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Ground Investigation - Geotechnical

Hologic, Crewe Road, Wythenshawe

May 2020

Site Ref: 6041/HOO-G v1.0

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Ground Investigation - Geotechnical

1. Introduction

This report is an account of an intrusive Geotechnical Ground Investigation carried out by GeoAssist Limited at the request of Brennan Consult Ltd on behalf of their Client JDA-Architects for the development at Hologic, Crewe Road, Wythenshawe.

The object of this geotechnical investigation was to obtain information on the nature, depth and extent of the superficial deposits beneath the site to assess ground conditions for a Commercial development.

Geotechnical parameters and groundwater regime were to be obtained.

The work was commissioned following acceptance of the quotation and an instruction to proceed issued by Brennan Consult Ltd on behalf of the Client, JDA-Architects on 11th February 2020.

During the course of the fieldwork the scope of the investigation was extended to include a potential further extension and the location of a water storage tank.

The approximate grid reference for the centre of the site is 380225E, 389920N.

The approximate area of the Site scheduled for investigation is outlined with a solid red line on the Site plan in Appendix A1 along with the exploratory hole locations.

2. Description of the Site

2.1 Present

The site is accessed off Crewe Road, Wythenshawe and currently incorporates warehouse/offices with associated hard standing and soft landscaping. The site to be developed forms an irregular shape and is relatively level with the surrounding area. The vast majority of the area for the proposed development is surfaced with grass.

The site is bounded by Wythenshawe Road to the west and north, a wooded area to the north along with residential properties on Wythenshawe Road, existing warehouse and offices to the east, and Crewe Road and commercial premises to the south.

2.2 Proposed

At present the proposed plan for the Site is to construct a warehouse to the west of the existing building together with an extensive hard standing area to the west of the new structure. A water tank is to be placed to the rear of the existing warehouse building.

3. Geology

The geological information as indicated on the BGS database, shows the site to be located over Fluvio-Glacial deposits of sand and gravels and Glacial Till.

The underlying solid geology is shown as being Siltstones and Mudstones of Bollen Mudstones of the Triassic period.

No faults in the solid geology are shown as passing directly beneath the site.

4. Mineworkings and Mineral Extraction

Examination of the Geological Map of the area indicates that the underlying bedrocks are not coal bearing.

The site is not located within a Coal Authority Development High Risk Area.

The site lies outside the Cheshire Brine Compensation District

Consequently, the risk to the development on this site in respect of past, present or future coal workings or mineral extraction is classified as low.

5. Intrusive Investigation

5.1 Exploratory Hole Programme

One exploration hole referenced BH1 was undertaken using light cable tool percussive techniques.

Initially four exploratory holes referenced WS1 to WS4 were undertaken using windowless sampling and dynamic probing techniques. Subsequently, exploratory holes WS5 and WS6 were undertaken in order to enable ground conditions for further development structures to be evaluated.

One foundation trial Pit was excavated using a mechanical excavator in order to assess the nature of the foundations of the existing warehouse building.

The location of the exploratory holes is shown on the site plan in Appendix A1.

Exploratory holes WS1, WS2 and WS4 were converted to gas/groundwater monitoring holes.

The remaining exploratory holes were backfilled on completion.

The details of the strata in the exploratory holes were recorded by a suitably qualified Professional Engineer.

All intrusive work was carried out generally in accordance with British standard 5930: 1999/2015 Code of Practice for Site Investigations and British Standard 10175: 2011 where relevant and applicable.

The initial fieldwork was completed in stages between the 24th February and 13th March 2020 in mixed weather conditions.

The subsequent fieldwork was undertaken on the 17th April in fine weather conditions.

5.2 Field Sampling and Testing

Representative samples were taken of all the strata encountered in the exploratory holes.

In Situ Dynamic Penetration tests using the Standard SPT drop weight and drop height were carried out in the exploratory holes. All samples were stored in airtight containers and returned to the laboratory for subsequent examination and testing.

In situ CBR tests were undertaken utilising a TRLDPC probe at locations across the area of the proposed hard standing.

Observations of groundwater conditions were made throughout the fieldwork operations.

5.3 Field Results

Full details of the subsoil conditions in the exploratory holes are given in the exploratory hole log sheets, which form Appendix C1 to this report. The in situ TRL DCP CBR results are given in Appendix C2. The groundwater monitoring readings to date are given in Appendix C3.

6. Laboratory Investigation

6.1 Geotechnical Testing

The following geotechnical tests to be performed in GeoAssist's laboratory on samples recovered from the exploratory holes.

Table 6.1 Geotechnical Testing

TEST	PURPOSE
Shear Strength from Hand Vane/Hand Penetrometer test	Assessment of in-situ shear strength of cohesive deposits
Natural Moisture Content and Classification test	Assessment of in-situ subsoil conditions and compressibility/shrinkage of cohesive deposits
Sulphate and pH test	Assessment of potential aggressive ground conditions with respect to subsurface concrete
Particle Size Distribution test	Determination of grading characteristics of granular deposits
Consolidation Test	Assessment of settlement characteristics of organic deposits.

6.2 Test Results

The results of the hand vane/hand penetrometer shear strength tests are given on the exploratory hole logs in Appendix C1.

The geotechnical test results are given in the laboratory test results summary sheets, which form Appendices D1 to D5 to this report.

7. Subsurface Stratigraphy

The subsoil profile obtained from the exploratory holes consists of made ground to depths between 0.60m to 0.70m over silty sand with fibrous peat horizon over sands and gravels underlain by slightly gravelly sandy very silty clay with Siltstone and Mudstone bedrock present at depth.

Further details of the subsurface stratigraphy can be found in the exploratory hole log sheets which form Appendix C1 to this report.

Table 7.0 Subsoil Profile Summary

Strata	Depth of Strata (m) below ground level	
	Top	Base
Topsoil/Made Ground - MG Variable mixed granular	Ground Level	0.30 to 0.70
Upper silty Sand	0.30 to 0.70	1.30 to 1.70
Fibrous Peat	1.30 to 1.70	1.50 to 2.00
Lower silty Sands and Gravels	1.50 to 2.00	3.80 to 4.60
Very silty Clay with silt partings and occasional gravel	3.80 to 4.60	9.70 to 11.10
Clayey Siltstone and Mudstone	9.70 to 11.10	Not proven

8. Groundwater

Groundwater was encountered at depths between 0.80m and 2.00m during the course of the fieldwork. The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken.

Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.

Subsequent monitoring of groundwater levels spanning a period from 28th February to 1st May 2020 in the standpipe installations at WS1, WS2 and WS4, recorded groundwater at depths ranging between 1.25m and 2.00m. The indications are that there is an upper groundwater at shallow depth (0.80 to 1.00m) perched on the fibrous peat which inhibits and slows the flow of water to/from the silty sands and gravels present directly beneath the peat.

9. Geotechnical Properties

The following sections summarise the geotechnical properties for the main strata encountered on this site and are based on physical description, measured and empirical values.

9.1 Made Ground - MG

Made ground has been identified on the entire site as being mixed mainly granular.

Table 9.1 Summary of Geotechnical Properties – Made Ground

Property	Number of Tests	Range of Results	Derived Value
None applicable			

9.2 Upper Silty Sand

Granular fraction loose to medium dense.

Table 9.2 Summary of Geotechnical Properties – Upper silty Sand

Property	Number of Tests	Range of Results	Derived Value
Sulphate 2:1 Water:Soil Extract	5	260 to 660 mg/l	660 mg/l
Ph	5	6.7 to 7.1	NA
N value Uncorrected from SPT tests	5	10 to 15	6 accounting for presence of ground water

9.3 Fibrous Peat

Clayey fine fibrous Peat.

Table 9.3 Summary of Geotechnical Properties – Fibrous Peat

Property	Number of Tests	Range of Results	Derived Value
Natural Moisture Content	6	250 to 342 %	NA
Volume Compressibility (25 to 50 kN/m ²)	2	2.22 to 2.34 m ² /MN	2.34 m ² /MN
Secondary Compression (25 to 50 kN/m ²)	2	0.9 to 1.0	1.0 % strain per log time cycle

9.4 Lovers Sands and Gravels

Silty Sands and Gravels generally in medium dense state of compaction.

Table 9.4 Summary of Geotechnical Properties – Sands and Gravels

Property	Number of Tests	Range of Results	Derived Value
N value Uncorrected from SPT/CPT tests	7	5 to 28	14

9.5 Silty Clay

Sandy silty to very silty Clay with gravel, medium to high in strength

Table 9.5 Summary of Geotechnical Properties – Silty Clay

Property	Number of Tests	Range of Results	Derived Value
Plasticity Index	4	29% to 35%	31
Equivalent N value Uncorrected from CPT tests	34	6 to 52	24
Shear Strength From Hand Vane tests	14	55 to 110kN/m ²	78kN/m ²

9.6 Clayey Siltstone and Mudstone

Siltstone and Mudstone – very weak in strength

Table 9.6 Summary of Geotechnical Properties – Siltstone and Mudstone

Property	Number of Tests	Range of Results	Derived Value
Plasticity Index	1	9%	NA
Equivalent N value Uncorrected from SPT/CPT tests	6	55 to 94	82

10. Geotechnical Assessment

10.1 Design Criteria

Design criteria have not been assumed for the proposed development as the development covers various structures on variable ground and it is envisaged that for the main structures, piles will be the preferred foundation option.

10.2 Foundation Design Considerations

Made ground overlying silty sand with a fibrous peat horizon varying in thickness from 0.20m and 0.40m and is present within influencing depth and consequently shallow depth foundations are not considered suitable for use on this site.

10.3 Pile Foundations

Pile foundations are preferable for the structural foundations for this commercial development due to the various structures to be incorporated on this development and the limitation as noted by the consultants Engineer of settlements for high bay racking of less than 20mm. The magnitude of the loads to be taken by pile foundations can only be determined by consultation with the relevant piling contractor. The depth of penetration of piles will be dependent on the pile type and the most favourable option would be to locate piles on the siltstone and mudstone bedrock present at 10 to 11m depth. It is not recommended that piles are terminated in the very silty clay present at shallower depth as they are high in plasticity and consequently adverse settlements are likely to occur.

10.4 Excavations

Ancillary shallow depth excavations (<1.20m) in the made ground will require nominal support with control of groundwater generally by pumping from open sumps.

10.5 Carriageway Construction

The exploratory holes CBR1 to CBR4 encountered grass and topsoil overlying silty Sand.

The in-situ TRLDPC tests over the area indicated that CBR values at 0.30m depth ranged from 5% to 7% with a mean of 6%. The CBR values obtained at 0.50m depth ranged from 4% to 12% with a mean of 9%.

It should be noted the horizon of peat is present within influencing depth of the pavement and long-term settlements and differential movements will occur due to the consolidation and creep within the peat even under relative low loads. In order to limit the impact of these long-term movements mitigation measures such as introducing a geogrid into the pavement design to even out differential settlements are recommended.

The subsoil will be susceptible to deterioration/softening in adverse weather conditions during car park construction and excavation of subsoil and subbase placement should be undertaken in a progressive continuous operation. The nature of the ground is such that localised very loose areas will be encountered during construction that will require excavation and replacement with suitably compacted inert granular material.

10.6 Subsurface Concrete Attack

The results of the soluble sulphate and pH tests carried out on samples of subsoil obtained from this site in general indicate that according to Building Research Establishments Special Digest 1 (2005) no particular precautions for concrete foundations will be required.

Generally, the use of concrete mix design sulphate class DS-2 and according to ACEC Class AC-2 of Table C2 conditions can be used for subsurface concrete mix design.



Matthew Benson MSc GMICE
Geotechnical/Environmental Engineer



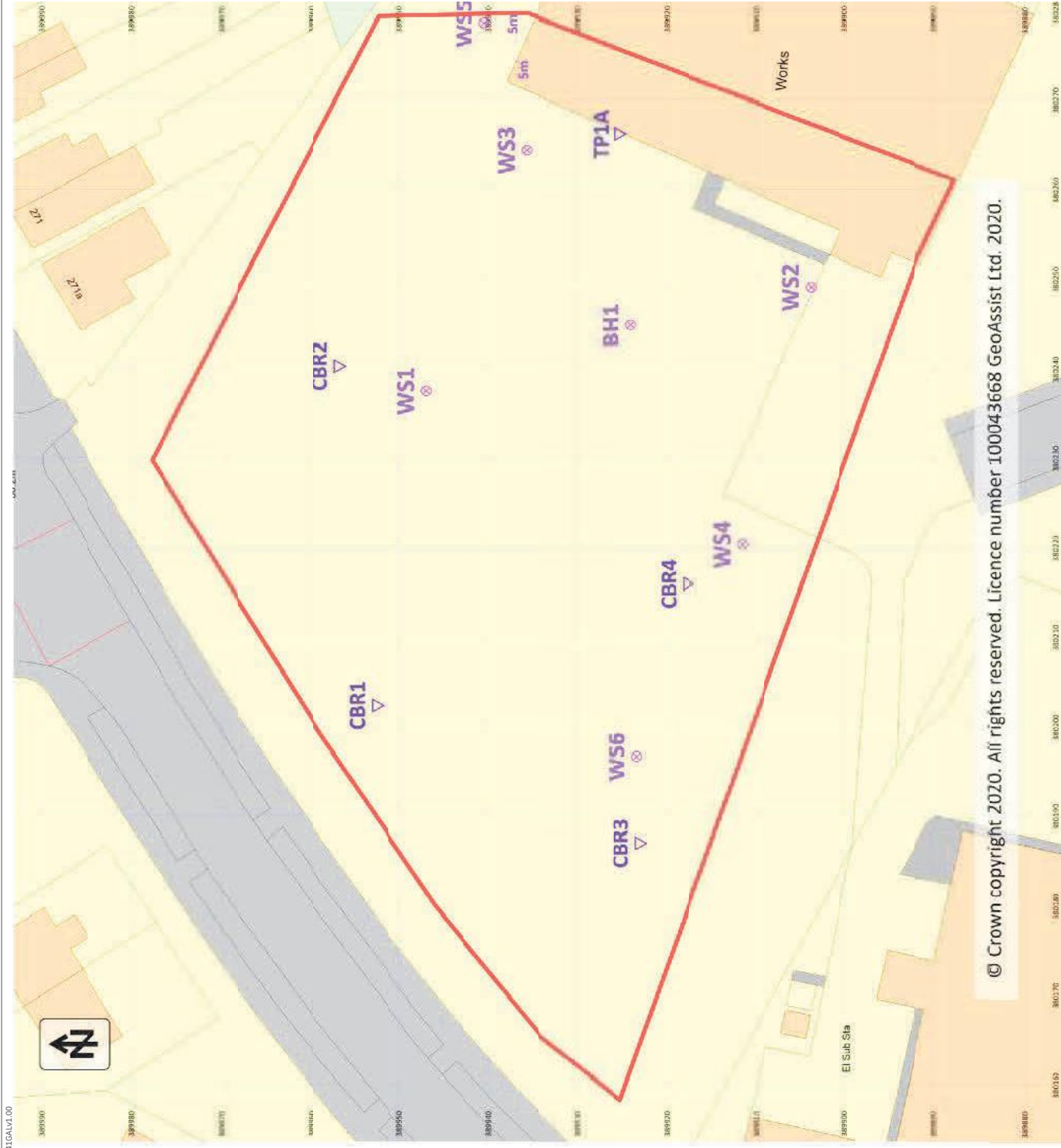
Mark Richardson MSc CEng MICE
Technical Director

Field investigations have been restricted to a level of detail required to achieve the stated objectives of the work. Ground conditions are, and can be, variable and have only been tested at isolated locations across the site. Therefore, the potential exists for ground conditions to be encountered which are different to those considered in this report.

This report has been prepared by GeoAssist Limited with all reasonable professional skill, care and diligence within the terms of the contract with JDA-Architects. The report is confidential to JDA-Architects, their/the named persons advisors and bankers, and GeoAssist Limited accepts no responsibility of whatever nature to third parties to whom this report may be divulged. GeoAssist Limited owns the copyright in this report. All rights are reserved, and unauthorised use is prohibited. JDA-Architects may use the report for their/her/his own purposes.

Appendix A

A1 Site Plan with Exploratory Hole Locations



A1 BH Location Plan

Site Name	Hologic
Location	Crewe Road, Wythenshawe
GeoAssist Ref	6041H00
Client	JDA-Architects
	The Warehouse
	Saxon Street
	Denton
	Manchester
	M34 3DS
Planning Consultant	
NGR (centre of site)	380225.389920
Production Date	April 2020
Survey Method	
Surveyor	Others
Status	Final v1.00
Base Survey	OSGB36

Appendix B

- B1 Terminology used in Soil Descriptions
- B2 List of Abbreviations
- B3 Concrete in Aggressive Ground

Terminology used in Soil Descriptions

The procedure and principles given in BS EN ISO 14688-1:2002 Part 1: 'Identification and description' have been adopted in producing the soil descriptions contained within this report.

The general identification and description of soils is based on a flexible system for immediate (field) use by experienced persons, covering both material and mass characteristics by visual and manual techniques.

Details are given of the individual characteristics for identifying soils and the descriptive terms in regular use, including those related to the results of tests from the field.

This part of ISO 14688 is applicable to natural soils *in situ*, similar man-made materials *in situ* and soils redeposited by man.

Particular sections of BS EN ISO 14688-1:2002 Part 1 are reproduced here in order to clarify the production of the soil descriptions contained within this report.

Identification of soil

General

Soil characteristics that generally permit soil to be identified with adequate accuracy for general (or preliminary) characterization are outlined below. A more accurate identification and classification based on grading, plasticity or organic content can be achieved by laboratory tests. In addition to identifying soils, the condition in which a soil is encountered, any particular secondary constituents, other features of a soil, such as carbonate content, particle shape, surface roughness of particles, odour, any common names and the geological classification are indicated.

The identification and description of soils generally follows the flow chart in Figure B1.1 attached.

Particle size

Particle size is the fundamental basis for designating mineral soils using particle fractions to distinguish the soil mechanical behaviour.

Table B1 shows the terms to be used for each soil fraction and its sub-fractions, together with the corresponding chosen range of particle sizes.

Basic soils are soils with uniform grading (i.e. they consist of particles of only one size range as specified in Table B1.1

Table B1.1 Particle Size Fractions

Soil fractions	Sub-fractions	Symbols	Particle sizes mm
Very coarse soil	Large boulder	LBo	> 630
	Boulder	Bo	> 200 to 630
	Cobble	Co	> 63 to 200
Coarse soil	Gravel	Gr	> 2,0 to 63
	Coarse gravel	CGr	> 20 to 63
	Medium gravel	MGr	> 6,3 to 20
	Fine gravel	FGr	> 2,0 to 6,3
	Sand	Sa	> 0,063 to 2,0
	Coarse sand	CSa	> 0,63 to 2,0
	Medium sand	MSa	> 0,2 to 0,63
	Fine sand	FSa	> 0,063 to 0,2
Fine soil	Silt	Si	> 0,002 to 0,063
	Coarse silt	CSi	> 0,02 to 0,063
	Medium silt	MSi	> 0,006 3 to 0,02
	Fine silt	FSi	> 0,002 to 0,006 3
	Clay	Cl	≤ 0,002

APPENDIX B1

Form No.: QF029AEN

Composite soils

General

Most soils are composite and consist of principal and secondary fractions. They are designated by a noun (main term) describing the principal fraction and by one or more adjectives (qualifying terms) describing the secondary fractions (e.g. sandy gravel saGr, gravelly clay grCl).

Principal fraction

The principal fraction in terms of mass determines the engineering properties of the soil and is given in capital letters for clarity.

In the case of very coarse soils, the principal fraction is the relevant very coarse soil fraction predominating in terms of mass. The very coarse fraction should be separated from the sample before identifying the fine and coarse fractions.

In the case of coarse soils, the principal fraction is the relevant coarse soil fraction predominating in terms of mass.

Composite coarse soils include a fines fraction (silt and/or clay) that does not determine the engineering properties of the soil.

In the case of fine soils, the principal fraction is the relevant fine soil type determining the engineering properties of the soil.

In the case of composite fine soils, the fines fraction determines the engineering properties of the soil. The fines fraction is regarded as determining the characteristics of a composite soil if this is of at least medium dry strength or exhibits a certain degree of plasticity.

In both cases, the soil is termed either "clay" or "silt", depending on the plasticity of the fines fraction and not on the grading.

Secondary fractions

Secondary and further fractions do not determine but will affect the engineering properties of the soil. The secondary fractions as adjectives are placed with the term describing the principal fraction in the order of their relevance.

If coarse secondary fractions are present in a particularly small or particularly large proportion, the term "slightly" or "very" shall precede the qualifying term.

If it is a fine soil, the properties of which are determined by fines fractions, a soil can be identified as "silt" or "clay" by checking for the presence of fine secondary constituents on the basis of its plasticity properties.

If, in the case of coarse soils, two soil fractions are present in approximately equal proportions, an oblique shall be placed between the relevant terms, e.g. gravel/sand (Gr/Sa) or fine/medium sand (FSa/MSa).

Plasticity

Assessment of the plasticity and identification of a soil as either silt or clay permits the soil to be qualified as being of low plasticity or high plasticity.

An exact determination can only be made by establishing the liquid limit and the plastic limit in laboratory tests.

Organic content

Small quantities of dispersed organic matter in a soil can produce a distinctive odour and colour. The intensity of odour and colour indicates the proportion of organic matter and should be described.

Determination of consistency

The consistency of a cohesive soil shall be determined in a manual test, permitting the following identification and description:

- a) a soil is to be identified as **very soft** if it exudes between the fingers when squeezed in the hand;
- b) a soil is to be identified as **soft** if it can be moulded by light finger pressure;
- c) a soil is to be identified as **firm** if it cannot be moulded by the fingers, but rolled in the hand to thick threads without breaking or crumbling;
- d) a soil is to be identified as **stiff** if it crumbles and breaks when rolled to thick threads but is still sufficiently moist to be moulded to a lump again;
- e) a soil is to be identified as **very stiff** if it has dried out and is mostly light coloured. It can no longer be moulded but crumbles under pressure. It can be indented by the thumbnail.

Preliminary descriptions are based on visual and manual identification only.

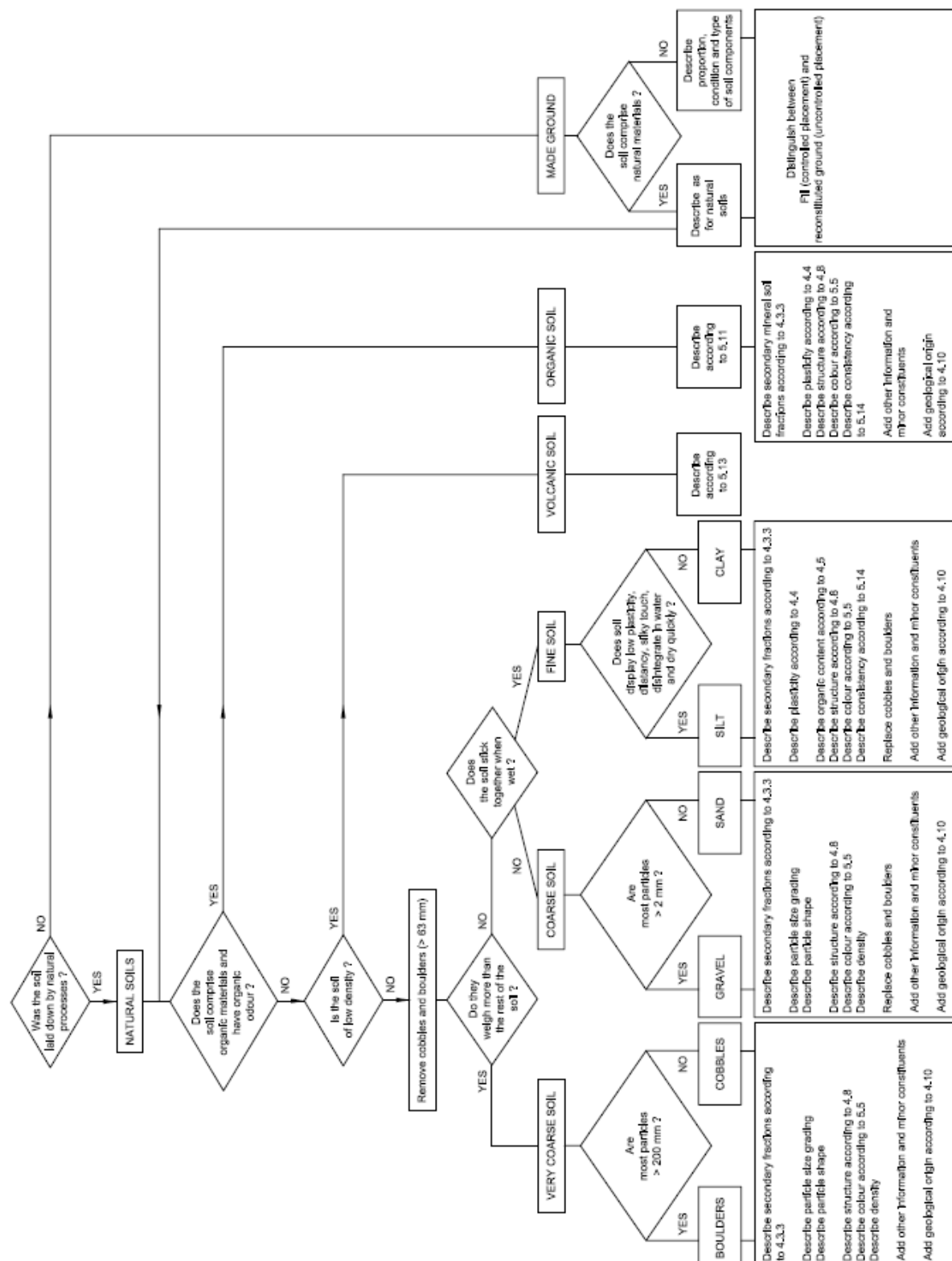


Figure B1.1 Flow chart for the identification and description of soils

Terminology used in Soil Classification

The procedure and principles given in BS EN ISO 14688-2:2004 Part 2: 'Principles for a classification' have been adopted in producing the soil descriptions contained within this report where laboratory or in situ field tests have been carried out.

The classification principles established in this part of ISO 14688 permit soils to be grouped into classes of similar composition and geotechnical properties and, with respect to their suitability for geotechnical engineering purposes.

This part of ISO 14688 is applicable to natural soil and similar man-made material *in situ* and redeposited, but it is not a classification of soil by itself.

Particular sections of BS EN ISO 14688-1:2002 Part 2 are reproduced here in order to clarify the production of the soil descriptions contained within this report.

Principles of soil classifications

General

Soils shall be classified into soil groups on the basis of their nature, which is the composition only, irrespective of their water content or compactness, taking into account the particle size distribution (grading), plasticity, organic content, genesis as appropriate.

The most common approach to classification is to divide the soils on the basis of particle size grading and plasticity. The division is made on the relative size fractions present for the coarser soil fractions, determined on the whole sample, and on the plasticity of the finer fractions (Table B1.2).

Table B1.2 Principles of a classification of soils

Criterion	Soil group	Quantification	Denomination into groups of similiar properties		Further subdivision as appropriate by	
Wet soil does not stick together	very coarse	most particles > 200 mm	Bo	xBo	Requires special consideration	
		most particles > 63 mm	Co	boCo, saCo, grCo sagrCo		
	coarse	most particles > 2 mm	Gr	coGr saGr, grSa cosaGr sasiGr, grsiSa	Particle size (grading) Shape of grading curve Relative density Permeability	
		most particles > 0,063 mm	Sa	siGr, clGr orSa siSa, clSa, saclGr	(Mineralogy) (Particle shape)	
Wet soils sticks together	fine	low plasticity dilatant	Si	saSi sagrSi saclSi	Plasticity Water content Strength, sensitivity Compressibility, stiffness (Clay mineralogy)	
		plastic non-dilatant	Cl	clSi, siCl orSi, orCl sagrCl		
Dark colour, low density	organic		Or	saOr, siOr clOr	Requires special consideration	
Not naturally	Made ground	deposited	Mg	xMg	Man-made material	Requires special consideration
				Relaid natural materials	As for natural soils	
Key to symbols					Cases requiring special consideration should be classified according to national or project requirements	
Soil	Principal	Secondary or tertiary component				
Boulders	Bo	bo	Gr(gr) and Sa(sa) can be subdivided into fine F(f), medium M(m) or coarse C(c)			
Cobbles	Co	co				
Gravel	Gr	gr				
Sand	Sa	sa				
Silt	Si	si				
Clay	Cl	cl	any combination of components			
Organic	Or	or				
Made ground	Mg	—				
		x				

APPENDIX B1

Form No.: QF029AEN

Fractions

Soil is a mixture of materials of different particle size, which are grouped into fractions as specified in BS EN ISO 14688-1.

Classification of coarse and very coarse soils is to be based on the particle size distribution alone (see Table B1.3)

Table B1.3 Classification of very coarse soils

Fraction	Percent by mass	Term
Boulders	< 5	low boulder content
	5 to 20	medium boulder content
	> 20	high boulder content
Cobbles	< 10	low cobble content
	10 to 20	medium cobble content
	> 20	high cobble content

In the case of soils composed of both fine and coarse material, classification is to be based on both plasticity and particle size distribution.

Particle size distribution (grading)

The particle sizes and their distribution in a soil are determined by mechanical analysis carried out by the separation of the coarser fractions by sieving on a series of standard sieves and the determination of the finer fractions by sedimentation.

The results of the sieving and sedimentation process are plotted as a grading curve.

Plasticity

The fine fractions of soil, represented by clay and silt and containing clay minerals (see also BS EN ISO 14688-1), both alone or in mixtures with coarser material, are usually classified according to their plasticity characteristics. This is carried out on the basis of laboratory tests to determine the liquid limit w_L and plastic limit w_P .

Organic content

When soils with organic constituents are classified according to their organic content (Table B1.4), a distinction is to be made between organic soils and mineral soils with an organic content.

Table B1.4 Classification of soils with organic constituents

Soil	Organic content (≤ 2 mm) % of dry mass
Low-organic	2 to 6
Medium-organic	6 to 20
High-organic	> 20

Classification of coarse and composite organic soils accumulated *in situ* is based on the type of organic matter and that of organic soils, on the genetic origin and the degree of decomposition of the organic constituents.

APPENDIX B1

Form No.: QF029AEN

Undrained shear strength of fine soils

The terms to be used for the designation of the undrained shear strength according to the results of laboratory and field tests are given in Table B1.5.

Table B1.5 Undrained shear strength of fine soils

Undrained shear strength of clays	Undrained shear strength c_u kPa
Extremely low	< 10
Very low	10 to 20
Low	20 to 40
Medium	40 to 75
High	75 to 150
Very high	150 to 300
Extremely high ^a	> 300
^a Materials with shear strength greater than 300 kPa may behave as weak rocks and should be described as rocks according to ISO 14689-1.	

Table B1.6 Guiding values for the division of mineral soils on a basis of the contents of various fractions

Fraction	Content of fraction in wt % of material ≤ 63 mm	Content of fraction in wt % of material ≤ 0,063 mm	Name of soil	
			Modifying term	Main term
Gravel	20 to 40 > 40		gravelly	gravel
Sand	20 to 40 > 40		sandy	sand
Silt + clay (fine soil)	5 to 15	< 20	slightly silty	silt silt clay clay
		≥ 20	slightly clayey	
	15 to 40	< 20	silty	
		≥ 20	clayey	
	> 40	< 10		
		10 to 20	clayey	
		20 to 40	silty	
		> 40		

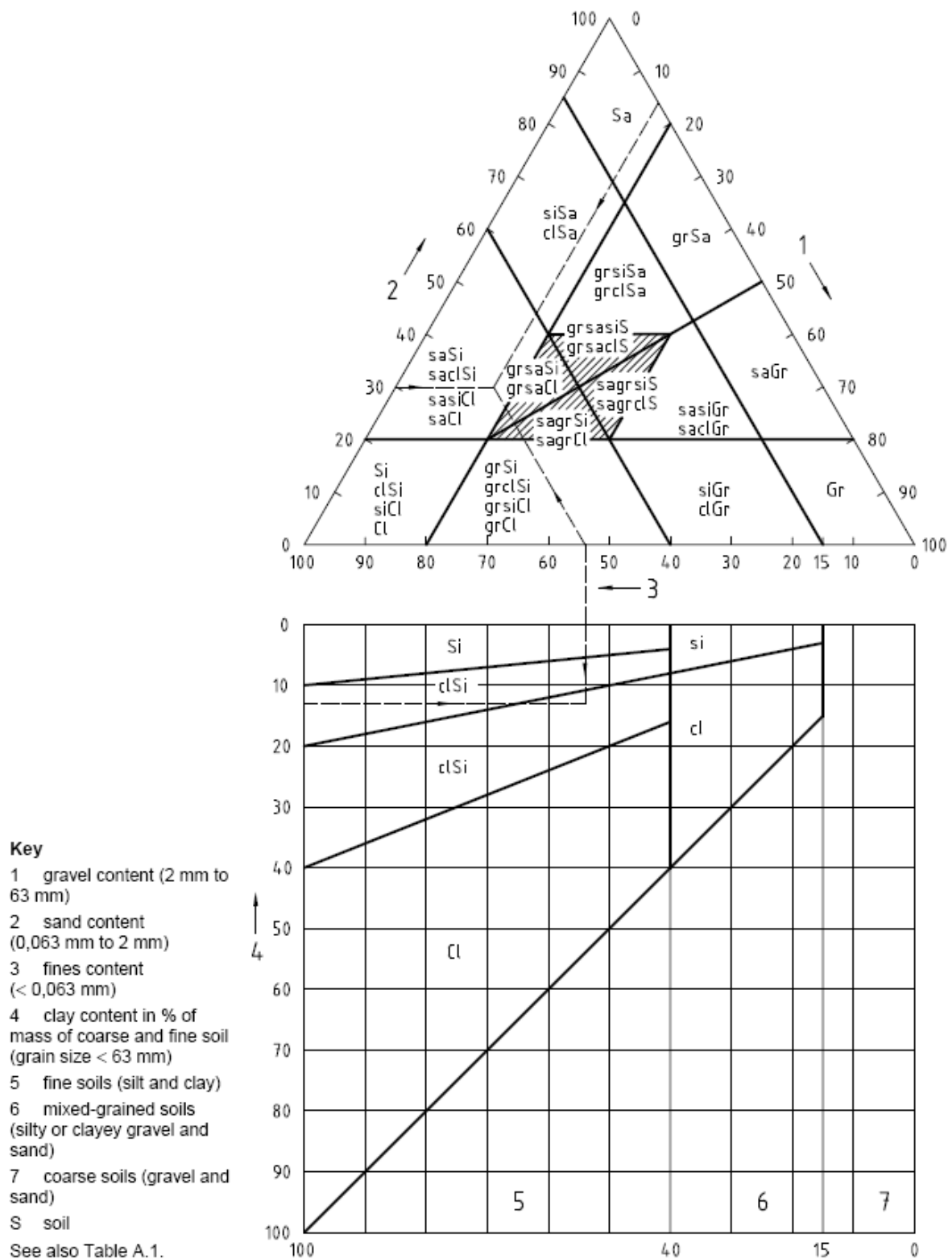


Figure B1.2 Classification of soils, based on grading alone

References

BS EN ISO 14688-1: 2002

Geotechnical investigation and testing — Identification and classification of soil — Part 1: Identification and description

BS EN ISO 14688-2: 2004

Geotechnical investigation and testing — Identification and classification of soil — Part 2: Principles for a classification

Abbreviations

Exploratory Hole log

Sample Type

AGS Code	Sample Type	AGS Code	Sample Type
B	Bulk Disturbed sample	SPT	Penetration Test – split spoon
CBR	CBR sample	U	Undisturbed sample – open drive
CPT	Penetration Test – cone	UF	Undisturbed sample failed recovery
D	Small disturbed sample	W	Water sample
PU	Piston sample	C - ES	Environmental sample

SPT and CPT – Standard Penetration Test

Blow Count (N) – If full penetration of 450mm then the total number of blows for the last 300mm is given.

If limited penetration following 150mm seating blows then the number of blows for the stated penetration is given.

If limited penetration then the total number of blows for the stated penetration is given.

The N values are actual blows recorded and uncorrected.

U - Undisturbed Sample

Blow Count – total number of blows for recovered length

Legend – As per British Standard – if blank then CAVITY/OPEN HOLE

Core Rec.:

T - Total Core Recovery as a percentage of the cored run

S – Solid Core Recovery as a percentage of the cored run

RQD – Rock Quality Designation as a percentage of the cored run

FI – Fracture index as number of fractures per metre

l_f – Fracture spacing as the average length of solid core pieces between natural fractures over core length of reasonable uniform characteristics

APPENDIX B2

Form No.: QF033AEN

Laboratory Test Summary Sheet

Tests on Soils

AGS Code	Test Name	AGS Code	Test Name
ASB	Asbestos	IDEN	In Situ Density
BDEN	Bulk Density	IGNIS	Loss on Ignition
CBR	California Bearing Ratio	IVAN	In Situ Vane
CD	Consolidated drained (single stage)	LS	Linear shrinkage
CDM	Consolidated drained (multi stage)	MCVG	Moisture Condition Value
CLSS	Atterberg Limits	NMC	Natural Moisture content
CMPG	Compaction	OMS	Organic Matter
CNMT	Contaminant and Chemical	PD	Particle density
CONG	Consolidation	PHS	pH
CU	Consolidated undrained with pwp measurement (single stage)	PTST	Laboratory permeability
CUM	Consolidated undrained with pwp measurement (multi stage)	RELD	Relative Density
DDEN	Dry Density	SHBG	Shear box
FRST	Frost Susceptibility	SLIM	Shrinkage Limit
GRAD HY	Particle Size (Hydrometer)	SULWS	Sulphate on 2:1 Water:Soil Extract
GRAD WS	Particle size (wet Sieve)	TNPC	Ten Per Cent Fines
HVP	Hand vane – peak	UU	Unconsolidated quick undrained (single stage)
ICBR	In situ CBR	UUM	Unconsolidated quick undrained (multi stage)

Tests on rocks and Aggregates

AGS Code	Test Name	AGS Code	Test Name
ACV	Aggregate crushing value	SHOR	Shore hardness
BRAZ	Tensile Strength by Brazilian method	SOUN	Aggregate Soundness Test
LOSA	Aggregate Los Angeles Abrasion	UCS	Uniaxial Compressive Strength
PLSI	Point Load Index – size corrected	WTAB	Aggregate Water Absorption

4. Reference AGS Format Edition 3

Concrete in Aggressive Ground

1. Assessing the Aggressive Chemical Environment

In order to assess the levels of sulphate in the ground or groundwater, which may have a deleterious effect on concrete, the sulphate content of soil and groundwater may be determined in accordance with BS 1377 (2001) Test 3:5. The sulphate contents determined are grouped into Aggressive Chemical Environment for Concrete (ACEC) site classifications in Building Research Establishment Special Digest 1 – Part 1 (2005) Tables C1 and C2 as reproduced below.

Based on this classification BRE Special Digest 1 gives recommendations for the design of suitable concrete mixes to resist chemical attack for each ACEC classification. Care should be taken in the interpretation of results over the site area, if classification is based solely on groundwater analysis, it should be based on the highest sulphate concentration recorded. Where a large number of results from soil analysis are available it should be based on the average of the highest 20 per cent of the results. If a varied set of results are recorded from a limited sampling programme it is important to carry out further analyses before a detailed classification is given.

2. References

BS 1377: 2001: 'Methods of Test for Soils for Civil Engineering Purposes': British Standards Institution.

BRE Special Digest 1: 2005: 'Concrete in Aggressive Ground': Building Research Establishment.

Table C1 Aggressive Chemical Environment for Concrete (ACEC) classification for natural ground locations ^a						
Sulfate Design Sulfate Class for location	2:1 water/soil extract ^b	Groundwater	Total potential sulfate ^c	Groundwater Static water	Mobile water	ACEC Class for location
1	2 (SO ₄ mg/l)	3 (SO ₄ mg/l)	4 (SO ₄ %)	5 (pH)	6 (pH)	7
DS-1	< 500	< 400	< 0.24	≥ 2.5	> 5.5 ^d 2.5–5.5	AC-1s AC-1 ^e AC-2z
DS-2	500–1500	400–1400	0.24–0.6	> 3.5 2.5–3.5	> 5.5 2.5–5.5	AC-1s AC-2 AC-2s AC-3z
DS-3	1600–3000	1500–3000	0.7–1.2	> 3.5 2.5–3.5	> 5.5 2.5–5.5	AC-2s AC-3 AC-3s AC-4
DS-4	3100–6000	3100–6000	1.3–2.4	> 3.5 2.5–3.5	> 5.5 2.5–5.5	AC-3s AC-4 AC-4s AC-5
DS-5	> 6000	> 6000	> 2.4	> 3.5 2.5–3.5	≥ 2.5	AC-4s AC-5

Notes

- Applies to locations on sites that comprise either undisturbed ground that is in its natural state (ie is not brownfield – Table C2) or clean fill derived from such ground.
- The limits of Design Sulfate Classes based on 2:1 water/soil extracts have been lowered relative to previous Digests (Box C7).
- Applies only to locations where concrete will be exposed to sulfate ions (SO₄) which may result from the oxidation of sulfides (eg pyrite) following ground disturbance (Appendix A1 and Box C8).
- For flowing water that is potentially aggressive to concrete owing to high purity or an aggressive carbon dioxide level greater than 15 mg/l (Section C2.2.3), increase the ACEC Class to AC-2z.

Appendix B3

Page 1 of 2

GeoAssist Limited

Table C2 Aggressive Chemical Environment for Concrete (ACEC) classification for brownfield locations ^a								
Sulfate and magnesium						Groundwater		ACEC
Design Sulfate Class for location	2:1 water/soil extract ^b		Groundwater		Total potential sulfate ^c	Static water	Mobile water	Class for location
1	2	3	4	5	6	7	8	9
	(SO ₄ mg/l)	(Mg mg/l)	(SO ₄ mg/l)	(Mg mg/l)	(SO ₄ %)	(pH) ^d	(pH) ^d	
DS-1	< 500		< 400		< 0.24	≥ 2.5	> 6.5 ^e 5.5–6.5 4.5–5.5 2.5–4.5	AC-1s AC-1 AC-2z AC-3z AC-4z
DS-2	500–1500		400–1400		0.24–0.6	> 5.5 2.5–5.5	> 6.5 5.5–6.5 4.5–5.5 2.5–5.5	AC-1s AC-2 AC-2s AC-3z AC-4z AC-5z
DS-3	1600–3000		1500–3000		0.7–1.2	> 5.5 2.5–5.5	> 6.5 5.5–6.5 2.5–5.5	AC-2s AC-3 AC-3s AC-4 AC-5
DS-4	3100–6000	≤ 1200	3100–6000	≤ 1000	1.3–2.4	> 5.5 2.5–5.5	> 6.5 2.5–6.5	AC-3s AC-4 AC-4s AC-5
DS-4m	3100–6000	> 1200 ^e	3100–6000	> 1000 ^e	1.3–2.4	> 5.5 2.5–5.5	> 6.5 2.5–6.5	AC-3s AC-4m AC-4ms AC-5m
DS-5	> 6000	≤ 1200	> 6000	≤ 1000	> 2.4	> 5.5 2.5–5.5	≥ 2.5	AC-4s AC-5
DS-5m	> 6000	> 1200 ^e	> 6000	> 1000 ^e	> 2.4	> 5.5 2.5–5.5	≥ 2.5	AC-4ms AC-5m

Notes

- a Brownfield locations are those sites, or parts of sites, that might contain chemical residues produced by or associated with industrial production (Section C5.1.3).
- b The limits of Design Sulfate Classes based on 2:1 water/soil extracts have been lowered from previous Digests (Box C7).
- c Applies only to locations where concrete will be exposed to sulfate ions (SO₄²⁻), which may result from the oxidation of sulfides such as pyrite, following ground disturbance (Appendix A1 and Box C8).
- d An additional account is taken of hydrochloric and nitric acids by adjustment to sulfate content (Section C5.1.3).
- e The limit on water-soluble magnesium does not apply to brackish groundwater (chloride content between 12 000 mg/l and 17 000 mg/l). This allows 'm' to be omitted from the relevant ACEC classification. Seawater (chloride content about 18 000 mg/l) and stronger brines are not covered by this table.

Appendix C

- C1 Exploratory Hole Logs BH1, WS1 to WS6 and TP1
- C2 TRLDGP CBR Test Summary CBR1 to CBR4

GeoAssist Limited		Exploratory Hole Record Sheet						Ref: BH1	
Consultant: Brennan Consult Ltd		Project: Hologic Location: Crewe Road, Wythenshawe						Sheet: 1	
Client: JDA-Architects		Equipment: Light Cable Percussive Rig					Ground Level: 30.17 m.AOD Co-ordinates: Easting: 380244.8(m) Northing: 389924(m) Dates: 24/02/2020 to 24/02/2020		
Drilling Foreman: M Walton STRATUM DESCRIPTION Engineer/Geologist: M Benson		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests			Field Records	
					Depth (m) from to	Sample Type/No	Blow Count N/(U)		
0 Grey/dark brown gravel - MADE GROUND		0.20	29.97						
Brown silty fine to medium sand with brick and sandstone fragments - MADE GROUND		(0.50) 0.70	29.47		0.30	0.40	C1		Standing water in insepction pit at 0.80m depth P1 at 1.00m - 2,4/3,4,4,4
Medium dense brown with dark grey bands silty fine to medium SAND		(1.00)			0.70	0.80	C2		
					1.00	1.45	P1	15	
		1.70	28.47		1.50	1.60	D1		
Dark grey/black sandy clayey fine fibrous PEAT		2.00	28.17		1.70	1.80	D2		
2 Loose grey silty fine to medium SAND		(1.00)			2.00	2.45	P2	5	P2 at 2.00m - 1,2/1,2,1,1
					2.50	2.60	D3		
		3.00	27.17		3.00	3.45	CP1	17	CP1 at 3.00m - 3,3/3,4,4,6
3 Medium dense grey slightly silty very sandy rounded to subrounded GRAVEL		(1.10)			3.00	3.10	D4		
					3.50	3.60	D5		
4 Firm brown medium strength silty CLAY with silt partings		4.10	26.07		4.00	4.45	P3	9	P3 at 4.00m - 1,1/2,2,2,3
		(1.40)			4.50	4.60	D6		
					5.00	5.45	U1	(17)	Hand vane at 5.00m - 79kPa
		5.50	24.67		5.50	5.60	D7		Hand vane at 5.40m - 71kPa Hand vane at 5.50m - 69kPa
5 Firm to stiff medium to high strength brown very silty CLAY		(4.30)			6.00	6.10	D8		
					6.50	6.95	P4	13	P4 at 6.50m - 2,2/3,3,3,4
					7.00	7.10	D9		
					8.00	8.45	U2	(22)	Hand vane at 8.00m - 63kPa
					8.50	8.60	D10		Hand vane at 8.40m - 81kPa
		9.80	20.37						
10 Stiff to very stiff high to very high strength brown very silty CLAY					9.80	10.25	P5	28	P5 at 9.80m - 2,2/4,6,8,10
Remarks: 24/01/2020: Inspection pit excavated to 1.00m depth to avoid services. Hard Boring form 11.10m to 11.70m - 30 minutes The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.							Logged: M Benson Date: 26/02/2020 Checked: M Richardson Date: 28/02/2020 Site Ref: 6041/HOO Scale 1:50		

GeoAssist Limited		Exploratory Hole Record Sheet					Ref: BH1		
Consultant: Brennan Consult Ltd		Project: Hologic Location: Crewe Road, Wythenshawe					Sheet: 2		
Client: JDA-Architects		Equipment: Light Cable Percussive Rig				Ground Level: 30.17 m.AOD Co-ordinates: Easting: 380244.8(m) Northing: 389924(m) Dates: 24/02/2020 to 24/02/2020			
Drilling Foreman: M Walton STRATUM DESCRIPTION Engineer/Geologist: M Benson		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests Depth (m) from to		Sample Type/No	Blow Count N/(U)	Field Records
10		(1.00)			10.50	10.60	D11		Hand penetrometer at 10.50m - 172kPa
11		10.80	19.37						
Stiff to very stiff high to very high strength brown and redbrown gravelly sandy silty CLAY		11.10	19.07		11.00	11.45	P6	68	P6 at 11.00m - 4,7/12,15,16,25
Brown/grey clayey SILTSTONE and MUDSTONE with sandstone									
12		(1.05)			11.70	12.15	P7	88	P7 at 11.70m - 7,11/21,15,19,33
12.15		18.02							24/02/2020: On completion of exploratory hole at 12.15m. Casing at 4.50m. Standing water level Nil. On withdrawal of casing exploratory hole backfilled and reinstated.
Exploratory Hole terminated at 12.15m									
13									
14									
15									
16									
17									
18									
19									
20									

Remarks: 24/01/2020: Inspection pit excavated to 1.00m depth to avoid services. Hard Boring form 11.10m to 11.70m - 30 minutes The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.		Logged: M Benson Date: 26/02/2020 Checked: M Richardson Date: 28/02/2020 Site Ref: 6041/HOO Scale 1:50	
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GeoAssist Limited		Exploratory Hole Record Sheet					Ref: WS1		
Consultant: Brennan Consult Ltd		Project: Hologic Location: Crewe Road, Wythenshawe					Sheet: 1		
Client: JDA-Architects		Equipment: Archway Dart Rig and Dynamic Probing					Ground Level: 30.08 m.AOD Co-ordinates: Easting: 380237.4(m) Northing: 389947(m) Dates: 25/02/2020 to 25/02/2020		
Drilling Foreman: M Walton STRATUM DESCRIPTION Engineer/Geologist: M Benson		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests Depth (m) from to		Sample Type/No	Blow Count N/(U)	Field Records
0 Grass over dark grey sandy TOPSOIL		0.20	29.88						
Dark grey gravelly silty sandy clay - MADE GROUND		(0.40) 0.60	29.48						
1 Loose to medium dense brown ironstained slightly silty fine to medium SAND		(1.00)			0.70 0.80 0.90 1.00 1.00	D1 D2 CP1	10		Damp at 0.60m depth
Brown clayey fine fibrous PEAT		1.60	28.48		1.60 1.80	U1			
2 Grey gravelly silty SAND		1.80	28.28						
Loose to medium dense grey/brown silty SAND and GRAVEL		2.00	28.08		2.00	CP2	10		Wet from 1.90m depth
3 Medium dense grey slightly silty SAND and GRAVEL		(1.00)							
		3.00	27.08		3.00	CP3	11		
		(1.00)			3.50 3.60	D3			
4 Medium dense brown silty SAND		4.00	26.08		4.00	CP4	10		
		(0.60)							
Firm brown very silty CLAY - Interpreted Stratum		4.60	25.48		4.80 4.90 5.00	D4 CP5	8		Hand vane at 4.80m - 55kPa
5 Dynamic Probing from 5.00m depth Interpreted Strata from from 5.00m depth		(2.60)			6.00	CP6	14		
		7.20	22.88		7.00	CP7	23		
6 Firm to stiff very silty CLAY - Interpreted Stratum		(2.00)			8.00	CP8	26		
		9.20	20.88		9.00	CP9	52		
7 Stiff to very stiff very silty CLAY - Interpreted Stratum		(0.80)							
		10.00	20.08						
8 9 10									
Remarks: The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.							Logged: M Benson Date: 26/02/2020 Checked: M Richardson Date: 28/02/2020 Site Ref: 6041/HOO Scale 1:50		

GeoAssist Limited		Exploratory Hole Record Sheet					Ref: WS1		
Consultant: Brennan Consult Ltd		Project: Hologic Location: Crewe Road, Wythenshawe					Sheet: 2		
Client: JDA-Architects		Equipment: Archway Dart Rig and Dynamic Probing			Ground Level: 30.08 m.AOD Co-ordinates: Easting: 380237.4(m) Northing: 389947(m) Dates: 25/02/2020 to 25/02/2020				
Drilling Foreman: M Walton Engineer/Geologist: M Benson		STRATUM DESCRIPTION		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests		Field Records
						Depth (m) from to	Sample Type/No	Blow Count N/(U)	
10 Clayey SILTSTONE and MUDSTONE - Interpreted Stratum		(0.40) 10.40	19.68			10.10	CP10	94	25/02/2020: On completion of exploratory hole at 10.40m. Casing at 4.00m. Standing water level at 1.70m depth. On withdrawal of casing groundwater/gas monitoring standpipe installed to 4.00m depth with response zone from 1.00m to 4.00m.
Exploratory Hole complete at 10.40m									
-11									
-12									
-13									
-14									
-15									
-16									
-17									
-18									
-19									
-20									
Remarks: The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.							Logged: M Benson Date: 26/02/2020 Checked: M Richardson Date: 28/02/2020 Site Ref: 6041/HOO Scale 1:50		

GeoAssist Limited		Exploratory Hole Record Sheet					Ref: WS2		
Consultant: Brennan Consult Ltd		Project: Hologic Location: Crewe Road, Wythenshawe					Sheet: 1		
Client: JDA-Architects		Equipment: Archway Dart Rig and Dynamic Probing				Ground Level: 30.14 m.AOD Co-ordinates: Easting: 380249(m) Northing: 389903.8(m) Dates: 25/02/2020 to 25/02/2020			
Drilling Foreman: M Walton STRATUM DESCRIPTION Engineer/Geologist: M Benson		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests Depth (m) from to		Sample Type/No	Blow Count N/(U)	Field Records
0 Grey/brown sandy gravel and brick - MADE GROUND		(0.70) 0.70	29.44		0.70 0.80 0.90 1.00	D1 D2 CP1	14	Damp at 0.70m depth Wet from 1.60m depth	
1 Medium dense brown ironstained slightly silty fine to medium SAND		(0.70) 1.40	28.74		1.50 1.60	D3	21		
Brown clayey fine fibrous PEAT		1.60	28.54		2.00	CP2	23		
2 Grey gravelly silty SAND		(0.40) 2.00	28.14		2.50 2.60	D4	23		
3 Medium dense grey/brown silty SAND and GRAVEL		(1.80) 3.80	26.34		3.90 4.00 4.00	D5 CP4	10	Hand vane at 3.90m - 98kPa	
4 Firm to stiff brown very silty CLAY		(2.20) 6.00	24.14		5.00	CP5	14		
5 Dynamic Probing from 5.00m depth Interpreted Strata from from 5.00m depth		6.00	24.14		6.00	CP6	26		
6 Stiff brown very silty CLAY - Interpreted Stratum		(2.50) 8.50	21.64		7.00 8.00	CP7 CP8	32 36		
7 Stiff to very stiff brown very silty CLAY - Interpreted Stratum		(1.50) 10.00	20.14		9.00	CP9	43		
8 9 10									

Remarks:

 The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken.
 Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.

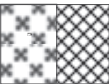
Logged: M Benson
 Date: 26/02/2020
 Checked: M Richardson
 Date: 28/02/2020
 Site Ref: 6041/HOO
 Scale 1:50

GeoAssist Limited		Exploratory Hole Record Sheet					Ref: WS2		
Consultant: Brennan Consult Ltd		Project: Hologic Location: Crewe Road, Wythenshawe					Sheet: 2		
Client: JDA-Architects		Equipment: Archway Dart Rig and Dynamic Probing			Ground Level: 30.14 m.AOD Co-ordinates: Easting: 380249(m) Northing: 389903.8(m) Dates: 25/02/2020 to 25/02/2020				
Drilling Foreman: M Walton Engineer/Geologist: M Benson		STRATUM DESCRIPTION		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests		Field Records
						Depth (m) from to	Sample Type/No	Blow Count N/(U)	
10		Clayey SILTSTONE and MUDSTONE - Interpreted Stratum		(0.35) 10.35	19.79		10.00	CP10	79
		Exploratory Hole complete at 10.35m							
-11									
-12									
-13									
-14									
-15									
-16									
-17									
-18									
-19									
-20									
Remarks: The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.							Logged: M Benson Date: 26/02/2020 Checked: M Richardson Date: 28/02/2020 Site Ref: 6041/HOO Scale 1:50		

GeoAssist Limited		Exploratory Hole Record Sheet					Ref: WS3		
Consultant: Brennan Consult Ltd		Project: Hologic Location: Crewe Road, Wythenshawe					Sheet: 1		
Client: JDA-Architects		Equipment: Archway Dart Rig and Dynamic Probing				Ground Level: 30.21 m.AOD Co-ordinates: Easting: 380264.3(m) Northing: 389935.7(m) Dates: 25/02/2020 to 25/02/2020			
Drilling Foreman: M Walton STRATUM DESCRIPTION Engineer/Geologist: M Benson		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests Depth (m) from to		Sample Type/No	Blow Count N/(U)	Field Records
0 Grey/brown sandy gravel with brick fragments - MADE GROUND		0.30	29.91						
Brown silty sand and brick fragments - MADE GROUND		(0.40) 0.70	29.51			0.70 0.80	D1		Damp at 0.70m depth
1 Medium dense brown ironstained silty fine to medium SAND		(0.90)							
Brown clayey fine fibrous PEAT		1.60	28.61						
Grey gravelly silty SAND		1.80	28.41			1.70 1.80	D2		Wet from 1.80m depth
2 Medium dense grey/brown silty SAND and GRAVEL		2.00	28.21						
		(1.00)							
		3.00	27.21						
3 Medium dense grey slightly silty SAND and GRAVEL		(1.00)							
		4.00	26.21						
4 Grey gravelly slightly silty SAND		(0.60)							
		4.60	25.61						
Firm brown very silty CLAY - Interpreted Stratum									Hand vane at 4.80m - 55kPa
5 Dynamic Probing from 5.00m depth Interpreted Strata from from 5.00m depth		(1.40)							
		6.00	24.21			6.00	CP1	7	
6 Firm to stiff very silty CLAY - Interpreted Stratum		(1.20)							
		7.20	23.01			7.00	CP2	21	
7 Stiff to very stiff very silty CLAY - Interpreted Stratum									
						8.00	CP3	40	
		(2.50)							
						9.00	CP4	50	
8 Clayey SILTSTONE and MUDSTONE - Interpreted Stratum		9.70	20.51			9.70	CP5	112	
9 Exploratory Hole complete at 9.97m		9.97	20.24						
Remarks: The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.							Logged: M Benson Date: 26/02/2020 Checked: M Richardson Date: 28/02/2020 Site Ref: 6041/HOO Scale 1:50		

GeoAssist Limited		Exploratory Hole Record Sheet					Ref: WS4		
Consultant: Brennan Consult Ltd		Project: Hologic Location: Crewe Road, Wythenshawe					Sheet: 1		
Client: JDA-Architects		Equipment: Archway Dart Rig and Dynamic Probing					Ground Level: 30.12 m.AOD Co-ordinates: Easting: 380220.3(m) Northing: 389911.5(m) Dates: 25/02/2020 to 25/02/2020		
Drilling Foreman: M Walton STRATUM DESCRIPTION Engineer/Geologist: M Benson		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests Depth (m) from to		Sample Type/No	Blow Count N/(U)	Field Records
0 Grass over grey brown sandy TOPSOIL		0.20	29.92						
Grey/brown silty sand - POSSIBLE MADE GROUND		(0.40) 0.60	29.52						
Loose to medium dense brown/dark brown ironstained slightly silty fine to medium SAND		(0.70)			0.70	0.80	D1		Damp at 0.60m depth
Brown clayey fine fibrous PEAT		1.30	28.82		1.30	1.40	U1		
Medium dense brown gravelly silty fine to medium SAND		1.50	28.62						Wet from 1.60m depth
Medium dense grey slightly silty SAND and GRAVEL		(0.90)							
Medium dense grey slightly silty SAND and GRAVEL		2.40	27.72						
Firm brown very silty CLAY - Interpreted Stratum		(2.20)							
Dynamic Probing from 5.00m depth Interpreted Strata from from 5.00m depth		4.60	25.52						Hand vane at 4.70m - 59kPa
Firm to stiff very silty CLAY - Interpreted Stratum		(3.40)			6.00		CP1	6	
Stiff to very stiff very silty CLAY - Interpreted Stratum		8.00	22.12		7.00		CP2	10	
Firm to stiff very silty CLAY - Interpreted Stratum		(1.00)			8.00		CP3	17	
Stiff to very stiff very silty CLAY - Interpreted Stratum		9.00	21.12		9.00		CP4	33	
Stiff to very stiff very silty CLAY - Interpreted Stratum		(1.00)							
10		10.00	20.12						
Remarks: The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.							Logged: M Benson Date: 26/02/2020 Checked: M Richardson Date: 28/02/2020 Site Ref: 6041/HOO Scale 1:50		

GeoAssist Limited Consultant: Brennan Consult Ltd Client: JDA-Architects	Exploratory Hole Record Sheet				Ref: WS4 Sheet: 2	
	Project: Hologic Location: Crewe Road, Wythenshawe				Ground Level: 30.12 m.AOD Co-ordinates: Easting: 380220.3(m) Northing: 389911.5(m) Dates: 25/02/2020 to 25/02/2020	
Equipment: Archway Dart Rig and Dynamic Probing						
Drilling Foreman: M Walton Engineer/Geologist: M Benson		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests Depth (m) from to Sample Type/No Blow Count N/(U)	Field Records

10	Clayey SILTSTONE and MUDSTONE - Interpreted Stratum	(0.56)			10.10	CP5	85	25/02/2020: On completion of exploratory hole at 10.56m. Casing at 4.00m. Standing water level at 1.80m depth. On withdrawal of casing groundwater/gas monitoring standpipe installed to 5.00m depth with response zone from 1.00m to 5.00m.
	Exploratory Hole complete at 10.56m	10.56	19.56					
-11								
-12								
-13								
-14								
-15								
-16								
-17								
-18								
-19								
-20								

Remarks: The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.	Logged: M Benson Date: 26/02/2020 Checked: M Richardson Date: 28/02/2020 Site Ref: 6041/HOO Scale 1:50
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GeoAssist Limited		Exploratory Hole Record Sheet					Ref: WS5		
Consultant: Brennan Consult Ltd		Project: Hologic Location: Crewe Road, Wythenshawe					Sheet: 1		
Client: JDA-Architects		Equipment: Archway Dart Rig and Dynamic Probing				Ground Level: 30.27 m.AOD Co-ordinates: Easting: 380278.5(m) Northing: 389940.5(m) Dates: 17/04/2020 to 17/04/2020			
Drilling Foreman: M Walton Engineer/Geologist: M Benson		STRATUM DESCRIPTION		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests Depth (m) from to Sample Type/No Blow Count N/(U)		Field Records
0 Grass over dark grey sandy TOPSOIL		0.30	29.97						
Dark brown silty fine to medium SAND		(0.70)				0.50 0.60	D1		
1 Loose to medium dense brown silty fine to medium SAND		1.00	29.27			1.00	CP1	12	
Dark brown clayey fine fibrous PEAT		(0.60)				1.30 1.40	D2		
2 Loose to medium dense grey/brown silty SAND and GRAVEL		1.60	28.67			1.80 1.90	D3		
		(2.00)	28.27			2.00	CP2	10	Wet from 2.00m depth
		(1.80)				3.00	CP3	9	
3 Firm to stiff brown very silty CLAY		3.80	26.47						Hand vane at 3.80m - 65kPa
4 Firm to stiff brown very silty CLAY - Interpreted Stratum		(0.70)				4.00	CP4	6	
		4.50	25.77						Hand vane at 4.50m - 86kPa
5 Dynamic Probing from 5.00m depth Interpreted Strata from from 5.00m depth						5.00	CP5	11	Hand vane at 4.80m - 97kPa
		(3.00)				6.00	CP6	17	
		7.50	22.77			7.00	CP7	27	
8 Stiff very silty CLAY - Interpreted Stratum						8.00	CP8	36	
		(1.70)							
		9.20	21.07			9.00	CP9	53	
9 Stiff to very stiff very silty CLAY - Interpreted Stratum		(0.80)							
		10.00	20.27						
10									
Remarks: The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.								Logged: M Benson Date: 20/04/2020 Checked: M Richardson Date: 20/04/2020 Site Ref: 6041/HOO Scale 1:50	

GeoAssist Limited Consultant: Brennan Consult Ltd Client: JDA-Architects	Exploratory Hole Record Sheet				Ref: WS5 Sheet: 2									
	Project: Hologic Location: Crewe Road, Wythenshawe				Ground Level: 30.27 m.AOD Co-ordinates: Easting: 380278.5(m) Northing: 389940.5(m) Dates: 17/04/2020 to 17/04/2020									
Equipment: Archway Dart Rig and Dynamic Probing														
Drilling Foreman: M Walton STRATUM DESCRIPTION Engineer/Geologist: M Benson			Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	<table border="1"> <thead> <tr> <th colspan="2">Samples/Tests</th> <th rowspan="2">Blow Count N/(U)</th> </tr> <tr> <th>Depth (m) from</th> <th>to</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td></td> </tr> </tbody> </table>	Samples/Tests		Blow Count N/(U)	Depth (m) from	to			
Samples/Tests		Blow Count N/(U)												
Depth (m) from	to													

10	Clayey SILTSTONE and MUDSTONE - Interpreted Stratum	10.33	19.94		10.00	CP10	71	17/04/2020: On completion of exploratory hole at 11.00m. Casing at 4.00m depth. Standing water level at 2.50m depth. On withdrawal of casing exploratory hole backfilled and reinstated.
	Exploratory Hole complete at 10.33m							
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								

Remarks: The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.	Logged: M Benson Date: 20/04/2020 Checked: M Richardson Date: 20/04/2020 Site Ref: 6041/HOO Scale 1:50
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GeoAssist Limited		Exploratory Hole Record Sheet					Ref: WS6		
Consultant: Brennan Consult Ltd		Project: Hologic Location: Crewe Road, Wythenshawe					Sheet: 1		
Client: JDA-Architects		Equipment: Archway Dart Rig and Dynamic Probing				Ground Level: 29.71 m.AOD Co-ordinates: Easting: 380196.6(m) Northing: 389923.4(m) Dates: 17/04/2020 to 17/04/2020			
Drilling Foreman: M Walton STRATUM DESCRIPTION Engineer/Geologist: M Benson		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests Depth (m) from to		Sample Type/No	Blow Count N/(U)	Field Records
0 Grass over dark grey sandy TOPSOIL		0.30	29.41						
Medium dense dark brown/light brown silty fine to medium SAND					0.50	0.60	D1		
-1 (1.20)					1.00		CP1	11	
1.50 28.21									
Dark brown clayey fine fibrous PEAT		1.70	28.01		1.60	1.70	D2		
-2 Medium dense grey/brown silty SAND and GRAVEL					2.00		CP2	14	
-3 (2.70)					3.00		CP3	10	
-4 4.40 25.31					4.00		CP4	28	
Firm to stiff brown very silty CLAY		(0.60)							
-5 5.00 24.71					5.00		CP5	8	
Stiff very silty CLAY - Interpreted Stratum Dynamic Probing from 5.00m depth Interpreted Strata from from 5.00m depth									
-6 (2.00)					6.00		CP6	14	
-7 7.00 22.71					7.00		CP7	19	
Stiff to very stiff very silty CLAY - Interpreted Stratum									
-8 (3.00)					8.00		CP8	31	
-9 9.00					9.00		CP9	38	
10 10.00 19.71									
Remarks: The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.							Logged: M Benson Date: 20/04/2020 Checked: M Richardson Date: 20/04/2020 Site Ref: 6041/HOO Scale 1:50		

GeoAssist Limited		Exploratory Hole Record Sheet					Ref: WS6			
Consultant: Brennan Consult Ltd		Project: Hologic Location: Crewe Road, Wythenshawe					Sheet: 2			
Client: JDA-Architects		Equipment: Archway Dart Rig and Dynamic Probing			Ground Level: 29.71 m.AOD Co-ordinates: Easting: 380196.6(m) Northing: 389923.4(m) Dates: 17/04/2020 to 17/04/2020					
Drilling Foreman: M Walton Engineer/Geologist: M Benson		STRATUM DESCRIPTION		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests Depth (m) from to Sample Type/No Blow Count N/(U)		Field Records	
10		Very stiff very silty CLAY - Interpreted Stratum		(0.50) 10.50	19.21		10.10	CP10	50	17/04/2020: On completion of exploratory hole at 11.16m. Casing at 4.00m depth. Standing water level at 2.50m depth. On withdrawal of casing exploratory hole backfilled and reinstated.
Clayey SILTSTONE and MUDSTONE - Interpreted Stratum		(0.66) 11.16		18.55		10.50	CP11	62		
11		Exploratory Hole complete at 11.16m								
12										
13										
14										
15										
16										
17										
18										
19										
20										
Remarks: The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.							Logged: M Benson Date: 20/04/2020 Checked: M Richardson Date: 20/04/2020 Site Ref: 6041/HOO Scale 1:50			

Exploratory Hole Record SheetRef: **TP1****Consultant:**

Brennan Consult Ltd

Project: Hologic**Location:** Crewe Road, WythenshaweSheet: **1****Client:**

JDA-Architects

Equipment:1.5 Tonne Tracked
Excavator**Ground Level:** m.AOD**Co-ordinates:** Easting: (m)

Northing: (m)

Dates: 13/03/2020 to 13/03/2020

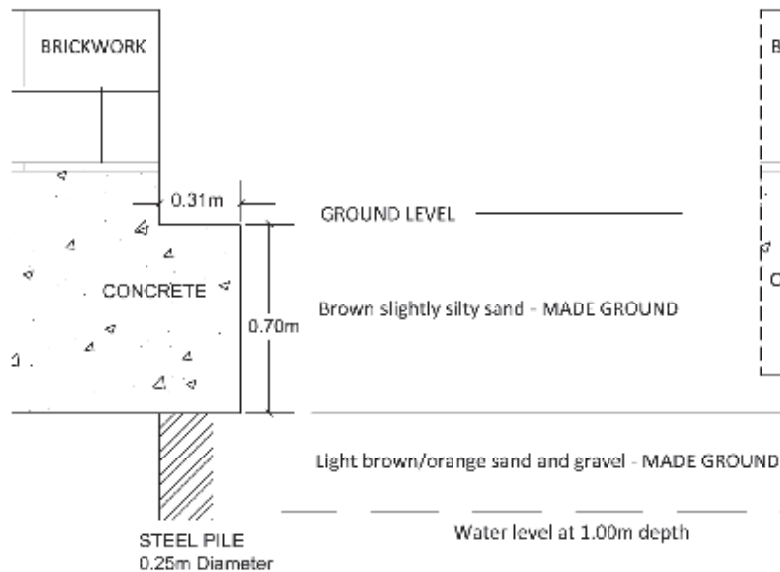
Drilling Foreman: M Walton

STRATUM DESCRIPTION

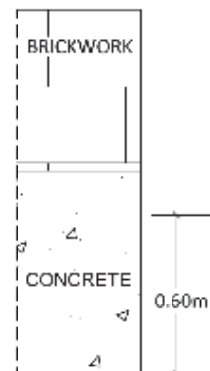
Engineer/Geologist: M Benson

Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests		Blow Count N/(U)	Field Records
			Depth (m) from to	Sample Type/No		

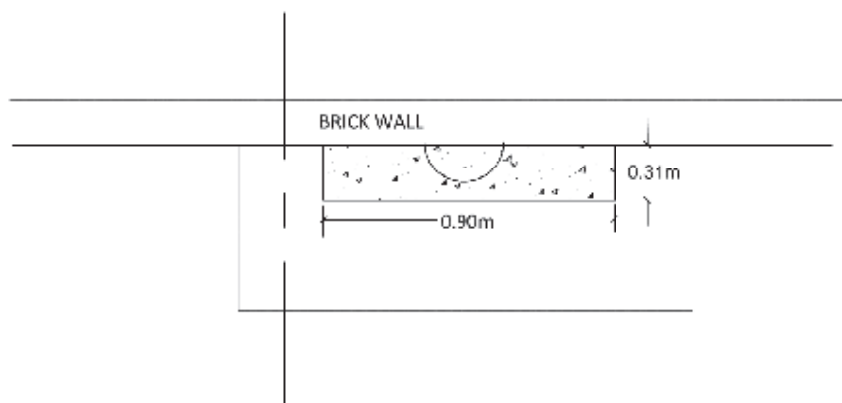
Section AA



Section BB



Section BB Section AA

**Remarks:**

The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken.

Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.

Logged: M Benson

Date: 13/03/2020

Checked: M Richardson

Date: 16/03/2002

Site Ref: 6041/HOO

Not to scale

Site Reference:			6041 HOO			
Project Site:			Hologic			
Project Location:			Crewe Road, Wythenshawe			
Client:						
Consultant:			Brennan Consult Ltd			
TRL DCP CBR SUMMARY SHEET						
Reference	Depth	Level mAOD	Material		TRLDCP Interpreted CBR at 0.30m depth	TRLDCP Interpreted CBR at0.50m depth
	m				%	%
CBR1	0.30	29.8	Sand		7	
CBR1	0.50	29.6	Sand			10
CBR2	0.30	29.8	Sand		5	
CBR2	0.50	29.6	Sand			9
CBR3	0.30	29.7	Sand		5	
CBR3	0.50	29.5	Sand			4
CBR4	0.30	29.8	Sand		7	
CBR4	0.50	29.6	Sand			12
Note: The CBR values have been assessed using the TRLDGP equipment and UKDCP software and are appropriate for the conditions encountered on site at the time of undertaking the testing A layer of Peat is present at less than 1.50 m depth across the site Groundwater level is variable and will be present within influencing depth of pavement subbase						

Ground Water Readings

[illegible]

Appendix D

D1	Laboratory Summary Sheet
D2	Classification Summary
D3	Sulphate and pH Summary
D4	Particle Size Distribution Graphs
D5	Consolidation Test Graphs

GeoAssist Limited SOIL LABORATORY SUMMARY SHEET	Project:	Hologic	Site Ref:	6041/HOO
	Location:	Crewe Road, Wythenshawe	Project Code :	
	Client:	JDA-Architects		
	Consultant :	Brennan Consult Ltd	Hole Ref	BH1 and WS1 to WS6

Sample Ref.	Depth m	Sample Description	Classification					Triaxial Compression					Chemical		
			LL %	PL %	PI %	% passing 425 µ	Moist Cont. %	Bulk Density Mg/m ³	Sample Diameter mm	Lateral Pressure kN/m ²	Deviator Stress kN/m ²	Shear Cohesion kN/m ²	So ₄ 2:1 extract Soil:Water mg/l	pH	Test Code
BH1 D2	1.70	Dark grey/black sandy clayey fine fibrous PEAT					66								NMC
BH1 D4	3.00	Grey slightly silty very sandy rounded to subrounded GRAVEL					-								GRAD WS
BH1 D7	5.50	Brown very silty CLAY	54	25	29	99	25								NMC CLSS
BH1 P7	11.70	Brown/grey clayey SILTSTONE and MUDSTONE	28	19	9	99	12								NMC CLSS
WS1 D1	0.70	Brown ironstained slightly silty fine to medium SAND					-						480	6.8	SULWS PHS
WS1 D2	0.90	Brown ironstained slightly silty fine to medium SAND					-								GRAD WS
WS1 U1	1.60	Brown clayey fine fibrous PEAT					250 295								NMC CONG
WS1 D3	3.50	Grey slightly silty SAND and GRAVEL					-								GRAD WS
WS1 D4	4.80	Brown very silty CLAY	55	25	30	99	27								NMC CLSS
WS2 D1	0.70	brown ironstained slightly silty fine to medium SAND					-						660	6.9	SULWS PHS
WS2 D2	0.90	brown ironstained slightly silty fine to medium SAND					-								GRAD WS
WS2 D3	1.50	Brown clayey fine fibrous PEAT					286								NMC
WS2 D5	3.90	brown very silty CLAY	55	24	31	97	22								NMC CLSS

GeoAssist Limited SOIL LABORATORY SUMMARY SHEET	Project:	Hologic	Site Ref:	6041/HOO
	Location:	Crewe Road, Wythenshawe	Project Code :	
	Client:	JDA-Architects		
	Consultant :	Brennan Consult Ltd	Hole Ref	BH1 and WS1 to WS6

Sample Ref.	Depth m	Sample Description	Classification					Triaxial Compression					Chemical		Test Code
			LL %	PL %	PI %	% passing 425 μ	Moist Cont. %	Bulk Density Mg/m ³	Sample Diameter mm	Lateral Pressure kN/m ²	Deviator Stress kN/m ²	Shear Cohesion kN/m ²	So ₄ 2:1 extract Soil:Water mg/l	pH	
WS3 D1	0.70	Brown ironstained silty fine to medium SAND					-						410	6.7	SULWS PHS
WS3 D2	1.70	Brown clayey fine fibrous PEAT					301								NMC
WS4 D1	0.70	Brown/dark brown ironstained slightly silty fine to medium SAND					-						400	6.9	SULWS PHS
WS4 U1	1.30	Brown clayey fine fibrous PEAT					342 345								NMC CONG
WS5 D1	1.30	Brown silty fine to medium SAND					-						260	7.1	SULWS PHS
WS5 D4	4.50	Brown very silty CLAY	58	23	35	96	14								NMC CLSS

Site Reference:			6041	HOO				
Project Site:			Hologic					
Project Location:			Crewe Road, Wythenshawe					
Client:			JDA-Architects					
Consultant:			Brennan Consult Ltd					
	CLASSIFICATION TEST							
Borehole Reference	Sample	Depth	Liquid Limit	Plastic Limit	Plasticity Index	% passing 425 micro	Natural Moisture Content	Material Code
BH1	D7	5.50	54	25	29	99	25	CH
WS1	D4	4.80	55	25	30	99	27	CH
WS2	D5	3.90	55	24	31	97	22	CH
WS5	D4	4.50	58	23	35	96	14	CH
		Mean	56	24	31	98	22	
very silty		Maximum	58	25	35	99	27	
CLAY		Minimum	54	23	29	96	14	
	Standard Deviation		2	1	3	2	6	
		Count	4	4	4	4	4	
BH1	P7	11.70	28	19	9	99	12	CL
clayey		Mean						
MUDSTONE		Maximum						
SILTSTONE		Minimum						
	Standard Deviation							
		Count	1	1	1	1	1	

Site Reference:			6041	HOO		
Project Site:			Hologic			
Project Location:			Crewe Road, Wythenshawe			
Client:			JDA-Architects			
Consultant:			Brennan Consult Ltd			
	GEOTECHNICAL SULPHATE AND PH TEST					
Borehole Reference	Sample	Depth	SO4 2:1 Water:Soil extract mg/l	pH	SO4 Water mg/l	
WS1	D1	0.70	480	6.8		
WS2	D1	0.70	660	6.9		
WS3	D1	0.70	410	6.7		
WS4	D1	0.70	400	6.9		
WS5	D1	1.30	260	7.1		
		Mean	442	6.9		
ALL		Maximum	660	7.1		
		Minimum	260	6.7		
	Standard Deviation		146	0.1		
		Count	5	5		

GeoAssist Limited**CONSOLIDATION TEST**

Project: Hologic
 Location: Crewe Road, Wythenshawe
 Client: JDA-Architects
 Consultant: Brennan Consult Ltd

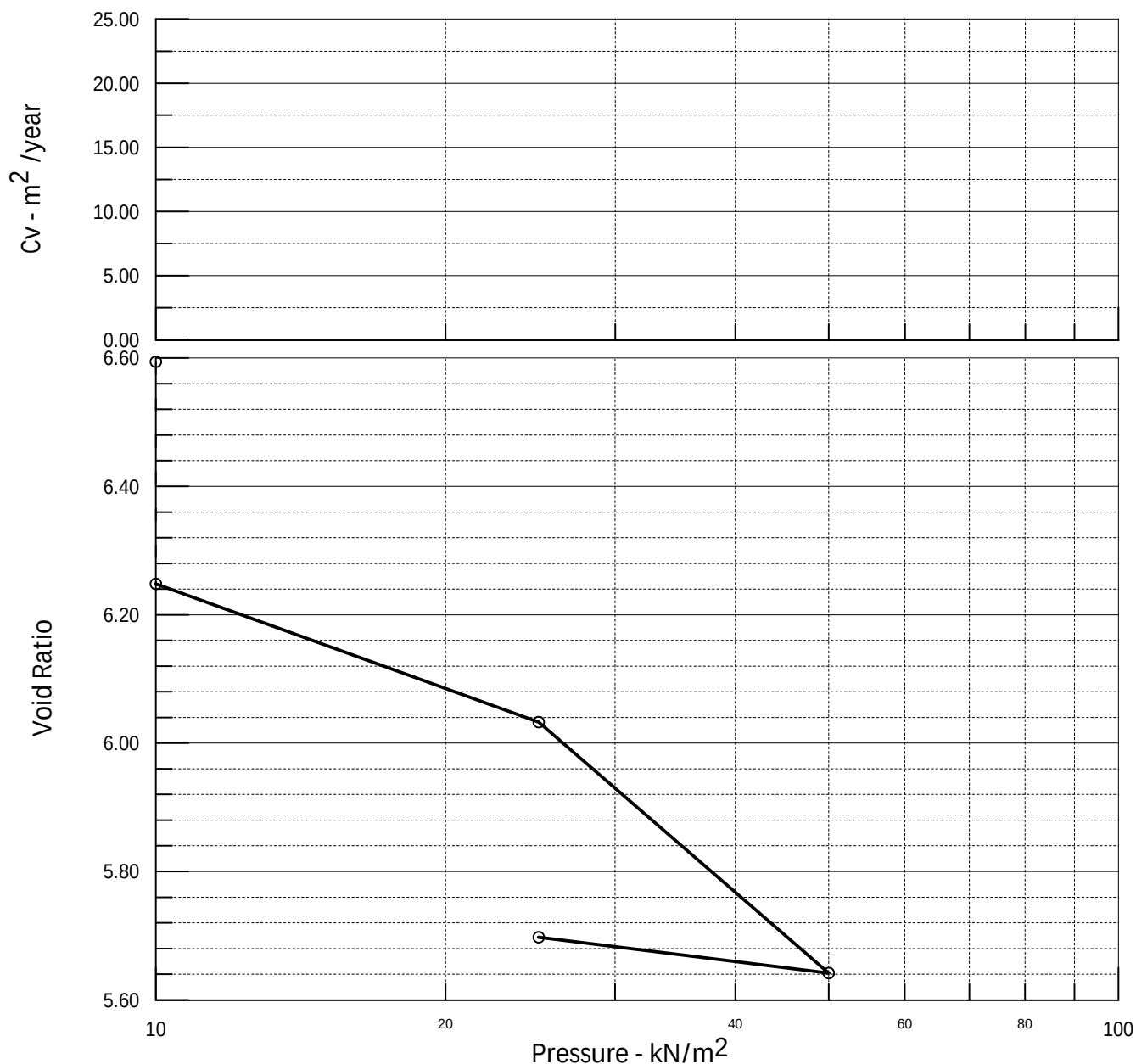
Site No: 6041
 Site Ref: HOO

Hole Ref: WS1
 Sample No: U1
 Depth: 1.60m

Pressure Range kN/m ² from to	Void Ratio end of increment	Volume Compressibility m _v - m ² /MN	Consolidation Coefficient c _v - m ² /year	Bulk density(Mg/m ³)	1.04
0 10	6.2479	4.56	Indet	Dry density(Mg/m ³)	0.26
10 25	6.0327	1.98	Indet	Specific gravity	2.00 Assumed
25 50	5.6418	2.22	Indet	Initial Moist. Cont. (%):	295.6
50 25	5.6976	0.34	Indet	Final Moist. Cont. (%):	281.9
				Initial Void ratio:	6.5941
				Final Void ratio:	5.6976
				Thickness(mm):	19.0
				Diameter(mm):	76.0

Exhibits Secondary Consolidation Csec = 0.9

Abbreviation: N.A. = Not applicable
 Indet. = Indeterminate



GeoAssist Limited**CONSOLIDATION TEST**

Project: Hologic
 Location: Crewe Road, Wythenshawe
 Client: JDA-Architects
 Consultant: Brennan Consult Ltd

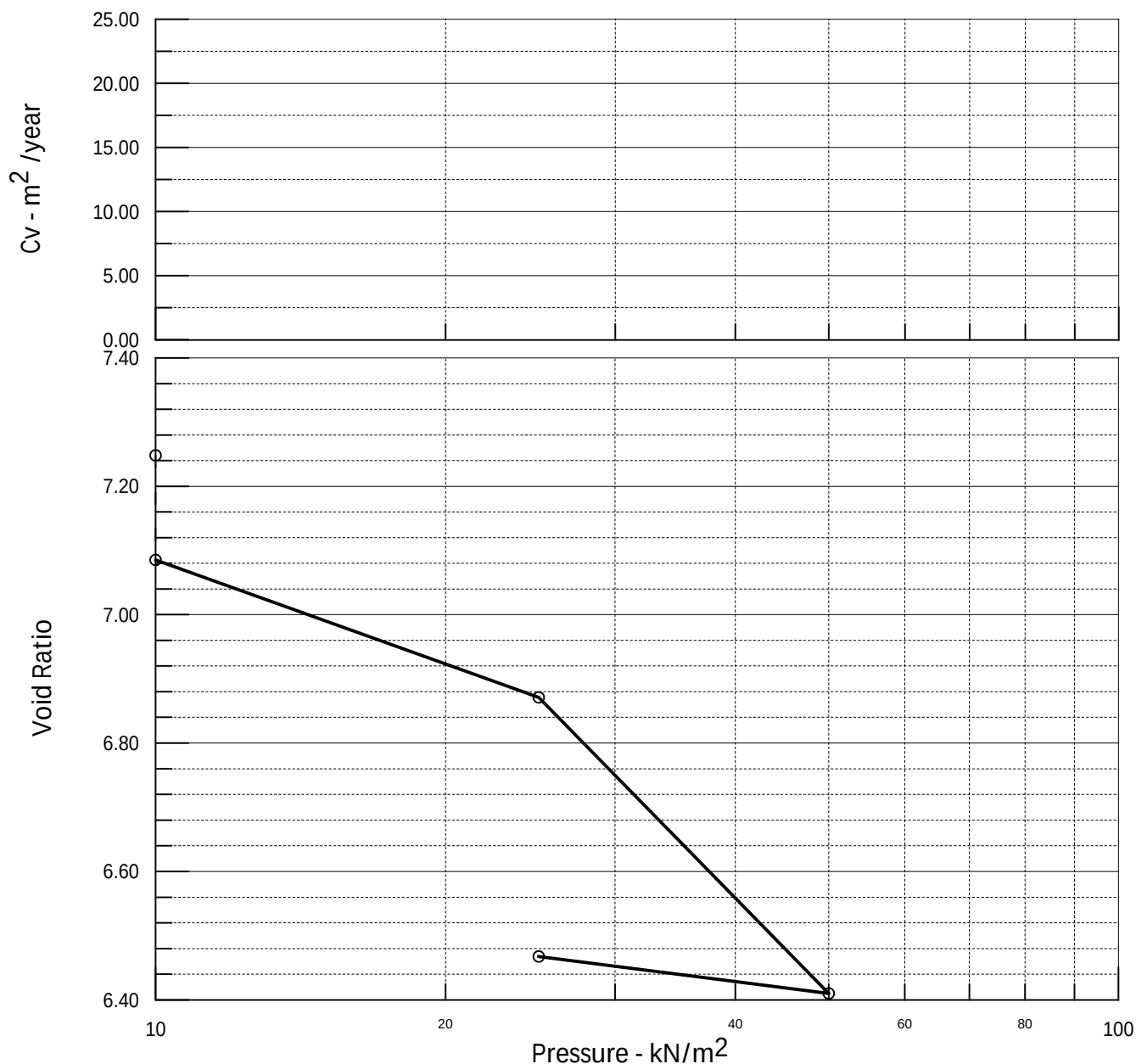
Site No: 6041
 Site Ref: HOO

Hole Ref: WS4
 Sample No: U1
 Depth: 1.40m

Pressure Range kN/m ² from to	Void Ratio end of increment	Volume Compressibility m _v - m ² /MN	Consolidation Coefficient c _v - m ² /year	Bulk density(Mg/m ³)	1.03
0 10	7.0849	1.98	Indet	Dry density(Mg/m ³)	0.24
10 25	6.8710	1.76	Indet	Specific gravity	2.00 Assumed
25 50	6.4101	2.34	Indet	Initial Moist. Cont. (%):	324.9
50 25	6.4674	0.31	Indet	Final Moist. Cont. (%):	322.0
				Initial Void ratio:	7.2481
				Final Void ratio:	6.7266
				Thickness(mm):	19.0
				Diameter(mm):	76.0

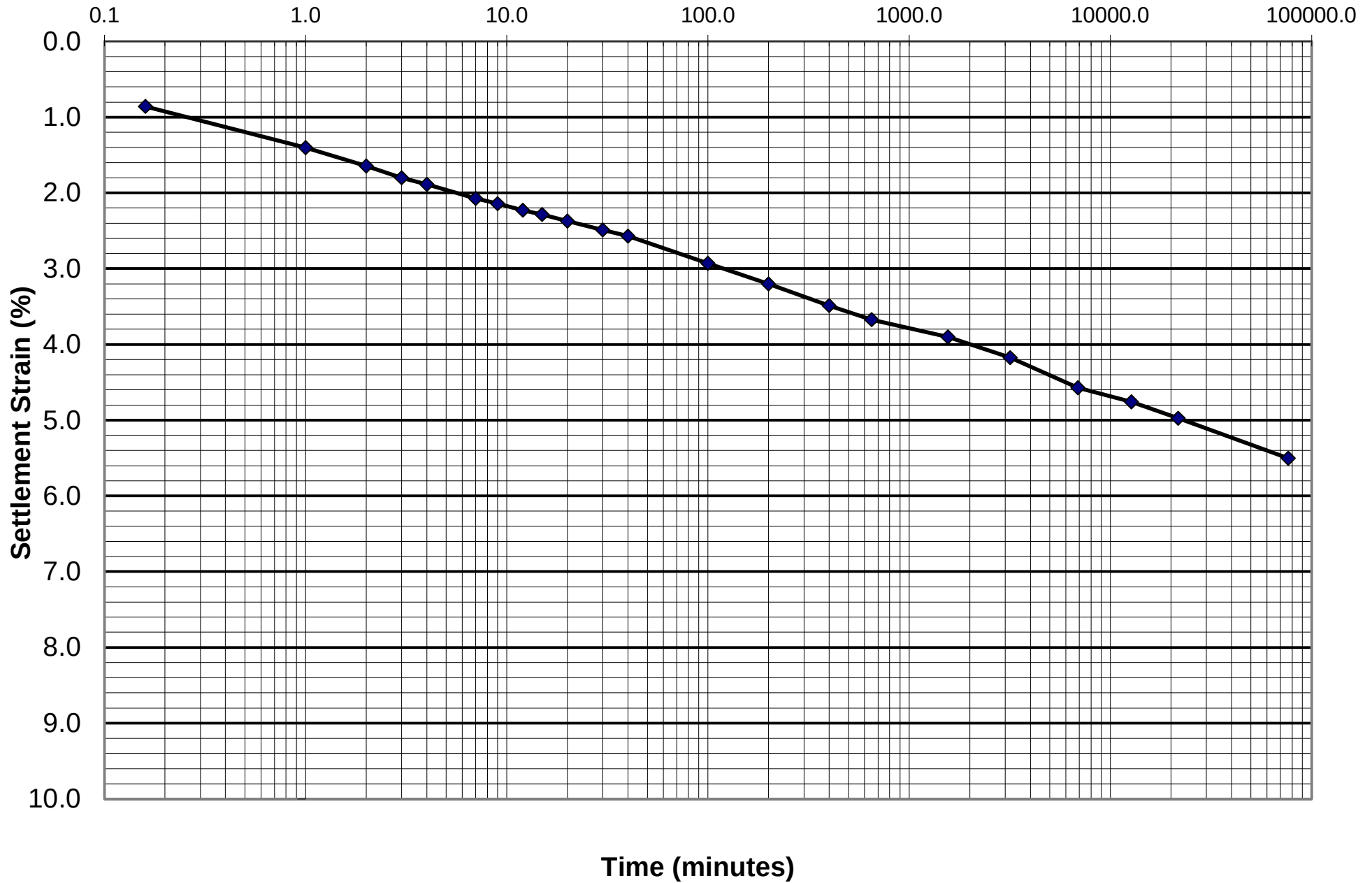
Exhibits Secondary Consolidation Csec = 1.0

Abbreviation: N.A. = Not applicable
 Indet. = Indeterminate



Oedometer Plot

Site: 6041/HOO WS1 Sample: U1 Depth: 1.60 Stress:25 to 50 kN/m2



Oedometer Plot

Site: 6041/HOO WS4 Sample: U1 Depth: 1.40 Stress:25 to 50 kN/m2

