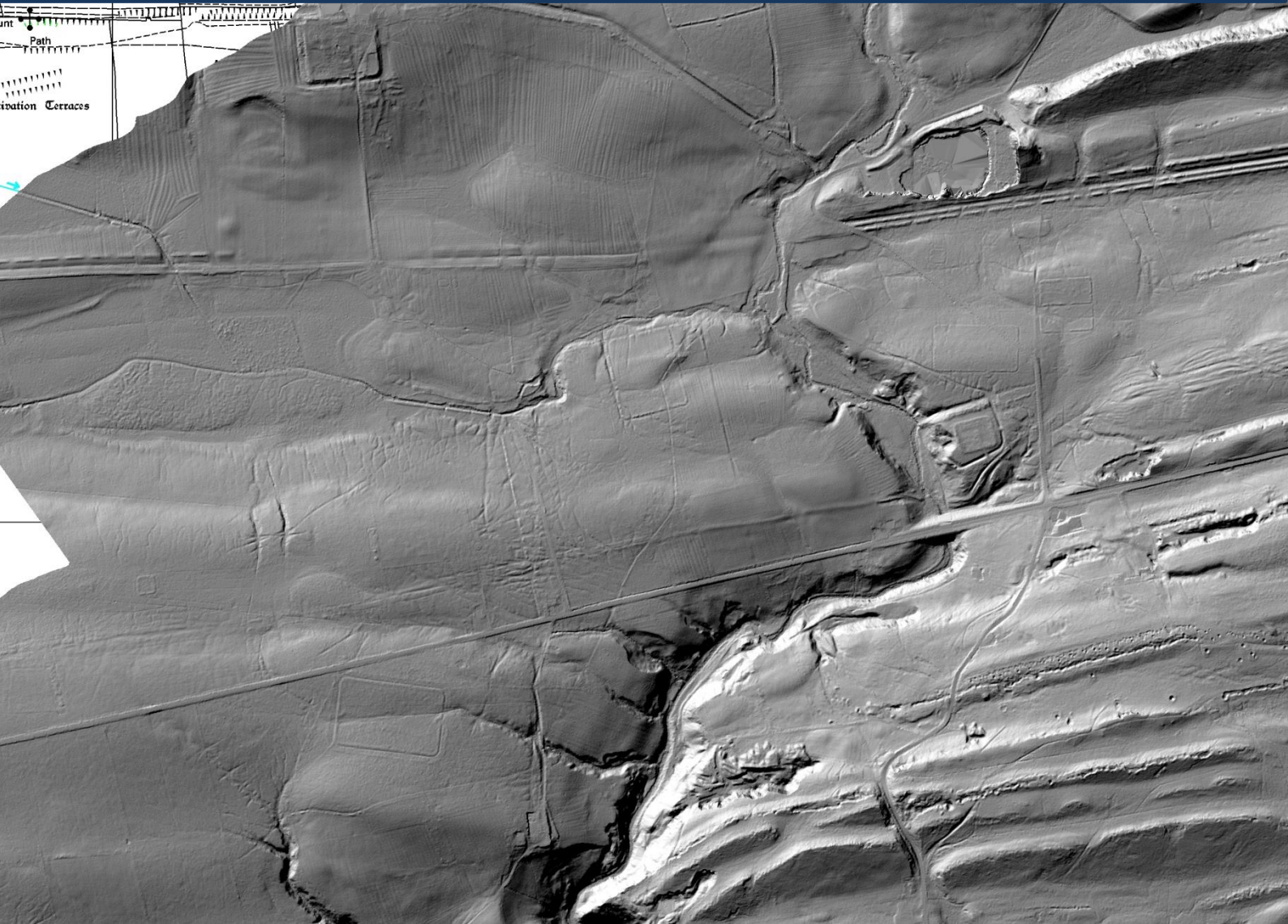




Hadrian's Wall and LiDAR

New features in an ancient frontier landscape



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FREDHI Report 1

2015

Introduction

BBC History commissioned FREDHI (Frontiers of the Roman Empire Digital Humanities Initiative) at Newcastle University to assess LiDAR data the Hadrian's Wall corridor and Cumbrian coast to determine the amount of 'new' archaeological information available. LiDAR data was provided by the Environment Agency (via the BBC) for the purpose of this exercise. The work was conducted between 9-20 March 2015.

LiDAR presents great opportunities to identify new archaeological features and reassess those already known. This initial scoping exercise has identified a number of significant new features that are worthy of further investigation. In addition, if the latent potential of LiDAR data were combined with the results of other methods and techniques – such as geophysical survey, aerial photography, and recent excavations (nearly all outside of accessible public knowledge), represents as massive increase in data that pushes a new interpretation of Hadrian's Wall.

Key results of the study are presented first, followed by brief conclusions and recommendations. Figures referred to in these sections can be found below in a longer statement of the basic aims and methodology of the study, and a more detailed discussion of the results. A brief glossary has also been provided for reference and detail.

Key Results

1. New camps:
 - a. Three probable and previously unrecognized camps have been identified at Carrawburgh (Fig 3), Milecastle 24 (Fig 4), and Chesters (Fig 5).
 - i. **Significance:** Camps provide insight into the early stages of military occupation and/or the construction of Hadrian's Wall. The size and location of camps helps us to identify key locations in the landscape, opening up new interpretations.
 - ii. **At Chesters**, the ramparts may relate to a camp that pre-dates Hadrian's Wall, **or** perhaps indicates an expanded defensive compound **to the north of the Wall** – an otherwise unprecedented feature along Hadrian's Wall.
2. Improved understanding of forts:
 - a. Possible identification of the ramparts at Castlesteads (Fig 6).
 - i. **Significance:** The Roman fort at Castlesteads is detached from Hadrian's Wall and sits on a bluff to its south; the fort remains were levelled in the 19th century to provide a platform for a walled garden associated with Castlesteads House, and no modern survey of the fort exists. The LiDAR data may indicate the course of two of the fort ramparts.
 - b. Identification of *vicus* settlement remains outside of the walls of the fort at Halton Chesters (Fig 7), Chesters (Fig 8), and Carvoran (Fig 9).
 - i. **Significance:** The extent and survival of the settlement outside of a fort provides a better indication of how large the military community was. LiDAR and geophysical surveys have shown that there were quite large and extensive communities of people settled outside the fort walls.
 - ii. **At Carvoran**, the footprints of buildings are found north of the fort and south of the Vallum. At this location, there is a unique occurrence of the Vallum diverting to the north; these buildings may help explain this diversion.
 - c. Possible modification of the fort at Beckfoot (Fig 10).
 - i. **Significance:** Very little is known about the fort at Beckfoot, but the identification of a rampart inside the fort suggests a late Roman (4th century) modification that has never been attested in the northern frontier. Similar activity has been seen at forts in other Roman frontiers (along the Rhine and Danube), but not in northern Britain.

- d. Improved visibility of the road infrastructure around forts.
 - i. **Significance:** While the locations of forts are generally known, the way in which they fit into the broader landscape remains a mystery. Identification of new roadways and reassessment of previously suspected roads allows us to understand how the military communities and others moved around and through forts, including how forts were linked for strategic and economic reasons.
 - ii. **New roads** can be seen at Beckfoot, Carvoran, Chesters, possibly Halton Chesters, and possibly Birdoswald.
3. More native settlement than previously appreciated:
 - a. Six new native settlements or enclosures have been identified, many of these proximal to Roman military remains.
 - i. **Significance:** The number of 'native' settlements provides some indication of the population levels of the frontier zone, and the increased numbers of these settlements suggest that the frontier was more populated than previously recognized. This in turn begs questions as to the impact of military occupation and building Hadrian's Wall.

Conclusions and Recommendations

The scoping exercise has been highly successful in the identification of a number of new features or sites in the Hadrian's Wall corridor. In addition, LiDAR provides a recent and reliable guide to archaeological features that are no longer visible on the surface, providing a useful corrective to pre-existing knowledge. To those unfamiliar with Hadrian's Wall, the relatively small number of sites and features indicated above may seem modest and unexciting. But it must be remembered that Hadrian's Wall has been the focus of scholarly attention and survey for at least 250 years – longer than most archaeological monuments – and it is relatively rare to find new archaeological features. The fact that so many new features were identified during this brief exercise (and with significant gaps in the LiDAR data) underscores that longer and closer examination is likely to reveal even more new sites.

These identifications merit further research attention, including site visits and further examination in conjunction with other types of survey data – namely those of geophysical survey and aerial photography. The combined use of the latter surveys with LiDAR provides complementary information that could significantly enhance current understanding of Hadrian's Wall.

A site/sector particularly noteworthy is the Birdoswald sector, for a number of reasons:

- Good evidence for camps and forts related to the military occupation of the frontier before Hadrian's Wall was built.
- It has been argued that this may have been one of the first areas of construction for Hadrian's Wall, particularly due to the unusual size and location of the milecastles (48 and 49).
- The fort at Birdoswald has some unusual and unexplained extremely high quality masonry.
- The Birdoswald sector saw the change from a stone-built Wall curtain to a turf-built Wall.
- The Turf Wall was subsequently rebuilt in stone along a different course, providing insight into the dynamic aspects of the frontier.
- There are significant remains of a Roman bridge where it carried the Wall across the River Irthing.
- Recent (and unpublished) excavations have been carried out in the cremation cemetery west of the fort.
- Excavations in the fort have revealed intriguing evidence of occupation into the 'Dark Ages' past the tradition 'end of Roman Britain'.
- English Heritage's National Mapping Programme has a detailed report of new remains in this sector, which is complemented by LiDAR data.

To conclude, there is a considerable amount of new evidence relating to Hadrian's Wall that is only known within academic circles, and this information is suitable for addressing the following questions:

- How settled was the region prior to Roman military occupation?
- Was there a significant amount of military activity prior to the construction of Hadrian's Wall?
- What was the sequence or priority of the building program for the Wall?
- To what extent was the Wall and its garrisons a huge imposition on the landscape?
- How did the Wall and the frontier change over time?

Aims and Methodology

The primary aim of the exercise was to determine the extent and significance of new sites and information relating to Hadrian's Wall that have been revealed by LiDAR data.

Key types of information and locations were examined to provide the best assessment within the brief remit of the exercise. As LiDAR reveals variation in topography and is capable of revealing even the slightest deviation or change in form, three types of data were looked for that provided the greatest probability of being observed:

- Ditches and embankments
- Pits and mounds
- Linear and curvilinear building features (namely walls)

Drawing upon FREDHI's expertise on Hadrian's Wall, key locations were targeted that would best demonstrate new information and that related to current unresolved research problems. Four key themes were identified, with specific locations examined in reference to these themes. These were:

1. The Stanegate Road and other Roman roads;
2. The camps at Haltwhistle Burn and other locations where more camps might be expected;
3. Forts, extra-mural settlements and other immediate environs;
4. 'Native' settlement.

The Stanegate road and the camps provide insight into the history of the frontier before Hadrian's Wall was built, as well as the building process of the Wall. Examination of the forts and their extramural settlements provides insight into the size and scale of military settlement in the Wall corridor. Native settlements provide some insight into the non-military population of the frontier, though these remains can be difficult to date without excavation. The relationship and proximity of native settlements to military sites can also reveal important insights into the nature of these differing communities in the frontier, as well as providing greater understanding of the siting of military installations.

LiDAR data was provided by the Environment Agency (via BBC) in DTM and DSM formats. The majority of data is of 1m resolution, though there were a few small pockets of data at 50cm resolution.

It should be noted that when the data was provided, there were significant areas of the Wall corridor that had not yet been surveyed, and for which there was no data. These gaps impacted upon the ability to identify the features and thematic data noted above. The gaps from west to east are:

- The course of the Wall from Carlisle Airport to Walton, Cumbria;
- The land immediately north of the Wall from Garthside to Birdoswald fort, Cumbria, including a length of the Wall itself;
- A missing patch of the Wall around Gap Farm (east of Gilsland);
- Land south of the Wall west of Greenhead;
- Length of the Wall, and land to its north and south from Walltown (east of Carvoran) to Great Chesters, including Haltwhistle Common;
- A large area from Twice Brewed to Fozy Moss, including the most iconic and recognizable length of Wall (the Housesteads sector) and the area around Vindolanda;

- Brown Moor;
- Warden parish (south of Chesters fort);
- A length of Wall from Brunton to Greenfield, and the land immediately north of it;
- Lands south of the Wall and north of the River Tyne, roughly from Acomb to Corbridge;
- Lemington, Denton, and West Benwell.

These gaps, particularly the large area of the central sector and the tracts south of the Wall, have limited a considerable amount of the scoping of the Stanegate road.

The DTM data from the Environment Agency was added to a geodatabase to create a mosaic layer in ArcGIS 10.2. This mosaic was then processed with Hillshade image analysis for conducting the exercise. The Hillshade image was visually assessed at 1:6000 scale, which was deemed the most suitable scale for maximizing coverage while still being able to identify archaeologically-interesting variations in topography. Images provided below are exports of the Hillshade analysis with modified contrast and lightness settings to increase visibility of the relevant features, using arrows or superimposed lines to further indicate these.

As part of the exercise, the English Heritage map of Hadrian's Wall (2014 edition) was the primary reference in establishing if 'new' sites and features were already known, as this map has incorporated information from the Hadrian's Wall National Mapping Programme and other relatively recent projects. GoogleEarth was also consulted to determine if features were visually extent in satellite imagery, and to clarify where features may relate to agricultural activity of recent decades or centuries.

There was no scope for confirmation of new archaeological information by direct observation 'on the ground' during the course of the exercise, and it is advised the site visits be made to further confirm the presence of new sites or features prior to any potential publication or broadcasting.

The Stanegate

The Stanegate is a pre-Hadrianic road, laid before the Wall was built, that runs between the Roman sites at Corbridge in the east and Carlisle in the west. The course of this road is known in many places, but hypothesized and unproven for much of its course. It has also been postulated – though never proven – that there were extensions east of Corbridge and west of Carlisle.

The LiDAR was examined for evidence of the Stanegate and any putative extensions. Unfortunately, tracking of the Stanegate proved extremely difficult, due to the current limitations of existing data. There was no LiDAR data west of Corbridge on which to view or search for the Stanegate until reaching Hill Top, east of Haltwhistle Burn. Here it is clear that some short lengths of the Stanegate depicted on the EH map as 'not visible/no longer visible' can be confirmed in the LiDAR data.

A stretch not previously observed/mapped can also be found running immediately west of Carvoran approaching the Pow Charney Burn. Another possible new stretch may be found east of the Mains Rigg signal station, lying south of the proposed course along a former field boundary at NY 61824 65337. It is also clear from the LiDAR that Mains Rigg sits within a larger sub-rectangular ditched enclosure (Fig 1).

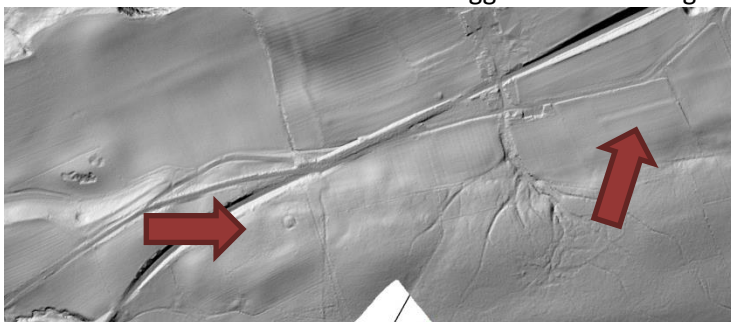
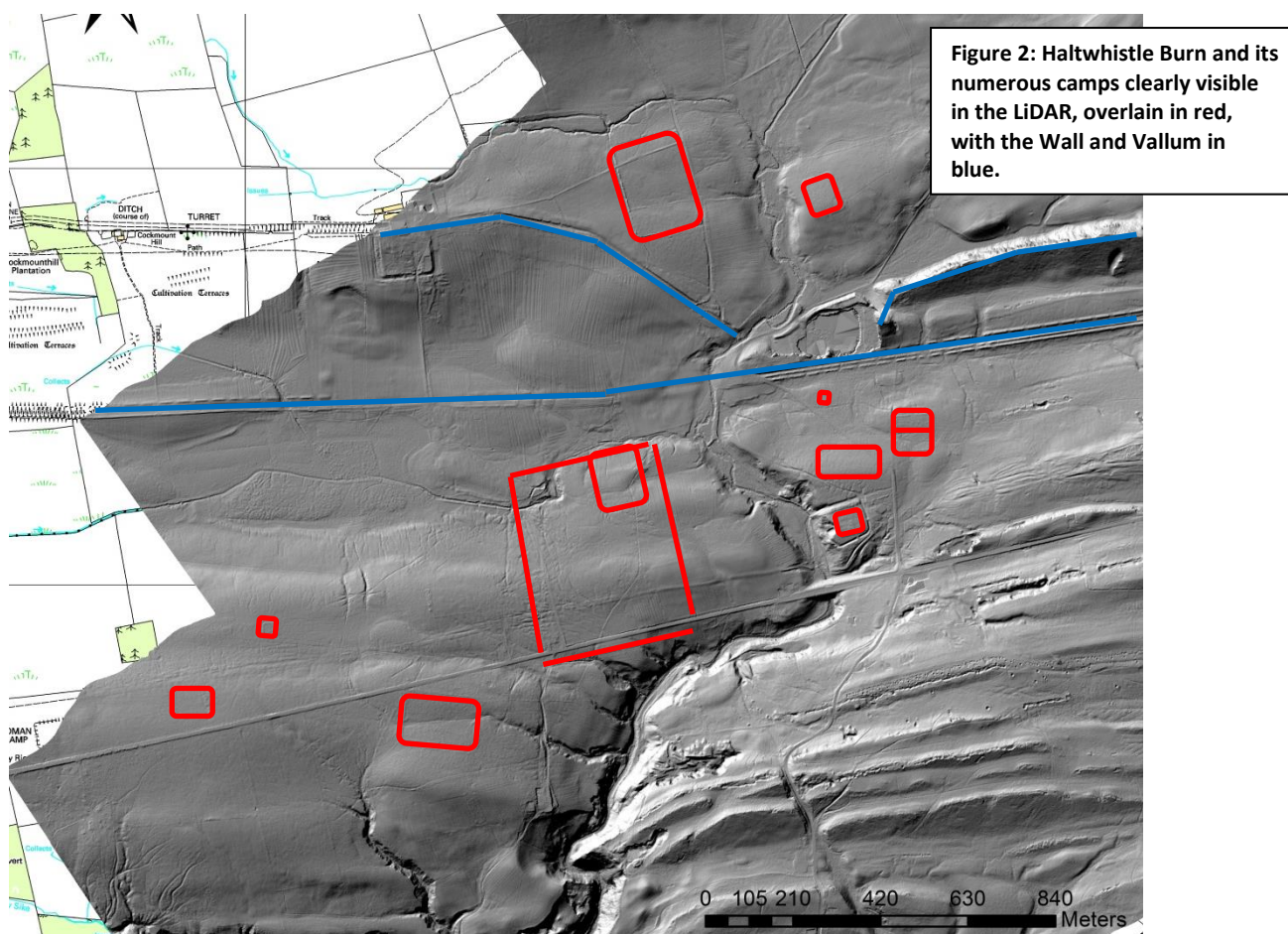


Figure 1: The Stanegate and Mains Rigg enclosure.

Camps and the pre-Hadrianic frontier

The Wall corridor is well known for its provision of 'temporary' camps, identified traditionally through the remains of upstanding earth ramparts and/or aerial photographic identification of ditches in crop mark features. Some of these camps are to be associated with the pre-Hadrianic frontier, and should be understood as remains of military campaigns and activities that date *circa* AD 70-115; other camps are 'building camps' associated with the construction of Hadrian's Wall. It is not always feasible to determine the function or date of camps, particularly where the Stanegate and Hadrian's Wall are very close. Haltwhistle Burn is a notable area where a number of existing rectangular and sub-rectangular camps are visible, and these are even more clearly visible in the LiDAR (cover & Fig 2).



No new camps were encountered at Haltwhistle Burn, though it should be noted that the western portion of this area, where a number of camps are already known, is lacking LiDAR data.

The Birdoswald-Gilsland sector was explored as a prospective area for new camps to be discovered. Unfortunately, no new camps were encountered, though a new enclosure sitting inside (probably pre-dating) a Roman camp was discovered (discussed below in Native settlements).

A probable new camp was discovered, however, north of the fort at Carrawburgh at NY 855713 (Fig 3). This camp appears to be the classic playing card shape with a length of approximately 60m (east-west). This new camp can be added to the five other camps previously known in the vicinity (between milecastle 29 and 33), and it is the first to be found to the north of the Wall in this locality.

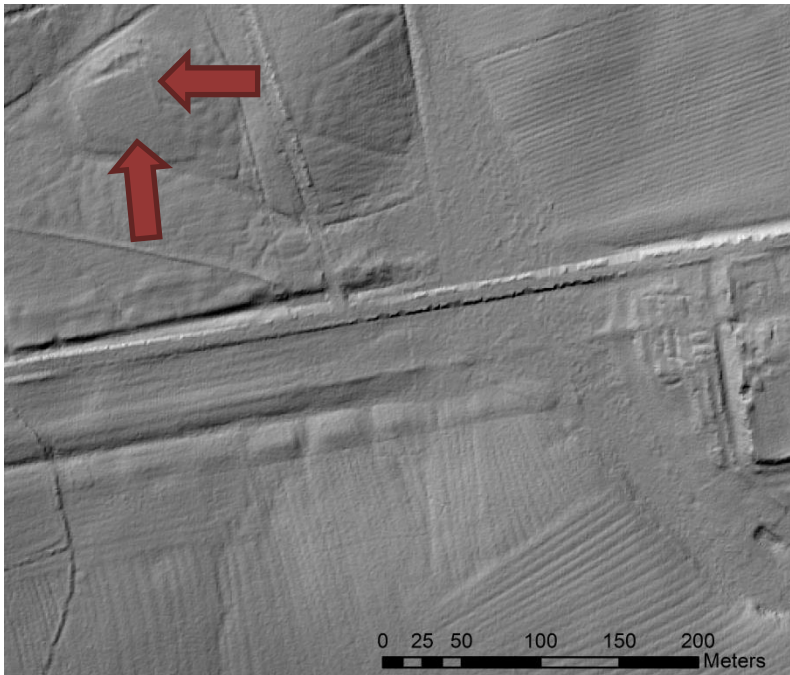


Figure 3: A new camp to the northwest of Carrawburgh fort, its position indicated by arrows outside the south and east ramparts. Carrawburgh fort is centred on the right edge of the image.

South of milecastle 24, a very regular square enclosure was discovered (Fig 4). In form, it does not match a typical Roman camp, and it is too square to be a native settlement. It may be an enclosure of post-Roman date, but the enclosure does not appear to survive in any earthworks that are visible in GoogleEarth, nor does it bear any relation to the post-Medieval and modern field systems. The low relief of the embankment is consistent with long-term ploughing of the field, reducing the height and smoothing out the banks; the degree of plough-reduction is greater, but comparable to that of the south mound of the Vallum visible in the north of the field immediately west of the enclosure.

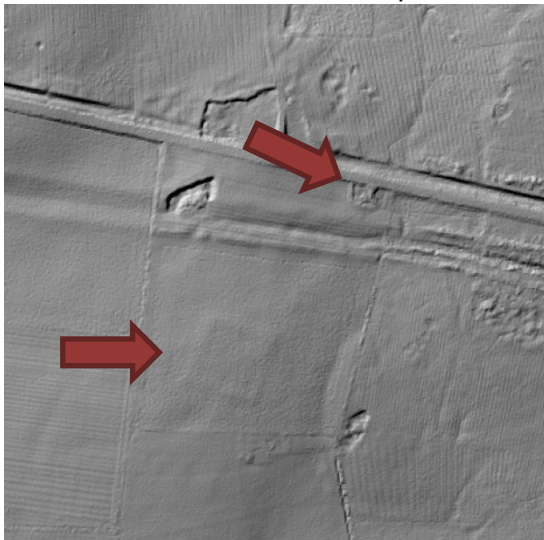
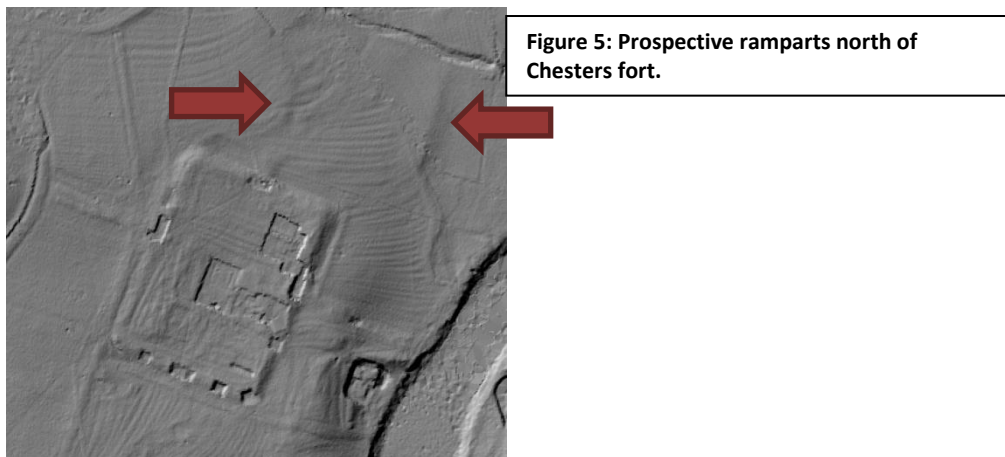


Figure 4: A square enclosure of uncertain date, position indicated by the arrow. The Vallum is a very strong feature running to the north of the enclosure, as is the milecastle, also indicated by an arrow.

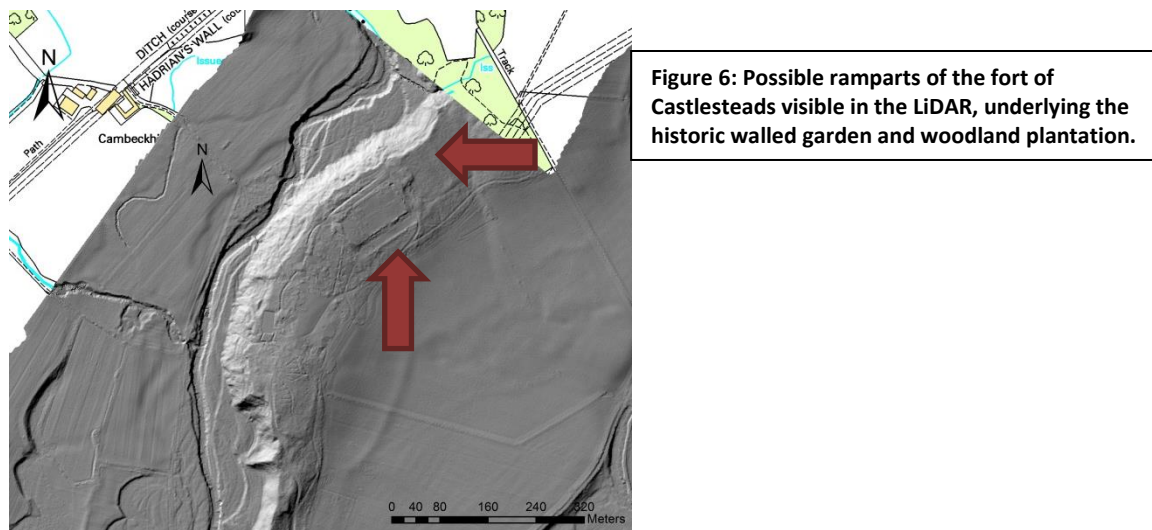
Another prospective camp rampart was found north of the fort at Chesters, with a parallel to its west (Fig 5). This presumed rampart does not connect to another rampart, but the scale and appearance is consistent with camp ramparts, though this identification remains very tentative.



Forts and extramural settlements

Nearly all the forts associated with the pre-Hadrianic Stanegate and Hadrian's Wall were clearly visible in the LiDAR, provided there was data for the location. The exceptions to this were those forts in urban areas, such as the forts at Newcastle and Benwell, and Stanwix and Carlisle, or those lying under historic settlements, such as Rudchester and Burgh-by-Sands. Despite the excellent visibility of forts in the LiDAR, there was very little new information revealed about the fort structures themselves. Of more significance were the remains of buildings, roads, and other features found outside the fort walls.

The fort at Castlesteads was a target of interest, given that the fort remains were levelled and incorporated into a walled garden for a country house, and the location is obscured from aerial imagery by woodland plantation. Unfortunately, no archaeological features can be positively discerned from the LiDAR, though it is possible that the line of the south and east ramparts has been preserved, though this could also indicate terracing or pathways associated with the country house landscaping (Fig 6). No visible traces of the extensive extramural settlement revealed by geophysics are visible, either.



At Nether Denton, Chapelburn, two ramparts (north and west) were visible, though the modern farm buildings obscure the eastern rampart.

In contrast, extramural remains of the vicus were partly visible at the forts of Halton Chesters (Fig 7), Chesters (Fig 8), and Carvoran (Fig 9). In all three cases, the outlines of building footprints are visible, and in some cases roads are visible as well.

At Halton Chesters, the vicus buildings can be seen between extend fields of Medieval ridge-and-furrow, and presumably survived because the density of surviving (though ruinous) structural remains was such that it interfered with pre-modern agriculture.



Figure 7: Remains of the vicus outlined in red, to the southwest of the fort of Halton Chesters. Hadrian's Wall lies under the road running across the top of the image.

The vicus at Chesters is particularly visible to the southwest of the fort, with a clearly visible road network and occasional building footprints.

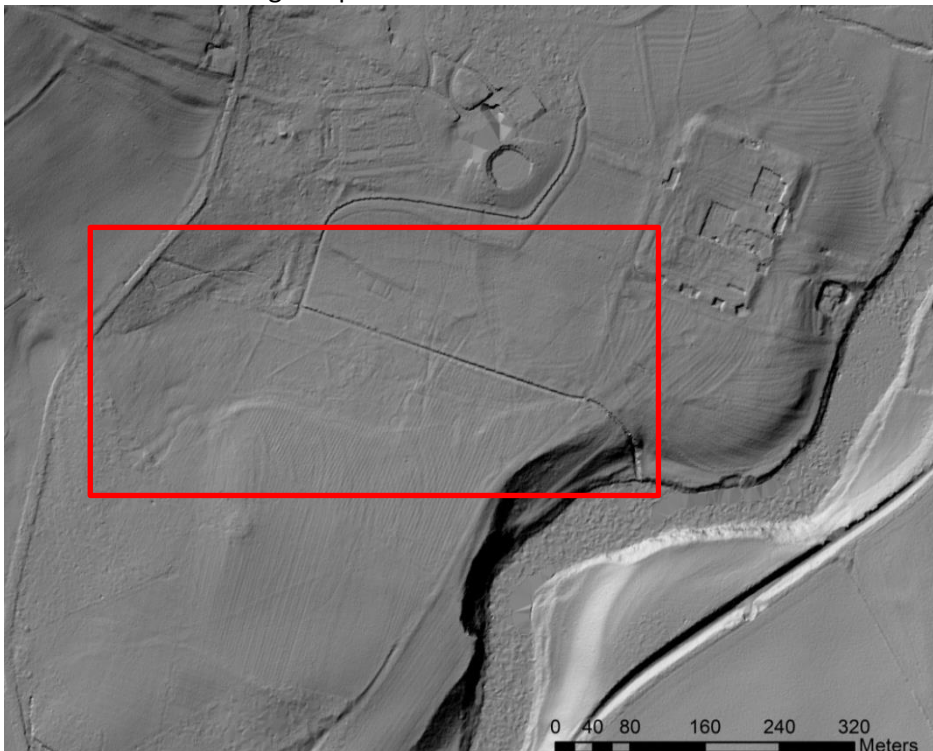


Figure 8: Vicus remains to the southwest of the fort at Chesters.

At Carvoran, the fort is detached from Hadrian's Wall and located south of the Vallum, which has generally been understood as meaning that the fort was added to the Wall after it (and the Vallum) were constructed. The greater mystery, however, is why the Vallum (uniquely) bows to the north at this location. It has been hypothesized that a previous and no-longer visible fort forced this deviation of the Vallum, but

the existence of such a fort is unproven (though its presence has been possibly detecting through geophysical survey). No new fort is visible in the LiDAR, but there are footprints of buildings to the north of the known fort and the Vallum.

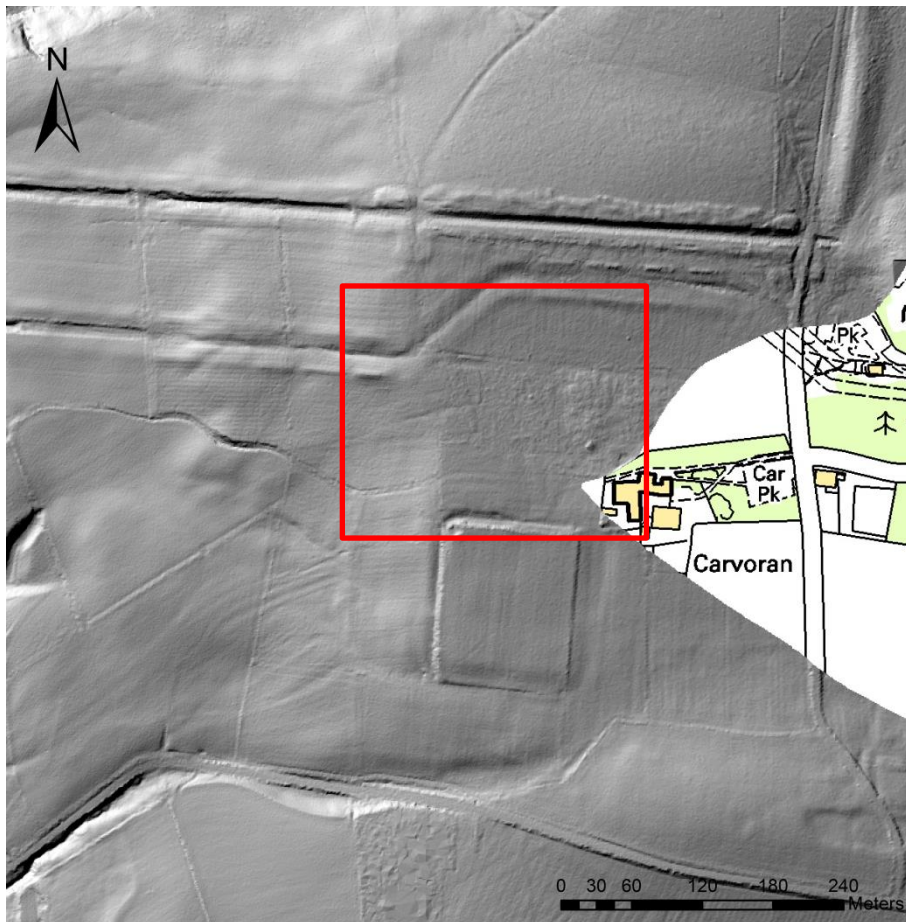


Figure 9: Vicus remains at Carvoran, significantly located to the north of the fort and between the fort and Vallum. Perhaps this explains the strange and unique occurrence of the Vallum diverting to the north.

Examination of the fort at Beckfoot did reveal an intriguing new feature. In addition to the eastern and southern ramparts of the fort, there appears to be an internal embankment within the fort, running roughly north-south (Fig 10). This suggests internal partitioning of the fort which is a feature commonly found in forts in the later Roman Empire during the 4th century, but otherwise unattested in the northern frontier zone. If this is the case, this would be an intriguing insight into the late Roman defence of the frontier, perhaps tying into refurbishments at other coastal military sites.

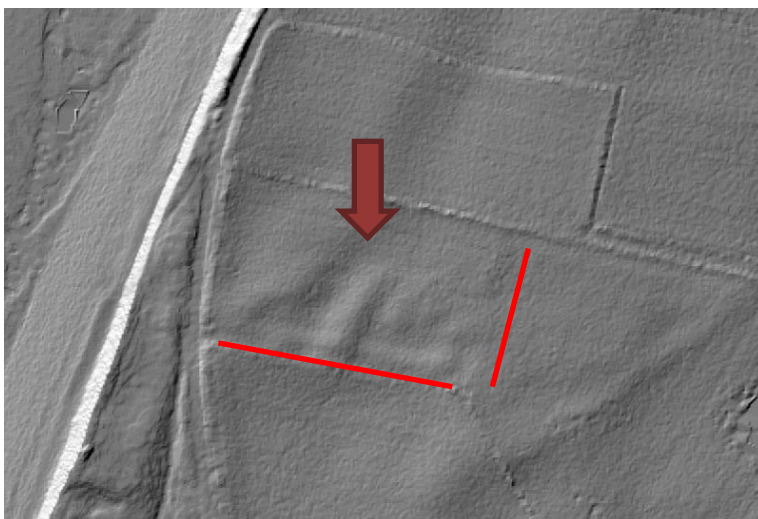


Figure 10: A north-south embankment inside the fort at Beckfoot. The arrow is indicating the position of the embankment, and lines are running externally parallel to the outer ramparts of the fort.

‘Native’ settlements

A number of native settlements are known from the Wall corridor, but this cursory exercise found further sites of interest, including an ditched enclosure east of the fort at Rudchester (Fig 11), south of Downhill Quarries (Fig 12), Shildon (Fig 13), south of Limestone Corner (Fig 14), and inside the camp south of Chapel House, west of Carvoran (Fig 15).



Figure 11: Ditched enclosure east of the fort of Rudchester, to the north of the Wall, which lies under the modern road.



Figure 12: Ditched enclosure south of Down Hill quarries, with the Vallum clearly visible to the north. Post-Medieval drains and field boundaries appear to cut across the enclosure on three sides.

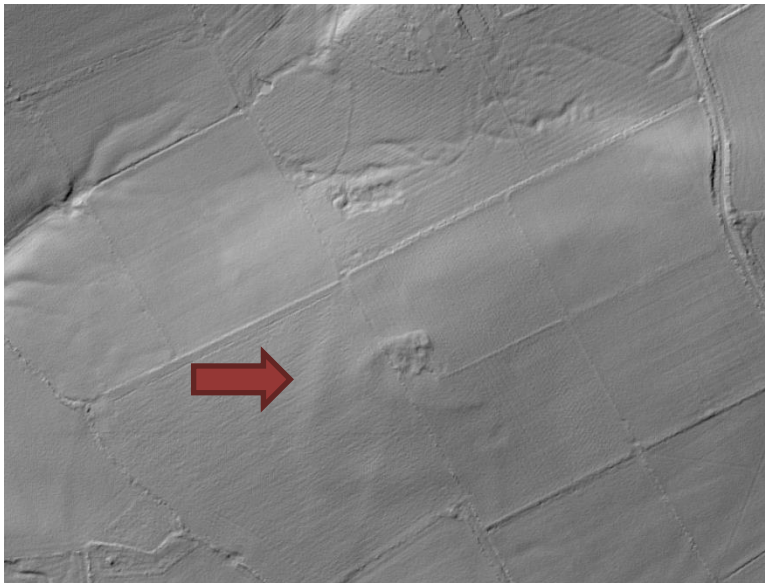


Figure 13: Embanked enclosure with central oval feature at Shildon, to the southeast of Down Hill quarries.

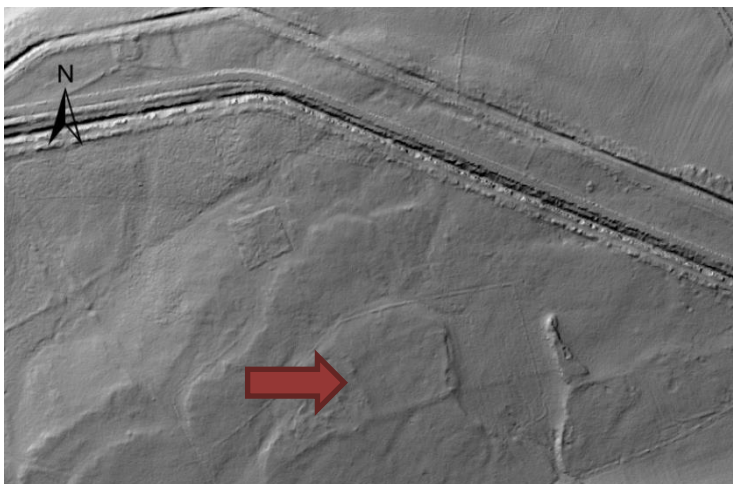


Figure 14: Embanked enclosure to the south of a known Roman camp, itself south of the Vallum and Wall at Limestone Corner. Inside the enclosure are circular formations that may be evidence for internal structures.

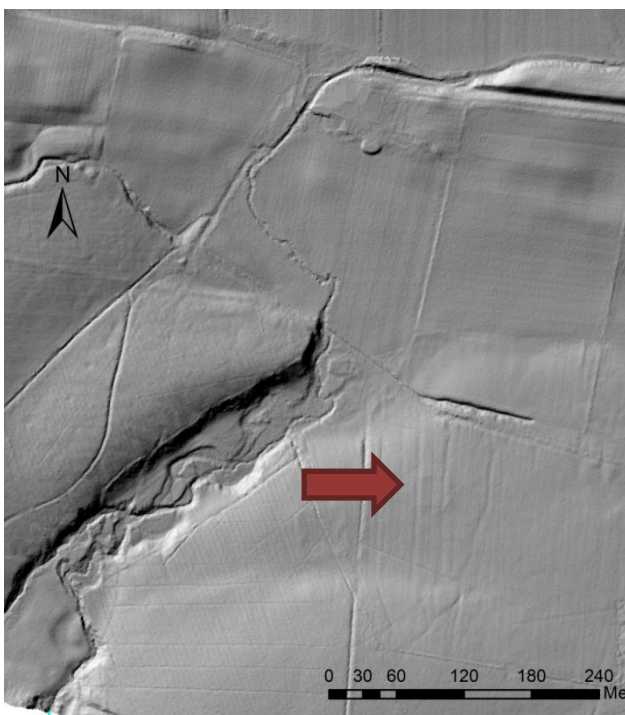


Figure 15: An enclosure found inside a known Roman camp (the west rampart passed through the red arrow), approximately half the size of the camp to its west (beneath the left end of the arrow).

Glossary

Hadrian's Wall is composed of a number of individual elements that in total create a monumental complex that is referred to in short as Hadrian's Wall. These elements are:

Ditch – a ditch that runs laterally in front of the Wall curtain (to its north); there are some locations where the ditch was not dug, for example along crags/cliffs.

Berm – the strip of land between the Wall curtain and the ditch; at the eastern end of the Wall, a new discovery is that obstacles were placed on the berm possibly acting as a further defensive feature.

Wall curtain – the actual mural aspect of Hadrian's Wall; from Wallsend to Birdoswald the curtain was originally built in stone; from Birdoswald to Bowness-on-Solway the curtain was originally built in turf. These are referred to as the Stone Wall and Turf Wall. Subsequently, the Turf Wall was demolished and replaced with stone.

The Vallum – a unique feature that runs south of the Wall that was a monumental undertaking in and of itself. The Vallum consists of a ditch flanked to its north and south by large earth embankments. In some locations, for example Limestone Corner, the ditch was never completely dug, but the Vallum was. This indicates that Vallum was considered a priority and essential element to the Wall complex.

Fort – a rectangular enclosure that acted as the primary base for units garrisoned along the Wall. Most forts are attached to the Wall curtain, but some exceptions are detached, as at Carvoran.

Milecastle – approximately every Roman mile, a small fortlet was constructed against the back of the Wall curtain. This fortlet provided a gateway through the Wall, though it is uncertain if everyone could cross the Wall at a milecastle or if use was restricted to soldiers. There are some milecastles that have not yet been located.

Turret – approximately every one-third of a Roman mile a tower was constructed against the back of the Wall curtain. Turrets are thought to have functioned as observation platforms. Some turrets have not yet been located.

Camp – a temporary military settlement, usually consisting of a ditch with earth ramparts. Some camps were built/used as part of the conquest and occupation of northern Britain. Other camps are thought to be 'building camps' that were used during the course of the construction of Hadrian's Wall.

Stanegate – a road running from Corbridge to Carlisle, linking a number of pre-Hadrianic forts. The road is therefore earlier than Hadrian's Wall. There is debate as to whether or not this road extended east of Corbridge and/or west of Carlisle.