



# REPORT

## Cocker Tidal Channel and Cockerham Marsh SSSI Restoration Investigation

### Task 3 – Catchment Nature Based Solutions

Client: Lancashire Wildlife Trust, Natural England & Environment Agency

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## Preamble

The present study forms part of an initiative called 'Our Future Coast', which is instigated by the Department for Environment Food and Rural Affairs (Defra), Wyre Council and the Environment Agency (EA).

'Our Future Coast' is focused on working with nature to safeguard coastal communities through seventeen projects across the north west of England, from Formby in the south to Millom Marshes in the north.

The 'Cocker Tidal Channel & Cockerham Marsh SSSI Restoration Investigation' is one of these projects, being led by Natural England in partnership with Lancashire Wildlife Trust and the Environment Agency.

The 'Our Future Coast' programme aims to develop a suite of natural buffer strips to increase coastal resilience of vulnerable hot spots in the north west. Natural coastal buffer strips can provide multiple benefits, including reducing flood risk, reducing coastal erosion, increasing biodiversity and water quality, providing carbon capture and other ecosystem services such as recreation and well-being.

Buffer strips with their rich vegetation, act as natural means of capturing sediment and dissipating wave energy. Buffer strips include developing salt marsh, managed realignment, reclaiming redundant brownfield sites, dune systems, and intertidal lagoons to provide storage of surface water during high tide.

Further information about the programme can be found here:

[Our Future Coast | The Flood Hub](#)

# 1 Introduction

## 1.1 Overview

The downstream reach of the River Cocker in Lancashire flows in a north-westerly direction, discharging into southeast Morecambe Bay across the intertidal expanse of Cockerham Sands (**Figure 1**). The 1.5 km reach between a sluice gate at Cocker Bridge and Morecambe Bay is tidal, flowing within an artificially straightened channel, which was cut in the 1960s.

The cut Cocker channel joins into a naturally meandering channel (Patty's Farm Creek) at a confluence just seaward of Bank End Farm. Beyond this confluence, the Outer Cocker Channel flows in a meandering manner across intertidal areas of Cockerham Sands.

Prior to the excavation of the new cut in the 1960s (shown in red in **Figure 2**), the natural outflow of the River Cocker was a meandering channel across Cockerham Marsh (shown in orange in **Figure 2**). There is some argument that the new cut has placed increased energy at the confluence (shown as a yellow box in **Figure 2**) between the artificial River Cocker channel and Patty's Farm Creek (shown in blue in **Figure 2**), increasing the tendency for this combined outer channel to incise close to the flood embankment near this point.

Morecambe Bay is a highly dynamic environment, and the alignment of channels can change significantly within a short timescale in response to the governing tidal and sedimentary processes, freshwater discharge from rainfall across the catchment, and the effects of winds, waves and surges during storms.

Following a period of notable channel movement towards the north at the confluence of the cut Cocker Channel and Patty's Farm Creek, in 2012 residents alerted the Environment Agency to the loss saltmarsh fronting the flood embankment and raised concerns at that time about potential flood risk to Bank End Farm and Caravan Park and the nearby Bank Houses Caravan Park.

This prompted a Geomorphological Appraisal by the Environment Agency (Swift, 2013) which incorporated Historical Trend Analysis (HTA) of historical maps and datasets as well as Expert Geomorphological Assessment (EGA) informed by observations from a site visit. Recognising the uncertainties associated with the future extent of saltmarsh erosion due to the dynamic nature of the physical environment, the study recommended enhanced monitoring be undertaken, in combination with further assessment of the suitability of options to address the flood risk (whilst allowing the system to respond as naturally as possible to wider environmental forcing) by means of: (i) enhancing protection of the existing channel bank using bio-engineered brushwood mattresses (or similar); (ii) in-channel flow deflectors; and (iii) strengthening of the main flood embankment near Bank End Farm. The study also suggested that options to re-naturalise the tidal channel of the River Cocker could be considered if that too would alleviate erosion and associated flood risk pressure at Bank End Farm.

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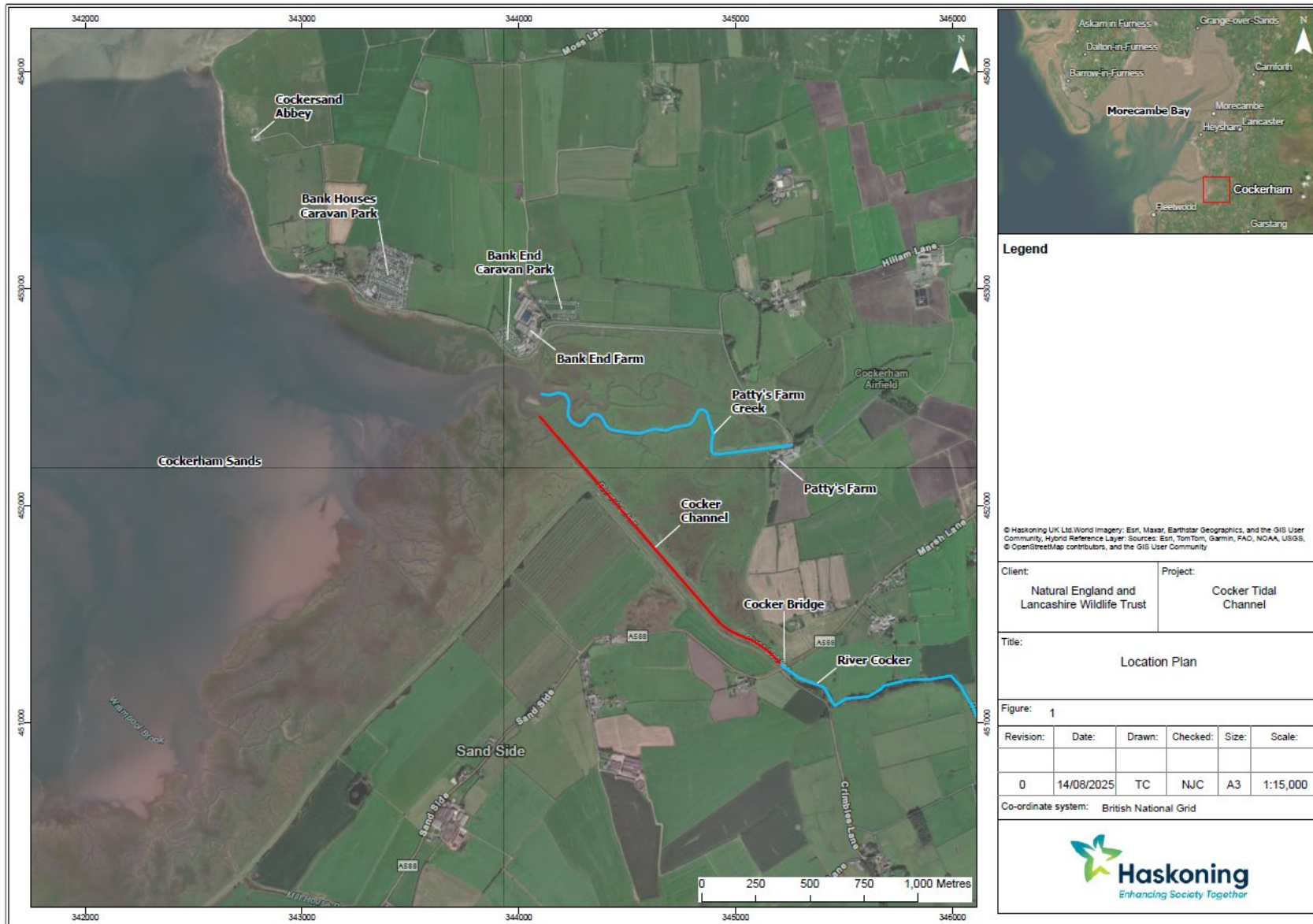


Figure 1 Location plan

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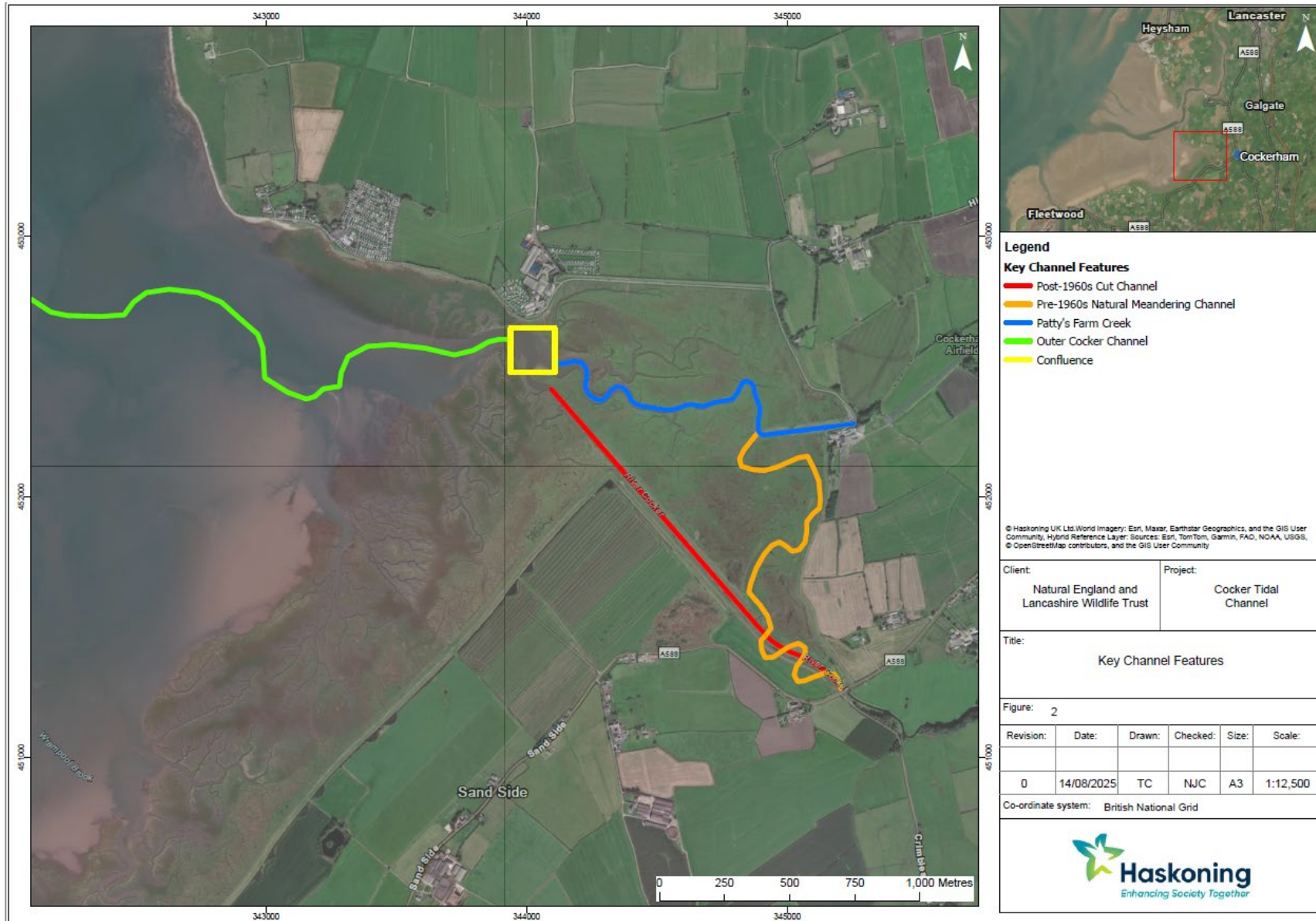


Figure 2 Key channel features (after Swift, 2013)

The present Cocker Tidal Channel and Cockerham Marsh Site of Special Scientific Interest (SSSI) Restoration Investigation more widely investigates potential for restoration of natural processes, morphology and habitat in this area and how this might provide other benefits to the estuary and the wider catchment, particularly land drainage and flood risk. The study comprises four main tasks, namely:

- Task 1 – Desk-Based Review and Site Visit
- Task 2 – Optioneering, Modelling and Design
- Task 3 – Catchment Nature Based Solutions (NBS)
- Task 4 – Cockerham Marsh SSSI

This report relates to **Task 3 – Catchment Nature Based Solutions**.

### 1.2 Task 3 – Catchment Nature Based Solutions

There is a net landward movement of sediments into Morecambe Bay originating offshore and this has led to gradual infilling of the Bay. In addition to offshore sources of sediments, there is an onshore source of sediment from the River Cocker catchment (due to natural erosion and agricultural activities) that is likely to exacerbate any issues associated with high sediment loads coming from offshore. The constant sediment movement into the Bay, which is acting as a sediment sink, causes blockages to tidal gates and outfalls resulting in backed up surface water that cannot drain off of agricultural land (Haskoning, 2025).

The Cocker Channel was formerly desilted yearly until some point in the 1990s, with the arisings used to strengthen the embankment between Cocker Bridge and Patty's Farm. As recently as December 2024/January 2025, some (unconsented) clearance of deposited sediment from the channel was undertaken. Thus, the River Cocker catchment is also prone to flooding due to channel siltation and blockage of tidal sluices and gates by sediments. Two challenges are identified in the catchment, namely:

- Land drainage: this is related to flooding caused by water remaining on land in the lower catchment because of inability to drain any further.
- Sediment supply: this refers to eroded fine sediments emanating from natural erosion and farmlands in the river catchment.

The aim of **Task 3 – Catchment Nature Based Solutions**, is to identify nature-based solutions to water and sediment management that could potentially be implemented in the River Cocker catchment upstream of Morecambe Bay.

Nature-based solutions (NBS) are actions to protect, sustainably manage, and restore natural and modified ecosystems that address societal challenges effectively and adaptively, simultaneously benefiting people and nature<sup>1</sup>.

The subsequent sections of this report present the results of a desk-based assessment that was undertaken to determine the extent to which nature-based solutions in the upstream River Cocker catchment could potentially address the two identified challenges. The solutions are not, however, intended to address the supply of sediments coming from offshore into Morecambe Bay and the lower River Cocker.

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<sup>1</sup> UNEP (2025). <https://www.unepfi.org/nature/nature/nature-based-solutions/>. Accessed 06/11/2025

## 2 Methodology

As identified in Section 1.2, the River Cocker catchment faces two principal challenges: land drainage and sediment supply. These two challenges are related such that where sediments block drains and sluice gates, that can translate into water backing up behind these structures and subsequently increase the risk of flooding.

### 2.1 Desk-based analysis

A desk-based analysis of catchment data (e.g. land use, LiDAR, water body classification) was undertaken to identify baseline condition of the River Cocker catchment and inform our understanding of the catchment and the land drainage and sediment supply issues that affect it. The datasets considered in our review included:

1. Fluvial and surface water flood risk mapping<sup>2</sup>
2. Water body status classification and pressure data hosted online in the Environment Agency's Catchment Data Explorer (EA CDE)<sup>3</sup> and Water Quality Archive<sup>4</sup>.
3. SCIMAP<sup>5</sup> model outputs for the catchment.
4. Condition assessments and other data held by Natural England on the SSSIs that make up the Morecambe Bay Special Area of Conservation (SAC) and Ramsar, Morecambe Bay and Duddon Estuary Special Protection Area (SPA), the Wyre-Lune Marine Conservation Zone (MCZ), and the Lune Estuary and Cockerham Marsh SSSIs<sup>6</sup>. Data on sediment pressures are limited, however, Water Environment Regulations water body classification summaries and SSSI condition assessments can be used to infer where sediments may be an issue, thus the need to assess the conditions of the protected areas.
5. Catchment geology<sup>7</sup>.
6. LiDAR elevation data<sup>8</sup>.
7. Land use data<sup>9</sup>.

### 2.2 Digital data analysis

Elevation data (LiDAR) were analysed in a Geographical Information System (GIS) environment to understand the topography of the catchment and help identify potential sources of surface flow pathways and water/sediment sinks. Identifying flow pathways is significant for suggesting NBS measures aimed at disconnecting surface runoff from source to sink. Slope map of the area was also produced to identify potential sources of sediment through erosion of steep slopes, and this was significant because of the delivery of sediments from agricultural lands. Analysis of satellite imagery and land-use map of the study area was conducted to understand the land use types. Finally, the Sensitive Catchment Integrated Modelling and Analysis Platform (SCIMAP) Model was used to produce erosion risk and flow connectivity risk maps of the area.

<sup>2</sup> <https://flood-map-for-planning.service.gov.uk/map?seg=fz,fzpd&cz=346445.7,450534.8,14.993843> accessed 08/09/2025

<sup>3</sup> <https://environment.data.gov.uk/catchment-planning/WaterBody/GB112072065880> accessed 04/09/2025

<sup>4</sup> [https://environment.data.gov.uk/water-quality/view/explore?search=Don+river+&area=&samplingPointType.group=&samplingPointStatus%5B%5D=open&loc=&\\_limit=500](https://environment.data.gov.uk/water-quality/view/explore?search=Don+river+&area=&samplingPointType.group=&samplingPointStatus%5B%5D=open&loc=&_limit=500)

<sup>5</sup> [my.SCIMAP: Web based diffuse pollution risk mapping](https://my.SCIMAP: Web based diffuse pollution risk mapping)

<sup>6</sup> <https://designatedsites.naturalengland.org.uk/SiteSearch.aspx> accessed 04/09/2025

<sup>7</sup> <https://mapapps2.bgs.ac.uk/geoindex/home.html> accessed 04/09/2025

<sup>8</sup> [environment.data.gov.uk/survey](https://environment.data.gov.uk/survey) accessed 04/09/2025

<sup>9</sup> <https://www.ceh.ac.uk/data/ukceh-land-cover-maps> accessed 04/09/2025

The SCIMAP model is a catchment-scale decision support framework that uses geospatial data to identify Critical Source Areas (CSAs)<sup>10</sup> of floodwater and fine sediments and informs the spatial targeting of flood management measures (Pearson et al. 2022). The model uses four input parameters: a digital elevation model, land cover data, rainfall data and stream network maps of a study catchment. In this project, the online version of the model was used to identify:

1. Hydrological connectivity of the Cocker catchment. In the context of NBS for flood hazard reduction, this is the ease with which water can move from the location in the catchment where runoff is generated to rivers or lakes (Reaney, 2022).
2. Risk of soil erosion within the catchment. This relates to sediment and nutrient pollution. As stated in section 3.4.1.1, entrained sediments can transport nutrient pollution from farms into water bodies.

The SCIMAP model outputs are presented in section 3.5.

### 2.3 Identification of NBS options

Desk-based analysis of the JBA online natural process mapping<sup>11</sup> was the starting point for identifying NBS options in the area of interest. JBA options include:

- Additional floodplain woodland
- Additional riparian woodland
- Additional catchment woodland
- Enhanced floodplain reconnection

Areas of potential opportunities were identified online using the JBA mapping tool, and the results were enhanced using other data sources and SCIMAP analysis of the catchment. The combined results from these methods are presented in section 4. Delineation of areas suitable for identified NBS options was based on analysis of:

- SCIMAP mapping
- Land-use map
- Flood zone map
- Digital analysis in GIS.

Table 1 explains the methodology for delineating individual NBS options.

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<sup>10</sup> CSAs are defined as hillslope areas that produce rapid overland runoff and which are well connected to the channel network. Heathwaite, et al (2005).

<sup>11</sup> <https://naturalprocesses.jbahosting.com/Map> accessed 08/09/25

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Table 1. NBS options and methodology for map delineation

No.	NBS option	Methodology for delineating option
1	Intercepting fast flow pathways	SCIMAP connectivity mapping was used to identify areas best suited for this option such as areas of high connectivity values (>0.49). This threshold was chosen as the mid-way point in the range of scores (connectivity values ranged between 0 and 1).
2	Additional floodplain and riparian woodland	Flood zone 3 <sup>12</sup> shapefile was used to define a floodplain where this option NBS could be applied. For ordinary watercourses, we applied a 5 m buffer on either side from the centre line of the watercourses.
3	Installing large woody materials	Analysis of satellite imagery showed areas of woodland land use along the Cocker River, we delineated these areas for installing large woody materials. The headwaters of the river were already identified for woody materials intervention. To reduce the risk to infrastructure flooding, we set a 20 m buffer upstream and downstream of infrastructure crossing of the river in suggesting locations for this NBS option.
4	Improving riparian buffer	A 5 m riparian corridor for the River Cocker and ordinary watercourses was created to show where this NBS option could potentially be applied.
5	Cross slope interceptors and beetle bank	We used land-use map to identify arable areas suitable for this NBS measure.
6	Cover cropping and grassland cover	We used the land-use map to identify areas that are not currently occupied by grassland cover to be suitable for this NBS option.
7	Reducing stocking density	Reducing stocking density is restricted to pastoral land where livestock are present. In identifying possible locations for this option in the Cocker catchment, we have assumed that all grassland can be grazed, and thus can benefit from reduced stocking density. We merged all grassland types identified on the land-use map and delineating areas under this new classification as suitable for this NBS option.
8	Introduction of offline and sediment ponds	We used the risk of erosion map produced from SCIMAP online modelling to delineate potential areas where this NBS option could be implemented.
9	Wetland creation	It is assumed that this option would be best located along the river floodplain. Thus, we have used the flood zone 3 shapefile to define a floodplain. For ordinary watercourses, we applied a 5 m buffer on either side from the centre line of the watercourses for introducing offline storage ponds and wetland creation.

<sup>12</sup> Flood Map for Planning - Flood Zones accessed 08/09/25

No.	NBS option	Methodology for delineating option
10	Improved floodplain reconnection	We have used the flood zone 3 shapefile to define a floodplain. For ordinary watercourses, we applied a 5 m buffer on either side from the centre line of the watercourses for this option.
11	Improving soil quality	This option is restricted to arable and pastoral lands, thus, we used the land-use map of the area to identify the land uses where improving soil quality could be implemented, i.e. grassland and arable land uses.

### 3 Baseline data

#### 3.1 Flood risk pressures

Environment Agency maps of flood extents from fluvial and tidal sources for flood zones 2<sup>13</sup> and 3<sup>14</sup> and flood extents from surface water flooding for various annual likelihoods of occurrence (both present-day and with future climate change) are available from the ‘Flood maps for planning’ website<sup>15</sup>. **Figure 3** and **4** show the risk of flooding from rivers and sea, and surface water flood risk maps of the River Cocker catchment, respectively. These figures show the onshore catchment only. Flood risk data for the coastal catchment have been presented in Figures 15 – 22 of the Task 1 – Desk-Based Review report and thus are not presented in this report.

If the tidal and river flood defences were not present, then parts of the River Cocker catchment would be at risk of flooding from the river and the sea. The flood risk in different parts of the catchment is categorised from high to very low, as explained in **Table 2**. The River Cocker floodplain, and fields adjacent to drains and other ordinary watercourses<sup>16</sup> have ‘high’ risk of fluvial flooding. There is ‘high’ risk of surface water flooding in topographically low areas (such as ponds and ditches) reflecting the relationship between topography and flooding. The upper region of the catchment is characterised by limited flood risk as shown in **Figure 3**, elevation values in this region rises up to 160 m AOD. There is high flood risk in the low-lying land (elevation values less than 14 m AOD) that are not connected to the River Cocker; however, these areas are dominated by ditches and other ordinary water courses.

<sup>13</sup> Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding.

<sup>14</sup> Land having a 1 in 100 or greater annual probability of river flooding or a 1 in 200 or greater annual probability of sea flooding.

<sup>15</sup> <https://flood-map-for-planning.service.gov.uk/map?seq=fz,fzpd&cz=346445.7,450534.8,14.993843> accessed 08/09/2025

<sup>16</sup> An ordinary watercourse is a watercourse that is not part of a main river and includes rivers, streams, ditches, drains, cuts, culverts, dikes, sluices, sewers (other than public sewers within the meaning of the Water Industry Act 1991) and passages, through which water flows. It is not required for water to flow through the watercourse at all times for it to be considered as an ordinary watercourse

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Table 2. Flood risk description

Risk category	Description
High	Greater than or equal to 3.3% chance in any given year (1 in 30)
Medium	Less than 3.3% (1 in 30) but greater than or equal to 1% (1 in 100) chance in any given year
Low	Less than 1% (1 in 100) but greater than or equal to 0.1% (1 in 1,000) chance in any given year
Very low	Less than 0.1% chance in any given year (1 in 1,000)

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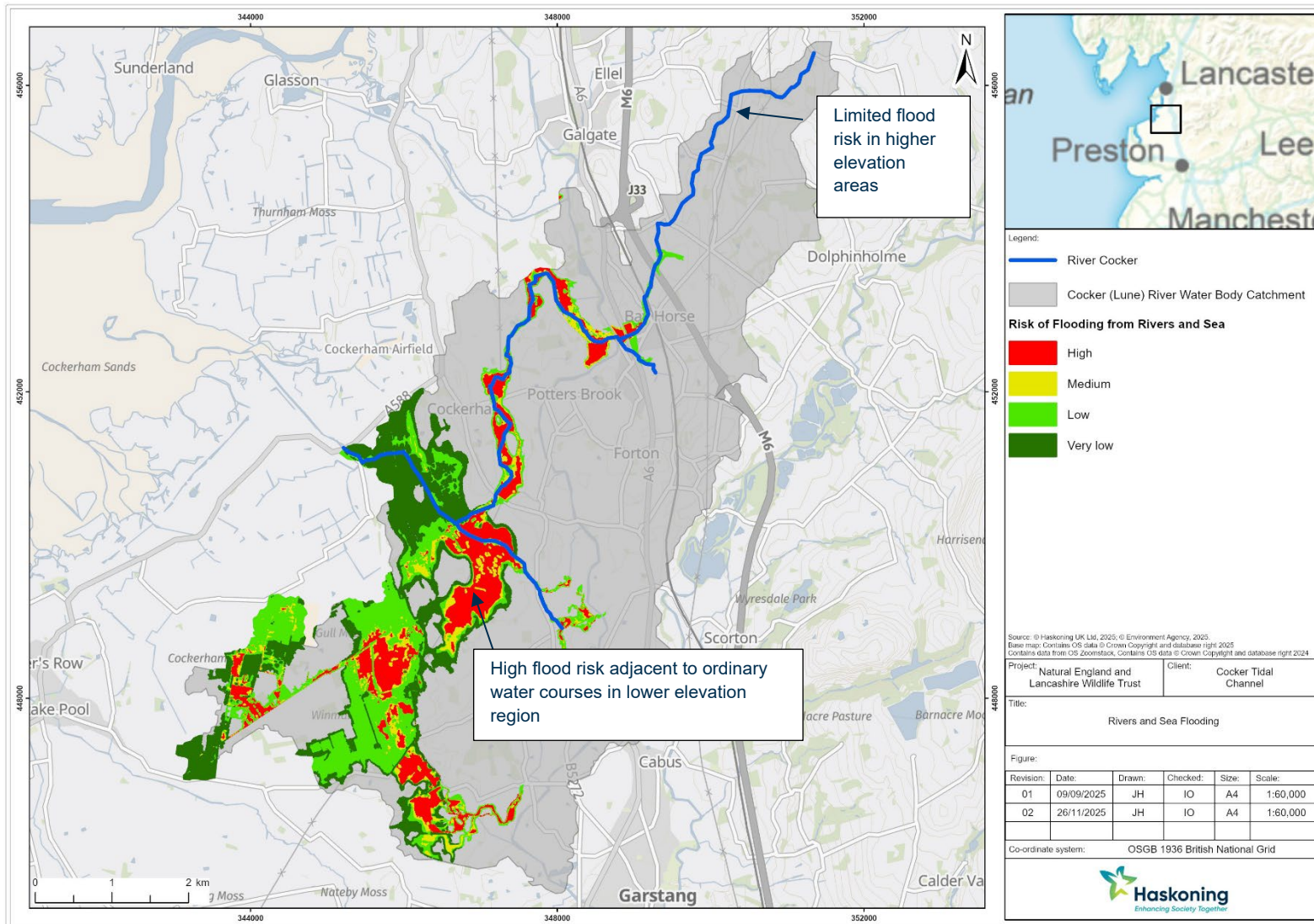


Figure 3. Risk of flooding from rivers and sea.

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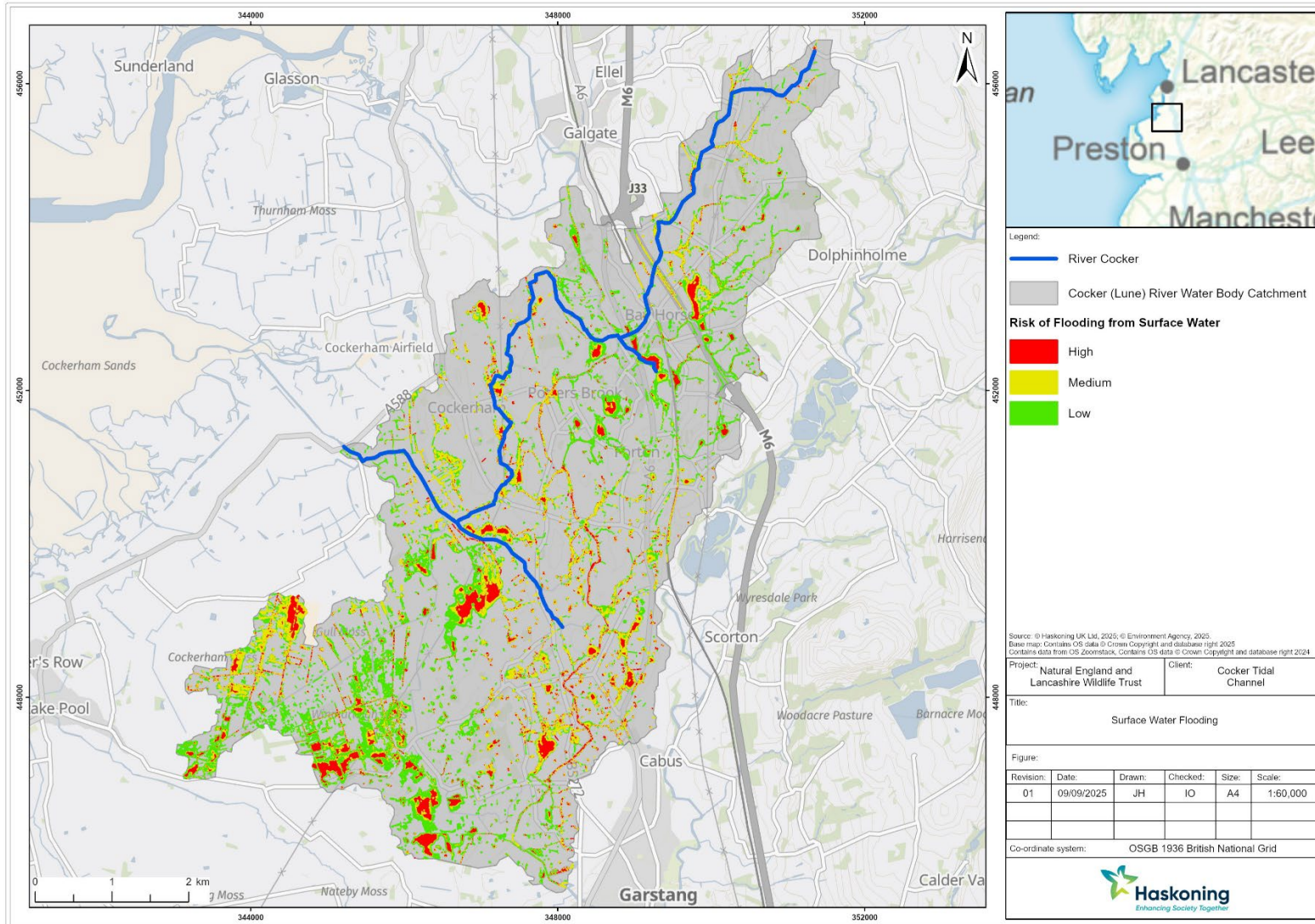


Figure 4. Risk of surface water flooding.

## 3.2 Geology and soils

### 3.2.1 Superficial geology

The superficial geology of the catchment is made up of:

1. Tidal flat deposits (TFD), including mud flat and sand flat deposits of Quaternary Period. They consist of unconsolidated sediment, mainly mud and/or sand. They may form the top surface of a deltaic deposit<sup>17</sup>. These deposits constitute the dominant superficial geology in the catchment and are found from north to south.
2. Salt marsh deposits of Quaternary Period which consist of dominantly very fine-grained sand and mud, with interbedded shell layers, plant roots, characterised by irregular wavy bedding, deposited on flat, poorly drained land that is subject to periodic or occasional flooding by saline or brackish water<sup>18</sup>. This geology is found close to Cockerham Marsh.
3. Till of the Devensian Stage consisting of diamicton<sup>19</sup>. This geology covers the central and northern zones of the catchment.
4. Peat of the Quaternary Period. This is a partially decomposed mass of semi-carbonized vegetation which has grown under waterlogged, anaerobic conditions, usually in bogs or swamps<sup>20</sup>. This geology is located around the Winmarleigh area.

### 3.2.2 Bedrock geology

The bedrock geology comprises:

1. Sherwood Sandstone Group of the Induan Age (TI) — Anisian Age (TA) and comprises of Sandstone, red, yellow and brown, part pebbly; conglomeratic in lower part; pebbles generally extraformational quartz and quartzite, with some intraformational clasts; subordinate red mudstone and siltstone<sup>21</sup>. Sherwood Sandstone covers majority of the Cocker River Catchment from the south to the central region.
2. Accerhill Sandstone of the Chokierian Substage (CH) — Alportian Substage (CO) which comprises of fine- to coarse-grained sandstone, with sandstone seatearths and thin coals<sup>22</sup>. This geological formation is found in the middle part of the catchment.
3. Millstone Grit Group of the Namurian Stage (CN) — Namurian Stage (CN) and comprises broadly upward-coarsening cyclic sequences of sandstone, siltstone and grey mudstone, with subordinate and typically thin coal seams and seatearth (palaeosol) horizons<sup>23</sup>. Millstone Grit is found in the upper part of the catchment.

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<sup>17</sup> <https://webapps.bgs.ac.uk/lexicon/lexicon.cfm?pub=TFD>

<sup>18</sup> <https://webapps.bgs.ac.uk/lexicon/lexicon.cfm?pub=SAMD>

<sup>19</sup> <https://webapps.bgs.ac.uk/lexicon/lexicon.cfm?pub=TILLD>

<sup>20</sup> <https://webapps.bgs.ac.uk/lexicon/lexicon.cfm?pub=PEAT>

<sup>21</sup> <https://webapps.bgs.ac.uk/lexicon/lexicon.cfm?pub=SSG>

<sup>22</sup> <https://webapps.bgs.ac.uk/lexicon/lexicon.cfm?pub=ACHS>

<sup>23</sup> <https://webapps.bgs.ac.uk/lexicon/lexicon.cfm?pub=MG>

### 3.2.3 Soils

The soil in the catchment comprises:

1. Saltmarsh soils with loamy texture, naturally wet and drains mostly to the sea<sup>24</sup>.
2. Loamy and clayey soils of coastal flats with naturally high groundwater<sup>25</sup>
3. Loamy and sandy soils with naturally high groundwater and a peaty surface<sup>26</sup>
4. Freely draining slightly acid loamy soils. The water protection issues associated with these soils are:
  - a. groundwater contamination with nitrate;
  - b. siltation and
  - c. nutrient enrichment of streams from soil erosion<sup>27</sup>.
5. Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils. The water protection issues associated with these soils are:
  - a. overland flow from compacted or poached fields
  - b. organic slurry, dirty water, fertiliser, pathogens and
  - c. fine sediment can all move in suspension or solution with overland flow or drain water<sup>28</sup>.
6. Freely draining floodplain soils with loamy texture. Flooding of cultivated fields with potential topsoil scour and increased silt deposition in the river is a water protection issue for this soil type<sup>29</sup>.

### 3.3 Elevation, slope gradient and land use

The elevation ranges between 7 and 160 m AOD. The upper part of the catchment is dominated by higher elevations rising up to 160 m AOD. Low elevation values are recorded particularly in the southwest with values of 7 m AOD. The slope gradient ranges between 0° and 74°.

A land use map of the catchment is presented in **Figure 5**. Improved grassland is the dominant land use covering 27.4 km<sup>2</sup> while calcareous grassland covers the smallest area with 0.0003 km<sup>2</sup>. Improved grassland is not restricted to a particular part of the catchment, rather it is spread across the entire catchment as shown in **Figure 5**. Conversely, broadleaf woodland is particularly located on the eastern side of the catchment.

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<sup>24</sup> <https://www.landis.org.uk/soilsguide/soilscapes.cfm?ssid=1>

<sup>25</sup> <https://www.landis.org.uk/soilsguide/soilscapes.cfm?ssid=21>

<sup>26</sup> <https://www.landis.org.uk/soilsguide/soilscapes.cfm?ssid=23>

<sup>27</sup> <https://www.landis.org.uk/soilsguide/soilscapes.cfm?ssid=6>

<sup>28</sup> <https://www.landis.org.uk/soilsguide/soilscapes.cfm?ssid=18>

<sup>29</sup> <https://www.landis.org.uk/soilsguide/soilscapes.cfm?ssid=12>

# Project related

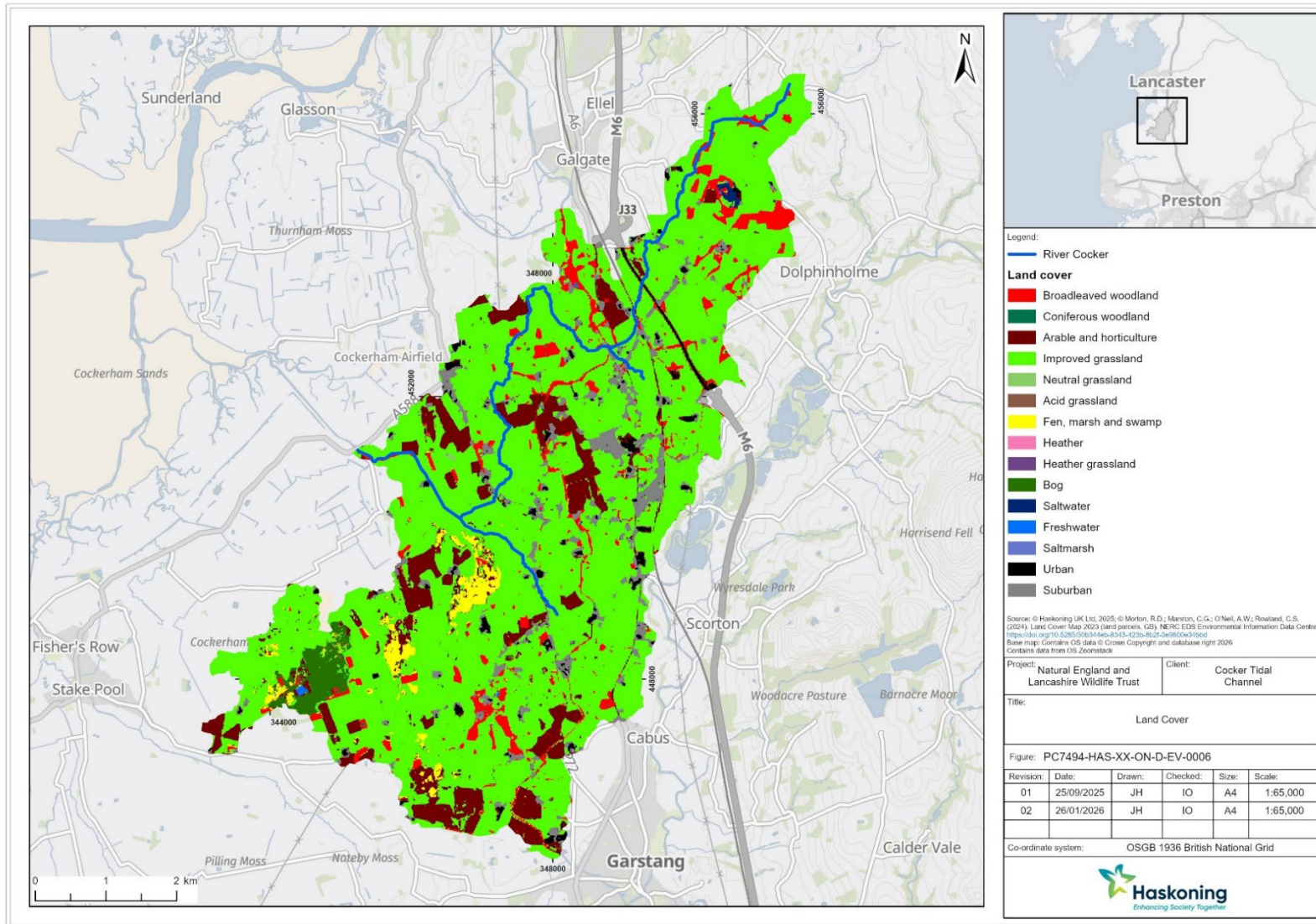


Figure 5. Land-use map

### 3.4 Pressures on water body status

This section presents a description of catchment land-use pressures from farming activities (sediments and nutrients). The site falls within the Cocker (Lune) river water body, hence data on the Cocker river water body available on the EA's CDE are presented below. There is no upstream water body.

#### 3.4.1 Cocker (Lune) Water Body (GB112072065880)

##### 3.4.1.1 Status and objectives

This heavily modified river water body (**Table 3**) has 'Moderate' Overall, Ecological and Physico-chemical (Ammonia and Phosphate) status classifications. Ammonia and phosphates have therefore been identified by the EA as pressures on the water body. The Biological quality elements (Invertebrates) are classed as 'Good' while the Hydromorphological Supporting Elements 'Supports Good' status (**Table 4**). The Chemical elements 'Do not require assessment' in the 2022 classification, however, in the 2019 classification, the water body had a chemical status of 'fail'<sup>30</sup>.

Although the EA data presented in this section focusses on nutrients (phosphorus and nitrogen/ammonia), it is still very relevant because high nutrient loads are indicative of agricultural land-use pressures, such as rapid runoff and the supply of fine sediment. Phosphorus is typically present in the particulate rather than dissolved phase and therefore is indicative of fine sediment supply.

Although the hydrological regime is 'high' status (**Table 4**), this does not necessarily mean that the hydrology is not a pressure in the catchment (e.g. leading to rapid runoff and flood risk); rather, it is not a pressure on the ecological status of the water body, hence the 'high' classification.

Mercury and two Persistent Organic Pollutants (POPs), polybrominated diphenylethers (PBDE; historically used as flame retardants) and perfluorooctane sulphonic acid (PFOS; a textile stain repellent and fire-fighting chemical) are ubiquitous and exceed biota EQSs at many of the sites sampled. Although these substances are now banned or restricted in the UK, they are slow to break down and are still found in the environment<sup>31</sup>.

Table 3. Basic attributes of the Cocker (lune) water body

Water body name	Cocker (Lune) water body
Water body ID	GB112072065880
Hydromorphological designation	Heavily modified
Catchment area (km <sup>2</sup> )	37.9
Length (km)	17.5
Upstream water body	None
Downstream water body	None

<sup>30</sup> <https://environment.data.gov.uk/catchment-planning/WaterBody/GB112072065880> accessed 04/09/2025

<sup>31</sup> EA (2021). Chemicals: challenges for the water environment. <https://www.gov.uk/government/publications/chemicals-challenges-for-the-water-environment> accessed online 18/09/25

## Project related

Table 4. Status classification and objectives for the Cocker (Lune) water body

Classification item	Classification (2022)	Objective and Year
<b>'Overall Water Body'</b>	Moderate (2019)	Good (2063)
<b>'Ecological'</b>	Moderate (2019)	Good
<b>Biological quality elements</b>	Good (2019)	Good (2015)
Invertebrates	Good (2019)	Good (2015)
Macrophytes and Phytobenthos Combined	High (2019)	Good (2015)
<b>Physico-chemical quality elements</b>	Moderate (2019)	Good
Ammonia (Phys-Chem)	Moderate (2019)	Good
Dissolved oxygen	High (2019)	Good (2015)
pH	High (2019)	Good (2015)
Phosphate	Moderate (2019)	Good
Temperature	High (2019)	Good (2015)
<b>Specific Pollutants</b>		Not assessed (2015)
<b>Hydromorphological Supporting Elements</b>	Supports Good (2019)	Supports Good (2015)
Hydrological Regime	High (2019)	Supports Good (2015)
<b>Supporting elements (Surface Water)</b>	Moderate (2019)	Good
Mitigation Measures Assessment	Moderate or less (2019)	Good
<b>'Chemical'</b>	Does not require assessment (2022)	Good (2063)
<b>Priority hazardous substances</b>	Does not require assessment (2022)	Good (2063)
Hexachlorobutadiene	Good (2019)	Good (2015)
Perfluorooctane sulphonate (PFOS)	Good (2019)	Good (2015)
Benzo(a)pyrene	Good (2019)	Good (2015)
Hexachlorobenzene	Good (2019)	Good (2015)
Hexabromocyclododecane (HBCDD)	Good (2019)	Good (2015)
Heptachlor and cis-Heptachlor epoxide	Good (2019)	Good (2015)

## Project related

Classification item	Classification (2022)	Objective and Year
Polybrominated diphenyl ethers (PBDE)	Fail (2019)	Good (2063)
Mercury and Its Compounds	Fail (2019)	Good (2040)
Dioxins and dioxin-like compounds	Good (2019)	Good (2015)
<b>Priority substances</b>	Good (2022)	Good (2015)
Cypermethrin (Priority)	Good (2019)	Good (2015)
Fluoranthene	Good (2019)	Good (2015)
<b>Other Pollutants</b>	Does not require assessment (2022)	Does not require assessment (2015)

### 3.4.1.2 Catchment pressures

The EA has identified six reasons for not achieving good (RNAGs) for this water body (Table 5). Affected classification elements include phosphate, ammonia and outstanding mitigation measures. These quality elements are failing to achieve 'Good' status due to point source pollution, diffuse pollution and physical modifications respectively. These catchment pressures arise from:

- Agriculture and rural land management (runoff of sediments and nutrients),
- The water industry (treated effluent discharges).
- Local and central government (flood defences).

There is no upstream water body, hence these pressures originate from within the water body catchment. Although there is no downstream river water body, pollutants from agricultural and wastewater treatment activities originating from this catchment will likely be transported into the downstream Cocker Channel and further into Morecambe Bay and downstream coastal water bodies. RNAG data suggests that nutrient (and hence also sediment) supply from agriculture has been identified as a pressure by the EA in this catchment. Fine sediment supply from agricultural activities can exacerbate the offshore supply of sediments into Morecambe Bay and further exacerbate the siltation of sluices and valves. Hence, NBS measures suggested in this report are aimed at not only slowing the flow<sup>32</sup> but also mitigating the sediment pressures from onshore sources.

<sup>32</sup> Retaining water in the catchment to reduce the time to flood peak and reduce flood risk further downstream.

## Project related

Table 5. Reasons for not achieving good for the Cocker (Lune) water body

ID	Classification Element	Category	Business Sector	Surface Water Management Issue (SWMI)	Surface Water Management Issue (SWMI) Certainty
587923	Phosphate	Agriculture and rural land management		Point source	Confirmed
565349	Polybrominated diphenyl ethers (PBDE)	No sector responsible	Not applicable	Measures delivered to address reason, awaiting recovery	Confirmed
565348	Phosphate	Water Industry	Waste water treatment	Point source	Confirmed
565347	Ammonia (Phys-Chem)	Agriculture and rural land management	Agriculture - Livestock	Diffuse source	Confirmed
10002588	Mitigation Measures Assessment	Local and Central Government	Not applicable	Physical modification	Confirmed
565346	Mercury and Its Compounds	No sector responsible	Not applicable	Measures delivered to address reason, awaiting recovery	Confirmed

### 3.5 Sensitive Catchment Integrated Modelling and Analysis Platform (SCIMAP) Model output

As explained in **section 2.2**, SCIMAP is an online modelling tool that identifies source areas of floodwater and fine sediments and informs the spatial targeting of flood management measures. SCIMAP has become a key modelling tool within the Catchment Partnerships in all 100+ catchments across England and cross-border with Wales as part of Defra's Catchment-Based Approach (CaBA) programme. The National Trust is using SCIMAP to identify erosion risk and fine sediment connectivity across all 41 catchments in its northern region, and to produce catchment management plans<sup>33</sup>.

SCIMAP model output show the surface flow connection and erosion risk maps of the Cocker Catchment in **Figure 6 and 7**, respectively. There are high connectivity values particularly in the north of the catchment, **Figure 6**. This part of the catchment is at a higher elevation (160 m AOD) than the southern region of the catchment. Although improved grassland is the dominant land use, broadleaved woodland is also found in the high flow connectivity area. **Figure 7** shows that the greatest risk of soil erosion occurs particularly in the north, central and southeast regions of the catchment. As noted, the northern part has higher elevations than the other regions of the Cocker Catchment. In terms of NBS, these identified areas of higher risks offer the opportunity for further investigation and application of solutions to slow the flow and trap potentially eroded sediments before they get into the nearby water bodies.

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<sup>33</sup> Royal Geographical Society (with IBG) (2023) Evidence-based catchment management with SCIMAP. Available at <https://rgs.org/SCIMAP> Last accessed on: 27/11/2025

Project related

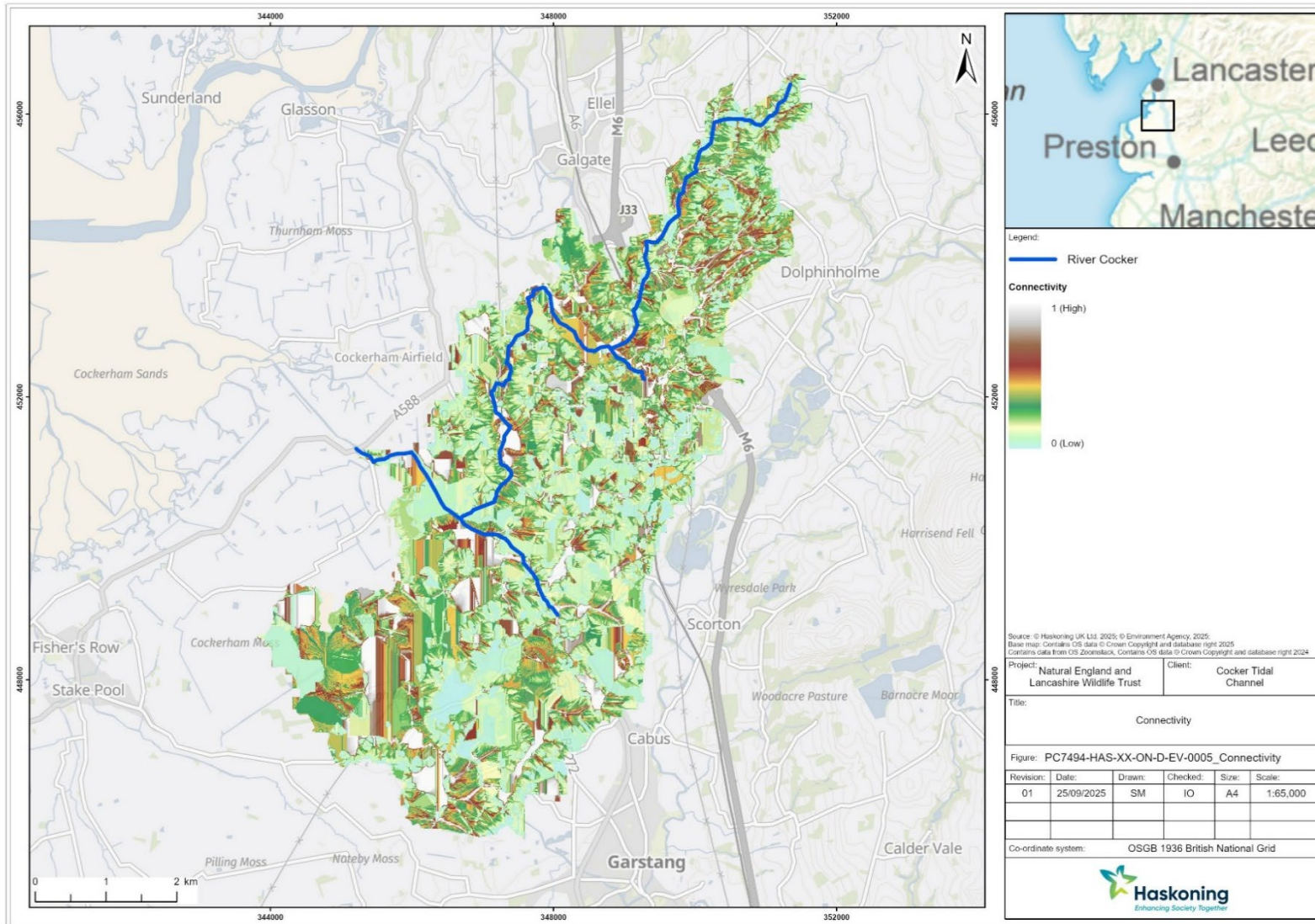


Figure 6. Surface flow connection risk

# Project related

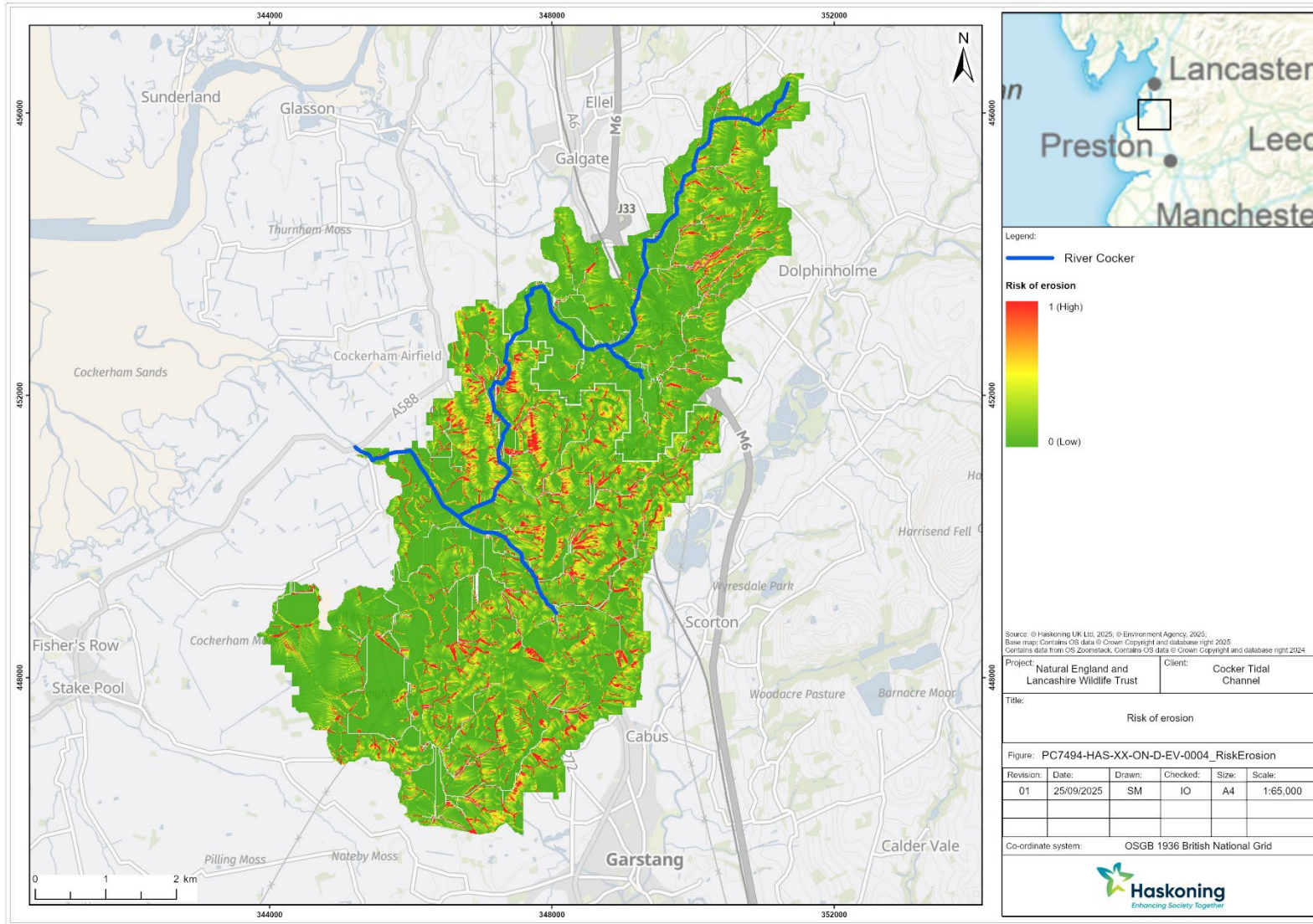


Figure 7. Erosion risk

### 3.5.1 Condition assessment of protected areas

The water body falls under three protected areas, the Morecambe Bay Ramsar Site (UK11045), Morecambe Bay and Duddon Estuary Special Protection Area (UK9020326) and the Morecambe Bay Special Area of Conservation (UK0013027). The Wyre-Lune Marine Conservation Zone, Lune Estuary SSSI and Cockerham Marsh SSSI are close to and are hydrologically connected to the Cocker channel.

The Morecambe Bay Ramsar Site (UK11045) is a staging area for migratory waders and waterfowl including internationally important numbers of passage ringed plover (*Charadrius hiaticula*)<sup>34</sup>. It covers 374 km<sup>2</sup>. The Morecambe Bay & Duddon Estuary SPA (UK9020326) covers 669 km<sup>2</sup> and is designated as SPA because it is used regularly by over 20,000 seabirds in any season<sup>35</sup>. The Morecambe Bay Special Area of Conservation (UK0013027) covers 615 km<sup>2</sup> and is designated as SAC because it hosts a variety of habitats including Atlantic salt meadows (*Glauco-Puccinellietalia maritima*) (saltmarsh), Atlantic decalcified fixed dunes (*Calluno-Ulicetea*) (coastal dune heathland) and coastal lagoons<sup>35</sup>. The Wyre-Lune Marine Conservation Zone is designated for the protection of smelt (*Osmerus eperlanus*), and it covers 92 km<sup>2</sup>. Natural England<sup>36</sup> has not provided any data on the conditions of the above-named protected areas.

The Lune Estuary SSSI covers 76 km<sup>2</sup> and is designated for supporting migratory birds. A large part of the estuary, between Knott End and Cockersands Point, is covered by the Wyre–Lune Sanctuary which provides a protected roost for wintering pink-footed geese (*Anser brachyrhynchus*). Some of the saltmarshes are of interest for their breeding bird populations and collectively support a variety of plant communities and a number of uncommon plant species<sup>37</sup>. In terms of SSSI condition summary, 100% of the site is in a favourable condition<sup>38</sup>. However, **Table 6** shows that there are several pressures faced by the Lune Estuary SSSI.

Table 6. Lune Estuary SSSI – pressures<sup>39</sup>

Broad pressure	Pressure	Pressure identified	Risk	Pressure status
Land Management	Overgrazing livestock	14/02/2022	High	Potential
Coastal Impacts	Hydrological Management of the Coast	02/04/2019	High	Potential
Disturbance and Recreational Impacts	Recreational Disturbance	17/01/2018	High	Potential
Planning and Development Impacts	Energy Development	29/03/2012	Medium	Potential

<sup>34</sup> <https://jncc.gov.uk/jncc-assets/RIS/uk11045.pdf> accessed 04/09/2025

<sup>35</sup> <https://publications.naturalengland.org.uk/publication/6242841537806336> accessed 04/09/2025

<sup>36</sup> <https://designatedsites.naturalengland.org.uk/SiteSearch.aspx> accessed 04/09/2025

<sup>37</sup> <https://designatedsites.naturalengland.org.uk/PDFsForWeb/Citation/1001709.pdf> accessed 04/09/2025

<sup>38</sup> <https://designatedsites.naturalengland.org.uk/ReportUnitConditionSummary.aspx?SiteCode=S1001709&ReportTitle=Lune%20Estuary%20SSSI> accessed 04/09/2025

<sup>39</sup> <https://designatedsites.naturalengland.org.uk/SitePressures.aspx?SiteGuid=9faa95e3-5a50-e411-a6ba-000d3a2004ef&SiteCode=S1001709&SiteName=Lune%20Estuary%20SSSI> accessed 04/09/2025

Land use and overgrazing pressures are potential contributors towards rapid runoff (e.g. by compacting soils if livestock densities are too great) and sediment supply (e.g. through increased runoff velocities and also direct pressures on watercourses through livestock poaching) in the Lune Estuary SSSI. The livestock pressure also supports what the WER classification sets out above, in relation to ammonia and phosphorus pressures.

Located on the west side of the Cocker Channel and adjacent to the Lune Estuary SSSI, the Cockerham Marsh SSSI covers 0.1 km<sup>2</sup>. Characteristics of this SSSI have been described in a separate report (Haskoning, 2026).

### 3.6 Conceptual framework of the River Cocker catchment

From its source near Yeat House Farm and Higher Knowe Hill south of Quernmore, the River Cocker flows in a south-westerly direction until it is joined by the Potters Brook close to the A6 (Preston Lancaster Road) (**Figure 8**). From here, the river briefly flows in a northwest direction before turning south near Middle Lodge and Cragg Hall Farm. The river maintains this southern movement past Cockerham from where it flows north into Morecambe Bay through the Cocker Channel. In terms of physical infrastructure, the river has been crossed by a number of roads from source to mouth including the M6, A6, B5272, A588, Bay Horse, Saltoake and Cockerham roads, as well as the West Coast railway main line. At the crossing points, the river is either bridged or culverted.

Land use along the approximately 17.5 km length of the river is predominantly rural with farm fields and farmhouses clearly visible in the satellite imagery along both banks of the river. Areas of riparian woodland are also visible. Given the dominance of agricultural activities in the catchment, it is not surprising therefore that nutrient pollution (Phosphate and Ammonia) arising from agricultural pollution is a confirmed challenge in this catchment.

Flood currents in Morecambe Bay are generally stronger and are able to transport more sediment than the ebb tide. As a result, there is a net landward movement of sediment, and the Bay is slowly infilling. The bed sediments are dominated by very fine and fine sands and muds in the inner Bay. The vegetated areas of the intertidal attenuate wave and tidal energy, bind sediments within the roots and encourage additional sediment deposition (Swift, 2013).

This indicates that there is an offshore supply of sediments into the Bay. However, the evidence presented in **Section 3.4.1.2** suggests that sediment pollution is an agricultural pressure in the Cocker Catchment. Farming activities can exacerbate sediment transport from farmlands into the Cocker River which may eventually be transported into Morecambe Bay through the Cocker Channel. Thus, in addition to offshore sediment supply, there is the potential for river-transported sediment supply into the Bay. Sustained sedimentation leads to net accretion of the marsh surface in tidal frame, tide locking and blocks sluices which need clearance or cause back-up flooding upstream.

Given that there are no upstream water bodies, river-transported nutrients and sediment pollution in the River Cocker Catchment originate within the catchment itself. As noted in **section 1.2**, catchment NBS can help to address the sediment issue by reducing agricultural runoff and sediment supply from the onshore river catchment.

# Project related

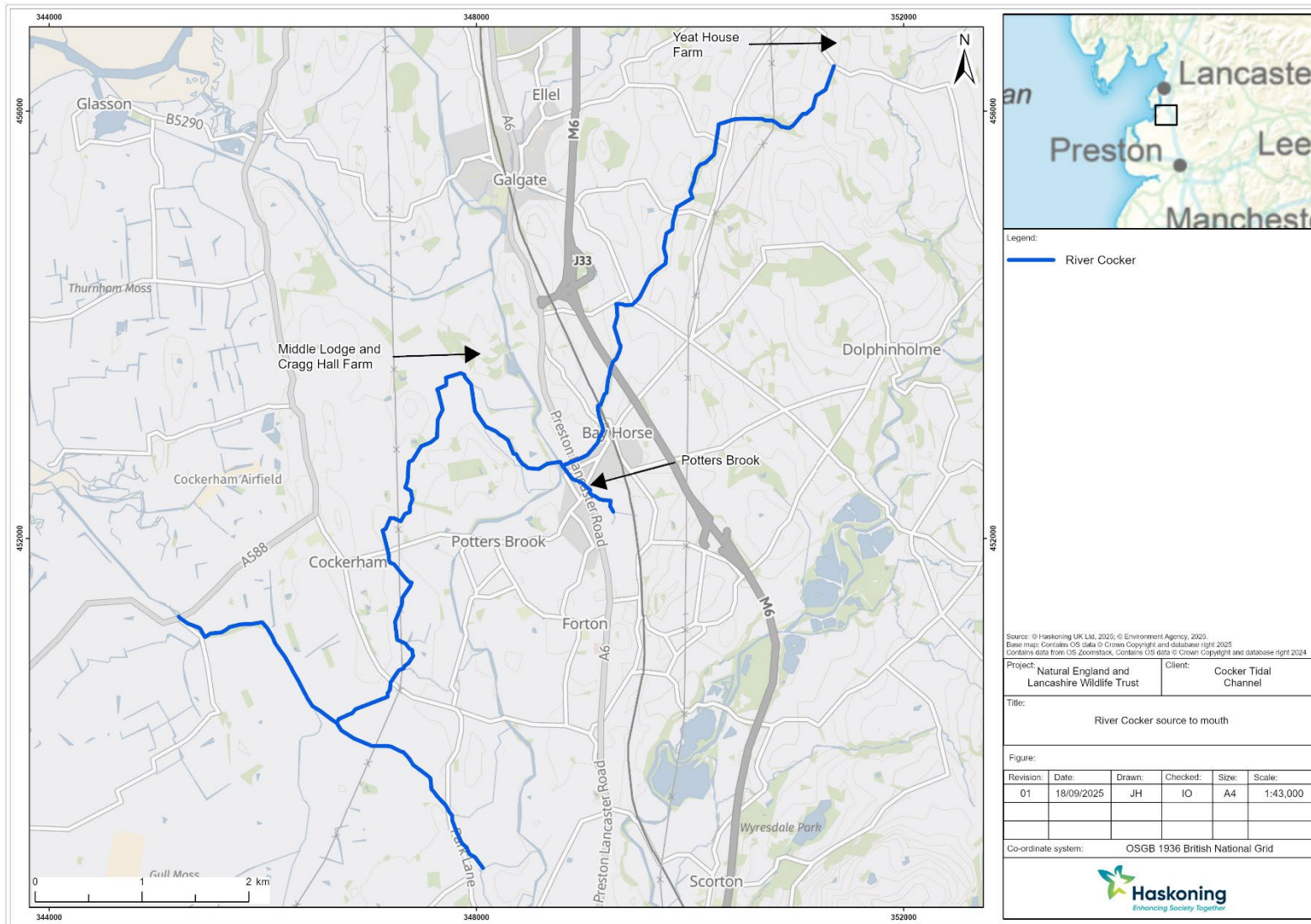


Figure 8. River Cocker, from source to mouth.

## 4 Identification of nature based solutions

### 4.1 Nature based solutions for flood and erosion risk management

The overarching aim of this report is to identify nature-based solutions to water and sediment management that could potentially be implemented in the River Cocker catchment upstream of Morecambe Bay. The methodological approach adopted for this report relates to managing the challenges of flooding, sediment production, transport and delivery in the catchment. Typically, measures adopted to manage flooding and delivery of sediments from source areas to river networks result in an alteration to the overall catchment hydrological response. These measures can attempt to either disconnect areas of high connectivity or increase storage capacity downstream of areas generating overland flow (Metcalf et al, 2017).

This section presents different nature based solutions identified from the methodological approach adopted in the report including assessment of JBA opportunities mapping as well as other techniques explained in **section 2**. Results of SCIMAP online modelling shown in **section 3.5** identified the surface flow connection and erosion risks, respectively, in the catchment. Analyses of flood zone and land-use maps were also completed to identify NBS options.

### 4.2 Potential for application in the River Cocker catchment

**Section 0** identified sediment pollution (and by extension, nutrient pollution as explained in **Section 3.4.1.1**) as an agricultural pressure in the Cocker catchment. Fine sediments are transported by overland flow from source into the river networks, thus measures aimed at disconnecting flow and managing sediments would reduce supply of nutrient pollutants. Shapefiles of maps where NBS options could be most beneficial (shown in the succeeding figures) will be made available to the EA and relevant agencies working on flood risk in the area such that they can zoom into individual fields/farms of choice and discuss further with landowners. Due to scale, some recommended options are best viewed in GIS.

The following NBS options could potentially be implemented to reduce flow connectivity and manage sediment transport in the Cocker catchment.

#### 4.2.1 Intercepting fast flow pathways

Overland flow pathways transfer surface runoff and eroded sediments into watercourses quickly, resulting in a rapid rise in river levels and contributing towards the flashy nature of catchments. Intercepting fast flow pathways is a technique to manage surface runoff. This prevents the rapid transfer of rainfall to watercourses and reduces sediment loads in the flow, thereby reducing diffuse pollution levels in the watercourse and reduced flood levels downstream<sup>40</sup>. Benefits associated with this NBS option includes reduced flood peak, removal of sediment load from surface flow thereby improving water quality and sediment deposition can increase crop yield by enriching soil nutrients such that less fertiliser is applied on the soil.

Intercepting fast flow pathways can be achieved by using natural materials (such as earth bunds and kested hedges – **Figure 9**) to prevent the rapid transfer of surface runoff to the River Cocker and other ordinary watercourses in the catchment. The methods for implementing bunds and kested hedges are provided in detail<sup>41</sup>. This NBS technique would be most effective along flow paths identified using the SCIMAP connectivity map (**section 3.5**) as shown by the red shading in **Figure 10**.

<sup>40</sup> *Runoff Attenuation Features. A guide for all those working in catchment management.*

[https://research.ncl.ac.uk/proactive/belford/papers/Runoff\\_Attenuation\\_Features\\_Handbook\\_final.pdf](https://research.ncl.ac.uk/proactive/belford/papers/Runoff_Attenuation_Features_Handbook_final.pdf) accessed online 08/09/25

<sup>41</sup> <https://thefloodhub.co.uk/wp-content/uploads/2018/11/North-West-NFM-handbook.pdf>. Accessed 08/09/25



Figure 9. Bunds (A and B) and kested hedge<sup>41</sup> being constructed across primary flow pathway.

# Project related

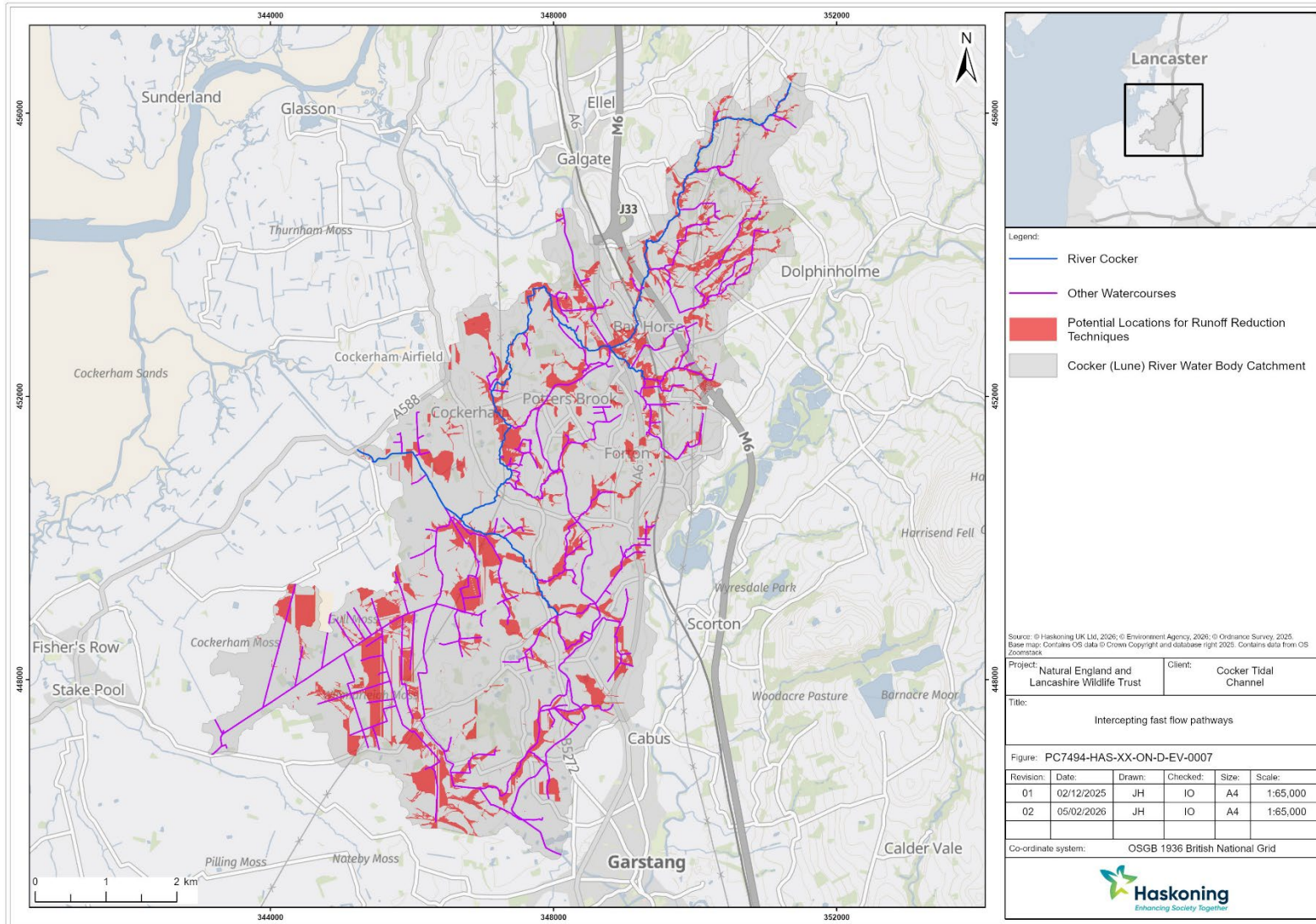


Figure 10. Potential locations where intercepting fast flow pathways could be beneficial within the Cocker Catchment

#### 4.2.2 Additional floodplain and riparian woodland

Floodplain and riparian woodland refers to a woodland area next to a river or stream that acts as a transition zone between the terrestrial (non-floodplain) and the aquatic environments (Molles, 2008). These areas also contribute to stabilization of river banks<sup>42</sup>. Benefits associated with planting more trees in the floodplain (**Figure 11**) and along the riverbanks include enhancing surface roughness (particularly the understorey), slowing the flow and retention of sediments, as well as environmental benefits (biodiversity and shading). For example, as part of Natural Flood Management (NFM) in the Wyre catchment, farmers and landowners can be paid to host and maintain a range of NFM interventions including tree planting with the aim of reducing flooding<sup>43</sup>. Increasing cross-slope woodland would reduce the rate of surface flow, improve water quality and reduce erosion.

In the long run, additional floodplain and riparian woodland would lead to the introduction of large woody materials in the floodplain and channel which can further slow the flow as well as deflect flows in-channel and potentially increase floodplain connectivity. Planting shrubs and pinning large wood to the woodland floor can provide greater resistance to surface runoff, thus slowing the speed of surface flow and allowing more time for infiltration. Woodland roughness can also be increased by planting dense understorey species such as holly or hazel.

As identified in **Section 3**, rows of riparian woodland were identified in the Cocker catchment, however farming (arable and grazing) is the dominant land use. When considering additional riparian woodland, tree planting should only take place in suitable areas and should consider existing features of riparian environment. The use of native tree species is recommended. Additional floodplain and riparian woodland would be most effective along floodplains and riparian corridor (**Figure 12**).



Figure 11. Recently planted riparian woodland in the Lune catchment<sup>44</sup>

<sup>42</sup> Foundation for water research (2014). *Demystifying natural water retention measures*

<sup>43</sup> <https://wyreiverstrust.org/wyre-nfm> accessed 26/01/26

<sup>44</sup> Image courtesy of Lune Rivers Trust

# Project related

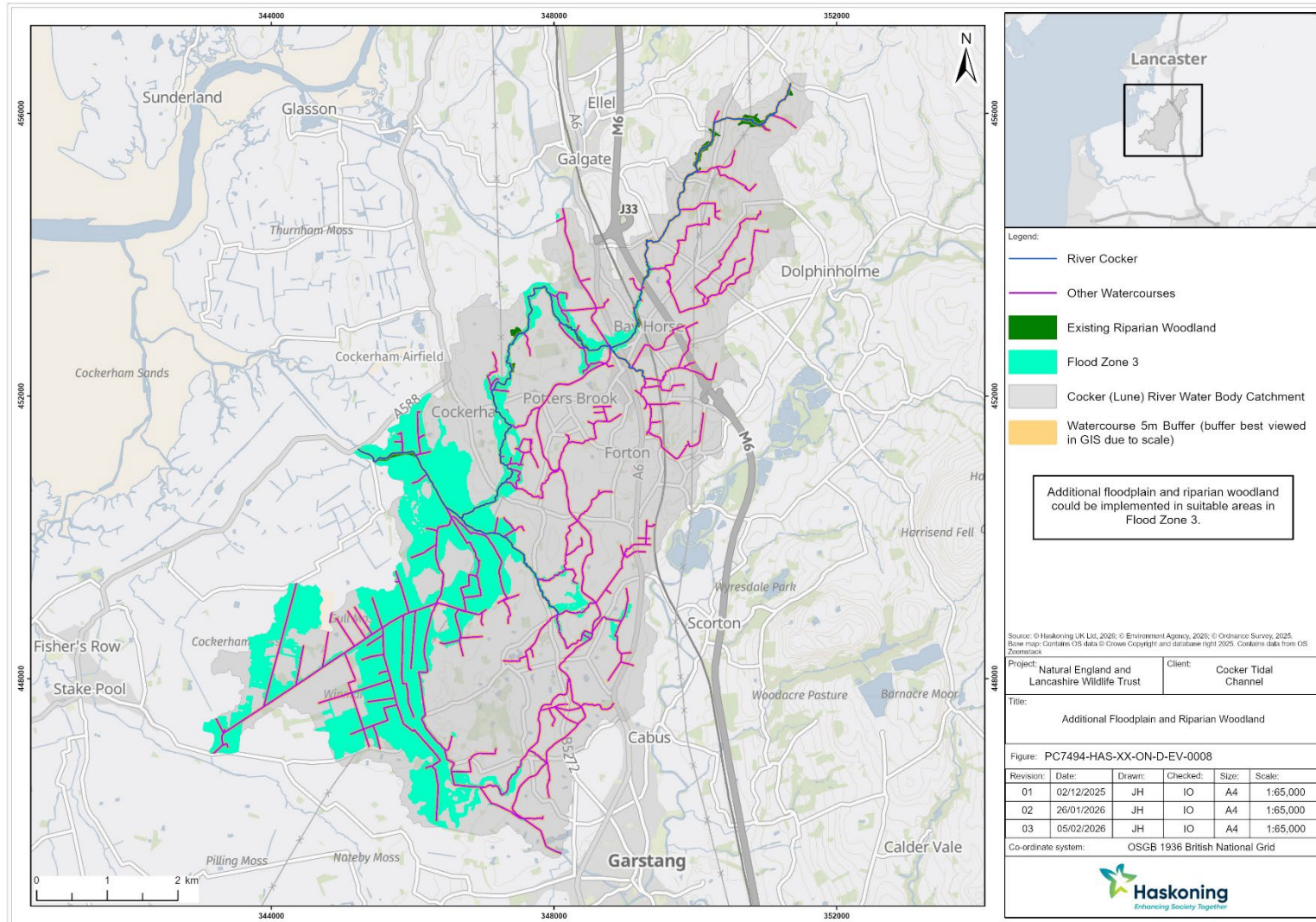


Figure 12. Additional floodplain and riparian woodland in the river floodplain

### 4.2.3 Installing large woody materials

Large wood refers to branches, trunks, root boles or entire trees that fall into the channel. Fallen trees and branches are a natural part of tree-lined river ecosystems and provide morphological diversity, localised flow diversity and areas of refuge within the channel. The use of large woody materials for NBS may also include the preservation of woody materials in the river channel and should be targeted on a catchment scale for maximum benefit.

River Cocker floodplain as well as land adjacent to ordinary watercourses and other ditches in the Cocker catchment have 'high' risk of fluvial and surface water flooding as identified in **Section 3.1**. Introducing large woody materials (**Figure 13**) in these watercourses would slow the flow of peak flood water and potentially divert flow onto the floodplain. This option would be beneficial in the headwaters of the River Cocker, as well as areas of woodland land use and in the smaller ordinary watercourses.

The buffer zones mentioned in **Table 1** are shown in **Figure 14**. Woody materials should not be placed within the buffers to avoid flooding of infrastructure. It is recommended that where possible existing on-site woody materials are used in any construction.



Figure 13. Large woody materials

# Project related

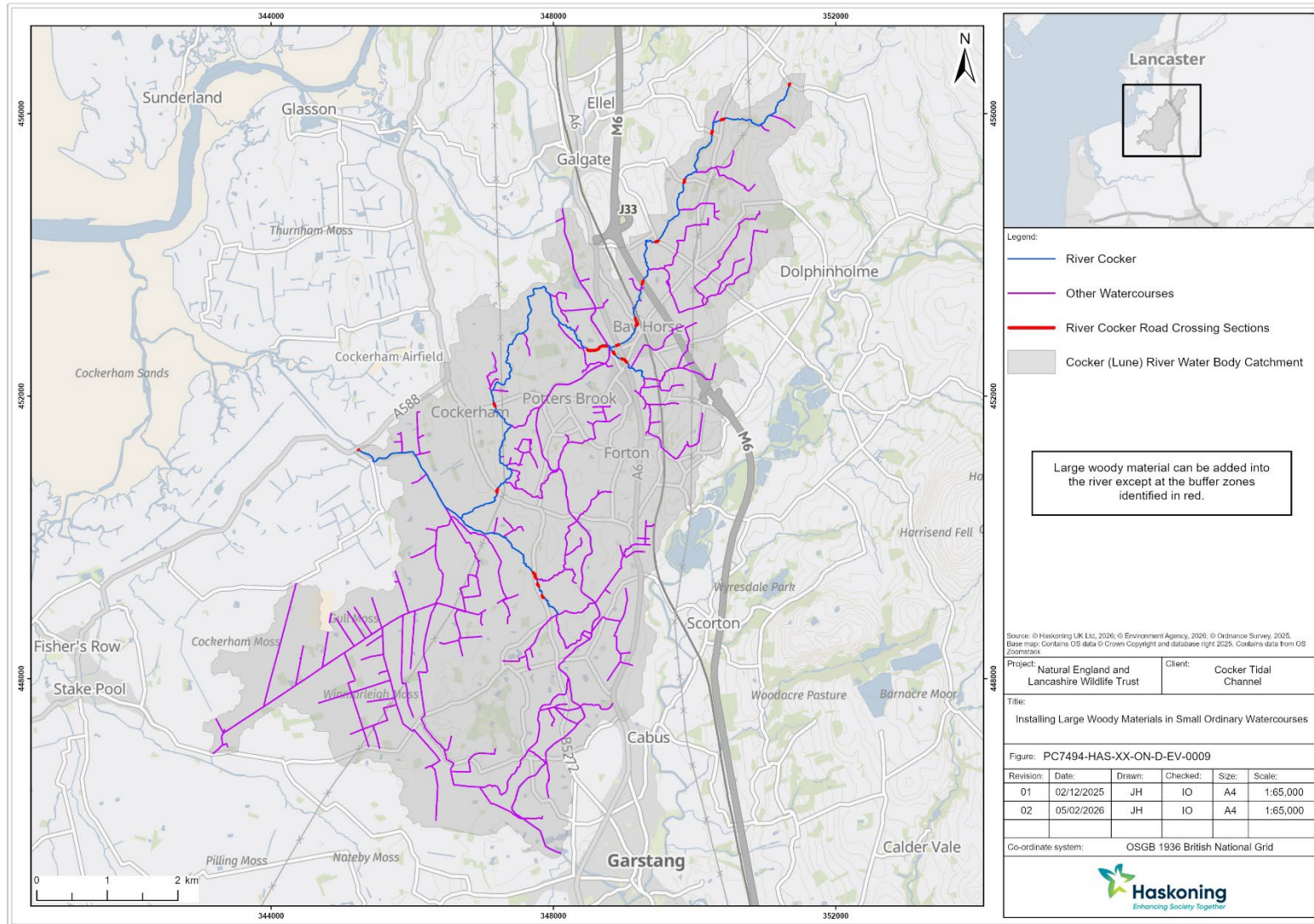


Figure 14. Large woody materials can be added into the river except at the buffer zones identified in red.

#### 4.2.4 Improving riparian buffer

Riparian buffer refers to vegetated strips of land more than 5 m wide running along the banks of watercourses. Benefits of riparian buffers include trapping fine sediment in surface runoff, preventing it entering the channel and limiting erosion through the actions of tree roots that bind and stabilise channel banks. Vegetation within buffer strips increases surface roughness and reduces runoff rates, which in turn promotes infiltration (Hoffmann et al., 2009).

Sediments can be transported from farmlands into the river, thus contributing to the sedimentation problem at Morecambe Bay. Therefore, introducing and enhancing riparian buffers with fencing to prevent access by grazing livestock (**Figure 15**) or planted with cover crops would create a 'sieve' such that sediments can be trapped and stored on-land before they get to the river channel. Suitable areas for improving riparian buffer are shown in **Figure 16**.



Figure 15. Fencing stabilises riverbank and reduces sediment loading in stream

# Project related



Figure 16. 5 m riparian buffer around watercourses

#### 4.2.5 Cross-slope bank (Beetle banks)

Approximately 3 m to 5 m wide and a least 0.4m high, a cross-slope or beetle bank is a permanent, raised, uncut grassy strip across a field<sup>45</sup> (Figure 17). They can be planted across long or steep slopes or along natural drainage ways to minimise the effect of farm fields on runoff and sediment delivery<sup>46</sup>. They can stop pollution from fertiliser or pesticide reaching sensitive habitats, prevent eroded soil from getting into watercourse and slow/divert flood water.

Figure 18 shows where beetle banks could be implemented.



Figure 17. Beetle bank<sup>47</sup>

<sup>45</sup> <https://defrafarming.blog.gov.uk/create-and-maintain-beetle-banks/> accessed 08/09/25

<sup>46</sup> EA (2011). *Sediment matters. A practical guide to sediment and its impacts in UK rivers.*

<sup>47</sup> <https://www.gwct.org.uk/farming/advice/sustainable-farming/beetle-banks/> accessed 08/09/25

# Project related

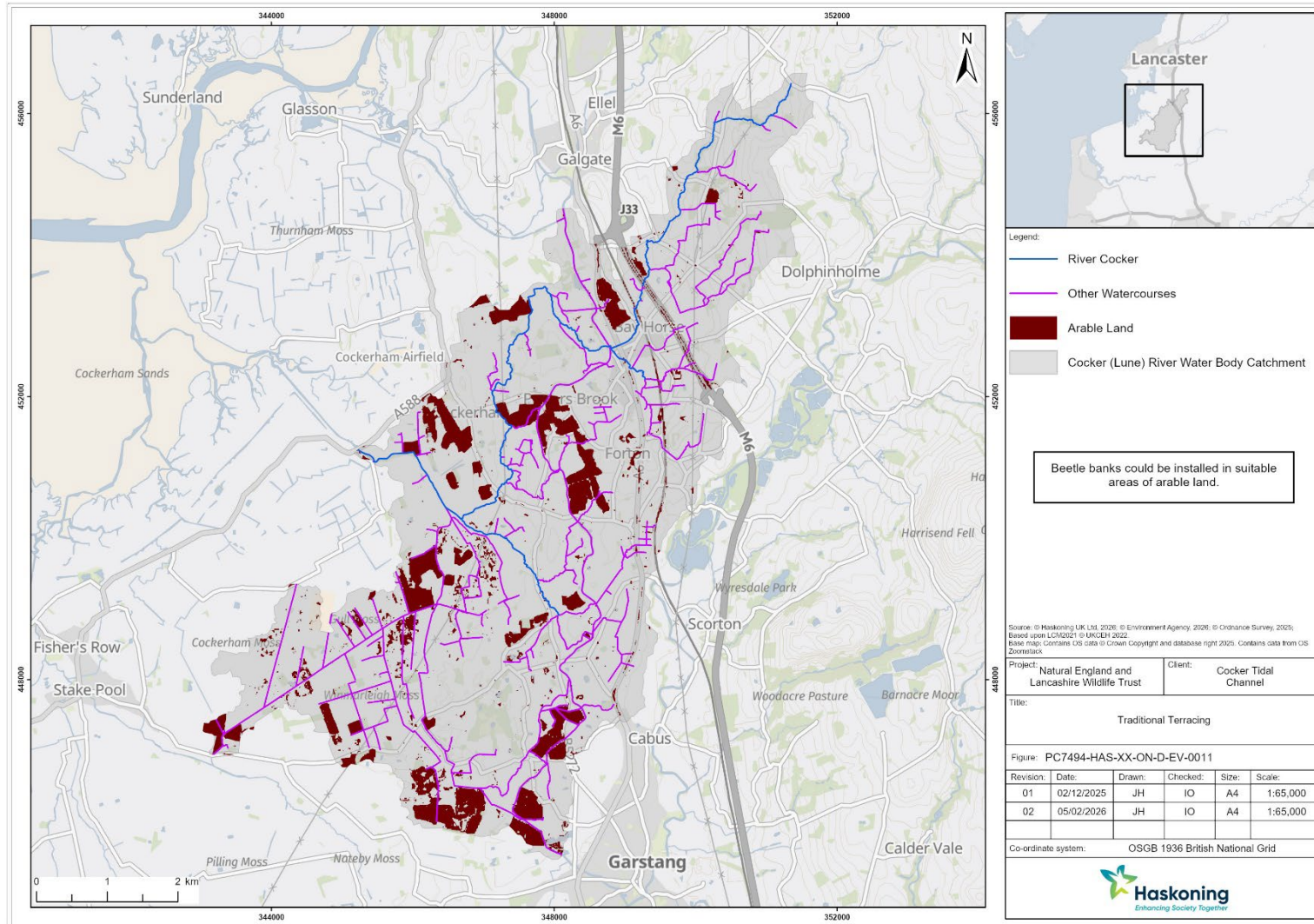


Figure 18. Potential areas where beetle banks could be implemented.

#### 4.2.6 Cover cropping and increasing grassland cover

Cover crops are especially useful to mitigate erosion on high-risk sloping land; they encourage infiltration and reduce overland flow velocity. Cover crops are best employed when land would otherwise be left bare during the crop rotation process and are typically used either prior to main production cycle, e.g., potatoes, sugar beet, or post-harvest, e.g., cereals. Replacing arable crops with cover crops, especially after harvest to prevent direct impact of raindrops and animal trampling will reduce erosion.

Increasing grassland cover (**Figure 19**) can help manage surface runoff by slowing the flow, reduce erosion and prevent nutrient leaching into nearby water bodies. **Figure 20** shows areas that can benefit from this method in the Cocker catchment.



Figure 19. Cover cropping<sup>48</sup>.

<sup>48</sup> <https://www.farmprogress.com/cover-crops/10-reasons-to-use-cover-crops> accessed 08/09/25

# Project related

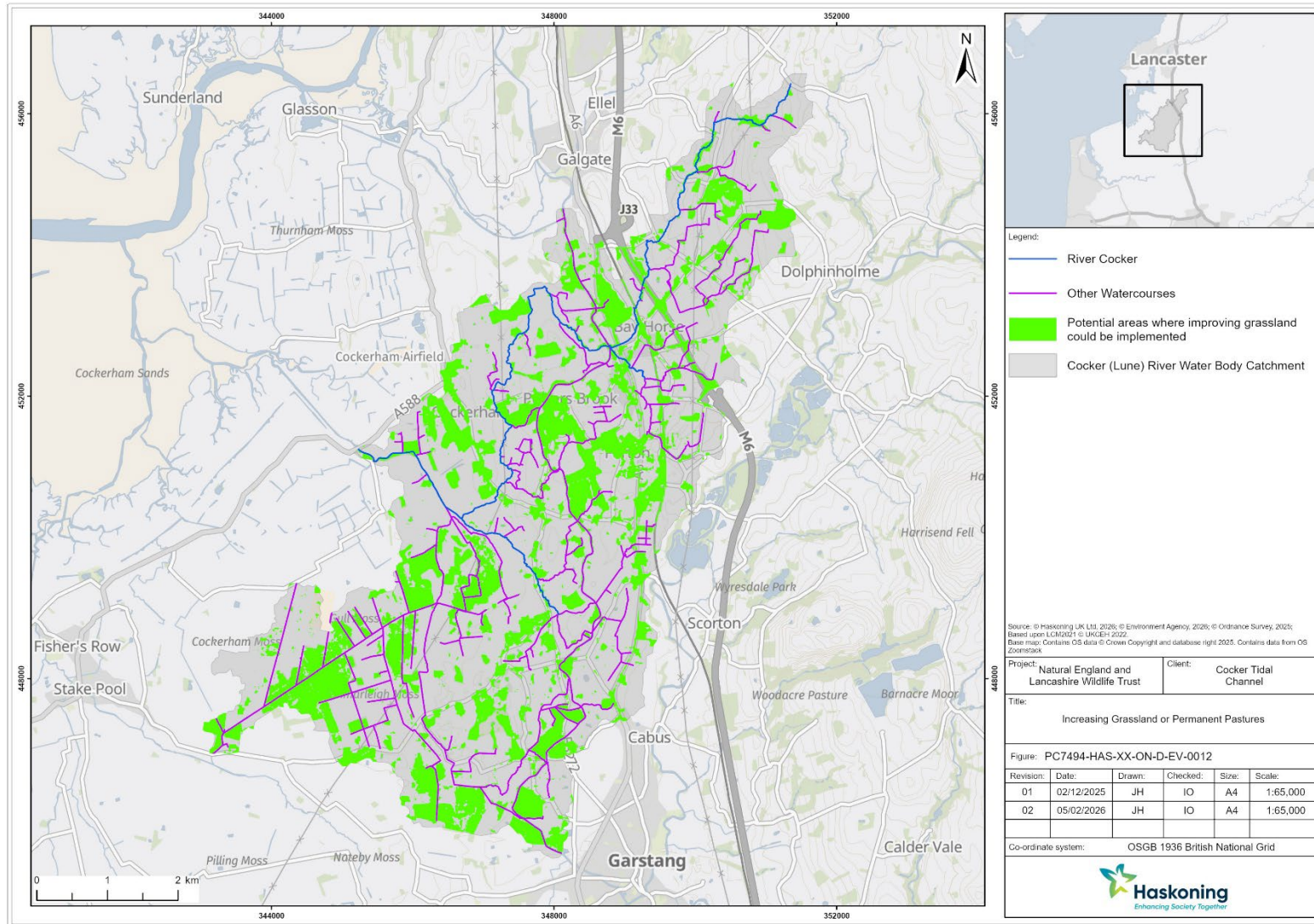


Figure 20. Potential areas where cover cropping and increasing grassland could be implemented.

#### 4.2.7 Reducing stocking density

Intensification of livestock production may increase the level of farm effluents, pesticides such as sheep-dipping chemicals as well as bacterial and other contaminants which in combination with increased overland flow due to soil compaction may increase the risk of water-quality degradation (Hooda et al, 2000; Nicholson et al, 2012). Livestock can also increase bank erosion through poaching (**Figure 21**).

As identified in **Table 5**, Ammonia concentrations are currently too high to achieve 'Good' status in the Cocker (Lune) water body catchment due to livestock activities. Thus, reducing stocking density would reduce the concentration of associated pollutants with livestock farming and therefore lead to an improvement in water quality. Reducing stocking density will also reduce sediment supply from poaching. **Figure 22** shows areas where this NBS option could be implemented.



*Figure 21. Bank erosion due to poaching.*

# Project related

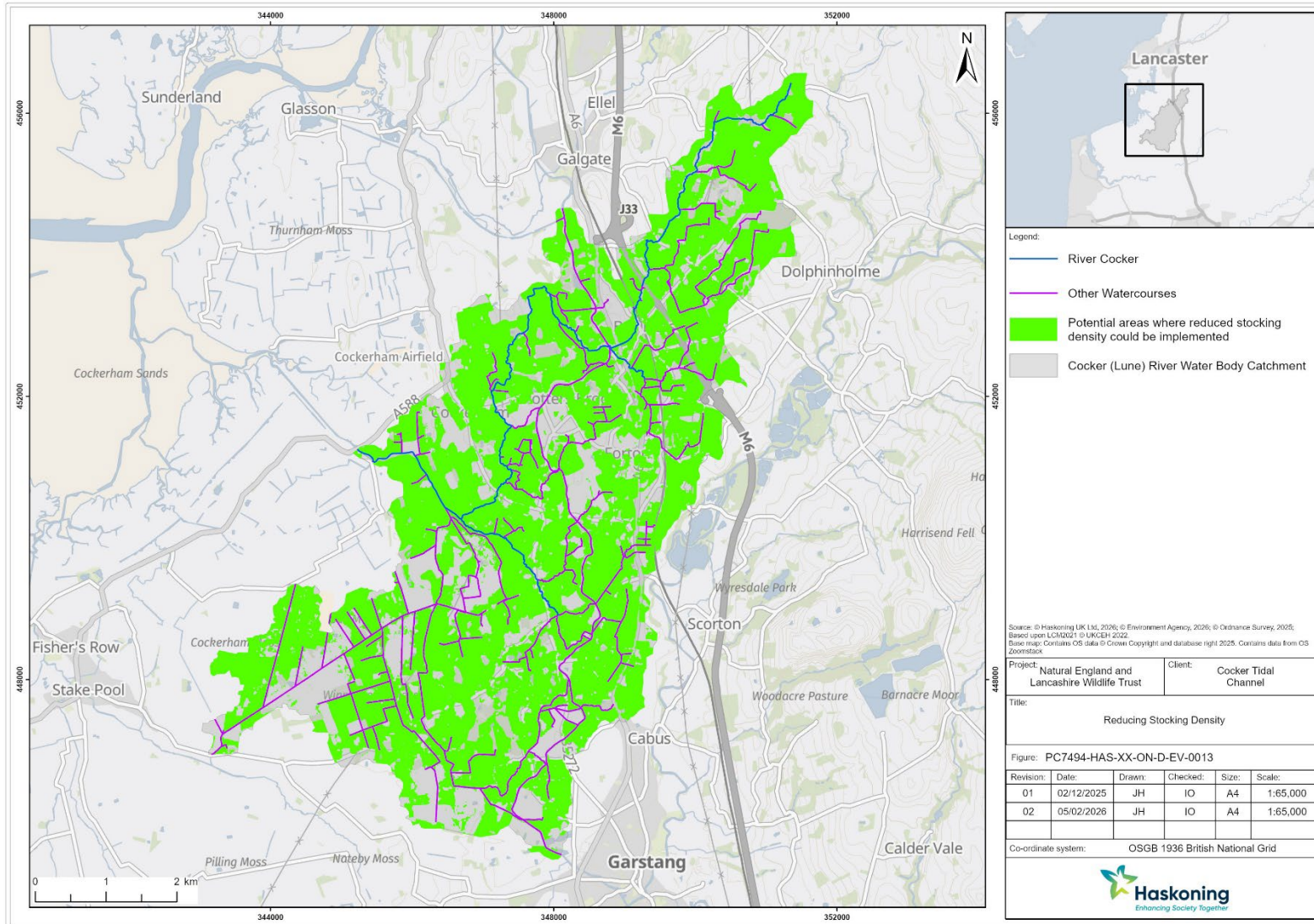


Figure 22. Potential areas where reduced stocking could be implemented.

#### 4.2.8 Introduction of offline and sediment ponds

Offline ponds are ponds adjacent to the watercourse that can reduce flood peaks downstream by physically storing some of the flow but also slowing the rate of the flood peak downstream<sup>49</sup>. They can serve as sediment ponds when they provide an area where muddy run-off from fields or tracks is allowed to settle in order to prevent sediment entering a watercourse and causing pollution (**Figure 23**). By so doing, these ponds reduce the risk of water pollution.

Benefits of these ponds include improvement of water resource quality by reducing phosphates and sediment entering the ground in a downslope feature<sup>50</sup>. By diverting some of the river flow out and into a small storage pond, a proportion of the flood water is attenuated. In addition, by forcing some of the flow to travel through a storage pond, the route for the flow downstream is more tortuous and therefore flood peaks downstream are slower to rise. This could lead to formation of wetland habitat thereby supporting a number of bird species and other aquatic plants, animals and invertebrates.

This option would be effective along high risk of erosion areas identified using the SCIMAP online modelling (**section 3.5**) (**Figure 24**).



Figure 23. Three sediment traps constructed in series to intercept surface runoff and encourage settling out of sediment in the River Coquet catchment, Northumberland (© Nick Barber, Newcastle University).

<sup>49</sup> *Runoff Attenuation Features. A guide for all those working in catchment management.*

[https://research.ncl.ac.uk/proactive/belford/papers/Runoff\\_Atenuation\\_Features\\_Handbook\\_final.pdf](https://research.ncl.ac.uk/proactive/belford/papers/Runoff_Atenuation_Features_Handbook_final.pdf) accessed online 08/09/25

<sup>50</sup> <https://www.gov.uk/countryside-stewardship-grants/sediment-ponds-and-traps-rp7> accessed 08/09/2025

# Project related

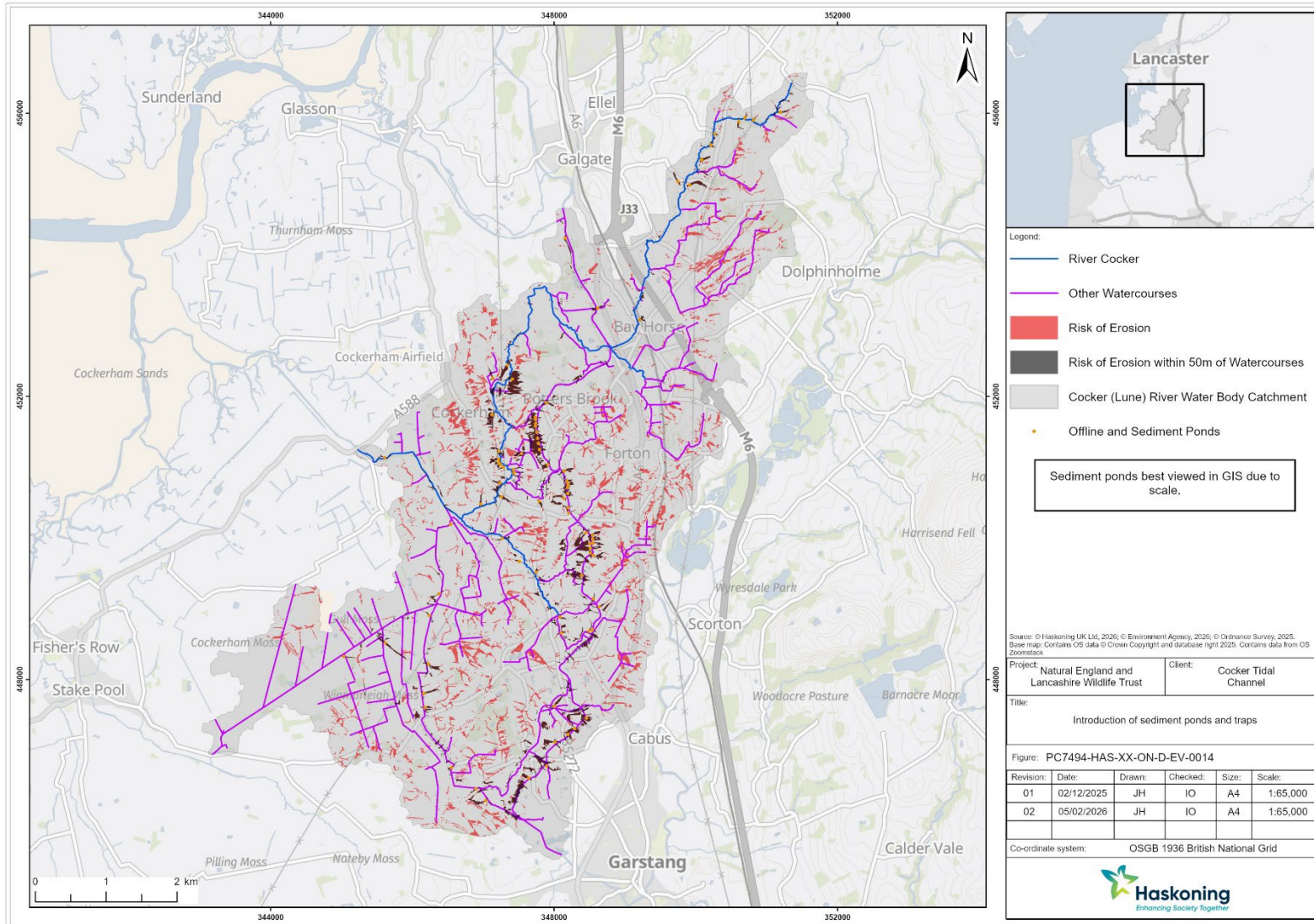


Figure 24. Potential locations for offline and sediment ponds.

#### 4.2.9 Wetland creation

Wetlands are areas of low-lying land where the water table is at or near the surface for most of the time, leading to characteristic habitats<sup>46</sup> (**Figure 25**). Benefits of wetland include flood control, storm protection, groundwater replenishment among others. Wetland creation is best suited for floodplains, **Figure 26** shows where this NBS option can be implemented in the Cocker catchment.



Figure 25. Wetland<sup>51</sup>.

<sup>51</sup> <https://qaiacompany.io/wetland-habitats-explanation-types-animals/> accessed 08/09/25

# Project related

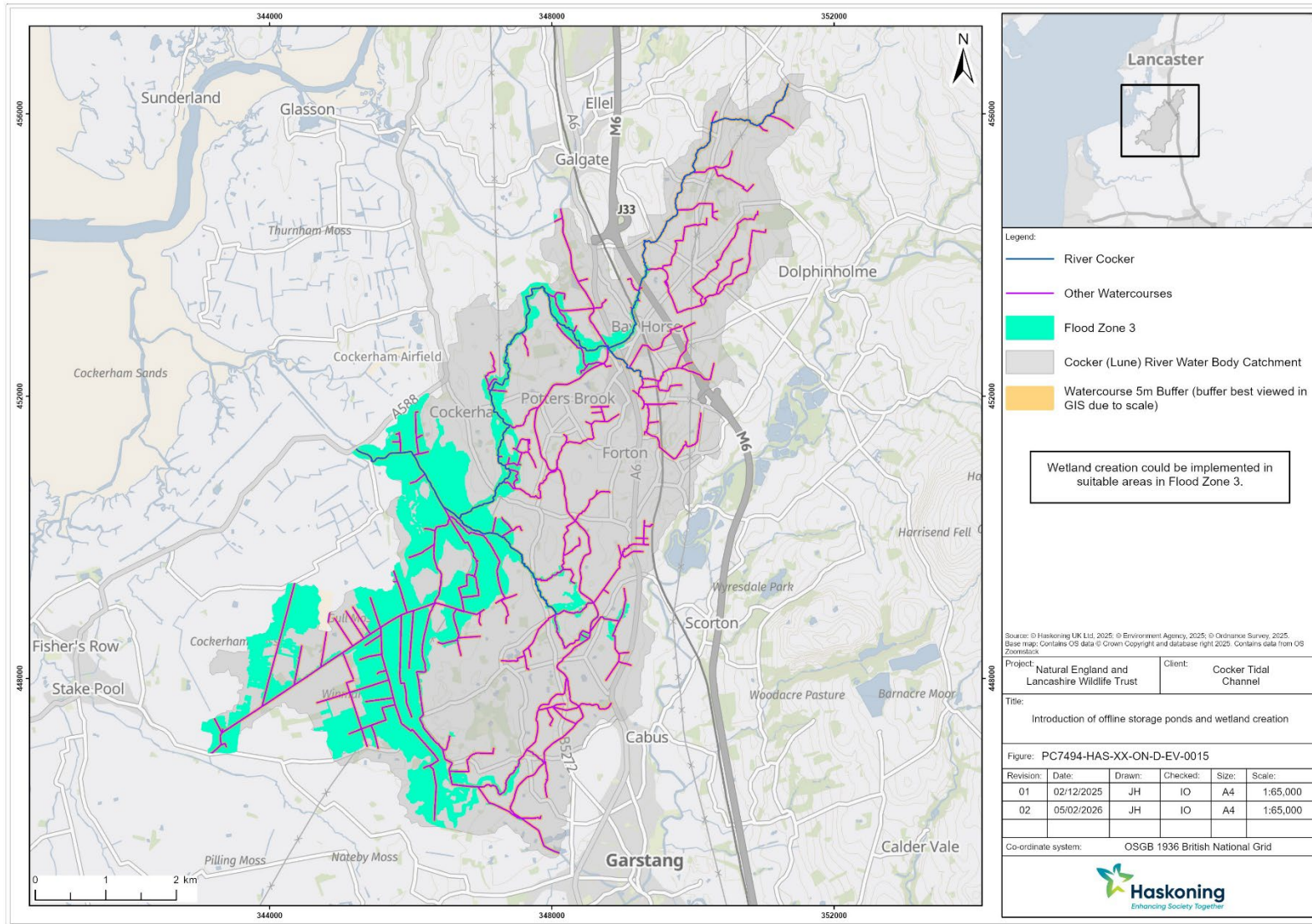


Figure 26. Potential areas where wetland creation could be implemented.

#### 4.2.10 Improved floodplain reconnection

Where there is a good connection between the river and the floodplains (**Figure 27**), the floodplains could serve as sediment sinks during floods. This would reduce the speed of transfer of sediments from source (farmlands) to the Bay by increasing the resident time of sediments in the floodplain. Reconnected floodplains may also enhance restoration of wetland habitats. Improved floodplain reconnection would be best located along the river floodplain (**Figure 28**).



Figure 27. Before and after image of floodplain reconnection of the Whit beck<sup>41</sup>.

# Project related

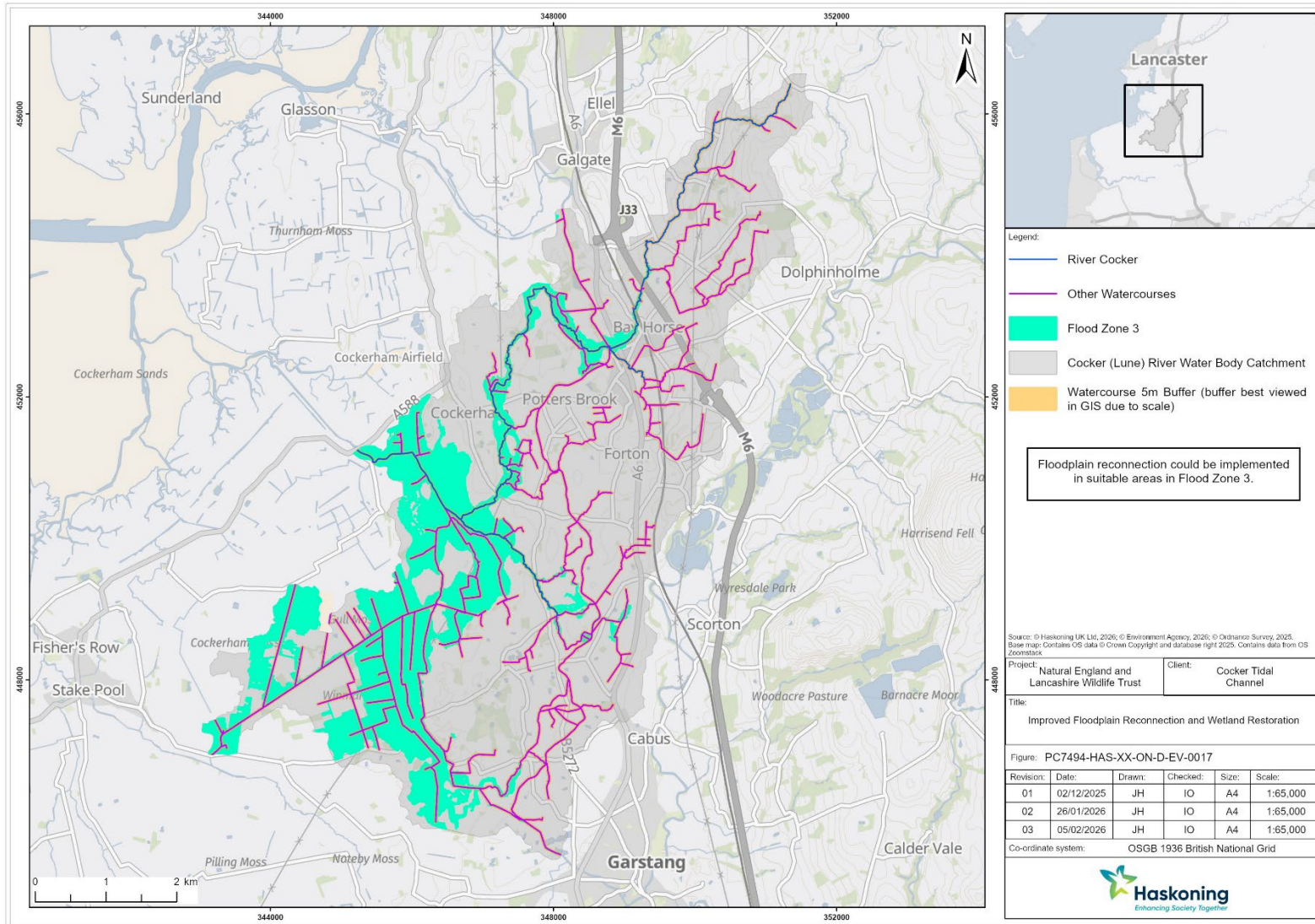


Figure 28. Potential locations for floodplain reconnection.

#### 4.2.11 Improving soil quality

Soil compaction results in poor root growth and plant establishment, drowned roots, root and crown rots as well as slow drainage<sup>52</sup> and subsequent ponding. Therefore, measures aimed at improving soil quality such as improving soil aeration (**Figure 29**), increasing the soil organic matter level with compost, organic mulches, living plants, and cover crops would improve crop growth and drainage.

Improving soil quality would be beneficial for farmers in terms of improving agricultural yield, reducing need for fertilisers and reducing ponding on farmlands. This option is restricted to arable and pastoral lands as shown in **Figure 30**. There are recent examples of the use of aerators on farmland for this purpose in the Pilling area under a sister Our Future Coast funded project, and lessons could be shared between landowners.



*Figure 29. A soil aerator can be used to aerate a field previously subject to heavy grazing pressure and compaction.*

<sup>52</sup> <https://extension.umd.edu/resource/common-soil-problems/> accessed 26/11/2025

# Project related

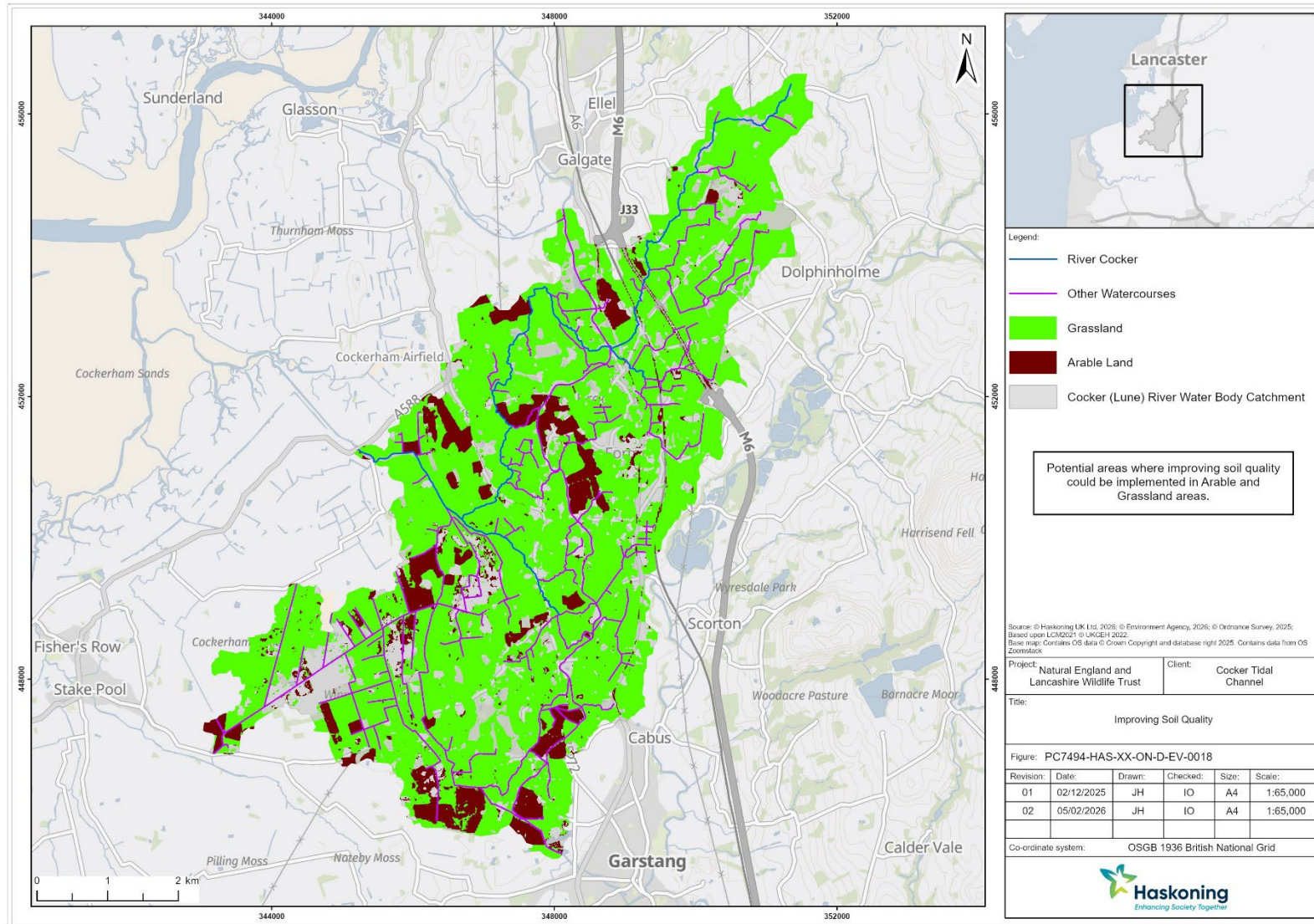


Figure 30. Improving soil quality

## 5 Conclusions

The aim of this report is to identify nature-based solutions to water and sediment management that could potentially be implemented in the River Cocker catchment upstream of Morecambe Bay. To achieve this aim, baseline data of the catchment were accessed from different online sources while the SCIMAP online modelling tool was also adopted to identify areas at high risks of flow connectivity (related to land drainage) and erosion (related to sediment production). A total of 12 NBS options were identified for the catchment based on the methodological approach used. These NBS options are minor interventions and are not anticipated to occupy large expanses and they represent opportunities that could be explored at individual farmlands and locations. Therefore, the suggested NBS options are not absolute solutions for individual farms and fields in the catchment. It is hoped that the accompanying maps and shapefiles would form the basis for the next phase of discussions between the EA and NE and landowners on suitable options for individual plots of land.

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