

ANSHAM ARCHITECTS LTD

SITE AT ENCOMBE GARDENS, SANDGATE CT20 1DG

SITE INVESTIGATION AND SLOPE STABILITY REPORT

Reference: 1099/SI

18th May 2018

CLIENT: Ansham Architects Ltd
Unit 1
83 Cheriton Road
Folkestone
Kent
CT20 1DG

SITE: Site at Encombe Gardens
Sandgate
Kent
CT20 3DE

SITE INVESTIGATION AND SLOPE STABILITY REPORT

Reference: 1099/SI

18th May 2018

Prepared By:

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FOREWORD

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REFERENCES

Reference 1	British Geological Survey
Reference 2	BS 5930: Code of Practice for Site Investigations, BSI 1999
Reference 3	BS 1377: Methods of Tests for Soils for Civil Engineering Purposes 1990
Reference 4	NHBC Standards Chapter 4.2 Building Near Trees
Reference 5	BRE Special Digest 1:2005

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FOREWORD

1. This document has been prepared by Peter Baxter Associates Ltd with all reasonable skill, care and diligence within the terms of the contract with the Client and within the limitations of the resources devoted to it by agreement with the client.
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1.0 SUMMARY

- 1.1 Peter Baxter Associates (PBA) were commissioned by the Client, Ansham Architects Ltd, to carry out a slope stability analysis of a development site in Sandgate, Kent, and to determine the foundation design parameters for the development's foundations and retaining wall. To derive this information, PBA carried out a site investigation outlined below. The Site is a 4000m² area of undeveloped wooded land on two levels off of Encombe Gardens, Sandgate, Kent CT20 3DE. It is proposed to build a large three storey detached house of modern aspect incorporating a basement with swimming pool. The Site is in an area with a history of landslips. The Site location is shown in Fig 1 and its topography on drawing 1099/001 in Appendix F, which also includes drawings illustrating the development. Photographs of the Site are included in Appendix E.
- 1.2 PBA carried out a site investigation on 10th April 2018, comprising two window sample boreholes of 6m depth, along with dynamic probing to 7m depth and three trial pits. The soils were logged by a PBA geologist and the groundwater level was measured one week after drilling at 3m depth. The scope of investigation was limited by the overgrown nature of the Site and ecological survey constraints. This report describes the observations, field and laboratory tests of the investigation, discusses the slope analysis soil parameters and analysis sections, summarises the results of the analyses and recommends foundation and retaining wall types and design parameters.
- 1.3 The site comprises two plateaus separated by a 3m-5m high bank with a slope of 1 in 1.8. The upper plateau is the larger and will be developed. The soils comprised variable soft to firm Clays to 6m depth. It was concluded that these soils were slipped soil from the unstratified nature of the ground and fragments of sandstone from the overlying Folkestone Formation. Groundwater was measured at 3.2 m depth on 24th April. Observations suggested that the 1:1.8 slope had moved in the past and had a factor of safety against failure close to 1.0. Effective strength parameters for the slope analysis and for retaining wall design parameters were adopted from a recognised correlation with plasticity index and verified by analysing the existing slope. Undrained shear strength parameters were correlated to insitu test results. These parameters and their precursors are summarised in Table 1 and are considered to be conservative. Their derivation is discussed in Section 5.1.

- 1.4 The slope analyses output is summarised in Table 2. The Site will require a piled retaining wall retaining 3m of soil to be constructed along the boundary of the new house with Encombe Gardens prior to excavation, due to the weak and variable nature of the Site soils and the consequences of road collapse. A second retaining wall would be required along the side of the basement swimming pool retaining 1.5m. This was analysed as a piled wall but could form part of a monolithic swimming pool structure. A worst-case analysis section was developed by inspection and is given as Figure 2. The minimum acceptable factor of safety adopted was 1.5 to two significant figures. The analyses were carried out using Geoslope software, mainly using Bishop's Method of Slices.
- 1.5 To stabilise the bank between the two levels of the Site, additional clay fill may be placed in horizontal layers to reprofile the slope to 1V:2.5H. Clay selectively excavated from basement excavation may be used and a placement methodology is given in Section 6.2.
- 1.6 The piled retaining wall along the boundary with Encombe Gardens will need to be propped by the basement and ground floor slabs to have an adequate long-term factor of safety. In the short term, during construction, the piles may act as cantilevers. Retaining wall design parameters are recommended in Section 6.2. Sheet piles may be considered for this wall in place of contiguous bored piles.
- 1.7 Bored piled foundations are recommended for the new house, as the bearing capacity of the slipped soils are considered inadequate. A 450mm diameter pile 16m in length was estimated to have a safe working load of 300kN. The clay soils were of low volume change potential and a number of trees will be removed. Heave precautions will be required under the basement slab including the swimming pool and are detailed in section 6.1. The pool should be designed to resist uplift buoyancy forces.
- 1.8 Laboratory testing established that the design sulphate class for concrete in contact with the Site soils is DS-1.
- 1.9 To enable the piled retaining wall and bearing piles to be designed the ground must be investigated to a greater depth than that covered in this report. A 20m deep borehole, as close as possible to the centre of the house, is recommended, to be drilled with a cable percussion technique with recovery of undisturbed samples for shear strength testing and insitu tests at 2m intervals. Access for this borehole rig will require clearance of some trees.

2.0 SITE DESCRIPTION

2.1 Site Location and Description

2.1.1 The Site is an area of undeveloped land situated to the south of numbers 20 to 23 Encombe Gardens. The site postcode given in this report is that for No.20, and the National Grid Coordinates are 620030E, 135180N. Encombe Gardens is a residential close of detached houses that curves steeply upslope from Sandgate Esplanade. The Site is approximately 24m above sea level and is wooded with young and mature trees. The Site area is approximately 4000m² and the Site is approximately 500m west of Sandgate centre. An historic ice house structure is shown on maps at the south of the Site and a public footpath runs along the southern boundary. The site location is shown on Figure 1 and the Site is illustrated by photographs in Appendix E. Photograph viewpoints are shown on drawing 1099/001 as P1 to P5.

2.1.2 The Site varies in level. Approximately 60% of the Site area is a plateau at around 24.5 mAOD. Banks of 1V:1.8H fall to the east of this plateau to a lower area at 16.5m AOD. The Site topography is detailed on drawing 1099/001 in Appendix F.

2.1.3 The surrounding area has a history of landslips and is shown as such on British Geological Survey archives (Reference 1).

2.2 Proposed Development and Site Investigation Objectives

2.2.1 The Client proposes to build a large detached house of modern aspect over three stories fronting Encombe Gardens and the eastern bank. The lower storey will be a semi basement up to 3m deep incorporating a swimming pool 1.5m below basement floor level. Retaining walls will be required along the Encombe Gardens boundary and bounding the swimming pool. The property incorporates large glazed areas and clear spans. The proposed structure, and its location within the Site, are illustrated on the Client's drawings 1615/405, 1615/407, and 1615/412 which are included with acknowledgements in Appendix F.

2.2.2 The Client required a slope stability analysis, to confirm the stability of the developed Site. The Client also required sufficient information to design the development's foundations and retaining walls. Peter Baxter Associates developed a site investigation methodology, subject to Site access limitations, that is described in Section 3 of this Report

2.3 Geological Data

- 2.3.1 A review of geological data from the British Geological Survey (Reference 1) confirmed that the Site was situated in an area with a history of landslips. The underlying soil was shown as Sandgate Formation (sandstone, siltstone and mudstone). Geological maps are presented in Appendix A.

3.0 FIELDWORK

3.1 Description of Field Works

3.1.1 Following a pre-mobilisation site visit, two 6m deep boreholes were drilled using a windowless sample technique. Dynamic probing was conducted to 7.3m depth to 7.3m depth adjacent to each borehole. Borehole WS1 was installed with a groundwater monitoring installation. Three trial pits were excavated with a 1.5T minidigger, which was also used to gain access for the windowless sample rig through the overgrown Site.

3.1.2 The works were carried out on 10th April 2018 by Peter Baxter Associates' (PBA's) drilling contractor; Siteserve Ltd, under the supervision of a PBA geologist. The core samples were logged in a laboratory by PBA's geologist. The Site investigation was carried out in accordance with BS5930 (Reference 2).

3.2 Observations

3.2.1 The Site's natural soils comprised topsoil and made ground over sandy Clays to a depth of 6m. The Clays were generally firm to stiff but soft layers were encountered at depth along with sandstone fragments. These indicators suggest that the soils are slipped material to 6m depth.

3.2.2 The soils are detailed on the Borehole Logs and Trial Pit Logs, presented in Appendix B1 and B2. Photographs of the core samples are included in Appendix E.

3.2.3 Groundwater seepages were not observed in the boreholes. A subsequent visit on 24th April recorded a groundwater depth of 3.2m in borehole WS2. Groundwater details are included on the borehole and trial pit logs.

3.2.4 Some trees were observed to be inclined or bent with an inclined lower trunk and vertical upper trunk, suggesting that the soils beneath the trees had slipped during the lifetime of the trees, estimated as 10 to 40 years. No signs of recent slips were observed but the Site was overgrown with low vegetation, making such observations difficult.

3.3 In Situ Testing

3.3.1 Super heavy dynamic probing tests (DPSH) were carried out near the window sampling boreholes, using a rig mounted tool. This tool comprises a 63.5kg weight falling 540 mm, which drives a 20mm diameter cone into the ground via rods. The numbers of blows per 100mm of penetration are recorded. The number of blows

recorded over 300mm are taken as equivalent to the Standard Penetration Test (SPT) values. The equivalent SPT N-values with depth are presented in Appendix B3.

- 3.3.2 An SPT value of 5 is considered representative of the soils to 3.5m – 5.0m depth, where the SPT value drops to zero. This low reading corresponds to soft layers observed in the core from the boreholes. From 3.5m depth the SPT values show an increasing trend to SPT = 15 at 6m depth. A measure of undrained soil strengths can be obtained from the equivalent SPT (N values) by the recognised relationship $C_u = 6N$ to $9N$. Above 3.5m a derived C_u value of 45 kPa is considered valid and at 6m depth a value of 75 kPa may be used.

4.0 LABORATORY TESTING

4.1 General

4.1.1 Laboratory testing was carried out by Peter Baxter Associates Laboratories, Gillingham, Kent, in accordance with Reference 3. The test reports are presented in Appendix C.

4.2 Classification and Particle Size Distribution Tests

4.2.1 Atterburg limits and natural moisture contents were tested on seven samples from both boreholes recovered from between 1.2m and 5.6m depth. The plasticity index results ranged between 12% and 19%. These results indicated a clay with a low volume change potential (Reference 4). The plasticity indices were fairly consistent with depth and location. This report is included in Appendix C1.

4.2.2 The natural moisture content of the Clay was higher in all cases than the plastic limit of the Clay.

4.2.3 The natural moisture content was significantly higher at depths identified as soft by the geologist.

4.2.4 Two particle size distribution tests carried out on samples recovered from the trial pits confirm that the soil is a very sandy Clay. The laboratory test reports are included in Appendix C3.

4.3 Sulphate Tests

4.3.1 Testing for pH and soil soluble sulphate was carried out on three samples. The reports are presented in Appendix C2 and indicate a soil sulphate content of 0.1g/l to 0.5g/L.

4.4 Shear Vane Testing

4.4.1 Shear vane tests were carried out on cores from borehole WS1. The results are plotted on the borehole log for WS2 and ranged from 27 to 60 kPa with a mean average of 37 kPa. These results were comparable with the undrained shear strengths derived using dynamic probing discussed in Section 3.3.

5.0 SLOPE STABILITY ASSESSMENTS

5.1 Soil Parameters

- 5.1.1 The soil parameters used in the analysis are summarised on Table 1.
- 5.1.2 The drained shear strength parameters of the slipped clay were derived from an empirical correlation between the effective angle of internal friction ϕ' of clays and the plasticity index, suggested by Terzaghi. A worst-case plasticity index of 19% corresponded to a derived ϕ' value of 30° . The residual shear effective angle of internal friction was estimated as 50% of 30° , i.e. 15° . The effective cohesion was conservatively assumed to be zero.
- 5.1.3 These values were checked by incorporation in a slope analysis with a 4.5m high 1 in 1.8 slope, which from inspection of the survey presented in Appendix F, was a typical slope of the bank between the upper and lower levels of the Site. This bank was assumed to be close to failure, with a factor of safety of 1.0. The analysis gave a factor of safety of 1.04, which is considered to verify the strength parameters adopted for the slipped material.
- 5.1.4 The undrained shear strengths of the slipped material were established from the equivalent SPT test results (N values) by the recognised relationship $C_u = 6N$ to $9N$ and from laboratory shear vane testing, as 3.3. and 4.4. The undrained shear strength of the slipped material was assessed as 50kPa and 75kPa for the unslipped material.
- 5.1.5 The bulk density of all soils was defined as 18kN/m^3 , from literature.
- 5.1.6 As described in Section 5.4 two fill types were examined to improve the factor of safety of the bank slope. A granular fill (imported well graded gravel or recycled concrete was allocated a ϕ' value of 45° and reworked slipped clay compacted in layers was given the parameters $\phi' = 30^\circ$, $c' = 0$, $C_u = 75\text{kPa}$. These reworked parameters were taken as similar to the Clay's peak shear strength when compacted in layers with controlled moisture contents.

5.2 Retaining Structures

- 5.2.1 Two retaining structures will be required for the proposed development; the "Road Wall" retaining Encombe Gardens above a 3m deep basement and the "Swimming Pool Wall", which retains 1.5m of soil between the basement and the pool to the east.

5.2.2 Contiguous bored pile retaining walls were used in the analysis for the “Road Wall”. The piles were 600mm diameter at 750mm spacing 9m long with a yield moment of 234 kNm. This method of wall construction is considered necessary due to the proximity of the road and its buried settlement sensitive services and the weakness of the slipped soils that it would retain. The wall was modelled as propped in the long term by the basement and first floor slab.

5.2.3 A similar construction technique was used in the analysis for the “Swimming Pool Wall”. This wall was modelled with 450mm diameter 600mm spacing piles 4.5m long with a yield moment of 113 kNm. A conventional reinforced concrete counterfort construction could be used for this wall, but it is considered that piled foundations for this wall would be required.

5.3 Slope Analysis Methodology

5.3.1 The analysis section is shown as Figure 2 and was developed as a worst case from the topographic survey and Client’s drawings. The slope stability analyses were carried out using GeoSlope software and Bishop’s Method of Slices. The output is summarised on Table 2 and plots from the analysis software are included in Appendix D. A minimum factor of safety (FOS) of 1.5 was considered appropriate.

5.4 Analysis Output

5.4.1 Five analyses were carried out. Analysis 1 was the existing ground with the retaining walls installed. The factor of safety against shallow slip failures on the eastern bank was inadequate at 1.04. Analysis 2 examined a 1m thickness of granular fill with a ϕ' value of 45° . The lowest factor of safety for this section was 1.26 against a failure through the Road Wall. This factor of safety is insufficient, as is the FOS of 1.38 that the analysis gave for a failure of the eastern bank.

5.4.2 Analysis 3 modelled short term stability of the Road Wall piles acting as unpropped cantilever members. Undrained shear strength parameters were used and a satisfactory FOS of 4.49 was predicted.

5.4.3 Analysis 3.1 was of the same geometry as Analysis 3.0 and examined the long term stability of the Road Wall. To achieve the satisfactory FOS of 1.79, it was necessary to prop the Road Wall in the long term. These prop forces were provided by the ground floor slab at the top and the basement slab at base of excavation. The forces were 25kN/m run for the ground floor slab and 50kN/m run for the basement slab. Due to limitations of the slope stability software, the prop

forces were modelled and are displayed as ground anchors. An alternative analysis technique (Janbu's method) gave a similar FOS value. This section also modelled the placement of some additional as dug clay fill placed in horizontal layers along the face of the eastern bank, to reprofile the slope to 1V:2.5H. A long term FOS of 1.48 for this bank was given, which is considered satisfactory.

5.4.4 Analysis 4 considered the implications if the slipped material was present at depths greater than the 6m assumed in the preceding sections. A satisfactory factor of safety of 1.48 against eastern bank failure was indicated.

5.4.5 The factors of safety quoted above are the lowest factors of safety of those calculated for each analysis. The FOS against failure of the Swimming Pool Wall and against large scale slope failure were much higher. It is concluded that the risk of large scale slope failure from this development is very low.

6.0 CONCLUSIONS

6.1 Recommended Foundation Type and Design Considerations

- 6.1.1 On the basis of the information obtained during this investigation, it is recommended that piled foundations are adopted for the development. The slipped ground extends too deep and is too soft to support the expected high column loads of the proposed house. Bored replacement piles, possibly drilled using the continuous flight auger technique, would be preferable to driven piling, which would generate excessive noise and vibration in nearby properties. The design of piled foundations is usually the responsibility of specialist contractors, but as an illustration, a 450mm diameter bored pile of 16m length is estimated to have a safe working load of 300kN. Groundwater is present and must be allowed for by the piling contractor.
- 6.1.2 The Site soils are predominantly Clay of low volume change potential and a number of trees will be removed to construct the property. Ground heave can be expected and the basement slab, including the swimming pool, must have a minimum void dimension of 50mm if cast on compressible material (Reference 4).
- 6.1.3 The groundwater level at rest was measured at approximately XXXm. The swimming pool and its foundations should therefore be designed to counteract buoyancy uplift.

6.2 Piled Retaining Wall Design and Bank Construction

- 6.2.1 Bored pile retaining walls are generally designed by a specialist piling contractor. The recommended effective stress design parameters for the retaining wall are: topsoil $\phi = 25^\circ$, $c' = 0$, bulk density = 18kN/m³, slipped ground: $\phi = 15^\circ$, $c' = 0$, bulk density = 18kN/m³, unslipped material $\phi = 30^\circ$, $c' = 0$, bulk density = 18kN/m³. The derivation of these parameters is discussed above. $C_u = 40$ kPa (topsoil made ground) and $C_u = 75$ kPa (Weald Clay) are recommended. The contractor's design would be expected to use piles with similar yield moments to those given in Table 2, but not necessarily the same diameter or depth.
- 6.2.2 An alternative to bored piles would be sheet piling. Similar design parameters would apply to sheet piles.
- 6.2.3 The clay fill should be selectively excavated from the basement excavation and placed in horizontal layers along the slope. The minimum layer width must be 3m. A 1m deep key trench must be excavated at the foot of the slope and must be

immediately backfilled in layers. The clay must be compacted with a tined vibratory roller and have a shear strength at or greater than 50kPa. A suggested compaction regime is 9 passes of a 3T tandem roller over 150mm thick layers. If the compacted clay is soft enough for a finger to penetrate, it must be removed and replaced with drier material. No vegetation, bricks or other debris, or frozen material must be incorporated. The works should be inspected and tested by a suitably experienced engineer or inspector.

6.3 Design Sulphate Class

- 6.3.1 The soil test reports presented in Appendix C indicate a soil sulphate content of 0.1g/l to 0.5g/L. This equates to a design sulphate class of DS-1 (Reference 5).

6.4 Further Investigation

- 6.4.1 To enable the piled foundations and retaining walls to be designed, the soils below 6m depth must be investigated. A 20m deep borehole should be drilled following clearance of sufficient trees to enable rig access. This should incorporate standard penetration tests at 2m intervals, undisturbed samples for undrained shear strength testing and Atterburg limit tests and or particle size distribution tests.

P Baxter BEng CEng MICE (Director)

For and on behalf of Peter Baxter Associates Ltd

TABLES

TABLE 1 SUMMARY OF SOIL PARAMETERS

Soil Description	ϕ ' degrees	c ' KN/m²	Cu KN/m²	Bulk Density kN/m³
Slipped clays	15	0	50	18
Undisturbed Clay	30	0	75	18
Granular Fill	45	0	0	18
Reworked clay fill	30	0	75	18

TABLE 2 SUMMARY OF ANALYSIS OUTPUT

Analysis	Description	Analysis Method	Swimming Pool Retaining Wall	Road Retaining Wall	Factor of Safety	Remarks
1	Piled retaining walls, 1 in 1.8 existing slope	Bishop	4.5m long 0.45m diameter piles @ 0.6m centres, yield moment 113kNm	9m long 0.6m diameter piles @ 0.75m centres, yield moment 234kNm	1.04	Shallow failure of slope. Insufficient FOS
2	Piled retaining walls, stone fill on slope $\phi = 45^{\circ}$	Bishop	4.5m long 0.45m diameter piles @ 0.6m centres, yield moment 113kNm	9m long 0.6m diameter piles @ 0.75m centres, yield moment 234kNm	1.26	Failure in Road retaining wall Insufficient FOS
		Bishop			1.38	Failure of slope. Insufficient FOS
3	Compacted fill added to slope to reprofile 1:2.5	Bishop	4.5m long 0.45m diameter piles @ 0.6m centres, yield moment 113kNm	9m long 0.6m diameter piles @ 0.75m centres, yield moment 234kNm	4.49	Undrained short term. Unpropped retaining wall.
3.1	Compacted fill added to slope to reprofile 1:2.5	Bishop	4.5m long 0.45m diameter piles @ 0.6m centres, yield moment 113kNm	9m long 0.6m diameter piles @ 0.75m centres, yield moment 234kNm. Propped by base slab 50kN/m run, and ground floor slab 25kN/m run	1.79	Drained short term analysis
		Janbu			1.83	Similar failure surface
		Bishop			1.48	Slope failure
4	As 3.1 but depth of slipped fill increased	Bishop	4.5m long 0.45m diameter piles @ 0.6m centres, yield moment 113kNm	9m long 0.6m diameter piles @ 0.75m centres, yield moment 234kNm. Propped by base slab 50kN/m run, and ground floor slab 25kN/m run	1.48	Slope failure
		1.48				

Minimum Factor of Safety 1.5

FIGURES



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Notes



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Client

Ansham Architects

Project

Encombe Gardens Stability Review

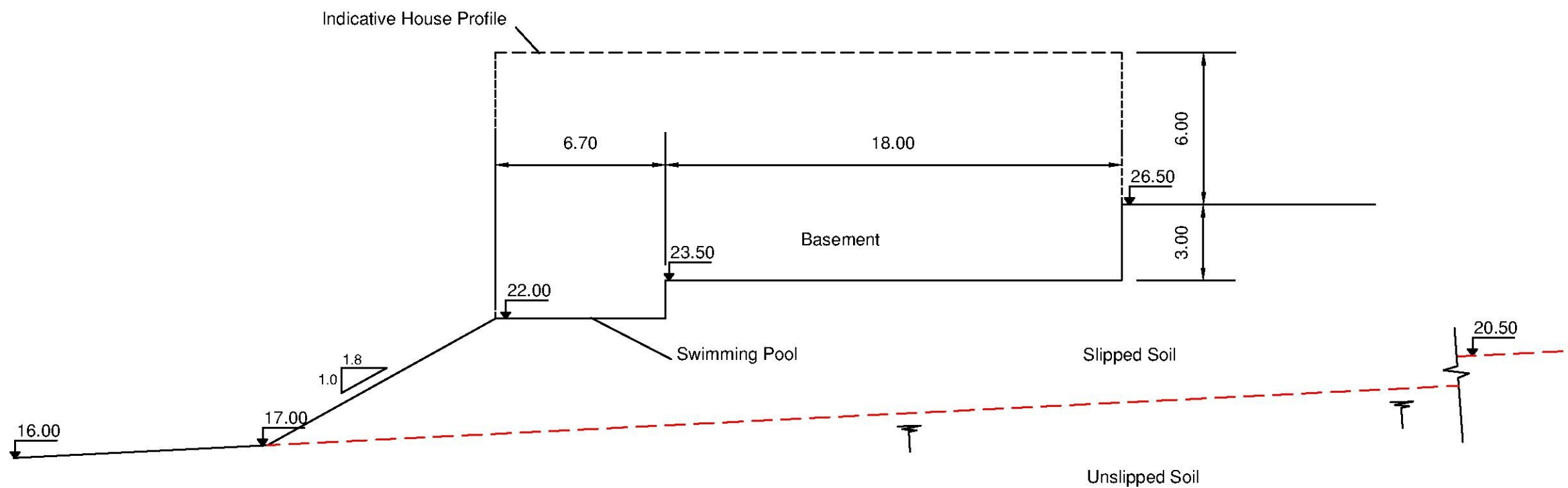
Title

Site Location Plan

A	18.05.18	GB	PB	Information
Rev.	Date	Drm.	App.	Revision

Drawn	GB	Checked	PB
Size	A3	Scale	NTS
Status	Informatio		

Drawing No.	Rev.
1099/Figure 1	A



Notes



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Client

Ansham Architects

Project

Encombe Gardens Stability
Review

Title

Analysis Cross Section

A	18.05.18	GB	PB	Information
Rev.	Date	Drm.	App.	Revision
Drawn GB			Checked PB	
Size	A3	Scale	1:20	Status Informatio
Drawing No. 1099/Figure 2				Rev. A

APPENDICES

APPENDIX A GEOLOGICAL MAPS

Geology 1:50,000 Maps Legends

Artificial Ground and Landslip

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	SLIP	Landslide Deposit	Clay, Silt and Sand	Not Supplied - Quaternary

Superficial Geology

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	TFD	Tidal Flat Deposits	Clay and Silt	Not Supplied - Holocene
	ALV	Alluvium	Clay, Silt, Sand and Gravel	Not Supplied - Holocene
	STOB	Storm Beach Deposits	Gravel	Not Supplied - Quaternary
	PEAT	Peat	Peat	Not Supplied - Quaternary
	BTFU	Beach and Tidal Flat Deposits (Undifferentiated)	Sand, Silt and Clay	Not Supplied - Quaternary
	HEAD	Head	Clay and Silt	Not Supplied - Quaternary
	HEAD	Head	Clay, Silt, Sand and Gravel	Not Supplied - Quaternary

Bedrock and Faults

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	GLT	Gault Formation	Mudstone	Not Supplied - Albian
	HY	Hythe Formation	Sandstone and [Subequal/subordinate] Limestone, Interbedded	Not Supplied - Aptian
	SAB	Sandgate Formation	Sandstone, Siltstone and Mudstone	Not Supplied - Aptian
	FO	Folkestone Formation	Sandstone	Not Supplied - Aptian
	AC	Atherfield Clay Formation	Mudstone, Sandy	Not Supplied - Aptian
	WC	Weald Clay Formation	Mudstone	Not Supplied - Hauterivian

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Geology 1:50,000 Maps

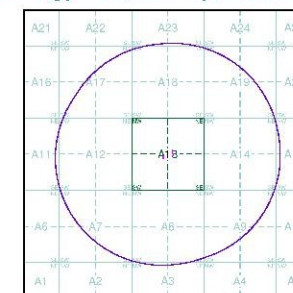
This report contains geological map extracts taken from the BGS Digital Geological map of Great Britain at 1:50,000 scale and is designed for users carrying out preliminary site assessments who require geological maps for the area around the site. This mapping may be more up to date than previously published paper maps.

The various geological layers - artificial and landslip deposits, superficial geology and solid (bedrock) geology are displayed in separate maps, but superimposed on the final 'Combined Surface Geology' map. All map legends feature on this page. Not all layers have complete nationwide coverage, so availability of data for relevant map sheets is indicated below.

Geology 1:50,000 Maps Coverage

Map ID: 1
Map Sheet No: 305
Map Name: Folkestone and I
Map Date: 1966
Bedrock Geology: Available
Superficial Geology: Available
Artificial Geology: Not Available
Faults: Not Supplied
Landslip: Available
Rock Segments: Not Supplied

Geology 1:50,000 Maps - Slice A



Order Details:

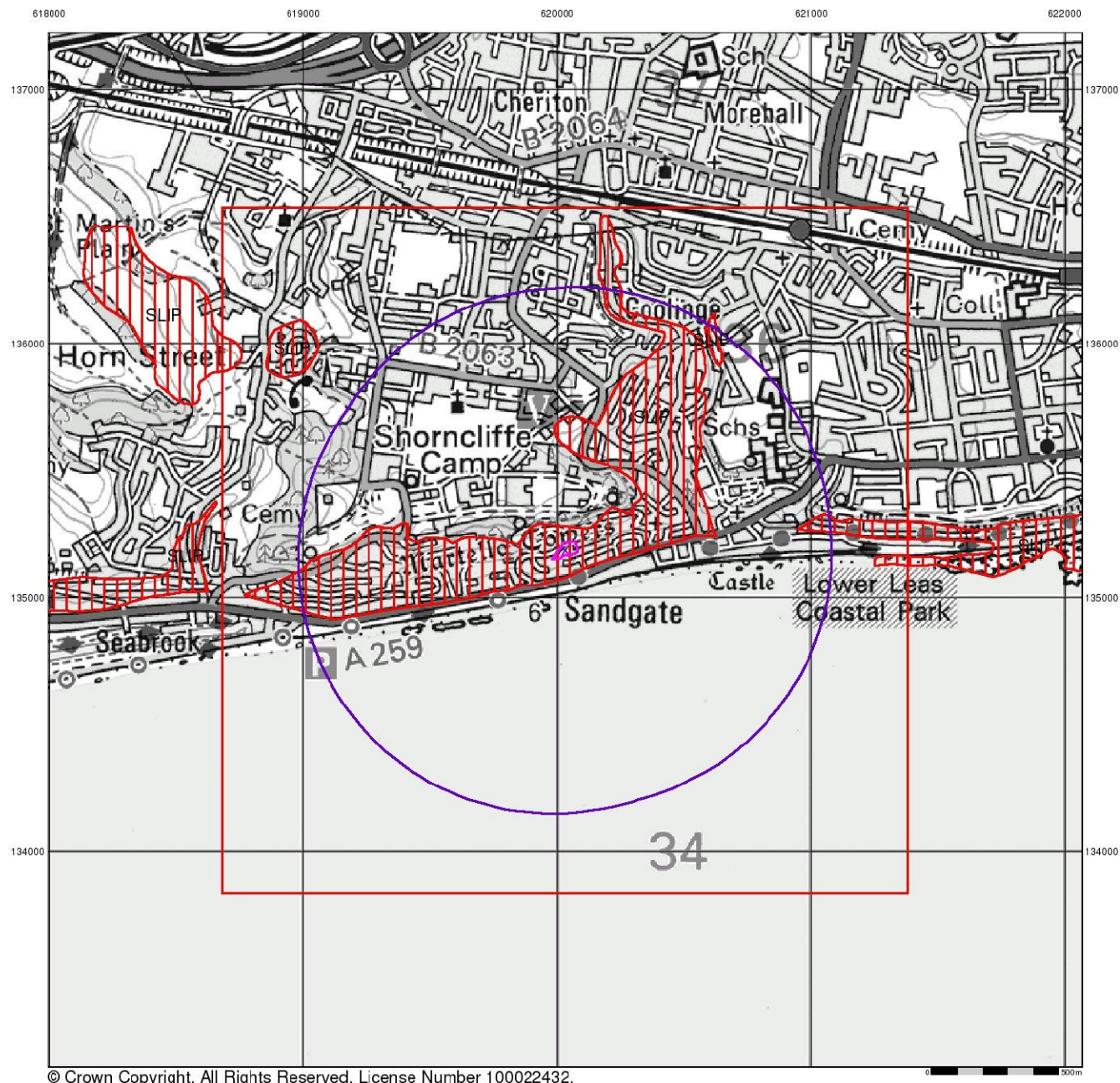
Order Number: 166230501_1_1
Customer Reference: 1099
National Grid Reference: 620030, 135180
Slice: A
Site Area (Ha): 0.4
Search Buffer (m): 1000

Site Details:

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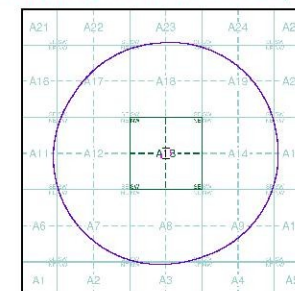
Artificial ground is a term used by BGS for those areas where the ground surface has been significantly modified by human activity. Information about previously developed ground is especially important, as it is often associated with potentially contaminated material, unpredictable engineering conditions and unstable ground.

Artificial ground includes:

- Made ground - man-made deposits such as embankments and spoil heaps on the natural ground surface.
- Worked ground - areas where the ground has been cut away such as quarries and road cuttings.
- Infilled ground - areas where the ground has been cut away then wholly or partially backfilled.
- Landscaped ground - areas where the surface has been reshaped.
- Disturbed ground - areas of ill-defined shallow or near surface mineral workings where it is impracticable to map made and worked ground separately.

Mass movement (landslip) deposits on BGS geological maps are primarily superficial deposits that have moved down slope under gravity to form landslips. These affect bedrock, other superficial deposits and artificial ground. The dataset also includes foundered strata, where the ground has collapsed due to subsidence.

Artificial Ground and Landslip Map - Slice A



Order Details:

Order Number: 166230501_1_1
 Customer Reference: 1099
 National Grid Reference: 620030, 135180
 Slice: A
 Site Area (Ha): 0.4
 Search Buffer (m): 1000

Site Details:

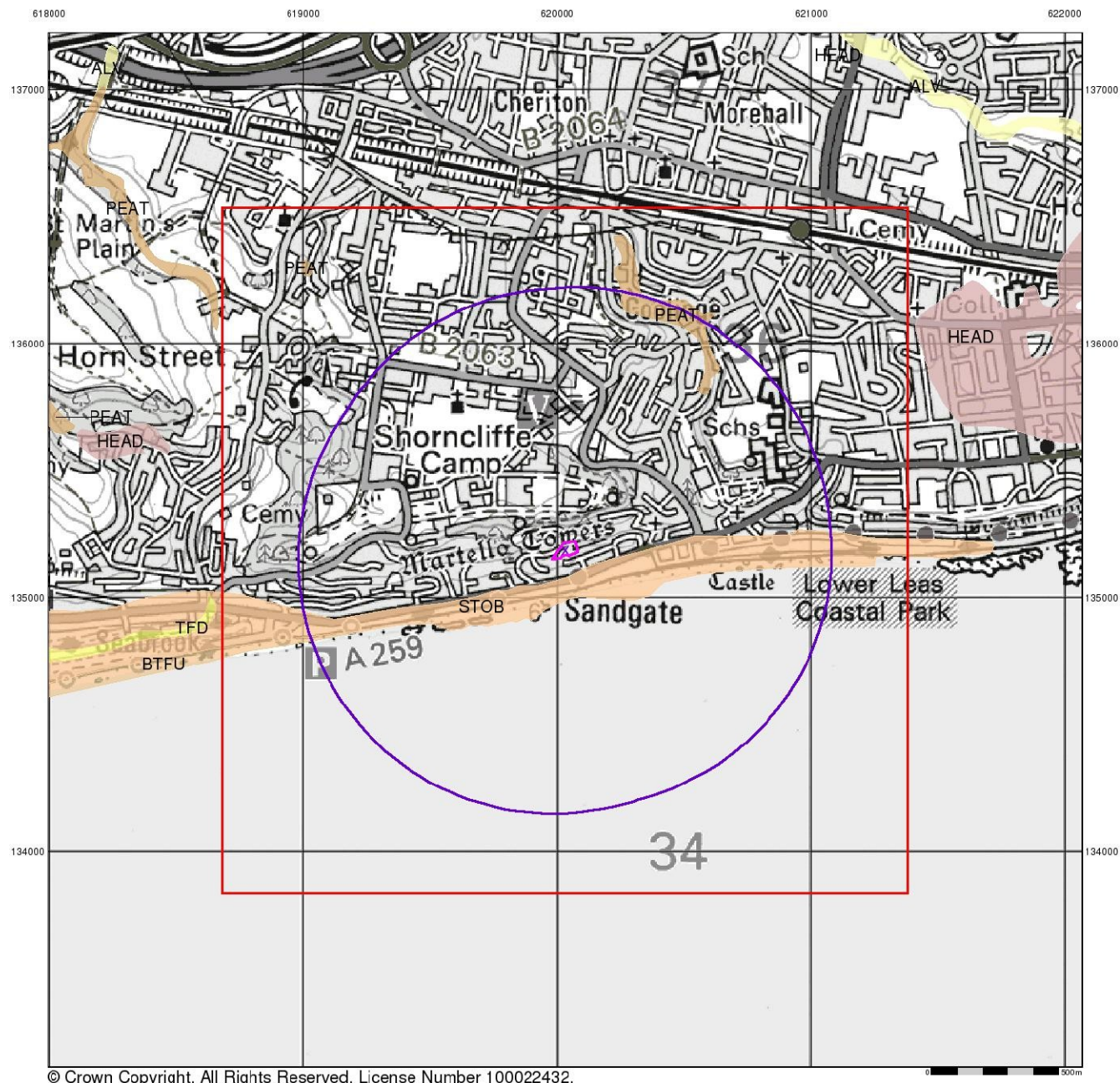
20, Encombe, Sandgate, FOLKESTONE, CT20 3DE

Landmark
 LANDMARK INFORMATION GROUP

Tel: 0844 844 9952
 Fax: 0844 844 9951
 Web: www.envirocheck.co.uk

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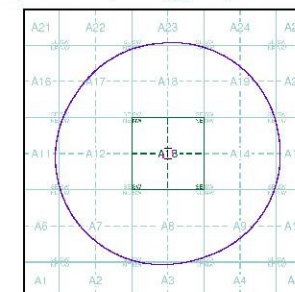
Superficial Geology

Superficial Deposits are the youngest geological deposits formed during the most recent period of geological time, the Quaternary, which extends back about 1.8 million years from the present.

They rest on older deposits or rocks referred to as Bedrock. This dataset contains Superficial deposits that are of natural origin and 'in place'. Other superficial strata may be held in the Mass Movement dataset where they have been moved, or in the Artificial Ground dataset where they are of man-made origin.

Most of these Superficial deposits are unconsolidated sediments such as gravel, sand, silt and clay, and onshore they form relatively thin, often discontinuous patches or larger spreads.

Superficial Geology Map - Slice A



Order Details:

Order Number: 166230501_1_1
 Customer Reference: 1099
 National Grid Reference: 620030, 135180
 Slice: A
 Site Area (Ha): 0.4
 Search Buffer (m): 1000

Site Details:

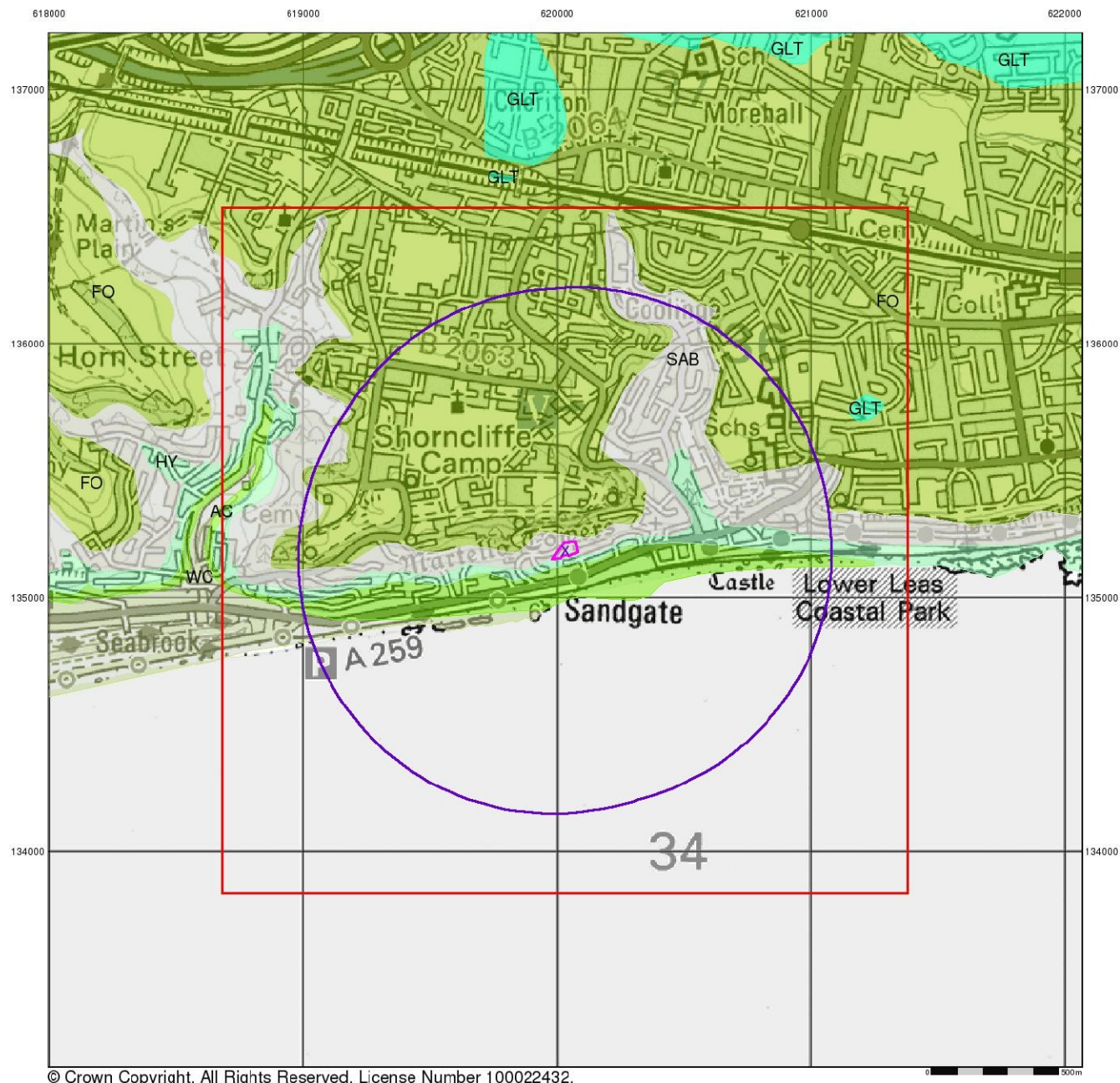
20, Encombe, Sandgate, FOLKESTONE, CT20 3DE

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Bedrock and Faults

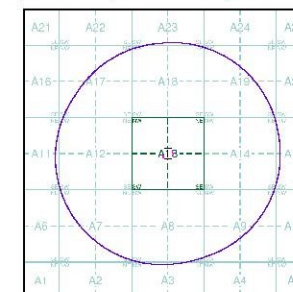
Bedrock geology is a term used for the main mass of rocks forming the Earth and are present everywhere, whether exposed at the surface in outcrops or concealed beneath superficial deposits or water.

The bedrock has formed over vast lengths of geological time ranging from ancient and highly altered rocks of the Proterozoic, some 2500 million years ago, or older, up to the relatively young Pliocene, 1.8 million years ago.

The bedrock geology includes many lithologies, often classified into three types based on origin: igneous, metamorphic and sedimentary.

The BGS Faults and Rock Segments dataset includes geological faults (e.g. normal, thrust), and thin beds mapped as lines (e.g. coal seam, gypsum bed). Some of these are linked to other particular 1:50,000 Geology datasets, for example, coal seams are part of the bedrock sequence, most faults and mineral veins primarily affect the bedrock but cut across the strata and post date its deposition.

Bedrock and Faults Map - Slice A



Order Details:

Order Number: 166230501_1_1
 Customer Reference: 1099
 National Grid Reference: 620030, 135180
 Slice: A
 Site Area (Ha): 0.4
 Search Buffer (m): 1000

Site Details:

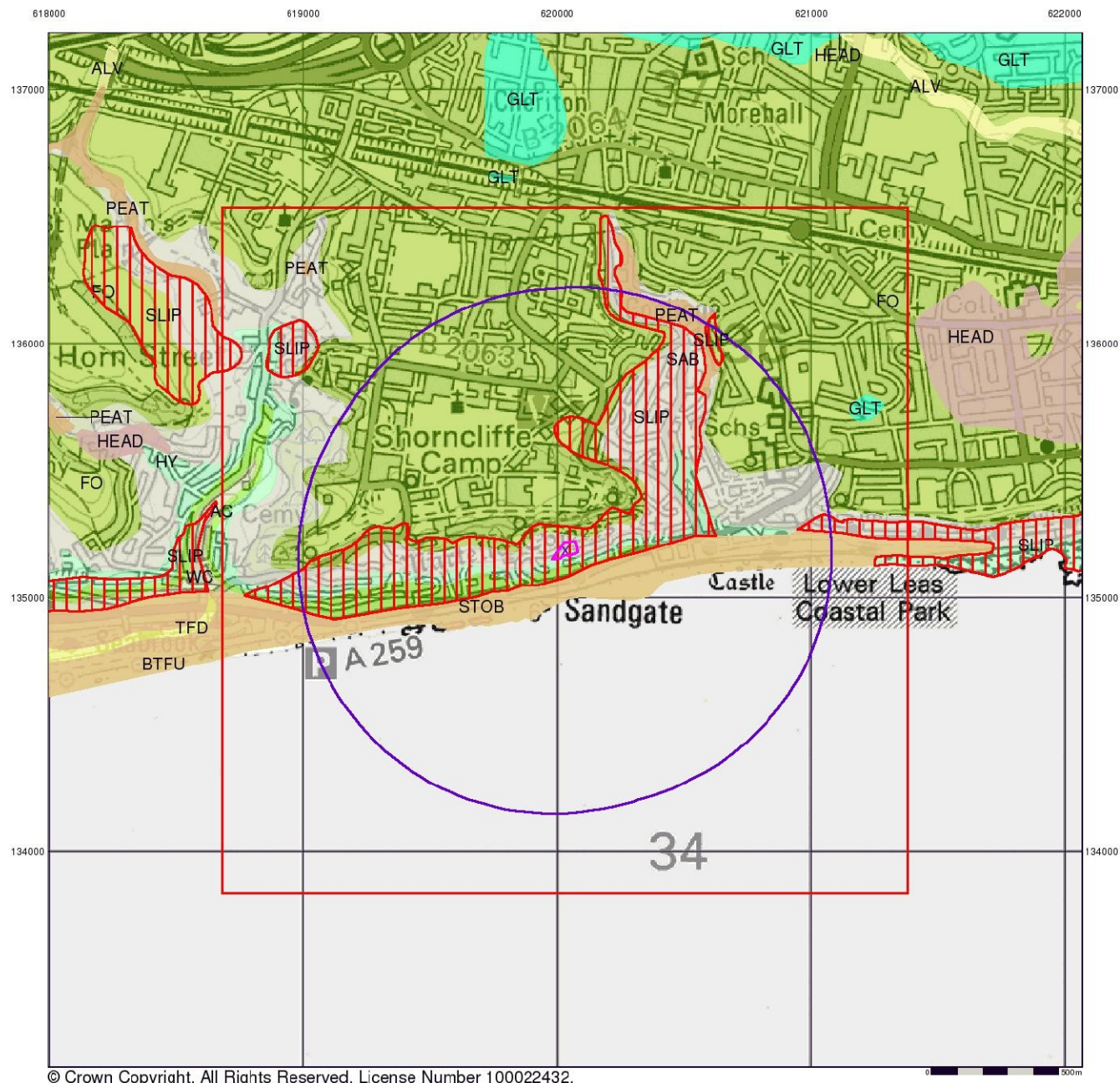
20, Encombe, Sandgate, FOLKESTONE, CT20 3DE

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 Fax: 0844 844 9951
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Combined Surface Geology

The Combined Surface Geology map combines all the previous maps into one combined geological overview of your site.

Please consult the legends to the previous maps to interpret the Combined "Surface Geology" map.

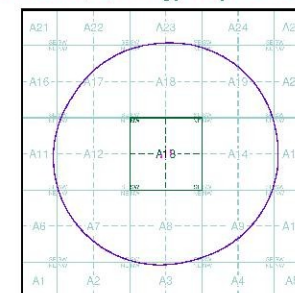
Additional Information

More information on 1:50,000 Geological mapping and explanations of rock classifications can be found on the BGS website. Using the LEX Codes in this report, further descriptions of rock types can be obtained by interrogating the 'BGS Lexicon of Named Rock Units'. This database can be accessed by following the 'Information and Data' link on the BGS website.

Contact

British Geological Survey
Kingsley Dunham Centre
Keyworth
Nottingham
NG12 5GG
Telephone: 0115 936 3143
Fax: 0115 936 3276
email: enquiries@bgs.ac.uk
website: www.bgs.ac.uk

Combined Geology Map - Slice A



Order Details:

Order Number: 166230501_1_1
Customer Reference: 1099
National Grid Reference: 620030, 135180
Slice: A
Site Area (Ha): 0.4
Search Buffer (m): 1000

Site Details:

20, Encombe, Sandgate, FOLKESTONE, CT20 3DE

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Web: www.envirocheck.co.uk

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APPENDIX B

FIELD DATA

APPENDIX B1

Borehole Logs



Peter Baxter Associates Ltd, Suite 7, Reservoir House,
 51 Thomas Longley Road, Madway City Estate,
 Rochester, Kent ME2 4FB Tel: 01634 717974

Project: Encombe Gardens, Sandgate CT20 3DE

Client: Ansham Architects

Date Started: 10/04/2018
 Date Completed: 10/04/2018

Method/Plant Used: Windowless Sampling
 Diameter: 100mm

Ground Level:

Co-ordinates:

BH/WS/TP

WS1

Job
 Number
 1099

Progress			Strata				Samples and Tests				Installation
Date	Casing	Water	Level (m AOD)	Legend	Depth (Thickness)	Description of Strata	Depth	Type	Test	Field Results	
					0.30 (0.40) 0.70 (0.60) 1.30 (1.10) 2.40 (0.60) 3.00 (1.20) 4.20 (0.90) 5.10 (0.40) 5.50 (0.25) 5.75 (0.25) 6.00	Topsoil Stiff brown slightly sandy CLAY with sandstone and brick fragments Firm dark brown sandy CLAY with sandstone fragments (Landslip Debris) Stiff brown mottled orange brown slightly sandy CLAY with sandstone fragments and rootlets (Landslip Debris) Stiff dark brown sandy CLAY with sandstone fragments and rootlets (Landslip Debris) Soft to firm greenish grey mottled brown sandy CLAY rootlets (Landslip Debris) Soft brown sandy CLAY with siltstone fragments (Landslip Debris) Firm to stiff dark brown CLAY with rootlets (Landslip Debris) Firm greenish grey sandy CLAY Stiff dark brown sandy CLAY (Landslip Debris) End of Borehole	0.60 1.30 2.30 3.20 4.20 5.50	D D D D D			
Notes/Remarks			No groundwater encountered				Scale 1:50	Logged KB	Checked PB		



Peter Baxter Associates Ltd, Suite 7, Reservoir House,
 51 Thomas Langley Road, Madway City Estate,
 Rochester, Kent ME2 4FB Tel: 01634 717974

Project: Encombe Gardens, Sandgate CT20 3DE

Client: Ansham Architects

Date Started: 10/04/2018
 Date Completed: 10/04/2018

Method/Plant Used: Windowless Sampling
 Diameter: 100mm

Ground Level:

Co-ordinates:

BH/WS/TP
WS2

Job
 Number
1099

Progress			Strata				Samples and Tests				Installation
Date	Casing	Water	Level (m AOD)	Legend	Depth (Thickness)	Description of Strata	Depth	Type	Test	Field Results	
					0.20	Topsoil					
					(0.40)	Stiff grey brown sandy CLAY with rootlets (Landslip Debris)	0.50	D			
			1.0		0.60						
					(1.20)	Stiff brown mottled grey slightly sandy CLAY (Landslip Debris)	1.30	D			
			2.0		1.80						
					(1.10)	Stiff brown sandy CLAY (Landslip Debris)	2.30	D			
			3.0		2.90						
					(0.70)	Firm brown mottled orange brown sandy CLAY with siltstone fragments (Landslip Debris)	3.20	D	HV HV HV	30kPa 60kPa 36kPa	
			4.0		3.60						
					(1.40)	Firm green grey mottled brown sandy CLAY with rootlets (Landslip Debris)	4.20	D	HV HV	30kPa 27kPa	
			5.0		5.00						
					(1.00)	Soft olive greenish grey mottled brown sandy CLAY (wet) (Landslip Debris)	5.50	D D			
			6.0		6.00						
						End of Borehole					
			7.0								
			8.0								
			9.0								
			10.0								
						End of Borehole					
Notes/Remarks						Scale		Logged		Checked	
No groundwater encountered during drilling. GWL 3.2m depth on 24/04/18						1:50		KB		PB	

APPENDIX B2

Trial Pit Logs



TRIAL PIT LOG

Site: Encombe Gardens, Sandgate CT20 3DE Kent TN12 6JU		TP 1
Excavation Method Mini Excavator	Ground Level	Project: Site Investigation
Location	Date 10/04/2018	
Client: Ansham Architects		Numbr 1096

Depth (m)	Samples/ Tests	Water Depth (m)	Field Records	Depth (m bgl)	Thickness m	Description of Strata	Legen
1.30	D				(0.30) 0.30	TOPSOIL with roots and rootlets	
				0.50	(0.60)	Loose grey brown silty SAND	
				1.0	0.90 (0.40)	Brown clayey SAND with sandstone fragments (Landslip Debris)	
1.80	D			1.50	1.30		
				2.0		Stiff grey brown mottled orange brown silty SAND	
				3.0		Base of Trial Pit	

Plan	Remarks



TRIAL PIT LOG

Site: Encombe Gardens, Sandgate CT20 3DE
Kent TN12 6JU

TP
2

Excavation Method
Mini Excavator

Ground Level

Project:
Site Investigation

Location

Date
10/04/2018

Client:
Ansham Architects

Numbr
1095

Depth (m)	Samples/ Tests	Water Depth (m)	Field Records	Depth (m bgl)	Thickness m	Description of Strata	Legen
1.10	D				(0.30) 0.30	TOPSOIL with roots and rootlets	
				0.50	(0.60)	Firm brown slightly sandy CLAY with mudstone/sandstone and rootlets 0.60m: Concrete boulder and brick fragments	
				1.0	0.90 (0.40)	Stiff grey sandy CLAY with sandstone/siltstone fragments and rootlets (Landslip Debris)	
1.90	D			1.50	1.30		
				2.0		Base of Trial Pit	
				3.0			

Plan

Remarks

Scale 1:25

Logged KB

Checked PB



TRIAL PIT LOG

Site: Encombe Gardens, Sandgate CT20 3DE
Kent TN12 6JU

TP
3

Excavation Method
Mini Excavator

Ground Level

Project:
Site Investigation

Numbr

Location

Date
10/04/2018

Client:
Ansham Architects

1095

Depth (m)	Samples/ Tests	Water Depth (m)	Field Records	Depth (m bgl)	Thickness m	Description of Strata	Legen
1.00	D				(0.30)	TOPSOIL with roots and rootlets	
				0.50	0.30	Firm brown mottled orange brown slightly sandy CLAY with sandstone gravel and cobbles	
				1.0	(0.60)		
					0.90		
				1.50	(0.40)	Grey brown clayey SAND with rootlets (Landslip Debris)	
1.70	D				1.30	Below 1.70m: yellow brown	
				2.0			
						Base of Trial Pit	
				3.0			

Plan

Remarks

Scale

1:25

Logged

KB

Checked

PB

APPENDIX B3
Equivalent SPT Plots



Project: Sandgate Encombe Gardens

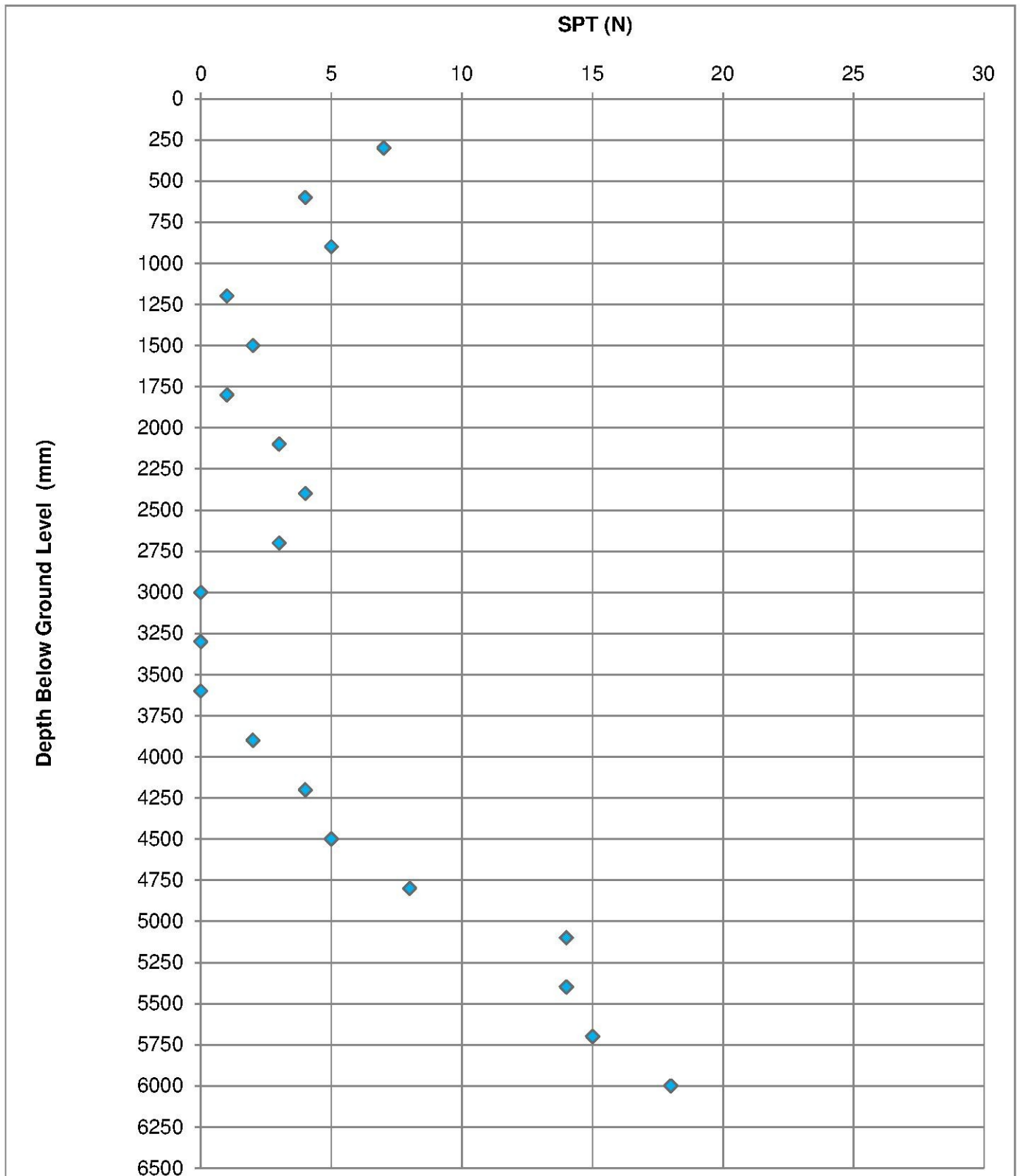
Job: 1099

Client: Ansham Architects

Date: Apr-18

Equivalent SPT/ Depth Plot

Location: WS1





Project: Sandgate Encombe Gardens

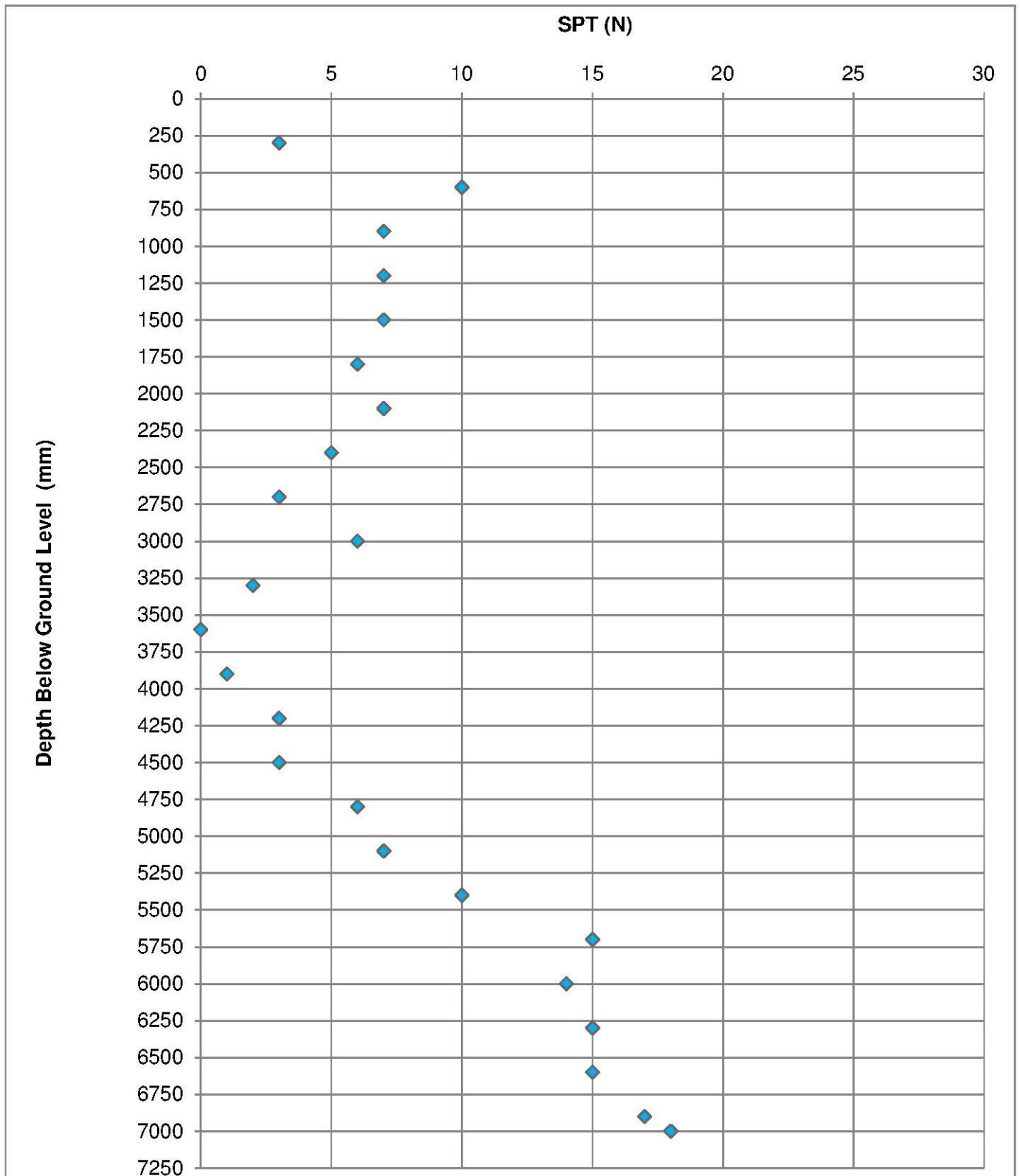
Job: 1099

Client: Ansham Architects

Date: Apr-18

Equivalent SPT/ Depth Plot

Location: WS2



APPENDIX C
LABORATORY TEST REPORTS

APPENDIX C1
Atterburg Limits Test Report

Client: Ansham Architects Ltd

Report No: 1099/MC1

Address: Unit 1
83 Cheriton Road
Folkestone
Kent
CT19 4AT

Your Ref: N/A

Report Date: 11/05/2018

Client Contact: Mr Shyam Patel

Site: Encombe Gardens, Sandgate CT20 3DE

Test Requested: **Determination of Moisture Content, Liquid, Plastic Limits & Plasticity Index**

Test Method: BS 1377-2: 1990, Test Nos. 3.2; 4.4 (1 point LL); 5.3; & 5.4

Sample Details: Sampled and submitted by: Peter Baxter Associates Ltd

Date Sampled: 10/04/2018

Date Received: 10/04/2018

Date Tested: 17/04/2018

TEST RESULTS:

Laboratory Reference	Client Reference		MC (%)	L.L (%)	P.L (%)	P.I (%)	% Retained on 425µm sieve	Condition of Test	Sample Type
	BH/WS/TP	Ref.							
1099/01	WS1 @ 1.20m	N/A	20	36	17	19	1	Natural	D
1099/02	WS1 @ 3.00m	N/A	23	38	22	16	1	Natural	D
1099/03	WS1 @ 4.00m	N/A	27	34	19	15	0	Natural	D
1099/04	WS1 @ 5.60m	N/A	26	34	22	12	0	Natural	D
1099/05	WS2 @ 2.30m	N/A	20	41	22	19	2	Natural	D
1099/06	WS2 @ 4.20m	N/A	29	35	21	14	0	Natural	D
1099/07	WS2 @ 5.50m	N/A	30	35	21	14	0	Natural	D

Visual Descriptions:

Laboratory Reference	Client Reference	Description
1099/01	WS1 @ 1.20m	Brown sandy CLAY with rootlets
1099/02	WS1 @ 3.00m	Brown sandy CLAY with rootlets
1099/03	WS1 @ 4.00m	Grey sandy CLAY
1099/04	WS1 @ 5.60m	Grey sandy CLAY
1099/05	WS2 @ 2.30m	Brown sandy CLAY with gravel
1099/06	WS2 @ 4.20m	Olive green brown sandy CLAY
1099/07	WS2 @ 5.50m	Olive green sandy CLAY

Note: All samples received for this job shall be disposed of after 28 days of this report.

END OF TEST REPORT.....

Signed: _____ Kwaku Baah - Laboratory Manager

For and on behalf of PBA Laboratories

APPENDIX C2
Sulphate and pH Test Report

Client: Ansham Architects Ltd

Address: Unit 1
83 Cheriton Road
Folkestone
Kent

Report No: 1099/CH1

Your Ref: N/A

Report Date: 11/05/2018

Client Contact: Mr Shyam Patel

Site: Encombe Gardens, Sandgate CT20 3DE

Test Requested: Determination of pH Value and Sulphate Content

Test Method: BS 1377-3: 1990, Clauses 5.5 & 9.5

Sample Details: Sampled and submitted by: Peter Baxter Associates Ltd
Date Sampled: 10/04/2018
Date Received: 10/04/2018
Date Tested: 23/04/2018

TEST RESULTS:

Laboratory Reference	Client Reference		Soil Sulphates as SO ₄		Water Sulphates as SO ₄	pH	CLASS*	Dry Mass Passing 2mm test sieve (%)	Description
	BH/WS	Sample Ref	Total (%)	Water Soluble (g/L)	(g/L)				
1099/01	WS1 @ 1.20m	N/A	-	0.1	-	6.1	DS-1	99	Brown sandy CLAY with rootlets
1099/02	WS1 @ 3.00m	N/A	-	0.5	-	5.7	DS-1	97	Brown sandy CLAY with rootlets
1099/04	WS1 @ 5.60m	N/A	-	0.2	-	6.2	DS-1	100	Grey sandy CLAY

* Classification based on Tables C1 & C2: BRE Special Digest 1:2005

.....END OF TEST REPORT.....

Signed:  Kwaku Baah - Laboratory Manager

For and on behalf of PBA Laboratories

APPENDIX C3
Particle Size Distribution Test Reports

Client: Ansham Architects Ltd

Report No: 1099/08

Address: Unit 1, 83 Cheriton Road
Folkestone
Kent
CT19 4AT

Your Ref: N/A

Report Date: 11/05/2018

Client Contact: Mr Shyam Patel

Site: Encombe Gardens, Sandgate CT20 3DE

Test Requested: Particle Size Distribution

Test Method: BS 1377-2 : 1990 : Clause 9.2

Sample Details: Sampled and submitted by: Peter Baxter Associates Ltd
Client Ref: TP1 @ 1.20m
Laboratory Ref: 1099/08
Date Received: 10/04/2018

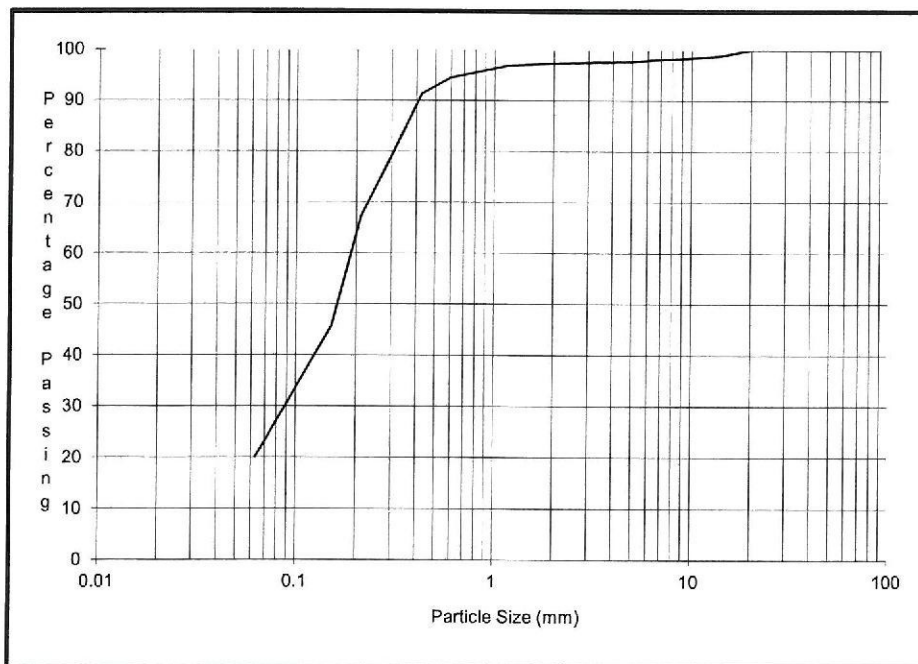
Date Tested: 20/04/2018

Date Sampled: 10/04/2018

Type of Sample Disturbed

Visual Description: Brown very sandy CLAY with rootlets

Preparation Method : In accordance with BS 1377-1:1990



PARTICLE SIZE	
mm	% Passing
90	100
75	100
63	100
50	100
37.5	100
28	100
20	100
14	99
10	98
6.3	98
5	98
3.35	98
2	97
1.18	97
0.6	94
0.425	91
0.3	79
0.212	68
0.15	46
0.063	20

Comments :

Signed : [Redacted Signature] Kwaku Baah - Laboratory Manager

For and on behalf of PBA Laboratories

Client: Ansham Architects Ltd

Report No: 1099/09

Address: Unit 1, 83 Cheriton Road
Folkestone
Kent
CT19 4AT

Your Ref: N/A

Report Date: 11/05/2018

Client Contact: Mr Shyam Patel

Site: Encombe Gardens, Sandgate CT20 3DE

Test Requested: Particle Size Distribution

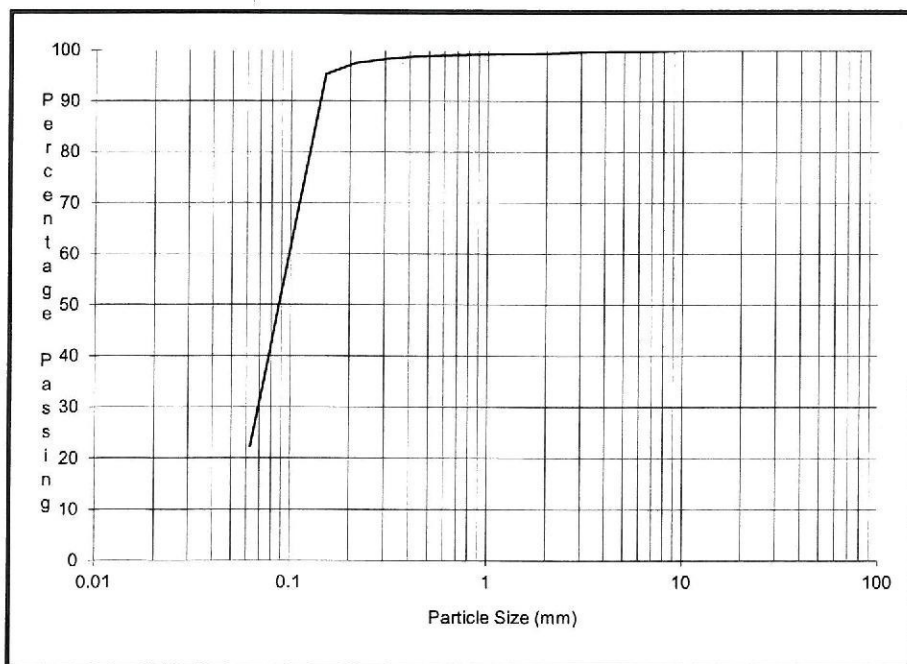
Test Method: BS 1377-2 : 1990 : Clause 9.2

Sample Details: Sampled and submitted by: Peter Baxter Associates Ltd
Client Ref: TP3 @ 1.70m
Laboratory Ref: 1099/09
Date Received: 10/04/2018

Date Tested: 20/04/2018
Date Sampled: 10/04/2018
Type of Sample Bulk

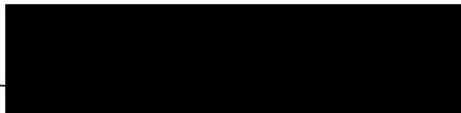
Visual Description: Olive green brown very sandy CLAY with rootlets

Preparation Method : In accordance with BS 1377-1:1990



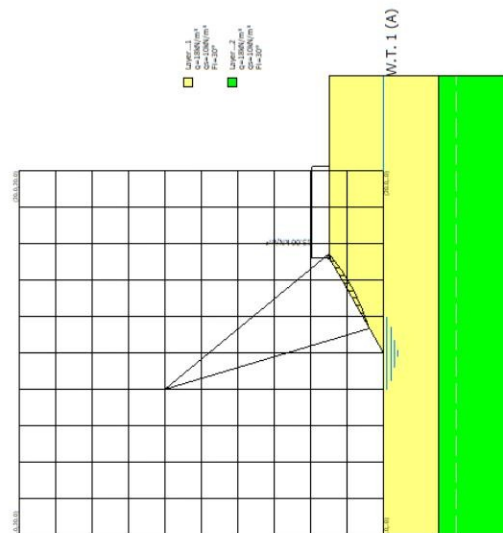
PARTICLE SIZE	
mm	% Passing
90	100
75	100
63	100
50	100
37.5	100
28	100
20	100
14	100
10	100
6.3	100
5	100
3.35	100
2	99
1.18	99
0.6	99
0.425	99
0.3	98
0.212	97
0.15	95
0.063	22

Comments :

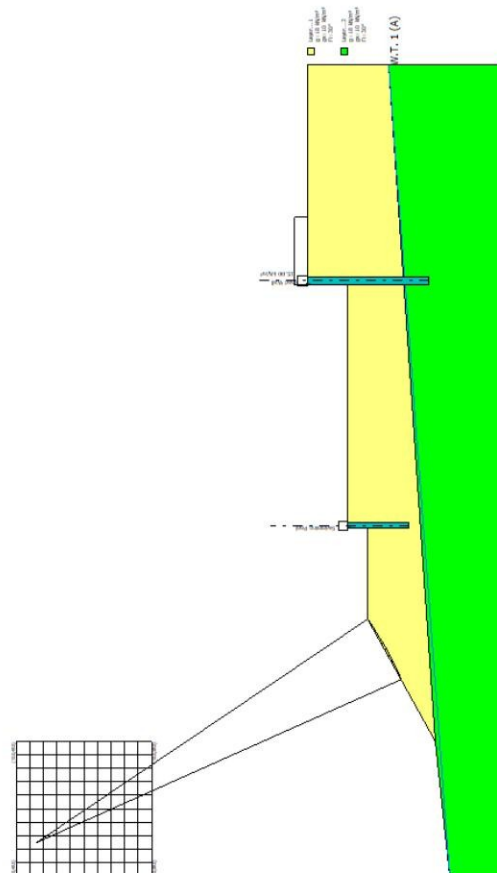
Signed :  Kwaku Baah - Laboratory Manager

For and on behalf of PBA Laboratories

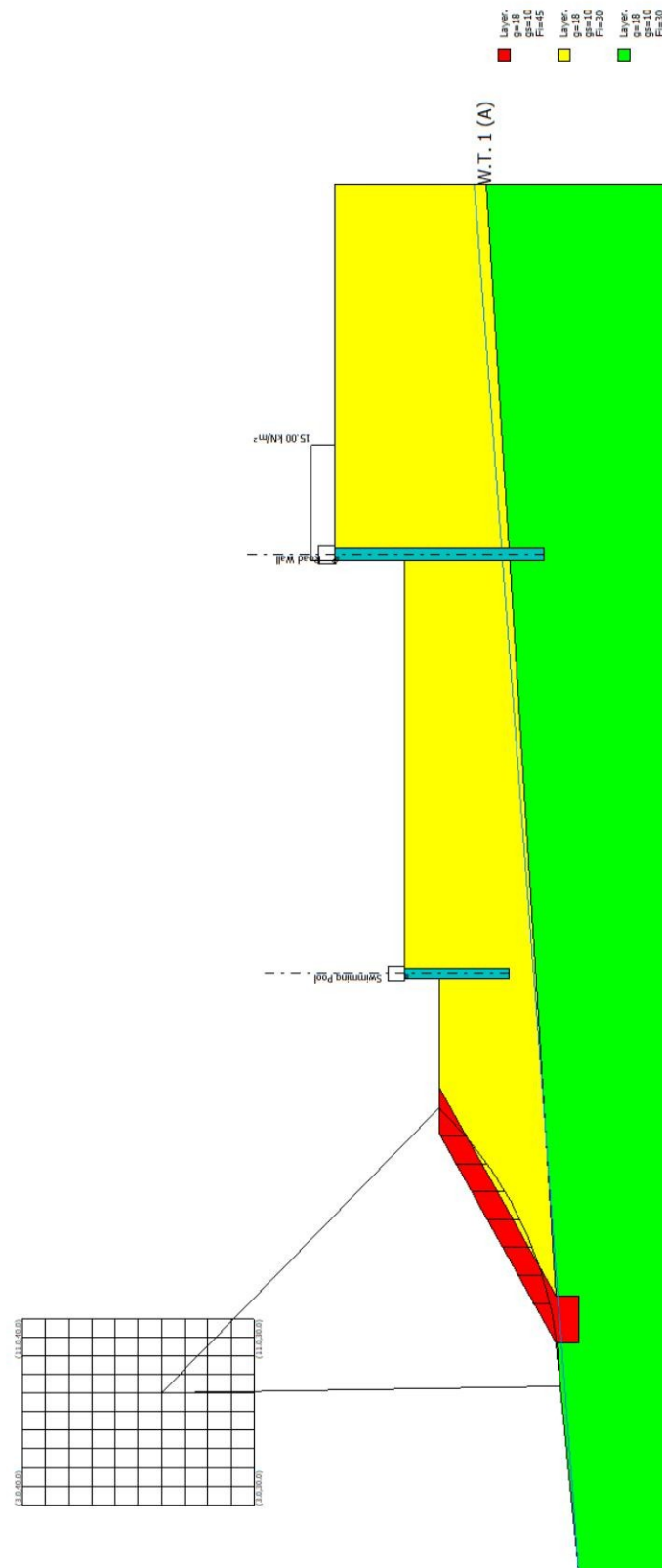
APPENDIX D
SLOPE STABLITITY ANALYSIS PLOTS



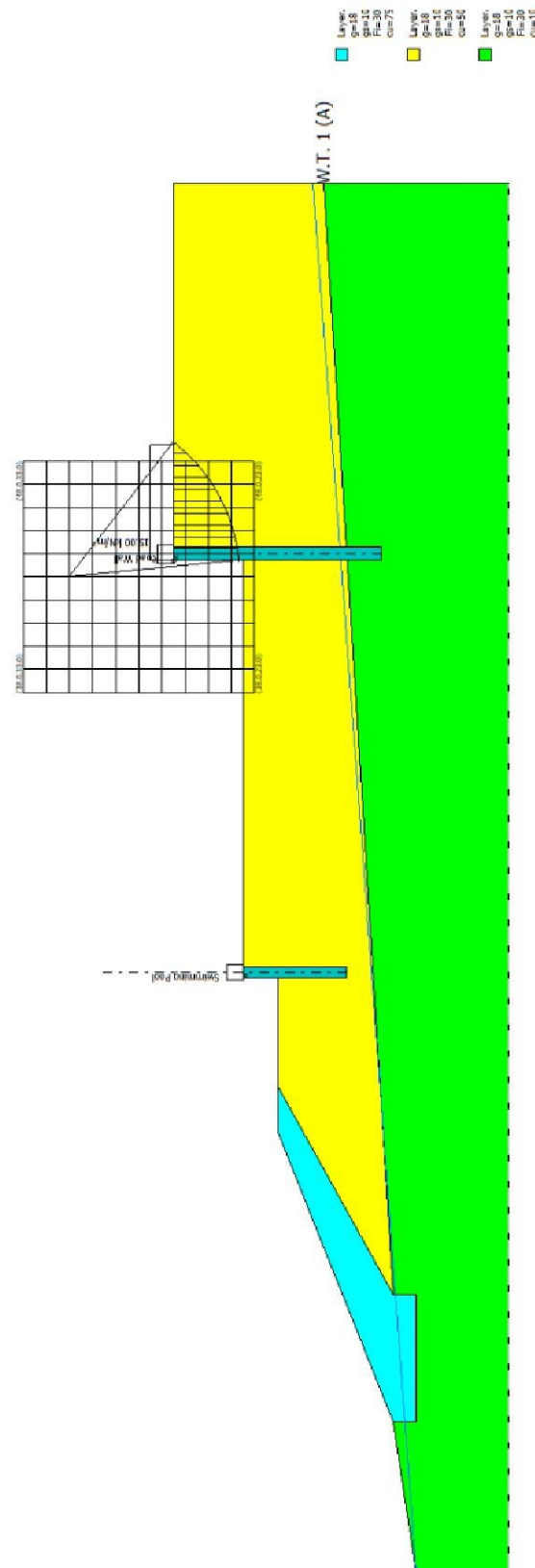
1 in 1.5 slope to verify soil parameters. FOS 1.03



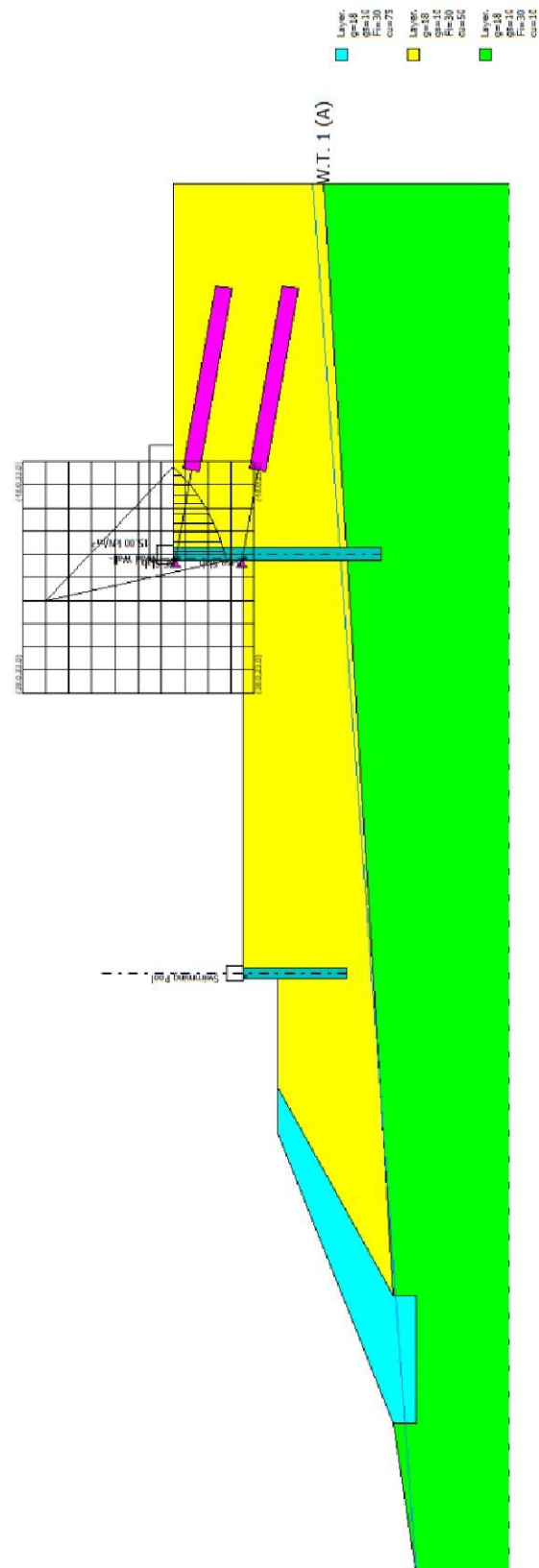
Analysis 1. FOS 1.04



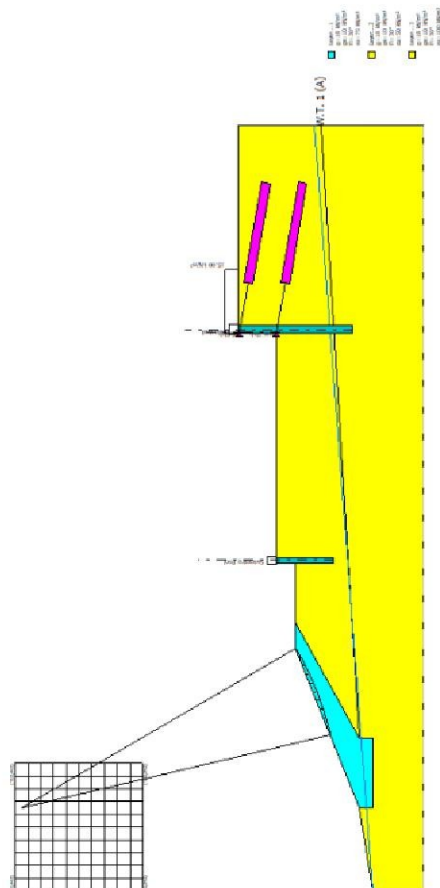
Analysis 2. FOS 1.38 on slope



Analysis 3. FOS 4.49 short term



Analysis 3.1 Long Term, wall propped by basement and ground floor slabs



Analysis 4.0, Slipped ground to 12mAOD, shallow slope failure

APPENDIX E PHOTOGRAPHS



Photo 1 Site from Encombe Gardens



Photo 2 Site from Encombe Gardens showing bent trees on slope



Photo 3 Site from Encombe Gardens showing bent trees on slope



Photo 4 Site from Encombe Gardens



Photo 5 Site from footpath illustrating level differences



Photo 6 Site showing 1 in 1.8 analysed slope



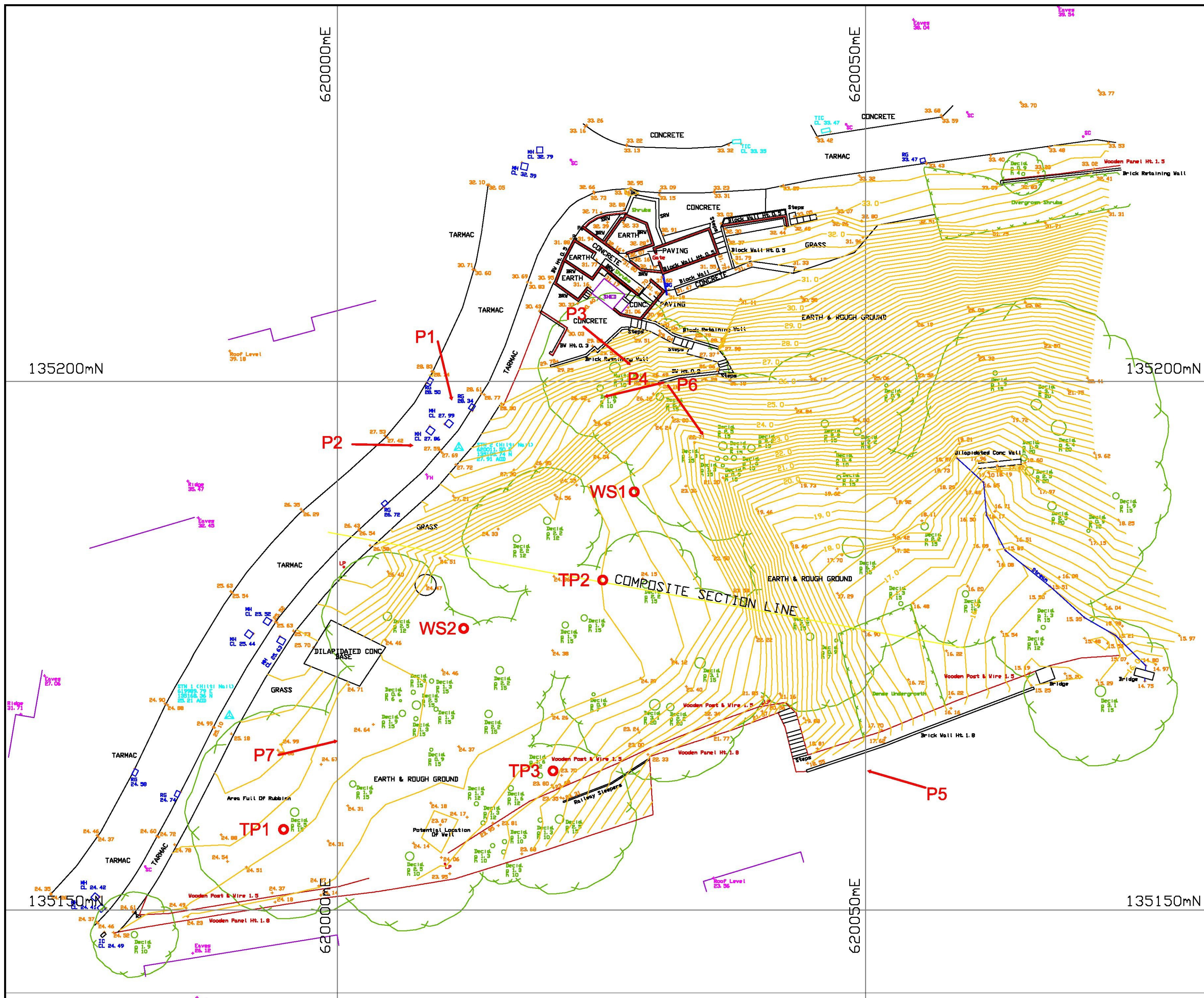
Photo 7 Site



Typical trial pit



APPENDIX F DRAWINGS



Notes
Based on client survey drawing 10960-17
March 2017, Siteh Suurveying Services



Peter Baxter Associates Ltd, Beaufort House, Sir
Thomas Longley Road, Medway City Estate,
Rochester, Kent ME2 4FB. Tel. +44 (0)1634 717974

Client
Ansham Architects

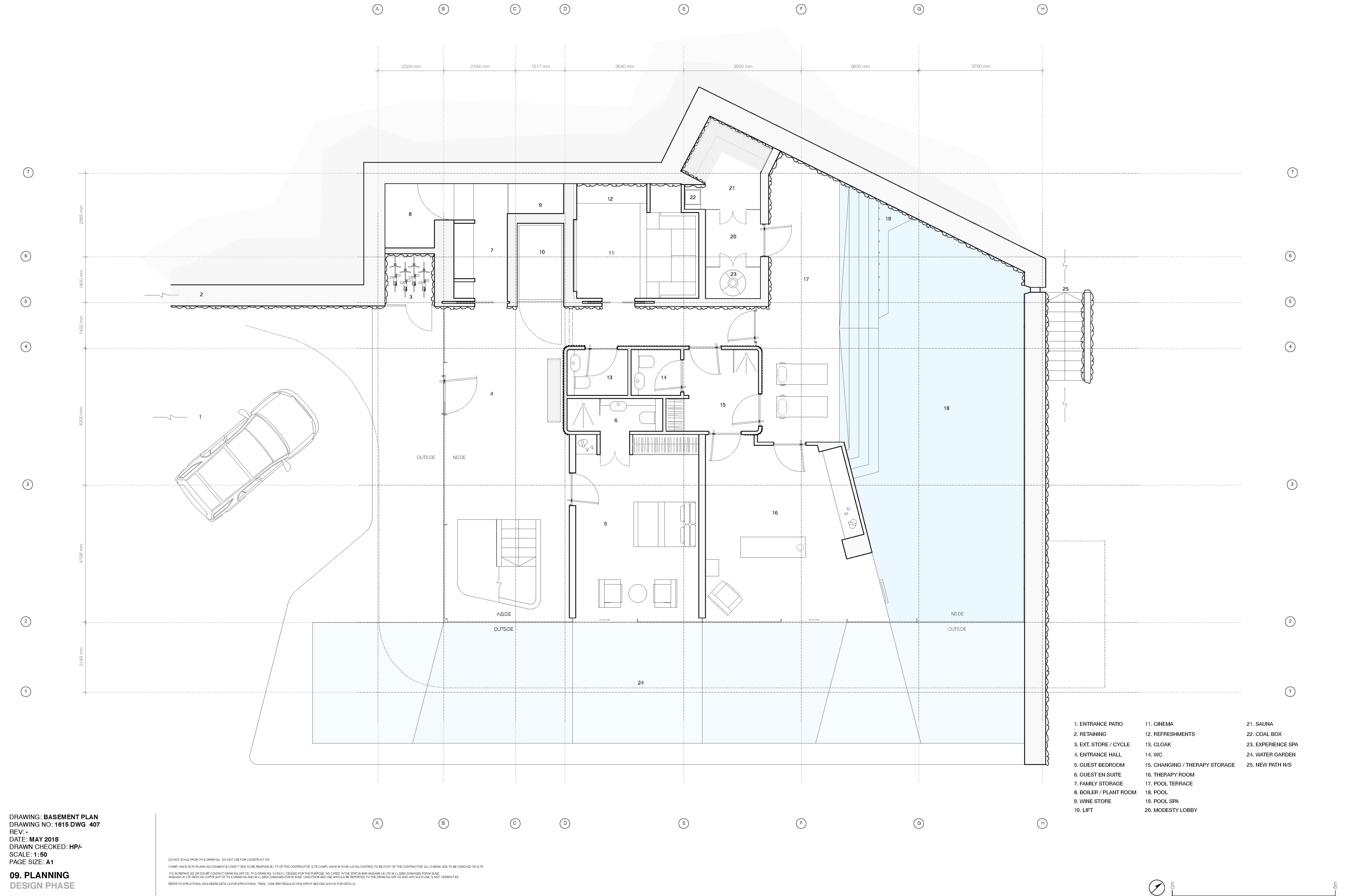
Project
Encombe Gardens Stability
Review

Title
Survey Showing Analysis
Section and Investigation Locations

A				
Rev.	Date	Dm.	App.	Revision

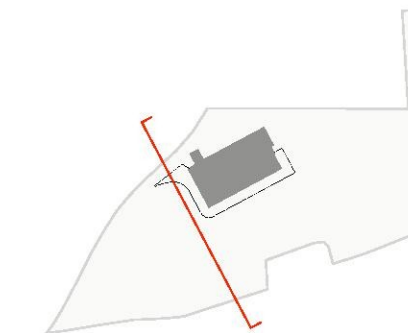
Drawn	GB	Checked	
Size	A2	Scale	1:250
		Status	Information
Drawing No.	1099/001	Rev.	A



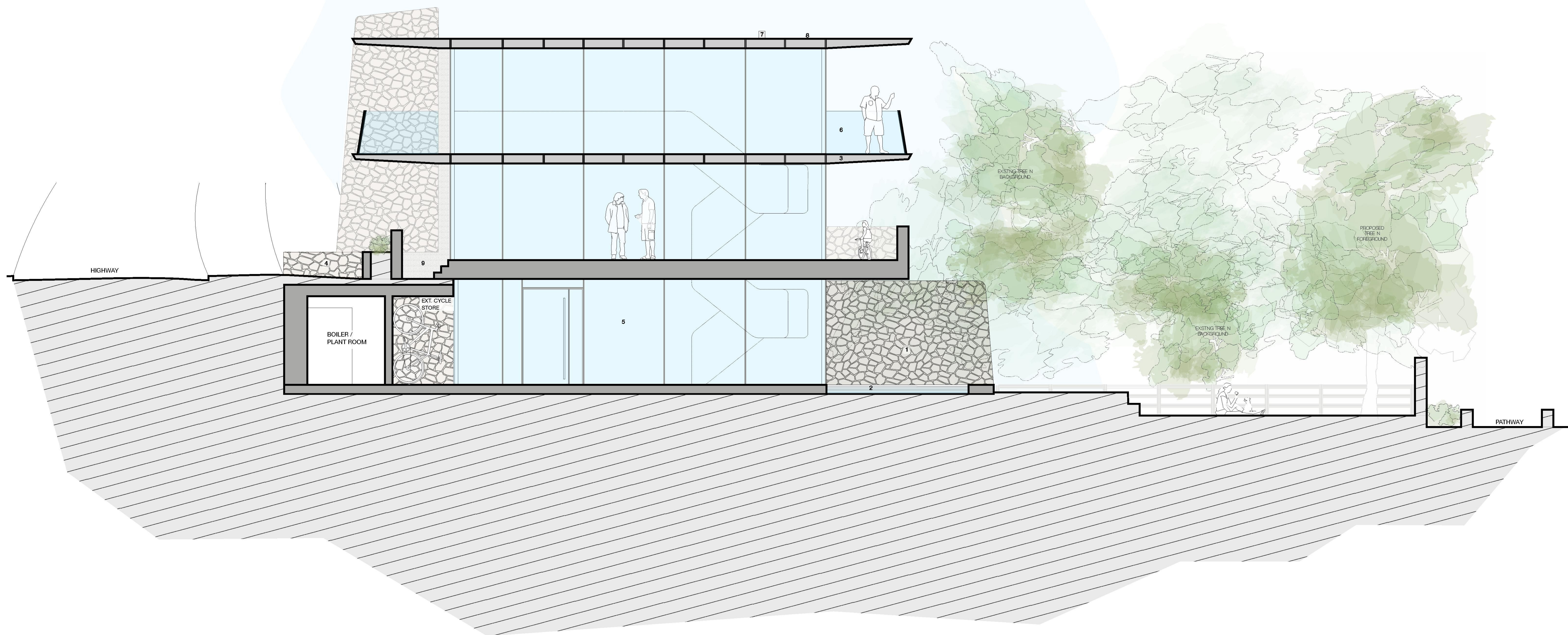


DRAWING: BASEMENT PLAN
DRAWING NO: 1615 DWG 407
REV: -
DATE: MAY 2018
DRAWN CHECKED: HP/
SCALE: 1:50
PAGE SIZE: A1

09. PLANNING
DESIGN PHASE



1. RAGESTONE
2. PORCLLIEN TILE
3. ALUMINIUM CLADDING
4. RAGSTONE TILES
5. FLAMELESS GLAZING
6. TAPERED GLASS BALISTRADE
7. CHIMNEY FLUME
8. GREEN SEEDUM ROOF
9. STUCCO



DRAWING: **ELEVATION**
DRAWING NO: **1615 DWG 412**
REV: -
DATE: **MAY 2018**
DRAWN CHECKED: **HP/-**
SCALE: **1:50**
PAGE SIZE: **A1**

09. PLANNING DESIGN PHASE

[illegible]