CARLISLE AND CALDEW FAS, WILLOWHOLME, CARLISLE, CUMBRIA

Archaeological Borehole Survey and Watching Brief

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SUMMARY

As part of the Carlisle and Caldew Flood Alleviation Scheme (FAS), the Environment Agency (EA) authorised the construction of a flood defence wall and embankment on the Willowholme Industrial Estate, immediately to the west of the West Coast Mainline Railway, Carlisle, Cumbria (NGR NY 392565). The proposed flood defences are situated within the boundary of the Hadrian's Wall World Heritage Site (WHS; National Monument No CU2819). The flood wall was to be supported on a series of 7m-deep piles, some 80 of which lay in two staggered 135m-long rows within the Scheduled Monument Area for the Roman *Vallum*. The *Vallum* was a substantial earthwork that ran parallel to the southern (inner) edge of Hadrian's Wall and, although the position of the Wall at Willowholme has been recorded during excavations in the 1880s, the exact location of the *Vallum* in the area is uncertain. Due to this uncertainty, and in consideration of the archaeological significance of the area, the Hadrian's Wall Archaeologist for English Heritage (EH) requested that development should be accompanied by an appropriate programme of archaeological works. These works were divided between the Archaeological Practice, and Oxford Archaeology North (OA North). The principal programme element delegated to OA North, and reported upon here, comprised the extraction of a series of borehole (BH) samples from the points at which each of the piles along one row were to be sunk; the extracted cores were to be examined for archaeological deposits, principally those associated with the *Vallum*. In addition, an archaeological watching brief was to be maintained during all intrusive groundworks, which comprised the removal of tarmac surfaces on the industrial estate, and a topsoil strip to the south-west of the sewerage works. Following acceptance of a project design, OA North was commissioned by EA to undertake the works, which took place in July 2009.

The first stage of the works comprised the removal of modern overburden and tarmac surfaces from the development area. This was enacted by a mechanical excavator operated by Volker Stevin and working under the supervision of an OA North archaeologist. The BH positions were then set out by OA North using a differential GPS, and the coring undertaken by a terrier rig manned by a specialist team from Soil Mechanics. The sequence of deposits, and their relative thickness and depth, was recorded on-site, before each core was disposed of. Although it had been intended to bore to the full 7m depth of impact, the presence of an impenetrable layer of coarse river gravel meant the coring had to be abandoned at a depth of between 0.8m and 2.1m below ground level. As the requisite depth was not achieved in any of the BH, the Hadrian's Wall Archaeologist requested the excavation of three test pits (TP) as an alternative means of investigation. In order to maintain the integrity of the ground for the piling operation, the TP were located approximately 4m to the west of the proposed flood wall. Each TP measured 2m square and was excavated to a depth of 3m, at which depth the water table prevented further excavation.

The TPs and BHs revealed similar results, with thick bands of silty material overlying thin gravel and sandy layers, generally indicating periods of high and low energy alluviation. The gravel layer that had halted the terrier rig was observed to be over 1m thick and, in TP1 and 3 the deposit continued beyond the excavated depth. In TP2, however, the natural boulder clay was observed as the water table was reached at the base of the TP. No archaeological remains were observed during the programme of works.

ACKNOWLEDGEMENTS

OA North would like to thank Alan Thomson of the Environment Agency for commissioning the project, and Alan Rushworth of the Archaeological Practice for providing the project design and for his liaison. OA North are also grateful to Amanda Stobbs of Axis for overall project management, and to the team from Soil Mechanics for their drilling expertise. Further thanks are extended to Nick Wood of Volker Stevin and Robin Murray of the Environment Agency, for facilitating the on-site works. OA North would also like to extend thanks to Mike Collins, the English Heritage Archaeologist for Hadrian's Wall, for his input and advice.

Becky Wegiel, Denise Druce and Pete Schofield undertook the fieldwork. Becky also wrote the report, which was illustrated by Alix Sperr and Anne Stewardson. The project was managed by Stephen Rowland who, together with Emily Mercer, edited the report.

1. INTRODUCTION

1.1 CIRCUMSTANCES OF THE PROJECT

1.1.1 As part of the Carlisle and Caldew Flood Alleviation Scheme (FAS), the Environment Agency (EA) has authorised the construction of a flood defence wall and embankment on the Willowholme Industrial Estate, immediately to the west of the West Coast Mainline Railway, Carlisle, Cumbria (NGR NY 392565; Fig 1). The proposed flood defences are situated within the Scheduled Area for Hadrian's Wall (National Monument No CU2819), which is part of the United Nations Educational, Cultural and Scientific Organisation (UNESCO) Frontiers of the Roman Empire World Heritage Site (WHS; UNESCO serial id 430bis-001), and thus considered an area of extremely high archaeological potential. The flood wall was to be supported on a series of 7m-deep piles, some 80 of which lay in two rows within the putative area of the Roman *Vallum*. The *Vallum* was a substantial earthwork that ran parallel to the southern (inner) edge of Hadrian's Wall and, although the position of the Wall at Willowholme has been recorded during excavations in the 1880s (Ferguson 1888), the exact location of the *Vallum* in the area is uncertain. Due to this uncertainty, and in consideration of the archaeological significance of the area, the Hadrian's Wall Archaeologist for English Heritage (EH) requested that development within the Scheduled Area should be accompanied by an appropriate programme of archaeological works. These works were divided between the Archaeological Practice (AP), and Oxford Archaeology North (OA North). AP was charged with maintaining a watching brief within the Scheduled Area for Hadrian's Wall, itself, the results of which are presented elsewhere. The principal programme element delegated to OA North was to comprise the extraction of a series of borehole (BH) samples from the points at which each of the piles along one row were to be sunk; the extracted cores were to be examined for archaeological deposits, principally those associated with the *Vallum*. In addition, an archaeological watching brief was to be undertaken during all intrusive groundworks. Following acceptance of a project design, OA North was commissioned by EA to undertake the works, which took place in July 2009.

1.1.2 During the coring, it was apparent that the boreholes were not reaching the depth of impact that would result from the development. In consultation with AP and EH it was decided to drill each borehole to the maximum depth possible, but to augment the programme through the excavation of three test pits. This report documents the results of the coring and test pit programme, together with any significant information gained during the watching briefs undertaken by OA North in association with the development.

1.2 LOCATION, GEOLOGY AND TOPOGRAPHY

1.2.1 Carlisle lies on the Cumberland Plain, approximately 8km above the tidal limit of the River Eden and some 13km upstream of the Solway Firth. The

historic city is situated on the south bank of the Eden close to its confluence with the River Caldew. Carlisle has developed on a promontory of land extending roughly north to south, bounded by the floodplain of the Eden to the north and north-east, and to the west by the scarp above the Caldew. The development site is situated within Willowholme Industrial Estate, to the west of Carlisle's historic core and on the opposite bank of the River Caldew, directly across the river from Carlisle Castle (NGR NY392565; Fig 1). The industrial estate occupies the southern part of Willow Holme, a large area of low-lying flood plain situated in a loop of the River Eden west of its confluence with the Caldew.

1.2.2 The solid geology of the Carlisle area comprises soft, reddish Triassic St Bees sandstone of the Sherwood Sandstone Group, which lies above the Permian St Bees shales and is itself overlain and intercalated with the less extensive grey Kirklinton sandstone (British Geological Survey 1982; McCarthy *et al* 1998, 1–2). At Carlisle, the sandstone outcrops to form the roughly triangular-shaped bluff occupied today by the medieval castle. Over most of the modern city centre the sandstone is covered by a thick deposit of orange-pink boulder clay. To the north-east, however, east of the castle and just north of the medieval walled city, the southern edge of a pre-Roman channel of the River Eden was found in 1998, some 300m south of the present river channel (OA North 2008). The precise course of the river during the Roman period in this area is not known, although it probably lay much closer to the core area of settlement than is the case today.

1.2.3 West and north-west of the historic settlement, in the Willow Holme area, the precise position of the main channels of the Eden and Caldew at any time in the past is difficult to determine, although in all likelihood the Eden lay further south than today and has gradually moved northwards through time, eating into the steep scarp of Etterby Scaur, on the north bank, and depositing a considerable depth of alluvial deposits to the south over the Willowholme area (Ferguson 1888, 167-8). That the upper part of this sediment has accumulated since the Roman period was demonstrated by excavations in 1886, where the foundations of Hadrian's Wall were found beneath eight feet (*c* 2.4m) of alluvium (*op cit*, 171). Unsurprisingly, the whole of the study area is depicted as flood plain alluvium on twentieth-century geological mapping (Ordnance Survey 1969). Judging by the modern topography, it seems unlikely that the Caldew has ever lain very much further east than at the present day, although it could conceivably have flowed slightly closer to the castle rock in ancient times. However, there may have been more potential for movement north of the castle, at the confluence with the Eden, although there is no evidence to indicate how far, if at all, the Caldew has shifted its course in this area in historic times.

1.2.4 In addition to the two main rivers, three minor watercourses cross the study area. The first, known from at least the mid-eighteenth century as the Little Caldew, flows roughly south to north, west of, and broadly parallel to, the main channel of the Caldew, which it joins within the study area. From this confluence a second channel, known as Willowholme leat or simply The Cut, flows almost due west from the Caldew across Willowholme to join the

River Eden west of the present sewage works. The origins of the Little Caldew are unclear, but it seems likely that it was extensively modified, if not actually created, by human agency, probably during the medieval period, in order to serve as a mill-race. Willowholme leat is certainly artificial, however, being created in the 1820s to provide the Carlisle Navigation Canal with additional water. The third watercourse is a small stream, known as the Parham Beck, which flows roughly south to north, approximately 300m west of the Little Caldew, before entering the Cut via a culvert. The precise character of the Parham Beck is uncertain, not least because its original meandering course has been obliterated, but it is probably of natural origin.

2. METHODOLOGY

2.1 PROJECT DESIGN

2.1.1 Following consultation with EH, a project design (*Appendix 1*) was compiled by AP and OA North and submitted by Axis, on behalf of EA, to accompany an application for Scheduled Monument Consent (SMC) for the construction of the FAS embankment and wall. As far as possible, OA North undertook the coring and watching brief in full adherence to the project design, which complied with current legislation and accepted best practice, including the revised Code of Conduct (2008) and the relevant professional standards of the Institute for Archaeologists (IfA). However, due to the nature of the ground conditions, it was not possible for any of the boreholes to reach the maximum investigation depth of 7m below ground level (bgl). Consequently, following consultation and electronic correspondence, the Hadrian's Wall Archaeologist for EH requested the excavation of three test pits as an alternative means of investigating the area.

2.2 WATCHING BRIEF

2.2.1 The first phase of the watching brief entailed monitoring the removal of a narrow strip of concrete/tarmac surface within the footprint of the proposed boreholes within the Brown Brothers and A Plant yards (Plate 1). This modern material was removed by Volker Stevin using a stone saw and a mechanical excavator fitted with a 1m-wide toothed bucket. A second phase of watching brief occurred on Willowholme Road, just to the south-west of the sewerage works (Fig 1). This was a 30m by 4m topsoil strip which, due to the presence of underground cables (including high voltage electrical mains), was undertaken by hand.

2.3 ARCHAEOLOGICAL CORING

2.3.1 The position and height at ground level of each borehole was plotted using differential GPS and the cores were extracted using a terrier rig (Fig 2; Plate 2). These were opened on site and examined for archaeological horizons or features (Plates 3 and 4); the sedimentological sequence within each core was recorded and any that showed potential were retained for further analysis.

2.4 TEST PITS

2.4.1 Three test pits (TP1-3) were placed at either end of, and roughly midway along, the piling line (Fig 2). The TPs were excavated approximately 4m to the west of the boreholes, in order not to disturb the integrity of the ground for the purposes of the subsequent piling. Other considerations in their placement comprised the location of existing buildings, features, and access arrangements. The tarmac surface was cut with a stone saw, and removed by mechanical excavator fitted with a 1m-wide toothed bucket. The underlying

deposits were then removed by the mechanical excavator fitted with a 1.8m ditching bucket. The depth considered necessary to assess the potential for surviving archaeology was 4m bgl, but in each TP the water table was encountered at approximately 3m bgl, and thus prevented full excavation (Plate 5).

2.5 RECORDING

2.5.1 Throughout the programme, all exposed horizons were examined for archaeological remains and, where appropriate, cleaned by hand to aid their definition and description. Observations and deposit descriptions were recorded on *pro-forma* recording sheets and an indexed photographic record was maintained in digital, colour slide and monochrome print formats.

2.6 ARCHIVE

2.6.1 A full archive has been produced to professional standards in accordance with current English Heritage guidelines (English Heritage 1991). The paper and digital archive will be deposited at the Cumbria Record Office in Carlisle, and a copy of the report will be deposited with the Cumbria Historic Environment Records (HER) in Kendal.

3. ARCHAEOLOGICAL AND HISTORICAL BACKGROUND

3.1 INTRODUCTION

3.1.1 The following section provides a summary of the historical and archaeological background of the Willowholme area in order to provide a context to the fieldwork.

3.2 THE PREHISTORIC PERIOD

3.2.1 No evidence for prehistoric activity is known from the area, which is perhaps unsurprising in view of the low-lying character of the area, its susceptibility to flooding even up to the present day, and the likelihood that any prehistoric levels that might exist lie buried beneath several metres of alluvium. It is conceivable, although there can be no proof, that the important ford at Etterby Wath, which is recorded from the medieval period onwards (Jones 1976, 82), originated at a far earlier date, possibly even as early as prehistoric times (HER 41754). The only discovery of prehistoric remains within the study area was made in the early 1990s at the Cumberland Infirmary, which occupies a low hilltop site at the south-west corner of the study area, south of Willow Holme (Flynn and McCarthy 1993; McCarthy *et al* 1998, 4–5). Here the remains of five roundhouses, part of a settlement of Bronze Age or Iron Age date, were exposed. Just outside the study area, excavations on the site of the Maltsters' Arms public house on John Street, *c* 200m south of Willow Holme, recovered a Neolithic Langdale axe fragment, a hammer stone and two pieces of flint debitage (North Pennines Archaeology 2004). All these items were, however, either unstratified or residual in later contexts.

3.3 THE ROMAN PERIOD

3.3.1 At Willow Holme, the archaeology of the Roman period is dominated by Hadrian's Wall, which crossed the study area on an east-north-east to west-south-west alignment. The developmental history of the Hadrian's Wall frontier system is complex (Breeze 2006, 50-3), particularly so in its western sector, west of the River Irthing, where it was initially constructed of turf and rebuilt in stone later (often on a slightly different line). Furthermore, the Wall itself was only one element, albeit the most significant, of the frontier system; north of the Wall (in most areas at least) was a ditch (*op cit*, 62-3), whilst to the south, situated at widely varying distances from the Wall, lay the *Vallum*, an enigmatic earthwork comprising a flat-bottomed ditch, 6m wide by 3m deep, flanked by mounds. The purpose of the *Vallum* continues to excite debate, but was probably intended to control access to the rear portions of the wall (*op cit*, 86-7). Although the nature, and indeed, the position, of the *Vallum* at Willowholme is uncertain, it was very rarely omitted from the Hadrian's Wall 'suite'. Another linear element of the frontier system was a road, known as the Military Way. In many areas this ran along the north mound of the *Vallum*, but west of the Irthing it frequently

lay between the Wall and *Vallum* (*op cit*, 89). Work probably commenced on the Wall in AD 122–23 (Breeze and Dobson 2000, 66), although it is possible that the Turf Wall was begun slightly earlier (Shotter 2004, 75-9). With the exception of a break of no more than 20 years, when the northern frontier of Britannia was advanced to the Forth-Clyde isthmus during the reign of Antoninus Pius (AD 138-161), Hadrian's Wall remained in commission to the end of the Roman period. It would seem that the western sector of the Turf Wall, including the section in the Willow Holme area, was not rebuilt in stone until the return from Scotland (Breeze 2006, 60), which probably occurred in the AD 150s (Bidwell 1999, 23).

3.3.2 The line of the Turf Wall in this area is not known, but it must presumably cross the study area somewhere in the vicinity of the Stone Wall. When excavated elsewhere, it has been found to be *c* 6m wide at the base and built of cut turves laid in courses (Breeze 2006, 58). In some places, the rampart was placed on a cobble foundation up to 5.8m wide (*op cit*, 60), although this feature does not seem to have existed everywhere. There is evidence that in boggy ground the Turf Wall rested on a piled foundation (*ibid*). The Stone Wall was first seen at Willow Holme in 1854 during the construction of a sewer (Ferguson 1888, 168; Simpson 1932, 149), and was exposed again in two places in 1886, close to the first site, in the angle formed by the main railway line from Carlisle to Glasgow and the branch line to Port Carlisle (Ferguson 1888, 171-2). Here, the Wall had been reduced almost to its foundation, which rested on river gravels, but enough survived to demonstrate that it had been 2.36m wide above foundation level. The remains of the Wall at this point were buried beneath 2.44m of alluvial silt (*ibid*). The Wall foundation was located again east of the main railway line and was found to be similarly preserved (*op cit*, 174). During the same excavation campaign, the Wall and Wall Ditch were located north of the Eden, on top of the steep bank above Hyssop Holme Well, and a search was made for traces of the bridge that carried the Wall over the river, but without success (*op cit*, 172-3). In 1932, a further stretch of the Stone Wall several metres in length was found close to the site of the original (1854) exposure during the construction of a new sewer (Simpson 1932). Here the foundation was 2.69m wide and comprised a layer of rough sandstone flags *c* 100mm thick, bedded in puddled clay, and laid directly upon the natural gravel subsoil. Above foundation level only two of the northern-facing stones remained, offset by *c* 163mm from the outer face of the foundation (*op cit*, 150). The depth at which the remains lay beneath the modern surface is not stated in the report, but the published photograph indicates that the Wall lay beneath a thick deposit of alluvium.

3.3.3 On the evidence of spacing, Milecastle 67 should lie just west of the study area, close to the south end of the Waverley Viaduct (now long disused) that once carried the Carlisle to Edinburgh railway line across the Eden. Whilst no trace of Milecastle 67 has been found, Roman coins were unearthed west of the viaduct in 1861, and a gold necklace of probable second century date was found a short distance further west in 1860 on the site of the former canal engine shed (Ordnance Survey (OS) 1865). Turrets 66a and 66b should also lie somewhere in the Willow Holme area (Milecastle 66 was located

north of the Eden, on top of the steep bank above Hyssop Holme Well), but whilst the approximate positions of these structures can be calculated on the evidence of spacing, their precise locations are unknown. Neither the Wall Ditch, the *Vallum*, or the Military Way have been seen at Willow Holme, though all presumably cross the area, buried deep beneath alluvial silts like the Wall itself. On the 1937 edition of the OS 25-inch map a line labelled 'probable course of *Vallum'* is shown crossing Willow Holme a little over 70m south of, and parallel to, the line of the Wall, but this is not based on archaeological evidence. North of the Eden, the north mound of the *Vallum* is depicted on the 1966 edition of the OS 1:1250 map (NY 3956 NE) as lying *c* 56m south of the Wall, but there can be no guarantee that this is reflected in the Willow Holme area. Traces of the *Vallum* have, however, been observed west of the study area, on the higher ground at Davidson's Banks, where it lay just south of the Wall.

3.3.4 With the exception of Hadrian's Wall itself, few Roman remains are known from within the study area, a notable exception being the rural settlement that was excavated at the Cumberland Infirmary. Here, where several roundhouses were also discovered (*Section 3.2*), part of a multi-phase Roman settlement was exposed, comprising rectilinear timber buildings and cobbled surfaces associated with palisaded and ditched enclosures (Flynn and McCarthy 1993). Dating evidence suggested a floruit for this site in the late first-second century AD. The only other record of Roman material from within the study area is of a small fragment of samian pottery, found in 1976-7 on the south-west edge of the modern sewage works, close to the line of Hadrian's Wall (*ibid*).

3.4 THE EARLY MEDIEVAL PERIOD

3.4.1 There is no evidence for early medieval activity or occupation within the study area. It is conceivable that the important medieval ford at Etterby Wath, which crossed the Eden from Willowholme on the south to Etterby on the north (Jones 1976, 82), was already in use in the pre-Norman period (and indeed much earlier), which would imply that a road or track leading to the ford across Willow Holme, and which subsequently developed into Willowholme Road, was also in existence, although there can be no proof of this.

3.5 THE LATER MEDIEVAL PERIOD

3.5.1 It is during the medieval period that the first references to the area appear in contemporary documents. The name of Willow Holme is believed to derive from the personal name Gueri; the Pipe Roll of 1130 refers to Gueri the Fleming, who owned land and houses in Carlisle (Jones 1976, 82), and whilst there is no direct documentary proof, it is thought highly probable that part of Gueri's holding was at Willow Holme, which in the Middle Ages was known as Weryholme (*ibid*). The Holme element of the place name probably derives from the Old Norse holmr, which was adopted into late Old English and used in a general sense to denote flat or low-lying ground, or a river-meadow

(Mills 1976, 45; Gelling 1984, 50-2). Gueri's land lay adjacent to the southern end of Etterby Wath, an important ford across the River Eden, and it is likely that he, together with his contemporary Etard (who gave his name to the village of Etterby on the north bank of the river) were given their lands in order to secure both ends of this crossing (Jones 1976, 82). The allocation of these estates across the wath was part of a wider policy to safeguard the approaches to Carlisle in the early Norman period by the creation of the baronies of Burgh and Liddell and the introduction of new tenants to the important local lordships of Scaleby, Rickerby and Botcherby (*ibid*).

3.5.2 During the medieval period, Willow Holme formed part of the socage manor of Carlisle, some 1,300 acres of arable, meadow and pasture land forming part of the revenue of the Crown (Spence 1984, 65-6). On a plan of the manor produced in 1611 (*op cit*, pl II) the Willow Holme portion is estimated at 111 acres (*op cit*, 67) and its boundaries are shown, but whether this reflects the situation in the medieval period is not known. From 1376 the manor, together with the castle and other royal demesnes, was committed to the custody of the sheriff of Cumberland at an annual rent (*op cit*, 74). From this date farming-out of parcels of land for rent became increasingly common, although documentary sources suggest that this had begun earlier, and by the early post-medieval period Willow Holme, like other parts of the manor, was held by a large number of different tenants. In the aftermath of the Black Death of 1349, the income paid to the sheriff from socage tenants was around a third less than previously (*op cit*, 281), which provides an indication of the possible level of mortality in the city. Some of the city's leading burgesses used their position to obtain grants of the royal demesnes once these began to be farmed out. One such was John de Blenkinsop, who in 1377 received a 13-year lease of lands in Weryholme; this grant was subsequently renewed twice (*op cit*, 368). The clerical poll tax returns of 1379 and 1380 for Carlisle deanery record that Gilbert Grout, an unbeneficed chaplain, briefly held the farm of the royal demesne of Weryholme (*op cit*, 306). The canons of the Priory of St Mary's in the city had acquired holdings in the area by *c* 1220 and possibly considerably earlier (*op cit*, 71-2), although later documents suggest the Priory held much of its land in the socage manor as freehold.

3.5.3 With the probable exception of what is now the Bridge Street/Church Street frontage to the south, it is unlikely that many buildings were erected in the area during the medieval period. No medieval maps of Carlisle exist, but cartographic depictions from the seventeenth century show the whole area as open fields, with limited ribbon development extending west along the road leading from the west gate of the city. In view of its location, on a low-lying flood plain at the confluence of two rivers, it seems likely that the area was given over largely to pasture and meadowland rather than arable cultivation, although evidence is lacking. That the area was subject to severe (and presumably frequent) inundation is indicated by a documentary reference of 1401, when John de Blenkansop, a former mayor (presumably the same individual recorded in 1377), requested a reduction in the rent of his land at Weryholme, which had been ruined by floods and by frequent Scottish raids (Summerson 1993, 396). Early in the same year, the castle demesnes at

Weryholme were said to be 'in great part diminished, and diminished from day to day, by the frequent flood of water around there' (*op cit*, 397). No medieval sites are known within the study area, although the Little Caldew may be of medieval origin, perhaps originating as a mill-race to supply the medieval corn mill at Denton, which lay south of the study area (HER 41077).

3.6 THE POST-MEDIEVAL PERIOD

3.6.1 At Willow Holme, the early post-medieval period probably saw little change, with the area doubtless continuing to be used largely for pasture and meadow. That this was the case is suggested by a documentary reference to the construction of a siege-work west of Carlisle during the Parliamentarian siege of the city in 1644-5. The work was constructed on the top of Catcoates Bank, from where it 'commanded the Willowholme, and rendered it useless to the garrison as a grazing ground' (Ferguson 1891, 112).

3.6.2 During the sixteenth century it would appear that much of the socage manor of Carlisle, of which Willow Holme formed part, had, for a variety of reasons including political expediency and laxness on the part of the Exchequer, slipped from the control of the Crown (Spence 1984, 79). In the early seventeenth century steps were taken to remedy this situation. Two detailed Exchequer surveys conducted in 1608 and 1611 recorded a large number of tenants and landholders, from the Dean and Chapter of the Cathedral to members of the aristocracy and local traders and craftsmen, many of whom claimed to hold their land freehold or by customary tenure, and who therefore paid no rent to the Crown. Willow Holme, as shown on a plan produced to accompany the 1611 survey (*op cit*, 67) comprised 111 acres of demesne land. In the same year a sixty-year lease on the manor, demesnes and castle was granted to Francis Clifford, Earl of Cumberland, who undertook prolonged legal proceedings to reclaim manor lands from those who claimed freehold or customary tenure over them. These proceedings, which continued through the 1620s and 1630s, demonstrated that many tenants had no permanent claim on their holdings, which remained the property of the Crown. By December 1630, 42 acres in Willow Holme had been recovered and it was recommended that the land should be enclosed, but this was not done (*op cit*, 76). However, other lands in Willow Holme continued to be held by important Carlisle citizens, some of whom were summoned before the Council of the North at York to answer the Cliffords' complaints that they had refused to quit their holdings (*op cit*, 77). One of the few landholders to succeed in their legal claim to manor land was Thomasine Tullie, widow of George Tullie, who kept her land at the Sauceries (east of the River Caldew) because the Court decided that it was really part of her freehold in Willow Holme but had been separated from that holding by a change in the river's course (*ibid*).

3.7 PREVIOUS ARCHAEOLOGICAL INTERVENTIONS

3.7.1 The earliest recorded archaeological observations made in the Willowholme area occurred in 1854, when the stone rebuild of Hadrian's Wall was seen during the construction of a sewer (Ferguson 1888, 168; Simpson 1932, 149). The Stone Wall was exposed again in three places in 1886; two of the exposures occurred close to the first site, in the angle formed by the main railway line from Carlisle to Glasgow and the branch line to Port Carlisle (Ferguson 1888, 171-2), whilst the third was situated east of the main railway line. The sites of the exposures were marked with inscribed stones (*op cit*, 174; Simpson 1932, 149). In 1932, a further stretch of the Stone Wall several metres in length was found close to the site of the original (1854) exposure during the construction of a new sewer (Simpson 1932). Here too, the Wall foundation was buried beneath a thick accumulation of river deposits.

3.7.2 No further archaeological work was undertaken in the Willow Holme area until 1988, when the Central Excavation Unit (CEU) excavated a trial trench 40m long and 2m wide across the presumed line of Hadrian's Wall, on the site of a proposed tarmac batching plant at NY 338750 556460 (HER 13662). A deposit of modern ash and clinker 0.5m deep was found to overlay clean alluvial sand and no trace of the Wall was found.

3.7.3 The most extensive archaeological excavation undertaken within the study area took place in 1992-3 on the site of the Cumberland Infirmary, south-west of Willow Holme, in advance of the proposed redevelopment of the site. There, the remains of a prehistoric settlement of possible Bronze Age or Iron Age date, were overlain by extensive Romano-British occupation levels. (Flynn and McCarthy 1993; McCarthy *et al* 1998, 4–5). Further phases of evaluation and excavation occurred on the same site in 1997-8.

3.7.4 A watching brief was maintained in 2005 during the erection of a telephone mast at a site adjacent to Willow Holme Road (Martin 2005), very close to the site where Hadrian's Wall was located in 1886 in the angle between the railway lines. In spite of its location, however, the mast was found to have been sited on an artificial bank composed of modern overburden and rubbish up to 3m thick. No archaeological deposits were recorded.

3.7.5 Similar deposits were also encountered during archaeological evaluations conducted elsewhere in the industrial estate in 2007, in connection with the Carlisle City FAS. In the first phase of works, three trenches were excavated, one immediately beside the main West Coast railway line at the point where the railway bisects the line of Hadrian's Wall, the other two further to the south-west, next to the Parham Beck (The Archaeological Practice 2007a). In the former trench 1.5m of modern debris, possibly levelling material, was found to overlie a level that may have been associated with the old railway sidings. Since the Stone Wall in this area is known to lie *c* 2.44m below the level of the nineteenth-century ground surface, it was concluded that today the remains of the Wall are likely to lie at least 3.9m below ground. In the trenches next to Parham Beck, nineteenth-century debris was removed to a depth of 1.55m below the modern surface, after which excavation ceased. The second phase of evaluation took place close to the north end of the Little

Caldew (The Archaeological Practice 2007b). There, modern levelling debris and twentieth-century alluvial deposits were found to overlie nineteenth-century rubbish deposits that in turn sealed a possible stake-built fence adjacent to the south bank of the Willowholme leat, which is known to have been cut in 1825. No earlier deposits were encountered.

3.7.6 In December 2008, OA North supervised the extraction of six geotechnical boreholes through the railway embankment bordering the Willowholme Industrial Estate and the neighbouring sewerage works. No features or deposits of archaeological interest were encountered during the programme (OA North 2009).

4. RESULTS

4.1 WATCHING BRIEF

4.1.1 The watching brief began at the southern end of the site (Fig 2), in the Brown Brothers yard. A layer of black tarmac, 0.1m thick, was removed that overlay a mid-pinkish-brown loose hardcore base. The northern end of the area was part of the A-Plant yard. The black tarmac, 0.15m thick, was removed, revealing a layer of light yellowish-brown loose gravel, forming a sub-base for the yard. At the very northernmost end of the site, the hardcore base was not evident, but the area appeared to be made-up with building rubble that comprised sandstone blocks, modern brick and mortar. No archaeological deposits were observed.

4.1.2 The second phase of watching brief was located further to the north-west and comprised a topsoil strip alongside Willowholme Road within the Hadrian's Wall WHS boundary (Fig 1). There were a great many services running through the area, and so there was very little undisturbed land left. The dark blackish-brown clay silt topsoil was observed to be 0.2m thick. This sealed a reddish-brown clay silt subsoil, which was only visible in places. No archaeological remains were observed (Plate 6).

4.2 BOREHOLES

4.2.1 In total, 41 boreholes were drilled, and the results, which were broadly similar along the length of the piling line, are presented descriptively in *Appendix 2* and as a schematic section drawing on Fig 3. Broadly, the uppermost 0.2m of sediment within each core comprised made ground, which sealed various silt deposits varying from 0.1m - 1.5m in depth. These silt deposits were generally reddish-brown and flecked with charcoal, but, particularly at the top of the sequence, were occasionally grey. The reddish-brown silts within the southern half of the piling line often sealed a 0.1m- to 0.75m depth of alternating bands of sandy gravels, sand and reddish-brown sandy silt, which individually were approximately 0.04m to 0.1m thick. Where present, these in turn sealed an impenetrable layer of river gravel, through which no further coring could be undertaken with the terrier rig. The depth at which this gravel was encountered varied, but was generally at around 11m OD (as little as 0.2m bgl) at the northern end of the piling line, and 10m OD (up to 2.2m bgl) at the southern end.

4.2.2 There was a suspicion that grey silt deposits within the upper portions of BH105 and 107 might represent archaeological features, and these cores were retained for more detailed examination. This revealed that the stratigraphy recorded in BH105 and 107 was likely to represent changes in sedimentation rate and/or sedimentary processes. The shifts from fairly homogeneous silt to finely laminated silt in both cores probably indicated temporary increases in tidal influence on the flooplain deposits. As such, the deposits were not considered archaeologically significant.

4.3 TEST PITS

4.3.1 ***TP1 (ground level at 12.1m OD)***: removal of the tarmac and hardcore revealed a 0.3m-thick layer of dark brownish-grey clay silt with a moderate amount of charcoal flecking and coal inclusions (***171***). The base of the deposit was very uneven, and there was evidence of iron panning between this deposit and the next. The next layer, ***172***, was a dark reddish-brown clay silt, 0.5m thick, and was a very homogenous and sterile-looking deposit. Below was a very similar dark reddish-brown clay silt (***173***), 0.6m thick, but there was significantly more charcoal than that above. Beneath this was yet another layer of sterile clay silt, ***174***, which was 0.6m thick.

4.3.2 Underlying the thick bands of clay silt, at approximately 2.1m bgl, the geology changed to gravels and sands. The first band was a relatively thick (0.4m) deposit of coarse gravel, ***175***, with an average pebble diameter of 50mm. Below this were narrow bands of alternating black and orange gravels, ***176***, which appeared to be continuing beyond the maximum depth of excavation at 2.9m bgl, whereat the water table was reached. Plate 5 shows the general trend of deposits found in all three of the test pits.

4.3.3 ***TP2 (ground level at 11.9m OD):*** the uppermost stratigraphic sequence in TP2 was not dissimilar to TP1, with 0.1m of greyish-brown clay silt with charcoal flecking and modern bricks (***177***), sealing a 0.5m-thick layer of dark reddish-brown clay silt (***178***). At 0.7m bgl, the geology changed to homogenous, banded but loose yellowish-brown gravels (***179***) to a depth of 2.6m bgl, where a very dark blackish-brown compact gravel, ***180***, was apparent. This compact layer was approximately 0.4m thick, and overlay what appeared to be natural boulder clay (***181***) at the base of the test pit. No further excavation could take place as the water table had been reached at 3m below the ground surface.

4.3.4 ***Test Pit 3 (ground level at 11.5m OD):*** beneath the modern surfacing materials was a greyish-brown clay silt, 0.1m thick (***182***), which sealed a reddish-brown clay silt (***183***). At 0.8m bgl, bands of river gravel (***184***) were apparent, which continued down to a depth of 2.6m bgl. Below this was a layer of pinkish-brown sandy silt (***185***) that was observed continuing past the base of the test pit and the water table.

5. CONCLUSIONS

5.1 DISCUSSION

5.1.1 No clear archaeological horizons, and certainly no Roman finds, were identified during the course of the programme of site investigation works. The evidence would suggest that, either the *Vallum* did not lie within the area of investigation, or, if it did so, it must have taken a form rather different to its known (and generally very consistent) character demonstrated elsewhere. Those parts of Hadrian's Wall identified to the north of the present area were found to lie on top of river gravels (Ferguson 1888), which are likely to be analogous to those that proved beyond the bite of the terrier rig in the present scheme of investigation. As such, it seems probable that the *Vallum* would have been dug through the same deposits and, should, therefore, have stood out as a very distinctive 'soft spot'. Given that only a veritable torrent would supply the energy needed to deposit the river gravels, it seems highly unlikely that the *Vallum*, or any other archaeological features, would be sealed beneath these gravels. The approximately 3m intervals of the boreholes should mean that at least one would have contacted the *Vallum* 'soft spot' (approximately 3m to 6m in width and up to 3m in depth). Relative to their neighbours, 'soft spots' could be said to have been encountered in BH89, BH93 and BH140. However, there was no pattern indicative of a deep, ditch-like feature, whilst the deposits within these 'soft spots' were identical to those observed elsewhere. When considered together with the rest of the data, it is apparent that these 'soft spots' are more likely to be more extreme examples of the general fluctuations at which the top of the river gravel was encountered, and seem merely indicative of natural undulations which latterly filled with flood silts.

5.1.2 On the basis of the results of the site investigation, it seems unlikely that the *Vallum* lies within the area of disturbance from the proposed pile-founded wall. Although the proximity of the Eden and the Caldew may have dictated that the juxtaposition of Wall and *Vallum* was somewhat anomalous, the present evidence would suggest that, as at Davidson's Banks, to the west, the *Vallum* lay rather closer to the rear of the Wall, and thus to the north of the OA North investigation area.

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7. ILLUSTRATIONS

7.1 FIGURES

7.2 PLATES

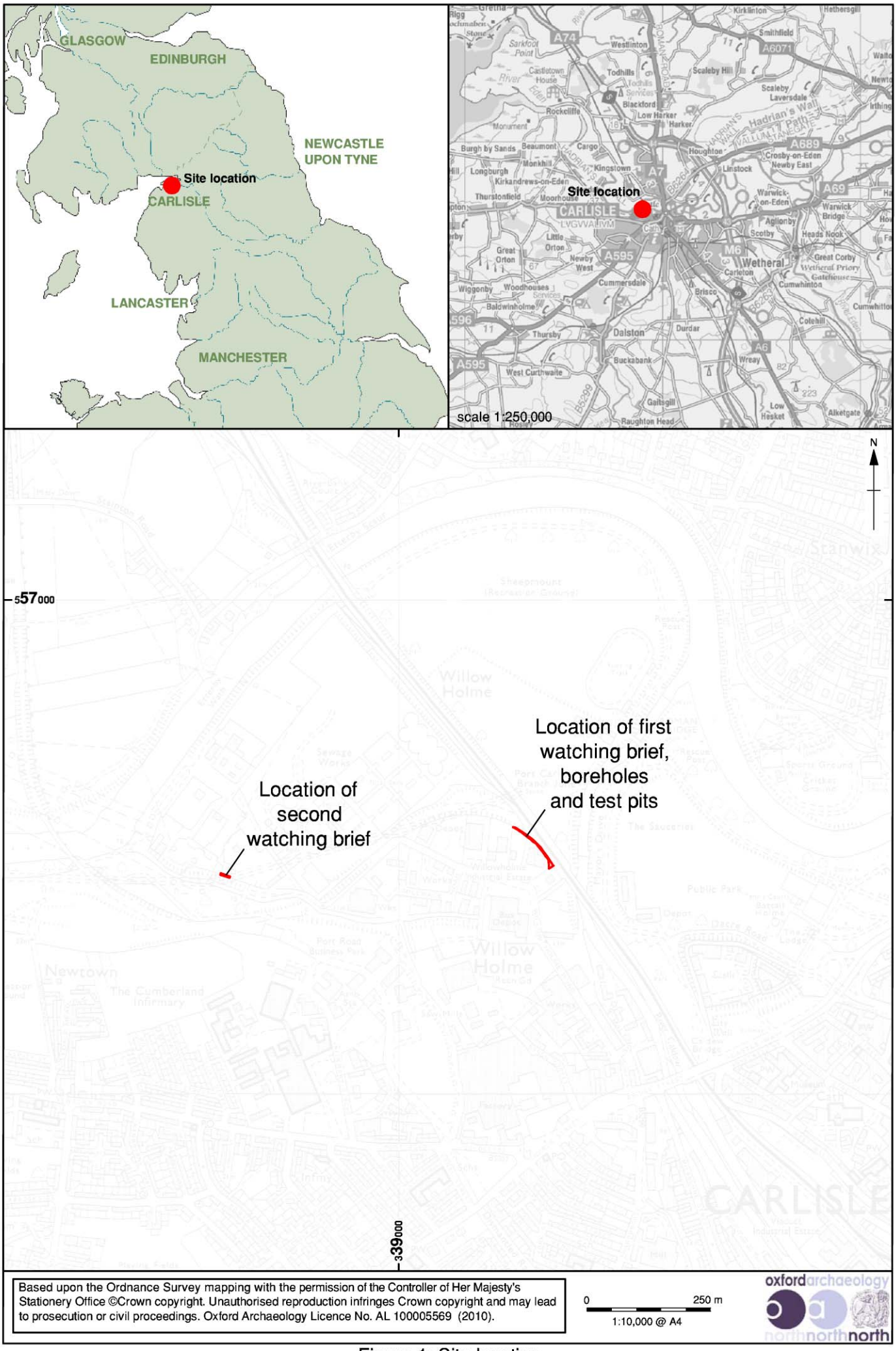

Figure 1: Site location

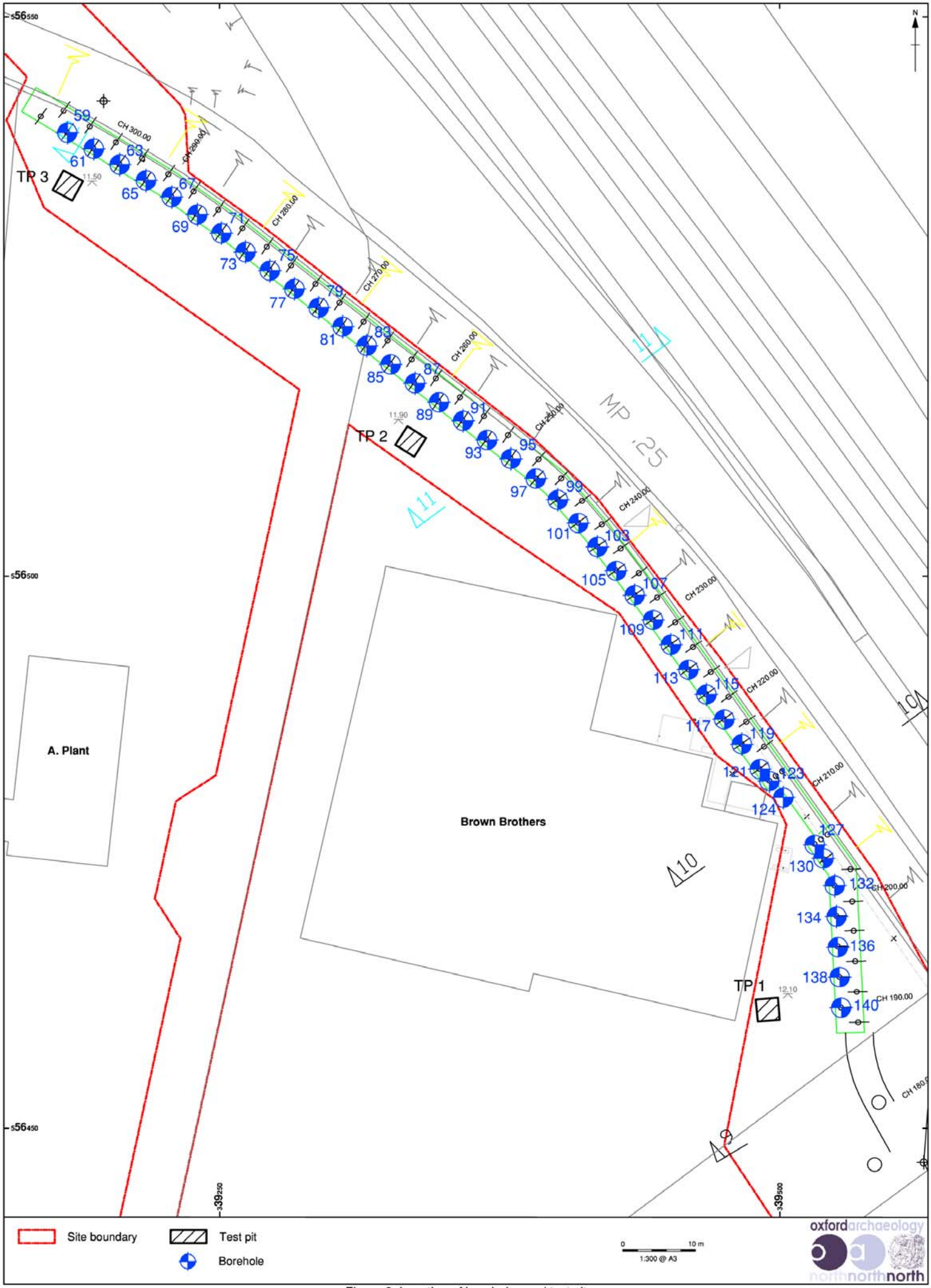

Figure 2: Location of boreholes and test pits

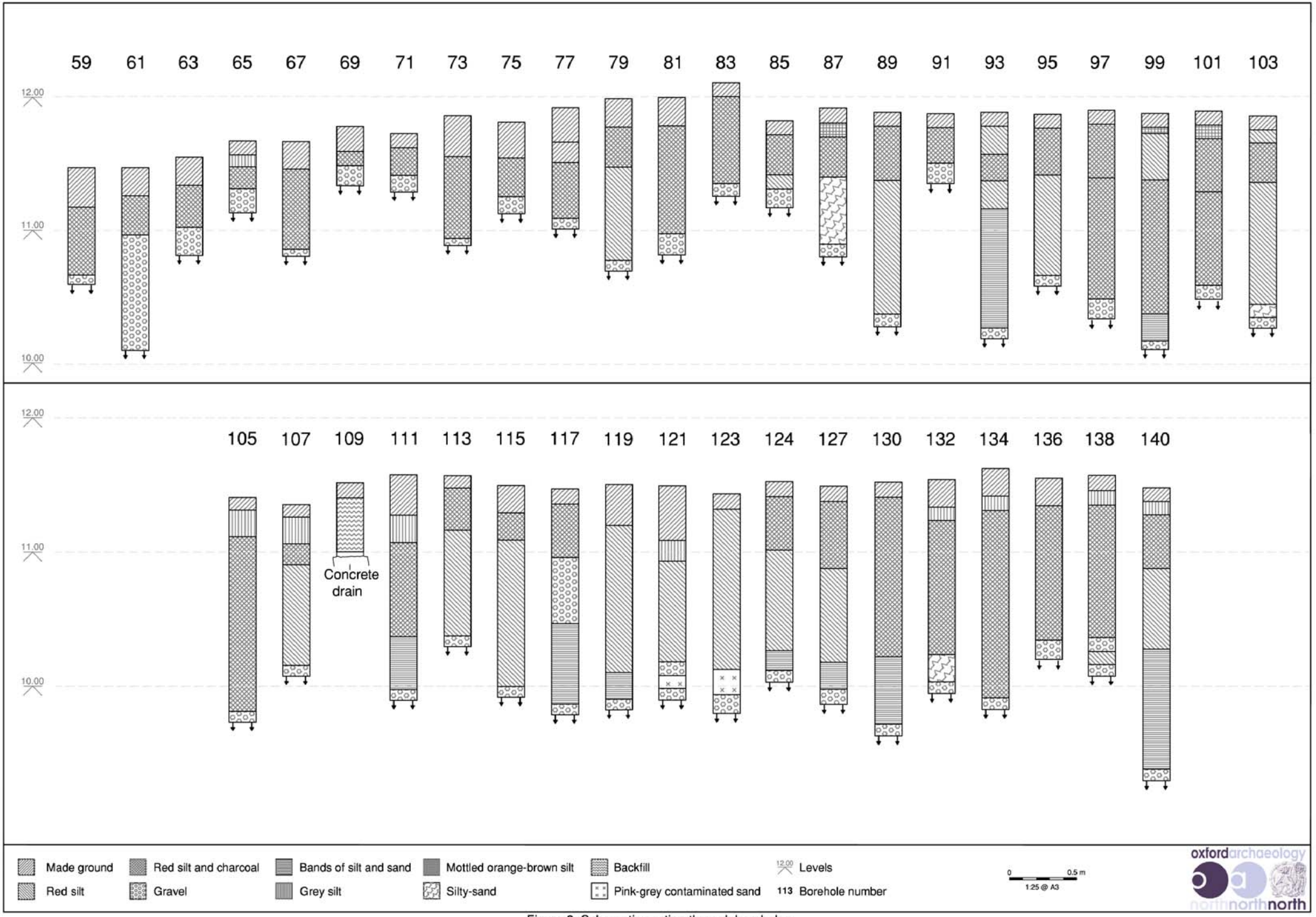

Figure 3: Schematic section through boreholes

Plate 1: View southwards along the area of boreholes and watching brief

Plate 2: Terrier rig in operation

Plate 3: Example cores

Plate 4: Cores under examination

Plate 5: South-east-facing section of Test Pit 3, showing general deposits found within all three pits

Plate 6: View of monitored topsoil strip area on Willowholme Road, facing east

APPENDIX 1: PROJECT DESIGN

1. INTRODUCTION

1.1 Background

1.1.1 The following represents a project design for the archaeological monitoring of groundworks associated with the construction of a flood defence embankment across the line of Hadrian's Wall in Willow Holme, NW of Carlisle centre, and a flood defence wall, immediately to the south, across the suggested line of the Vallum. These construction works form part of the Caldew and Carlisle City Flood Alleviation Scheme: Detailed Design Phase 2, CL19.

1.1.2 The Project Design has been prepared at the request of English Heritage, advisors to the Department of Culture, Media and Sport (DCMS), and accompanies an application for scheduled monument consent with respect to the construction of the flood defence embankment across the line of Hadrian's Wall (National Monument No. CU2819).

1.1.3 The location of the works may potentially impact upon the remains of Hadrian's Wall and the Vallum in Willow Holme (Environment Agency 2006a, 17-18, 33, 42, cf. Gazetteer site no 1), which forms part of the Hadrian's Wall World Heritage Site.

1.1.4 This project is designed to mitigate the cultural heritage impact of the proposed flood alleviation works by ensuring that the historic remains are fully recorded.

1.1.5 Execution of the recording work forms a condition of the planning consent granted to the flood alleviation scheme (Planning Application Ref: 1/07/1473)

1.2 Historical background

1.2.1 The proposed flood embankment lies adjacent to the point where the West Coast Main Line intersects the line of Hadrian's Wall in Willow Holme. The existence of the Wall at this point is firmly established. Remains of the Wall curtain were found here by the Cumberland Excavation Committee in 1886 and inscribed stones were erected at that time to mark the Wall's position. Two of these stones (C and D) still stand today, on the east side of the WCML trackbed and between the main lines and the freight lines respectively, although given the substantial alteration to the surrounding ground levels and to the railway itself entailed by late 19th-century/early 20th-century rubbish dumping and by the construction of the freight lines, it is open to question whether either stone stands in its original position. Nevertheless this is virtually the only location in Willow Holme where the Wall's remains can be pinpointed with absolute confidence. As a result, this stretch of the Wall's course is protected as a scheduled ancient monument (National Monument No. CU2819).

1.2.2 The remains of the Wall were encountered at a depth of 8ft (c. 2.40m) in 1886 and comprised the clay bedding layer, flagged foundation, and fragments of the first course (Ferguson 1887, 167).

1.2.3 Remains of the Wall were also clearly identified further to the west, within the area of the present Water Treatment Works, during sewer construction in 1854, in 1886 and by F.G. Simpson in 1932 (MacLauchlan 1858, 75-6 n.2; Ferguson 1887, 167; Simpson 1932, 150; *cf*. fig 2). These remains were in a similar state of preservation to those found beside the railway line, with the foundation flagging being encountered at a depth of 1.35m (4ft 6ins) or more (MacLauchlan 1858, 75-6 n.2; Simpson 1932, 150; *cf*. Ferguson 1887, 167).

1.2.4 The remains of the Vallum, by contrast have never been observed in Willow Holme and consequently its exact course across the flood plain is uncertain. It is assumed, however, that the monument ran fairly close behind the Wall curtain, as it did at the nearest points where it has been recorded, namely at the west end of Rickerby Park, next to the Scotland Road/Brampton Road (A7/B6264) junction, in Stanwix, to the east (Simpson 1934, 156-7; 1935, 257-8, fig 31), and Davidson's Banks opposite Stainton, to the west (Simpson 1933, 275).

1.3 FAS evaluation and site investigation results: 2007-9

1.3.1 In order to evaluate the impact of the proposed flood defence embankment an archaeological trench was excavated by the Archaeological Practice Ltd across the line of Hadrian's Wall on the W side of the WCML in January 2007 (*see* Archaeological Practice 2007). A series of geotechnical site investigations, involving window sampling and boreholes (WSA-C; BH02-03), which were undertaken along the course of the proposed flood embankment in December 2008, were archaeologically monitored by Oxford Archaeology North (*see* OAN 2009) supplementing a smaller number of monitored bore hole site investigations undertaken in 2007 (BH511-514). These investigations are plotted on Fig 3 and their results, in terms of the depth of obvious modern overburden revealed, are tabulated below (*see* Table 1).

Table 1: CL19 Archaeological Evaluation & Geotechnical Site Investigation Results

Intervention	WSA	WSB	WSC	BH513	2007 AP eval trench	BH02	BH03	BH512	BH511
Depth of mod. overburden/ made ground	3.4m	3.3m	3.3m	4.2m	1.5m+ (bottom not reached)	3.0m	1.0m over 0.6m clay	0.78m ov. 1.92m redeposited clay	0.6m (tarmac & made ground)

1.3.2 The evaluation trench beside the WCML established that substantial quantities of overburden had been dumped over the site, some of it perhaps quite recently. A layer which was interpreted as former railway trackbed (perhaps sidings) was revealed beneath the modern dumps at a depth of 1.5m (alternatively this could simply represent late 19th/early 20th-century rubbish deposits). During the 19th century, Hadrian's Wall was reported to lie 2.4m (8ft) below the contemporary ground surface at this point. It may now be assumed to lie *at least* a further 1.5m beneath present ground surface (a probable combined depth of 3.9m below present ground surface), far below the level which it is envisaged will be impacted by construction operations for the flood embankment. The trench also intersected a mound of recently made ground running along the western edge of the site next to the WCML and where it did so the spoil was removed to create a more level stable platform for the machine prior to excavation of the trench proper. The mound was predominantly composed of loose clayey spoil not dissimilar to but less compacted than the underlying 0.70-0.80m deep, orange brown sandy-clay layer (HW1 001) which formed the uppermost layer in the trench and which in turn overlay a dark clayey silt layer (HW1 002) containing a great deal of modern rubbish. The mound is therefore of no archaeological significance. The excavation team were informed on site that the spoil had been excavated from elsewhere on the site and dumped at the rear next to the WCML. Map/pictorial evidence shows that the Edinburgh-Carlisle Waverley line formerly ran the length of the site on an embankment and this has now been largely been graded down presumably as a result of various earthmoving operations of this kind.

1.3.3 The geotechnical site investigations extended this picture. To the north of Hadrian's Wall the three window samples WSA-C and borehole BH513 revealed made ground containing brick, ash and clinker, consistent with identification as the residue of late 19th-early 20th-century rubbish dumping, to depths of between 3.3-3.4m (WSA-C) and 4.2m (BH513). Within the scheduled Wall corridor deposits of made ground, incorporating fragments of ash, clinker, housebrick, concrete wood and sandstone were encountered to a depth of 3m which may be compared with the results of the evaluation trench. To south of the scheduled Wall corridor the depth of obvious rubbish deposits reduced to 1m (BH03) and 0.78m (BH512)., although these lay over a 0.6-1.92m thick redeposited clay layer also identified as made ground, perhaps representing part of the embankment for the North British Railway's Waverley line and Silloth branch which formerly joined the West Coast Main Line at Port Carlisle Branch Junction immediately to the south (next to the A Plant/Brown Brothers sites).

1.3.4 Only one borehole has been drilled in the yards along the course of the flood defence wall. BH511, located at the southern end of the proposed wall, revealed a 0.6m depth of made ground, comprising tarmac (0.1m), a coarse angular stone underlay to the tarmac (0.15m) and mid-brown sandy

gravel (0.35m). This overburden in turn covered a 1.4m thick deposit of orangey brown sandy silt with natural river gravel reached at a depth of 2m below the present ground surface.

1.3.5 Three trial pits excavated at the south end of Sheepmount Park, on the east side of the WCML, revealed no trace of the Vallum, but these were positioned to the north and south of the scheduled corridor where it is suggested the Vallum may have been located (*see* Archaeological Practice 2009). Again evident deposits of late 19th-early 20th-century rubbish containing black ash, broken crockery, glass bottles, brick etc, were exposed extending down to depths of between 2.7m and 3.0m, but the ground level here is much higher than that of the yards on the west side of the WCML.

1.3.6 Despite the negative results of the evaluation and site investigation conducted hitherto, the potential significance of the archaeological remains located within the footprint of the FAS works, beside the WCML, is such that a programme of monitoring and recording has been requested by English Heritage, to ensure that any surviving historic remains encountered during the construction works are appropriately recorded.

2. SCHEME OF INVESTIGATION

A programme of archaeological monitoring and recording sufficient to mitigate the cultural heritage impact of the groundworks associated with the construction of the flood defence embankment and wall, is described below.

2.1 Location

2.1.1 The proposed flood defence embankment and wall are located on the west side of West Coast Main Line (WCML) in Willow Holme, NW of Carlisle city centre, as shown on the attached plans.

2.1.2 The flood defence wall is planned to run for a distance of 122m along the rear (N side) of two industrial units currently utilised by Brown Brothers and A Plant, at the foot of the embankment for the WCML.

2.1.3 The flood embankment connecting to the northern end of the wall commences on the higher ground around the Vodaphone mast, immediately to the north of the industrial units, and continues 85m northward alongside the WCML, extending across the scheduled course of Hadrian's Wall and terminating approximately 30m north of the Wall where it ties into the existing railway embankment.

2.2 Nature of the construction works

2.2.1 The construction works entailed as part of CL19 are described in detail in the summary of works prepared by Jacobs on behalf of Environment Agency, attached here as Appendix A, and illustrated on the relevant technical drawings (IMNW525/CL19/23750-4), also attached (*see* Appendix B), which should all be consulted.

2.2.2 In brief, the flood defence wall in the Brown Brothers and A Plant yards will take the form of an L-shaped wall. The excavation trench for the wall is up to 3m wide and 600mm deep and will be dug in a series of 5.8m long bays, with no open bay excavation trench closer than 30m to another active trench at any stage, to ensure the stability of the existing embankment for the WCML. The 2.5m wide, 0.6m deep, wall-base forms a pile cap supported by a total of 79 bored piles, each 450mm in diameter, arranged in a staggered configuration in 2no bored pile sets. The piles will be bored to a depth of 7m (down to 4m aOD), with centres spaced at 2.9m. Installation of the piles will precede the excavation of the trenches for the pile-cap units.

2.2.3 Construction of the flood embankment across the line of Hadrian's Wall will entail the excavation of a pre-existing linear mound of recently made ground (see 1.3.2) to form a flat surface, the stripping of vegetation and loose material to an estimated depth of c. 600mm below existing ground level (*see* IMNW525/CL19/23750, 23752-3).

2.2.4 Removal and relaying of three utility cables (1 x BT, 2 x low voltage electricity: *see* IMNW525/CL19/23752) will be required during construction of the embankment. The cables are

located towards the southern end of the embankment (S of the scheduled corridor) and are expected to lie within 700mm of existing ground level.

2.3 Programme of investigation

2.3.1 The archaeological impact of the groundworks for the flood defence embankment (including utility diversions) and the construction trench for the pile-cap of the flood defence wall will be mitigated by means of a conventional watching brief, as detailed in section 3.

2.3.2 It is also proposed to extract and analyse power-augured cores from the centre of each pile location in one of the two rows of piles, prior to commencement of piling operations, so that the sequence of recovered sediments can be examined, recorded and interpreted. It is intended this will provide a profile of sub-surface deposits along the entire length of the flood defence wall and thereby mitigate by record any impact on significant archaeological features, most notably the Vallum. The sampling strategy will provide a total of around 40 cores (the exact number depending on which row is selected) and their 2.9m spacing should be sufficiently close to ensure that at least one core goes through the Vallum ditch fills if remains of the ditch are preserved at any point along the length of the flood defence wall. The cores will go down to the full 7m of pile impact or until bedrock or natural boulder clay is identified, whichever is reached first. The concrete/tarmac hard-standing in the industrial units will be removed along the line of the flood wall to enable the coring to take place and the removal of this surface will be monitored by means of a conventional watching brief.

2.3.3 The components of the programme of works and associated archaeological mitigation along the line of the flood defence wall will thus comprise, in order of occurrence:

1. Removal of hard-standing surface (monitored by archaeological watching brief undertaken by Oxford Archaeology North)

2. Coring along one of the rows of piles – a total of c 40 cores (recorded and analysed by Oxford Archaeology North)

3. Completion of piling operations

4. Excavation of pile cap trench (monitored by a watching brief by The Archaeological Practice Ltd)

5. Completion pile cap and wall superstructure construction

2.3.4 The construction of the flood defence embankment over the scheduled course will take place at a separate stage, with archaeological monitoring by watching brief taking place when required in conjunction with earth-stripping and utility diversion operations.

3. METHOD OF INVESTIGATION

3.1 Watching Brief

3.1.1 The Field Investigation will be carried out by means of Archaeological Watching Brief and the extraction and analysis of power-augured cores from the centres of selected construction pile locations.

3.1.2 A detailed programme will be prepared prior to the commencement of the on-site works. Environment Agency and or the works contractor will keep the Archaeological Practice and Oxford Archaeology North appraised of any alterations to this schedule during the course of the works. The archaeological contractors will, in turn, keep English Heritage and the Cumbria County Historic Environment Service appraised of any significant discoveries.

3.1.3 All sections and deposits exposed during the specified works within the scheduled area will be systematically examined to identify, sample and record, as appropriate, any previously unidentified archaeological features.

3.1.4 All excavations undertaken during the specified works will be subject to this watching brief.

3.1.5 Any archaeological deposits encountered will be recorded photographically. Photographic recording shall also be undertaken where no archaeological features are encountered, and include general working shots.

3.1.6 Should any archaeological features be identified, sufficient time will be allowed to investigate and record these features within practicable operational parameters.

3.1.7 In the event of the discovery of archaeological remains which are of greater significance than anticipated, work will cease and the English Heritage Hadrian's Wall Archaeologist and County Archaeological Officer, together with a representative of the developer will be notified. An assessment will be made of the importance of the remains and a mitigation strategy for recording or preservation *in situ*, as appropriate, will be agreed upon by all the parties.

3.1.8 Should additional staff time and resources be deemed necessary by the archaeological contractor to excavate, record and sample revealed archaeological features.

3.1.9 In the event of human burials being discovered, the archaeological contractor will procure and comply with all statutory consents and licences under the Burial Act 1857. Where any part of a human burial is disturbed the whole burial will be archaeologically exhumed.

3.1.10 Appropriate procedures under the relevant legislation will be followed in the event of the discovery of artifacts covered by the provisions of the Treasure Act 1996.

3.2 Augur Survey

3.2.1 **Setting-out:** in order for the piles to be mitigated effectively, it will be necessary to survey-in their exact locations as specified by EA, or their construction engineers. Survey will use suitable electronic equipment, such as a total station theodolite, (TST) or differential GPS (DGPS), which can be accurate to within 10mm. The locations to be bored will be demarcated using spray paint, marker flags, or other appropriate means.

3.2.2 **Augering:** a mechanical excavator or other appropriate means will be used to peck out/cut through the tarmac surface at each of the borehole locations. The firm nature of the substrate means that it will not be possible to use a hand auger, and it is instead proposed that windowless core samples in 1 metre lengths will be taken using a towed Terrier rig operated by suitably qualified engineers working under OA archaeological supervision. It is expected that the cores will be to a depth of 7m (the depth of pile impact) or until bedrock or natural boulder clay is identified, whichever is reached first. If the ground is impenetrable to a Terrier rig, it may be necessary, in accordance with a cost variation in agreement with the client, to use a percussion rig to obtain continuous sampling. In the event that tarmac removal reveals upper deposits of modern made ground containing building rubble impenetrable to the Terrier rig, it is proposed that these be dug-out by an archaeologically supervised mechanical excavator. Such excavation will not continue beyond the base of modern deposits and thus will not impact upon archaeological deposits. Should deposits associated with Hadrian's Wall Vallum be identified, in agreement with EH, it is proposed that a borehole should be drilled into the Vallum between existing cores, in order to provide better characterisation of the feature and its fills. This borehole would be at the expense of another within a more sterile location.

3.2.3 **Recording and field assessment:** following extraction, cores will be given a unique cross-referable number, and the relative depth of each 1m section will be recorded for extrapolation from the OD height at the top of the sequence. The site archive will include both a photographic record and maps showing the locations of the cores. It may not be possible for the field recording and assessment to keep pace with the Terrier rig, and it may thus be necessary for excess samples to be taken back to the laboratory at Lancaster for completion. Whether in the field or the laboratory, the sample tubes will be opened with suitable cutting equipment, and the core rapidly cleaned with a blunt knife or similar tool to provide a clear surface free of smears. Recording and lithological assessment of 1m core sections will be undertaken on a summary *pro-forma* sheet by an OA North environmental archaeologist following the English Heritage Guidelines for Geoarchaeology (2007) and using standard quaternary (Late Devensian and Holocene) terminology. The assessment will include the identification

of significant layers, descriptions of the colour of the matrix using the Munsell soil charts, the texture of the mineral components, inclusions and the thickness and boundary characteristics of each lithological unit of the cores. Representative cores from each deposit would be retained, but it is not proposed to keep the cores except where they have the potential for the retention of specific palaeoenvironmental or archaeological data (which may, or may not, be preserved by waterlogging). Cores to be retained will be capped and resealed in an appropriate manner to prevent deterioration, induration or desiccation.

3.2.4 Environmental Assessment: following completion of the site works, it will be necessary to undertake a programme of laboratory assessment on selected core samples retained during the fieldwork. Accordingly, a project design will be compiled, presenting a scheme of laboratory work to assess the potential of the recovered data set to address relevant research questions in a meaningful way. Where appropriate, all stakeholders (EH, CCCHES, EA, Archaeological Practice and Axis) will be consulted during the formulation of the design, which will be submitted, care of Archaeological Practice, for the approval of the Local Planning Authority (LPA), who in turn may wish to consult with EH and CCCHES. The project design will include a timetable and details of the resources required from the contingency budget. Following approval from the LPA, and provision of funds from the Client, in order to meet the planning conditions, the environmental assessment project design would be enacted in full. The English Heritage Guidelines for Environmental Archaeology (2002) will be consulted during this phase of the project. Sub-samples would be taken from suitable locations from each core, and subjected to an appropriate scheme of laboratory assessment. These techniques are outlined below, but it is highly unlikely that all retained cores would have material suitable for all forms of assessment.

3.2.5 Loss on ignition (LOI): to determine whether there is a potential for environmental analysis of any alluvial deposits identified, the organic content will be measured by Loss on Ignition. Small sediment samples will be weighed and dried for a minimum of 12 hours at 105°. They will be re-weighed and placed in a muffle furnace at a temperature of 550° for 2 hours, to burn off the organic material in the sediment. The samples will be re-weighed and the organic content of the sediment calculated.

3.2.6 Pollen: the pollen in the sediment will be assessed to help understand the nature and processes of accumulation of the waterlogged deposits and also the local environment. Sub-samples, 10-20 ml in volume, will prepared for pollen analysis using a standard chemical procedure (method B of Berglund & Ralska – Jasiewiczowa (1986), using HCl, NaOH, sieving, HF, and Erdtman's acetolysis, to remove carbonates, humic acids, particles > 170 microns, silicates, and cellulose, respectively. The samples were then stained with safranin, dehydrated in tertiary butyl alcohol, and the residues mounted in 2000 cs silicone oil. Slides will be examined at a magnification of 400x (1000x for critical examination) by equally-spaced traverses across at least two slides to reduce the possible effects of differential dispersal on the slide (Brooks & Thomas, 1967). For the assessment a pollen count for each sample of at least 100 land pollen and spores will be reached. *Lycopodium* tablets (Stockmarr, 1971) will be added to a known volume of sediment at the beginning of the preparation so that pollen concentrations could be calculated. Pollen identification will be made using the keys of Moore *et al*. (1991), Faegri & Iversen (1989), and a small modern pollen reference collection. Andersen (1979) will be followed for identification of cereal-type grains. Indeterminable grains will also be recorded as an indication of the state of the pollen preservation. Plant nomenclature will follow Stace, 1997. The data will be presented in tables as either percentage values or actual numbers of pollen grains and spores. The interpretation of the data may help in our understanding of the nature in which the waterlogged deposits accumulated and also of the local environment.

3.2.7 Waterlogged and charred plant remains: the potential for waterlogged and charred plant remains will be assessed in sub-samples from the sediment samples. These will be wet sieved through a series of standard meshes and the residues examined with a binocular microscope. All types of plant material will be noted and identified if possible, as will their relative quantities, in a simple scale of abundant – rare. Plant remains may record the nature of the deposits, the local environment and the economy of the sites.

3.2.8 Invertebrate remains: the sediment samples may be assessed for invertebrate remains, but this will necessitate large sub-sample and, dependent on the nature of the sediments, may not possible. The samples would be submitted to the relevant specialist, who would process them by paraffin

flotation techniques and assess the flots for the presence of invertebrate remains. If these are present they are invaluable to our understanding of the nature of the deposits, possible urban habitation conditions and the economy of the sites.

3.2.9 Diatoms: the sediments may be assessed for the presence and absence of diatoms. If present the diatoms will be identified and quantified. Small sub-samples of the sediment samples will be submitted to the relevant specialist (Dr Philip Barker and), who will prepare 10ml samples following the standard hydrogen peroxide and hydrochloric acid procedure (Batterbbee 1986). Diatoms are freshwater or marine algae with a silica frustule or chamber, which is resistant to decay. They are habitat specific and are therefore a good indicators of such characteristics as salinity and water quality (English Heritage, 2002).

3.2.10 Foraminifera: the sediments may be assessed for the presence and absence of foraminifera. Small sub-samples will be submitted to Dr John Whittaker, the specialist, who will process and assess their potential for the survival of foraminifera.

3.2.11 Radiocarbon dating: suitable material for radiocarbon dating may be selected from each of the lithological units and from the top and bottom of the sequence. This material will be submitted to Dr Gordon Cook of the Scottish Universities Environmental Research Centre for AMS dating.

3.2.12 Report: the results of the environmental and geoarchaeological assessment will be submitted as a written report with the relevant data tables. As far as possible, the different forms of data will be integrated with existing information (such as previous studies and Lidar mapping) to provide a more holistic interpretation of the archaeology and fluvio-sedimentological history of the site. The data from the core descriptions and the geoarchaeology assessment will be inputted into specialist software and the relevant illustrations produced. On the basis of the assessment results, recommendations will be made for further analysis, and for retention and storage. These recommendations will take the form of an updated project design and costed programme of works, compiled in consultation with appropriate stakeholders, and submitted for approval by the LPA. Following approval by the LPA, it is understood that the completion of the programme of analysis outlined in the updated project design will be a planning condition and, accordingly, an agreement will be sought from the Client to permit the works to be undertaken and the planning condition to be met.

3.3 Watching Brief Recording

3.3.1 A full and proper record (written, graphic and photographic, as appropriate) will be made for all work during the course of the watching brief, using pro-forma record sheets and text descriptions appropriate to the work. Written descriptions should comprise both factual data and interpretative elements. Accurate scale plans and section drawings will be drawn at 1:50, 1:20 and 1:10 scales as appropriate. Sections will be related to Ordnance Datum (i.e. levels will be recorded as above Ordnance Datum – aOD).

3.3.2 The stratigraphy of the excavation will be recorded even when no archaeological deposits have been identified.

3.3.3 Where stratified deposits are encountered, a 'Harris' matrix will be compiled.

3.3.4 The excavation will be accurately tied into the National Grid and located on a 1:1250 or 1:500 map of the area, using a total-station-theodolite.

3.3.5 A photographic record of all contexts will be taken in colour transparency and black and white print and will include a clearly visible, graduated metric scale. A register of all photographs will be kept. The location of all photographs will be recorded on a plan base.

3.3.6 Drawings, photography and written records of discrete features, where deemed necessary, will be sufficient to allow interpretation of the material and the preparation of a report on the site.

3.4 Finds Processing

3.4.1 All processing, storage and conservation of finds recovered in the course of the watching brief will be carried out in compliance with the relevant IFA and UKIC (United Kingdom Institute of Conservation) guidelines.

3.4.2 Finds will be scanned to assess the date range of the assemblage with particular reference to pottery. Artefacts will be used to establish the potential for all categories of finds, should further archaeological work be necessary.

3.4.3 All bulk finds which are not discarded will be washed and, with the exception of animal bone, marked. Marking and labelling will be indelible and irremovable by abrasion. Bulk finds must be appropriately bagged and boxed and recorded. This process will be carried out no later than two months after the end of the excavation.

3.4.4 All small finds will be recorded as individual items and appropriately packaged. Vulnerable objects must be specially packaged, and textiles, painted glass and coins stored in appropriate specialist systems. This process will be carried out within two days of the small find being excavated.

3.4.5 Assessment and analysis of artefacts and environmental samples will be carried out by an approved, named specialist.

3.4.6 The deposition and disposal of artefacts will be agreed with the legal owner and recipient museum prior to the work taking place. Where the landowner decides to retain artefacts, adequate provision will be made for recording them.

3.4.7 During and after the excavation and watching brief, all objects will be stored in the appropriate materials and storage conditions to ensure minimal deterioration and loss of information (this will include controlled storage, correct packaging, regular monitoring of conditions, immediate selection for conservation of vulnerable material). All storage will have appropriate security provision.

3.5 Watching Brief Environmental Sampling and Dating

3.5.1 If significant archaeological deposits are encountered during the watching brief, selective sampling will be carried out in a manner consistent with *The Management of Archaeological Projects* (English Heritage 1991) and *Archaeological Science at PPG16 Interventions: Best Practice for Curators and Commissioning Archaeologists* (English Heritage 2003). Jacqui Huntley, English Heritage North-East Regional Advisor for Archaeological Science (0191 3743643), has been consulted for advice regarding a sampling strategy for dating and environmental evidence.

3.5.2 Bulk samples of 30 litres will be taken from significant fills/deposits evidently resulting from or modified by human activity. Deposits fills totalling less than 30 litres in volume will be sampled in their entirety. Samples will be taken from all deposits/fills containing charcoal, unless the contexts are evidently subject to modern contamination.

3.5.3 Laboratory processing of samples shall only be undertaken if deposits are found to be reasonably well dated, or linked to recognisable features and from contexts the derivation of which can be understood with a degree of confidence.

3.5.4 The potential requirement for specialist analyses is an unavoidable risk in all such investigations. Although the evaluation results would suggest that the likelihood of such analyses being required in this case is relatively low, the possibility can not be entirely dismissed, and the investigation of any features/deposits which are considered significant would be undertaken as a non-negotiable part of this specification. Any such analyses would be carried out by specialists and priced to the client on a cost-only basis.

3.6 Production of Site Archive

3.6.1 Following the completion of the Field Investigation and before any of the post-excavation work is commenced, an archive (the Site Archive) containing all the data gathered during fieldwork will be prepared. This material will be quantified, ordered, indexed and rendered internally consistent. It will be prepared according to the to the standard specified in English Heritage's MAP 2 document,

Appendix 3 (English Heritage 1991) and in accordance with the UKIC guidelines. A summary account of the context record will be included and written by the supervising archaeologist.

3.6.2 The archive and finds will be submitted to the designated repositary, Tullie House Museum, Carlisle, within 6 months of the end of the fieldwork. The location of artefacts will be stated in the archive.

3.7 Production of Final Reports

3.7.1 Following completion of the watching brief and augur-survey, separate reports will be prepared collating and synthesizing the data relating to the two component parts of the mitigation.

3.7.2 The reports will be bound, with each page and heading numbered. It will include as a minimum the following:

- a summary statement of methodologies used/a description of the methodologies employed, work undertaken and results obtained;
- a site location plan related to the national grid;
- a front cover to include the NGR;
- the dates on which the fieldwork was undertaken;
- plans, sections or profiles, as necessary, recorded at an appropriate scale, recording all features identified during the watching brief and showing the location and position of augured deposits;
- a description of any specialist work undertaken and the results obtained;
- a concise, non-technical summary statement of results;
- a copy of the project design and indications of any agreed departure from the details;
- an explanation to any agreed variations to the brief, including any justification for any analyses not undertaken;
- conclusions;
- a complete bibliography of sources from which data has been derived.

3.7.3 Copies of the reports will be provided within two months of the completion of fieldwork to the English Heritage Hadrian's Wall Archaeologist, and the developer. An additional copy of each will be lodged with the Cumbria Heritage Environment Record.

3.8 Publication of Results of Archaeological Works

3.8.1 The Contractor will, at the request of the English Heritage Archaeologist for Hadrian's Wall, prepare a short report on the work for publication in an agreed journal.

3.8.2 Summary reports of the project will be prepared, if necessary, for inclusion in the appropriate Notices, Annual Reviews, Reports, etc.

3.9 OASIS

3.9.1 An entry for inclusion in the Online Access to Index of Archaeological Investigations Project (OASIS) will be prepared and submitted.

4. EXECUTION OF THE SCHEME OF INVESTIGATION

4.1 The Developer has appointed The Archaeological Practice Ltd. as a professionally competent Archaeological Contractor, on agreed terms, to execute the scheme.

4.2 All work will be carried out in compliance with the codes of practice of the Institute of Field Archaeologists (IFA) and will follow the IFA Standard and Guidance for Archaeological Excavations.

4.3 All archaeological staff will be suitably qualified and experienced for their project roles. Before commencement of work they will have been made aware of what work is required under the specification and they will understand the aims and methodologies of the project.

4.4 The Developer will allow all the appointed archaeological contractor, English Heritage and the Cumbria County Historic Environment Service all reasonable access to the site in order to undertake the watching brief and monitor archaeological scheme, subject only to safety requirements.

4.5 The archaeological contractor appointed to manage the execution of the scheme shall ensure that:

4.5.1 the appropriate parties are informed of the objectives, timetable and progress of the archaeological work

4.5.2 the progress of the work is adequately and effectively monitored and the results of this are communicated to the appropriate parties.

4.5.3 significant problems in the execution of the scheme are communicated at the earliest opportunity to the appropriate parties in order to effect a resolution of the problems.

4.6 The archaeological contractor will carry, and will ensure that other archaeological contractors involved in the scheme carry appropriate levels of insurance cover in respect of Employers Liability, Public and Third Party Liability & Professional Indemnity.

4.7 The archaeological contractor will liaise with the appointed CDM Planning Supervisor and prepare or arrange for the preparation of a Safety Plan for the archaeological work.

4.8 At or before the commencement of the scheme the Developer, the appointed Archaeological Contractors, the County Archaeological Officer and other appropriate parties will agree arbitration procedures to be followed in the event of any unresolvable difficulties or disputes arising from the scheme

4.9 Careful assessment has led to the definition of a number of research objectives which identify with a high degree of likelihood the kind of archaeological deposits which the investigation will encounter. Nevertheless, it is possible that discoveries will be made which could not reasonably have been foreseen on the basis of all the information currently available. Any difficulties arising from unforeseen discoveries will be resolved by discussion between all the parties involved. There will be a presumption, the investigation having been carried out in accordance with the schedule set out in this document, and to the satisfaction of the County Archaeological Officer, and all other considerations being equal, that no executive or financial obligation shall attach to any particular party in the event of unforeseen discoveries being made, and that the executive and financial responsibility for dealing with such unforeseen discoveries shall rest outside the currently agreed scheme of investigation.

4.10 The Archaeological Contractor(s) appointed to execute the scheme will procure and comply with all statutory consents and licences under the Disused Burial Grounds (Amendment) Act 1981 regarding the exhumation and interment of any human remains discovered within the site, and will comply with all reasonable requirements of any church or other religious body or civil body regarding the manner and method of removal, re-interment or cremation of the human remains, and the removal and disposal of any tombstones or other memorials discovered within the site. The Developer will incur all costs resulting from such compliance.

5. TIMETABLE AND STAFFING

5.1 The construction works which it is proposed to monitor archaeologically are scheduled to commence in July 2009, with further time required to produce an appropriately illustrated report on the work, as detailed above.

5.2 The project archaeologist or another professionally trained archaeologist of equivalent competence will be present on site during the specified site investigations. The project archaeologist will be able to call on additional staff if necessary (all professionally trained archaeologists).

5.3 Personnel & Sub-contractors:

Archaeological Practice	***Sub-Contractors***
Project Manager: Alan Rushworth	*Oxford Archaeology North* (Augur Survey)
PA: Project Archaeologists	*Palaeoecology Research Services Ltd*
(Marc Johnstone, Ronald Brown)	(Environmental remains)
	Alan Williams (Medieval pottery)
	Gary Forster (Roman Pottery)
	Lindsay Allason-Jones (Small finds)
	Chris Tolan-Smith (Flint & stone tools)

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APPENDIX A: CALDEW & CARLISLE CITY FLOOD ALLEVIATION SCHEME: DETAILED DESIGN PHASE 2, CL19

AXIS: TECCHNICAL INFORMATION FOR SCHEDULED MONUMENT CONSENT

APPENDIX B: TECHNICAL DRAWINGS DETAILING PROPOSED FLOOD DEFENCE EMBANKMENT AND WALL ADJACENT TO THE WEST COAST MAIN LINE (CALDEW & CARLISLE CITY FAS CL19)

IMNW525/CL19/23750-T1:	Activity Schedule Plan and Site Boundary - CL19 Site
IMNW525/CL19/23751-T1:	Brown Brother/A-Plant: General Arrangement & Cross Sections
IMNW525/CL19/23752-T1:	WCML–Sewerage Works: Embankment General Arrangement & Cross Sections (S)
IMNW525/CL19/23753-T1:	WCML–Sewerage Works: Embankment General Arrangement & Cross Sections (N)
IMNW525/CL19/23754-T1:	Wall/Pile Layout

APPENDIX 2: TABLE OF BOREHOLE RESULTS

Borehole	Context	Depth (m bgl)	Geology
59 (11.47 AOD)	***1***	0m - 0.3m	Made ground, building rubble, including sandstone blocks and modern brick
	2	0.3m - 0.8m	Reddish-brown clay silt with charcoal flecking
	3	0.8m +	Sandy gravel, rounded pebbles, 30mm diameter
61 (11.47 AOD)	***4***	0m - 0.2m	Made ground, building rubble, including sandstone blocks and modern brick
	5	0.2m - 0.5m	Reddish-brown clay silt, coal and charcoal flecking
	6	0.5m - 1.4m+	Sandy gravel, rounded pebbles, 30mm diameter
63 (11.55 AOD)	***7***	0m - 0.2m	Made ground, building rubble, including sandstone blocks and modern brick
	8	0.2m - 0.4m	Reddish-brown clay silt, coal and charcoal flecking
	9	0.4m - 1.3m+	Sandy gravel, rounded pebbles, 30mm diameter
65 (11.68 AOD)	***10***	0m - 0.1m	Made ground, hardcore rubble
	11	0.1m - 0.2m	Grey clay silt
	12	0.2m - 0.35m	Reddish-brown clay silt, coal and charcoal flecking
	13	0.35m - 1m+	Sandy gravel, rounded pebbles, 30mm diameter
67 (11.67 AOD)	***14***	0m -0.2m	Made ground, hardcore rubble
	15	0.2m - 0.8m	Reddish-brown clay silt, coal and charcoal flecking
	16	0.8m+	Sandy gravel, rounded pebbles, 30mm diameter
69 (11.79 AOD)	***17***	0m - 0.1m	Made ground, predominantly mortar and modern brick fragments
	18	0.1m - 0.3m	Reddish-brown clay silt, coal and charcoal flecking
	19	0.3m - 0.9m+	Sandy gravel, rounded pebbles, 30mm diameter
71 (11.73 AOD)	***20***	0m - 0.1m	Mortar and brick rubble
	21	0.1m - 0.3m	Reddish-brown clay silt, coal and charcoal flecking
	22	0.3m - 0.8m+	Sandy gravel, rounded pebbles, 30mm diameter
73 (11.86 AOD)	***23***	0m - 0.3m	Mortar and brick rubble
	24	0.3m -0.9m	Reddish-brown clay silt, coal and charcoal flecking
	25	0.9m+	Sandy gravel, rounded pebbles, 30mm diameter
75 (11.81 AOD)	***26***	0m - 0.25m	Mortar and brick rubble
	27	0.25m - 0.55m	Reddish-brown clay silt, coal and charcoal flecking
	28	0.55m - 1.2m+	Sandy gravel, rounded pebbles, 30mm diameter
77 (11.92 AOD)	***29***	0m - 0.25m	Made ground, hardcore
	30	0.25m - 0.4m	Brick rubble
	31	0.4m - 0.8m	Reddish-brown clay silt, coal and charcoal flecking
	32	0.8m+	Sandy gravel, rounded pebbles, 30mm diameter
79 (11.99 AOD)	***33***	0m - 0.2m	Brick rubble and mortar
	34	0.2m - 0.5m	Reddish-brown clay silt, coal and charcoal flecking
	35	0.5m - 1.2m	Reddish-brown clay silt, no charcoal
	36	1.2m+	Sandy gravel, rounded pebbles, 30mm diameter
81 (12.00 AOD)	***37***	0m - 0.2m	Made ground, hardcore
	38	0.2m - 1m	Reddish-brown clay silt, coal and charcoal flecking
	39	1m - 1.2m+	Sandy gravel, rounded pebbles, 30mm diameter
83 (12.11 AOD)	***40***	0m - 0.1m	Made ground, hardcore
	41	0.1m - 0.75m	Reddish-brown clay silt, coal and charcoal flecking
	42	0.75m+	Sandy gravel, rounded pebbles, 30mm diameter
85 (11.82 AOD)	***43***	0m - 0.1m	Made ground, hardcore
	44	0.1m - 0.4m	Reddish-brown clay silt, coal and charcoal flecking
	45	0.4m - 0.5m	Reddish-brown clay silt, no charcoal
	46	0.5m- -1.2m+	Sandy gravel, rounded pebbles, 20mm diameter
87 (11.91 AOD)	***47***	0m - 0.1m	Made ground, hardcore
	48	0.1m - 0.2m	Mottled brownish-orange clay silt
	49	0.2m - 0.5m	Reddish-brown clay silt, coal and charcoal flecking
	50	0.5m - 1m	Reddish-brown silty-sand

Borehole	Context	Depth (m bgl)	Geology
	51	1m - 1.2m+	Sandy gravel, rounded pebbles, 20mm diameter
89 (11.89 AOD)	***52***	0m - 0.1m	Made ground, hardcore
	53	0.1m - 0.5m	Dark reddish-brown clay silt, with charcoal flecking
	54	0.5m - 1.5m	Mid reddish-brown clay silt
	55	1.5m+	Sandy gravel, rounded pebbles, 30mm diameter
91 (11.87 AOD)	***56***	0m - 0.1m	Made ground, hardcore
	57	0.1m - 0.35m	Reddish-brown clay silt, coal and charcoal flecking
	58	0.35m - 1.2m+	Sandy gravel, rounded pebbles, 20mm diameter
93 (11.89 AOD)	***59***	0m - 0.1m	Made ground, hardcore
	60	0.1m - 0.3m	Mid reddish-brown clay silt
	61	0.3m - 0.5m	Dark reddish-brown clay silt, with charcoal flecking
	62	0.5m - 0.7m	Mid reddish-brown clay silt
	63	0.7m - 1.6m	Numerous alternating bands of sands and silty-sands, <50mm thick
	64	1.6m+	Sandy gravel, rounded pebbles, 30mm diameter
95 (11.89 OAD)	***65***	0m - 0.1m	Made ground, hardcore
	66	0.1m - 0.45m	Dark reddish-brown clay silt, with charcoal flecking
	67	0.45m - 1.2m	Reddish-brown clay silt, no charcoal
	68	1.2m+	Sandy gravel, rounded pebbles, 30mm diameter
97 (11.91 AOD)	***69***	0m - 0.1m	Made ground, hardcore
	70	0.1m - 0.5m	Dark reddish-brown clay silt, with charcoal flecking
	71	0.5m - 1.4m	Reddish-brown clay silt, with charcoal flecking
	72	1.4m - 1.7m+	Sandy gravel, rounded pebbles, 20mm diameter
99 (11.88 AOD)	***73***	0m - 0.1m	Made ground, hardcore
	74	0.1m - 0.15m	Mottled mid brown clay silt with charcoal and iron panning
	75	0.15m - 0.5m	Reddish-brown clay silt
	76	0.5m - 1.5m	Mid reddish-brown clay silt with charcoal flecking
	77	1.5m - 1.7m	Numerous alternating bands of sands and silty-sands, <50mm thick
	78	1.7m+	Sandy gravel, rounded pebbles, 30mm diameter
101 (11.90 AOD)	***79***	0m - 0.1m	Made ground, hardcore
	80	0.1m - 0.2m	Mottled brownish-orange clay silt
	81	0.2m - 0.6m	Dark reddish-brown clay silt, with charcoal flecking and modern brick
	82	0.6m - 1.3m	Reddish-brown clay silt, with charcoal flecking
	83	1.3m - 1.4m+	Sandy gravel, rounded pebbles, diameter 20mm
103 (11.87 AOD)	***84***	0m - 0.1m	Made ground, hardcore
	85	0.1m - 0.2m	Dark reddish-grey clay silt
	86	0.2m - 0.5m	Reddish-brown clay silt, with charcoal flecking
	87	0.5m - 1.4m	Reddish-brown clay silt
	88	1.4m - 1.5m	Sand
	89	1.5m - 1.6m+	Sandy gravel, rounded pebbles, 20mm diameter
105 (11.95 AOD)	***90***	0m - 0.1m	Made ground, hardcore
	91	0.1m - 0.3m	Greyish-brown clay silt
	92	0.3m - 1.6m	Reddish-brown clay silt, with charcoal flecking
	93	1.6m+	Sandy gravel, rounded pebbles, 30mm diameter
107 (11.90 AOD)	***94***	0m - 0.1m	Made ground, hardcore
	95	0.1m - 0.3m	Greyish-brown clay silt
	96	0.3m - 0.45m	Reddish-brown clay silt, with charcoal flecking and fired clay
	97	0.45m - 1.2m	Reddish-brown clay silt
	98	1.2m+	Sandy gravel, rounded pebbles, 30mm diameter
109 (12.06 AOD)	***99***	0m - 0.1m	Made ground, hardcore
	100	0.1m - 0.5m	Drain backfill, coring stopped by modern concrete drain
111 (12.11 AOD)	***101***	0m - 0.3	Made ground, hardcore
	102	0.3m - 0.5m	Greyish-brown clay silt
	103	0.5m - 1.2m	Reddish-brown clay silt, with charcoal flecking

Borehole	Context	Depth (m bgl)	Geology
	104	1.2m - 1.6m	Numerous alternating bands of sands and silty-sands, <50mm thick
	105	1.6m+	Sandy gravel, rounded pebbles, 30mm diameter
113 (12.11 AOD)	***106***	0m - 0.1m	Made ground, hardcore
	107	0.1m - 0.4m	Reddish-brown clay silt, with charcoal flecking
	108	0.4m - 1.2m	Reddish-brown clay silt
	109	1.2m+	Sandy gravel, rounded pebbles, 30mm diameter
115 (12.04 AOD)	***110***	0m - 0.2m	Made ground, hardcore
	111	0.2m - 0.4m	Dark reddish-brown clay silt with charcoal flecking
	112	0.4m - 1.5m	Reddish-brown clay silt
	113	1.5m+	Sandy gravel, rounded pebbles, 30mm diameter
117 (12.01 AOD)	***114***	0m - 0.1m	Made ground, hardcore
	115	0.1m - 0.5m	Dark reddish-brown clay silt with charcoal flecking
	116	0.5m - 1m	Sandy gravel
	117	1m - 1.6m	Numerous alternating bands of sands and silty-sands, <50mm thick
	118	1.6m+	Sandy gravel, rounded pebbles, 30mm diameter
119 (12.04 AOD)	***119***	0m - 0.3m	Made ground, hardcore
	120	0.3m - 1.4m	Reddish-brown clay silt
	121	1.4m - 1.6m	Numerous alternating bands of sands and silty-sands, <50mm thick
	122	1.6m+	Sandy gravel, rounded pebbles, 30mm diameter
121 (12.03 AOD)	***123***	0m - 0.4m	Made ground, hardcore
	124	0.4m - 0.55m	Grey clay silt with charcoal flecking
	125	0.55m - 1.3m	Reddish-brown clay silt
	126	1.3m - 1.4m	Gravel
	127	1.4m - 1.5m	Pinkish-grey sand, possible diesel contamination
	128	1.5m+	Sandy gravel, rounded pebbles, 30mm diameter
123 (11.97 AOD)	***129***	0m - 0.1m	Made ground, hardcore
	130	0.1m - 1.3m	Reddish-brown clay silt
	131	1.3m - 1.5m	Light greyish-blue clay silt, possible diesel contamination
	132	1.5m - 1.6m+	Sandy gravel, rounded pebbles, 30mm diameter
124 (12.06 AOD)	***133***	0m - 0.1m	Made ground, hardcore
	134	0.1m - 0.5m	Dark reddish-brown clay silt with charcoal flecking
	135	0.5m - 1.25m	Reddish-brown clay silt
	136	1.25m - 1.4m	Numerous alternating bands of sands and silty-sands, <50mm thick
	137	1.4m+	Sandy gravel, rounded pebbles, 30mm diameter
127 (12.03 AOD)	***138***	0m - 0.1m	Made ground, hardcore
	139	0.1m - 0.6m	Dark reddish-brown clay silt with charcoal flecking
	140	0.6m - 1.3m	Reddish-brown clay silt
	141	1.3m - 1.5m	Numerous alternating bands of sands and silty-sands, <50mm thick
	142	1.5m+	Sandy gravel, rounded pebbles, 30mm diameter
130 (12.07 AOD)	***143***	0m - 0.1m	Made ground, hardcore
	144	0.1m - 1.3m	Dark reddish-brown clay silt with charcoal flecking
	145	1.3m - 1.8m	Numerous alternating bands of sands and silty-sands, <50mm thick
	146	1.8m+	Sandy gravel, rounded pebbles, 30mm diameter
132 (12.09AOD)	***147***	0m - 0.2m	Made ground, hardcore
	148	0.2m - 0.3m	Grey clay silt with charcoal flecking
	149	0.3m - 1.3m	Dark reddish-brown clay silt with charcoal flecking
	150	1.3m - 1.5m	Silty-sand
	151	1.5m+	Sandy gravel, rounded pebbles, 30mm diameter
134 (12.17 AOD)	***152***	0m - 0.2m	Made ground, hardcore
	153	0.2m - 0.3m	Grey clay silt with charcoal flecking
	154	0.3m - 1.7m	Dark reddish-brown clay silt with charcoal flecking

Borehole	Context	Depth (m bgl)	Geology
	155	1.7m+	Sandy gravel, rounded pebbles, 30mm diameter
136 (12.10 AOD)	***156***	0m - 0.2m	Made ground, hardcore
	157	0.2m - 1.2m	Dark reddish-brown clay silt with charcoal flecking and coal
	158	1.2m - 1.6m+	Sandy gravel, rounded pebbles, 20mm diameter
138 (12.11 AOD)	***159***	0m - 0.1m	Made ground, hardcore
	160	0.1m - 0.2m	Brownish-grey clay silt
	161	0.2m - 1.2m	Dark reddish-brown clay silt with charcoal flecking and coal
	162	1.2m - 1.3m	Sandy gravel, rounded pebbles, 20mm diameter
	163	1.3m - 1.4m	Reddish-brown clay silt
	164	1.4m+	Sandy gravel, rounded pebbles, 30mm diameter
140 (12.02 AOD)	***165***	0m - 0.1m	Made ground, hardcore
	166	0.1m -0.2m	Brownish-grey clay silt
	167	0.1m - 0.6m	Dark reddish-brown clay silt with charcoal flecking and coal
	168	0.6m - 1.2m	Reddish-brown clay silt
	169	1.2m - 2.1m	Numerous alternating bands of sands and silty-sands, <50mm thick
	170	2.1m+	Sandy gravel, rounded pebbles, 30mm diameter