Please enter available data in the rows associated with the test (grey) cells. Calculation cells initially display either "0.0000" or "#DIV/0!".
If any calculation cells below state "0.00000", testing has NOT been undertaken that contributes to that Hazardous Property.

Haswaste, developed by Dr. Iain Haslock.

371654
Ugly Brown Building

WAC

TP/WS/BH		BH10	BH14A
Depth (m)		3.00	0.80
Envirolab reference		19/01381/2	19/01381/5
% Moisture	%	20.8	9.4
pH (soil)		12.12	10.42
pH (leachate)			
Arsenic	mg/kg	8	3
Cadmium	mg/kg	0.7	0.5
Copper	mg/kg	37	19
CrVI or Chromium	mg/kg	1	1
Lead	mg/kg	267	68
Mercury	mg/kg	0.58	0.35
Nickel	mg/kg	65	9
Selenium	mg/kg	1	1
Zinc	mg/kg	149	59
Barium	mg/kg		
Beryllium	mg/kg		
Vanadium	mg/kg		
Cobalt	mg/kg		
Manganese	mg/kg		
Molybdenum	mg/kg		
Antimony	mg/kg		
Aluminium	mg/kg		
Bismuth	mg/kg		
CrIII	mg/kg		
Iron	mg/kg		
Strontium	mg/kg		
Tellurium	mg/kg		
Thallium	mg/kg		
Titanium	mg/kg		
Tungsten	mg/kg		
Ammoniacal N	mg/kg		
ws Boron	mg/kg		
PAH (Input Total PAH **OR** individual PAH results)			
Acenaphthene	mg/kg	0.12	0.03
Acenaphthylene	mg/kg	0.02	0.01
Anthracene	mg/kg	0.12	0.07
Benzo(a)anthracene	mg/kg	0.47	0.26
Benzo(a)pyrene	mg/kg	0.47	0.21
Benzo(b)fluoranthene	mg/kg	0.57	0.28
Benzo(ghi)perylene	mg/kg	0.25	0.14
Benzo(k)fluoranthene	mg/kg	0.22	0.11
Chrysene	mg/kg	0.57	0.31
Dibenzo(ah)anthracene	mg/kg	0.06	0.04
Fluoranthene	mg/kg	0.95	0.58
Fluorene	mg/kg	0.07	0.02
Indeno(123cd)pyrene	mg/kg	0.28	0.17
Naphthalene	mg/kg	0.03	0.03
Phenanthrene	mg/kg	0.42	0.29
Pyrene	mg/kg	0.82	0.45
Coronene	mg/kg	0.10	0.05
Total PAHs (16 or 17)	mg/kg		
TPH			
Petrol	mg/kg		
Diesel	mg/kg		
Lube Oil	mg/kg		
Crude Oil	mg/kg		
White Spirit / Kerosene	mg/kg		
Creosote	mg/kg		
Unknown TPH with ID	mg/kg	536.0	174.0
Unknown TPHCWG	mg/kg		
Total Sulphide	mg/kg		
Complex Cyanide	mg/kg		
Free (or Total) Cyanide	mg/kg		
Thiocyanate	mg/kg		
Elemental/Free Sulphur	mg/kg		
Phenols Input Total Phenols HPLC **OR** individual Phenol results.			
Phenol	mg/kg		
Cresols	mg/kg		
Xylenols	mg/kg		
Resourcinol	mg/kg		
Phenols Total by HPLC	mg/kg		
BTEX Input Total BTEX **OR** individual BTEX results.			
Benzene	mg/kg		
Toluene	mg/kg		
Ethylbenzene	mg/kg		
Xylenes	mg/kg		
Total BTEX	mg/kg		
PCBs (POPs)			
PCBs Total (eg EC7/WHO12)	mg/kg		
PBBs (POPs)			
Hexabromobiphenyl (Total or PBB153; 2,2',4,4',5,5'- if only available)	mg/kg		

Please enter available data in the rows associated with the test (grey) cells. Calculation cells initially display either "0.0000" or "#DIV/0!".
If any calculation cells below state "0.00000", testing has NOT been undertaken that contributes to that Hazardous Property.

Haswaste, developed by Dr. Iain Haslock.

371654
Ugly Brown Building

WAC

TP/WS/BH		BH10	BH14A							
Depth (m)		3.00	0.80							
Envirolab reference		19/01381/2	19/01381/5							

POPs Dioxins and Furans Input Total Dioxins and Furans **OR** individual Dioxin and Furan results.

2,3,7,8-TeCDD	mg/kg									
1,2,3,7,8-PeCDD	mg/kg									
1,2,3,4,7,8-HxCDD	mg/kg									
1,2,3,6,7,8-HxCDD	mg/kg									
1,2,3,7,8,9-HxCDD	mg/kg									
1,2,3,4,6,7,8-HpCDD	mg/kg									
OCDD	mg/kg									
2,3,7,8-TeCDF	mg/kg									
1,2,3,7,8-PeCDF	mg/kg									
2,3,4,7,8-PeCDF	mg/kg									
1,2,3,4,7,8-HxCDF	mg/kg									
1,2,3,6,7,8-HxCDF	mg/kg									
2,3,4,6,7,8-HxCDF	mg/kg									
1,2,3,7,8,9-HxCDF	mg/kg									
1,2,3,4,6,7,8-HpCDF	mg/kg									
1,2,3,4,7,8,9-HpCDF	mg/kg									
OCDF	mg/kg									
Total Dioxins and Furans	mg/kg									

Some Pesticides (POPs unless otherwise stated)

Aldrin	mg/kg									
α Hexachlorocyclohexane (alpha-HCH) *(leave empty if total HCH results used)*	mg/kg									
β Hexachlorocyclohexane (beta-HCH) *(leave empty if total HCH results used)*	mg/kg									
α Cis-Chlordane (alpha) ***OR*** *Total Chlordane*	mg/kg									
δ Hexachlorocyclohexane (delta-HCH) *(leave empty if total HCH results used)*	mg/kg									
Dieldrin	mg/kg									
Endrin	mg/kg									
χ Hexachlorocyclohexane (gamma-HCH) (lindane) ***OR*** *Total HCH*	mg/kg									
Heptachlor	mg/kg									
Hexachlorobenzene	mg/kg									
o,p'-DDT *(leave empty if total DDT results used)*	mg/kg									
p,p'-DDT ***OR*** *Total DDT*	mg/kg									
χ Trans-Chlordane (gamma) *(leave empty if total Chlordane results used)*	mg/kg									
Chlordecone (kepone)	mg/kg									
Pentachlorobenzene	mg/kg									
Mirex	mg/kg									
Toxaphene (camphechlor)	mg/kg									

Tin

Tin *(leave empty if Organotin and Tin excl Organotin results used)*	mg/kg									

Organotin

Dibutyltin; DiBT	mg/kg									
Tributyltin; TriBT	mg/kg									
Triphenyltin; TriPT	mg/kg									
Tetrabutyltin; TeBT	mg/kg									

Tin excluding Organotin

Tin excl Organotin	mg/kg									

envirolab

Haswaste, developed by Dr. Iain Haslock.

Please enter available data in the rows associated with the test (grey) cells. Calculation cells initially display either "0.0000" or "#DIV/0!".
If any calculation cells below state "0.00000", testing has NOT been undertaken that contributes to that Hazardous Property.

371654
Ugly Brown Building

WAC

TP/WS/BH		BH10	BH14A							
Depth (m)		3.00	0.80							
Envirolab reference		19/01381/2	19/01381/5							

Asbestos in Soil	Thresholds										
Asbestos detected in Soil (enter Y or N)	Y		N	N							
Asbestos % Composition in Soil (Matrix Loose Fibres or Microscopic Identifiable Pieces only)	see "Carc HP7 % Asbestos in Soil (Fibres)" below	%									
Carcinogenic HP7 % Asbestos in Soil (fibres or micro pieces) *Please be advised, if the calculation cell is "0.00000" DOES NOT MEAN asbestos testing has been undertaken and the result is zero.*	≥0.1%		0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Asbestos Identifiable Pieces visible with the naked eye detected in the Soil (enter Y or N)	Y										

If Asbestos in Soil above is "Y", the soil is Hazardous Waste HP5 and HP7

If Asbestos in Soil above is "Y", but Asbestos % above is "<0.1%", the soil is Non Hazardous Waste. You can only use Asbestos % results where loose fibres or micro pieces are only present. You cannot use Asbestos % results when visual identifiable pieces are present.

If visual identifiable pieces of asbestos are present, you cannot use Asbestos % results and the whole soil sample is Hazardous Waste HP5 and HP7 Construction material containing Asbestos 17 06 05. Therefore, if Asbestos in Soil above is "Y", the Asbestos % above is "<0.1%", but the Asbestos Identifiable Pieces visible with the naked eye is "Y", the soil is Hazardous Waste.

Identifiable Pieces are Cement, Fragments, Board, Rope etc. ie anything ACM that is not Loose Fibres.

All visual asbestos pieces need to be removed leaving only fibres (or micro pieces) with an Asbestos % Composition in Soil result of <0.1% for the soil to become non-hazardous waste.

Hazardous Property	Thresholds	Cut Off Value	**If cells below turn yellow and the text turns red, the samples should be classified as Hazardous Waste.**								
Corrosive HP8	≥5%	<1%	0.00099	0.00053	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Irritant HP4	≥10%	<1%	0.00415	0.00230	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Irritant HP4	≥20%	<1%	0.01383	0.00367	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Specifc Target Organ Toxicity HP5	≥1%		0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Specifc Target Organ Toxicity HP5	≥20%		0.00003	0.00003	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Specifc Target Organ Toxicity HP5	≥1%		0.01040	0.00165	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Specifc Target Organ Toxicity HP5	≥10%		0.04245	0.01576	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Aspiration Toxicity HP5	≥10%		0.04245	0.01576	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Acute Toxicity HP6	≥0.1%	<0.1%	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Acute Toxicity HP6	≥0.25%	<0.1%	0.00088	0.00039	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Acute Toxicity HP6	≥5%	<0.1%	0.00026	0.00030	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Acute Toxicity HP6	≥25%	<1%	0.03502	0.00988	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Acute Toxicity HP6	≥0.25%	<0.1%	0.00005	0.00003	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Acute Toxicity HP6	≥2.5%	<0.1%	0.00015	0.00017	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Acute Toxicity HP6	≥15%	<0.1%	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Acute Toxicity HP6	≥55%	<1%	0.00006	0.00005	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Acute Toxicity HP6	≥0.1%	<0.1%	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Acute Toxicity HP6	≥0.5%	<0.1%	0.00025	0.00025	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Acute Toxicity HP6	≥3.5%	<0.1%	0.00011	0.00013	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Acute Toxicity HP6	≥22.5%	<1%	0.03486	0.00975	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Carcinogenic HP7	≥0.1%		0.02115	0.00616	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Carcinogenic HP7	≥0.1%		0.000000000	0.000000000	0.000000000	0.000000000	0.000000000	0.000000000	0.000000000	0.000000000	0.000000000
Carcinogenic HP7	≥1%		0.00002	0.00002	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Carcinogenic HP7 Unknown TPH with ID	≥1,000mg/kg		424.51	157.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Carcinogenic HP7 b(a)p marker test (Unknown TPH with ID only) Cell only applicable if TPH >1,000mg/kg	≥0.01%		0.06945	0.10934	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
pH Corrosive HP8 pH (soil or leachate)	H8 ≥11.5		12.12	10.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00
pH Corrosive HP8 pH (soil or leachate)	H8 ≤2		12.12	10.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Toxic for Reproduction HP10	≥0.3%		0.02115	0.00616	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Toxic for Reproduction HP10	≥3%		0.04245	0.01576	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Mutagenic HP11	≥0.1%		0.00015	0.00017	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Mutagenic HP11 Unknown TPH with ID	≥1,000mg/kg		424.51	157.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mutagenic HP11 b(a)p marker test (Unknown TPH with ID only) Cell only applicable if TPH >1,000mg/kg	≥0.01%		0.06945	0.10934	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Mutagenic HP11	≥1%		0.01040	0.00165	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Produces Toxic Gases HP12 Sulphide	≥1,400mg/kg		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Produces Toxic Gases HP12 Cyanide	≥1,200mg/kg		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Produces Toxic Gases HP12 Thiocyanate	≥2,600mg/kg		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HP13 Sensitising	≥10%		0.01040	0.00165	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

Table 3 of the CLP, CL Inventory, ATPs, IARC, Concawe, MSDSs, REACH + Pesticide Properties databases. Worst case REACH + MSDS's used for "*" STOT + Acute Toxicity.

Please enter available data in the rows associated with the test (grey) cells. Calculation cells initially display either "0.0000" or "#DIV/0!".
If any calculation cells below state "0.00000", testing has NOT been undertaken that contributes to that Hazardous Property.

Haswaste, developed by Dr. Iain Haslock.

371654
Ugly Brown Building

WAC

TP/WS/BH			BH10	BH14A							
Depth (m)			3.00	0.80							
Envirolab reference			19/01381/2	19/01381/5							
Ecotoxic HP14 amended v6	≥25%	<0.1%	0.05122	0.01743	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Ecotoxic HP14 amended v6	≥25%	<0.1% (except Be, V, Te, Tl, Petrol, Diesel, Crude Oil, Kerosene, White Spirit, Crosote, TPH, TPHCWG, Phenol, Cresols, Xylenols, T-Phenols, CompCN, Thiocyanate, Toluene, Ethylbenzene, Xylene + BTEX 1%).	0.09367	0.03319	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Ecotoxic HP14 amended v6	≥25%	<0.1% (except Be, V, Te, Tl, Petrol, Diesel, Crude Oil, Kerosene, White Spirit, Crosote, TPH, TPHCWG, Phenol, Cresols, Xylenols, T-Phenols, CompCN, Thiocyanate, Toluene, Ethylbenzene, Xylene + BTEX 1%).	5.54614	1.90043	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Persistent Organic Pollutant (PCB, PBB or POP Pesticides)	>0.005%		0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
Persistent Organic Pollutant (Total Dioxins+Furans)	>0.0000015%		0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000
Persistent Organic Pollutant (Individual Dioxins+Furans)	>0.0000015%		0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000

If other contaminants need adding to Haswaste, please contac

APPENDIX S
GEOPHYSICAL REPORT

The Trustees of the St Pancras Way Block A Unit Trust & Big Lobster Ltd

Ugly Brown Building

Geophysical Report

Project no. 193152

MARCH 2019

RSK GENERAL NOTES

Project No.: 193152_R01(00)

Title: Geophysical Report, Ugly Brown Building

Client: The Trustees of the St Pancras Way Block A Unit Trust & Big Lobster Ltd

Date: 12th March 2019

Office: RSK, 18 Frogmore Road, Hemel Hempstead, Herts, HP3 9RT
Tel: +44 (0)1442 416652
Fax: +44 (0)1442 437550
www.rsk.co.uk

Status: Final

Author	**Jessica Slamaker** Consultant Geophysicist	**Technical reviewer**	**Timothy Grossey** Director
Signature		Signature	
Date:	12th March 2019	Date:	12th March 2019
Project manager	**James Cotterill** Senior Geophysicist	**Quality reviewer**	**Rebecca Dabbs** Team Administrator
Signature		Signature	
Date:	12th March 2019	Date:	13th March 2019

CONTENTS

FIGURES

EXECUTIVE SUMMARY

RSK Geophysics were commissioned by Claire Siberry of RSK Environment Ltd on behalf of The Trustees of the St Pancras Way Block A Unit Trust & Big Lobster Ltd (the "client"), to carry out a geophysical investigation at 6A St Pancras Way (Ugly Brown Building), London. The project was commissioned to determine the depth to the base of the several pile types, including; the contiguous piled walls on the northern boundary of the site and to the Thames Water Sewer, the sheet pile wall along the canal wall and the historic brick canal wall. This was achieved by undertaking geophysical tests within boreholes positioned across the site.

Project Findings

Site Setting and Current Usage	The site is located at Ugly Brown Building, 6A St Pancras Way, London. The site is currently in use as offices. The geophysical surveys were undertaken in boreholes situated along the canal, on the northern site boundary, and in the parking area adjacent to the Thames Water Sewer.
Survey Objectives	The objective of the survey was to determine the depth of various pile types across the site, including; contiguous piled walls on the northern site boundary and to the Thames Water Sewer, the sheet pile wall along the canal wall and the historic, brick canal wall. To enable testing, seven boreholes were installed at ground level to depths of between 25-30 m. The holes were located between 0.54 and 1.93 m lateral distance away from the piles/walls of interest.
Geophysical Techniques Employed	The geophysical techniques employed were downhole parallel seismics and downhole magnetometry. The geophysical fieldwork was conducted on the 11th and 12th February 2019.
Geophysical Investigation Findings	The techniques have identified the canal sheet pile wall at depths of between 6.80 – 8.08 mbgl. The old canal wall has been detected at a depth of 3.39 mbgl at BH4, a good correlation to the record depth of 3.50 m. At BH15 the old canal wall was detected at a depth of 5.14 mbgl, this value has a lower confidence as the historic wall was below concrete and its position could only be approximated. At BH1 and BH2 the data was of good quality; the records indicate the piles to be 21.70 m. Interpreted depths of the pile at BH6 do not have a high level of confidence, the magnetic data does not follow the same trend observed elsewhere on site. The seismic data is of lower quality, there is less contrast between interpreted seismic velocities from the pile and ground below. In addition to this, due to not having direct access to the pile, it cannot be ascertained from the data if the seismic waves have passed through the pile of interest. The interpreted results are presented in **Figures 5 to 13** for boreholes 1,2, 4, 6, 7, 10 and 15 respectively. The results are also summarised in **Table 2**.

1 INTRODUCTION

1.1 Introduction

RSK Geophysics were commissioned by Clair Siberry of RSK Environment Ltd on behalf of The Trustees of the St Pancras Way Block A Unit Trust & Big Lobster Ltd (the "client"), RSK Environment Ltd carried out a geophysical investigation at Ugly Brown Building, London. The project was commissioned to determine the depth to the base of the several pile types, including; the contiguous piled walls on the northern boundary of the site and to the Thames Water Sewer, the sheet pile wall along the canal wall and the historic brick canal wall.

1.2 Details of the Project

The project was carried out on the 11th and 12th February 2019, and included the following:

- Parallel seismic testing within seven boreholes;
- Down hole magnetometer survey within seven boreholes;
- An Interpretive Report

1.3 Limitations

Non intrusive geophysical techniques seek to locate boundaries across which there is a marked contrast in physical properties. Such a contrast may be detected remotely because it gives rise to a geophysical anomaly, which is indicative of variation in a physical property relative to some background value. Insufficient contrast (including high levels of cultural noise) can result in masking of the sought anomaly. Therefore, there may be other conditions prevailing at the site which have not been revealed by this investigation and which have therefore not been taken into account in this report.

The response of the ground to different physical forces can be highly variable. Interpretation of the responses contained in this report is based on experience in similar environments and site conditions.

The materials encountered and samples obtained during on-site intrusive investigations represent only a small proportion of the materials present on-site. It should be accepted, therefore, that the interpretation from remotely sensed geophysical data may be inconsistent with that arising from direct methods of investigation.

2 THE SITE

2.1 Location and Regional Setting

The site is located at Ugly Brown Building, 6A St Pancras Way, London.

The geophysical surveys were undertaken in seven boreholes located at ground level of the site. The boreholes were located adjacent to the canal, to the contiguous piled wall on the northern boundary and in the parking area at the front of the building adjacent to the Thames Water Sewer contiguous piled wall.

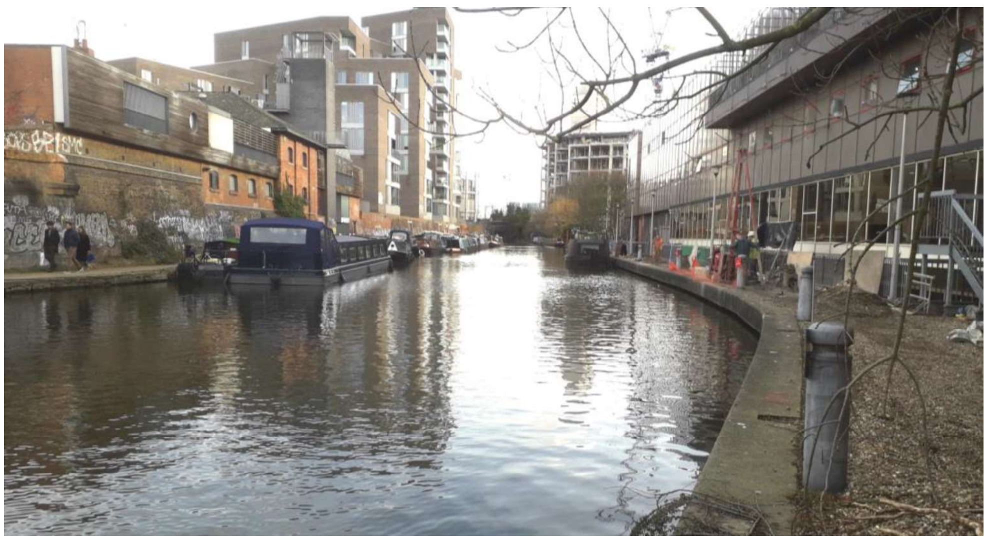


Plate 1: Looking along the canal wall towards BH10

2.2 Geology

Published geological maps indicate that the site is underlain by the London Clay Formation.

Borehole logs from the RSK Environment Ltd site investigation show that below concrete and made ground, the local geology consists of the London Clay Formation and in several holes the Lambeth Group was encountered at the base of the intrusive locations.

3 THE SURVEY

3.1 Objective and Geophysical Approach

A geophysical survey was carried out to determine the depth to several pile types across the site at Ugly Brown Building. To enable the testing, seven boreholes were installed to depths of approximately 25-30 m. The holes were located between 0.54 and 1.93 m lateral distance away from the target piles/walls.

The geophysical techniques employed were that of parallel seismic testing and downhole magnetometry. The works were conducted on 11th and 12th February 2019.

3.2 Downhole Parallel Seismic Technique

This technique operates by directing an elastic wave through the foundation from the surface and recording its arrival time at different depths. This technique required a borehole to be drilled parallel to, and as close to the pile as possible, boreholes should ideally be within 1 m of the sheet pile. The borehole should extend to a depth 3-5 m below the anticipated depth of the pile.

3.2.1 Theory

The survey is conducted by lowering a string of hydrophones down the borehole which will detect the vibrations that have propagated down the pile structure and across to the borehole (**Figure 3**). Striking the top of the pile or structure with a sledgehammer generates the vibrations to propagate directly down through the structure and through the pile if present. A seismograph connected to the hydrophone will record the digital signal from the hydrophones allowing the arrival time of the energy to be recorded. Analysis of the first arrival times of seismic data at an array of distances from the source can provide information on the geometry, depth, and elastic properties of subsurface materials, and the possible presence of piled foundations.

3.2.2 Application to Site

The parallel seismic technique is commonly used to determine the depth to the toe of a piled foundation. Variations in the calculated velocities (based on recorded first arrival times) at each of the sensors are recorded. These are then analysed to determine the depth at which a change in the velocity is observed. A constant velocity is expected within the pile; typically this is faster than the velocity of the surrounding geology. Analysis of the data allows determination of this inflection point and hence the depth to the toe of the pile. Following data acquisition at each depth the hydrophone string was raised by 0.25 m and additional data was recorded.

3.2.3 Equipment

A 24 channel hydrophone array (1 m hydrophone spacing) was connected to a Geometrics 24 channel Geode seismograph. Seismic waves were created using a sledge hammer to strike the top of the pile directly or its assumed position, when not directly accessible. See equipment specifications in **Appendix A**.

3.3 Downhole Magnetometry Technique

Magnetic surveying is a passive method based on the measurement of localised perturbations to the Earth's magnetic field caused by the presence of buried ferrous targets (e.g., pipes, cables, drums, military ordnance etc.).

3.3.1 Theory

In the UK, the strength of the Earth's magnetic field is on the order of 48,000 nanoTesla (nT). Geological or manmade features can cause local variations in the Earth's magnetic field which can also be measured by a magnetometer.

Magnetic surveys may be conducted over the ground surface or downhole using specialist sensors. In a borehole, data is collected in a systematic manner as the probe is raised up and lowered down the borehole and then presented as a profile plot with depth (nT) from which inferences may be drawn regarding the nature of the sub surface. The amplitude and shape of an individual anomaly will reflect the dimensions, and magnetic susceptibility of the buried target (**Figure 4**).

3.3.2 Equipment

The equipment used was the Foerster Ferex 4.032 Fluxgate Magnetometer (see **Appendix A** for equipment specifications). The sensing element of a fluxgate magnetometer consists of one or more cores of magnetic alloy, around which are wound coils through which alternating current can be passed. Variations in the electrical properties of the circuits with magnetisation of the cores can be converted into voltages proportional to the external magnetic field along the core axes. This instrument is single channel and consists of a pair of fluxgate type sensors mounted 650 mm apart, in-line, in a waterproof non-magnetic probe housing. When operated vertically, it measures the difference in the vertical component of the induced magnetic field between the sensors. As a gradiometer, both fluxgate sensors in the Ferex probe respond equally and simultaneously to temporal changes in the magnetic field. Hence, sources of noise are automatically minimised. Depth measurements are made relative to the centre of the probe.

3.3.3 Application to Site

The presence of the metalwork within a pile can be detected by measuring the induced magnetic field with a magnetometer and therefore the pile length can be estimated based on the presence of the increased magnetic response.

The survey is conducted by raising the probe up the length of the borehole, taking measurements at small discrete intervals (0.20 m). The induced magnetic field strength is relatively high while adjacent to the sheet pile, however the field shows considerable variation at the ends, before trending to quiet, uniform readings, representing the background values of the magnetic field, in the surrounding ground. This trend can be used to detect the end of any metal within the pile. Theoretically the location with the largest fluctuation in magnetic field strength (gradient) corresponds to the base of sheet pile wall.

The readings were repeated over three tests to check for repeatability and ensure data quality was good.

3.4 Survey Design

All boreholes were installed to depths of between 25-30 m below ground level. In each borehole 80 mm ID PVC casing was installed and filled with water prior to the start of the survey. Four holes were situated along the canal edge, two further holes were situated at the northern edge of the site, and BH6 in the front car park of the building. The holes were between 0.54 and 1.93 m lateral distance away from the piles/walls. The site layout is shown in **Figure 2**. The distances between the boreholes and pile strike points are summarised below in **Table 1**.

Table 1: Location Summaries

BH ID	Target Pile	Site Location	Distance to Strike Point from BH	Top of Pile Exposed?
BH1	Contiguous Pile	Northern boundary of site	1.11 m	Yes
BH2	Contiguous Pile	Northern boundary of site	0.67 m	Yes
BH4 – Sheet Pile	Canal sheet pile wall	Along canal edge	0.85 m	No – under concrete top
BH4 – Old Canal Wall	Historic masonry wall	Along canal edge	0.75 m	Yes
BH6	Contiguous Pile	Adjacent to TW Sewer	1.93 m	No
BH7	Canal sheet pile wall	Along canal edge	0.80 m	No – under concrete top
BH10	Canal sheet pile wall	Along canal edge	0.84 m	No – under concrete top
BH15- Sheet Pile	Canal sheet pile wall	Along canal edge	0.54 m	No – under concrete top
BH15- Old Canal Wall	Historic masonry wall	Along canal edge	0.65 m	No – Beneath concrete pathway

The seismic equipment was lowered to the bottom of the hole, measurements were taken, and the equipment was then raised up the hole by 0.25 m. The magnetometer was lowered to the bottom of the hole and measurements taken every 0.20 m as the instrument was raised up the hole.

Seismic signals were induced into the pile by striking the top of the piles/walls. The canal wall sheeting is situated below a concrete top and the position could only be approximated. At BH6, the impact point was positioned at the expected location of a beam which may be connected to the pile of investigation, however the actual structure cannot not be confirmed. The impact points were all within a meter height of the top of the borehole.

3.5 Data Processing and Presentation

Seismic Data

In the field measurements were made relative to the top of the pipe install, as this was the most accurate method for determining the depths. All results have been presented relative to ground level. Topographic information was collected on site on an arbitrary grid, this data has been fitted to the supplied topographic information and approximate heights referenced to Ordnance Datum have been supplied. In addition to this the seismic data have been corrected to account for the offset between the borehole and the sheet pile wall.

The seismic data were processed using the specialist software suite SeisImager 2D. The data for each shot record were analysed and the time of the first arrival of seismic energy at the hydrophones picked using the PickWin module. All picks are made by hand, by the same operator to ensure consistency. The first arrival pick data are used to obtain velocity graphs for the shot record. Changes in gradient of the travel time plots indicate a change in velocity and can be used to identify the base of the piles/walls.

A correction factor is applied to the depth derived from the travel time graphs to account for the effect of the pile-to-borehole distance.

In applying the pile-to-borehole offset correction the seismic velocities of the pile and surrounding medium must be also be accounted for.

The depths determined from the lowest hydrophone analysis are corrected accordingly for the borehole-pile offset. Generally, the larger the offset between the pile and the borehole then the greater the correction to be applied.

Magnetic Data

Magnetic data were imported into Excel where the tests for each location were combined onto one chart. The charts were imported and scaled to the correct depth in AutoCAD. Three tests were undertaken in each hole to ensure repeatability, each test is presented as a different colour (green, orange and red) and presented parallel to the seismic data at each hole in **Figures 5-13**.

4 DATA INTERPRETATION

4.1 Data Quality

Recorded seismic data were generally of very good quality with a repeatable coherent signal being observed through the length of the test area.

At BH4 and BH15 the depth to the old canal wall was also investigated. This was exposed at BH4 and beneath concrete at BH15. Data quality on these tests was reduced and there was little gradient change making it difficult to determine the change in response from the wall to the ground below.

BH6 was positioned at 1.93 m laterally away from the expected pile location. The pile was not exposed, and the structure below may be a combination of beam and pile, with the possibility that there may be an air gap between the two. It is thought a combination of these affects has reduced the signal quality of the seismic data. Although a change in gradient has been interpreted, the interpreted depth is shallower than records suggest the pile toe should be present. Further to this, as the pile and borehole are situated at a distance greater than 1 m, there is less confidence in the magnetic data for this borehole, as the distance is at the limit of the Ferex's detection capabilities.

BH10 retained water poorly, as a result the data quality is reduced at this position and the top hydrophones in particular, did not receive good signal.

Where the seismic results were difficult to interpret a lower level of confidence has been applied to the results of this test and a larger error bound applied. Seismic records acquired were checked prior to demobilisation to ensure data with a suitable signal to noise ratio had been achieved.

In all boreholes, the magnetic data showed a high level of repeatability between the three tests.

Plate 2: Seismic data collection setup at BH2

4.2 Results

Figures 5, **6, 7**, **8, 9, 10, 11, 12 and 13** display the results graphically, whilst the results are summarised below and in **Table 1** of this report.

Seismic Data

In all boreholes two general velocity trends were identified: The first of these, the 'fast' velocity, is interpreted to correspond to the pile. Following this an area of slower velocities corresponding to the surrounding ground material beneath the toe of the pile.

As described in section 3.2, in typical borehole seismic surveys the crossover point from higher velocities (indicative of foundations) to the lower velocity (indicative of London Clay Formation) is used to calculate the depth to the toe of the pile. The corrected depth of the sheet pile takes into account the distance the borehole is from the pile.

Magnetic Data

The magnetic data in all boreholes situated along the canal displayed similar trends. The vertical dipole fluctuates around zero indicating the presence of the steel sheet pile. At approximately 7 m depth, a classic sharp change in gradient is observed, interpreted as the base of the sheet pile. Boreholes one and two also displayed similar trends, with a sharp in gradient observed at depths of around 24-25 m, indicting the pile cap has a metal cage around it for the entire length of the pile.

At BH6 the magnetic data does not follow the same trend observed at the other boreholes.

Magnetic data was not utilised for interpretation of the historic canal wall as it is understood to be of masonry construction with no internal metalwork.

4.2.1 BH1

Data collected at BH1 were of good quality with a clear change in seismic velocity detected at 22.94 mbgl. The magnetic data showed a change in response at 24.67 mbgl. The pile was fully exposed and the pile was hit in the centre. The records indicate the pile depth to be 21.70 m. See **Figure 5** for the results of the geophysical survey.

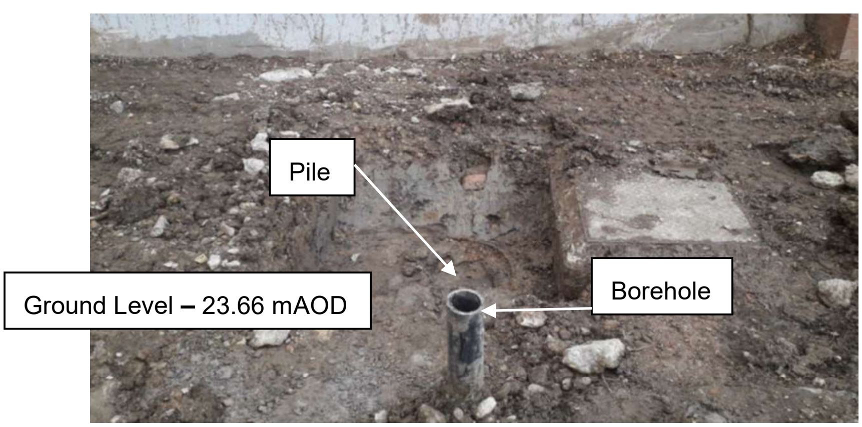


Plate 3: BH1 Layout

4.2.2 BH2

Data collected at BH2 were of good quality with a clear change in seismic velocity detected at 22.13 mbgl. The magnetic data showed a change in response at 23.65 mbgl. The pile was fully exposed, and the pile was hit in the centre. The records indicate the pile depth to be 21.70 m. See **Figure 6** for the results of the geophysical survey.

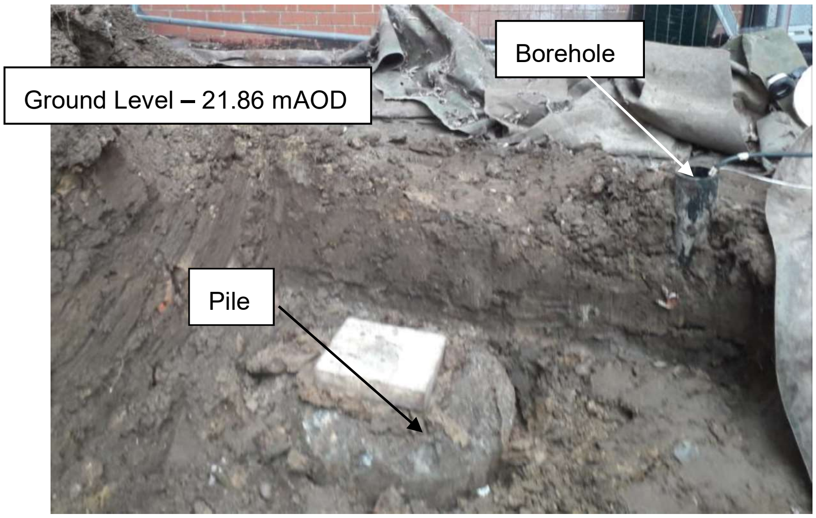


Plate 4: BH2 Layout

4.2.3 BH4

Canal Sheet Wall

Data collected at BH4, when hitting the sheet pile, was of good quality with a clear change in seismic velocity detected at 6.79 mbgl. The magnetic data showed a change in response at 7.64 mbgl. The exact position of the sheeting was unknown due to the concrete top, several positions were trialled before choosing where to hit along the wall. See **Figure 7** for the results of the geophysical survey.

Old Canal Wall

Data collected at BH4, when hitting the historic masonry canal wall, gave clear first arrivals. The canal wall was exposed and was hit at the approximate centre. Due to the change being shallow, limited first arrivals could be identified with the 'fast velocity' indicative of travelling through the wall as opposed to geology sedimentary deposits. The contrast in velocity values was not as clear, and as such the change in gradient harder to interpret. A change in seismic velocity has been interpreted at 3.39 mbgl. As the wall is of brick construction the magnetic data could not be used to aid in interpretation. The records indicate the wall depth to be 3.50 m. See **Figure 8** for the results of the geophysical survey.

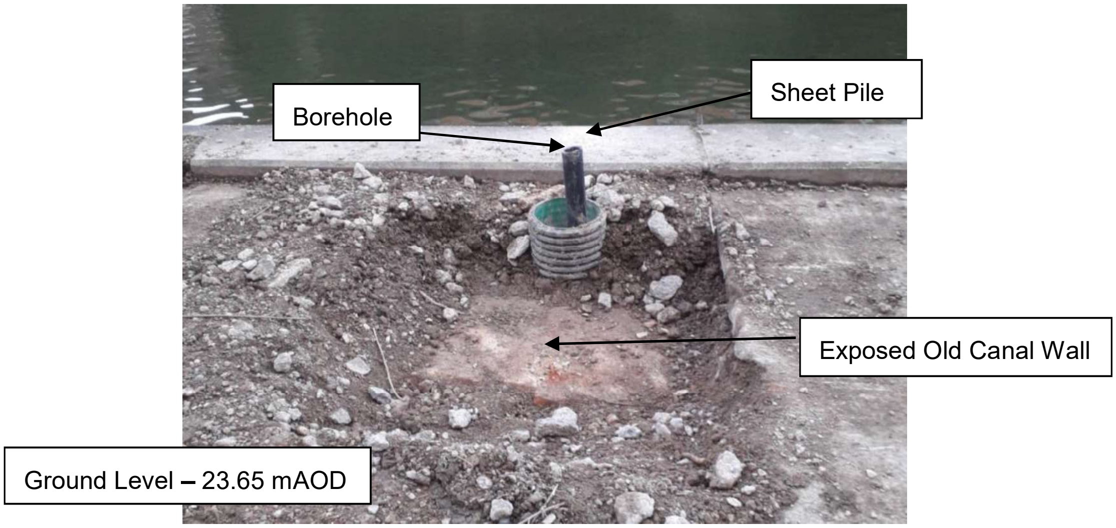


Plate 5: BH4 Layout

4.2.4 BH6

Data collected at BH6 were of lower quality, towards the bottom of the hole first arrivals could not be identified. As the distance between the borehole and expected pile location was almost 2 m, the change in velocity between off-end shots and those travelling through the pile are subtler than other locations. Further to this it is possible that, as the pile and beam locations were not exposed, not all the seismic signal was passing into the intended pile. A subtle change in seismic velocity is detected at 18.43 mbgl and this has been interpreted as the base of the pile. Magnetic data at BH6 does not show the same trend as elsewhere across the site. As the borehole is positioned ~2 m away from the pile, the Ferex may not be close enough to detect any possible reinforcement within the pile and it cannot be relied upon as an indication of the depth. The records indicate the pile depth to be 24.51 m.

See **Figure 9** for the results of the geophysical survey.

4.2.5 BH7

Data collected at BH7 were of good quality with a clear change in seismic velocity detected at 7.48 mbgl. The magnetic data showed a change in response at 7.94 mbgl. The exact position of the sheeting was unknown due to the concrete top, several positions were trialled before choosing where to hit along the wall. See **Figure 10** for the results of the geophysical survey.

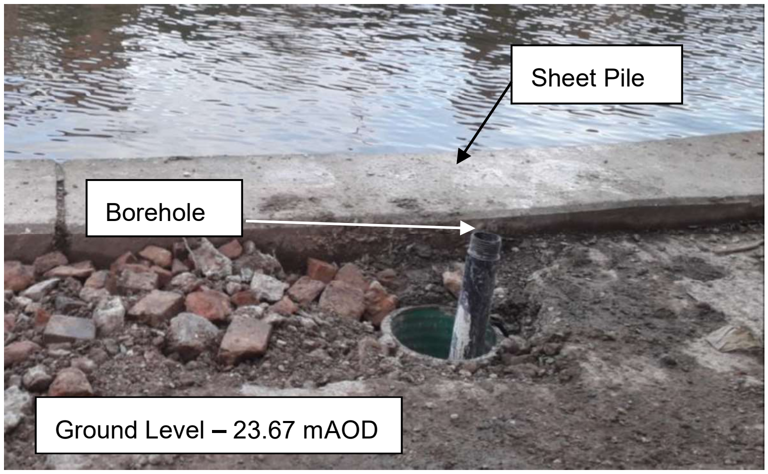


Plate 6: BH7 Layout

4.2.6 BH10

Data collected at BH10 were of variable quality, the hole did not retain water well and this resulted in the top hydrophones receiving a poor signal. A change in seismic velocity was detected at 7.28 mbgl. The magnetic data showed a change in response at 7.25 mbgl. The exact position of the sheeting was unknown due to the concrete top, several positions were trialled before choosing where to hit along the wall. See **Figure 11** for the results of the geophysical survey.

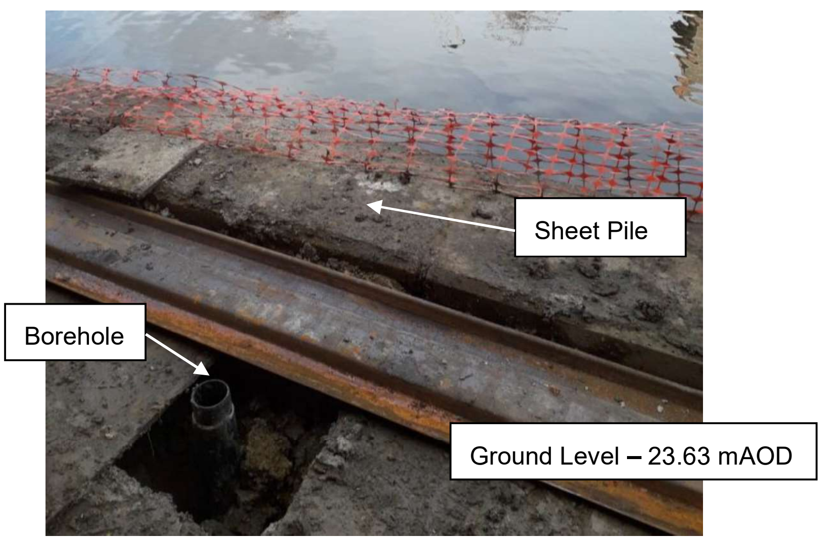


Plate 7: BH10 Layout

4.2.7 BH15

Canal Sheet Wall

Data collected at BH15, when striking the sheet pile wall, were of good quality with a clear change in seismic velocity detected at 8.08 mbgl. The magnetic data showed a change in response at 8.08 mbgl. The exact position of the sheeting was unknown due to the concrete top, several positions were trialled before choosing where to hit along the wall. See **Figure 12** for the results of the geophysical survey.

Old Canal Wall

Data collected at BH15, when striking the historic canal wall, gave clear first arrivals. The canal wall was not exposed at this location, and the concrete walkway was hit at the approximate position of the wall, by measuring from the borehole. The response was different to that achieved when hitting the historic canal wall at BH4. A subtle change in seismic velocity has been detected at 5.14 mbgl. This depth is not similar to that interpreted from the BH4 data, where the wall was hit directly, and as such the level of confidence in this interpretation is low. As the wall is of brick construction the magnetic data could not be used to aid in interpretation. The records indicate the wall depth to be 3.50 m. See **Figure 13** for the results of the geophysical survey.

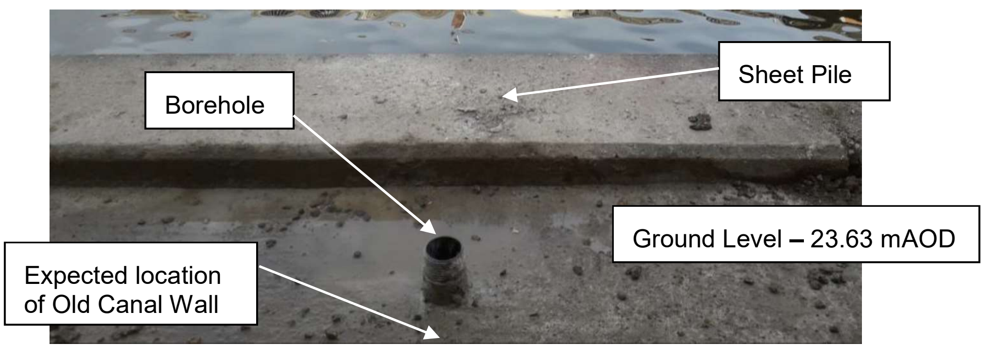


Plate 8: BH15 Layout

4.3 Summary

Slight variations in the interpreted pile depth are present between the magnetic and seismic data at each borehole. In general these variations are within the error bounds of the techniques.

The techniques have identified the canal sheet pile wall at depths of between 6.80 – 8.08 mbgl. The old canal wall has been detected at a depth of 3.39 mbgl at BH4, a good correlation to the record depth of 3.50 m. At BH15 the old canal wall was detected at a depth of 5.14 mbgl, this value has a lower confidence as it does not correlate, as well, to the record depth. At BH1 and BH2, the detected depths of the contiguous pile are at 22.94 and 22.13 mbgl respectively; these show a reasonable correlation with the expected depth indicated on records.

Interpreted depths of the pile at BH6 do not have a high level of confidence, the magnetic data does not follow the same trend observed elsewhere on site. The seismic data showed a smaller contrast between interpreted seismic velocities from the pile and ground below. In addition to this it cannot be ascertained from the data if the seismic waves have passed through the pile of interest.

A summary of the findings is presented in the table below.

Table 2: Interpreted Results

BH ID	Seismic (depth to base of pile/wall) Uncorrected	Seismic (depth to base of pile/wall) Corrected for offset between pile and borehole	Magnetics (limit of metalwork)	Record Depth (If available)
BH1	23.76 mbgl +/- 1.00 m	22.94 mbgl +/- 1.00 m	24.67 mbgl +/- 1.0 m	21.70 m
BH2	22.62 mbgl +/- 0.5 m	22.13 mbgl +/- 0.5 m	23.65 mbgl +/- 1.0 m	21.70 m
BH4 – Sheet Pile	7.24 mbgl +/- 0.5 m	6.79 mbgl +/- 0.5 m	7.64 mbgl +/- 1.0 m	
BH4 – Old Canal Wall	4.19 mbgl +/- 1.00 m	3.39 mbgl +/- 1.00 m	N/A	3.50 m
BH6	20.51 mbgl +/- 1.00 m	18.43 mbgl +/- 1.00 m	N/A	24.51 m
BH7	7.86 mbgl +/- 0.50 m	7.48 mbgl +/- 0.50 m	7.94 mbgl +/- 1.00 m	
BH10	7.68 mbgl +/- 1.00 m	7.28 mbgl +/- 1.00 m	7.25 mbgl +/- 1.00 m	
BH15- Sheet Pile	8.46 mbgl +/- 0.50 m	8.08 mbgl +/- 0.50 m	8.08 mbgl +/- 1.00 m	
BH15- Old Canal Wall	5.67 mbgl +/- 1.00 m	5.14 mbgl +/- 1.00 m	N/A	3.50 m

Note: depths relative to metres below ground level (mbgl)

5 CONCLUSIONS

- RSK Geophysics were commissioned by Claire Siberry of RSK Environment Ltd on behalf of The Trustees of the St Pancras Way Block A Unit Trust & Big Lobster Ltd (the “client”) to carry out a geophysical investigation at Ugly Brown Building, London. The project was commissioned to determine the depth to the base of the several pile types, including; the contiguous piled walls on the northern boundary of the site and to the Thames Water Sewer, the sheet pile wall along the canal wall and the historic brick canal wall. This was achieved by undertaking geophysical tests within boreholes positioned across the site.

- To enable the testing, seven boreholes were drilled to depths of approximately 25-30 m. The holes were located between 0.54 and 1.93 m lateral distance away from the target piles/walls.

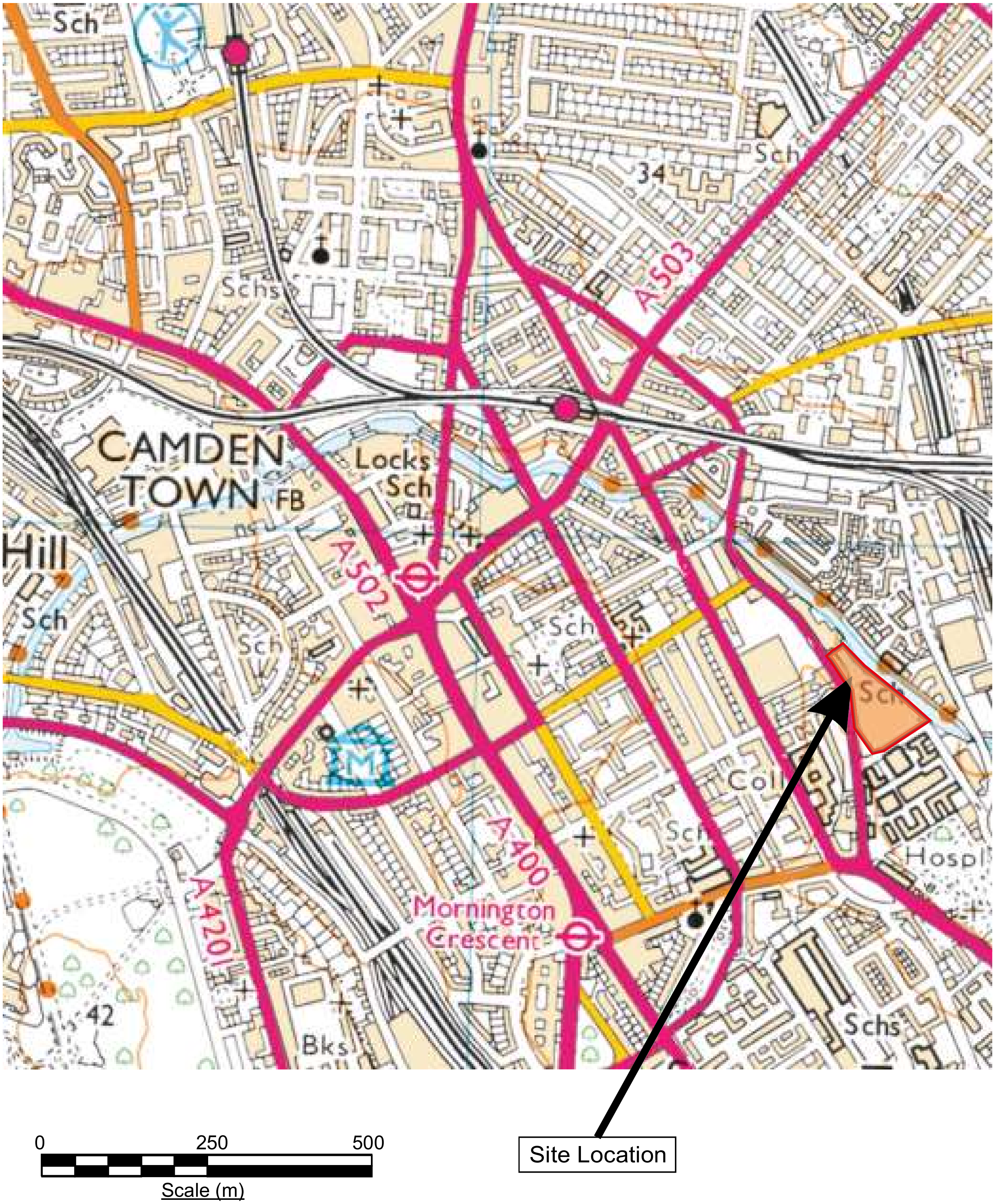
- The geophysical techniques employed were downhole parallel seismics and downhole magnetometry. The geophysical fieldwork was conducted on the 11th and 12th February 2019.

- A summary of the interpreted results is presented in **Table 2.**

- The interpreted results are presented in **Figures 5 to 13**.

- The data collected during the geophysical investigation is remotely sensed data and should be verified prior to construction work.

FIGURES



Notes

Extract from Ordnance Survey map

Reproduced from Ordnance Survey mapping with the permission of the Controller of Her Majesty's Stationery Office.

N
W E
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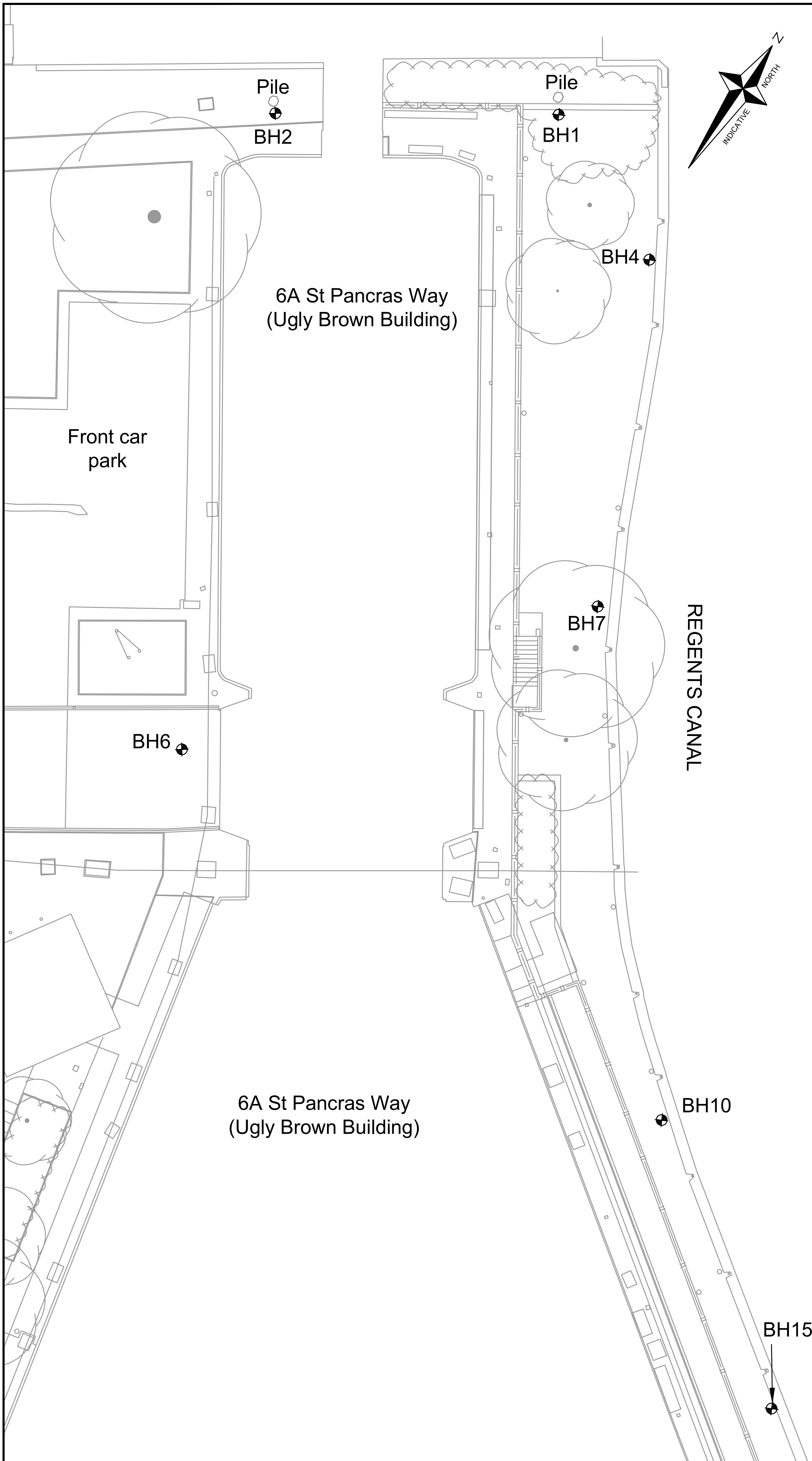
RSK

SITE LOCATION

Client: THE TRUSTEES OF THE ST PANCRAS WAY BLOCK A UNIT TRUST & BIG LOBSTER LTD	**Figure No:** FIGURE 1	**Project No:** 193152
Site/Project: UGLY BROWN BUILDING	**Scale:** As Shown	**Date:** MARCH 2019

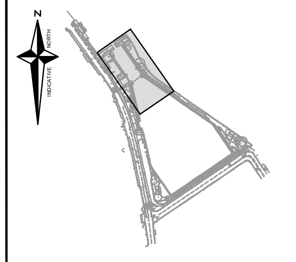


NOTES

The specific risks associated with the content of this drawing are considered to be:–

(1) The topographical baseplan has been supplied by the client and has not been checked for accuracy.

SHEET.LAYOUT



KEY

INTRUSIVE LOCATION WITH GEOPHYSICAL TESTING

RSK
18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT
United Kingdom
Tel: +44 1442 437500
Fax: +44 1442 437550
Email: safeground@rsk.co.uk
Web: www.rsk.co.uk

Client
THE TRUSTEES OF THE ST PANCRAS WAY BLOCK A UNIT TRUST & BIG LOBSTER LTD

Project Title
UGLY BROWN BUILDING

Drawing Title
SITE LAYOUT

Drawn	Date	Checked	Date	Approved	Date
JS	28/02/19	JC	28/02/19	TG	05/03/19

Scale	Orig Size	Dimensions
1:200	A3	

Project No.	Drawing File
193152	193152_FIGURE 2

Drawing No.	Rev.
193152_FIGURE 2 Sheet 1 of 1	

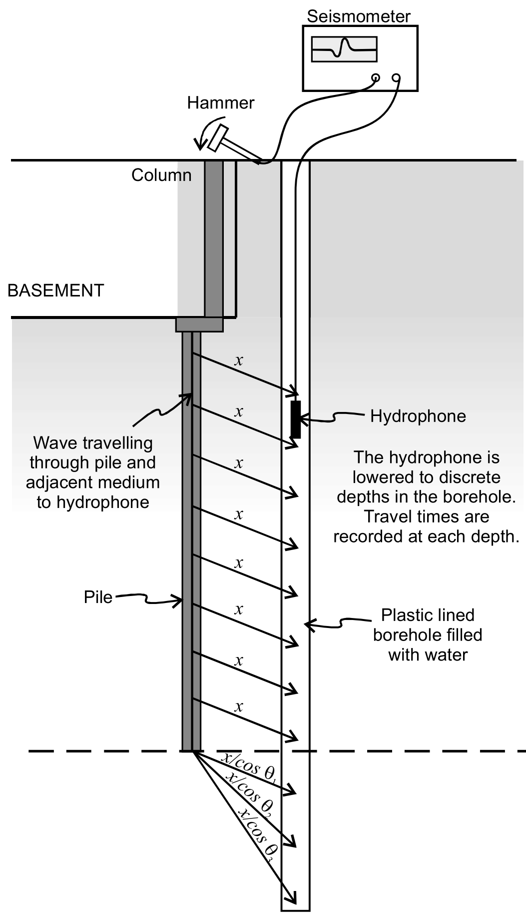
Scale
0 2 4 6 8 10m

BASIC THEORY:

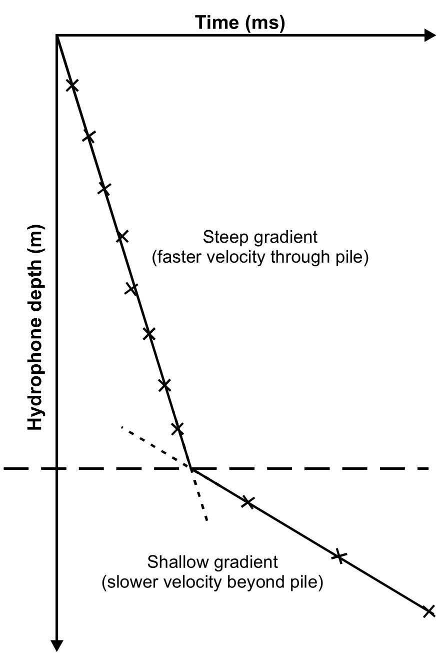
In parallel seismic testing, the depth of a pile can be determined from the change in velocity of a compressional wave induced at the top of the pile. Typically, the wave travels rapidly through the pile and then slows in the surrounding medium.

This technique requires a borehole to be drilled parallel to, and within 1 metre of the target pile. The borehole should extent to a depth of 3 - 5m below the anticipated base of the pile. Typically the borehole has an internal diameter ≥ 50mm**.** It is plastic lined and filled with water to provide acoustic coupling with the immersed hydrophone.

The hydrophone is immersed to discrete depths (at say 200mm increments). At each depth a compressional wave is induced at the top of the pile from a hammer blow. An evaluation of the travel time of the of this pulse down the pile and across the intervening material to the hydrophone permits an assessment of pile length to be made (see below).

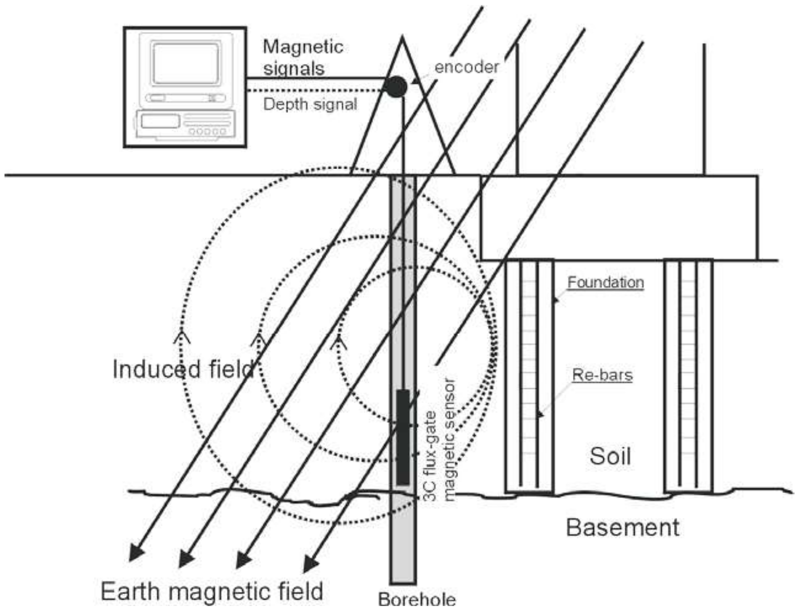


A plot of arrival time versus hydrophone depth illustrates the change in compressional wave velocity beyond the base of the pile. The wave travels more slowly through the ground to reach the hydrophone, hence the change in gradient.

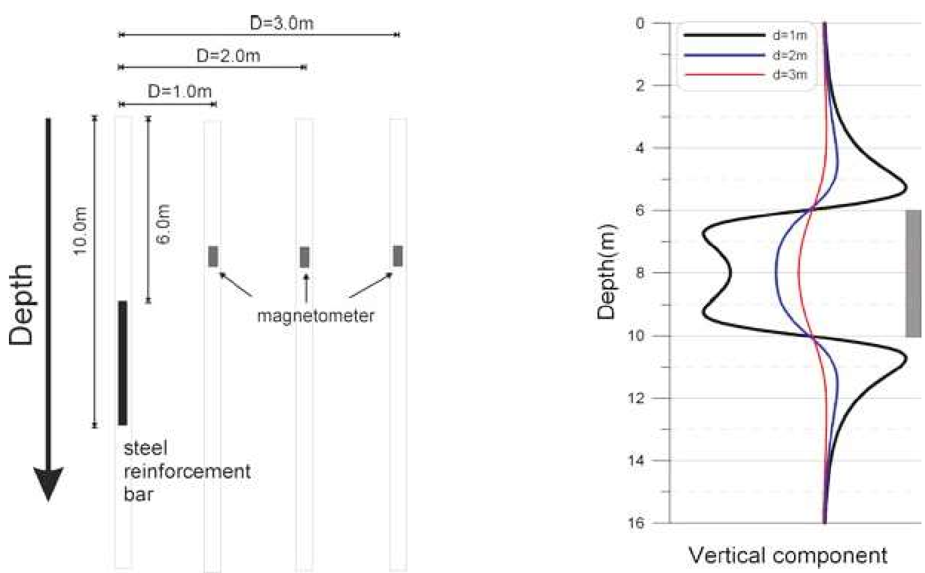


RSK	**THE DOWNHOLE PARALLEL SEISMIC TECHNIQUE**
Client: THE TRUSTEES OF THE ST PANCRAS WAY BLOCK A UNIT TRUST & BIG LOBSTER LTD	Figure: 3	Job: 193152
Site/Project: **UGLY BROWN BUILDING**	SCALE N/A	DATE March 2019

A The principle of downhole magnetic surveying for unknown foundations

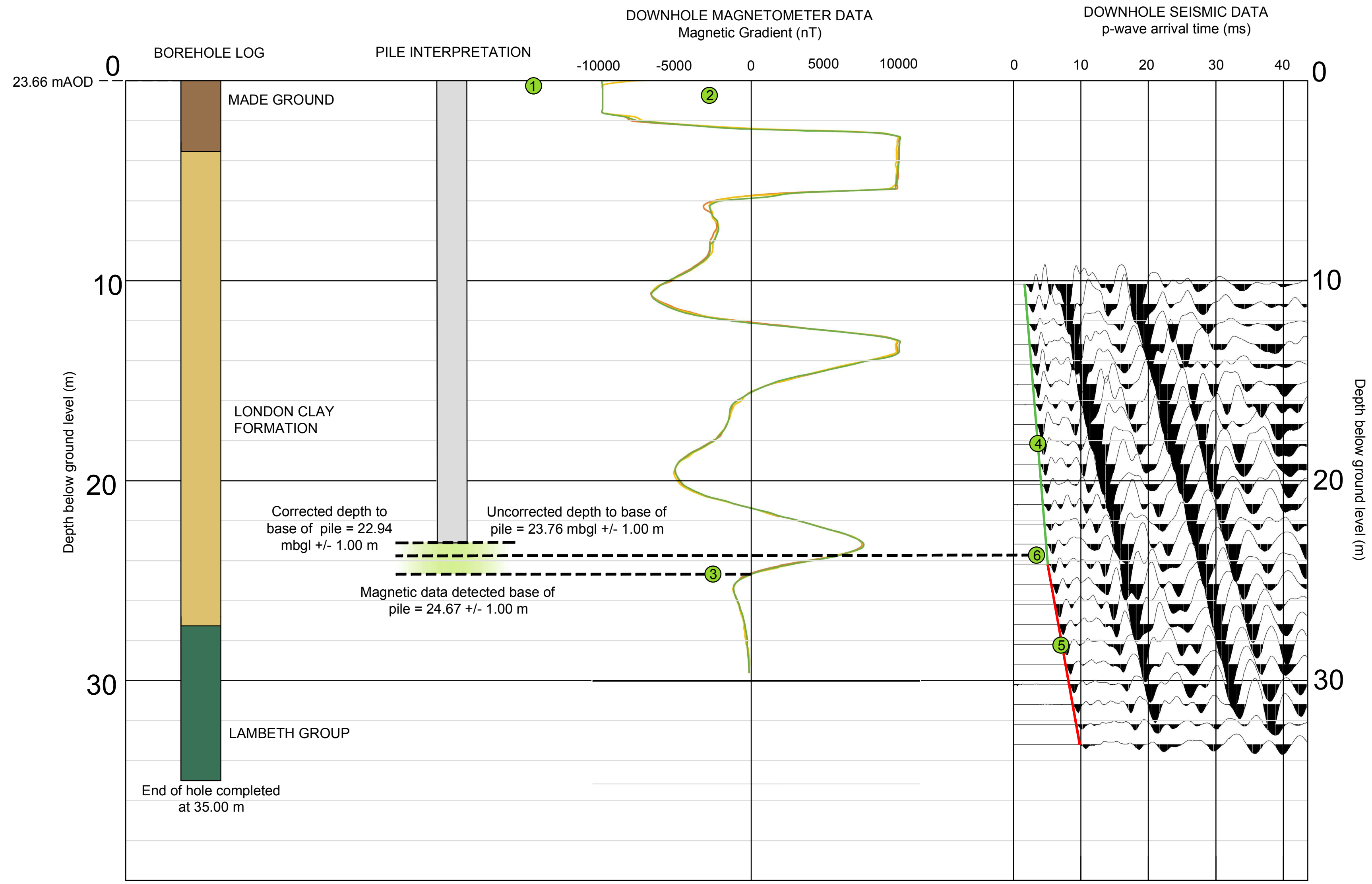


B Example magnetic data for differing offsets (from Jo, Cha and Choi)



RSK	THE DOWNHOLE MAGNETIC TECHNIQUE	
Client: THE TRUSTEES OF THE ST PANCRAS WAY BLOCK A UNIT TRUST & BIG LOBSTER LTD	Figure: 4	Job: 193152
Site/Project: UGLY BROWN BUILDING	SCALE N/A	DATE March 2019

BH1



Features & Interpretation

1. Ground level
2. Varying magnetic response near surface
3. Change in magnetic response suggests end of ferrous material, indicating base of reinforced pile, at **24.67 mbgl (-1.01 mAOD) +/- 1.00**
4. Uniform fast velocity (Vp=4,012 m/s) indicative of refracted arrival from pile
5. Uniform slow velocity (Vp=1,970 m/s) indicative of off-end velocity of ground below sheet pile
6. Inflection point at 23.76 mbgl shows on-set of 'off-end' wave. To adjust for borehole located approximately 1.10 m laterally away from sheet pile gives a depth adjusted pile base depth of **22.94 mbgl (-0.55 mAOD) +/- 1.00m.**

Note: Depths referenced to metres below ground level (mbgl)

Rev.	Date	Amendment	Drawn	Chkd.	Appd.

RSK

Client
THE TRUSTEES OF THE ST PANCRAS WAY BLOCK A UNIT TRUST & BIG LOBSTER LTD

Project Title
UGLY BROWN BUILDING

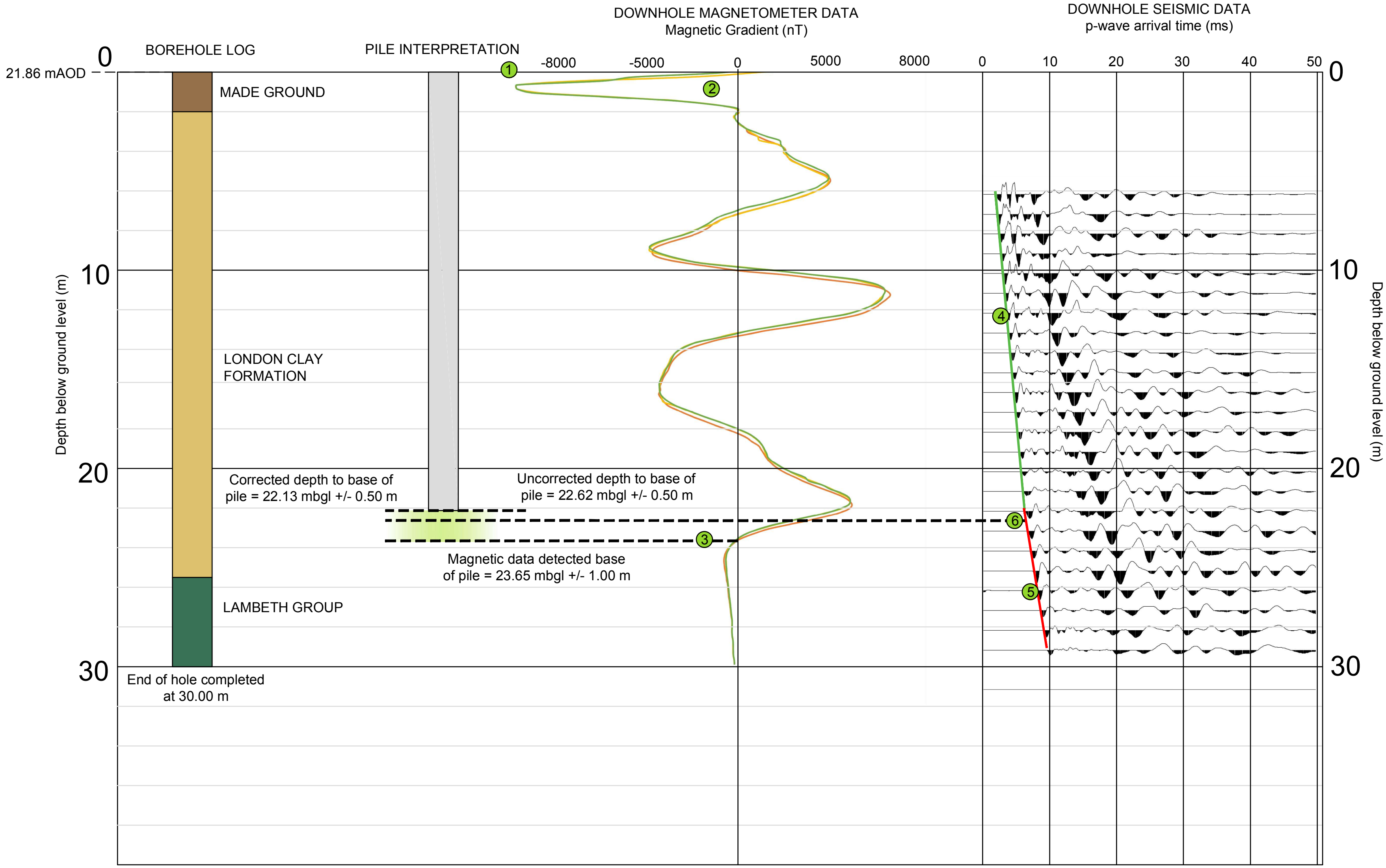
Drawing Title
GEOPHYSICS DOWNHOLE RESULTS - BH 1

Drawn	Date	Checked	Date	Approved	Date
JS	28/02/19	JC	28/02/19	TG	05/03/19

Vertical Scale	Orig Size	Dimensions
1:200	A3	

Project No.	Drawing File
193152	193152_FIGURE 5

Drawing No.	Rev.
193152_FIGURE 5 Sheet 1 of 1	



BH2

Features & Interpretation

1. Ground level
2. Varying magnetic response near surface
3. Change in magnetic response suggests end of ferrous material, indicating base of pile, at **23.65 mbgl (-1.79 mAOD) +/- 1.00 m**
4. Uniform fast velocity (Vp=3,624 m/s), indicative of refracted arrivals from pile
5. Uniform slow velocity (Vp=2,088 m/s)indicative of off-end velocity of ground below pile
6. Inflection point at 22.62 mbgl shows on-set of 'off-end' wave. To adjust for borehole located approximately 0.67 m laterally away from pile gives an adjusted pile base depth of **22.13 mbgl (-0.27 mAOD) +/- 0.50m**.

Note: Depths referenced to metres below ground level (mbgl)

Rev.	Date	Amendment	Drawn	Chkd.	Appd.

RSK

Client
THE TRUSTEES OF THE ST PANCRAS WAY BLOCK A UNIT TRUST & BIG LOBSTER LTD

Project Title
UGLY BROWN BUILDING

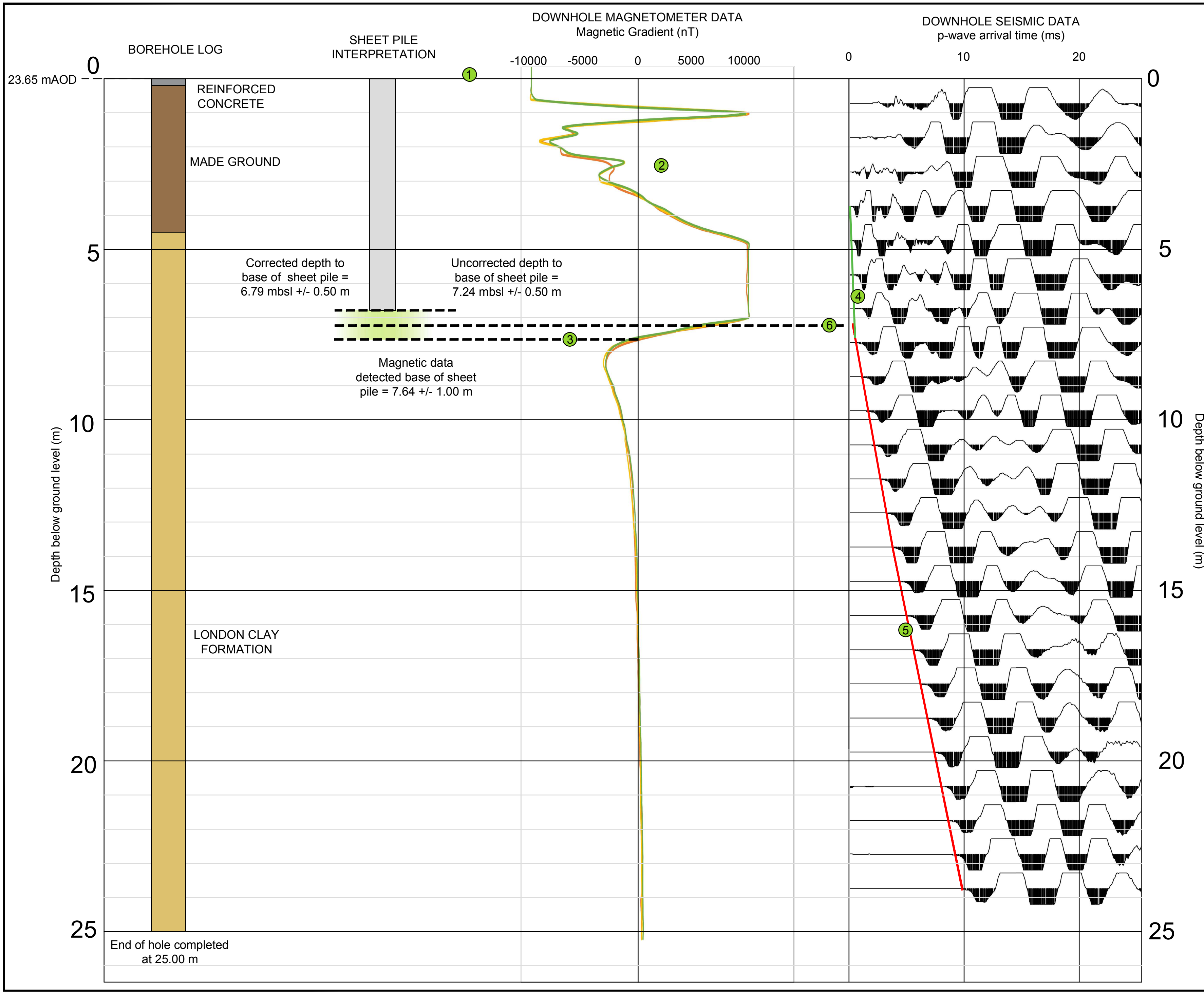
Drawing Title
GEOPHYSICS DOWNHOLE RESULTS - BH 2

Drawn	Date	Checked	Date	Approved	Date
JS	28/02/19	JC	28/02/19	TG	05/03/19

Vertical Scale	Orig Size	Dimensions
1:200	A3	

Project No.	Drawing File
193152	193152_FIGURE 6

Drawing No.	Rev.
193152_FIGURE 6 Sheet 1 of 1	



BH4

Features & Interpretation

1. Ground level
2. Varying magnetic response near surface
3. Change in magnetic response suggests end of ferrous material, indicating base of metal sheeting, at **7.64 mbgl (16.01 mAOD) +/- 1.00 m**
4. Uniform fast velocity (Vp=3,595 m/s) indicative of refracted arrivals from sheet pile
5. Uniform slow velocity (Vp=1,678 m/s) indicative of off-end velocity of ground below sheet pile
6. Inflection point at 7.24 mbgl shows on-set of 'off-end' wave. To adjust for borehole located approximately 0.85 m laterally away from sheet pile gives a depth adjusted pile base depth of **6.79 mbgl (16.86 mAOD) +/- 0.50m.**

Note: Depths referenced to metres below ground level (mbgl)

Rev.	Date	Amendment	Drawn	Chkd.	Appd.

RSK
18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT
United Kingdom
Tel: +44 1442 437500
Fax: +44 1442 437550
Email: geophysics@rsk.co.uk
Web: www.rsk.co.uk
www.environmental-geophysics.co.uk

Client
THE TRUSTEES OF THE ST PANCRAS WAY BLOCK A UNIT TRUST & BIG LOBSTER LTD

Project Title
UGLY BROWN BUILDING

Drawing Title
GEOPHYSICS DOWNHOLE RESULTS - BH4 SHEET PILE

Drawn	Date	Checked	Date	Approved	Date
JS	28/02/19	JC	28/02/19	TG	05/03/19

Vertical Scale	Orig Size	Dimensions
1:100	A3	

Project No.	Drawing File
193152	193152_FIGURE 7

Drawing No.	Rev.
193152_FIGURE 7 Sheet 1 of 1	