CENTRE OF ARCHAEOLOGY

Land at Newlands, South Cerney

ARCHAEOLOGICAL MAP REGRESSION AND SITE INTERPRETATION

PN 16-07

Project No. 16-07

04/2016

Land at Newlands, South Cerney

ARCHAEOLOGICAL MAP REGRESSION AND SITE INTERPRETATION

By

WILLIAM MITCHELL

Project Archaeologist

	Name	Position
Edited by/ Reviewed by:	K.Colls	Archaeological Project Manager
Approved by:	K.Colls	Archaeological Project Manager
	Signature:	
Version: Draft v3a		**Version Date:** 12.04.2016

For

Mr and Mrs Jacob

Newlands

Cirencester Road

South Cerney

GL7 6HU

Centre of Archaeology

Faculty of Computing, Engineering and Science

Staffordshire University

R102, Science Centre

Leek Road,

Stoke-on-Trent

ST4 2DF

(+44) 01782 294037

Site: Land at Newlands, South Cerney

Project: Archaeological map regression and site interpretation

NGR: Centred on National Grid Reference SU 04733 97980

Archaeological Contractor: Centre of Archaeology, University of Staffordshire

1 INTRODUCTION

1.1 This document constitutes a summary of the information currently available and to hand regarding a property boundary located between the Newlands and Claymeadow properties, South Cerney. A site visit was undertaken on 23rd March 2016. This has been followed by an analysis of the historic maps and a review of the background information.

1.2 The purpose of the archaeological map regression and site interpretation is to highlight the presence of an historic site boundary and ditch between the land at Newlands and the land to the North named Claymeadow (NGR SU 04723 98055 to SU 04561 98022).

1.3 This report outlines the recorded information regarding the boundary. Part of the purpose of this documentation is to advise on land ownership based on topographical observation and archaeological principals and to suggest further archaeological work to support these statements.

2 SITE DESCRIPTION AND LOCATION

2.1 The historic boundary in question runs across open field land in a west to east direction, it is made up of a rural hedge and ditch boundary and runs for approximately 165m. To the north of the boundary is called Claymeadow, to the south of the boundary is called Newlands. The Newlands property is bounded on the east by Cirencester Road and on the west by a disused railway cutting. The land slopes in a moderate gradient in an easterly direction towards the road.

3 HISTORIC MAPS AND PHOTOGRAPHY

3.1 The earliest detailed map available is the 1875- 1884 Ordance Survey County Series for Gloucestershire (Plates 1 and 2). This map clearly shows the boundary in question (between fields 51 and fields 54, 55 and 56). This boundary continues in a westerly direction until it reaches a north south boundary (field 50). The boundary is illustrated as a single line with a hedgerow drawn using a standardised convention.

3.2 The boundary became bisected by the Swindon and Cheltenham railway extension in 1883, but remained in existence either side of the railway embankment. The railway cutting is clear on the Ordnance Survey maps from 1902 onwards (see 1902 and 1921 below, Plates 3 to 6). The boundary remains (between fields now recorded as 478 and 479) and continues on the western side of the railway cutting.

3.3 The aerial photography from 1946 (Plate 7) confirm that boundary is still in existence either side of the railway cutting, as it is on the OS 1960 map (Plates 8 and 9). Satellite imagery from 1999 onwards (Plates 10 to 12) confirm the continued presence of the boundary which is defined by a mature hedgerow across the Newlands ownership (east of the railway cutting) although the boundary has been removed from the west side of the railway (Plate 9). These images also show evidence of ridge and furrow across a wide area.

3.4 Recent photography (Plates 13 and 14) and photographs taken of the boundary in question from 2012 onwards (Appendix 1) confirm the presence of the ditch, bank and hedge. They can be used to to track the development of the fences and the functioning of the culvert. The photos also assist in producing a chronology of site development on the Claymeadow site.

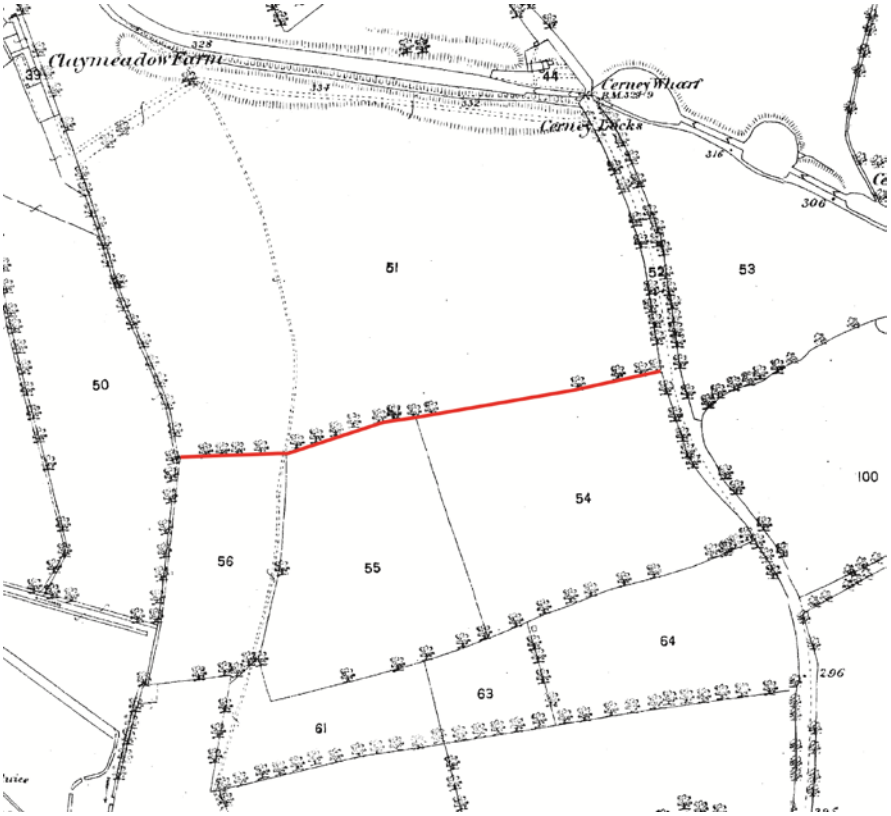


Plate 1: OS County Series Gloucestershire 1875-1884 showing boundary in red

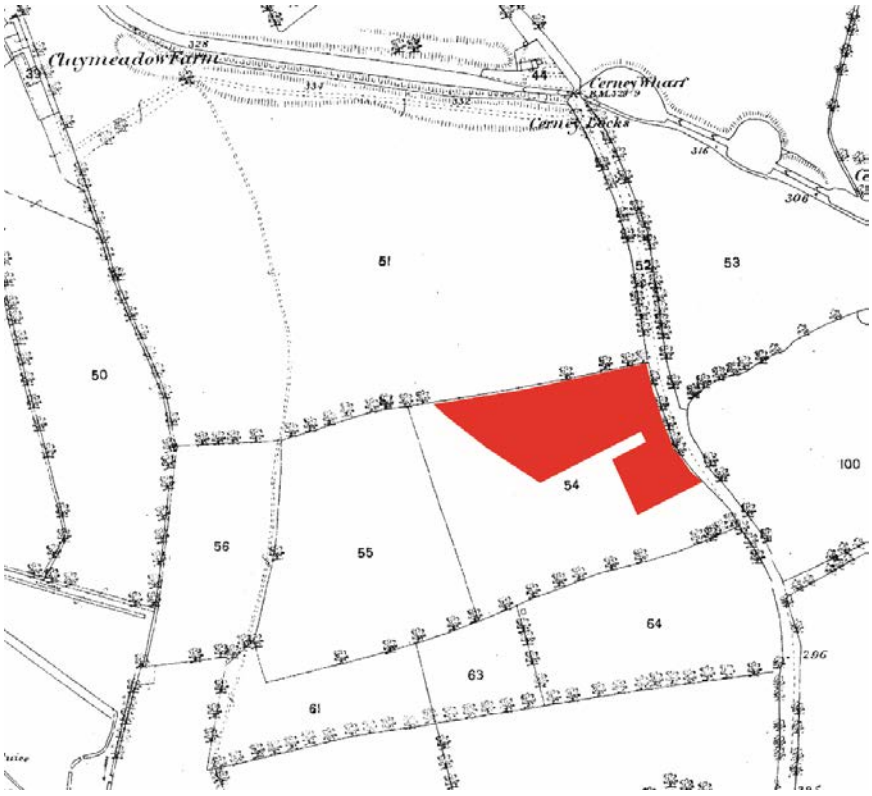


Plate 2: OS County Series Gloucestershire 1875-1884. (Newlands plot highlighted)

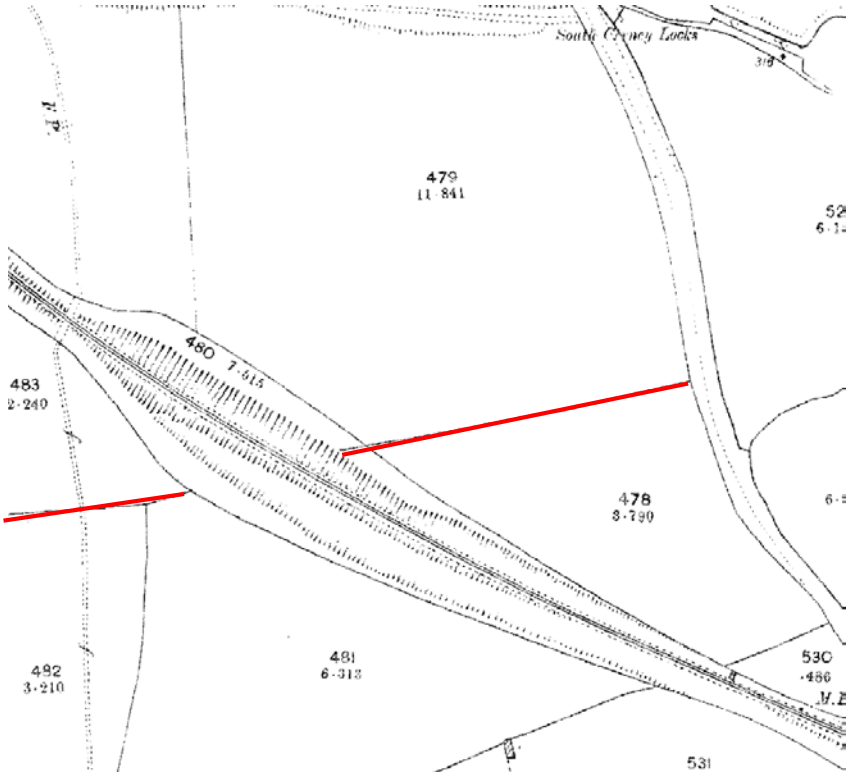


Plate 3: OS County Series Gloucestershire 1902

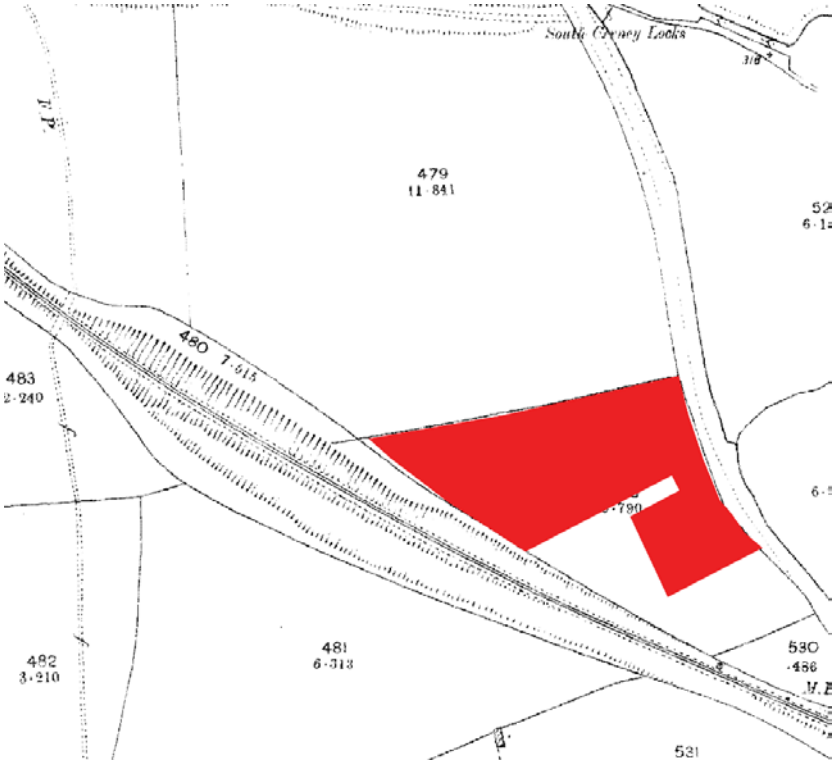


Plate 4: OS County Series Gloucestershire 1902 (Newlands plot highlighted)

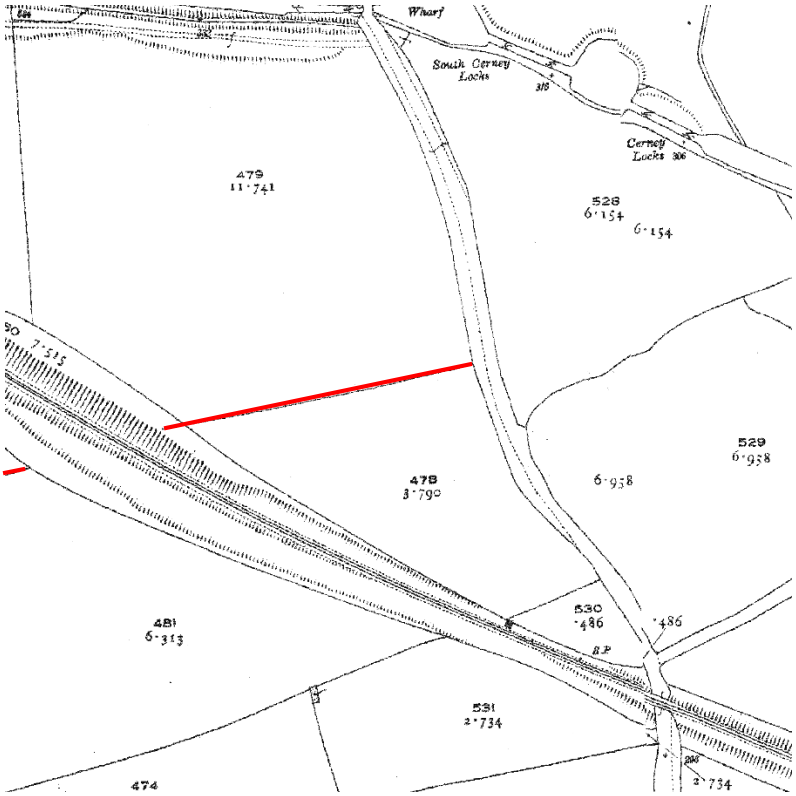


Plate 5: OS County Series Gloucestershire 1921

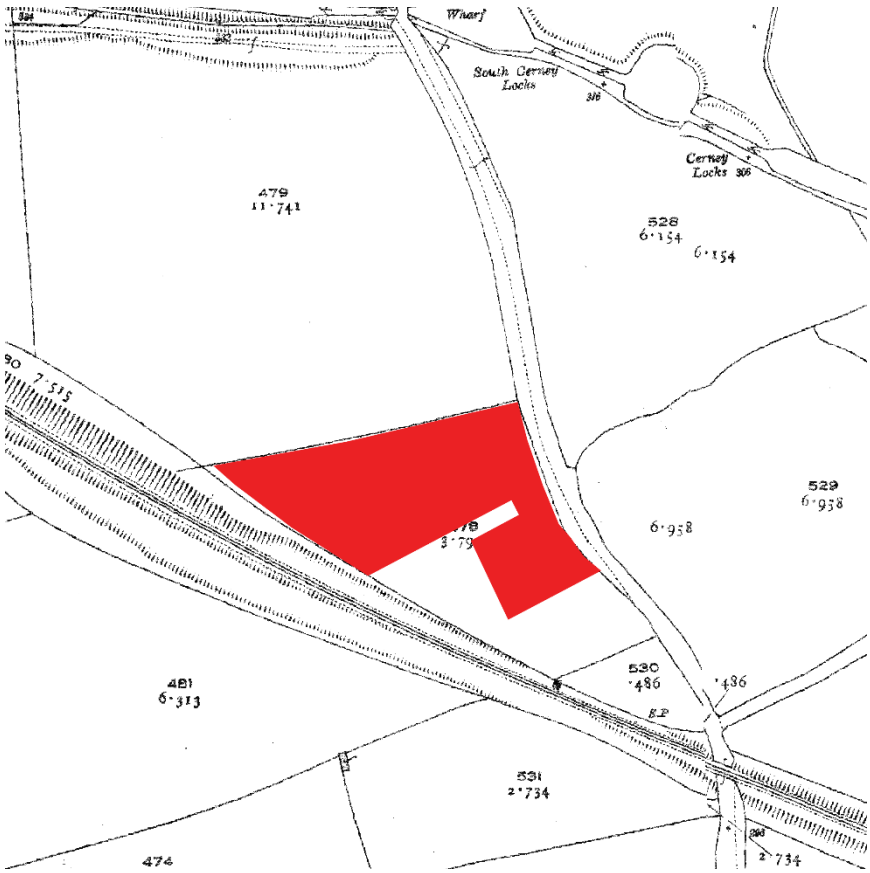


Plate 6: OS County Series Gloucestershire 1921 (Newlands plot highlighted)

Plate 7: Aerial Photograph 1946 (Newlands plot highlighted in second picture)

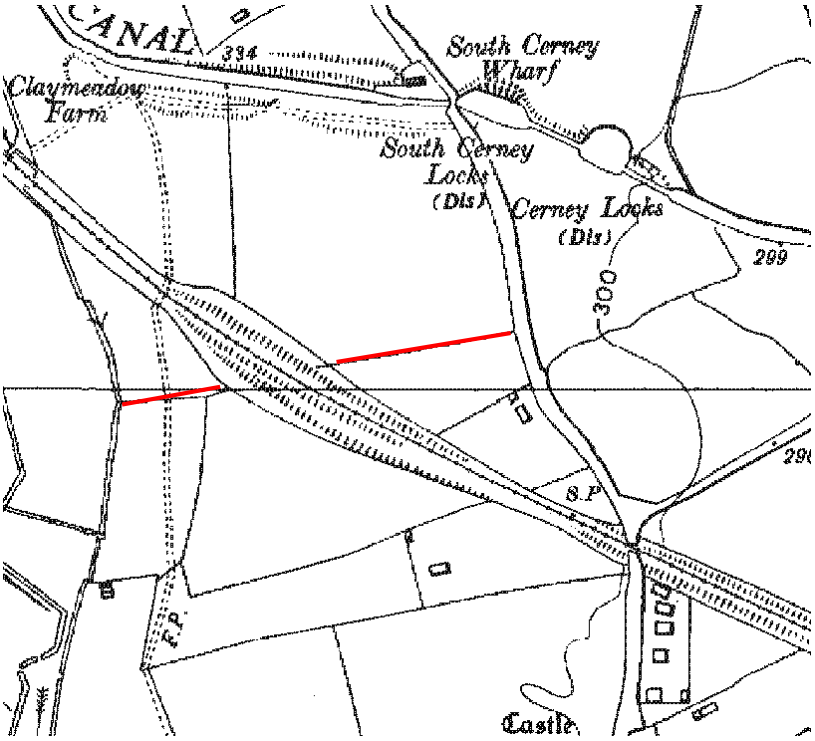


Plate 8: OS County Series Gloucestershire 1960

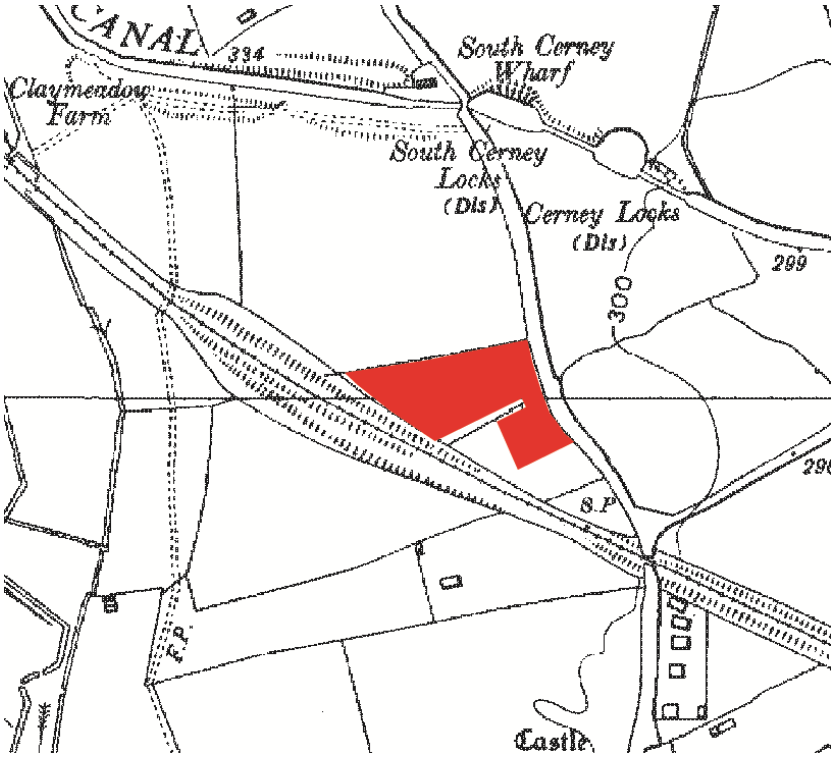


Plate 9: OS County Series Gloucestershire 1960 with Newlands in red

Plate 10: Satellite image 1999 (Getmapping imaging)

Plate 11: Satellite image 2005 (Google Earth Images)

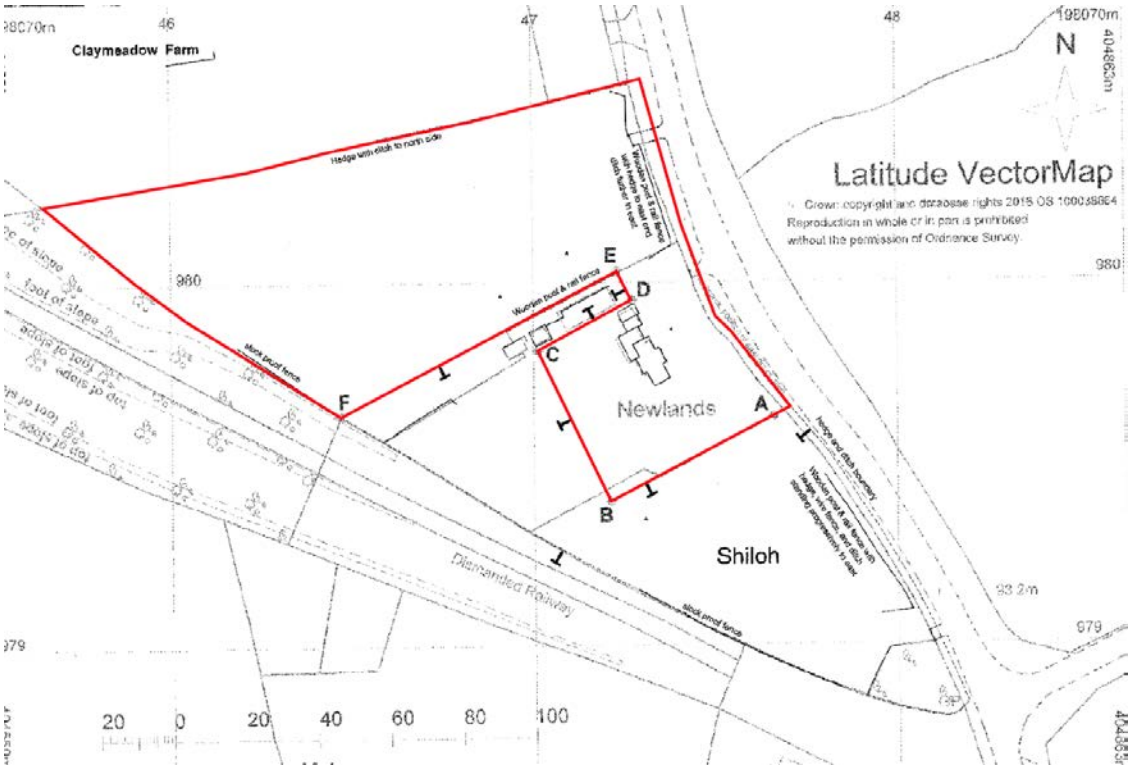


Plate 12: Modern survey plan (March 2016)

Plate 13: Detail of bank (foreground), ditch and fence. Looking north towards Claymeadow.

Plate 14: Ditch and bank (with mature hedge/treeline). The two fences (with remains of the third on the ground) which form the boundary are visible. Photo taken facing east, the sloping gradient is evident.

4 PREVIOUS ARCHAELOGICAL AND GEOPHYSICAL WORK

4.1 **GPR Survey -** In January 2016 a Ground Penetrating Radar (GPR) survey was carried out aimed at identifying any remnants of the former boundary (ditch, bank and hedge). Two survey areas were located to the west of the railway cutting and one area was situated to close to the railway cutting on the east side (now within Hill View Farm land; Plate 15). Analysis of the cartographic evidence demonstrates that the boundary in dispute (east of the railway) is a continuation of the same boundary which existed to the west of the railway prior to its removal. Although at this location the ditch was backfilled, there were surviving clues to the position of the ditch and its size and depth. Vegetation changes, land surface changes and existing trees of a similar type and age to those adjoining the existing ditch all supported evidence of its existence.

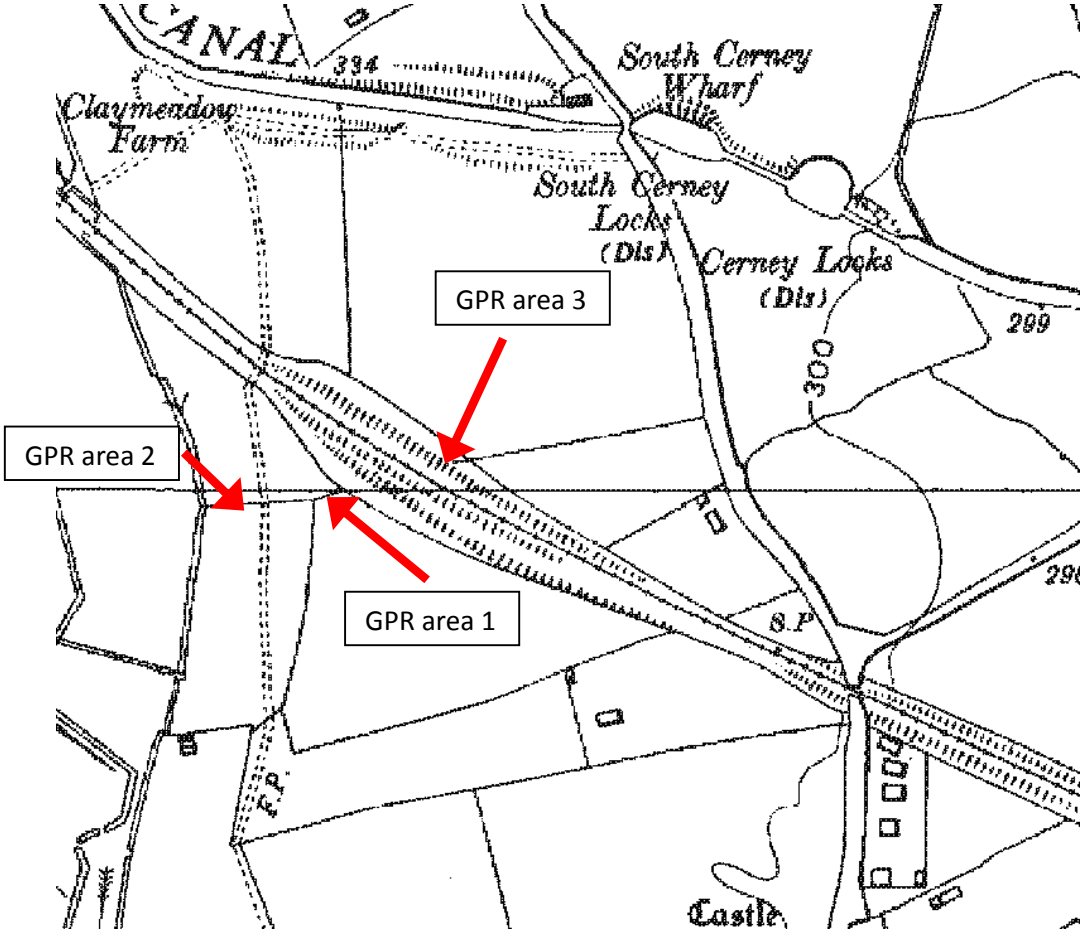


Plate 15: Survey locations for the three GPR areas surveyed in Jan 2016

4.2 The GPR survey was undertaken at a number of points along the boundary line shown on the historical maps of the field within Hill View Farm, in an area immediately adjacent to the Newlands (Plate 15; see Appendix 2 for full report). All the survey data from the area confirmed the presence of a backfilled ditch where an historical ditch is presumed to have existed, as known from the historic maps and visible cropmarks. The GPR also defined the profile of the ditch in the survey, with depths ranging from 0.56m to 0.74m. There was also evidence of anomalous material which aligned along the south bank of the ditch. This was consistent with the remains of a cut down hedge.

4.3 The hedge line survives immediately west of the Newlands property, this is associated with the ditch present on the Newlands property and indicates clearly the alignment of the ditch at this point. (Carrick Utsi 2016).

4.4 **Archaeological excavation of the adjacent Claymeadow property.** In 1996 an archaeological excavation was undertaken in advance of the construction of a small car park measuring c.15m by 30m (Plates 16 and 17). This was located in what is known as the Claymeadow property immediately to the north of the boundary and ditch in question. The excavation revealed part of a ridge and furrow field system deriving from medieval arable cultivation. In addition to this a shallow field quarry was identified, measuring 4m across by 0.4m deep, located in the far south-east corner of the excavation area. The quarry appeared to cut into the southernmost earthwork ridge and therefore post-dated it. The purpose of this was probably to provide limestone for field boundary walls. No stratigraphic relationship was observed between this field quarry, and the adjacent southern ditch. (Parry, 1996). Five ridges and four furrows were identified running in a north east to south west orientation. These were all shallow and the ridges rose to heights of 0.1m to 0.35m above the furrow bases. These recorded furrows were all orientated in the same direction, this direction appears to be subtly different to that of the boundary fence and hedge which is east to west.

4.5 The limit of the excavations to the south meant that the furrow for the southernmost ridge was not identified. The full extent of the field quarry was also not exposed. The excavations respected the post and wire boundary fence which was in existence and they did not continue past this. An older post and wire fence was recorded on the drawing but left *in situ*.

4.6 These excavations did not appear to effect the boundary fence(s) or ditch in any way. The excavations respected the longstanding fence-line. The excavation area itself was adjacent to only a small part of the boundary which continues, complete with fence, ditch, ridge and hedge in a westerly direction for a further 145m. Therefore, neither the excavation, or the introduction of the car park, could have created the ditch which is clearly visible close to the existing hedge-line.

4.7 It is to be noted that neither the ridge and furrow, or the small field quarry were dated during these excavations. It is therefore possible that they could date from the medieval period onward. As Eyre states; '*the occurrence of ridge-and furrow on the present landscape has frequently been invoked as evidence of former open-field cultivation, and since there has been little evidence of the extension of the open fields after the Black Death, the limits of ridge-and –furrow can thus be held to the same as the limits of late-medieval cultivation. Unfortunately, it has been demonstrated quite conclusively that the practice of throwing land into ridge-and-furrow persisted right up to the end of the nineteenth century and even beyond. (Eyre, 1955, 80)'.*

4.8 Therefore the ridge and furrows could have been introduced after the excavation of the ditch which certainly occurred prior to 1875 when it is recorded on the earliest available Ordnance Survey map.

4.9 The most likely scenario however, is that the presence of the ridge and furrow is unrelated to that of the ditch, which occurred after the ridge and furrows went out of use. Research has shown that after the 18th century enclosure acts which enclosed small landholdings into larger farms, ditches and hedges were thrown up often along pre-existing ridge and furrow earthworks.

Plate 16: Location of the 1996 archaeological excavation for a new car park at Claymeadow (Parry 1996)

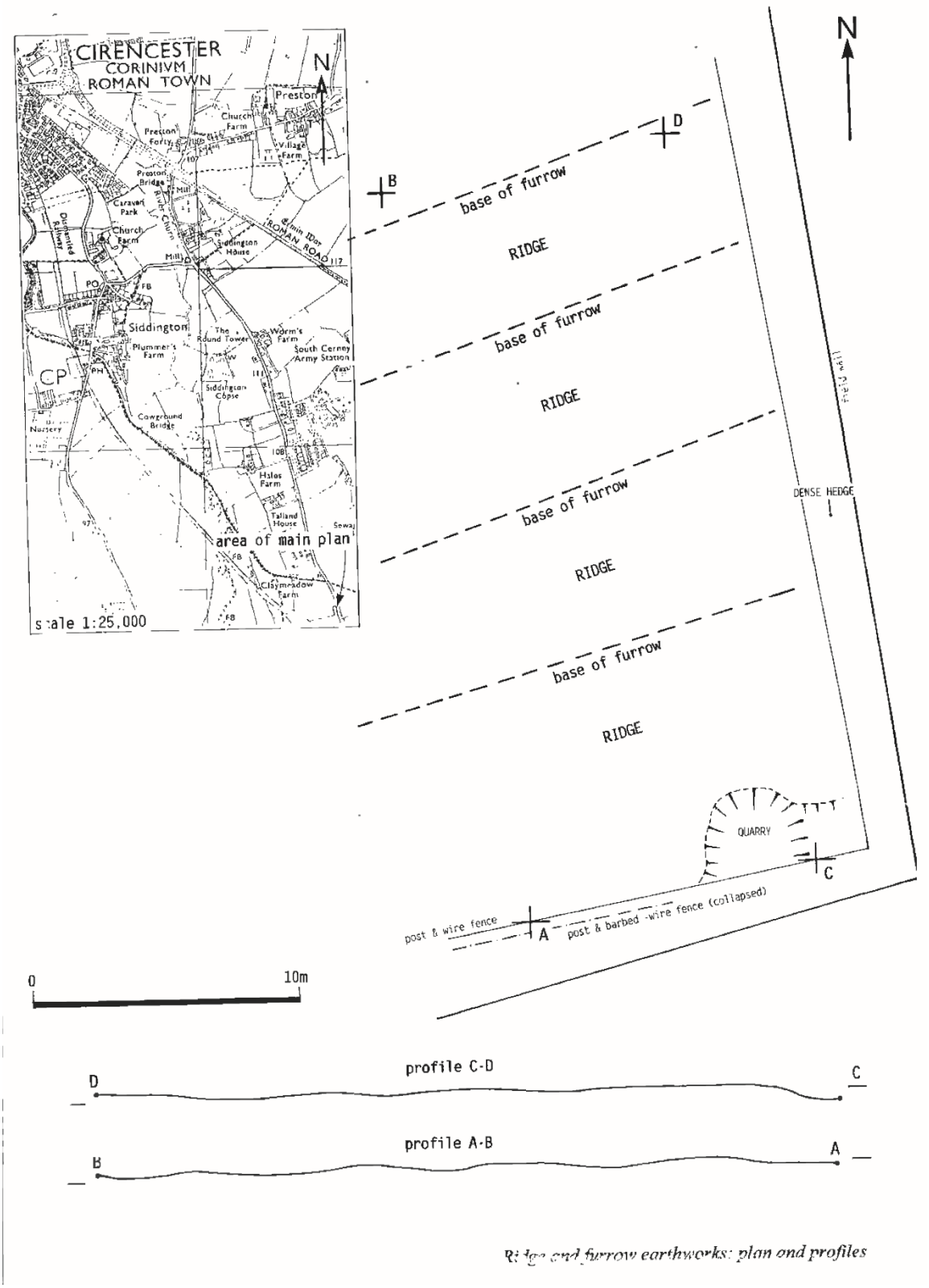


Plate 17: Illustration from the Claymeadow carpark excavation (Parry 1996). Site location (top left), archaeological feature plan (main image), site profile/section drawings (bottom image)

5 ARCHAEOLOGICAL AND TOPOGRAPHICAL OBSERVATIONS

5.1 On the southern (Newlands) side there is clear evidence of a raised bank running from west to east along the field. This raised bank can be observed along the entire length and is most obvious towards the western end.

5.2 The hedge (which is primarily made up of mature Ash) and other typical hedge plants (mixed with blackthorn, hawthorn and crab apple) grows from this raised bank. Barbed wire has been attached to some of these trees.

5.3 North of this hedgerow and bank and between the extant fences (see below, fences 2 and 3) there is a lower area which constitutes a ditch. This contains very silty and organic soil consistent with a gradual accumulation of material. Much of this is entirely silted up and waterlogging is present. There is standing water at the far eastern end nearest the road (Cirencester Road) and a stone revetment with culvert.

5.4 The boundary lies on land which visibly slopes in an easterly direction. Water flows from a stone culvert in an easterly direction. This water presumably drains from the raised land to the north and the west. The stone culvert is positioned centrally to the east to west ditch and it is constructed at a lower level than the field. It appears to function much like a terrace or revetment to hold back and regulate the flow of water, silt and debris. The water from the culvert feeds into the north-south drainage ditch alongside the road (Cirencester Road).

5.5 There is evidence of three fences to the north of this ditch. Fence 1 is no longer standing (collapsed or removed) but is still present lying on the ground and constructed of small timber posts and barbed wire. Fence 2 represents a post and wire fence and is still standing (recorded in the excavations of 1996). Similar in construction to fence 1, this was erected prior to 1996 to replace the earlier fence. Fence 3 represents a new 5ft-6ft timber palisade fence topped with wire erected in 2013. It

was erected by neighbours to the north and runs adjacent to previous post and wire fences (1 and 2).

5.6 A further obstacle has been erected along the southern side of the boundary in the form of a length of barbed wire attached where possible to the trunks of the ash hedge. At one location to the east, this has been added to by the addition of a former metal gate. This appears not to constitute a fence but a temporary barrier to protect larger animals from falling into the lower area to the north.

Evidence for the existence and survival of a ditch.

- The presence of a bank attests to the presence of a ditch as the excavated material from the latter has been used to create the former. Following agricultural traditions, a hedge was planted on the bank.

- Topographically, the ditch is more pronounced at the western end of the boundary (as is the bank) but a more subtle, shallow, silted continuation of the ditch is identifiable at the eastern end of the boundary. The presence of a culvert at the eastern end (draining into the north-south roadside ditch) and the field gradient (sloping west to east) suggests that an additional function of the ditch would appear to be field drainage.

- The furrow ditches which are recorded in both Claymeadow and Newlands fields on a number of aerial images are on a slightly different alignment to the boundary bank, hedge and ditch. In addition, the archaeological excavation in 1996 confirmed that the furrow ditches are shallow in nature.

- As illustrated in their report, the archaeological excavation in 1996 respected the fence boundary present at the time (fence 2) so the ditch would not have been disturbed in any way.

- To the west of the railway, the remains of the same boundary that is in dispute was identified and characterized by Ground Penetrating Radar. The survey identified evidence of a large boundary/drainage ditch and a removed hedge. The ditch varied in depth from 0.56 to 0.74m, although even the shallowest section of the ditch was significantly deeper than any of the furrow ditches recorded in the Claymeadow archaeological investigation in 1996.

- We are aware of further reference to the existence of a ditch to the north of the hedge as confirmed by two independent surveyors. This is referred in the Transfer of Part document (10th September 2012) at Clause 12.7 in the Property Register for Title number GR 367461:

"To the extent that there are hedges and ditches now existent along boundaries between Points J, I and H on the Plan then they are subject to the rebuttable legal presumption in respect thereof…"

6 CONCLUDING STATEMENT AND RECOMMENDATIONS

6.1 Evidence from the cartographic and photographic sources has confirmed the existence of the boundary from at least 1875. This boundary existed in the form of a hedge and ditch from this period. Observational evidence confirms that this hedge sits upon a bank, which likely originates from the excavation of the ditch. The ditch has been identified through GPR survey at its western end, just outside of the Newlands boundary.

6.2 In order to accurately record the gradient of slope which exists from west to east, and to produce an accurate profile of the visible raised bank and ditch, a topographical survey should be undertaken. Profile recording should be undertaken at more than one location across the bank and ditch to provide accurate comparison.

6.3 Confirmation of the continued presence of a boundary/drainage ditch to the north of the existing hedge-line between Newlands and Claymeadow can be completed through archaeological trial trenching. Archaeological trenching, sometimes called archaeological evaluation, represents the excavation of small, defined areas to record the archaeological features which are present. Sometimes these trenches are excavated by hand, but usually the modern vegetation and topsoil is removed using mechanical excavators.

6.4 It is our recommendation that a series of trial trenches are excavated through the boundary in order to fully record the raised bank and the ditch. Three high priority trenches should be completed through the bank and ditch and up to the current timber palisade trench fence. These would be evenly spaced out along the boundary. One of these trail trenches should be immediately adjacent to the archaeological excavation of 1996. The aims of this trench would be to confirm the extent of the archaeological excavations, the shallow quarry and the bank and ditch.

6.5 A further trial trench should also be completed within the land belonging to Hill View Farm (GPR area 3), the aim of which would be to identify the character and extent of the ditch, in support of the previous GPR information.

6.6 Excavation of these trial trenches would allow a comparison to take place between the profiles of the boundary ditch in the archaeological trenches, the recorded profiles of the furrow ditches in Claymeadow in 1996, and the profiles of the boundary ditch identified to the west of the railway by GPR survey (Appendix 2). The recorded ditch profiles will also allow a much fuller interpretation of the feature to be suggested as drainage/boundary ditches are markedly different in width and depth to other agricultural topographical features such as furrows.

6.7 Detailed recording of the stone culvert is recommended to investigate its relationship with the ditch. The culvert appears to be constructed within the profile of the ditch. Further information regarding this profile, construction technique, flow of water and

difference in ground levels should be recorded. Additional research into the origins of this culvert would be beneficial to establish date and purpose.

Centre of Archaeology 12th April 2016

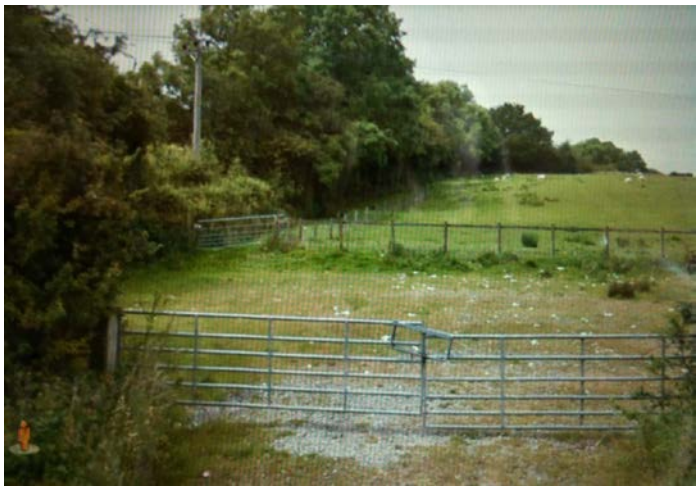
References:

Carrick Utsi, January 2016, *'Ground Penetrating Radar Survey of Three areas within Hill View Farm'*, South Cerney. EMC Radar Consulting.

Eyre R, 1955, *'The Curving Plough-strip and its Historical implications'*. The agricultural history review, pp80-94

Parry, C, 1996 *'Ridge and furrow earthworks, north of South Cerney, Gloucestershire. Report on Archaeological recording'*, September 1996. Gloucestershire County Council. Archaeology Service.

APPENDICIES



Appendix 1: Newlands hedge. Looking from Claymeadow to the south west. Pre 2012.

Appendix 2: Newlands hedge with timber removed. 2012. Looking north.

Appendix 3: Pre 1996 Post and wire boundary fence. 2012. Looking north-east

Appendix 4: Pre 1996 Post and wire boundary fence and former post and wire boundary fence as recorded in the 1996 excavation report.

Appendix 5: Pre 1996 post and wire boundary fence, ditch and bank. 2012 facing west.

Appendix 6: Pre 1996 post and wire boundary fence, ditch and bank. 2012 facing west. Detail shot.

Appendix 7: Ditch with evidence of waterlogging in 2012.

Appendix 8: Ditch with evidence of waterlogging. Eastern end of ditch.

Appendix 9: Stone culvert at eastern end of Newlands ditch which feeds into north-south roadside ditch.

Appendix 10: North south roadside ditch in flood.

EMC Radar

Consulting

Ground Penetrating Radar Survey

of Three Areas within Hill View Farm, South Cerney

for

Dr and Mrs M P Jacob

Newlands, South Cerney, Gloucestershire GL7 6HU

7th January 2016

(Draft issued 7th December 2015)

CONTENTS

SURVEY OBJECTIVE

Dr & Mrs Jacob have identified the position of an historical ditch which adjoins and continues into their property, Newlands, South Cerney, from old maps of the area. Although this ditch has been backfilled and also cut through by a railway (also no longer extant), there are some above ground clues to the position of this ditch, notably in vegetation changes, land surface changes and existing trees of a similar type and age to those adjoining the existing ditch.

This Ground Penetrating Radar (GPR) survey was carried out in order to test the existence of the backfilled historical ditch at a number of points along the lines shown in historical maps of the field SU0497 (also 5795) within Hill View Farm and along the top of the embankment of the former railway cutting immediately adjacent to the property owned by Dr and Mrs Jacob.

SURVEY STRATEGY

Use of Ground Penetrating Radar

GPR operates on the same principles as conventional radar except that it uses a wider frequency range, a shorter pulse, and a much shorter range of detection. The radar generates a short pulse which is transmitted into the ground via a transmitting antenna. The return signal is received by another (receiver) antenna. The amplitude of the returning signal provides information about changing ground characteristics with depth. The use of the radar does not affect underlying deposits: it is non-destructive.

GPR cannot identify the nature of the material through which the electromagnetic pulses pass. The signals returned to the radar are the result of changes in the electromagnetic properties between two or more adjacent materials. The amplitude (strength) of the returned signals is a measure of the magnitude of the difference between these materials rather than being a characteristic of any one material. GPR identifies backfilled ditches on the basis of electromagnetic differences between the ditch profile and the surrounding soil, usually caused by weathering and the long exposure of the ditch to open air. Backfill is identified on the electromagnetic differences between the ditch contents, the ditch profile and the surrounding soils.

It is not unusual to find that a historic ditch retains more moisture than the surrounding environment, usually because the backfill is different in nature to the surrounding soil and sometimes less compact. There are a number of potential visual indicators of a ditch which, although backfilled, continues to retain greater moisture content than the surrounding land, for example, greater vegetation growth and darker coloured grass. Since these exist, at least in some areas of the backfilled ditch, this is an indicator that GPR can be used to identify the ditch from the surrounding landscape on the basis of moisture content if nothing else.

In order to locate a linear feature such as a ditch, it is necessary for the GPR to cross the feature rather than attempt to follow it.

Equipment

The equipment used was a single channel Groundvue 3_1 with a 400MHz antenna. The

choice of frequency was determined by the expectation that the ditch, although likely to be wet, was originally relatively shallow. A 400MHz antenna has a wavelength, in dry soil, of c. 25cm, giving the possibility of identifying relatively small targets, of the order of 3cm or above.

Site Conditions

The ground was wet and the surface covered in long grass in Areas 1 and 2, and by tree roots and associated plants and tree debris in Area 3. These are not ideal conditions for GPR since it is important to keep the antennas in constant contact with the ground surface in order to ensure maximum transmission of the electromagnetic pulses (radio waves) into the ground. The radar was therefore used mounted on a protective skid and hand towed at a relatively slow speed and the survey lines were placed in positions where the grass had been suppressed to some extent. The resulting ground coupling was good in Areas 1 and 2 but poor in Area 3.

Site Coverage

Three survey lines were completed in Area 1 at the top of the hill and a further three survey lines in Area 2 at the bottom of the hill. Two survey lines were completed along the former railway embankment (Area 3). All survey lines were carried out across the expected line of the ditch, based on historical information and/or vegetation ("crop") marks (See Appendix). In all cases, whether crop marks were visible or not, the survey line was extended for several metres before and beyond the expected location. This ensures that an isolated ditch has been picked up and not one part of another type of feature (e.g. backfilled ridge and furrow).

Survey Parameters

A depth setting of 40nanoseconds was applied to all of the survey lines. In dry soil, this would be equivalent to 2m. In the site conditions, based on a calibrated velocity of 0.075m.ns, the full probing depth is 1.5m. A sampling interval of 3.88mm along the line of travel of the radar was used. An area survey was not considered necessary as the aim was to confirm the existence of the ditch at certain expected points where historic maps indicated that a ditch had formerly been present. Site surface conditions at the time of survey were, in any case, not suitable for a full area survey.

Calibration

Radars measure in nanoseconds time because the transmission velocity of radio waves depends upon the electrical and magnetic properties of the material through which they pass. Water, which has a high relative permittivity, slows down the speed of transmission.

In order to translate the nanoseconds time into centimetres/metres, it is necessary to calibrate the transmission velocity. The curve of the hyperbolas visible in the data is determined by the transmission velocity. For this survey curve fitting was used in survey lines 2 (Area 1), 8 (Area 2) and 22 (Area 3). The best fit in all three instances was 0.075m/ns which is consistent with the range of known values for wet inorganic soil.

The calibrated velocity of 0.075m/ns has been used to translate depths into centimetres.

Fieldwork

The fieldwork was carried out on Friday, 20th November 2015.

Survey Results

All of the GPR data has been processed using the following standard procedures:

- Removal of Tzero;
- Background removal to remove any constant background thus highlighting anomalous material;
- Application of gain to compensate for the decrease in signal strength with increasing depth;
- Application of a bandpass Butterworth to limit signals to those of the radar range (200MHz to 800MHz).

These are all standard procedures, routinely applied to GPR data.

Area 1: Top of the hill in Field SU0497 (also 5795)

Location of Survey Reference Points

Two survey reference points were established on concrete fence posts adjacent to the existing hedge and were marked 1 and 2 with paint. Figure 1 shows Marker 1. This is the third concrete post to the South of a distinctive tri-partite concrete post on the brow of the hill, illustrated in Figure 5.

Marker 2 lies to the North of Marker 1 and is the second concrete post South from the distinctive tri-partite concrete post (See Figures 2, 3, 4 and 5). The hedge referred to forms the western boundary between the former railway cutting and the field cf. the 1921 map in the Appendix which illustrates the historically recorded line of the railway cutting and also the ditch dividing area 483 to the North from area 481 to the South.

Since the grass was uncut and the ground surface therefore less than ideal for the purposes of the survey (risk of poor ground coupling), the first survey line, cern2 was taken along the track visible in Figure 2 above (and also in Figures 4 and 5). This track roughly follows the line of the existing hedge and fence but is not parallel to it. It was much easier to maintain ground coupling along this line than across the deeper parts of the grass.

Markers 1 and 2 on the GPR data indicate when the radar passed the two marked posts. The distance of the path from marker 1 was 3.85m and from marker 2 5.55m.

Survey line cern3 was carried out immediately adjacent to cern2. Survey line cern4 followed the same direction but was carried out at a distance of 2m to the West of cern1.

Survey line cern5 was collected along another path at the brow of the hill: see Figure 6. The start point of this survey line was 29.4m from marker 1 and 22.2m from marker 2. The end point of cern5 was at 29.55m from marker 1 and 8.6m from marker 2.

Figure 1: Marker 1.

Figure 2: Looking towards the brow of the hill and Marker 2 from Marker 1.

Figure 3: Marker 2.

Figure 4: Marker 2 in the wider context of the fence.

Figure 5: Marker 2 relative to the tri-partite post and the unmarked concrete post.

Figure 6: Track on brow of hill (marker 2 in background)

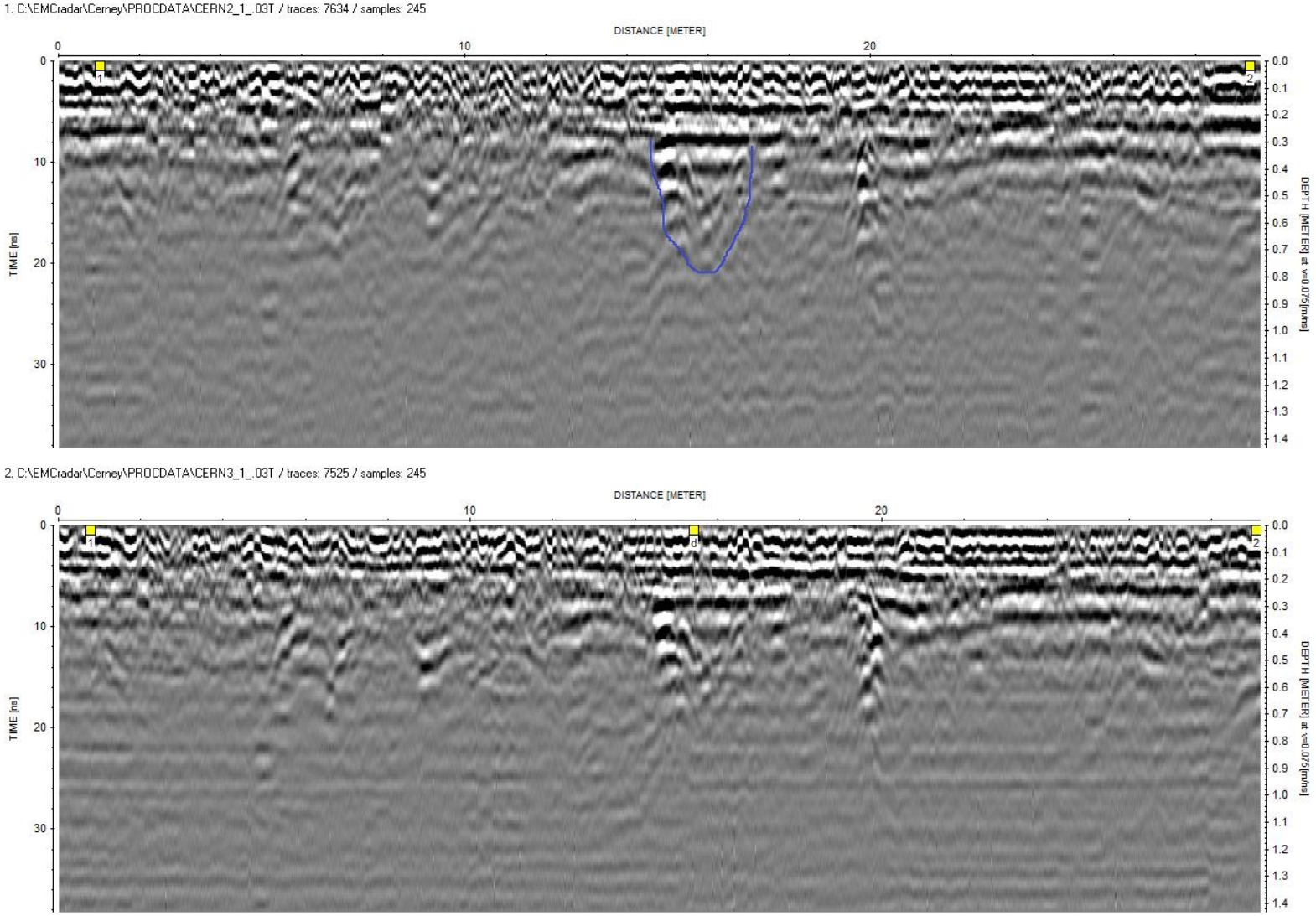


Figure7: Survey Lines 2 and 3 showing the outline of a shallow ditch (outlined in blue in line 2).

Area 1 Commentary

Figure 7 shows the data from survey lines 2 and 3. In both of these lines a shallow backfilled ditch is clearly visible, sealed in by the first 20cm of the near surface, indicating a growth of material over the top of the backfill. In line 3, marker "d" was added to the data to indicate the position of the ditch as known from historical plans and it can be seen that the positions coincide very neatly. The depth of the ditch in both plots is c. 16ns which translates to c. 74cm at the calibrated transmission velocity.

There are a number of other buried objects, indicated by various hyperbolic signals. This is as expected and will represent buried materials. The obvious example is stones but there may any amount of other material buried within the soil.

Figure 8 shows the data from survey lines 4 and 5. Line 4 was taken along a line at 2m to the West of lines 2 and 3. The marker "d" was added to the data at the time of survey to indicate the expected position of the ditch, on the basis of historical information. Line 4, the upper survey line in Figure 8, shows clearly a backfilled ditch at this point. The many black and white hyperbolas suggest that there is anomalous material in the ditch at this point. Anomalous in this case means material which is electromagnetically different from the surrounding soil and is indicated by the strength of signal, as displayed by the degree of contrast in the data. There is some ringing (echo effects) from the infill near the base of the ditch which may be obscuring the outline of the base of the ditch. The depth of the ditch at this point is c. 15ns which equates to 56cm.

Another stratigraphic dip is also visible in this same survey data, at 12.8m distance from the ditch noted above. This depression is centred on x = 5m and extends to a depth of 18.3ns (or c. 69cm at the calibrated velocity). This is very different from the previously identified ditch in that the infill material appears to be more homogeneous in electromagnetic terms.

Survey line 5 is illustrated in the lower half of Figure 8. This survey data was collected along the brow of the hill, travelling towards the boundary hedge separating the field from the line of the former railway. The outline of a ditch is clearly visible from x = 2.34m to 3.82m, x being the line of travel of the radar. The ditch appears to be somewhat deeper at this point at 18.6ns or 70cm. The outline to the right hand side (S/SW) shows a series of objects defining the side of the ditch, culminating in a faint hyperbola at the base. This also indicates the presence of electromagnetically anomalous material within the ditch infill and is therefore consistent with the previous evidence. Marker "d" was added to the data at the time of survey and indicates the expected position of the ditch, based on historical map evidence.

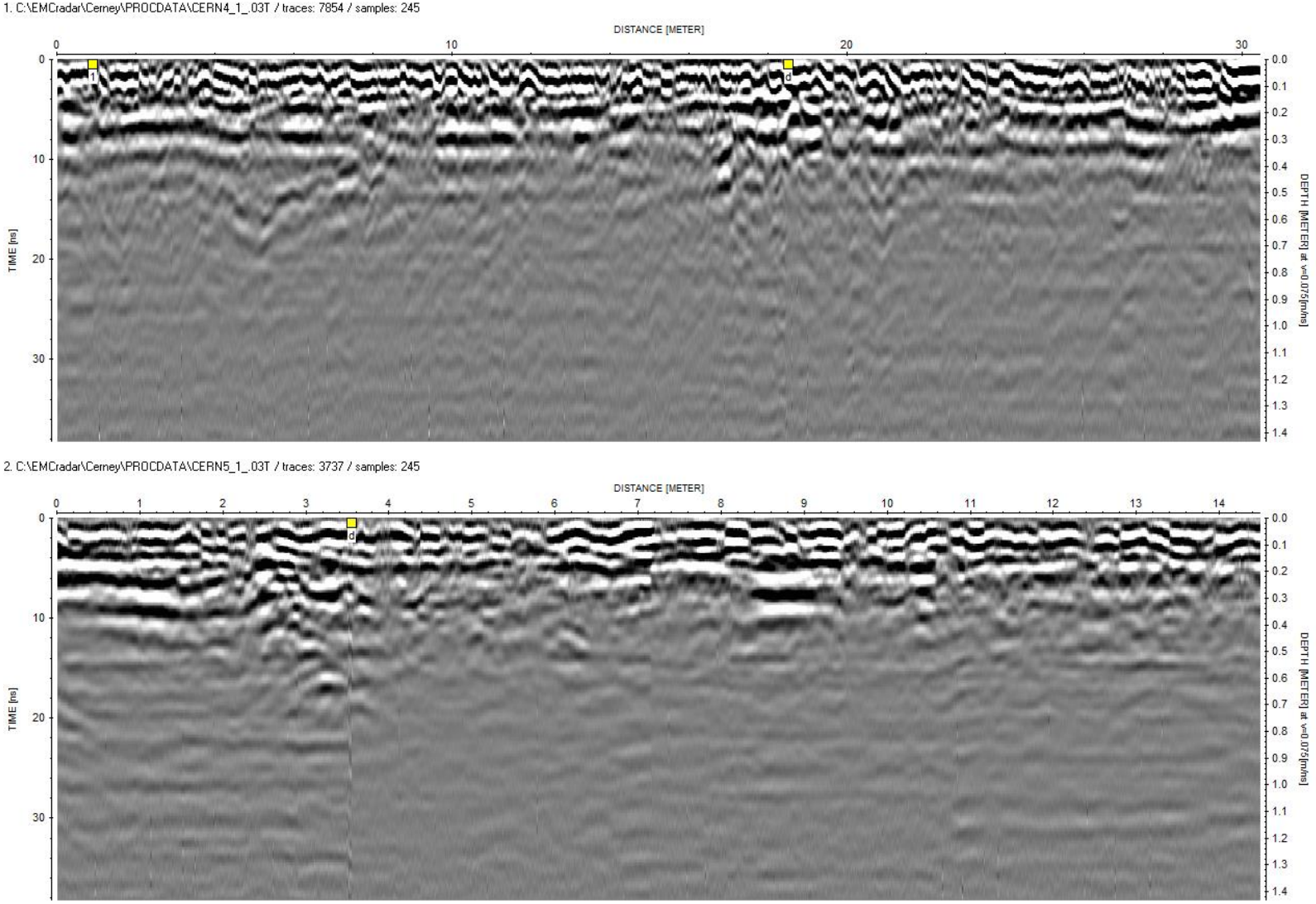


Figure 8: Survey Lines 4 and 5 illustrating a backfilled ditch at position "d".

Area 2: lower end of the hill in Field SU0497 (also 5795)

Location of Survey Reference Points

Three reference points were used to establish the start and end of survey line Cern 6. Point A was the foot of the retaining post for the main gate and point B the foot of the far post of the adjacent "kissing" gate (see Figure 9).

Figure 9: Survey Reference points A and B.

Point C was the base of a fence post easily distinguished by its central position relative to a stand of trees (see Figure 10). From the perspective of Figure 9, the fence illustrated in Figure 10 is to the left hand side (approximately West). The area tested corresponds to the western end of the ditch dividing area 483 to the North from area 482 to the South, recorded in the 1921 map of the area: see Appendix.

The positions of markers 1 and 2 were as follows.

Distance from Reference Point	To Marker 1	To Marker 2
A		82.95m
B		80.83m
C	19.45m	
Marker 2	19.45m	

Figure 11 shows the position of Marker 2 with the gate used for reference points A and B in the background. In this image, marker 1 lies behind the viewer. All survey lines have the point at which the mid-point of the radar passed markers 1 and 2 marked on the data.

Survey line Cern 6 was taken along the track adjacent to markers 1 and 2. Cern 7 was taken on the next track towards the hill. This track ran in the same direction as Cern 6 but was not parallel to it. Its position was 1.14m from marker 1 and 1.24m from marker 2.

Figure 10: Survey Reference Point C.

Figure 11: Marker 2 and the position of the survey line (track directly to the right)

Survey line Cern 8 was taken along a line further towards the hill (i.e. to the right in Figure 11) at a greater distance from the markers. At marker 1, this track lay 16.4m from the marker and at marker 2 13.2m from the marker. The position of all three survey lines were dictated by where the surface grass had been trampled or driven on so that it was possible to maintain good ground coupling. All lines are illustrated from Marker 1 to Marker 2.

Area 2 Commentary

The expected position of the ditch, originally from historical maps, was identified during the survey by the farmer who owns this field as he was able to distinguish a change in the colour of the grass. During the survey he did not have access to the screen showing the radar data but it will be seen from the data that the identified positions all correlate with the ditches detected by the GPR.

Figure 12 shows that there is relatively little material sealed beneath the near surface, particularly in comparison with the data gathered at the top of the hill. There is one single clear feature visible in both survey lines, namely a backfilled ditch. In line 6 the more southerly side shows very clearly, that to the North less so. In line 7 both sides are clear but there is also a single strong signal return on the South side of the ditch. Although it is not possible to define the material buried at this edge of the ditch since all signals are the product of change from one material to another, this evidence is consistent with a ditch lying to the North of a hedge which has been cut back and left to decompose. If this interpretation is correct, the change of material in Line 7 would be likely to be from soil to a tree stump and the material in line 6 could potentially represent wood remains left in the ditch as part of the backfill.

Survey line 8 is consistent with survey lines 6 and 7 and clearly shows a single backfilled ditch at the expected position (Figure 13). The ditch is outlined by 3 strong hyperbolic returns: one on either side and one at the base.

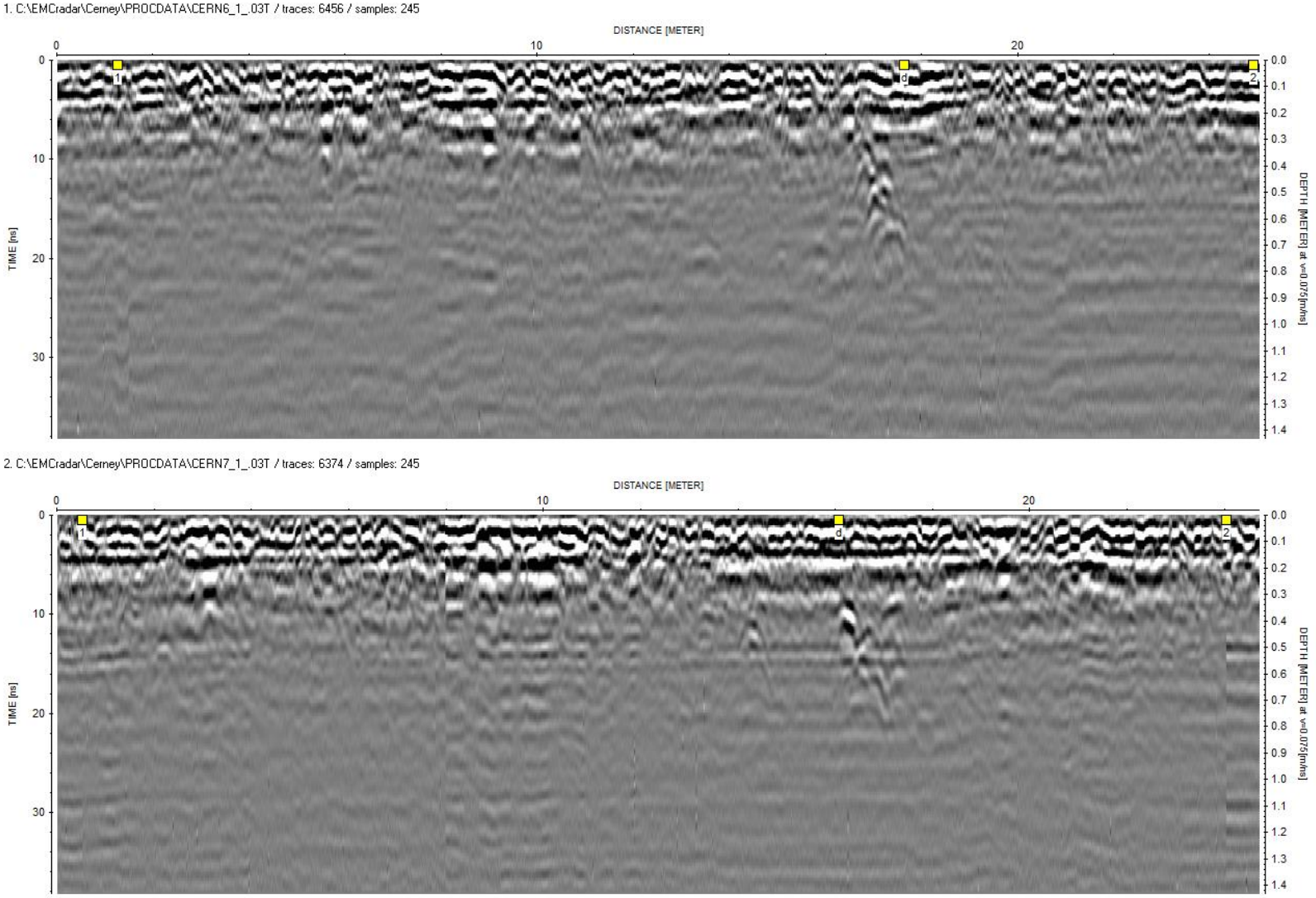


Figure 12: Survey Lines 6 and 7 showing a shallow ditch in the expected location.

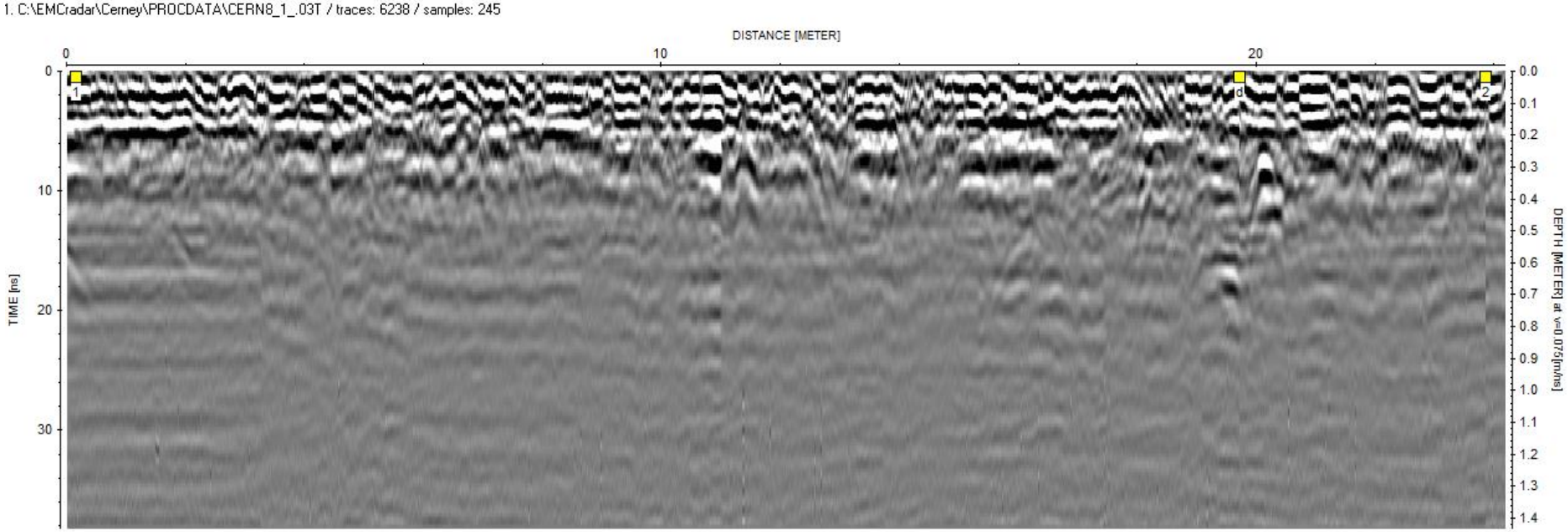


Figure 13: Survey line 8 showing the position of the backfilled ditch.

Area 3: Former Railway Embankment, to the East of Field SU0497 (also 5795).

It can be seen from Figures 14 and 15 that the existing hedge and ditch continue into the area of the former railway embankment. Although the ditch is not visible at ground surface level, the older trees continue the line of the existing hedge. The tree with two markers in front of it in Figure 14 is one of the continuations, as can be seen from Figure 15, the view towards the existing hedge from this same tree. The 1921 map in the Appendix to this report also suggest continuity into this area. It was extremely difficult to survey in this area because of the irregular nature of the ground and the amount of surface debris. Tree roots protruding into the surface proved particularly problematic. This area contained a much higher clay content than either Areas 2 or 3. Unfortunately, wet clay is one of the conditions which can potentially make it difficult to deploy GPR. If sufficient ionised material is present and also the means of mobility, the electromagnetic pulses pass into the ground as a weak electric current which is then dissipated, a process known as Attenuation. Since little or no signal is returned to the Receiver antenna, there is little or no data on which to form an opinion. Most clays provide the requisite ion content and water the mobility. It is possible that better results could be obtained when this soil dries out.

The centre of this line of trees was taken as the marker for the purposes of this survey attempt (the second marker 1 in the data in Figure 16.

Area 3 Commentary

Two survey lines were attempted, both are presented as running from SE to NW along the path at the top of the embankment (Figure 16). Neither is wholly satisfactory. This is due to the rough terrain as well as to the presence of a relatively high proportion of wet clay. The former is evidenced by the lift off of the antenna (presumably over a tree root) and by a series of abrupt changes for the full depth of the data which suggest that the encoder wheel was becoming jammed occasionally. The strong striping effect across both data sets is strongly suggestive of a high level of attenuation. These repeat signals are effectively echo effects (ringing) and not real strata.

Provided that either the ion content (clay) can be reduced or the means of mobility (water) removed, it might be possible to survey this area again. Clearly the clay content cannot be removed but a GPR survey is likely to be more successful when the embankment has dried out. However, it is very doubtful if this is actually necessary given that the continuity observable in the line of old trees associated with the ditch on the other side of the fence indicates clearly the alignment of the ditch at this point.

Figure 14: Continuation of tree line from extant hedge and ditch.

Figure 15: Continuity of the hedge.

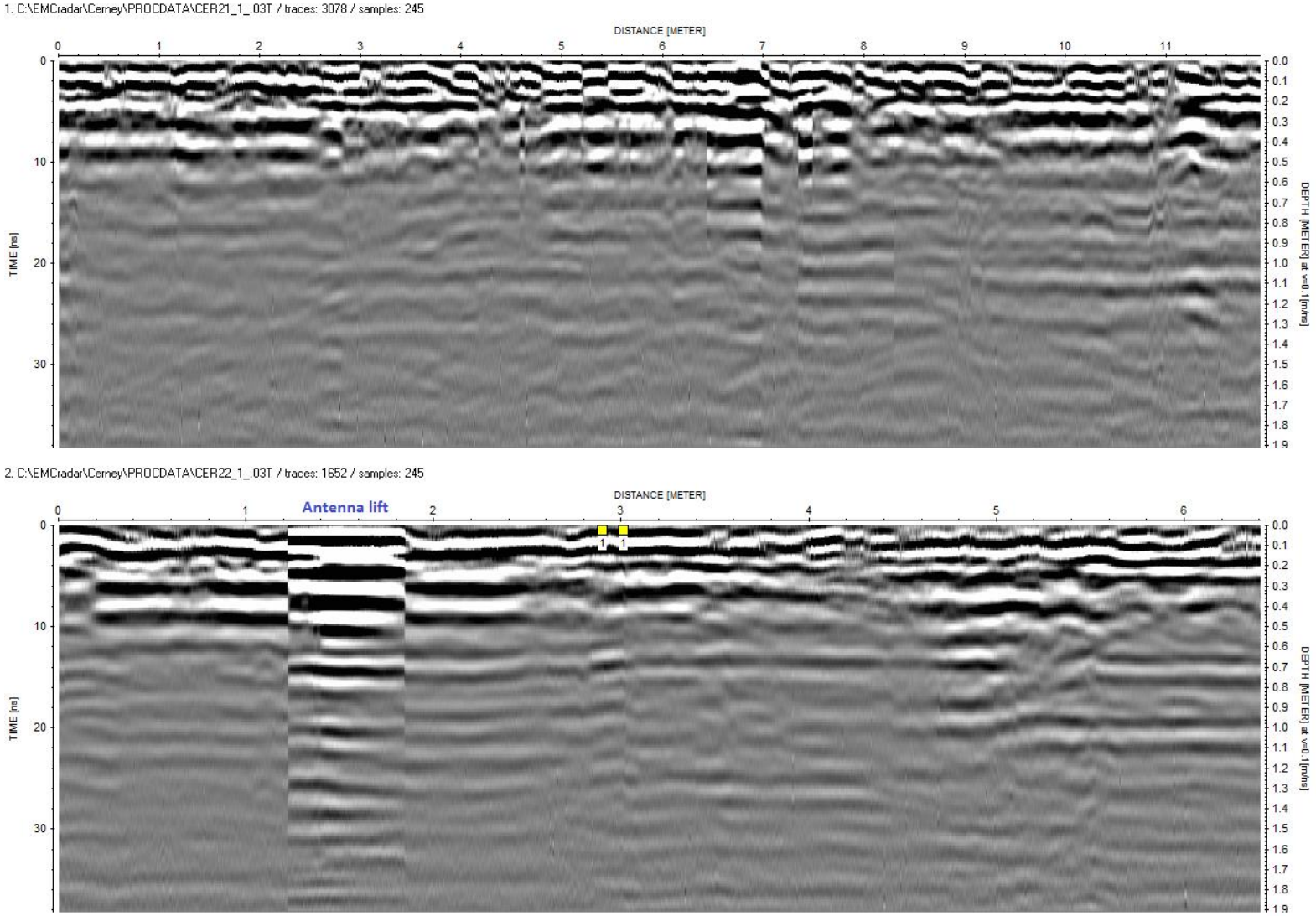


Figure 16: Survey lines 21 and 22 showing the unsuitability of the terrain.

CONCLUSIONS AND RECOMMENDATIONS

All of the survey data from Area 1, the top of the hill, and Area 2, the foot of the hill, in Field SU0497 (also numbered 5795) shows the presence of a backfilled ditch in the area where a historical ditch is presumed to have existed from the historical maps of the field and also, where applicable, from crop marks visible in the vegetation (currently grass). This survey therefore confirms the existence and backfilling of this ditch. It is notable that one characteristic of this ditch is the presence of anomalous material in the backfill i.e. anomalous in electromagnetic terms relative to the surrounding soil.

In Area 2 there is some evidence that part of the anomalous material aligns along the South bank of the ditch. Although it is not possible to be prescriptive about the nature of this material, the evidence is consistent with the remains of a cut down hedge left in situ.

It was not possible to reach a conclusion on the basis of the GPR data in Area 3 for the reasons given in this report, primarily unsuitable wet soil with a high clay content but also unsuitable surface conditions. However this does not appear to be critical given the good visibility of the hedge across the top of the embankment and the association of this hedge with the ditch on the other side of the eastern fence.

Further Information

Any queries arising from the content of this report or the GPR survey to which it refers should be addressed in the first instance to Mrs Erica Carrick Utsi, EMC Radar Consulting.

EMC Radar Consulting
13 West End
Haddenham
Ely
Cambridgeshire
CB6 3TD

Tel: 01353 741033

e-mail: erica@emcradar.co.uk

Appendix: 1921 Map showing the ditch line tested (between 483 to the North and 481/482 to the South)