

The Origin and Palaeoglaciological Significance of Herefordshire's Ice Age Ponds

Olivia Verplancke (x4c62@students.keele.ac.uk) | Supervisors - Dr Richard Waller & Dr Ian Stimpson

1. Overview

- Herefordshire underwent numerous periods of glaciation during the Late Pleistocene (~20,000yrs ago)
- Area has received little recognition as a palaeoglaciological ice-margin landscape and therefore poorly understood
- There are numerous depressions of glacial origin so far assumed to be kettle holes that create ecologically significant pond and wetland habitats

Research Aim

To apply a multiparametric approach of geomorphological and geophysical techniques to develop a detailed understanding of the formation of Ice Age Ponds and how they fit within the narrative of the palaeoglaciological landsystem.

2. The Herefordshire Landsystem

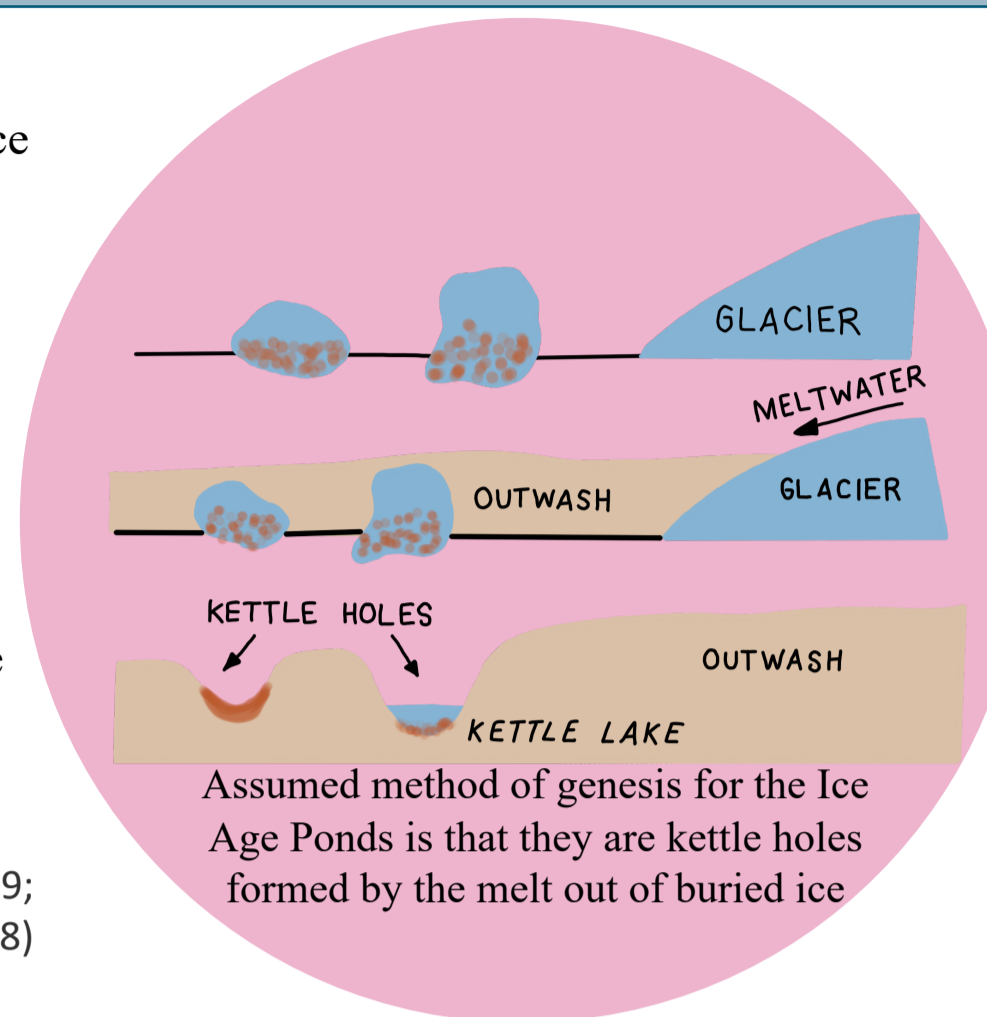
- Located at the margin of a large terrestrial ice lobe flowing from West to East from Central Wales
- Terminal moraine location has been contested by several authors during the 20th Century
- Two apparent major recessional moraines – detail pattern of glacial retreat
- Many areas of hummocky moraine – indicate periods of ice stagnation
- Most kettle holes appear within areas of hummocky moraine
- Many of the landforms have a low preservation potential and are vulnerable to anthropogenic modification



Ice-Margin Landsystem in Southern Iceland, demonstrating how Herefordshire may have looked when glaciated (Image credit Dr R. Waller)

3. Kettle Holes

- Morphology reflects sediment composition of the ice block
- Found in various settings within the ice-margin landsystem – e.g. outwash plains and hummocky moraine
- Term 'Kettle Hole' is applied inconsistently within the literature – little consideration of possible variations in genesis between different landsystem settings
- Melting of buried ice may be delayed by a presence of permafrost – therefore unknown if kettle holes may be formed after glacier has retreated
- Often vulnerable to anthropogenic modification (Maizels, 1977, 1992; Eyles *et al.*, 1999; Evans, 2009; Waller *et al.*, 2012; Götz *et al.*, 2018)



4. Methods

Desk Study

- A desk study will establish the geology of the area, the locations of prominent landforms, and determine the setting of any work already undertaken in the area, e.g. the Ice Age Ponds Project

Geomorphological Mapping

- Mapping will be completed within ArcGIS using both aerial imagery and hillshaded DEM
- Features to be mapped and classified according to their morphology and landsystem setting
- GIS work will be validated through field reconnaissance

Geophysical Surveying

- Two complementary geophysical survey techniques chosen to investigate subsurface structure of depressions: *Electrical Resistivity Tomography & Ground Penetrating Radar*
- These methods have been successfully applied within environments containing kettle holes as well as in palaeoglaciological reconstruction

5. Initial Observations

- Depressions of Sites 1, 2 & 3 show great variation in morphology and landsystem setting
- Few Ice Age Ponds appear within outwash plains, most occur within hummocky moraine
- Hummocky moraine morphology is not consistent across the landscape, topographic differences between all three sites
- Inferred that there are several different processes that occurred to create these diversities in landforms**

6. Developing the Research

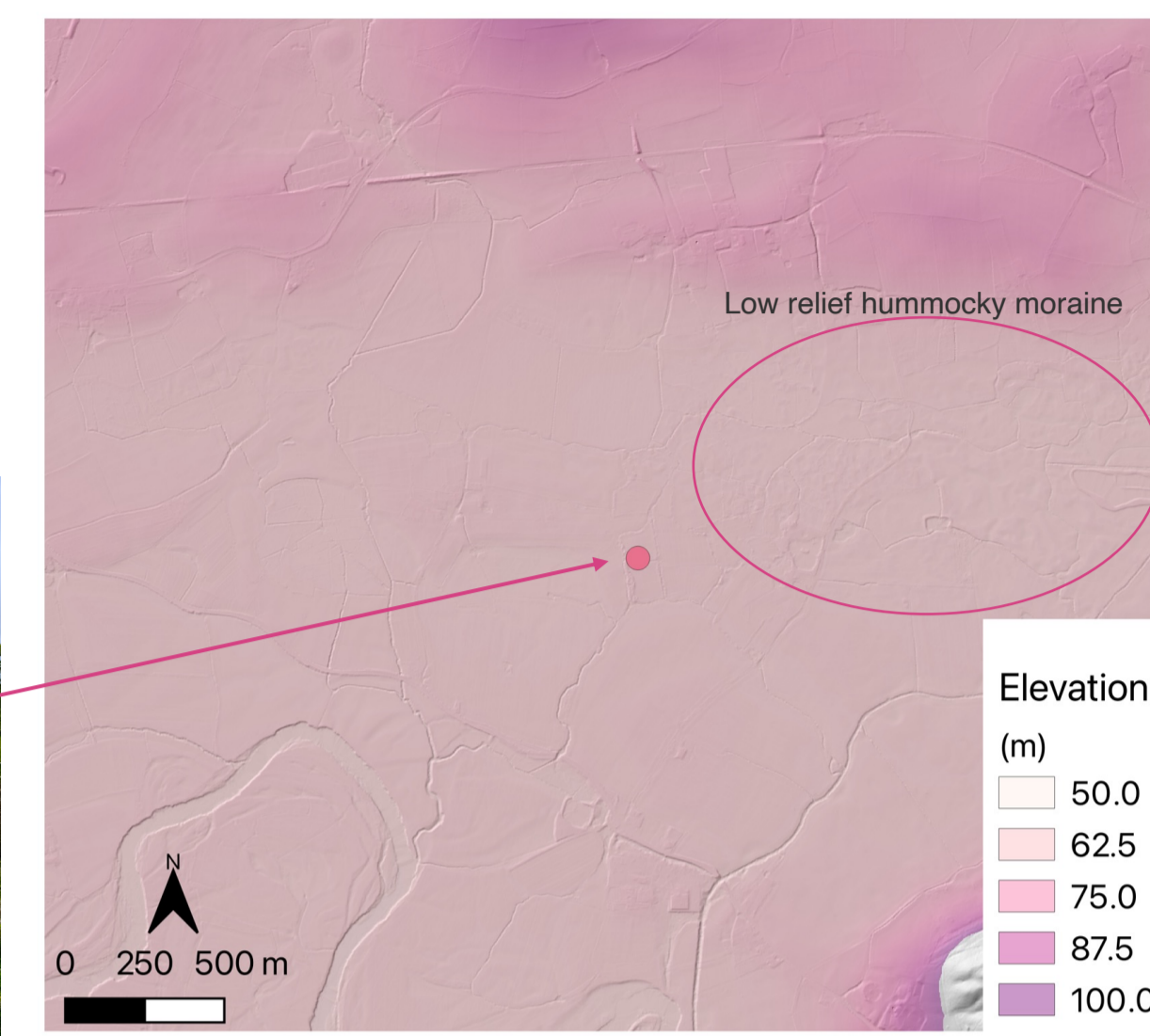
- Further geomorphological investigations required to determine a potential relationship between hummock and depression morphology
- Continued literature review focusing on the equifinality of glacial and periglacial depressions to provide further methods of genesis for these Ice Age Ponds which have not been considered
- Applying geophysical techniques will demonstrate the depressions' internal structures, helping to build the narrative of their genesis

7. Summary

- Herefordshire provides a well preserved but under-researched palaeoglaciological landscape
- Kettle holes lack a consistent definition raising questions over their genesis in this setting
- Initial findings demonstrates many glacial landforms with varying morphologies across the landsystem indicating multiple possible methods of formation
- This research will reduce the knowledge gap surrounding Herefordshire's palaeoglaciological landsystem through a multiparametric approach

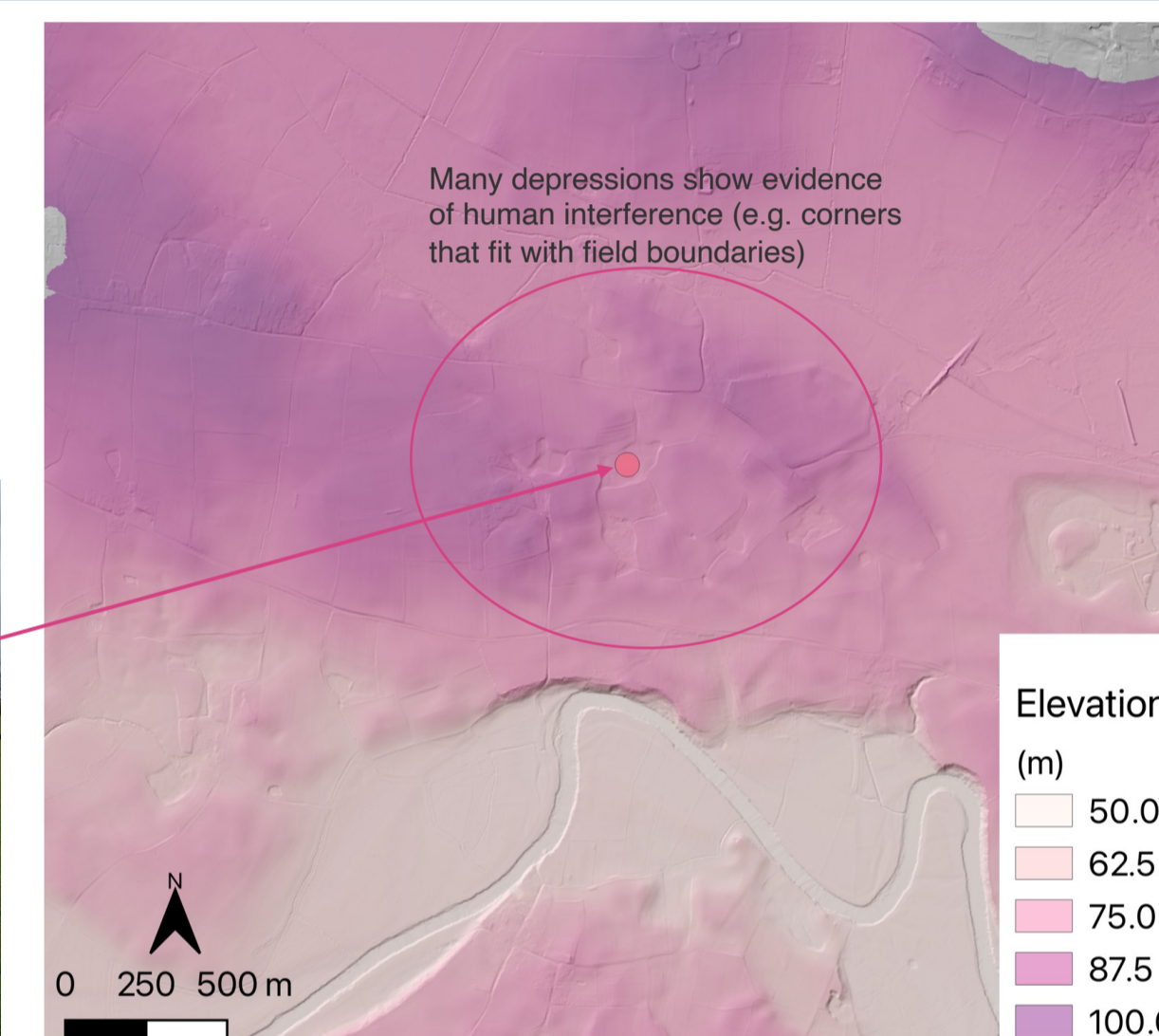
Site 1. Letton

Round depressions more typical of kettle hole morphology. The LiDAR (left) demonstrates flat topography, this area is situated behind the Staunton Moraine and is believed to be an Ice Walled Lake Plain



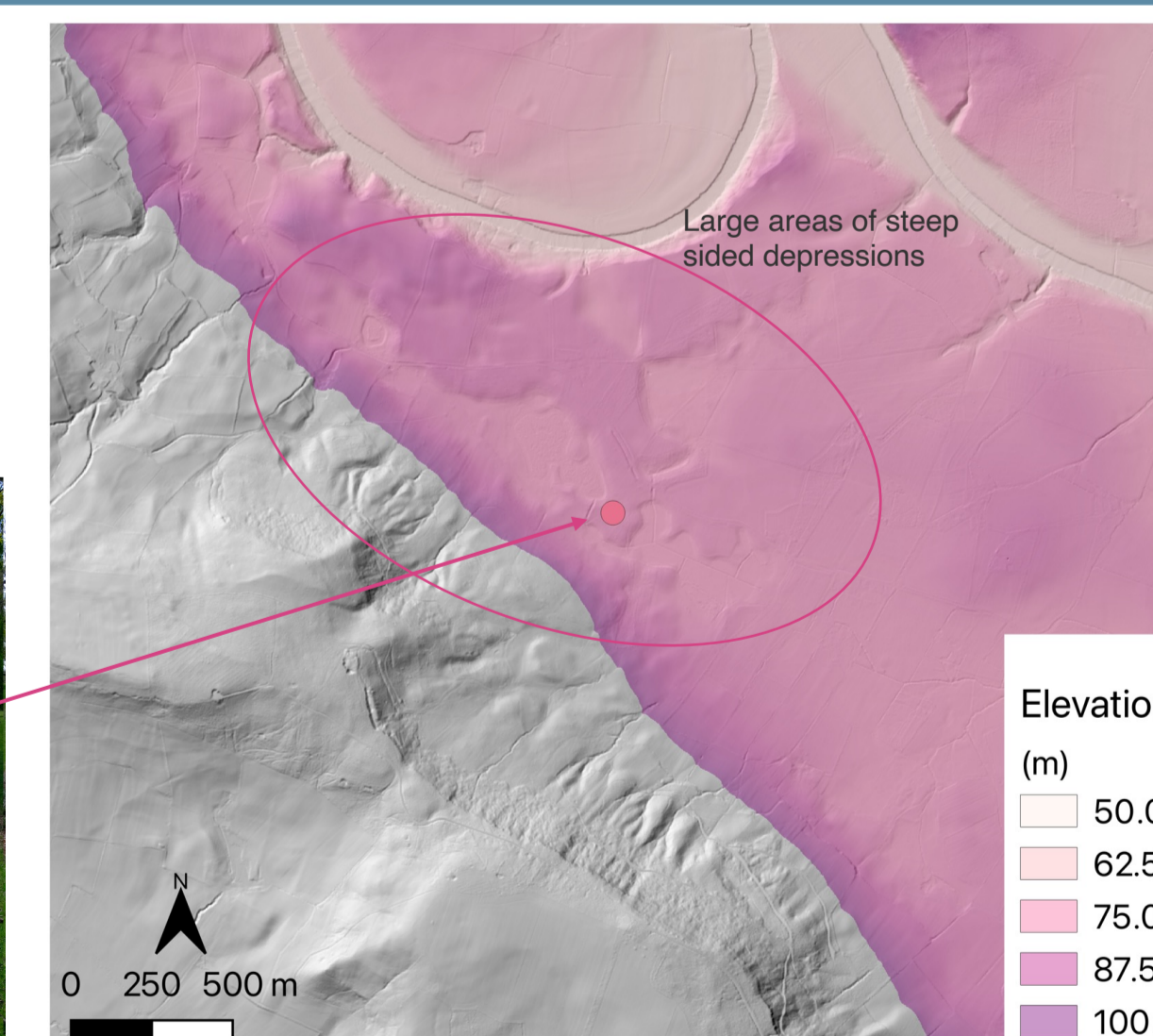
Site 2. Kenchester

Large irregular shaped depressions set within large irregular hummocks - also demonstrates high levels of anthropogenic modification through agricultural practices and potentially the Roman Settlement situated here



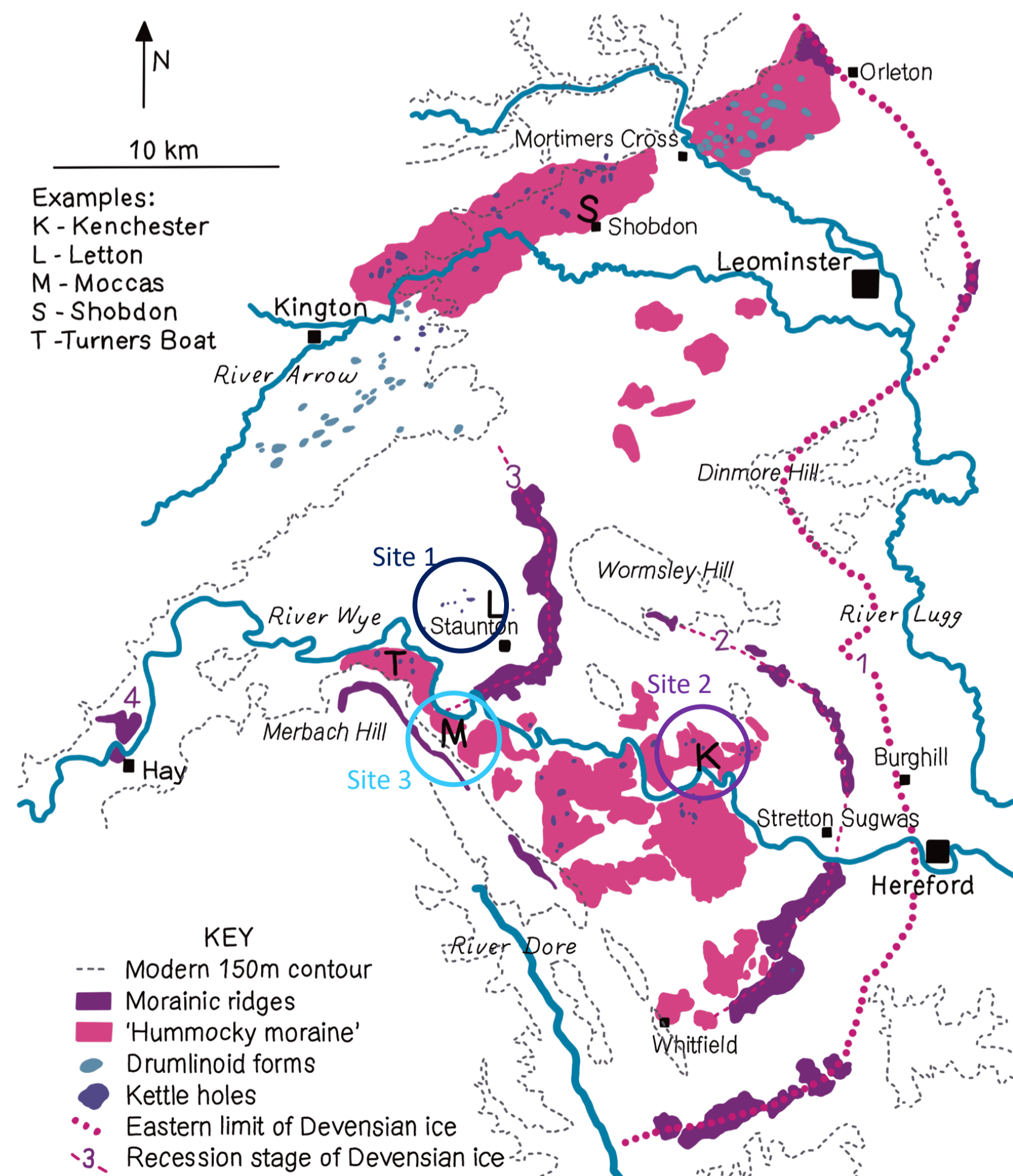
Site 3. Moccas Park NNR

Flat-topped rolling hummocks with intervening rounded depressions - this location is subject to a management plan, and the depression have been influenced by the creation of drainage channels



References

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Geomorphological Map of Herefordshire demonstrating the distribution of palaeoglaciological landforms described in Sections 2 and 3, indicated sites correspond with initial observations (Section 5)

(After Richards, 2005)