Annex C: Mapping methodology
South Yorkshire Local Nature Recovery Strategy - Step 5: "Map areas that could become of particular importance for biodiversity" project

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Executive Summary

The South Yorkshire Mayoral Combined Authority (SYMCA) commissioned NCS to complete Step 5 of the South Yorkshire Local Nature Recovery Strategy (LNRS) process - mapping the Areas that Could Become of Particular Importance for Biodiversity (ACB). This report presents the rigorous, collaborative, and evidence-based process of updating the South Yorkshire habitat basemap, and developing the first drafts of the mapped measures and ACB map. This work was driven by the collaboration between the mapping team, Working Group and wider stakeholder and expert group, whose feedback and decision-making were instrumental to shaping the maps.

The development and sense-checking of the LNRS maps was completed in a series of stages:

- **1st mapping stage**: Create a habitat basemap, determine which measures are mappable, and develop methodologies for the proposed mappable measures.
- **2nd mapping stage**: Map the measures and conduct a comprehensive, iterative quality assurance review of the mapped measures and habitat basemap.
- **3rd mapping stage**: Sense-check and review all mapped measures by the Working Group and a wider South Yorkshire (SY) stakeholder and expert group. This stage included multiple stakeholder engagement activities, and included determining the prioritisation and constraint strategies, which led to the final pre-public consultation version of the maps.

The feedback from a comprehensive, in-depth Working Group review of the Priorities and Measures was combined with the feedback from the workshop series. From this feedback, mapped measures underwent substantial changes, with 11 mapped measures either combined or becoming unmapped from the first mapping stage, for a new total of 32 mapped measures out of 102 measures total. This included changes to individual mapped measures, which were reviewed and sense-checked by the workshop participants and Working Group, who determined whether mapped opportunities made sense for the particular measure at hand, and could suggest where areas either needed to be added or removed. During the third mapping stage, workshop participants and the Working Group also determined and applied prioritisation and constraint strategies to individual measures, and across measures, this reduced the mapped measures total coverage from 58 percent at the beginning of this mapping stage, to 39 percent. All of the feedback combined has shaped the current versions of the habitat basemap, mapped measures and ACB map. This feedback has developed a pre-public consultation ACB map with a 23 percent coverage of the LNRS area. This coverage exemplifies a systematic, evidence-based, collaborative approach to targeting nature recovery opportunities in the areas that make the most sense, provide wider benefits, and support National Environmental Objectives (NEOs) in South Yorkshire.

Contents

1. The first mapping stage

1.1. Introduction

The South Yorkshire Mayoral Combined Authority (SYMCA) commissioned environmental consultancy Natural Capital Solutions (NCS) to complete **Step 5 of the South Yorkshire Local Nature Recovery Strategy (LNRS) process - mapping the Areas that Could Become of Particular Importance for Biodiversity (ACB)**. Before the first mapping stage began, data from the Supporting Authorities and LNRS partners had already been gathered and documented by SYMCA. In addition, a number of workshops, each focused on a specific broad habitat category, had taken place to identify priorities and measures for the South Yorkshire LNRS. These were given to NCS at the start of the **first mapping stage**, so they were able to work out which measures could be mapped, and which data sets could be used to do so. Following further discussion with the LNRS Working Group a mapping method was established for each of the measures that were mappable. These were the primary steps of the first mapping stage, which was to create a habitat basemap, determine which measures were mappable, and develop methodologies for the proposed mappable measures. Following this, the **second stage** was to create the mapped measures and conduct a comprehensive, iterative quality assurance review of the mapped measures and habitat basemap. The **third and final stage** included further sense-checking and revision of the mapped measures by the Working Group and a wider South Yorkshire (SY) stakeholder and expert group. This stage brought together feedback from the wider stakeholder and expert group and the Working Group to determine how best to prioritise and constrain measures, which led to the final pre-public consultation version of the habitat basemap, mapped measures, and ACB map (see Figure 1).

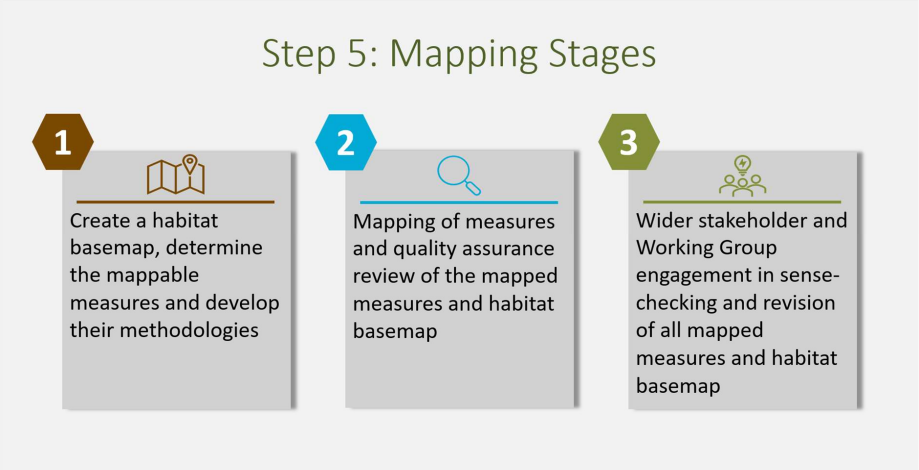


Figure 1. The three mapping stages of Step 5 in the LNRS process, mapping the Areas that Could Become of Particular Importance for Biodiversity.

Here, we detail the methodologies used during each mapping stage, and the prioritisation strategies and constraints that were applied to individual measures and across measures, discuss how the

stakeholder feedback influenced and refined the LNRS maps and present the pre-public consultation version of the mapped measures. Further detail on these methods is outlined in the *Appendices* at the end of the document, and a spreadsheet that documents the spatial data used to create the basemap and each mapped measure accompanies this report.

1.2. Habitat basemap methodology

Approach to mapping habitats

The first step towards mapping 'Areas that Could Become of Particular Importance for Biodiversity' (ACB) for the South Yorkshire LNRS was to produce a **detailed map of the habitats present across South Yorkshire**. A detailed basemap had been created as part of the South Yorkshire natural capital and biodiversity mapping project completed in 2021, and the aim was to update this with habitat data that had since been collected by the LNRS partners and purchased by SYMCA. **A detailed habitat map is an important component of any assessment of natural capital assets** and was required for mapping the 'enhance measures', and to run the mapping of current benefits delivered by the natural capital in South Yorkshire, and the opportunities for enhancement for the 'create' measures (*see Glossary*).

To do this, we used Ordnance Survey Mastermap polygons as the underlying mapping unit, and then a series of different data sets to classify each polygon to a detailed habitat type, and to associate a range of additional data (such as designations, public accessibility, elevation) with each polygon. The data used to classify the habitat in each polygon ranged from UKHab data (provided by the Supporting Authorities and partner organisations of the LNRS), to freely available GIS layers such as the Natural England Priority Habitat Inventory and licensed products such as Bluesky's national tree map (all data used is outlined in Box 1 below, and detailed in an accompanying Excel spreadsheet 'Basemap and mapped measures data.xlsx').

Box 1: Data used to classify habitats in the basemap:

1. Ordnance Survey MasterMap
2. Bluesky National Hedgerow Map
3. Bluesky National Tree Map
4. Local Wildlife Site and other surveyed habitat data from all Supporting Authorities (including habitat banks)
5. Sheffield and Rotherham Wildlife Trust sites and Landscape Partnership data
6. Yorkshire Water asset habitat data
7. Forestry Commission National Forest Inventory
8. Natural England Traditional Orchards
9. Natural England Priority Habitat Inventory
10. Natural England Ancient Woodland Revised

Please note that other data sets were used for the mapped measures (see 'Basemap and mapped measures data.xlsx'). For example, OS Open Rivers was used for a more detailed river network than is present in the basemap, and Sheffield City Council street tree data was used in some of the urban habitat-related measures.

Using these data, the GIS polygons were classified into Phase 1 broad habitat types (e.g. **broadleaved woodland**, **semi-natural grassland**), as well as more detailed habitat groups (e.g. **acid grassland**, **calcareous grassland**). The **habitat basemap consists of approximately 4.3 million polygons**. For further information on the datasets used in the basemap, please see "Basemap and mapped measures data" spreadsheet. Note that the **basemap provides the best approximation of habitat types that can be achieved** based on the data provided by SYMCA and partners, and **although carefully checked manually, some areas have not been ground-truthed and will inevitably contain errors**.

We prioritised certain data sets for the polygon habitat classification process, the most reliable data were considered to be the surveyed habitat data from the Supporting Authority Local Wildlife Sites, habitat banks and other surveyed areas, along with Wildlife Trust reserve and landscape partnership project areas, and Yorkshire Water asset survey data. Initially we had used a habitat basemap from the 2023 update (Nature Recovery Network mapping) of the original 2021 South Yorkshire habitat basemap. However, after checks of the resulting LNRS basemap, by members of the LNRS Working Group, this layer was found to incorrectly classify significant areas of SY as heathland. The **Working Group** was instrumental in developing and sense-checking all of the Step 5 maps, and was comprised of stakeholders and supporting authorities (*see Glossary*):

- **South Yorkshire Mayoral Combined Authority**, *LNRS Responsible Authority*
- **Barnsley Metropolitan Borough Council**, *LNRS Supporting Authority*
- **City of Doncaster Council**, *LNRS Supporting Authority*
- **Natural England**, *LNRS Supporting Authority*
- **Peak District National Park**, *LNRS Supporting Authority*
- **Rotherham Metropolitan Borough Council**, *LNRS Supporting Authority*
- **Sheffield City Council**, *LNRS Supporting Authority*
- **Don Catchment Rivers Trust**
- **Environment Agency**
- **Forestry Commission**
- **Sheffield and Rotherham Wildlife Trust**
- **Yorkshire Wildlife Trust**

The heathland classification error that the Working Group identified in the basemap came from Phase 1 data provided by SYMCA and partners in the 2021 mapping. As a result, this 2023 layer was excluded from the next run of the LNRS basemap. There was the potential to lose a few habitat updates as a result of this exclusion, but on balance we believed that not using it would create a more accurately classified final basemap .

The basemap will be far superior in accuracy to the 2021 and 2023 versions because the polygons in between the supplied surveyed data were classified using the NCS classification process that uses

numerous freely available woodland and priority habitat data sets, as well as the licenced Bluesky national hedgerow and tree data.

Please note that **the Forestry Commissions Trees Outside Woodlands data was not used in the basemap**, because the accuracy of this data set was found to be questionable when using it for such a broad coverage. In addition, the Centre for Ecology and Hydrology hedgerow data appeared to overestimate the number of hedgerows in the SY area, so these data were not used. The Bluesky hedgerow and woodland products were superior and worked well for this location.

A particular challenge, as always with this kind of mapping, was classifying polygons where more than one habitat was present. This was possible where the NCS mapping specialists were supplied surveyed data and OS polygons that had been split to reflect a mosaic of habitats within a boundary. Outside of these areas mixed habitats containing woodland and scrub, or grassland with woodland were classified in detail, but not all combinations of habitats could be accommodated. Other areas, where there was a mismatch between data sources, or land use is changing rapidly, remained a challenge.

1.3. Mapping of measures: Process

One of the **primary objectives** of the "Areas that Could Become of Particular Importance for Biodiversity" or the **ACB map, is to identify areas where** the responsible authority and local partners determine that **effort should be concentrated**, in order **to restore habitat** and **achieve the greatest amount of benefits for biodiversity** and **the wider environment**. This mapping is intended to be strategic and to build on **Lawton's Principles of bigger, better and more joined up** areas for wildlife. It should build on **areas identified in the "Areas of Particular Importance for Biodiversity" (APIB) map whilst incorporating practical actions** (measures) that if delivered, can help **achieve nature recovery priorities** in the area (*see Glossary*).

The first step in creating the ACB map was to determine which measures could practically be mapped in South Yorkshire, that would **join up or expand existing areas of particular importance for biodiversity**, and help accomplish **nature recovery priorities**. The responsible authority had collated a large quantity of data from local stakeholders to aid in the APIB and ACB mapping, and the first step was to review these data and ensure the spatial data were suitable for measures mapping. The following information related to each data layer was recorded in the **'Basemap and mapped measures data.xlsx' spreadsheet**:

- GIS layer title
- Data description (reasonably detailed) and origin
- Relevant to mappable measures? Y/N. If Y including the number/code for each measure it is relevant to. If N include reason why it is not suitable.
- Alterations required to enable suitability? Y/N. If yes, detail.
- Data readily available for LNRS mapping? Y/N
- Licence required for inclusion? Y/N if yes, detail.

- Notes – this is for extra information where data sets may be relevant under certain circumstances.

The datasets that could be used for the ACB mapping were determined by reviewing the data that the responsible authority had sent in against these criteria. **Understanding the available data more fully was essential** for the next step of the process, where the measures themselves were reviewed (*Section 2*).

Each measure from the shortlist of priorities and measures (already categorised by habitat: River, wetland and bog; Grassland and heathland; Woodland; Urban; Farmed landscapes) **was reviewed with a spatial perspective**, and **with the aim of understanding whether there were available data that could be used** to map the measures. If it was determined that there were available data that could be used to map a particular measure, the next step was to determine whether the measure had an "enhance" or "create" focus.

Measures with an "enhance" focus are closely linked with the APIB map and their focus is on **the restoration and enhancement of habitats that currently exist** within South Yorkshire. For these measures, the mapping team used the habitat basemap (*Section 1.2 above*, *Appendix A.1*) to map the areas of existing habitat on which that measure as focused. The **mapping team** consisted of Natural Capital Solutions in close collaboration with SYMCA.

Measures with a "create" focus build on the APIB map and are **aimed at buffering, connecting** and **creating new habitats**. The proposed methods for these measures incorporated NCS opportunity mapping, which identifies where new habitat can be created to buffer and connect up existing habitats for biodiversity, and delivers **wider environmental benefits** (*see the Appendices A.2 and A.3*).

Once measures deemed to be mappable were identified, and proposed mapping methods established, the mapping team then consulted with the Working Group. Working together, the Working Group and mapping team **reviewed all of the Priorities and Measures** in a series of discussions, focusing on the measure wording and proposed mapping methodologies (including proposed data). These discussions **concentrated on one priority at a time**. Although these discussions largely revolved around the proposed mapping methodologies, Working Group members had the **opportunity to comment on any of the changes made** to the Priorities and Measures throughout the process. Through this intensive iterative process, the Working Group and mapping team were able to identify several more datasets that could be used for mapping measures and measure wording was revised for consistency, especially in regards to mappable measures, which were revised to accurately align with the mapping.

Once all of the measures were reviewed for their mapping suitability, with wording and mapping methodologies approved by the Working Group, the next step was to use the available data to map the measures (second mapping stage).

2. The second mapping stage

2.1. Mapping and reviewing the measures

During the first stage, the Priorities and Measures were reviewed in their entirety and measures that could be taken forward for mapping were determined, with draft versions of the measure wording and methodologies approved by the Working Group. The next mapping stage was to **use the available data to map the measures**, and to **review the mapped measures and their methodologies** as they became available with the Working Group.

The measures were mapped using the methodologies initially agreed by the Working Group, the outputs from the NCS mapping *(*outlined in *Section 1.3 above* and in the *Appendices*), and the data presented in the accompanying Excel spreadsheet 'Basemap and mapped measures data.xlsx'. The aim was to **capture the measure wording as accurately as possible**, ensuring that the number of **opportunities identified for each were constrained to** areas that constituted as far as possible **'real' implementable and strategic opportunities**.

The mapped opportunities for each measure were presented at the **field scale**. This means that the maps show the fields in which the identified opportunities lie, rather than showing the slivers of land adjacent to existing habitats, which bear no relationship to existing fields and boundaries. The justification for this was as follows:

- Presenting the mapped measures using the slivers of land/water that are an output from the opportunity modelling would promote a false sense of accuracy[1]. These **areas will require ground-truthing** before determining whether they are in fact suitable opportunities for measure delivery. While mapping the opportunities by parcel can highlight all of a land parcel (field or site) for which only the edges or a small portion may be an actual opportunity, it **allows flexibility as to where in the field the opportunity is delivered once surveyed**, **based on ecological principles, best practice** and **practicalities of delivery**.

- In NCS's experience of mapping for other LNRS, **NE have specified a preference for the opportunities to be mapped at field scales**. In addition, in some LNRS that have already passed through final consultation, much courser mapping units have been used and presented in the maps (e.g. hexagons), which arguably are less practically useful in that they do not reference field boundaries or other habitat feature boundaries.

- **Defra require the mapped measure outputs to be digitally referenced**. This is much easier if the opportunities are presented as parcels.

It is important to note that the **mapped measures are only as good as the data available to map them**. Frequently, no one data set perfectly fitted a measure. Therefore, measures often ended up being **mapped using a combination of available data sets** that were adapted as much as possible to present implementable and strategic opportunities for nature recovery in line with the measure

[1] In addition to this when these slivers are mapped they pixelate when inspected closely in maps.

wording. In a small number of instances, the mapped measure does not perfectly reflect the measure, and where this is the case the **measure wording is prescriptive**. For example, there are a few watercourse margin measures (RI-01-02, RI-02-05) which were mapped using a series of buffers, these buffers try to capture the river bank top and canal banksides respectively, using best averages of these widths across South Yorkshire. However, it is very likely that these watercourse margins will change over time, and there may be a discrepancy between the area of the mapped buffer and where the river bank top and canal bankside (mentioned in the measure descriptions) actually are in the field. It is also important to understand that the final mapped measures needed to be agreed across all the Working Group stakeholders, and consequently **represents a compromise across the varying needs and expertise of the individuals and organisations involved**.

The process for reviewing the mapped measures for quality assurance followed the same, simple process for all mapped measures. First, the **mapping team mapped the measures using the agreed methodology**, and the **best available data and techniques**, and then the **mapping team and Working Group reviewed groups of mapped measures** as they became available. This process was used to sense-check the mapped measures quickly, catch any errors or missed opportunities early-on, streamline the mapped measure revision process, and allow Working Group members to get a sense of the mapped measures as a collective.

Early on in the reviewing process, Working Group members raised concerns regarding the best way to provide feedback, as many of the Working Group members were **representatives for their much larger organisations**, stressing the need for **more input** from their respective groups to be included. The approach agreed upon was to create **a master spreadsheet**, that everyone in the Working Group could access, either by Sharepoint or via emailed attachment, that included the most up-to-date version of the Priorities and Measures, including:

- Version History page (for quality control)
- Mapped measures and their methodologies
- Any outstanding actions
- An organised list of historical iterations of the Priorities and Measures

As the mapped layers became available, the Working Group also gained access to the **South Yorkshire LNRS Habitat Viewer mapping portal**, an online mapping portal. The South Yorkshire Habitat Viewer allowed Working Group members to view the following (as they became available):

- Habitat basemap
- Local Authority District boundary lines
- Areas of Particular Importance for Biodiversity (APIB) map
- Areas marked as urban
- Constraints layer
- Mapped measures
- ACB map

The Priorities and Measures master spreadsheet and South Yorkshire Habitat Viewer allowed Working Group members - and anyone within their associated organisations - to review the Priorities and Measures and the mapping progress in their own time and provide feedback on any aspects as needed. As quality assurance review meetings began taking place, these two resources allowed

Working Group members to review changes before and after the meetings, to provide clarity and organised feedback.

2.2. Quality assurance review of the mapped measures

Quality assurance review method

The quality assurance review of the mapped measures was **a rigorous, collaborative review of all of the draft mapped outputs** by the Working and mapping groups prior to the wider stakeholder engagement events. The mapped measures reviewed were initially grouped by general habitat type, with woodland-related measures reviewed first. These reviews occurred during regularly-scheduled Working Group meetings, with occasional meetings added to provide more time for these reviews. This was done to increase productivity and time management for both the mapping and Working Groups.

During the quality assurance reviews, the mapping team presented the mapped measures, their most current measure description, and the agreed methodology. The Working Group would review the mapped opportunities and query any anomalies (in either the measure description, the methodology or a specific opportunity area). The mapping team and Working Group would discuss any queries together before decisions were reached by the group on whether to implement any changes or not for each measure. Following these review meetings, the mapping team would incorporate any agreed changes to the mapping, before updating the master spreadsheet and Habitat Viewer with the changes so the Working Group could view the changes made, and make any further suggestions if needed.

Quality assurance review: Reflections on changes to the mapped measures

At the beginning of this mapping stage, there were 49 measures designated for mapping out of 113 measures total. When the quality assurance review process began, by **general habitat type** there were:

Water-related: 17 proposed mapped measures

Woodland: 13 proposed mapped measures

Urban: 11 proposed mapped measures

Grassland and heathland: 8 proposed mapped measures

Of these, 29 mapped measures were “enhance” focused and 20 were “create” focused. Through the careful sense-checking and intensive review by the Working and mapping groups, by the time the mapped measures were presented to the wider stakeholder group in the stakeholder webinar, there were 43 mapped measures.

From the original 49 mapped measures, there was only one measure that was changed to unmapped relating to the water environment, this was a wetland-related measure, “Manage key areas for breeding and wintering bird populations (e.g. curlew, snipe) including floodplain meadows and wet grassland sites”. This measure was changed to unmapped as there was significant overlap with other water-related measures. The Working Group decided to add wording about the species

that would benefit from nature recovery action to any mapped measures which had substantial overlap with this measure. Additionally, before the stakeholder workshop series, one river-related measure, focused on white willows, was moved to the woodland category.

Only one woodland measure, relating to new traditional orchard creation, was not taken forward. This measure was not taken forward at this time because the local authorities were unsure where the best areas for these would be, or what the best methodology for identifying these areas was. Thus, it was felt this measure would be best as a general, unmapped measure, applicable to all of South Yorkshire, so individuals could determine whether traditional orchard creation was appropriate on their site on a case-by-case basis.

There were four urban habitat-related measures, one relating to urban street tree maintenance, and the other three broadly relating to the creation and enhancement of green infrastructure, which were not taken forward for mapping. These were not taken forward as the wording and / or mapping were too broad and did not have a strong, strategic approach, or it was out of scope of the LNRS.

Of the grassland and heathland-related measures, two heathland measures were combined into the new HE-01-02, "Create wet heath and complimentary mosaics of heathland, grassland, wetland, and scrub habitat, including transitional habitats…" which was mapped.

This review process allowed the Working Group to collaborate with the mapping team and develop **a draft of the mapped measures and ACB that made sense for individual Local Authorities and across South Yorkshire**. Following this iterative review of the mapped measures, the mapping moved into the **third and final stage** before the pre-public consultation version drafts of the maps, a review and sense-checking by a wider stakeholder and expert group from across South Yorkshire. There was cross-over between when this mapping stage finished and when the third stage began, so not all changes had been agreed on by the Working Group at the time of the workshops (*see Section 3.3.*). However, all first drafts of the mapping had been reviewed by the Working Group, with certain measures reviewed multiple times, as a result of the iterative process outlined above. The conclusion of this mapping stage, and some queries left hanging over certain measures, were only resolved following the Working Group's review of the entirety of the Priorities and Measures, which they completed as the wider stakeholder engagement was taking place (*see Section 4*).

3. The third mapping stage: Two simultaneous reviews

3.1. Two reviews at once

Prior to presenting the mapped measures and their methodologies to the wider stakeholder and expert group, the mapped measures were decided on and reviewed by the Working Group (*Section 2*). By this stage, the Working and mapping groups had been working closely together to develop and review the Step 5 maps, but the wider SY LNRS stakeholder and expert group had not been involved in the mapping yet. One of the **main aims of the third stage** was to engage this wider group in the mapping process in order to provide **fresh perspective** and **more expert and local knowledge** to **sense-check the mapped outputs** before the public consultation stage. A staged approach was used to update the wider stakeholder and expert group on the LNRS process and prepare them to give informed feedback on the maps during a series of workshops (see Figure 2 below).

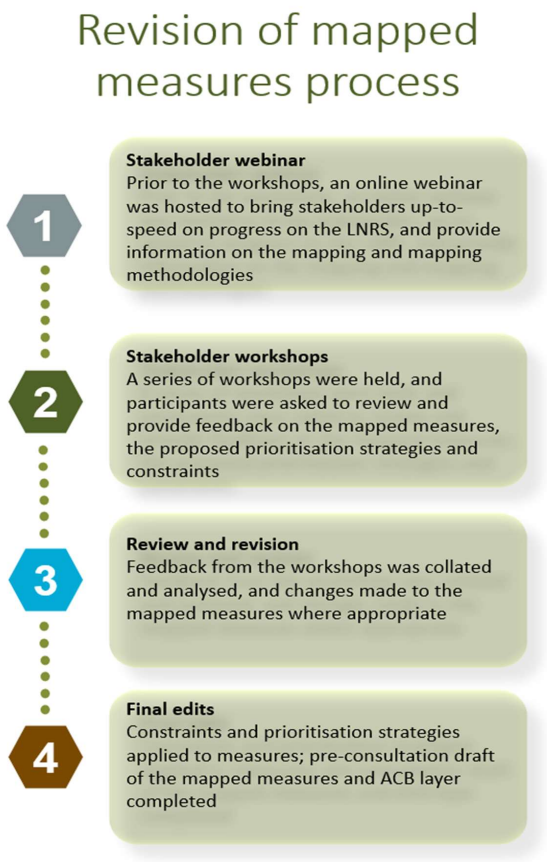


Figure 2. A flow diagram of the four stages of revising the mapped measures to create the pre-public consultation draft of the mapped measures and ACB layer.

During the wider stakeholder engagement process, the Working Group was conscientious about sending representatives from their groups that had not been heavily involved in the process thus far to the stakeholder engagement events. This was done to **bring more representatives from the Supporting Authorities into the LNRS process**, to **gain fresh perspective** and **sense-check** the results. Simultaneously, those representatives who had been working closely with the mapping team reviewed all of the mapped outputs in their entirety, and provided detailed feedback, which the mapping team subsequently reviewed and acted on where appropriate following the workshops (*see Section 4*).

3.2. Stakeholder webinar: Updates on the LNRS progress and mapping

The first engagement event with the wider stakeholder and expert group was the online webinar. The stakeholder webinar was held in mid-January 2026, it was intended to **increase awareness** about the LNRS with the wider South Yorkshire stakeholder and expert group and **update** them **on the current mapping work**.

At this stage, it was important to gain fresh perspective on the mapping, and include a wide variety of stakeholders and experts from multiple sectors in the mapping process. Table 1 below lists all of the organisations who were invited to the webinar and workshop series.

Table 1. A list of all of the organisations invited to the wider SY LNRS stakeholder and expert engagement events.

Organisation name:				
Advanced Wellbeing Research Centre, SHU	Dearne Valley Farmers cluster	National Farmers Union (NFU)	Royal Society for the Protection of Birds	The Conservation Volunteers
Barnsley Biodiversity Trust	Forestry Commission	National Highways	Sheffield City Council	The Land Trust
Barnsley Nats	Garganey Trust	National Trust	Sheffield Area Geology Trust (SAGT)	University of Sheffield South Yorkshire Sustainability Centre
Barnsley Metropolitan Borough Council	Green Estate	Nature North	Sheffield Green Spaces Forum	University of Sheffield
Bradfield Farmers Group	Greengage Environmental	Natural England	Sheffield Green Spaces Forum	Wentworth Fitzwilliam Estates
BSG Ecology	Harworth Group	Network Rail	Sheffield Hallam University	Wild Moors
Nuttgens Urban Forestry	Historic England	North Lincolnshire - Environmental Farmers Group	Sorby Natural History Society	Woodland Trust
City of Doncaster Council	J & E Dickinson	Opus	South Yorkshire Woodland Partnership	Yorkshire Water
Consultant ecologist	Kids Plant Trees	Peak District National Park Authority	Sheffield and Rotherham Wildlife Trust	Yorkshire Wildlife Trust

Country Land & Business Association (CLA)	Limestone Ridge Farmers	Rotherham Metropolitan Borough Council	SYMCA - A Tree For Everyone	

In total, there were 49 organisations invited to the webinar and workshop series. Of these, 13 registered for the event. The webinar and workshop series took place near the end of the government's financial year, which is a busy time for many, and may have influenced attendance.

The stakeholder webinar was hosted by SYMCA, with presentations from Natural England and NCS. During the webinar, attendees were updated on the progress of the LNRS thus far, reviewed the methodologies used for the mapping (both for the habitat basemap as well as the mapped measures) and could ask questions and reflect on the methods ahead of the workshops.

As part of the update on the mapping progress, examples of some of the main mapping outputs, including the habitat basemap, "enhance" measures and "create" measures were presented to attendees (see Figures 3-5). **When the webinar took place, there were 43 mapped measures and 113 measures in total**. Of the **mapped measures, 27 were "enhance" and 16 were "create"**.

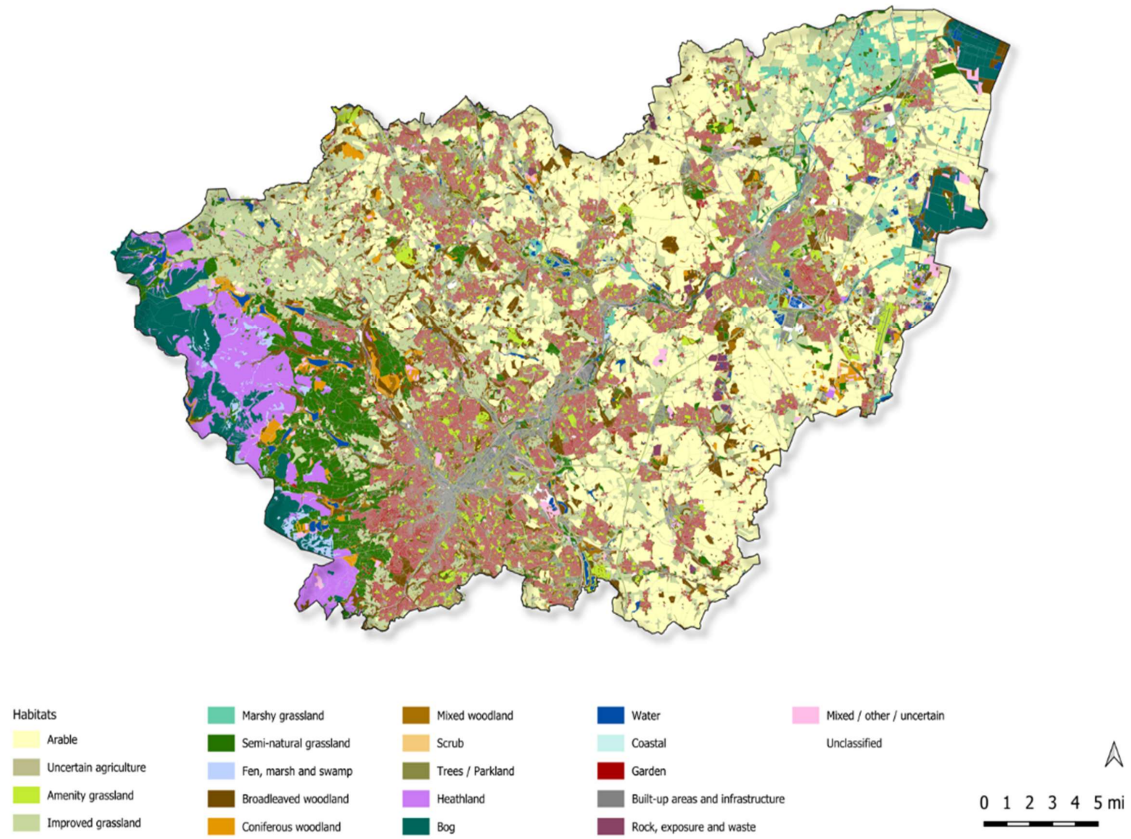


Figure 3. The South Yorkshire habitat basemap displayed during the webinar.

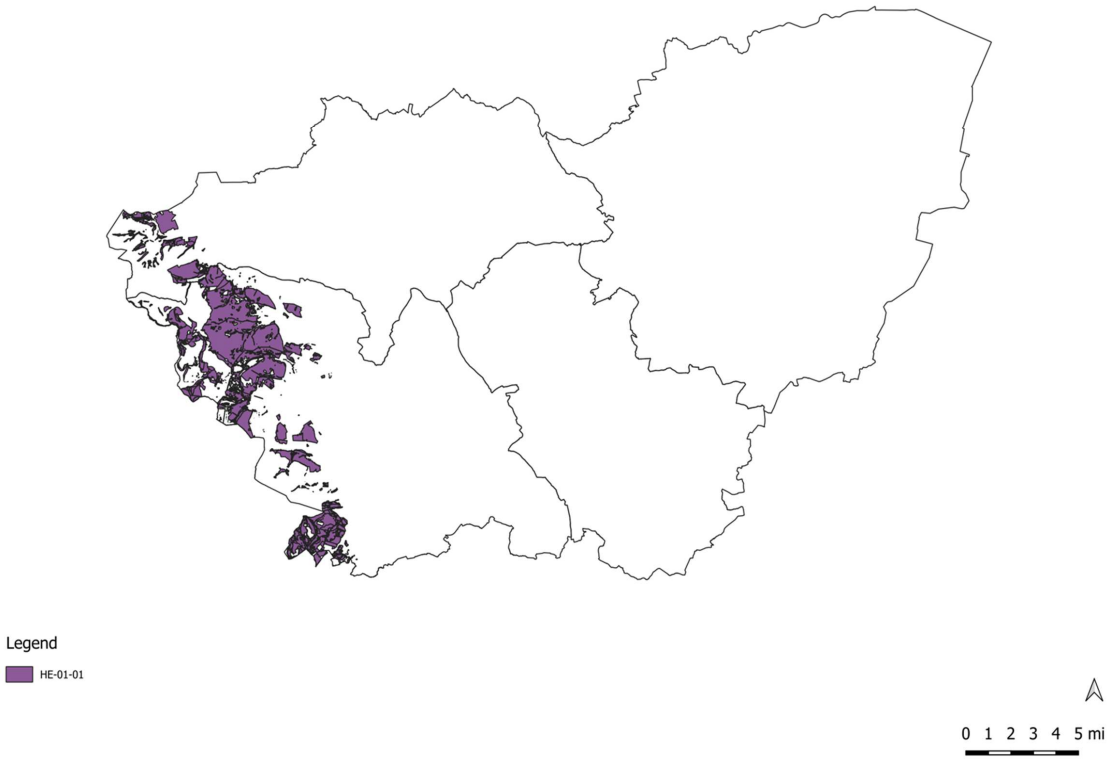


Figure 4. An example of an enhance measure, HE-01-01, shown during the webinar. HE-01-01 is, "Restore and enhance wet heath and complimentary mosaics of heathland, grassland, wetland, woodland, and scrub habitat, including transitional habitats, for example through an appropriate level of grazing, natural regeneration and using blocking grips and gullies."

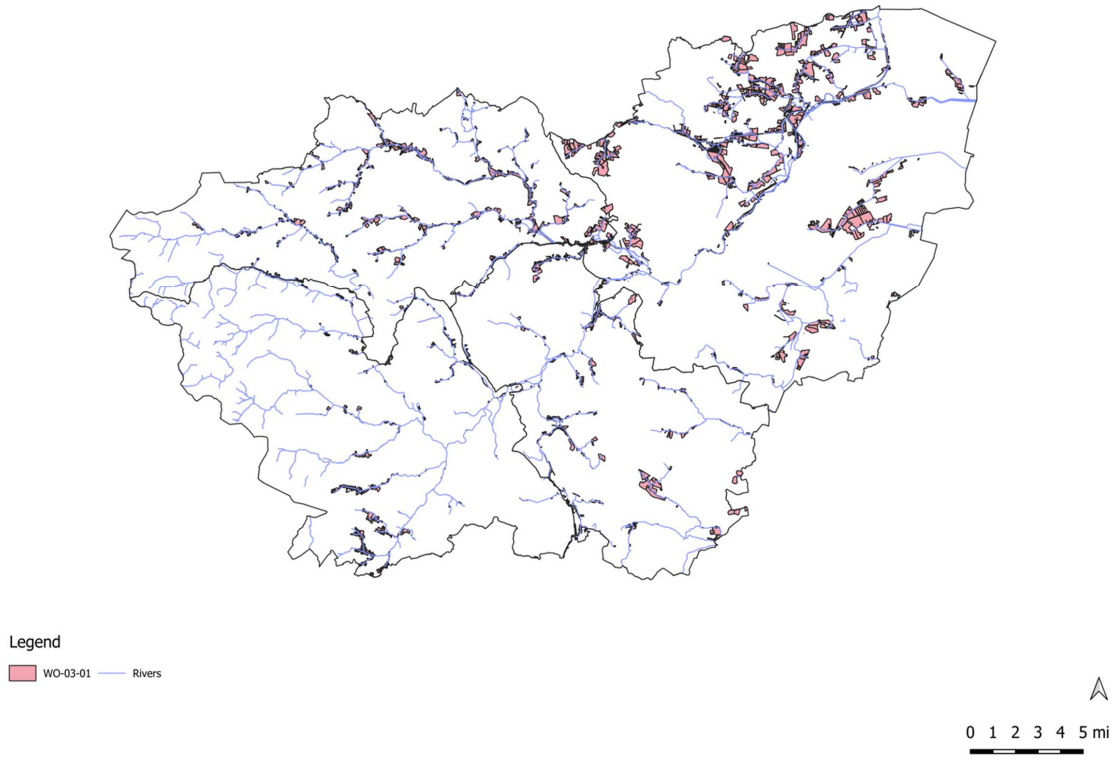


Figure 5. An example of a create measure, WO-03-01, displayed during the webinar. This map also displays the river network that runs throughout South Yorkshire (in light blue). WO-03-01 [now WO-01-06] was, "Create riparian woodland as part of natural flood management projects to reduce flooding, water quality, provide cooling and improve water quality for aquatic life or rewetting appropriate areas."

The webinar was recorded and the recording was sent to all those who were on the wider stakeholder group list (whether or not they were able to attend the webinar) and was later published to the South Yorkshire LNRS's YouTube channel, available *here*.

The webinar was intended to provide the workshop participants with information about the LNRS and the mapping methodology used, to prepare them to give informed feedback on the mapped outputs. For those who were unable to attend the upcoming workshops, information was provided as to how they could still provide feedback on the LNRS (see Figure 6).

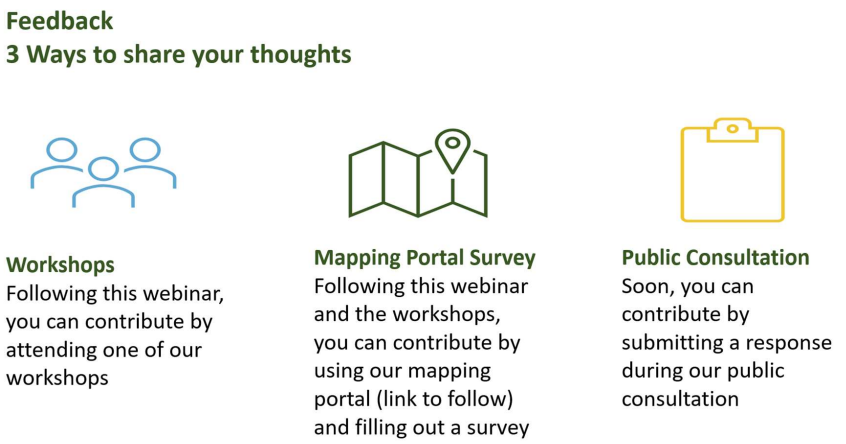


Figure 6. Different options for providing feedback that were highlighted during the stakeholder and expert webinar.

3.3. General habitat type workshop series

Workshop overview

A series of workshops were held from the end of January to the beginning of February 2026. These workshops were facilitated by SYMCA and NCS. The workshops were grouped by general habitat type, representing the **four habitat types with mapped measures**, namely:

- **Grassland and heathland**
- **Urban**
- **Woodland**
- **Water-related**

The **main aims for these workshop**s were to **update participants on the LNRS progress, brainstorm prioritisation** and **constraint strategies**, and provide an opportunity to **sense-check the mapped outputs**. Stakeholders and experts from across South Yorkshire, **representing the environmental, public, business, and agricultural sectors**, were brought together for these workshops. They provided an opportunity to gain **local, on-the-ground knowledge** and **in-depth habitat and systems**

expertise, to ultimately ensure an **accurate representation of the area's nature recovery opportunities**.

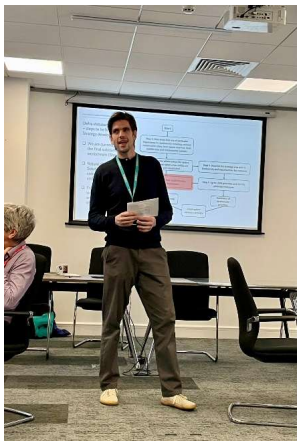
Although each workshop had a different general habitat focus, the structure of each workshop was the same. The mapping team developed the **workshop agenda**, which included:

- **Introduction**: Background information session on the LNRS and mapping progress, main aims of the session, and explanation of the break-out group activity.
- **Break-out session**: Four break-out sessions during each session, where a group visited one of the four tables to review mapped measures and record any feedback, before moving on to the next session, and so on.

~ Break ~ (between 2nd and 3rd break-out session)

- **Prioritisation discussion**: Review of the current percentage of overlap between measures and the current percentage of the combined measures map, discussion of best methods for prioritising and using constraints.
- **Summing up, and next steps**

The introduction section reiterated much of the same information that was included in the webinar (*see Section 3.2. above*), as well as an explanation of the break-out sessions.



Workshop break-out sessions

The **break-out sessions constituted the main activity of the workshops**, and they were designed to optimise the time that participants had to review and provide feedback on the mapped measures (see Figure 7 below).

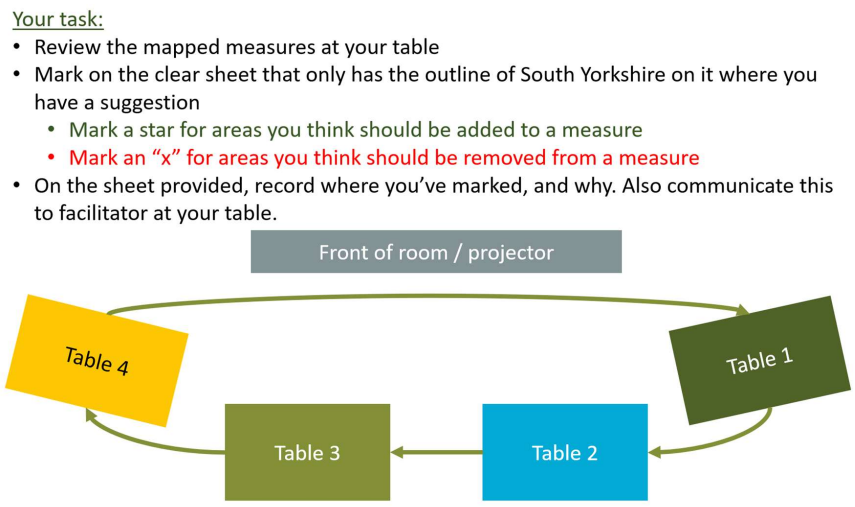


Figure 7. Slide from the introduction presentation, with the guidelines for the break-out session, and a diagram of how to move between tables.

The number of measures discussed per workshop varied, as some habitats had more mapped measures than others. At the time of the workshops, the **habitat groups respectively had**:

- **Water-related**: 15 mapped measures
- **Woodland**: 13 mapped measures
- **Grassland and heathland**: 8 mapped measures
- **Urban**: 7 mapped measures

At the workshops, a couple grassland-related mapped measures were not displayed. This was because they both only had one site mapped, and were under heavy scrutiny from the Working Group. The maximum number of mapped measures that an individual group had to review at a table during the break-out sessions was five. Measures were combined with other measures of similar focus where possible, in an attempt to make reviewing them more straightforward. For example, in the woodland break-out group that featured five maps, these maps were grouped into two measures relating to clough woodlands (WO-03-04, "Restore clough woodlands from areas where they have been lost…" and WO-03-05: "Increase riparian woodland, scrub and mosaic habitats in suitable cloughs of upper catchments…"), and three measures relating to ancient woodlands (RI-03-06: "Identify, record, and expertly manage ancient and veteran white willows…", WO-04-01: "Restore all ancient woodland into positive management…", and WO-04-02: "Connect and buffer existing ancient woodland with woody habitat corridors…").

During the break-out sessions, **each table was provided with**:

- Maps and information sheets relating to the table's mapped measures.
- A copy of the Areas that are of Particular Importance for Biodiversity (APIB) map (*see Glossary*)

- Habitat basemap
- A clear acetate sheet with an outline of South Yorkshire on it

For the **water-related workshop**, each table was also provided with:

- Map of the rivers system throughout South Yorkshire, to be used with the other maps for reference.

The **information sheets** at each table contained a copy of the break-out session directions, the Priority description that the mapped measures fit within, the mapped measures full description, and the mapped measures methodology. On these information sheets, measures which were still actively being reviewed by the Working Group (and so perhaps were not in their final version) were marked with an asterisk (*), which was explained at the bottom of the sheet. These information sheets also contained tables for participants to fill in, where they could indicate whether they wanted an area added or removed from a measure, provide their reasoning for their suggestion, and their contact details, so the mapping team could follow up on any feedback if necessary.

Requirements for feedback

The **maps developed for the LNRS used a broad evidence base, with the most up-to-date data available, and fine-scale modelling**. By the time the workshops were held, the maps had already **undergone an extensive review and refining process by the Working Group** (*see Section 1 above*). Additionally, the maps were still actively being refined by the Working Group separately as the workshops were taking place (*see Section 4*). At this stage, the mapping team decided to **focus workshop efforts on the mapped measures** because although they had been carefully checked manually, they were not ground-truthed. The wider stakeholder and expert group engagement provided an excellent opportunity to use this group's collective knowledge to **capture more insight**

and local knowledge in the mapped measures and **catch any data gaps or misalignment** before the maps went out to public consultation. It should be noted, that although the main aim of the workshops was to sense-check the mapped measures, **participants were reminded they could still provide feedback on the habitat basemap**.

During the break-out sessions, workshop participants reviewed the mapped measures and their methodologies, using the other maps provided as references. They were asked to a**ssess whether the opportunities identified made sense** for the specific measure, and provide feedback on **whether areas within the maps needed to be added or removed**. Participants were asked to provide **sound ecological reasoning to support any suggestions made**, and given a mapped measure's description, describe to the best of their ability why certain areas did not make sense for inclusion, or why they needed to be included.

There were two copies (a digital and hard-copy) made of participants feedback during the workshops. Participants were asked to fill in the information sheet with their suggestions, which served as the hard-copy. Meanwhile, a facilitator at each table recorded the feedback using specialised online pin-drop survey forms created by SYMCA. Facilitators digitally inputting feedback during the workshops expedited the feedback review process. In addition, facilitators used the mapping portal as a tool to answer any questions about other measures that may not have been available at the table.

Reviewing the workshop feedback

After the workshops, the mapping team ensured all feedback from the hard-copies was transferred to the online pin-drop survey forms and began reviewing all of the suggestions for additions and removals of sites for each mapped measure. The vast **majority of suggestions made provided**

sound ecological reasoning and were taken forward, with the mapping team implementing the changes requested for each measure.

Concerns were raised about certain measures not covering various issues, for example, a lack of pollution-specific measures, which were in fact addressed by other measures. These comments were likely made as the workshop participants were not provided with a complete list of the priorities and measures at the workshops, and they may not have had time to review the other mapped measures from the mapping portal before their workshop session.

Others voiced concern over whether or not certain opportunities should be retained, as participants feared the current landowners would not be amenable to the opportunities on their land. However, the mapping and Working Groups decided these opportunities should remain; as the evidence-base supported an opportunity there, other LNRSs in other Responsible Authorities had implemented similar standards, and it was felt to be a more consistent approach, especially as the landowner could change their mind, or the land could change hands, but the opportunity of the land remained regardless. This was also done with the recognition that if landowners were opposed to certain opportunities on their land, they could make their opinions known during the public consultation, as suggested in the guidance.

There were also some suggestions which were not taken forward as the suggested areas covered very limited areas, and concerns were raised over whether they were not ecologically or strategically significant due to their limited coverage. Additionally, there were a number of revisions to the measures after the Working Group completed their in-depth review of them following the workshops, but regardless of whether measures were merged with other measures or re-numbered, the workshop participants' feedback was still implemented.

Commented [AH1]: Some of the sites suggested were considered too small to be ecologically worth while as well, so not included. Not sure if we want to say this though!

Commented [MR1R2]: Put something together but maybe highlight with Laurie - he can decide whether to include or not.

3.3.a. Determining the prioritisation strategy

It became apparent as the mapped measures were developed, that some of the **mapped measures covered a large percentage of the county** and there was a **significant amount of overlap** between

mapped measures. The LNRS guidance warns against "indiscriminate or widespread mapping of areas", as the ACB map is intended to **target effort in areas where it will have the most benefit** (LNRS Statutory Guidance, para 77). The mapping should be strategic, with Natural England generally advising that measures should cover 30 – 50 percent of a LNRS area. When the workshops took place, all of the mapped measures combined covered 58 percent of South Yorkshire, with a 55 percent overlap across measures (see Figure 8).

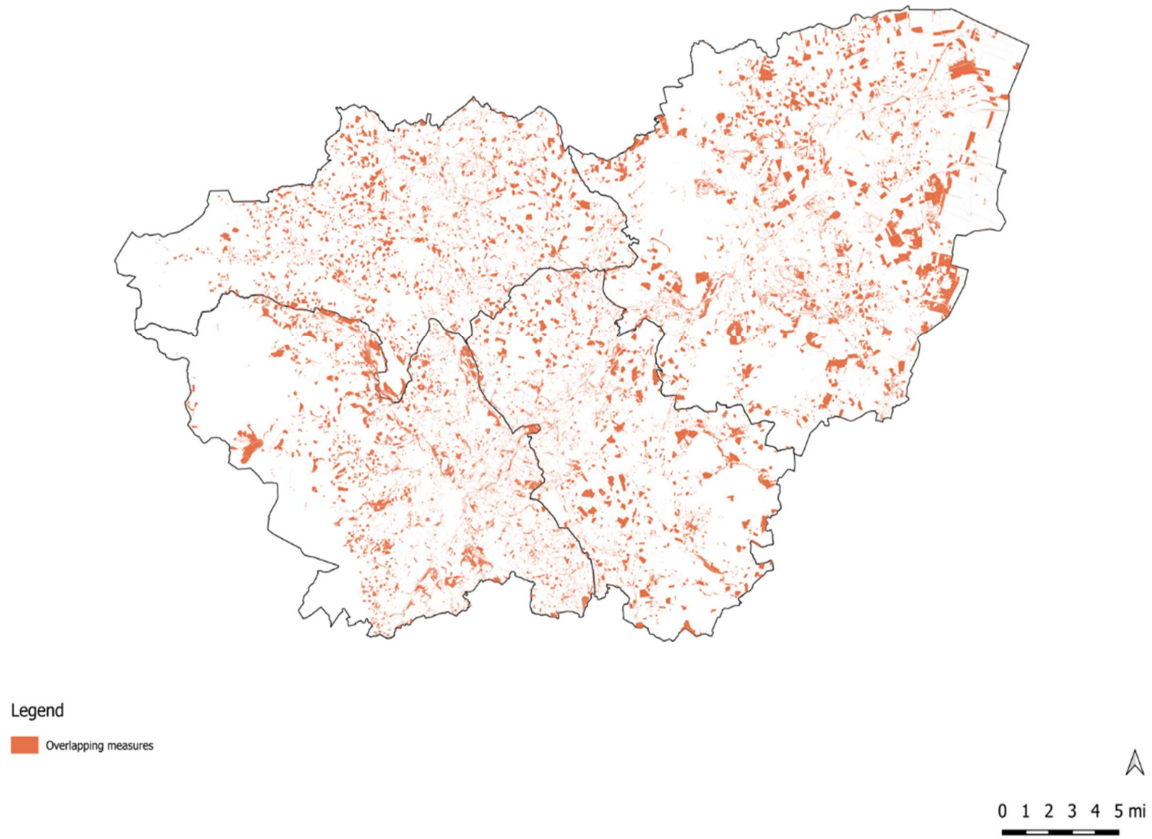


Figure 8. A map displaying the overlapping measures coverage shown during the webinar.

Due to this large coverage, one of the aims of the workshop series was to **discuss the best way of prioritising and constraining the mapped measures** with the stakeholder and expert group, in order to achieve the strategic coverage outlined by the guidance. Several prioritisation strategies were presented to the workshop participants, these were based on strategies other Responsible Authorities had used in their LNRS, such as prioritising opportunities that will help achieve national environmental objectives (NEOs) (*see Glossary*), prioritising by Priority Habitat Inventory, or prioritising South Yorkshire's unique and scarce habitats. Participants discussed potential strategies to use with their table groups, before a more general discussion was held with the entire group. The ideas discussed by each group were recorded during each workshop, and these were later collated and analysed. The Working Group reviewed the workshop discussion findings, the results of which are described below.

Focusing woodland creation opportunities

Before the workshop series began, the Working and mapping groups realised that some **woodland measures had extremely widespread coverage**, and wanted to use the workshops to discuss ways of reducing this. At the beginning of the prioritisation discussion, the mapping team raised these concerns in order to foster specific suggestions regarding these measures. A widely-supported suggestion was to **prioritise the woodland measures by** using the England Woodland Creation Low Sensitivity Map (v4.0) to **remove any opportunities from areas that are unsuitable for woodland creation**. The Working Group decided to use this suggested prioritisation strategy to further prioritise measures WO-01-04 and WO-04-02, thus **only displaying opportunities within low-sensitivity areas** (areas well-suited for woodland creation, with low environmental and / or social constraints).

Prioritising the APIB and other environmental benefits

Two other methods for prioritising measures with large coverage were to **prioritise using the other environmental benefits (and the NEOs they support)** that would be enhanced by that opportunity, and if they would **buffer or join up APIB areas**. These prioritisation strategies were echoed across all four workshops and the Working Group supported them. After the mapping team prioritised opportunities that joined-up or buffered the APIB, or would benefit biodiversity and the delivery of other environmental benefits, the mapped measures showed **significantly less coverage** and a **more strategic approach**.

Prioritising where measures overlap

During the workshops, there was a brief discussion about the number of mapped measures which overlapped, with the prioritisation discussions providing some insights into how best to address these. The idea to prioritise **unique or scarce habitats** where they occurred in South Yorkshire was popular in the workshop discussions, and accepted by the Working Group. Based on the mapped outputs and expert knowledge, the **following habitats were prioritised across the four Local Authorities**:

- **Barnsley Metropolitan Borough Council**: Grassland, wetland and heathland
- **City of Doncaster Council**: Heathland, grassland*
- **Rotherham Metropolitan Borough Council**: Grassland, wetland, heathland
- **Sheffield City Council**: Wetland, grassland**

* There would be many wetland and woodland opportunities

**Heathland was not included here as there are many opportunities for upland heathland on peat soils, where woodland is constrained

Generally, if there were areas where multiple measures overlapped, the above prioritisation list was considered for each Local Authority area respectively, and the most scarce habitat prioritised. However, some measures were further prioritised to favour these unique and scarce habitats, see Table 2 below.

Table 2. All mapped measures that were further prioritised to favour unique and scarce habitat opportunities across South Yorkshire.

Measure #	Prioritisation for Barnsley	Prioritisation for Doncaster	Prioritisation for Rotherham	Prioritisation for Sheffield
WE-01-01 *Create and manage mosaics of fen, marsh, swamp and open water habitats through hydrological and vegetation management, for example introduction of suitable plant species to increase diversity and ecological connectivity.*	Areas intersecting GR-01-03 were removed in order to prioritise grassland creation	Areas intersecting HE-02-02 and GR-01-03 were removed in order to prioritise heathland and grassland creation	Areas intersecting GR-01-03 were removed in order to prioritise grassland creation	NB: Only a few opportunities due to the restriction of the constraints dataset across the region.
GR-01-03 *Create new semi-natural grassland habitats of value and secure good management on these sites, prioritising sites that buffer existing 'Good' grasslands.*	N/A	Areas intersecting HE-02-02 were removed in order to prioritise heathland creation.	N/A	Areas intersecting WE-01-01 were removed in order to prioritise wetland creation.
HE-02-01 *Manage and restore heathland to prevent loss of condition and extent, including where present as part of a habitat mosaic.*	Areas intersecting WE-01-01 or GR-01-03 were removed in order to prioritise wetland and grassland creation.	N/A	Areas intersecting WE-01-01 or GR-01-03 were removed in order to prioritise wetland and grassland creation.	Areas intersecting WE-01-01 or GR-01-03 were removed in order to prioritise wetland and grassland creation.

HE-02-02 *Create and buffer wildlife-rich and structurally diverse heathland habitat mosaics of acid grassland and scrub to improve connectivity for heathland species between new and existing heathland sites, for example in the Humberhead Levels. This could include seed and brash collection from donor sites.*	Areas intersecting WE-01-01 or GR-01-03 were removed in order to prioritise wetland and grassland creation.		Areas intersecting WE-01-01 or GR-01-03 were removed in order to prioritise wetland and grassland creation.	Areas intersecting WE-01-01 or GR-01-03 were removed in order to prioritise wetland and grassland creation.
WO-01-04 *Create new woodlands to buffer and connect existing woodlands to enable habitat connectivity and increase the overall tree and woodland cover in South Yorkshire, ensuring resilience to wildfire in new woodland and promoting public access to woodlands.*	Areas intersecting WE-01-01 or GR-01-03 or HE-01-02 or HE-02-02 were removed in order to prioritise wetland, grassland and heathland creation.	Areas intersecting HE-02-02 and GR-01-03 were removed in order to prioritise heathland and grassland creation.	Areas intersecting WE-01-01 or GR-01-03 or HE-01-02 or HE-02-02 were removed in order to prioritise wetland, grassland and heathland creation.	Areas intersecting WE-01-01 or GR-01-03 were removed in order to prioritise wetland and grassland creation.
WO-01-07 *Create and enlarge existing species-diverse mosaics as transitional habitats between new grassland and woodland*	Areas intersecting WE-01-01 or GR-01-03 or HE-01-02 or HE-02-02 were removed in order to prioritise wetland,	Areas intersecting HE-02-02 and GR-01-03 were removed in order to	Areas intersecting WE-01-01 or GR-01-03 or HE-01-02 or HE-02-02 were removed in order to prioritise wetland,	Areas intersecting WE-01-01 or GR-01-03 were removed in order to prioritise

sites, incorporating scrub, hedgerows, wood pasture, ancient and veteran trees.	grassland and heathland creation.	prioritise heathland and grassland creation.	grassland and heathland creation.	wetland and grassland creation.
WO-03-01 *Create and manage new wet and riparian woodland where it will support the presence of priority species, and where it will provide wider ecological connectivity and ecosystem benefits including flood alleviation.*	Areas intersecting WE-01-01 or GR-01-03 or HE-01-02 or HE-02-02 were removed in order to prioritise wetland, grassland and heathland creation.	Areas intersecting HE-02-02 and GR-01-03 were removed in order to prioritise heathland and grassland creation.	Areas intersecting WE-01-01 or GR-01-03 or HE-01-02 or HE-02-02 were removed in order to prioritise wetland, grassland and heathland creation.	Areas intersecting WE-01-01 or GR-01-03 were removed in order to prioritise wetland and grassland creation.
WO-04-02 *Connect and buffer existing ancient woodland with woody habitat corridors using appropriate blend of conventional planting with natural colonisation and natural regeneration.*	Areas intersecting WE-01-01 or GR-01-03 or HE-01-02 or HE-02-02 were removed in order to prioritise wetland, grassland and heathland creation.	Areas intersecting HE-02-02 and GR-01-03 were removed in order to prioritise heathland and grassland creation.	Areas intersecting WE-01-01 or GR-01-03 or HE-01-02 or HE-02-02 were removed in order to prioritise wetland, grassland and heathland creation.	Areas intersecting WE-01-01 or GR-01-03 were removed in order to prioritise wetland and grassland creation.

The prioritisation strategies significantly reduced the overall extent of the mapped measures. The **prioritisation strategies used aligned with the statutory guidance**; ultimately **creating mapped outputs that are joined-up, prioritise unique and rare habitats**, and **provide multiple environmental benefits across South Yorkshire which support NEOs**.

3.3.b. Constraints

Once the prioritisation strategies had been decided and implemented, the final step in developing the mapping was to review and add the constraints (although note that some general constraints were used in the opportunity mapping process (*see Appendix A.2.*). **Constraints are an important tool** in further **targeting opportunities**, and **ensuring only areas with low environmental, historical and social risks** are included. To target opportunities in this way, the **main constraints applied to "create" measures** were:

- **Agricultural Land Classification**: All agricultural land of high value, with a Grade 1-3a, were removed as an opportunity
- **Airports**: The Doncaster airport site was removed
- **Allocated sites**: All developed or under development sites, according to planning allocations, were removed
- **Inland rock**: This constraint was specifically applied to woodland creation opportunities

- **Local heritage**: Local heritage sites provided by the Supporting Authorities were removed
- **Peaty soils**: Any woodland opportunities on peaty soils (from Natural England's Peaty Soils Location map) were removed (as woodland on peat soils can serve as a source of carbon emission, rather than sequestration or storage and can change the hydrology dynamics of peatland)
- **Playing fields**: Playing field sites provided by the Supporting Authorities were removed. However, some may still appear, and it was decided to retain these as there may be opportunities for wildlife corridors or habitat buffers along the borders of these areas.
- **Priority habitats**: All priority habitats (Natural England) were removed
- **Registered parks and gardens**: All registered parks and gardens (from the National Heritage List for England) were removed
- **Scheduled monuments**: All scheduled monuments (from the National Heritage List for England) were removed

Following discussions with the Working Group, **further constraints were applied to some measures**. The constraints were added to **focus opportunities further**, and **ensure opportunities were not appearing in areas that would be inappropriate** (such as creation of floodplain grazing marsh in urban areas, or woodland in bog). Some examples of other constraints applied include: national designations, the Environment Agency floodzone data, and urban built-up areas or infrastructure or gardens.

4. Reflections: Exploring how the mapped measures changed

Throughout the third project stage, the **mapped measures were carefully scrutinised and sense-checked by a wide range of stakeholders and experts, representing multiple sectors**. This process included an in-depth review by Working Group members who had worked closely on the mapped outputs throughout the LNRS process. During this project stage, the mapped measures were reviewed by stakeholders and experts during the workshop series, and by the Working Group separately, before **the feedback from both groups was collated, analysed and implemented where appropriate**. At the same time, the workshop participants' suggestions for prioritising between and across measures were reviewed by the Working Group and mapping team, and **a series of prioritisation strategies were applied to the mapped measures**. The constraints used on the mapped measures were also reviewed as part of the Working Group's efforts, and **additional constraints were added to some measures, in line with the statutory guidance and the prioritisation strategies**.

The feedback from the workshops was straightforward to address, as workshop participants were only asked to make suggestions regarding the mapped outputs and whether the mapped opportunities made sense for the measure description, or whether certain areas needed to be added or removed from the measure's map. This feedback was then reviewed individually by the mapping team, and if sound reasoning had been provided for the suggestion and the suggestion was technically feasible, it was taken forward.

The feedback from the Working Group's review was much more intensive, as there were multiple rounds of feedback where they made similar suggestions for additions and removals as the

workshop participants, but they also considered the Priorities and Measures as a whole. As part of their review, the Working Group closely investigated measure and priority wording, the mapping methodologies used, and examined whether the mapped outputs made sense as a collective, or whether there were measures that would be stronger if combined. The Working Group has an in-depth knowledge of the Supporting Authorities' available data and they suggested certain measures should not be mapped in this iteration of the LNRS because of current data limitations.

Collaboration: Reviewing the Working Group's feedback

There were **two rounds to the Working Group's in-depth review of the Priorities and Measures**. In the **first round**, after receiving all mapped measures, each Supporting Authority submitted their feedback on the Priorities and Measures. Given the number and range of feedback from the Working Group, the mapping team created a spreadsheet form to support collaboration on the suggestions made. After the first round of feedback, the mapping team reviewed all of the feedback, and provided suggestions and comments in the spreadsheet. In the **second round** of feedback, this spreadsheet was shared with the Working Group and allowed each of the Supporting Authorities within the Working Group to view all of the comments made on the wording or methodology for each measure from all of the other Supporting Authorities[*], along with the mapping team's comments. The Supporting Authorities were asked to review this sheet, and either provide further feedback as to suggested approaches or wording, or signal their approval of a suggestion.

Once all Supporting Authorities submitted their final feedback, it was reviewed by the mapping team. By this time, the Working Group had reached general consensus on the Priorities and Measures, so no further discussions were necessary. The mapping team summarised the agreed changes on each measure, distinguishing between measures that needed wording changes, measures with mapping changes, and measures with both types of changes needed. This updated spreadsheet with the summaries, any final comments, and the final mapped measures list was circulated to the Working Group. The mapping team applied all agreed changes to the mapped measures, handing off the final wording change decisions directly to the Working Group.

In total,

- **9 mapped measures methodologies** were adjusted
- **10 mapped measures were combined** to create 3 mapped measures
- **3 mapped measures were changed to unmapped**
- **Priority (RI-03) was merged with RI-02**
- **9 mapped measures required wording changes**

Additionally, a couple of placeholder measures were removed at this stage, as they became species-specific measures.

Following all of the changes made during this project stage, the **complete pre-public consultation draft version of the Priorities and Measures contains 32 mapped measures of 102 measures total.** This list has been **substantially reduced from the beginning of this project stage**, when there were

[*] Note that the Peak District National Park was not directly consulted during this stage, as they did not have capacity to review all LNRS changes. Instead, the PDNP created a guidance as to their recommendations for LNRS, which was consulted during this process.

43 mapped measures and 113 measures total. Seven "enhance" and four "create" measures have either been combined or become unmapped, for a **new total of 20 "enhance" and 12 "create" measures**. When all of the measures are combined, the **total coverage across South Yorkshire is now 39%**, a steep reduction of 19 percent compared to its percentage before the workshops (58%). As discussed, woodland was a primary focus for the prioritisation and constraint strategies, and the current woodland area now covers:

- Existing woodland (habitat basemap): 11% (remained the same)
- Enhance woodland measures = 6% (previously 7%)
- Create woodland measures = 13% (previously 31%)

The **current ACB layer**, generated after all of the Working Group and workshop feedback was applied, now **covers a strategic 23% of the county**.

5. Conclusions

The mapping stages described in this document follow the **rigorous, collaborative**, and **evidence-based process of updating the South Yorkshire habitat basemap and determining and refining the mapped measures**, in order **to create** the pre-public consultation version of the **ACB map**. This work was driven by the **collaboration between the mapping team, Working Group and wider stakeholder and expert group**. The Working Group and wider stakeholder and expert group's **feedback and decision-making were instrumental** in shaping the current versions of the habitat basemap, mapped measures and ACB map.

Engagement began with the Working Group, comprised of representatives from the LNRS supporting authorities and Defra-family partners, who reviewed the habitat basemap, which was created by updating the SY natural capital and biodiversity mapping project's basemap. In the **first mapping stage**, the Working Group and mapping team also reviewed the draft Priorities and Measures list and worked together to determine which measures could be taken forward for mapping, and what the methodologies for these mapped measures should be. Both the habitat basemap and mapped measures were further refined by the Working Group in the **second stage**, when the first maps were produced and subsequently examined by the Working Group. Decisions regarding changes to the methodologies or specific sites were settled on, with some of the mapped measures reviewed multiple times, as a result of the iterative review process the mapped measures underwent at this stage. Once a first draft of all mapped measures had been reviewed, the **third mapping stage** began, with two separate, simultaneous reviews. The first was a comprehensive review of the Priorities and Measures by the Working Group, and the second encompassed a series of engagement activities with a wider range of stakeholders and experts from across South Yorkshire. The series of engagement activities with the wider stakeholder group included an online webinar, and a series of workshops (organised by general-habitat type) where the workshop participants sense-checked the mapped outputs.

The feedback from the comprehensive, in-depth Working Group review of the Priorities and Measures was combined with the feedback from the workshop series. From this feedback, mapped measures underwent substantial changes, with 11 mapped measures either combined or becoming

unmapped from the beginning of the workstream phase, for a new total of 32 mapped measures out of 102 measures total. Individual mapped measures were reviewed and sense-checked by the workshop participants and Working Group, who determined whether mapped opportunities made sense for the particular measure at hand, and could suggest where areas either needed to be added or removed. The mapped measures were then further revised by implementing prioritisation and constraint strategies, suggested by the workshop participants and Working Group, that aligned with the guidance. The workshop participants and Working Group considered and shared the strategies they felt would work best for South Yorkshire, which led to substantial changes in the prioritisation and constraints associated with individual measures, and across measures. The total coverage of mapped measures across South Yorkshire was reduced from 58 percent at the beginning of the third mapping stage, to 39 percent. The steep reduction in overall coverage was achieved in this stage after both the prioritisation strategies and constraints were applied to the mapped measures.

The current pre-public consultation versions of the habitat basemap, mapped measures layer and ACB have now been finalised. The combined feedback from the workshop participants and the Working Group has led to a substantial reduction in the number of mapped measures, from 43 mapped measures at the beginning of this workstream phase, to 32 mapped measures currently. By **general habitat type, the mapped measures currently have**:

- **Water-related**: 14 mapped measures (previously 15)
- **Woodland**: seven mapped measures (previously 13)
- **Grassland and heathland**: seven mapped measures (previously eight)
- **Urban**: three mapped measures (previously seven)
- **Farmland**: one mapped measure (previously none)

All of the combined feedback has developed a pre-public consultation **ACB map with a 23 percent coverage of the LNRS area**. This coverage **exemplifies a systematic, evidence-based, collaborative approach to targeting nature recovery** opportunities in the areas that make the most sense, provide wider benefits, and support NEOs in South Yorkshire.

Glossary

- **Areas of Particular Importance for Biodiversity (APIB**): Map of all national conservation sites, local nature reserves, and other locally important areas for biodiversity (e.g. local wildlife sites, irreplaceable habitats).
- **Areas that Could Become of particular importance for biodiversity (ACB)**: Map of areas where habitat restoration or creation could achieve the most for biodiversity and wider environmental benefits.
- **Create measures**: relate to habitat-creation sites, actions are centred around creating new habitat to buffer, join-up or increase a particular habitat or habitat mosaic
- **Enhance measures**: relate to existing sites, and actions are centred around the restoration, enhancement or management of the site.
- **Measures**: actions to take to help achieve the LNRS priorities
- **National Environmental Objectives (NEOs)**: Encompass various national environmental goals, such as increasing the total tree and woodland cover from 14.5% (of total land area) to 16.5% by 2050. LNRS should "seek to contribute" to relevant NEOs, this should be a core pillar of the LNRS development process.
- **Priorities**: list of identified main goals for recovering or enhancing biodiversity within the LNRS area
- **Responsible Authority**: the leading authority on the LNRS, appointed by Defra Secretary of State. South Yorkshire Mayoral Combined Authority is the Responsible Authority for the South Yorkshire LNRS, and as such, is required to work with stakeholders from the public, private and voluntary sectors to meet the requirements set out by the LNRS Statutory Guidance.
- **Supporting Authority**: comprised of all Local Authorities (LPAs), National Park Authorities, and Natural England. Supporting Authorities are involved in and support all aspects of the LNRS preparation.

Appendices

A.1 Basemap Habitat Asset Register

Table A.1 shows the asset register for South Yorkshire. It identifies the broad habitat types found across the region, the area of each in ha, and the proportion of the region that each of them covers.

Table A.1 Basemap habitat asset register table displaying total area coverage (ha) of broad habitats in South Yorkshire.

Habitat type	Total area (ha)	Total area (%)
Amenity grassland	6026.5	3.9
Bog	6060.5	3.9
Broadleaved woodland	11771.2	7.6
Built-up areas and infrastructure	19634	12.6
Coastal	9.4	0
Coniferous woodland	1403.2	0.9
Cultivated / disturbed land	40291.5	25.9
Fen, marsh and swamp	980.2	0.6
Garden	11440.7	7.4
Heathland	6319.1	4.1
Improved grassland	22187.4	14.3
Marshy grassland	2539.8	1.6
Mixed / other / uncertain	4534.3	2.9
Mixed woodland	1054.2	0.7
Rock, exposure and waste	558.4	0.4
Scrub	602.6	0.4
Semi-natural grassland	10074.4	6.5
Trees / Parkland	6277.9	4

Uncertain agriculture	937	0.6
Unclassified	527	0.3
Water	2234.6	1.4
TOTAL	**155,463.9***	**100**

*Please note that the total area quoted in the asset register is 250 hectares larger than the actual area of South Yorkshire. This is due to there being small overlaps in polygons in the basemap GIS layer. This is a product of knitting together numerous different layers of GIS habitat data. It takes a very long time to deal with this issue, and sometimes it is not possible to resolve it completely. As we are not using area data for this project from the basemap, it is not a problem. If the area data from this asset register is to be used, this issue needs to be taken into consideration.

A.2 Biodiversity opportunity maps

The importance of landscape-scale conservation and ecological networks has become increasingly recognised over recent years. Many wildlife sites have become isolated in a landscape of unsuitable habitats and efforts are now being directed towards enlarging existing sites, linking existing habitat patches, and increasing connectivity, in line with the Lawton principles. Species are more likely to survive in larger habitat networks, are able to move and colonise new sites, and are more resilient to climate change and other detrimental impacts.

Habitat opportunity mapping to enhance biodiversity follows this ethos by using ecological networks to identify potential areas for new habitats. Identified areas will be ecologically connected to existing habitats, thereby expanding the size of the existing network, increasing connectivity and resilience, and potentially increasing the ecological quality of the new site.

The approach used here identifies three categories of opportunity, indicating three priority levels of importance for each habitat and ecosystem service mapped. It was performed for five key habitat groupings, incorporating the main semi-natural habitats found in South Yorkshire. The broad habitats and their constituent types are shown below:

Box A.1. Broad habitat descriptions for the five major habitat types used in the LNRS.

Broad habitat	Specific habitats included
Wet grassland and wetland	Marshy grassland, floodplain grazing marsh, lowland fen and swamp (reedbed)
Bog	Bog, blanket bog, lowland raised bog

Heathland	Acid grassland mosaic, dry heath (with or without woods / trees /scrub), marshy grassland, dry dwarf shrub heath (acid / basic), wet dwarf shrub heath , upland heathland, wet heathland with cross-leaved heath
Semi-natural grassland	Neutral, acid, calcareous, rough and semi-improved grasslands
Woodland	Broadleaved and mixed woodland types (excludes coniferous woodland, parkland or individual trees)

In the mapping of measures (*Sections 2 and 3*), opportunity mapping was also run for more specific habitat types. This included ancient woodlands (as a subset of woodland), lowland meadows, calcareous grassland, floodplain grazing marsh and other individual habitat types. Heathland opportunities were also mapped, grouped alongside acid grassland, which can often be interchangeable.

Biodiversity opportunity mapping follows a four-step process, and is based on the approach developed by Catchpole (2006)[2] and Watts et al. (2010)[3]. It is based on estimating the permeability of the landscape for typical species of each habitat type and the distance that species would move through the landscape. In all cases, constrained areas (areas where new habitat could not be created) will be excluded and typically includes existing buildings, gardens, infrastructure and water, existing high-quality habitats, heritage features, and gas pipelines and overhead cables (for woodland only). Note that opportunity areas for the five broad habitats often overlap. The mapping will identify two different opportunity zones:

- **Buffer** – areas that are immediately adjacent to existing habitat patches and will usually be the priority for habitat creation.
- **Stepping stone** – areas that are slightly further away from existing habitats, but are close enough to be ecologically connected, and could potentially be used to create stepping-stone habitats that could link up more distant habitat patches.

Three different priority levels are also identified:

- **Priority 1** – buffer and stepping stones close to existing nationally designated sites (e.g. SSSI's) or ancient woodland (for woodland opportunity map only).
- **Priority 2** – areas close to existing locally designated sites (either Local Nature Reserves or Local Wildlife sites).
- **Priority 3** – areas close to undesignated sites in the wider countryside.

As the buffer and stepping stone areas identify portions of land in relation to the ecological network for each habitat, it often results in thin slivers of land being identified adjacent to existing habitats,

[2] Catchpole, R.D.J. (2006). Planning for Biodiversity – opportunity mapping and habitat networks in practice: a technical guide. *English Nature Research Reports*, No 687

[3] Watts, K., Eycott, A.E., Handley, P., Ray, D., Humphrey, J.W. & Quine, C.P (2010). Targeting and evaluating biodiversity conservation action within fragmented landscapes: an approach based on generic focal species and least-cost networks. *Landscape Ecology,* 25: 1305–1318.

which bear no relationship to existing fields and boundaries. As habitat creation or restoration projects usually operate on whole fields, an additional step will be taken to identify those fields that present buffer and stepping stone opportunities.

A.3 Ecosystem services opportunity maps

Ecosystem services opportunity [or wider environmental benefit and non-environmental co-benefit] mapping is a Geographic Information System (GIS) based approach used to identify potential areas for the expansion of key habitats to meet different environmental objectives, whilst taking constraints into account. Opportunities have been mapped to:

- **reduce surface water runoff** (and hence flood risk),
- **reduce soil erosion and improve water quality**,
- **ameliorate air pollution**,
- **reduce noise pollution,**
- **reduce urban heat,**
- **enhance public access to natural greenspace**.

The first step of this process is to map ecosystem service provision and demand (*see section A.5*).

The opportunity mapping uses the basemap and the ecosystem service mapping to highlight the top 5%, 10%, 10-25% and 25-50% best opportunity areas for each respective service, indicating four levels of importance, based on the ecosystem services maps. Constrained areas are excluded and, as for the biodiversity opportunity maps, will consist of existing buildings, infrastructure, gardens and water, existing areas of high-quality habitats, and listed heritage assets. Initial opportunity layers were converted into field-scale maps.

- The water flow regulation opportunity map identifies areas where runoff is currently high and could be reduced through changing land use or habitats. The greatest number and highest priority opportunities generally correspond to areas with relatively steeper slopes. Areas of bare soils, such as quarries and mineral extraction sites, are also highlighted as priorities throughout the study area.

- The water quality (soil erosion) regulation opportunity map focusses on areas where soil erosion is currently high and could be reduced through habitat change. To further prioritise the opportunity areas identified, we will gather information on the overall waterbody status from the Water Framework Directive, for each river waterbody catchment. This data will be used to weight the opportunity map, with catchments with worse water quality given greater weighting. Opportunities will be focussed close to watercourses and especially on arable land, which is a significant source of soil erosion.

- The air pollution regulation opportunity map is demand led, so areas highlighted will be those with the highest demand, but currently low supply of the service. This tends to be urban areas and close to main roads, with no existing tree cover.

- The noise regulation opportunity map is also demand led, so areas highlighted will be those with the highest demand, but currently low supply of the service. As for air pollution regulation, this tends to be urban areas close to main roads, with no existing tree cover.

- The local climate (urban heat) regulation opportunity map works in a similar way to the previous two and highlights areas with the highest demand, but currently low supply of the service. The urban heat island effect is entirely focussed in the larger urban areas, so this map will highlight locations in and immediately adjacent to these urban areas which are not currently constrained by buildings and infrastructure, and with no existing tree cover or lakes/rivers.

- The accessible natural greenspace opportunity map also focuses on areas with the highest demand, where supply is low. The best opportunities for increasing access to the natural environment are concentrated around the edges of the urban areas, often in rings around the edges of settlements.

A.4 Combined opportunity maps – delivering multifunctionality

In addition to mapping the individual opportunities, multiple opportunities were mapped. These area areas where new habitat can be created that provides opportunities to enhance more than one of the services mapped previously. These are areas that could deliver multifunctional outcomes. This was assessed by overlaying individual opportunity maps to determine the degree of overlap, examining each of the main habitat types in turn. Here, if an opportunity fell within the top 10% (highest) opportunity it is given a score of 3, an opportunity in the 10-25% (high) zone is given a score of 2, and an opportunity in the 25-50% (medium) zone is given a score of 1. Biodiversity opportunities (*Appendix A.5)* can also score between 1 and 3, with the highest priority score taking precedence where there is more than one opportunity in the same location. The combined score is summed, with the higher the sore indicating the greatest priority in terms of delivering multiple benefits[4].

The maps were combined in a number of different ways, depending on the objective. When biodiversity enhancement was the primary objective, as was usually the case for the LNRS, we have restricted combined opportunities to areas that present a biodiversity opportunity. Hence opportunity areas are only included for locations that are ecologically connected to existing habitats. Some of the measures also focus on specific or combined environmental benefits, such as combining the water flow, water quality and woodland biodiversity opportunities together to highlight the best areas to plant woodland to reduce flood risk and enhance water quality.

[4] Note that for broadleaved woodland, all ecosystem services maps are combined, along with the woodland biodiversity opportunity map (each scored out of 3), so the combined opportunity score is out of a theoretical total of 15. For semi-natural grassland and wet grasslands and wetlands, air quality regulation opportunity areas are not included as these habitats will not significantly improve the provision of this service, hence the combined score is out of a theoretical total of 12.

A.5 Modelling and mapping ecosystem services (benefits)

Using the habitat basemap it was possible to quantify and map the environmental benefits and co-benefits that these habitats (natural capital) provide to people. These ecosystem service models are the basis for informing the ecosystem service opportunity maps (*Appendix A.4, above*). The ecosystem services mapped that were relevant to the South Yorkshire LNRS are outlined in Box A.2.

Box A.2: Ecosystem services mapped

- **Air purification** (air quality regulation) estimates the relative ability of vegetation to trap airborne pollutants or ameliorate air pollution. Woodland habitats are by far the most effective habitat type at providing this service, but all woody habitats including hedgerows and scattered trees have some effect.
- **Noise regulation** is the capacity of the land to diffuse and absorb noise pollution. Complex vegetation cover, such as woodland, trees and scrub, is considered to be most effective, and the effectiveness of vegetation increases with width.
- **Local climate regulation** estimates the capacity of an ecosystem to cool the local environment and cause a reduction in urban heat maxima. Natural vegetation, especially trees / woodland and water bodies, are able to have a moderating effect on local climate, making nearby areas cooler in summer and warmer in winter.
- **Water flow regulation** is the capacity of the land to slow water runoff and thereby potentially reduce flood risk downstream. The model is based on roughness (dependent on habitat type), slope, and imperviousness (based on soil type).
- **Water quality (soil erosion) regulation** maps the risk of surface runoff becoming contaminated with high sediment loads before entering a watercourse, with a higher water quality capacity indicating that water is likely to be less contaminated. The model focuses on sedimentation risk from agricultural land, rather than urban diffuse pollution.
- **Accessible nature capacity** maps the availability (public access) of natural areas and scores them by their perceived level of naturalness.

For every ecosystem service listed in Box A.2, the capacity of the natural environment to deliver that service – or the current supply – was mapped. For air quality regulation, noise regulation, local climate regulation, and accessible nature, it is also possible to map the local demand (the beneficiaries) for these services. The importance and value of ecosystem services can often be dependent upon its location in relation to the demand for that service, hence capturing this information provides useful additional insight and will be used in the ecosystem services opportunity mapping (*Appendix A.3*).

The capacity models were applied at a 5m by 5m resolution, while the demand models were mapped at 10m resolution providing fine scale mapping across the area. The models were based on the detailed habitat information determined in the basemap, together with a variety of other external data sets (e.g. digital terrain model, UK census data, open space data, and many other data sets and models). Note, however, that many of the models are indicative (showing that certain areas

have higher capacity or demand than other areas) and in all cases the capacity and demand for ES is mapped relative to the values present within the wider study area (South Yorkshire).