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Mapping *Isca*: geophysical investigation of Priory Field, Caerleon

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INTRODUCTION

In the spring of 2006 geophysical and topographic surveys were undertaken of Priory Field, in the south-western corner of the legionary fortress that lies below modern Caerleon.[1] The fortress, known to the Romans as *Isca*, has been the focus of work for more than 150 years and archaeologists from the National Museum of Wales, Cardiff University (in its various incarnations) and, more recently, the Glamorgan-Gwent Archaeological Trust have all excavated in and around Caerleon (Fig. 1). The earliest investigations took place in 1843, though it was the intensive series of campaigns of the 1920s to 1960s that established the internal layout of large parts of the fortress as well as its chronology (Nash-Williams 1954; Jarrett 1969; Boon 1972). Further excavations in the 1970s and 1980s added considerably to our knowledge of *Isca* and today the base of the Second Augustan Legion at Caerleon is one of the best understood legionary fortresses of the Roman Empire (Petrikovits 1975; Boon 1987; Brewer 2000; Brewer 2002). Yet there are large areas of the fortress that have not been the subject of any archaeological work and about which a great deal remains to be discovered. In particular, almost nothing was known about the south-western corner of the fortress between the *via praetoria* and the dextral side of the *via principalis*, though modern plans of *Isca* sometimes fill this space with putative buildings, especially barrack blocks.[2] Obtaining a more detailed and reliable plan of the fortress and the civilian *canabae* around it is an essential part of understanding Roman Caerleon and this objective was highlighted as a priority in the Caerleon Research Framework produced in 2004.[3]

The use of geophysical survey is an effective method of locating buildings as well as other archaeological features beneath the modern ground surface and, over the last two decades or so, the various techniques of geophysical prospection have transformed our knowledge of the distribution and layout of all types of settlements in Roman Britain. Undertaking geophysical surveys of those parts of *Isca* about which very little is known was the obvious next step forward and we are fortunate that, unlike the other permanent legionary fortresses of *Deva* (Chester) and *Eburacum* (York), on the whole these areas at Caerleon have not been built over. The main objectives of the Priory Field surveys were to locate and identify the remains of buildings that once stood there, thereby adding to our understanding of the fortress layout, and to investigate how this part of Caerleon had been used in the many centuries since the end of the Roman period.

METHODOLOGY

Geophysical surveys

Surveys were laid-out using a Trimble 4700 GPS system. The base-station was located over an arbitrary point (Fig. 2; STN1), and data logged for three hours on an initial visit. The station coordinates were established by post processing using RINEX and IGS Rapid Orbit corrections. Grids were laid out from pre-planned 'round-number' 20m intervals of National Grid, uploaded to the GPS system, with the stakeout undertaken using a Trimble 4700 RTK rover unit with the 4700 base-station repositioned on the

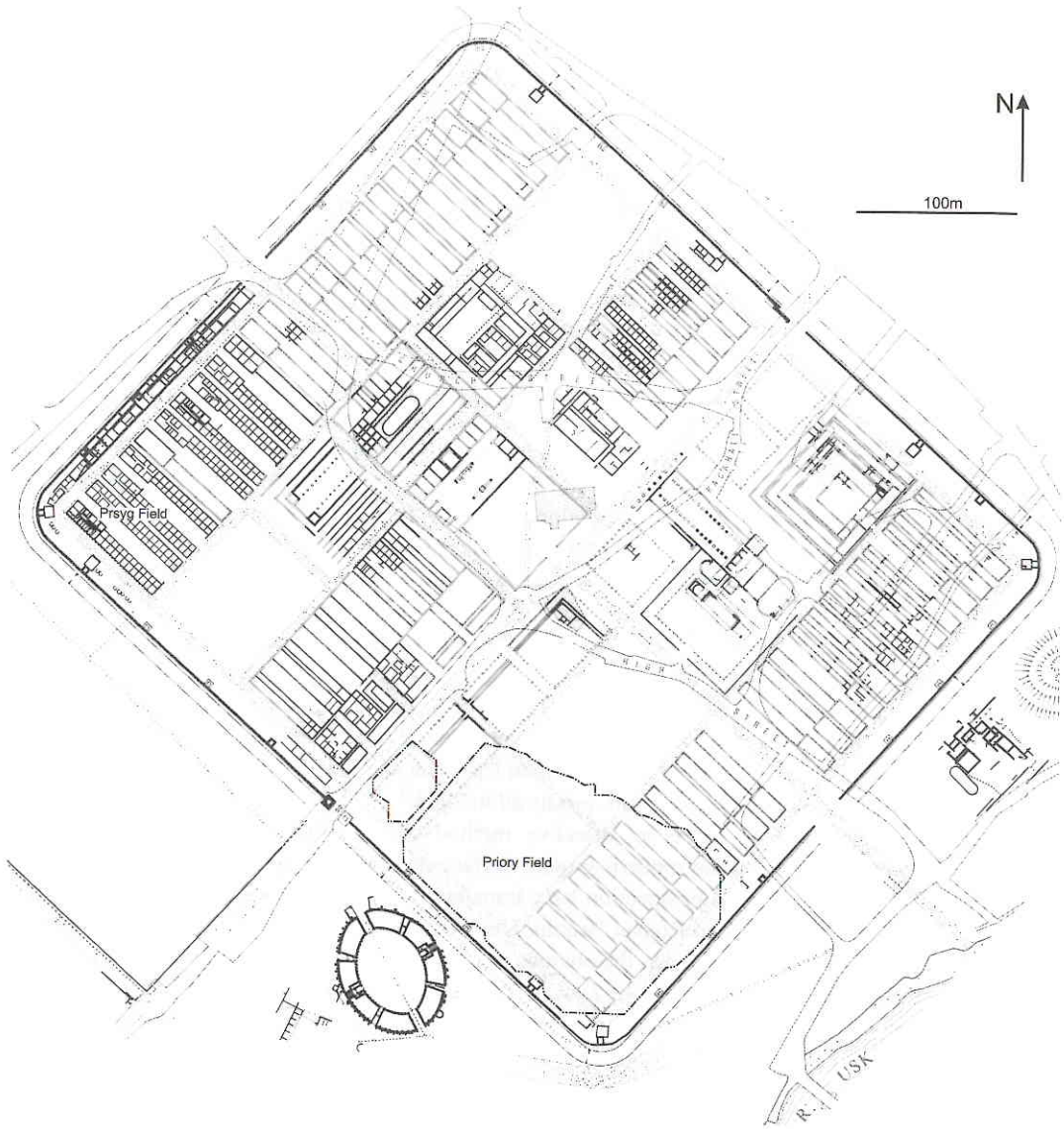

Fig. 1. Plan of the legionary fortress at Caerleon (*Isca*) showing known and presumed details of the internal layout, as well as the limits of the 2006 Priory Field geophysical surveys.

same point. The 20m grids were marked by wooden survey pegs. Pegs within areas of poor GPS reception were located using conventional methods using tapes. Grid locations and the survey co-ordinate system are shown in Figure 2. The survey exceeded English Heritage and the Institute of Field Archaeologists guidelines: the survey grid was located well within tolerances of 0.1m with respect to the National Grid and points within the grid located to within 0.04m of the local grid (English Heritage 1995; Gaffney and Gater 1991).

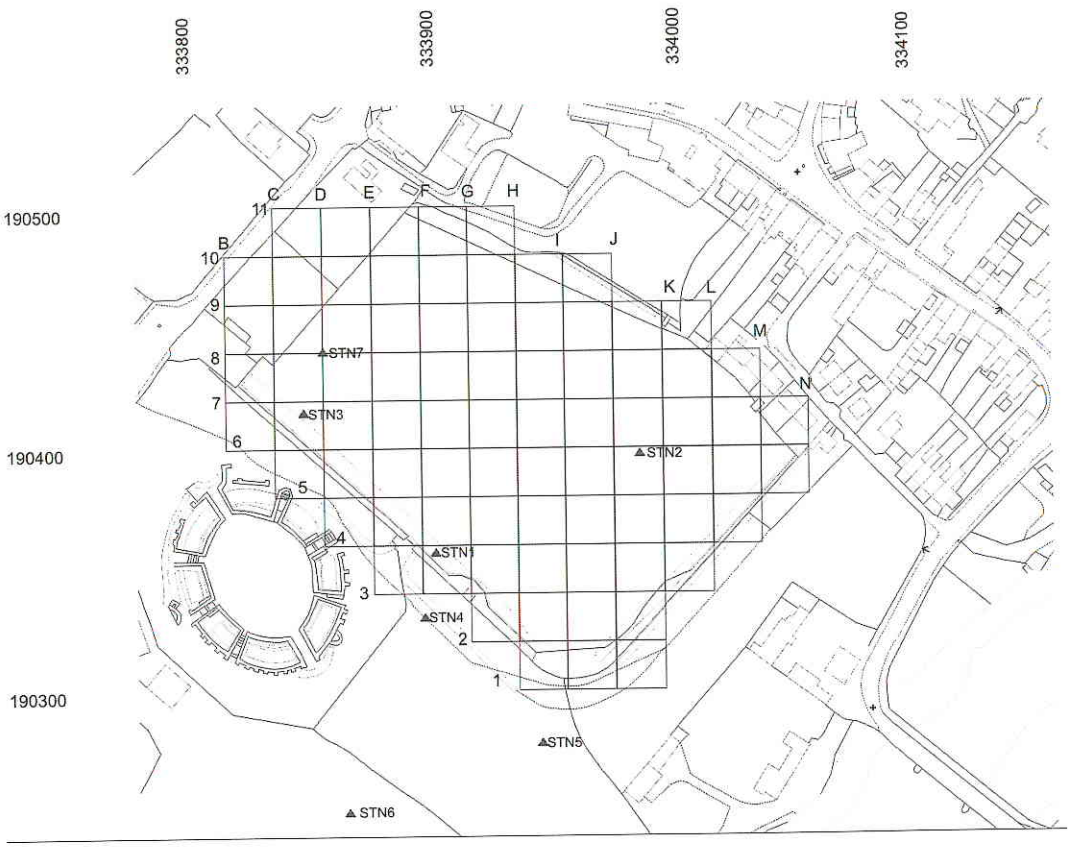

Fig. 2. Survey location and grid layout. 20m survey grids are lettered in eastings and numbered in northings. STN1 is the primary GPS base-station, STN2–7 are DM and/or backsight locations.

The magnetic gradiometer survey was undertaken using a pair of Geoscan fluxgate magnetometers operating in tandem on a CF6 frame. The master gradiometer was an FM256, the slave an FM36. The survey was conducted on 20m grids with a 1m walked traverse interval (0.5m traverse interval on the combined dataset, the 'double density' mode), walked in parallel and with a 0.25m sample interval (i.e. raw data grid has 0.5 × 0.25m node spacing). The main ground resistivity survey was undertaken with a Geoscan RM15 resistivity meter, operating two pairs of mobile electrodes on a PA5 frame, via an MPX15 multiplexer. The mobile electrode pairs had a 0.5m spacing (giving the main component of the response from 0.5–0.7m depth), with 1m between centres, to give a 1m effective traverse interval. Data was collected on 20m grids, walked in zigzag pattern, with 0.5m sample interval (i.e. raw data grid has 1.0 × 0.5m node spacing).

Multiple-spaced survey

The multiple-spaced survey involved a combination of mobile probe spacings of 0.75, 1.0, 1.25 and 1.5m and was walked in parallel to allow for construction of symmetrical grids from the asymmetrical probe array (Fig. 3). The survey was conducted within a small 40m by 10m area, extending over the

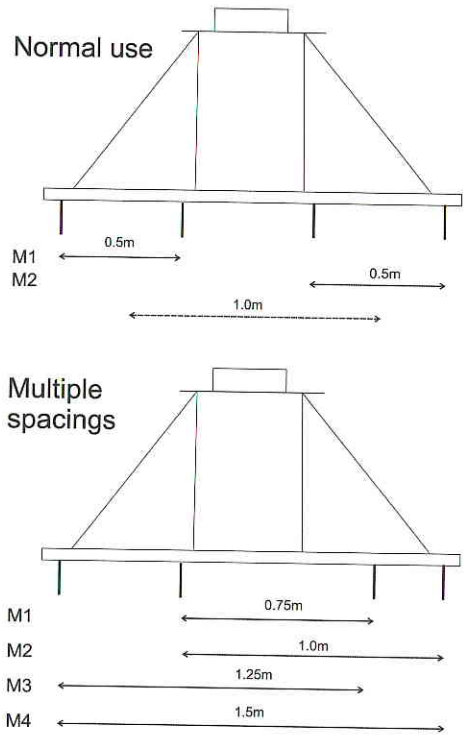

Fig. 3. Arrangement of mobile probes for the two different ground resistivity surveys.

north-eastern end of the northern granary and part of the central granary. Even increasing the probe spacing to 0.75m allowed the clearer recognition of a low resistivity zone separating the two buildings. The high-resistivity walls on either side of this gap are poorly imaged at 1.0m spacing, but are very clear at 1.25 and 1.50m spacings. In general this data suggest that at a depth of 0.5m the remains are disturbed by ploughing, while the main external wall foundations of the buildings extend much deeper and are probably being imaged at depths of 1.5–2.25m below the surface.

Topographic survey

Both a Nikon DTM330 EDM and the Trimble 4700 RTK system were used to obtain the high-quality topographic survey. The principal topographic survey tool was the Trimble 4700 RTK GPS system, with the Nikon EDM used to fill in data in areas of poor GPS reception, particularly under tree cover. Both systems were controlled by dataloggers running Trimble Survey Controller software (for this project a TSC1 running Survey Controller v7.7, with calibration files patched to OSTN02, was used with the GPS and a TSCe running Survey Controller v10.8, which includes OSTN02, with the EDM).

The surveys were undertaken between 1 and 8 April 2006 during a period of dry weather when Priory Field was under pasture with short grass.

RESULTS AND INTERPRETATION

Geophysical results

The results of the gradiometer and ground resistivity surveys are shown on Figures 4 and 5 as greyscale images. The best results were obtained from the gradiometer, which shows the roads as slight positive magnetic anomalies and the walls of buildings as negative anomalies. The ground resistivity survey was less rewarding and the buildings within the fortress are very poorly imaged with only a few buildings shown with any certainty. It appears that the 0.5m probe spacing used for the survey, which receives most data from perhaps 0.5–0.7m below ground surface, was imaging at too shallow a depth to register sufficient contrast between any walls and their surroundings. The trial evaluation using wider probe spacings produced much better results and suggests that the main wall foundations of the buildings lie between 1.5 and 2.25m below the modern surface of Priory Field.

The very intense linear anomaly that cuts across the northern part of the field shows the course of the iron pipe that supplied water from the Priory to the farm buildings that used to stand in the northern part of the survey area (once part of the walled garden of the Priory, now a grassed section of the garden of Broadlands), while the two pairs of intense anomalies close to the north-eastern and south-western field

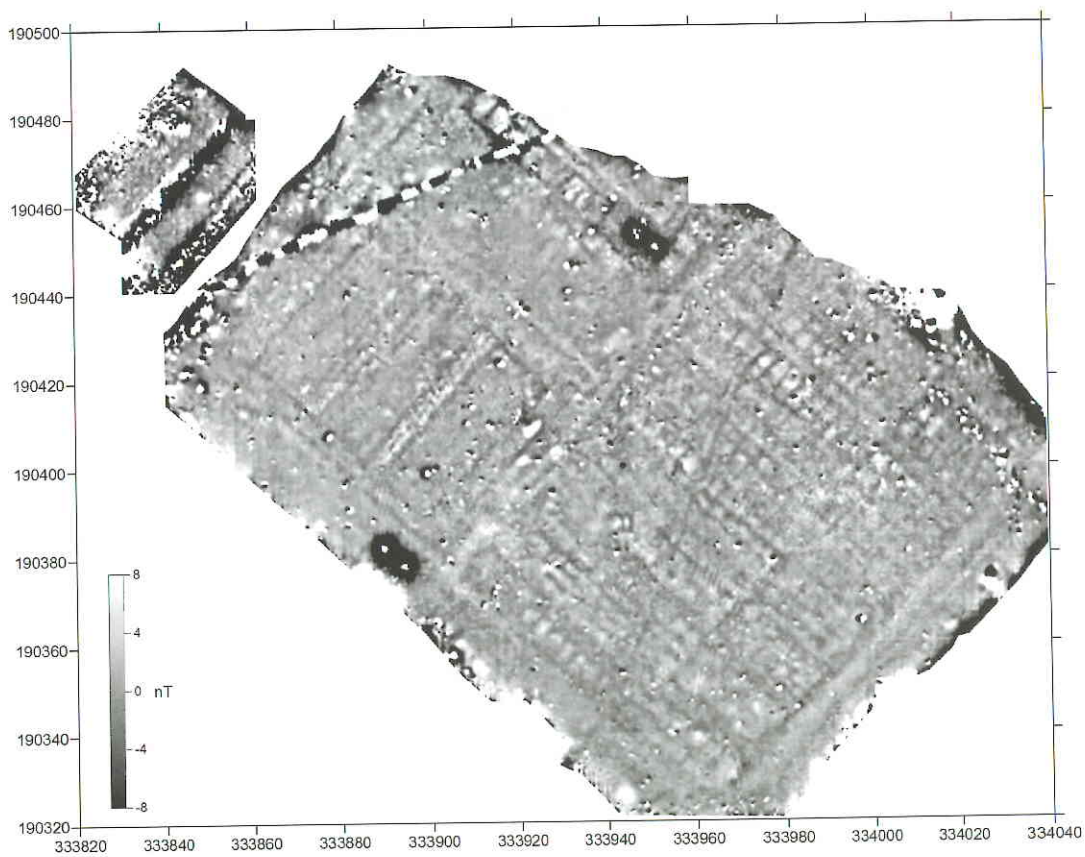

Fig. 4. Magnetic gradiometer survey.

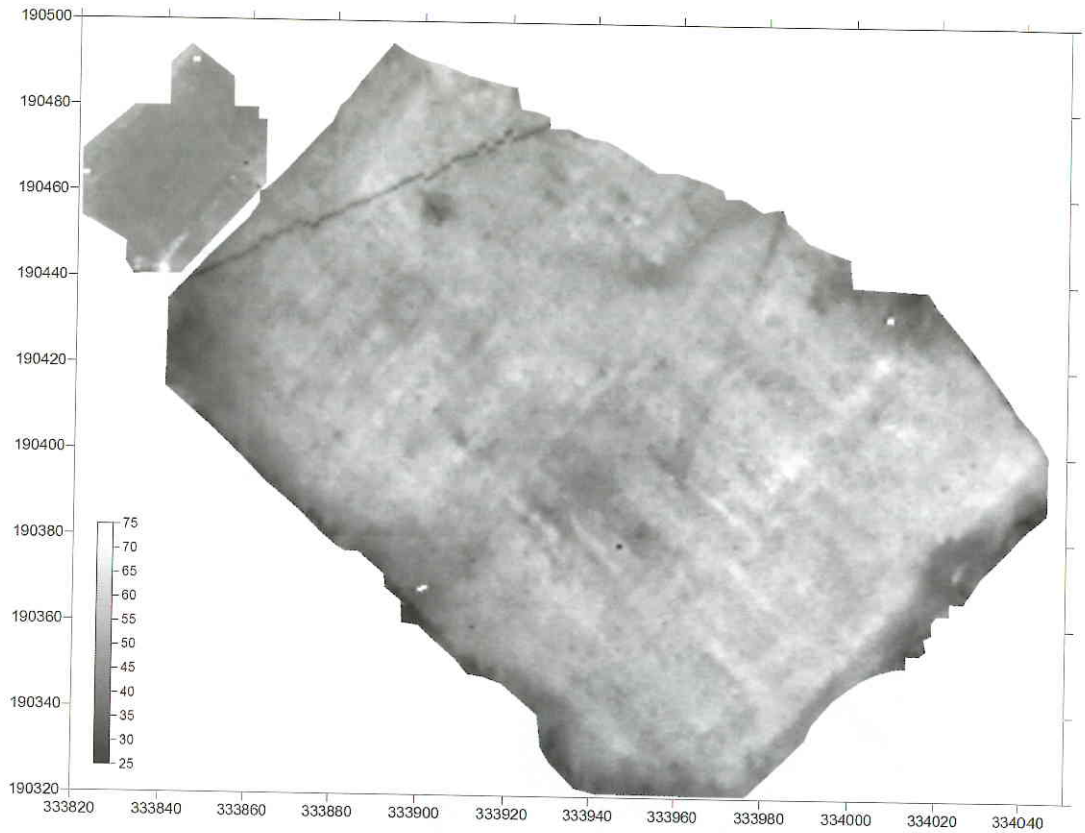

Fig. 5. Ground resistivity survey, 0.5m mobile probe spacings (greyscale: 20 ohm black to 75 ohm white).

boundaries probably record the location of Caerleon Rugby Club's goalposts before the club moved to its present site outside the fortress in the 1960s. The linear anomaly extending south-south-west from the direction of the Priory (on both the gradiometer and ground resistivity survey results) is interesting. Its composite magnetic and resistivity properties complicate the obvious interpretation as a cut feature of some kind and, while it may be a Roman drain (its intersection with the northern end of the latrine block on the south-western defences providing a possible destination), the fact that the feature was detected by the 0.5m-spaced ground resistivity survey means that it is unlikely to be of any great antiquity. It is probably a post-Roman drain, but a grubbed-out hedge cannot be excluded.

Apart from such traces of very recent activity, however, the surveys produced no evidence to indicate that Priory Field was occupied by buildings after the Roman period and it is likely that this part of Caerleon has been cultivated for a very long time. Fainter traces of several stone structures were revealed by both geophysical surveys across Priory Field (though clearest in the gradiometer results) and the proposed reconstruction of these buildings is shown on Figure 6. The buildings in Priory Field are, in most cases, characteristic of military architecture in the early Imperial period and the surveys have produced a remarkably clear plan of the arrangement of buildings in the south-western part of the legionary fortress.

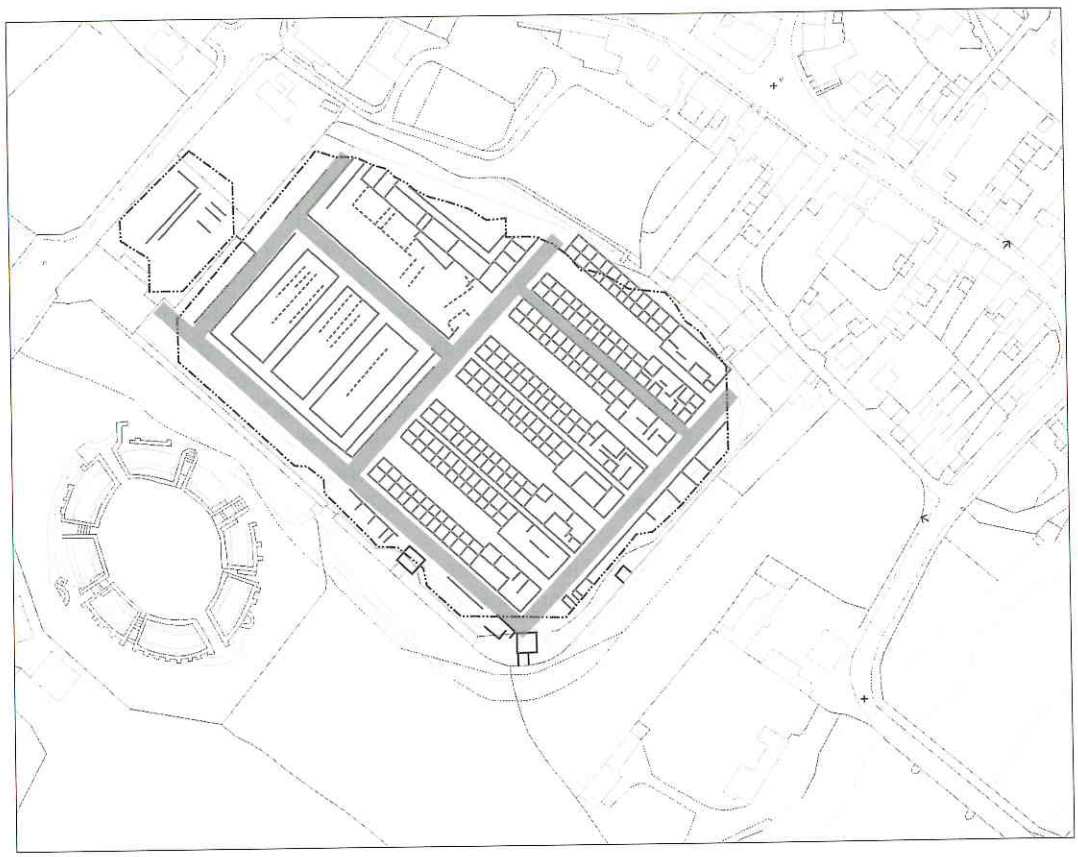

Fig. 6. Interpretation of geophysical survey results in Priory Field.

The south-eastern and south-western boundaries of Priory Field reuse the fortress's outer wall and the *intervallum* road can be seen running alongside the rampart behind this wall. The surveys picked up traces of what might be buildings constructed within the rampart, though these structures are not well imaged because of interference from the modern metal fences situated on the Roman rampart. The resistivity results show a narrow linear positive feature within the rampart on the south-eastern side that may be the inner face of an interval tower (predicted on the fortress plan to lie a few metres to the north-east of this position). However, modern bricks lying on the surface were noticed in this area and the interpretation of this anomaly remains uncertain.

The interior of the fortress itself was subdivided into blocks, or *insulae*, by the street-grid that is such a distinctive part of Roman military installations. Priory Field covers a large part of the dextral side of the *praetentura* at the front of the fortress, bounded by the *via praetoria* to the north-east and the *via principalis* to the north-west. Minor streets running between these two main thoroughfares and the *intervallum* road against the fortress wall divided Priory Field into three separate blocks, each of which was occupied by buildings of different forms and functions.

Barrack blocks

The southern corner of Priory Field contained eight centurial barrack blocks running along the front wall of the fortress (Fig. 7). These are of the standard size and shape for legionary barracks, consisting of rows of paired rooms for the legionaries themselves and a much larger suite of rooms at one end that served as the centurions' quarters (Petrikovits 1975, 35–43). The barrack blocks are arranged in the usual manner, with pairs of barracks facing one another across an alleyway that led either to the *intervallum* road or the parallel road to the north. The three pairs of barracks in the south-western corner would have housed a complete *quingenary* cohort, while the fourth pair on the other side of a minor road was part of a second cohort's quarters that presumably extended to the *via principalis* as it entered the fortress through the *porta principalis*. The equivalent set of barracks in the western corner of the fortress (i.e. the dextral side of the *retentura*), was excavated by Nash-Williams in Prysg Field between 1927 and 1929, and these together with the Priory Field examples are the only barrack blocks from Caerleon for which we have complete plans (Nash-Williams 1931). In fact, there seems to be little difference between the Priory Field and Prysg Field barracks, though whether this similarity extends to their chronologies will only be confirmed by excavation. The centurions' quarters of the Priory Field barrack blocks are 4m longer than predicted on the existing fortress plan (Boon 1987), though this is most probably a draughting error that now can be corrected.

Each barrack block of this type was intended to house a complete century, which by the early empire consisted of eighty men. It is thought that the century was subdivided into ten *contubernia* of eight men and that each *contubernium* was allocated one pair of rooms in the barracks; perhaps one room for sleeping and another for cooking as well as storage. It is noticeable that the interiors of the rear rooms of each *contubernia*'s quarters are often imaged as higher positive anomalies than the front rooms on the gradiometer results, most likely indicating the location of hearths in the rear rooms. The Priory Field barrack blocks, like those in Prysg Field, have twelve pairs of rooms as well as the centurions' quarters rather than the ten that it is believed were necessary to house the full century of legionaries. The details of Roman military architecture, however, are notoriously unpredictable and many barracks from legionary fortresses and auxiliary forts of the early empire contained fewer or more than the ten suites of rooms anticipated by modern notions of the Roman army as a homogeneous force. The Priory Field and Prysg Field examples suggest that the Caerleon standard, for whatever reason, was twelve pairs of rooms per stone barrack block.

Granaries

The row of centurial barrack blocks was separated from the area to the north-west by a street that ran between the *intervallum* road and the *via praetoria*. The part of the fortress beyond this street was divided into two *insulae* by a tributary road that led up to the *via principalis*. The geophysical surveys show that the southernmost of these blocks was filled by a row of three very large rectangular buildings arranged at right-angles to the barracks and apparently enclosed on three sides by a compound wall (Fig. 8). These buildings were each *c.* 42m long and 15m wide, and their plans allow us to identify them with confidence as store buildings, probably for the storage of grain and other perishable provisions. The Romans would have called these buildings *horrea*, a term that includes stores of a variety of forms and functions, though today they are known as military granaries (Rickman 1971). Large rectangular hall-like granaries have been recorded at many military installations in Britain and other frontier provinces of the Roman Empire. They are usually very well-built structures, often provided with thick buttressed walls and raised floors, features that were designed to protect these buildings' valuable contents from various threats, including theft, damp, overheating and contamination by insects and rodents (Rickman 1971, 215–36; Gentry 1976).

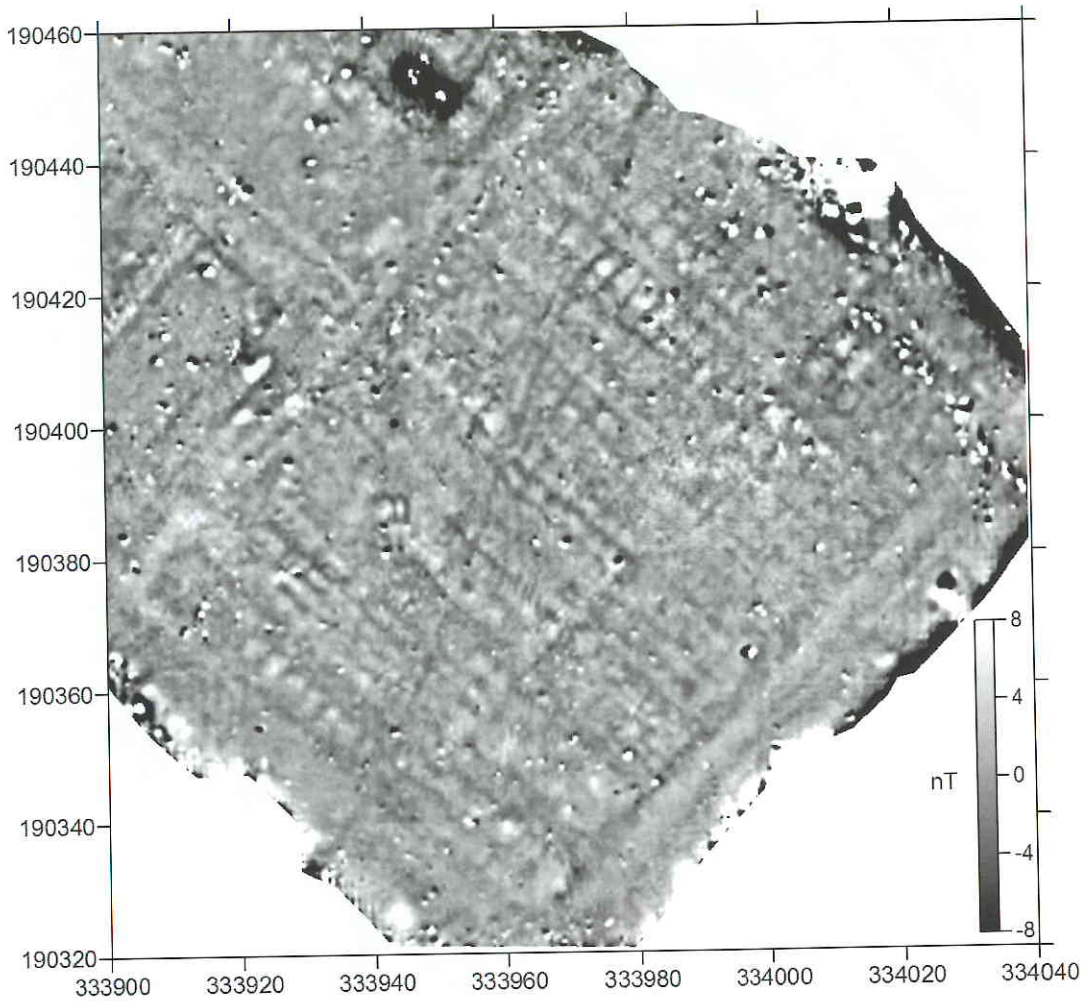

Fig. 7. Close-up of the centurial barrack blocks (magnetic gradiometer survey results).

It is possible to use the gradiometer and the multiple-spaced resistivity survey results together to see the buried remains of the Priory Field granaries in greater detail (Fig. 9). Traces of the buttresses on external faces of these buildings' walls are visible in the results of the ground resistivity survey using the widest probe spacing (1.5m), while the gaps between the three buildings are imaged as particularly strong magnetic responses on the gradiometer results, suggesting that these spaces are filled with occupation debris. Faint linear anomalies were detected within the central and northern granaries by the multiple-spaced resistivity surveys, particularly at 0.75m and 1.0m spacings. It is likely that these are longitudinal dwarf walls, which would have supported the granaries' raised internal floors (Rickman 1971, 221–3).

Military granaries were entered from the short side and a number of excavated examples were provided with covered entrances and loading platforms at one end. The row of three timber granaries excavated at the legionary fortress at Usk was fronted by a covered portico, while the examples from Inchtuthil had

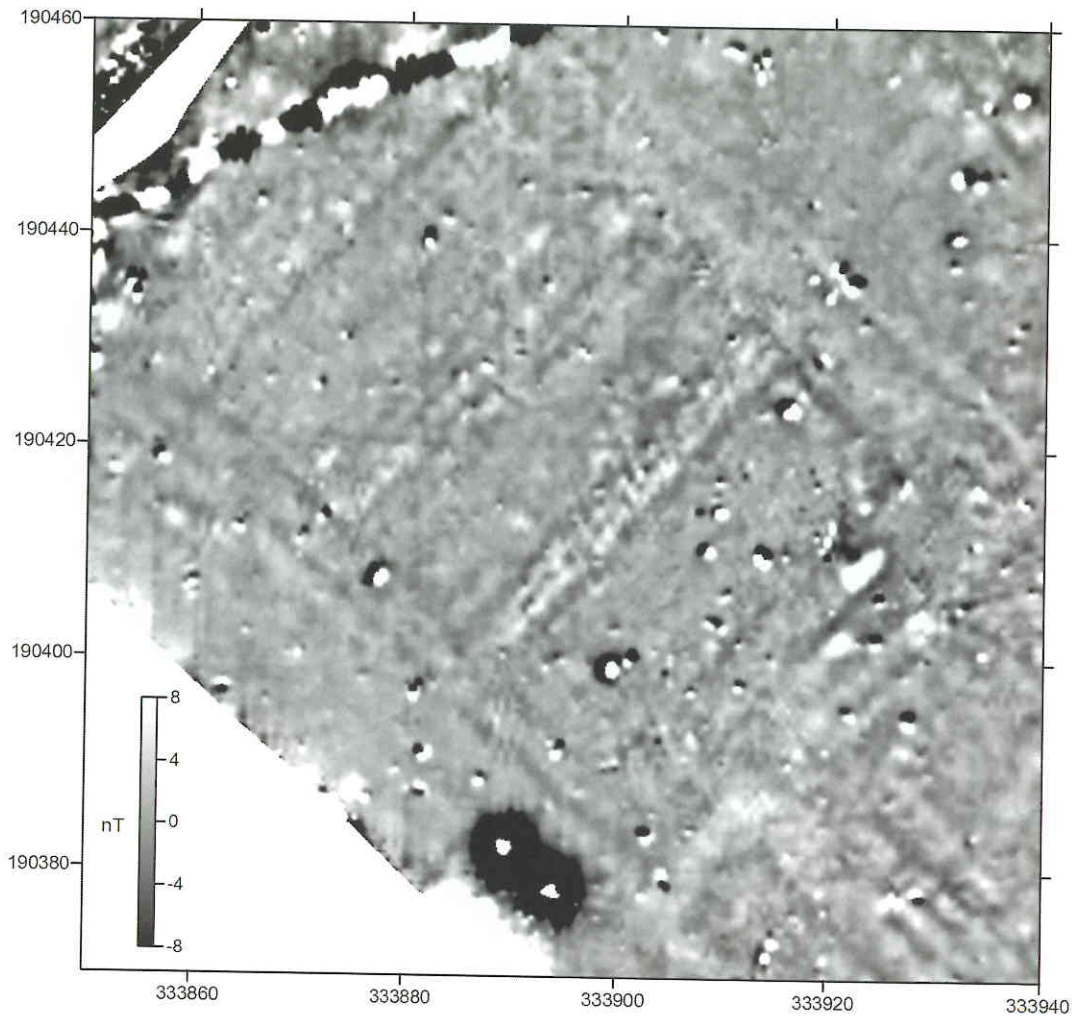

Fig. 8. Close-up of the military granaries (magnetic gradiometer survey results).

loading bays with roofs supported on posts at both ends (Manning 1981, 138–46 and 168–82; Pitts and St Joseph 1985, 117–9). Covered entrances, where wagons could be backed up and their cargoes unloaded, are also known from several stone military granaries in legionary fortresses and auxiliary forts. The granaries at Housesteads, for instance, appear to have been built with loading platforms, though in other cases it is thought that steps would have provided access from the loading bays into the raised interiors of these buildings (Petrikovits 1975, 83–5; Rickman 1971, 233). The results of the geophysical surveys at Priory Field did not identify loading bays, but wagons brought to these granaries presumably would have been able to turn on the road in front of them and evidence for covered entrances may well simply await discovery.

The identification of *Isca*'s granaries in the part of the fortress close to the *porta principalis dextra* is not a complete surprise and several archaeologists have previously suggested that the dextral side of the

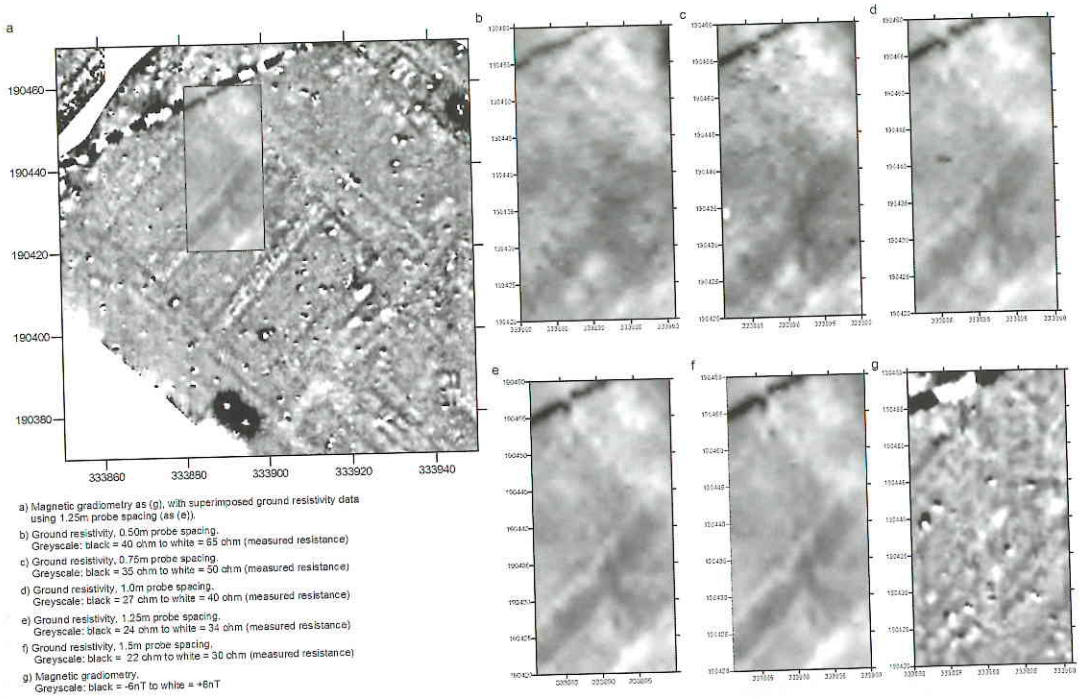

Fig. 9. Results of the multiple-spaced resistivity survey: *a*, 1.25m mobile probe spacing survey superimposed on magnetic gradiometer survey; *b–f*, ground resistivity results; *g*, magnetic gradiometer survey detail.

praetentura would have included the legionary granaries, or at least some of them (Jarrett 1969, 33; Boon 1972, 16; Boon 1987, 12–4). Other possible locations have been proposed too, particularly in the area close to the *porta praetoria* to either side of the modern High Street (Rickman 1971, 236). Although *Isca* may have had more than three store-buildings in total, the 2006 surveys confirm the presence of military granaries in the dextral side of the *praetentura*. This is a logical location for the fortress granaries as it is close to the road that led to the wharves on the bank of the river Usk where supplies brought to *Isca* by sea would have arrived. Legionary granaries, both in timber and stone, are usually found close to fortress gates, highlighting the importance of imported provisions and the need to store these close to the main thoroughfares. This would have meant that wagons bringing material and supplies into the fortress would not have caused too much disruption to the day-to-day life of its garrison. Three of the six timber granaries identified at Inchtuthil are next to gates, while the other three are slightly further away but still easily accessible from the gates along the *intervallum* road (Pitts and St Joseph 1985, 117 and fig. 83). The position of *Isca*'s granaries close to the *porta principalis dextra* and the road to the fortress harbour is mirrored exactly by the legionary granaries at Chester, discovered in 1954–56 (Petch and Thompson 1959, 33–60; Carrington 1986). Here three large rectangular granaries, measuring at least 48.5m by 13.4m were excavated in the *praetentura* close to the *porta principalis dextra* and, therefore, the part of the fortress closest to the quays that it is thought were situated in the Roodee area of the modern city. Clearly, convenience was the most important consideration when deciding where to store grain in a legionary fortress, as the granaries at Chester and now Caerleon show.

Courtyard building and 'yard'

The *insula* across the road from the entrances to the three granaries contained an extensive area of open ground in front of a very large building, of which only the south-western range and the southern corner lie beneath Priory Field. Although the geophysical results in this part of the field were disturbed by the modern service trench and postholes for the rugby goal, the surveys have provided sufficient details to suggest that this building would have comprised a central courtyard with surrounding ranges of rooms (Fig. 10). Whether the courtyard building was square or rectangular in plan and had ranges on three or four sides are questions that must remain unanswered, at least for the time being. Nevertheless, the side of the building located by the 2006 survey measured approximately 48m and it is clear that the building, whatever its shape, occupied almost the full width of the *insula*. The south-western range was divided into at least six rooms, separated into two groups of three by a central narrow space, probably the building's main entrance. Some of these rooms, particularly those at the northern end of the range, show a very strong magnetic signature, perhaps suggesting the presence of burnt material. A corridor, possibly colonnaded, would have provided covered access to the rooms arranged around the central courtyard. Only three rooms of the building's south-eastern side lay within Priory Field, with the rest of this range, like the other two sides, extending beneath the grounds of the Priory Hotel.

Rectangular courtyard buildings like the Priory Field example have been identified at a number of legionary fortresses throughout the empire, including Nijmegen, Neuss, Bonn, *Vindonissa*, *Carnuntum*, *Aquincum* (Petrikovits 1975, 82–91) and Lambaesis (Le Bohec 1989, 416). These buildings have been

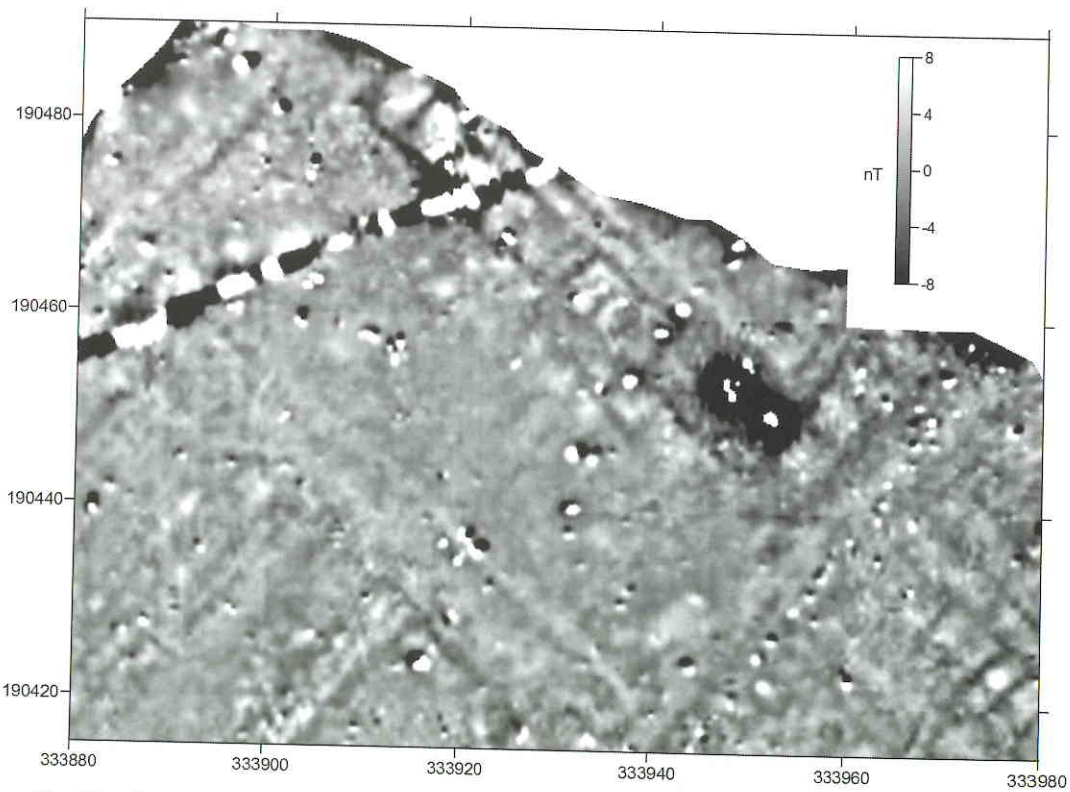

Fig. 10. Close-up of the courtyard building and open area (magnetic gradiometer survey results).

identified as stores and warehouses for non-perishable goods and the arrangement of rooms around a central courtyard is certainly similar to the plans of civil store buildings known from Rome and Ostia (Rickman 1971, 15–122). The so-called Severan Marble Plan of Rome, of which only fragments survive, shows square or rectangular courtyard buildings lining the banks of the river Tiber. These are labelled as *horrea* and were known by the names of their owners or original builders. For example, the *Horrea Lolliana* was probably built by Marcus Lollius, consul in 21 BC, or his son and had become imperial property by the reign of Claudius (Carrettoni *et al.* 1955; Rickman 1971, 164–5). The *Horrea di Hortensius* in Ostia was a rectangular building over 100m in length with a colonnaded courtyard and narrow rooms along its four sides (Rickman 1971, 64–9). At Inchtuthil a building that Richmond originally identified as the *basilica exercitatoria* (exercise hall) was later described by Petrikovits as a *schola* or officers' club (Petrikovits 1975, 78–80). Boon noticed that the Inchtuthil building was in the same relative position as the northern part of Priory Field in Caerleon (his Area IV) and suggested that 'Area IV, opposite the exercise-yards of the baths, may have held a club-house for other ranks; that is the suggested identification of a building at Inchtuthil in a similar position' (Boon 1987, 14). However, the identification of the Inchtuthil building as either an exercise hall or a club-house is far from certain and the current thinking is that it was probably a workshop or store-building (Pitts and St Joseph 1985, 123–8).

Although the size and form of the courtyard building at Priory Field are uncertain, it is clear that the building itself and the large open area in front of it were part of the same complex. The open space lay between the courtyard building and the military granaries, and it probably should be seen as linking these buildings rather than separating them. Wagons bringing supplies into Caerleon would have needed space to turn and unload their cargoes and it seems reasonable to identify the courtyard building as a store or warehouse for those goods that did not need to be kept in the ventilated military granaries on the opposite side of the large open yard. Furthermore, it would have made logistical sense for the military planners of the fortress to keep *Isca*'s main storage area within a relatively small part of the fortress that was closest to the gate leading to and from the harbour. On the other hand, a more industrial function for at least part of the courtyard building is suggested by the high magnetic anomalies obtained from the interior of some rooms. The geophysical surveys also detected faint traces of what could be superficial structures built against the front wall of the proposed courtyard store-building, indicating perhaps the demand for extra storage space in the fortress (though the dating of these shadowy structures needs to be confirmed before any conclusions regarding their functions are made).

Topographic results

The topographic survey was conducted to provide a high-resolution survey of Priory Field and the mounded slopes to the south and south-east of the amphitheatre. The primary result of the survey is a dataset imaged here as a contour plot (Fig. 11a) and shaded relief image (Fig. 11b). The shaded relief image clearly shows the difference in topographic data for the two areas surveyed. Within Priory Field the survey revealed three main banks with shallower linear ridges running between them at different alignments. One bank runs north-east to south-west close to and parallel to the south-eastern defences. A second bank on the same alignment follows the south-eastern side of the *insulae* containing the granaries and store-building, while a third runs north-west to south-east along the eastern edge of the Roman granaries. These banks do not correspond directly to any known aspect of the buried Roman archaeology and are therefore interpreted as post-Roman field boundaries and headlands. The mounded slopes below the amphitheatre include a digitate dump extending southwards from the 11m contour (at ST 33860 90290) and a simpler elongate ridge extending southwards (from ST 33820 80270). These two mounds are probably spoil dumps from the Wheelers' excavations of the amphitheatre in 1926 and 1927, and together they obscure approximately 1 hectare of the original ground surface.

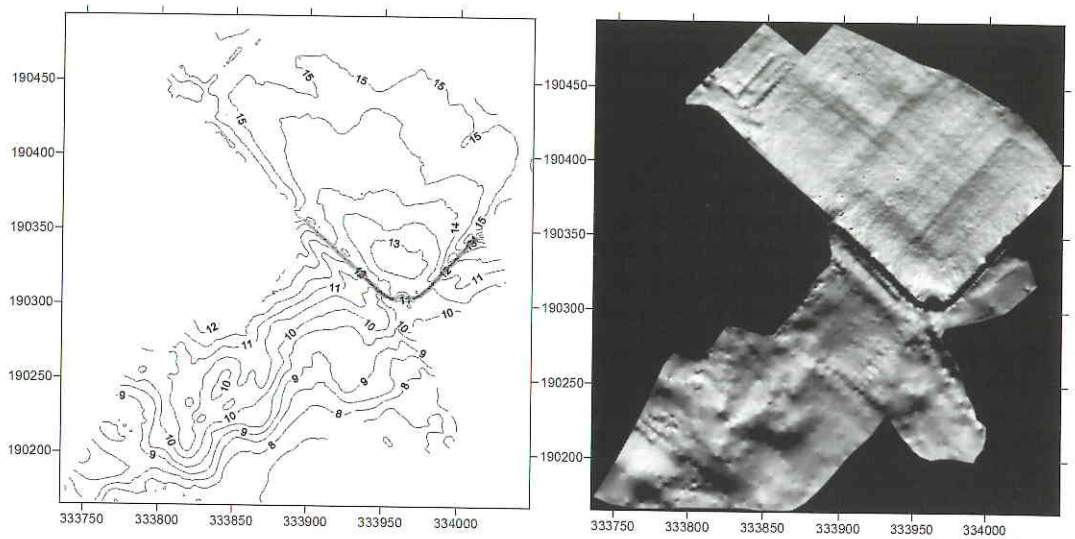

Fig. 11. Topographic survey: *left* results presented as contours above Ordnance Datum; *right* results presented as a shaded relief model illuminated from the north.

CONCLUSIONS

The geophysical and topographic surveys at Priory Field have revealed a wealth of information about the south-western part of the legionary fortress of *Isca*. Although the geophysical data can provide only a simple two-dimensional view of structural features, the surveys have located eight barrack blocks, three military granaries and a courtyard store-building and yard.

The barrack blocks were in the expected location, though the existing fortress plan had incorrectly drawn these 4m shorter than other barrack blocks in the fortress. Some internal details of the barracks were visible, confirming that, as in other barracks at Caerleon, they contained twelve pairs of rooms. Three rectangular buildings, arranged in a row and apparently enclosed by an outer compound wall, were found in the *insula* to the north-west of the barrack blocks. The size and shape of these buildings (42m by 15m), together with their buttressed wall foundations and unconfirmed internal longitudinal sleeper walls, suggest that they were granaries. The location of their loading bays is unclear, but it is likely that the entrances to these granaries were on their inner short sides. The *insula* opposite the granaries contained an extensive open area and a large courtyard building, probably a store or workshop. Some traces of buildings within the south-western and south-eastern ramparts were detected, but details of these were obscured by the proximity of the modern metal fences. Post-Roman agricultural use of Priory Field is indicated by several banks that are almost certainly the remains of former subdivisions of the field. Geophysical and topographic evidence indicates orthogonal ploughing that post-dates these ridges; such strong ploughing was commonly seen in the area during the Second World War.

Techniques of geophysical prospection and imaging are both areas where considerable advances have been made in the last two decades, yet the results of such surveys will always flatten the buried stratigraphy into a two-dimensional representation of the archaeological remains. While the surveys of Priory Field have answered a number of important questions about the layout of the south-western part

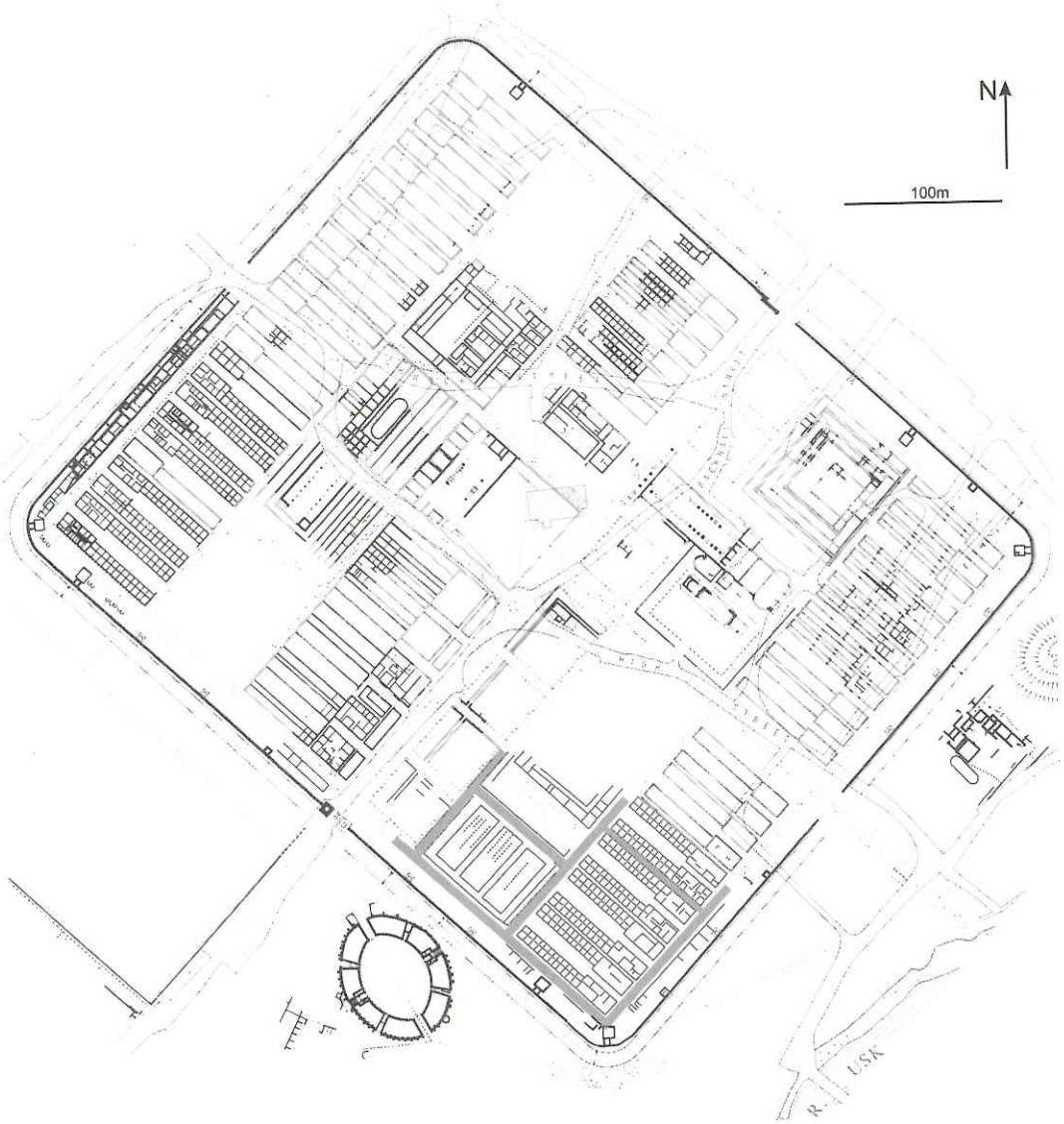

Fig. 12. Interpreted Priory Field geophysical survey results superimposed on the fortress plan.

of the legionary fortress, the results raise new questions about the functions and histories of the buildings that have been located. Answers to these important new questions can be provided only through careful excavation of the Priory Field buildings; a time-consuming but rewarding process, which would take our knowledge of *Isca* a step further forward.

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NOTES

1. The surveys were directed by Drs Tim Young and Alan Lane and were the practical element of the undergraduate 'Surveying and Prospecting' module at the Cardiff School of History & Archaeology, Cardiff University. The survey was conducted with the kind co-operation of Cadw, Mr Michael Haines of Broadway Farm and Mr P. Rollings of Broadlands. We are grateful to Mr Andrew Seaman, postgraduate demonstrator, and to the students who took part in the survey.
2. The interior of Priory Field has not been excavated, although the field margins in the southern corner were investigated by Bosanquet and King in 1909 (Bosanquet and King 1963) and by Mason in 1982 (Mason and Macdonald 1997). These excavations revealed parts of the defences, a turret and several rampart buildings (including a cookhouse and a latrine), while the southern corner of the barrack block closest to the corner angle was located in 1909.
3. The framework document, which can be found at: http://www.cf.ac.uk/hisar/archaeology/crc.html, arose from a proposal in the Cadw-sponsored Research Agenda for Wales drawn up in 2002/3 (see http://www.cpat.org.uk/research/serom.htm). Priory Field had been surveyed previously by Geophysical Surveys of Bradford (GSB 1991), but with only very limited results. Few geophysical surveys have been undertaken elsewhere in Caerleon and none are published (although a summary of the results of the Mill Field survey appears in Evans 2000).