of SSSIs already designated for these interests.

3.2. Selection of sites - issues

Three key issues are involved with regard to the selection of sites.

The first key question is how the protected sites and other areas forming the network would be selected. There are at least two different approaches that could be used. Firstly, as now, each site could be assessed individually on the current features of interest it holds against national selection guidelines (their current contribution). Secondly, sites could be selected for their contribution to the network not only for the interest they hold now but also that they could hold in future, i.e., both current and potential contributions. This second approach gives greater flexibility in terms of future contribution and is particularly important to maximise adaptation potential. Note that such an approach may not in itself require a change in legislation but the guidelines for the selection of SSSIs (JNCC 2013) would require to be updated to formally accommodate a more adaptive approach.

A second key question is whether sites should continue - as now - to be designated only for particular ecological features or whether this should be broadened to a “whole of nature” approach. This would create 'nature nuclei' that may avoid a “conservation contradiction” where current approaches, by being focussed only on a few features, limit climate adaptation through focussing management on maintaining site feature as at notification rather than allowing adaptation to a new state. Note, however, that there is considerable merit in the current system in providing an important and established level of legal protection. Perhaps the best way forward is to progressively build on, rather than completely overhaul this approach. Section 4 below outlines how this could be done.

A third key question relates to SSSIs that no longer hold the ecological features that they were notified for. Clearly, new sites can be notified, and existing sites holding interest features can be maintained, but as the effects of climate change are increasingly being seen, then the question of the status of sites that no longer hold their designated interest will become significant. We consider it important that such sites should continue to be protected with the existing boundaries maintained. For example, the number of

overwintering wading birds may decline on a particular protected area on an estuary to the extent that technically the site no longer qualifies for these species, however, the estuary itself provides a wide range of other ecosystem services and will remain an important part of the wider nature recovery network providing habitat for many resident and migrant species. Indeed, modelling of change across the UK Special Protection Area network predicts, for individual sites, both loss of former qualifying species but acquisition of new ones (Johnston *et al.* 2013). Pan-European analysis of change in non-breeding waterbird occurrence within SPAs demonstrates just such 'replacement' processes in action (Pavón-Jordán *et al.* 2015, 2019, 2020). Protecting all such areas of current and potential importance as part of wider national conservation planning is therefore logical.

It has been suggested that sites might be selected on the basis of their provision of ecosystem services. Whilst inherently attractive as an option and ecological common sense, this raises multiple issues that would need careful consideration in future, not least how a cost-effective form of management and monitoring could be put in place that was also scientifically robust.

A related issue is the scale of planning assessment for any network. Taking a landscape scale approach is clearly beneficial and would allow the network to include more extensive and functioning ecosystems that are sympathetically managed in future. At an international scale, this issue has been under debate for decades in the context of selection criteria for wetlands of international importance (Stroud & Davidson 2021), testimony to the complexity of the issues it raises[5]. Further testing of this concept in the context of creating an ECN would be useful.

3.3. Assess the current legal framework

Table 1 includes a summary of the key pieces of legislation relevant to the creation of an ECN. A range of legislation has been developed over the years with the intention of protecting nature across the UK. Legislation does, however, have to be interpreted and implemented, establishing good practice for a particular situation or period of history. It is apparent now that what was an appropriate interpretation of the legal framework some decades ago, may now need to evolve, keeping the effective practices and changing those that need to adapt to new situations. For example, with climate change it will be important to increase the number and extent of protected areas - as recognised over a decade ago by Lawton *et al.* (2010) and with pressures, such as from pollution, addressed and prevented.

Whilst this report does not provide a detailed analysis of the legal framework relating to the designation of protected areas or to the management of the surrounding areas of land and

[5] in particular the potential balancing of 'service provision' with other 'non-service' interests

sea, some priorities for action seem to be prerequisites for the effective development of the ECN.

It is important at the outset to clarify what flexibilities exist in the current status quo, for example:

- Existing on-site and off-site pressures and threats to SSSIs should be tackled with renewed vigour to enhance ecological resilience.
- There could be more SSSIs – especially for threatened habitats in the lowlands – fulfilling government policy that *all* qualifying sites be included within the series.
- Sites could be larger - again especially in the lowlands to allow expansion of areas occupied by interest features and especially in anticipation of colonising species and habitats; and
- Boundaries could be modified as the interest features alter their distribution, accepting this may be associated with an administrative burden to undertake such change, and noting issues raised above as to the value of maintaining as large an 'estate' for nature as possible, not least to restore past losses.

Suggested actions and possible changes to legislation and current interpretation include:

- Define (ideally in law) the overarching purpose of developing an Ecologically Connected Network as a component of the NRN, underpinning nature recovery and adaptation to climate change across England.
- Allow the notification of whole protected areas as essential parts of the network and in anticipation of colonisation by species and habitats. Whilst this may seem rather theoretical, numerous models predict the likely spread of species and habitats and this is being shown in practice, (Johnston *et al.* 2013; Pavón-Jordán *et al.* 2015, 2019, 2020; Natural England & RSPB 2019) hence adopting “ecological anticipation” will be important and potentially make the functioning of the network more effective and longer lasting.
- Consider the selection of protected areas to allow for a rolling list of “features” to be defined within existing boundaries and allow for boundary changes for nature conservation purposes, to enhance the adaptive ability of that protected area, ideally with a minimal administrative burden. Note the importance of clarity at any one point in time as to what each site is “for”.
- Allow for protected areas that lose their current interest features to retain legal protected status and still form part of the wider network, becoming 'nature nuclei' for the future, where re-colonisation from spreading species and habitats may occur.
- Make monitoring and reporting on the state of the network of protected areas a statutory duty for Natural England, with a regular reporting cycle to Parliament[6].
- Whilst not directly involved in the identification of protected areas, the legal and policy approach to agriculture and how the land, especially that surrounding

[6] This would be analogous to regular reporting on the state of other elements of national infrastructure such as health service statistics. Note this does not imply annual monitoring, rather annual reporting of current state of knowledge – essential if the network is to be managed adaptively.

protected areas is managed, is highly relevant to the success of ECN creation. Indeed, without the enhanced sympathetic management of these wider landscapes and marine areas the creation of the network will be less effective and consequently, nature recovery will be more problematic.

- Encourage adding “nature conservation” as a management objective for areas currently designated for landscape and/or recreational purposes, (National Parks, Areas of Outstanding Natural Beauty [AONB] – Table 1).
- Finally, if land is to be managed for nature, then this implies a shift from intensive agricultural production in many cases. It is important that the capital value of such land is maintained and that the wider tax regime does not act as a disincentive for such change of use. Landowners and managers should not be penalised for doing the right thing for nature.

3.4. Assess the current portfolio

The SSSI series' original purpose was to protect a “representative sample” of species, habitats and geological features across the country and was not intended to be a comprehensive or holistic nature conservation mechanism. However, DEFRA's SSSI Code of Guidance (DEFRA 2003), in a statement of government policy, noted that "The sites included within the series of SSSIs are intended collectively to comprise the full range of natural and semi-natural habitats and the most important geological and physiographical sites. The SSSI series should therefore include **all** of our most valuable nature conservation and earth heritage sites, selected on the basis of well-established and publicly available scientific criteria.". This useful change of policy gives the potential for a more complete network to be created.

Whilst there may be diverging views on the effectiveness of the designation system, SSSIs have undoubtedly protected key sites and so provided a baseline of nature that might otherwise have been destroyed. In the context of developing the ECN, they provide an essential and valuable starting point. The challenge now in creating a wider network is to ensure a mutually supporting system of legislation, policy and practice that also facilitates adaption to climate change as far as possible.

The current SSSI series and system of designation has many strengths, including:

- Their significant profile and public awareness.
- An acknowledged conservation success story.
- A national focus for biodiversity and geodiversity conservation delivery; and
- Typically, good governance processes with owners and occupiers.

Alongside these strengths, however, are perceived weakness, including:

- Lack of enforcement of regulations leading to sub-optimal management.
- Monitoring and assessment being not fit for purpose.
- Governance problems.

- Lack of dynamism and change recognition – especially problematic in light of climate change.
- Sites being often isolated ‘islands’ in wider countryside.
- Inadequate resources to underpin the designation process and site management.
- Unclear or conflicting objectives at network and site scales.
- Limited ability to maintain features.
- *Ad hoc* historic development of the network; and
- Network inherently incomplete.

The development of a coherent network therefore needs to build on the strengths and tackle the current weakness in a determined way.

Importantly, the wider landscape designations (National Parks and AONB), were established to conserve and enhance natural beauty, wildlife, and cultural heritage and to promote public enjoyment and understanding. They tend to be larger than most SSSIs hence potentially providing nature with significant space to recover and adapt. However, the lack of ability to direct or incentivise land-use within these areas, and their limited focus on biodiversity, has been seen as highly constraining on whether these areas can be considered as 'protected' (Cox *et al.* 2018; Starnes *et al.* 2021). Accordingly, legislative change is needed to create the right management 'tools' for these areas to become an integral part of the ECN, contributing a regime for landscape scale conservation management.

Protected areas are currently subject to a number of ongoing pressures and threats, in addition to those of climate change. These include water and air pollution, eutrophication, and direct habitat loss. Many protected areas are small, and the overall 'estate' is fragmented across the country, hence the effects of such impacts can be severe, especially if enforcement action to limit these threats is lacking or ineffective. Tackling issues that impact on current protected areas is a key action in ECN establishment and to enhance the current poor condition of many sites.

In summary, the current suite of SSSIs forms an important starting point for the creation of an ECN. Whilst SSSIs are spread across the county, many are small (especially in the lowlands), and their distribution is fragmented. Several factors in the legislative and policy landscape mean that there is an opportunity now to tackle existing threats and to begin to create a network.

3.5. Decide which protected areas to include

As noted in Section 3.3, the creation of the ECN needs to encompass more than an expanded network of SSSIs and include areas of land and sea such as Marine Protected Areas, National Nature Reserves, and National Parks. Whilst SSSIs are the primary focus in this report, examining the nature conservation potential of other areas will be an important element of the practical development of the ECN. Many of these other

designations are larger and contain a greater diversity of habitats than most SSSIs, hence give potential to provide greater connectivity and flexibility in management.

Table 1 summarises the various types of designated sites that could be involved in the creation of the ECN. Taken together these act as a starting point, providing a large and reasonably connected area for nature. It is important also to view these areas within a wider landscape supported by the Environmental Land Management Scheme (ELMS) and the provisions of the Environment Act introducing species population targets – all positive steps for the recovery of nature overall.

“Many of the building blocks of an ECN are there but joining them up will be key”.

Key issues for early consideration will include:

- The setting of targets to inform assessment of delivery against aims and objectives. This will be a role for governance structures (Section 3.10).
- Decisions as to whether local or national priorities will determine the shape of network. (This would include consideration of the key habitat types found across England).
- Decisions as to how the regional nature of biodiversity across England would be accounted for in any network. Could local priorities and values for conservation action be included to enhance the direct link to local communities and to help ensure their engagement? Setting regional targets as part of the country-wide network has the potential to deliver real benefit locally; for example, larger areas of good moorland habitat in Yorkshire and the Peak District – larger and better-connected native woodland in lowland areas, and managed retreat for some coastal areas.
- Determining how network-scale decisions would be taken? Currently management decisions are taken on a site-by-site basis, governed largely by current legislation that focusses on maintaining particular “features” on sites as the rationale for the protection of individual sites. What are the pros and cons of changing such an approach to consider network scale requirements?

Table 1. Designated sites in England and their potential significance within the Ecologically Connected Network

Type of site related or other policy measure	Organisation responsible for establishment	Responsible for oversight / implementation of management	Objective of measures	Opportunities
Nature Recovery Network (NRN)	DEFRA & NE together with partners, legislation, and funding, will create the NRN to restore and enhance England's wildlife-rich places	Defra, NE, and partners	To create NRN, by 2042 DEFRA, NE and partners will: restore 75% of protected sites on land (including freshwaters) to favourable condition so nature can thrive create or restore 500,000 hectares of additional wildlife-rich habitat outside of protected sites recover threatened and iconic animal and plant species by providing more, diverse, and better-connected habitats support work to increase woodland cover	N/A

Type of site related or other policy measure	Organisation responsible for establishment	Responsible for oversight / implementation of management	Objective of measures	Opportunities
			achieve a range of environmental, economic, and social benefits, such as carbon capture, flood management, clean water, pollination, and recreation	
Ramsar Site	Designated by DEFRA on the recommendation of NE	NE	The maintenance of the ecological character of the site through wise use	An integral ECN element
World Heritage Sites	United Nations Educational, Scientific and Cultural Organisation (UNESCO)	Ultimately DEFRA	Natural and cultural sites considered of 'Outstanding Universal Value' inscribed by UNESCO	Opportunities to deliver nature recovery and establish an ECN through natural WHS (the Jurassic Coast) and cultural WHS such as the English Lake District and the Cornwall and West Devon Mining Landscape
Global Geoparks	Certified by the UNESCO Global Geoparks Council	Developed and managed locally	Single, unified geographical areas where sites and landscapes of international	Provide opportunities to develop an ECN and nature recovery across

Type of site related or other policy measure	Organisation responsible for establishment	Responsible for oversight / implementation of management	Objective of measures	Opportunities
			geological significance are managed with a holistic concept of protection, education and sustainable development	larger geological landscapes via their bottom-up approach of combining conservation with sustainable development through involvement of local communities
Special Protection Area	Classified by DEFRA on the recommendation of NE	NE	The sustaining of the species for which the site was classified, *inter alia* through habitat management and other measures	An integral ECN element
Special Area of Conservation	Classified by DEFRA on the recommendation of NE	NE	The sustaining of the species for which the site was classified, *inter alia* through habitat management and other measures	An integral ECN element
National Parks (NP)	Established by Acts of Parliament with recent NP	Individual NP Authorities co-ordinated by National Parks UK	NPs are designated for the preservation of species and genetic diversity;	Will require legislative change to enable NP Authorities to

Type of site related or other policy measure	Organisation responsible for establishment	Responsible for oversight / implementation of management	Objective of measures	Opportunities
	authorities established by Statutory Instrument		maintenance of environmental services; and tourism and recreation	appropriately control and incentivise land management for conservation rationales
Areas of Outstanding Natural Beauty (AONB)	Established by same Acts of Parliament as NPs. Further regulation and protection under CRoW Act. Equal status to NPs in planning decisions on landscape issues (NPPF 2012)	AONBs in general remain the responsibility of their local authorities by means of special Committees (or Conservation Boards if extending into a number of local authority areas)	Principal aim to conserve and enhance the natural beauty of the designated landscape. Secondary aim to meet the need for quiet enjoyment of countryside having regard for the interests of those who live and work there	Will require legislative change to enable AONB Committees to appropriately control and incentivise land management for conservation rationales
Heritage Coast	Countryside Commission. No statutory designation	A heritage coast is defined by agreement between the relevant maritime local authorities and Natural England	Established to conserve the best stretches of undeveloped coast in England and protected through development control with the planning system. Paragraph 114 of the NPPF 2012 states that local	Unlikely to be relevant without a change of objective

Type of site related or other policy measure	Organisation responsible for establishment	Responsible for oversight / implementation of management	Objective of measures	Opportunities
			authorities should: 'maintain the character of the undeveloped coast, protecting and enhancing its distinctive landscapes, particularly in areas defined as heritage coast, and improve public access to and enjoyment of the coast.'	
National Nature Reserve (NNR)	Established by NE	NE together with other bodies under formal agreement	Established to protect some of the most important habitats, species, and geology, and to provide 'outdoor laboratories' for research	An integral ECN element
Site of Special Scientific Interest (SSSI)	Notified by NE on behalf of the Secretary of State for the Environment	NE	To protect all England's most valuable nature conservation and earth heritage sites, selected on the basis of well-established and publicly available scientific criteria	An integral ECN element

Type of site related or other policy measure	Organisation responsible for establishment	Responsible for oversight / implementation of management	Objective of measures	Opportunities
Marine Conservation Zone (MCZ)	Established by Act of Parliament. Designated by DEFRA	Marine Management Organisation responsible for making byelaws in English inshore waters to protect MCZs	Areas designated with the aim to protect nationally important, rare, or threatened habitats and species. Conservation objectives established by NE and JNCC	Potentially of relevance as long as there are site management plans
Marine Nature Reserve (MNR)	Established under W&C Act. Also, one voluntary MNR. NE can apply to Defra to establish. (Schedule 12 of Marine & Coastal Access Act 2009 allows conversion of existing MNRs into newer MCZs)		To conserve marine fauna, flora or geology of physiographical features; or for the purpose of research or study of such special features	MCZs numerically of more significance
Local Wildlife Sites **aka Ecosite / Site of Interest to nature Conservation (SINC)**	Non-statutory designations recognised in the NPPF which gives some protection from development	Many local organisations such as The Wildlife Trusts work in partnership to protect sites and advise landowners on land	Identified and selected locally, by partnerships of local authorities, nature conservation charities, statutory agencies, ecologists, and local nature	Potentially of significance as long as resources for management

Type of site related or other policy measure	Organisation responsible for establishment	Responsible for oversight / implementation of management	Objective of measures	Opportunities
		management and grants	experts, using robust, scientifically determined criteria and detailed ecological surveys. Selection based on most important, distinctive, and threatened species and habitats within a national, regional, and local context	
Regionally Important Geological/ geomorphological Sites (RIGS) **aka Local Geological Sites**	Locally designated through notification to local planning authority. Non-statutory (with same status as Local Wildlife Sites - above)	Selection by local RIGS Groups	Identified against four criteria – scientific, educational, historical and aesthetic values, and conserved and protected as a material consideration through local and national planning policies. RIGS are designated by locally developed criteria, and are important as an educational, historical, and recreational resource	Potentially of significance

Type of site related or other policy measure	Organisation responsible for establishment	Responsible for oversight / implementation of management	Objective of measures	Opportunities
Local Nature Reserve (LNR)	Designated by Act of Parliament by principal local authorities	Local authorities with or without voluntary group (*e.g.,* Wildlife Trust) help	The local authority must control the LNR land - either through ownership, lease, or agreement with owner. LNR managers need to care for and protect site natural features and give public access	An integral ECN element
Nature Reserves managed and/or owned by conservation NGOs	Relevant NGO	Relevant NGO	Sustaining the features for which reserve is selected and managed	An integral ECN element
Biosphere reserves	Designated under the intergovernmental MAB Programme by the Director-General of UNESCO following the decisions of the MAB International Coordinating Council (MAB ICC)	Local authorities with local voluntary partnership groups	Sites for testing interdisciplinary approaches to understanding and managing changes and interactions between social and ecological systems, including conflict prevention and management of biodiversity	Potential to support other designated areas

Type of site related or other policy measure	Organisation responsible for establishment	Responsible for oversight / implementation of management	Objective of measures	Opportunities
Environment Land Management Scheme (ELMS): Sustainable Farming Incentive (SFI)	DEFRA. Began piloting in 2021 before launch in 2022	DEFRA	Payment to farmers to manage land in an environmentally sustainable way. SFI made up from a set of standards related to *e.g.,* hedgerows or grassland, specifying management actions	Significant potential to support other designated areas. The Conservation and Enhancement Scheme (to re-launch in October 2022), has significant potential to support any ECN/Nature Recovery initiative – specifically those areas that do not qualify for ELMS
Environment Land Management Scheme: Local Nature Recovery	DEFRA. Will be piloted in 2022 before launch in 2024	DEFRA	Payment for actions to support local nature recovery and achievement of local environmental priorities. Scheme encourages collaboration between farmers, helping them work together to improve their local environment	Significant potential to support other designated areas

Type of site related or other policy measure	Organisation responsible for establishment	Responsible for oversight / implementation of management	Objective of measures	Opportunities
Environment Land Management Scheme: Landscape Recovery	DEFRA. Ten projects piloted in 2022 before launch in 2024	DEFRA	Support for landscape and ecosystem recovery through long-term projects, e.g.: restoring wilder landscapes large-scale tree planting peatland and salt marsh restoration	Significant potential to support other designated areas
Local Nature Recovery Strategies (LNRS)	Local authorities	Local authorities	Flagship measure in the Environment Bill establishing new system of spatial strategies for nature to plan, map, and help drive more coordinated, practical, focussed action and investment in nature's recovery to build NRN	N/A

Glossary

AONB	Area of Outstanding Natural Beauty
CROW Act	Countryside and Rights of Way Act
NP	National Park
NPPF	National Policy Planning Framework
W&C Act	Wildlife and Countryside Act

3.6. Climate change risk assessment

A fundamental part of designing the ECN will be to evaluate the level of risk from climate change to the existing portfolio of SSSIs. There is likely to be a spectrum of sensitivity to climate change, with some sites being highly vulnerable and likely to change, while others (including some[7], but by no means all, geodiversity sites) will be more resilient to change. Undertaking a triage, where vulnerability to climate change is determined will help inform management and their potential role in the ECN. This should, in turn, help focus higher frequency monitoring activity on the most vulnerable sites and help inform the adaptive management of each site. This does of course also mean that site management objectives need to be considered as part of this exercise.

Ultimately given the extent and speed of climate change it may not be possible to manage some sites in a way that maintains their current interest features. In this case management decisions will need to be made about what the site offers to the ECN. As discussed above, such sites are likely to still be valuable as "nature nuclei" allowing other species and habitats to spread, hence it seems inevitable that management in these cases will need to focus on adaptation, with decisions as to either facilitate, accept, or resist change.

At the network scale, it is important that in cases where some interests are lost on particular sites that compensatory measures are taken. So it may be, for example, that some threatened habitat types change their distribution in future. Tracking such change via new or enlarged protected areas will play a large part in the overall resilience of the system. Developing such an adaptive management approach would, of course, be a significant departure from the current, relatively static notification system and would be best implemented with the full participation of stakeholders.

3.7. Species, habitats, and ecosystems

Whilst there will be several different starting points for the creation of the ECN, it is important to consider the ecological resource that currently forms the content of protected areas. The development of the ECN will need a clear focus and starting by examining the current extent and distribution of English habitats seems logical. Annex 1 summarises the extent of broad habitats in England. What is particularly striking about the habitats listed in the Annex 1 is how small an area of the country they represent. It is clear that many of these habitats are contained in small and fragmented areas, hence a large percentage

[7] Some geodiversity systems are both subject to change and vulnerable to the consequences of change (such as increased demand for engineered solutions to erosional impact) (Natural England & RSPB 2019).

increase in their coverage within the ECN would, in effect, only represent a relatively small increase in absolute terms.

Table 2 summarises the limited extent of some important habitats in England and gives recommendations for appropriate inclusion in the ECN.

Table 2. Approximate extent of habitats of small extent in England, where this is known. See Annex 1 for full listing of habitats and their areas. Source Lake et al. (2020). Produced with permission from Princeton University Press.

Extent in England	Recommendation	Habitat type (English extent in km^2 in brackets)
< 10 km^2	Important to ensure complete representation within ECN given national rarity, priority status and past losses	Turlough and fluctuating mere (<1); Calaminarian grasslands (2); Northern hay meadow (9); Upland calcareous grassland (3); Montane scrub (<1); Mountain ledge (1)
11-20 km^2	Important to ensure high representation within ECN given national rarity and priority status.	Saline lagoon (14); Peat-stained (dystrophic) waters (13); Lowland meadow and pasture (16); Purple moor-grass and rush pasture (25); High montane heath and snow-bed (11); Montane dwarf-shrub heath (12); Limestone pavement (20); Rocky slopes (16); Lowland dry oak and birch wood (45); Yew wood (12)
21-100 km^2	Important to ensure significant representation within ECN given national scarcity and priority status	Coastal vegetated shingle (42); Sand dune (73); Upland Lake, loch, and tarn (89); Scree (37); Reedbed (70); Upland mixed ash wood (75); Wet woodland (26)

Table 3 presents a “first-cut” attempt at assessing the capacity various habitat types may have for adaptation to climate change. The key point is that judgements can be made about the likely capacity to adapt that will help focus management action as part of the ECN creation. Most of habitats listed with limited scope for adaptation potential are also those with low climate change impacts.

Table 3. Scope for adaptation to climate change in habitats. Based largely on Lake *et al.* (2020). Produced with permission from Princeton University Press.

High level habitat group	Significant scope for CC adaptation (including restoration and removal of pressures and threats)	More limited scope for CC adaptation (including lower conservation priority habitats)
Coastal	Mudflat and sandflat; Saltmarsh; Sand dune	Coastal vegetated shingle; Hard cliff and cliff slope; Littoral rock; (Saline lagoon); Soft cliff
Freshwaters	Peat-stained (dystrophic) waters; Upland Lake, loch, and tarn; Chalk River and stream; Fast flowing river and stream; sluggish river and stream	Nutrient-rich Lake; Other type of lakes (mesotrophic, marl, lowland nutrient-poor, & brackish); Turlough and fluctuating mere
Grasslands	Coastal and floodplain grazing marsh; Lowland calcareous grassland; Lowland dry acid grassland; Lowland meadow and pasture; Northern hay meadow; Purple moor-grass and rush pasture; Upland acid grassland; Upland rush pasture	Calaminarian grasslands
Heathlands	Lowland dry heath; Lowland wet heath; Upland dry heath; Upland wet heath	N/A
Mountains	Montane dwarf-shrub heath; Montane scrub	High montane heath and snow-bed; Mountain ledge;
Other habitats	N/A	Arable; Brownfield; Garden, Traditional orchard
Rocky habitats	N/A	Limestone pavements; Rock slopes; Scree
Scrub	N/A	Bracken; Hedgerow; Mixed scrub
Wetlands	Blanket bog; Lowland fen; Raised bog; Reedbed; Valley mire	Upland spring and flush
Woodlands	Beech wood; Lowland dry oak and birch wood; Lowland mixed oak and ash wood; Upland birch wood; Upland mixed ash wood; Upland oak wood; Wet woodland. Yew wood	Coniferous plantation; Wood pasture

In considering the priorities for action on habitats across England then previous work (Galbraith & Stroud 2021) has suggested that a regionally based approach could be developed with a focus on:

- habitats typical (currently representative) of the region.
- habitats likely to expand their distribution/extent in a region because of climate change (*e.g.,* southern heathland types in the English midlands). Typically, these are likely to be examples of habitats at the current northern edge of distribution, in some cases with the potential to colonise from mainland Europe; and
- habitats that are currently at risk of change or severe climate change impact where there is need for enhanced management inputs to sustain their distribution (including northerly habitats at the southern edge of their distribution).

Overlaying the future distribution of habitats along with the species level analysis below will produce a series of ecosystem complexes (species and habitat assemblage “weather maps” of the countryside), thereby informing the targeting of effort in future.

Combining a regional assessment with the list of priority habitats whilst taking account of the habitat’s respective adaptation ability, would provide a useful approach.

This approach could reveal which habitats are priority for action (Annex 1), where they occur across the country (regional assessment) and how likely they were to undergo rapid change as a result of climate change.

In developing the ECN, different habitats will raise different issues. For example, lowland raised mires are the end point of thousands of years of ecological and geomorphological development. They are also spatially restricted – they only occur where they are. Thus, the creation of 'new' raised mires is not feasible on human timescales (although this is not to say that restoration should not commence immediately at degraded or partially destroyed systems). Whilst it may take hundreds of years for such mires to reach their original ombrotrophic states, in the interim, such restoration areas will provide a range of other wetland habitats. Given this inability to recreate fully such areas it becomes especially important to include all remaining examples of such habitats within the ECN irrespective of their current condition.

In contrast, it is more practical to restore, and indeed create, wet grasslands using long-established and well-known conservation management techniques (Treweek *et al.* 1997). New agri-environment measures under ELMS give very considerable potential to recreate extensive areas of wetland grassland habitat, including through the restoration of functioning riverine floodplains. Not least because of the high extent of depletion of lowland wet grasslands through much of England, these wet grasslands restoration areas could make a considerable contribution to the ECN (and '30 x 30'), especially if planned and undertaken at a landscape-scale.

The inclusion of protected areas in the ECN for threatened species as part of overall species recovery is key to the purpose of the ECN and will be significant in delivering the

success of the initiative, raising the profile of the ECN with stakeholders and with the wider public.

As noted in previous reports (Galbraith & Stroud 2021), Outcome 3 of the Government's *Biodiversity 2020* strategy (DEFRA 2011) contained an ambition to ensure that *'By 2020, we will see an overall improvement in the status of our wildlife and will have prevented further human-induced extinctions of known threatened species.'*

Protecting and enhancing England's Section 41[8] species and habitats is key to delivering this government aspiration. Whilst now becoming somewhat dated, the value of using the S41 lists as a starting point is that they tie directly into an existing statutory process with associated lists of necessary actions already developed and agreed, and with the conservation status of various groups already clear[9].

The S41 list includes:

Group 1: globally threatened or near-threatened species (115 species).

Group 2: European threatened or near-threatened species (78 species).

Group 3: nationally threatened species in rapid decline or IUCN Critically Endangered (320 species) in the UK or GB.

Group 4: other nationally threatened species (430 species).

With the inclusion of threatened species as part of the ECN, and especially given the inclusion of species targets in recent legislation, then it is important that targets are agreed for the recovery of their populations. Several key characteristics of species populations have been recognised and agreed internationally as being appropriate measures to consider in assessing when species populations might be considered favourable.

The following text from the text of Article 1 of the Convention on Migratory Species, illustrates the key aspects to be considered, and whilst referring to migratory species, this could easily be interpreted for all species within the ECN.

Text from Article 1c of the Convention on Migratory Species

c) "Conservation status" will be taken as "favourable" when:

> (1) population dynamics data indicate that the migratory species is maintaining itself on a long-term basis as a viable component of its ecosystems.

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[8] of the 2006 Natural Environment and Rural Communities Act

[9] For example, see the List of habitats and species of principal importance in England

(2) the range of the migratory species is neither currently being reduced, nor is likely to be reduced, on a long-term basis.

(3) there is, and will be in the foreseeable future sufficient habitat to maintain the population of the migratory species on a long-term basis; and

(4) the distribution and abundance of the migratory species approach historic coverage and levels to the extent that potentially suitable ecosystems exist and to the extent consistent with wise wildlife management.

3.8. Developing a regional pilot

It is suggested that a short-term regional trial is undertaken, moving from the theory to practice and to examine the practical issues involved in developing an ECN using these habitats and a range of species as the basis for a "whole of geo-biodiversity" approach to developing the ECN. Whilst it is relatively simple in theory to create an ECN for one habitat or species, this becomes much more complex when the needs of multiple habitats and species must be considered, yet this is the challenge in the face of climate change impacts. Such a trial need not be an overly long exercise, and should not delay wider implementation, but working through the practical issues involved with stakeholders at the landscape scale, examining how to manage and link existing protected areas is an important prerequisite before a national scheme is implemented.

3.9. Develop an effective monitoring system

"If you do not know the facts you cannot take effective action"

Monitoring is a prerequisite for the development and effective management of any network of protected areas. Developing an actively managed ECN in England will thus require that the "state" of the resource is known and that changes are tracked over time. This will provide a clear feedback loop from monitoring the state of resources to adaptive management practices. This will be especially important in tracking and responding to the consequences of climate change. Previous work (Galbraith & Stroud 2021) has suggested that a "risk based" approach to monitoring could be developed where those sites judged to be more susceptible to climate, and other changes, are monitored more frequently than others in the network (Section 3.6).

In relation to existing SSSIs, monitoring schemes were established several decades ago but – owing to resource constraints – have struggled to be effective (Galbraith & Stroud 2021). An important element of developing the ECN will be to critically assess and learn from the problems of the *status quo*, and accordingly plan future monitoring so that it will have greater potential for delivery.

3.10. Develop network governance and stakeholder communications

The operation and management of an ECN that underpins nature recovery will require a coordinated approach involving a wide range of organisations at both the national and local level. Decisions will need to be made at both the network level and at the individual site level.

Taking decisions at the network level will be a new and potentially challenging area of governance hence will need to be designed carefully and the membership of any governance structure given consideration early in the process. Section 4 outlines how this could be undertaken. In summary the governance body would need to:

- Include all the major landowners and managers involved.
- Promote buy-in to a common vision and develop a co-ordinated approach across all organisations and agencies either directly managing protected areas or responsible for controlling land use.
- Create a high-level forum that brings all these parties together and help revitalise the governance processes involved.
- Create common standards and a reporting schedule for the network, balancing the need for consistency with that of flexibility.
- Take account of regional variation in ecosystems across the country.
- Ensure that communication at all levels is a key part of ECN development. As for engaging land management stakeholders, it is important that the public are aware of ECN development, and to the extent possible, engaged in management, monitoring, and reporting on the state of sites in the future.
- Engage, through JNCC, with the sister country conservation bodies.

Organisationally several 'set-up' issues will need decision, *inter alia*:

- Whether such a forum has an independent Chair? We suggest this would be a good idea and would help to promote inclusivity and transparency.
- What should be the reporting schedule to government?
- How to undertake and communicate risk assessment.

3.11. What does success look like?

Developing agreed guidance on what success looks like should be an early task for the Stakeholder Forum that we recommend be created as part of the overall governance structure of the network. It is important that the challenging vision of creating the ECN is underpinned by clarity on what success will look like, and on how long it might take to reach this state.

Several components are likely to be involved in assessing success, namely:

- That the proposed '30 by 30' target and other related global targets from CBD are met in England. The current text of the target contains several component issues beyond simple extent of sites, each requiring innovative approaches and renewed determination to meet the target.

  Target 3. "Ensure that at least 30 per cent globally of land areas and of sea areas, especially areas of particular importance for biodiversity and its contributions to people, are conserved through effectively and equitably managed, ecologically representative, and well-connected systems of protected areas and other effective area-based conservation measures and integrated into the wider landscapes and seascapes".

  - "contribution to people is conserved" – requires a landscape level ecosystem services approach
  - "effective and equitably managed" – effective management is a key aspect of meeting the target
  - "ecologically representative and well-connected systems" – requires connectivity and a network approach
  - "other effective area-based conservation measures" – so not only strictly protected areas but also other areas of land and sea
  - "integrated into the wider landscape" – requires buffer zones and other wider countryside measures.

- Having ecological targets to quantify change – for example, doubling the extent of threatened habitats in x years.
- Ensuring that species and other targets outlined in the 2021 Environment Act are met (See 3.7 above – section relating to species).
- That the Natural Capital contained in the Network is increased and that the curve of nature loss is stopped.
- That an effective "risk-based" monitoring system for habitats and species is implemented across the network.
- That an effective system of governance is established and that stakeholders play an active part in the creation, management, and monitoring of the ECN.
- That there is wider public awareness of, and support for, the creation of the ECN.

Indeed, it could be argued that none of the above targets will be met without the creation of a Nature Recovery Network (NRN) and with an ECN as a key component of this.

Risks

Multiple metrics (summarised by Hayhow *et al.* 2019) document the poor condition and depletion of biodiversity throughout the UK. Monitoring has documented, in a single human generation, the near complete loss through lowland England of formerly widespread species such as Curlew *Numenius arquata* and Snipe *Gallinago gallinago* (as just two of many possible examples). The risk is that without a step-change in nature conservation provision, such losses will continue – moving still further away from global aspirations to "halt and reverse the loss of biodiversity".

The ECN as a component of the NRN provides a major opportunity to start to reverse these negative trends and whilst its initial design may be imperfect or incomplete, it remains important to make every effort to bring about its creation.

In summary, this section has outlined the vision and purpose of the ECN, considered the selection of sites, assessed the current legal framework and suggested changes for the future, assessed the state of the current portfolio of SSSIs that would form the starting point for ECN creation. It has highlighted the need for coordination and governance across key organisations, stressed the need for an effective system of monitoring to be in place, and suggested the development of a proactive approach to wider public involvement in ECN management.

The following section examines the creation of the ECN in practice and provides a step-by-step approach to its creation.

4. The practicalities of building the Ecologically Connected Network as a component of the NRN and delivering the '30 x 30' target.

A practical step by step guide.

Stage 1. Defining the current baseline

1. Define and agree the aims of the network – nature – carbon – access – or a combination then develop management objectives.
2. Agree the primary objectives as “nature recovery and supporting adaptation to climate change”.
3. Agree success targets – what does nature recovery look like, and how do you know when you have achieved this? – (see 3.11 above).).
4. Clarify the existing resource to be included in the network including the number and extent of SSSIs and clarity the features they are currently designated and managed for, as well as being clear on the inclusion (or otherwise) of other protected areas. It is important to decide whether to include others such as NNR, SPA, SAC, National Parks, AONB and more local designations at the outset of the process (see 3.5 above).
5. Clarify the geological context, extent of habitat and species features of particular interest (Annex 1), *i.e.,* undertake and publish an audit of the current SSSI 'estate'.
6. Clarify what flexibilities exist under current legislation in practice to modify protected areas including the designation feature, purpose, selection, number, extent, and boundary change. Assuming some flexibility exists then test which could be applied as a start in the creation of the network.
7. Clarify what policy and funding mechanisms exist, and which actors’ control these, to enhance the management and monitoring of existing sites and to underpin the development of the network.
8. Clarify what organisational co-ordination mechanism (governance) is needed to ensure the full potential of network creation.

Stage 2. Developing the network concept and mechanisms in practice.

1. Undertake a climate change sensitivity assessment of the protected areas involved – to ensure that existing site management is optimal given the management objectives of each area. (See Natural England & RSPB 2019). Much of this

assessment could be “desk-based” and it seems likely that the sensitivity and likelihood of change for many sites will already be known, in outline at least.

2. Identify and agree management objectives in light of this assessment at the network level. This is important as it is anticipated that some protected areas will be resilient and others much less so. Equally it may be necessary to modify the management of some to enhance resilience whilst changing management on others may be problematic. For example, even with climate change impacts an estuarine protected area will probably retain ecological importance (especially if managed retreat occurs), whereas a protected area holding a rare or already threatened habitat may lose all its current ecological interest if adaptive management is not deployed.
3. Annex 1 provides an overview of threatened habitats in England and could be used as a start point for the development of a network. At present only a certain percentage of each of these habitats is included in protected areas. Judgements could be made about increasing this percentage to underpin the network, and on how this could be achieved in terms of the number of sites (for example, a larger number of small sites, or a smaller number of large sites) for each habitats type. Whilst this could be derived from a theoretical perspective, we suggest that a practical examination of options initially via a pilot of the approach would be more meaningful and would reveal issues such as the level of “buy-in” from local communities and landowners, for example.
4. Consider what options exist on the ground for boundary changes, expansion of the existing sites, the creation of "buffer or expansion areas” around protected areas and how this could link to nearby sites (bigger, better managed and more joined up).
5. Develop a risk-based monitoring programme, focussing on those protected areas that are most at risk of damage or significant change.
6. In light of these assessments, suggest any changes in legislation that might be required to create the Ecologically Connected Network of protected areas. Importantly, this report makes suggestions on the key areas of legislation that may need to be changed to facilitate network development, hence if these suggestions are acted upon, then work to create the network can begin immediately.
7. It seems likely that there is a considerable flexibility in current legislation that is not fully utilised in the context of creating an Ecologically Connected Network. So, for example, whilst the SSSI series provides a representative sample of habitats across the country, that representation could be increased in number and scale without further changes to legislation. Current policy and practices have established the baseline of protected areas we see today, but if nature is to recover in a rapidly developing climate impacted world, then policy needs to change, and the baseline needs to shift.

Stage 3. Putting this into practice

Note - We suggest that the following approach is used initially in several trial areas including both upland and lowland landscapes (over a two - year period?) and

ideally in a coastal/marine area to test the mechanisms involved, and to be able to assess the level of cost involved and the likely benefits that could result in the short-term. The need for a trial period is emphasised as it is important to test the various approaches “on the ground” and to learn as the trial develops.

1. Convene an Advisory Group of stakeholders including landowners, managers, and other agencies responsible for planning and managing the land and freshwater/marine resource.
2. Define the landscape scale boundary of the trial areas
3. Define the duration of the trial
4. Agree success criteria and key outcomes (including milestones see Section 3.11) for the trial period. (These should include communications and engagement issues as well as conservation outcomes *per se*).
5. Identify the key aspects to be monitored and develop a risk-based monitoring plan that outlines how this will be delivered.
6. Identify the types and identity of protected areas to be included (possibly in parallel with 5 above).
7. Undertake a climate vulnerability assessment/ risk of change assessment for all protected areas included in the trial.
8. Consider how the trial area will fit into a wider national network of protected areas and then identify the key management outcomes – options include:
    - continued management of current sites.
    - expansion of formal boundaries.
    - addition of buffer zones.
    - sympathetic management of wider surrounding areas (beyond buffer zones).
    - creation of new sites; and
    - scope for linked habitat restoration.
9. Consider the spatial arrangement of options above, for example the potential to create corridors between extant (and/or new) protected areas.
10. Desk study to outline future scenario for the trial area and to consider how to incorporate “ecological anticipation” into network design, so how to cater for colonising species and habitats, and how to manage sites that no longer hold their original features of interest.
11. Review with Advisory Group at regular interval and re-assess progress after one year.
12. Assuming such an initial trial is undertaken in several parts of the country, coordination across areas will be important to share experience and to learn together. The ability to develop effective coordination at scale would be a key aspect of the trial.
13. Once the trial is underway it seems likely that much will be learned in the early stages that could be deployed in other parts of the country and rapid exchange of experience and of lessons learned, should be encouraged.

14. A formal review of the trial should be undertaken on completion as this will provide information to help design and implement the whole ECN across the country.

5. References

Convention on Migratory Species 2014. Ecological networks: a strategic review of aspects relating to migratory species. UNEP/CMS/COP11/Doc.23.4.1.2. 57 pp.

Convention on Migratory Species 2020. The role of ecological networks in the conservation of migratory species. UNEP/CMS/Resolution 12.7 (Rev.COP13). 8 pp.

Convention on Migratory Species 1979. Convention text. UNEP/CMS. 6 pp.

COX, K., GROOM, A., MERCER, I. & JENNINGS, K. 2018. National Parks or Natural Parks: how can we have both? *British Wildlife* 30(2): 87-96.

DASGUPTA, P. 2021. The Economics of Biodiversity: the Dasgupta review. London: HM Treasury. 610 pp.

Department for Environment, Food and Rural Affairs 2003. *Sites of Special Scientific Interest: encouraging positive partnerships. Code of guidance*. 50 pp.

Department for Environment, Food and Rural Affairs 2011. *Biodiversity 2020: A strategy for England's wildlife and ecosystem services.* Department for Environment, Food and Rural Affairs, London. 48 pp.

GALBRAITH, C.A. & STROUD, D.A. 2020. *Approaches for improving condition and biodiversity safeguard/enhancement.* Unpublished think piece for NatureScot. 28 pp.

GALBRAITH, C.A. & STROUD, D.A. 2021a. *Sites of Special Scientific Interest (SSSIs) in England: their historical development and prospects in a changing environment.* Unpublished report to Natural England. 87 pp.

GALBRAITH, C.A. & STROUD, D.A. 2021b. *Developing the management and monitoring of protected areas in a changing environment.* Unpublished report to NatureScot. 30 pp.

HAYHOW, D.B., EATON, M.A., STANBURY, A.J., BURNS, F., KIRBY, W.B., BAILEY, N., BECKMANN, B., BEDFORD, J., BOERSCH-SUPAN, P.H., COOMBER, F., DENNIS, E.B., DOLMAN, S.J., DUNN, E., HALL, J., HARROWER, C., HATFIELD, J.H., HAWLEY, J., HAYSOM, K., HUGHES, J., JOHNS, D.G., MATHEWS, F., MCQUATTERS-GOLLOP, A., NOBLE, D.G., OUTHWAITE, C.L., PEARCE-HIGGINS, J.W., PESCOTT, O.L., POWNEY, G.D. & SYMES, N. 2019. *The State of Nature 2019*. The State of Nature partnership.

HLAD, B. & SKOBERNE, P. 2001. *Biological and landscape diversity in Slovenia.* Ministry of the Environment and Spatial Planning, Ljubljana. 242 pp.

IPCC 2022. *Climate Change 2022. Impacts, adaptation, and vulnerability. Summary for policymakers. Working Group II contribution to the sixth assessment report of the Intergovernmental Panel on Climate Change*. 37 pp. IPCC, Bonn, Germany.

JOHNSTON, A., AUSDEN, M., DODD, A.M., BRADBURY, R.B., CHAMBERLAIN, D.E., JIGUET, F., THOMAS, C.D., COOK, A.S.C.P., NEWSON, S.E., OCKENDON, N., REHFISCH, M.M., ROOS, S., THAXTER, C., BROWN, A., CRICK, H.Q.P., DOUSE, A., MCCALL, R.A., PONTIER, H., STROUD, D.A., CADIOU, B., CROWE, O., DECEUNINCK, B., HORNMAN, M. & PEARCE-HIGGINS, J.W. 2013. Observed and predicted effects of climate change on species abundance in protected areas. *Nature Climate Change* 3: 1055-1061. doi:10.1038/nclimate2035

Joint Nature Conservation Committee 2013. *Guidelines for the Selection of Biological SSSIs.* JNCC, Peterborough.

LAKE, S., LILEY, D., STILL, R. & SWASH, A. 2020. *Britain's habitats. A field guide to the wildlife habitats of Great Britain and Ireland.* Princetown University Press, Oxford. 416 pp.

LAWTON, J.H., BROTHERTON, P.N.M., BROWN, V.K., ELPHICK, C., FITTER, A.H., FORSHAW, J., HADDOW, R.W., HILBORNE, S., LEAFE, R.N., MACE, G.M., SOUTHGATE, M.P., SUTHERLAND, W.J., TEW, T.E., VARLEY, J., & WYNNE, G.R. 2010. *Making Space for Nature: a review of England's wildlife sites and ecological network.* Report to DEFRA. 119 pp.

Natural England & RSPB 2019. *Climate Change Adaptation Manual - Evidence to support nature conservation in a changing climate.* 2nd Edition. Natural England, York, UK.

Natural England, JNCC, Natural Resources Wales, NatureScot & Northern Ireland Environment Agency 2021. *Nature Positive 2030 – Summary Report.* JNCC: Peterborough. 56 pp. ISBN: 978-1-86107-636-6

PAVÓN-JORDÁN, D., FOX, A.D., CLAUSEN, P., DAGYS, M., DECEUNINCK, D., DEVOS, K., HEARN, R.D., HOLT, C.A., HORNMAN, M., KELLER, V., LANGENDOEN, T., ŁAWICKI, L., LORENTSEN, S.H., LUIGUJÕE, L., MEISSNER, W., MUSIL, P., NILSSON, L., PAQUET, J.Y., STIPNIECE, A., STROUD, D.A., WAHL, J., ZENATELLO, M. & LEHIKOINEN, A. 2015. Climate-driven changes in winter waterbird abundances in relation to EU protected areas. *Diversity and Distributions* 21: 571-582.

PAVÓN-JORDÁN, D., CLAUSEN, P., DAGYS, M., DEVOS, K., ENCARNAÇAO, V., FOX, A. D., … LANGENDOEN, T. 2019. Habitat and species mediated short- and long-term distributional changes in waterbird abundance linked to variation in European winter weather. *Diversity and Distributions* 25: 225–239.

PAVÓN-JORDÁN, D., ABDOU, W., AZAFZAF, H., BALAŽ, M., BINO, T., BORG, J. J., BOŽIČ, L., BUTCHART, S. H. M., CLAUSEN, P., SNIAUKSTA, L., DAKKI, M., DEVOS, K., DOMSA, C., ENCARNAÇAO, V., ETAYEB, K., FARAGÓ, S., FOX, A. D., FROST, T., GAUDARD, C., … LEHIKOINEN, A. 2020. Positive impacts of important bird and biodiversity areas on wintering waterbirds under changing temperatures throughout Europe and North Africa. *Biological Conservation* 246: 108549. https://doi.org/10.1016/j.biocon.2020.108549

ROMÃO, C., RICHARD, D. & JONES-WALTERS, L. 2012. *Protected areas in Europe — an overview.* European Environment Agency, Copenhagen. 130 pp.

STARNES, T., BERESFORD, A.E., BUCHANAN, G.M., LEWIS, M., HUGHES, A. & GREGORY, R.D. 2021. The extent and effectiveness of protected areas in the UK. *Global Ecology and Conservation* 30: e01745.

STROUD, D.A. & DAVIDSON, N.C. 2021. Fifty years of criteria development for selecting wetlands of international importance. *Marine & Freshwater Research* 72: 1-15. https://doi.org/10.1071/MF21190

TICKNER, D., OPPERMAN, J., ABELL, R.; ACREMAN, M., ARTHINGTON, A.H., BUNN, S.E., COOKE, S.J., DALTON, J., DARWALL, W., EDWARDS, G., YOUNG, L. 2020. Bending the curve of global freshwater biodiversity loss — An emergency recovery plan. *Bioscience* 70(4): 330–342. https://doi.org/10.1093/biosci/biaa002

TREWEEK, J., DRAKE, M., MOUNTFORD, O., NEWBOLD, C., HAWKE, C., JOSE, P., SELF, M. & BENSTEAD, P. 1997. The *Wet Grassland Guide. Managing floodplain and coastal wet grasslands for wildlife.* 254 pp. RSPB, Sandy.

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Annex 1. High level summary of English habitats and scope for protection

Source: Lake *et al.* 2020. Produced with permission from Princeton University Press.

High level habitat types	Habitats Directive Annex I type (yellow highlight & * = priority habitat types)	UK Priority habitat	Extent (km^2)	Opportunities for development of protected areas including adaptation
Coastal habitats				
Coastal vegetated shingle	1210 Annual vegetation of drift lines 1220 Perennial vegetation of stony banks	Coastal vegetated shingle	42	Occurrence and extent geomorphologically determined. Limited structural climate change impacts - adaptation opportunities limited but include restoring the mobility of shingle allowing full range of successional stages. Important to ensure significant representation within NRN given national scarcity
Hard cliff and cliff slope	1230 Vegetated Sea cliffs of the Atlantic and Baltic Coasts	Maritime cliff and slope	137	Occurrence and extent geomorphologically determined. Limited structural climate change impacts - adaptation opportunities limited
Mudflat and sandflat	1110 Sandbanks which are slightly covered by sea water all the time 1130 Estuaries 1140 Mudflats and sandflats not covered by seawater at low tide	Intertidal mudflats	5,584	Will be significantly impacted by rising sea levels and associated 'coastal squeeze'. Adaptation will involve widescale managed retreat.

High level habitat types	irective Annex I type (yellow highlight & * = priority habitat types)	UK Priority habitat	Extent (km2)	Opportunities for development of protected areas including adaptation
Coastal habitats				
Littoral rock	H8330 Submerged or partially submerged sea caves H1170 Reefs	Intertidal under-boulder communities Intertidal chalk		Occurrence and extent geomorphologically determined. Limited structural climate change impacts - adaptation opportunities limited
Saline lagoon	1150 *Coastal lagoons	Saline lagoons	14	Natural occurrence and extent largely geomorphologically determined, although creation of new lagoons possible using well-established techniques. Adaptation opportunities likely limited although will need to include measures to address 'coastal squeeze'. Important to ensure high representation within NRN given national rarity and priority status.
Saltmarsh	1310 Salicornia and other annuals colonizing mud and sand 1320 Spartina swards (*Spartinion maritimae*) 1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) 1420 Mediterranean and thermo-Atlantic halophilous scrubs (*Sarcocornetea fruticosi*)	Coastal saltmarsh	224	Will be significantly impacted by rising sea levels and associated 'coastal squeeze'. Adaptation will involve widescale managed retreat.
High level habitat types	**Directive Annex I type (yellow highlight & * = priority habitat types)**	**UK Priority habitat**	**Extent (km2)**	**Opportunities for development of protected areas including adaptation**

Coastal habitats				
Sand Dune	2110 Embryonic shifting dunes 2120 Shifting dunes along the shoreline with *Ammophila arenaria* ('white dunes') 2130 *Fixed coastal dunes with herbaceous vegetation ("grey dunes') 2140 *Decalcified fixed dunes with *Empetrum nigrum* 2150 *Atlantic decalcified fixed dunes (*Calluno-Ulicetea*) 2160 Dunes with *Hippophaë rhamnoides* 2170 Dunes with *Salix repens* ssp. *argentea* (Salicion arenariae) 2190 Humid dune slacks 2250 *Coastal dunes with Juniperus spp.	Coastal sand dunes	73	Occurrence and extent largely geomorphologically determined. Likely to be impacted by greater coastal erosion processes. Adaptive management is needed using strategic approaches. Important to ensure significant representation within NRN given national scarcity and priority status
Soft cliff	1230 Vegetated Sea cliffs of the Atlantic and Baltic Coasts	Maritime cliff and slope	Unknown	Occurrence and extent geomorphologically determined. Limited structural climate change impacts - adaptation depends on non-intervention and encouragement of natural processes
High level habitat types	**Directive Annex I type (yellow highlight & * = priority habitat types)**	**UK Priority habitat**	**Extent (km2)**	**Opportunities for development of protected areas including adaptation**

Freshwaters				
Nutrient-rich (eutrophic) lake	3150 Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* — type vegetation	Eutrophic standing waters	204	Status strongly influenced by catchment hydrology and surrounding land uses. Limited recreation possibilities (complex and expensive), although significant restoration opportunities as part of lowland wetland adaptation processes
Other types of lake (mesotrophic, marl, lowland nutrient-poor, & brackish)	3110 Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*) 3140 Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp	Mesotrophic lakes	Unknown	Influenced by catchment hydrology and surrounding land uses. Limited recreation, although significant restoration opportunities as part of adaptation processes
Peat-stained (dystrophic) waters	3160 Natural dystrophic lakes and ponds	Oligotrophic and dystrophic lakes	13	Occurrence and extent determined by occurrence and condition of surrounding peat landscapes. Important to ensure significant representation within NRN given national rarity and priority status. Adaptative management needs include establishment of appropriate grazing regimes
Pond, ditch, canal	3130 Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea* 3140 Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. 3150 Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* — type vegetation 3160 Natural dystrophic lakes and ponds	Ponds	Pond, no. 234,000 Ditch extent unknown Canal 3,300 km	Linear habitats that have important spatial ecological connectivity functions. Accordingly, important to ensure significant representation within NRN. Status strongly influences by nutrient run-off from surrounding farmland, catchment hydrology and other surrounding land uses

	3170 *Mediterranean temporary ponds			
High level habitat types	**Directive Annex I type (yellow highlight & * = priority habitat types)**	**UK Priority habitat**	**Extent (km2)**	**Opportunities for development of protected areas including adaptation**
Freshwaters (continued)				
Turlough and fluctuating mere	3180 *Turloughs	Aquifer fed naturally fluctuating water bodies	<1	Occurrence and extent geomorphologically determined. Adaptation opportunities limited. Important to ensure complete representation within NRN given national rarity and priority status
Upland lake, loch, and tarn	3130 Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea*	Oligotrophic and dystrophic lakes	89	Occurrence and extent largely geomorphologically determined. Important to ensure significant representation within NRN given national scarcity. Adaptation measures will include reduction of atmospheric pollution inputs and reduction of sedimentation caused by over-grazing
Chalk river and stream	3260 Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation	Rivers	3,900 km	Occurrence and extent largely geomorphologically determined. Significant adaptation challenges to sustain hydrological regimes in face of future water demands. Adaptive conservation management needs to address catchment management including nutrient run-off from surrounding farmland
High level habitat types	**Directive Annex I type (yellow highlight = priority habitat types)**	**UK Priority habitat**	**Extent (km2)**	**Opportunities for development of protected areas including adaptation**
Freshwaters (continued)				
Fast flowing river and stream	3260 Water courses of plain to montane levels with the	Rivers	unknown	Occurrence and extent largely geomorphologically determined. Adaptive conservation management needs to address catchment management

	Ranunculion fluitantis and *Callitricho-Batrachion* vegetation			including afforestation, heather-burning, overgrazing and agricultural pollution at low altitudes
Sluggish river and stream	3270 Rivers with muddy banks with *Chenopodion rubri* p.p. and *Bidention* p.p. vegetation	Rivers	unknown	Occurrence and extent largely geomorphologically determined however significant restoration and recreation possibilities
Grasslands				
Calaminarian grasslands	6130 Calaminarian grasslands of the *Violetalia calaminariae*	Calaminarian grassland	2	Occurrence and extent determined by underlying geology and past mining processes. Important to ensure complete representation within NRN given national rarity and priority status. Adaptation management should focus on enhancing connectivity – as feasible - between habitat fragments to allow species spread
Coastal and floodplain grazing marsh	None	Coastal and floodplain grazing marsh	2,181	Occurrence and extent largely determined by surrounding landscapes. However major restoration and recreation possibilities exist in context of wetland adaptation and supported by agri-environment initiatives but need to be undertaken strategically for greatest benefit
High level habitat types	**Directive Annex I type (yellow highlight & * = priority habitat types)**	**UK Priority habitat**	**Extent (km2)**	**Opportunities for development of protected areas including adaptation**
Grasslands (continued)				
Lowland calcareous grassland	6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (*important orchid sites)	Lowland calcareous grassland	490	Potential occurrence largely geologically determined. Significant restoration and recreation possibilities and supported by agri-environment initiatives, including a focus on enhancing

				connectivity between habitat fragments to allow species spread
Lowland dry acid grassland	2330 Inland dunes with open *Corynephorus* and *Agrostis* grasslands	Lowland dry acid grassland	201	Significant restoration and recreation possibilities and supported by agri-environment initiatives to restore functional pastoral landscapes
Lowland meadow and pasture	6510 Lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*)	Lowland meadows	16	Important to ensure significant representation within NRN given national rarity, priority status and past losses. Significant restoration and recreation possibilities supported by agri-environment initiatives
Northern hay meadow	6520 Mountain hay meadows	Upland hay meadow	9	Important to ensure complete representation within NRN given national rarity and priority status. Significant restoration and recreation possibilities (the techniques for which are well-established) and supported by agri-environment initiatives
Purple moor-grass and rush pasture	6410 Molinia meadows on calcareous, peaty, or clayey-silt-laden soils (*Molinion caeruleae*)	Purple moor-grass and rush pasture	25	Important to ensure significant representation within NRN given national scarcity. Significant restoration and recreation possibilities and supported by agri-environment initiatives specially to restore appropriate grazing regimes
High level habitat types	**Directive Annex I type (yellow highlight & * = priority habitat types)**	**UK Priority habitat**	**Extent (km2)**	**Opportunities for development of protected areas including adaptation**
Grasslands (continued)				
Upland acid grassland	None	n/a	3,760	Significant restoration and recreation possibilities and supported by agri-environment initiatives. Likely trade-offs with other upland habitats in the context of climate change adaptation (*e.g.,* rewilding including the spread of upland woodlands)

Upland calcareous grassland	6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (*important orchid sites) 6230 *Species-rich *Nardus* grasslands, on silicious substrates in mountain areas (and submountain areas in Continental Europe	Upland calcareous grassland	3	Important to ensure complete representation within NRN given national rarity, priority status and past losses. Significant restoration and recreation possibilities and supported by agri-environment initiatives, in particular through the use of conservation grazing to prevent succession to other habitats
Upland rush pasture	None	n/a	3,760	Significant restoration and recreation possibilities and supported by agri-environment initiatives, in particular the establishment of appropriate grazing regimes
Heathlands				
Lowland dry heath	4030 European dry heaths	Lowland heathland	580	Likely will need significant adaptation management to maintain status (including integrating into local economies), although restoration and recreation possibilities (techniques for which are well known) supported by agri-environment initiatives
High level habitat types	**Directive Annex I type (yellow highlight & * = priority habitat types)**	**UK Priority habitat**	**Extent (km2)**	**Opportunities for development of protected areas including adaptation**
Heathlands (continued)				
Lowland wet heath	4010 Northern Atlantic wet heaths with *Erica tetralix* 4020 *Temperate Atlantic wet heaths with *Erica ciliaris* and *Erica tetralix*	Lowland heathland	unknown	May need adaptation management to maintain status

Upland dry heath	4030 European dry heaths	Upland heathland	1,488	Likely trade-offs with other upland habitats in the context of climate change adaptation (*e.g.,* spread of upland woodlands). Will benefit from more sustainable management that enhances carbon capture and storage, including reduction of grazing levels
Upland wet heath	4010 Northern Atlantic wet heaths with *Erica tetralix*	Upland heathland	688	Likely trade-offs with other upland habitats in the context of climate change adaptation (*e.g.,* spread of upland woodlands). Will benefit from more sustainable management that enhances carbon capture and storage, including reduction of grazing levels
Mountains				
High montane heath and snow-bed	6150 Siliceous alpine and boreal grasslands 6170 Alpine and subalpine calcareous grasslands	n/a	11	Occurrence and extent geomorphologically and climatically determined. Important to ensure significant representation within NRN given national rarity and priority status. Adaptation measures will include control of grazing and trampling
High level habitat types	**Directive Annex I type (yellow highlight & * = priority habitat types)**	**UK Priority habitat**	**Extent (km2)**	**Opportunities for development of protected areas including adaptation**
Mountains (continued)				
Montane dwarf-shrub heath	4060 Alpine and Boreal heaths	Upland heathlands	12	Occurrence and extent geomorphologically and climatically determined. Important to ensure high representation within NRN given national rarity and priority status. Adaptation measures will include reduction of atmospheric pollution inputs and control of trampling

Montane scrub	4080 Sub-Arctic *Salix* spp. Scrub	Inland rock outcrop and scree habitats	<1	Occurrence and extent geomorphologically and climatically determined. Important to ensure complete representation within NRN given national rarity and priority status. Adaptation will involve reduction of grazing
Mountain ledge	6430 Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels	Inland rock outcrop and scree habitats	1	Occurrence and extent geomorphologically determined. Limited structural climate change impacts - adaptation opportunities limited other than reduction of grazing (including access by animals). Important to ensure complete representation within NRN given national rarity and priority status
Other habitats				
Arable	None	Cereal field margins	47,749	Scope for a range of local management regimes under agri-environment initiatives
Brownfield	None	Open mosaic habitats on previously developed land	unknown	Scope for a range of local management regimes, including working with potential developers of sites of importance
High level habitat types	**Directive Annex I type (yellow highlight & * = priority habitat types)**	**UK Priority habitat**	**Extent (km2)**	**Opportunities for development of protected areas including adaptation**
Other habitats (continued)				
Garden	None	n/a	?	Scope to nationally promote gardening for wildlife
Traditional orchard	None	Traditional orchards	170	Scope to sustain and restore under agri-environment initiatives
Rocky habitats				

Limestone pavement	8240 *Limestone pavements	Inland rock outcrop and scree habitats	20	Occurrence and extent geomorphologically determined. Limited structural climate change impacts - adaptation opportunities limited although conservation grazing important to prevent succession. Important to ensure high representation within NRN given national rarity, priority status and extensive past losses
Rocky slopes	8220 Siliceous rocky slopes with chasmophytic vegetation 8210 Calcareous rocky slopes with chasmophytic vegetation	Inland rock outcrop and scree habitats	16	Occurrence and extent geomorphologically determined. Limited structural climate change impacts - adaptation opportunities limited. Important to ensure high representation within NRN given national rarity and priority status. Adaptation will involve reduction of grazing
Scree	8110 Siliceous screes of the montane to snow levels (*Androsacetalia alpinae* and *Galeopsietalia ladani*) 8120 Calcareous and calcshist screes of the montane to alpine levels (*Thlaspietea rotundifolii*)	Inland rock outcrop and scree habitats	37	Occurrence and extent geomorphologically determined. Limited structural climate change impacts - adaptation opportunities limited. Important to ensure significant representation within NRN given national scarcity. Adaptation will involve reduction of grazing
High level habitat types	**Directive Annex I type (yellow highlight & * = priority habitat types)**	**UK Priority habitat**	**Extent (km2)**	**Opportunities for development of protected areas including adaptation**
Scrub				
Bracken	None	n/a	91,100	Not a conservation priority
Hedgerow	None	Hedgerows	420,000	Scope to encourage restoration so as to enhance connectivity between other woody habitats
Mixed scrub	None	n/a	unknown	A successional stage that is inherently dynamic with scope to sustain as part of habitat matrices

Wetlands				
Blanket bog	7130 Blanket bogs (*if active bog) 7150 Depressions on peat substrates of the *Rhynchosporion* 7140 Transition mires and quaking bogs	Blanket bog	2,300	Occurrence and extent climatically determined. Significant adaptation opportunities for restoration of degraded blanket bogs. Important to ensure significant representation within NRN given functional irreplaceability of habitat
Lowland fen	7210 *Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* 7230 Alkaline fens	Lowland fens	119	Occurrence and extent geomorphologically determined. Significant opportunities for restoration and recreation as part of wetland adaptation in lowlands
High level habitat types	**Directive Annex I type (yellow highlight & * = priority habitat types)**	**UK Priority habitat**	**Extent (km2)**	**Opportunities for development of protected areas including adaptation**
Scrub				
Raised bog	7110 *Active raised bogs 7120 Degraded raised bogs still capable of natural regeneration 7150 Depressions on peat substrates of the *Rhynchosporion* 7140 Transition mires and quaking bogs	Raised bogs	174	Occurrence and extent geomorphologically determined. Significant opportunities for restoration of degraded raised bogs. Important to ensure significant representation within NRN given functional irreplaceability of habitat

Reedbed	None	Reedbed	70	Important to ensure significant representation within NRN given national scarcity. Adaptation will include management that prevents succession to other vegetation types through appropriate grazing and reed-cutting
Upland spring and flush	7220 *Petrifying springs with tufa formation (*Cratoneurion*) 7240 *Alpine pioneer formations of the *Caricion bicoloris-atrofuscae* 7210 *Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* 7140 Transition mires and quaking bogs	Upland flushes, fens, and swamps	unknown	Occurrence and extent geomorphologically (and possibly climatically) determined. Important to ensure significant representation within NRN given likely national scarcity
High level habitat types	**Directive Annex I type (yellow highlight & * = priority habitat types)**	**UK Priority habitat**	**Extent (km2)**	**Opportunities for development of protected areas including adaptation**
Scrub (continued)				
Valley mire	7140 Transition mires and quaking bogs 7150 Depressions on peat substrates of the *Rhynchosporion*	Lowland fens	unknown	Occurrence and extent geomorphologically determined. Significant opportunities for restoration as part of wetland adaptation in lowlands, including support for appropriate grazing regimes. Important to ensure significant representation within NRN given functional irreplaceability of habitat
Woodlands				
Beech wood	9120 Atlantic acidophilous beech forests with *Ilex* and sometimes also	Lowland Beech and Yew woodland	170	South-eastern distribution. Significant restoration (de-coniferisation) and recreation opportunities.

	Taxus in the shrublayer (*Quercion robori-petraeae* or *Ilici-Fagenion*) 9130 Asperulo-*Fagetum* beech forests			Adaptation will be enhanced through encouraging spread of woods beyond their current boundaries and ensuring continuity of veteran trees
Coniferous plantation	None	n/a		Not a conservation priority
Lowland dry oak and birch wood	9190 Old acidophilous oak woods with *Quercus robur* on sandy plains	Lowland mixed deciduous woodland	45	South-eastern distribution. Significant restoration and recreation opportunities. Important to ensure significant representation within NRN given national scarcity. Adaptation will be enhanced through encouraging spread of woods beyond their current boundaries
High level habitat types	**Directive Annex I type (yellow highlight & * = priority habitat types)**	**UK Priority habitat**	**Extent (km2)**	**Opportunities for development of protected areas including adaptation**
Woodlands (continued)				
Lowland mixed oak and ash wood	9160 Sub-Atlantic and medio-European oak or oak-hornbeam forests of the *Carpinion betuli*	Lowland mixed deciduous woodland	700	Significant restoration opportunities and management needs where traditional interventions have been abandoned. Adaptation will be enhanced through encouraging spread of woods beyond their current boundaries
Upland birch wood	None	Upland birchwoods	unknown	Likely trade-offs with other upland habitats in the context of climate change adaptation (*e.g.,* upland heaths). Significant restoration and recreation opportunities. Adaptation will be enhanced through encouraging spread of woods beyond their current boundaries and encouraging regeneration processes through control of grazing
Upland mixed ash wood	9180 *Tilio-Acerion forests of slopes, screes, and ravines	Upland mixed ashwoods	75	Important to ensure significant representation within NRN given national scarcity. Significant restoration and recreation opportunities.

	8240 *Limestone pavements			Adaptation will be enhanced through encouraging spread of woods beyond their current boundaries and encouraging regeneration processes through control of grazing. Likely significantly impacted by Ash dieback disease
Upland oak wood	91A0 Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles	Upland Oak woods	200	Likely trade-offs with other upland habitats in the context of climate change adaptation (*e.g.,* upland heaths). Significant restoration and recreation opportunities. Adaptation will be enhanced through encouraging spread of woods beyond their current boundaries and encouraging regeneration processes through control of grazing
High level habitat types	**Directive Annex I type (yellow highlight & * = priority habitat types)**	**UK Priority habitat**	**Extent (km2)**	**Opportunities for development of protected areas including adaptation**
Woodlands (continued)				
Wet woodland	91E0 *Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*AlnoPadion, Alnion incanae, Salicion albae*) 91D0 *Bog woodland	Wet woodland	26	Inherently successional. Significant restoration and recreation opportunities in context of wider wetland restoration and adaptation processes. Important to ensure significant representation within NRN given national scarcity.
Wood pasture	None	Wood pasture and parkland	578	Will depend on significant long-term management inputs. Considered at low risk from climate change but important to ensure continuity of veteran trees and 'veteranize' younger trees
Yew wood	91J0 Taxus *baccata* woods of the British Isles	Lowland Beech and Yew woodland	12	Important to ensure high representation within NRN given national rarity, priority status and functional irreplaceability. Adaptation will be enhanced through encouraging spread of woods beyond their current boundaries and ensuring continuity of veteran trees

Annex 2. Matrix summary of issues raised Natural England's SSSI Future Vision Internal Workshop: 18 January 2022

	What's good about SSSIs	What are the problems?	Promotion of climate change adaptation (CCA)	Extent of change	Next steps
National focus for conservation action	National conservation 'flagship' areas	N/A	SSSIs act as a focus for national biodiversity CCA SSSIs act as hotspots for species and habitats to allow spread Need to more explicitly recognise SSSI role in CCA	Overall ambition, scope, and objective setting for network needs to be greatly enhanced	Develop clear objectives and priorities as a matter of immediacy Develop a plan with desirable actions and next steps/ actions Undertake risk assessment and scenario-setting
Strong legislative basis	Protection from development Statutory basis give inherent long-term protection	Legal and policy issues remain	Statutory basis needs to be enhanced	N/A	N/A
Site selection	Science-based Regional basis for selection within UK guidelines	Process of feature selection 'fossilises' grounds for importance	CCA not reflected in SSSI Selection Guidelines	Likely need to revise SSSI Guidelines	Engage with other country conservation bodies

	What's good about SSSIs	What are the problems?	Promotion of climate change adaptation (CCA)	Extent of change	Next steps
Network design	N/A	Lack of national scale objectives or network design	N/A	Need to create a functional network	Plan and undertake pilot projects at regional scale
Geodiversity	Some sites selected for both biological and geological interests	Failure to well integrate geological with biological SSSIs giving missed opportunities	N/A	N/A	Plan how to better integrate geological with biological SSSIs
Relations with owners & occupiers	Long established so well understood Often good	Sometimes poor Enforcement problems	Owners and occupiers are the key to necessary management	Need for more inclusive relationships	Keep owners and occupiers on-side as a matter of priority – explain the way forward and the thinking: joint mission
Relations with stakeholders	SSSI provides shared objectives and mission	N/A	Need to develop shared understanding and buy-in in relation to development of network and CCA	Need for more inclusive relationships	Give priority to communication and engagement with stakeholders: shared thinking
Financial incentives for management	N/A	Lack of strong financial incentive to invest in good land-use	Finance packages will be necessary to incentivise actions	N/A	N/A

	What's good about SSSIs	What are the problems?	Promotion of climate change adaptation (CCA)	Extent of change	Next steps
Overall resourcing	N/A	Inadequate to deliver monitoring and adaptive management	Funding from government urgently needs to be more realistic and in line with the scale of the task(s)	N/A	Resourcing for developing initiatives to enhance the network needed
Public awareness	SSSIs enhance the public understanding of conservation. Part of the post-covid green 'new normal'	Could be much better	Need to develop greater understanding in relation to development of network and CCA: what that will imply	N/A	N/A
Size of sites and boundaries	N/A	Typically, too small, and often too tightly defined around interests Inflexibility of boundary modification	Small size of sites limits scope for CCA	Sites need to be larger	Undertake pilot programme to review and enhance size of SSSIs
Relationship with surrounding countryside	N/A	Lack of buffer areas and ecological connections with surrounding sites	Lack of buffer areas limits scope for CCA Need to enhance ecological connection with surrounding landscapes	Needs to be a strong focus of activity to enhance and create opportunities	Undertake pilot programme to trial ways to ecologically integrate SSSIs with surrounding areas

	What's good about SSSIs	What are the problems?	Promotion of climate change adaptation (CCA)	Extent of change	Next steps
Connectivity with other SSSIs	N/A	Often limited or lacking	Greater connectivity would assist CCA and biodiversity recovery generally	Wildling and restoration have important roles	Undertake pilot programme to enhance connectivity of SSSIs
Site objectives	N/A	Sometimes conflicting objectives for different interests	CCA not reflected and should be	Need to better understand risks of change through /scenario-setting	N/A
Site management	Some consider flexibility is possible	Many consider processes determining management inflexible	CCA not reflected	Will need to be considered in the list of network objectives. No one-size fits all Partitioner training needed	N/A
Monitoring	In theory, management determined adaptively by monitoring of state	In practice, lack of monitoring means adaptive management has broken down at most sites	Important to enable adaptation	Partitioner training needed	N/A
Administrative processes	N/A	Complex and time-consuming	Need to allow more rapid adaptive responses: greater flexibility	Need to be reformed	Reform administrative processes to enhance cost-effective delivery of objectives

	What's good about SSSIs	What are the problems?	Promotion of climate change adaptation (CCA)	Extent of change	Next steps
Condition of sites	N/A	Existing poor condition of many / most sites	Reporting on condition essential to guiding and understanding CCA	N/A	Need to implement adequate reporting on condition
Pressures and threats	N/A	Failure to address existing pressures and threats	Existing pressures and threats limit scope for adaptation and resilience: need to address	Address existing pressures and threats to enhance resilience	N/A

Annex 3. Matrix summary of issues raised Natural England's SSSI Future Vision External Workshop: 2 March 2022

	What's good about SSSIs?	Can the existing SSSI statutory framework respond to change?	Can the SSSI adaptation response be improved?	What is our vision? Revolution or evolution?	Blue sky thinking: how best to support natural world adaptation? Do we need SSSIs?	Agreeing the next steps
National focus for conservation action	Successful national conservation 'flagship' areas. Focal areas for collaborative working between private, public and environmental NGO sectors Long-established means familiarity	Provide a national focus for biodiversity adaptation actions and policy Theoretically feasible, practically rarely achievable: current SSSI processes clunky and not designed for the rate of climate change. Needs to be fast and flexible	SSSIs could be national focus for adaptation measures but any change must be robust against non-nature interests	Need more outcome-based approach looking to deliver nature recovery rather than protection and including areas outwith SSSIs with outcomes based on adaptive capacity of wider landscapes	SSSI good at what they do in general terms Important that flexibility to change designations doesn't allow SSSIs to be denotified without very rigorous checks	Designate more of what is currently important - reduce extent of wider countryside

	What's good about SSSIs?	Can the existing SSSI statutory framework respond to change?	Can the SSSI adaptation response be improved?	What is our vision? Revolution or evolution?	Blue sky thinking: how best to support natural world adaptation? Do we need SSSIs?	Agreeing the next steps
Strong legislative basis	Protection from development Statutory basis give inherent long-term protection: rules are well-known Legal status gives accountability for damage	Administrative processes exist but need to be reformed to reflect dynamic rather than static contexts	Land use planning system only utilised for hard development - use it to plan out natural environments to a greater extent. LRNS gives opportunities	Stronger legislation, or implemented existing legislation, to tackle the big large-scale pressures	Protect sites which are compensation for protected site loss, currently protection doesn't follow Integrate biodiversity policy across all sectors	Clarify SSSI purpose in legislation and put conservation objectives on a statutory footing
Site selection	Selected on 'scientific' criteria without having to 'balance' economic interests	Severely limited by original purpose to protect 'a representative sample'. New purpose of helping nature adapt to change needed	Yes by developing flexibility and responsiveness in terms of the number and size of sites.	Publish NE's review of SSSI adequacy. Change needed to adapt to rapidly	Choices of new designations need to reflect the effects of climate change Develop biogeographic	Better understand and select sites within international contexts

	What's good about SSSIs?	Can the existing SSSI statutory framework respond to change?	Can the SSSI adaptation response be improved?	What is our vision? Revolution or evolution?	Blue sky thinking: how best to support natural world adaptation? Do we need SSSIs?	Agreeing the next steps
				changing situation.	approach to sites and conservation	
Network design	Representative sites with good geographic spread	Current system based on *status quo* not the future role of site in response to future species shifts	Support to design and implement an ECN. Creation of a national network with a regional approach.	Need to increase network coverage and scope through expanding extent covered currently and increasing connectivity of sites	Designate for potential as much as current interests	Collaboratively agree purpose/objective and scale of a nature network.
Geodiversity	Geological and geo-morphological SSSI series = one third of SSSI - best series of geo sites in world	Coastal erosion & sea level rise present opportunities and challenges for geo SSSI	N/A	Be clear where objectives are for natural functioning; habitat management or preservation e.g., static geology	Enhanced communication about the value of geodiversity would be timely.	N/A

	What's good about SSSIs?	Can the existing SSSI statutory framework respond to change?	Can the SSSI adaptation response be improved?	What is our vision? Revolution or evolution?	Blue sky thinking: how best to support natural world adaptation? Do we need SSSIs?	Agreeing the next steps
Relations with owners & occupiers	Good awareness of designation & processes. legislation built around engagement with owners/ occupiers - vital Governance strong against many threats and generally seen as fair/ proportionate	Necessary collaboration with those that own/manage land: advice consistency needed Need to address landowning attitudes seeing SSSI obligations as cost, rather than benefit or opportunity	More engagement with landowners needed to explain and get buy in where change of management might be needed	Need to shift perceptions and consider how to motivate site managers. Financial incentives to manage for nature are important for the future.	Relationships with owners / occupiers crucial	Keep owners and occupiers on-side as a matter of priority – explain the way forward and the thinking: joint mission
Relations with stakeholders	Well-recognised in other sectors including planning and agriculture	Need to understand social and economic contexts of land management. SSSI regime not the only	Need to develop vision and success criteria jointly with stakeholders	Communications strategy needed - including conflict	Better coherence between actions of all actors directing the different statutory "designations"/incentive schemes: needs to	Collaborate better with universities, NGOs, & general volunteer sector (citizen science): government agencies cannot do it alone

	What's good about SSSIs?	Can the existing SSSI statutory framework respond to change?	Can the SSSI adaptation response be improved?	What is our vision? Revolution or evolution?	Blue sky thinking: how best to support natural world adaptation? Do we need SSSIs?	Agreeing the next steps
		influence on site condition		resolution processes Need to bring people with us	be a collective mission	Develop cross-organisational common mission thinking... Promote links between SSSIs & other agendas (e.g., health, mental health, social prescribing)
Financial incentives for management	SSSIs provide focus for both public and private investment	Need clear incentives to manage for nature on SSSIs in future and in the surrounding areas of land and sea.	Note that the creation of an ECN will take additional resources but that the creation of the network is seen as a priority.	Ensure land under conservation management exempt from inheritance tax to same extent as farmland - status quo a major disincentive	Change financial support so SSSI regarded as positive rather than negative to landowners Investigate and develop green finance solutions to SSSI management	Develop a broader range of financial incentivisation options
Overall resourcing	Needs costed programme to bring all into	Essential but requires streamlining of	Realistic resourcing needed: costed (and funded!)	Adequate funding is needed to	Need a workforce that is trained, resourced and empowered to	Resourcing for developing initiatives to enhance the network

	What's good about SSSIs?	Can the existing SSSI statutory framework respond to change?	Can the SSSI adaptation response be improved?	What is our vision? Revolution or evolution?	Blue sky thinking: how best to support natural world adaptation? Do we need SSSIs?	Agreeing the next steps
	favourable condition. Designation and legal status helps secure external funding	systems and/or increased funding	program of measures to bring all SSSI into favourable condition Resource relevant bodies to deliver their objectives. Adequate no. of trained local staff are critical	deliver objectives for individual sites and the SSSI series	enforce protection and manage SSSI network	needed *e.g.,* regional pilot programmes and trials
Public awareness	Well known system protecting key sites and species. Many easily accessed by public, delivering many benefits but engagement variable	N/A	Need to develop greater public understanding of network development re climate change adaptation: what that will imply?	Need positive change but also need to ensure that what we have already is valued	SSSI story is very good- we need to explain and promote it better Need more public engagement, good story about their importance and wider role, not just nature...	N/A

	What's good about SSSIs?	Can the existing SSSI statutory framework respond to change?	Can the SSSI adaptation response be improved?	What is our vision? Revolution or evolution?	Blue sky thinking: how best to support natural world adaptation? Do we need SSSIs?	Agreeing the next steps
	depending on access					
Demonstration values	Mechanism to demonstrate optimum management and how to measure effectiveness of interventions. Local show-cases of 'best'	SSSIs provide national focus for adaptation processes	The need to trial or pilot the development of an ECN was stressed to minimise risk and to develop a cost-effective approach.	N/A	N/A	Use Nature Recovery Areas to demonstrate how SSSIs can better link to surrounding areas; fast track some so results can be publicised
Size of sites and boundaries	Existing portfolio of sites spread across the country. Provide a valuable starting point for the	Constrained by relatively small size and fixed boundaries meaning difficult for SSSIs to adapt to change But some boundaries flexible and respond to change -*e.g.,*	Implement Lawton review (better, bigger, more and joined) by inter alia implementing already complete/near complete SSSI and SPA Reviews will significantly move	Sites need to be larger and more connected	SSSIs need to follow the Lawton principles of Bigger, Better and More joined-up Dramatically expand SSSI coverage Use legislation to trigger buffers around	Target known gaps in network, NE review, SPA 3rd Review and SSSI review - gaps and issues with overly tight boundaries

	What's good about SSSIs?	Can the existing SSSI statutory framework respond to change?	Can the SSSI adaptation response be improved?	What is our vision? Revolution or evolution?	Blue sky thinking: how best to support natural world adaptation? Do we need SSSIs?	Agreeing the next steps
	creation of an ECN.	river/coastal boundaries can move with erosion giving extant framework for wider application	towards a comprehensive network, fix gaps and provide more robust boundaries		all biological SSSIs to enhance connectivity	
Relationship with surrounding countryside	Provide a focus for action. The areas surrounding existing SSSIs seen as priority for sympathetic management.	N/A	Maximise opportunities of other (agri-) measures to sensitively manage areas around existing sites. SSSI vs wider countryside currently a complete dichotomy	Evolution for SSSIs but within a revolutionary / transformational approach to land use	Look beyond the 30% - to additional 70% - and start to address key drivers at landscape scale - thus lifting state of not just SSSIs but wider countryside Better integrate all tools that influence/direct land-use. Use agri-scheme potential to support SSSI (e.g., create buffer zones)	Consider how agri-environment, protected areas (in widest context) and other land management incentives can link together and be mutually supportive

	What's good about SSSIs?	Can the existing SSSI statutory framework respond to change?	Can the SSSI adaptation response be improved?	What is our vision? Revolution or evolution?	Blue sky thinking: how best to support natural world adaptation? Do we need SSSIs?	Agreeing the next steps
Connectivity with other SSSIs	A core network that can facilitate species movement and range shifts	SSSI decision making needs to be less site specific & consider functional connectivity between sites to gain benefits across site network	Use NRN and LNRS opportunities to create corridors that link sites	Designate new SSSI to respond to the specific threat of climate change – e.g., sites for their potential to support directional connectivity	International collaboration needed to maintain a "conveyor belt" of protection for species moving northwards	Need to undertake a pilot project to examine the practicalities of managing SSSIs and their surrounding areas in a joined-up way.
Site objectives	A system of agreeing site objectives is already in place and could be used in the creation of an ECN.	N/A	Need to develop a positive vision of objectives for sites and share with stakeholders	Be clear where site objectives are for natural functioning (e.g., uplands, coast, wetlands, rivers); habitat management (e.g., hay meadows, ark sites for species);	N/A	N/A

	What's good about SSSIs?	Can the existing SSSI statutory framework respond to change?	Can the SSSI adaptation response be improved?	What is our vision? Revolution or evolution?	Blue sky thinking: how best to support natural world adaptation? Do we need SSSIs?	Agreeing the next steps
				preservation (e.g., static geology)		
Site management	Management flexibility is possible to an extent	Some flexibility within existing framework for adaptive management but requires confident and knowledgeable local staff/site managers *SSSI Guidelines* already allow for adaptation friendly approaches, e.g., buffer notification, ecological units, land for restoration potential – but not used	Need to redesign monitoring and management cycle to adequately allow for shifting environmental outcomes/adaptation but – critically – without lowering standards	N/A	Clear focus on and accountability for delivery of SSSI management. Legally binding protected area targets, better use of proactive management and enforcement measures by NE Use existing flexibility within SSSI system to adapt sites to current and imminent climate change impacts	Upskill NE advisors in local teams with knowledge of climate change adaptation
Monitoring	Temporal baseline from condition assessment	Problem of reliance on 40-year-old NVC to describe vegetation given vegetation	Need more information on likely changing	Monitoring is the bedrock of action without which we	Long-term surveillance to assess change will be critical	Put more money and resource into monitoring

	What's good about SSSIs?	Can the existing SSSI statutory framework respond to change?	Can the SSSI adaptation response be improved?	What is our vision? Revolution or evolution?	Blue sky thinking: how best to support natural world adaptation? Do we need SSSIs?	Agreeing the next steps
	monitoring theoretically allows understanding of status	composition may have changed since	species/assemblages on sites	literally do not know what we're doing		
Administrative processes	Process exists and allows focussed dialogue with stakeholders.	NE 'regulatory process' for enabling adaptation of sites/targets/designation will have to be more agile if this is to happen at pace	More flexibility of statutory planning /designation framework re SSSI revisions and changes – especially boundary and feature changes. Current system cumbersome: too long, too complex	Simplify what is a very complex system	Liberate SSSIs from the difficult administration /legalities that tie them down	Get clarity on true legislative barriers (c.f. perceived/interpretational) to SSSI reform Undertake root and branch review of how to get best from current system - driven and supported by the top
Condition of sites	N/A	N/A	Sites in favourable condition more resilient, so more focus needed on improving condition	First SSSI all in favourable condition	N/A	N/A

	What's good about SSSIs?	Can the existing SSSI statutory framework respond to change?	Can the SSSI adaptation response be improved?	What is our vision? Revolution or evolution?	Blue sky thinking: how best to support natural world adaptation? Do we need SSSIs?	Agreeing the next steps
Pressures and threats	N/A	Levels of protection for SSSIs not precautionary enough to prevent continued increased pressure from land use System gives inadequate regard to landscape-scale pressures	Address more quickly multiple other adverse impacts and pressures that reduce ability of sites to adapt	Massive reduction of broad scale adverse pressures needed (air quality, water quality, water quantity) through revolutions in farming, transport, water supply & wastewater treatment	Tackle key pressures to give sites greater resilience Tackle pressures at different levels: site level (e.g., habitat suitability); catchment/regional level (e.g., nutrient management) and national level (e.g., air pollution, climate change)	N/A

Annex 4. Developing a Nature Recovery Network[10]

"Through changes in the way we manage our land, we will develop a Nature Recovery Network providing 500,000 hectares of additional wildlife habitat, more effectively linking existing protected sites and landscapes, as well as urban green and blue infrastructure. Such a network will deliver on the recommendations from Professor Sir John Lawton: recovering wildlife will require more habitat; in better condition; in bigger patches that are more closely connected.

As well as helping wildlife thrive, the Nature Recovery Network could be designed to bring a wide range of additional benefits: greater public enjoyment; pollination; carbon capture; water quality improvements and flood management.

The network could contain a range of land cover types, including new woodland and coastal habitats. Other parts of the network covering peatland, grassland or scrub will lend themselves to environmentally sensitive farming and livestock management, within a wider patchwork of agricultural activity.

We will identify what a network could look like and the steps that are needed to make this happen. For example, we will investigate putting in place up to 25 new catchment or landscape scale nature recovery areas to significantly expand wildlife habitat. These would help build resilience to climate change, and provide opportunities for species and ecosystem recovery, and for the reintroduction of formerly native species, as well as for local community engagement and business development.

We will look initially at opportunities for nature recovery through peatland restoration, natural flood management and woodland planting. We will also look at establishing wildflower recovery areas. This would make it easier for people to visit flower-rich meadows, grasslands and heathland close to their homes. These could be linked to new and existing green infrastructure to extend wildlife corridors into towns and cities and provide opportunities for conserving wildflowers and insect pollinators.

We want to see local communities and businesses more involved. Data and mapping tools under development will help us come up with proposals that offer the maximum wildlife, economic and social gain.

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[10] Source: 25 Year Environment Plan, pp. 58-59

Voluntary partnerships and private sector sponsorship will help broaden the funding base for this exciting network. We will also continue to work with partners around our National Nature Reserves encouraging wildlife to brim over and colonise new sites.

Actions we will take include:

Investigating how we roll out a Nature Recovery Network which will provide an additional 500,000 hectares of wildlife habitat building on other plans for landscape-scale recovery for peatland, woodlands and natural flood management.

Considering how landscape scale restoration of wildflower rich grassland, meadows and heathlands could be part of the Nature Recovery Network to provide better access for people alongside improved habitat for pollinating insects.

Considering delivery options for the Nature Recovery Network over the next two years, as we develop and pilot our new environmental land management system and investigate the use of other new and innovative funding mechanisms.

Evaluating the wider economic and social benefits as we develop the network."

Natural England is here to secure a healthy natural environment for people to enjoy, where wildlife is protected and England's traditional landscapes are safeguarded for future generations.

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