LM04157: AES Comparative monitoring and evaluation of dry stone walls

Final Report

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CONTENTS

List of Figures

List of Tables

EXECUTIVE SUMMARY

Project aim

The aim of the project is to support the delivery of the Beauty, Heritage, and Engagement objectives set out in the 25 Year Environment Plan (25YEP). This aligns with the updated commitments and targets outlined in the Environmental Improvement Plan 2023 (EIP2023), by providing evidence that assesses the extent to which previous agri-environment schemes (AES) have been successful in safeguarding and enhancing the stock of stone wall and stone-faced bank boundaries in England. This evidence will be a valuable resource for policy makers so that they might review, enhance, or redirect AES funding to better achieve 25YEP and EIP2023 objectives.

The project evaluates the effectiveness of previous AES, specifically Environmental Stewardship (ES) and Countryside Stewardship (CS), both at national level and by examining the condition of walls and banks in four case study locations. This provides an evidence base for strategic assessment of grant funding for the maintenance and restoration of walls and banks. It examines the extent to which AES influence and curate the flows of wider ecosystem services that derive from walls and banks, improving our understanding of how public goods can be delivered through their maintenance and restoration. The disparities between wall and bank offers under ES and CS are assessed, examining the impact of decisions to phase out maintenance offers for walls and banks under CS.

The evidence will support decisions regarding the extent to which grant funding interventions for walls and banks are needed under the Environmental Land Management (ELM) schemes, either through CS, the Sustainable Farming Incentive (SFI), and other AES, for the renewal, maintenance and protection of walls and banks and associated ecosystem services.

Approach

To achieve the project aim, Natural England identified six objectives for the project:

1) Undertake a literature review to provide broad context.
2) Map and analyse the national uptake of wall and bank options under ES and CS.
3) Select four contrasting case study locations for detailed investigation and map the field boundaries.
4) Undertake surveys to assess the condition and management of walls and banks in the case study areas.
5) Explore the role of walls and banks in providing ecosystem services in the case study areas.
6) Provide a clear set of areas for improvement to Defra to be used for the purposes of scheme development for successor schemes and future grant offers.

Key findings

Rapid literature review

- **Walls and banks are environmentally significant**: Walls and banks are long-standing landscape features, deeply embedded in England's rural identity, with a strong historical legacy and visible contribution to landscape character across centuries.
- **There has been limited research and evidence to date**: Despite their significance, walls and banks remain under-surveyed at a national level. Monitoring efforts have been more often focused on hedgerows, with less consideration of stone walls and banks, particularly in upland landscapes, in both research and national surveys. Existing data on walls and banks is limited and imprecise, with broad estimates and poor sampling procedures highlighting the need for more robust and consistent methodologies.
- **Ecosystem service value is under-recognised and under-researched**: While walls and banks provide a wide range of ecosystem services, these services are not consistently quantified.
- **Economic and social benefits justify investment**: Wall and bank restoration delivers clear returns through rural employment, skill retention, and tourism, supporting the case for targeted funding and further research into valuation methods that reflect their multifunctional contributions.

Review of GIS sources, methods and techniques

- **Current remote-sensing datasets often fail to accurately identify walls and banks:** They are frequently misclassified or excluded entirely during data filtering. This highlights the need for more tailored methods and improved classification techniques specifically designed to detect walls and banks.
- **AI and machine learning offer potential for mapping stone walls**: They perform well when supported by high-quality lidar and contextual data, but their accuracy depends on the quality of inputs, availability of reliable training data, and the characteristics of the landscape.
- **A mixed-method approach provides the most accurate results**: By combining reliable GIS datasets, lidar-based models, and manual or semi-automated classification methods, it is possible to more effectively identify and map stone walls across different landscapes.

Review of wider policy context

- **There is relatively less focus on walls and banks in high-level policy**: Despite their central role in shaping landscape character and supporting agro-pastoral systems, walls and banks receive limited attention in national strategies such as the 25YEP and EIP2023, which largely prioritise natural over cultural heritage.
- **Management is often reactive rather than preventative**: Current support has focused more on restoration of walls and banks once deterioration has occurred, rather than proactive management.
- **Sustainable Farming Incentive**: Including maintenance actions for walls and banks in the SFI is a positive step, supporting their preservation and recognising their environmental and cultural importance.

- **Terminology and definitions remain unclear and inconsistent**: Existing legislation and grant schemes often conflate or exclude certain boundary types leading to gaps in protection and inconsistent treatment across features.
- **Policy integration is limited across landscape scales**: Government policy and delivery schemes have generally focused on individual features or farm-level interventions, rather than recognising field boundary systems as interconnected landscape-scale assets. This approach risks overlooking the cumulative cultural, environmental, and practical significance of stone walls across wider rural areas. The Landscape Recovery Scheme offers potential to address this gap by enabling wall and bank management to be incorporated within coordinated, large-scale landscape projects, where their collective value can be more effectively recognised and managed.

National Character Area (NCA) profile analysis

- **Widespread recognition of walls and banks as defining landscape features**: Over 90% of NCA profiles reviewed identified walls and banks as key components of landscape character, contributing to both the cultural identity and visual distinctiveness of their areas, especially in upland and historic farming landscapes.
- **Strong policy support through Statements of Environmental Opportunity (SEO)**: The majority of profiles (88%) included SEOs that promote the conservation, restoration, and use of traditional materials and skills for managing walls and banks, highlighting their importance not only for landscape aesthetics but also for biodiversity, heritage, and sustainable land management.
- **Inconsistent terminology and lack of technical definitions limit clarity**: Many profiles used varied and sometimes interchangeable terms to describe walls and banks without defining their construction, form, or materials. This inconsistency complicates cross-area comparisons and could hinder effective targeting of restoration and conservation efforts.
- **Walls and banks contribute differently to ecosystem services**: While both feature strongly in cultural services, walls tend to support geodiversity and aesthetic value, whereas banks offer more in terms of regulating and supporting services, such as pollination, water regulation, and biomass energy, reflecting differences in structure and ecological function.

National uptake of ES and CS wall and bank options

- **Uptake is concentrated in upland areas**: The majority of wall and bank options are located in the Upland, Upland Fringe, and Western Mixed Agricultural Landscape Types and on lower-grade agricultural land.
- **Stone wall options dominate overall uptake, with bank options more regionally specific**: Over 90% of maintenance, and restoration options relate to walls, particularly in the north of England and Gloucestershire, whereas bank options are more prevalent in the South West.
- **Significant legacy from the ES Entry Level Scheme (ELS)**: A substantial portion of wall and bank boundaries were previously covered under now-expired ELS agreements. These agreements often included both maintenance and restoration options, covering tens of thousands of kilometres nationally. The data show that most of this uptake occurred prior to 2023, with relatively fewer boundaries now under live agreements suggesting that past participation may have a strong influence on current condition.

Remote sensing analysis of walls and banks in the case study areas

- **The techniques used were generally effective in identifying stone walls in the case study area**: Freestanding walls on open ground were accurately detected, but the methods were less successful at recognising historically significant relict boundaries, especially where these were less visible or partially degraded in the landscape.
- **Remote sensing effectively identifies boundary types at scale**: Walls make up a significant proportion of field boundaries in Swaledale, Coldeaton, and Todmorden, though classification is more challenging in the bank-dominated landscape of Dunstone.
- **Banks are difficult to distinguish from other vegetated features:** Highlights a need for improved classification techniques or supplementary data sources in regions where banks are prominent.
- **Aerial Photography Interpretation (API) can support landscape-scale assessments**: However, it tends to overestimate wall degradation and struggles with shadow effects and orientation bias.

Uptake of wall and bank options in the case study areas

- **Wall option uptake is relatively low:** 10% of boundaries in the case study areas are currently under option.
- **Legacy ES agreements account for the majority of wall options**: 75% of total uptake. CS is yet to achieve comparable uptake.
- **There is marked spatial variation in option uptake across areas:** Swaledale shows the highest proportion of wall boundaries under option, while Todmorden and Coldeaton have most boundaries either outside AES agreements or not covered by any option.
- **Maintenance options are more common than restoration**: Both represent a small proportion of boundaries.

Field survey of boundary type and condition

- **Boundary condition varies by case study area**: Swaledale and Dunstone have the highest proportion of well-maintained boundaries, while Todmorden exhibits the poorest condition overall, with nearly half of surveyed boundaries requiring major repair or classified as derelict.
- **Traditional construction methods dominate:** Dunstone (94%), Swaledale (82%). In contrast, Todmorden and Coldeaton rely more heavily on modern materials such as top wire and fencing to reinforce or replace traditional boundaries.
- **Most boundaries are potentially eligible for AES interventions**: 73% are suitable for SFI maintenance actions and 17% potentially qualifying for CS restoration options, indicating strong scope for targeted funding support.

Impact of AES status and options on boundary condition

- **AES interventions are associated with improved boundary condition**: Boundaries under AES options are significantly more likely to be in excellent or good condition, especially in Dunstone (95%), Coldeaton (89%) and Swaledale (88%).

- **Statistical relationships are significant but weak**: While analysis confirms that AES status and option type have a measurable impact on boundary condition, these effects are modest and influenced by other environmental or operational variables.
- **AES participation alone is not sufficient**: Boundaries that are within AES agreements but not covered by specific wall or bank options tend to be in poorer condition than those entirely outside of any AES agreement. The management of boundaries outside agreements may have been influenced by legacy agreements, particularly ESL, which are now closed. This makes for a complicated picture in trying to determine cause and effect.
- **There are area-specific differences in effectiveness**: In Todmorden, only 64% of AES-managed boundaries were in good condition, compared with over 80% in the other case studies. This suggests that local factors may influence the success of AES uptake.

Agreement holder survey

- **Traditional walls and banks remain central to upland farming:** Agreement holders strongly value these features for livestock management, property delineation, and shelter, reflecting their ongoing importance in day-to-day farm operations. Their practicality and embeddedness in the working landscape make them indispensable to hill farming.
- **Boundary management is strongly influenced by land tenure**: Farmers on short-term tenancies are less likely to invest in maintaining or restoring walls and banks, as they will not see the long-term benefits. Secure tenure encourages investment in boundary infrastructure.
- **Walls and banks are key to livestock management and shelter**: All agreement holders stressed the practical importance of walls and banks for managing and protecting livestock, especially in harsh weather. They are viewed as essential farm infrastructure.
- **Time and skilled labour are major constraints**: Maintaining walls and banks is labour-intensive, and many agreement holders cited a lack of time and available skilled wallers as key barriers. This is especially acute on larger farms where workloads have increased.
- **Funding is essential but often insufficient**: AES grants are crucial to enabling wall and bank restoration, but many agreement holders reported that current payment rates do not reflect the true cost of materials or labour. Restoration work often depends on this financial support.
- **AES has enabled work that would not otherwise occur**: Many agreement holders stated that without AES support, walls and banks would continue to deteriorate. The schemes enable both restoration and maintenance that would be financially unviable otherwise.
- **There is cautious optimism about new SFI actions**: While some agreement holders plan to take up new SFI maintenance actions, many are still undecided due to lack of information, complexity of the schemes, and concerns over compatibility with existing agreements.
- **Improvements for scheme delivery is desired**: Agreement holders want simpler applications, better digital tools, clearer guidance, and more realistic funding rates. Local advice, flexible timelines, and recognition of regional differences were also frequently suggested improvements.

- **Walling carries personal and cultural significance**: Many agreement holders feel a deep emotional and historical connection to their walls and banks, linking the practice to family heritage, local identity, and a sense of pride in maintaining the landscape.
- **Walls and banks are ecologically valued**: Agreement holders showed high awareness of the ecological benefits of walls and banks, frequently mentioning their value as habitats for birds, mammals, invertebrates and lichens, especially where hedges or trees are present.
- **Public appreciation**: Agreement holders reported frequent positive feedback from both locals and visitors. This social recognition contributes to a sense of pride.

Analysis of ecosystem services using the Social Return on Investment (SROI) modelling of walls and banks

- **Private investment is a critical but under-recognised driver of ecosystem service benefits**: Across all case study areas, private contributions (mainly unpaid labour by agreement holders) exceeded public funding, highlighting the importance of farmer time and effort in maintaining and restoring wall and bank infrastructure and its associated benefits.
- **Provisioning and cultural services generate the highest value flows, but ecological contributions may be underestimated**: The majority of benefits were linked to livestock management, property boundaries, local employment, and cultural value. However, the relatively low valuation of supporting and regulating services suggests that current financial proxies may undervalue biodiversity and flood prevention contributions, particularly where banks dominate.
- **Wall and bank condition and visibility are key to service delivery**: High levels of benefit were not always linked to the longest lengths of improved walls; rather, factors such as wall condition, accessibility, landscape integration, and use by farmers and visitors more strongly influenced the value of benefit flows.
- **Data limitations restrict full understanding of benefit flows over time**: The absence of baseline data, reliance on current live agreements, and uniform outcome indicators limited the ability to fully capture spatial and temporal variation in ecosystem service delivery. However, the model's adaptability allows for future refinement and scenario testing across landscapes.

Areas for improvement

There are 20 areas for improvement that derive from the research:

Wall and bank protection and maintenance

1) **Streamlining application and administrative processes:** Consider simplifying scheme requirements to reduce the burden on applicants and make participation more accessible for farmers and land managers.
2) **Investing in improved digital tools and mapping systems:** Develop user-friendly platforms for submitting evidence (e.g. photos and measurements) and provide clearer, more intuitive mapping that links directly to scheduled work areas, reducing the risk of error and non-compliance.

3) **Reviewing and adjusting payment structures:** Payment rates could be increased to reflect rising costs and inflation, funding could be allowed for essential repairs (such as storm damage), and flexibility in delivery periods could be enhanced.

Wall and bank restoration and repair

4) **Simplifying and streamlining restoration claims:** Explore whether to allow gap walling and repair works without the need for prior approval or capital plans. Explore introduction of straightforward processes based on photographic and measurement evidence.

5) **Assess how funding reflects real-world costs and site difficulty:** Review grant levels to match the rising costs of wall restoration, and whether to offer supplements for high or steep walls and challenging terrain. Assess whether to vary payments based on regional conditions and material quality requirements.

6) **Improving scheme flexibility and responsiveness:** Explore the potential of adaptive agreements that allow additions or variations as restoration progresses or needs change. Assess how payment processes can support cash flow, and provide better access to advice through more local, experienced support staff.

7) **Supporting workforce and access needs:** Assess how to invest in training to grow the availability of skilled wallers, and ensure funding covers a meaningful percentage of restoration costs. Improving rural broadband and mobile phone coverage could reduce barriers for digital submissions in remote areas.

High-level government policy considerations

8) **Integrating walls and banks more fully into national environmental policy frameworks:** To improve support for walls and banks, they could be integrated into national environmental policy in particular recognising their ecosystem service contributions.

9) **Establishing clear, consistent definitions and protections for all boundary types:** Developing standardised terminology and guidance that distinguishes between boundary types, could support equitable policy support and prevent protection gaps in future legislation, AES development and planning processes.

10) **Evidence for ELM:** This report provides clear evidence of the value of wall and bank maintenance. Retaining these actions within the scheme can help safeguard landscape character, cultural heritage, and long-term environmental benefits.

11) **Building on the popularity of wall and bank options:** These options are highly valued across the upland farming community and offer a strong foundation for deeper engagement with farmers and land managers. Their appeal could help encourage the adoption of a wider range of actions and options that collectively support multiple environmental objectives.

12) **Clear and consistent communication:** Survey respondents reported confusion about the development of the SFI and ELM schemes, as well as uncertainty around their future eligibility. It is important to provide clear, timely information to help farmers understand what to expect from AES in both the medium and long term.

NCA profiles

13) **Developing consistent terminology and clearer descriptions of walls and banks features:** Standardising the language used across NCA profiles should support clearer understanding and better-targeted conservation and management actions.

14) **Strengthening the integration of walls and banks into SEOs:** Future NCA profile updates should consistently recognise the role of walls and banks in ecosystem services, and embed specific, actionable priorities for their maintenance, restoration, and promotion of traditional skills.

Future research: Developing the evidence base

15) **Monitoring:** Existing surveys provide only limited information on the condition or extent of walls and banks over time. A dedicated national monitoring programme could be established to track changes and trends in the resource. This would support more effective targeting and spatial prioritisation, and could be integrated into the NCA profile framework.

16) **Living laboratories:** This project has produced robust baseline data on over 27,000 field boundaries across four contrasting case study areas. These datasets provide a valuable foundation for future research into ecosystem service benefit flows, as well as the relationships between farmers, land managers, their walls and banks, and AES.

17) **Understanding the continuing influence of past AES agreements:** Wall and bank restoration and maintenance options have been part of AES for over 30 years. The impact of this investment on the flow of benefits can last for many decades. Yet the long-term changes resulting from this sustained investment remain underexplored. It is suggested that future research examines how the management of walls and banks has evolved throughout this entire period, in order to better understand the enduring impact of AES.

Future research: Enhancing understanding and valuation of wall and bank ecosystem services

18) **Investigating the true ecological value of walls and banks:** Developing improved financial proxies and ecological metrics could better capture the biodiversity and regulating service contributions of stone walls and banks, particularly in relation to habitat connectivity, flood mitigation, and soil protection.

19) **Assessing the role and value of private investment in ecosystem service delivery:** It is suggested future research could explore in greater depth how agreement holders' time, skills, and informal maintenance efforts contribute to benefit flows, and how these private investments can be better supported, measured, and recognised in future agri-environment models.

20) **Examining the influence of wall visibility, condition, and accessibility on cultural and provisioning services:** Conducting spatially explicit research could help build understanding of how the location, physical state, and public interaction with wall features affect perceptions of value and service delivery across different landscape contexts.

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ACRONYMS

Acronym	Description
25YEP	25 Year Environment Plan
AES	Agri-Environment Scheme
AI	Artificial Intelligence
ALB	Arms Length Body
ALC	Agricultural Land Class
ALT	Agricultural Landscape Type
API	Areial Photography Interpretation
BIR	Benefit-to-Investment Ratio
BPS	Basic Payment Scheme
CAP	Common Agricultural Policy
CBA	Cost-Benefit Analysis
CCRI	Countryside and Community Research Institute
CCS	Classic Countryside Stewardship
CHM	Canopy Height Model
CRoW	Countryside and Rights of Way Act
CS	Countryside Stewardship
CVM	Contingent Valuation Methods
DCNN	Deep Convolutional Neural Networks
DEFRA	Department for Environment, Food and Rural Areas
DSM	Digital Surface Model
DTM	Digital Terrain Model
EIA	Environmental Impact Assessment (EIA)
ELC	European Landscape Convention
ELM	Environmental Land Management
ELS	Entry Level Stewardship

Acronym	Description
ES	Environmental Stewardship
ESA	Environmentally Sensitive Area
ESL	Environment Systems Limited
EU	European Union
FEP	Farm Environment Plan
FER	Farm Environment Record
GAEC	Good Agricultural and Environmental Condition
GIS	Geographic Information System
HEFER	Historic Environment Farm Environment Record
HLC	Historic Landscape Character
HLS	Higher Level Stewardship
LCPHE	Land Cover Plus: Hedgerows England Dataset
Lidar	Light Detection and Ranging
LCA	Landscape Character Assessment
LR	Landscape Recovery
LPIS	Land Parcel Information System
LUC	Land Use Consultants
MWTP	Marginal Willingness To Pay
NCA	National Character Area
NDVI	Normalized Difference Vegetation Index
Nef	New Economic Foundation
NEODG	Natural England Open Data Geoportal
OELS	Organic Entry Level Stewardship
OGL	Open Government Licence
OS	Ordnance Survey

Acronym	Description
OSMM	OS MasterMap
OSNGD	OS National Geographic Database
PDNP	Peak District National Park
PRoW	Public Right of Way
PSEUL	Public Sector End User Licence
PSG	Project Steering Group
RDPE	Rural Development Programme for England
ROI	Return On Investment
RPA	Rural Payments Agency
SEO	Statements of Environmental Opportunity
SFI	Sustainable Farming Incentive
SPOT	Satellite Pour l'Observation de la Terre
SPS	Single Payment Scheme
SROI	Social Return On Investment
UELS	Uplands Entry Level Stewardship
UK	United Kingdom
UKCEH	UK Centre for Ecology and Hydrology
WHS	World Heritage Site
WTP	Willingness To Pay
YDNP	Yorkshire Dales National Park

1 INTRODUCTION

1.1 Background to the project

The aim of the project is to support the delivery of the Beauty, Heritage, and Engagement objectives set out in the 25 Year Environment Plan (25YEP) (see Defra, 2018). This aligns with the updated commitments and targets outlined in the Environmental Improvement Plan 2023 (EIP2023) (Defra, 2023a), by providing evidence that assesses the extent to which previous agri-environment schemes (AES) have been successful in safeguarding and enhancing the stock of stone wall and stone-faced bank boundaries in England. This evidence will be a valuable resource for policy makers so that they might review, enhance, or redirect AES funding to better achieve 25YEP and EIP2023 objectives.

The project evaluates the effectiveness of previous AES, specifically Environmental Stewardship (ES) and Countryside Stewardship (CS), both at national level and by examining the condition of walls and banks in four case study locations. This provides an evidence base for strategic assessment of grant funding for the maintenance and restoration of walls and banks. It examines the extent to which AES influence and curate the flows of wider ecosystem services that derive from walls and banks, improving our understanding of how public goods can be delivered through their maintenance and restoration. The disparities between wall and bank offers under ES and CS are assessed, examining the impact of decisions to phase out maintenance offers for walls and banks under CS.

The evidence will support decisions regarding the extent to which grant funding interventions for walls and banks are needed under the Environmental Land Management (ELM) schemes, either through CS, the Sustainable Farming Incentive (SFI), and other AES, for the renewal, maintenance and protection of walls and banks and associated ecosystem services.

1.1.1 Environmental Stewardship

Environmental Stewardship is a voluntary scheme that was launched in 2005 and closed to new entrants in 2015. The Rural Payments Agency (RPA) manages existing agreements on behalf of the Department for Environment, Food and Rural Affairs (Defra) until they reach their agreed end date. The original elements of ES were launched in 2005, comprising Entry Level Stewardship (ELS), Organic Entry Level Stewardship (OELS); and Higher Level Stewardship (HLS). A fourth element, Uplands Entry Level Stewardship (UELS), was launched in 2010. Although the scheme closed to new entrants in 2015, many HLS and ELS with HLS agreements have been extended multiple times. As a result, a significant number of these agreements are now set to continue until 2028.

Under the entry level element of ES agreement holders could select maintenance options for walls and banks which committed them to maintaining the boundaries for the period of the agreement (5 years). These maintenance options were non-compulsory, and it was up to the agreement holder to decide if they would like to include some or all of their walls and banks in their agreements.

While the entry level did offer some options for restoring walls and banks, these were not widely used. The majority of restoration work was instead funded through capital items as part of HLS agreements, which provided more targeted support for rebuilding and repairing these traditional boundary features.

1.1.2 Countryside Stewardship

Countryside Stewardship is a voluntary scheme, managed by the RPA on behalf of Defra, and provides financial incentives for farmers and land managers to look after and improve the environment. It replaced the ES scheme in 2016 and has since been significantly updated to align

with the Environmental Land Management (ELM) framework and the introduction of the Sustainable Farming Incentive (SFI) scheme. Under CS, agreement holders can apply for capital grants to fund the restoration of walls and banks. However, unlike the previous ELS under ES, CS does not include maintenance options for walls and banks.

1.2 Project aims and objectives

The aim of the project is to evaluate the impact of the ES and CS on the maintenance and restoration of walls and banks. To achieve this aim Natural England identified six objectives for the project:

1) Undertake a literature review to provide broad context.
2) Map and analyse the national uptake of wall and bank options under ES and CS.
3) Select four contrasting case study locations for detailed investigation and map the field boundaries.
4) Undertake surveys to assess the condition and management of walls and banks in the case study areas.
5) Explore the role of walls and banks in providing ecosystem services in the case study areas.
6) Provide a clear set of areas for improvement to Defra to be used for the proposes of scheme development for successor schemes and future grant offers.

1.3 Report structure

The remainder of this report is structured into seven sections. The project's methodology, including the approaches and techniques used, is described in Section 2. Key findings from the literature review are then explored in Section 3. A national overview of the uptake of wall and bank options under ES and CS schemes follows in Section 4. Section 5 examines the condition and characteristics of walls and banks in the case study areas. Insights from the agreement holder and walling contractor surveys are presented in Section 6. The role of walls and banks in providing ecosystem services is investigated in Section 7. Finally, Section 8 brings together the report's conclusions and areas for improvement, drawing on the empirical evidence to offer clear guidance for future action.

2 METHODOLOGY

2.1 Introduction

This section sets out the methodology and methods used to evaluate the impact of the ES and CS on the maintenance and restoration of walls and banks. The methodological framework was designed to achieve the 6 project objectives. The methodology was structured around six tasks:

- **Task 1**: Undertake a literature review to provide broad context.
- **Task 2**: Review of wall and bank option uptake under ES and CS.
- **Task 3**: Selection of case study locations and filed boundary mapping.
- **Task 4**: Condition assessment and interview surveys in the case study areas.
- **Task 5**: Ecosystem service flows.
- **Task 6**: Reporting and outputs.

2.2 Task 1: Undertake a literature review to provide broad context

The literature review aimed to provide context for the project by:

- Reviewing wall and bank options within the ES and CS schemes, drawing on handbooks and guidance documents produced by Natural England and Defra.
- Examining previous research on walls and banks to understand the current state of knowledge, based on an internet search for published academic papers and research reports. Given the limited timeframe and available resources, a rapid review approach was adopted, prioritising speed over comprehensiveness. It is therefore acknowledged that some relevant academic studies may have been overlooked.
- Investigating methods for conducting field boundary mapping and condition surveys, also based on an internet search for relevant academic papers and reports.
- Reviewing the top 50% of National Character Area (NCA) profiles with the highest uptake of AES wall and bank options to understand the importance of walls and banks to these areas.
- Analysing government policy through a review of published policy documents.

2.3 Task 2: Review of wall and bank option uptake under ES and CS

2.3.1 Data sources

The live ES datasets available from the Natural England Open Data Geoportal (NEODG) provides information on the general location of wall and bank options for current agreements. The datasets provide a snapshot of option and agreement uptake toward the end of the scheme's life. These datasets only show ES agreements that are still live today. The ES agreements are ones that have been extended as they have all passed their original end dates.

The datasets do not provide a comprehensive picture of uptake and coverage over the duration of the schemes life as it is a legacy scheme, beginning in 2005 and closing to new entrants in 2015, and as a result there are no longer any ELS only agreements or OELS only agreements in this dataset as ELS and OELS where only 5 year agreements. There are likely to have been many ES agreements that have expired and are not accounted for by the live datasets. Although walls and banks covered by such agreements are no longer covered by the option prescriptions, participation in the schemes may have had an influence on current boundary management practices. To provide an indication of the magnitude of this issue, Natural England provided a bespoke dataset containing information on ES agreements that had expired during the period from January 2005 to December 2019. The CS scheme began in 2016 and as a newer scheme it is less affected by the issue of expired agreements.

2.3.2 Environmental Stewardship

This sub-section describes the content of two live ES scheme datasets downloaded from the NEODG and a bespoke dataset of closed ES agreements provided by Natural England. The datasets are:

- **Environmental Stewardship Scheme Options, 15/03/2024 Updated dataset**: Environmental Stewardship Scheme Options (England) | Natural England Open Data Geoportal (arcgis.com)
- **Environmental Stewardship Scheme Agreements, 15/03/2024 Updated dataset**: Environmental Stewardship Scheme Agreements (England) | Natural England Open Data Geoportal (arcgis.com)

- **Environmental Stewardship Option Uptake Selected Options Summary. Closed agreements**.

ES scheme options, 15/03/2024 updated dataset

The Geographic Information System (GIS) location of option records is at 2 spatial scales:

- **Parcel level**: The option (point feature) occurs within the boundaries of the parcel.
- **Agreement level**: The option (point feature) occurs withing the boundary of the agreement.

Each record contains information for 28 variables. The dataset no longer has any ELS only agreements or OELS only agreements as ELS and OELS were only 5 year agreements and have all expired. There are 12 ES wall and bank protection and maintenance options, categorised by scheme type, boundary type, and location. These options are spatially located at the agreement level. Additionally, there are five ES wall and bank restoration and repair options, categorised by scheme type and boundary type. There are also four ES wall and bank restoration and repair option supplements.

ES scheme agreements, 15/03/2024 updated dataset

The dataset contains 7,509 records for live scheme agreements. Agreement holders may have more than one agreement. The records represent ES scheme agreement polygons (includes farm business and payment info). Each record contains information for 28 variables. The dataset no longer has any ELS only agreements or OELS only agreements as ELS and OELS were only 5 year agreements and have all expired.

ES option uptake selected options summary: Closed agreements

The dataset contains 15,502 records for closed scheme agreements that included ELS wall and bank boundary protection and maintenance options. Each record contains information for 9 variables. The dataset also contained 406 records for closed scheme agreements that included ELS wall and bank restoration and repair options. Each record contains information for 9 variables.

2.3.3 Countryside Stewardship

Countryside Stewardship replaced ES in 2016 and is part of the Agricultural Transition to Defra's new ELM schemes. This sub-section describes the content of two live CS scheme datasets downloaded from the NEODG. The datasets are:

- Countryside Stewardship Scheme 2016 Management Options, 15/07/2023 dataset. Countryside Stewardship Scheme 2016 Management Options (England) | Natural England Open Data Geoportal (arcgis.com)
- Countryside Stewardship Scheme 2016 Management Areas, 15/03/2024 Updated dataset. Countryside Stewardship Scheme 2016 Management Areas (England) | Natural England Open Data Geoportal (arcgis.com)

The management options dataset is not up to date. The geoportal webpage says a further update is awaited from the RPA.

CS scheme 2016 management options, 15/07/2023 dataset

The dataset contains 1,097,101 records for scheme options. The spatial dataset describes the location of all scheme options within the CS scheme from 01/01/2016 onwards. The data has been produced by linking tabular information extracts from the scheme administration system against a

national extract of the Land Parcel Information System (LPIS) held by the RPA. The GIS location of option records is at parcel level. The option (point feature) occurs within the boundaries of the parcel. Each record contains information for 26 variables. There are three wall and bank restoration and repair options. The options are categorised according to boundary type.

CS scheme 2016 management areas, 15/03/2024 updated dataset

The dataset contains 42,851 records for scheme agreements. Agreement holders may have more than one agreement. The spatial dataset describes the geographic extent and location of all land under management within the CS AES from 01/01/2016 onwards. Each record contains information for 17 variables.

2.3.4 Other data sources used to support the national analysis

The following data sources were used to support the national analysis:

- Administrative areas:
  - English Counties.
- Altitude:
  - Moorland line.
- Agricultural Landscape Types (ALT).
- National Character Areas (NCA).
- Agricultural Land Classes (ALC).
- Protected landscapes:
  - National Parks.
  - National Landscapes, previously known as Areas of Outstanding Natural Beauty (AONB).
- World Heritage Sites (WHS).

2.3.5 Limitations of the data for the analysis

The NEODG data has significant limitations for further granular option-level analysis in that it identifies the land parcels where walls and banks are under option rather than the exact location of the boundaries, or partial sections of walls and banks within any parcel, that themselves are under option.

The datasets have limited agreement time depth, being restricted to live agreements with continuous updates being made, so very much represent a specific moment in time.

2.4 Task 3: Selection of case study locations and mapping field boundaries

2.4.1 Selection of case study locations

Building on the outputs of Task 2, four case study locations were selected to undertake a detailed assessment of wall and bank condition and surveys of ES and CS agreement holders and walling contractors to determine the impacts of the schemes and the ecosystem services provided.

The criteria for selection of case study areas was specified in the Request for Quotation (RFQ):

- All four case studies to have different (contrasting) locations, features, typographies and agricultural activity to ensure a diverse range of findings and embody a varied study.
- The case study areas should be approximately 5 x 10 km^2.
- Three must be dominated by wall options, one by bank options.
- Walls or banks have to be a significant feature of the case study areas.
- Three must be located within protected landscapes, and one outside the protected landscapes network.
- The case study areas must have a sufficient level of AES uptake for the agreement holder survey (4 ES and 4 CS per case study).

2.4.2 Mapping field boundaries

Land Parcel Identification System

Land Parcel Identification System (LPIS) data, Supplied by the RPA, was used as the de facto digital dataset for locating boundaries. In most cases, LPIS parcels correspond to agricultural fields enclosed by physical boundaries.

To create the field boundaries, the LPIS land parcel polygons were converted into line features. A field boundary is defined as the length between two nodes. A node is a point where a boundary either connects with another boundary feature (e.g. a wall or bank in the corner of a field) or terminates without connecting to anything (e.g. a wall or bank by a river or a shelter boundary that stands alone within a field).

There are three main limitations when using LPIS data to identify field boundaries:

- **Phantom field boundaries**: These do not exist on the ground. For example, they may appear where non-eligible land, such as a farm track, is marked within a field.
- **Artifact field boundaries**: These are very short boundaries (under 5 m) that can be generated when converting polygons into lines.
- **Missing field boundaries**: Some boundaries are not recorded in LPIS, such as derelict or relict boundaries that are gradually disappearing from the landscape. Additionally, stand-alone boundaries used for livestock shelter do not form part of LPIS data.

To improve accuracy, all boundaries under 5 m were excluded from the digital dataset. Other exclusions included garden walls, built-up areas (villages, hamlets, and urban zones), and farmyard curtilages. In addition, non-LPIS boundaries identified through aerial photography were added to the dataset. The accuracy of the technique is discussed in more detail in Appendix 1. Using this method, we estimate that approximately 90% of field boundaries in the case study areas have been identified.

AES agreement status

Node to node lengths of boundaries in the case study areas were be identified as being:

- Agreement (ES or CS) – with wall and bank options:
  - Boundary under option including option code.
  - Boundary not under option.
- Agreement (ES or CS) – no wall/bank options:

- Boundary.

- Non-agreement land:
  - Boundary.

For each node to node length of boundary any AES options applying to it was tagged using the AES option codes (see Section 2.3). The option maps for ES identify the walls and banks that are being maintained or restored and option code. Maps are GIS generated and the boundaries to be maintained or restored are either identified by GIS (Figure 2.1) or drawn on by hand (Figure 2.2).

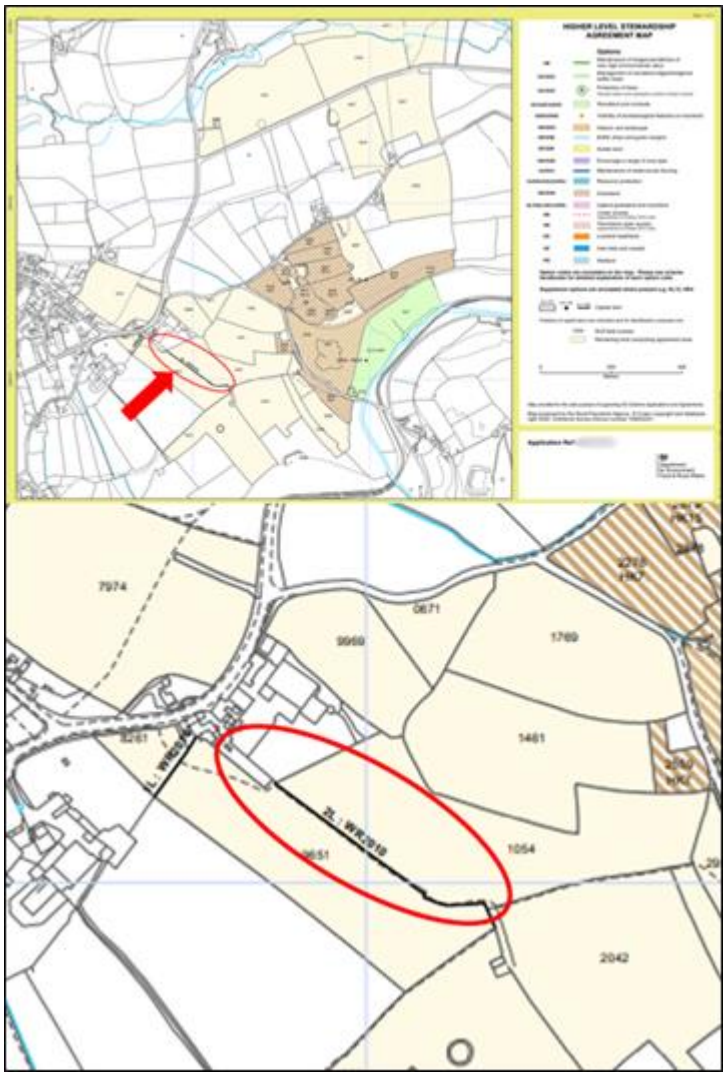


Figure 2.1 ES option map identifying a wall boundary to be restored under WR2010

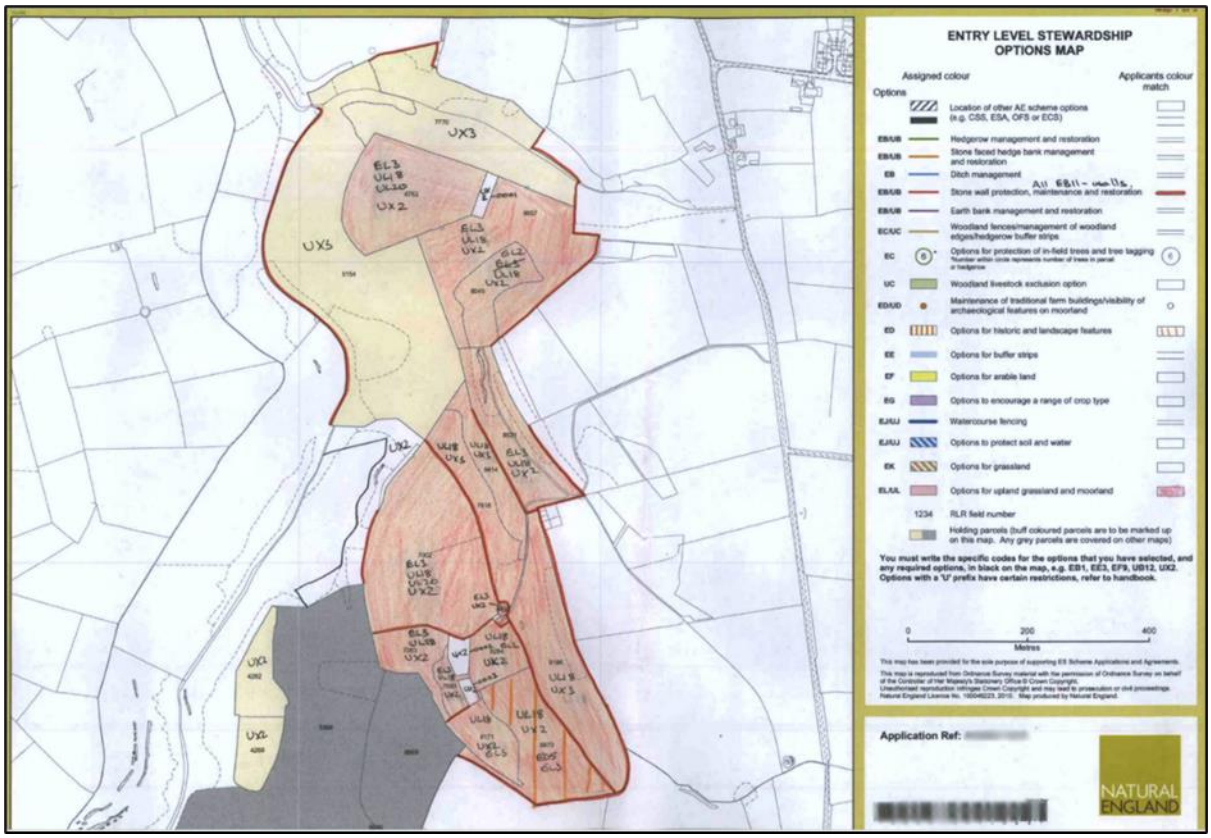


Figure 2.2: ES option map identifying wall boundaries to be maintained under EB11

The option maps for CS identify the boundary to be repaired or restored and option code. Maps are GIS generated and the boundaries to be repaired are either identified by GIS (Figure 2.3) or drawn on by hand (Figure 2.4).

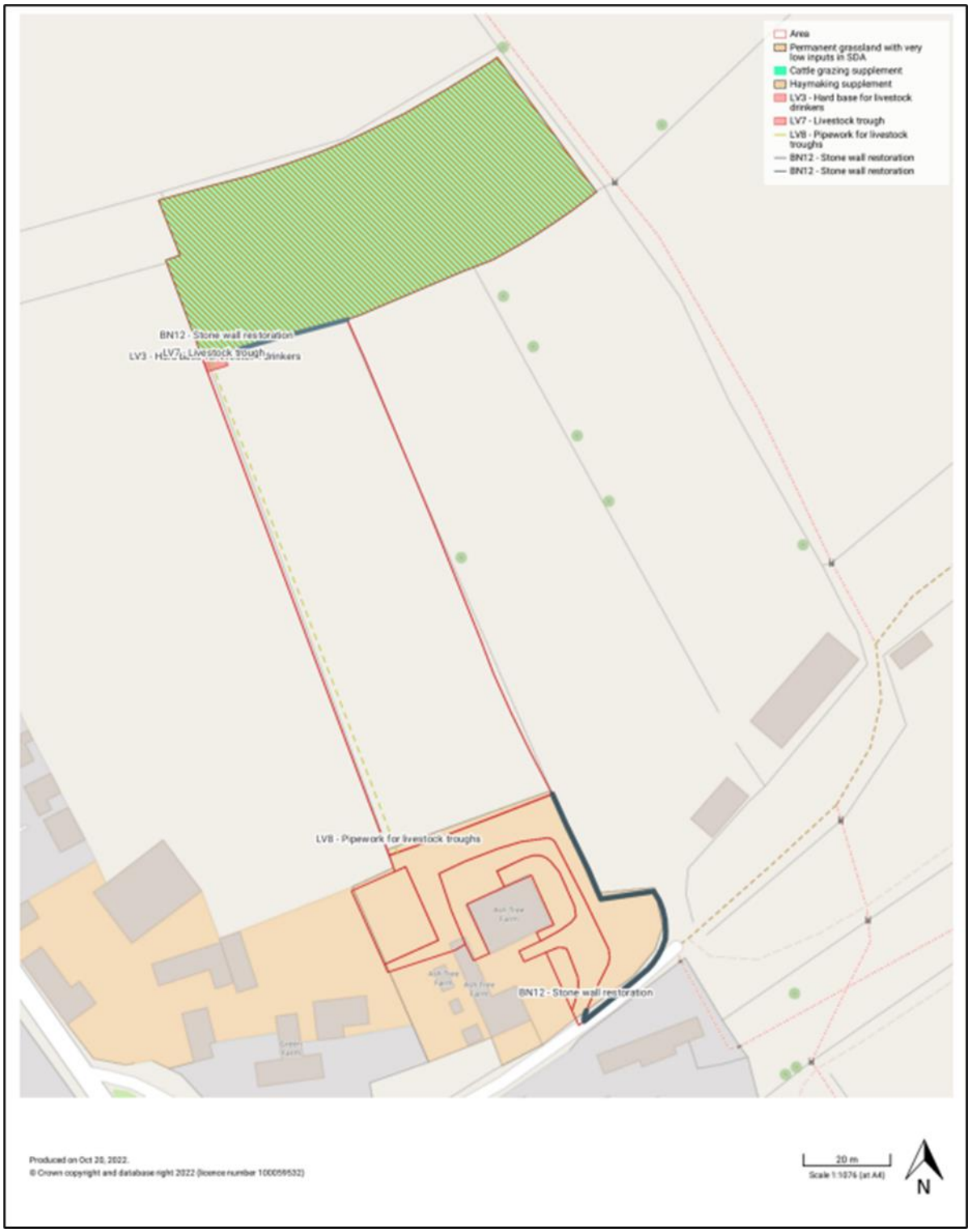


Figure 2.3: CS option map identifying wall boundaries to be restored under BN12

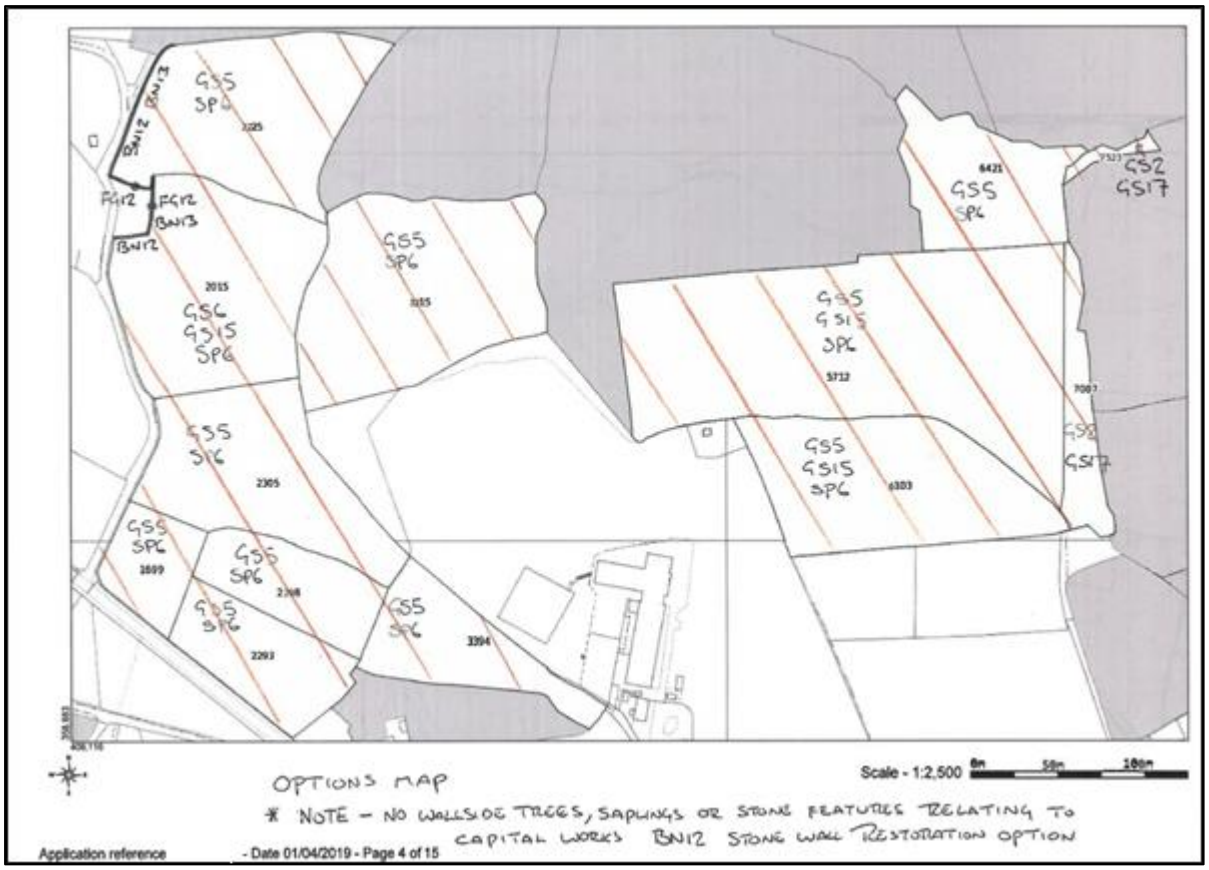


Figure 2.4: CS option map identifying wall boundaries to be restored under BN12 and BN13

Recording land status

The habitat, grade and accessibility of land in proximity to each field boundary was recorded. Both sides of the boundary were assessed simultaneously and lengths were tagged with the predominant class or status. Land status has been tagged to the field boundary lengths with a code marker (Table 2.1).

Table 2.1: Land status categories tagged to individual field boundaries

Land status type	Dataset
Habitat	Living_England_Habitat_Map_Phase4_-2642780954473822030
Agricultural Land Classification Grade	ALC_Grades_(Provisional)___ADAS_&_Defra
Moorland Line	Moorland_line_d
Countryside and Rights of Way Act 2000 (CRoW)	CRoW_Access_Land___Natural_England
Public Right of Way (PRoW)	Individual to each local authority

Habitat

Habitat classes have been taken from the Living England Habitat Map (Table 2.2). The description was taken from 'A-pred' in the LE attribute column (this is the class considered most likely for the LE polygon).

Table 2.2: Habitat classification

Description
Acid, Calcareous, Neutral Grassland
Arable and Horticultural
Bare Ground
Bare Sand
Bog
Bracken
Broadleaved, Mixed and Yew Woodland
Built-up Areas and Gardens
Coastal Saltmarsh
Coastal Sand Dunes
Coniferous Woodland
Dwarf Shrub Heath
Fen, Marsh and Swamp
Improved Grassland
Scrub
Unclassified
Water

Agricultural Land classification status

Agricultural land classification is a system used to categorize and describe different types of agricultural land based on various factors such as soil type, climate, land use practices, topography, and vegetation cover. These classifications help policymakers and land managers understand and manage agricultural land more effectively. The land is categorised into five grades, with Grade 1 being the highest quality and Grade 5 being the lowest. There further are classes for non-agricultural and urban land. While most land is included in the classification, there are some minor gaps nationally.

Table 2.3: Agricultural Land Classification

Code	Description
ALC_G1	Grade 1 - Land within this grade has little to no limitations to agricultural use
ALC_G2	Grade 2 - This land has minor limitations which affect crop yield, cultivations or harvesting
ALC_G3a	Grade 3a - Land capable of consistently producing moderate to high yields of a narrow range of arable crops (e.g. cereals) or moderate yields of a wide range of crops (e.g. cereals, grass, oilseed rape, potatoes, sugar beet and less demanding horticultural crops).
ALC_G3b	Grade 3b - This land is capable of producing moderate yields of a narrow range of crops (mainly cereals and grass) or lower yields of a wider range of crops, or high yields of grass (for grazing/harvesting).
ALC_G4	Grade 4 - Land included within this grade suffers severe limitations that significantly restrict the range and/or yield of crops to be grown
ALC_G5	Grade 5 - This land has severe limitations which restricts use to permanent pasture or rough grazing, except for occasional pioneer forage crops.

Moorland line

For field boundaries adjacent to the moorland line, areas of Common or CRoW land; these take the status of the land in which the majority of the boundary sits.

Accessibility

The following designations have been tagged:

- The boundary feature is on or adjacent to common land.
- The boundary feature is on or adjacent to CRoW land.
- There is a PRoW within 30m of the boundary feature.

2.5 Task 4: Condition assessment and interview surveys in the case study areas

2.5.1 Condition assessment

The purpose of the wall and bank condition assessment was to collect data to help establish the effectiveness of AES funding for the maintenance, repair, and restoration of walls and banks. It supplemented the agreement holder interviews by providing verified field data on the condition of walls and banks in the case study areas.

Work carried out by to map the boundaries within the case study areas identified c.27,000 boundaries. It was not possible within the scope of this project to assess every boundary. It was agreed with the Project Steering Group (PSG) that the focus of the fieldwork should be on undertaking more high-level assessments rather than fewer more detailed assessments. The review of the options, undertaken as part of the literature review, showed that the prescriptions for both ES and CS options were relatively broad-brush. The maintenance and repair options focused on getting the walls and banks into 'good condition'. This was loosely qualified as without gaps and with repairs carried out in the traditional style and materials. As such, this was the information that the survey was designed to capture (see Appendix 10.10).

To establish the effectiveness of AES on the condition of walls and banks, it was necessary to collect counterfactual information. This enabled a comparison of boundaries under option and not under option, to determine whether there was any difference in condition. Considering this, it was established that it would be useful to collect data from three categories of wall and bank status:

- In agreement and under option.
- In agreement but not under option.
- Not in agreement.

It was agreed with the PSG that the level of detail collected on each boundary would vary depending on their status. This led to the development of three types of survey forms:

- Case study area overview.
- Detailed survey.
- High-level survey.

Case study area overview

The purpose of this form was to capture the contribution of walls and banks to the case study area at a broader, landscape level. This included a description of the overriding character of the walls and

banks within each case study area and how they contributed to landscape character. It also considered the ecological potential of the area.

Detailed survey

For those walls and banks under option where the agreement holders were interviewed, a more detailed assessment was performed. This captured not only the condition of the wall or bank but also noted any associated stone features and their condition.

High-level survey

The final survey form was designed for all remaining walls and banks, that is, all those under option but where the agreement holder was not being interviewed, those in agreement but not under option, and those not in any agreement. It was a simplified version of the detailed survey form.

Ecological evaluation

The literature review reported that the ecological value of walls and banks was acknowledged at a broad level but remained an under-researched area, with limited understanding of their role or value in biodiversity provision across the wider landscape. Although this was an area in desperate need of more research, it was not within the scope of this project to carry out ecological surveys of individual walls and banks. However, in recognition of the consensus that there were ecological benefits derived from their presence in the landscape—as habitats for flora and fauna and as corridors or stepping stones in the landscape — an attempt was made to include some assessment of the ecological potential of the case study areas.

This was approached in two ways. The first was at the higher, case study area level. This appraised the potential contribution of the walls and banks to the ecology of the area, given the environmental conditions and the characteristics of the walls and banks.

The second was at the individual boundary survey level. The proposal was to consider the ecological potential of the wall or bank in the four different categories of condition. When the condition of the wall or bank was selected by the surveyor, it was automatically linked to a level of ecological potential. While this did not provide an exact value for the ecological contribution of the wall, it served as a proxy for a detailed ecological assessment and gave some indication of the potential ecological contribution of the walls and banks within the case study area.

Selection of walls and banks within the case study areas

The selection of walls to be surveyed was largely informed by the following factors:

- **Access**: The complexities of arranging access to private land owned by multiple landowners meant that the proximity of the walls to a PRoW or public highway was a key determinant.
- **Geographical spread**: The aim was to avoid collecting data for one type of boundary status (under option, in agreement but not under option, and not under option) from a single area within the case study. This helped minimise the risk of skewing the data by deriving information from a single landowner who either regularly or rarely carried out maintenance or repairs on their boundaries.
- **Use**: The use of the LPIS data source as the means of identifying boundaries had its limitations, one of which was that it sometimes included buildings and ‘phantom’ boundaries. It also did not distinguish between domestic boundary walls and those in agricultural use. As the former would not qualify for AES funding (and were unlikely to be maintained in the same way as agricultural boundaries), they were excluded from

the survey. However, the extent of this issue could only be determined once fieldwork commenced.

- **Comparable numbers**: The aim was to ensure an even spread of assessments across the different wall statuses (under option, in agreement but not under option, and not under option) to aid comparison. As a minimum, the goal was to collect data on approximately 500 of each. This was more achievable in some case study areas than others, and the complexities of Dunstone were addressed separately below.

Dunstone

A different approach was required for the Dunstone case study area, which focused on collecting data on banks rather than stone walls. However, LPIS data analysis could not positively identify banks. Instead, the distinction could only be made between vegetated, unvegetated, and wooded boundaries.

The vegetated boundaries identified hedged or treed boundaries but could not ascertain whether they were on top of a bank. The unvegetated boundaries included fences and possible walls and banks. It was also often impossible to positively identify the presence of a boundary (stone or otherwise) in the wooded areas due to tree cover.

In short, the only boundaries that could be positively identified as a bank before fieldwork commenced were those subject to bank options as part of an AES agreement. However, in order to maintain a consistent approach across all areas, particularly in terms of access and geographical spread, a selection of boundaries was still made before the surveyors went on-site using the same parameters.

Given the uncertainty surrounding the existence of boundaries in the 'wooded' category, these were excluded from the potential survey at the outset. However, this decision could be amended on-site if a surveyor encountered a wooded boundary that was a bank and could be surveyed. Otherwise, selections were made from the vegetated and unvegetated boundary categories.

The aim was to survey approximately 500 banks. However, several factors made achieving this target uncertain:

- The field survey work was expected to take longer due to the additional effort required to positively identify banks on-site, in contrast to the relative certainty of wall selection in the other case study areas.
- The actual number of banks within the case study area was unknown, making it unclear whether a total of ~1,500 was an achievable target. Additionally, the inclusion of stone walls, fences, and vegetated boundaries within the datasets meant that the survey team was likely to experience a lower 'hit rate.'
- Due to vegetation cover, the condition of the bank was likely to be harder to ascertain. In such cases, banks that were not adjacent to a PRoW or public highway might need to be discounted from the survey, as they would be impossible to inspect from a distance.

2.5.2 Interview surveys

Case study coverage

The aim was to complete 8 agreement holder interviews (4 ES and 4 CS) and 2 walling contractor interviews whin each case study. The purpose was to gather views and opinions on wall and bank management, including the reasons behind different management decisions and perceptions of the

usefulness of AES maintenance and restoration options. These interviews were not intended to be representative of all agreement holders in the case study areas.

Recruiting agreement holders in Todmorden proved challenging, primarily due to difficulties in making contact. As a result, and with the agreement of the PSG, additional agreement holders were recruited in Swaledale and Coldeaton. Overall, the response to the surveys was positive, with 40 interviews completed and a balanced distribution between ES and CS agreement holders (Table 2.4)

Table 2.4: Response to the agreement holder and walling contractors survey

Case study area	CS agreement holder	ES agreement holder	Walling contractor	Total
Swaledale	5	5	2	12
Todmorden	2	3	2	7
Coldeaton	5	5	2	12
Dunstone	4	3	2	9
Total	**16**	**16**	**8**	**40**

Purpose of the agreement holder and walling contractor surveys

The purpose of the agreement holder and walling contractor surveys was twofold:

- To better understand how and why agreement holders managed the walls and banks on their holdings in the way they did and also how they engaged with AES.
- To gather the information required for the exploration of ecosystem service flows (see Section 2.6).

Agreement holder interview

The objectives of the agreement holder (usually a farmer) interviews were to determine:

- Whether participation in the schemes has enhanced views on and an appreciation of walls and banks, their position and role in the farming system and local landscape, and the craft skills required to maintain and repair them.
- The factors that influence agreement holder decision making.
- Wall and bank restoration and maintenance expenditure.
- Stakeholder outcomes arising from the utilisation, restoration, and maintenance of walls and banks.

The agreement holder interview schedule (see Appendix 10.5) collected both quantitative and qualitative information about the holding, AES, and attitudes and was divided into in nine sections:

1) Characteristics of the farm.
2) Nature of boundaries on the farm.
3) Functions of walls and banks on the farm.
4) Farm level outcomes.
5) Views on ecology, landscape, and attitudes towards walls and banks.
6) Investment costs – agreements and public funding (maintenance; restoration).
7) Investment costs – expenditure and time/resource inputs.
8) Wider area outcomes.

9) Final questions.

Walling contractor interview

The objectives of the walling contractor interviews were to determine:

- The characteristics of walls and banks in the area.
- The nature and type of work carried out.
- Their views on the function of walls and banks.
- The economic aspects of the work.
- Knowledge and skills aspects of their work.
- Impacts of walls and banks restoration and maintenance.

The interview schedule (see Appendix 10.6) collected both quantitative and qualitative information the walling contractor's activities and attitudes and was divided into six sections:

1) Local characteristics of walls and banks.
2) Financial and employment issues.
3) Knowledge and skills.
4) Landscape and identity outcomes.
5) Views on ecology, landscape, and attitudes towards walls and banks.
6) Concluding questions.

Organising the interview surveys

A team of four interviewers from CCRI undertook the surveys. Each surveyor was allocated a case study area. A training and guidance manual was prepared for the interviewers, outlining each stage of the fieldwork, health and safety protocols, how to complete the interview schedule, and how to enter information onto the central database. The interviewers attended a training event in July 2024.

Arranging the interview

Before making contact, an introductory letter explaining the purpose of the survey was sent to all agreement holders via email or post. This was followed by a telephone call to arrange the interview. The contact letter was accompanied by an information sheet outlining the purpose of the survey (Appendix 10.7) and a consent form for participation in the project (Appendix 10.8). A debrief sheet was provided to interviewees at the time of the interview (Appendix 10.9).

Before each agreement holder interview, the interviewers reviewed the supporting documentation for the agreement, where available, to familiarise themselves with the location of the AES options. The interviews lasted between 45 minutes and an hour, depending on the complexity of the agreement. Interviews took place in locations with a flat surface, such as a kitchen or office table, so that both the agreement holder and surveyor could review the maps together.

Where permission was granted, the interviews were recorded. Direct quotations and extracts from the interview summaries are included as part of the analysis to highlight the respondents' perspectives on scheme management and their views on wall and bank management. These extracts are edited for concision, readability, and confidentiality. Data from the interview schedules were entered online generating a Microsoft Excel spreadsheet, which was analysed using the IBM SPSS statistical software suite.

2.6 Task 5: Ecosystem service flows

2.6.1 Introduction

A number of issues arise from the nature of the data available for populating the model. On the investment side of the model the information available was based on live CS and ES agreements over the period 2010-25. These provided information on the different options available to agreement holders regarding capital grants available for restoration and revenue grants for annual maintenance and repair of walls and banks. It was not possible to identify with accuracy the actual amount of funding allocated to a specific section of wall and bank as agreements only indicated the length (in metres) and relevant option (which included activities such as: restoration, repair, fencing and top wiring along with supplements for working on difficult ground and purchase of stone, and amount of funding allocated.

It is possible to ascertain the walls and banks where different options were allocated, but not the extent to which they applied to the same or different sections of walls and banks. Nor is it possible to definitively establish the point in time at which improvement took place as agreements span multiple years. In addition to public funding the agreement holder interviews also collected data on the level of time invested by the agreement holder, his/her family and any hired labour outside of the ES and CS agreements, along with respondent estimates of the value of this additional labour. Investment thus consists of ES and CS grant funding (public investment) and additional agreement holder inputs (private investment).

The Social Return on Investment (SROI) model measures outcomes based on the level of improvement generated through the length of wall and bank that received some form of ES or CS stewardship support. This estimate was then utilised in the model as a measure of the proportion of total walls and banks in the case study area where wall and bank condition was improved at some point over the 2010-25 period, leading to higher levels of benefit flows from the ecosystem service functions delivered across the case study area by walls and banks.

The ecosystem services generated by walls and banks are assessed at case study level (50 km^2 areas) as these features are part of an integrated landscape that generates benefit flows over an area (Figure 2.5). The ecological (supporting) services, for example, are dependent on a network of features (in the form of walls and banks) that create conditions that contribute to habitat provision and biodiversity. Improving the condition of a single wall and bank may have a very limited impact on services generated, especially if it is in an exposed position, does not link to other habitats to create a wildlife corridor, does not provide shelter for livestock, or is hidden in the landscape (and cannot be seen by visitors or local residents). In a similar fashion, provisioning services, such as shelter for livestock, are provided through an intact network of walls and banks rather than a single wall and bank. In terms of cultural services, it is the density of walls and banks, their historical significance, and influence on landscape that generate valued outcomes for both residents of the area and visitors.

Benefit flows arise from the network of walls and banks that exist and their overall condition. The model therefore is based on a determination of the ecosystem services generated by walls and banks across the case study landscape (50 km^2) and not by single boundaries or individual farm areas. The base level of services is generated by the total length of walls and banks in the case study area, and the number of farmers, walling contractors, local residents, and estimated visitors to the area are the main beneficiaries.

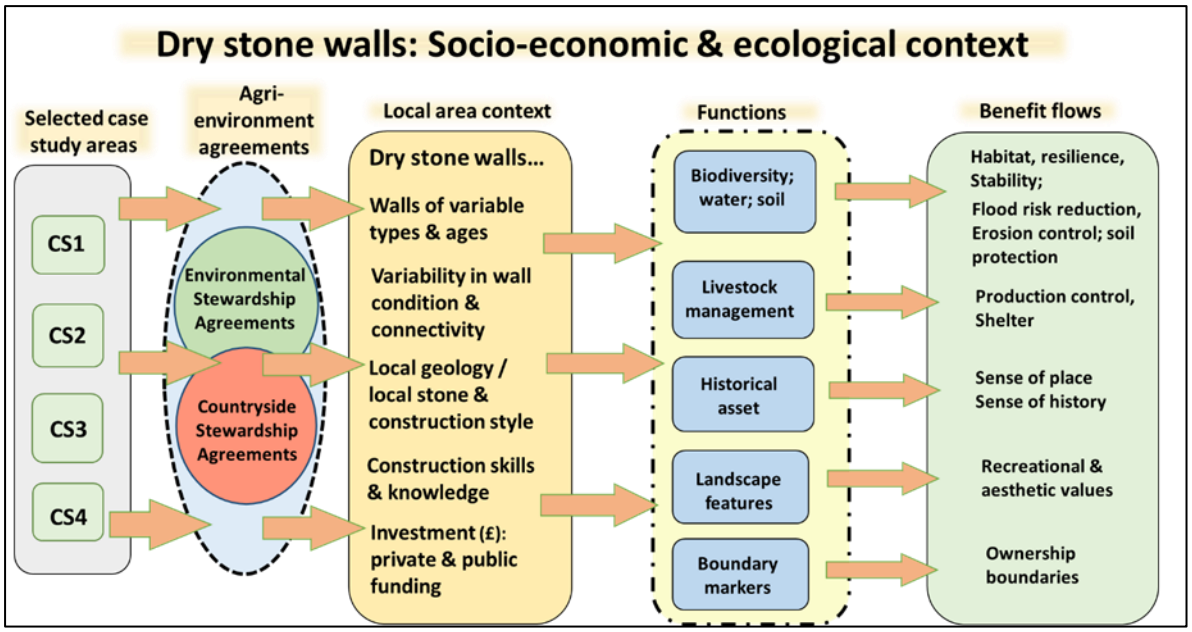


Figure 2.5: Overview of the socio-economic and ecological context of the project

2.6.2 Exploration of ecosystem service flows

Figure 2.6 summarises the conceptual design of the SROI model, the model is based on the New Economic Foundation (Nef) approach to valuing social outcomes of interventions (Cabinet Office, 2009). The model has been modified through previous CCRI work on assessing benefit flows from dry stone walls in the Peak District National Park (Powell et al., 2018) and valuation of walls in the Cumbrian landscape (Powell et al., 2020) as part of a broader valuation of SHINE assets.

The SROI model was modified to explore the outcomes generated by improvement of walls and banks through agri-environment agreement options, exploring outcomes within the wider landscape. In terms of Supporting services this related to 'Intrinsic flows' - benefits provided by the wall itself such as 'wall habitat' and ecological niches, shelter provided by the wall for plant, invertebrate and animal species, and the stone itself acting as a substrate for lichens and mosses. Walls/banks also create 'extrinsic flows', for example through connectivity, creating a link between adjacent habitats and management processes, through providing a network of areas within which livestock can be more effectively managed, and through their combined impact on the cultural heritage and aesthetic appearance of the landscape.

In all cases wall and bank 'condition' affects the potential for service delivery across all our main domains of ecosystem services. In particular, the model is concerned with wall and bank condition in terms of its ecological potential, in terms of its capacity for managing livestock (extent to which walls and banks are stockproof), and the visible impact on the landscape (in terms of aesthetic value of landscape). Data were collected on wall and bank condition in terms of ecological potential and the extent to which boundaries were intact, defective, derelict or remnants. In addition, ecological 'potential' was assessed through field surveys in each case study area based on surveyor judgement of habitat potential, adjacent priority habitat, and boundary condition.

Regulating services were assessed through agreement holder interviews which explored the extent to which walls and banks contribute to flood prevention, and soil and crop protection. Although identified as potential services, previous and current work suggest that regulating services of walls and banks are quite limited in all the case study areas.

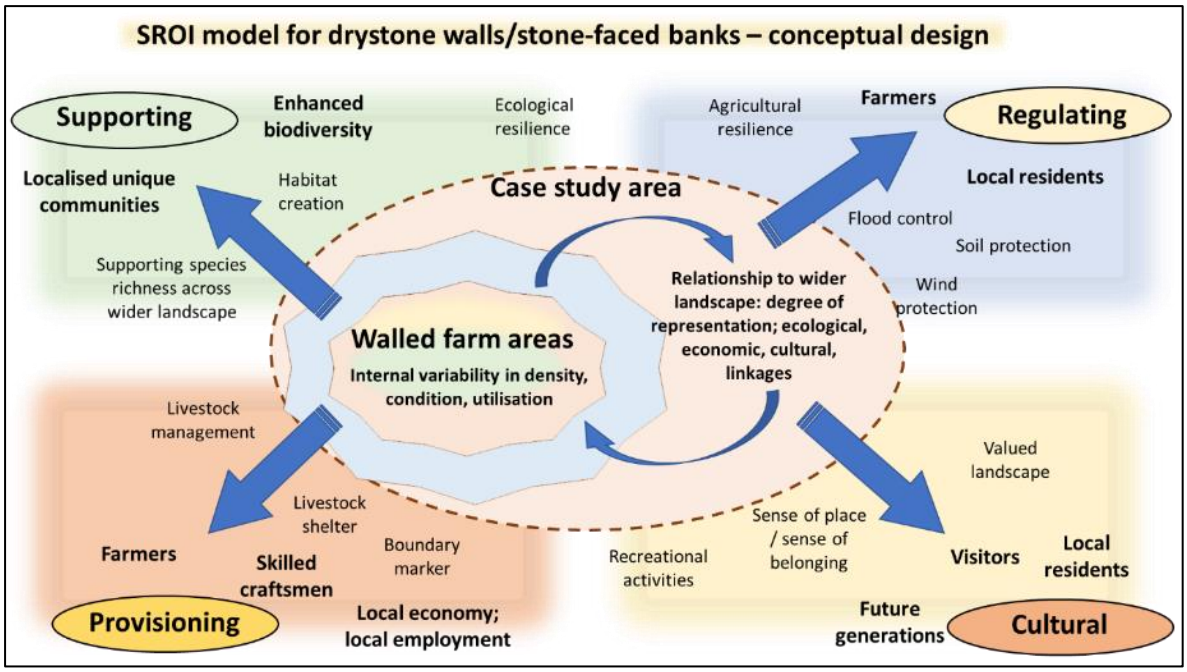


Figure 2.6: SROI model: conceptual design

Provisioning services focused largely on the agricultural management benefits from having an intact network of stockproof walls and banks that provide shelter for livestock, assist in management, provide employment and generate income through purchase of local services. Cultural services are assessed through examination of benefits to local residents and visitors to the area based on assumptions made about the proportion of resident and visitor populations that benefit in different ways from the aesthetic values generated by a walled landscape.

2.6.3 Model operation

The SROI model is developed through three stages (Figure 2.7). Stage 1 involves identification of outcomes generated by walls and banks and those who benefit from those outcomes (stakeholders in Figure 2.7). The characteristics of beneficiaries from investment in improving walls and banks (which can include the non-human as well as the human environment), the way in which they benefit, and the scale or numbers of beneficiaries are key aspects assessed at this stage. Once the main outcomes are identified, indicators are developed to measure the extent to which different stakeholders benefit from the outcomes and any change in the benefit flows that occur. Data are collected from relevant stakeholders through field surveys and interviews. Stage 2 involves converting the outcome indicator measures into monetary values using financial approximations. These are drawn from activities that deliver similar benefits as the outcomes of interest but have a market price (for example, using the cost of a training course to approximate the value of improvements in skills or knowledge). Benefits generated over a specific time period are then converted to present value measures and compared to the level of investment required to generate the outcomes (Benefit-investment ratio). The third stage of the model involves sensitivity testing to explore the effect of variation in key measures.

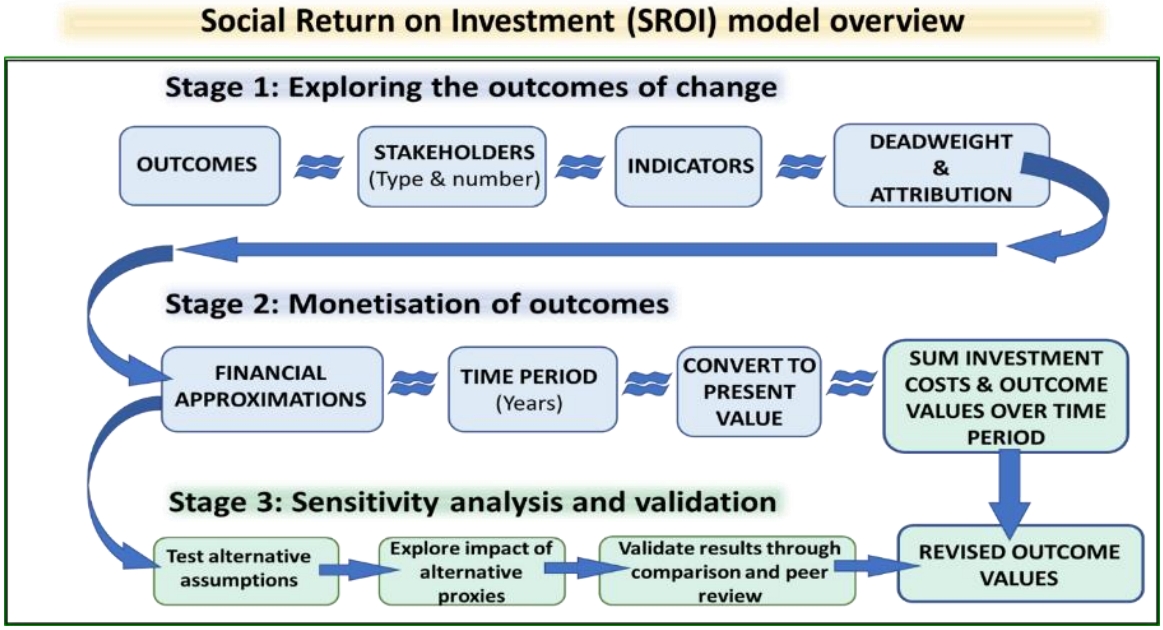


Figure 2.7: SROI model: development and operation

2.7 Task 6: Reporting and outputs

After each research task was completed, an internal interim report was produced to describe the findings. These reports were reviewed by the PSG, and feedback was provided to the contractors. The interim reports have contributed to this comprehensive final report. Additional outputs include the provision of data and metadata to Natural England from Tasks 2 and 4, a webinar, a two-page project summary, and an infographic.

3 LITERATURE REVIEW

3.1 Introduction

The literature review is divided into five sections:

- Technical review of individual AES.
- Rapid review of previous research.
- Review of GIS sources, methods and techniques.
- NCA profile review.
- Government policy review.

3.2 Technical review of individual Agri-Environment Schemes

3.2.1 Introduction

This section will cover:

- **A brief history of AES and options for walls and banks**.
- **An overview of ES and CS**.

- **A technical description of walls and banks ES**: Technical definitions and option descriptions.
- **A technical description of walls and banks in CS**: Technical definitions and option descriptions.

3.2.2 Brief history of AES and options for walls and banks

Although there were local AES for the management of agricultural habitats and landscape features, including walls and banks, from the mid-1980s (see Figure 3.1), the first large scale AES that had a significant impact on wall and bank management did not begin until 1987 with the launch of the first tranche of six Environmentally Sensitive Areas (ESA) (Boatman et al., 2008). By 1994 there were 22 ESAs. The ESA scheme was voluntary and operated through formal management agreements which lasted for 10 years with an option to renew. The scheme was based on annual management payments with an opportunity to apply for grants to undertake capital works for items such as the restoration of walls and banks. The payments reflected income forgone and any costs incurred (Defra, 2004). Ecoscope (2003) undertook a review of ESA management prescriptions for walls and banks and found that the majority entailed the maintenance of stock-proof boundaries and preventing the removal of material from existing boundaries without permission. This encouraged the retention of traditional boundaries as a functional component of farming systems, thereby reinforcing landscape character, and the retention of historically important relict boundaries in the landscape.

In 1991 the Classic Countryside Stewardship (CSS) scheme[1] was launched to allow farmers and land managers outside ESAs to apply for payments to undertake environmental management. CSS was a competitive scheme based on annual management payments and grants for capital works. In contrast to the ESA scheme, CCS did not pay for the maintenance of walls and banks, but there were opportunities for capital grants for wall and bank restoration (Ecoscope, 2003). By 2002 the area covered by both schemes had grown considerably to over 1 million hectares (see Figure 3.2). Both schemes closed to new entrants in 2004 and were replaced by ES in 2005.

[1] So named to distinguish the scheme for the Countryside Stewardship scheme launched in 2015.

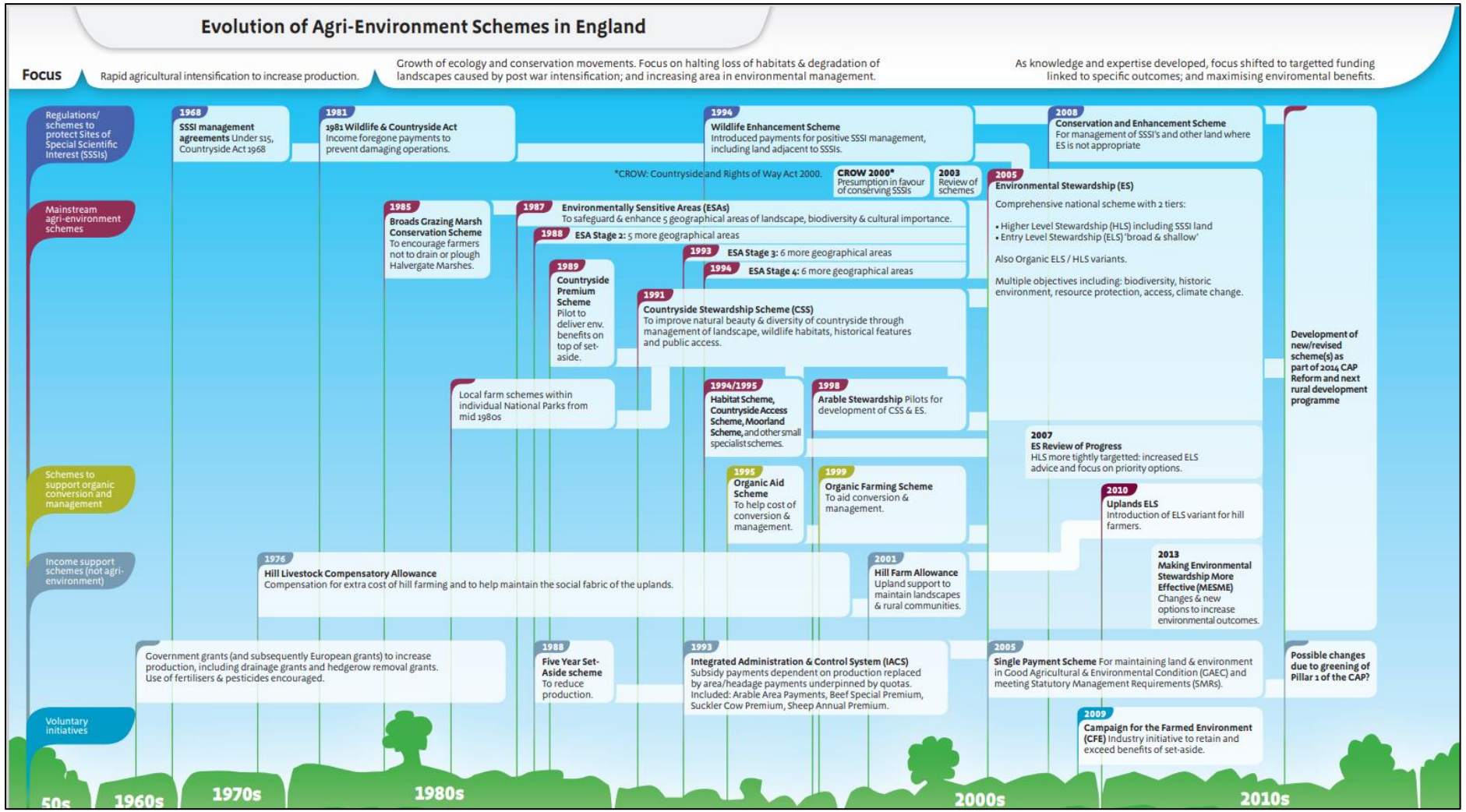


Figure 3.1: Evolution of AES in England 1968-2014
Source: Natural England (2015)

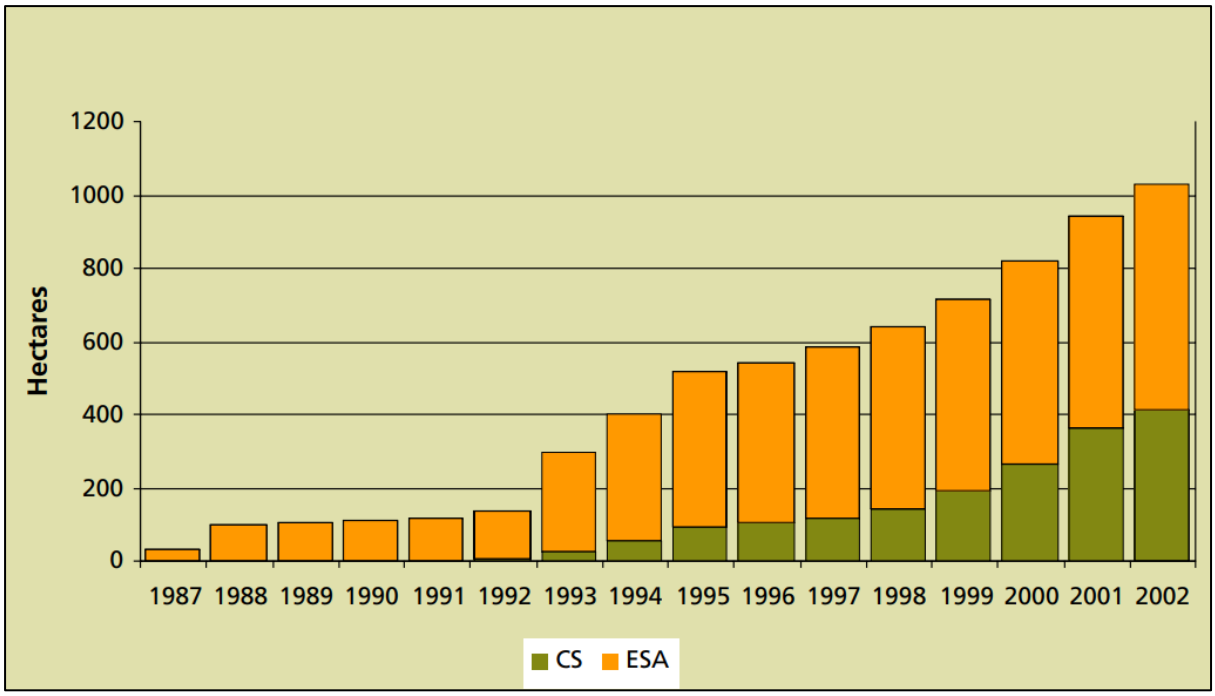


Figure 3.2: Uptake of ESA and CS (000s ha) 1987-2002
Source: Defra (2004)

Understanding the influence of these early AES on the management of walls and banks on agricultural land has been the subject of numerous monitoring and evaluation studies. A common challenge in many of these studies has been defining the unit of analysis, that is what exactly constitutes a wall or bank. An issue with the early AES schemes, and one which persists to the present day (see sections 2.5 and 4.2), is the flexible use of language in AES guidance documents when describing walls and banks. While the use of local terms and local definitions in scheme documents was well suited to delivery at the local level and sensitive to local conditions, the varied use of terms and terminology has made it difficult to study the impact of the schemes at a regional and national level.

As a start-point for this project a workable definition of walls and banks is needed, and the following were used:

- **Walls**: For wall boundaries, LUC (2007) conclude that most stone walls share a number of common features (such as a height of around 1.3 m and the presence of a row of copestones along the top) and that the methods of walling and the vernacular styles of wall vary significantly regionally, with there also being sub-regional differences according to geology, age, topography and function. wall boundaries also include the following descriptions which have been found in various AES documents:
    - Dry stone wall.
    - Dry-stone wall.
    - Drystone wall.
    - Stone dykes.
    - Stone fences.
- **Banks**: These have an earth core, built up on each side with local stone, the height being the same as the base width, and its batter is tapered with an inward curve from the base, with the top being half the width of the bottom. Bank boundaries also include the following descriptions which have been found in various AES documents:
    - Stone faced bank.

- Stone-faced hedge bank.
- Stone-faced hedgebank.
- Stone faced hedge bank.
- Stone faced hedgebank.
- Stone hedge banks.
- Stone hedgebank.
- Cornish hedge.
- Cornish hedge bank.
- Cornish hedgebank.
- Devon hedge.
- Devon hedge bank.
- Devon hedgebank.

Defra (2004) found that the ESA and CCS schemes made a major contribution to the restoration of traditional landscape features and buildings. Over 1,100 km of 'dry stone walls'[2] had been restored with commitments under CCS for a further 1,500 km.

Boatman et al. (2008) undertook a wide-ranging review of the environmental benefits supplied by AES which included all published studies of wall and bank management in ESAs and CSS (see Box 3.1). They concluded that:

> Schemes have successfully targeted historic field boundaries in England, with evaluation revealing that management under AES was mainly appropriate, although lack of a baseline precluded the demonstration of significant benefits. (Boatman et al., 2008, p6)

Box 3.1: Studies of ESA and CCS scheme boundary management

ADAS (2002) undertook a survey of the condition of walls on 171 case-study agreement holdings in six ESAs, with complementary data on farmer attitudes, behaviour and costs. The quality of wall renovation work was also assessed on 89 case-study holdings in five ESAs. The survey found substantial variation in the wall maintenance commitment within and between the ESAs. For example, less than a fifth of all walls in the Cotswold Hills were identified as stockproof, and holdings had on average only three walls to maintain under ESA prescriptions. In contrast over four-fifths of all walls in West Penwith were identified as stockproof, with holdings having on average 59 walls to maintain under ESA prescriptions. The report concluded that these substantial variations had implications for the costs of wall maintenance incurred between different holdings and between different ESAs. In most ESAs, a 'good' level of wall renovation was recorded for at least two-fifths of walls, with most of the remainder of the work being considered to be 'acceptable'.

Ecoscope (2003) made qualitative judgements of impact, based upon the individual scheme data, and concluded that significant landscape enhancement had taken place in some of the English ESAs. For example, in the Lake District ESA there had been considerable enhancement of field boundaries, while in the Cotswolds ESA there had been an increase in the maintenance and total length of dry stone walls.

Courtney et al. (2007) evaluated the impact of ESA and CCS capital works on dry stone walls within the Yorkshire Dales National Park. The study found that 354 agreement holders used the ESA and CCS schemes to renovate 128 km of dry stone wall and were paid £1.9 m. A survey of agreement holders found that in the absence of the restoration grant, half of these would have carried out no restoration work at all. It was frequently mentioned that it would have

[2] Possibly a catch-all term to include wall/bank boundaries.

been too expensive to restore the walls without the grant assistance, and where a stock proof boundary was required a post and wire fence would have been used instead. The study concluded that the schemes helped to maintain and enhance the historic character and special qualities of the Yorkshire Dales National Park. This study provides evidence of scheme additionality, albeit based upon farmer surveys to judge what would have happened without the schemes.

According to Dwyer and Kambites (2005) perhaps the most obvious landscape impact of the schemes is where they have been used to enhance the condition of traditional field boundaries and a range of monitoring reports have shown that there has been a substantial uptake of management options for traditional field boundaries across the UK. An impressive array of output statistics has been recorded.

Source: Boatman et al. (2008, pp91-94)

3.2.3 Overview of ES and CS

Environmental Stewardship

Environmental Stewardship is a voluntary scheme that was launched in 2005 and closed to new entrants in 2015. It was replaced by CS in 2016. The Rural Payments Agency (RPA) manages existing agreements on behalf of the Department for Environment, Food and Rural Affairs (Defra) until they reach their agreed end date. In 2007 ES became part of the Rural Development Programme for England 2007-2013 (RDPE) which was funded as part of the European Union's (EU) Common Agricultural Policy (CAP). There are currently over 7,000 live ES agreements.

The ES scheme provides payments to farmers and land managers in England who deliver environmental management on their land and has five major objectives:

- Conserve wildlife.
- Maintain and enhance landscape quality and character.
- Protect the historic environment.
- Protect natural resources.
- Promote public access and understanding of the countryside.

There are four elements to ES: Entry Level Stewardship (ELS); Organic Entry Level Stewardship (OELS); and Higher Level Stewardship (HLS); which were launched in 2005; and Uplands Entry Level Stewardship (UELS), which was launched in 2010. Briefly, the key features of the four elements of ES are as follows:

- **ELS** provides a straightforward approach to supporting the good stewardship of the countryside. This is done through simple and effective land management that goes beyond the Single Payment Scheme (SPS) requirement to maintain land in good agricultural and environmental condition (GAEC). ELS agreements lasted for five years and could be renewed on completion. All ELS only agreements have expired.
- **OELS** is the organic strand of ELS. It is geared to organic and organic/conventional mixed farming systems and is open to all farmers not receiving Organic Farming Scheme aid. OELS aims to encourage a large number of organic farmers across a wide area of farmland to deliver simple yet effective environmental management. OELS agreements lasted for five years and could be renewed on completion. All OELS only agreements have expired.

- **UELS** supports hill farmers with payments for environmental management. This element of ES succeeded the Hill Farm Allowance. It is open to all farmers with land in Severely Disadvantaged Areas (SDA), regardless of the size of the holding. UELS agreements lasted for five years and could be renewed on completion. All UELS only agreements have expired.
- **HLS** involves more complex types of management than ELS. Farmers and land managers receive advice and support, and agreements are tailored to local circumstances. The agreements last for 10 years and could be renewed on completion. A Farm Environment Plan (FEP) is prepared which appraises the environmental value of the land by identifying 'features' and suggests appropriate HLS management options for them. HLS applications are assessed against specific local targets and agreements are offered where they meet these targets and represent good value for money. They can be combined with ELS, OELS or UELS and these entry-level agreements are the ones that remain live if they are combined with a live higher-level agreement.

There are 12 ES wall and bank protection and maintenance options. The options are categorised according to scheme type, boundary type, and location. These options are spatially located at the agreement level. There are five ES wall and bank restoration and repair options. The options are categorised according to scheme type and boundary type (Gaskell, 2024a).

Countryside Stewardship

Countryside Stewardship is a voluntary scheme, managed by the RPA on behalf of Defra. Natural England provides technical advice to RPA and Defra on scheme design. CS provides financial incentives for farmers, foresters and land managers in England who deliver environmental benefits on their land by:

- Conserving and restoring wildlife habitats.
- Flood risk management.
- Woodland creation and management.
- Reducing widespread water pollution from agriculture.
- Keeping the character of the countryside.

Countryside Stewardship replaced ES in 2016 and will be incorporated into an expanded scheme as part of the new ELM schemes in 2023 and into 2024 (Defra 2023). There are two elements to CS (see Defra, 2014; RPA, 2019a & b):

- **Higher Tier**: Aimed at land that requires complex management tailored to individual sites.
- **Mid Tier**, which provides a range of options and capital items that help to deliver a broad range of environmental benefits.

There are three CS wall and bank restoration and repair options available to Higher Tier agreement holders. The options are categorised according to boundary type (See section 2.5). There are no protection and maintenance options (Gaskell, 2024b).

Cross compliance

In 2005 the SPS was introduced as part of the reform of the CAP. The SPS decoupled agricultural support from production and aimed to provide basic income support to farmers and agricultural land managers, and deliver a range of public goods. A range of cross-compliance conditions were introduced in order to avoid the abandonment of agricultural land and to ensure that it was

maintained in good agricultural and environmental condition. If a farmer failed to meet the cross-compliance conditions their payments could be reduced or cancelled altogether.

In England farmers were asked to demonstrate that they were keeping the land in Good Agricultural and Environmental Condition (GAEC) to maintain habitats and landscape features (RPA and Defra, 2005). GAEC 13 encouraged *'the retention of walls for the benefit of the landscape, wildlife and future generations',* and highlighted the opportunities provided by ES for maintenance and restoration payments. While GAEC 13 prevented the removal of stone from existing boundaries, and thereby helped to retain derelict and abandoned walls in the landscape, there was no requirement to maintain or restore the boundaries.

In the period since 2005 the SPS was replaced by the Basic Payment Scheme (BPS) in 2015, which in turn was replaced by delinked payments in 2024. And over the same period the GAEC rules for wall and bank became more nuanced and sophisticated. So by 2022, the GAEC for boundaries (GAEC 7a) included '*stone walls, earth banks and stone banks*' (RPA, 2022) (see Table 3.1). However, cross-compliance ended on 1 January 2024 and, to date, continued protection of landscape features applies only to hedgerows and Scheduled Monuments[3].

Table 3.1: Part of GAEC7a Boundaries

Stone Walls, Earth Banks and Stone Banks
Rules for stone walls, earth banks and stone banks must be followed if any of these apply: • it has a continuous length of at least 10 metres. • it has a continuous length of less than 10 metres which meets another boundary at each end. • it has a continuous length of less than 10 metres which forms an enclosure. An earth bank is a mound without a hedge, distinct from the surrounding landform. A stone bank is an earth bank faced with natural stone. You must not: • remove existing stone walls, earth banks and stone banks. • remove earth or stone from an existing stone wall, stone bank or earth bank. Rules for stone walls, earth banks and stone banks do not apply if you either: • widen an existing gateway in a stone wall, earth bank or stone bank to allow machinery or livestock access. The gateway should be no wider than 10 metres and the newly created ends finished to a vertical face • use the stone or earth removed from the stone wall, earth bank or stone bank to repair another stone wall, earth bank or stone bank on your holding which is in a better condition than the one you remove the stone or earth from • have written permission from RPA to do so, in order to enhance the environment, improve public or agricultural access, or for reasons relating to livestock or crop production. You must receive written permission from RPA before you carry out this work.

Source: RPA (2022)

ES and CS boundary option data analysis

The structure and organisation of Natural England data systems were designed to manage the delivery of AES rather than monitor the impact of those schemes. There are numerous well know challenges in extracting data from Natural England datasets (see for example Boatman and Parry, 2008; Gaskell et al. 2014, 2023; Gaskell, 2024a & b).

> *Data on uptake of the Environmental Stewardship Schemes is available through GENESIS, the IT software created to manage applications and agreements. A variety of*

[3] https://www.gov.uk/guidance/rules-for-farmers-and-land-managers#protect-landscape-features

pre-defined reports are available; bespoke reports can also be requested. Data include the area of land in each strand (Entry Level, Organic Entry Level and Higher Level), and amounts of each option. Option location identifiers vary according to the option concerned. Whole field, part field and margin options are identified by the field in which they occur, but boundary options (e.g. options for management of hedges, ditches, stone walls) are identified only at farm level, because they cannot be assigned to a specific field… Each farm has a map showing the location of options on the farm, but most of these are not held electronically; instead they are scanned from paper originals. It would be possible to digitise them for use with a GIS, but this would be time-consuming. (Boatman and Parry, 2008, p.66)

Evaluating the effectiveness of ES and CS boundary management options has to meet the following challenges (Gaskell 2024a & b):

- ES wall and bank protection and maintenance options are identified only at farm level on GIS.
- ES and CS wall and bank restoration and repair options are identified only at parcel level on GIS.
- There are issues with duplicated records in ES and CS wall and bank option datasets held by Natural England.
- There are issues with matching ES and CS agreement holders to agreement and option records.

3.2.4 ES and CS options

Environmental Stewardship

Entry level Stewardship

The following options for walls and banks were available under ELS (Table 3.2 & Table 3.3).

Table 3.2: Entry Level Stewardship (including Uplands ELS)

Option Code	Option Description
EB4	Stone-faced hedgebank management on both sides
EB5	Stone-faced hedgebank management on one side
EB11	Stone wall protection and maintenance
UB4	Stone-faced hedgebank management on both sides on or above the Moorland Line
UB5	Stone-faced hedgebank management on one side on or above the Moorland Line
UB11	Stone wall protection and maintenance on or above the Moorland Line
UB15	Stone-faced hedgebank restoration
UB17	Stone wall restoration

Table 3.3: Organic Entry Level Stewardship

Option Code	Option Description
OB4 / EB4	Stone-faced hedgebank management on both sides
OB5 / EB5	Stone-faced hedgebank management on one side
OB11 / EB11	Stone wall protection and maintenance
UOB4 / UB4	Stone-faced hedgebank management on both sides on or above the Moorland Line
UOB5 / UB5	Stone-faced hedgebank management on one side on or above the Moorland Line
UOB11 / UB11	Stone wall protection and maintenance on or above the Moorland Line
UOB15 / UB15	Stone-faced hedgebank restoration
UOB17 / UB17	Stone wall restoration

For SDA land in Upland ELS and Upland OELS, the following compulsory requirements are also relevant (Table 3.4).

Table 3.4: SDA land in Upland ELS and Upland OELS

Option Code	Option Description
UX2 / UOX2	Upland grassland and arable requirements

Higher Level Stewardship

Under HLS there are capital items for wall and bank restoration and repair (Table 3.5).

Table 3.5: HLS capital items for wall and bank restoration and repair

Item Code	Item Description
WR2010	Stonewall restoration
WRS	Stonewall supplement – stone from holding
WRQ	Stonewall supplement – stone from quarry
WRD	Stonewall supplement – difficult sites
TW	Stonewall supplement – top wiring
BS2010	Stone-faced hedge bank repair
BR	Stone-faced hedge bank restoration

In addition, there are several capital items related / supplementary to wall and bank options (Table 3.6).

Table 3.6: HLS supplements for walls and banks

Item Code	Item Description
ERC	Casting up supplement – hedge bank options
LSP	Stone gate post
WSS2010	Step over stile in a stone wall
WST2010	Step through stile in stone wall

Countryside Stewardship

The following options for walls and banks were available under CS Higher Tier (Table 3.7 & Table 3.8).

Table 3.7: CS Higher Tier capital items for walls and banks

Item Code	Item Description
BN1	Stone-faced bank repair
BN2	Stone-faced bank restoration
BN12	Stone wall restoration

Table 3.8: Highet Tier supplements

Item Code	Item Description	Parent Option
BN13	Top wiring – stone wall	BN12
BN14	Stone wall supplement – stone from quarry	BN12
BN15	Stone wall supplement – difficult sites	BN12
FG13	Stone gate post	BN2, BN12

3.2.5 Definition of walls and banks

None of the handbooks or manuals define what a wall or bank boundary is. Options that could be used for the maintenance, repair or restoration of wall boundaries are included in the ELS and OELS options EB4/OB4, EB5/OB5, EB11/OB11, UB11/OUB11 and UB17/UOB17; however, the option descriptions are for 'stone-faced' banks or hedgebanks and 'stone walls'. Furthermore, although many of the prescriptions are appropriate for the repair of dry stone walls, they also permit use of mortar in certain circumstances. This suggests that the options are not exclusively for dry stone walls and that the options were intended to be used more broadly for any walls or banks that are identified as historically important features of the landscape.

Similarly, there is no definition of 'field boundary'. Options for walls and banks appear under the detailed management prescriptions for 'B options for boundary features management' for entry and organic entry level stewardship. However, although the introduction states that 'field boundaries are important elements of the countryside as landscape and historic features; for wildlife habitat and for stock management and shelter' it goes onto say 'hedges across long, steep slopes may reduce soil erosion as they intercept and slow surface run-off water before it builds into damaging flow, particularly where there is a margin or buffer strip alongside.'[4] Although it can be assumed that references to field boundaries throughout the handbooks are applicable to all types of field boundary, it is not clear if this was the intention or the term is used principally for hedges.

It is also not clear exactly what walls these options could be applied to. Internal field walls, such as sheep folds, are also eligible under EB11/OB11, UB11/OUB11 and UB17/UOB17. However, it is unclear whether this is also true for BN1, BN2 and BN12 or if these are only eligible for field boundary features, as appears to be the case for EB4/OB4 and EB5/OB5. It is unclear if other stone structures within a field system associated with its functionality – such as stone sluices – would have been eligible for EB11/OB11, UB11/OUB11, UB17/UOB17 or BN12 and relevant supplements.

3.2.6 Definition of key terms

There are several key terms within the ELS and OELS handbooks that do not have clear definitions in relation to walls or banks. These include management, maintenance, protection and restoration. This is true also of the manuals and guidance accompanying CS.

[4] Natural England (2012) *Entry Level Stewardship: Environmental Stewardship Handbook*. p.44; Natural England (2012) *Organic Entry Level Stewardship: Environmental Stewardship Handbook*. p.45

The HLS handbook does provide some guidance in section 2.1.2 'what is the difference between the maintenance, restoration and creation options?'[5].

- Maintenance options apply to features that are already in 'good condition'. Management under 'maintenance' options are expected to maintain the 'status quo', with limited scope for enhancing the environmental interest.
- Restoration options apply to features that have been identified as present but not in 'good condition'. It states that 'more positive management will be necessary and certain activities will need to stop, in order that, over time, the feature is restored.'
- Creation options are not applicable to wall and bank options in ES, as they are 'limited to the circumstances where a need for habitat creation has been identified.'

Although this gives some indication as to the different scenarios in which the options might apply, these definitions rely on the term 'good condition' to qualify them, which has its own limitations.

3.2.7 Eligibility and scope

The introduction to the detailed management prescriptions for 'B options for boundary features management' under ELS and OELS[6] contains detailed eligibility criteria and specifications for hedges. There is no equivalent for the wall or bank options that are included in this section.

For options relating to the maintenance and protection of stone walls (EB11/OB11, UB11/UOB11) the only requirement for eligibility appears in the individual prescriptions for those options, which states that the walls must be in 'good condition'. Options relating to the restoration of stone walls (UB17/UOB17) state that they are 'available for walls that require major rebuilding, where sections of the wall are unstable and may collapse and/or where sections of the wall have slumped.'

There are no specific eligibility criteria included in the HLS handbook or CS manual for capital items relating to walls or banks.

In the transition from ES to CS, the scope of works that were eligible also narrowed. The options in ES to support the management of banks and the 'protection and maintenance' of stone walls do not have equivalent options under CS. Provisions for such work do not appear to have been subsumed into the options for CS but instead omitted altogether.

3.2.8 Use of traditional and local styles

The ELS and OELS prescriptions for EB11/OB11, UB11/UOB11 and UB17/UOB17 explicitly state that the materials and construction must be of a traditional dry stone wall but permit the use of mortar when that is the traditional method of construction. It is assumed that the distinction would be based upon the relevant NCAs but the means of identifying what is 'traditional' to the area is not identified. As such, the term 'traditional' lacks a definition within the option prescriptions.

Similarly, the CS options of BN1, BN2 and BN12 discuss local styles. What constitutes a local style is not defined within the options or prescriptions. It is assumed that these styles are intended to be inferred by NCAs. However, much like their ES counterparts, this is not explicit within the option prescriptions, rendering these terms without a definition.

[5] Natural England (2013) *Higher Level Stewardship: Environmental Stewardship Handbook*. p.12

[6] Natural England (2012) *Entry Level Stewardship: Environmental Stewardship Handbook*. p.44; Natural England (2012) *Organic Entry Level Stewardship: Environmental Stewardship Handbook*. p.45

Requirements UX2 and UOX2 from ELS and OELS also contain prescriptions that specify maintenance and restoration must retain any 'tradition features', but gives more clarity than other options by stating that this includes features 'such as stiles, sheep creeps and stone gateposts'. Notably, it says these apply to dry stone walls, rather than the all-encompassing 'stone walls' of the other options. UX2 and UOX2 also prescribe that:

> *Any maintenance, restoration and repair of hedgebanks must be carried out in the traditional materials used in the original construction, including appropriately shaped and sized local natural stone, following the style characteristic to the local landscape.*[7]

Following this, there is also a prescription in relation that states:

> *Any maintenance, restoration and repair of hedgebanks must be carried out in the traditional materials used in the original construction, including appropriately shaped and sized local natural stone, following the style characteristic to the local landscape.*

The reference to appropriately sized stone used in local-style stonework suggests that 'hedgebanks' in this instance include stone-faced hedgebanks. However, the prescription also contains terms that themselves ambiguous, such as maintenance, restoration, and repair.

3.2.9 Establishing and defining condition

References are made throughout the handbooks and manuals to the requirement for stone walls to either be in good condition already (in the case of ELS and OELS maintenance options) or to be made good through repair. EB11/OB11 and UB11/OUB11 can only be applied to complete walls in ‘good condition’ while the result of UB15/OUB15 and UB17/OUB17 ought to be a relevant section of bank/wall in ‘good condition’. What constitutes ‘good condition’ is only specified in the prescriptions for EB11/OB11 and UB11/OUB11, where it is defined as:

> *A wall in good condition is at its original height to below the top stones with at least 75 per cent of top stones in place (where they formed part of the original construction) and no gaps along the entire length.*[8]

This definition does not account for the functionality or structural integrity of the wall. Consequently, it is not clear whether the works are required to make the walls stockproof again, or whether gap filling and consolidation is sufficient to be considered 'good'. Also of note is that fact that although 'traditional' construction methods are stipulated within the option prescription, it is not included within the definition of ‘good condition’. So adherence to traditional or local construction methods and appearance is not a determining factor on the assessment of condition.

None of the options relating to banks provided a definition of 'good condition'. This leaves these options without clear expectations.

A similar problem is present within CS options. Although terms such as ‘good condition’ are not used, only BN12 suggests what the resulting quality of the feature should be after the required works have been completed (stable), with no daylight shining through and suitable for the control of livestock. BN1 and BN2 simply state that to be considered successful, a length of bank will be rebuilt. Although the option prescriptions then outline the steps that should be taken for repair or restoration, there is no mention of the need for the work to be carried out by suitably skilled and experienced trades people, and a thorough understanding

[7] Natural England (2012) *Entry Level Stewardship: Environmental Stewardship Handbook*. p.42; Natural England (2012) *Organic Entry Level Stewardship: Environmental Stewardship Handbook*. p.44

[8] Natural England (2012) *Entry Level Stewardship: Environmental Stewardship Handbook*. p.50; Natural England (2012) *Organic Entry Level Stewardship: Environmental Stewardship Handbook*. p.52

of the expectations of post-completion condition of the bank is not evident from the option prescription.

The emphasis on height as an indication of condition is problematic as it does not account for the overall stability of the structure. This specifically hinders CS options BN1 and BN2, which can only be applied to banks which have lost over 50% of their height. This could discourage landholders from taking proactive measures to repair and consolidate such features at an earlier, less expensive, stage.

Although the degree of completeness is the only straightforward way to measure the condition through the records which are stipulated in CS options BN1, BN2 and BN12 (pictures taken prior to, during and after the works) such records are insufficient as to inform on the true condition of the wall. Stability of masonry and the requirement for consolidation can only be informed by onsite inspection from a suitably experienced or qualified individual. It does not appear that an onsite inspection is specified by any of the above options.

3.2.10 Post-completion maintenance and monitoring

In none of the options does there appear to be a prescription for post-completion monitoring or maintenance work programmes. This type of stipulation in grant funding protects the financial investment that has been made. Without additional monitoring after the completion of works, there seems little to prevent the walls and banks from degrading and requiring additional restoration and repair.

3.2.11 Contribution to the historic environment and wildlife

For ELS and OELS, the handbook references the importance of walls and banks as habitats and historic assets in their own right. However, their maintenance and restoration are only identified as a priority for protecting and enhancing the landscape. This underplays their importance beyond just being landscape features, a factor that is recognised elsewhere in the handbook, for example:

> *This option supports the restoration of these banks to maintain them as features in the landscape, and to benefit wildlife – UB15 / UOB15*
>
> *Stone walls of all types are important for stock management and as landscape and historic features. They are also potentially important habitats for lichens, mosses and ferns, invertebrates, reptiles, birds and small mammals – EB11 / OB11 / UB11 / UOB11*

The introduction to the detailed management prescriptions for 'B options for boundary features management' under entry and organic entry level stewardship[9] states that 'field boundaries are important elements of the countryside as landscape and historic features; for wildlife habitat and for stock management and shelter.' Although on a first glance this would appear to relate to all types of field boundaries, it goes on to say 'hedges across long, steep slopes may reduce soil erosion as they intercept and slow surface run-off water before it builds into damaging flow, particularly where there is a margin or buffer strip alongside.' Unfortunately, this skews the message towards hedges and is a missed opportunity to highlight the importance walls and banks also have in this regard.

In the same section of the higher level stewardship handbook setting out the detailed management prescriptions, only hedgerows and ditches are mentioned. This is possibly

[9] Natural England (2012) *Entry Level Stewardship: Environmental Stewardship Handbook*. p.44; Natural England (2012) *Organic Entry Level Stewardship: Environmental Stewardship Handbook*. p.45

because there are no management options relating to walls and banks, only capital items. However, no similar information is given in the capital items section. As such, there is no indication of the significance of walls and banks for HLS.

In CS, the prescription for BN12 highlights the role of walls in providing habitats and they are considered a positive for biodiversity. However, this acknowledgement is not seen in the relevant bank options, BN1 and BN2, and as such contrasts ELS and OELS.

With all this in mind, the importance of walls and banks as more than functional features of the landscape is hinted at but not fully recognised within all ES and CS options. Considering this, as well as the fact that walls and banks do not feature on modern HEFER (historic environment farm environment record) mapping, it does appear as though these have not been considered as heritage assets in their own right, and recognition for their contribution to other ecosystem services is limited.

3.3 Rapid review of previous research

3.3.1 Introduction

This section will cover:

- Academic papers and reports on importance of walls and banks in terms of agriculture and landscape character over time, drawing upon their historical context.
- Academic papers and reports on the condition of walls and banks in England.
- Role and importance of walls in 21st century land management in terms of agriculture and landscape character, and the extent to which they contribute to local economies and heritage and craft skills.
- Natural and social ecosystem service flows provided by walls and banks.

3.3.2 Academic papers and reports on importance of walls and banks in terms of agriculture and landscape character over time, drawing upon their historical context

The history of walls and banks in England dates back to the 2nd millennium BC (LUC, 2007) and they create much of the character of upland landscapes (Winchester, 2016). In many NCAs these boundaries make a significant contribution to landscape character (see section 5). Over the centuries there have been many periods of wall and bank building. From the piece meal enclosure associated with land improvement and livestock management, the enclosure of open arable field systems from the 14th century onward, to the Parliamentary enclosures of the 18th and 19th centuries. There is often a complex pattern of field boundaries from different eras occupying the same landscape (LUC, 2007).

Interest in the evolution of landscapes containing walls and banks stretches back to at least the 1940s. Raistrick (1946) investigated the history of wall boundaries in the Pennines, and Rollinson (1972) described regional patterns of wall boundaries in the Lake District. Brooks (1973) wrote a thesis on walls and wall building in West Yorkshire and Mitchell (1992) studied wall boundaries in the Yorkshire Dales. More recently Beaumont (2006) and Budge et al. (2008) have studied the history of wall boundaries in the Yorkshire Dales National Park (YDNP) and Mendip Hills National Landscape respectively, and Winchester (2016) has written about the history and heritage of wall boundaries at a national level. There have been fewer studies of the evolution of landscapes containing bank boundaries. Rule (1974) studied the hedge banks of Mid and West Cornwall and Menneer (Undated) has described the construction and character of Cornish hedge banks.

The development of Landscape Character Assessment (LCA) and Historic Landscape Characterisation (HLC) approaches from the 1980s onwards has given a new impetus to the study of walls and banks and their relationship with the landscape (see for example Clark et al., 2004; English Heritage and Countryside Agency, 2006; YDNPA, 2008). In such studies field patterns and field boundaries become important elements in defining landscape and historic landscape character:

> *During the thousands of years over which the English landscape has been farmed, each generation has used its own techniques and customs to win produce from the land. In the passage of time, Bronze Age fields have been subsumed within medieval field systems that have in turn been reorganised by private enclosure or Act of Parliament; these later enclosures have been amalgamated and modified to suit mechanised farming. This has not been a uniform process of change. In some places, the earliest field patterns survive as earthworks, abandoned as climate or population changes forced once-productive land into rough pasture, heathland or moor. These earthworks can now appear as patterns of banks or terraces (lynchets) cut into the hillside. Traces of medieval and earlier land tenure are to be found everywhere, surviving in the irregular boundaries of fields formed by piecemeal clearance of woodland and in the sinuous boundaries of the long curves created by medieval ploughing. Boundaries marked by hedges and walls are often the oldest features in the countryside still in use today. These include prehistoric field walls in areas of marginal farming and Saxon hedges dated by charter and species count.* Trow and Tunnicliffe (2007, p12)

Historic England has also published farmstead and landscape statements for all of the rural NCAs which combines an analysis of field and farmstead patterns to identify the historic character of traditional farmsteads and how they relate to their surrounding landscapes[10].

3.3.3 Academic papers and reports on the condition of walls and banks in England

The underlying, but rarely stated aim, of much agri-environment policy in England has been to protect and enhance the post-enclosure landscape of the late 19th century. This was a vernacular landscape, dominated by local styles and materials, which had evolved over the centuries and often describes, able it rather loosely, as the 'traditional agricultural landscape'.

Until the Second World War the general consensus in England was that a prosperous agriculture sector would maintain the character of the countryside and the valued features within. Threats to the countryside were seen to emanate from uncontrolled urban expansion and non-agricultural activities encroaching on rural land and these would be kept in check by the land use planning system. Therefore, there was no reason to control agricultural land management or incentivise farmers to manage their farms in an environmentally friendly way, as good agricultural and environmental management was perceived as synonymous. However, during the post-war period the agricultural industry in England has been transformed through the processes of land-use intensification, enterprise specialisation and farm enlargement, and as a consequence the maintenance of valued countryside character is no longer necessarily a by-product of agricultural production.

The environmental impacts of the post-war transformation of agriculture started to be noticed in lowland arable farming systems the 1960s and 1970s where rapid landscape change was taking place through the removal of hedgerows, the felling of woodlands, the ploughing and reclamation of low intensity grassland and the construction of new agricultural buildings (see for example, Westmacott and Worthington, 1974; Beckett, 1975). In upland landscapes, where most walls and banks are located, the environmental impacts of changing agricultural practices were often more subtle resulting from lack of management rather than active removal. In the case of field boundaries, there

[10] https://historicengland.org.uk/research/current/discover-and-understand/rural-heritage/farmsteads-character/

was often a contrast between the active removal of hedgerows to create larger fields in the intensifying lowlands and the abandonment of maintenance of walls and banks in the uplands where farm enlargement and extensified livestock management systems were common processes. However, by the late 1970s and into the 1980s researchers were paying greater attention to the changes taking place in upland landscapes (see for example, ITE, 1978; Sinclair, 1983; Woods, 1984).

During the 1980s there was also a growing interest in developing methods and techniques to quantify the extent of field boundaries at a national level and provide estimates for the length and condition of different types of boundary (see for example, Barr et al., 1986; Hunting Surveys and Consultants, 1986; Countryside Commission, 1991, 1996; Gaskell and Tanner, 1991; Barr et al., 1993; ADAS, 1994; House of Commons, 1998).

However, the majority of resources were focused on determining the nature of change taking place to hedgerows in lowland landscapes. This was manifest in a number of ways, whether it be the underrepresentation of upland landscapes in the time-series data collected by the Countryside Survey programme (see Barr and Watkins, 2001) or the subjugation of walls and banks below hedgerows in calculations of boundary lengths (see Petit et al., 2003). In 1996 the Countryside Commission lamented that:

> *After hedgerows, stone walls are arguably our most notable traditional field boundary. Although lack of management, dereliction and loss of hedgerows have been the subject of extensive public debate, the condition of dry stone walls have had a comparatively low profile.* (Countryside Commission, 1996).

Previous surveys of walls and banks in England have been limited, but their total distribution has been identified as between 80,000-120,000 km of stock across the nation. This very broad estimate is testament to the lack of robust sampling procedures. A study carried out by ADAS for the Countryside Commission in 1994 (Countryside Commission, 1996), revealed the deteriorating condition of drystone walls was widespread across England and only 13% were considered to be in good condition. The report concluded that:

> *Since a very large proportion are in a poor state, the landscape impact of their future decline could be very significant. The rate of wall loss would be expected to accelerate if the condition of walls continues to worsen.* (Countryside Commission, 1996)

3.3.4 Role and importance of walls in 21st century land management in terms of agriculture and landscape character, and the extent to which they contribute to local economies and heritage and craft skills

In the UK dry stone walls have been recognised as a valued element in the landscape for some time, not only in terms of their role as boundary markers and in agricultural management but also for their impacts on the cultural landscape. More recent recognition of the cultural value of dry-stone structures (including walls and terraces) across European countries has come from the Council of Europe where the significance of dry-stone structures has been included in the European Landscape Convention of the Council of Europe (Council of Europe 2019). The adopted Memento makes reference to utilisation of local resources, the value of local knowledge and 'know how' impact on landscapes, capacity for controlling erosion and water run-off, and contribution to rural sustainability.

In England dry stone walls are an integral part of the landscape and cultural heritage of many upland areas (Powell et al., 2018). Stone walls mark routeways, identify territorial, occupancy and tenurial boundaries, provide wildlife habitats and corridors, separate rough grazing from meadows, pastures and arable land and enable the management and movement of people and livestock. Dry stone walls remain a dominant form of enclosure in upland areas where the stone resource tends to be readily available, they influence the landscape and are appreciated by residents and visitors, and they

contribute to local employment (Winchester 2016; Powell et al., 2018). Despite their longevity in the landscape and continued agricultural use a report on landscape change in the National Parks of England and Wales during the 1970s and 80s indicated overall reduction in the length of both hedgerows and stone walls (and an increase in fencing). The extent of change varied across national parks and the rate of change altered over the time period (Countryside Commission 1991). More recent work suggests a continuation in decline, though slowed somewhat by agri-environment schemes providing financial support for maintenance and restoration.

As noted in earlier work (Powell et al., 2018) the existing stock of dry stone walls in England reveals wide variation in terms of age (can be traced back over 2,000 years, but which is predominantly of late 18th and 19th century date); function (mainly livestock and crop management); local economic impacts, including local employment); and, contribution to landscape character, due to the pattern, density and survival of dry stone walls in the landscape. Maintenance issues and costs were also shown to vary according to construction mode, local geology and topography including soils, and the economics and nature of modern farming. In areas where dry stone walls retain agricultural value regular maintenance occurs from regular gap maintenance to complete re-building, contributing to local rural economies and providing employment, in addition to contributing to the more intangible cultural values of landscape and place. Aspects that are starting to be recognised more widely across Europe (Council of Europe, 2019; Feroldi et al., 2021; Agnoletti et al., 2015)

Valuing dry stone walls

There is limited evidence in the literature of valuing dry stone walls. Early work utilised contingent valuation methods (CVM) to value elements in the wider landscape (Willis and Garrod, 1993) noting a preference among survey respondents for the status quo when exploring options for landscape change. In early studies walls and hedgerows tended to be considered together under the broader heading of 'field boundaries' rather than valued as independent aspects of the landscape influencing the value of the natural capital stock. More recent studies have revealed underlying values among local populations for dry stone walls and also the more familiar potential for bias in CVM approaches associated with payment vehicles (a tax) and provision of information to survey participants unfamiliar with valuing public goods (Pappalardo et al., 2022).

The concept of 'countryside capital' was developed as a means of exploring rural sustainable development and identifying the level and need for investment in natural, social and economic capital, in attracting and addressing the impacts of tourism (Garrod et al., 2006) and more recent studies have begun to explore agricultural landscape preferences in different settings (Van Zanten et al., 2016) and the role of nature-based-tourism on rural economies (Iversen et al., 2023) noting that large scale changes can alter the potential for nature-based-tourism. The concept of natural capital has developed alongside wider adoption of ecosystems services approaches to investigate rural issues where natural, social, cultural and economic capital are closely integrated. Valuing natural capital, however, has proved elusive with studies tending to focus on individual elements of natural capital rather than exploring the integrated systems that exist. Natural capital is not just a stock resource that generates multiple benefit streams over time but a complex system integrating social and natural processes where changes in one area (e.g. technology or climate) can have far reaching implications for quality of the stock and the benefits generated.

Previous work valuing dry stone walls (Powell et al., 2018) utilised an ecosystem services approach, assessing value in terms of the benefit streams generated over time for different types of stakeholder within distinct areas. Benefits included contributions to:

- Biodiversity.
- Agricultural management and understanding of historic and present land management.

- Landscape character and local distinctiveness.
- How landscapes are experienced and perceived by people.
- Sense of place and well-being.
- Understanding of the historic functions of dry stone walls.

Valuation was based on examination of the functions performed by walls within specific localities and the outcomes for different types of stakeholder category, which can range from supporting livestock management to providing wildlife habitat and a sense of place to residents of the area. Functions were identified and categorised according to the concepts of ecosystem services, in other words the notion that aspects of the environment provide a range of supporting services that benefit society and the environment on which it depends. The functions are envisaged as services generated by the existing stocks of capital: natural, cultural, social, economic (see Figure 3.3) and captured using a return on investment framework incorporating levels of investment as well as measuring outcome values.

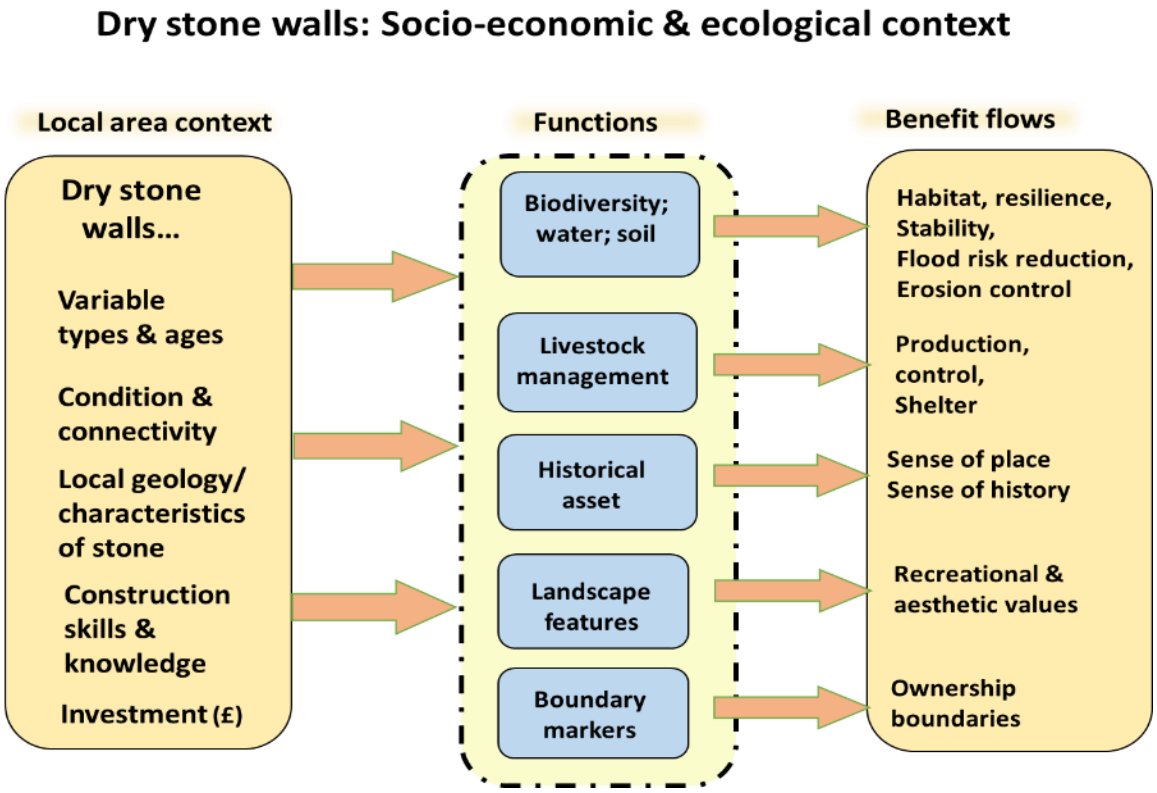


Figure 3.3: Functions and benefit flows from dry stone walls

Values were generated using a cost-benefit analysis (CBA) approach based on a return on investment (ROI) model based on the New Economics Foundation framework (New Economics Foundation, 2008; SROI Network (2012) for assessing SROI. The approach is thus a form of CBA whereby 'flows' or 'streams' of costs and benefits are valued over a specific time period, and compared on a present value basis (using discounting) to provide a ratio of overall costs to overall benefits over the period of interest. The framework utilises a surrogate methodology for assigning market values to ecosystem services that do not have market prices.

The 2018 study was limited to testing of the ROI approach in three areas of the Peak District National Park (PDNP) where sample sites were selected to explore the variability of walled landscapes in terms of geology, condition and utilisation. Model outputs revealed a pattern of present values across the sample sites over a 50-year time horizon (discounted at 3.5%) which matched expectations based on field assessment of the walls in each area. Highest rates of return (9.96:1 in the Tideswell area) related to a greater density of dry stone walls compared to the other areas, in better condition, and with a more significant impact on the landscape (Table 3.9). Cultural heritage indicator scores were also higher due to strong inter-relationship with other historical assets and legibility.

Table 3.9: Summary output data from the accounting model (dry stone walls)

Defined Area	Total Present Value of ecosystem service benefit flows (£) (50-yr time horizon)	Total Present Value of maintenance costs (£) (50-yr time horizon)	Benefit-Cost Ratio (£)
Ughill Case Study Area (Dark Peak)	£4,538,915	£999,428	4.54
Tideswell Case Study Area (White Peak)	£36,722,574	£3,688,365	9.96
Flash Case Study Area (SW Peak)	£1,155,123	£1,102,310	1.05
PDNP Overall	£192,114,930	£113,660,444	1.69
PDNP value: aggregated from case study areas	£668,710,418	£136,056,590	4.91

Source: Powell et al. 2018

The Flash area in the South West Peak District had the lowest benefit to cost ratio (1.05 to 1). The area is characterised by a shorter overall length of wall, walls in poorer condition with significant gaps and areas of collapse giving the landscape a neglected appearance in places. As revealed more recently in relation to large scale changes in woodland cover in upland areas (Iversen et al., 2023) key elements of landscape can influence people's sense of place and diminish cultural values.

More recent work (Azzopardi et al., 2023) has explored the inter-related nature of heritage and environmental values in relation to ecosystem-based approaches. The paper attempts to link heritage and environmental values utilising the 'Life Framework of Values' (Kenter and O'Connor, 2022). The study noted that heritage and environment are closely entwined, with people valuing the environment they live in as heritage and a way of creating meaning in their environment and suggesting that it is heritage that 'underpins natural, economic and socio-cultural value'. The paper also emphasised that case study participants "…did not meaningfully distinguish between cultural and natural heritage; the environment was not only a setting for human-made heritage objects but was itself valued as heritage".

In practice, beyond emphasising the importance of accounting for multiple stakeholder perspectives on heritage values, the approach is of limited utility as it does not address issues of who benefits from changes in the quality and/or quantity of the stock of natural capital, nor how those changes should be valued. The 'value concepts and indicators' put forward for measuring heritage value have already been largely integrated into the 2018 valuation model described above (Powell, et al., 2018)

while the ecological and 'biocultural diversity' values are rather limited, relying on assessment of 'existence' and biodiversity value, which tends to rely on some form of contingent valuation approach.

Monetisation of existence value has proved problematic for environmental economists with approaches limited to willingness-to-pay (or accept) surveys of individuals, or deliberative approaches that attempt to reach some form of group or societal consensus. All approaches face similar problems of income constraints, information bias, protest bids (e.g. beliefs that the good or service is invaluable, cannot be priced, or is not for sale) and embedding (for example, assessing the value of a single species compared to the whole). Part of the problem stems from trying to measure the value of the capital stock, rather than the benefit streams generated, and partly from limited understanding of socio-ecological system linkages, operations and resilience.

3.3.5 Natural and social ecosystem service flows provided by walls and banks

Introduction

The majority of literature reviewed for this project relates to dry stone walls. All of the UK and Ireland based literature accessed and explored to help identify and assess the ecosystems services and benefits generated relate to dry stone walls. In addition, some of the European references refer to a wider range of drystone forms of architecture, which includes walls, buildings, and more importantly hillside terraces (particularly in Mediterranean areas). Terraced hillsides where the terraces are supported by stone embankments and/or walls are identified as important cultural landscapes where they occur.

While there is quite a large body of literature and research on England's hedgerows very little information was found in relation to the dominant types of bank in the south-west of the country:

- **Devon banks** typically consist of an earth bank, often faced with stone or turf, and usually planted with hedges. They vary significantly in construction although the standard bank has a ditch running along one side (formed when removing earth for the bank) a steep concave side to deter access by animals. The hedge on top is an integral part of the structure and is often maintained through traditional methods like laying or coppicing.
- **Cornish banks**, also known as Cornish hedges, are generally more substantial and distinctive than Devon banks. They are built with stone, often in a dry stone walling style, with soil packed between and vegetation growing on top. They also tend to be narrower and more vertical than Devon banks, with a more formal stone appearance.

Significant ecosystem services noted in the literature relate to the cultural heritage (Hoskins, 1943; Tieskens et al., 2017;), livestock management (Devon Hedge Group, 2025) and contribution to biodiversity (Wolton et al., 2013; Wolton, 2018), suggesting in each case that the benefit flows generated may potentially exceed those from dry stone walls (see Section 3.5). In Devon and Cornwall many of the banks pre-date the enclosure period having formed a valued cultural landscape for a longer period than other parts of England (Turner, 2004; Stanes, 2009). In terms of their value in agriculture banks are identified as providing higher levels of shelter from wind (winter) and shade (summer) for livestock compared to dry stone walls.

Stone-faced banks form a more complex landscape feature than dry stone walls, consisting usually of at least 3 elements: a ditch; an earth/stone raised bank, and a hedgerow comprised of multiple species (there may also be trees present). Ecologically they tend to be much richer, providing habitat and food for a wider range of plants, insects, reptiles and fauna than dry stone walls.

The only research cited in the literature providing detailed assessment of ecosystem services provided by banks is that by Wolton, which focuses mainly on the supporting and provisioning

services. References to cultural services are drawn from the more historical literature which provides some indication of the age of banks and their historical value, but not from an ecosystem services perspective. Given the complex nature of banks, their significance in terms of ecosystem services generated in South-West England, and the lack of clarity on the level of public and private investment, it would be beneficial to support some research to ascertain the value of the various benefit flows. This could be done through a modified SROI model that focuses on the resource inputs into construction, restoration, repair and maintenance of banks, and the variability in benefit flows generated.

Provisioning services

Recent studies have explored in more detail some of the service flows generated by dry stone walls. In terms of provisioning services Powell et al. (2018) noted the principal past and present functions of dry stone walls in the Peak District relate primarily to agricultural management of the land:

- Manage different types and ages of livestock.
- Act as permeable barriers to shelter livestock and crops.
- Organise livestock close to settlements and farmsteads or in areas of open grazing, typically in small and inter-connected paddocks or in circular pounds.
- Mark out individually-managed blocks of land, as distinct from the communal management of unenclosed land and strips within in-bye land.
- Enable blocks of land to be managed efficiently and productively for pasture and cropping.
- Take stones cleared off land for grazing and cropping.
- Mark out estate and other territorial boundaries - parishes, manors and parkland.
- Prevent livestock from encroaching into woodland, limekilns and industrial sites including lead rakes.

Economic values are based largely on the improved efficiencies of livestock management, as well as providing shelter during bad weather. The level of maintenance and continued demand for restoration also provide employment, contributing to local economies and maintaining the traditional local skills. Courtney et al. (2007) explored the social and economic impacts of grant-funded traditional farm building and dry stone wall restoration in the YYDNP over the 1998-2004 period accounting for 191 km of wall restoration. They estimated the magnitude of income effects to the wider local economy to be around £6.42 m - £7.10m for the period and suggesting that walling schemes are likely to have generated between £3.46 m and £5.41 m within the wider local economy through direct, indirect and induced effects and creating 19.0 FTEs.

Supporting services

Supporting services largely relate to the underlying processes and linkages supporting biodiversity and functioning of ecological systems. Previous valuation work on dry stone walls has been limited in its assessment of ecological value due to lack of information regarding its role in supporting biodiversity, and the effect of geology and construction on habitat availability (Collier, 2012). The ecological value of dry stone walls can be described from two perspectives:

- The ecological value of the individual wall as a habitat for various animals and plants.
- The wider ecological value created through the network of walls in the landscape; walls can form ecological ‘stepping stones’ in the landscape among other structures, such as rough pasture and improved fields.

In both instances walls can support wider biodiversity of an area and provide habitat for flora and fauna (Stonewalls, 2024). Research in a variety of European countries has focused on the biodiversity value of dry stone walls (IUCN, 2020; Manenti, 2014) which includes mosses and lichens, insects, amphibians, reptiles, small mammals and birds, as well as regulating the micro-climate and providing ecological corridors and protection from predators. The ecology of dry stone walls remains an under-researched area with limited understanding of their role or value in biodiversity provision across the wider landscape (Collier, 2012; Hollingsworth and Collier, 2020). Recent studies on limestone walls in Ireland have shown that Bryophytes and lichens dominate the vegetation but are strongly affected by the local micro-climatic character (Ruas et al., 2022). It was also suggested that Bryophytes and lichen cover could be used to define the wider habitat quality of dry stone walls and that changes in some farm management practices could enhance habitat quality. Whether these results could be applied to other areas where the underlying geology is different is unknown. Little ecological work appears to have been accomplished beyond studies of limestone walls in Ireland and some Mediterranean locations. This is likely to result in continued potential undervaluation of the ecology of walled landscapes.

Regulating services

Relatively little work has been carried out on the potential for dry stone walls to regulate ecological systems. Some limited evidence suggests walls can play a role in flood management through slowing down rainfall run-off (which may be of value where climate change is predicted to increase storm intensity) but there is limited evidence of where and when this might generate positive outcomes. Reductions in soil erosion have also been put forward as a regulating benefit, although this is largely dependent on the local context. In Mediterranean countries and alpine areas, where stone walls have long been utilised for terracing hill sides, soil maintenance and prevention of erosion are clear benefits, enabling local people to farm the land sustainably over long time periods (Agnoletti et al., 2015; Bertolino and Corrado, 2021).

In the UK, where the majority of dry stone walls are in upland areas of permanent pasture or rough grazing, and utilised mainly for livestock management, soil erosion is not an issue. Dry stone walls, however, can provide other localised regulating services such as livestock shelter from wind and bad weather. Farmers in the Peak District, for example, have noted the value of shelter in enabling lambing to occur outside (on lower slopes), and in protecting livestock from storms in winter and providing shade in summer. Walls also have the potential to affect the micro-climate in their immediate vicinity, enabling different plant and insect species to flourish.

Cultural services

Cultural ecosystem services are a more complex area of assessment and valuation, partly driven by disagreements over what constitutes a ‘cultural service’. The most immediate and visible impact of dry stone walls tends to be on the landscape. A walled landscape has a clear influence on the landscape character. A walled landscape may have developed over long periods enabling social and economic development to be traced through the location, characteristics, and construction of walls, providing a sense of place as well as of history and belonging for local residents. A walled landscape can be regarded as an expression of human-nature interaction and valued by both local residents and visitors for its aesthetic appearance and value but unless people are aware of their existence the cultural heritage values will not be appreciated (Feroldi et al., 2021).

Recent studies have revealed the close relationship between cultural and natural capital in generating heritage values in a range of European countries. In Slovenia an exploration of natural and built elements in the landscape revealed a close association between built elements (including dry stone walls), local identity, heritage and traditional knowledge (Kostanjšek and Golobič, 2023). In southwestern Poland dry stone walls fulfilled multiple objectives in creating a cultural landscape, including marking territorial boundaries, providing protection from wind and water erosion of arable

fields, and acting as a record of historical change (Duma at al, 2020). In Italy, Assandri et al. (2018) identified close relationships between agricultural practices, stone walls and bird conservation in shaping a cultural landscape based on viticulture. Aesthetic and cultural heritage landscape values were closely linked to the biodiversity (bird species richness) indicating the need for integrated management approaches to attain multiple objectives.

Monetising cultural values is difficult due to the interrelated nature of ecological and cultural ecosystem services. A range of revealed and stated preference techniques have been applied to assess landscape values, including, for example, travel cost, hedonic pricing (Garrod and Willis, 1992) and Willingness-to-pay (WTP) (contingent valuation and choice experiment approaches) (Hanley et al., 1998). UK studies started in the early 1990s when contingent valuation methods were seen as a means of valuing non-market goods and services and improving policy decisions.

Hasund et al. (2011) utilised a choice experiment to determine the marginal willingness to pay (MWTP) for 28 agricultural landscape attributes in Sweden. Stone walls were found to have the highest value among various linear field elements with a MWTP of 240 SEK per year. This was interpreted as meaning that participants in the study were willing to pay this amount in extra tax to obtain a landscape with this linear element.

3.4 Review of GIS sources, methods and techniques

3.4.1 Introduction

This section will cover:

- Remote-sensing methods for determining boundary type and condition.
- GIS datasets.
- Artificial Intelligence (AI) technology-based methodologies.
- Areas for improvement on methods and datasets.

A working definition of wall condition

As part of agri-environment monitoring in the 1980s and 1990s, ADAS (1994) developed a method of field-based visual assessment of the condition of stone walls to create a baseline of evidence. This included defining discrete lengths of wall for survey by creating 'nodes' where walls join other boundaries or where they terminate. The ADAS survey adopted a slightly amended version of condition categories used by the Dry-Stone Walling Association of Great Britain, with the only major change being the removal of Category G (no wall present) (see Table 3.10).

Table 3.10: Condition categories developed for a national survey of dry stone walls in ESAs

Class	Condition	Summary description
A	Excellent condition	Full height wall, no gaps, does not require maintenance
B	Sound with minor defects	Minor structural defects, repair or replacement of some top stones required. Not in danger of collapse.
C	Major signs of advancing or potential deterioration	Structural defects which require major repair or rebuilding, may be in danger of collapse. Up to 40% topstone missing.
D	Early stage of dereliction	Gaps in wall - up to one-fifth of wall length
E	Derelict wall	Gaps on over one-fifth of wall length.
F	Remnants of wall	Totally derelict, much stone removed or buried.
G	Wall removed	No signs of wall or part wall.

Source: LUC (2007)

The LUC study developed a method for determining whether particular stone walls are of historic or landscape importance in the knowledge that the guidance produced may be used by farmers, Local Authorities and the RPA to support GAEC.

3.4.2 Remote-sensing methods for determining boundary type and condition

Identifying presence of individual field parcels

Digital land parcel boundary data were used as starting point to map boundary features. There are standardised, accurate and precise national digital boundary datasets in England derived in whole or part from remote sensing. These are produced and maintained by Ordnance Survey (OS) (as part of their MasterMap data series) and the RPA (for all field parcels in England); both are licensed products, that are available for use by Defra and its Arm's Length Bodies (ALBs).

There are situations where licensed national boundary datasets have not been used in the mapping of boundary features, for example, UKCEH Land Cover Plus: Hedgerows (2016-2021) England Dataset (LCPHE) (Broughton et al., 2023). A classic method, typically used in this situation, is to establish the location of boundaries using edge detection on a time-series of optical satellite imagery. The time series is important as it increases the possibility of cloud free coverage being available for analysis.

In New Zealand, North et al. (2018) used SPOT (Satellite Pour l'Observation de la Terre) imagery to identify linear features that surrounded regions of low spectral variability throughout the time series. This was achieved by calculating the standard deviations through a moving window for each image, averaging the results to create a single composite, and applying 16 directional filters to identify potential boundary lines. These were then thresholded and combined into a single boundary layer.

This method is robust and transferable on the assumption that there are significant spectral differences through time across adjacent fields. Success is less likely in upland environments characterised by subtle changes in land cover during the year. Furthermore, it does not identify the type of boundary in place, only the presence of a land parcel boundary. Machine learning from a RUSBoost[11] classifier (García-Pedrero et al., 2017), contour-finding, using graph-based growing (Wagner and Oppelt, 2020), and convolutional neural networks (Reda and Kedzierski, 2020) are all reliable methods for field parcel identification; although it is import to recognise that the study had access to digital field parcel data from the outset.

Identifying presence of boundary features

Methods used to remotely identify boundary features, such as walls and banks, vary based on the availability and quality of the input data and the level of information required about the features (e.g., presence of the feature of interest or categories of condition).

Lidar is routinely used to identify and delineate boundaries that have a height characteristic. Luscombe et al. (2022) rapidly quantified tree, hedgerow, woodland, and potential wall features across the UK landscape, using open Digital Surface Model (DSM) and Digital Terrain Model (DTM) lidar data.

By calculating a Canopy Height Model (CHM), user-defined height thresholds above 0.75 m were applied to classify features outside of a potential false-positive mask, into broad class descriptions. Stone walls did not occupy their own class, because the project was focused on the detection of hedgerows, with the process eliminating anything that was not a hedgerow. Walls were therefore

[11] RUSBoost is an algorithm to handle class imbalance problems in data with discrete class labels. It uses a combination of RUS (random under-sampling) and the standard boosting procedure AdaBoost, to better model the minority class by removing majority class samples.

included with other boundary features that were not of interest to the project and identified as either:

- 0.75 – 1.3 m (Scrub, Bushes, or Misc >10 m^2) or,
- 0.75 – 1.3 m (Fragmented—Scrub, Bushes, or Misc, e.g., fence / wall <10 m^2).

It was also noted that stone walls were likely to be mapped as scrub, but no quantification of this was reported.

This issue also features within the UKCEH LCPHE which also focusses on the mapping of hedgerows. In this product, 1 m resolution CHMs were thresholded above 0.5 m into height classes that are compatible with the Countryside Survey field survey hedgerow classes, and smoothed/filtered to clean the data and remove boundaries that were adjacent to land covers (such as water, moorland) that are not associated with hedgerows. It is this filtering process that removes potential walls from the output, as it was assumed that the excluded land cover classes (e.g., mountain/moor/heath) were unlikely to contain hedgerow features. Even with the filtering in place, the LCPHE model could not easily differentiate between woody features and other solid boundaries, such as walls, meaning that some walls in habitats that hedgerows are typically found in will be classified as hedgerow and so constitute as a source of error in the output.

The role and potential of AI technology-based methodologies

Advances have been made mapping walls from remote sensing using machine learning algorithms. In Connecticut, USA, 1 m lidar-derived DEMs, hillshade maps of multiple directions, slope, and land cover maps were used within two Deep Convolutional Neural Networks (DCNN) models (Suh and Ouimet, 2023). By supplementing the existing stone wall training data with manual digitisations, U-Net DCNN models were selected as the classifier, as these tend to produce high accuracy outputs with relatively limited data. Post-processing routines were applied to eliminate impervious ground cover (e.g., roads) and land cover classes that would likely contain low-quality lidar returns (e.g., conifer).

Evaluations across two test sites suggested high accuracies for mapping walls (>= 80%) against the validation data, with consistently higher accuracies associated with a greater number of input rasters (five different hillshade maps and slope data) though it should be noted that the areas where this has been explored are dominated by stone walls and not a mixture of hedge/stone wall, so the likelihood of confusion between these two classes in the output data will be low.

The two different DCNN models indicated variable performance across the test sites when compared side-by-side. However, both models were shown to have greater errors of omission than commission (for instance, walls went undetected), although better results were achieved with the inclusion of more lidar-derived data.

It was noted that stone wall-like features appeared on the hillshade images that were not stone walls (e.g., road edges and curves), and that this error cannot be controlled, only reduced through post-processing such as masking for impervious cover data. It was also noted that the angle of the hillshade models could render height features as invisible in the data if the hillshade angle matched that of the wall direction, though this reduced using a stack of multiple directional input data. Additionally, the brightness/darkness of the hillshade models impacted the accuracy of the outputs.

In Denmark, Trotter et al. (2022) used modified U-Net Convolutional Neural Networks on 0.4 m resolution lidar data. It was noted that the height data (including a CHM) was not sufficient to identify stone walls, due to the confusion with vegetation and/or dense forest, but provided context on potential locations for training data. An additional edge-detection dataset was derived from the DTM. Data Augmentation was used (where existing data is manipulated to create additional, similar data to train on) due to a low volume of training data, low transferability and relatively high

overfitting within the model. The application of Convoluted Neural Networks on all the lidar data suggested a good result (>80%) when using the DTM alone, but a higher accuracy (88%) when including the CHM and edge-detection data. It was noted that the classification performed best in open areas, and that the inclusion of optical imagery (e.g., NDVI) may help where structures have vegetation and trees growing on the surface.

3.4.3 Review of GIS sources and areas for improvement on their use

A range of GIS sources was reviewed from a practical standpoint (see Table 3.11), and areas for improvement were formulated regarding the techniques to be employed in Tasks 3 and 4 (see Table 3.12).

Table 3.11: Review of GIS sources of potential relevance to the study

Theme	GIS source	Licence	Suitability	Recommended
Field parcel	Ordnance Survey MasterMap (OSMM)	Public Sector End User Licence (PSEUL)	Highly accurate and precise dataset that defines most field parcels and many contain attributes. Road bounding walls may be included.	Essential Basemap for case study areas including PRoWs.
Field parcel	RPA Land Parcel Identification System (LPIS).	PSEUL	Highly accurate and precise dataset that defines all registered field boundaries. Matches the AES data.	Essential Digital boundaries for the case study areas: identify agreement land, node creation, tagging walls with AES and other data
Field boundary	UKCEH Land Cover Plus: Hedgerows (2016-2021) England	Depends on intended use. Non-commercial use available for an admin fee.	Only shows hedges. Uses UKCEH Land Cover spatial framework, so the spatial accuracy may not match that of OSMM or LPIS.	Optional Could be used to eliminate hedges from field boundaries and for checks of case study areas to ensure they are not dominated by hedgerows.
Access	Public Rights of Way (PRoWs)	Open Government Licence (OGL)	Accurate line feature data	Essential Task 3: To facilitate fieldwork and provide context for the evaluation.
Boundary context	National Character Areas (NCA)	Open Government Licence (OGL)	This dataset can characterise a landscape based on their likely boundary type, including 'Dry stone walls', and allows the interpreter to focus on these areas for analysis.	Suggested Task 2 (national option uptake) to inform Task 3 (select case study areas where it can be used to filter for areas that are likely to have wall features.
Stone walls	Ordnance Survey Field Boundary	PSEUL	A line feature representing the field boundary features adjacent to, or contained within, areas of agricultural land, trees, rough grassland or heath.	This is a new product by Ordnance Survey.
Land cover	Natural England's (NE) The Living England (LE)	Open Government Licence (OGL)	Land cover maps based on UK Biodiversity Action Plan Broad Habitats, with an overall accuracy of 88%.	Essential Task 3: To identify and tag land cover in case study areas. Task 4: To identify qualifying land covers likely to have stone walls present.
Land cover	UKCEH Land Cover Maps	No cost for Defra and ALBs.	As above but more time consuming to obtain	Task 3: Optional

Theme	GIS source	Licence	Suitability	Recommended
Feature Height	Environment Agency National LiDAR Programme	Open Government Licence (OGL)	Provides lidar composite data at 1 m spatial resolution across England, accurate to RMSE +/- 15 cm. DTM, DSM (first and last returns) available, which can be used to create CHM.	Essential Task 4: Can be used to model field boundaries, and identify field boundaries that have a height profile.
Imagery	Aerial Photography for Great Britain	PSEUL	High resolution aerial photography data, re-flown every 5 years. Colour-infrared bands are available to determine vegetated/non-vegetated features. There can be significant differences in the times flown from one field to another, both in season and in years.	Essential Task 3: To identify boundary type through visual interpretation (manual)
Imagery	Sentinel-2	Creative Commons CC BY-SA 3.0	Moderate resolution satellite imagery with a high repeat capture frequency.	Essential Task 4: Multi-spectral bands are available to determine vegetated/non-vegetated features. Multi-temporal imagery can be used to identify the presence of a field boundary. The resolution is too low to determine between a wall and hedge.
Wall agreement status	Collated agreement document from Natural England	n/a	Suitable but time consuming to transcribe option placement (is in scheme ES or CS) in relation to lengths of wall.	Essential Task 3: Required to identify walls in agreement

Table 3.12: Recommended classification approaches to use in the study

Classification	Outline (methods likely to be used)	Data required	Suitability	Recommended
Mixed method – manual / semi-automated	• Use existing field boundary data (LPIS) • Identify physical boundaries using lidar CHM • Manually attribute boundary with feature type (e.g., wall, etc.) • Attribute features of interest using contextual data (e.g. Land cover)	• Field boundary data • Context data (e.g., NCA, NE LE) • Lidar CHM • Aerial CIR imagery	• Works well for relatively small areas of interest, such as this, and where there is no ground survey data on the presence/absence of stone walls. • A highly accurate and precise method, but can be time and resource heavy depending on the size of the area.	Yes: Task 3
Machine learning (ML) / AI	• Pre-process input data and ground observations. • ML selection and parameterisation • Train ML model using ground observations of stone wall and physical boundary features. • Run ML model and validate outputs using ground observations of stone wall and physical boundary features.	• Field boundary data • Context data (e.g., NCA, AES) • Land cover • Lidar DTM • Lidar DSM • Lidar CHM • Lidar hillshade • Aerial CIR imagery	• Works well for relatively large areas of interest and where there is substantial ground survey data on the presence/absence of stone wall features. • Can be highly accurate depending on the quality of the input data, ground survey data, model selections and parameterisations.	Yes: Task 4

3.5 NCA profile review

3.5.1 Introduction

This section will cover:

- Brief overview of the purpose and contents of NCA profiles.
- Summary statistics on the importance of walls and banks in individual NCAs.

3.5.2 Background to NCA profiles

NCA profiles are guidance documents produced by Natural England that help communities understand and make decisions about their local landscapes. They provide useful information for planning conservation work across whole areas, support the creation of Nature Improvement Areas, and encourage joint working through Local Nature Partnerships. They also help people make informed choices about how land is looked after and how it might change in the future.

NCA boundaries are defined by the common cultural and natural attributes of the landscape, not administrative boundaries. These attributes create a consistency of character that makes one place distinct from the next. They include considerations such as geology, topography, natural landscape features such as waterbodies and trees, settlement patterns and human interventions, and land use. There are 159 are profiles across England.

Each NCA profile follows a consistent format and covers the same range of topics. The main sections include:

- **Summary**: Providing an overview of the NCA.
- **Key characteristics**: A list of bullet points highlighting the defining features of the landscape.
- **Description**: Explains how the landscape has developed over time, identifies distinctive natural and cultural features, outlines the main influences on change, and provides a general analysis of the area's ecosystem services.
- **Opportunities**: Includes Statements of Environmental Opportunity (SEOs), which suggest practical actions and priorities to protect and enhance the valued qualities of the landscape.
- **Facts and Key data**: Provides supporting information about the area's environmental and socio-economic characteristics.
- **Landscape change**: Describes how the landscape is changing, supported by evidence and context.
- **Analysis**: I Identifies key opportunities for landscape enhancement and improvements to ecosystem services.

3.5.3 Scope of review

Due to limited resources, it was not possible to review all 159 NCAs. Instead, an attempt was made to analyse the top 50% (53) of the 107 NCA areas identified in Task 2, where AES bank/wall options had been used (see Table 3.13).

NCA profiles do not use consistent terminology for stone walls and banks, so each document had to be searched using a set of key terms, including ‘drystone’, ‘dry stone’, ‘dry-stone’, ‘stone’, ‘wall’, ‘stone-faced’, and ‘banks’.

Four NCA profiles— Cheviot Fringe, The Culm, Oswestry Uplands, and Devon Redlands— contained no references to walls and banks and were therefore excluded from the analysis.

Table 3.13: National Character Areas reviewed

NCA code	NCA name	Dominant stone boundary type	AES wall/bank options
21	Yorkshire Dales	Stone wall	4,236
10	North Pennines	Stone wall	3,476
8	Cumbria High Fells	Stone wall	2,376
36	Southern Pennines	Stone wall	1,700
52	White Peak	Stone wall	1,362
19	South Cumbria Low Fells	Stone wall	1,247
53	South West Peak	Stone wall	1,217
9	Eden Valley	Stone wall	1,194
107	Cotswolds	Stone wall	972
51	Dark Peak	Stone wall	923
33	Boland fringe & Pendle Hill	Stone wall	862
150	Dartmoor	Stone-faced bank	849
17	Orton Fells	Stone wall	666
25	North York Moors and Cleaveland Hills	Stone wall	609
20	Morecambe Bay Limestones	Stone wall	582
5	Border Moors and Forests	Stone wall	560
11	Tyne Gap and Hadrian's Wall	Stone wall	540
22	Pennine Dales Fringe	Stone wall	530
141	Mendip Hills	Stone wall	486
37	Yorkshire Southern Pennine Fringe	Stone wall	468
156	West Penwith	Stone-faced bank	405
7	West Cumbria Coastal Plain	Stone wall	352
152	Cornish Killas	Stone-faced bank	352
151	South Devon	Stone-faced bank	350
34	Bowland Fells	Stone wall	330
50	Derbyshire Peak Fringe and Lower Derwent	Stone wall	280
35	Lancashire Valleys	Stone wall	277
2	Northumberland Sandstone Hills	Stone wall	272
64	Potteries and Churnet Valley	Stone wall	258
16	Durham Coalfield Pennine Fringe	Stone wall	255
12	Mid Northumberland	Stone wall	188
153	Bodmin Moor	Stone-faced bank	172
6	Solway Basin	Stone-faced bank	156
147	Blackdowns	Stone-faced bank	146
38	Nottinghamshire, Derbyshire and Yorkshire Coalfield	Stone wall	138
141	Exmoor	Stone wall	105

NCA code	NCA name	Dominant stone boundary type	AES wall/bank options
155	Carnmenellis	Stone-faced bank	100
18	Howgill Fells	Stone wall	94
65	Shropshire Hills	Stone wall	59
54	Manchester Pennine Fringe	Stone wall	54
1	North Northumberland Coastal Plain	Stone wall	54
4	Cheviot	Stone wall	49
157	The Lizard	Stone-faced bank	48
136	South Purbeck	Stone wall	46
105	Forest of Dean and Lower Wye	Stone wall	33
30	Southern Magnesian Limestone	Stone wall	28
73	Charnwood	Stone wall	28
92	Rockingham Forest	Stone wall	27

3.5.4 Definitions

None of the NCA profiles reviewed provide a clear definition of what constitutes a wall or a bank. In several cases, different terms are used interchangeably within the same profile—such as 'drystone', 'dry stone', 'sandstone rubble', and 'stone walls'—as seen in the Northumberland Sandstone Hills (NCA 2). Also, the profiles do not describe the methods of construction, size, form, or specific details of walls and banks. Instead, references to these features tend to focus on their visual significance within the landscape and their role in contributing to ecosystem services.

3.5.5 How is the significance of walls and banks reflected?

Nine out of 10 of NCA profiles (92%) specifically identify stone walls as important landscape features and 29% make reference to the importance banks (Figure 3.4). Furthermore, walls and banks are frequently mentioned throughout the profiles (Figure 3.5) as key components of the character areas.

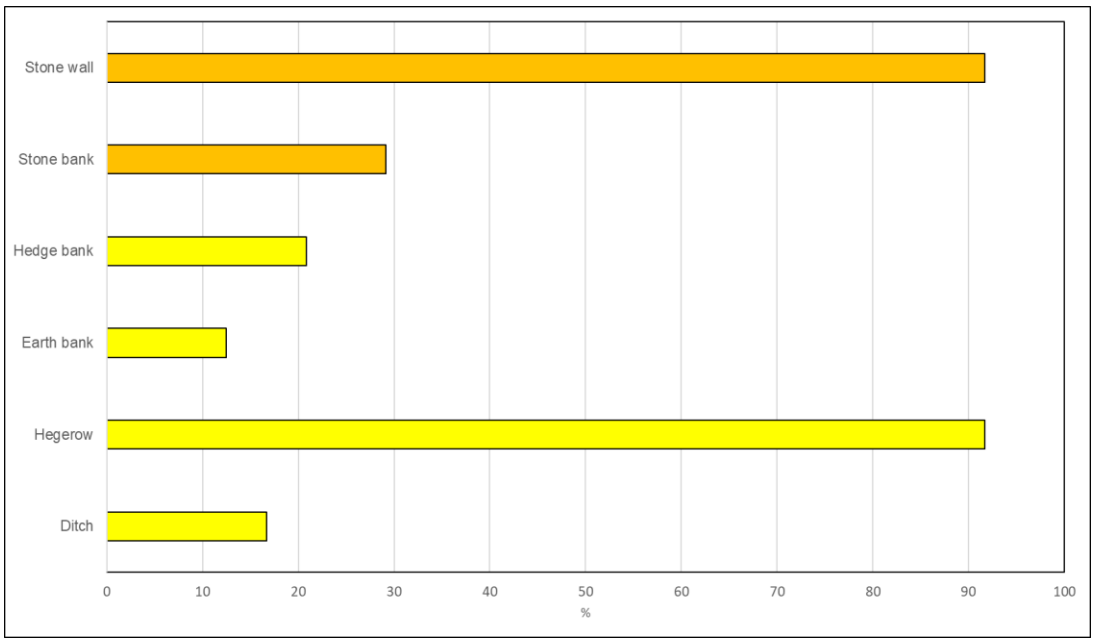


Figure 3.4: Boundary types identified in NCA profiles

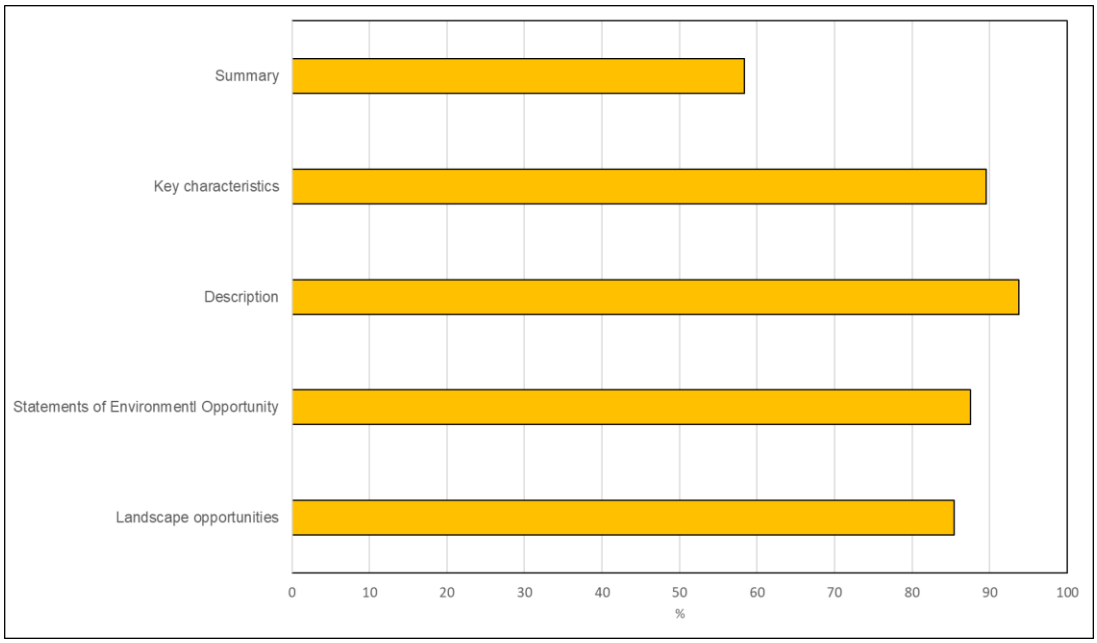


Figure 3.5: Section references to walls or banks in NCA profile documents

Walls and banks are identified as being a key characteristics of NCAs in nine out of 10 cases (89%) (Box 3.2) and 94% of profiles specifically recognise the contribution of walls and banks to the areas character.

Box 3.2 Example NCAs where walls and banks are identified as key characterises of the area

NCAs dominated by walls

***Cumbria High Fells**: Field pattern of pastoral hill-farming with small valley in-bye fields, rougher intakes/allotments on valley sides and common grazing on the open fells; separated by a network of dry stone walls.*

***Yorkshire Dales**: Large numbers of characteristic stone field barns… strong patterns of drystone walls, with very large, rectangular enclosures on fell tops, much smaller enclosures in dales.*

***Northumberland Sandstone Hills**: A mixture of piecemeal and regular enclosure, bounded by drystone walls but often broken up by coniferous shelterbelts.*

***Orton Fells**: Fields bounded by drystone walls of local limestone which… form very strong patterns and reflect historical settlement and farming.*

***Southern Pennines**: Enclosed upland pastures and hay meadows enclosed by drystone walls on the hillsides, and narrow valleys with dense gritstone settlements in the valleys, with steep slopes often densely wooded, providing strong contrast with open moorlands.*

***White Peak**: Grassland enclosed by limestone walls, with small narrow strip fields often of medieval origin around villages, and larger rectangular fields away from the villages.*

***South West Peak**: Intricate and distinctive field boundary patterns often with historic associations; gritstone walls at higher elevations and hedgerows at lower elevations.*

NCAs dominated by banks

***Cornish Killas**: A characteristic network of stone-faced earthen banks (Cornish hedgebanks), many enclosing fields in use since medieval times.*

***Carnmenellis**: Irregular ancient fields and very distinct regular 18th- and 19th-century enclosures dominated by Cornish hedges constructed from moorland boulders.*

***Dartmoor**: A strong field pattern defined by granite walls, granite-faced banks or hedgebanks – which surrounds the open moorland.*

***South Devon**: Wildflower-rich, often treeless, hedgebanks providing field boundaries and borders to the typical narrow sunken lanes.*

***Exmoor**: Older field patterns are defined by irregular hedges and stone walls. Medieval field systems occur across the area.*

***West Penwith**: A rich, internationally important cultural heritage tracing human occupation and activity from prehistory. One of the best surviving functional patterns of field enclosure originating in the Romano-British era or earlier; an ancient pattern of often tiny, irregular fields enclosed by Cornish hedges.*

Most NCA profiles (88%) contain SEOs or related additional opportunities which make reference to walls and banks, with 27% having SEOs explicitly relevant to these features (see for example, Table 3.14). These SEOs aim to conserve, enhance and restore the walls and banks that contribute to each area's unique landscape character. They promote sustainable land management, support traditional skills and building materials. The SEOs often highlight the importance of banks not only for their visual and cultural significance but also for their role in supporting biodiversity, regulating water flow, reducing soil erosion, and reinforcing local identity. They also emphasise the value of community engagement, education, and the promotion of local heritage to improve understanding, enjoyment and stewardship of the landscape.

Similar to SEOs, 85% of NCA profiles also made mention of walls and banks as either a landscape attribute or a justification for the inclusion of a landscape attribute.

Table 3.14: Example NCAs were walls and banks are identified in SEOs

NCA	SEO	Achieved by
Orton Fells	Manage and enhance the enclosed farmland with its diverse pastures, leys and meadows, dispersed farmsteads and quiet villages, strong field patterns and drystone walls, and species-rich road verges, to maintain livestock and dairy farming, the soils, and the sense of place and history, and to enhance its landscape character and biodiversity value.	• Maintaining and restoring the drystone walls, using local stone where possible and following local building styles, in particular restoring those areas of strong field patterns that retain evidence of medieval and post-medieval field systems. • Supporting traditional building skills and maintaining the strong link between geology and built form in this area by using locally sourced materials and local skilled craftsmen for both walling and building repair and construction.
Howgill Fells	Conserve and enhance the pastoral lower slopes and valleys with their complex of field patterns, hedges and drystone walls; their range of pasture types, including northern hay meadows, purple moor-grass, species-rich verges, woodlands, and waterside and boundary trees; and their dispersed farmsteads and villages, to conserve upland farming culture and to enhance landscape character and biodiversity.	• Maintaining drystone walls and hedgerows (where they are in good condition) and restoring or re-creating both walls and hedges using local stone and hedging styles (where condition has declined, or where they have been replaced by fencing), to maintain habitat connectivity and cultural influence of farming patterns in the landscape and to encourage a reduction in levels of replacement by fencing.
Yorkshire Dales	Protect the glacio-karst landscape and important geological sites, such as Malham Cove, as well as the historical environment, including drystone walls and field barns, to retain sense of place and the strong relationship between the landscape and the underlying geology.	• Encouraging restoration of built structures, particularly field barns and drystone wall networks, using local stone and traditional techniques wherever possible and allowing sympathetic conversion to new uses where appropriate. • Maintaining the area's traditional buildings and structures and the link to underlying geology by encouraging use of local materials and supporting training in traditional skills, such as drystone walling, and historic building restoration
Southern Pennines	Manage and enhance the pastoral character of the moorland fringes, lower hills and valleys, with their mosaics of pastures and meadows and their strong field patterns defined by drystone walls, to improve ecological networks and strengthen landscape character.	• Retaining and restoring historic patterns of drystone walls on the moorland fringes, on upland pastures, around farmsteads and settlements, and along tracks.
White Peak	Maintain and enhance the limestone plateau's farmed pastoral landscape with its distinctive pattern of drystone walls, dew ponds, archaeology and habitats such as hay meadows and limestone heaths, to allow a viable and sustainable farming industry that produces high-quality food and supports thriving rural communities.	• Protecting, maintaining and restoring networks of drystone walls and field barns using traditional materials, styles and techniques. • Supporting training and apprenticeships in drystone walling and traditional crafts.

NCA	SEO	Achieved by
South West Peak	Protect, manage and enhance the moorland fringes and valleys, with their mosaics of habitats including moorland, heathland, woodland, meadows and pastures, strong field boundary patterns defined by drystone walls and hedgerows, and small, dispersed settlements, to safeguard water quality, enhance biodiversity and ecological networks and strengthen the distinctive historic landscape character of the South West Peak.	• Conserving and enhancing the local building tradition expressed through vernacular buildings and strong field and settlement patterns defined by drystone walls and hedgerows, by promoting the maintenance and restoration of traditional farmsteads, listed buildings and field boundaries, and respecting the local building tradition, using traditional materials and local stone.
Forest of Dean and Lower Wye	Protect, manage and enhance the pastoral character of the farmland, with its ancient species-rich hedgerows, drystone walls and traditional orchards. Retain traditional management techniques on the network of small, neutral lowland meadows with its characteristic small-field structure and narrow winding lanes.	• Conserving, restoring and managing traditional drystone walls (and associated features and techniques), and maintaining their function in the landscape.
Carnmenellis	Conserve, manage and increase the understanding of the unique historic landscape and its geological and heritage assets, including the internationally important mining legacy, the distinctive granite tors, the prehistoric and later settlements and ritual remains, and the unique Cornish hedges and field patterns.	• Maintaining and restoring Cornish hedges, stone walls, hedgerows and other boundary features while respecting the varying pattern of ancient field systems and reflecting local variations in style and composition through careful research and using locally sourced granite. • Replacing lost Cornish hedges, stone walls and hedgerows where they can help impede cross-land water flows within the valleys, help prevent soil erosion and agricultural run-off, especially in the south where there is more arable. • Maintaining the distinctive granite landscape features of Cornish hedges, walls, crosses, standing stones and stone stiles.
West Penwith	Conserve, manage and increase understanding of the valuable and interlinked geological and cultural heritage assets including the mining legacy, recognised as part of a World Heritage Site, the distinctive granite tors, prehistoric and later settlements and ritual remains, the unique Cornish hedges and field patterns, which combined produce a unique historic and cultural landscape acknowledged as being of international importance.	• Conserving the Cornish hedges as both wildlife corridors and internationally important cultural landscape features. • Protecting and increasing understanding of the cultural and biodiversity importance of the ancient field systems and Cornish hedgerows, and how with other forms of connected habitat they reflect the millennia of changes and provide stepping stones for the area's habitats and species

Table 3.15: Example NCAs were walls and banks are identified as landscape attributes

NCA	Landscape attribute	Justification for selection
Cheviot	Large regular fields enclosed by drystone walls or dykes on higher ground and hedgerows in the valley bottoms.	Strong patterns of enclosure dating from the late-18th and 19th centuries. Walls constructed from local stone reinforce links with the underlying geology.
Cumbria High Fells	Field pattern of pastoral hill farming with small valley in-bye fields, rougher intakes/allotments on valley sides and common grazing on the open fells.	Field pattern developed from medieval period, with farming system of enclosed land in the valley and open shared common grazing on the fell. Contributing to the Outstanding Universal Value of the WHS bid. Dry stone wall field boundaries with some hedges, boundary trees and pollards in valleys. Historic elements of field pattern include medieval ring garths, separating enclosed valley land from the open fells, and 18th century onwards enclosure of fell intakes
Orton Fells	Pastoral landscape with pastures and meadows, many of them rich in flowering species, bounded by drystone walls and with field barns in the valleys and on lower-lying land on the fringes.	Nearly 700 km of drystone walling is under management through the Environmental Stewardship Scheme.
Howgill Fells	Small, mostly irregular-shaped fields, on lower ground bounded by drystone walls and hedges with straight-edged fields on the higher valley sides.	The hedges and drystone walls give a time depth to an area which is otherwise lacking in obvious archaeological features apart from drove roads, and scattered settlements, pinfolds, wash-folds and shielings, mostly on the slopes towards Sedbergh and around the periphery of the NCA.
Yorkshire Dales	Characteristic stone buildings and farmsteads together with a strong pattern of drystone walls which run from the valley bottoms to the high tops.	Drystone walls run up from the valley bottoms to the high tops, often snaking their way around limestone outcrops and cliffs. Some of these walls date from medieval times and are of great historical importance. In many areas, both the valley bottoms and the higher in-bye and allotment land have distinctive regular patterns of drystone walls. The walls form very large rectilinear enclosures on the higher fell tops with smaller enclosures in the dales and irregular patterns around settlements.
Southern Pennines	Striking visual continuity, through extensive use of local building materials with sandstone flags on roofs, creating a high degree of visual unity to towns, villages and farmsteads; also fields are bounded by drystone walls which form strong patterns in places.	Patterns of walls particularly strong on higher shelves of land where upland pastures fringe the moorland.
White Peak	Grassland enclosed by grey limestone drystone walls, with small narrow strip fields, often of medieval origin, around villages, and larger rectangular fields away from the villages.	Sinuous, narrow fields show the remains of medieval field systems around villages, with well-preserved networks in areas such as Chelmorton and Wardlow. Further away from the village the field boundary patterns are larger and typical of the planned, regular enclosures created under the Parliamentary Enclosures Acts

NCA	Landscape attribute	Justification for selection
South West Peak	Historic field patterns bounded by drystone walls and in the lower valleys by hedgerows.	Drystone walls reflect the local geology and are constructed from local gritstone.
Forest of Dean and Lower Wye	Distinctive field pattern of small irregular enclosures surrounded by ancient hedgerows or stone walls particularly in the south. Larger rectilinear fields in the more arable districts.	A pattern of small fields enclosing priority lowland meadow habitat particularly at St Briavels and Hewelsfield Commons, criss-crossed by narrow winding lanes and bounded by ancient hedgerows.
Cotswolds	Buildings and drystone walls utilising locally quarried stone.	The Cotswolds are famous for the ever-present honey to whitish coloured oolitic limestone used in walls, houses, mansions and churches, and drystone walls which bring a sense of harmony and unity to the built environment. Low drystone walls are prominent on the high wold, enclosing large arable fields and adding to a sense of openness and harmony across the area.
Dartmoor	Surrounding the main moor a gentler landscape of small, irregular pasture fields, bounded by drystone walls and banks topped with hedges and mature trees.	An historic farmed landscape retaining medieval field patterns and post-medieval hedgebanks enclosing small fields of pasture. Winding rural lanes linking nucleated hamlets and villages, with high hedgebanks and many hedgerow trees create a strong sense of enclosure. Sunken lanes form tunnels through pockets of woodland and mature hedgebanks. At the fringes of the open moorland a strong pattern of late 18th- and 19th-century 'newtakes', bounded by granite drystone walls and low hedgebanks, and now enclosing rough grazing land.
Cornish Killas	The ancient pattern and method of field enclosure, cultivation and agriculture tell of the long occupation and versatility of the landscape.	Cornish hedgebanks, built from stone cleared from fields and topped by gnarled bushes and stunted trees, testify to the longevity of occupation of the land. Cornish hedgebanks provide valuable habitats for a rich array of flora and fauna, and are of cultural importance.
Carnmenellis	A distinctive and varied pattern of field, enclosures and settlements reflecting a long and ongoing history of agricultural activity and a dispersed settlement.	Cornish hedges are a distinctive feature contributing to the sense of place, as well as providing wildlife corridors allowing species movement and migration
West Penwith	A long history of human occupation is evident in the numerous heritage assets to be found across the landscape.	The story of human occupation is told by the many, and often protected, heritage assets to be found; prehistoric barrows, stone circles, hill-top enclosures, and early settlements linked by trackways flanked by Cornish hedges. The low level of human occupation has meant that there is also a high value ecological network present in the area consisting of pockets of rough land, unimproved grassland and coastal heathland linked by a dense network of hedges and sunken lanes

Walls and banks are recognised for offering environmental benefits and contributing to ecosystem service opportunities (Figure 3.6). Although there are only nine NCA profiles where banks dominate, the analysis can be further by separating NCAs dominated by walls from those dominated by banks. Although the conclusions can only be tentative, walls and banks appear to differ in their provision of ecosystem services, reflecting their structural characteristics and interactions with the surrounding environment (Figure 3.7). Both excel in cultural ecosystem services, contributing significantly to a sense of place and sense of history, as they are often longstanding landscape features with historical and cultural significance. walls enhance geodiversity by exposing rock surfaces, which provide microhabitats for lichens, mosses, and invertebrates. However, their influence on regulating services such as water flow, soil quality, and pollination is relatively limited. In contrast, banks provide more regulating and supporting ecosystem services. They contribute more significantly to biomass energy, water regulation and pollination.

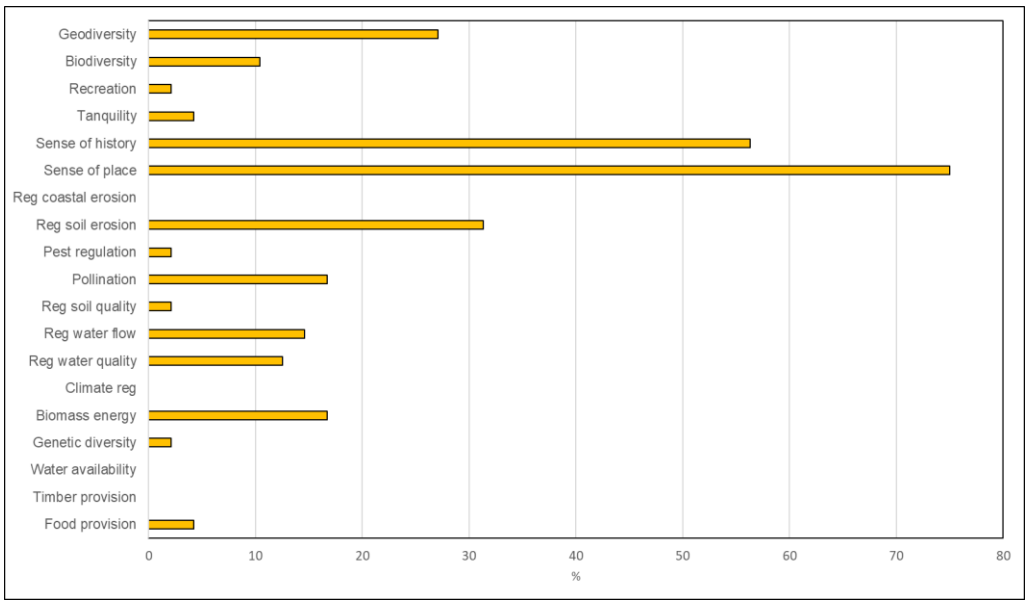


Figure 3.6: Ecosystem service opportunities for walls and banks

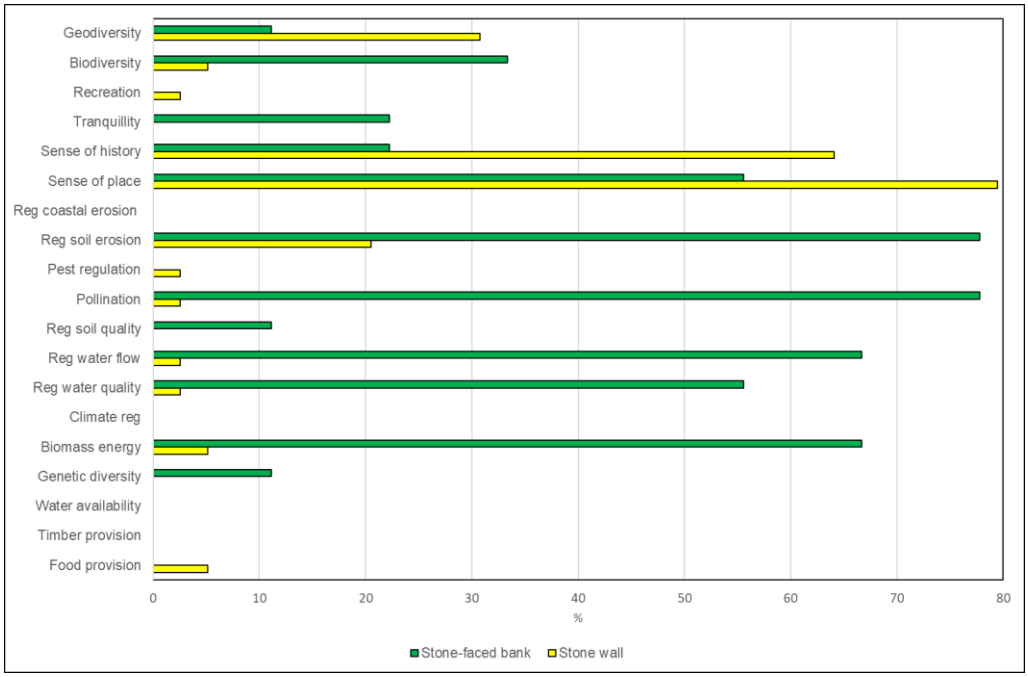


Figure 3.7: Comparing ecosystem service opportunities between walls and banks

3.6 Review of wider policy context for walls and banks

3.6.1 Introduction

This section will cover:

- The current state of national Government commitments relating to walls and banks.
- Where walls and banks fit in with AES, 25YEP and EIP2023 and ELMS.

This section of the review examines government policy and strategy, both current and emerging, that have the potential to interact with walls and banks in agricultural landscapes. While generally of relatively low individual value in terms of cultural and natural heritage, cumulatively, systems of historic land division are perhaps the most numerous and ubiquitous evidence of historical farming activity in our western and upland landscapes. Nevertheless, these features are rarely considered at the landscape scale, either in understanding and appreciating the contribution to historic landscape character and significance that they make. Management and restoration, like much activity in the conservation space, tends to focus on the micro-scale – 'fixing' practical issues and addressing aesthetic considerations, but rarely thinking about the systems at a landscape or even whole-farm scale.

3.6.2 International commitments

The UK is a signatory to a range of international agreements that seek to protect or enhance elements of the national and global environment that have broad relevance to historic field boundaries.

These include:

- Venice Charter (International Charter for the Conservation and Restoration of Monuments and Sites) 1964.
- European Convention on the Protection of the Archaeological Heritage 1969, revised by the Valetta Convention 1992.
- World Heritage Convention (Convention concerning the Protection of World Cultural and Natural Heritage) 1974.
- Charter for the Protection and Management of the Archaeological Heritage 1990.
- Council of Europe Landscape Convention 2000.
- Council of Europe Framework Convention on the Value of Cultural Heritage for Society 2005.
- ICOMOS-IFLA Principles concerning Rural Landscapes and Heritage 2017.

While historic field boundaries (and, indeed, specific asset types in general) are not directly mentioned in the convention/agreement text, their wider contribution to the historic character, the archaeological record, sense of place and distinctiveness of our rural landscapes is tacitly recognised.

Substantial work, undertaken in response to the European Landscape Convention (ELC), to deliver historic landscape characterisation (HLC) for the whole of England – sponsored by Historic England and its predecessor body – served to raise awareness and appreciation of both the character and value of the rural landscape structure provided by walls, hedges and other land division.

3.6.3 Legislation

Hedgerow Regulations 1997

The Hedgerow Regulations confer a measure of protection on any hedgerow that has been present for over 30 years and that fulfils additional cultural or natural heritage criteria, including where hedges:

- incorporate archaeological features recorded in the relevant historic environment record[12], or scheduled monuments[13];
- mark the boundary of a pre-1600 AD estate or manor, or is visibly related to any building or feature derived from said asset; or
- are recorded as being an integral part of a field system pre-dating the Inclosure Acts.[14]

In addition, the natural heritage and landscape value of hedges is also considered – broadly as a consequence of habitat value on account of species richness and/or the presence of specific species.

The regulations therefore confer a measure of additional protection on vegetated field boundaries, including stone-faced banks, Cornish hedges and historic boundary dykes – but not features that are solely of stone construction and unvegetated. Such features should therefore be given due consideration through the planning process, and in applications for land use change managed through the forestry and agriculture environmental impact assessment (EIA) regulations. (The Regulations do not prevent removal of hedgerows but do serve to ensure that they are understood by applicants and considered by decision-makers.)

3.6.4 Environmental policy and strategy

25-year Environment Plan (2018)

The 25YEP sets out government actions to help the natural world regain and retain good health under 10 themes. It covers ecosystem health and function, seeks to manage and improve air and water quality, protect species and provide better habitats, and tackling climate change – as well as seeking an approach to agriculture, forestry and fisheries that 'puts the environment first'.

The 25YEP, while not dealing with the historic environment in substantive detail, acknowledges the interlinks between natural and cultural heritage – and the poor decisions that have been made in the past because of a lack of understanding of the ecosystem services delivered by our cultural heritage. However, actions do not necessarily consider the tension, and may in fact conflict, between proposals for nature recovery, habitat creation and restoration, and the physical evidence of the cultural processes that created our valued landscapes.

Environmental Improvement Plan (2023)

The Environmental Improvement Plan (Defra, 2023a) represents the first iteration of government reviewing the 25YEP, to be undertaken at five-yearly intervals as a requirement under the Environment Act 2021.

It adopts the targets and actions from the 25YEP, so the relative lack of coverage and detail relating to the historic environment persists – while undertaking to '…enhance beauty, heritage, and

[12] 'Sites and Monuments Record' for the purposes of the legislation

[13] In such cases the scheduling, under the Ancient Monuments and Archaeological Areas Act 1979 takes precedence.

[14] See Schedule 1, Part II of the Hedgerow Regulations 1997 for the definitive list of criteria.

engagement with the natural environment' no specific actions are established relating to heritage assets or historic landscapes.

Environmental Land Management (2023 update)

The Environmental Land Management (ELM) schemes are designed to provide England with a post-Brexit replacement for the CAP AES and its local expressions, including the 'Pillar 2' delivery vehicles of ES and, latterly, CS.

ELM, like its predecessors, does include some provision regarding the historic environment – although at a relatively high level. At present, the process of tapering off direct payments (production subsidies), government is increasing funding to and priority of the rollout of ELM schemes.

Three schemes are currently in place as part of the transition measures, providing payments for environmental and climate goods and services:

- **SFI**: Pays farmers to adopt and maintain sustainable farming practices that can protect and enhance the natural environment alongside food production, and also support farm productivity (including by improving animal health and welfare, optimising the use of inputs and making better use of natural resources)
- **CSHT**: Pays for more targeted actions relating to specific locations, features and habitats.
- **Landscape Recovery**: Will pay for bespoke, longer-term, larger scale projects to enhance the natural environment.

Heritage provisions acknowledge the importance of historic landscapes, archaeological sites and historic buildings and structures in contributing to local distinctiveness and sense of place – and the potential for mutually beneficial management of these assets and natural heritage objectives.

The 2023 ELM update (Defra, 2023b) indicates that government expects the provisions of CS to roll over into the new scheme, specifically:

- Taking historic and archaeological features out of cultivation (HS2).
- Using reduced-depth, non-inversion cultivation on historic and archaeological features (HS3).
- Controlling scrub on historic and archaeological features (HS4).
- Managing historic and archaeological features on grassland (HS5).
- Maintaining designed or engineered waterbodies (HS6).
- Managing historic water meadows through traditional irrigation (HS7).
- Restricting crop establishment depth to protect archaeology under an arable rotation (HS9).

A new action to manage historic features under permanent woodland cover is proposed.

Historic land divisions are dealt with separately under the 'boundaries' theme, with the following provisions proposed.

Hedgerows

Increasing the length of hedgerows and optimising the benefits existing hedgerows offer to wildlife, water quality and carbon sequestration is a priority.

Under CS, Defra already pays for the management of hedgerows by rotational cutting and leaving some hedgerows uncut (BE3), restorative pruning of fruit trees (BE7), and capital grants to plant and restore hedgerows.

In addition to what is already available, the following new actions are proposed:

- annual incremental cutting
- leaving hedgerows uncut for longer
- assessing and recording hedgerow condition
- maintaining existing hedgerow trees, or establishing new ones

It will be possible to adopt these new actions on earth or stone-faced banks, like Cornish or Devon hedges, if there is woody growth on top of the bank.

Dry stone walls

Defra want to protect traditional dry stone walls by supporting their ongoing maintenance, and their restoration where they have become derelict.

The 2023 update states that "Under CS, capital grants to restore **dry stone walls** (BN12)" are provided [our emphasis]. This is not strictly the case – BN12 does not explicitly state that grants are for dry stone walls, but this is implied in the requirements section, where applicants are instructed not to use concrete or mortar.

In addition to what is already available, Defra plan to pay for a new action to maintain dry stone walls in good condition.

Stone-faced banks

Under CS, capital grants to repair stone-faced banks (BN1) or restore them (BN2) are offered. An additional grant to maintain stone-faced banks in good condition is proposed.

Implications

The addition of management options for historic boundaries, and walls in particular, is a significant step forward for CS as these grants have the potential to arrest the decline in walls, rather than having to wait until they are in such poor condition that they require 'restoration'.

3.6.5 Conclusions

A range of international and domestic commitments provide the context for the management and support of walls and banks. Outside of specific ELM actions, and their predecessors, specific consideration of walls and banks are rare in domestic and international commitments. This is despite their playing a substantial role in informing the character and 'beauty' of landscapes across a significant proportion of England. Their condition and active use are essential in providing stock management and grazing control across the uplands, and represent the physical remains of millennia of agro-pastoralism that shaped the landscape and continues to play an important role in local distinctiveness and identity.

4 NATURE AND EXTENT OF WALLING OPTION UPTAKE

4.1 Introduction

This section builds upon the literature review to present an analysis of the uptake of wall and bank options for the ES and CS schemes from 2005 to 2023.

The data available from the Natural England Open Data Geoportal (NEODG) provides information on live ES and CS agreements and the general location of wall and bank boundary option uptake which allows national and regional patterns to be analysed and described. The pattern of option uptake is analysed to determine variations between ES and CS. A spatial analysis of option uptake was undertaken in relation to:

- Administrative boundaries.
- Altitude.
- Agricultural Landscape Type (ALT).
- National Character Area (NCA).
- Agricultural Land Class (ALC).
- Protected landscapes.

The intention was to gain a comprehensive understanding of the distribution of options related to the protection and maintenance as well as the repair and restoration of walls and banks across England with the aim to identify both similarities and differences between ES and CS.

This analysis helped to inform the selection of four case study locations to undertake a detailed assessment of wall and bank boundary conditions and a survey of ES and CS agreement holders to determine the impacts of the schemes and the ecosystem services provided.

4.2 Live Environmental Stewardship agreements

There were 1,884 agreement holders with 1,979 ES agreement that contained wall and bank protection and maintenance and/or restoration and repair options. The vast majority of agreement holders (97%) had a single ES agreement (Table 4.1). However, there were 61 agreement holders (3%) who had two or more agreements. Agreement holders with three or more agreements tended to be large estates or third-sector organisations, such as The National Trust (24 agreements) Wildlife Trusts and National Park Authorities.

Table 4.1: Number of agreements with wall/bank protection and maintenance and/or restoration and repair options per agreement holder

Number of agreements	Agreement holders	%	Cu%
1	1,823	96.8	96.8
2	50	2.7	99.4
3	9	0.5	99.9
5	1	0.1	99.9
24	1	0.1	100
Total	**1,884**	**100**	

Just under half the ES agreements (47%) combined protection and maintenance options with restoration and repair options. 40% of agreements were solely for wall and bank protection and maintenance and 14% were solely for restoration and repair (Table 4.2).

Table 4.2: Combinations of wall/bank options contained within ES agreements

ES option combinations	Agreements (No.)	%
Protection & maintenance and restoration & repair	925	46.7

ES option combinations	Agreements (No.)	%
Protection & maintenance only	787	39.8
Restoration and repair only	267	13.5
Total	**1,979**	**100**

Entry Level plus Higher Level Stewardship agreements were the dominant agreement type (1,952, 98.6%) of which a small proportion (42, 2.2%) were organic agreements. There were 27 agreements that were solely Higher Level Stewardship and these were engaged with restoration and repair options (Table 4.3).

Table 4.3: Combinations of wall/bank options by agreement type

ES option combinations	Entry Level plus Higher Level Stewardship	Organic Entry Level plus Higher Level Stewardship	Higher Level Stewardship	Total
Protection & maintenance & restoration & repair	912	13	0	925
Protection & maintenance only	767	20	0	787
Restoration and repair only	231	9	27	267
Total	**1,910**	**42**	**27**	**1,979**

4.3 Live Environmental Stewardship options

4.3.1 Wall and bank protection and maintenance option uptake

There were 3,338 option records with wall and bank protection and maintenance options (B4, B5 & B11[15]) (Table 4.4).

Table 4.4: Environmental Stewardship: Protection and maintenance options

Option code	Protection and maintenance option title	Option records (No.)
EB4	Stone-faced hedge bank management on both sides	200
OB4	Stone-faced hedge bank management on both sides (organic)	6
UB4	Stone-faced hedge bank management (both sides) on/above ML	20
UOB4	Stone-faced hedge bank management (both sides) on/above ML (organic)	1
EB5	Stone-faced hedge bank management on one side	200
0B5	Stone-faced hedge bank management on one side (organic)	8
UB5	Stone-faced hedge bank management (one side) on/above ML	24
UOB5	Stone-faced hedge bank management (one side) on/above ML (organic)	0
EB11	Stone wall protection and maintenance	1,929
OB11	Stone wall protection and maintenance	36
UB11	Stone wall protection and maintenance on/above the moorland line	910
UOB11	Stone wall protection and maintenance on/above the moorland line (organic)	4

[15] Includes entry level (E), uplands entry level (U) organic entry level (O) and uplands organic entry level (UO) options.

Option code	Protection and maintenance option title	Option records (No.)
Total		**3,338**

84 option records (2.5%) had 0 metres of wall and bank under protection and maintenance options. These records were excluded from further analysis. During the analysis it was found that there may be a risk of double counting the length of wall and bank boundaries under the protection and maintenance options as there seems to be repeated records for different time periods over the duration of the agreement. In an attempt to address the double counting issue, the dataset was filtered to select wall and bank protection and maintenance options that were live or had recently ended (Jan 2023 onward). This resulted in 1,727 agreements with 2,607 records (B4, B5 & B11), covering 9,122 km of boundary. The average length of boundary covered by the options per option record was 3.5 km. The shortest length covered was 5 m, while the largest was 32.7 km (Table 4.5). The vast majority of the boundaries (90%) were stone walls (B11) (Figure 4.1).

Table 4.5: Length of wall and bank boundaries covered by ES protection and maintenance options 2023/24

Option code	Option records (No.)	Option records (%)	Total length (km)	Total length (%)	Mean (km)	Minimum (m)	Maximum (km)
B11	2,276	87.3	8,183.9	89.7	3.6	5	32.7
B4	164	6.3	566.2	6.2	3.5	38	23.3
B5	167	6.4	372.2	4.1	2.2	40	14.4
Total	**2,607**	**100.0**	**9,122.3**	**100.0**	**3.5**	**5**	**32.7**

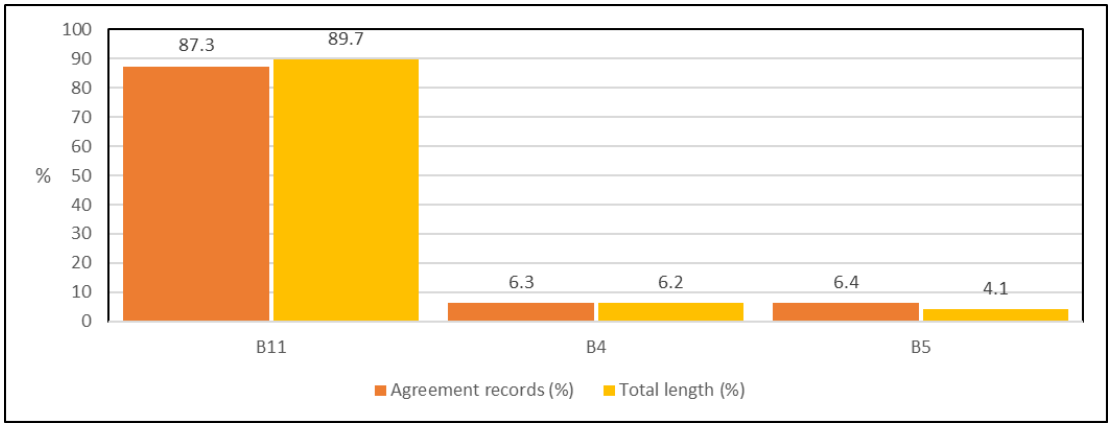


Figure 4.1: Uptake by ES protection and maintenance option type

4.3.2 Wall/bank restoration and repair option uptake

There were 5,778 option records with wall and bank restoration and repair options (UB15, UB17, BR, BS & WR) (Table 4.6) and 1,211 agreements. Three-quarters of the agreements (74%) had multiple option records.

Table 4.6: ES: Restoration and repair options

Option code	Restoration and repair option title	Option records (No.)
UB15	Stone-faced hedge bank restoration (ELS)	22
UB17	Stone wall restoration (ELS)	142
BR	Stone-faced hedge bank repair	102
BS	Stone-faced hedge bank restoration	11
BS2010	Stone-faced hedge bank restoration	131
WR	Stone wall restoration	513
WR2010	Stone wall restoration	4,857
Total		**5,778**

There were 1,211 agreements containing 5,753 restoration and repair options covering 403 km of wall and bank boundary. The average length of boundary covered by the options per option record was 70 m. The shortest length covered was 1 m, while the largest was 1.7 km. The vast majority of the restoration work (97%) was undertaken on stone walls (WR & UB17) (Table 4.7).

Table 4.7: Length of wall/bank boundary covered by ES restoration and repair options

Option code	Option records (No.)	Option records (%)	Total length (km)	Total length (%)	Mean (m)	Minimum (m)	Maximum (m)
WR	5,346	92.9	385.4	95.7	159	1	1,712
UB17	141	2.5	3.8	0.9	27	1	225
BR	102	1.8	5.1	1.3	50	1.5	500
BS	142	2.5	8.0	2.0	160	10	630
UB15	22	0.4	0.6	0.2	28	2	80
Total	**5,753**	**100**	**402.9**	**100**	**70**	**1**	**1,712**

Table 4.8: ES: Restoration and repair supplements

Option code	Restoration and repair supplements	Option records (No.)
WRS	Supplement - wall restoration	604
WRD	Stone wall supplement - difficult sites	899
WRQ	Stone wall supplement - stone from quarry	855
TW	Stone wall supplement - top wiring	1,712
ERC	Casting up supplement - hedgebank options	1,033
WSS	Step-over stile in stone wall	0
WST	Step-through stile in stone wall	1
LSP	Stone gate post	216
Total		**5,320**

4.4 Closed Environmental Stewardship agreements and options

4.4.1 Wall/bank protection and maintenance option uptake

There were 15,520 agreements with 18,909 wall and bank protection and maintenance options (B4, B5 & B11[16]) covering 73,416 km of boundary. The average length of boundary covered by the options per option record was 3.9 km. The shortest length covered was 1 m, while the largest was 104.9 km (Table 4.9). The vast majority of the boundaries (85%) were stone walls (B11).

Table 4.9: Closed ES agreements: Length of wall/bank boundaries covered by protection and maintenance options

Option code	Option records (No.)	Option records (%)	Total length (km)	Total length (%)	Mean (km)	Minimum (m)	Maximum (km)
B11	15,717	83.1	62,807	85.5	4.0	1	101.4
B4	1,498	7.9	5,759	7.8	3.8	1	104.9
B5	1,694	9.0	4,850	6.6	2.9	1	102.1
Total	**18,909**	**100**	**73,416**	**100**	**3.9**	**1**	**104.9**

Figure 4.2 shows that the vast majority of the protection and maintenance options for walls and banks are no longer covered by live ES agreements (see Table 4.10). This pattern is repeated for the length of walls and banks (Figure 4.3 and Table 4.10). This would suggest that there a considerable number of walls and banks that were once covered by ELS protection and maintenance options which have since expired. While the figures should be treated with caution, as there may be issues with double counting, it is recommended that future research should investigate the impact of the 5-year ELS agreements on the attitudes and behaviour of land managers toward management of walls and banks.

[16] Includes entry level (E), uplands entry level (U) organic entry level (O) and uplands organic entry level (UO) options.

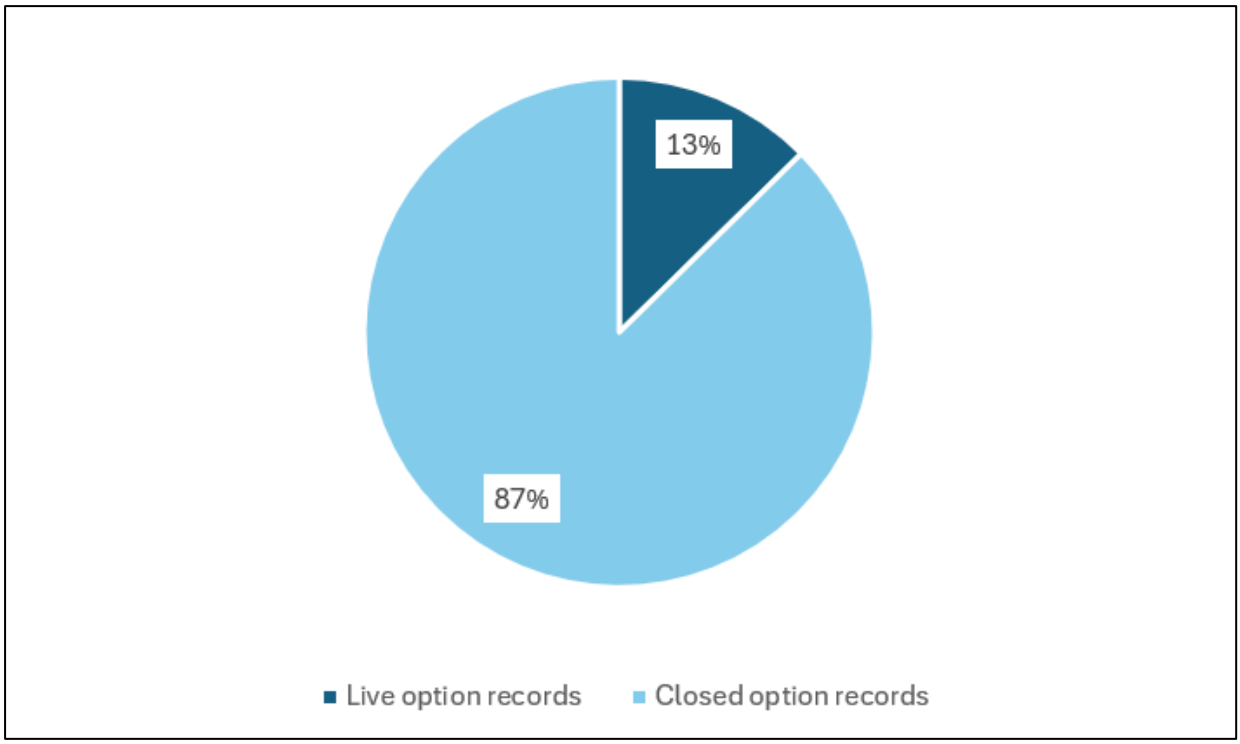


Figure 4.2: Comparing wall/bank protection and maintenance options for live and closed ES agreements

Table 4.10: Comparing wall/bank protection and maintenance options for live and closed ES agreements

Option code	Live option records	Closed option records	All option records	Live total length (km)	Closed total length (km)	All total length (km)
B11	2,276	15,717	17,993	8,183.9	62,806.7	70,990.6
B4	164	1,498	1,662	566.2	5,759.3	6,325.5
B5	167	1,694	1,861	372.2	4,849.8	5,222.0
Total	**2,607**	**18,909**	**21,516**	**9,122.3**	**73,415.8**	**82,538**

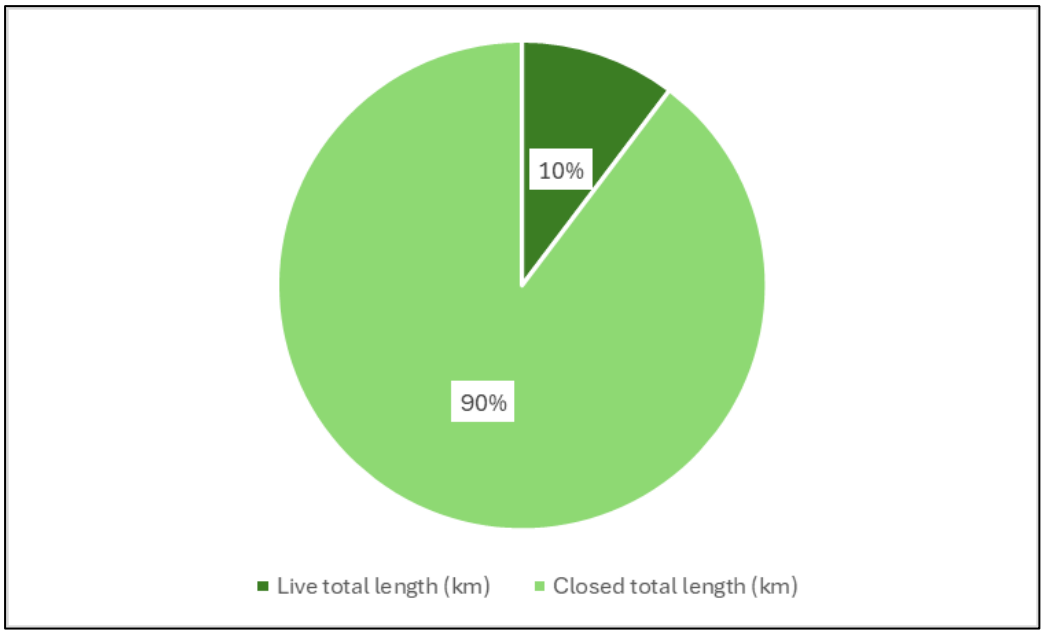


Figure 4.3: Comparing the total length of walls and banks covered by protection and maintenance options for live and closed ES agreements

4.4.2 Wall/bank restoration and repair option uptake

Data was available for only the ELS restoration and repair options (UB15 and UB17). There were 406 agreements containing 407 restoration and repair option records covering 403 km of wall and bank boundary. The average length of boundary covered by the options per option record was 29 m. The shortest length covered was 1 m, while the largest was 240 m. The vast majority of the restoration work (96%) was undertaken on stone walls (UB17) (Table 4.11).

Table 4.11: Closed ES agreements. Length of wall/bank boundary covered by ELS restoration and repair options

Option code	Option records (No.)	Option records (%)	Total length (km)	Total length (%)	Mean (m)	Minimum (m)	Maximum (m)
UB17	384	94.3	11.2	95.5	29.2	2	240
UB15	23	5.7	0.5	4.5	22.9	1	40
Total	**407**	**100**	**11.7**	**100**	28.8	**1**	**240**

4.5 Live Countryside Stewardship Agreements

The CS options dataset contained 3,300 agreements with wall and bank restoration and repair options (BN12, BN1 & BN2). The CS agreement area dataset contained 2,337 agreements with wall and bank restoration and repair options (BN12, BN1 & BN2). Scoping agreement holder characteristics is difficult at present because of the discrepancies between the datasets and also because 19% of agreement holder records in the CS option dataset are listed as unavailable. The 2,377 agreements in the CS agreement area dataset were all classed as live agreements. Mid Tier agreements were most common (69%) followed by CS Capital Grants (20%) (Table 4.12).

Table 4.12: Type of CS agreement with wall/bank options

CS agreement type	Agreements (No.)	%
Mid Tier	1,616	69.1
Higher Tier	281	12.0
Capital Grants	438	18.7
Tree Health Restoration	2	0.1
Total	**2,337**	**100**

4.5.1 Live Countryside Stewardship options

Wall and bank restoration and repair option uptake

In the CS options dataset there were 10,451 option records with wall and bank restoration and repair options (BN12, BN1 & BN2) (Table 4.13). There were 3,300 CS agreements with wall and bank restoration and repair options. Two thirds of the agreements (65%) had multiple option records.

Table 4.13: CS: Restoration and repair options

Option code	Restoration and repair option title	Option records (No.)
BN1	Stone-faced bank repair	493
BN2	Stone faced bank restoration	853
BN12	Stone wall restoration	9,105
Total		**10,451**

There were 3,300 CS agreements containing restoration and repair options covering 1,029 km of wall and bank boundary. The average length of boundary covered by the options per option record was 99 m. The shortest length covered was 1 m, while the largest was 3.6 km. The vast majority of the restoration work (92%) was undertaken on stone walls (BN12) (Table 4.14).

Table 4.14: Length of wall/bank boundary covered by CS restoration and repair options

Option code	Option records (No.)	Option records (%)	Total length (m)	Total length (%)	Mean (m)	Minimum (m)	Maximum (m)
BN12	9,105	87.1	947,842	92.2	104	1	3,574
BN1	491	4.7	31,841	3.1	65	1	717
BN2	853	8.2	49,711	4.8	58	1	472
Total	**10,449**	**100**	**1,029,394**	**1**	**99**	**1**	**3,574**

Table 4.15: CS: Restoration and repair option supplements

Option code	Restoration and repair supplement option title	Option records (No.)
BN13	Stone wall – top wiring	3,334
BN14	Stone wall supplement - stone from quarry	1,887
BN15	Stone wall supplement - difficult sites	195
FG13	Stone gate post	39
Total		**5,455**

4.6 Mapping live ES and CS uptake

The spatial pattern of option uptake was analysed to determine variations between ES and CS. This is important to be able to establish:

- The variation in uptake of options available for a particular scheme.
- The variation in uptake of options between schemes.
- Whether there is geographical clustering or gaps where relevant AES options might be expected and how this relates to important factors that might influence this (e.g., protected or administrative status, altitude or for areas where walls are characteristic of the landscape).

The intention was to gain a comprehensive understanding of the distribution of options relevant to walls and banks both under the ES and CS schemes (Figure 4.4 and Figure 4.5).

4.6.1 National uptake of CS and ES options and supplements

The evaluation identified 14,436 unique ES options pertaining to the management of walls and banks and 15,906 unique CS options and supplements. However, it is important to consider that these are contained within considerably smaller overall number of agreements with many agreements showing dense clusters of wall and bank options present, reflecting the large overall volume of boundaries requiring management locally.

Figure 4.4 to Figure 4.8 show ES and CS option and supplement distribution across England. Options relevant to wall and bank boundary protection and maintenance as well as repair and restoration are concentrated in the North of England as well the South West, with a distinct separate cluster around Gloucestershire.

Figure 4.4 to Figure 4.8 further illustrate clear regional pattern across both the ES and CS scheme of the prevalent occurrence of different options relating to either the management of walls and banks, with options concerning wall more prevalent in the north of the country and in the distinct Gloucestershire-centred cluster while options specific to bank boundaries are predominantly located in the South West, though there is a small concentration in the far north east of England of these options and particularly the ES supplement ERC (Casting up supplement - hedgebank options).

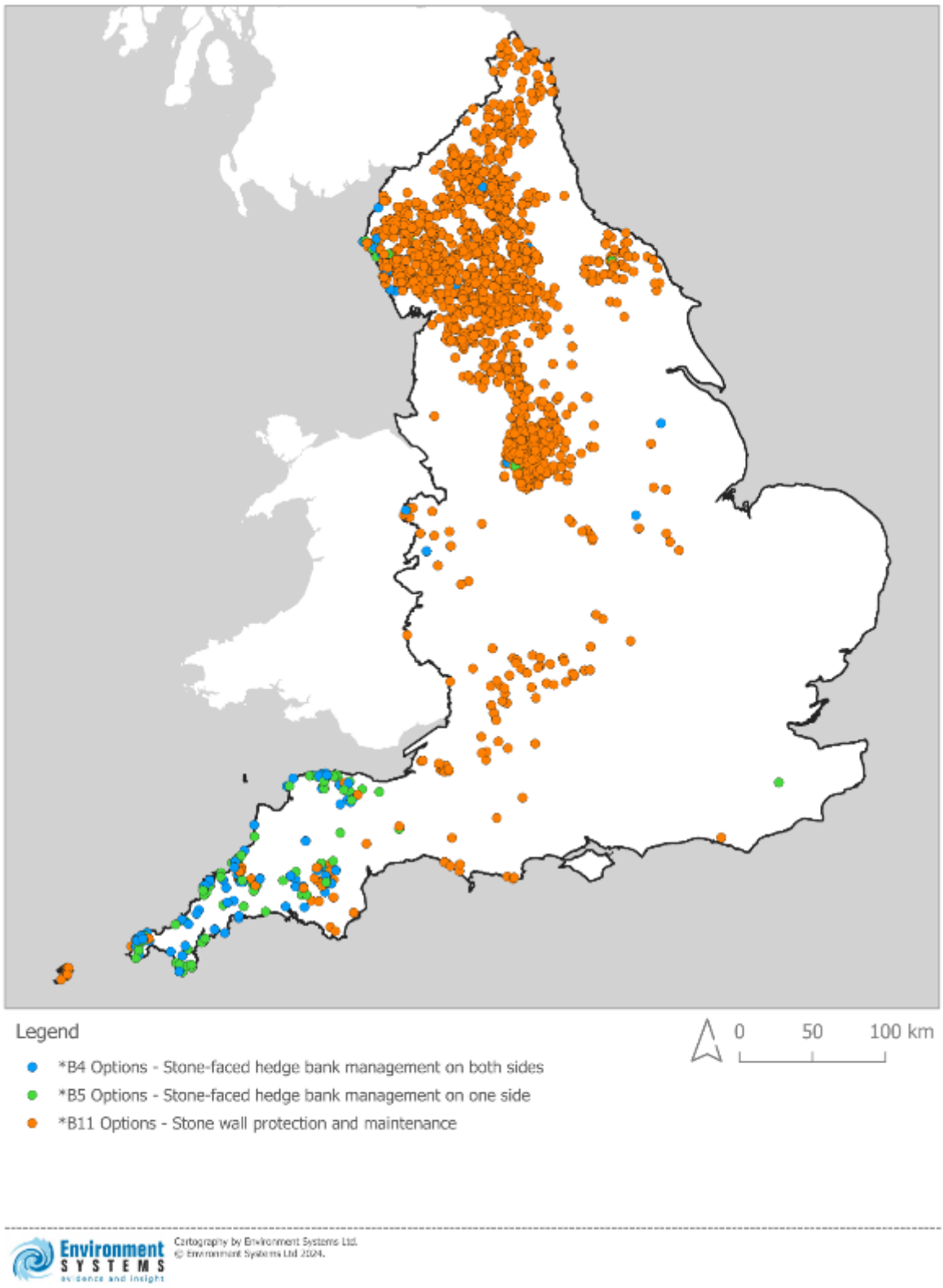


Figure 4.4: ES protection and maintenance options

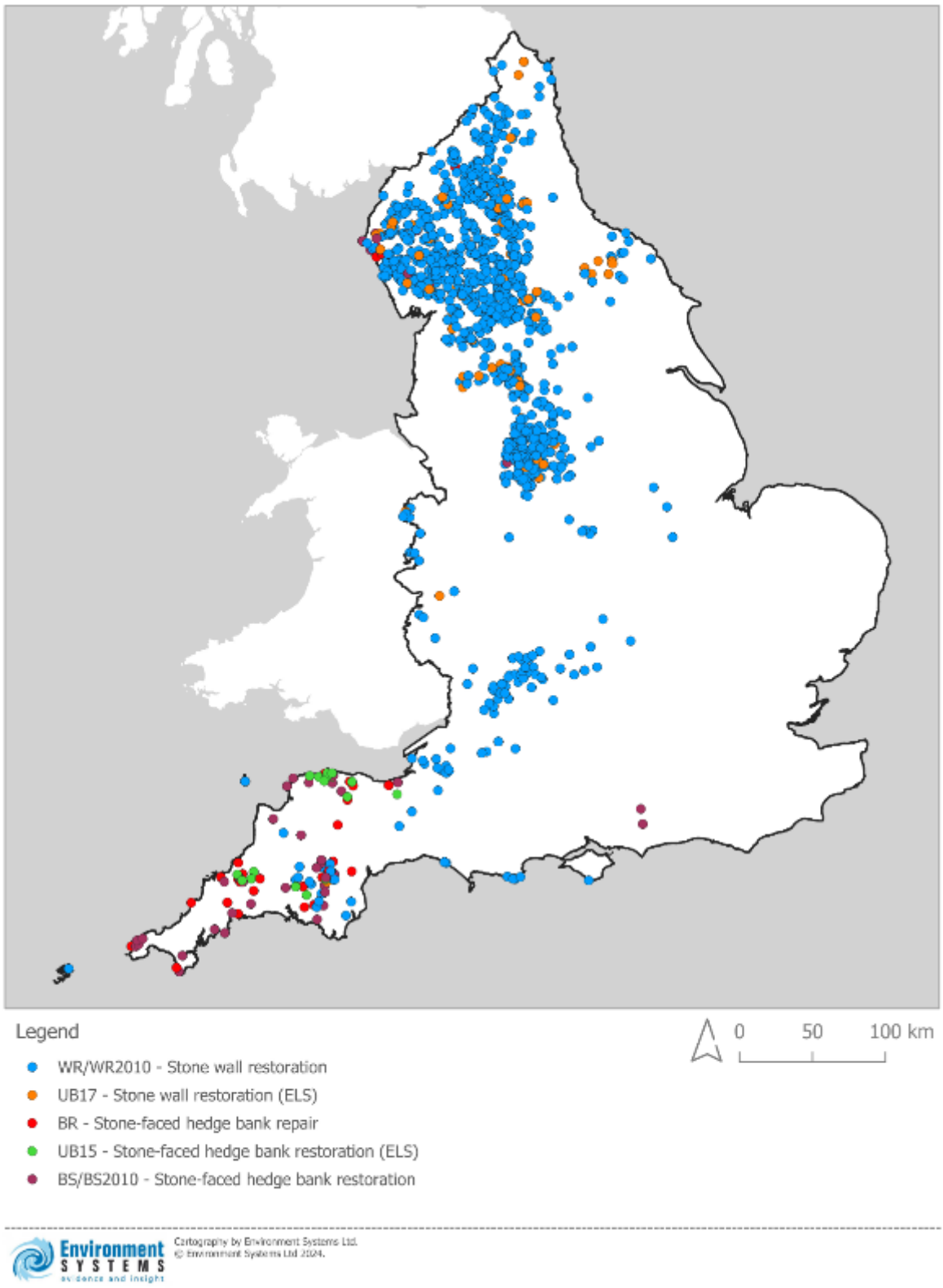


Figure 4.5: ES restoration and repair options

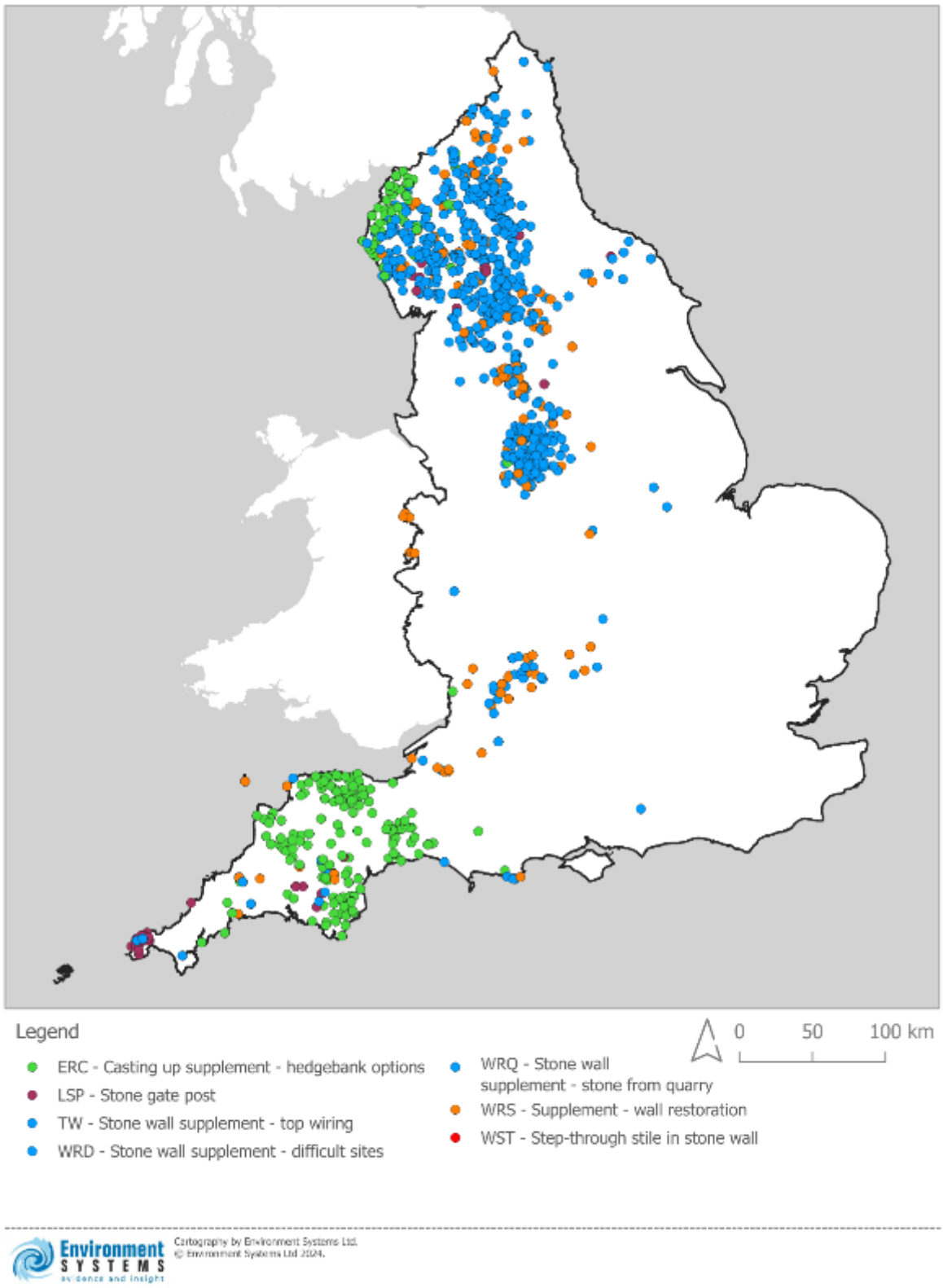


Figure 4.6: ES restoration and repair supplements

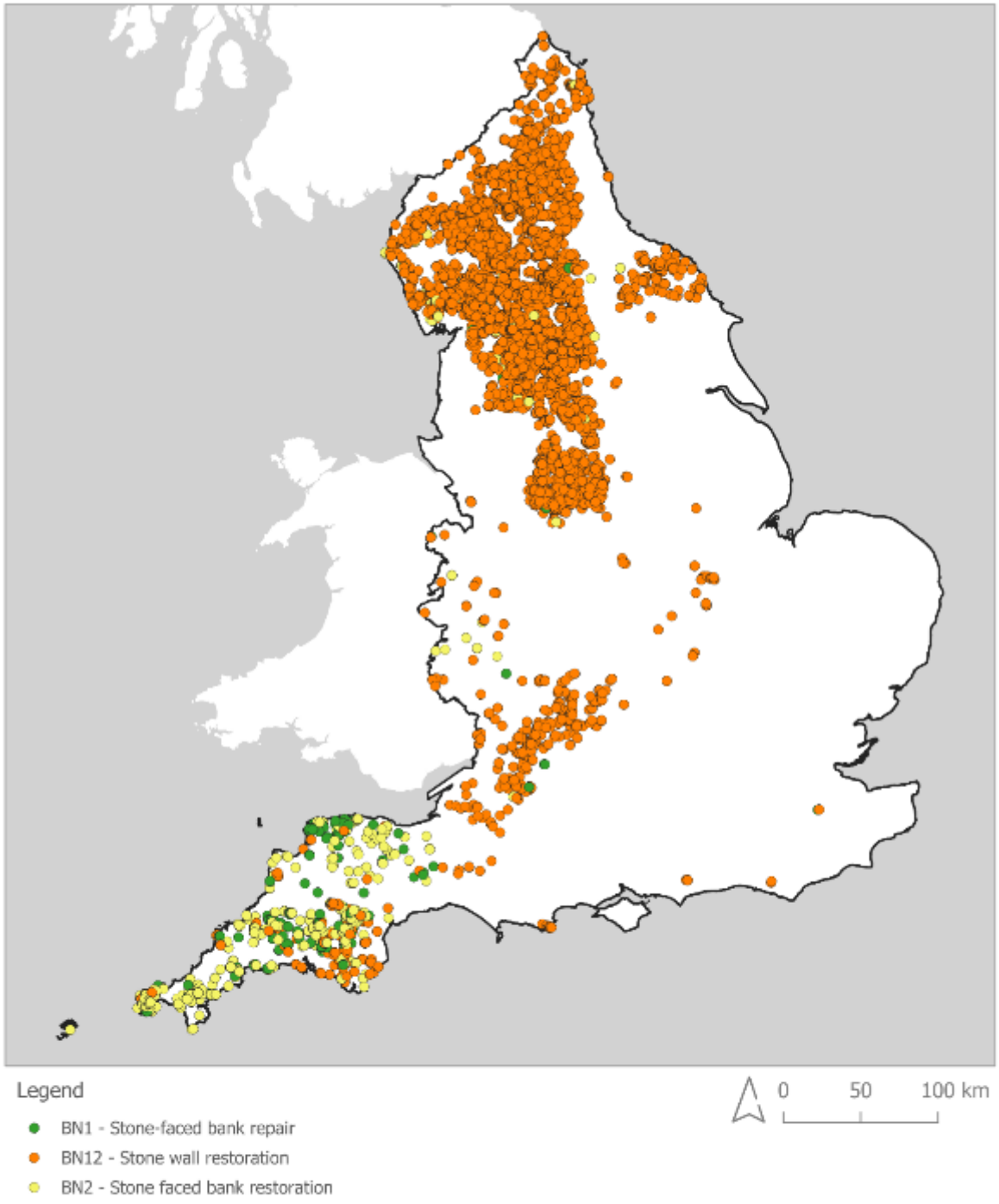


Figure 4.7: CS restoration and repair options

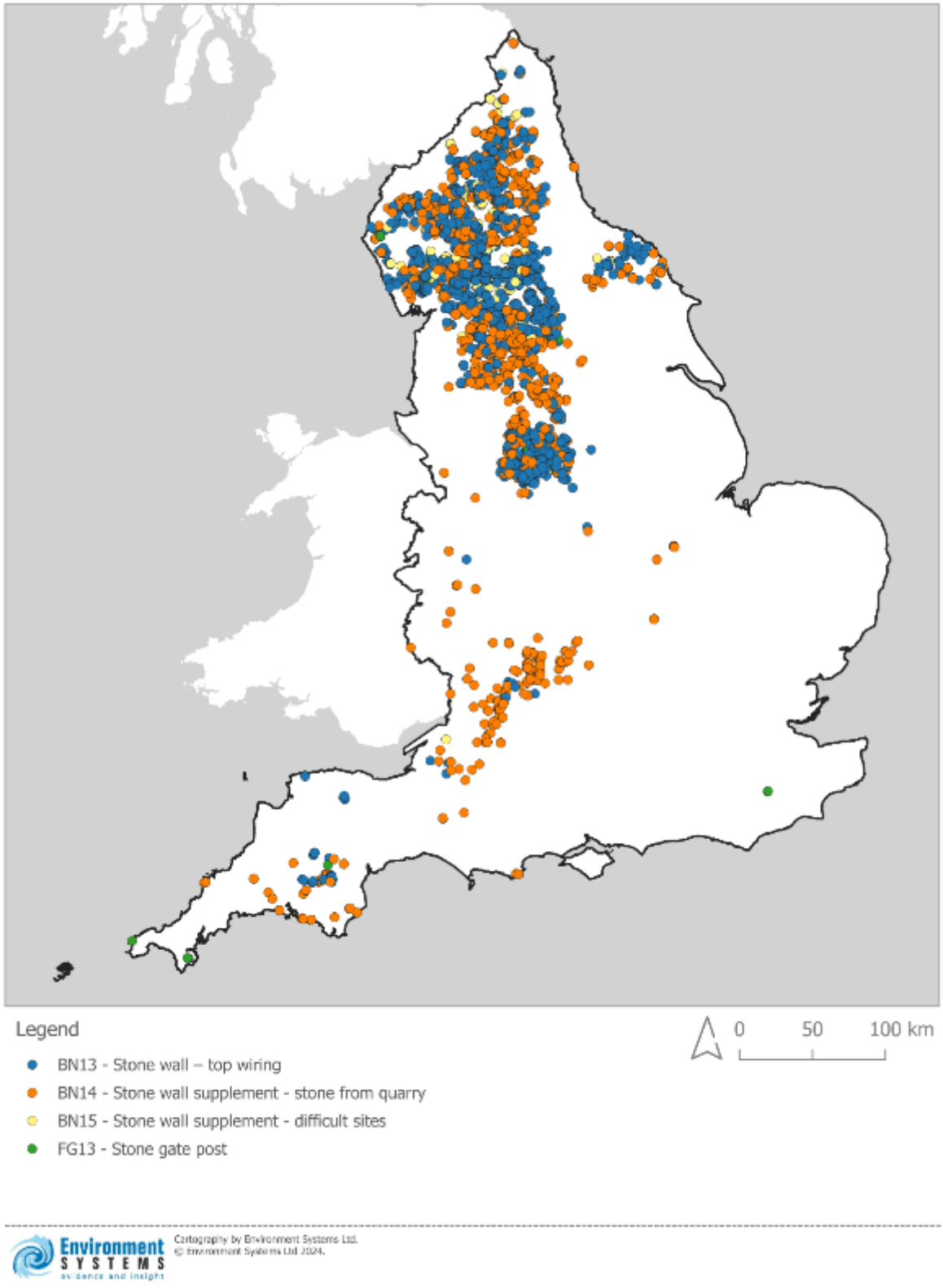


Figure 4.8: CS restoration and repair option supplements

4.6.2 Administrative boundaries (English Counties)

Counties with the highest densities of wall and bank boundary options across both the ES and CS schemes within England include Cumbria, Northumberland, Durham and North Yorkshire particularly. Lancashire and West Yorkshire as well as South Yorkshire and Staffordshire also display significant presence of relevant options (Figure 4.9 and Figure 4.10).

Further south there are significant concentrations within Gloucestershire and Somerset and particularly in Devon and Cornwall.

These strong regional patterns reflect the regionally prevalent use of walls and banks in the enclosure of land parcels for stock management and the delineation of ownership boundaries. walls are a recognised typical landscape characteristic within these counties, contributing to their individual distinctiveness.

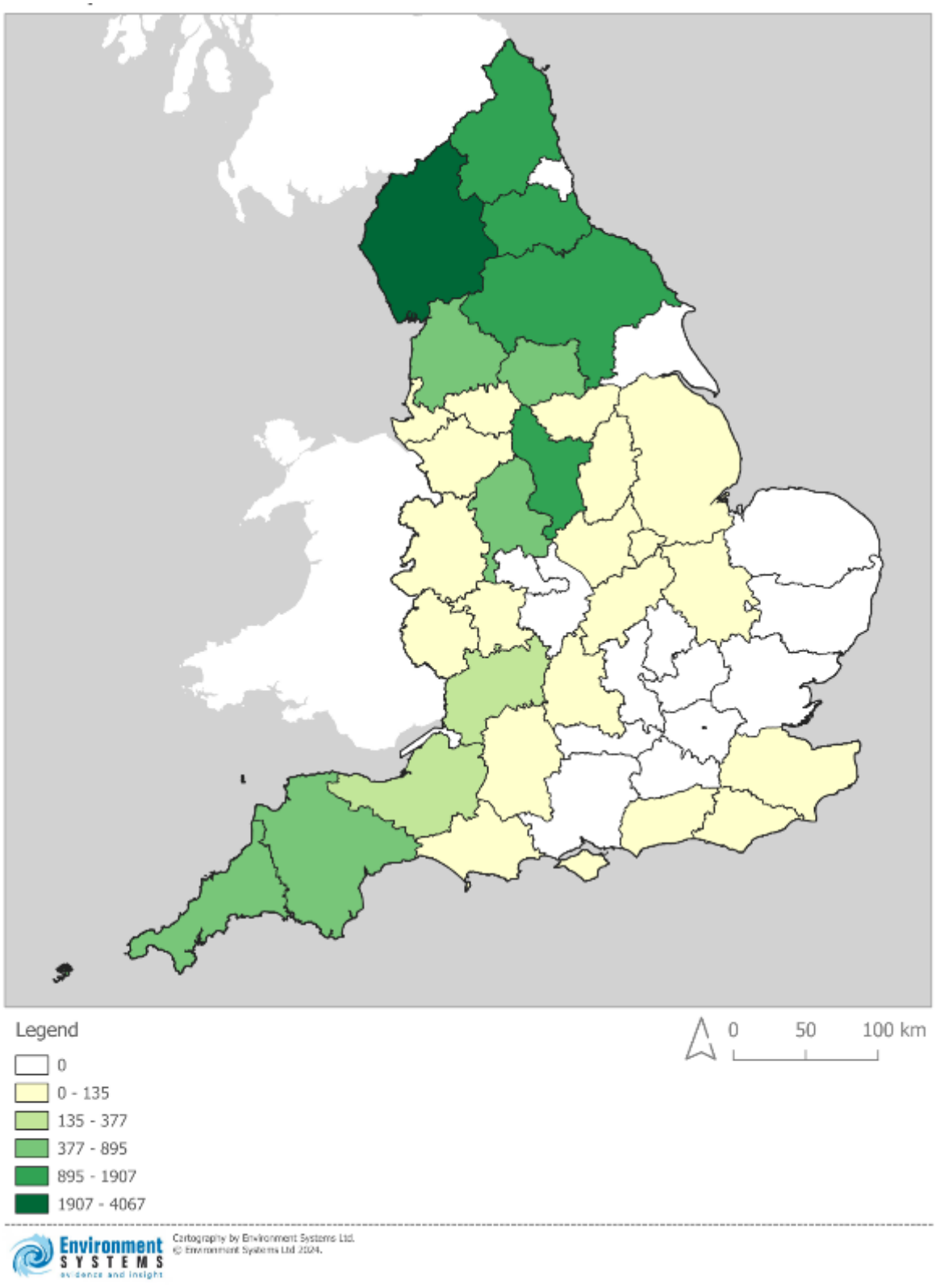


Figure 4.9: ES wall/bank options and supplements: Density per county

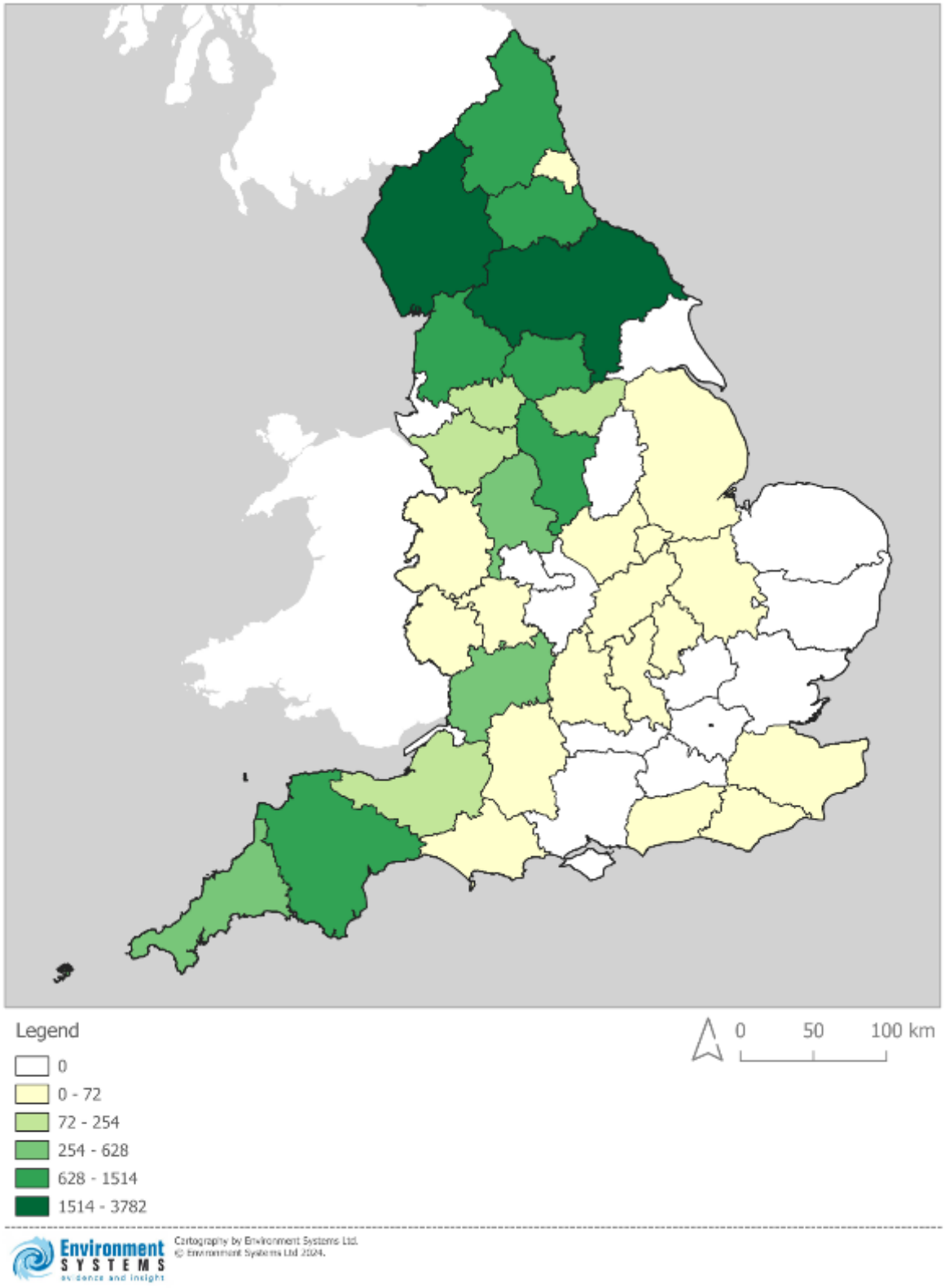


Figure 4.10: CS wall/bank options and supplements: Density per county

4.6.3 Altitude (Option uptake above the moorland line)

Stone walls, as compared to the majority of banks are generally more common at higher altitudes in England and particularly at the upper reaches of the enclosure boundaries just below the more open upland moorlands. Historically, higher altitude areas in England were often used for grazing livestock, particularly sheep. Stone walls were built to create boundaries between fields or enclosures, providing containment for livestock. The terrain at higher altitudes tends to be more rugged and is often sloped, making it challenging to install and maintain traditional fencing or hedgerows. Stone walls, being constructed from locally sourced stone without mortar, are well-suited to the uneven terrain, providing a durable solution for stock proof enclosures.

Table 4.16 to Table 4.20 as well as Figure 4.11 and Figure 4.12 below describe the distribution of ES and CS options included in the analysis above the moorland line. The ES scheme contains dedicated option variations to be applied on and above the moorland line and this is reflected in uptake across all related protection and maintenance options (Table 4.16). Stone wall restoration and repair options under ES do not make this particular distinction and about a quarter of these are located above the moorland line. It is noteworthy that nearly a third (33 %) of WRD (Stone wall supplement - difficult sites) occurrences (Table 4.18) are located above the moorland line, reflecting the more difficult conditions for access and the transportation of materials likely to be found here.

Table 4.16: ES: Protection and maintenance options above the moorland line

Option code	Protection and maintenance option title	%
EB4	Stone-faced hedge bank management on both sides	6.5%
OB4	Stone-faced hedge bank management on both sides (organic)	0.0%
UB4	Stone-faced hedge bank management (both sides) on/above ML	40.0%
UOB4	Stone-faced hedge bank management (both sides) on/above ML (organic)	0.0%
EB5	Stone-faced hedge bank management on one side	8.5%
0B5	Stone-faced hedge bank management on one side (organic)	0%
UB5	Stone-faced hedge bank management (one side) on/above ML	45.8%
UOB5	Stone-faced hedge bank management (one side) on/above ML (organic)	0.0%
EB11	Stone wall protection and maintenance	18.1%
OB11	Stone wall protection and maintenance	5.2%
UB11	Stone wall protection and maintenance on/above the moorland line	37.3%
UOB11	Stone wall protection and maintenance on/above the moorland line (organic)	25.0%
Total		**22.2%**

Table 4.17: ES: Restoration and repair options above the moorland line

Option code	Restoration and repair option title	%
UB15	Stone-faced hedge bank restoration (ELS)	22.7%
UB17	Stone wall restoration (ELS)	25.4%
BR	Stone-faced hedge bank repair	4.9%
BS	Stone-faced hedge bank restoration	0%
BS2010	Stone-faced hedge bank restoration	8.4%
WR	Stone wall restoration	26.5%
WR2010	Stone wall restoration	22.5%
Total		**22.2%**

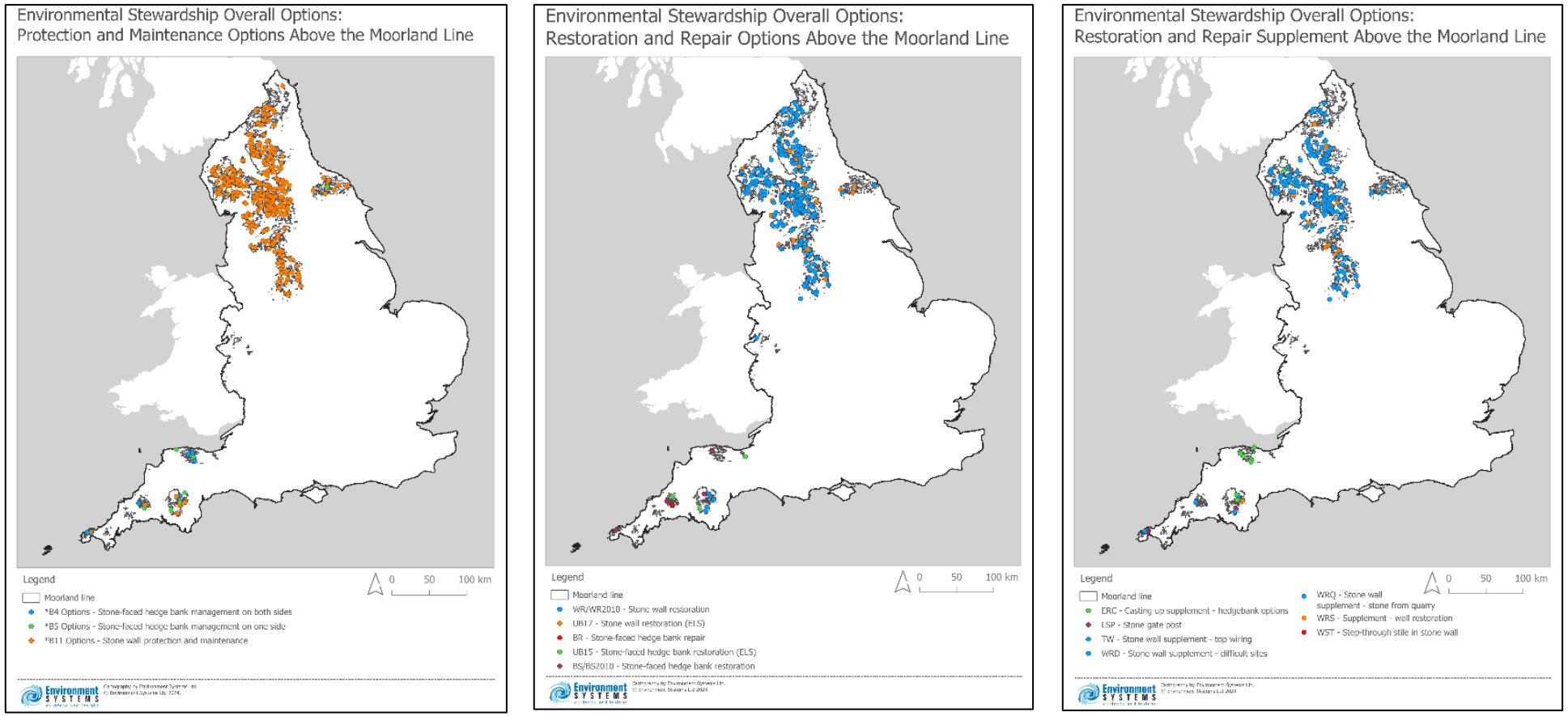


Figure 4.11: ES wall/bank options above the moorland line

Table 4.18: ES restoration and repair supplements above the moorland line

Option code	Restoration and repair supplements	%
WRS	Supplement - wall restoration	20.2%
WRD	Stone wall supplement - difficult sites	32.9%
WRQ	Stone wall supplement - stone from quarry	19.5%
TW	Stone wall supplement - top wiring	25.1%
ERC	Casting up supplement - hedgebank options	5.2%
WSS	Step-over stile in stone wall	0%
WST	Step-through stile in stone wall	0%
LSP	Stone gate post	16.2%
Total		**20.8%**

Compared to ES, a significantly smaller proportion of relevant CS options are located above the moorland line (Table 4.19 and Table 4.20), generally less than 10%. The notable exception again is BN 15 (Stone wall supplement - difficult sites) of which just over half (50.3%) of instances are located above the moorland line, reflecting a similar pattern under ES and the distinct challenges encountered by land managers in more remote and inaccessible locations while ensuring good condition of walls and banks.

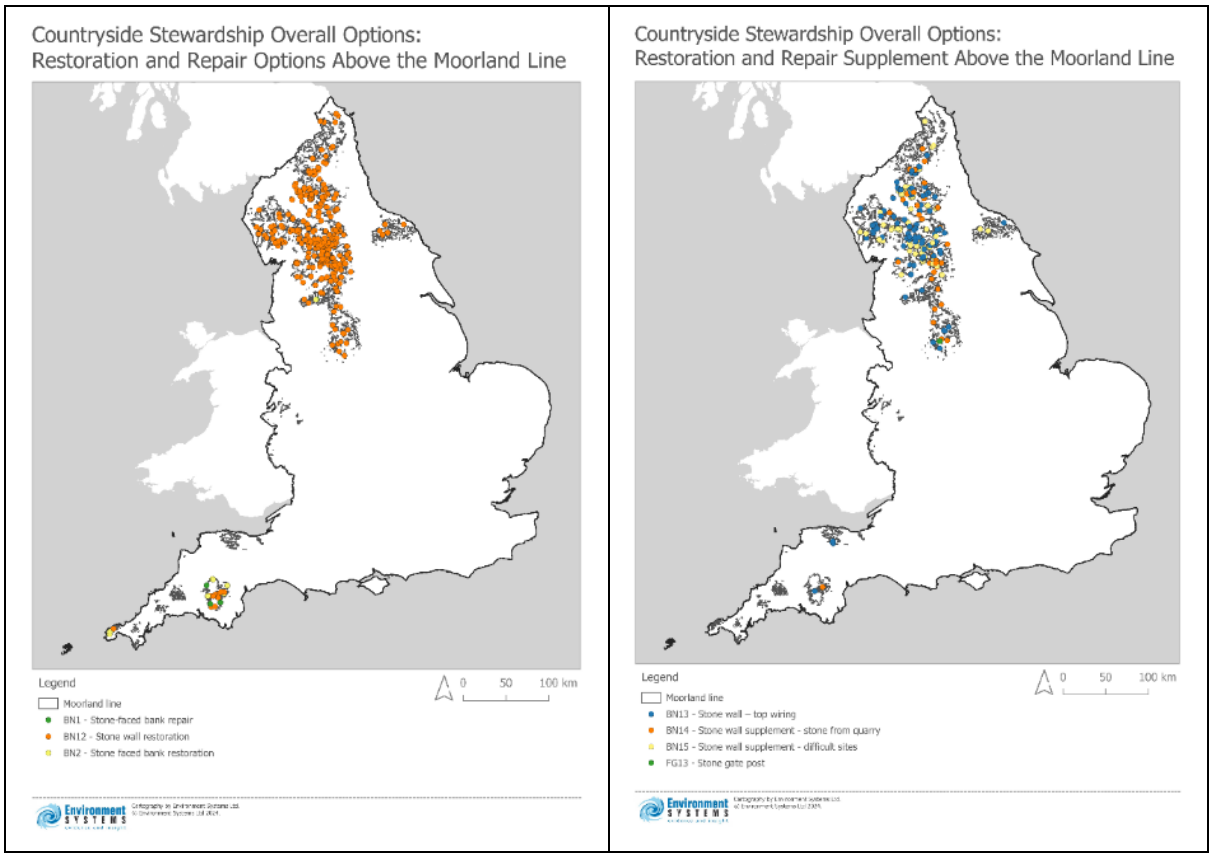


Figure 4.12: CS wall/bank options above the moorland line

Table 4.19: CS restoration and repair options above the moorland line

Option code	Restoration and repair option title	%
BN1	Stone-faced bank repair	2.6%
BN2	Stone faced bank restoration	1.4%
BN12	Stone wall restoration	4.7%
Total		**4.3%**

Table 4.20: CS restoration and repair option supplements above the moorland line

Option code	Restoration and repair supplement option title	%
BN13	Stone wall – top wiring	6.8%
BN14	Stone wall supplement - stone from quarry	3.4%
BN15	Stone wall supplement - difficult sites	50.3%
FG13	Stone gate post	7.6%
Total		**7.0%**

Just over 20% of all relevant ES options and supplements occur above the moorland line. This number is considerably lower for CS options and supplements around 5% (Table 4.19 and Table 4.20). This likely indicates the lower level of enclosure in the uplands above the moorland line, despite the prevalence of relevant options in upland dominated northern English counties and areas such as the Peak District and the Yorkshire Dales but also highlights that legacy ES agreements with options relevant to wall and bank boundary management are more prevalent above the moorland line, compared to CS agreements and might require increased focus to ensure transition into follow-up schemes.

4.6.4 Agricultural Landscape Types (ALT)

There are 159 NCAs. Each NCA represents an area of distinct and recognisable character at the national scale. Their boundaries follow natural lines in the landscape. The NCAs have been combined to create five ALTs that characterise the main agricultural landscapes in England (Figure 4.13):

- Upland
- Upland Fringe
- Western Mixed
- Chalk and Limestone
- Eastern Arable
- South East Mixed

The Upland ALT accounts for 78% of ES and 66% of CS wall and bank option uptake. There is also significant wall and bank boundary option uptake in the Upland Fringe and Western Mixed ALTs (see Table 4.21)

Table 4.21: Wall/bank boundary option uptake by ALT

Agricultural Landscape Type	ES option records (No.)	ES option records (%)	CS option records (No.)	CS option records (%)
Upland	9,274	78.0	9,849	65.5
Upland Fringe	896	7.5	3,380	22.5
Western Mixed	1,047	8.8	1,162	7.7
Chalk and Limestone	572	4.8	573	3.8
Eastern Arable	60	0.5	76	0.5
South East Mixed	2	0.0	7	0.0
Unclassified	37	0.3	0	0.0
Total	**11,888**	**100**	**15,047**	**100**

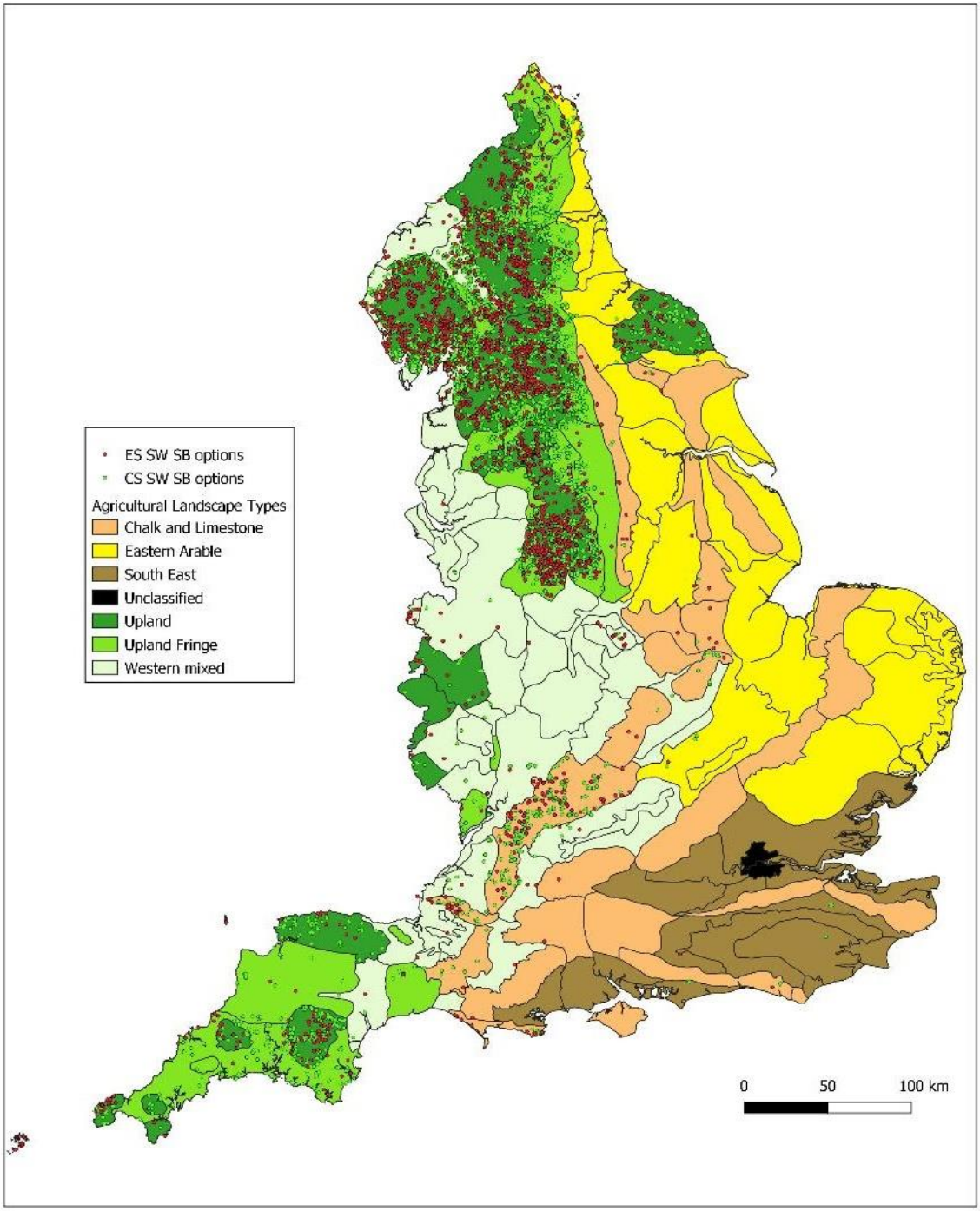


Figure 4.13: ES and CS wall/bank boundary option uptake by ALT

4.6.5 National Character Areas (NCA)

Stone walls and banks play a pivotal role in defining the character and distinctive identity of many NCAs in England. As integral components of England's rural heritage, walls and banks contribute to the sense of place and continuity within NCAs.

Figure 4.14 and Figure 4.15 illustrate the density of option uptake across all NCAs in England, mirroring the geographical patterns explored in Section 4.6.1. Distribution and uptake patterns of relevant options across NCAs are broadly consistent between the ES and CS scheme. The highest

density of options within both schemes is found in NCAs in Northern England across the Peak District, the Yorkshire Dales and Cumbria and Northumberland as well as in the North York Moors.

While ES option distribution appears to be even across the South West of the country, CS options are particularly concentrated within Dartmoor and slightly less so in northern Devon.

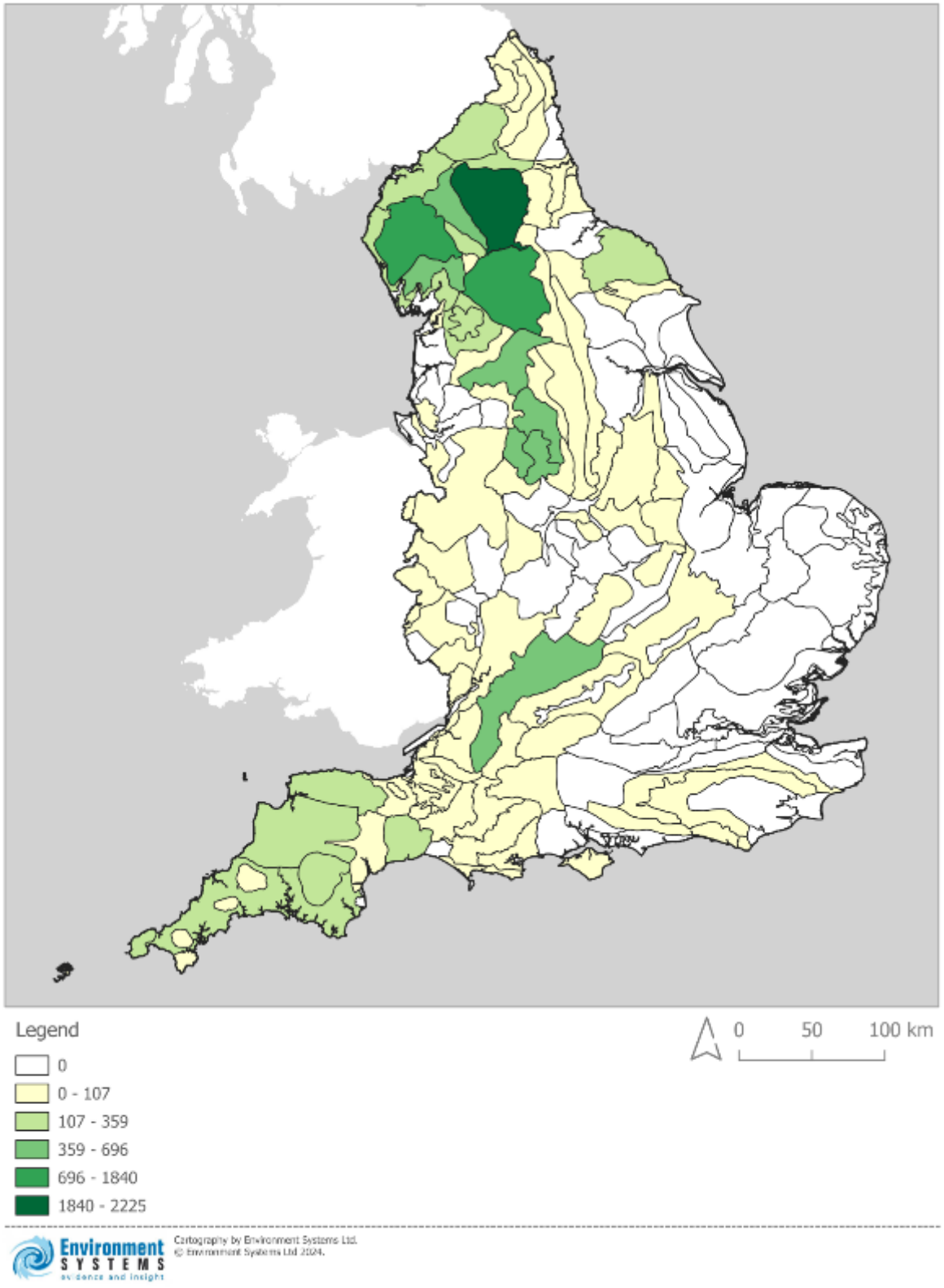


Figure 4.14: Environmental Stewardship: Density across National Character Areas

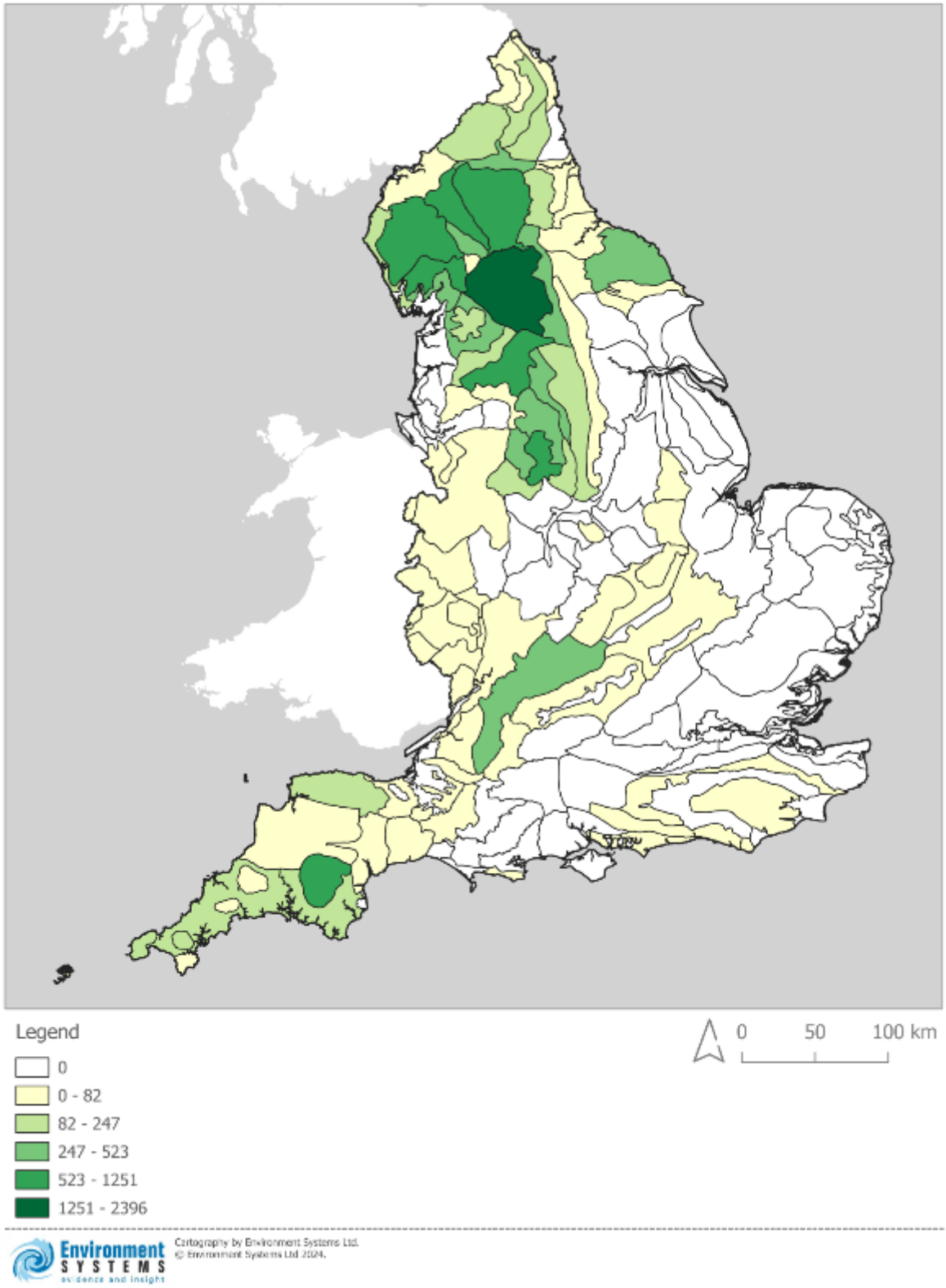


Figure 4.15: CS density across National Character Areas

4.6.6 Agricultural Land Classification (ALC)

Table 4.22 to Table 4.24 detail the distribution of all ES option included in the analysis across different ALC types. Across all options there is a consistent pattern of occurrences being highly concentrated across ALC grades 3, 4 and 5, land generally of lower agricultural versatility most commonly used for grazing, for example commonly found on upland fringes. This pattern is consistent with those of national option distribution as agriculture in counties and NCAs with high ES option density relevant to wall and bank boundary management is frequently dominated by livestock grazing and less arable land management. Once again nearly half (49%) of instances WRD (Stone wall supplement - difficult sites) are found on ALC grade 5, which is consistent with its similar pronounced presence at higher altitudes above the moorland line.

Table 4.22: ES protection and maintenance options by ALC

Option code	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Non Agricultural	Urban	Outside ALC
EB4	0%	1%	41.5%	27.5%	20.5%	2.5%	1%	6.0%
OB4	0%	0%	33.3%	0%	50.0%	16.7%	0%	0%
UB4	0%	0%	20%	40%	40.0%	0%	0%	0%
UOB4	0%	0%	0%	0%	100%	0%	0%	0%
EB5	0%	0%	40.0%	29.5%	23.0%	2.0%	0.5%	5%
0B5	0%	0%	37.5%	12.5%	37.5%	12.5%	0%	0%
UB5	0%	0%	16.7%	41.7%	37.5%	0%	4.2%	0%
UOB5	0%	0%	0%	0%	0%	0%	0%	0%
EB11	0.1%	0.8%	20.0%	38.9%	31.6%	0.8%	0.2%	7.7%
OB11	0%	0%	61.1%	22.2%	16.7%	0%	0%	0%
UB11	0%	0%	8.8%	32.4%	48.1%	0.6%	0%	10.1%
UOB11	0%	0%	25.0%	25.0%	50.0%	0%	0%	0%
Total	<0.1%	0.5%	19.9%	35.6%	35.0%	0.9%	0.2%	7.9%

Table 4.23: ES restoration and repair options by ALC

Option code	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Non Agricultural	Urban	Outside ALC
UB15	0%	0%	22.7%	27.3%	40.9%	0%	4.6%	4.6%
UB17	0%	0%	6.3%	34.5%	52.1%	0%	0%	7.0%
BR	0%	0%	21.6%	18.6%	33.3%	25.5%	0%	1.0%
BS	0%	0%	18.2%	63.6%	18.2%	0%	0%	0%
BS2010	0%	0%	38.2%	25.2%	30.5%	0%	0%	6.1%
WR	0%	0%	18.9%	25.2%	47.2%	1.6%	0%	7.2%
WR2010	<0.1%	0.3%	13.0%	39.9%	35.8%	0.6%	0.2%	10.4%
Total	<0.1%	0.3%	14.1%	37.6%	37.1%	1.1%	0.2%	9.7%

Table 4.24: ES restoration and repair supplements by ALC

Option code	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Non Agricultural	Urban	Outside ALC
WRS	0%	0%	24.2%	30.0%	36.8%	1.3%	0.8%	7.0%
WRD	0%	0%	11.6%	28.6%	48.6%	0.8%	0%	10.5%
WRQ	0%	0.7%	18.1%	37.2%	33.1%	0.8%	0.4%	9.7%
TW	0%	0.1%	8.6%	41.8%	40.7%	0.2%	0%	8.6%
ERC	0.1%	1.2%	44.7%	37.8%	13.1%	2.2%	0.1%	0.8%
WSS	0%	0%	0%	0%	0%	0%	0%	0%
WST	0%	0%	100%	0%	0%	0%	0%	0%
LSP	0%	0%	24.1%	32.4%	24.1%	9.7%	0.5%	9.2%
Total	**0.02%**	**0.4%**	**20.1%**	**36.3%**	**34.3%**	**1.3%**	**0.2%**	**7.4%**

This pattern is similar across all CS options included in the analysis (see Table 4.25 and Table 4.26) with a particular concentration of options and supplements on grade 4 land. Section 4.6.3 indicated that only very few CS options were located above the moorland line where there is a particular high likelihood of land being graded at 5 and this likely reflects the pattern observed here. One notable exception is a 60% occurrence of BN15 (Stone wall supplement - difficult sites) on grade 5 land and a 26% occurrence of the same supplement on land outside the ALC. This might be land that is of a nature that excluded it from being considered under ALC, indicating very low suitability for agricultural purposes.

Table 4.25: CS restoration and repair options by ALC

Option code	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Non Agricultural	Urban	Outside ALC
BN1	0%	3.0%	48.5%	36.3%	8.9%	0.2%	0%	2.8%
BN2	0%	2.1%	46.1%	44.1%	6.1%	0.4%	0%	1.2%
BN12	0%	0.5%	18.5%	53.8%	15.8%	0.5%	0.1%	10.8%
Total	**0%**	**0.8%**	**22.1%**	**52.2%**	**14.7%**	**0.5%**	**0.1%**	**9.7%**

Table 4.26: Countryside Stewardship: Restoration and repair option supplements by ALC

Option code	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Non Agricultural	Urban	Outside ALC
BN13	0%	0.2%	11.1%	56.7%	20.0%	0.8%	0.1%	11.4%
BN14	0%	0.5%	22.5%	50.5%	13.0%	0.5%	0.1%	12.8%
BN15	0%	1.5%	1.5%	10.8%	60%	0.5%	0%	25.6%
FG13	0%	2.6%	30.8%	53.9%	10.3%	2.7%	0%	0%
Total	**0%**	**0.4%**	**14.8%**	**52.9%**	**18.9%**	**0.8%**	**0.1%**	**12.3%**

4.6.7 Protected Landscapes

Stone walls and banks hold significant cultural, historical, and environmental importance within designated landscapes such as National Parks, National Landscapes (previously AONBs), and WHSs, often contributing to their distinctive landscape character and reason for designation as protected landscapes. Beyond their aesthetic appeal, they serve practical purposes, delineating boundaries, controlling livestock, and preventing soil erosion. Moreover, they can provide vital habitats for various flora and fauna, contributing to biodiversity conservation.

Table 4.27: ES protection and maintenance options within protected landscapes

Option code	National Parks (%)	AONB (%)	WHS (%)
EB4	19.7%	44.1%	7.0%
OB4	42.9%	28.8%	14.3%
UB4	40%	30%	0%
UOB4	0%	0%	0%
EB5	26.4%	38.2%	9.1%
0B5	33.3%	22.2%	11.1%
UB5	50%	33.3%	0%
UOB5	0%	0%	0%
EB11	38.4%	22.1%	13.6%
OB11	10.5%	36.8%	7.9%
UB11	48.9%	17.6%	17.5%
UOB11	40%	0%	20%
Total	**39.4%**	**23.2%**	**13.9%**

Table 4.28: ES restoration and repair options within protected landscapes

Option code	National Parks (%)	AONB (%)	WHS (%)
UB15	56.5%	30.4%	4.4%
UB17	43.8%	23.5%	12.4%
BR	30.8%	30.8%	24.8%
BS	72.7%	0%	0%
BS2010	31.0%	23.2%	9.2%
WR	27.2%	40.5%	1.9%
WR2010	41.3%	25.2%	13.1%
Total	**39.9%**	**26.4%**	**12.3%**

Table 4.29: ES restoration and repair supplements within protected landscapes

Option code	National Parks (%)	AONB (%)	WHS (%)
WRS	23.6%	25.5%	7.0%
WRD	45.5%	15.8%	16.6%
WRQ	22.1%	49.0%	2.4%
TW	46.6%	20.3%	15.7%
ERC	25.5%	18.9%	6.3%
WSS	0%	0%	0%
WST	0%	0%	0%
LSP	19.1%	38.9%	26.3%
Total	**35.2%**	**24.9%**	**11.8%**

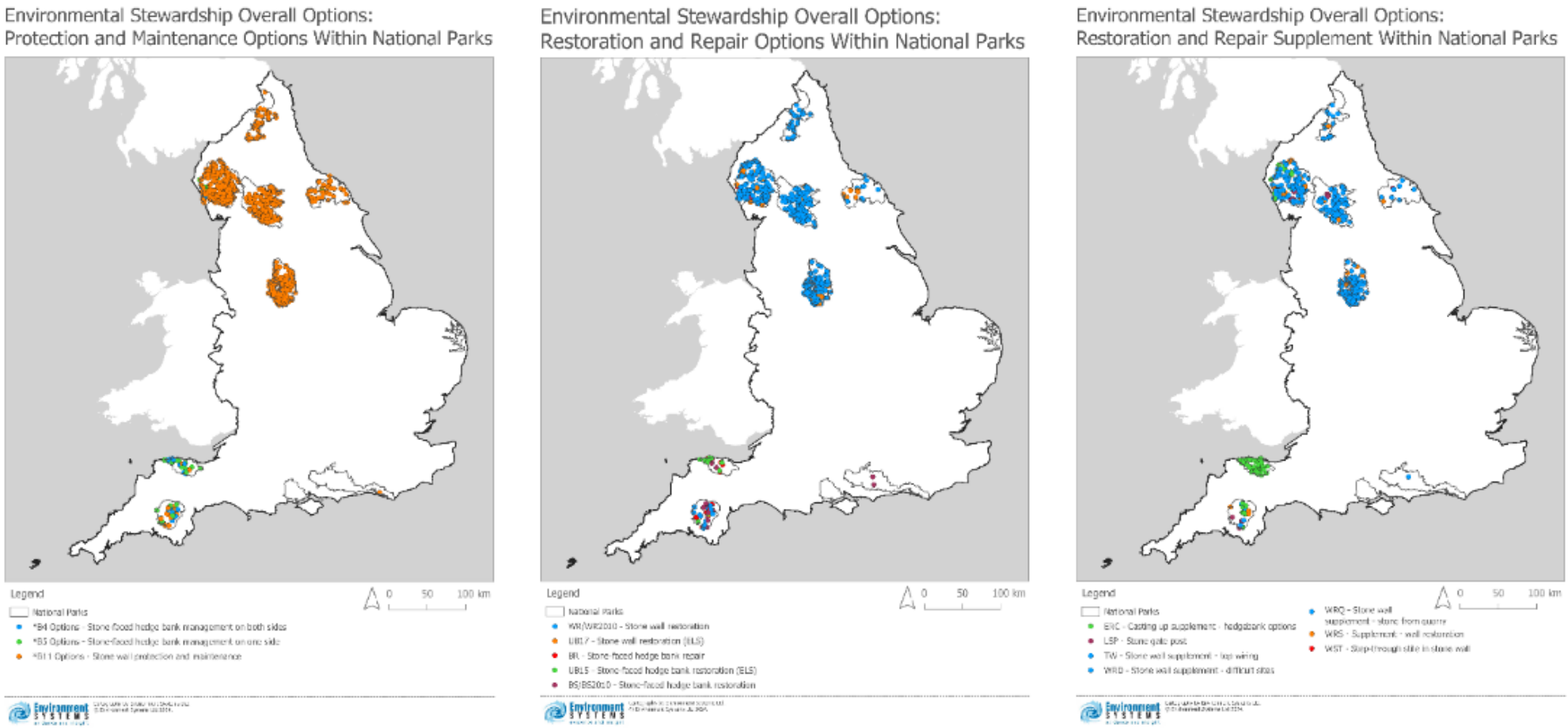
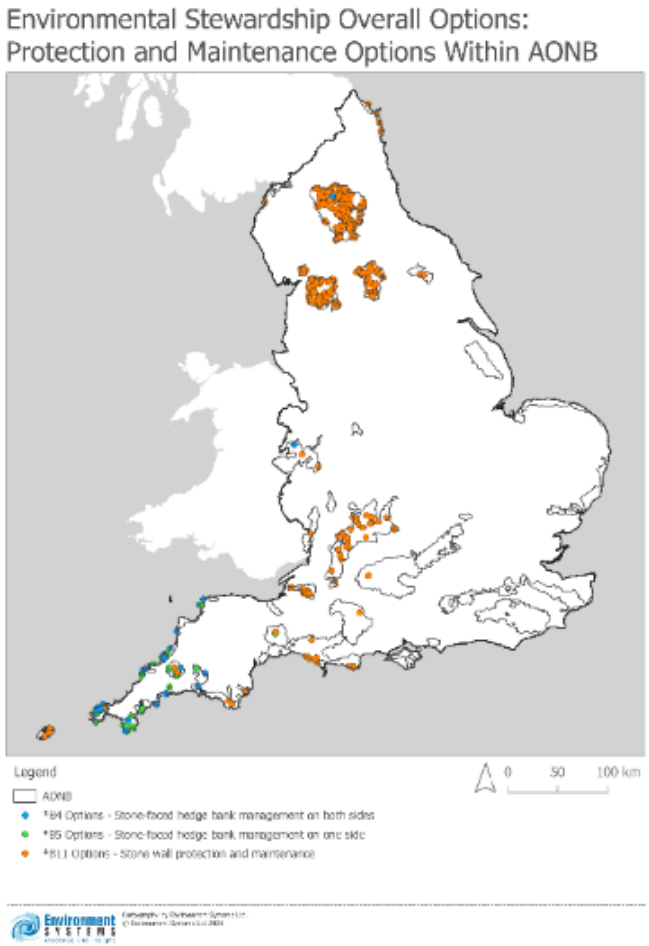
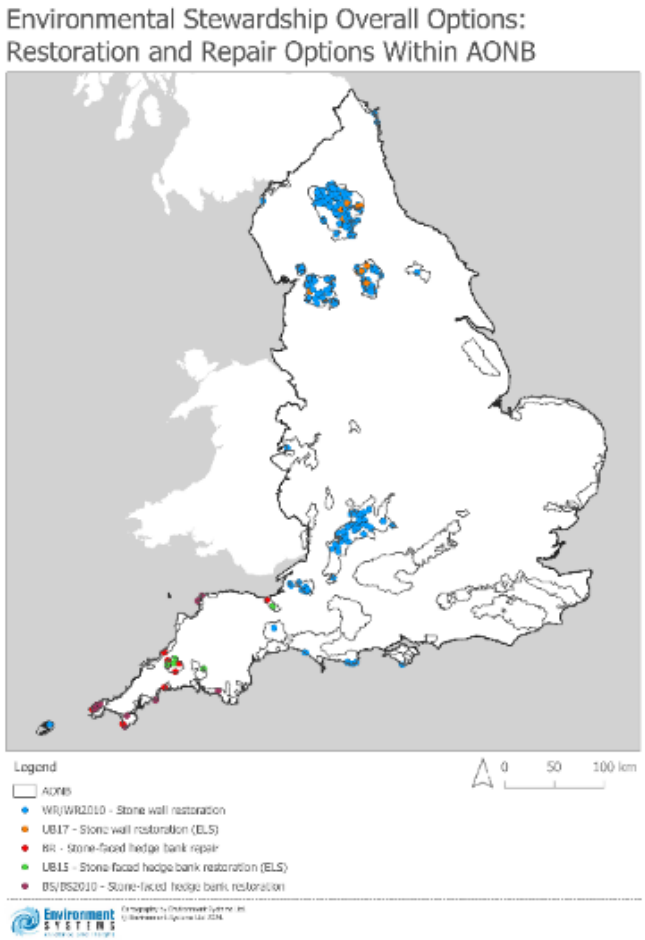


Figure 4.16: ES wall/bank options within National Parks





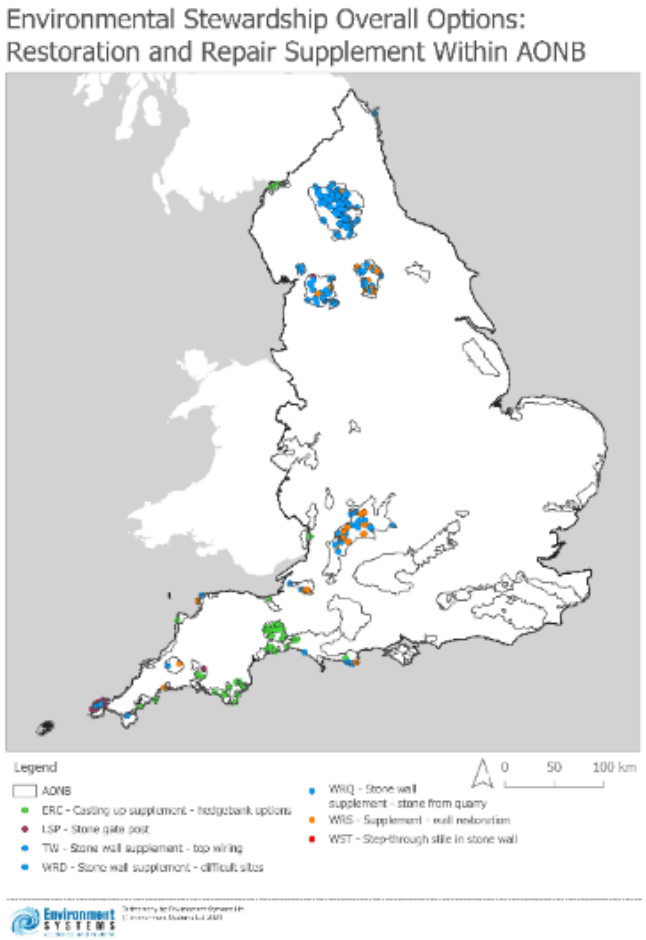


Figure 4.17: ES wall/bank options within AONBs

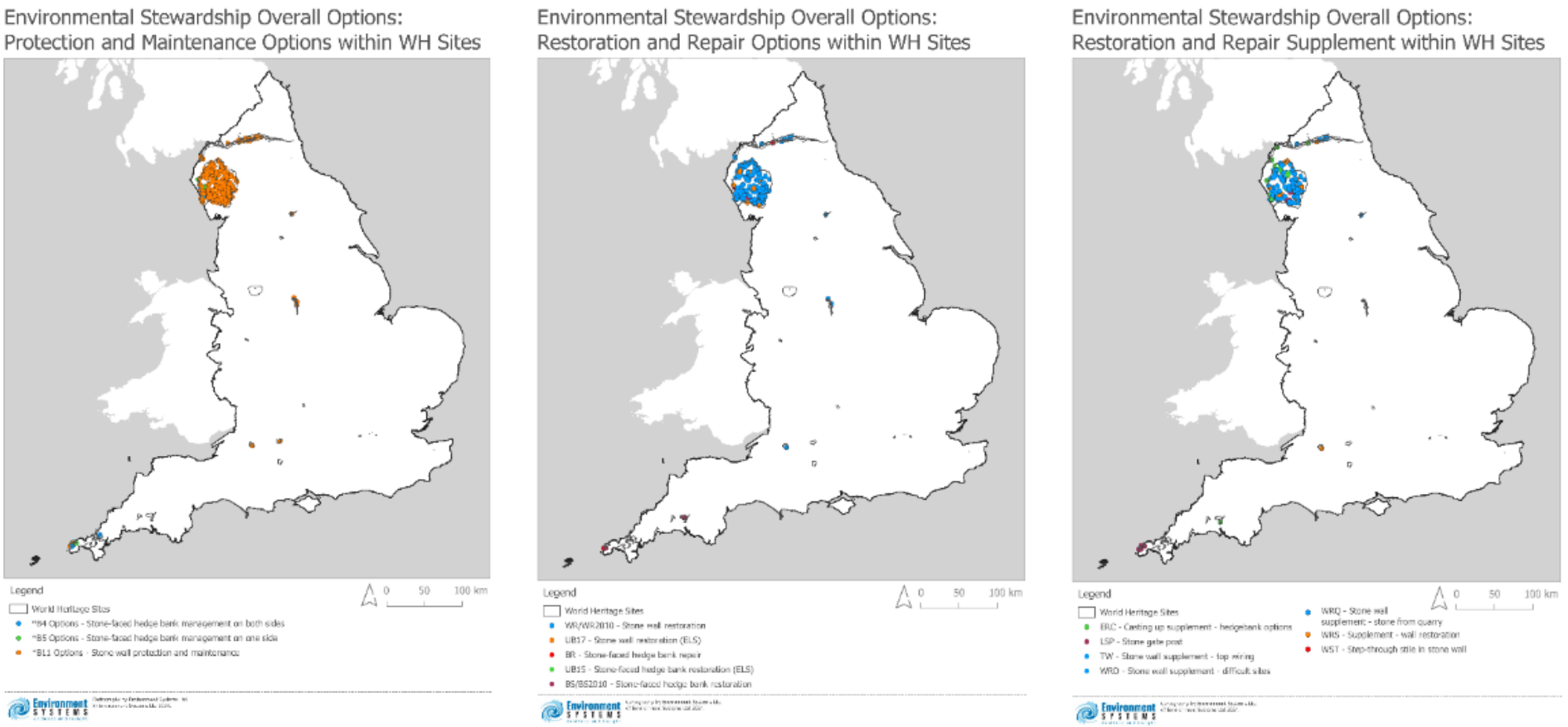


Figure 4.18: ES wall/bank options within World Heritage Sites

Table 4.30: CS restoration and repair options within protected landscapes

Option code	National Parks (%)	AONB (%)	WHS (%)
BN1	39.5%	19.5%	4.7%
BN2	36.4%	21.4%	5.3%
BN12	35.8%	17.3%	9.1%
Total	**36.1%**	**17.7%**	**8.6%**

Table 4.31: CS restoration and repair option supplements within protected landscapes

Option code	National Parks (%)	AONB (%)	WHS (%)
BN13	41.9%	16.1%	11.5%
BN14	24.4%	22.1%	7.8%
BN15	50.4%	25%	17.4%
FG13	51.9%	14.8%	27.8%
Total	**36.5%**	**18.4%**	**10.6%**

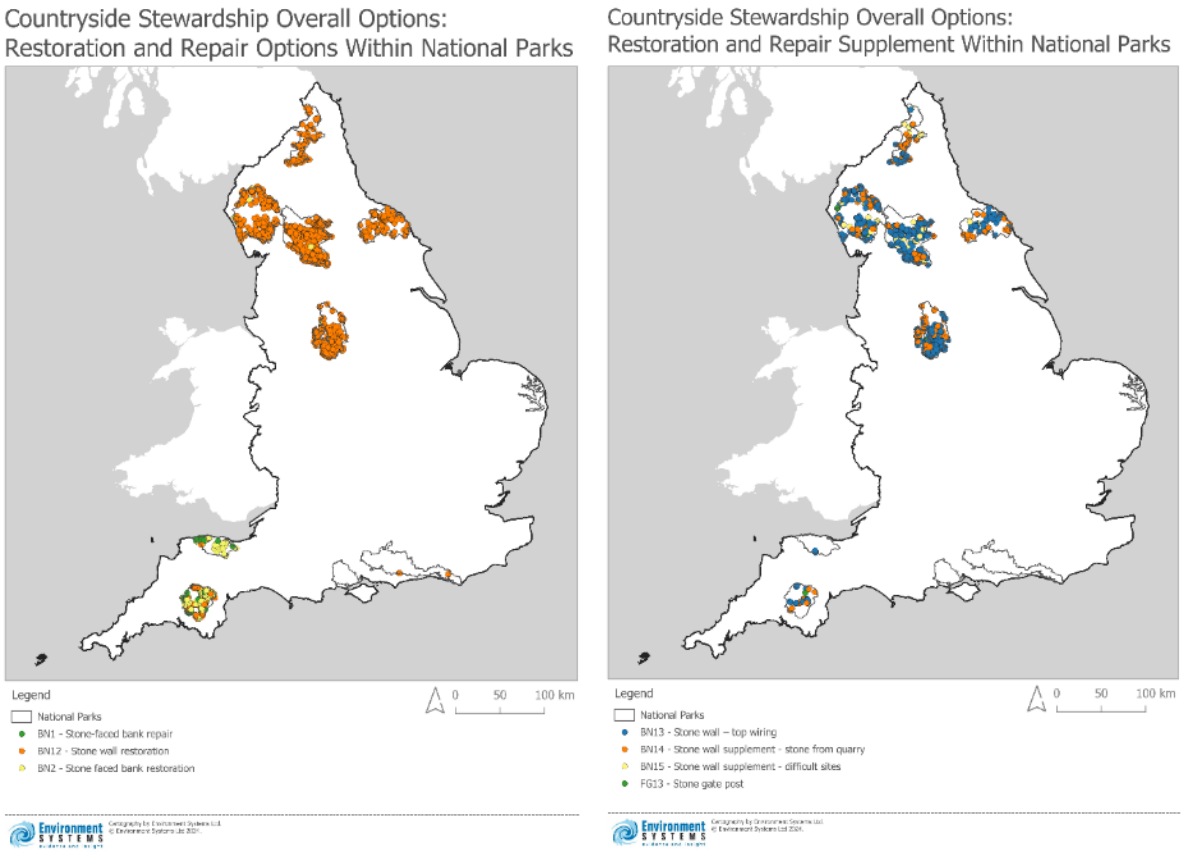


Figure 4.19: CS wall/bank options within National Parks

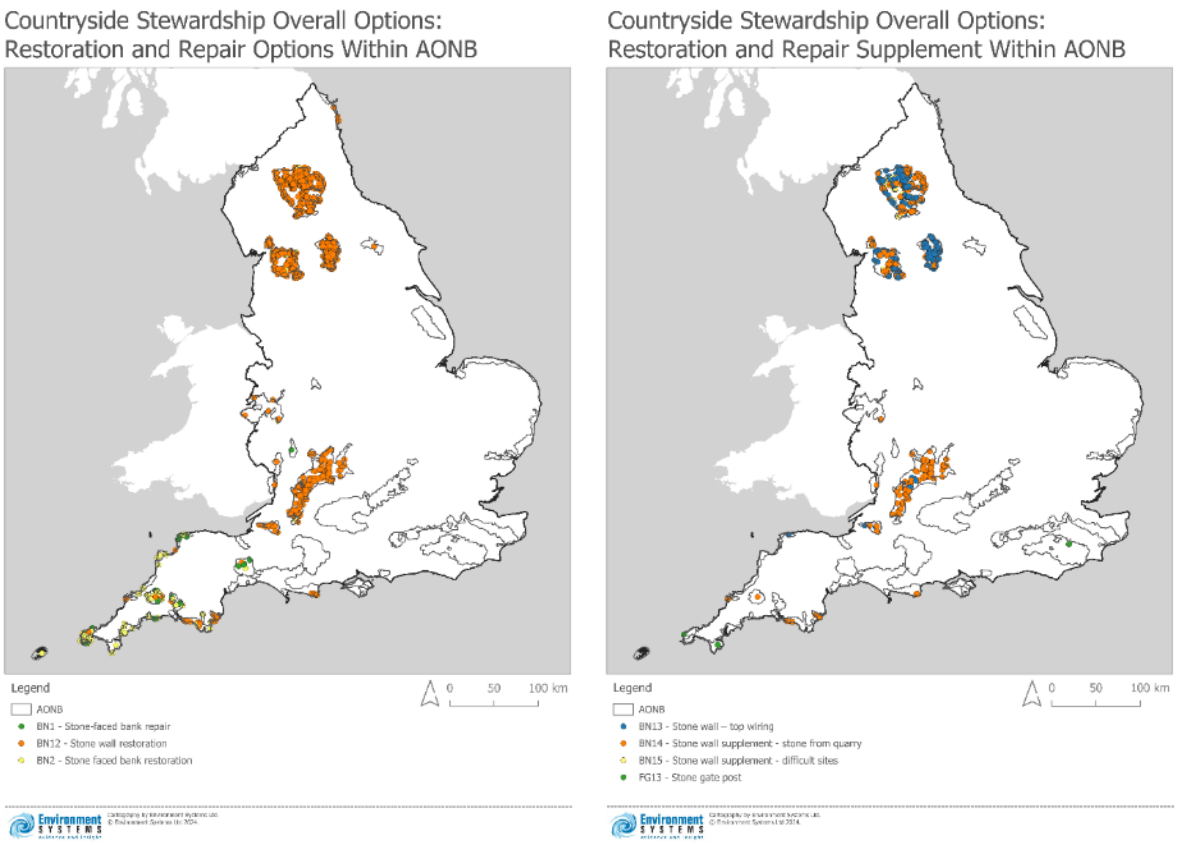


Figure 4.20: CS wall/bank options within AONBs

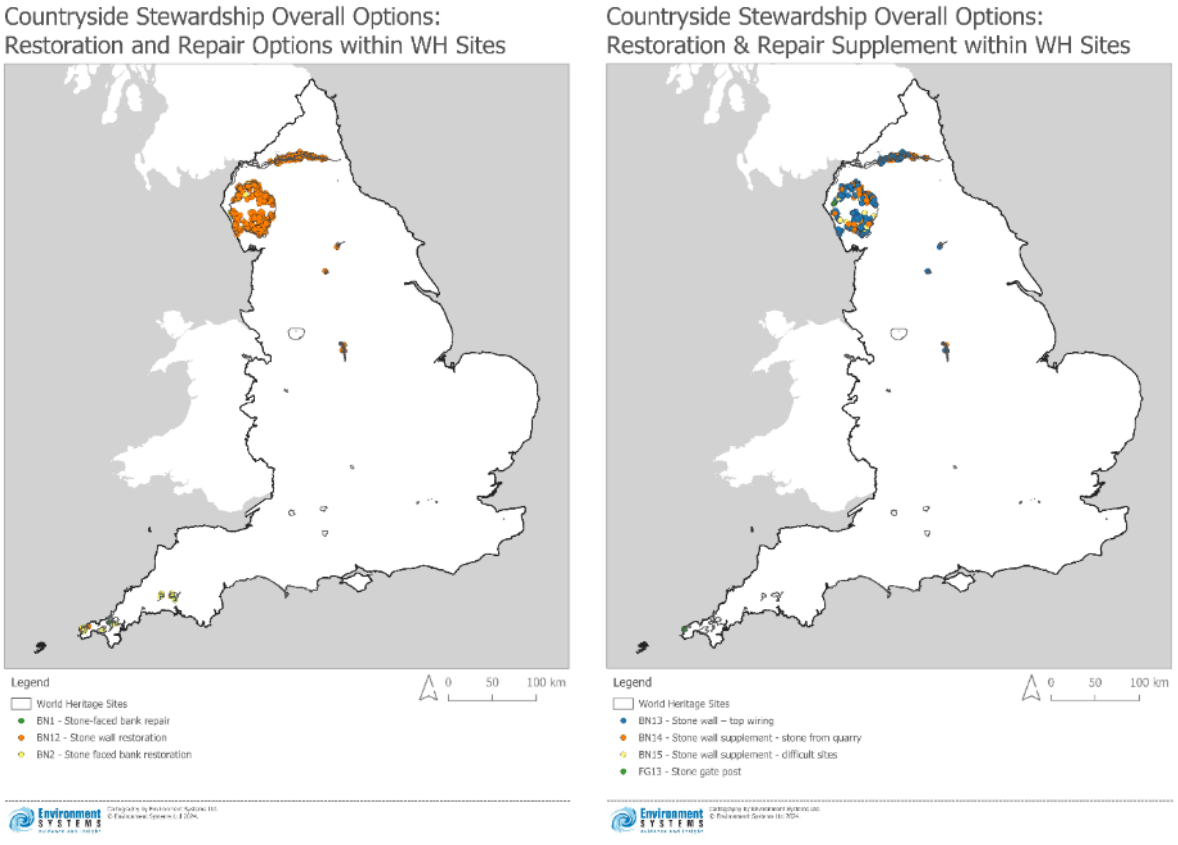


Figure 4.21: CS wall/bank options within World Heritage Sites

4.7 AES option uptake summary

Options relevant to wall and bank boundary protection and maintenance as well as repair and restoration are concentrated in the North of England as well the South West, with a distinct separate cluster around Gloucestershire.

Just over 20% of relevant ES options and supplements occur above the moorland line, this number is considerably lower for CS options and supplements around 5%. This likely indicates the lower level of enclosure in the uplands above the moorland line, despite the prevalence of relevant options in upland dominated northern English counties and areas such as the Peak District and the Yorkshire Dales.

WRD (ES) and BN15 (CS) which are supplements for stone wall restoration and repair on difficult sites are most prevalent above the moorland line with respectively 30 and 50% of occurrences found here. This would reflect the likelihood of increased access difficulties to such sites.

Over 90% of ES and CS options are located withing 3 ALTs (Uplands, Upland Fringe and Western Mixed).

Both ES and CS options are concentrated on land of poorer ALC grades, the vast majority of options are located on land of ALC grade 3-5, with particular supplements WRD (ES) and BN15 (CS) occurring predominantly on land of ALC grade 4 and 5 which is likely to be commonly coinciding with sites at higher altitudes.

Options relevant to walls and banks are prevalent in protected landscapes located in the Upland, Upland Fringe and Western Mixed ALTs, contributing to their unique landscape character.

Patterns of geographical uptake between relevant options across the ES and CS schemes are largely consistent with only minor variations.

4.8 Selection of the case study locations

Selection of the four case study locations was achieved using a five-stage process:

- Short list of 10 NCAs with high levels of AES wall and bank option uptake (see Table 3.13).
- Review of NCA profiles to confirm that walls and banks were prominent features.
- Select three NCAs substantial protected area coverage on one outside.
- Select three NCAs dominated by walls and one by banks. Dartmoor NCA was the only candidate with sufficient bank option uptake to be considered.
- Review of AES agreement coverage within each NCA to ensure sufficient uptake within potential 5 x 10 km^2

The four case study locations (Figure 4.22) were confirmed with the PSG and are described in Table 4.32:

- Swaledale
- Todmorden
- Coldeaton
- Dunstone

The boundary of the Swaledale case study area was designed to follow the mid-Swaledale section of the Swaledale and Arkengarthdale Barns and Walls Conservation Area, to capture the main concentrations of stone walls along the valley. The other three case study areas each covered a 5 x

10 km² block. The Coldeaton case study area crossed the border between the White Peak and South West Peak NCAs to ensure sufficient AES agreements were included for the survey.

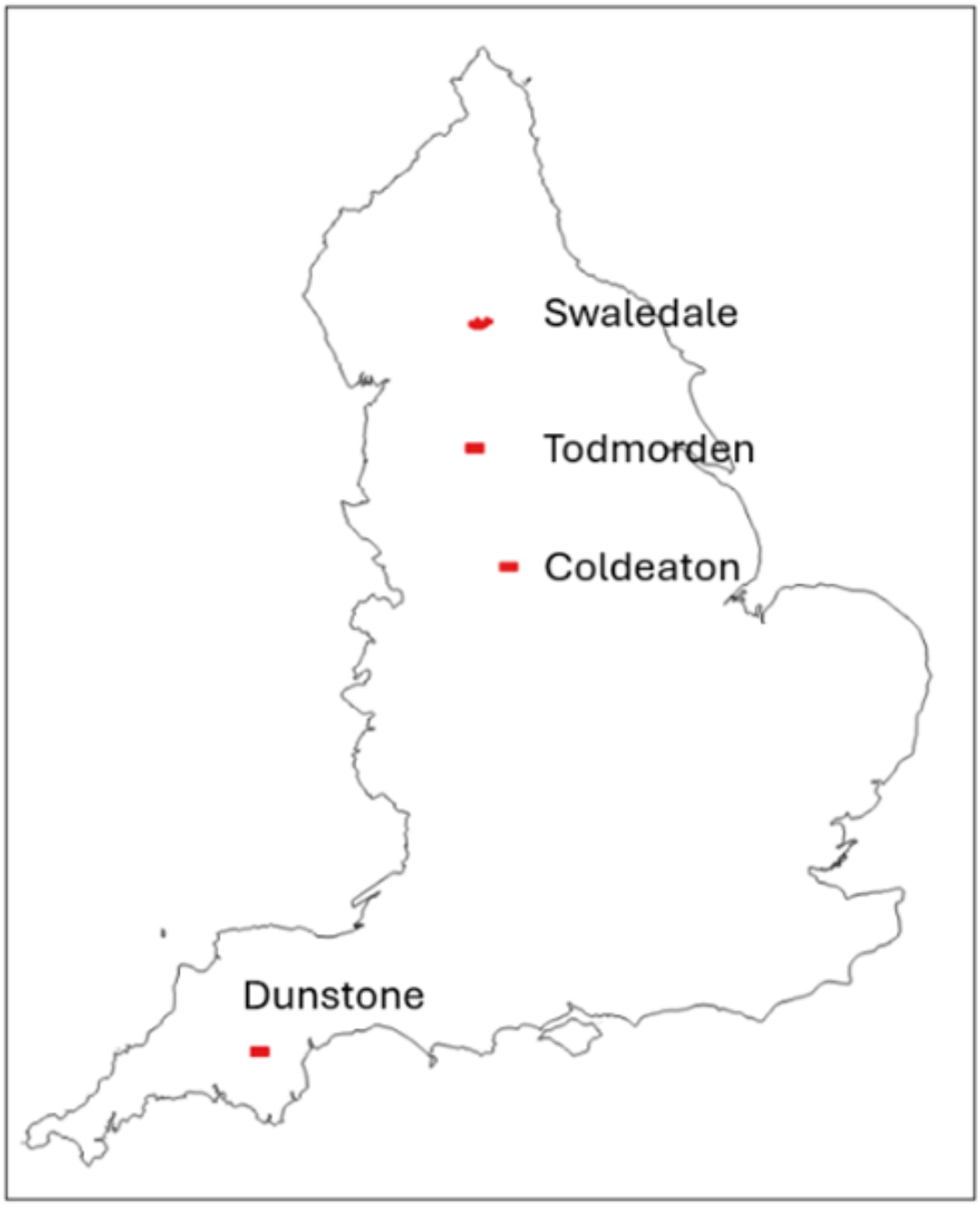


Figure 4.22 Location of the case study areas

Table 4.32: Summary characteristics of the case study areas

Case study location	Protected area	NCA	NCA AES option uptake	NCA key characteristics	NCA boundary features	NCA field patterns
Swaledale	Yorkshire Dales NP	Yorkshire Dales	4,236	Large numbers of characteristic stone field barns, particularly in Swaledale and Wensleydale, and strong patterns of drystone walls, with very large, rectangular enclosures on fell tops, much smaller enclosures in dales, and often older, irregular patterns around settlements.	Field boundaries are generally distinctive drystone walls, enclosing large, rectilinear fields on the higher fells and smaller, older and irregular fields within the dales and particularly around villages. There has been an increase in the number of drystone walls with top wire attached to them to heighten the wall to stop sheep jumping over. Walls often stretch up the valley sides at right angles to the valley which is a characteristic feature of the dales. There is a strong pattern of wall styles throughout the dales.	The fell tops are largely unenclosed although some have been divided into large allotments with the lower slopes having larger enclosed fields. Fields are typically large and rectilinear on the higher fells with smaller, older and irregular shaped fields within the dales and particularly around villages.
Todmorden	No	South Pennines	1,700	Enclosed upland pastures and hay meadows enclosed by drystone walls on the hillsides, and narrow valleys with dense gritstone settlements in the valleys, with steep slopes often densely wooded, providing strong contrast with open moorlands	Field boundaries are predominantly drystone walls constructed with local sandstones from the Millstone Grit and the Coal Measure Series or in some localities, limestone. Walled tracks lead from the valley bottoms to the fell tops, giving access to the open moorland for summer grazing.	The upland pastures that fringe the moorlands are bounded by drystone walls and are generally small to medium in size, with localised areas of larger fields in regular geometric patterns dating from the 19th-century enclosures. While boundary walls are sound, internal field boundaries are often in poor condition due to lack of maintenance.
Coldeaton	Peak District NP	White Peak & South West Peak	1,312 1,217	Grassland enclosed by limestone walls, with small narrow strip fields often of medieval origin around villages, and larger rectangular fields away from the villages. Intricate and distinctive field boundary patterns often with historic associations;	The predominant boundary type on the plateau and higher ground is drystone walling made of local stone (either limestone or gritstone). Later walls are often made of quarried stone, with earlier walls of rougher 'rubble' stone. Hedgerows are common on lower ground,	Around villages fields tend to be small and narrow, often with boundaries of medieval origin. Fields further away from villages tend to be large and rectangular, delineated by a regular network of drystone walls. There are some

Case study location	Protected area	NCA	NCA AES option uptake	NCA key characteristics	NCA boundary features	NCA field patterns
				gritstone walls at higher elevations and hedgerows at lower elevations	mostly of hawthorn and blackthorn. Gritstone walls enclose the higher fields while hedgerows are more common on lower ground and the foothills, with a prevalence of holly in valley bottoms in the south-west.	particularly good examples of the strip field system, dating from the Parliamentary Enclosures Acts, in the Chelmorton area. Grazing land in the upland areas includes both large enclosures on lower, better drained and flatter margins to the moor and small, clean, in-bye enclosures around isolated farmsteads. Many of the large enclosures are areas of land that have been reclaimed from the moor in the past.
Dunstone	Dartmoor NP	Dartmoor	862	A small-scale pastoral landscape – with a strong field pattern defined by granite walls, granite-faced banks or hedgebanks – which surrounds the open moorland.	Relic boundaries dating to the Bronze Age lie abandoned on the open moor. Within the present day enclosed land, fields are bounded by the traditional Devon hedgebank, thought to date from the late medieval period but sometimes built on much earlier foundations. By contrast, the vast central 'newtakes' created mainly between about 1780 and 1820, enclose once open moorland, and have distinctive drystone walls.	Strong, small irregular field patterns, characterised by drystone walls, stonefaced hedgebanks and hedgerows represent a mix of piecemeal enclosure of medieval strips, generally completed by 16th century, to the home closes of ring-fenced medieval farms on the moorland edge. There are larger and more rectilinear fields of late 18th and 19th century date (newtakes) on some higher ground, especially in the south and west

4.8.1 Swaledale

History

This area of mid-Swaledale is sited in the Swaledale and Arkengarthdale Barns and Walls Conservation Area. Its special character derives from the close-knit pattern of small fields and the field barns for over-wintering cattle with which they are associated (Figure 4.23), these mostly dating from the later 18th century with some evidence also for earlier fabric and building platforms. A long history of pastoral farming since the 14th century, specialising in the production of cheese and butter, has also sustained the exceptional survival in the valley sides of prehistoric and Romano-British settlement and field systems, and of multi-period earthworks resulting from earlier settlement and land use.

Farmsteads are typically built as linear arrangements of attached farmhouses and working buildings, and farming incomes were supplemented by incomes from by-employment in the textile industry, in quarrying and in lead mining. Farmsteads developed within valley-bottom settlements, Gunnerside retaining the outline of a medieval stock farm, and from the later medieval period on valley sides. The drystone walls thus form an integral part of the in-bye land where arable, pasture and meadow had developed by the 14th century, and also the intakes from valley sides that are associated with the foundation of new farmsteads between the 14th and 19th centuries. Some walls mark very ancient boundaries, these including those that bounded the in-bye land and those surmounting earlier field banks in 'co-axial' patterns of walls that can be prehistoric in date.

Figure 4.23: Swaledale barn and wall landscape

Field survey overview

Walls in Swaledale featured numerous different stone types and featured both coursed and rubble constructions, often in close proximity to one another but generally stood between 1 m and 1.5 m

tall and were c.0.5 m wide with a profile that slightly widened towards the base. One of the most common types of wall was constructed of sandstone cut into large blocks, often with regular and large coping stones. Gritstone and limestone have also been employed and in such cases, it is not uncommon to find two or more parallel lines of through stones that run nearly the entire length of the wall giving a coursed appearance. With Gritstone and limestone walls, coping stones comprised of large, rounded boulders often placed loosely on top of a wall, sometimes on top of a course of wide, flat stones (Figure 4.24). Large stone-built field barns were often exploited to act as part of the field boundary. Top wire was a common feature, as were thin strips of fencing along the top of the walls.

Figure 4.24: Coping stones, Swaledale

Features were uncommon in walls. Gateposts were rare, which meant that the entire section of the wall was often exposed, including hearting and pinning/wedge stones. Where gateposts were present, these were often ornamental in nature being large, square set, and featuring some kind of rounded stone on top. Sheep creeps were common (Figure 4.25), however, these were regularly blocked with a variety of materials including metal gates, wood, and stone. Stiles (narrow gaps in walls), sometimes with thin, vertical stone slabs on either side, served to provide PRoW access (Figure 4.26) and often featured a small wooden gate on one side. In a few instances, these gaps only appeared part way up the wall.

Figure 4.25: Sheep creep, Swaledale

Figure 4.26: Style in a stone wall, Swaledale

4.8.2 Todmorden

History

The walls in this area relate to a dispersed pattern of farmsteads, including a high proportion of which include 'yeoman-clothier' farms of 15th-17th century date with timber-framed and aisled houses and barns – the latter for storing harvested corn and hay, and also livestock. From the 15th century, the development of the textile industry was a major factor in increasing the numbers and density of dwellings and farms, as well as the associated further enclosure of moorland with irregular and semi-irregular fields bounded by walls. This process included the subdivision of earlier large arable fields and pastures, the expansion of farmland into the higher valley slopes and the piecemeal enclosure of some areas of communally-managed moorland. Many areas not enclosed on this basis (a process that continued into the 19th century) were subject to a final phase of planned enclosure with straight-sided fields (Figure 4.27).

Figure 4.27: Planned enclosure, Todmorden

Many farmhouses were provided with dairies, and also with loomshops on upper floors or in their lower ends. The development of steam-powered industry, especially in the late 18th and 19th centuries, led to the growth of settlements along Calderdale including Todmorden and Hebden Bridge. Long-standing and new landowners with wealth derived from the textile industry also funded the rebuilding of farmsteads for the dairy industry and new drystone walls bounding reorganised and some newly-enclosed fields after the 1860s.

Field survey overview

The walls are generally shaped rubble stone with a wide base tapering towards the top of the wall. Larger stones feature at the base of the walls, with smaller stones used as levelling towards the wall tops. On average the walls stand to c.1.5 m, can be up to a 1 m wide at the base and as little as 0.3 m at the top. All walls feature coping stones. These range from roughly rectangular stones aligned

lengthways across the top of the wall, or flat-bottomed rounded stones positioned to form a uniform wall height. In a few cases an extending drip course at the tops of walls was observed.

Some distinction was observed between wall style, the type of stone available (workable stone) and land ownership. The use of softer sandstones and walls associated with field enclosures for larger more prosperous farms tended to be more squared and uniform (Figure 4.28).

Figure 4.28: Regular stone walling, Todmorden

Large carved stone gateposts are common, some with rounded tops. In a number of cases a set of three gateposts were observed, comprising two large posts supporting the field gate and a third a smaller pedestrian access (Figure 4.29).

Figure 4.29: Carved gateposts, Todmorden.

4.8.3 Coldeaton

History

This area is mostly located in the White Peak NCA, the area to the west of the Manifold Valley including Warslow being in the South West Peak. Its walls illustrate the mixed farming associated with its villages and dispersed farmsteads from the medieval period, the enclosure of moorland and reorganisation in the 18th and 19th centuries when the rearing of cattle There is rich evidence across this area, best-preserved in the former open moorlands which were enclosed after 1650 or have remained as open calcareous grassland, for prehistoric burial and ritual sites; there is some evidence also for settlement, which has been mostly concealed by later layers in the valleys. The internationally-significant Ecton Hill copper mines to the north-west retain evidence for their working from the Bronze Age.

The field boundaries in the South West Peak and in the village farmlands of the White Peak were mostly formed by the mid 17th century; boundaries around villages often retain the outlines of fields enclosed on a piecemeal basis from medieval strip fields, fields and the farmsteads associated with them also retaining the evidence for reworking - typically with quarried and dressed stone - in the 18th and 19th centuries. In contrast are areas of more irregular pre-1650 enclosure – concentrated to the west - and the survey-planned fields of post-1650 (mostly post-1750) regular enclosure of the open commons and wastes which were particularly extensive in the White Peak. Close observation of the footings of some walls may reveal orthostats and other features which can – as proven at Roystone Grange just to the east – be two thousand or more years old. Whilst farmsteads in areas of early enclosure are most likely to have retained evidence of pre-1650 fabric, those in areas of regular enclosure are more likely to be closely associated with the dates of enclosure and be formally arranged around yards. The field boundaries in surviving areas of open commons mostly date from short-lived episodes of enclosure in the late 18th and 19th centuries.

Field survey overview

Walls were generally rubble built out of limestone, as well as possibly gritstone, and stood between 1 m and 1.5 m tall and c.0.5 m wide with a profile that slightly widened towards the base. The top of the walls featured thin and vertical coping stones (Figure 4.30). Top wire regularly formed an important part of the stock proofing of these dry-stone walls and often consisted of more than one line of wire, though these often slumped below the height of the wall.

Figure 4.30: Typical stone wall, Coldeaton

Walls often had a number of features. Gateposts were a common element of walls, often taking the form of thin slabs which were either short (standing slightly below the height of the wall), or tall (matching the height of the wall) (Figure 4.31). These gateposts were often not in use and had been replaced by wooden or metal posts. Sheep creeps were uncommon but stiles regularly featured along walls providing PRoW access. These stiles took the form of narrow gaps in walls, regularly with thin, vertical, stone slabs on either side which could easily be stepped through and sometimes required the opening of a small wooden gate on one side. Troughs are common and are often placed through walls, perpendicular to the field boundary, so that they can serve animals located on both sides of the wall.

Figure 4.31: Gateposts, Coldeaton

While rare, dewponds and watering ponds integrated onto the field systems/dry-stone walls were also observed across the case study area (Figure 4.32).

Figure 4.32: Derelict stone wall with dewpond, Coldeaton

4.8.4 Dunstone

History

Stone walls and hedgebanks mark the boundaries of the strong field patterns which define Dartmoor and which developed in close association with its farmsteads; these include a high proportion of medieval origin and longhouses where people and animals originally shared the same entrance. The high moor had developed by the 1st millennium BC as a vital summer grazing resource for a large part of Devon, with ancient boundaries flanking the droveways which provided access to it. These areas retain exceptionally high concentrations of prehistoric ceremonial or ritual sites, settlement sites and extensive field systems formed of low stony banks topped in turf, known as reaves. Farmsteads relate to medieval and post-medieval intakes from the moor, with the 'inbye fields' (closest to them) bounded by 'corn ditches' which are banks with a stone-face and ditch on the moorland side and sloping grass bank on the inner face.

Where walled boundaries exist, these are often built as walls or banks. Some substantial walls exist, including some built by prisoners of war in the early 19th century. The boundaries of the moorland fringe mostly date from the medieval and post-medieval periods, when from the 15th century the farming economy became more pastoral in nature, and have left distinctive patterns in the landscape. Many retain the forms and outlines of medieval plough strips, some describe the outline of oval or irregular stick enclosures and others relate to the reorganisation of farmland and sometimes taking-in of moorland when arable cultivation was expanded from the late 18th century. These changes were also accompanied by enclosure of some areas of the high moor, and the completion of the first turnpike across it in 1772.

Field survey overview

Stone-faced banks are generally rubble built using locally sourced stone, and typically vary between 1 m and 1.5 m tall and c.2 m wide forming an upside-down U in profile. Where banks take the form of drop banks, the higher ground behind the drop bank and the stone facing will either meet at a 90 degree angle or meet at a more acute angle as the ground gradually rises to the required height before forming a stone facing. Hedges on top of stone-faced banks were more common than not and were left in various states of maintenance, most often being overgrown often obscuring any stone facing. It also appears that stone-faced banks have been repaired by simply adding more soil, on top of the stone facing. Often, the stone facing of these banks was most visible where they terminated at gates and gateposts (Figure 4.33).

Figure 4.33: Stone-faced bank, Dunstone

The banks along narrow roads tended to be taller, sometimes up to c.2 m in height, potentially reflecting the greater emphasis on the need to be stockproof (Figure 4.34). Stone-faced banks associated with cattle (beef and dairy) farms were typically in better condition than those where sheep were perceived to be the primary livestock. It is unclear if this is due to lesser emphasis on stock proofing boundaries associated with sheep, damage caused by the sheep themselves, or the generally more exposed locations where sheep were being kept leading to more natural erosion of the banks.

Figure 4.34: Roadside stone-faced bank, Dunstone

Where stone walls were present, these were often constructed of very large boulders at the base and smaller rubble stones above.

Two distinct types of gateposts are commonly in use. The first comprises a pair of thin slabs as gateposts; one shorter slab standing slightly below the height of the wall, and a taller slab matching the height of the wall or slightly above it. The taller of the gateposts are used to hinge the gate, which opens outwards from the shorter post. The second, are large blocks of stone carved to form gateposts of equal size with a rounded top. In some cases, these have been replaced by modern concrete copies. The gates themselves vary from traditional wooden gates, to modern tubular metal gates (Figure 4.35).

Figure 4.35: Gatepost, Dunstone

Sheep creeps appear to be uncommon and where they are found are often blocked and not in use. It is possible that some have been adapted to enable a water trough to be inserted to service two fields. Stiles are a regular featured through stone walls along the PRoW network. These stiles take the form of narrow gaps in walls, further restricted by vertical thin stone slabs on either side which can easily be stepped through or over but prevent access by farm animals. Some have the addition of a small wooden gate on one side.

5 NATURE AND CONDITION OF WALLS AND BANKS IN THE CASE STUDY AREAS

5.1 Introduction

This section presents the findings of the case study analysis and is divided into three parts:

- Results of the remote sensing analysis of walls and banks across the four case study areas.
- Uptake of wall and bank options within ES and CS.
- Findings from the field survey, examining boundary types, their condition, and the impact of AES protection and maintenance, and repair and restoration options.

5.2 Remote sensing of boundary type and condition

5.2.1 Prominence of stone walls and stone-faced boundaries

Across the four case study areas over 27,000 boundaries were identified (Table 5.1). Aerial photograph interpretation (API) was used to identify field boundaries that were walls. Where it was not possible to determine if a boundary was a wall, for example if it was hidden by tree cover or in deep shadow or a possible phantom boundary, it was recorded as "Other". Table 5.1 and Figure 5.1 show that walls were a prominent feature in Swaledale (82%), Coldeaton (62%) and Todmorden (52%). In contrast, only 17% of field boundaries in Dunstone were classified as walls. Banks were a prominent feature in this study area, but it was difficult to distinguish them from other boundary types, such as hedge banks and earth banks. To improve the classification in Dunstone, the "Other" category was subdivided to identify vegetated boundaries (66% of all boundaries), which were likely to be associated with banks.

Table 5.1: Number of field boundaries in each case study area

Case study	Stone	Other	Total
Swaledale	5,435	1,157	6,592
Todmorden	3,842	3,622	7,464
Coldeaton	5,453	3,390	8,843
Dunstone	780	3,855	4,635
Total	**15,510**	**12,024**	**27,534**

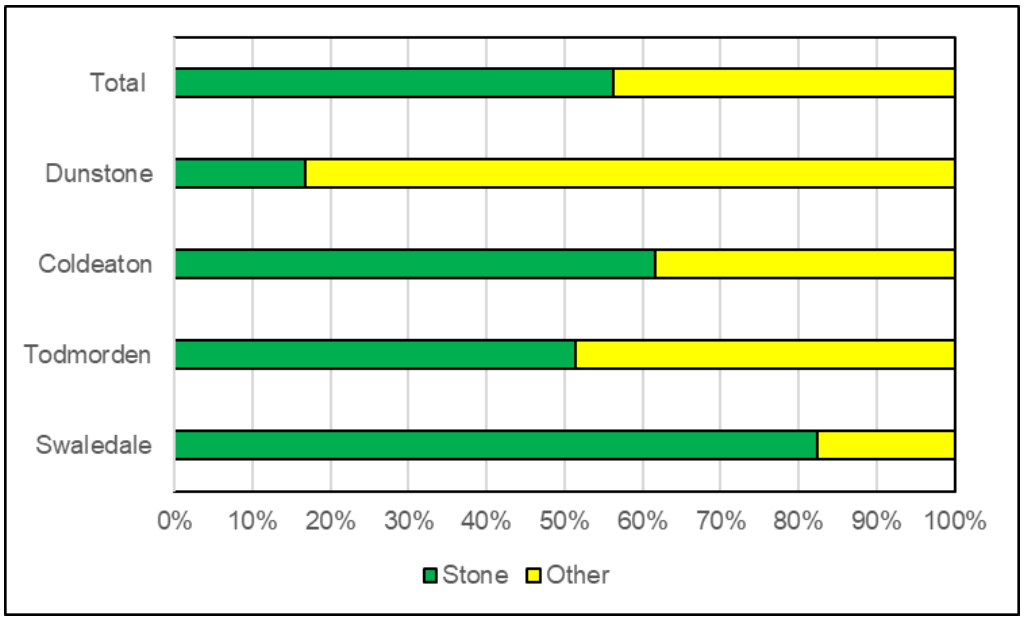


Figure 5.1. Proportion of stone wall boundaries in each case study area

Remote sensing identified over 2,900 km of field boundaries in the four study areas. Table 5.2 and Figure 5.2 show that:

- Swaledale has the highest proportion of wall boundaries (500.2 Km, 79%).
- Todmorden has a more even distribution between wall (387.3 Km) and other types (402.6 Km).
- Coldeaton has the longest total boundary length (948.9 Km), with a significant proportion being walls (567.4 Km, 60%).
- Dunstone has the shortest total boundary length (535.4 Km) and the lowest amount of wall boundaries (105.3 Km). Bank boundaries could not be distinguished from vegetated boundaries meaning the majority of its boundaries fall under the "Other" category.

Table 5.2: Length of field boundaries in each case study area (Km)

Case study	Stone	Other	Total
Swaledale	500.2	133.5	633.8
Todmorden	387.3	402.6	789.9
Coldeaton	567.4	381.5	948.9
Dunstone	105.3	430.1	535.4
Total	**1,560.2**	**1,347.7**	**2,907.9**

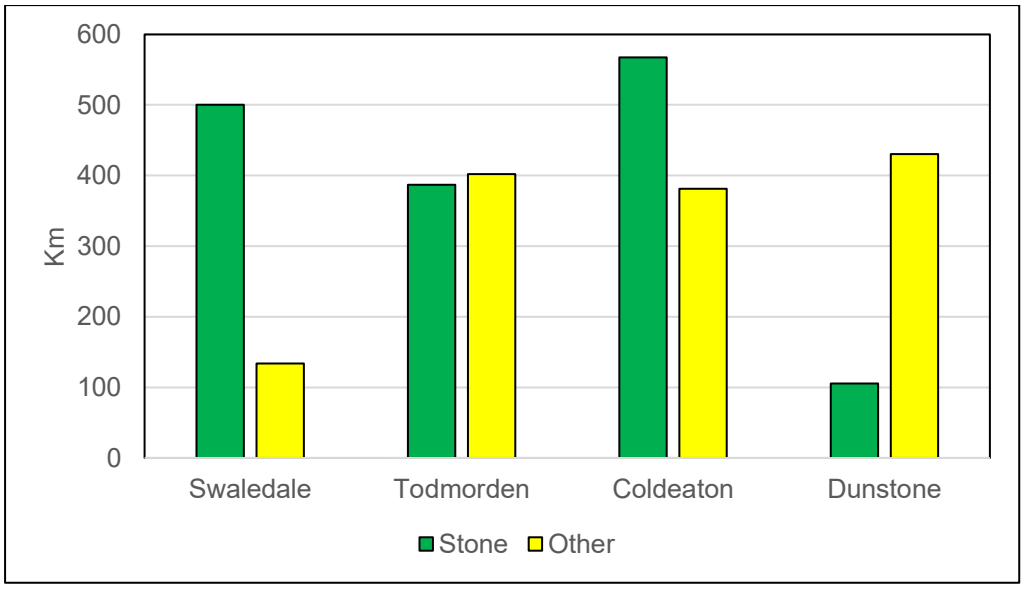


Figure 5.2: Length of field boundaries in each case study area

5.3 The condition of stone walls

Using the Swaledale case study as a test case, wall condition was mapped using remote sensing approaches to generate information on the accuracy of predicted condition, with an assessment of:

- Automated analysis of Lidar (Light Detection and Ranging) data.
- Visual interpretation of aerial photography.

Data on the condition of walls from the Swaledale field survey was used to assess the accuracy of results derived from remote sensing. The field survey recorded wall condition data for 1,762 node to node lengths of walls in the case study area using four condition categories (Table 5.3).

Table 5.3: Condition categories used in the field survey

Condition category	Description
A – Excellent condition	No gaps or obvious repair needs
B – Minor defects	Localised repair needs but no gaps
C – Major defects	Extensive repairs and some gap rebuild required
D – Derelict	Extensive sections lost and substantial rebuild required

The results of the remote sensing data analysis are presented in more detail in Appendix 10.3. A summary of the key findings is presented below.

5.3.1 Automated analysis of aerial Lidar

The test used aerial Lidar data from the Environment Agency to assess the condition of walls through automated analysis. The Lidar datasets included the Composite First Return Digital Surface Model (DSM) and the Digital Terrain Model (DTM) at a 1-metre resolution, from which a Canopy Height Model (CHM) was derived. The CHM highlighted elevated features in the landscape, such as buildings, trees, and walls. Several data preparation steps were undertaken to refine the analysis. A random forest algorithm was then applied to classify walls into the four condition categories (A, B, C, D), using a 70:30 training-to-testing data split. The model was tested in seven different configurations, with wall conditions grouped in various ways to assess classification effectiveness (Table 5.4).

The analysis made several assumptions regarding Lidar data reliability and its ability to represent wall condition accurately. The field survey data was assumed to be the ground truth for training, meaning any inaccuracies in the survey would propagate into the model's predictions. The model's performance was evaluated using a confusion matrix, which provided accuracy metrics, including overall accuracy (OA), user accuracy (UA), and producer accuracy (PA). Tests showed that classifying all four wall conditions separately resulted in the lowest accuracy (25%), while grouping walls into broader categories improved classification, with the best-performing test achieving 70% accuracy (see Table 5.4).

Table 5.4: Results of tests used to evaluate the effectiveness of the random forest classification

	Group 1	Group 2	Group 3	Group 4	Overall Accuracy %
Test 1	A	B	C	D	25
Test 2	A, B	C	D		41
Test 3	A	B, C	D		45
Test 4	A	B	C,D		40
Test 5	A	B, C, D			54
Test 6	A, B, C	D			70
Test 7	A, B	C, D			60

The results suggest that Lidar data can be a useful tool for identifying derelict walls (Test 6) and distinguishing between walls in generally good and poor condition (Test 7). However, classification accuracy remains limited by the resolution of Lidar data and the challenges of differentiating between intact walls with similar height characteristics. The study highlights the need for supplementary data sources, such as high-resolution imagery or advanced machine learning techniques, to improve classification accuracy.

5.3.2 Visual interpretation of aerial photography

The visual interpretation of aerial photography (API) was used to supplement the Lidar analysis in assessing the condition of walls in the Swaledale case study area. API involved analysing high-resolution georeferenced aerial imagery (0.25-metre resolution) to classify wall condition.

The Ordnance Survey National Geographic Database (OSNGD) of Field Boundaries was used to identify the walls as it is ready to use at a national level and so has potential to form a basis for replicating and scaling an automated remote sensing condition assessment. Four condition categories were used: intact walls, moderately damaged walls, derelict walls, and non-wall features (incorrectly classified boundaries). This classification differed from that used in the field survey due to the vertical perspective of API. The results identified 6,280 (52.8%) intact walls, 2,046 (17%) moderately damaged walls, 2,288 (19%) derelict walls, and 1,271 (11%) non-wall features, indicating that the OS NGD dataset likely overestimates the presence of walls.

A comparison between API and field survey data was conducted through spatial analysis by overlaying condition classifications on aerial imagery. This helped identify discrepancies and assess potential sources of misclassification, such as vegetation cover, shadow effects, and topographic influences. A key limitation of API was its inability to differentiate between walls with minor damage and those in more advanced states of deterioration, leading to challenges in distinguishing between stockproof and non-stockproof boundaries. Additionally, shadow effects influenced classification accuracy, with east–west-oriented walls aligning more closely with field survey data than north–south walls, where shadows were often absent, causing some well-preserved walls to be misclassified as deteriorating.

Despite these limitations, API remains a useful tool for large-scale wall assessments, offering rapid identification of general wall condition across extensive landscapes. While the technique tends to overestimate wall damage, due to the lack of lateral perspective and reliance on visual artefacts, it

provides coverage for inaccessible areas where field surveys may not be feasible. API and field surveys are complementary, with API serving as an initial assessment tool and field surveys providing more precise condition evaluations.

5.4 Uptake of ES and CS agreements

5.4.1 Introduction

The NEODG provides information on live ES and CS agreements. These datasets also show the general location of wall and bank boundary option uptake within the case study areas. However, they only include agreements that are currently active, meaning they do not present a complete picture of uptake and coverage throughout the entire duration of the schemes.

This distinction is important because ES is a legacy scheme that began in 2005 and closed to new entrants in 2015. As a result, the dataset no longer includes any Entry Level Scheme (ELS) only agreements, as these lasted just five years. Many ES agreements have likely expired and are therefore not represented in the live dataset.

5.4.2 AES uptake in the case study areas

Table 5.5 shows the number of live AES agreements across four case study areas. Overall, there are 235 agreements, with 83 under ES and 152 under CS, with CS agreements being most common in all the case study areas (Figure 5.3).

Table 5.5: Number of live AES agreements in the case study areas

Case study	ES	CS	Total
Swaledale	20	23	43
Todmorden	18	32	50
Coldeaton	21	46	67
Dunstone	24	51	75
Total	**83**	**152**	**235**

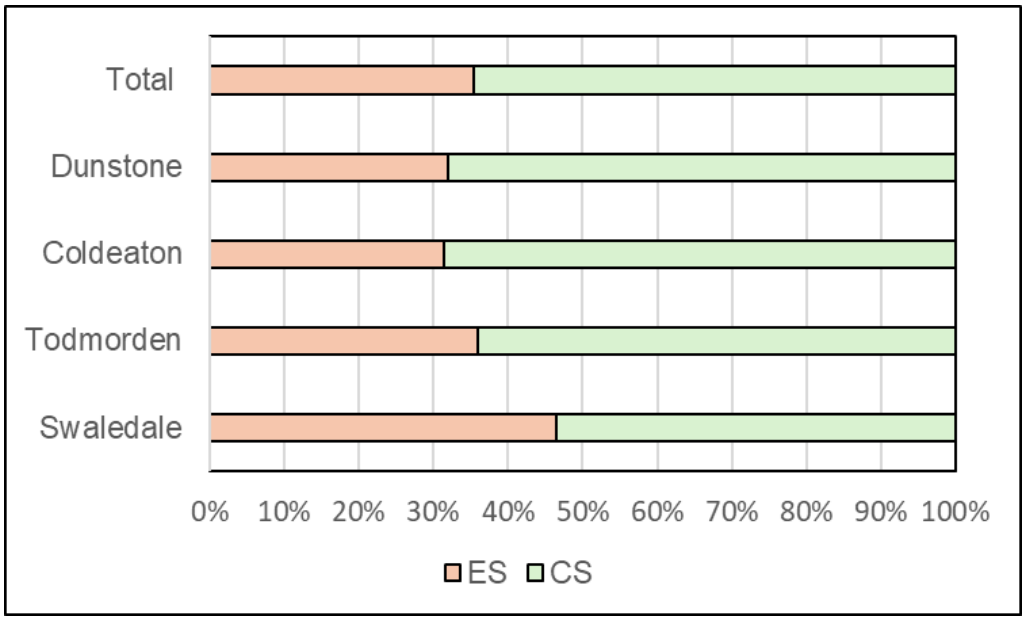


Figure 5.3: Proportion of live ES and CS agreements in the case study areas

The number of field boundaries on land within ES and CS agreements, as well as those outside any agreement, is shown in Table 5.6. The analysis assumes that a field boundary located at the edge of an agreement belongs to that agreement, and a small proportion (4%) are shared between both ES and CS agreements where they border each other.

In Swaledale there is a fairly even split between ES (37%), CS (29%) and non AES (27%) boundaries (see Figure 5.4). In Todmorden, most boundaries (72%) are non-AES, with only 15% under ES and 13% under CS. Coldeaton follows a similar pattern, with 59% being non-AES boundaries, 19% under ES and 20% under CS. Dunstone has the lowest total number of boundaries (4,635), with 23% ES, 43% under CS, and 29% outside AES agreements. Overall, across all case study areas, non-AES boundaries account for nearly half of the total (49%), while CS has a slightly higher proportion of boundaries (24%) than ES (23%).

The distribution of field boundaries under AES agreements, as well as those outside any agreement, is illustrated in Figure 5.5 to Figure 5.8 for each case study area. These figures highlight the spatial variation in boundary coverage.

Table 5.6: Number of field boundaries on live AES agreement land

Case study	ES	CS	ES & CS	Non AES	Total
Swaledale	2,425	1,905	514	1,746	6,590
Todmorden	1,133	937	51	5,343	7,464
Coldeaton	1,647	1,740	279	5,177	8,843
Dunstone	1,078	1,998	232	1,327	4,635
Total	**6,283**	**6,580**	**1,076**	**13,593**	**27,532**

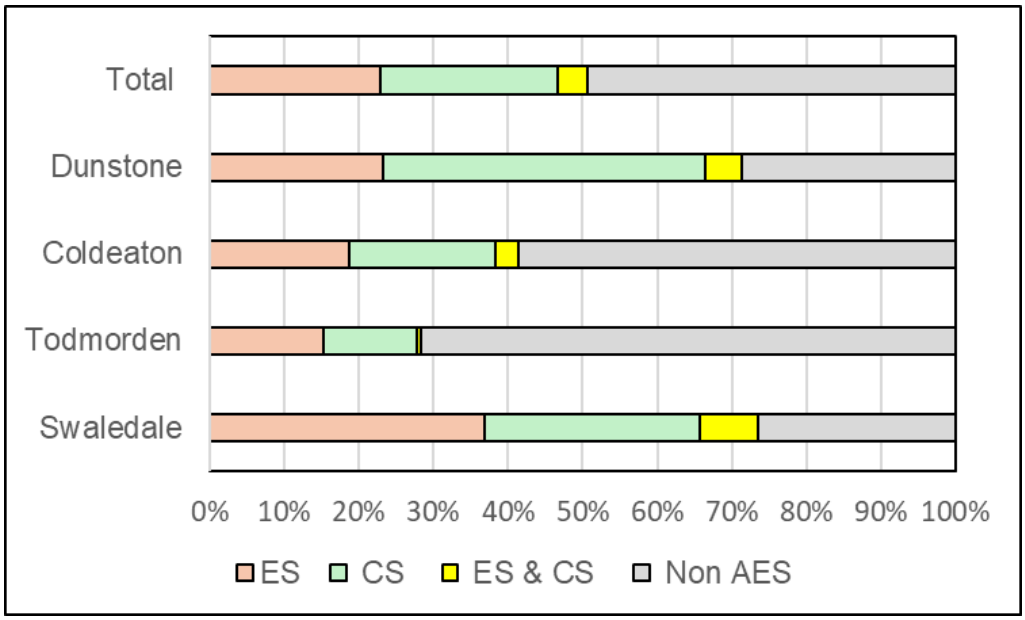


Figure 5.4: Proportion of field boundaries on live AES agreement land

Figure 5.5: Distribution of ES, CS and non-AES boundaries in Swaledale

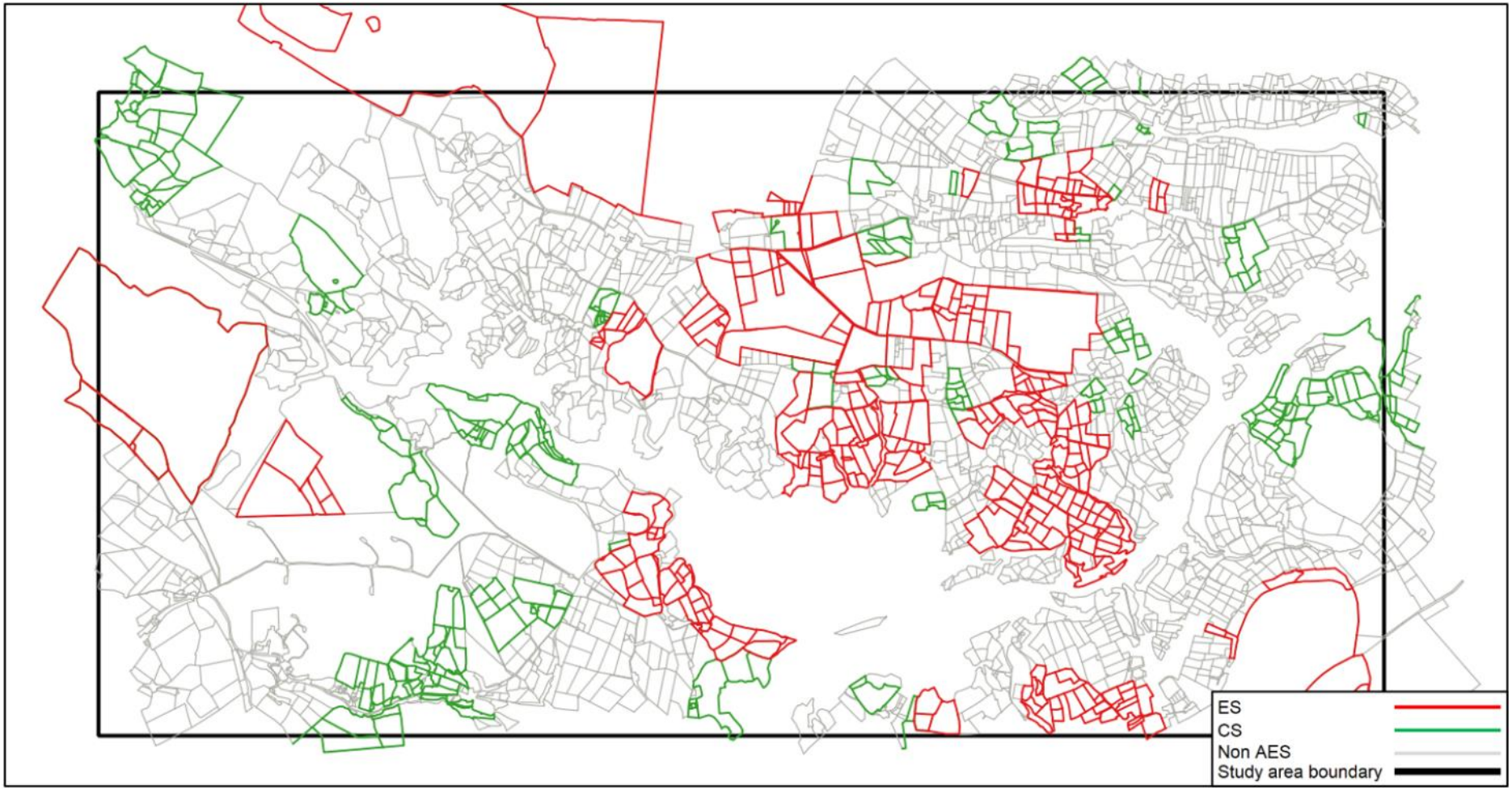


Figure 5.6: Distribution of ES, CS and non-AES boundaries in Todmorden

Figure 5.7: Distribution of ES, CS and non-AES boundaries in Coldeaton

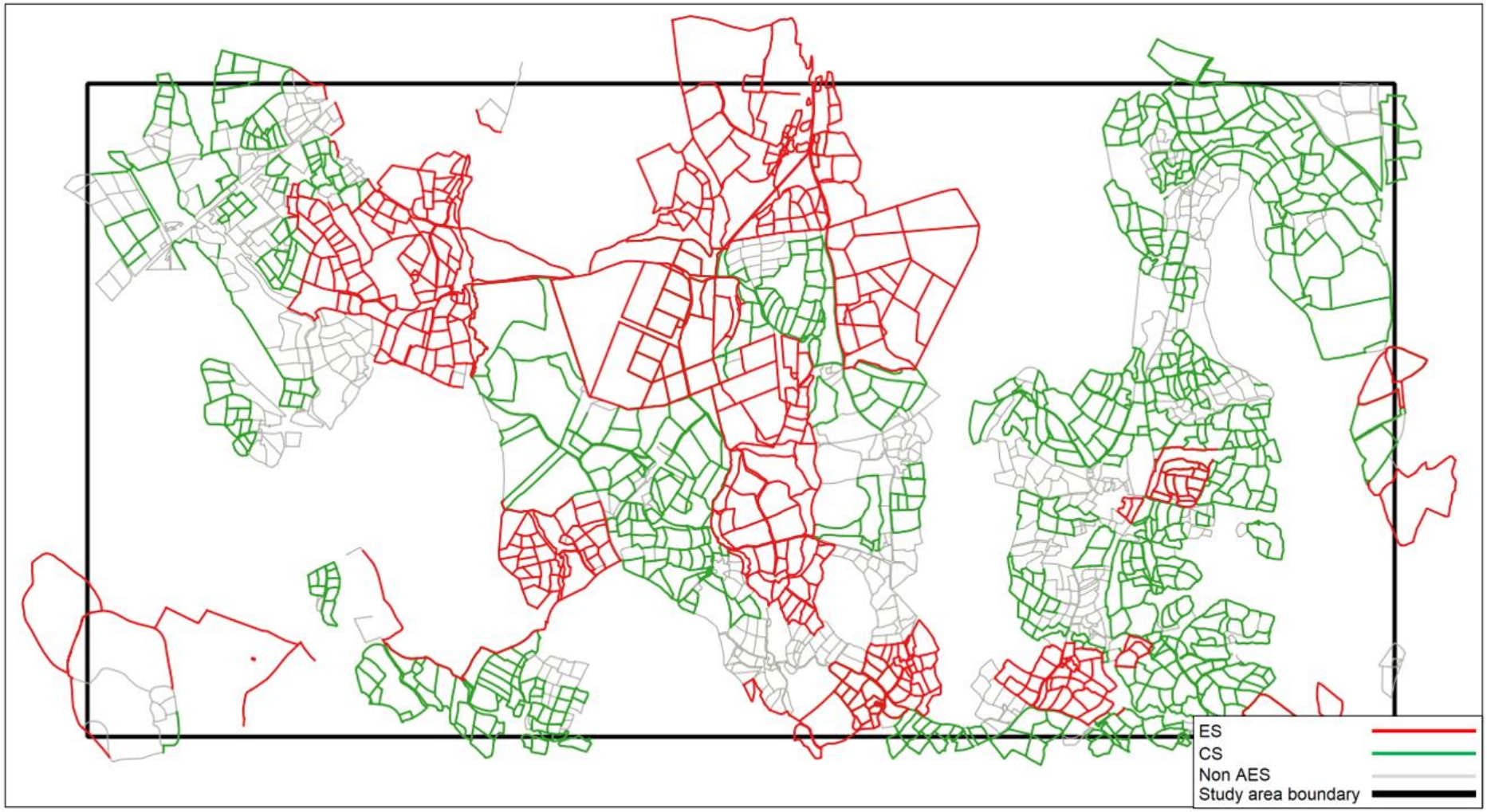


Figure 5.8: Distribution of ES, CS and non-AES boundaries in Dunstone

5.5 Uptake of options

5.5.1 AES options and wall boundaries

Although just over half (51%) of all boundaries are on land covered by live AES agreements and, as Section 5.2.1 has shown, a high proportion of these boundaries in Swaledale, Todmorden and Coldeaton are walls, it is up to the agreement holder to include eligible walls as part of their agreements.

The uptake of wall options varies across the case study areas, as shown in Table 5.7. Swaledale has the highest uptake, with 752 boundaries (14%) under wall options, while the majority (62%) are on agreement land but not under option, and 24% are outside any agreement (see Figure 5.9). In Todmorden, wall uptake is lower, with only 6% of boundaries included, while 25% have no option and the majority (69%) fall outside agreements. Coldeaton follows a similar trend, with 9% of boundaries under wall options, 32% without, and 59% outside AES agreements. Dunstone has the lowest overall total, with just 60 boundaries (8%) under wall options, 62% without, and 31% not covered by any agreement. However, it must be remembered that the majority of boundaries in the Dunstone case study are banks. Across all case study areas, only 1,491 (10%) boundaries have wall options, while 43% have no such option, and 48% are outside AES agreements, indicating that wall option uptake is relatively low compared to the total number of boundaries.

Table 5.7: Uptake of wall options in the case study areas (No.)

Case study	Option	No option	No agreement	Total
Swaledale	752	3,394	1,289	5,435
Todmorden	210	973	2,659	3,842
Coldeaton	469	1,747	3,235	5,451
Dunstone	60	480	240	780
Total	**1,491**	**6,594**	**7,423**	**15,508**

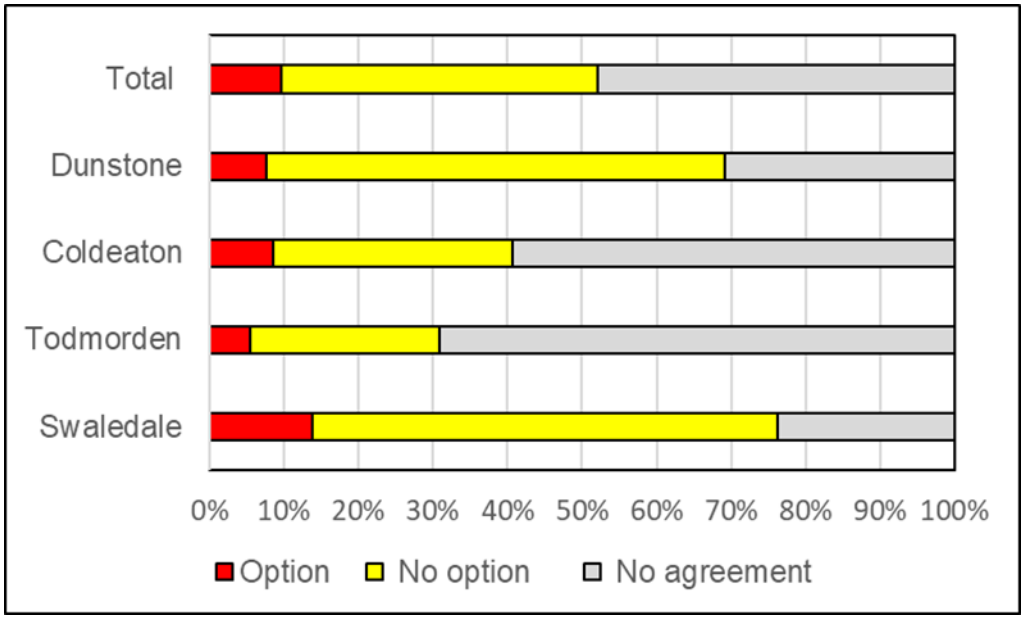


Figure 5.9: Uptake of wall options in the case study areas (%)

5.5.2 ES and CS options

Table 5.8 shows the uptake of wall options under ES and CS agreements across the case study areas. Swaledale has the highest uptake, with 561 wall options under ES (74%) and 193 under CS (26%) (see Figure 5.10). In Todmorden, 82% of wall options are under ES, while only 18% are under CS. Coldeaton follows a similar pattern, with 79% of its wall options under ES and 21% under CS. Dunstone, which has the fewest wall options overall, is the only area where CS options (42) outnumber ES options (18), making up 70% of its total.

Across all case study areas, ES accounts for 75% of the total wall options, while CS represents 25%, indicating a stronger uptake of wall options under ES agreements.

Table 5.8: Number of ES and CS wall options in each case study area

Case study	ES	CS	Total
Swaledale	561	193	754
Todmorden	173	37	210
Coldeaton	371	98	469
Dunstone	18	42	60
Total	**1,123**	**370**	**1,493**

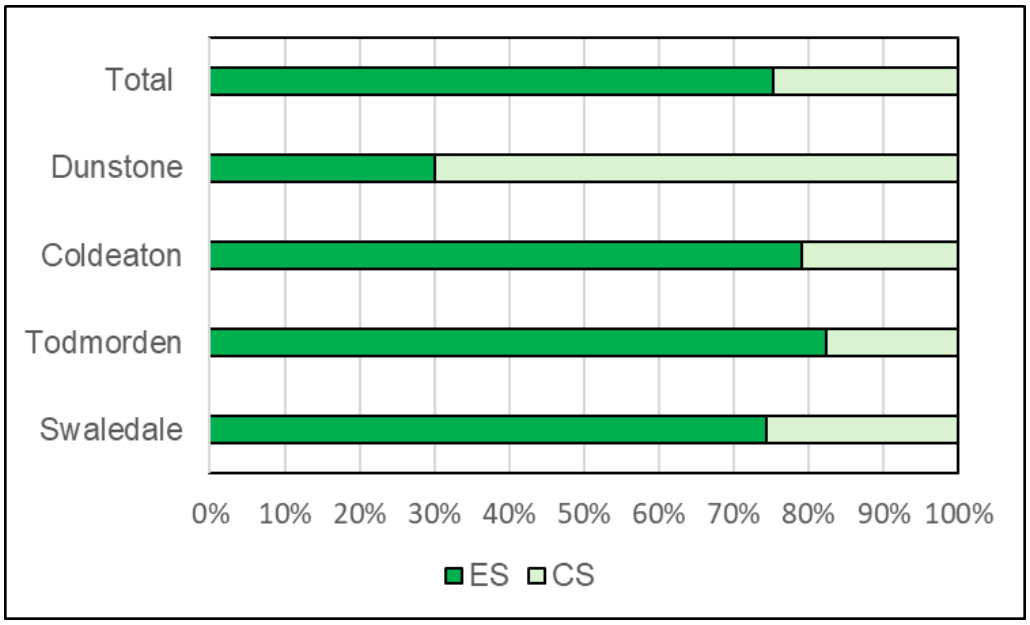


Figure 5.10: Proportion of ES and CS wall options in the case study areas

5.5.3 Restoration and maintenance

Table 5.9 shows the distribution of restoration and maintenance options across the four case study areas. Overall, 3.2% of boundaries were restored and 6.4% are being maintained. Swaledale (9%) and Coldeaton (6%) had the highest proportion of boundaries under maintenance options (Figure 5.11) and Dunstone (6%) and Swaledale (5%) had the highest proportion or boundaries under restoration options.

These results show that although the proportion of walls currently under restoration and maintenance options is relatively low there are substantial variations between the case study areas.

Table 5.9: Number of restoration and maintenance options in each case study area

Case study	Restored boundary	Maintained boundary	Other boundary	Total
Swaledale	271	480	4,684	5,435
Todmorden	54	156	3,632	3,842
Coldeaton	123	343	4,987	5,453
Dunstone	48	10	722	780
Total	496	989	14,025	15,510

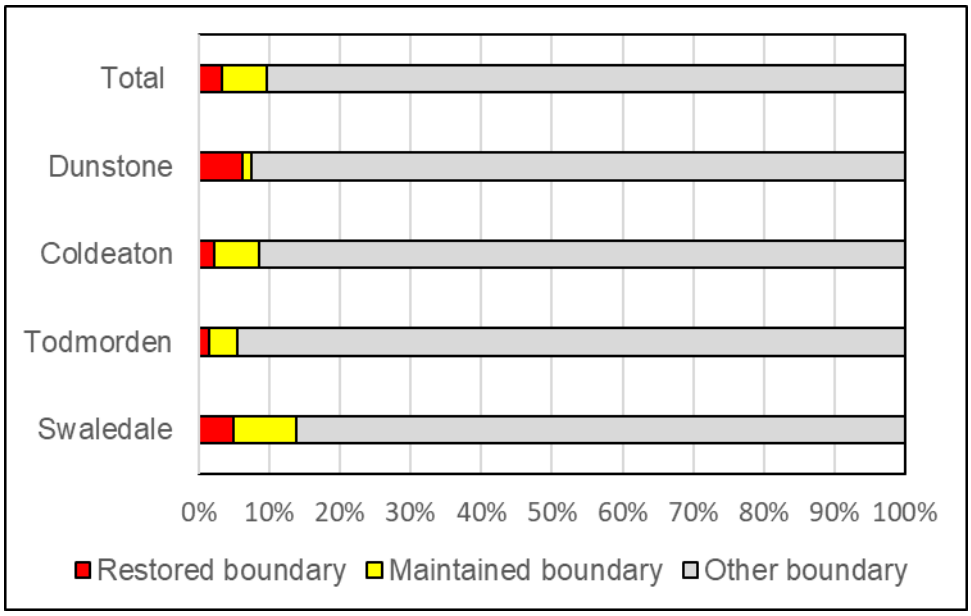


Figure 5.11: Proportion of restoration and maintenance options in each case study area

The distribution of field boundaries under restoration and maintenance options, is illustrated in Figure 5.12 to Figure 5.15 for each case study area. These figures highlight the spatial variation in option uptake.

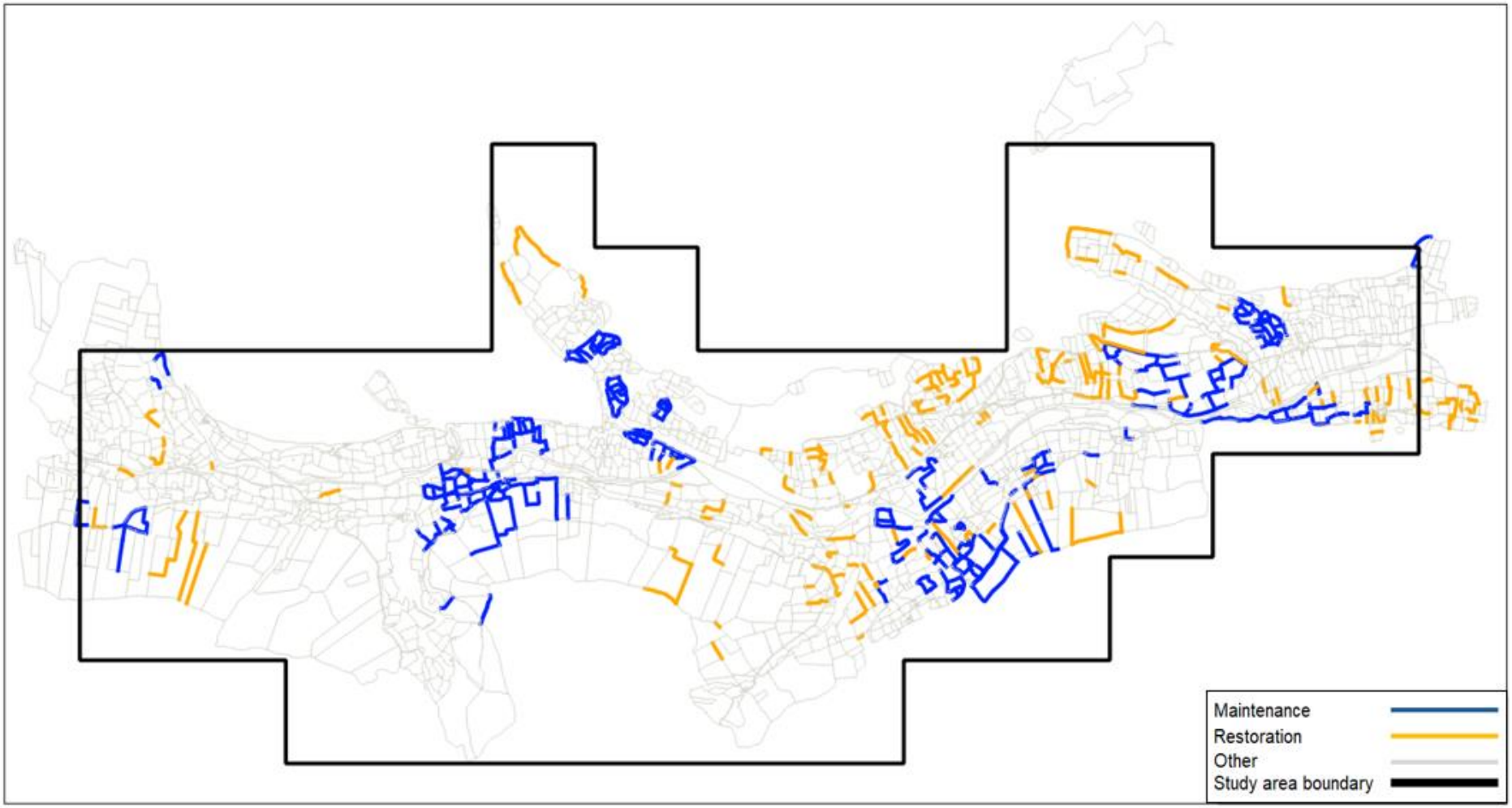


Figure 5.12: Distribution of maintenance and restoration options in Swaledale

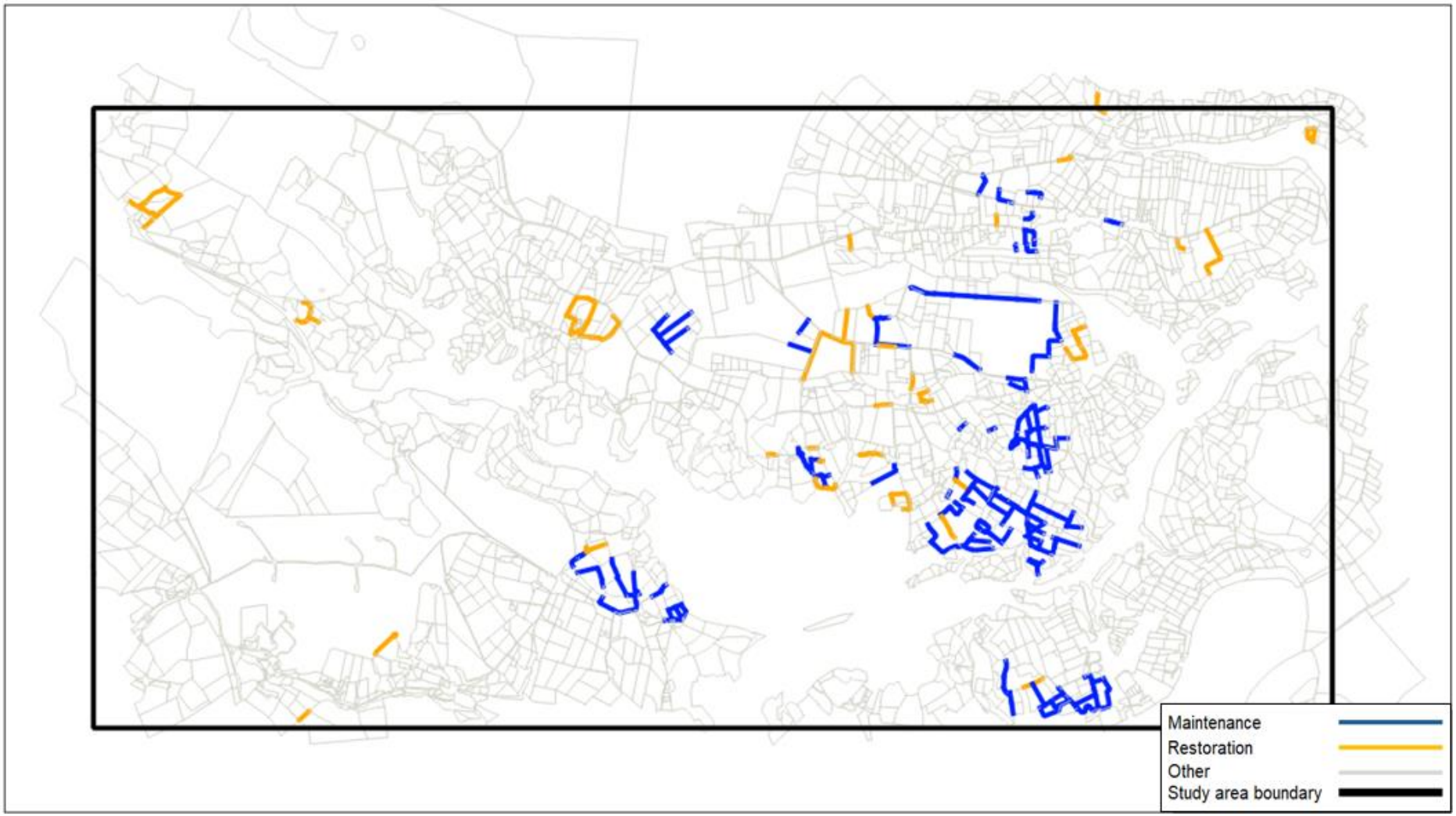


Figure 5.13: Distribution of maintenance and restoration options in Todmorden

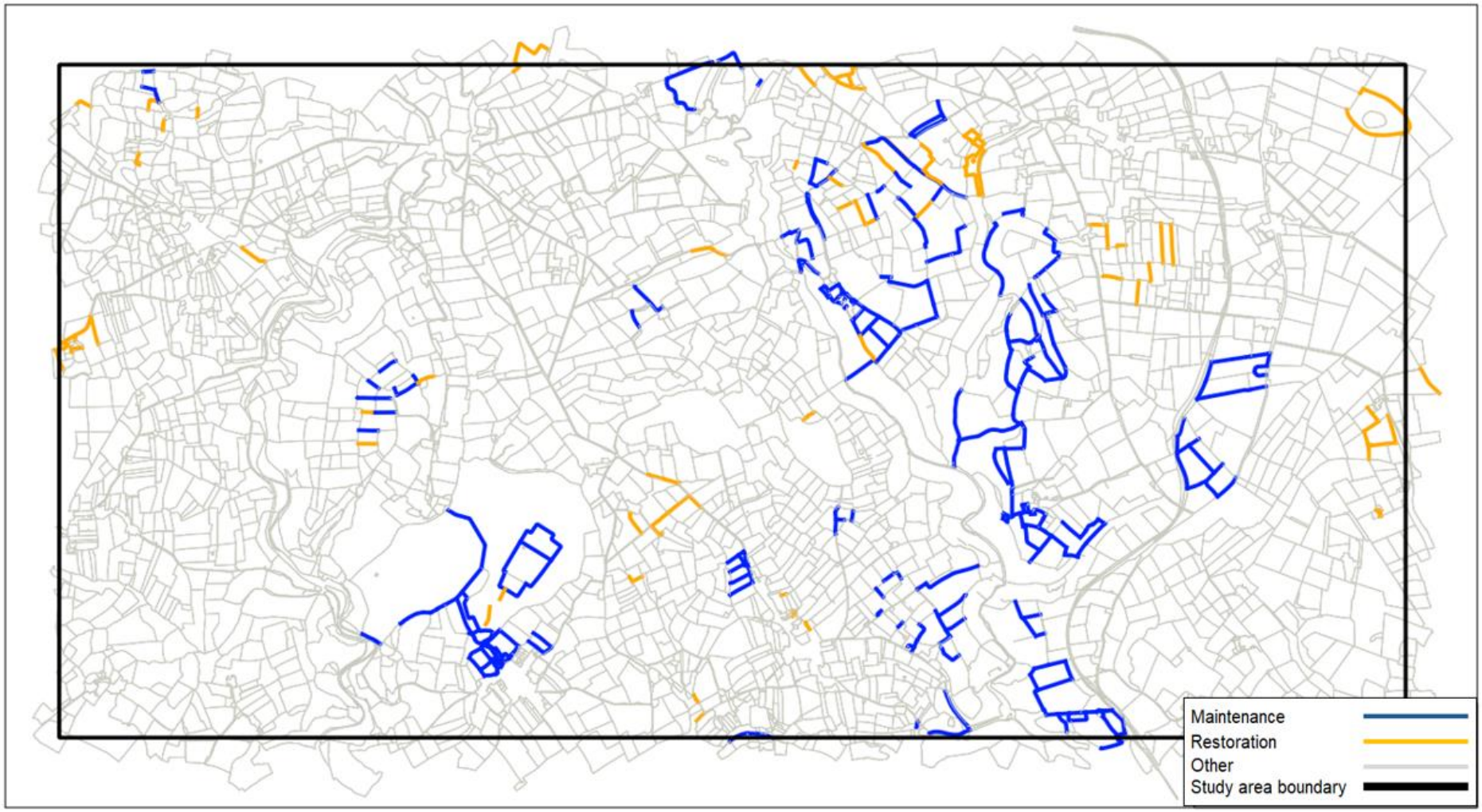


Figure 5.14: Distribution of maintenance and restoration options in Coldeaton

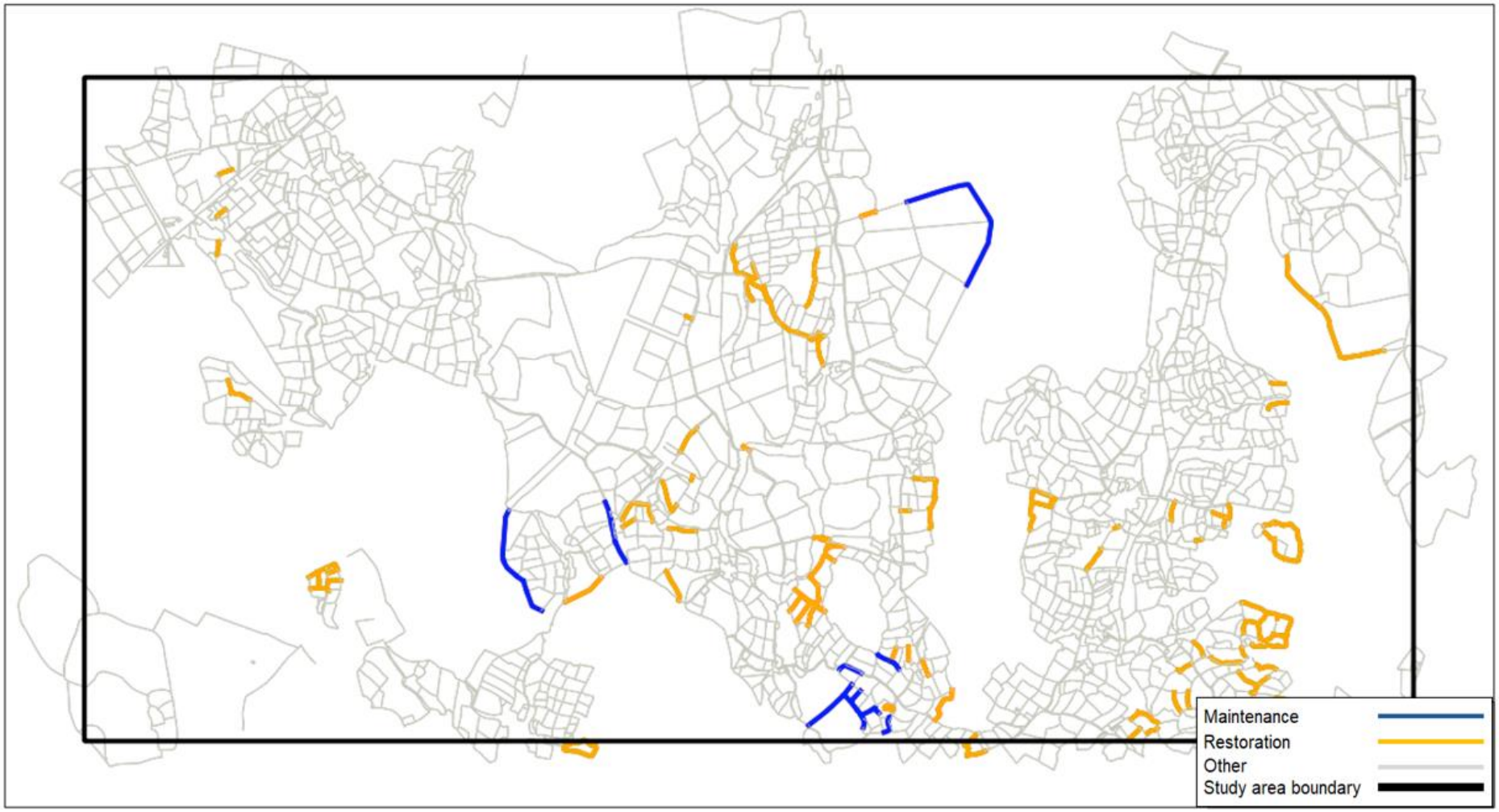


Figure 5.15: Distribution of maintenance and restoration options in Dunstone

5.6 Field survey of boundary type and condition

5.6.1 Introduction

To establish the impact of AES options on the condition of walls and banks, it was necessary to collect counterfactual information. This enabled a comparison of walls and banks under option and not under option, to see whether there was any difference in condition. Based on this approach, data collection was organised into three categories:

- In an agreement and under an option.
- In an agreement but not under an option.
- Not in an agreement.

Resource limitations prevented a complete survey of each study area, so a sampling approach was adopted to ensure a reasonable geographical spread of boundaries across each case study. The sample was not random and was largely determined by the ability to access and visually inspect field boundaries via PRoW and publicly accessible land. Table 5.10 show the distribution of field boundaries included in the field survey according to their AES status. The completed survey provided reasonable coverage of the case study areas (Figure 5.16), and reflected the broader population (see Figure 5.9).

Table 5.10: Number of field survey boundaries by AES status in each case study area

Case study	Option	No option	No agreement	Total
Swaledale	307	1095	360	1762
Todmorden	108	334	1222	1664
Coldeaton	112	253	1062	1427
Dunstone	38	752	322	1112
Total	**565**	**2434**	**2966**	**5965**

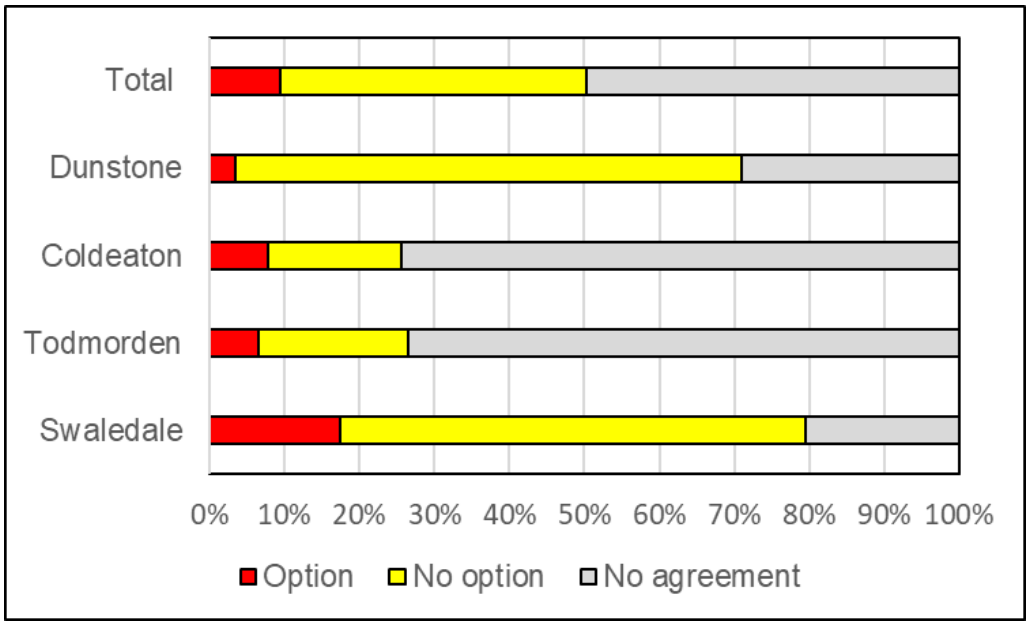


Figure 5.16: Proportion of field survey boundaries by AES status in each case study area

5.6.2 Boundary type and condition

Overall, 71% of stone boundaries were built entirely from traditional materials, while 29% incorporated modern materials (Table 5.11 & Figure 5.17). Modern materials, such as wall top wire, were often used to prevent sheep from jumping over walls, while post and wire fencing reinforced traditional boundaries in disrepair, to keep livestock contained. In some cases, wire fencing served as a temporary measure until the boundary could be repaired using traditional materials. However, in other instances, the traditional boundary had been replaced entirely by a freestanding post and wire fence that was stock proof on its own.

Dunstone had the highest proportion of traditional boundaries (94%), with minimal use of modern materials. The construction of boundaries in Swaledale has remained predominantly traditional, with 82% of boundaries using only traditional materials. In contrast, Todmorden had the greatest integration of modern materials, with 45 percent of its boundaries incorporating them. Coldeaton also had a relatively high proportion of modern materials (42%). These figures indicate significant regional differences in boundary construction, with Dunstone and Swaledale maintaining more traditional practices while Todmorden and Coldeaton incorporate modern materials to a greater extent.

Table 5.11: Number of boundaries containing stone materials in each case study area

Case study	Stone wall	Stone wall & topwire	Stone wall & fence	Stone wall & hedge	Stone wall, hedge & fence	Hedged stone-faced bank	Stone-faced bank	Total
Swaledale	1,442	159	152	5	4	0	0	1,762
Todmorden	897	86	665	14	2	0	0	1,664
Coldeaton	833	357	222	5	10	0	0	1,427
Dunstone	133	7	57	6	6	732	171	1,112
Total	**3,305**	**609**	**1,096**	**30**	**22**	**732**	**171**	**5,965**

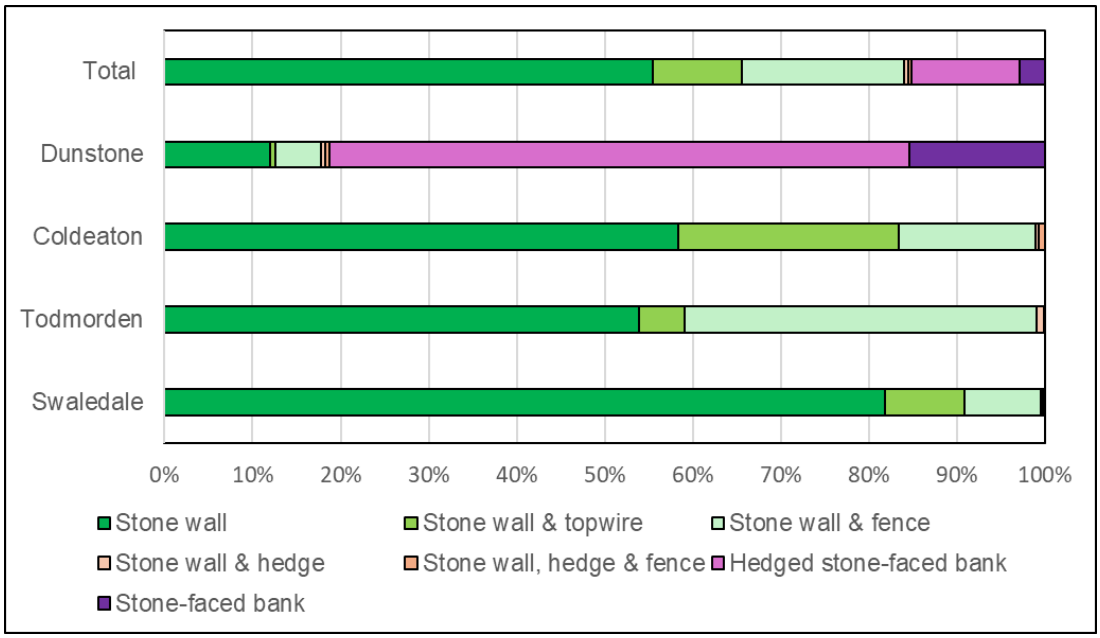


Figure 5.17: Proportion of boundaries containing stone materials in each case study area

Table 5.12 shows the number of wall and bank boundaries in the different condition categories across the four case study areas. Overall, just over half the boundaries (53%) were in excellent condition, 20% had minor defects, 17% had major defects, and 10% were derelict (Figure 5.18). Dunstone (64%) and Swaledale (61%) had the highest proportion of boundaries in excellent condition, while Todmorden had the largest proportion in poor condition, with 21% derelict and 25% with major defects.

Table 5.12: Number of stone boundaries classified by condition in each case study area

Case study	Excellent	Minor defects	Major defects	Derelict	Total
Swaledale	1,077	334	223	128	1,762
Todmorden	617	288	410	349	1,664
Coldeaton	742	354	260	71	1,427
Dunstone	722	213	114	63	1,112
Total	**3,158**	**1,189**	**1,007**	**611**	**5,965**

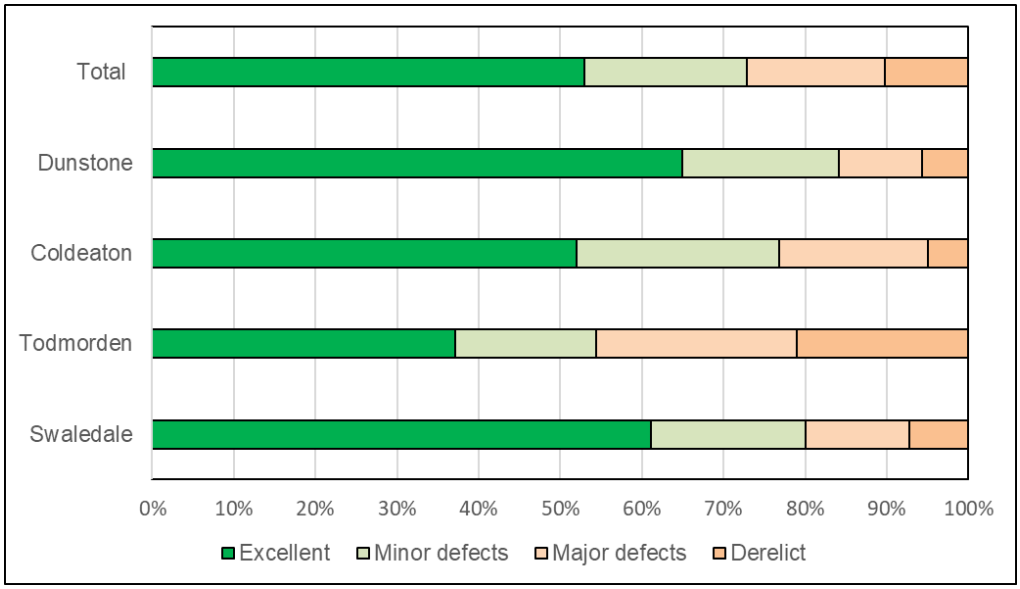


Figure 5.18: Stone boundary condition by case study area

The condition of the stone boundaries can also be used to identify opportunities for management using the maintenance options under the new SFI scheme and the existing restoration and repair options under CS. Looked at in this way, boundaries in excellent condition or with minor defects would likely be eligible for SFI maintenance payments, whereas boundaries with major defects could be restored using the CS restoration and repair options (see Figure 5.19).

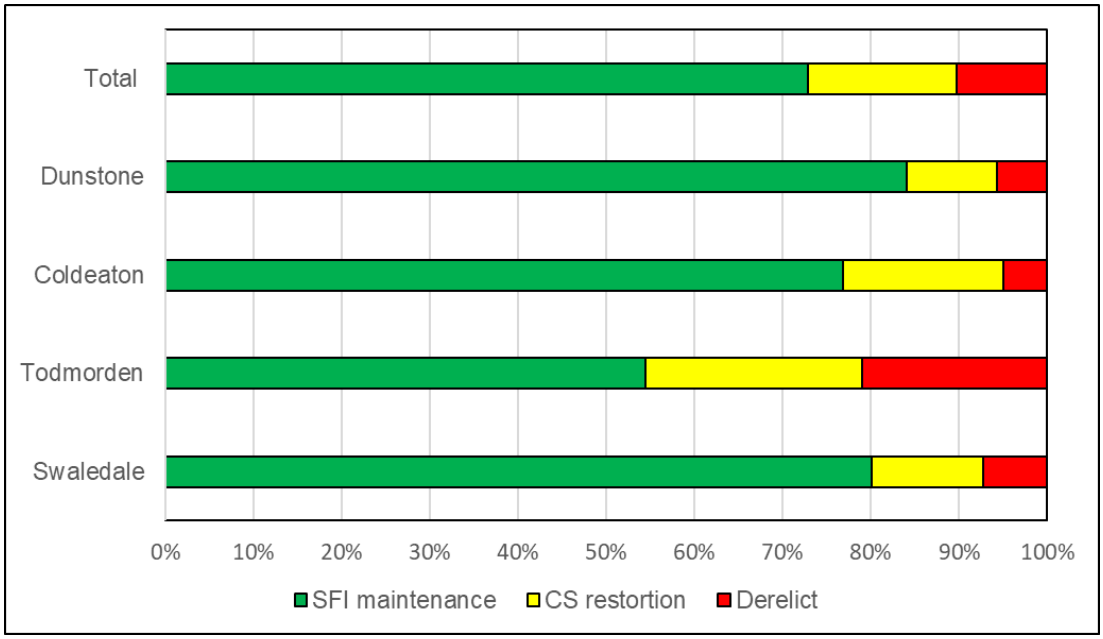


Figure 5.19: Proportion of boundaries potentially eligible for AES options for each study area

5.7 Impact of AES status and options on boundary condition

To evaluate the relationship between the adoption of EAS options and the condition of the field boundaries a Chi-Square test was applied. This statistical method determines whether observed differences are statistically significant or simply due to chance, helping to assess whether AES interventions have a measurable impact.

To quantify the strength of any identified relationships, Cramér's V was used. This measure indicates how strongly two factors are connected, providing valuable insights into the effectiveness of AES options. By applying these tests, we can make evidence-based assessments of policy impacts, ensuring that decisions are informed by robust statistical analysis rather than assumptions or random variation.

Chi-Square tests were conducted separately for each case study area to identify statistically significant relationships between different AES attributes and the condition of field boundaries. The AES attributes analysed included:

- AES status:
    - **Under option**: Boundaries currently managed under a maintenance or restoration option.
    - **In an AES agreement but not under option**: Boundaries within an AES agreement where the agreement holder has obligations to avoid active damage but is not undertaking specific management.
    - **Not in an agreement**: Boundaries not influenced by an AES agreement, serving as a counterfactual for comparison.
- Type of AES option:
    - **Restored boundary**: Boundaries managed under an ES or CS repair or restoration option.
    - **Maintained boundary**: Boundaries under an ES protection and maintenance option.
    - **Other boundary**: Boundaries not classified under the above categories.

This analysis helps to identify how different AES approaches influence field boundary conditions, providing evidence to support future policy decisions.

5.7.1 AES status and boundary condition

The Chi-Square tests confirmed a statistically significant relationship between AES status and boundary condition across all case study areas. The results were significant at the 1% level, meaning there is only a 1% chance that the observed relationship is due to random variation rather than a real effect. However, the Cramér's V measurement indicated that the strength of these relationships is relatively weak, suggesting that while AES status plays a role, other factors are also likely to influence boundary condition.

Figure 5.20 illustrates that boundaries managed under AES options are generally better maintained, with a high proportion classified as either excellent or having only minor defects (Intact). In Dunstone, 95% of AES-managed boundaries fall into these categories, followed by Coldeaton (89%) and Swaledale (88%). This suggests that AES interventions are effective in preserving boundary condition. However, Todmorden is an exception, where only 64% of boundaries under AES options are maintained, indicating potential challenges or differences in management effectiveness in this area.

In Swaledale, Todmorden, and Coldeaton, boundaries located on AES agreement land but not under an option are less maintained than those not in an agreement, suggesting that AES participation alone does not guarantee better boundary condition unless specific management options are in place.

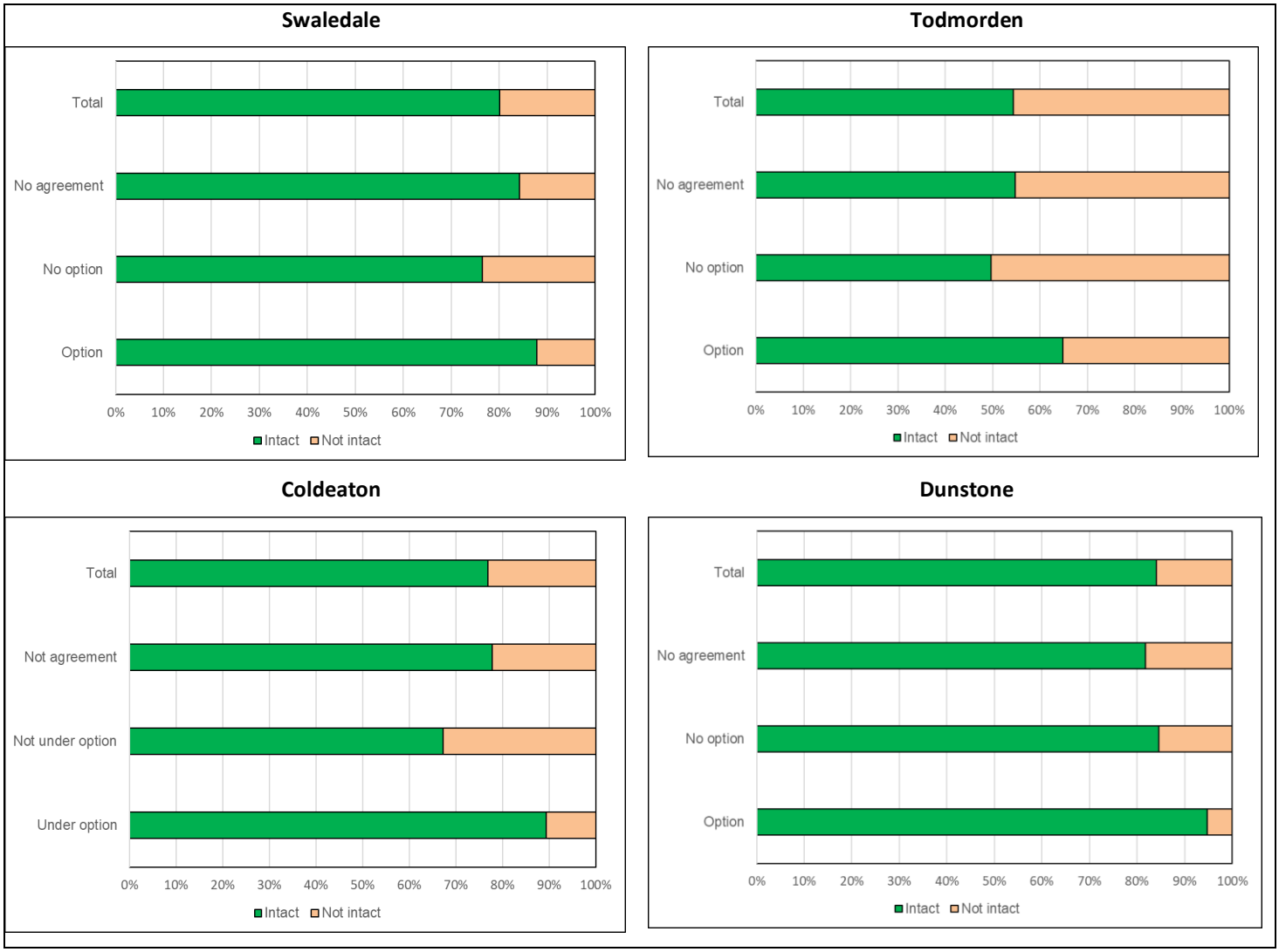


Figure 5.20: Impact of AES status on boundary condition in each study area

5.7.2 AES option type and boundary condition

The Chi-Square tests found that there was a statistically significant relationship between AES option type and boundary condition in all the case study areas. The tests were significant at the 1% level.

Overall, boundaries under restoration and maintenance options show high levels of upkeep in three of the four case study areas, Todmorden being the exception. Additionally, Figure 5.21 highlights that boundaries managed under ES maintenance options tend to be in better condition than those under restoration options in most cases. Dunstone (100%) and Coldeaton (95%) show particularly high levels of maintenance, though it is important to note that the number of boundaries under AES options in the Dunstone field survey was low, which may affect the reliability of this finding.

Evidence from the agreement holders suggest that some farmers may not have completed the restoration work, due to unforeseen circumstances such as bad weather or labour shortages. Despite being included in their capital works plans, these challenges may have prevented restoration work from being carried out, potentially explaining why some boundaries under restoration options remain in poor condition.

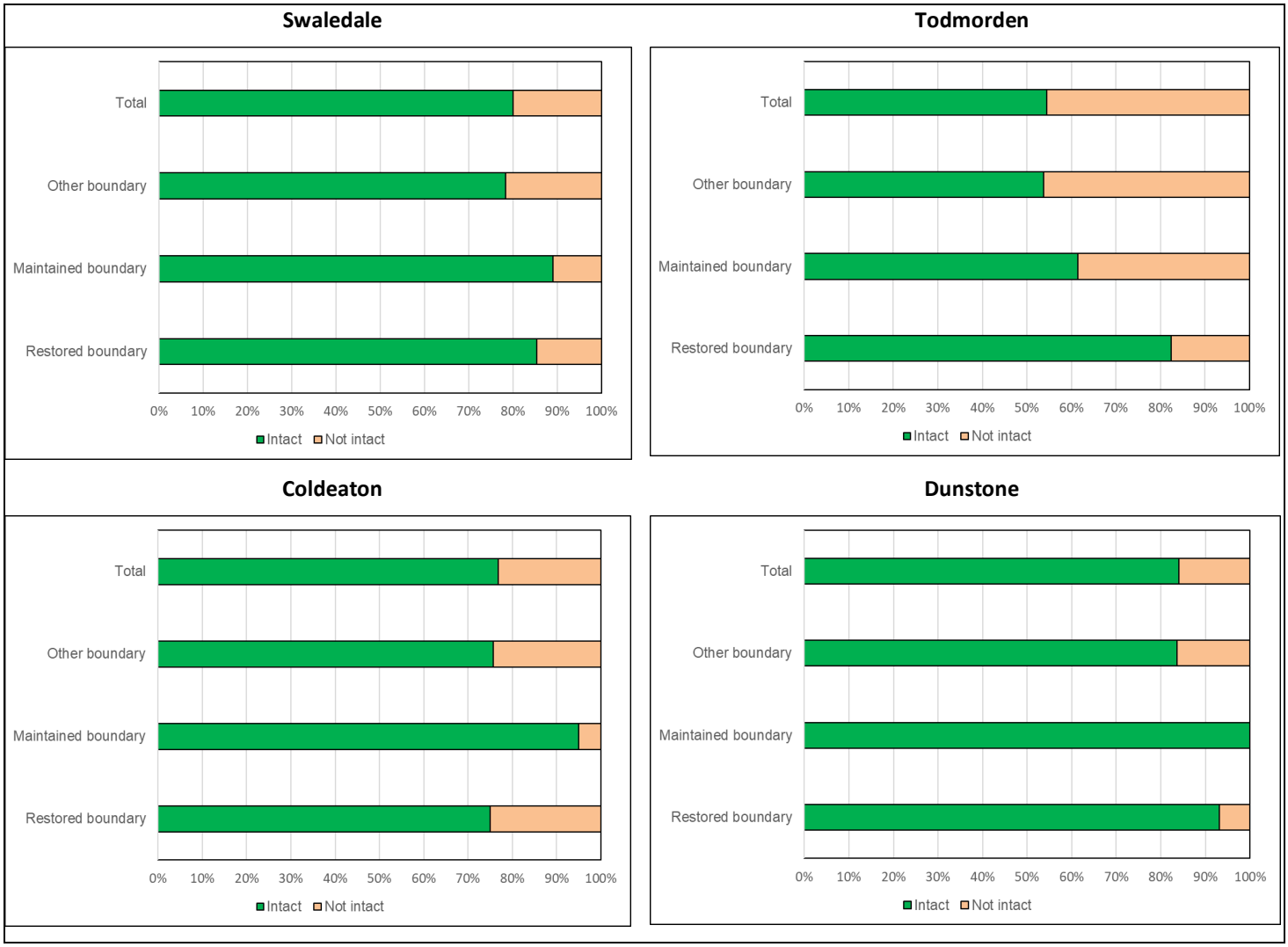


Figure 5.21: Impact of restoration and maintenance options on boundary condition in each case study area

6 AGREEMENT HOLDER AND WALLING CONTRACTOR SURVEYS

6.1 Introduction

This section presents the findings from interviews conducted with agreement holders and walling contractors across the case study areas. The surveys had two main aims. The first was to explore how and why agreement holders managed the walls and banks on their land in particular ways, and how they engaged with AES — the focus of this section. The second aim was to gather information to inform the assessment of ecosystem service flows, which is discussed in Section 7. In total 40 interviews were completed, 32 agreement holders and 8 walling contractors (see Table 2.4) and they offer valuable insights into the factors influencing management decisions and the role of AES in shaping practices on the ground.

6.2 Farming and land management

6.2.1 Current situation

The 32 agreement holders managed holdings that reflected the pastoral upland character of farming in the case study areas. Grassland in the form of meadows and/or pastures was present on all farms, with only one holding in Dunstone producing any arable crops.

All respondents identified their farms as upland in nature. All but one — a hay producer in Todmorden — had livestock enterprises, primarily sheep and cattle. Sheep systems varied widely, with both pure-bred and cross-bred flocks being common. Cattle enterprises were predominantly focused on beef production. In Dunstone, 3 of the 7 agreement holders also kept hill ponies.

Over half of the respondents (59%) did not rely solely on agriculture for their income and were engaged in a variety of non-farming activities, including holiday accommodation and property letting, off-farm employment and services, agricultural contracting, and land rental. These reflect a broader trend of farm diversification and income generation beyond traditional agriculture across all case study areas.

Holdings varied considerably in size, ranging from 5 hectares in Todmorden to over 280 hectares in Swaledale. Land tenure was often complex, with mixed tenure (a combination of owned and rented land) being the most common arrangement, reported by 16 respondents. Ten holdings were solely owned, while 6 were fully rented. Rental agreements included a range of tenures, from multi-generational tenancies to short-term grazing licences and common grazing rights on moorland.

Respondents highlighted tenancy as an important factor affecting wall and boundary management. Responsibility for boundary upkeep often depended on tenancy agreements, and the length of the tenancy could influence whether it was considered worthwhile to invest in wall maintenance or restoration.

> *Respondent says that they will not invest in wall repair on short term let land. These are amalgamated farms that were in poor repair. Landlord would get all the benefit… Wants to convert short term tenancy land into long term. This would allow investment. Not worth repairing walls on that land if they won't see the benefit. (Swaledale)*

When asked how the size of their farms compared with others in their area, 14 respondents (44%) considered their holdings to be above average, 8 (25%) saw them as average, and 10 (31%) viewed them as below average. These responses highlight a contrast between case study areas (Figure 6.1). In Swaledale, farms were generally perceived as above average in size, whereas in Coldeaton, the perception was that farms tended to be smaller than average.

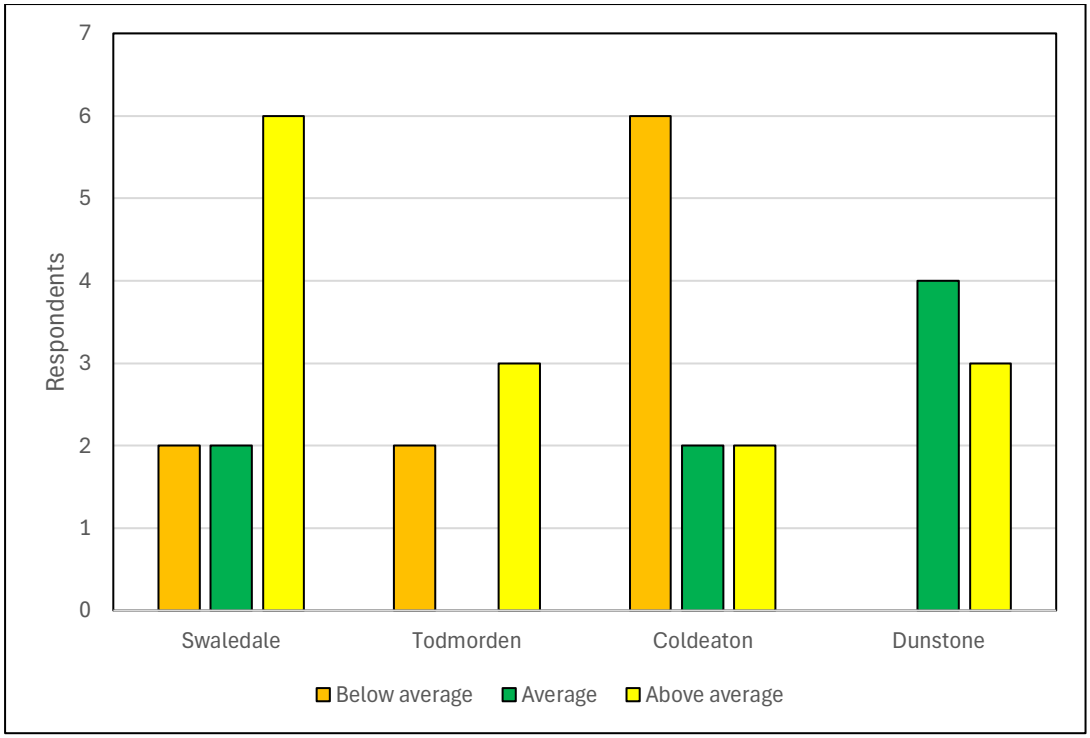


Figure 6.1: Agreement holder perception of farm size

6.2.2 Future plans

Figure 6.2 shows the goals the respondents have for their farms over the next 5 years. The key takeaway is one of stability where respondents or not planning major changes in farm size and enterprise management.

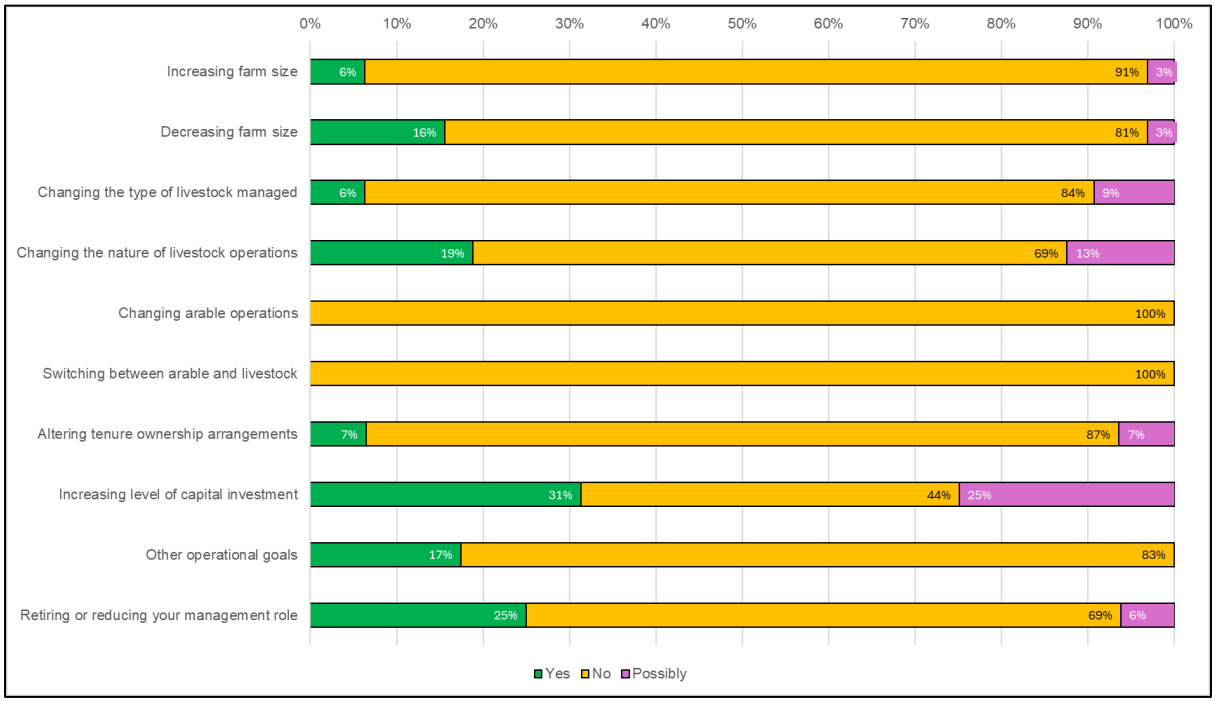


Figure 6.2: Goals for the farm over the next 5 years

Farm size

Overall, most farmers were not actively pursuing expansion. The dominant themes were retirement planning, land tenure constraints, contentment with current size, and a focus on consolidation or infrastructure improvement. Only a few respondents indicated a desire or potential to increase the size of their farms, and even these were heavily qualified by external circumstances. Similarly, most farmers had no plans to reduce the size of their holdings and felt current sizes were either optimal or necessary for their livelihood. Where downsizing was considered, it was typically tied to future retirement or succession plans. A few had already taken steps to reduce their workload or landholding, while others were actively focused on maintaining or even rebuilding their farms.

Tenure

Most respondents reported no plans or need to change their current land tenure arrangements. Many were owners or had secure long-term tenancies, such as lifetime or Duchy agreements, limiting opportunities for change. A few mentioned interest in shifting from short-term to longer-term agreements to justify investment, particularly in boundary maintenance. Some tenure changes were underway due to retirement and family succession.

Livestock management

Most respondents planned to maintain their current livestock systems, which suited their land, terrain, and business needs. A few considered changes such as increasing herd size, diversifying into alpacas, or cross-breeding for better meat yield. Some were downsizing due to age, health, or issues with public access. Future changes in a few cases depended on succession.

Capital investment

Respondents' views on capital investment varied. Some had already made significant improvements or were undertaking work supported by grants, particularly for livestock handling, manure storage, pollution control, and building restoration. Others expressed interest in investing—often dependent on access to funding or longer-term tenancy arrangements. A few mentioned specific ideas like converting redundant buildings or improving winter housing. However, many saw no current need, cited age or financial constraints, or felt further investment wouldn’t yield a worthwhile return. In some cases, future decisions depended on succession or securing the farm’s long-term future.

Other operational goals

Other goals mentioned were to diversify income, particularly through holiday accommodation or off-farm work, often in response to the loss of the BPS. Some had conservation-focused objectives, such as enhancing the floristic value of hay meadows. Others were in transition, having just taken over the farm or planning to increase their role in farm management.

Retirement

Most respondents had no retirement plans in the immediate future, aiming instead to continue or further develop the business. For some, farming was framed more as a

lifestyle, with long-term planning focused on conservation rather than income. In several cases, retirement was acknowledged as inevitable, but the exact timing remained uncertain. Some were already stepping back, with the next generation gradually taking over, while others saw retirement on the horizon but were not yet in a position to act.

6.3 Nature and management of field boundaries

6.3.1 Type of field boundary found on holdings

The agreement holder survey confirmed that stone walls are the dominant boundary type in Swaledale, Todmorden, and Coldeaton. (Figure 6.3) In Dunstone, stone-faced banks were reported on five of the seven holdings, with individual examples also noted on one holding each in Todmorden and Coldeaton. Hedges or hedgebanks were present in all case study areas, as were modern fences. Additionally, one respondent in Coldeaton noted that a river formed a natural boundary for some fields.

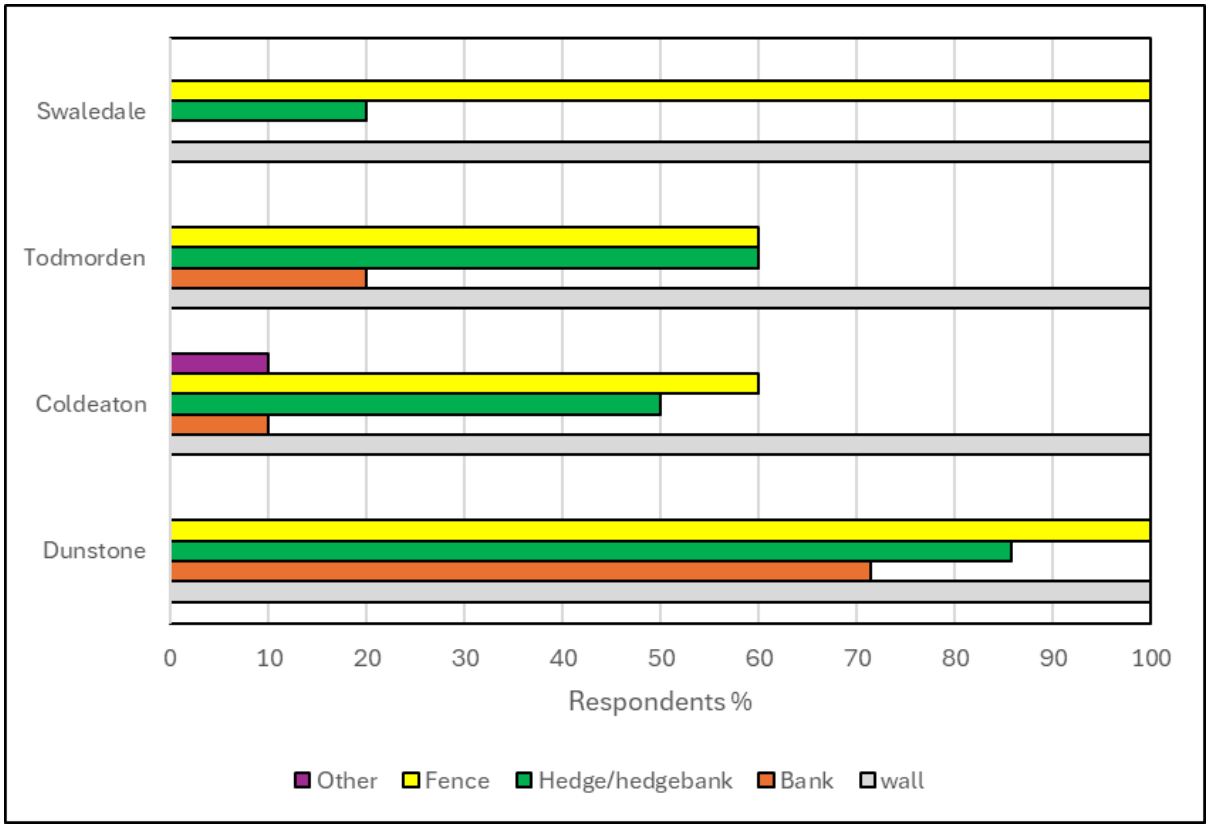


Figure 6.3: Types of field boundary found on farms

Most respondents reported no significant change in the distribution of boundary types over the past 10 years. Where changes had occurred, they were generally modest and specific, such as the addition of fencing, often to protect or supplement existing walls, divide fields, or meet AES requirements near watercourses or woodland. Some respondents had planted new hedgerows or and most had rebuilt walls as part of AES. Overall, boundary patterns have largely remained stable, with change driven mainly by practical needs or opportunities provided by AES.

Views on whether boundary types have changed across the wider area over the past 10 years were mixed. Many respondents said they had seen little or no change, though several noted a gradual decline in wall maintenance due to cost, time pressures, and lack of skilled labour. In contrast, some reported an increase in fencing, often linked to AES requirements, especially around woodlands and watercourses. A few respondents observed that grant schemes had prompted the reinstatement of old boundaries, including stone walls and banks. Others commented on poor enforcement, with walls being removed or neglected without consequence. Overall, the pattern suggests increased reliance on fencing, uneven wall maintenance, and boundary investment largely driven by the availability of public funding.

> *A lot of fencing as part of AES options. Water courses and woodlands. Farms are getting larger so less time for farmers to wall and contractors are expensive. More walls becoming derelict. Mainly those losing their use (internal walls). (Swaledale)*
>
> *Less well maintained walls. "A lot of them walls, it's not as if you don't want them up, they're better up. It's just A), the cost and B), getting somebody to do it." (Swaledale)*
>
> *Not really, most of the big changes were 40-50 years ago when many walls fell in and bigger fields created. Thought the main cause was changes to dairy enterprises requiring reorganisation of fields. (Todmorden)*
>
> *Walls have been removed or have been left deliberately to decay; even had to rebuild one wall that was not their responsibility to protect their land and livestock because neighbour refused to do it (rented farm so no benefit to them as tenant). This rebuild was supported through CS. (Coldeaton)*
>
> *Mentioned neighbours removing walls without sanction, even though not supposed to, and with no redress; same for flower-rich fields that were sold then walls removed, ploughed and re-seeded with rye grass; perceived lack of monitoring and enforcement so people get away with it. (Coldeaton)*
>
> *There is a lot more fencing, people are letting walls go because it is tough and expensive… More people using a digger to go walling - they use much larger stone, changes the landscape as they are not using traditional walling techniques, and there are people using quarried stone rather than field stone. (Dunstone)*
>
> *Say there are two types of farmer round here - those that ranch their livestock and the cattle go wherever they want, they don't do much with their boundaries, don't maintain them and then every 10 yrs or so they need to do a lot of repair and restoration work. The other kind maintain the walls and banks to keep them stockproof. That is what I do. (Dunstone)*

The walling contractors had observed a decline in the number of skilled wallers, with significantly fewer contract wallers now than a decade ago, and many skilled workers having left the trade. In some cases, wallers are travelling in from other regions to meet demand. The reduction in the local workforce has created concerns about quality, with some contractors critical of the standards of work done by less experienced or less committed teams. Overall, while funding opportunities may have grown in some areas, the availability of skilled labour has not kept pace.

6.3.2 Agreement holder knowledge of their walls and banks

Age and history

Respondents were very knowledgeable about the age and history of the walls and banks on their holdings with 88% being able to provide details. Some demonstrated deep local knowledge, referencing historical periods such as the Romano-British era, Medieval strip fields, and Parliamentary Enclosures of the 18th and 19th centuries. Several could identify specific changes linked to Enclosure Acts, with some referring to Enclosure maps, deeds, or family records to support their understanding. Several pointed out the time depth of walls and banks on different parts of their holding. While some respondents admitted to limited knowledge, they were generally aware that their boundaries dated at least to the 19th century. Overall, the responses reflected both a strong sense of heritage and continuity, and an awareness that wall and bank age varies across farms, depending on location, land use history, and enclosure patterns.

> *Knew a lot about the history of the dale and that walls could be hundreds of years old or relatively recent (Parliamentary enclosures in L18 and early 19C. Said that the walls are mainly for stock control and to protect the meadows. Some walls are not boundaries but for shelter and a place to put the stones cleared from the fields. Says that fragmented farms were typical in the dales and date back centuries to the height of the lead mining era. This is still the case today. Very few farms are in a ring fence so property boundaries make up a high proportion of the walls. Said that the impact of Parliamentary enclosures varies with township. Some cow pastures were never enclosed. (Swaledale)*
>
> *Knows the farm is part of an ancient landscape with lots of features and archaeology. A lot of ancient meadows. A lot of reorganisation of field boundaries in 1700's, also with Parliamentary Enclosure Acts in 1800s. Meadow walls are shorted than moor walls. That is because cattle use meadows and sheep on the moor. Walls for sheep will often have 'furl holes'. (Swaledale)*
>
> *Late 18th or early 19th century farmhouse and associated walls. Some will have been rebuilt and maintained over years, but in essence the layout and character still reflects as it was originally 200 years ago. (Todmorden)*
>
> *Lots of the old walls near [place name] were taken down decades ago, and on the highest land are straight walls which were well-made by the Fielden estate who had income from the textile industry to invest in farming. (Todmorden)*
>
> *Did not really know, but was aware that the walls originated at least in the C19th from their deeds and recognised during conversation that they were strip fields fossilising Medieval ridge and furrow – part of the Medieval infield. (Coldeaton)*
>
> *Only that they are old, over 100 years old or more, probably in the C19th. (Coldeaton)*
>
> *Oldest walls on our farm are from a pound - from transhumance times when people brought animals up for summer pasture. There are small fields associated with the pound - at least 2,000 yrs old, also field strips and lynchets. (Dunstone)*

"Some parts of the ancient reeve system are 4,000 years old. Some of these are identified on the tithe map. Every boundary is on the tithe map." (Dunstone)

Type of construction, quality of materials and ease of management

All the respondents were able to talk about the construction and management of the walls and banks on their holdings. They reported that most walls and banks were built using locally sourced stone, tailored to the distinct geological zones within their holdings. They described a wide range of stone quality across their farms, often linked to local geology and the origin of the material. Many reported mixed quality, with some areas having hard, durable stone and others containing crumbly, rounded or laminated stone that is harder to wall. Limestone was frequently described as variable—sometimes solid and workable, but often soft or shaley, making it difficult to build with. Sandstone and gritstone were generally viewed more favourably, though quality could still vary depending on source. Stones sourced from riverbeds were often described as rounded and difficult to work with, while quarried stone was seen as better for long-lasting structures. Several agreement holders demonstrated detailed knowledge of their land's stone types and their suitability for walling.

Had an intimate knowledge of where the good and bad walls are on the farm. Says geology, slope and firmness of the standings are all important in determining how much risk a wall is at. (Swaledale)

Limestone is very slim and can crumble. Often have to bring in "truffs" [through stones] to stabilise limestone walls. Sandstone is usually easier to wall. Stone from field clearances easier to wall than stone from riverbeds. (Swaledale)

As well as geology, the origin of the stone is important. There are places on the farm where the stone was quarried, cleared from fields and fetched from the bottom of rivers and streams. They all affect the quality of the stone. Some of the quarried stone walls if built on good ground will last for 100 years. Stones rounded by river action are always difficult to wall but you learn the tricks with experience. (Swaledale)

Varies, some good Millstone Grit but can be crumbly if from a field quarry close to the soil. (Todmorden)

Yes, but only because there has been stone from collapsed walls available. Some imported stone used as well. (Todmorden)

[Quarry name] produces good quality stone, which is most of the holding. [Quarry name] stone is poor – small amount on the holding. (Coldeaton)

The limestone is rubbish – very crumbly; gritstone is not bad. (Coldeaton)

Good stone - we have not had to bring any in, there are stockpiles left over from previous owners and we have moorland rights on some of our land to extract stone. (Dunstone)

It is different grades in different parts of the farm but generally good quality. Some is smaller and more rounded, in other places large flat faced pieces. Smaller stone harder to work with, not good for the stone faced banks. (Dunstone)

Most agreement holders reported that certain walls or banks on their farms require more maintenance than others, often due to a combination of location, materials, ground conditions, and external pressures. Walls on steep slopes, boggy or unstable ground, and

near watercourses were commonly identified as more prone to collapse due to gravity, erosion, or flooding. Poor stone quality, such as small or crumbly stone, and single-skin construction also contributed to structural weakness. Animal pressure, particularly from sheep, deer, and badgers, was frequently mentioned as a cause of damage, along with tree roots and weather events like frost, wind, and snow. Walls near roads or PRoW were also at risk from vehicle collisions, climbers, or stone theft. While some walls have lasted for generations with minimal intervention, others—especially those on marginal ground or exposed sites—require regular rebuilding. In several cases, respondents noted that changes in land use, such as a shift from cattle to sheep, or effects of AES schemes (e.g. increased wetness of land next to walls), had increased pressure on boundary features.

Current condition of walls and banks on the holding

Nine out of ten respondents (91%) said they kept at least half of their wall and bank boundaries in a stockproof condition. Over half (53%) reported that 80% or more of their boundaries were stockproof. Where boundaries were not stockproof, this was usually due to localised issues, and reports of widespread dereliction were rare.

Barriers preventing the maintenance and repair of walls and banks

The main barriers to maintaining and repairing walls and banks reported by respondents were mainly practical and financial in nature (Figure 6.4). Lack of funding was the most frequently cited issue, mentioned by 87% of respondents. This reflects the high cost of both materials and labour involved in traditional walling, which is a time-consuming and skilled task. Without financial support, such as grants or subsidies, many agreement holders felt unable to carry out the necessary work to maintain their boundaries. Closely linked to this was the cost of the work itself, which 79% of respondents identified as a major obstacle, indicating that even where funding might be available, it may not fully cover the expense.

> *"Financial reasons will be why people are not keeping up the walls as much because it doesn't financially pay without grants, also its extremely hard work walling. If only they would bring back the scheme dad used to be on where you were paid for the wall you put up as you put it up. Pay as you go. Was it the old ESA?" (Swaledale)*
>
> *“The cost of getting these walls up is only going one way. It's like everything else in the country, and we're desperately underfunded for walling. You're getting a lot of them now [contractors], they're going on to hourly rates, where the rate is £35-£40 an hour. So they do a couple of hours and have a cup of tea.” (Swaledale).*
>
> *Grateful for the grants, particularly CS; couldn’t do the work without that support; fluctuations, over time, in the extent to which grant covers the costs is an issue; speed of payment against work done is another, significant, issue. (Coldeaton)*
>
> *Walls and earth banks are very expensive to restore - we need to use contractors to do some of the work - gets expensive. We have a lot of sites and rely on funding - requires a large bid to fix walls. (Dunstone)*

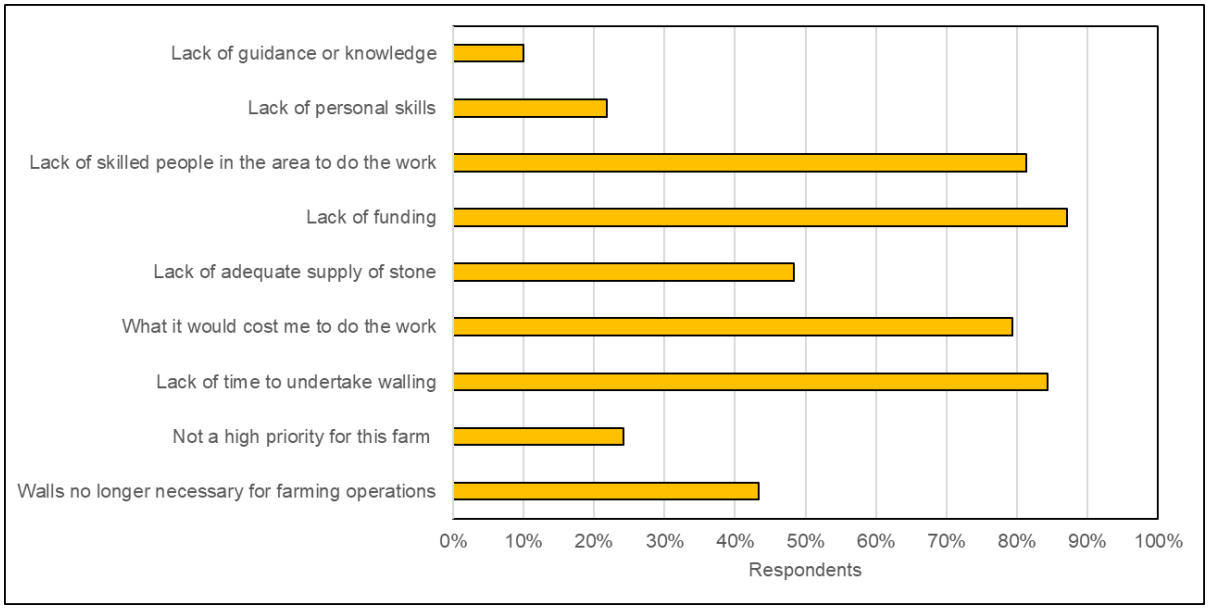


Figure 6.4: Barriers preventing the maintenance and repair of walls and banks

Time constraints were another major issue, with 84% of respondents reporting that they lacked the time to undertake walling. Wall repair is labour-intensive and often has to compete with other essential farm tasks. For many farmers, especially those running small or family-run holdings, time is already stretched across livestock management, land maintenance, and, increasingly, diversification activities. As a result, walling often falls down the list of priorities unless a wall poses an immediate risk to stock or property.

> *Always some that need doing. "We don't mind walling, but it's very time consuming. The way farming is gone now, where you've got to keep on top of everything because we've all got bigger, We just can't find enough time. We'd love to have all our walls and do it and but it is just now the days are getting shorter and you've got other things to do." (Swaledale)*
>
> *Major pressure on famers time on this farm and most others. Says farmers can find the time to do gaps but stretches are more of a challenge and farmers will tend to use contractors. "The problem is labour, you just can't get round them all because farms have got that much bigger than they used to be. In this farm there's blocks of land where the wall has gone down… so you don't bother with them." (Swaledale)*
>
> *Not by choice: "walling is a thing you can put to one side, because if stock need to be looked after you have to do it. But I really enjoy walling." Also said "Our farm was once seven farms and now there is just the two of us doing the walling." (Swaledale)*
>
> *Not by choice. Wants to keep the walls up. "There is the same amount of wall as there has always been, but there are less farmers. They used to be able to look after it all. 60 or 70 years ago it was just tidy away. But they've been gobbled up by neighbours and everybody's got bigger." (Swaledale)*
>
> *Always other jobs needing to be done on the holding - prioritisation means that walling not always the first priority. (Coldeaton)*
>
> *I work full-time off the farm, not got time to put into walling. (Dunstone)*

We have lots of other jobs to do but if the work is funded by a scheme then we can always find the time to do it. Having stockproof boundaries is essential for the way we manage the livestock - rotational grazing using boundaries to contain the cattle. (Dunstone)

Access to skilled labour also emerged as a significant barrier, with 81% of respondents saying there were not enough skilled people in the area to carry out the work. This shortage is compounded by the fact that dry stone walling is a traditional skill that requires experience and knowledge, and is increasingly hard to find locally. While some respondents had the personal skills to do the work themselves (22%), many did not, and only 10% cited a lack of guidance or knowledge as a barrier—suggesting that it is not awareness that is lacking, but the means to act on it.

Not enough local wallers. Says utility and infrastructure companies (water and rail) pay higher rates and they can't compete even with the grants. Limited supply of wallers has led to rapid increase in rates. Easily £40m. Also said remoteness was a disincentive for contract wallers. They might have to borrow your quad bike or hike across difficult terrain each day which reduces walling time. Also joked that some of the youngsters don't like being out of mobile phone signal range. (Swaledale)

High demand for wallers and need to be booked 2 years in advance (which brings its own issues of work against imposed grant-based timetables). Also skills vary; gave an example of one who rebuilt 200m with insufficient throughs that then had to have extensive repairs very soon afterwards. (Coldeaton)

No-one wants to do the restoration work. They don't want to get off their tractor. All our walls are on rough land. [Partner] and I do all the maintenance. (Dunstone).

Other, less frequently mentioned reasons included changing farming practices and priorities. 43% of respondents said that some boundaries were no longer necessary for their current farming operations, reflecting a shift in the role of traditional boundaries in modern livestock systems. Additionally, 24% indicated that walling was not a high priority compared to other tasks. Finally, 48% cited problems sourcing suitable stone, which further limits the ability to carry out repairs, particularly in areas where local stone is of poor quality or no longer readily available. Altogether, these findings highlight that while many farmers value their walls and banks, they are often constrained by a combination of limited resources, time pressures, and reduced access to skilled labour.

Walls have been removed and run fields together on rented land. Length of tenancy is a disincentive to invest in wall repair. Would not see the benefit. Would repair them and manage the land better if had long term tenancy. (Swaledale)

Some internal walls are effectively redundant as part of farming operations. (Coldeaton)

They still provide some biodiversity when fallen down. (Dunstone)

6.3.3 Walling contractor knowledge of walls and banks and working practices

Type of construction, quality of materials and ease of management

Walling contractors in the three wall-dominated case study areas viewed the standard approach to walling as a general baseline, but they stressed that techniques and styles

varied significantly depending on local materials and traditions. While some areas used a standard double-skinned wall with top stones, contractors often adapted their methods based on stone type, availability, and regional styles. Contractors emphasised the importance of working with the local geology, noting that even within short distances, walling styles and construction methods could differ due to variations in stone shape, size, and origin. It was suggested that older or internal farm walls were generally smaller, whereas boundary walls between farms, parishes, or townships were often taller and more substantial. Contractors noted that wall dimensions also responded to practical needs, such as containing more agile livestock breeds, leading to increased wall height in some areas. Some expressed frustration over being paid by length rather than area, as taller or more complex walls involved far more labour for the same rate.

> *There is a dales style, usually double skin with 2 or 3 sets of throughs depending on height. Usually top stones rather than sloped capes as in Cumbria and the Lake District. Broadly similar in the dales but definitely changes as you get into Cumbria and the Lake District. "Here we have top stones, capes, but in the Lake District, they don't have capes. They put them all on edge. So styles change as you go around the country." (Swaledale contractor)*

> *"Every wall is different, depending on the stone and the amount of throughs and things like that. So there isn't, what you would call a standard wall. That's one of our biggest grievances as a contract waller being paid on piecework, we're paid on the running metre. But some walls are nine foot high and some are four foot six high and you're paid the same for twice the work. So as contractors, we've all said the fairest way is to pay be the square meter, because obviously, some farms have big walls and some don't." Says "They have as big a lot of big walls in Swaledale, monstrous walls, and I don't know why." (Swaledale contractor)*

> *Dry stone walls - there is a unique style for Dartmoor. Its single width stone wall with a smooth vertical face which faces the common and a more rugged face on the other side, which may be less than vertical. In some cases the wall facing the commons may be slightly concave - aim is to deter livestock jumping over. The design dates from when different breeds of sheep and cattle were on the moor - it was sufficient to keep them out. (Dunstone contractor)*

It was reported that older walls tended to be more irregular, sometimes incorporating giant orthostats that could take a full day to reposition. In contrast, estate walls and those constructed as a result of organised enclosure tended to be more uniform and straight. Some estates even introduced stylistic elements reflecting wealth and aesthetic preferences.

> *A few walls have giant orthostats, old walls can be more sinuous in contrast to estate walls and walls of the 19th century which are surveyor-straight. Estate like fancy work as at [name] estate locally which had money from textiles/cotton and where crenelation were favoured in Victorian period and carried on into early C20th. Reservoir companies have their own styles too. (Todmorden contractor)*

Walling contractors reported considerable variability in the quality of stone, largely influenced by local geology, quarry depth, and stone source. Stones from small, shallow quarries near the surface often varied in strength and consistency, while later Victorian and early 20th-century walls sometimes used more uniform material imported from larger quarries. Limestone was described as particularly inconsistent, even within a single holding,

while gritstone tended to be more reliable. The quality of foundation stone was also mentioned as a key factor, especially where ground movement had occurred. Working with poor quality stone was a constant frustration but it was suggested that an experienced waller should be able to adapt their techniques to suit the conditions.

Walling contractors agreed that stone quality has a clear influence on wall construction, particularly in terms of stability, ease of build, and long-term durability. Walls built with small, rounded, or irregular stones were considered more difficult to construct and more prone to collapse. However, it was argued that argued that ground conditions and workmanship were just as important as stone quality and it was stressed that a skilled waller could work with most types of stone, compensating for weaknesses in material through proper foundation work and build technique. Still, the best quality walls, those that lasted longest, were generally those built from good, consistent stone on well-prepared foundations.

Working practices

The walling contractors reported that they mainly focused on restoration, repair, and maintenance, with new builds being relatively rare due to the high volume of existing walls and boundaries in poor condition. There was large demand for gapping and routine maintenance, especially in spring ahead of livestock turnout, while larger-scale rebuilding projects occupied the rest of the year.

> *Mostly restoration, gapping and maintenance. Tends to do 2 months gapping in spring, with the rest of the year rebuilding walls, grant work. Noted that some wallers tend to do garden work during the summer but then turn to farm boundary walls when the weather turns, to avoid churning up gardens (even though garden work is better paid. (Coldeaton contractor)*

There was also a growing demand for work with private, non-farming clients or on specialist projects, such as footpath and stile repairs, often in challenging locations like steep slopes. While preferences varied, the common thread was a clear pride in quality craftsmanship and a strong commitment to doing lasting work.

> *Mixture between accident repair work, and a lot of walling for farmers which consists of gap walling, restoration and a lot of footpath repairs. Says there are a lot of hikers who damaged the stiles and he is a specialist in repairing stiles. Says he likes to be challenged and will do a lot of difficult sights on steep slopes where it is difficult to gain access. Sites that other wallers won't take on. (Swaledale contractor)*

Walling contractors knew of many instances where farmers did very little stone wall or bank work themselves, largely due to lack of time, skills, or manpower. It was suggested that farmers tend to handle basic maintenance and gapping, while larger-scale rebuilding and restoration work is typically left to professionals. It was suggested that there has been a decline over the past few decades in farmers' walling ability. However, experiences varied, with some contractors observing a high level of proficiency on particular farms.

6.4 Views on ecology, landscape, and attitudes towards walls and banks

Agreement holders place a high value on stone walls and banks, particularly in terms of how they are perceived by others and their broader significance (Figure 6.5).

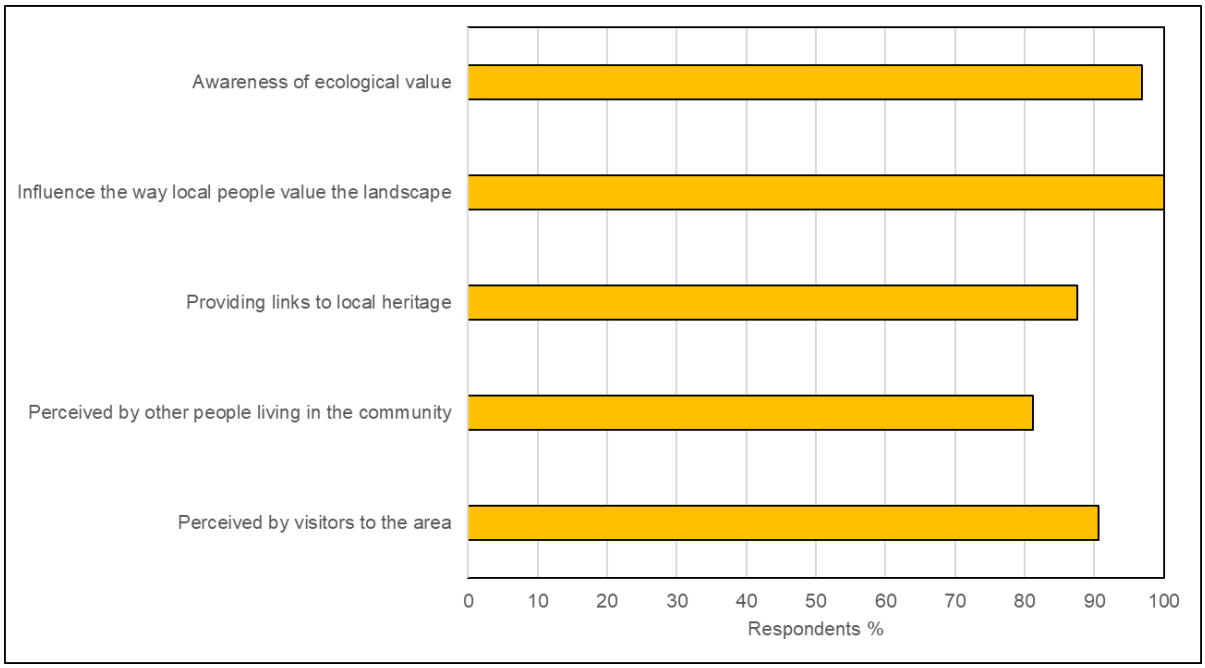


Figure 6.5: Agreement holder perceptions of the value of walls and banks

6.4.1 Awareness of ecological value

Agreement holders showed a very high level of awareness (97%) of the ecological value of their walls and banks, frequently identifying them as important habitats and wildlife corridors. Many noted the presence of birds, particularly small nesting species. There were also regular observations of small mammals using the walls for shelter and movement.

The value of walls for invertebrates and other smaller fauna was also recognised. Many agreement holders described finding spiders, butterflies, bees and other insects inhabiting the stones. Frogs, toads, and even Great Crested Newts were mentioned as benefiting from the wall environments.

When it came to vegetation, lichens, mosses, ferns and flowering plants were commonly observed, particularly in shaded or moist conditions. It was reported that noted that stone-faced banks, especially when topped with hedges, had even greater ecological value wan walls due to their structural complexity and layered habitat opportunities. These banks were said to support insects, reptiles, and birds, with the added benefit of flowering plants providing early nectar for pollinators.

> *Sees a lot of insects when gapping. Says mosses do best on shady side of the wall and in sheltered areas under crags, in gulleys and next to streams and rivers. "Every time you clear a gap out there is something in there". (Swaledale)*
>
> *Say lots of birds use walls to nest. Particularly robins, pied wagtails, sparrows (not totally sure they are called sparrows, small brown birds). Lots of mice,*

voles, frogs and toads. See evidence when clearing out walls to be repaired. Lots of creepy crawlies under the stones. Spiders are everywhere. (Swaledale)

The agreement holder thinks that bats inhabit some walls but not sure. Definitely lichen, butterflies and insects. Canadian geese seem to use them as shelter. Trees grow out of walls but not properly managed and folk get upset if they are cut. (Todmorden)

Agreement holder is passionate about wildlife. Says walls in this area were black and sooty because of the smoke from houses and factories. Lichens, sheltering flowers, Little Owls, voles and moles, spiders and wrens in the crannies; impression of many insects that warm themselves including butterflies. (Todmorden)

Agreement holder has seen stoats, wrens, great crested newts, toads etc. Wallers now leave small gaps to accommodate wildlife. (Coldeaton)

Recognises the walls as wildlife habitats and corridors; has seen a lot of wildlife, e.g. birds (e.g. wheatear); stoats, weasels, voles, shrews. (Coldeaton)

Stone walls have lichens, Bryophytes on the north faces; also mosses and ferns; provide important song posts for birds. We have also found owl pellets by the walls and hawk regurgitation. The relic walls provide bird habitat. The stone banks have lot of spring flowers, provide early pollen and nectar source for bees and other insects. Stone banks have an amazing array of species. Trees grow better on the stone banks, the banks protect the young trees. Hedges on the banks provide shelter and shade, trees bring up minerals from deeper in the soil. (Dunstone)

Agreement holder say they do not really know much about ecology of the area. Mentioned wildlife in one area but had no views on species or habitat provided by walls. Only thing they pointed out was that most stone-face banks had a mix of hedges and trees on them so they likely provided more scope for different species. But he also noted that when restoring the banks, the first task was to 'coppice' remove dead and diseased trees and 'open it out'. 'Without coppicing you cannot re-build the wall, that is part of the grant'. (Dunstone)

Despite the overall awareness, there were a few agreement holders who expressed limited ecological knowledge, or who had not actively observed the habitat value of their walls. In some cases, observations were more incidental, or based on the perceived benefit of hedges and trees growing alongside the walls. Others noted that ecological benefits might temporarily decrease during restoration work, especially when coppicing or removing vegetation, though they acknowledged potential for long-term gains once the structure was repaired.

The walling contractors were similarly well-versed in the ecological value of walls and banks and could discuss at length the different species they had encountered while at work. They noted that older and well-maintained walls provide shelter and breeding sites for invertebrates, reptiles, amphibians, small mammals, birds and even hedgehogs, stoats, and weasels. Walls also support a rich flora, with lichens, mosses, wildflowers, and ferns growing on or around them, especially in older structures. Banks, when combined with hedges, further enhance biodiversity, supporting fruiting trees, wild roses, and insects, particularly when managed through traditional practices like hedge-laying.

""What do you find in a wall? So, from mosses and lichens to refuges for rabbits, voles, of course, arachnids and spiders, snakes, even frogs, toads, especially toads and a host of insects from wood lice to centipedes. Oh, slow worms as well." (Swaledale contractor)

"Older walls hold lichens and mosses - you also see funguses and wildflowers. I have seen invertebrates in walls, lizards, toads, frogs, newts, snakes, shrews, mice. Small birds use walls, Stonechats fly onto them when they call out for mating. With stone banks you get rabbits, which are not good, make burrows and cause collapse. On stone faced banks you get flowering and fruiting trees, also spindle, wild rose. You get biodiversity if you are in a cycle of hedge-laying it grows on, attracts insects and birds. Walls and banks need managing, so much has fallen into disuse. A big problem today is just using flail every few years to manage hedges, and barbed wire to keep livestock out." (Dunstone contractor)

6.4.2 Influencing the way local people value the landscape

All the respondents felt that stone walls and banks played a play a significant role in shaping how local people perceive and value the landscape. Many stated that the distinct appearance of the walls, banks and associated field patterns is part of what attracts people to the area, with several referencing high house prices as an indicator of the area's desirability.

There was a strong sense that well-maintained wall and banks contribute to a positive impression of the landscape, with some agreement holders commenting that locals and visitors alike appreciate the visual impact of neat, intact walls, especially when viewed from a distance. Many reported that people walking through their farms regularly made positive remarks about the condition of the walls, particularly in areas along popular footpaths such as the Pennine Way or Calderdale Way. This feedback was clearly valued by the farmers, reinforcing a shared sense of pride in the upkeep of their field boundaries.

However, some agreement holders expressed uncertainty about how deeply this appreciation is felt across all sectors of the local population. While long-standing residents were believed to have a good understanding of the farmer's role in maintaining the landscape, there was more scepticism regarding newer arrivals and second homeowners, with suggestions that some may not fully recognise or value the ongoing work behind the scenes. Despite these mixed views, many agreement holders were clear that walls and banks are seen as part of the cultural heritage and local identity of the area. Walls and banks were seen not only as functional but also as markers of craftsmanship and place.

Thousands of people walk across the farm done every year on a footpath loop from the village. Locals like the lynchets and history on the farm. Locals like the intimacy of the walls and barns in the landscape. Also get wonderful views of the walls across the valley. (Swaledale)

"When you see these walls you know you are here". (Todmorden)

The farm is situated on Calderdale Way and close to Pennine Way, the walls are an important part of the landscape character. (Todmorden)

Said that so many people who pass the farm comment on how good and neat the walls look – high location with good views over valley landscapes with farmsteads and dry stone walls. (Todmorden)

People comment, recognise it as their heritage and that it adds to landscape character. (Coldeaton)

Iconic walls; people commenting all the while – who did it, how nice to see it done, particularly with curved corners (rather than right angles) around house, garden and entrance area. (Coldeaton)

Very important for landscape but the locals don't recognise it. Most people don't look closely at the place they live. We have a high density of second homes here. (Dunstone)

6.4.3 Providing links to the local heritage and historic development of the area

Links to heritage was recognised by most respondents (88%). Agreement holders expressed a strong and consistent belief that walls and banks are deeply linked to the local heritage and historic development of the landscape. Many described these features as integral to the area's identity, with references to the long history of walling, both as a craft passed down through generations and as a defining element of the local environment. Several noted that walling is "in people's blood," and viewed walls not just as functional structures, but as cultural artefacts representing continuity and tradition.

Some agreement holders provided detailed accounts of the historical documents which recorded the construction of walls in specific locations by groups of local men. These stories highlighted a clear awareness of how the present-day layout of the land has been shaped by past agricultural and social practices. In addition, many spoke about the age and character of specific walls on their holdings as evidence of the layered history within the landscape.

The role of walls and banks in shaping public understanding and appreciation of local heritage was also widely acknowledged. Agreement holders noted that visitors and locals alike comment on the walls, recognising them as part of a shared cultural heritage. Features such as old drovers' routes, lynchets, and varied wall construction styles contribute to a sense of place and historical depth. In some areas, local authorities and National Park Authorities were commended for promoting this heritage through signage and online information, enhancing public understanding of the walls' historical value.

However, not all agreement holders had considered there heritage aspects of their walls and banks. Some admitted they had little or no knowledge of the history of their field boundaries, or had not discussed it much despite having lived in the area all their lives. Nevertheless, the majority expressed a strong sense that the walls and banks are not only physical structures but also enduring symbols of the region’s cultural and historical identity, reflecting centuries of land use, community organisation, and rural life.

"Very knowledgeable about the age of the walls and the different character of the historic environment changing over short distances. “I think if you go up the hillside to [name of hamlet], it's older than it is down here. You can see it in the barns if you look at the gable end you can see that ling [heather] thatching line where they have altered it to put the stones on. It’s a lot older than it is down here, so there's some old walls up there, unbelievably old walls. Some of the walls have a lot bigger stones… a lot of bigger boulders in there.” (Swaledale)

“we do realize that the place is fairly old and it's got a lot of history. We always have, because our family has been here over 100 years we have a lot of knowledge of what's gone on. That’s why we've always thought it's a shame

to, you know, spoil it or let it go. That's why we took advantage of these barn and walling grants." (Swaledale)

Fundamental. Has lived here all his life, walls are integral to local heritage as they have so many different patterns. (Todmorden)

People comment, recognise it as their heritage and that it adds to landscape character. Field names, for example, demonstrate how people relate to the landscape. (Coldeaton)

Agreement holder says likely late Medieval/early post-Medieval origins and mentioned in C19th deeds. (Coldeaton)

The walls and banks are pretty much part of what the cultural heritage is in the area. Banks are very tradition - dug out by hand creating a ditch on one side. (Dunstone)

6.4.4 Perceived by the local community

Agreement holders overwhelmingly perceived that walls and banks are highly valued by other people living in the community (81%). Many reported receiving frequent and positive comments from both locals and visitors, particularly those walking through the landscape, with some farms located on or near public footpaths. These features were seen as part of what defines Swaledale and the South Pennines, forming a recognisable and cherished element of the area's visual and cultural identity. One respondent simply summarised that the walls are "part of what makes Swaledale Swaledale."

There was a clear sense that community members view walls and banks as symbols of a well-managed and cared-for landscape. People reportedly take pride in seeing the walls "looked after," with appreciation shown for their neatness, traditional form, and contrast with more modern or industrial fencing alternatives like barbed wire. Agreement holders noted that locals often "know who the good farmers are" based on the condition of their walls, suggesting that well-maintained boundaries contribute not only to aesthetic value but also to social recognition and respect within the farming community.

Several agreement holders spoke about the role of these structures in creating a sense of belonging and continuity. They felt that residents – whether long-term or new to the area – expect to see stone walls as part of the local landscape, and that these expectations shape how people connect with their environment. For many, the walls and banks are "part of the fabric of the landscape" and carry meaning beyond their practical use, symbolising tradition, identity, and rural life.

In addition to informal comments from passers-by, some agreement holders noted that community engagement with walls extends into education and heritage. One reported running a classroom for children and visitors, with nearly all participants commenting positively on the walls and the landscape they shape. This highlights a broader community awareness and appreciation of the historic and cultural value embedded in these structures, reinforcing their continued importance within both the visual and social life of the area.

The walling contractors generally felt that local people valued the walls and banks, viewing them as important cultural and landscape features that represent pride, care, and legacy in the area. The restoration and maintenance of walls and banks were understood to be symbols of respect for local heritage, as well as part of the practical farming infrastructure, and often drew positive comments from passers-by, reinforcing a shared sense of pride, identity and belonging.

"You know when the locals are interested because they'll stop and talk to you when you're walling… I would say that some of the locals are appreciative, but others that commute out they're not as bothered because they're away at first light in the back after dark so they don't see it anyway." (Swaledale contractor)

6.4.5 Perceived by visitors

Nearly all the agreement holders (91%) perceived that visitors held a strong appreciation for the walls and banks, often seeing them as central to the character and appeal of the landscape. Many respondents described frequent, positive interactions with tourists, particularly when walling near footpaths. Visitors were said to be fascinated by the craft of wall building, often stopping to ask questions about the structure and function of features like through stones. This curiosity was seen as genuine, with wallers noting how visitors admired the skill involved, even standing to watch them work.

Several agreement holders highlighted that the distinctive appearance of the walls and banks is one of the key reasons why tourists visit the area. Descriptions such as "iconic walls" and the landscape being "part of the tapestry" suggest that these features are closely tied to the region's visual identity.

Despite this generally positive perception, a few agreement holders expressed frustration with the impact of visitor behaviour. Some noted issues such as wall and bank damage caused by walkers climbing over, or stones being removed. Nonetheless, these negative views were often balanced by an appreciation that tourism supports the local economy and raises the profile of the landscape.

Overall, agreement holders believed that stone walls and banks contribute strongly to visitors' enjoyment of the area. While not everyone may fully understand their historical development or agricultural function, most visitors were thought to respond positively to the visual, cultural, and atmospheric presence of these boundaries.

"They love them. When I'm walling someone is always stopping to talk to me, the main thing they always ask you is what are the stones that stick out, the through stones. They just don't know what they are, and they're genuinely interested. Sometimes they'll just stand and watch you, they think it's such a skill and we don't realise because farmers are just taught to do it, but yeah, they are genuinely interested." (Swaledale)

Knows visitors like the scenery. They ask about the barns and the walls. Wanted to open the farm up for circular walk and applied for ESA funding in early 1990s. Wants visitors to have good experience in the dales. (Swaledale)

Lot of people who stop to talk are walkers/ tourists when he is out and about close to paths or walling. (Todmorden)

Visitors comment when walking by - iconic walls; people commenting all the while – "who did it, how nice to see it done". (Coldeaton)

Visitors love them, some people borrow stone from the walls - take the stones off the top of walls down the side of roads. They see it as part of the heritage - you see them taking photos of the walls. (Dunstone)

it is striking when you see it in the landscape, it's part of the tapestry. When you are out walling you get appreciation from some of the walkers who remark on the craft involved and the end product. (Dunstone)

The walling contractors reported that visitors show strong interest and appreciation for the walls and banks, often stopping to watch them at work, comment, and ask questions. Walls and banks were seen as a distinctive feature of the landscape, adding to the area's sense of place. In some cases, they are even a destination in themselves, with one contractor recalling Japanese tourists visiting specifically to see the walls.

> *"For Dartmoor it creates a sense of place - people notice it. Aesthetically walling is really pleasing to the eye, if done well in is in conjunction with the landscape, not opposing it. People really notice when a wall is restored. Value is massive, they define the landscape visually. I work near the general public often and people are drawn to it if you are working on a wall. It's in our DNA - the relationship of using natural material that is there and working out how to use it." (Dunstone contractor)*

6.5 Functions of walls and banks and impact of AES

6.5.1 Function of walls and banks

Figure 6.6 shows the different functions that agreement holders attributed to their wall and bank boundaries, with a strong emphasis on livestock management and property delineation.

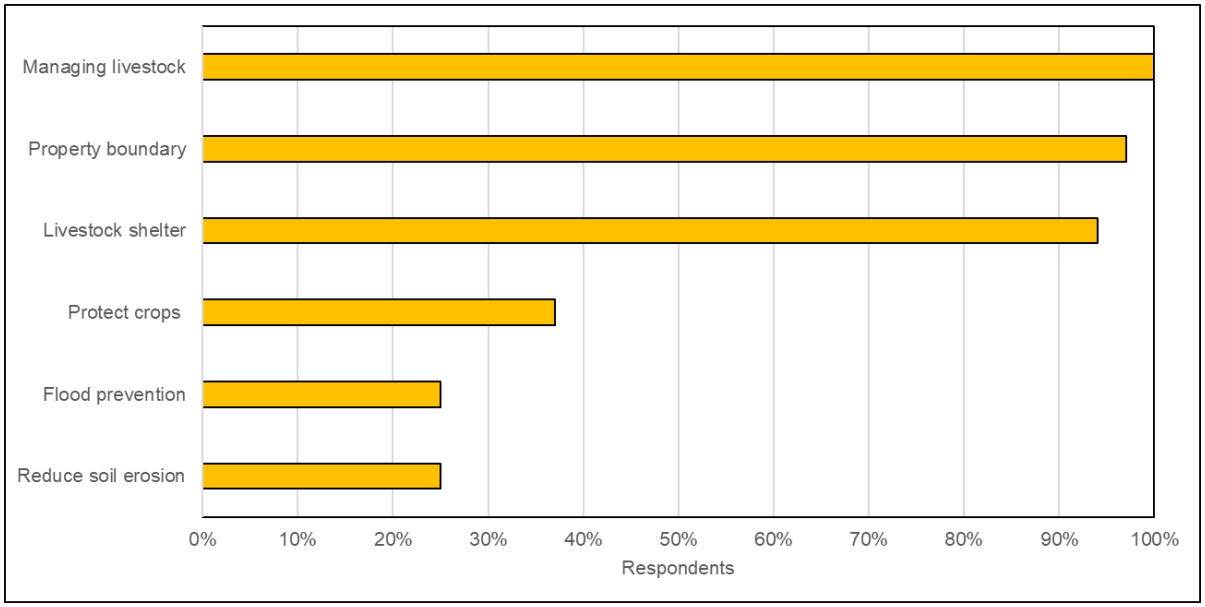


Figure 6.6: Wall and bank function in the case study areas

Livestock management

All respondents (100%) identified managing livestock as a primary purpose of walls and banks. Agreement holders value walls and banks highly for effective livestock management, seeing them as essential for controlling stock movement, maintaining boundaries, and supporting practices like rotational grazing. Many inherited good-quality walls, which continue to play a vital role in day-to-day operations. Walls help manage mixed livestock, particularly during tupping and lambing times, by keeping animals separate as needed. Some respondents relied on fencing and wall-top-wire alongside walls to enhance control, especially with more agile breeds of sheep. Internal field walls and banks, even if not

currently in use, are valued for their potential future utility. Damaged walls are seen as problematic, as they encourage sheep to jump, which can lead to more damage. Overall, walls and banks are seen as integral to traditional and modern farming, facilitating controlled grazing, stock safety, and long-term land management.

> *"Walls are important at tupping time when you have pedigree tups, you need to know which tup is with what sheep. You don't want them mixing up. So you need your walls which are good for that sort of thing. And keeping cows away from footpaths." (Swaledale)*

> *"In an ideal world, every gap that comes down you want to put back up. It's up for a reason is a wall, and then if you have broken walls that causes more harm than good, because you just encourages sheep to jump. If they jump over this little bit they'll learn how to jump over bigger." (Swaledale)*

> *Important for managing livestock. Even internal ones that are effectively redundant are still there to be used if and when needed in future. (Coldeaton)*

> *"We need the walls to protect the grazing against the common and for biosecurity - to keep diseased animals on the common from getting onto our land and infecting the herd." (Dunstone)*

Stock shelter

Similarly, 94% of respondents highlighted livestock shelter as an important function. Agreement holders value walls and banks as highly effective sources of livestock shelter, particularly in exposed or upland locations where weather conditions can be harsh. They are especially important during lambing time in spring and over the winter months. It was reported that sheep and cattle instinctively use them for shelter, often lying or standing near walls and banks, which can create small micro-climates. Banks topped with hedges or trees are considered particularly effective, offering more comprehensive cover than walls alone. The shelter provided is essential for outdoor lambing and for livestock that remain outside year-round. Some agreement holders are adapting land management to enhance this function, for example by letting hedges grow taller.

> *"Shelter is needed especially in lambing, when it is wet and wild. You can see this in the fields if it's been horrible and wet because it is black around the walls where the sheep have been stood sheltering. Most people lamb outside, so shelter is very important." (Swaledale)*

> *The sheep like to rest in the shade in summer and shelter from rain and wind in winter. Stone faced earth banks provide more effective shade and shelter as have hedges and sometimes trees on the top. (Dunstone)*

> *Walls, banks and hedges used heavily in winter as shelter. We are letting the hedges on the banks grow up to provide more shade and more shelter - it's becoming more important with climate change - the need for hedges is far greater. It also means I have to trim vegetation back around the base of walls and banks - livestock shelter there and get caught in the bramble. (Dunstone)*

Property boundaries

Defining property boundaries was also a key function, cited by 97% of respondents. Walls and banks were highly valued as property boundaries and agreement holders highlighted their role in preventing stock from wandering and neighbouring stock from encroaching. Maintenance is often seen as a shared responsibility, though disputes can arise if

neighbouring owners do not uphold their part. Despite some walls not being their responsibility, farmers may still rebuild them to protect stock or maintain good relations. Prioritisation is often given to walls and banks adjoining roads and common land.

> *"in Swaledale everybody is intertwined with everybody else, so a lot of walls are property walls." Say that they are a close-knit community, all the farmers know and help one another, many are related. "You kick one of us and we all scream." Also said "If you have a choice of going to a gap on your boundary that goes to the moor, or one in between your own fields, you go and do the boundary wall first." (Swaledale)*

> *"Like with this field I mentioned, I was keen to get the wall up because I don't want my sheep in my neighbours really causing a lot of trouble and work. So that's why, and I think a lot of farmers are the same, they don't want sheep straying all over the place, so they keep the wall up." (Swaledale)*

> *The agreement holder has had issues with a neighbouring property taking stone from one of his walls (Todmorden)*

> *All walls are field and property boundaries - this is the traditional characteristic in the locality(Todmorden)*

> *Lot of disparate small plots, so a lot of walls are boundaries. Has had to rebuild a wall that wasn't their responsibility because of lack of action by that owner and a need to prevent his stock trespassing. (Coldeaton)*

> *We have to maintain fences against neighbouring farmer's livestock (cattle), and against the common (stop the sheep getting in) (Dunstone)*

Crop protection, flood control soil erosion prevention

Other functions were less frequently mentioned. Crop protection was noted by 37% of respondents, which may reflect the fact that most holdings in the case study areas were livestock-based, with only 1 holding in the survey possessing arable land. However, some respondents mentioned the importance of keeping livestock out of meadowland to allow the grass to grow for silage or hay production.

> *Says a lot of the walls are property boundaries and it's important to keep them up. Internal walls are less important unless they are meadow walls. (Swaledale)*

Environmental benefits such as flood prevention and soil erosion control were recognised by 25% of respondents in each case. While not seen as the primary function of walls and banks, these responses suggest some awareness of the wider ecosystem services that well-maintained boundaries can offer.

> *Stops soil creep on steep slopes. Also can protect riverbanks (Swaledale)*

> *Perceived as reducing soil erosion but erosion mostly managed by significant amount of drainage works (Coldeaton)*

> *Massive benefit as farm on a hill and the walls and banks stop the water flow, prevent it escalating and taking soil away. (Dunstone)*

> *Some will provide this but all fields in permanent grass so erosion not a major problem. It is more of an issue around gateways where water gets channelled through. (Dunstone)*

Banks in the Dunstone case study area were reported to have a positive impact on flood control.

> *Yes - this is important about 15-20% boundaries, ones at the base of the hill definitely slow the water running off the farm. We are at the head of the catchment so it is particularly important to slow the run-off. (Dunstone)*

> *The boundaries both slow down and speed up water flow. More than anything else the banks divert the water, until it goes through a gateway. That's where you get the erosion. Need to put in drainage to the banks to manage the water - and maintain the drains, keep them clear - otherwise get pooling of water behind some of the banks. (Dunstone)*

6.5.2 Impact of AES support for wall and bank maintenance and restoration

Support for wall and bank maintenance and restoration

Figure 6.6 shows that agreement holders place a high value on AES support for the restoration and maintenance of walls and banks and 9 out of ten respondents (88%) said that that knowing what they know now, they would take up the wall and bank options again in future.

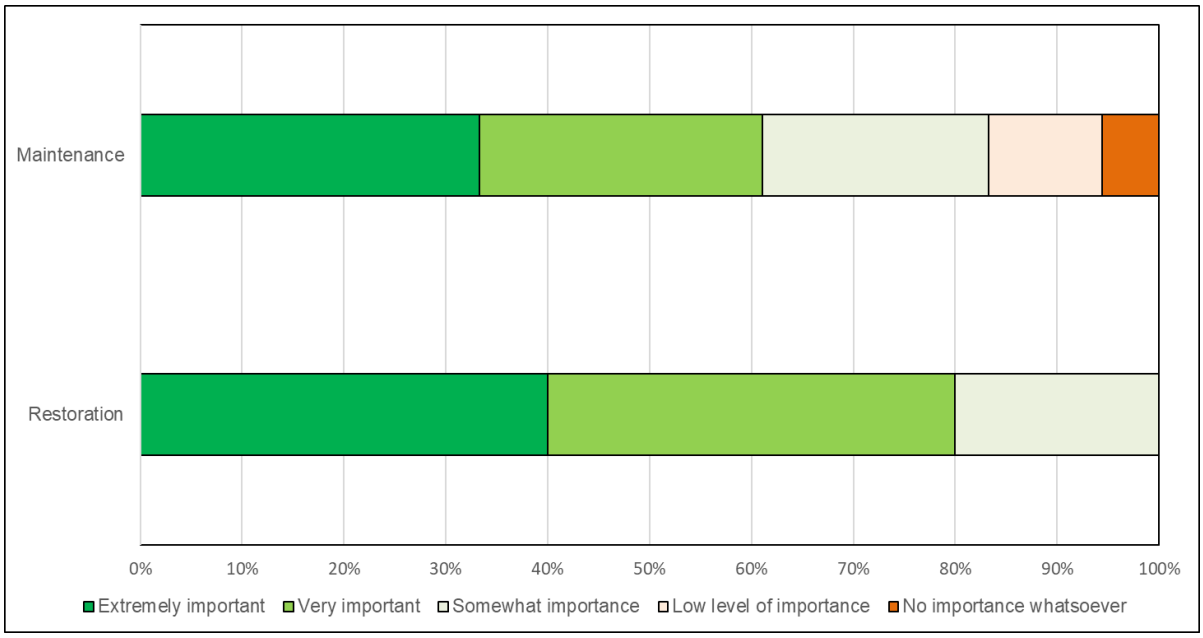


Figure 6.6: Importance of AES support for maintaining and restoring wall and banks

AES support for restoration is particularly valued, with 80% of respondents rating it as either extremely important or very important, and the remaining 20% seeing it as somewhat important. Restoration payments were considered essential by most agreement holders, who reported that without grant support, wall and bank restoration and repair would not have happened. Many emphasised that the cost of restoration was prohibitively high, and in the absence of funding, they would have resorted to cheaper alternatives such as fencing, patching, or abandoning the work entirely. While the grants were widely valued, they were also frequently described as insufficient, with rates covering only around half of the actual contractor costs. Some respondents called for increased support in recognition of the broader value of walls to landscape character, heritage, and farm infrastructure. Several agreement holders expressed frustration at past or current scheme limitations, including the absence of walling options under their agreements. Overall, restoration and

repair payments were viewed as vital to keeping walls functional and stockproof, supporting both farm viability and environmental aims.

> *Actual cost is £80 per metre so there is quite a shortfall. The scheme is still considered helpful as it is a contribution to the cost. But without the funding, he thinks that more walls will collapse (Todmorden)*
>
> *The scheme contributes towards the overall costs of rebuilding which are far greater than the grant rate; believes that Defra/the authorities should increase the percentage of funding, in recognition of the importance of the boundaries, not least for landscape character and heritage, as well as for farm and stock. (Coldeaton)*
>
> *Couldn't afford to do it without the grant so very little would be rebuilt, just patching and gapping when time permitted. (Coldeaton)*
>
> *The work would not get done without it. Most farmers go for a quick fix when need to do restoration - put in a rudimentary fence - they never have enough money to do it properly. (Dunstone)*
>
> *We could not do the work without the grant support. Which would mean our field boundaries would not be stockproof. (Dunstone)*
>
> *We could not afford to do all the work now without funding. We would still maintain fences - we cannot live without them because makes the boundaries stockproof. We would do cheaper options - bank over a wall and put a hedge on top - it's a quicker and cheaper option. (Dunstone)*

Maintenance is also considered important, though slightly less so, with 33% rating it extremely important and 28% very important. However, a notable minority place lower value on maintenance support, with 11% viewing it as of low importance and 6% as not important at all. It was reported that while the funding is helpful, it often falls short of the actual cost, creating a gap that still limits what can be achieved. For some, their walls and banks allowed them to reach the points threshold required to enter ELS and apply for much larger HLS agreement. For others, banks and walls contributed only a small portion of broader scheme income, but the payments are still appreciated. A few agreement holders expressed frustration about perceived unfairness in the way schemes are designed and rewarded, feeling that those who have historically looked after the land are not adequately supported.

SFI 2024

Although protection and maintenance options were discontinued with the end of ES in 2015, they have been reintroduced as actions under the under the SFI in 2024:

- **BND1**: Maintain dry stone walls.
- **BND2**: Maintain earth banks or stone-faced hedgebanks.

Agreement holders were asked if they were planning to use the SFI wall and bank maintenance actions. Figure 6.7 shows that just under half (42%) said yes, indicating a clear interest in taking up the new actions. A small proportion (13%) said no, while the largest group (45%) were unsure. This suggests that while there is a significant level of interest in the scheme, many agreement holders were still undecided and still gathering information about the scheme at the time of the survey. Several indicated they planned to use the scheme— some enthusiastically, others cautiously— often depending on factors such as eligibility, compatibility with existing ES or CS agreements, and the outcome of the HLS

transition. There were also concerns about payment levels and the broader direction of SFI, with some worried it may indirectly encourage reduced stocking or rewilding. Others were unsure, citing lack of time, clarity, or guidance, while a few noted that they had not looked into it at all or assumed they were ineligible.

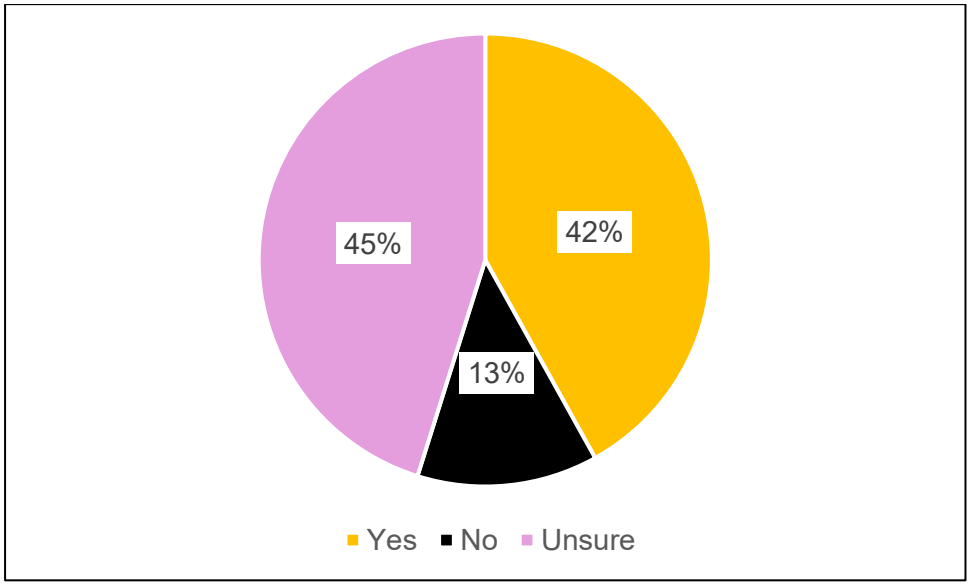


Figure 6.7: Interest in wall and bank actions as part of the SFI

Further practical benefits over the short term

Over the next 1 to 5 years, several agreement holders anticipated that their involvement in restoring and maintaining stone walls and banks through ES and CS would bring further practical benefits. These included more efficient and safer livestock management, increased stock proofing across holdings, and reduced maintenance needs. Some felt that successfully using the options had given them the confidence to take on more restoration work in future if capital funding became available. Others expected the boundary work to enable them to increase livestock numbers or prevent neighbouring stock from entering their land.

> *Benefits the business – makes work that much more efficient and easier than it might otherwise be; safer livestock management; continued peace of mind through knowing this. (Coldeaton)*
>
> *It has given us confidence to take on more dilapidated walls for when there is more capital funding. Lack of capital funding is an issue. (Dunstone)*

However, some agreement holders did not foresee any further benefits, with many stating simply “no”. There were also concerns about the long-term viability of hill farms, particularly with the loss of BPS and if AES funding was reduced.

Farm viability is on a knife edge. Does not think farm will survive if AES money is reduced as well as BPS. Already relies on non-farming income. (Swaledale)

Hoping there will be some real support for hill farmers to maintain the dales looking as they should. Govt. needs to replace the BSP with proper maintenance payments that will keep people on the land. (Swaledale)

Personal benefits of participation

Agreement holders described a wide range of personal benefits from their involvement in restoring and maintaining walls and banks using AES support. Many spoke with pride about the tradition and craftsmanship involved, expressing a deep cultural and emotional connection to the practice of walling. For some, it evoked a strong sense of continuity with past generations— highlighting memories of relatives who were wallers, and the satisfaction of working the same boundaries through time. Others reflected on the identity and heritage of farming communities where walling is both a practical skill and a cultural marker. Walling was described as a form of meaningful, even therapeutic, work—where the slow, skilled nature of the task contrasted with the pace of modern agriculture and offered something lasting and deeply rooted in place.

> *"My late brother was a fantastic waller, he took so much pride in it. If it hadn't been walled right he would take it down and do it again… We were brought up to be proud farmers, simple as that. Keep things as we found them, you know, tidy." (Swaledale)*
>
> *Connections with the past: "When I read my granddad's diaries from like the 50s, and he was doing the same walls that I'm doing now. He's talking about the same fields, the same rainy days, it's about one of the few things that has stayed the same. Like we have machinery now, we have big sheds, we have all this stuff, but walling is exactly the same as it was back then. You go with your gloves and you put a gap up." (Swaledale)*
>
> *Talked about the culture of walling in the dales and that there is a real craft aspect to it: "Some days you can look at stone and put them on like, bang, bang, bang. Then you can just get an hour where just nothing fits and you might as well just go and do something else. But then you can go back to the same gap a different day and they'll clag [adhere], clag like hell, it's just weird." Also said: "Some people can do it, the clever ones twig on, but some never get it, so don't waste your own time and do something else. It can be the best job but also the worst. If you're a one man band and you're doing a big stretch and you're facing the rain… it can be tough." (Swaledale)*
>
> *Sense of pride important. Does think that people notice them looking good as they get many comments on those that have been restored. "A good stone wall looks so impressive" (Todmorden)*
>
> *Pride in good jobs being well done; safer and better livestock management; peace of mind that cones from effective management of stock for the long-term. (Coldeaton)*
>
> *Walling is therapeutic. You do it more for yourself than someone else. When you build a wall you achieve something that will last for ever. (Dunstone)*

Alongside this cultural value, agreement holders also highlighted more practical personal benefits, including peace of mind from improved stock management, reduced stress from livestock trespassing, and aesthetic satisfaction in the improved appearance of the land. Some noted that good walls brought positive feedback from others, and in one case, even new customers for private walling work. A few linked walling to broader environmental improvements, such as better wildlife habitats, while others framed it as a moral responsibility—to care for the land, preserve heritage, and ensure future generations could continue the tradition. Although some respondents said they experienced no direct personal benefit, many described a strong sense of pride and purpose derived from the work, rooted in both identity and stewardship.

Peace of mind through effective management of stock for the long-term look of the farm – obvious that it is well-managed; aesthetics of the landscape as a result; it's all appropriate management of the land and landscape and this particular component of it. (Coldeaton)

It's about respect for the people that came before us- wanting to look after it, would do it for the love of it, its a moral imperative. (Dunstone)

Improving the delivery of maintenance options for walls and banks

Agreement holders provided a wide range of suggestions to improve the delivery of maintenance options for walls and banks. One of the most frequent points raised was the need to improve technology and simplify the administrative processes. Some of the respondents described the existing RPA interface as challenging, especially for those with limited digital literacy. The complexity of the current system often leads applicants to seek support from land agents, which can increase the overall cost of participating in the scheme. It was suggested that the RPA or Defra could develop simple, user-friendly apps to help users upload digital evidence of maintenance, making use of common tools like mobile phone cameras and measuring apps.

Respondents also highlighted the need to make the application process simpler and reduce the amount of paperwork involved. Some agreement holders reflected on earlier schemes, such as the ESA scheme, which they felt were easier to understand and manage. In comparison, they described the current process as sometimes confusing, with a greater chance of making mistakes. Many also asked for clearer mapping systems, as existing maps were seen as hard to read and made it difficult to know where different options should go. This uncertainty made some agreement holders worry about being penalised for mistakes, which could discourage them from taking on more complex or ambitious projects.

Funding was another concern for agreement holders, who felt that current payment levels do not reflect rising costs and suggested that rates per metre should be increased. Many said that a more substantial percentage of the total costs needs to be covered to make participation worthwhile. The availability of experienced contractors was seen as limited, and improved funding was viewed as a way to attract more skilled workers. Coordination between different schemes was also raised, with calls for better alignment to help farmers see what would suit them best.

Improving the delivery of restoration options for walls and banks

Agreement holders suggested a range of practical ways to improve restoration options for walls and banks. One of the most common requests was to simplify the application process. Some of the respondents said they rely on agents to complete the paperwork, which adds extra costs and stress. There was concern about making mistakes and facing penalties, especially when small errors can lead to funding being withdrawn. Clearer guidance, simpler agreements, and better support were all suggested to help farmers feel more confident when applying.

As with the maintenance options, funding was another key issue. It was suggested that current payments do not reflect the true cost of restoration, especially when stone needs to be brought in or the work is complex. Some suggested that payments should be based on quotes from local contractors rather than a flat rate per metre and that a square metre rather than a 'running' should be the unit of measurement. There were also calls for higher rates for walling work and for better funding of ongoing maintenance to protect previous

investments. Farmers also raised concerns about differences in funding levels between walls and banks, suggesting that the system should be clearer and more balanced.

Flexibility and local knowledge were seen as important ingredients to an improved system, although it was recognised that the direction of travel for AES was away from person to person advice. Having said this, some agreement holders felt that national schemes do not always suit every farm and called for local advisers who understand the area and would ultimately deliver better value for money in terms of beneficial environmental outcomes. They also suggested more flexible schemes that allow new work to be added over time, rather than fixing everything at the start. This would help farmers adjust to changes in costs, weather, or income. There were also calls to extend the payment periods. Spreading work and funding over 5 or 10 years, instead of 2, would allow more flexibility in finding contractors, managing time, and maintaining quality. Speeding up the application process, which some said takes up to 8 weeks, was also suggested to improve uptake and delivery.

There were also wider concerns about how farming is viewed within AES and there was some apprehension about the potential impacts of rewilding in the uplands. Overall, agreement holders showed a willingness to engage with the schemes but wanted them to be easier to use, more fairly funded, and better suited to the practical realities of upland farming.

The walling contractors proposed more flexible funding structures able to recognise differing situations, including scaled grant systems that account for site difficulty and the amount of preparation required. There were calls to shift payments from length to square metre and from piecework to daily rate payments, ensuring a living wage for wallers. Further improvements included better training and certification to uphold quality standards. There was concern about skills loss and a desire to see walling promoted in schools to attract younger generations.

7 ECOSYSTEM SERVICE FLOWS

7.1 Introduction

This section explores the ecosystem services associated with walls and banks through a SROI model. The methodology is described in Section 2 of this report while this section explores the investment in restoration, repair and maintenance of walls and banks, the nature and magnitude of outcomes and the benefit flows generated. Outcomes and benefit flows were assessed through agreement holder and walling contractor interviews in each of the case study areas. At the same time information on costs of wall restoration and maintenance were examined and the time and resource inputs of agreement holders taken into account in the model calculations. Four models were developed (one for each case study area) in order to explore the variability in outcomes and levels of investment and the influence of local context on the value of benefit flows. The Section examines the outcome indicators scores across the case study areas, the agreement holder investments (in terms of public and private finance) and the model results. The Section concludes with some discussion of the model strengths and weaknesses.

7.2 Identification of outcomes and indicator development

Outcomes from walls were based on previous research on valuing cultural heritage and other ecosystem services from drystone walls in England, along with literature and

Agreement holder discussion. Previous research with farmers and walling contractors have identified a range of benefits including:

- Provision of wildlife habitat
- Local employment and development of traditional skills
- Attracting visitors to the area; generating benefits to the local economy
- Supporting agricultural management, in particular providing a means of managing livestock, separating livestock from crops; provision of livestock shelter in both winter and summer
- Potential wellbeing for both residents and visitors from living in/visiting a walled landscape
- Preservation of traditional skills

Outcome indicators were developed and utilised in Agreement holder and walling contractor interviews to ascertain the extent to which outcomes were generated for different categories of beneficiary. Indicator scores were averaged across each case study area sample (Agreement holders and Walling Contractors) and utilised in the SROI models to assess the level of benefit flows experienced in each area.

7.2.1 Agreement holder knowledge and perception of walls and banks

Agreement holders provided an indication of the proportion of walls and banks on their farms which were considered to be functional for managing livestock in terms of whether they are stockproof, not stockproof, or derelict / remnant (Table 7.1). More than two-thirds of stone walls and banks were identified as stockproof in three of the study areas, the outlier being Todmorden where only around half were perceived as stockproof and more than a fifth as derelict or remnant. Across all four study areas almost three-quarters were perceived as stockproof, almost one fifth as not stockproof and a tenth as derelict or remnant. This information was compared to the wall condition survey carried out on a sample of farms in the case study areas and utilised in the SROI model to provide an indication of wall and bank functionality in relation to livestock management.

Table 7.1: Agreement holder perception of wall/bank functionality for livestock management

	Proportion of walls identified by agreement holders as stockproof, not stockproof, or derelict/remnant (Mean % for the case study area)				
	Swaledale	**Todmorden**	**Coldeaton**	**Dunstone**	**Case studies Mean**
Proportion stockproof	83.5	52.0	77.0	70.0	**73.6**
Proportion NOT stockproof	7.7	51.0	13.0	19.3	**18.7**
Proportion derelict /remnant	8.5	21.6	7.0	8.6	**10.1**

Note: Proportions are area averages based on agreement holder perceptions in response to separate questions and therefore do not total to 100%.

Agreement holders were asked for their views on the utility of funding for restoration and maintenance of the walls and banks on their land. Several questions in the agreement holder interviews explored perceptions relating to the utility and value of walls and banks. Table 7.2 summarises the responses across the case study areas regarding the perceived benefits from engaging with the maintenance of walls and banks). Respondents were asked to score four statements on a 5-point scale (where 1 = Strongly Disagree and 5 = Strongly Agree). Highest scores related to improvements in understanding of the cultural importance of walls and banks and their contribution to the local landscape.

A score of 2.9 (indicating a slight level of overall disagreement) was allocated to the statement regarding increased skills related to building and maintaining walls and banks. This was somewhat surprising but discussions with respondents revealed a relatively high level of skills acquired through years of regular maintenance work; thus, an additional programme to support training would be unlikely to generate much improvement. Lowest scores were attributed to a statement regarding generation of off-farm income, indicating this kind of activity was not widely pursued or viewed as a benefit. Scores were utilised in the SROI model as indicators of the scale of agreement holder benefit flows in relation to skills, employment opportunity, understanding and appreciation of walls and banks.

Table 7.2: Agreement holder perception of benefits from engaging in wall/bank maintenance

Engaging with the MAINTENANCE of stone walls (stone-faced banks) has…	Swaledale	Todmorden	Coldeaton	Dunstone	Overall Mean
…increased my skills in relation to building and maintaining stone walls / stone-faced banks.	2.2	3.2	2.8	1.8	**2.9**
…increased appreciation of the contribution that stone walls / stone-faced banks make to the landscape.	2.8	4.2	3.6	3.0	**3.8**
…increased understanding of the cultural importance of stone walls / stone-faced banks in this area	2.8	4.0	2.6	2.8	**3.4**
…enabled myself or family member to generate income from off-farm activity	1.8	3.0	2.0	2.2	**2.5**

Note: (Average respondent scores by case study area on a 5-point scale, where 1 = Strongly Disagree; 3 = Neither Agree nor Disagree; 5 = Strongly Agree).

Respondent perception of the extent to which the maintenance and restoration of walls and banks influence the local identity and landscape character of an area was explored through a series of statements using a similar 5-point 'Strongly disagree to Strongly Agree' scale. All respondents across the four case study areas agreed or strongly agreed with statements regarding the impact of wall and bank restoration on enhancing the landscape and making the area more attractive to visitors (Figure 7.2) while 90% agreed/strongly agreed with the statements about preserving important local heritage and the contribution to a stronger 'sense of place' among local residents. The proportion agreeing with the statement regarding altering 'appreciation of aesthetic value' of landscape is lower, but this could be attributed to respondents already having a high level of appreciation.

Scores on the 5-point scale were utilised in tandem with other responses to develop indicators for assessing the scale of benefit flows to visitors and residents regarding landscape, heritage and sense of place.

Respondents were also asked to respond to statements regarding their experience of wall/bank restoration (Figure 7.3). There were high levels of agreement from respondents across all four case study areas regarding the importance of heritage preservation, sense of pride and belonging, and positive experiences from being involved in helping to restore walls and banks in their local area.

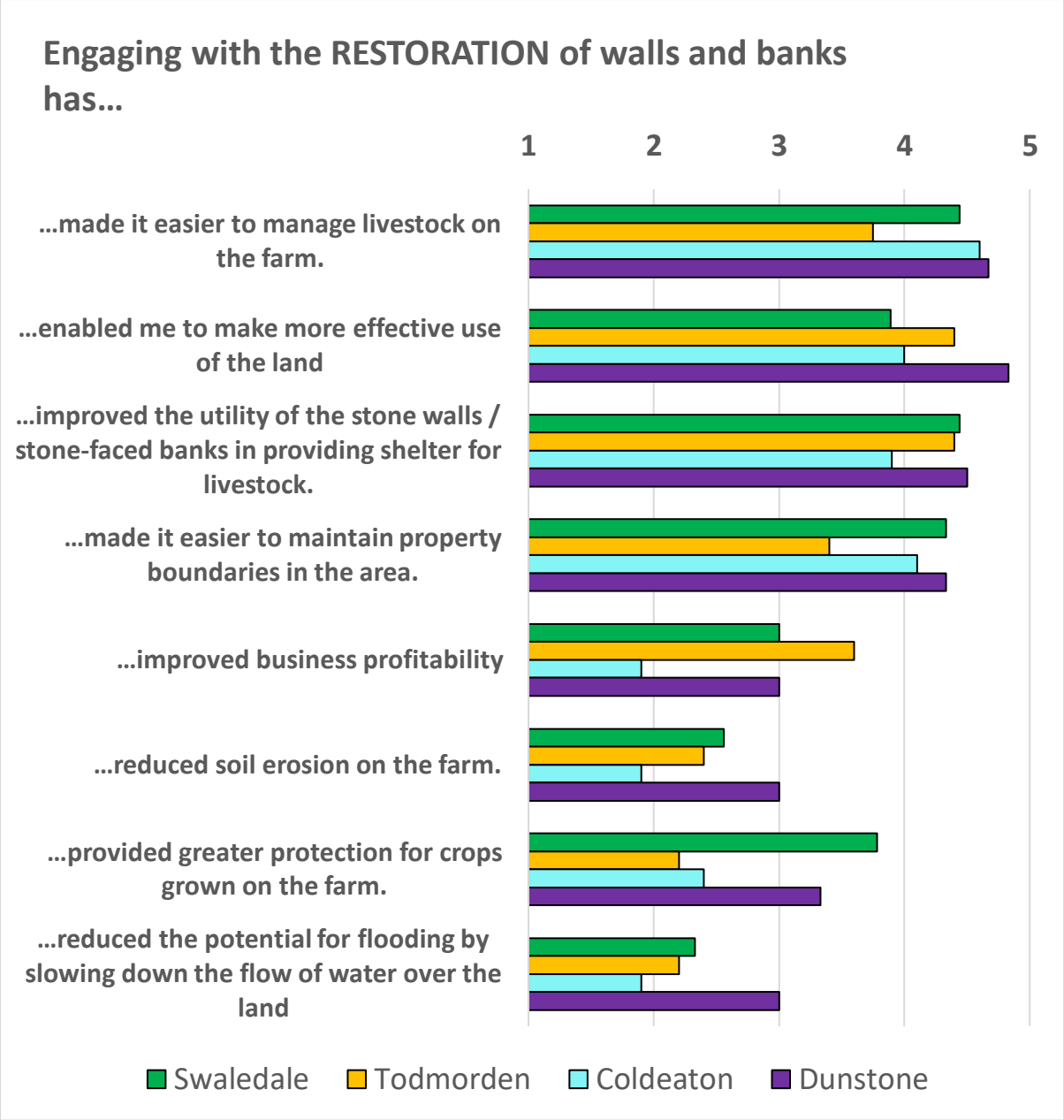


Figure 7.1: Agreement holder perception on the utility of walls and banks

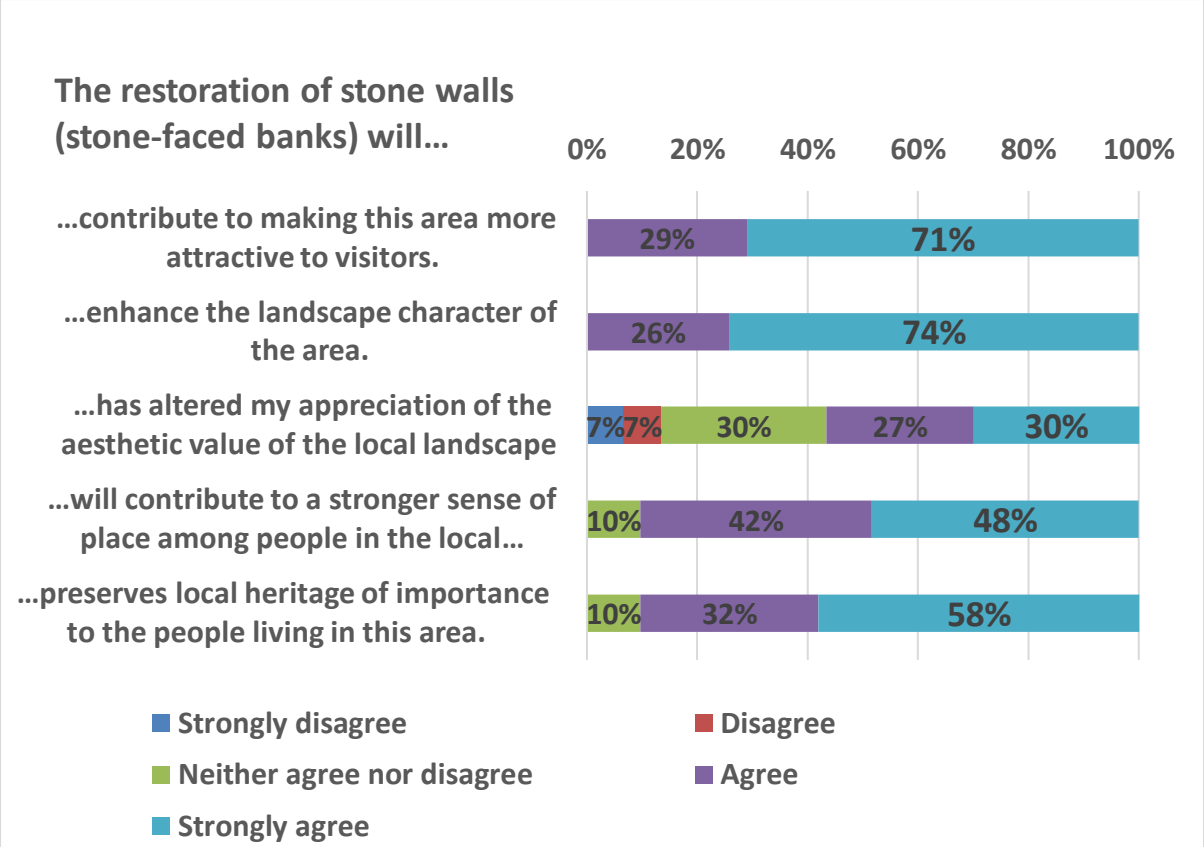


Figure 7.2: Agreement holder perception of benefits arising from restoration of walls and banks.

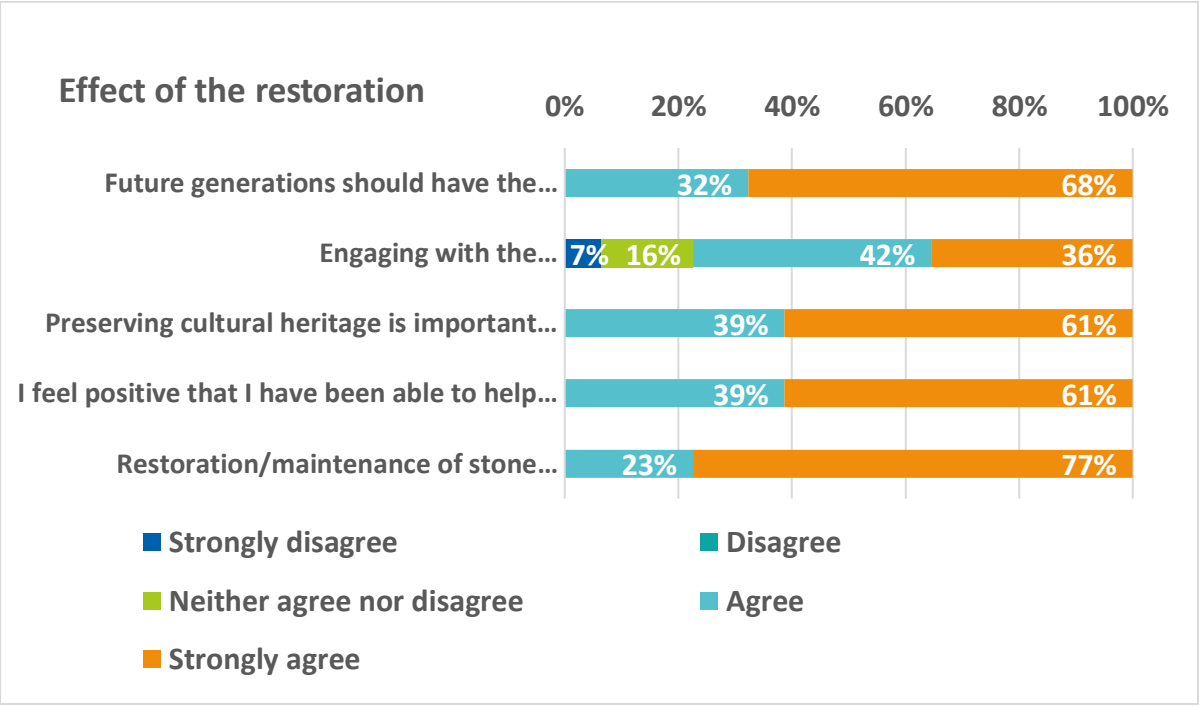


Figure 7.3: Agreement holder perception of the effects from involvement in restoration of walls and banks.

7.3 The investment model

There are two main elements in the investment model, public funding from CS and ES grant support and private investment, largely through the time contribution of agreement holders and family members in undertaking maintenance and repair work throughout the year. The sources of information and descriptions of the investment levels are discussed below.

7.3.1 Public investment

Information on the investment in walls and banks come from ES and CS agreements over the period 2010-25 for the four 50 km^2 case study areas. Due to data constraints, only agreements that are currently still 'live' were utilised to assess public investment. This is likely to under-estimate the full range of support as public funding that utilised in wall restoration prior to 2010 is not included. Agri-environment agreements that were operational during the period but had ended before 2025 are not included in the Benefit-to-Investment Ratio (BIR) calculations.

Public investment comes in two forms: capital grants for restoration and repair, and revenue grants for maintenance of agreed lengths of wall over multi-year periods. Agreement numbers vary across the case study areas as does the length of walls and banks and allocation of funding between capital and revenue grants, which is unevenly spread across the case study areas (Table 7.3). Whereas Swaledale and Todmorden had roughly similar amounts of revenue grant funding for maintenance, the level was significantly higher in Coldeaton (£0.247 million), and an order of magnitude lower in Dunstone (£26,678). In terms of capital funding Swaledale had less than half of the amount received by the other three areas. Looking at the total public investment figures, however, reveals that Coldeaton had the highest overall level (£0.583 million), twice the amount received by Swaledale, while Dunstone received the highest overall level of capital grant funding out of the four areas.

Dunstone, with the majority of field boundaries in the form of stone-faced banks, is a bit of an anomaly compared to the other three case study areas. A limited amount of revenue funding was available for maintenance (only 8.5% of the total over the 2010-25 period) of which £17,620 was allocated for stone-faced bank maintenance (across 4,912 metres). In terms of capital expenditure, £77,000 of the ES and CS funding was allocated to capital grants for stone-faced bank repair and restoration (26% of the total) while the majority of funding across the area was allocated to dry stone walling. This was surprising given that the length of banks is approximately three times greater than that of walls. The low level of revenue funding in Dunstone could be due to a number of factors. It could be a result of the far smaller length of walls in the area compared to banks, it may be that there is less demand for maintenance of banks (although no evidence was identified in the interviews to support this as a cause), or it could also possibly be an artefact of the current set of live agreements (information on expired ES and CS agreements is not available).

Swaledale, by contrast, has the lowest overall level of public investment (£0.283) with 60% of the funding in the form of revenue grants for maintenance and much lower levels of capital grant funding. But it also has the highest level of private investment (in the form of uncosted time invested by the agreement holder and family members outside of any CS and ES agreement), which is largely applied to maintenance and repair. As a result of this input Swaledale has the largest level of total investment over the period (£2.54 million). The high level of private investment in maintenance might also help explain the apparent lower level of demand for capital grant funding.

Table 7.3: Summary of public and private investment in case study areas 2010-25

Case Study Area	Swaledale	Todmorden	Coldeaton	Dunstone
Public investment: Capital	£112,343	£237,229	£221,176	£287,810
Public investment: Revenue	£171,143	£173,756	£247,723	£26,678
Total Public investment	**£283,486**	**£410,984**	**£583,447**	**£314,488**
Total Private Investment	**£2,263,200**	**£734,400**	**£1,125,600.**	**£2,019,771**
Total investment (Public + Private)	**£2,546,686**	**£1,145,384**	**£1,709,047**	**£2,334,260**
Average investment per year (2010-25)	£169,779	£76,359	£113,936	£155,617
Agreement holders 2010-25	23	30	35	43

Note: Based on current live ES and CS agreements and estimated value of agreement holder

7.3.2 Private investment

Agreement holder interviews explored the level of time invested in restoration, repair and maintenance of walls and banks in terms of average number of days per year the respondent (and family members) would spend doing work on walls and banks. There was considerable variation across the case study areas (Table 7.4) with least input in Todmorden (average of 5.4 days/farm/year) and most in Swaledale (average of 21.6 days/farm/year) with an overall average across the four areas of 12.2 days/farm/year.

Time inputs were rate at £160/day for family members and £320/day for Agreement holders. No other factors were costed (e.g. fuel for machinery; purchase of additional furniture such as gate posts, metalwork, gates). The variation in costed time inputs is thus based solely on time invested varying from £1,632/farm/year in Todmorden to £6,560/farm/year in Swaledale. Survey data using agreement holder estimated value of time costs explored during the interviews (plus a small amount of hired labour) generated an average farm investment rate of £3,819 per year, slightly higher than the one generated (£3,660) using assigned day rates.

Table 7.4: Agreement holder investment in maintenance

Agreement holder investment in maintenance (annual)					
Time and cost of investment in maintenance	**Swaledale**	**Todmorden**	**Coldeaton**	**Dunstone**	**Case study Mean**
Overall total days per area per year	216	27	73	73	97.2
Overall average days per farm per year	21.6	5.4	7.3	10.4	12.2
Total investment at day rate: £160/day Family members	£352	£96	£192	£206	£230
Total investment at day rate: £320/day AH only	£6,208	£1,536	£1,952	£2,926	£3,430
Average investment rate per farm per year (using fixed day rates for AH & family members)	£6,560	£1,632	£2,144	£3,131	£3,660

Note: Agreement holder and family members per year data derived from agreement holder interviews (n=32).

7.4 SROI modelling results

Table 7.5 summarises key features regarding wall length and density in each case study area. There is significant variation in overall wall length, from 567 km in Coldeaton (Peak District NP) to 105 km in Dunstone (Dartmoor NP). Dunstone is the only one of the four areas that has significant number of banks (typically a hedge topped earth bank with stone facing on either one or both sides). If banks are included alongside walls, then the overall density for the Dunstone area is 8.5 km per km^2; density of walls + banks within the case study areas thus varies from 7.7 km - 11.3 km / km^2.

In Dunstone it is worth noting that almost three-quarters (72.7%) of the ES and CS funding is allocated to walls, which account for 58% of the improved boundaries, while only 27.3% of the funding goes into support for banks (despite accounting for 75% of the length of the combined total of walls and banks).

Table 7.5: ES and CS investment in restoration, repair, and maintenance of walls and banks 2010-25

Investment	Swaledale (Yorkshire Dales NP)	Todmorden (West Yorkshire)	Coldeaton (Peak District NP)	Dunstone (Dartmoor NP)
Length of wall improved in km (ES + CS combined)	55.3	59.7	94.6	18.6
Density of walls in the case study area (km of stone walls per km^2)	10.0	7.7	11.3	2.08
Total length of dry stone walls in the case study area (km)	**500.8**	**387.2**	**567.4**	**105.3**
Total length of stone-faced banks in the case study area (km)	-	-	-	**321.0**
Density of stone-faced banks in the case study area (km of stone walls/km^2)	-	-	-	**6.4**

Note: The Dunstone case study area has more stone-faced banks (an estimated 321 km; 6.4 km banks per km^2) than walls. However, the overall lengths of walls and banks are approximate measures as 32.6 km of boundaries, for example, those adjacent to woodland, were hidden.

An overview of model outcomes is provided in Table 7.6. Total present value of benefits generated over the 2010 – 2025 period range from just over £4 million to £6.4 million. Benefit flows generated within case study areas are influenced by a wide range of factors including: number of agreement holders (ranging from 23 in Swaledale to 43 in Dunstone), current utilisation of walls and banks, extent of wall improvement, and the number of residents and visitors to the area. Total investment levels also vary significantly from £1.44 million in Coldeaton up to £2.54 million in Swaledale.

The current density of the wall network (and length of wall) does not seem to influence the value of benefit flows (or investment) as Swaledale has a much lower wall density than Coldeaton yet a much higher level of benefit flows and level of investment. The variation is more likely due to the significance of walls and banks in relation to the level of agricultural activity occurring in each area, number of agreement holders, resident population and visitor numbers benefitting. Todmorden, for example, has the lowest investment level and lowest overall value of benefits generated but is similar to Coldeaton in terms of the proportion of stone walls improved over the time period. But it also has the shortest length of wall/bank boundaries (387 km), the lowest density (7.7 km/km^2), and walls and banks in the poorest condition (52% were identified by agreement holders as not stockproof).

Table 7.6: Summary output data from SROI modelling of benefit flows from improvements to walls and banks in four case study area 2010-25.

Category of Outcome	Case Study areas (50 km²)				
	Swaledale	**Todmorden**	**Coldeaton**	**Dunstone**	**Average across 4 Case studies**
Total Present value of benefits	£6,312,996	£4,039,809	£4,767,320	£6,480,044	£5,400,042
Total Investment (Public + Private)	£2,546,868	£1,145,384	£1,709,047	£2,334,260	£1,933,890
Benefit-Investment Ratio (BIR)	**£2.48:1**	**£3.53:1**	**£2.79:1**	**£2.78:1**	**£2.90:1**
Proportion (by metres) of case study area dry stone walls and banks improved.	11.0%	15.5%	16.7%	4.3%	11.9%
Value of benefit flows contributed through improved walls and banks in case study area (based on proportion of metres improved)	£694,430	£625,362	£795,188	£280,586	£598,892

Total investment levels include both public funding (ES and CS grants) and private investment in terms of the additional time input by agreement holders outside of the work conducted as part of stewardship agreements. In all four case study areas the level of private investment, in terms of repair and maintenance (over the 15-year time period), exceeds that of the public investment (Table 7.3). Overall, the data suggest that benefit levels are higher in areas with higher levels of total investment (public + private). Care must be taken in drawing conclusions from these findings, however, as the level of public investment utilised in the model is based on current live agreements, while earlier agreements that may have expired are not included. In addition, the level of private investment is based on sampling and assumed to be constant across all agreement holders in a case study area over the time period (note also that the number of agreement holders per case study area varies) (Table 7.3).

Benefit-to-Investment ratios (BIR) vary from £2.48 for every £1 invested (Swaledale) up to £3.53 for each £1 invested (Todmorden) across the 15-year time period. There is no apparent straightforward relationship between the BIR and length of walls improved. In fact, Dunstone, has the smallest length of improved walls (4.3% of the total stone walls and banks in the case study area) while Todmorden has the second highest amount. Benefit generation, as noted above, depends on a wide range of factors. The two areas with highest proportion of improved walls (in terms of metres restored or maintained), Coldeaton and Todmorden, generate lower volumes of benefits than the two areas with smaller proportions of wall/banks improved. Todmorden, with the highest BIR is also

somewhat different from the other three areas. It is the only area not in a national park and has a much higher resident population than the other case study areas. This may partially account for a higher level of benefits generated by a large local population as well as having high visitor numbers, similar to the other areas. Swaledale generates a high level of benefits but lowest BIR, due largely to the high level of private investment which contribute to wall maintenance. A significant element in the difference between the BIR of the case study areas is the estimated level of private investment going into wall maintenance and repair.

It is also worth noting that although Dunstone and Swaledale have different proportions of improved walls the total benefits generated are similar. This may be partially explained through similar levels of boundary (walls + banks) included in the calculations (500 km of walls for Swaledale, 427 km of walls + banks for Dunstone), differences in wall condition, and variation in the number of residents and visitors in each case study area as well as the level of current utilisation of walls and banks for agricultural management.

7.4.1 Pattern of ecosystem service benefit flows

The proportion of benefit flows generated by the four domains of ecosystem service are similar across the case study areas (Table 7.7). In general, the highest proportion of benefits are generated through Provisioning services (ranging from 45% to 49% of total benefits) while the lowest proportion comes from Regulating services. Regulating services are largely related to flood prevention and protection of soil and plants from erosion. Although there has been some interest in the role of walled landscapes in slowing down the overland flow of water, the majority of farmers interviewed indicated it was not a function of walls on their land. In Dunstone, with a large proportion of banks, the situation is slightly different. Agreement holders interviewed noted a larger role played by banks in relation flood prevention, with some banks acting to slow down overland flow, but others playing a greater role in channelling and directing water flow, in one or two instances contributing to local flooding events rather than preventing. There was also some anecdotal evidence of banks damning water behind them only to give way when the pressure became too great. Outcome indicators utilised in agreement holder interviews demonstrated very limited roles for either banks or walls in slowing down the flow of water across the land, or in preventing soil erosion where the majority of the land is in permanent pasture.

Provisioning services, which account for the largest proportion of benefit flows by value (average of 47.3% across all four areas), include direct benefits to agreement holders in relation to improving the efficiency of livestock management and provision of livestock shelter, and provision of property boundaries. Repair and maintenance of walls and banks also creates local employment as the majority of walling contractors are locally based and spending within the local economy, and walls draw in visitors that also contribute to the local economy.

The value of Supporting service outcomes appears low (in three out of four areas below the 10% average across the four case studies) despite the fact that all agreement holders and walling contractors interviewed indicated an awareness of the significance of walls and banks for wildlife and biodiversity, and the ecological survey indicated a high ecological potential in all four areas. The apparent low level of value of the benefit flows is partially an artefact of the model and may be attributed to the financial proxies utilised, and the much higher level of value generated through Provisioning and Cultural services (based on high visitor numbers to National Parks landscapes). The value of supporting services in the Dunstone case study area was significantly higher (18% of total value generated) than in

the other three areas. This is explained by the presence of 321 km of hedge-topped stone-faced banks, with higher levels of habitat provision and biodiversity potential than in a walled environment. A higher proportion of boundaries (40%) were also mapped as being adjacent to protected areas and habitat other than improved grassland, arable, or urban land in Dunstone.

Table 7.7: Distribution of outcome benefits (2010-25) by ecosystem service domain (%)

Ecosystem Service domain	Proportion of total value 2010-25 (%)				
	Swaledale (Yorkshire Dales NP)	Todmorden (West Yorkshire)	Coldeaton (Peak District NP)	Dunstone (Dartmoor NP)	Overall Mean
Supporting	9.3	6.99	8.1	18.3	**10.7**
Regulating	5.3	2.93	1.0	01.1	**2.6**
Provisioning	46.6	49.3	45.6	47.6	**47.3**
Cultural	38.8	41.0	45.2	33.6	**39.6**

Cultural services varied from 33% to 45% of total value generated within case study areas. Cultural services include aesthetic and recreational value of landscapes for both residents and visitors, as well as accounting for wellbeing of residents and creating a sense of place, belonging and history. Visitors include both day visitors (some of which are potentially only driving through the landscape) and overnight or multi-day visitors. In assessing the scale of cultural service benefits generated, account has been taken of the accessibility of the case study areas, duration of stay of visitors and the proportion that engage in activities that are more likely to bring them into closer contact with walled landscapes.

7.5 Strengths and weaknesses of the SROI modelling

Sensitivity testing of the SROI model reveals a number of factors potentially influencing outputs. These include the following:

- Boundary data was drawn from a range of sources. Data come from GIS mapping of boundaries within case study areas, agri-environment agreement data on wall and bank improvement lengths, and condition scoring of a sample of boundaries within each case study area. The Dunstone mapping was unable to characterise the nature of all boundaries (33 km unknown) and agri-environment data was limited to agreements that are currently operational.
- Public investment data was limited to ES and CS agreements that are currently operational, with no information available regarding agreements that have expired. The public funding may therefore by under-estimating the true level of grant funding supporting wall restoration and maintenance.
- Resident populations of the case study areas were estimated using census and post-code district data. Todmorden has a significantly larger resident

population than the other areas, which potentially influences some of the cultural service outcomes.

- Visitor numbers to the three case study areas in national parks were estimated on the basis of National Park visitor survey data and the proportion likely to visit an accessible 50 km^2 area. Visitor data varied in quality and date of the survey. In Todmorden, which is not in a designated national park, a Calderdale tourism survey was utilised and a proportion of visitors were estimated to visit the case study area.
- Functionality is a measure of capacity for walls and banks in a specific location or area to deliver ecosystem service flows. Different factors influence the capacity (functionality) of walls and banks to deliver a range of services. Supporting and regulating services, for example, are dependent on density of walls and banks at landscape scale (e.g. to provide for wildlife corridors), and biodiversity may also depend on proximity to ecological 'reservoirs' as well as provision of habitat within walls and banks which can be influenced by construction style, and geological characteristics of the stone. Provisioning and cultural services depend on wall condition (the extent to which it can be said to be 'intact' and 'stockproof') and their visibility in the landscape and 'accessibility' to resident populations and visitors.
- Provisioning services are also linked to wall density and condition but as with cultural services social factors start to play a role in terms of how walls and banks are utilised by farmers / landowners, resident population, and visitors. It is worth noting that wall density per km^2 (or total wall length in a case study area) and overall condition are key factors across all four service categories.
- The SROI model assumes a level of benefits occur from Year 1 (as the vast majority of walls and banks were already in place). In practice some of the investment took place at later dates in the time period, so not all of the benefits generated by the investment included in this modelling exercise started at from the beginning of the period (. 2010). However, walls and banks in a case study area were generating partial benefits prior to the point when improvement took place (for example, walls and banks had to be in good condition to get accepted for grant support; private investment in maintenance was occurring, thus providing some, presumably lower, level of benefit flows).

7.5.1 Model weaknesses

Weaknesses relate largely to data issues, in particular being able to accurately estimate the number of beneficiaries in relation to provisioning and cultural benefit flows and ascertaining the level of public investment over the 2010 – 25 period.

The model structure tends to replicate patterns of output across different areas as it utilises an identical set of outcome indicators, although the indicator level varies based on the difference in scores from the local sample of agreement holders interviewed. Some of the indicators drawn from the agreement holder interviews in the case study areas revealed limited differences in the average scoring of outcomes across areas, which may account for similar patterns of outcome scoring and valuation.

The current approach lacks a baseline measure of condition. We do not have a measure of ecosystem service outcomes and benefit flows at the start of the time period (2010). What

we have is a measure of the condition of walls and banks following 15 yrs of investment (2025). We can therefore only account for the change in value brought about through the investment by multiplying the total value of benefits generated over the time period by the proportion of walls actually improved (which in percentage terms is relatively low, see Table 7.7). We also know, however, from boundary data in two of the study areas (Swaledale and Coldeaton) that the proportional length of walls that are brought back into effective utilisation through restoration, repair and maintenance is greater than the length (metres) wall actually improved. In Coldeaton, for example, the 16.7% of walls actually repaired improve the condition of 38.4% of the walls and in Swaledale, the 11% of walls repaired improved the condition and thus benefit flows from 15.5% of the walls in the area. These figures suggest that the improvement in the value of benefit flows presented in Table 7.7 is a minimum estimate resulting from the proportional improvements made in wall condition over the time period.

7.5.2 Model strengths

The model can accommodate variations in wall and case study area characteristics enabling flexibility in application. The model also incorporates measures of deadweight and attribution enabling contributions to benefits from alternative sources to be accounted for.

The model can be applied over multi-year periods enabling variability in timing of investment and outputs to be taken into account. The current model, based on the 2010-25 period incorporates both revenue and capital grant funding streams and the benefit flows over 15 years. Alternative scenarios and time periods can be explored to improve understanding of benefit flows from different ecosystem services, and also enable the valuation of marginal improvements within a larger landscape context.

8 LESSONS LEARNED AND AREAS FOR IMPROVEMENT

8.1 Lessons learned

The key takeaways from the project are as follows:

8.1.1 Rapid literature review

- **Walls and banks are environmentally significant**: Walls and banks are long-standing landscape features, deeply embedded in England's rural identity, with a strong historical legacy and visible contribution to landscape character across centuries.
- **There has been limited research and evidence to date**: Despite their significance, walls and banks remain under-surveyed at a national level. Monitoring efforts have more often focused on hedgerows, with less consideration of stone walls and banks, particularly in upland landscapes, in both research and national surveys. Existing data on walls and banks is limited and imprecise, with broad estimates and poor sampling procedures highlighting the need for more robust and consistent methodologies.
- **Ecosystem service value is under-recognised and under-researched**: While walls and banks provide a wide range of ecosystem services, these services are not consistently quantified.

- **Economic and social benefits justify investment**: Wall and bank restoration delivers clear returns through rural employment, skill retention, and tourism, supporting the case for targeted funding and further research into valuation methods that reflect their multifunctional contributions.

8.1.2 Review of GIS sources, methods and techniques

- **Current remote-sensing datasets often fail to accurately identify walls and banks:** They are frequently misclassified or excluded entirely during data filtering. This highlights the need for more tailored methods and improved classification techniques specifically designed to detect walls and banks.
- **AI and machine learning offer potential for mapping stone walls**: They perform well when supported by high-quality lidar and contextual data, but their accuracy depends on the quality of inputs, availability of reliable training data, and the characteristics of the landscape.
- **A mixed-method approach provides the most accurate results**: By combining reliable GIS datasets, lidar-based models, and manual or semi-automated classification methods, it is possible to more effectively identify and map stone walls across different landscapes.

8.1.3 Review of wider policy context

- **There is relatively less focus on walls and banks in high-level policy**: Despite their central role in shaping landscape character and supporting agro-pastoral systems, walls and banks receive limited attention in national strategies such as the 25-Year Environment Plan and the Environmental Improvement Plan, which largely prioritise natural over cultural heritage.
- **Management is often reactive rather than preventative**: Current support has focused more on restoration of walls and banks once deterioration has occurred, rather than proactive management.
- **Sustainable Farming Incentive**: Including maintenance actions for walls and banks in the SFI is a positive step, supporting their preservation and recognising their environmental and cultural importance.
- **Terminology and definitions remain unclear and inconsistent**: Existing legislation and grant schemes often conflate or exclude certain boundary types leading to gaps in protection and inconsistent treatment across features.
- **Policy integration is limited across landscape scales**: Government policy and delivery schemes have generally focused on individual features or farm-level interventions, rather than recognising field boundary systems as interconnected landscape-scale assets. This approach risks overlooking the cumulative cultural, environmental, and practical significance of stone walls across wider rural areas. The Landscape Recovery Scheme offers potential to address this gap by enabling wall and bank management to be incorporated within coordinated, large-scale landscape projects, where their collective value can be more effectively recognised and managed.

8.1.4 NCA profile analysis

- **Widespread recognition of walls and banks as defining landscape features**: Over 90% of NCA profiles reviewed identified walls and banks as key components of landscape character, contributing to both the cultural identity and visual distinctiveness of their areas, especially in upland and historic farming landscapes.
- **Strong policy support through SEOs**: The majority of profiles (88%) included SEOs that promote the conservation, restoration, and use of traditional materials and skills for managing walls and banks, highlighting their importance not only for landscape aesthetics but also for biodiversity, heritage, and sustainable land management.
- **Inconsistent terminology and lack of technical definitions limit clarity**: Many profiles used varied and sometimes interchangeable terms to describe walls and banks without defining their construction, form, or materials. This inconsistency complicates cross-area comparisons and could hinder effective targeting of restoration and conservation efforts.
- **Walls and banks contribute differently to ecosystem services**: While both feature strongly in cultural services, walls tend to support geodiversity and aesthetic value, whereas banks offer more in terms of regulating and supporting services, such as pollination, water regulation, and biomass energy, reflecting differences in structure and ecological function.

8.1.5 National uptake of ES and CS wall and bank options

- **Uptake is concentrated in upland areas**: The majority of wall and bank options are located in the Upland, Upland Fringe, and Western Mixed Agricultural Landscape Types and on lower-grade agricultural land.
- **Stone wall options dominate overall uptake, with bank options more regionally specific**: Over 90% of maintenance, and restoration options relate to walls, particularly in the north of England and Gloucestershire, whereas bank options are more prevalent in the South West.
- **Significant legacy from ELS**: A substantial portion of wall and bank boundaries were previously covered under now-expired ELS agreements. These agreements often included both maintenance and restoration options, covering tens of thousands of kilometres nationally. The data show that most of this uptake occurred prior to 2023, with relatively fewer boundaries now under live agreements suggesting that past participation may have a strong influence on current condition.

8.1.6 Remote sensing analysis of walls and banks in the case study areas

- **The techniques used were generally effective in identifying stone walls in the case study area**: Freestanding walls on open ground were accurately detected, but the methods were less successful at recognising historically significant relict boundaries, especially where these were less visible or partially degraded in the landscape.
- **Remote sensing effectively identifies boundary types at scale**: Walls make up a significant proportion of field boundaries in Swaledale, Coldeaton, and

Todmorden, though classification is more challenging in the bank-dominated landscape of Dunstone.

- **Banks are difficult to distinguish from other vegetated features:** Highlights a need for improved classification techniques or supplementary data sources in regions where banks are prominent.
- **Aerial Photography Interpretation (API) can support landscape-scale assessments**: However, it tends to overestimate wall degradation and struggles with shadow effects and orientation bias.

8.1.7 Uptake of wall and bank options in the case study areas

- **Wall option uptake is relatively low:** 10% of boundaries in the case study areas are currently under option.
- **Legacy ES agreements account for the majority of wall options**: 75% of total uptake. CS is yet to achieve comparable uptake.
- **There is marked spatial variation in option uptake across areas:** Swaledale shows the highest proportion of wall boundaries under option, while Todmorden and Coldeaton have most boundaries either outside AES agreements or not covered by any option.
- **Maintenance options are more common than restoration**: Both represent a small proportion of boundaries.

8.1.8 Field survey of boundary type and condition

- **Boundary condition varies by case study area**: Swaledale and Dunstone have the highest proportion of well-maintained boundaries, while Todmorden exhibits the poorest condition overall, with nearly half of surveyed boundaries requiring major repair or classified as derelict.
- **Traditional construction methods dominate:** Dunstone (94%), Swaledale (82%). In contrast, Todmorden and Coldeaton rely more heavily on modern materials such as top wire and fencing to reinforce or replace traditional boundaries.
- **Most boundaries are potentially eligible for AES interventions**: 73% are suitable for SFI maintenance actions and 17% potentially qualifying for CS restoration options, indicating strong scope for targeted funding support.

8.1.9 Impact of AES status and options on boundary condition

- **AES interventions are associated with improved boundary condition**: Boundaries under AES options are significantly more likely to be in excellent or good condition, especially in Dunstone (95%), Coldeaton (89%) and Swaledale (88%).
- **Statistical relationships are significant but weak**: While analysis confirms that AES status and option type have a measurable impact on boundary condition, these effects are modest and influenced by other environmental or operational variables.

- **AES participation alone is not sufficient**: Boundaries that are within AES agreements but not covered by specific wall or bank options tend to be in poorer condition than those entirely outside of any AES agreement. The management of boundaries outside agreements may have been influenced by legacy agreements, particularly ESL, which are now closed. This makes for a complicated picture in trying to determine cause and effect.
- **There are area-specific differences in effectiveness**: In Todmorden, only 64% of AES-managed boundaries were in good condition, compared with over 80% in the other case studies. This suggests that local factors may influence the success of AES uptake.

8.1.10 Agreement holder survey

- **Traditional walls and banks remain central to upland farming:** Agreement holders strongly value these features for livestock management, property delineation, and shelter, reflecting their ongoing importance in day-to-day farm operations. Their practicality and embeddedness in the working landscape make them indispensable to hill farming.
- **Boundary management is strongly influenced by land tenure**: Farmers on short-term tenancies are less likely to invest in maintaining or restoring walls and banks, as they will not see the long-term benefits. Secure tenure encourages investment in boundary infrastructure.
- **Walls and banks are key to livestock management and shelter**: All agreement holders stressed the practical importance of walls and banks for managing and protecting livestock, especially in harsh weather. They are viewed as essential farm infrastructure.
- **Time and skilled labour are major constraints**: Maintaining walls and banks is labour-intensive, and many agreement holders cited a lack of time and available skilled wallers as key barriers. This is especially acute on larger farms where workloads have increased.
- **Funding is essential but often insufficient**: AES grants are crucial to enabling wall and bank restoration, but many agreement holders reported that current payment rates do not reflect the true cost of materials or labour. Restoration work often depends on this financial support.
- **AES has enabled work that would not otherwise occur**: Many agreement holders stated that without AES support, walls and banks would continue to deteriorate. The schemes enable both restoration and maintenance that would be financially unviable otherwise.
- **There is cautious optimism about new SFI actions**: While some agreement holders plan to take up new SFI maintenance actions, many are still undecided due to lack of information, complexity of the schemes, and concerns over compatibility with existing agreements.
- **Improvements for scheme delivery are desired**: Agreement holders want simpler applications, better digital tools, clearer guidance, and more realistic funding rates. Local advice, flexible timelines, and recognition of regional differences were also frequently suggested improvements.

- **Walling carries personal and cultural significance**: Many agreement holders feel a deep emotional and historical connection to their walls and banks, linking the practice to family heritage, local identity, and a sense of pride in maintaining the landscape.
- **Walls and banks are ecologically valued**: Agreement holders showed high awareness of the ecological benefits of walls and banks, frequently mentioning their value as habitats for birds, mammals, invertebrates and lichens, especially where hedges or trees are present.
- **Public appreciation**: Agreement holders reported frequent positive feedback from both locals and visitors. This social recognition contributes to a sense of pride.

8.1.11 Analysis of ecosystem services using the SROI modelling of walls and banks

- **Private investment is a critical but under-recognised driver of ecosystem service benefits**: Across all case study areas, private contributions (mainly unpaid labour by agreement holders) exceeded public funding, highlighting the importance of farmer time and effort in maintaining and restoring wall and bank infrastructure and its associated benefits.
- **Provisioning and cultural services generate the highest value flows, but ecological contributions may be underestimated**: The majority of benefits were linked to livestock management, property boundaries, local employment, and cultural value. However, the relatively low valuation of supporting and regulating services suggests that current financial proxies may undervalue biodiversity and flood prevention contributions, particularly where banks dominate.
- **Wall and bank condition and visibility are key to service delivery**: High levels of benefit were not always linked to the longest lengths of improved walls; rather, factors such as wall condition, accessibility, landscape integration, and use by farmers and visitors more strongly influenced the value of benefit flows.
- **Data limitations restrict full understanding of benefit flows over time**: The absence of baseline data, reliance on current live agreements, and uniform outcome indicators limited the ability to fully capture spatial and temporal variation in ecosystem service delivery. However, the model's adaptability allows for future refinement and scenario testing across landscapes.

8.2 Areas for improvement

There are 20 areas for improvement that derive from the research:

Wall and bank protection and maintenance

1) **Streamlining application and administrative processes:** Consider simplifying scheme requirements to reduce the burden on applicants and make participation more accessible for farmers and land managers.
2) **Investing in improved digital tools and mapping systems:** Develop user-friendly platforms for submitting evidence (for example, photos and

measurements) and provide clearer, more intuitive mapping that links directly to scheduled work areas, reducing the risk of error and non-compliance.

3) **Reviewing and adjusting payment structures:** Payment rates could be increased to reflect rising costs and inflation, funding could be allowed for essential repairs (such as storm damage), and flexiblility in delivery periods could be enhanced.

Wall and bank restoration and repair

4) **Simplifying and streamlining restoration claims:** Explore whether to allow gap walling and repair works without the need for prior approval or capital plans. Explore introduction of straightforward processes based on photographic and measurement evidence.

5) **Assess how funding reflects real-world costs and site difficulty:** Review grant levels to match the rising costs of wall restoration, and whether to offer supplements for high or steep walls and challenging terrain. Assess whether to vary payments based on regional conditions and material quality requirements.

6) **Improving scheme flexibility and responsiveness:** Explore the potential of adaptive agreements that allow additions or variations as restoration progresses or needs change. Assess how payment processes can support cash flow, and provide better access to advice through more local, experienced support staff.

7) **Supporting workforce and access needs:** Assess how to invest in training to grow the availability of skilled wallers, and ensure funding covers a meaningful percentage of restoration costs. Improving rural broadband and mobile phone coverage could reduce barriers for digital submissions in remote areas.

High-level government policy considerations

8) **Integrating walls and banks more fully into national environmental policy frameworks:** To improve support for walls and banks, they could be integrated into national environmental policy in particular recognising their ecosystem service contributions.

9) **Establishing clear, consistent definitions and protections for all boundary types:** Developing standardised terminology and guidance that distinguishes between boundary types, could support equitable policy support and prevent protection gaps in future legislation, AES development and planning processes.

10) **Evidence for ELM:** This report provides clear evidence of the value of wall and bank maintenance. Retaining these actions within the scheme can help safeguard landscape character, cultural heritage, and long-term environmental benefits.

11) **Building on the popularity of wall and bank options:** These options are highly valued across the upland farming community and offer a strong foundation for deeper engagement with farmers and land managers. Their appeal could help encourage the adoption of a wider range of actions and options that collectively support multiple environmental objectives.

12) **Clear and consistent communication:** Survey respondents reported confusion about the development of the SFI and ELM schemes, as well as uncertainty around their future eligibility. It is important to provide clear, timely information to help farmers understand what to expect from AES in both the medium and long term.

NCA profiles

13) **Developing consistent terminology and clearer descriptions of walls and banks features:** Standardising the language used across NCA profiles should support clearer understanding and better-targeted conservation and management actions.

14) **Strengthening the integration of walls and banks into SEOs:** Future NCA profile updates should consistently recognise the role of walls and banks in ecosystem services, and embed specific, actionable priorities for their maintenance, restoration, and promotion of traditional skills.

Future research: Developing the evidence base

15) **Monitoring:** Existing surveys provide only limited information on the condition or extent of walls and banks over time. A dedicated national monitoring programme could be established to track changes and trends in the resource. This would support more effective targeting and spatial prioritisation, and could be integrated into the NCA profile framework.

16) **Living laboratories:** This project has produced robust baseline data on over 27,000 field boundaries across four contrasting case study areas. These datasets provide a valuable foundation for future research into ecosystem service benefit flows, as well as the relationships between farmers, land managers, their walls and banks, and AES.

17) **Understanding the continuing influence of past AES agreements:** Wall and bank restoration and maintenance options have been part of AES for over 30 years. The impact of this investment on the flow of benefits can last for many decades. Yet the long-term changes resulting from this sustained investment remain underexplored. It is suggested that future research examines how the management of walls and banks has evolved throughout this entire period, in order to better understand the enduring impact of AES.

Future research: Enhancing understanding and valuation of wall and bank ecosystem services

18) **Investigating the true ecological value of walls and banks:** Developing improved financial proxies and ecological metrics could better capture the biodiversity and regulating service contributions of stone walls and banks,

particularly in relation to habitat connectivity, flood mitigation, and soil protection.

19) **Assessing the role and value of private investment in ecosystem service delivery:** It is suggested future research could explore in greater depth how agreement holders' time, skills, and informal maintenance efforts contribute to benefit flows, and how these private investments can be better supported, measured, and recognised in future agri-environment models.

20) **Examining the influence of wall visibility, condition, and accessibility on cultural and provisioning services:** Conducting spatially explicit research could help build understanding of how the location, physical state, and public interaction with wall features affect perceptions of value and service delivery across different landscape contexts.

9 REFERENCES

ADAS (1994) National survey of the state of repair of dry stone walls. ADAS. Report to the Countryside Commission.

ADAS (2000) Environmental Monitoring in the Radnor ESA 1993 – 2000. ADAS. Report to National Assembly for Wales Agriculture Department.

ADAS (2002a) Environmental Monitoring in the Ynys Môn ESA 1993 – 2000. ADAS. Report to National Assembly for Wales Agriculture Department.

ADAS (2002b) Environmentally Sensitive Areas Scheme: Dry Stone Walls on ESA Agreement Holdings, ADAS report to Defra.

Agnoletti, M., Conti, L., Frezza, L., Monti, M., and Santoro, A. (2015) Features analysis of dry stone walls of Tuscany (Italy). Sustainability 7, 13887-13903. https://doi.org/10.3390/su71013887

Anthony, A. (2008) A journey down memory lane: in her final Voices column, Alison Anthony wanders down memory lane and discovers that despite physical changes, places can summon up powerful feelings. Mental Health Practice 11, 39-40.

Assandri, G., Bogliani, G., Pedrini, P. and Brambilla, M. (2018) Beautiful agricultural landscapes promote cultural ecosystem services and biodiversity conservation. Agriculture, Ecosystems & Environment, Volume 256, pp. 200-210. ISSN 0167-8809

Azzopardi, E., Kenter, J.O., Young, J., Leakey., C, O'Connor., S, Martino, S., Flannery, W., Sousa, L.P., Mylona, D., Frangoudes, K., Béguier, I., Pafi, M., da Silva, A.R., Ainscough, J., Koutrakis, M., da Silva, M.F. and Pita, C. (2023) 'What are heritage values? Integrating natural and cultural heritage into environmental valuation'. People and Nature, Vol. 5, no. 2, pp. 368-383. https://doi.org/10.1002/pan3.10386

Barr, C.J. (1991) Countryside Survey 1900: Field Handbook. Version 04. Institute of Terrestrial Ecology.

Barr, C.J. (2012). Countryside Survey 2000: Field Handbook. Version 03. Institute of Terrestrial Ecology.

Barr, C., Benefield, C., Bunce, B., Ridsdale, H., and Whittaker, M. (1986) Landscape changes in Britain. Institute of Terrestrial Ecology.

Barr, C.J., Bunce, R. G. H., Clarke, R. T., Fuller, this problem. R. M., Furse, M. T., Gillespie, M. K., Groom, Hallam, C. J., Hornung, M. and Howard, D. C. (1993) Countryside Survey 1990: Main Report (London: Department of the Environment)

Barr, C.J., and Watkins, J.W. (2001) Increasing upland representation in Countryside Survey 2000. Report to MAFF. BD1903.

Beaumont, H. (2006) Pointers to the Past: the historical landscape of Hebden township, Upper Wharfedale Yorkshire Archaeological Society Occasional Paper No 5.

Bertolino, M.A., and Corrado, F. (2021) Rethinking Terraces and Dry-Stone Walls in the Alps for Sustainable Development: The Case of Mombarone/Alto Eporediese in Piedmont Region (Italy). Sustainability Vol.13, no.21, 12122. https://doi.org/10.3390/su132112122

Boatman, N., and Parry, H. (2008a) Scoping study – Countryside Survey 2007 and links to agriculture. CSL. Report to Defra Agricultural Change and Environment Observatory.

Boatman, N., Ramwell, C., Parry, H.R., Jones, N., Bishop, J., Gaskell, P., Short, C.J., Mills, J., and Dwyer, J.C. (2008b) A review of environmental benefits supplied by agri-environment schemes, Land Use Policy Group, FST20/79/041.

Brooks, M. (1973) Dry Stone Walls and Wall Building in West Yorkshire. (MA thesis, University of Leeds).

Brooks, M. (1977) The Craft of a Dry Stone Waller. Folk Life 15, 96-105.

Broughton, R., Burkma, R., McCracken, M., Mitschunas, N., Norton, L., Pallett, D., Patton, J., Redhead, J., Staley, J., Wood, C. and Pywell, R. (2023) UKCEH Land Cover Plus: Hedgerows (2016-2021) England. Dataset documentation. UK Centre for Ecology and Hydrology. https://www.ceh.ac.uk/sites/default/files/2024-01/Documentation%20UKCEH%20Land%20Cover%20Plus%20Hedgerows.pdf

Budge, C., Lane, B., Osborne, P., and Polak, P. (2008) Can we date Mendip's stone walls? A pilot study in the Charterhouse area, The Charterhouse Environs Research Team.

Cabinet Office (2009) A guide to Social Return on Investment. HM Government.

Clark, J., Darlington, J., Fairclough, G. (2004) Using Historic Landscape Characterisation. English Heritage: London.

Collier, M.J. (2013) Field Boundary Stone Walls as Exemplars of 'Novel' Ecosystems. Landscape Research 38, 141-150. http://dx.doi.org/10.1080/01426397.2012.682567

Centre for Ecology and Hydrology (2001) Increasing upland representation in Countryside Survey 2000. Report to MAFF. BD1903.

Centre for Ecology and Hydrology (2009) England Results from 2007. NERC, Centre for Ecology and Hydrology.

Council of Europe (2019) Memento contributing to the implementation of the European Landscape Convention of the Council of Europe – Dry stone in the landscape, ancestral and innovative, for sustainable territories and Reference Report "Dry stone in the landscape, ancestral and innovative for sustainable territories". Presentation at 10th Council of Europe Conference on the European Landscape Convention, Strasbourg. https://rm.coe.int/council-of-europe-european-landscape-convention-10th-council-of-europe/168096844b

Countryside Commission (1991) Landscape Change in National Parks: Technical report, Countryside Commission, CCP359. http://publications.naturalengland.org.uk/publication/5216333889273856

Countryside Commission (1996) The condition of England's dry stone walls. Report by ADAS. CCP 482

Countryside Quality Counts CQC (2003) Changes in countryside character and countryside quality (Accessed via www.countryside-quality-counts.org.uk: Countryside Quality Counts).

Courtney, P., Gaskell, P., Mills, J., and Roberts, E. (2007) A Socio-economic study of grant-funded traditional dry-stone wall and farm building restoration in the Yorkshire Dales National Park. Final Report to English Heritage.

Courtney, P., Gaskell, P., Mills, J., Boase, R., Cheese, L., Jones, O., Kubinakova, K., Lewis, N., and Urquhart, J. (2008) Scoping Study on the Socio-Economic Benefits of Heritage in the National Parks. Final Report for English Heritage and Cadw. Project Report. CCRI, University of Gloucestershire.

Defra (2004) Countryside Stewardship and Environmentally Sensitive Areas Schemes: Annual Report 2002–03. PE9023. Defra. London.

Defra (2014) Introducing Countryside Stewardship, November 2014.

Defra (2018) A Green Future: Our 25 Year Plan to Improve the Environment. https://www.gov.uk/government/publications/25-year-environment-plan

Defra (2020) Outcome indicator framework for the 25 Year Environment Plan: 2020 update.

Defra (2023a) Environmental Improvement Plan 2023: First revision of the 25 Year Environment Plan. https://www.gov.uk/government/publications/environmental-improvement-plan

Defra (2023b) Environmental Land Management (ELM) update: how government will pay for land-based environment and climate goods and services. https://www.gov.uk/government/publications

Devon Hedge Group. Devon hedges and modern farming, management cycle and fencing. Accessed 21st March 2025. https://devonhedges.org/devon-hedges/farming/

Drake, R. (2008) A Solitary Trade: The art and craft of dry-stone walling, Bookcase, Carlisle

Duma, P., Latocha, A., Łuczak, A. and Piekalski, J. (2020) Stone Walls as a Characteristic Feature of the Cultural Landscape of the Izera Mountains, southwestern Poland. Int Jornal of Historical Archaeology. Vol.24, pp.22–43. https://doi.org/10.1007/s10761-019-00501-2

Ecoscope (1997) Countryside Stewardship: Monitoring and Evaluation of the Pilot Scheme 1991-96. Ecoscope. Report to the Countryside Commission.

Ecoscope (2003) Review of Agri-Environment Schemes: Monitoring Information and Research and Development Results, Report to Defra (Ecoscope Applied Ecologists. St Ives.).

English Heritage and Countryside Agency (2006) A Landscape Legacy: National Parks and the historic environment (London: English Heritage).

Farrar, N.S. (2006) Tacit knowledge, learning and expertise in dry stone walling (PhD University of Huddersfield).

Feroldi, A., da Silva, E., and Gonçalves, M. (2021) Drystone walls in the Algarve, Portugal. Characterization and interconnection with the geology and lithology. IOP Conference Series: Materials Science and Engineering, Volume 1203. DOI 10.1088/1757-899X/1203/2/022129

Firbank, L., Bradbury, R., McCracken, D., Stoate, C., Goulding, K., Harmer, R., Hess, T., Jenkins, A., Pilgrim, E., and Potts, S. (2011). Enclosed farmland.

García-Pedrero, A., Gonzalo-Martín, C., and Lillo-Saavedra, M. (2017) A machine learning approach for agricultural parcel delineation through agglomerative segmentation. International Journal of Remote Sensing 38, 1809-1819. https://www.tandfonline.com/doi/full/10.1080/01431161.2016.1278312

Garner L. (1984). Dry Stone Walls, Shire Album.

Garrod, G. and Willis, K.G. (1992) Valuing goods' characteristics: An application of the hedonic price method to environmental attributes. Journal of Environmental Management, Volume 34, Issue 1, pp.59-76, ISSN 0301-4797.

Garrod, B., Wornell, R. and Youell, R. (2006) Re-conceptualising rural resources as countryside capital: The case of rural tourism. Journal of Rural Studies, Volume 22, Issue 1, pp. 117-128.

Gaskell, P. (2007) Agricultural change and the conservation of cultural landscapes in the Yorkshire Dales. In Workshop on the cultural landscape as a heritage feature: A comparative study of the UK and Russia (School of Geography, University of Birmingham, Birmingham, UK).

Gaskell, P. (2009) Heritage in the uplands. In Inquiry into the future for England's upland communities, Commission for Rural Communities (Penrith, Cumbria, UK).

Gaskell, P. (2024a) LM04157: AES Comparative M&E of dry stone walls: Scoping study of the ES option data. Report to Natural England.

Gaskell, P. (2024b) LM04157: AES Comparative M&E of dry stone walls: Scoping study of the CS option data. Report to Natural England.

Gaskell, P., Dwyer, J.C., Jones, J., Jones, N., Boatman, N., Condliffe, I., Conyers, S., Ingram, J., Kirwan, J., Manley, W*., et al.* (2010) Economic and environmental impacts of changes in support measures for the English Uplands: An in-depth forward look from the farmer's perspective - Final Report to Defra (University of Gloucestershire).

Gaskell, P., Edwards, B., and Courtney, P. (2014). Evaluating the effectiveness of Environmental Stewardship for the conservation of historic buildings, Final Report to Natural England. University of Gloucestershire, Cheltenham.

Gaskell, P., Lake, J, Berry, R., Chivers, C., Lewis, N., White, N., Smith, K., Haig, S., Kubinakova, K., and Henderson, M. (2023) Assessing the Effectiveness and Cultural Value of Countryside Stewardship Options HS1 and HS8, Project Report to Defra. University of Gloucestershire, Cheltenham.

Gaskell, P. and Tanner, M. (1991). Agricultural change and environmentally sensitive areas. Geoforum 22, 81-90.

Hanley, N., MacMillan, D., Wright, R.E., Bullock, C., Simpson, I., Parsisson, D., and Crabtree, B. (1998) Contingent valuation versus choice experiments: estimating the benefits of Environmentally Sensitive Areas in Scotland. Journal of agricultural economics, 49 (1), 1–15.

Hart, E. (1980) The Dry-Stone Wall Handbook: Employing the Permanence and Beauty of Natural Stone, Thorsons, Northamptonshire.

Hasund, K.P., Kataria, M. and Lagerkvist, C.J. (2011) Valuing public goods of the agricultural landscape: a choice experiment using reference points to capture observable heterogeneity, Journal of Environmental Planning and Management, Vol.54:1,pp. 31-53.

Historic England (2018) Using Airborne Lidar in Archaeological Survey. The Light Fantastic Historic England Online https://historicengland org uk/imagesbooks/publications/using-airborne-lidar-in-archaeological-survey/heag179-using-airborne-lidar-in-archaeological-survey

Hoskins, W.G. (1943) The Reclamation of the Waste in Devon, 1550-1800. The Economic History Review, Vol. 13, No. 1/2, pp. 80-92. Published by: Wiley on behalf of the Economic History Society Stable URL: https://www.jstor.org/stable/2590517

Hollingsworth, L. and Collier, M. (2020) Ground flora of field boundary dry stone walls in the Burren, Ireland. British & Irish Botany Vol.2(4), pp.352-376.

House of Commons Select Committee on Environment Transport and Regional Affairs (1998). Thirteenth Report: The Protection of Field Boundaries, 3 November 1998. https://publications.parliament.uk/pa/cm199798/cmselect/cmenvtra/cmenvtra.htm

Hunting Surveys and Consultants (1986) Monitoring Landscape Change, Volume 1, Department of the Environment and Countryside Commission, Cheltenham.

Institute of Terrestrial Ecology (1978) Upland Land Uses in England and Wales, CCP 111, Countryside Commission, Cheltenham.

IUCN (2020) Dry Stone Walls. https://iucn.org/sites/default/files/2023-05/practice_f.stone-walls_final.pdf

Iversen, S.V., Van der Velden, N., Convery, I., Mansfield, L., Kjeldsen, C., Thorsøe, M. H. and Holt, C. (2023) Impacts of woodland planting on nature-based recreational tourism in upland England – A case study. Landscape and Urban Planning, Volume 230, pp.

Kenter, J.O., O'Connor, S. (2022) The Life Framework of Values and living as nature; towards a full recognition of holistic and relational ontologies. Sustainable Science, Vol. 17, pp.2529–2542. https://doi.org/10.1007/s11625-022-01159-2

Kostanjšek, B., and Golobič, M. (2023) Cultural ecosystem services of landscape elements and their contribution to landscape identity: The case of Slovenia. Ecological Indicators, Volume 157. ISSN 1470-160X

Land Use Consultants and Archaeology, A.C. (2007) Defining the historic and landscape importance of dry stone walls, report to Defra.

Lord, T. (2004) "One on Two, and Two on One": Preliminary results from a survey of dry stone walls on the National Trust Estate at Malham, In White, R. and Wilson, P. eds. Archaeology and Historic Landscapes in the Yorkshire Dales.

Luscombe, D.J., Gatis, N., Anderson, K., Carless, D., and Brazier, R.E. (2023) Rapid, repeatable landscape-scale mapping of tree, hedgerow, and woodland habitats (THaW), using airborne LiDAR and spaceborne SAR data. Ecology and Evolution 13, e10103.

Manenti, R. (2014) Dry stone walls favour biodiversity: a case-study from the Appennines. Biodiversity Conservation Vol. 23:1879–1893. DOI 10.1007/s10531-014-0691-9

Mansfield, L. (2005) Changes in upland agriculture and its effects on the environment: a case study from Cumbria, UK. In: European Society for Rural Sociology XXI Congress: A common European countryside? Change and continuity, diversity and cohesion in the enlarged Europe, 22-27 August 2005, Keszthely, Hungary.

Maskell, L.C., Norton, L.R., Smart, S.M., Carey, P.D., Murphy, J., Chamberlain, P.M., Wood, C.M., Bunce, R.G.H. and Barr, C.J. (2008) Field Mapping Handbook. CS Technical Report No.1/07. Centre for Ecology and Hydrology.

McElwee, G., and Gittins, P. (2024) Dry stone walling. Rural artisan enterprise in the urban economy. Journal of Rural Studies 105, 103179.

Menneer, R. (Undated) Cornish Hedges Education Pack produced by The Guild of Cornish Hedgers and supported by Cornwall AONB.

Mills, J., Gaskell, P., Short, C., and Manley, W. (2012) Attitudes to Uplands Entry Level Stewardship (University of Gloucestershire).

Mitchell, W. R. (1992) Drystone Walls of the Yorkshire Dales. Castelberg. North Yorkshire.

Murray, L., and Kudic, L. (2023) Walk the Line: Stone Walls, Lead Mines and Future Farming. In Border Urbanism: Transdisciplinary Perspectives, Q.M. Zaman, and G.G. Hall, eds. (Cham: Springer International Publishing), pp. 403-419.

Natural England (2009a) Agri-environment Schemes in England 2009, (NE194).

Natural England (2009b) Farming with nature: Agri-environment schemes in action (NE223).

Natural England (2012) Entry Level Stewardship: Environmental Stewardship Handbook.

Natural England (2012) Organic Entry Level Stewardship: Environmental Stewardship Handbook

Natural England (2013) Higher Level Stewardship: Environmental Stewardship Handbook.

Natural England (2015) Evolution of Agri-Environment Schemes in England (NE373).

New Economics Foundation (2008) Measuring value: a guide to Social Return on Investment (SROI) Second edition, 2008.

North, H.C., Pairman, D., and Belliss, S.E. (2019) Boundary Delineation of Agricultural Fields in Multitemporal Satellite Imagery. IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing 12, 237-251. https://ieeexplore.ieee.org/document/8584043

Norton, L.R., Maskell, L.C., Smart, S.S., Dunbar, M.J., Emmett, B.A., Carey, P.D., Williams, P., Crowe, A., Chandler, K., Scott, W.A., et al. (2012) Measuring stock and change in the GB countryside for policy – Key findings and developments from the Countryside Survey 2007 field survey. Journal of Environmental Management 113, 117-127.

Pappalardo, G., West, H.G., Nayga, R.M., Toscano, S. and Pecorino, B. (2022) The effect of a UNESCO world heritage site designation on willingness to pay to preserve an agri-environmental good: The case of the dry stone walls in Mt. Etna. Land Use Policy, Vol. 114.

Petit, S. (2009) The dimensions of land use change in rural landscapes: lessons learnt from the GB Countryside Surveys. Journal of Environmental Management 90, 2851-2856.

Petit, S., Stuart, R., Gillespie, M., and Barr, C. (2003) Field boundaries in Great Britain: stock and change between 1984, 1990 and 1998. Journal of Environmental Management 67, 229-238.

Powell, J., Lake, J., Gaskell, J., Courtney, P., and Smith, K. (2018) Developing an ecosystems approach –dry stone walls. Historic England, Research Report Series 43-2018. ISSN 2059-4453 (Online).

Powell, J., Berry, R., Smith, K., Lake, J., and Gaskell, P, (2020) Assessing SHINE features in the Lake District National Park using the NCA/Cultural Capital process. Historic England

Raistrick, A. (1946) The Story of the Pennine Walls, Dalesman Publishing Company Ltd.

Reda, K., and Kedzierski, M. (2020) Detection, Classification and Boundary Regularization of Buildings in Satellite Imagery Using Faster Edge Region Convolutional Neural

Networks. Remote Sensing 12, 2240. https://www.mdpi.com/2072-4292/12/14/2240

Riley, M., and Harvey, D. (2007) Oral histories, farm practice and uncovering meaning in the countryside. Social & Cultural Geography 8, 391-415.

Rollinson, A. (1972) Lakeland Walls. Dalesman Publishing Company Ltd.

Ruas, S., Rotch´es-Ribalta, R., ´O hUallach´ain, D., Volpato, A., Gormally, M., White, B. and Moran, J. (2022) Assessing stone walls habitat quality – Which factors affect bryophytes and macrolichens on farmland stone walls in Ireland? Ecological Indicators, Vol. 139.

Rule, A. (1974) Hedge Building in Mid and West Cornwall (Thesis, University of Leeds).

Rural Payments Agency (2019a) Countryside Stewardship: Higher Tier Manual. Rural Payments Agency.

Rural Payments Agency (2019b) Countryside Stewardship: Mid Tier and Wildlife Offers Manual. Rural Payments Agency.

Rural Payments Agency (2022) The guide to cross compliance in England 2022. RPA.

Rural Payments Agency and Defra (2005) Single Payment Scheme. Cross Compliance: Guidance for the Management of Habitats and Landscape Features. 2005 Edition.

Shoard, M. (1980) The theft of the countryside. Temple Smith.

Sinclaire, G. (1983) The Upland Landscape Study (Narbreth, Dyfed: Environmental information Services).

SROI Network (2012) A guide to Social Return on Investment. An update to the 2009 Guide to Social Return on Investment published by the Cabinet Office.

Stanes, R. (2009) The Husbandry of Devon and Cornwall. Report and Transactions of the Devonshire Association Advmt Sci., 141, pp.153-180. © The Devonshire Association, June 2009.

Stonewalls (2024) Project: Ecology of drystone walls. Online, accessed 15th April 2024. https://www.stonewalls.ch/project/ecology-of-drystone-walls

Stratigos, M.J., Ward, C., Hatfield, J.H., and Finch, J. (2023). Areas of Outstanding Nineteenth Century Beauty: Historic landscape characterisation analysis of protected areas in England. People and Nature 5, 198-212.

Suh, J.W., and Ouimet, W. (2023) Mapping stone walls in Northeastern USA using deep learning and LiDAR data. GIScience & Remote Sensing 60, 2196117.

Tieskens, K.F., Shaw, B.J., Haer, T., Schulp, C., Verburg, P. (2017) Cultural landscapes of the future: using agent-based modeling to discuss and develop the use and management of the cultural landscape of South West Devon. Landscape Ecology Vol.32, pp.2113–2132.

Trotter, E.F.L., Fernandes, A.C.M., Fibæk, C.S., and Keßler, C. (2022) Machine learning for automatic detection of historic stone walls using LiDAR data. International Journal of Remote Sensing 43, 2185-2211.

Trow, S., and Tunnicliffe, S. (2007) Farming and the historic landscape: An introduction for farm advisers. English Heritage and Defra.

Turner, S. (2004) The Changing Ancient Landscape: South-West England c. 1700–1900. Landscapes Vol. 1, pp. 18–34.

Urion, M.V. (1996). Wall working. Frontiers: A Journal of Women Studies 16, 77-86.

Van Zanten, B. T., Zasada, I., Koetse, M.J., Ungaro, F., Häfner, K. and Verburg, P. (2016) A comparative approach to assess the contribution of landscape features to aesthetic and recreational values in agricultural landscapes. Ecosystem Services, Volume 17, pp. 87-98.

Wagner, M.P., and Oppelt, N. (2020) Extracting Agricultural Fields from Remote Sensing Imagery Using Graph-Based Growing Contours. Remote Sensing 12, 1205. https://www.mdpi.com/2072-4292/12/7/1205

Westmacott, R. and Worthington, T. (1974) New Agricultural Landscapes, Countryside Commission, Cheltenham.

Wildgoose, M. (1991) The Drystone Walls of Roystone Grange. Archaeological Journal 148, 205-240.

Willis, K.G. and Garrod, G. (1993) Valuing landscape: A contingent valuation approach. Journal of Environmental Management., 37 (1) (1993), pp. 1-22.

Winchester, A. (2016) Dry Stone Walls: History and Heritage. Amberley Press: Stroud.

Wolton. R. (2018) The Natural Capital of Hedges: Briefing note for the Devon Hedge Group on the ecosystem services provided by hedges in Devon. https://devonhedges.org/devon-hedges/uses-ecosystem-services/

Wolton, R., Morris, R., Pollard, K. and Dover, J. (2013) Understanding the combined biodiversity benefits of the component features of hedges. Final Report for Defra. https://www.hedgelink.org.uk/cms/cms_content/files/16_2013_hedgerow_contract_final_report_v6c.pdf

Woods, A. (1984) Upland Landscape Change: A Review of Statistics, CCP 161, Countryside Commission, Cheltenham.

Yorkshire Dales National Park Authority (2007) Historic Landscape Management Characterisation Pilot Project, Swaledale, Yorkshire Dales National Park.

Yorkshire Dales National Park Authority (2015) Swaledale & Arkengarthdale Barns & Walls Conservation Area Appraisal, Adopted Document.