Gain

The Cornwall and West Devon Mining Landscape World Heritage Site

Ecological Audit Project

Appendix 6 Landscape Change Analysis Ground Truthing

March 2026

Ground truthing method

For each World Heritage Site Area (A1:A10), we selected the greatest land cover change and manually selected one 1km Grid Square in that Area that showed a high coverage for that change.

We then checked through the mapped Land Covers in that 1km Grid Square, comparing the Land Cover Change Maps, LCM 2000 and LCM 2024, to the Living England Maps (2022) and with Google Earth Pro Satellite maps for 2000 and 2023-2024 (the 1km grid squares were imported into Google Earth Pro).

The accuracy and confidence of the Land Cover classifications in that grid square were assessed based on a visual evaluation of the habitats evident in the satellite imagery. We checked for evidence of either confirmed or different habitat types to those categorised in the LCM 2024 maps (also noting time of year, as bracken encroachment may not be present over winter and could cause issues in categorising habitat). Because Satellite maps were not always available for 2024 or sometimes did not afford an unobstructed view of habitat cover, we used imagery from May or June 2023 or March or April 2025, depending on availability and image clarity.

Table 1. Criteria for assigning confidence to LCM Landscape Change.

Level		**Criteria 1: Living England**	**Criteria 2: Google Earth Pro**
Very Low		Less than 25% of Land Cover corresponds to the LCM data	Less than 25% of Land Cover corresponds to the LCM data
Low		Less than 50% of Land Cover corresponds to the LCM data	Less than 50% of Land Cover corresponds to the LCM data
Medium		50-75% of Land Cover corresponds to the LCM data	50-75% of Land Cover corresponds to the LCM data
High		Over 75% of Land Cover corresponds to the LCM data	Over 75% of Land Cover corresponds to the LCM data

Table 2: Assessing Land Cover Changes in each WHS Area level of accuracy – summary of results for each 1km grid square sample

WHS Area	Largest Land Cover Change	Sample Grid Square	Criterion 1: Living England	Criterion 2: Google Earth Pro
A1	Increase in Improved Grassland from reduction in Arable and Semi-Natural Grassland	SW3733	Very Low: The Land Cover Map data indicated that almost the entire coverage of this grid square is Improved Grassland, whereas the Living England map shows Unimproved Grassland, Arable & Horticultural and Dwarf Shrub Heath across most of this area. The only significant areas of alignment are in the Built-up Areas and Gardens. Overall, the greatest Land Cover Change appears to be due to inaccuracy in the LCM data.	Low: According to a visual assessment of the latest available aerial images of the grid square (05/2023), over half of the areas classified as Improved Grassland appear to be Semi-natural Grassland (possibly Semi-improved) or Arable. Some small areas classed as Arable appear to be Built-up Areas and Gardens or Improved Grassland. Overall, the greatest Land Cover Change appears to be due to inaccuracy in the LCM data.
A2	Reduction of Arable Land to Built-up Areas & Gardens and Coastal	SW5537	Medium: The Living England mapping includes multiple areas of Bare Ground, Sand Dunes and Broadleaved, Mixed & Yew Woodland in areas that are just classified as Built-up Areas and Gardens by the LCM. The Living England mapping has several areas of Bare Ground and Bare Sand, which align with the LCM Coastal classification, but Living England has a lot of Water in these areas, too, which is not included in the LCM. Based on the LCM 2000 data, it is possible that the major change – from Arable to built-up areas and Coastal habitat is accurate, but it is	High: The LCM has assigned some areas which are visibly open water as Built-up Areas and Gardens, and incorrectly assigned two areas of woodland as Arable, as well as a small parcel of rough grassland as Improved Grassland. However, the vast majority of the World Heritage Site in this grid square is saltmarsh, which has been correctly assigned as Coastal in the LCM. Visual inspection of satellite imagery suggests that none of the areas assigned as Arable in LCM 2000 was, in fact, arable land

			hard to ground-truth based on the almost entire absence of any Arable land cover in the grid square.	(appearing to be grassland or urban areas), so this major change is inaccurate.
A3	Increase in Improved Grassland from the reduction of Semi-natural Grassland	SW5931	Very low: There is a large contiguous area of Mountain, Heath & Bog (LCM), which Living England has largely classified as Bracken; Bracken is normally incorporated into Acid Grassland in LCM. There is alignment in small areas of Arable & Horticultural and Broadleaved, Mixed & Yew Woodland (Living England) and Arable and Broadleaf Woodland (LCM), but there is significant misalignment in a large swathe of Unimproved Grassland (Living England), which has been classified as Improved Grassland in the LCM. Overall, the greatest Land Cover Change appears to be due to inaccuracies in LCM data.	Medium: A large area of Mountain, Heath and Bog has been correctly assigned, as have two field parcels of Improved Grassland and some small areas of Broadleaf Woodland. There are several areas of apparent rough grassland incorrectly classed as Improved Grassland, however. A visual assessment of 2001 satellite imagery appears to show that the majority of the grassland in this grid square was heavily improved at the time, rendering the greatest change highlighted in the LCM data redundant.
A4	Reduction of Semi-natural Grassland from Increased Improved Grassland, Mountain, Heath & Bog and Broadleaf Woodland	SW6936	Low: There is a single contiguous area of Dwarf Shrub Heath and Bracken (Living England), much of which is classed as Broadleaf Woodland, Semi-natural Grassland or Improved Grassland in the Land Cover Map. There is some alignment in the classification of grassland, but also significant areas where Living England data shows Unimproved Grassland, but the LCM shows Improved Grassland.	Medium: Much of the Improved Grassland and Dwarf Shrub Heath in the south and west of the grid square is correctly assigned by the LCM, but there are some areas where a visual assessment of the satellite imagery shows areas of Semi-Natural Grassland or Dwarf Shrub Heath, which have been classed as Improved Grassland or Semi-Natural Grassland, respectively. Additionally, the LCM is missing some small

			Additionally, the LCM is missing some small areas of Built-up Areas & Gardens. There is limited Semi-natural Grassland present, and large areas of Improved Grassland and Heathland habitats, suggesting the highlighted greatest land cover change is correct.	areas of Built-up Areas & Gardens. Satellite imagery from 2001 shows that most areas designated as Improved Grassland, Heathland and Bracken habitats by Living England have been largely unchanged in the intervening years, so the change from Semi-natural Grassland is inaccurate.
A5	Increase in Improved Grassland from reduction in Semi-natural Grassland and Arable	SW6639	Very Low: Aside from some minor alignment on small areas of Broadleaf Woodland (LCM) and Broadleaved, Mixed & Yew Woodland (Living England), and Built-up Areas & Gardens, most of this grid square is classed as Unimproved Grassland in the Living England map and Improved Grassland in the LCM.	Medium: There is some alignment in the large areas of Improved Grassland, small tracts of Broadleaf Woodland and several areas of Built-up Areas & Gardens in the Land Cover Map and the assessed satellite imagery. A small amount of visible Broadleaf Woodland has been classed as Improved Grassland in the LCM, and several parcels of grassland that appear from a visual assessment to be more unimproved have been classed as Improved. Visual assessment of 2001 satellite imagery shows that much of the habitat in this grid square was Unimproved Grassland, so the greatest change seen was partially accurate, although there was no original arable land.
A6	Increase in Improved Grassland from	SW7443	High: Significant alignment in Built-up Areas & Gardens, Broadleaf Woodland (LCM) and	High: A visual assessment of the satellite imagery of this grid square shows significant

	reduction in Semi-Natural Grassland, broadleaf Woodland and Built-up Areas & Gardens		Broadleaved, Mixed & Yew Woodland and Scrub (Living England) and Improved Grassland (LCM) and Improved & Semi-improved Grassland (Living England). Some areas of grassland are classed as improved in the LCM and Unimproved under Living England mapping. There is limited Semi-natural Grassland present, and large areas of improved grassland and built-up areas, suggesting the highlighted greatest landcover change is at least partially correct.	alignment with much of the LCM's assignation of land parcels to Improved Grassland, Broadleaf Woodland and Built-up Areas & Gardens, but a few fields that visually appear to be Unimproved Grassland have been classed as Improved Grassland. The 2001 satellite image shows a greater coverage of Semi-natural Grassland in areas that now appear as Improved Grassland; there is no evidence of loss of Woodland or urban habitats, however.
A7	Increase in Improved Grassland from reduction in Arable and Semi-Natural Grassland	SW7050	Medium: Much of the grid square is classed as Mountain, Heath and Bog or Improved Grassland in the LCM, with corresponding Dwarf Shrub Heath and Improved & Semi-improved Grassland under Living England mapping. There are, however, several areas of Arable & Horticultural coverage (Living England) classed as Improved Grassland (LCM), as well as two areas classed as Dwarf Shrub Heath and Improved & Semi-improved Grassland (Living England) classed as Arable (LCM). This suggests that the greatest change in land cover highlighted is due to inaccuracies in the LCM data.	High: Large areas of Dwarf Shrub Heath in the Land Cover Map data appear accurate from a visual assessment of the relevant photograph. The central portion of Improved Grassland is also largely accurate, but in the north of the grid square are small areas assigned as Improved Grassland which appear to be semi-improved or unimproved. Satellite imagery from 2001 shows much greater levels of arable and rough grassland habitats, indicating that the highlighted greatest change in land cover is accurate.
A8	Reduction in Coniferous	SX0655	Medium:	Medium:

	Woodland due to increase in Broadleaf Woodland		High alignment across the two datasets in Built-up Areas & Gardens and Broadleaf Woodland (LCM) / Broadleaved, Mixed & Yew Woodland (Living England). Some areas of Coniferous Woodland and Fen, Marsh and Swamp highlighted in Living England data are missing from the LCM. This discrepancy suggests only a limited reduction of coniferous woodland, informing an increase of broadleaf.	The large area of Broadleaf Woodland is mostly accurate, but visual assessment shows significant areas of conifer retention that have not been classed as Coniferous Woodland in the LCM. Some small parcels of grassland, which appear rough or unimproved from visual assessment, have been assigned as Improved Grassland in the LCM. Historical satellite imagery shows the woodland areas entirely dominated by conifers, indicating the greatest change in landcover was from coniferous to broadleaf woodland, but was limited in its extent.
A9	Increase in Improved Grassland from reduction in Semi-natural Grassland	SX2771	Very Low: Over 50% of this grid square is classified as Bracken by Living England, but is variously classified as Improved Grassland, Semi-Natural Grassland and Broadleaf Woodland by the LCM. There is limited alignment between areas of Broadleaf Woodland (LCM) and Broadleaved, Mixed & Yew Woodland and Scrub (Living England) and Improved Grassland (LCM) and Improved & Semi-improved Grassland (Living England).	Very Low: Based on a visual assessment of satellite imagery, over half of this grid square is heathland and should be assigned to the Land Cover Map class Mountain, Heath and Bog. It is instead classed as Improved Grassland, Semi-Natural Grassland and Broadleaf Woodland, none of which appear accurate. There are a few correctly assigned areas of Improved Grassland and Broadleaf Woodland, but in several cases, there are areas assigned to these classes that, on

			Some small parcels of Built-up Areas & Gardens, Dwarf Shrub Heath and Unimproved Grassland in the Living England map are missing from the Land Cover Map data. Given the inaccuracy of the assignation of Improved Grassland by LCM, the highlighted change from Semi-natural Grassland is unverifiable.	visual inspection, appear to be Arable or Semi-natural Grassland. Historical satellite imagery (2001) shows that the heathland habitat has been present for over two decades, thus the semi-improved grassland to improved grassland change highlighted by LCM data is demonstrably inaccurate.
A10	Reduction in arable due to increase in Improved Grassland and Broadleaf Woodland	SX4172	Medium: High alignment in areas of woodland for both Broadleaved, Mixed & Yew Woodland and Coniferous Woodland (Living England) and Broadleaf Woodland and Coniferous Woodland (LCM). Several areas of Unimproved Grassland (Living England) are classed as Improved Grassland by the Land Cover Map. Large areas of Built-up Areas & Gardens in Living England mapping are missing from the LCM. Arable land cover is entirely missing from both datasets, but they disagree on the increase of Improved Grassland (LCM) vs Unimproved Grassland (Living England).	High: High accuracy in areas of woodland for both Broadleaf Woodland and Coniferous Woodland, but a few areas of grassland that appear to be rough or unimproved in the satellite image are classed as Improved Grassland by the LCM. Some small visible areas of Built-up Areas & Gardens are missing from the LCM. Visual assessment of satellite imagery from 2000 shows that there was never any arable land cover in this grid square, that the 2000 LCM was inaccurate in this regard, and therefore that the major land cover change is also inaccurate.

A recent report for the OEP (Rowland et al. 2024) compared methodologies and outputs for the 2021 Land Cover Map and the interim Living England mapping, which was not due for final publication until the following year. This showed extreme discrepancies among

grassland: LCM 2021 had more than double the area of Improved Grassland than interim Living England, and interim Living England had over four times more Acid, Calcareous, Neutral (ANC) Grassland than LCM 2021. This discrepancy appears to persist in the published Living England maps and LCM 2024, resulting in many of the inaccuracies highlighted by the ground-truthing exercise (see Table 1). The report further elucidates issues with LCM methodology for recent years (2015 onwards), noting that **overestimation of Improved Grassland and underestimation of Semi-natural Grassland are likely.**

For LCM 2024, the "User's accuracy" for Neutral and Acid Grasslands is 73.9% and 74.2%, respectively (i.e. there is less than 75% chance that a pixel classified as either of these Grassland types is correct), and "Producer's accuracy" for Neutral and Acid Grasslands is 73.9% and 67.1%, respectively (i.e. Fewer than 75% of these Grassland type reference points are correct; Rowland, et al. (2025)). The supporting documentation for LCM 2021 states that confusion of some semi-natural grassland with more improved grassland, particularly affects Neutral grassland, because the high productivity of Neutral Grassland makes it spectrally similar to Improved Grassland (Marston et al. 2023).

References

Marston, C.G.; O'Neil, A.W.; Morton, D.; Wood, C.M. & Rowland, C.S. (2023). **LCM2001 – the UK Land Cover Map 2021**. Earth System Science Data, 15, 4631-4649.

Rowland, C. S.; Morton, D.; Marston, C.G. & Maskell. L. (2024). **Recent Land Cover Change**, Report for the Office for Environmental protection. Issue 1, 08/01/24. UK centre for Ecology & Hydrology.

Rowland, C.S.; Marston, C.G. & O'Neil, A.W. (2025). **Land Cover Map 2024 (UK land cover statistics)**. NERC EDS Environmental Information Data Centre