Proposed extension to burial ground at St Nicholas Church, Studland, Dorset

NGR SZ03688257

Results of an archaeological evaluation

Prepared by:
Stephen Robinson

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archaeology

PROPOSED EXTENSION TO BURIAL GROUND AT ST NICHOLAS CHURCH, STUDLAND, DORSET (NGR SZ03688257)

Results of an archaeological evaluation

Summary

An archaeological evaluation, by trial trenching, on land at St Nicholas Church, Studland, Isle of Purbeck, Dorset (SZ03688257), was carried out by AC archaeology during May 2011, in order to assess the archaeological potential of the site of a proposed burial ground extension. The evaluation followed an earlier geophysical survey, by gradiometer, which identified a number of magnetic anomalies, or areas of magnetic disturbance, thought to derive from buried archaeological deposits. Extensive evidence for archaeological activity of Late Iron Age / Early Romano-British date was encountered in three of the trenches, situated in a low-lying area at the south extent of the site. This included artefacts relating to industrial activity in the form of salt working. A quantity of Late Iron Age pottery was recovered from two of these trenches where a significant number of archaeological features was encountered, including part of a large probable enclosure ditch. Full excavation of these deposits within the trial trenches was not possible due to safety constraints.

1. INTRODUCTION

1.1 This report sets out the results of an archaeological field evaluation on land at St Nicholas Church, Studland, Dorset (SZ03688257). The location of the site is shown on Fig.1.

1.2 The evaluation, carried out by AC archaeology during May 2011, was commissioned by Studland Church Lands Trust. It comprised a geophysical survey (Appendix 1) and trial trenching. It was undertaken in order to provide supporting information for a planning application for the change of use of agricultural land to burial ground, and was requested by Purbeck District Council, as advised by the Dorset County Council Senior Archaeologist (DCCSA).

1.3 The site comprises 0.641 hectares of pasture field situated immediately east of St Nicholas Church. The ground slopes down gently to the south and lies between 26m and 29m OD. The underlying geology comprises Tertiary Sand and Gravels of the Poole Formation.

1.4 The aim of the investigation was to identify the presence or absence of archaeological deposits on the site by the least destructive means and to determine their date, nature, function and degree of survival, thus determining whether the site contains overriding archaeological constraints to development.

2. ARCHAEOLOGICAL BACKGROUND

2.1 Although there are no previously recorded sites and monuments within the proposed extension area, burials of Romano-British origin were discovered in 1881, when rebuilding of the church and the extension of the present graveyard was undertaken. Further inhumations, comprising two cists burials were discovered in 1951 and 1955.

3. METHODOLOGY

3.1 The evaluation comprised the machine-excavation of eight trenches, representing a 2% sample of the site. Six of the trenches measured 10 x 1.6m, with the remaining two 5 x 1.6m in plan. Two of the trenches (Trenches 7 & 8) contained deep soils, in excess of 1m. The nature of these loose sandy soils and the proximity of the excavated spoil, making the trench edges unstable, resulted in archaeological deposits in both of these trenches recorded in plan only. This was agreed on site with the DCCSA. The location of the trenches as excavated is shown on Fig.1.

3.2 Topsoil and subsoil was removed by mechanical excavator working under constant archaeological supervision. Machining ceased either where archaeological deposits or natural geology was encountered. Relevant sections and trench surfaces were cleaned by hand to clarify the deposit sequence.

3.3 All deposits revealed were recorded using the standard AC archaeology pro-forma recording system, comprising written, graphic and photographic records, and in accordance with AC archaeology's *General Site Recording Manual, Version 1.* Detailed sections and plans were produced at 1:10 or 1:50. All site levels relate to Ordnance Datum located on St Nicholas Church and with a value of 30.93m OD.

3.4 The archive has been prepared using the site code ACW 350.

4. RESULTS

4.1 Introduction

Four of the eight trenches (Trenches 1, 5, 7 & 8) contained archaeological deposits, most notably Trenches 5, 7 & 8, where deposits and subsoil features of Late Iron Age to Romano-British date were encountered. Some of this activity appears to be associated with salt working. Although not fully investigated, deposits and features exposed in Trenches 7 and 8 clearly represent ancient occupation on the site, and of at least two phases, including part of a probable large ditched enclosure. None of the features observed could be clearly related to specific magnetic anomalies recorded as possible archaeological features on the geophysical survey. Trenches which contained archaeological features are described in text. Trenches deemed to be 'Negative' (i.e. not containing subsoil features), are summarised in table form only.

4.2 **Trench 1** (Plan Fig. 2a; section Fig. 2b – c; Plate 1)

This trench was NW-SE aligned and measured 10 x 1.6m in plan and positioned on ground sloping down gently to the south. A maximum depth of 500mm was excavated through topsoil, revealing two features, one of possible Romano-British origin and one of medieval origin and both cutting through natural subsoil. The layer sequence for this trench is described in Table 1.

Table 1: General depositional sequence in Trench 1

Context No	Depth b.g.s.	Description	Interpretation
100	0 - 500mm	Dark grey-black sandy loam.	Topsoil
101	150 - 400mm+	Mixed yellow or grey sandy clay.	Natural

Feature F103

This feature was linear in plan on a northeast to southwest alignment. It was 0.4m wide and was present within the trench for a length of 1.6m. It had a gentle sloping profile and slightly rounded base at a depth of 100mm. It contained a single fill 102, composed of a dark grey-black silty sand containing sparse small chert gravels and charcoal flecks. Due to the similarity in fill composition with the overlying topsoil, it could not be determined at what level this feature was cut from. A single sherd of Romano-British pottery was recovered from this feature.

Feature F105

This feature was sub-circular in plan with a maximum diameter of 0.35m. It had steep to moderately sloping profile and concave base at a maximum depth of 200mm. It contained a single fill (104), composed of slightly mixed dark grey-black / yellow sandy dark grey silty clay, containing sparse small chert gravels and charcoal flecks. This feature represents a former post-hole. A single sherd of medieval pottery was recovered from this feature.

Plate 1: Trench 1 – view from the SE

4.3 **Trench 5** (Plan Fig. 2d; sections Figs. 2e – f; Plate 2)

This trench was aligned approximately NE-SW aligned and measured 10 x 1.6m in plan and positioned on ground sloping down gently to the south. A maximum depth of 650mm was excavated through topsoil and subsoil, before a spread of material containing large quantities of fired clay was revealed (505). Two slots were excavated through this deposit (502 & 503), one of which revealed remnants of a burnt clay structure, representing part of a hearth (504). Fragments of briquetage (salt boiling vessels) were found associated with the deposits and indicates that the hearth may be associated with salt working on the site. The layer sequence for this trench is described in Table 2.

Table 2: General depositional sequence in Trench 5

Context No	Depth b.g.s.	Description	Interpretation
500	0 - 450mm	Light greyish brown sandy loam.	Topsoil
501	450 - 650mm max	Dark greyish brown clayey sand with occasional gravels.	Subsoil – colluvium
505	650 - 950mm max	Dark greyish black clayey sand with large quantities of fired clay fragments and occasional gravels and heathstone pieces.	Unclear in nature but containing components associated with salt working on the site.
506	950mm+	Yellowish brown / white -sandy clay / sand with occasional gravels.	Natural

Plate 2: Trench 5, showing deposits 504 / 505

4.4 **Trench 7** (Plan Fig. 2g; section Fig. 2h; Plate 3)

This trench was aligned approximately NW-SE aligned and measured 10 x 1.6m in plan and positioned on level ground in the most low-lying area of the site. A maximum depth of 1.25m was excavated through topsoil, subsoil and a deposit representing an occupational horizon before a number of archaeological features of Late Iron Age or Romano-British date was revealed. A small quantity of pottery sherds was recovered from the base of the trench. None of these features were investigated and were recorded in plan only. These features and the layer sequence for this trench is described in Table 3.

Table 3: General depositional sequence and feature descriptions in Trench 7

Context No	Depth b.g.s.	Description	Interpretation
700	0 - 550mm	Light greyish brown sandy loam.	Topsoil
701	550 - 950mm max	Dark greyish brown clayey sand with occasional gravels.	Subsoil – colluvium
702	950mm – 1.25m max	Dark greyish black silty sand with occasional heathstone, ironstone and flint/chert nodules, sparse charcoal flecks.	Occupational horizon – Late Iron Age/ Romano-British in origin.
704	1.25m+	Curvilinear feature – 3m x 0.25m exposed in plan and composed of mid-grey silty sand with sparse flint nodules and charcoal flecks.	Gully.
705	1.25m+	Small sub-circular feature – 0.3m diameter in plan and composed of dark grey-black silty sand with sparse heathstone pieces and charcoal flecks.	Post-hole ?.
706	1.25m+	Concentration of heathstone and ironstone pieces, most of which show burning /scorching on surface and covering an area of approximately 1.2m in plan.	Unclear, but possible remnants of hearth-like feature ?.
707	1.25m+	Curvilinear/linear feature – 1.6 -2.7m x 1.15m exposed in plan and composed of dark grey-black silty sand with occasional flint/chert nodules, heathstone and charcoal flecks.	Appears as junction of large ditched enclosure.
703	1.25m+	Yellowish brown / grey -sandy clay / sand with occasional gravels.	Natural

4.5 **Trench 8** (Plan Fig. 2i; Section Fig. 2j; Plate 4)

This trench was aligned approximately NW-SE aligned and measured 10 x 1.6m in plan and positioned on level ground at the most low-lying area of the site adjacent to Trench 7. A maximum depth of 1.15m was excavated through topsoil, subsoil and a deposit representing an occupational horizon before a number of archaeological features of Late Iron Age – Romano-British origin were revealed. A small quantity of pottery sherds was recovered from the base of the trench. None of these features were investigated and were recorded in plan only. These features and the layer sequence for this trench is described in Table 4.

Plate 3: Trench 7 – view from the SE

Table 4: General depositional sequence and feature descriptions in Trench 8

Context No	Depth b.g.s.	Description	Interpretation
800	0 - 550mm	Light greyish brown sandy loam.	Topsoil
801	550 - 850mm max	Dark greyish brown clayey sand with occasional gravels.	Subsoil – colluvium
802	850mm – 1.15m max	Dark greyish black silty sand with occasional heathstone, ironstone and flint/chert nodules, sparse charcoal flecks.	Occupational horizon – Late Iron Age/ Romano-British in origin.
804 - 810	1.15m+	Seven sub-circular features – 0.3m – 1m in diameter where exposed in plan, three of which were not so well-defined (Fs805, 806 & 810) All composed of dark grey-black silty sand some with occasional / sparse flint gravels, heathstone and charcoal flecks.	All with the exception of F809, which possibly represents part of a pit, appear to represent post-holes.
803	1.15m+	Yellowish brown / grey -sandy clay / sand with occasional gravels.	Natural

Plate 4: Trench 8 – view from the SE

4.6 'Negative' trenches

Table 5: Summary of trenches with no subsoil archaeological features

Trench	Depth below ground	Contexts	Description
2	0 - 200mm 200mm+ 200mm+	Topsoil - context 200 Infilling - context 201 Natural - context202	Approximately N-S aligned and 5 x 1.6m in plan. Positioned across moderately steep terrace representing line of former modern/post-medieval hedgerow-ditch boundary, now infilled. Topsoil composed of dark grey-black sandy loam. Infilling composed of mixture of topsoil and natural and containing wood , coal, cinder etc. Natural subsoil composed of yellow -grey sandy-clay / sand. Modern trench backfill also present at far north extent of trench.
3	0 - 300mm 300mm+	Topsoil - context 300 Natural - context301	Approximately E-W aligned and 5 x 1.6m in plan. Positioned on generally level ground. Topsoil composed of dark grey-black sandy loam. Natural subsoil composed of yellow -grey sandy-clay / sand with occasional gravels.
4	0 - 300mm 300mm+	Topsoil - context 400 Natural - context401	Approximately E-W aligned and 10 x 1.6m in plan. Positioned on generally level ground. Topsoil composed of dark grey-black sandy loam. Natural subsoil composed of yellow -grey sandy-clay / sand with occasional gravels.
6	0 - 400mm 400 - 650mm 650mm+	Topsoil - context 600 Subsoil – context 601 Natural - context602	NW-SE aligned and 10 x 1.6m in plan. Positioned on ground sloping down gently to the south. Topsoil composed of dark grey sandy loam. Subsoil composed of dark brown silty sand .Natural subsoil composed of yellow -grey sandy-clay / sand with occasional gravels.

5. THE FINDS
By Emma Firth

5.1 Summary

A moderate quantity of finds was recovered of predominately Late Iron Age/Early Roman date (70BC to AD75). Overall, all the finds are in good condition and show little signs of abrasion. Much of the pottery is of the mid 1st century transitional phase. Most notable in the assemblage is a range of material associated with the salt making industry, and includes fragments of briquetage and kiln furniture recovered from a dark deposit within Trench 5. The presence of this material indicates salt making is being carried out either on or in the very near vicinity of the site. Other finds from this trench includes late 1st century BC pottery, including the base of a Durotrigan bowl and a bead rim from a bowl. Flint was also recovered in smaller quantities; possibly indicating the presence of other industries, such as shale working, being carried out at the site.

5.2 Introduction and methodology

All finds recovered on site have been retained, cleaned and marked where appropriate. Finds were then quantified according to material type within each context. The assemblage was then scanned by context to extract information regarding the range, nature and date of artefacts represented. This information is briefly discussed below. The finds are discussed by material type, summarising the nature, date range and condition of the artefacts. The finds are quantified by material type and by context in Table 8.

5.3 Worked Flint

A total of nine pieces (350g) of flint was recovered during the evaluation. All of the flint is locally derived from the chalk and is fresh looking and consists predominately of flakes. There are no tools present. The flint was distributed in very small quantities within Trenches 5, 6 and 7.

The flint assemblage comprises the following:

Context	Description
505	Large squat flake
600	Flake
709	X1 cortical flake and x1 large flake
811	X1 flake with possible retouch and x1 flake

This unsystematic material is commonly found in association of sites of this date in the area and may have a general function for cutting or trimming, particularly if shale was being worked at the site. Even in the absence of any shale having been recovered at this site; the flint is still characteristic of this type of sites - sites yielding briquetage also showed evidence of shale production, as discussed by Farrar (1975). Evidence for several industries being carried out at one site is present at the nearby

site of Ower, where material associated with shale working and salt making industries were found (Cox in Woodward, 1986).

5.4 Worked stone

A single fragment (513g) of mudstone was recovered from context 503. The stone has been imported onto the site, though there is no evidence, such as grooves or worn surfaces, to suggest its use.

5.5 Ceramic building material

Two pieces (108g) of conjoining tile was recovered from the topsoil (context 600) within Trench 6. The tile is of an oxidised, sandy fabric and it is possibly handmade. Secure dating of this tile is problematic as there are no diagnostic features and the fabric and form of this type of object changes little through time. The tile does show evidence of knife trimming on its surface and it is considered to be of medieval date.

5.6 Briquetage and associated fired clay objects

A total of 33 pieces (703g) of fired clay and briquetage was recovered, all of which was recovered from three layers within Trench 5. The briquetage and associated fired clay objects are all associated with the salt making industry and similar objects have been found on sites within the Purbeck area.

Overall, the assemblage of briquetage and fired clay objects is in good condition and is dominated by props or bars and smaller undiagnostic vessel sherds. No rims or bases of vessels were observed in the assemblage. All the briquetage and associated material was recovered from Trench 5, within contexts 502, 503 and 503. The assemblage is quantified below in Table 6:

Table 6: Summary of Briquetage and fired clay

	Briquetage		Fired Clay Objects (rods)		Undiagnostic fired clay		Total number	Total weight
Context	No	Wgt (g)	No	Wgt (g)	No	Wgt (g)		
502	-	-	1	74	3	111	4	185
503	7	95	9	945	10	45	26	1085
505	6	50	2	175	5	57	13	282
Total Type	**13**	**145**	**12**	**1194**	**18**	**213**	**43**	**1552**

A total number of 13 sherds (145g) of briquetage was recovered from contexts 503 and 505 within Trench 5. All the sherds are small and though no diagnostic pieces such as rims or bases are present, they have been identified as being Fitzworth types (Farrar, 1975).

Rods and bars

The fabric of all the fired clay objects is a red fabric, heavily tempered with sub rounded white or pink quartz inclusions and sometimes having shale/mudstone inclusions. This fabric is the type known as Fitzworth and is comparable with material found at Ower (Hawkes, 1986) and Wytch Farm (Cleal, 1991). This fabric is very similar in appearance to the local pottery fabrics used for the BB1 pottery industry, produced from the locally available clays.

Circular sectioned props or bars, which taper to a rounded end, were recovered from layers within Trench five. This includes seven broken props from context 503; two fragments of props from context 502 and one prop fragment from context 503. These props are very regular in shape with smooth surfaces, unlike the examples from Ower which appear more irregular and with finger impressions. The generally have a diameter of 40mm, though one was noted with an oval section which measured 30mm at its narrowest and 40mm at its widest point. A fragment of bar from context 502 is of the same diameter as the other bars, but has been cut in half and has a u-shaped profile. No comparable object has been found, u-shaped spacers were noted at Ower, though their form was more crude and poorly executed that this example, which has even, smooth surfaces.

Two bar fragments, one with a rectangular section tapering to a slightly rounded end were recovered from context (503), and a section bar which is broken at either end from context (505). These fragments are comparable to the Type C kiln bars from Ower (Hawkes, 1986, Fig 51:207). The props or bars may have been used to support vessels used in the process of evaporation of salt.

A total of 18 small fragments (213g) of undiagnostic fired clay was recovered from contexts 505 and 503. The fired clay probably derives from kiln lining and is visually distinctive from the kiln furniture by the absence of any temper.

Plate 5: examples of briquetage objects

5.7 The Pottery

A total of 74 sherds (1090g) of pottery was recovered, with a mean sherd size of 14g. The sherds are generally in a good, fresh condition, although there is some evidence of abrasion on some surfaces. The date range of the sherds shows there was activity at the site from the Late Iron Age through to the early Romano-British period but that this date range extends no later than the Flavian period. Table 7 quantifies the pottery by period within each context, and Table 9 outlines the range of fabrics and forms present within each context.

Table 7: Summary of pottery by period

Context	Late Prehistoric		Late Iron Age		Romano-British		Medieval		Post Medieval		Total No	Total Wgt (g)
	no	wgt (g)	no	wgt (g)	No	wgt (g)	no	wgt (g)	no	wgt (g)		
102					1	2					1	2
104							1	3			1	3
300									2	14	2	14
400					1	1			1	18	2	19
503	2	10	26	552							28	562
505			17	137	3	106					12	242
709			4	57	2	45					6	102
811			5	66							5	66
Grand Total	**2**	**10**	**52**	**812**	**7**	**154**	**1**	**3**	**3**	**32**	**57**	**1010**

Late prehistoric

A total of two sherds (10g) of later prehistoric pottery were recovered from context 503. Both sherds are small and of a fine sandy fabric and one sherd is decorated with two parallel incised lines. The sherds are tentatively dated as Iron Age date.

Late Iron Age pottery

The bulk of the pottery, 52 sherds (812g) is of Late Iron Age date, and consists predominately of a ware commonly referred to as Durotrigan ware – a coarse quartz tempered fabric. Most of the assemblage was recovered from Trench 5 (contexts 503 and 505) and is associated with the briquetage and fired clay. Many of the sherds show evidence of smoothing and wiping and burnished wares are also present. None of the sherds appear to have decoration and the majority of the sherds are thought to derive from jars. Few forms were present, except for a bead rim from a small bowl (Lancley and Morris, 1987, Type 102, Fig 59, 36-39) and a foot ring (also from a Type 102 bowl). These have a date range from the 1st century BC to 1st century AD. All the vessels are handmade.

Other Late Iron Age fabrics include finer sandy wares, with thicker walls and a distinctive leached calcareous fabric recovered from context 709. One sandy sherd

has faint traces of a red (haematite?) coating. A single grog tempered sherd was recovered from context 811, and this is possibly also of Late Iron Age date.

Romano-British pottery

A total of seven sherds (154g) of Romano-British pottery was recovered. The sherds are mainly undiagnostic BB1 sherds, although three conjoining sherds of amphora were recovered from context 505. The amphora is Dressel 2-4 and was produced in Italy and is dated as 1st century AD. A 1st century type everted bead rim from a jar was present in context 505.

Table 8: Quantification of Finds by Material Type and by Context

Trench	Feature	Context	Flint		Stone		CBM		briquetage		Kiln furniture		Undiagnostic fired clay		Late Prehistoric Pottery		Late Iron Age Pottery		Romano-British Pottery		Medieval pottery		Post Medieval Pottery	
			No	wgt (g)	no	wgt (g)	No	wgt (g)	No	wgt (g)	no	wgt (g)	no	wgt (g)	no	wgt (g)	no	wgt (g)	No	wgt (g)	no	wgt (g)	no	wgt (g)
1		102	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	-	-	-	-
		104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	3	-	-
3		300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	14
4		400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	1	18
5		502	-	-	-	-	-	-	-	-	1	74	3	111	-	-	-	-	-	-	-	-	-	-
		503	1	93	1	513	-	-	7	95	9	945	10	45	2	10	26	552	-	-	-	-	-	-
		505	1	32	-	-	-	-	6	50	2	175	5	57	-	-	-	-	3	106	-	-	-	-
6		600	1	27	-	-	2	108	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7		709	4	62	-	-	-	-	-	-	-	-	-	-	-	-	4	57	2	45	-	-	-	-
8		811	2	136	-	-	-	-	-	-	-	-	-	-	-	-	5	66	-	-	-	-	-	-
		Grand Total	9	350	1	513	2	108	13	145	12	1194	18	213	2	10	52	812	7	154	1	3	3	32

Table 9: Pottery dates and wares within each context

Context	Date Range	Fabric	Form	min. No. vessels	Comments
102	Roman Pottery	Quartz tempered	PBS	1	small and undiagnostic
104	Medieval Pottery	Poole Harbour Type ware	PBS	1	moderately soft, pinky quartz grains but otherwise too small to be diagnostic
300	Post Medieval Pottery	Industrial white ware	Plate	1	19th/20th century whiteware plate or shallow bowl with flat rim
300	Post Medieval Pottery	Verwood type earthenware	PBS	1	
400	Post Medieval Pottery	Red earthenware	Base	1	red earthenware, olive glaze, unknown vessel type though likely to be a jar
400	Roman Pottery	fine, soft with no inclusions	PBS	1	too small and abraded to be positively identified, very soft fabric.
503	Late Iron Age	Durotrigan	Jar Rim/PBS	2	Small bead rim from bowl of 1st century BC date, rest are plain body sherds in same fabrics; Durotrogian bowl base late 1st century BC
503	Late Prehistoric	Sandy	decorated BS	1	small sherd but with two incised parallel lines, possibly of Late Iron Age date
505	Roman Pottery	Black burnished Wares Amphora	Rim	2	1st century Type 1- upright with bead on rim (Smith and Davis, 1993, page 203 Fig 122); Dressel 2-4 Italian C1st AD
505	Late Iron Age Pottery	Durotrigan	PBS	8	plain body sherds
505	Roman Pottery	BB1	PBS	12	various BB1
709	Roman Pottery	Black burnished Wares	Jar Rim base	1	base from jar and two plain body sherds
709	Late Iron Age	leached calcareous fabric; sandy fabrics	?jar PBS	3	thick wall, abundant voids ; quartz tempered, thick walls, one sherd reduced, one sherd has a red coating (?haematite coating) that is very abraded
811	Late Iron Age	coarse quartz; fine sandy fabric	Rim	1	hard fabric, thickened rim from everted jar, mid 1st transitional phase; small, burnished surfaces, small sandy fabrics
811	Late Iron Age	Sandy fabrics grog with voids	PBS	4	Plain, small sandy sherds; hard fabric, voids on surfaces
811	Late Iron Age		PBS	1	

6. CONCLUSIONS

6.1 With the exception of isolated subsoil deposits in Trench 1, the principal area of archaeological interest can be shown to be on the most low-lying area of the site, around Trenches 5, 7 & 8. This was also the area of most intense magnetic anomalies recorded by the geophysical survey.

6.2 It is difficult to provide an exhaustive description of the archaeological remains present here from such limited exposures, but it is clear that the geophysical survey and trial trenching have revealed the presence of a previously unrecorded Romano-British site believed to date from the period 70BC to 75AD. The most significant evidence is represented by the presence of salt working, as well as other features associated with settlement on the site.

6.3 Future use of the site for burial will impact adversely on the archaeological remains. A programme of site investigations may be required in the future.

7. REFERENCES

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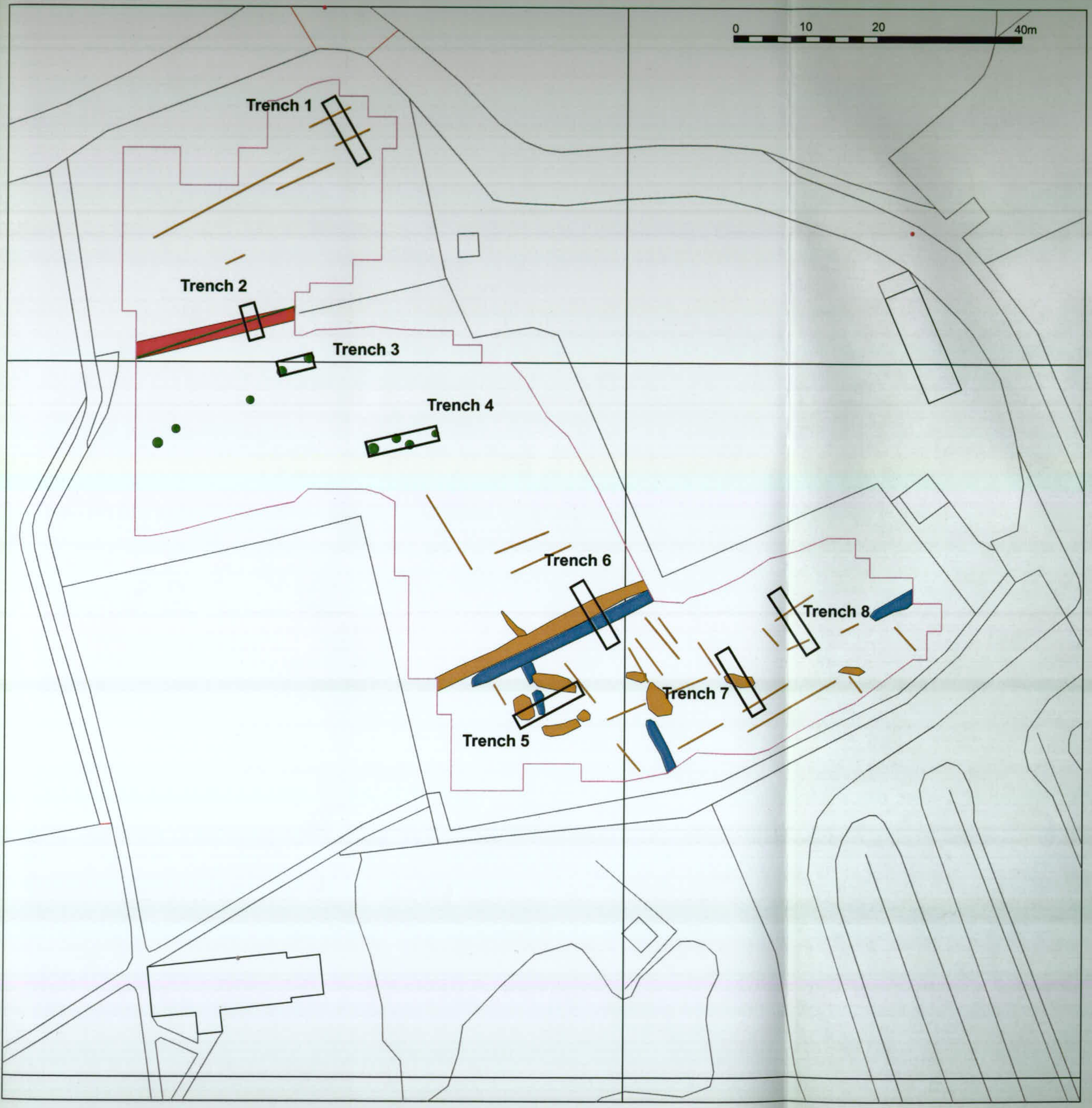
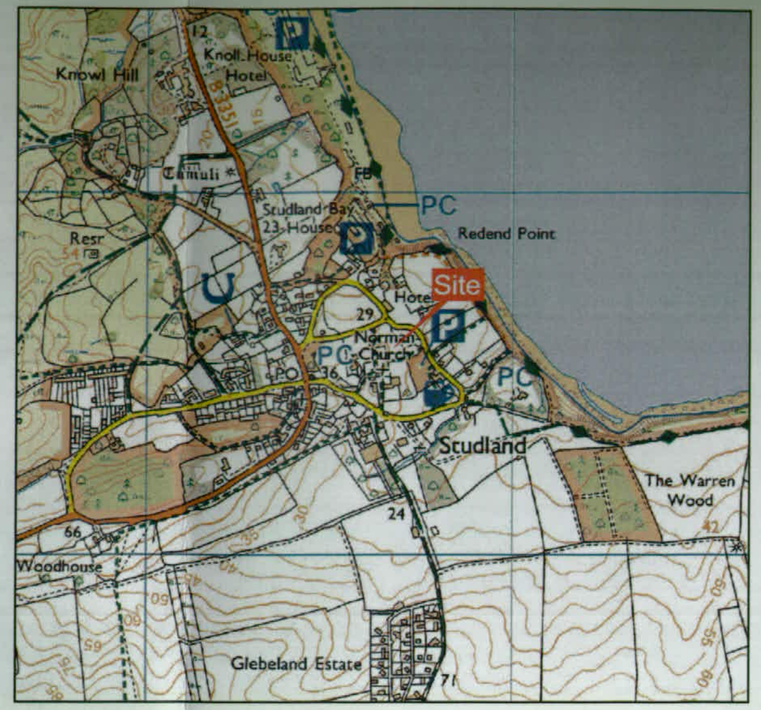
Appendix 1: geophysical survey report





Legend

- survey data limits
- possible services (drains, pipes, cables)
- possible archaeology

potential archaeology

- likely archaeology, positive anomaly (supporting evidence)
- possible archaeology, positive anomaly
- possible archaeology, negative anomaly
- possible ferrous material (2) (4)

PROJECT

Studland Church

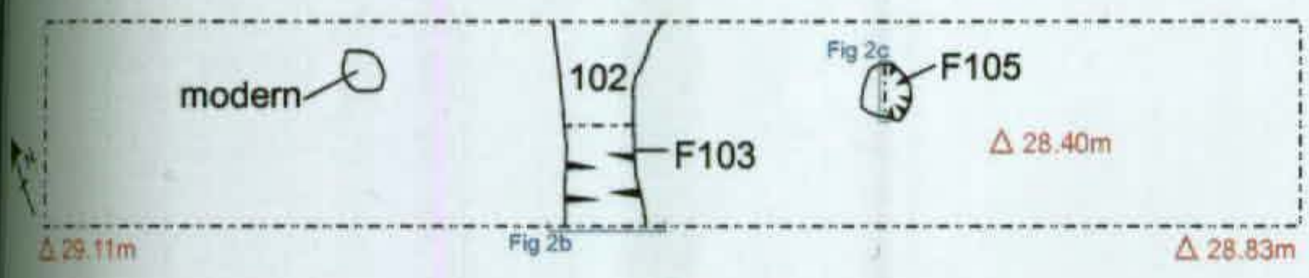
TITLE

Fig. 1: Site and trench location

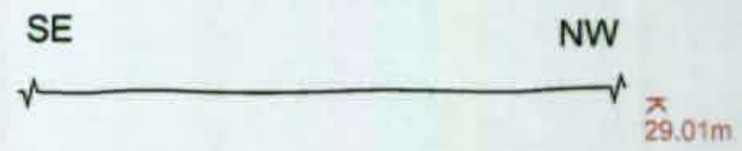
AC archaeology

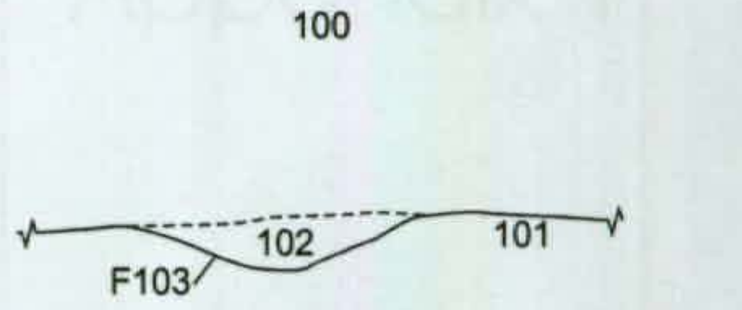
Trench 1

a) Plan

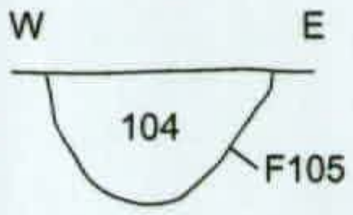


b) Section, F103



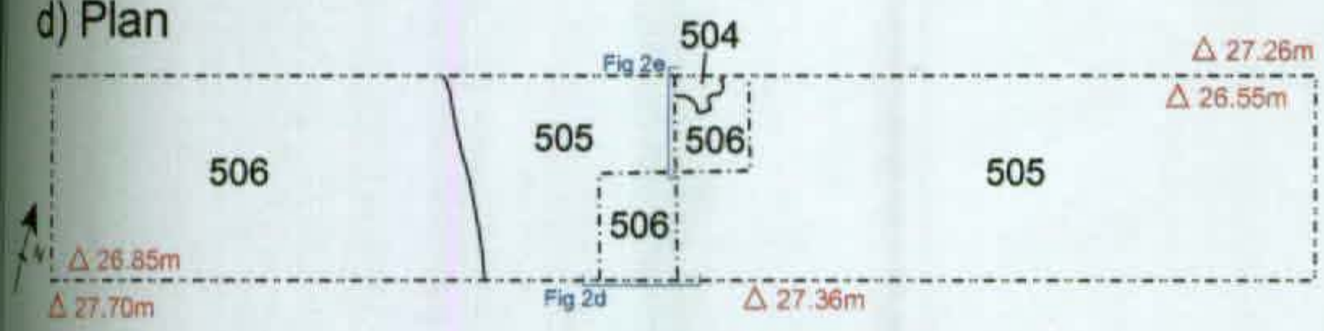


c) Section, F105

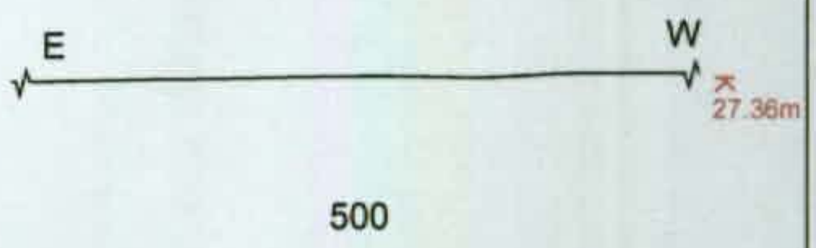


Trench 5

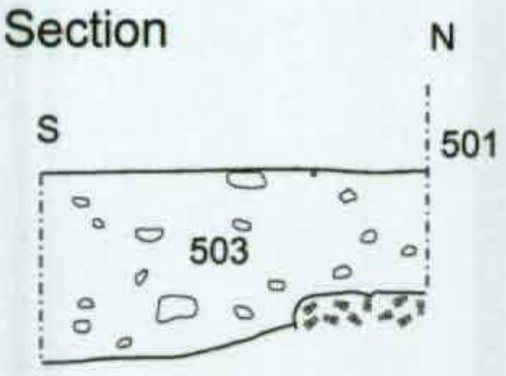
d) Plan

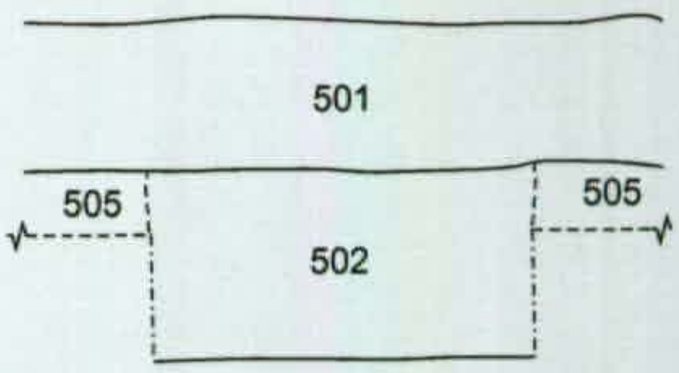


e) Section



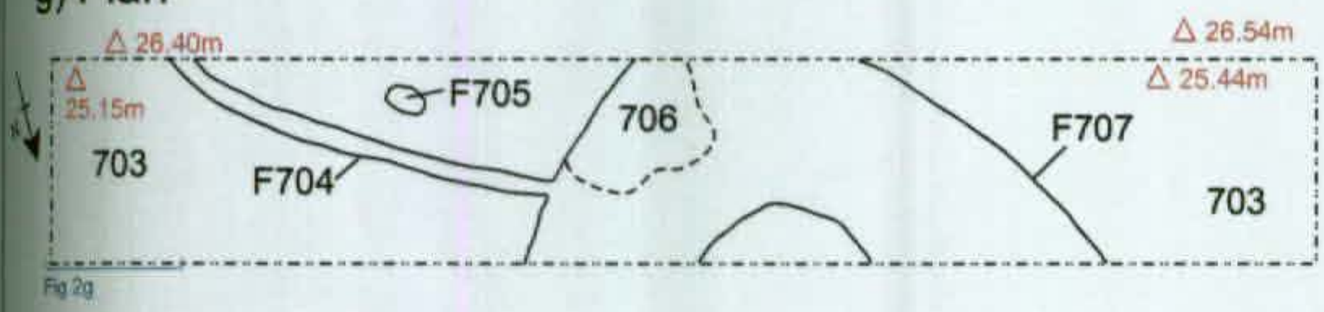
f) Section



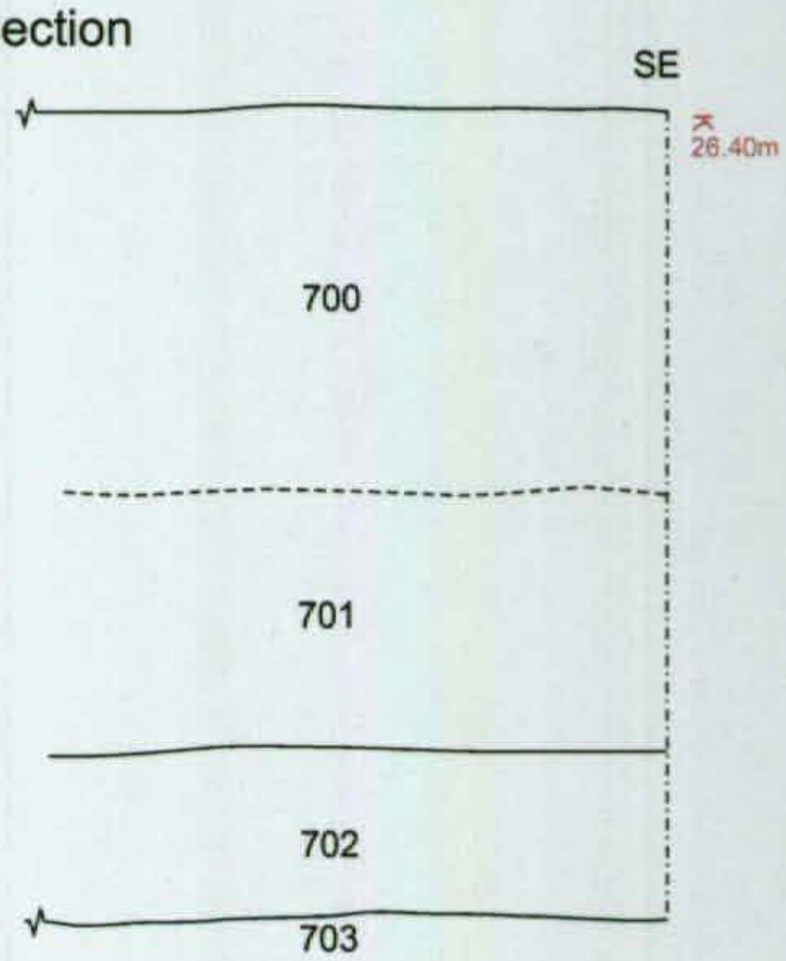


Trench 7

g) Plan

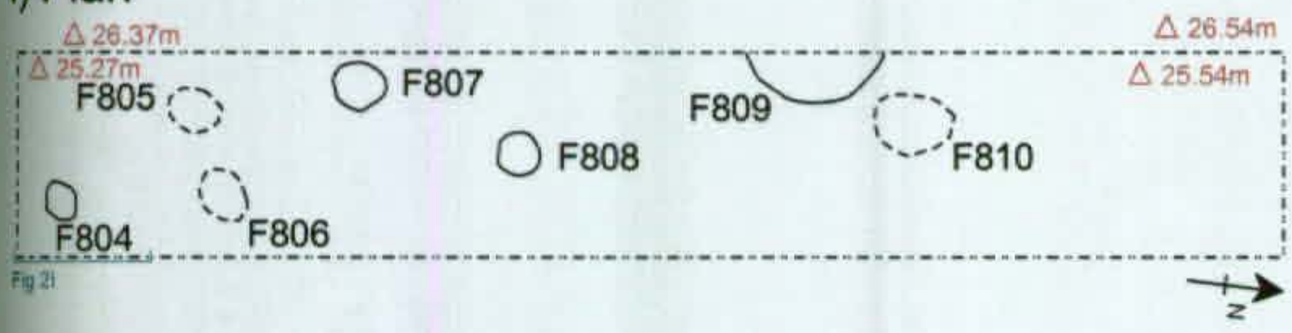


h) Section

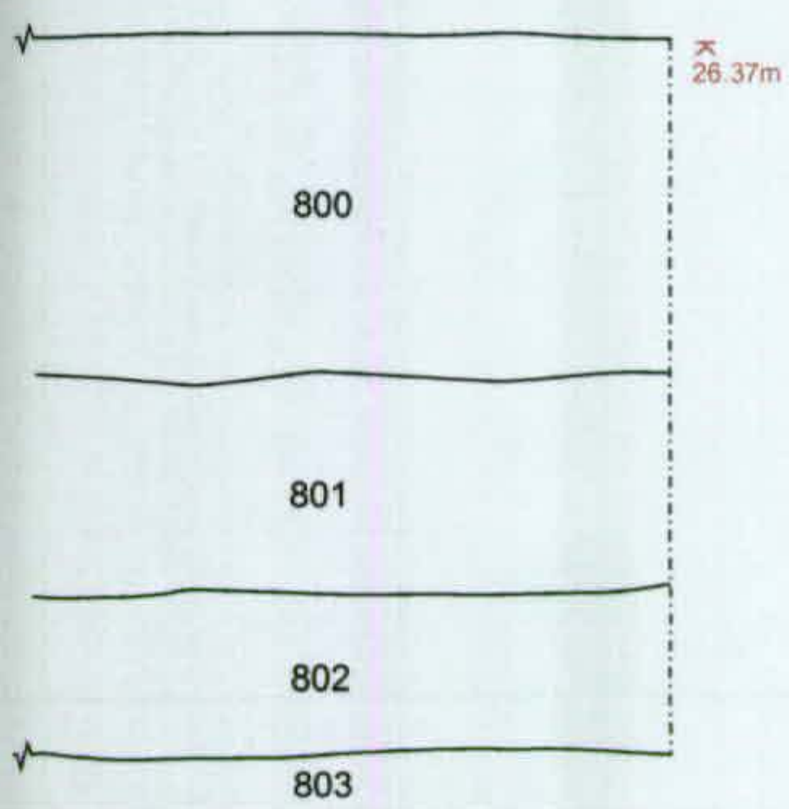


Trench 8

i) Plan



j) Section



PROJECT

Studland Church

TITLE

Fig. 2:
Plans and sections, Trenches 1, 5, 7 and 8

Appendix 1

Substrata
Archaeological Geophysical Surveyors

An Archaeological Gradiometer Survey

Land at St Nicholas' Church
Studland, Isle of Purbeck, Dorset

NGR 403680 82570

Report: 110426
Ross Dean BSc MSc MA MIfA

Substrata
Archaeological Geophysical Surveyors
2a Bath Terrace, Instow
Bideford, Devon EX39 4JL
Tel: 01271 861684
Mob: 07788627822
Email: ross.dean@hotmail.co.uk

Client:
AC Archaeology Ltd
Manor Farm Stables
Chicklade
Hindon
Nr. Salisbury
Wiltshire SP3 5SU

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Plate 1: Looking west-south-west along the southern boundary of the survey area ..... front cover
Author

Accompanying CD-ROM

Report ..... Adobe PDF format
Minimal processing data plot and metadata ..... Adobe PDF format
Survey areas and grids ..... Adobe PDF format
Data files ..... grid files generated using DW Consulting ArcheoSurveyor2
Shape files ..... ESRI standard

1 Introduction

Location:	Land at St Nicholas' Church, Studland
Parish:	Studland
District	Purbeck
County:	Dorset
NGR:	403680 82570

An archaeological gradiometer survey was completed across approximately 0.6ha at the above site. The survey was commissioned by Peter Cox of AC Archaeology Ltd, Manor Farm Stables, Chicklade, Hindon, Nr. Salisbury, Wiltshire SP3 5SU.

The survey was part of a programme of work designed to evaluate the survival of below-ground archaeological deposits across a proposed cemetery extension site, the results of which will allow the nature, extent and date of any surviving archaeological deposits within the application area to be understood and an appropriate planning decision made by the local planning authority.

2. Summary

The data analysis, results and recommendations are provided in section 6 of this report.

The magnetic contrast across the survey area was sufficient to define 14 groups of anomalies pertaining to potential archaeological deposits or structures. Three of these are likely to represent extensions of existing field boundaries. One group may represent part of a disrupted linear that does not coincide with any existing boundary. There is some evidence for at least one relatively large pit on the site. The remaining anomaly groups discussed in section 6 may pertain to archaeological linear deposits but may represent relatively recent ploughing, field drains or similar subsurface disruption.

As can be seen in figure 2, some of the linear anomaly patterns in the survey area are suggestive of disturbance of sub-surface deposits by ploughing and/or other agricultural activities. Given this, it is likely that more archaeological features exist than those potential features identified in the data set and that some of the anomalies identified as potential features will prove not to have archaeological origins.

Seven recommendations have been made concerning the need for further archaeological investigations of the potential archaeology, subject to an assessment of this survey and other archaeological work by the client and Dorset County Council Historic Environment Service.

3 Site description

3.1 Landscape, land use, geology and soils

Landscape

The site comprises a relatively flat field to the northeast of St Nicholas' Church and adjacent to the graveyard (figure 1).

Land use

At the time of the survey the field was under grass.

Geology

The northern part of the site is located on a solid geology of sand, silt and clay of the

Eocene Bracklesham group and Barton group. The southern part of the site has a solid geology comprising silty clay/mudstone, sandy silts and sandy clayey silts of the Eocene Thames group (British Geological Society, undated 1; undated 2).

Soils

The soils are defined as typical argillic brown earths of the Fyfield 4 association (Soil Survey of England and Wales, 1983). The association is of brown, coarse, loamy typical argillic brown earths which pass down to sand or sandstone:

0 - 20cm: dark brown, stoneless sandy loam
20 - 50cm: yellowish brown, stoneless sandy loam; weak medium subangular blocky structure
50 - 80cm: strong brown, stoneless or slightly stony sandy loam or sandy clay loam often with finer yellowish brown clay lamellae; moderate medium subangular blocky structure
80-100cm: yellowish brown, medium sand or soft sandstone

(Findley et al, 1983).

3.2 Related historical data

Known archaeological sites in the survey area

There are no known archaeological sites within the survey area. A number of ancient inhumations have been found in the grounds of the adjacent St. Nicholas' Church (Royal Commission on Historical Monuments (England), 1970: entry 47 St Nicholas' Church, sz 80 sw).

Historic Landscape Characterisation

The survey area is designated as 'Rolling wooded pasture' which is described as,

> 'Very mixed, with small-scale and generally piecemeal enclosure including assarts. Suggests relatively disorganised and opportunistic clearance and enclosure of woodland areas, perhaps in some cases associated with industrial activity, particularly pottery manufacture. Some evidence of small-scale planned enclosure adjacent to villages, but much less than in some other parts. '

(Dorset County Council, undated1; undated 2).

4 Survey description

4.1 Aims and objectives

Aims

1. define and characterise and detectable archaeological remains on the site.
2. inform any future archaeological investigation of the area.

Objectives

1. complete a gradiometer survey across agreed parts of the area
2. identify any magnetic anomalies that may be related to archaeological deposits, structures or artefacts
3. within the limits of the techniques and dataset, archaeologically characterise any such anomalies or patterns of anomalies
4. accurately record the location of the identified anomalies
5. produce a report based on the survey that is sufficiently detailed to inform any subsequent archaeological investigation about the location and possible archaeological character of the recorded anomalies

4.2 Summary of methodology

The standards used to complete this survey are defined by the Institute for Archaeologists (2010). The codes of approved practice that were followed are those of the Institute for Archaeologists (2008 and 2009) and Schmidt (2002). The document text was written using the house style of the Institute for Archaeologists (Institute for Archaeologists, undated).

This magnetometer survey was completed using a Bartington *grad*601-2 (dual sensor) fluxgate gradiometer and automatic data logger. The survey was conducted using 30m by 30m grids which were set out using a DGPS. The methodology and data processing are detailed in appendices 3 and 4.

5 Disclaimer and copyright

The recommendations contained within this report are the authors, based on his interpretation of the survey data. Every effort has been made to provide accurate descriptions and interpretations of the geophysical data set contained in this report. The nature of archaeological geophysical surveying is such that interpretations based on geophysical data, while informative, can only be provisional. It must be presumed that more archaeological features will be evaluated than those specified in this report. Geophysical surveys are a cost-effective initial step in the multi-phase process that is archaeology.

6 Results and recommendations

Refer to table 1 and figure 1 for the survey analysis and figure 2 in appendix 1 for the processed data.

This survey is designed to record magnetic anomalies. The analysis presented below attempts to identify and characterise anomalies and anomaly groups that may pertain to archaeological deposits and structures. The anomalies themselves cannot be regarded as actual archaeological features and the widths of the anomalies shown do not represent the width of any associated archaeological feature. More information about the apparent dimensions of geophysical anomalies is provided in appendix 1.

All the recommendations below assume that further archaeological investigations will be carried out on the site. Any decisions concerning further work will be made by the client and Dorset County Council Historic Environment Service. Please refer to sections 2 and 5.

6.1 Results

As can be seen in figures 1 and 2, some of the linear anomaly patterns in the survey area are suggestive of disturbance of sub-surface deposits by ploughing and/or other agricultural activities. Given this, it is likely that more archaeological features exist than those potential features identified in the data set and that some of the anomalies identified as potential features will prove not to have archaeological origins

The magnetic contrast across the survey area was sufficient to define 14 groups of anomalies pertaining to potential archaeological deposits and structures.

The linear anomaly groups 1, 5 and 6 are likely to represent extensions of existing field boundaries. Anomaly group 1 is visible on the ground as an earthwork.

Anomaly groups 2 and 3 represent ferrous materials deposited in a linear pattern suggesting two possible linear structures such as changes in slope.

Group 8 may represent part of a disrupted linear.

Given the size and relatively high magnetic response of group 10, it may represent a large pit.

Group 13 may represent either an archaeological deposit or, more likely, a natural deposit disrupted by ploughing.

The remaining groups (4, 7, 9, 11, 12 and 14) may pertain to archaeological linear deposits but they have trends similar to those more likely to represent ploughing, field drains or similar subsurface disruption.

6.2 Recommendations

6.2.1 Given the nature of the magnetic response of the survey area discussed above, any further archaeological investigations must assume that more archaeological features exist than those potential features identified in the data set.

6.2.2 Any surveying and other positional work using this report should make use of the maps provided in the shape files on the accompanying CD-ROM. While accurate, the paper reproductions presented here are at a scale suitable for survey description only and are not intended to offer sufficiently accurate positional

information.

6.2.3 The possible disrupted linear feature represented by group 8 does not coincide with the current local land division patterns. With this in mind, any further archaeological investigations need to be planned to take account of earlier historic and possibly prehistoric patterns of settlement and enclosure.

6.2.4 It is recommended that the linear anomaly groups 5 and 6 be investigated to establish their nature and date.

6.2.5 The components of anomaly group 8 may represent a disrupted linear archaeological feature and require further investigation to establish their nature and relationship to each other.

6.2.6 Anomaly group 10 has been identified as representing a possible large pit. Further archaeological investigation of this anomaly is recommended.

6.2.7 It is recommended that selection of the remaining anomaly groups highlighted as representing possible archaeology be considered for further investigation to establish their nature.

Survey data analysis

Site: Land at NGR 403680 82570
Land at St Nicholas' Church, Studland, Isle of Purbeck
Dorset
Report: 110426

field number	anomaly group	anomaly id	characterisation certainty	anomaly class	anomaly form	additional characterisation	comments	period	supporting evidence	associated anomaly group(s)
1	1	1	likely	positive	linear		visible ditch along line of removed field boundary			
1	2	2	possible	dipole			ferrous material deposited in a linear pattern suggesting a possible linear structure such as change in slope			
1	2	3	possible	dipole			ferrous material deposited in a linear pattern suggesting a possible linear structure such as change in slope			
1	2	4	possible	dipole			ferrous material deposited in a linear pattern suggesting a possible linear structure such as change in slope			
1	2	5	possible	dipole			ferrous material deposited in a linear pattern suggesting a possible linear structure such as change in slope			
1	2	6	possible	dipole			ferrous material deposited in a linear pattern suggesting a possible linear structure such as change in slope			
1	3	7	possible	dipole			ferrous material deposited in a linear pattern suggesting a possible linear structure such as change in slope			
1	3	8	possible	dipole			ferrous material deposited in a linear pattern suggesting a possible linear structure such as change in slope			
1	3	9	possible	dipole			ferrous material deposited in a linear pattern suggesting a possible linear structure such as change in slope			
1	3	10	possible	dipole			ferrous material deposited in a linear pattern suggesting a possible linear structure such as change in slope			
1	4	11	possible	positive	linear		tenuous - could be ploughing or drainage			
1	5	12	possible	positive	linear					6
1	6	13	possible	negative	linear					5
1	7	14	possible	negative	linear					
1	8	15	possible	positive	oval		part of a disrupted linear?			
1	8	16	possible	positive	oval		part of a disrupted linear?			
1	8	17	possible	positive	oval		part of a disrupted linear?			
1	8	18	possible	positive	oval		part of a disrupted linear?			
1	9	19	possible	negative	linear		part of a disrupted linear?			
1	10	20	possible	positive	oval	pit				
1	11	21	possible	positive	linear		uncertain whether archaeology or ploughing or drainage			
1	12	22	possible	positive	oval		uncertain whether archaeology or ploughing or drainage			
1	13	23	possible	positive	irregular		uncertain whether archaeology or natural			
1	14	24	possible	negative	linear		tenuous - could be ploughing or drainage			
1	1001	25	possible	repeated parallels			possible ploughing or field drainage			
1	1002	26	possible	repeated parallels			some of these trends may pertain to archaeology but most or all more likely to be related to ploughing or field drainage			
1	1003	27	possible	repeated parallels			some of these trends may pertain to archaeology but most or all more likely to be related to ploughing or field drainage			
1	1004	28	possible	repeated parallels						
1	1005	29	possible	repeated parallels						
1	2001	30	possible	high contrast linear			possible ferrous service pipe or cable along line of ditch			

Table 1: data analysis

2a Bath Terrace, Instow
Bideford, Devon EX39 4JL
tel: 01271 861684
mob: 07788627822
email: ross.dean@hotmail.co.uk

An Archaeological Geophysical Gradiometer Survey

Land at St Nicholas' Church
Studland, Isle of Purbeck, Dorset

NGR 403680 82570

Report: 110426

N

Legend

- survey data limits
- possible services (drains, pipels, cables)

certainty, class

- possible archaeology, repeated parallels (2)

potential archaeology

- likely archaeology, positive anomaly (supporting evidence)
- possible archaeology, positive anomaly
- possible archaeology, negative anomaly
- possible ferrous material (2) (4)

17 (5) anomaly group (anomaly id.)

Notes:

1. All interpretations are provisional and represent potential archaeological deposits.
2. Representative of trends; only anomalies relevant to potential archaeology are recorded.
3. Anomalies likely to represent very recent ground disturbance are not highlighted.
4. Filled circles used to define anomalies are symbols and do not indicate possible circular archaeological features unless specifically indicated in the text.

0 10 20 40 Meters

Figure 1: survey interpretation

7 Acknowledgements

Substrata would like to thank Peter Cox of the AC Archaeology Ltd for commissioning us to complete this survey. We would also like to thank Tony Freer, Treasurer to the Studland Church Lands Trust, for his help with site access and other matters on the day of the survey.

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Appendix 1 Survey Plots

General Guidance

The anomalies represented in the survey plots provided in this appendix are magnetic anomalies. The apparent size of such anomalies and anomaly patterns are unlikely to correspond exactly with the dimensions of any associated archaeological features.

A rough rule for interpreting magnetic anomalies is that the width of an anomaly at half its maximum reading is equal to the width of the buried feature, or its depth if this is greater (Clark, 2000: 83). Caution must be applied when using this rule as it depends on the anomalies being clearly identifiable and distinct from adjacent anomalies. In northern latitudes the position of the maximum of a magnetic anomaly will be displaced slightly to the south of any associated physical feature.

Substrata
Archaeological Geophysical Surveyors
2a Bath Terrace, Instow
Bideford, Devon EX39 4JL
tel: 01271 861684
mob: 07788627822
email: ross.dean@hotmail.co.uk

An Archaeological Geophysical Gradiometer Survey

Land at St Nicholas' Church
Studland, Isle of Purbeck, Dorset

NGR 403680 82570

Report: 110426

N

Legend

archaeology clip

Value

High : 10

nT

Low : -10

0 10 20 40 Meters

Figure 2: shade plot of processed data

Appendix 2 GIS classification schema

Substrata
Archaeological Geophysical Surveyors

2a Bath Terrace, Instow, Bideford, Devon EX39 4JL
Tel: 01271 861684, Mob: 07788627822, Email: ross.dean@hotmail.co.uk

GIS classification schema for gradiometer surveys
version 4

shapefile properties

all:		values in black
grad_potential_archaeology:	polygon	values in blue
grad_potential_archaeol_trends	polyline	values in brown
grad_potential_natural:	polygon	values in magenta
services:	polyline	values in green

field name	data type	length/precision	alias	values	notes
FID	*object Id*			system defined	
shape	*geometry*			system defined	
Id	*long integer*		anomaly id.	system defined	
area	short integer	0	area or field number	integer	
group	short integer	0	anomaly group	integer	
associated	text	50	associated anomaly group (s)	group (repeated as required space separated)	
certainty	text	50	characterisation certainty	"likely" "possible"	
class	text	50	anomaly class	"positive" "negative" "high contrast" "mixed" "dipole" "north-south high-low" "positive spread" "negative spread" "repeated parallels" "high contrast linear" "low contrast linear" "regular narrow linears" "sinuous broad linear" "irregular positive" "strong fade"	
form	text	50	anomaly or group form	"linear" "multilinear" "curvilinear" "oval" "subcircular" "circular" "rectilinear" "subrectangular" "polygon" "irregular"	1, 2
arch_char	text	50	archaeological characterisation (also see below)	quarry	3
comments	text	200		free form text	4
period	text	50		<date>(with supporting evidence) "modern" "post-medieval" "medieval" "Romano-British" "iron age" "bronze age" "neolithic" "mesolithic" "palaeolithic"	
supp_evid	text	200	supporting evidence	free form text	

gradiometer interpretation key (see note 5)

field name alias	certainty * characterisation certainty	class anomaly class	key (note 5)		legend	archaeological characterisation *SEE NOTE 3 BELOW*
potential archaeology	likely	positive		mars red	likely archaeology, positive anomaly (supporting evidence)	ditch, bank, routeway, enclosure, pit(s), posthole(s)
	likely	negative		dark navy	likely archaeology, negative anomaly (supporting evidence)	ditch, bank, routeway, enclosure, pit(s), posthole(s)
	possible	positive		seville orange	possible archaeology, positive anomaly	ditch, bank, routeway, enclosure, pit(s), posthole(s)
	possible	negative		moorea blue	possible archaeology, negative anomaly	ditch, bank, routeway, enclosure, pit(s), posthole(s)
	possible	high contrast		mars red	possible archaeology, high contrast	possible industrial/craft deposits
	possible	mixed		black	possible archaeology, mixed response	possible rubble
	possible	dipole		leaf green	possible archaeology, ferrous material (2, 4)	
	possible	north-south high-low		ginger pink	possible archaeology, north-south high-low	possible heated deposit
	possible	positive spread		seville orange	possible archaeology, positive spread	filled hollow or earthen surface
	possible	negative spread		moorea blue	possible archaeology, negative spread	possible stony surface
potential archaeological trends	possible	repeated parallels	line	raw umber	possible archaeology, repeated parallels (2)	cultivation traces, ridge-and-furrow
potential natural	possible	sinuous broad linear		apatite blue	possible natural, sinuous broad linear	palaeochannel or palaeoterrace
	possible	weak broad bipolar		quetzel green	possible natural, possible spring	spring(s)
	possible	mixed or strong fade		60% grey	possible natural, mixed or strong fade	near surface bedrock
services	likely	high contrast linear	line	leaf green	likely services (supporting evidence for drains, pipelines, cables)	
	possible	high contrast linear	line	quetzel green	possible services (drains, pipelines, cables)	
	possible	low contrast linear	line	sky blue	possible service trench	
	possible	regular narrow linears	line	grey 50%	possible field drains	

gradiometer hilo data scale

volcanic 3	+ive
dark umber	
mars red	
electron gold	
solar yellow	
blank	
blank	
missassippian 1	
permian 3	
moorea blue	
lapis lazuli	
dark navy	-ive

Notes

1 do not repeat anomaly class values (e.g. dipole)

2

anomaly form	anomaly/anomaly pattern description
linear	straight or near-straight
multilinear	more than one connected linear on different orientations
curvilinear	
oval	used for subcircular and oval smaller patterns (e.g. possible pits and postholes)
subcircular	used for larger patterns (e.g. possible roundhouses or ring ditches)
circular	
rectilinear	linears forming an apparent rectangular larger patterns (e.g. a possible enclosure or building)
subrectangular	a near-rectilinear quadrilateral smaller pattern (e.g. pits, graves)
polygon	linears and curvilinears forming an closed or near-closed polygonal larger patterns
irregular	

3 anomaly form is primary description, characterisation is a supporting description only - do not use unless 'form' needs further explanation

4 if there is supporting evidence then a more detailed characterisation can be included in this field and the 'certainty' field will be 'likely'

5 notes below interpretation key:

1. All interpretations are provisional and represent potential archaeological deposits.
2. Representative of trends; only anomalies relevant to potential archaeology are recorded.
3. Anomalies likely to represent very recent ground disturbance are not highlighted.
4. Filled circles used to define anomalies are symbols and do not indicate possible circular archaeological features unless specifically indicated in the text.

Appendix 3 Survey methodology

Substrata
Archaeological Geophysical Surveyors

2a Bath Terrace, Instow, Devon EX39 4JL
Email: ross.dean@hotmail.co.uk, Tel: 01271861684, Mob: 07788627822

A gradiometer survey project design: survey across land at NGR 403680 82570 land at St Nicholas' Church, Studland, Isle of Purbeck

Survey Aims and Objectives

Aims

1. Define and characterise and detectable archaeological remains on the site.
2. Inform any future archaeological investigation of the area.

Objectives

1. Complete a gradiometer survey across agreed parts of the survey area.
2. Identify any magnetic anomalies that may be related to archaeological deposits, structures or artefacts.
3. Within the limits of the techniques and dataset, archaeologically characterise any such anomalies or patterns of anomalies.
4. Accurately record the location of the identified anomalies.
5. Produce a report based on the survey that is sufficiently detailed to inform any subsequent archaeological investigation about the location and possible archaeological character of the recorded anomalies.

Survey Grid

1. The survey will use a temporary survey grid accurately positioned using a suitable DGPS system. The temporary grid will be co-registered to the Ordnance Survey National Grid using digital tiles provided by Substrata or suitable digital map tiles provided by the client.
2. The survey grid will be composed of continuous 30-metre square sub-grids with partial sub-grids to maximise the area surveyed where practical.
3. The survey grid location information and grid plan will be recorded as part of a project in a suitable GIS system.

Survey Equipment and Data Capture

1. The gradiometer survey will be completed using a Bartington *Grad*601-2 (dual sensor) fluxgate gradiometer and automatic data logger. The readings will be recorded on 1-metre traverses at 0.125-metre intervals using north-south orientated zigzag traverses. Sensor balance will be checked and adjusted at regular intervals.
2. Environmental conditions including land use, soils, terrain, ground conditions and weather will be recorded and a digital photographic record of the site pertinent to the geophysical survey will be provided.

Data Processing, Interpretation and Report

1. Data processing will be undertaken using DW Consulting's ArcheoSurveyor2.
2. Anomalies will be digitised and geo-referenced in the GIS project. They will be colour coded using Substrata's standard scheme to provide the most likely interpretation. Anomalies will be numbered and catalogued in the GIS and report text as systematic groups or individual anomalies as appropriate.
3. The final report will include a graphical and textual account of the techniques undertaken, the data obtained and an archaeological interpretation of that data and conclusions about any likely archaeology.

2a Bath Terrace, Instow, Devon EX39 4JL
Email: ross.dean@hotmail.co.uk, Tel: 01271861684, Mob: 07788627822

4. Three printed copies of the report will be provided. A PDF file of the report, the raw geophysical data files and the GIS project will be provided on CD-ROM with each printed copy.

Standards

Institute for Archaeologists (undated) *IfA house style*, [Online], Available: http://www.archaeologists.net/modules/icontent/inPages/docs/pubs/IFA%20HOUSE%20STYLE%202007.doc

Institute for Archaeologists (2010) *Draft Standard and guidance archaeological geophysical survey.* Reading: Author
[Online], Available: http://www.archaeologists.net/sites/default/files/node-files/geophysicsSG.pdf

Codes of approved practice

Institute for Archaeologists (2008) *Code of approved practice for the regulation of contractual arrangements in archaeology.* Reading: Author

Institute for Archaeologists (2008) *Code of conduct.* Reading: Author

Schmidt, A. (2002) Geophysical Data in Archaeology: A Guide to Good Practice, *ADS series of Guides to Good Practice.* Oxford: Oxbow Books
[Online], Available: http://ads.ahds.ac.uk/project/goodguides/geophys/

Table 2: Survey methodology - gradiometer survey	
Grid: *Method of Fixing:* DGPS set-out using pre-planned survey grids and Ordnance Survey coordinates. *Composition:* 30–metre by 30-metre grids *Recording:* Geo-referenced and recorded using digital map tiles.	
Equipment: *Instrument:* Bartington Instruments grad601-2 *Firmware:* version 6.1	**Data Capture:** *Sample Interval:* 0.125-metres *Traverse Interval:* 1 metre *Traverse Method:* zigzag *Traverse Orientation:* GN 0
Data Processing, Analysis and Presentation Software: DW Consulting ArcheoSurveyor2 ArcGIS 9 Golden Software Inc. Surfer 8 Autodesk AutoCAD 2004LT Microsoft Corp. Office Publisher 2003.	

Appendix 4 Data processing

Table 3: survey data processing - archaeology clip processing plot
Software: DW Consulting ArcheoSurveyor2 v 2.5.9.0
Stats Max: 48.90 Min: -50.36 Std Dev: 10.12 Mean: 0.30 Median: 0.06 Processes: 6 1 Base Layer 2 Clip at 1.00 SD 3 De Stagger: Grids: All Mode: Both By: -6 intervals 4 DeStripe Median Sensors: All 5 Clip at 1.00 SD 6 Interpolate: Match X & Y Doubled.

Appendix 5 Geophysical surveying techniques

1.0 Introduction

Substrata offers magnetometer (gradiometer) and earth resistance surveying. We also provide other archaeology-specific geophysical surveys such as ground penetrating radar and magnetic susceptibility. The particular method or combination of methods used depends on local soil conditions and the survey requirements.

Magnetometry and earth resistance surveying are frequently complementary. It is good practice to assess an area with a magnetometer survey and then selectively apply earth resistance surveys to areas identified as being likely to contain building remains and other buried archaeology.

The geophysical surveying equipment Substrata uses is specifically developed for archaeological surveying and is a proven technology. When used in conjunction with software designed to analyse and present the recorded data, these systems are capable of delivering fast and accurate assessments of the archaeology of both large and small sites. If excavation is required, the geophysical assessment can be used to place trenches over potential archaeological features. The gradiometers (a type of magnetometer) and resistance meters employed are sensitive to depths of between 0 and 3 metres below ground level, with maximum sensitivity at depths of 1.5 metres or less. Most surveys are designed to work within the 0 to 1.5 metre range.

2.0 Magnetometer scanning and area surveying

2.1 General concepts

Magnetometer surveying is used to detect and map small changes in the earth's magnetic field caused by concentrations of ferrous-based minerals within the soil and subsoil, and by magnetised materials buried beneath the surface. While most of these changes are too small to affect a compass needle, they can be detected and mapped by sensitive field equipment. During surveys the different magnetic properties of top-soils, sub-soils, rock formations and archaeological features are recorded as variations against a background value. Subsequently magnetic anomalies resulting from potential archaeology can be identified and interpreted. Identifiable archaeological features include areas of occupation, hearths, kilns, furnaces, ditches, pits, post-holes, ridge-and-furrow, timber structures, wall footings, roads, tracks and similar buried features.

2.2 Surveying instruments

A gradiometer is a type of magnetometer and is sensitive to relatively small changes in the earth's magnetic field. Substrata uses two types of gradiometer both specifically designed for field use by archaeologists. Our primary surveying instruments are Bartington *Grad*601-2 (dual sensor) fluxgate gradiometers with automatic data loggers. We also use a Geoscan FM36 fluxgate gradiometer with the option of either manual or automatic sampling triggers. The Bartington gradiometers provide proven technology in archaeological magnetic surveying and offer fast, accurate set-up and survey rates. The Geoscan FM36 provides an effective, if older, proven technology solution when surveys are required within woodland and other areas of limited accessibility. More technical details can be provided as required.

2.3 Magnetic scanning surveys

When speed and general assessment without data recording are key requirements, scanning with Bartington *Grad*601-2 gradiometers facilitate fast, on-site data analysis. This method allows rapid assessment of large areas of land such as proposed main communi-

cations routes, pipeline routes and significant commercial developments. Scanning is useful in complementing aerial surveys across wooded areas or fields under permanent pasture. This technique is also effective in the exploration of suspected archaeological sites provisionally identified during field walking and other archaeological surveys.

2.4 Magnetic area surveys

These are detailed area surveys employing a greater density of traverses and readings across the area of interest compared to scanning surveys. The current typical sampling interval for detailed area surveys is 0.125 metres on traverses 1.0 metre apart.

Typically, area surveys are undertaken when archaeological features are expected to be relatively concentrated or when a comprehensive survey is required. They are used to clarify areas of archaeological interest and to enable decisions to be made on the location of features to be preserved or excavated. Recent developments in the speed of surveying equipment such as the *Grad*601-2 system means that area surveys are often cost-effective alternatives to scanning surveys.

3.0 Earth resistance area and linear surveying

3.1 General concepts

This method measures changes in the electrical resistance of the ground being surveyed. In practice, differences in the electrical resistance of materials facilitates the detection and interpretation of masonry and brick foundations, paving and floors, drains and other cavities, large pits, building platforms, robber trenches, timber structures, ditches, graves and similar buried features.

Resistance to electrical current flow in the ground depends on the moisture content and structure of the soil and other materials buried beneath the surface. For example, the higher the moisture content of a soil, the less resistant it is to electrical current flow. A ditch completely buried beneath the present ground surface is likely to have an infill soil different to that surrounding the ditch in terms of compactness and composition. As a result, the soil filling the buried ditch will retain moisture in a different way to the surrounding soil which means it will have an electrical resistance at variance with the surrounding environment. By passing a small current through the ground it is possible to detect, record, plot and interpret such changes in electrical resistance.

3.2 Surveying instruments

For earth resistance surveying Substrata uses the Geoscan Research RM15 multi-probe resistance meters and purpose-built automatic data-loggers. The MPX15 multi-probe facility can be used to speed up standard surveys and it is also useful when simultaneous multiple-depth analysis is required.

3.3 Earth resistance area surveys

Earth resistance area surveys are excellent tools for the detailed planning of likely archaeological sites and particularly useful in the surveying of areas likely to contain building footings or similar structures.

3.4 Earth resistance linear surveys

Earth resistance linear surveys are useful when searching a large area for buried buildings or roads and similar large linear archaeological features.

Devon Office

AC archaeology Ltd
Unit 4, Halthaies Workshops
Bradninch
Nr Exeter
Devon
EX5 4LQ

Telephone/Fax: 01392 882410

Wiltshire Office

AC archaeology Ltd
Manor Farm Stables
Chicklade
Hindon
Nr Salisbury
Wiltshire
SP3 5SU

Telephone: 01747 820581
Fax: 01747 820440

www.acarchaeology.co.uk