Carlisle and Caldew FAS, Willow Holme, Carlisle,
Cumbria

Archaeological Watching Brief

Oxford Archaeology North

February 2009

Axis, on behalf of the Environment Agency

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SUMMARY

The Environment Agency has proposed the construction of a new embankment as part of the Carlisle Flooding Alleviation Scheme to the north of the Willowholme Industrial Estate, and immediately to the west of the West Coast Mainline Railway, at Willow Holme, Carlisle, Cumbria (NGR NY 39185 56590). Part of the scheme is situated within an area of extremely high archaeological potential, immediately to the south of the line of Hadrian's Wall and within the boundary of the Hadrian's Wall World Heritage Site (WHS), known as the Frontiers of the Roman Empire WHS. Consequently, Axis commissioned an archaeological watching brief on behalf of their client, the Environment Agency, to be undertaken during the preliminary phase of geotechnical groundworks to investigate the potential for archaeological remains.

The watching brief was undertaken by Oxford Archaeology North (OA North) in December 2008, during which time six geotechnical boreholes were drilled, although the first was abandoned due to compact stone at a shallow depth inhibiting drilling. Three were drilled with a terrier rig into the railway embankment to a depth of 5m, and were all through made ground (**WSA**, **WSB**, **WSC**). Two were drilled by percussion rig; **BH02** was drilled to 8 m and borehole **BH03** was drilled to 13.1 m. The overburden on the site was ash and clinker, above sand and gravel.

No features, structures or deposits of archaeological significance were observed during the drilling, and no artefacts recovered. However, the investigation was limited to the material recovered from the borehole core, from which it was difficult to ascertain precisely the archaeological potential of the site. It is recommended that should any further groundworks be undertaken, specifically opening up of a larger area, an additional watching brief should be maintained.

ACKNOWLEDGEMENTS

Oxford Archaeology North (OA North) would like to thank Amanda Stobbs of Axis for commissioning the project on behalf of the Environment Agency. Thanks are also due to Elly McMonies and Julie Burton of Jacobs, who undertook the on-site geotechnical work on behalf of the Environment Agency.

The watching brief was undertaken by Sandra Bonsall, who also wrote this report. The drawings were produced by Marie Rowland The project was managed by Emily Mercer, who also edited the report.

1. INTRODUCTION

1.1 CIRCUMSTANCES OF PROJECT

1.1.1 The Environment Agency has proposed the construction of a new flood alleviation scheme (FAS) in the area of Willow Holme, Carlisle (Fig 1). Part of the scheme may potentially impact upon surviving archaeological remains as it lies over the line of Hadrian's Wall, and within the Hadrian's Wall World Heritage Site (WHS), known as the Frontiers of the Roman Empire WHS. Consequently, Oxford Archaeology North (OA North) were commissioned by Axis, on behalf of the Environment Agency, to undertake an archaeological watching brief during preliminary geotechnical site investigation works. The work was undertaken between 11th-15th December 2008.

1.2 LOCATION, TOPOGRAPHY AND GEOLOGY

1.2.1 Carlisle lies on the Cumberland Plain approximately 8 km above the tidal limit of the River Eden, and some 13 km upstream of the Solway Firth. The site is situated to the north-west of the city of Carlisle, in Willow Holme, a large area of low-lying flood-plain situated in a loop of the River Eden and west of its confluence with the Caldew. More precisely, the site lies to the north of the Willowholme Industrial Estate, and immediately west of the West Coast Mainline Railway (NGR NY 39185 56590, Fig 1). It is located west of the historic settlement, on the opposite bank of the River Caldew, and north-west across the river from the castle.

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* 1990, 1-2). 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 (McCarthy *et al* 1990).

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 Willow Holme area (Ferguson 1888, 167-8). That the upper part of this sediment has accumulated since Roman times was demonstrated by excavations in 1886, when 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 modern geological maps (Ordnance Survey 1983). There is no evidence to indicate how far, if at all, the Caldew has shifted its course in this area in historic times (OA North 2008). 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. There may have been more potential for movement north of the castle, at the confluence with the Eden.

1.3 HISTORICAL AND ARCHAEOLOGICAL BACKGROUND

1.3.1 ***Roman Period:*** despite a long tradition of antiquarian interest in Roman Carlisle (*Luguvalium*), it has only been in recent years that additional information has become available regarding the origins, nature, and extent of Roman settlement in the city. The theory that the prominent bluff occupied by Carlisle Castle had been the site of a Roman fort was put forward as early as the mid-nineteenth century (Ferguson 1893a, 348–9), whilst subsequent analysis of the samian from the city pointed to an early Flavian military presence (Bushe-Fox 1913, 299-301). For many years, however, it was generally accepted that the fort lay south of the castle, in the vicinity of the medieval cathedral (Shaw 1924, 96-102; Simpson 1953, 234; Hogg 1955, 72). In fact, the fort's precise location remained unclear until the Annetwell Street excavations of 1973–84, which identified what proved to be the south rampart and south gate of a turf-and-timber fort extending north under the castle (Charlesworth 1980). A possible annexe lay on the south side of the fort (McCarthy 1991; Caruana 1992).

1.3.2 Dendrochronological dating has proved that the first fort was constructed in the autumn or winter of AD 72–3 (Groves in prep). Tree-ring dating also indicates that the interior of the fort was extensively refurbished in the autumn/winter of AD 83–4 (Caruana in prep; Zant in prep b). The fort was demolished in the early second century but was rebuilt, again in turf and timber, *c* AD 105, after only a short break. The second fort was not abandoned in the AD 120s when Hadrian's Wall and the presumed primary Wall-fort at Stanwix were constructed to the north, but continued in use to the beginning of the Antonine period (*ibid*). It was probably demolished as a consequence of the reoccupation of southern Scotland in the AD 140s, when the northern frontier was advanced to the Forth-Clyde isthmus. In the following 60–70 years, the fort site may have been occupied only intermittently; activity during this period has proved difficult to characterise, but it seems probable that the site was not used as a conventional fort at this time. Intensive occupation appears to have begun again in the early third century, when a rebuilding in stone occurred. Thereafter, occupation continued to the end of the Roman period, which on the evidence of coins and pottery extended into the fifth century.

1.3.3 At certain times during the Roman period, quite extensive suburbs extended along the main roads leading north and south from the town, but there is currently only very limited evidence for Roman activity west of the River Caldew (North Pennines Archaeology 2004). The exact position of the Roman road bridge over the River Eden is not known. During the Roman period, the Eden is likely to have lain well to the south of the modern river channel, but the discovery of a Roman bridge stone in the modern river suggests that the road may have been carried across both the river and the adjacent alluvial flats

on a long bridge of many arches, or a combination of causeways and arches (Caruana and Coulston 1987, 50).

1.3.4 During the course of the Roman period the settlement grew into a sizeable town, extending south and east of the fort. A milestone discovered near Penrith demonstrates beyond much doubt that the town had become the tribal capital of the Carvetii, the *civitas Carvetiorum*, by AD 223, and it seems likely that *civitas* status had been conferred on the town by Septimius Severus some years earlier (Edwards and Shotter 2005, 69). As in the fort, the first stone buildings appeared during the late second-early third century AD, and there is good evidence from a number of sites that intensive occupation within the town continued into the late fourth or early fifth century at least (*ibid*).

1.3.5 The Hadrian's Wall fort at Stanwix was situated less than 1 km north of Carlisle. The stone fort, which was the largest on the Wall, is conventionally dated to the AD 160s. Hadrian's Wall ran south-west from the fort towards Willow Holme and is presumed to have been carried over the River Eden on a bridge situated close to the river's present-day confluence with the Caldew (Hogg 1952, 149-52). Large numbers of bridge stones were dredged from the river close to this point in 1951 (*ibid*; Breeze 2006, 347) and some are still to be seen on the riverbank.

1.3.6 The archaeology at Willow Holme for the Roman period is dominated by Hadrian's Wall, which crossed the through the site on an east-north-east to west-south-west alignment. The developmental history of the Hadrian's Wall frontier system is complex (*op cit*, 50-3), particularly so in its western sector, west of the River Irthing, where it was initially constructed of turf (why is still a matter for debate (*op cit*, 58-9)) and rebuilt in stone (often on a slightly different line) later. 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 flanked by mounds, the purpose of which also continues to excite debate (*op cit*, 86-7). 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 according to current theories (Bidwell 1999, 23).

1.3.7 The line of the Turf Wall in the Willow Holme area is not known, but it must presumably cross the site 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 provided 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 (*op cit*, 171-2). Here, in the vicinity of the site of the watching brief, 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 (Ferguson 1888, 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 (*ibid*) (Plate 1) indicates that the Wall lay beneath a thick deposit of alluvium.

1.3.8 Neither the Wall Ditch, the Vallum, or the Military Way have been seen at Willow Holme, although all presumably cross the area, buried deep beneath alluvial silts. On the 1937 edition of the Ordnance Survey (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 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 site, on the higher ground at Davidson's Banks, where it lay just south of the Wall.

1.3.9 ***Medieval Period:*** it is during the medieval period that the first references to Willow Holme appear in contemporary documents, as Weryholme (Jones 1976, 82). 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).

1.3.10 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). 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 in Willow Holme was around a third less than previously (*op cit*, 281), which provides an indication of the possible level of mortality in the city.

1.3.11 It is unlikely that many buildings were erected in the Willow Holme area during the medieval period. No medieval maps of Carlisle exist, but cartographic depictions from the seventeenth century (Speed 1610) 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, 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).

1.3.12 ***Post-medievalPeriod***: 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. This 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 Willow Holme, and rendered it useless to the garrison as a grazing ground' (Ferguson 1891, 112).

1.3.13 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 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).

2. METHODOLOGY

2.1 WATCHING BRIEF

2.1.1 A programme of field observation was undertaken to record accurately the extent and character of any surviving archaeological features and/or deposits exposed during the course of the borehole drilling. The work comprised the systematic examination of any subsoil horizons exposed during the course of the groundworks, and the accurate recording of all archaeological features and horizons, and any artefacts, identified during observation.

2.1.2 All groundworks on the site were conducted under constant archaeological supervision. All exposed soil horizons were examined and described, and spoilheaps were carefully checked for any unstratified finds.

2.1.3 A daily record of the nature, extent and depths of groundworks was maintained throughout the duration of the project.

2.2 ARCHIVE

2.2.1 A full professional archive has been compiled in accordance with current IFA and English Heritage guidelines (English Heritage 1991). The paper and digital archive will be provided in the English Heritage Centre for Archaeology format and will be submitted to the Carlisle Record Office on completion of the project. Copies of the report will also be submitted to the Historic Environment Record. The Arts and Humanities Data Service (AHDS) online database *Online Access index of Archaeological Investigations* (OASIS) will be completed as part of the archiving phase of the project.

3. WATCHING BRIEF RESULTS

3.1 INTRODUCTION

3.1.1 Six geotechnical boreholes were drilled during the watching brief (Fig 2), although the first was abandoned due to compact stone at a shallow depth inhibiting drilling. Three window samples were drilled with a terrier rig; **WSA**, **WSB** and **WSC** to a depth of 5 m. The remaining two boreholes were drilled by percussion rig; **BH02** was drilled to 8 m and **BH03** was drilled to 13.1 m.

3.2 RESULTS

3.2.1 The table below shows a brief summary of the borehole strata encountered during the watching brief (more detail is provided in *Appendix 1*). The depths provided are from below current ground level. **WSA**, **WSB** and **WSC** were drilled into the railway embankment to a depth of 5 m, and were all through made ground, comprising dark grey slightly clayey fine to coarse sand with fragments of ash clinker, ceramic building material, concrete, wood and sandstone.

3.2.2 Boreholes **BH02** and **BH03** were drilled in an area where there was a thick top layer of dumped material, which consisted of clayey-sand with fragments of ash, clinker, ceramic building material, concrete, wood and sandstone.

Borehole	Depth (m)	Geology
WSA (14.41AOD)	3.4	Clayey-sand with fragments of ash, clinker and sandstone
	5.0	Gravelly-sand with fragments of sandstone
WSB (14.25AOD)	3.3	Clayey-sand with fragments of ash, clinker and sandstone
	5.0	Sandy-clay with fragments of sandstone
WSC (14.13AOD)	3.3	Clayey-sand with fragments of ash, clinker and sandstone
	5.0	Sandy-clay with sandstone
BH02 (13.56AOD)	3.0	Clayey-fine to coarse sand with fragments of ash clinker, ceramic building material, concrete, wood and sandstone
	5.5	Sandy-clay with sandstone
	8.0	Sand and sandstone gravel
BH03 (14.03AOD)	1.0	Clayey fine to coarse sand with fragments of ash clinker, ceramic building material, concrete, wood and sandstone

	4.0	Sandy-clay, becoming more organic by 1.6 m
	10.0	Coarse sandstone gravel
	11.5	Firm, reddish-brown mottled grey clay
	13.1	Mudstone

Table 1: Summary of borehole results

3.3 CONCLUSIONS

3.3.1 The watching brief recorded no archaeological features, structures or deposits during the course of monitoring the site investigation works. However, observation was extremely limited and not conducive to archaeological inspection and recording. Therefore, should further groundworks be undertaken to open up the area, it is recommended that this should be subject to further archaeological investigation.

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ILLUSTRATIONS

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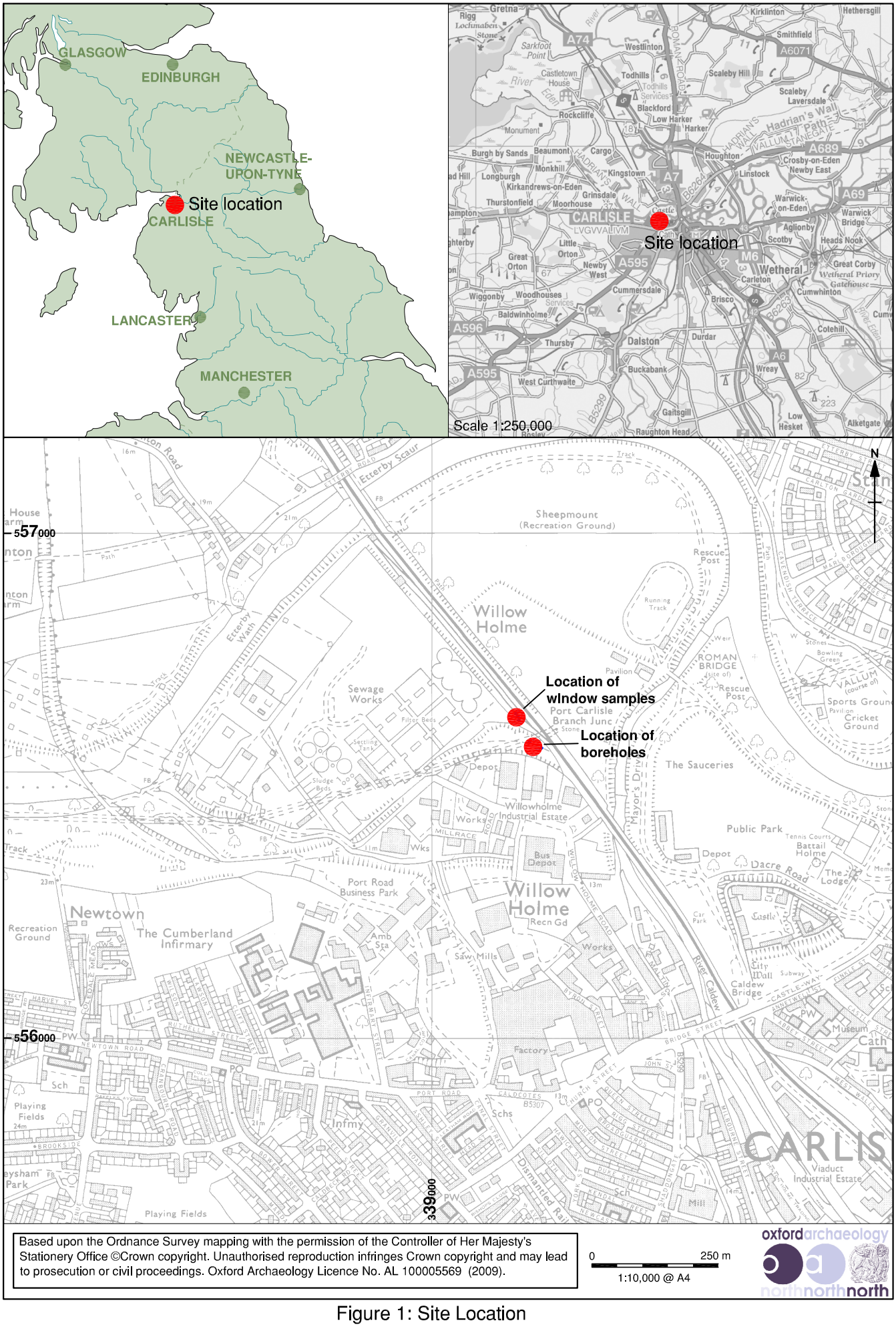

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Figure 1: Site Location

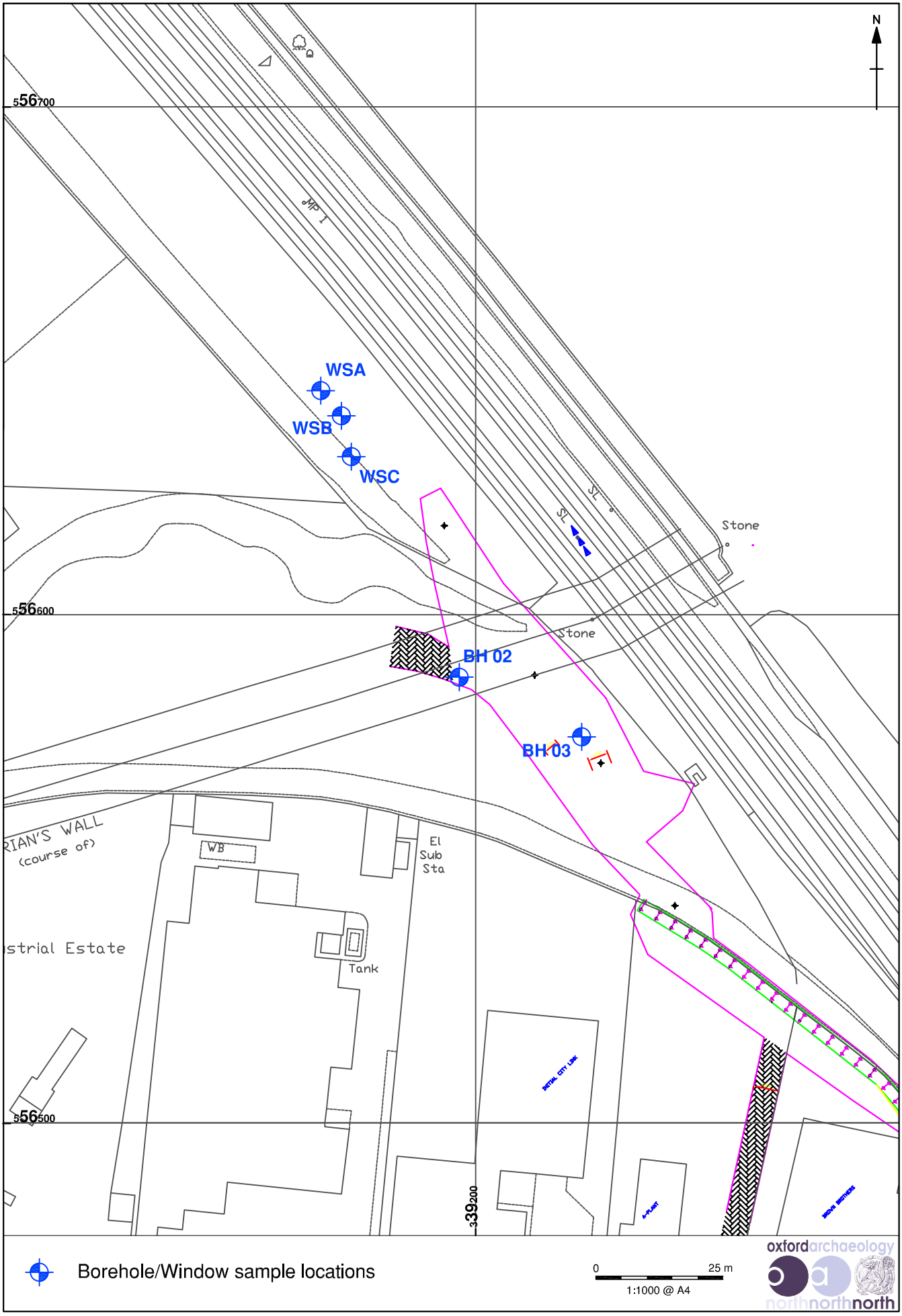

Figure 2: Location of boreholes

Plate 1: Hadrian's Wall exposed at Willow Holme in 1932

APPENDIX 1: BOREHOLE LOG DATA

NORWEST HOLST

Norwest Holst Soil Engineering Ltd.

DYNAMIC SAMPLING LOG

Hole ID.
WSA
Sheet 1 of 1

Contract No.	F15418	Method	Dynamic Sampling	Coordinates	339166.00 E
Project	Carlisle & Caldew FAS, Phase 2				556643.00 N
		Drilling Rig	Competitor	Ground Level	14.41m AOD
Client	Environment Agency	Driller	JS	Orientation	Vertical
		Logged by	TE	Date Started	11/12/2008
Consultant	Jacobs			Date Completed	11/12/2008

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling	SPT N & (U blows)	SPT type & depth	Install-ation
MADE GROUND: Dark grey slightly clayey fine to coarse sand and angular to subangular fine to coarse gravel sized fragments of ash, clinker and sandstone. (Ash Fill)				B1 0.00 - 1.20 D2 0.00 - 1.20 ES3 0.00 - 0.50 ES4 0.50 - 1.20 D5 1.20 - 2.00 D6 2.00 - 3.00 D7 3.30 - 4.00 D8 4.00 - 5.00			
		3.40	11.01				
Reddish brown gravelly very clayey fine to coarse SAND. Gravel is subangular to subrounded fine to coarse of sandstone.							
		5.00	9.41				
Sampling complete at 5.00 m.							

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL DYNAMIC SP LOG
Version	3.00
Revised	04/11/2004

NORWEST HOLST

Norwest Holst Soil Engineering Ltd.

DYNAMIC SAMPLING LOG

Hole ID.
WSB
Sheet 1 of 1

Contract No.	F15418	Method	Dynamic Sampling	Coordinates	339170.00 E
Project	Carlisle & Caldew FAS, Phase 2				556638.00 N
		Drilling Rig	Competitor	Ground Level	14.25m AOD
Client	Environment Agency	Driller	JS	Orientation	Vertical
		Logged by	TE	Date Started	11/12/2008
Consultant	Jacobs			Date Completed	11/12/2008

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling	SPT N & (U blows)	SPT type & depth	Install-ation
MADE GROUND: Dark grey gravelly fine to coarse sand sized fragments. Gravel sized fragments are angular to subangular fine to coarse of ash, clinker and sandstone.				B1 0.00 - 1.20 D2 0.00 - 1.20 ES3 0.00 - 0.50 ES4 0.50 - 1.20 D5 1.20 - 2.00 D6 2.00 - 3.00 D7 3.00 - 4.00			
Soft reddish brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of sandstone.		3.30	10.95	D8 4.00 - 5.00			
Sampling complete at 5.00 m.		5.00	9.25				

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL DYNAMIC SP LOG
Version	3.00
Revised	04/11/2004

NORWEST HOLST

Norwest Holst Soil Engineering Ltd.

DYNAMIC SAMPLING LOG

Hole ID. WSC
Sheet 1 of 1

Contract No.	F15418	Method	Dynamic Sampling	Coordinates	339172.00 E
Project	Carlisle & Caldew FAS, Phase 2				556630.00 N
		Drilling Rig	Competitor	Ground Level	14.13m AOD
Client	Environment Agency	Driller	JS	Orientation	Vertical
		Logged by	TE	Date Started	11/12/2008
Consultant	Jacobs			Date Completed	11/12/2008

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling	SPT N & (U blows)	SPT type & depth	Install-ation
MADE GROUND: Dark grey gravelly fine to coarse sand sized fragments. Gravel sized fragments are angular to subangular fine to coarse of brick, ash, clinker and sandstone.				B1 0.00 - 1.20 ES2 0.00 - 0.50 D4 0.10 - 1.20 ES3 0.50 - 1.20 D5 1.20 - 2.00 D6 2.00 - 3.00			
Soft reddish brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of sandstone.		3.30	10.83	D7 3.30 - 4.00 D8 4.50			
Sampling complete at 5.00 m.		5.00	9.13				

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL DYNAMIC SP LOG
Version	3.00
Revised	04/11/2004

NORWEST HOLST

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
BH02
Sheet 1 of 1

Contract No.	F15418	Method	Cable Percussion	Coordinates	339193.20 E
Project	Carlisle & Caldew FAS, Phase 2				556586.57 N
		Drilling Rig	Dando	Ground Level	13.56m AOD
Client	Environment Agency	Driller	LC	Orientation	Vertical
		Logged by	TE	Date Started	15/12/2008
Consultant	Jacobs			Date Completed	15/12/2008

Description of Strata	Depth Below G.L.	Datum Level	Sampling	SPT N & (U blows)	SPT type & depth	Install-ation
MADE GROUND: Brown clayey very sandy angular to subangular fine to coarse gravel sized fragments of ash, clinker, housebrick, concrete, wood and sandstone.			D1 0.00 ES2 0.25 B3 0.25 - 0.50 ES4 1.00 D5 1.00 B6 1.20 - 1.70 D7 2.00 B8 2.50 - 3.00	C9 C6	C 1.20 - 1.65 C 2.50 - 2.95	
Loose reddish brown slightly clayey gravelly fine to coarse SAND. Gravel is subangular to subrounded fine to coarse of sandstone.	3.00	10.56	D9 3.00 U10 3.50 - 3.95 D11 4.00	(14)		
---from 4.50m slightly gravelly very clayey			D12 4.50 - 4.95 B13 4.50 - 5.00	S7	S 4.50 - 4.95	
Firm grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse of sandstone.	5.00	8.56	D14 5.00			
Medium dense brown sandy subrounded to rounded fine to coarse GRAVEL of sandstone. Sand is fine to coarse.	5.50	8.06	D15 5.50 D16 6.00 B17 6.50 - 7.00 D18 7.00	C30	C 6.50 - 6.95	
Cable Percussion boring complete at 8.00 m.	8.00	5.56	D19 8.00	C27	C 8.00 - 8.45	

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL CP LOG
Version	3.09
Revised	17/12/2007

NORWEST HOLST

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID. BH03
Sheet 1 of 2

Contract No.	F15418	Method	Cable Percussion	Coordinates	339217.29 E
Project	Carlisle & Caldew FAS, Phase 2				556574.83 N
		Drilling Rig	Dando	Ground Level	14.03m AOD
Client	Environment Agency	Driller	LC	Orientation	Vertical
		Logged by	TE	Date Started	11/12/2008
Consultant	Jacobs			Date Completed	12/12/2008

Description of Strata	Depth Below G.L.	Datum Level	Sampling	SPT N & (U blows)	SPT type & depth	Install-ation
MADE GROUND: Dark grey gravelly fine to coarse sand sized fragments. Gravel sized fragments are angular to subangular fine to coarse of ash, clinker, housebrick and concrete.			D1 0.00 ES2 0.25 B3 0.25 - 0.50			
Soft low strength reddish brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is fine to medium locally coarse of sandstone.	1.00	13.03	ES4 1.00 D5 1.00 U6 1.20 - 1.65	(13)		
Soft dark grey slightly organic sandy CLAY.	1.60	12.43	D7 1.70 D8 2.00			
---from 3.50m to 3.95m reddish brown very clayey very gravelly fine to coarse sand. Gravel is angular to subrounded fine to coarse of sandstone, siltstone, quartzite and quartz.			D9 2.50 - 2.95 B10 2.50 - 3.00 D11 3.00 U12 3.50 - 3.95	S6 (36)	S 2.50 - 2.95	
Medium dense and dense brown sandy subrounded to rounded fine to coarse GRAVEL of sandstone, quartz and mixed lithologies. ---from 4.50m to 5.00m clayey sand and gravel	4.00	10.03	D13 4.00 B14 4.50 - 5.00 D15 5.00 D16 6.00 B17 6.50 - 7.00 D18 7.00 W19 7.00 D20 8.00 D21 8.00 - 8.50 D22 9.00 B23 9.50 - 10.00	C45 C27 C15 C49	C 4.50 - 4.95 C 6.50 - 6.95 C 8.00 - 8.45 C 9.50 - 9.95	

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL CP LOG
Version	3.09
Revised	17/12/2007

NORWEST HOLST

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
BH03
Sheet 2 of 2

Contract No.	F15418	Method	Cable Percussion	Coordinates	339217.29 E
Project	Carlisle & Caldew FAS, Phase 2				556574.83 N
		Drilling Rig	Dando	Ground Level	14.03m AOD
Client	Environment Agency	Driller	LC	Orientation	Vertical
		Logged by	TE	Date Started	11/12/2008
Consultant	Jacobs			Date Completed	12/12/2008

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
Firm very high strength reddish brown mottled grey CLAY.		10.00	4.03	D24	10.00				
				D25	11.00	(69)			
				U26	11.00 - 11.45				
Extremely weak reddish brown MUDSTONE. Recovered as stiff reddish brown mottled grey slightly gravelly CLAY. Gravel is angular fine to coarse of mudstone.		11.50	2.53	D27	11.50				
				D28	12.00				
				D29	12.50 - 12.95	S38	S	12.50	
				B30	12.50 - 13.00			12.95	
				D31	13.00				
Cable Percussion boring complete at 13.10 m.		13.10	0.93						

NOTES: All depths in metres, all diameters in millimetres.
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Version	3.09
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