



Intégrale

Understanding Ground Conditions

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Proposed Residential Development
Land South East of 18 Midford Lane
Limpley Stoke
Nr Bath
BA2 7GP

GEOTECHNICAL AND PHASE II CONTAMINATION REPORT

REPORT NO. 18022, January 2019

GEOLOGICAL • GEOTECHNICAL • ENVIRONMENTAL • ENGINEERING

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Proposed Residential Development
Geotechnical and Phase II Contamination Report
Land South East of 18 Midford Lane
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Client: Swinhay Limited

Intégrale Report No. 18022, January 2019

		Signature/Date
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EXECUTIVE SUMMARY

18022 - Land South East of 18 Midford Lane, Limpley Stoke

Swinhay Limited propose to develop this unoccupied land with 2 no. detached, split level dwellings.

The geology map reports Upper Rags & Bath Oolite (limestone) of Jurassic age, overlying the Twinhoe Beds and Combe Down Oolite of similar age. The BGS Viewer shows the site as being underlain by the Chalfield Oolite Formation (the parent unit). A former quarry face is present centrally and the thickness of quarry backfill is unknown. Old maps show that the site has remained largely unchanged since 1887, with some residential development in the surrounding areas, within Limpley Stoke.

Intrusive investigation by Greenfield Associates (Report No. RT/ML/101, March 2018) has established two distinct sequences of ground conditions; undisturbed areas and disturbed areas. In undisturbed areas, topsoil was proven over 'brashy' deposits comprising gravels and cobbles in a silt/clay matrix down to 1-2m with inferred limestone bedrock below. In disturbed areas, quarry backfill Made Ground was proven to 2.5-3.5 depth and the base of the quarry was not proven. Groundwater was not encountered.

Intégrale completed a phased intrusive ground investigation comprising mechanically excavated trial pits and deeper rotary probe boreholes in November 2018. The combined investigations have established deep (opencast) quarry backfill to c.8-10m in the eastern and central area and shallow depth 'backstowed' stone mine workings (between 3m to 10/11m depth) beneath the western area.

A preliminary slope stability assessment has tentatively concluded that shallow (1-2m deep) failure modes are the most critical. Measures to ensure adequate stability close to Warminster Road could include a combination of regrading, soil nailing and/or stability counterfort trenches. More rigorous analyses are required when the design has been finalised.

Consideration should be given to reducing the height of the trees, and implementing a long-term programme of tree management.

The poor quality, loose and variable depth backfill at this site will not be capable of supporting traditional strip or pad footings. Flexible/Rigid foundation rafts, with continuity of reinforcement and poured monolithically, evening out variations in formation compressibility, could be adopted following ground improvement by vibro-replacement. However, the boulder inclusions or risk of destabilising the current slope may be an issue and specialist vibro contractors should be consulted. A piled foundation is another foundation option. It is Intégrale's opinion that a piled, flexible raft could prove to be the most technically and economically attractive solution. Suspended ground slabs are required as the slab will be underlain by 600mm or more of non-engineered Fill. Design CBR values of at least 4-5% onto the quarry/mine backfill and 3-4% onto the weathered Upper Rags & Bath Oolite are feasible. Effective design friction (ϕ') of 35° is appropriate for the Quarry/Mine backfill and for the weathered Upper Rags & Bath Oolite.

Preliminary contamination assessment concludes that,

- Design and installation of passive anti-gas measures is required for all new houses and garages;
- Design Sulphate Class of DS-I and ACEC Class of AC-I are recommended for buried concrete;
- New water pipes require protection;
- Basic Radon protection measures are required;
- Surplus spoil should be removed to a suitably licenced tip.
- Import of certified uncontaminated topsoil is likely to be required for all garden areas.

1.0 INTRODUCTION

Swinhay Limited are proposing to develop this sloping and formerly quarried site with 2 No. detached split-level dwellings. Their architects are Stonewood Design Limited. Consulting structural engineers will be Clegg Associates.

Intégrale Limited (*Intégrale*) are commissioned to undertake a Geotechnical and Phase II Contamination report, which follows on from a previous 'Desk Study, Preliminary Ground Investigation and Interim Geotechnical Interpretative Report' completed by others. The scope of investigation was determined by Intégrale in liaison with Swinhay.

Contaminated land assessment and slope stability assessment is required in planning conditions imposed by Wiltshire Council.

This interpretative report summarises the previous study, considers additional desk study sources, describes the current scope of fieldworks, laboratory investigations and monitoring, discusses the ground and groundwater conditions encountered and gives advice on foundations and other geotechnical aspects. A preliminary slope stability assessment made.

The results of contamination analyses and generic quantitative risk assessment are reported and used to establish a conceptual model of pollutant linkages. Potential implications for the development are discussed and recommendations for further investigation or potential remedial works or design measures given.

2.0 THE SITE

2.1 Location and Description

As shown in Appendix A, the site is located within an irregular shaped plot of land to the north of Midford Lane in the village of Limpley Stoke. It has a central Ordnance Survey Grid Reference of E378006 N160671 and postcode BS2 7GP.

Notes describing the site were prepared during the site visit and are included as Appendix B, together with typical photographs. The main features and pertinent aspects on the site and immediately adjacent land are summarised below and annotated on Figure 1:

Current Use	Unoccupied, overgrown site.
Site Area & Shape	Irregular in plan shape. ~0.15Ha.
Maximum Dimensions	25-45m NE-SW x 45m NW-SE.
Ground Slopes & Topography	Ground slopes from Midford Lane along SW boundary, down to NE. Initially the slope is 'moderate', but steepens significantly adjacent at c.118-121m (AOD) to the A36 Warminster Road, which forms the NE boundary at approximately 107 - 109m AOD. A former quarry face is present centrally and locally forms a vertical rock face. The topographic information provided to date does not entirely 'tally' with site observations and consideration should be given to supplementing the existing information with further survey data.
Buildings	No buildings present on site.
Surfacings & Condition	100% soft ground, heavily overgrown, partially cleared by the client prior to investigation works.
Vegetation & Trees	Several juvenile, semi-mature and mature trees and shrubs across the site. Some of the trees are planned to be removed as part of the development.
Water Courses	None noted on, or adjacent, to site.
Site Boundary Features	SW – Midford Lane. NE – A36 Warminster Road. NW & SE - gardens of neighbouring residential plots.
Contamination Issues	No significant issues anticipated, however, the potential for contamination remains within quarry backfill materials.
Geotechnical Issues	Known quarry face within site and proposed buildings possibly spanning this. Unknown thickness of quarry backfill and possibility/probability of 'special' foundations being required. Potential for stability issues downslope, adjacent to A36 Warminster Road, if the slope is to be loaded/adjusted.

2.2 Published Geology and Mining

2.2.1 British Geological Survey (BGS) Mapping

BGS geological maps indicate the following strata beneath and adjacent to the site:

Map / Scale	ST 76 SE at 1:10,000 scale.
BGS On-Line Viewer	Accessed 11 th December 2018.
Artificial Ground	None mapped on, or adjacent, however, discrete areas of Made Ground and Worked Ground are mapped 100-300m W.
Superficial Deposits	None mapped on, or adjacent. Land downslope of the A36 Warminster Road (50m remote) are mapped as being affected by Ancient Landslip.
Solid Geology	Upper Rags & Bath Oolite (limestone) of Jurassic age, overlying the Twinhoe Beds and Combe Down Oolite of similar age. The BGS Viewer shows the site as being underlain by the Chalfield Oolite Formation (the parent unit).
Geological Features	An adit or mine mouth (abandoned) is mapped 300m SW with a shaft a further 100m remote.

2.2.2 BGS Previous Investigation Records

There are no relevant records available on the BGS viewer.

2.2.3 Previous Investigations

A previous study (dated 9th March 2018) has already been completed by others and a copy is available on Wiltshire Council's planning portal. The more pertinent aspects are briefly summarised below:

- The report is titled 'Desk Study, Preliminary Ground Investigation and Interim Geotechnical Interpretative Report' and appears to have been commissioned to consider the same scheme as is currently being proposed;
- An initial Desk Study was commissioned in 2015, with trial pitting being completed in February 2018;
- Basic radon protection measures were recommended;
- Historic mining has occurred to the south, south east and east, with two shafts and one air shaft within 250m. Stoke Hill mine remains active and is located 190m northwest;
- There are no landfill sites within 500m;
- Potentially contaminative land uses within 250m include sub-stations, telephone exchange and quarries;
- The bedrock is a Principal Aquifer with High Soil Leaching Potential;
- There are no records of water abstractions within 500m;
- 7 No. trial pits were mechanically excavated to 0.5-3.5m depth, which found two distinct sequences of ground conditions; undisturbed areas and disturbed areas;
- In undisturbed areas, topsoil was proven over 'brashy' deposits comprising Gravel and Cobbles with varying degree of sandy/silty clay matrix down to 1-2m depth, with inferred limestone bedrock below. A 'probable quarry back-face' was encountered in one location;
- In disturbed areas, quarry backfill Made Ground was proven to 2.5-3.5m depth and the base of the quarry was not proven;
- Piled foundations were recommended and suspended ground slabs were anticipated;
- Groundwater was not anticipated to pose a significant problem;
- No evidence of slope instability was observed, either localised or 'global' and the proposed houses were not thought to adversely affect the stability of the slope;
- The effects of increasing the loading on the lower slopes (by upfilling and terracing the gardens, if proposed) would need to be considered however, at that time, details were not available;
- Supplementary geotechnical investigation was proposed comprising rotary drilling;
- No soils or chemical testing was completed as part of the study.

2.2.4 Past Stone Mining

The site is in an area known for historical quarrying and mining within the Jurassic limestone and a former (suspected) quarry face was observed centrally. Therefore, a specialist 'Action' report was obtained from Terraforma Mine Searches Limited and a copy is included in Appendix C. The more pertinent aspects are summarised below:

- There are no recorded historical mining features within the site boundary; however
- The presence of small-scale, unrecorded mining features cannot be entirely discounted and it is recommended that:
 - A site walkover be completed to identify any signs of ground movement or historical mining features;
 - In terms of future development, a ground investigation was recommended.

2.3 Outline History

Historical maps were obtained as part of the previous study and reviewed alongside other sources of historical information. The reader is directed to that report for a more thorough description, although a brief summary is given below:

- The site appears to have remained largely unchanged since 1887, with some residential development in the surrounding areas, within Limpley Stoke;
- Bath stone quarries are known in the area, but there is also reference to older workings from “...open quarries either side of the A36...”.

Online sources show the site as being undeveloped, open land in 1884-1888, with a footpath forming the northwest boundary (in the same location as found at the time of writing). The site was located approximately mid-way between Stoke Hill Quarry, 100-150m northwest and an un-named quarry to the south east. Both quarry faces were orientated in a northwesterly-southeasterly direction and it may be the case that older quarrying occurred between these. If that is the case, the old quarry face may well pass directly through the current site. By 1898-1939, little had changed on site however, local quarries and mines had expanded with entries located 200m west, presumably to allow mining of limestone beneath the Forest Marble Formation.

2.4 Hydrogeology, Hydrology & Groundwater Vulnerability

Based on the published geological strata, topographic maps showing surface water courses and the Groundwater Vulnerability maps, the following can be anticipated at this site:

Soils Permeability	Highly permeable limestone bedrock anticipated with similarly high rates of permeability anticipated in (predominantly) coarse, granular, quarry backfill.
Anticipated Groundwater Table Depth	Deep (>10-20m).
Anticipated Groundwater Flow Direction	To NE, based on topography.
Aquifer Type	Principal Aquifer in bedrock.
Hydraulic Continuity of Groundwater and Water Courses	Possible given high permeability of bedrock. 'Issues' 200m NE and River Avon 350m NE.

2.5 Conceptual Exposure Model

This section draws together desk study information, outlines an initial conceptual exposure model and provides a qualitative assessment of potential contamination via a source-pathway-receptor framework for the proposed redevelopment.

2.5.1 Proposed Development

Planning permission for Application No. 18/03006/FUL has been granted by Wiltshire Council. Details of the proposed development are shown on drawings included in Appendix J and can be summarised as:

Buildings	2 No. 2-storey, split level, detached houses.
Car Parking	Car parking accessed directly from Midford Lane in SW.
Access Roads	None proposed.
Landscaping	Traditional private gardens. No details of landscaping scheme available at time of writing, but no terracing shown.
Foundations and Floor Slabs Shown on Preliminary Drawings	Assumed piled foundations with either piled floor slab or suspended slab.
Building Level	Split level houses requiring some cutting into slope. Original drawings may have included some errors, which suggested that there was up to 6m of cutting proposed. It is understood that is not the case and maximum excavations will be in the order of 3m with finished floor levels (of the lower level) at 116.5-117.5m AOD.

The planning conditions in the above application state that ‘...an investigation of the history and current condition of the site to determine the likelihood of the existence of contamination arising from previous uses...’ is required. A separate condition concerns whether ‘...land stability would be adversely affected by the proposed works...’. This report should address both these planning conditions.

2.5.2 Potential Sources of Contamination

The desk study has been used to identify the likely remnant contaminant sources and distribution. The potential current and historical on and off-site sources and the contaminants associated with these, derived using CLR8 Potential Contaminants for the Assessment of Land and through experience of industrial land use, are detailed below.

Potential Contaminants Associated with On-Site Sources			
Description	Metals, semi-metals, non-metals, inorganic chemicals and others	Organic chemicals	Ground Gases & Vapours
Backfilled Former Quarry	Given age of workings significant and widespread contaminative impact is considered unlikely, however there is a possibility of a range of metals, semi-metals, inorganics and asbestos.	Unlikely given age of workings.	Carbon dioxide from quarry backfill.

Potential Relevant Contaminants Associated with Off-Site Sources			
Description	Metals, semi-metals, non-metals, inorganic chemicals and others.	Organic chemicals	Ground Gases & Vapours
Electricity substation (mentioned in previous study)	As, B, Cd, Cr, Cu, Pb, Hg, Ni, Zn, NO ₃ ⁻ , SO ₄ ²⁻ , S ²⁻ , asbestos, pH.	Aromatic hydrocarbons, chlorinated aliphatic hydrocarbons, PCBs.	
Nearby quarries within 250m W, NW & SW (historical and active)	Range of metals, semi-metals, inorganics and asbestos.	Oil/fuel hydrocarbons, aromatic hydrocarbons, PAHs, chlorinated aliphatic hydrocarbons, organolead compounds.	Hydrocarbon vapours and carbon dioxide most likely.

2.5.3 Potential Pathways

To understand the potential risks posed by the contaminants to human receptors, the possible contaminant pathways need to be identified. The CLEA model (DEFRA & EA 2002) indicates potential exposure routes for assessing risks to human health for a residential setting (with home-grown produce uptake) as follows:

- Dermal exposure;
- Inhalation of particulates;
- Inhalation of soil vapour (indoor and outdoor);
- Inhalation of groundwater vapour (indoor and outdoor);
- Direct ingestion of soil;
- Ingestion of home-grown produce and soil attached to vegetables.

The potential pathways with respect to Controlled Waters will include:

- Downward migration through Quarry Backfill to underlying Principal Aquifer;
- Lateral migration through Made Ground to surface water (seems unlikely given distance);
- Lateral migration through groundwater to surface water (seems unlikely given distance).

2.5.4 Potential Receptors

For a residential end use and the known neighbouring land uses, the potential receptors to contamination (if present on site) are:

- Immediately adjacent residents – critical receptor female child;
- Construction workers – critical receptor female adult;
- Future site users – critical receptor female child.

The likely sensitive Controlled Waters receptors are considered to be:

- River Avon, 350m northeast;
- Principal Aquifer in bedrock.

Due to the location of the site, distance to nearest surface water receptor and geological conditions, the underlying Principal Aquifer is considered the most likely controlled waters receptor.

3.0 GROUND INVESTIGATION

In view of the anticipated ground conditions, current site layout and proposed redevelopment, a phased ground investigation was decided upon and the following scope of investigation was completed.

3.1 Trial Pitting

6 no. trial pits were mechanically excavated using a tracked excavator on Monday 12th November 2018. The trial pit locations, chosen by Intégrale, are shown on Figure 1 and were referenced as TPI-6. The general procedures adopted during trial pitting, together with the detailed trial pit records are included in Appendix D.

3.2 Soakaway Tests

Soakaway tests were carried out in TPI and TP4. The trial pits were filled from a tractor towed bowser and the water level measured over time. The general procedures adopted during soakaway testing together with the soakaway records are included in Appendix E and discussed in Section 5.

3.3 Rotary Probing Boreholes

5 no. boreholes were sunk using rotary probing equipment on Tuesday 20th November 2018. The borehole locations, chosen by Intégrale, are shown on Figure 1 and were referenced as RPI-5. Boreholes were sunk to between 10m and 18m depth. The general procedures adopted during rotary probing, together with the detailed borehole records are included in Appendix F.

3.4 Groundwater and Soils Gas Standpipe Installations and Monitoring

Standpipes were installed in Trial Pits 1-3 & 5 typically to between 1.5m and 2.0m depth and details are given on the trial pit records. Monitoring has been undertaken on six occasions and the results are included in Appendix G, together with the general procedures adopted for installing standpipes.

3.5 Geotechnical Laboratory Testing

A schedule of complementary soils testing was prepared by Intégrale. The physical tests were completed in accordance with BS 1377 (1990) by Southwest Geotechnical Limited. Chemical tests were completed by Chemtest Limited. The results are provided in Appendix H and the following shows the testing strategy:

Location	Depth (m)	Stratum	Testing	Criteria for test selection
TP3	1.0	WURBO	Natural Moisture Content, Atterberg Limits	Strata classification and characteristics
TP4	0.5	HWURBO	Natural Moisture Content, Atterberg Limits	Strata classification and characteristics
TP3	0.5	HWURBO	pH and water soluble sulphate	Concrete classification
TP2	1.4	MG	pH and water soluble sulphate	Concrete classification
TP5	1.0	MG	pH and water soluble sulphate	Concrete classification

MG – Made Ground, HWUPBO – Highly Weathered Upper Rags & Bath Oolite, WURBO - Weathered Upper Rags & Bath Oolite

3.6 Contamination Analyses

In view of the desk study and fieldwork findings, a schedule of soils analyses was prepared. The analyses were completed by Chemtest Limited and the results are provided in Appendix I. The following shows the testing strategy:

Location	Depth (m)	Stratum	Testing	Criteria for test selection
TP2	0.4	MG	Generic Contaminant Suite, Total TPH, Asbestos Screen	Generic contamination classification and risk to human health
TP1	0.5	MG	Generic Contaminant Suite, Total TPH, Asbestos Screen	Generic contamination classification and risk to human health
TP1	1.0	MG	Generic Contaminant Suite, Generic Leachate Suite, Total TPH, Asbestos Screen	Generic contamination classification, risk to controlled waters and risk to human health
TP4	0.1	TS/MG	Generic Contaminant Suite, TPH CWG, Asbestos Screen	Generic contamination classification and risk to human health
TP5	0.2	TS/MG	Generic Contaminant Suite, Total TPH, Asbestos Screen	Generic contamination classification and risk to human health

3.7 Referencing

Locations of the exploratory positions were set out using taped offsets from existing features.

4.0 GROUND & GROUNDWATER CONDITIONS

4.1 Summary of Strata Encountered

The strata encountered are variable across the site as shown in the tentative geological sections included as Figure 2 and can be summarised as follows:

A) Upper Terrace (TP3 & 4 and RPI & 2)

<u>Depth (m)</u>	<u>Description</u>
GL to 0.2/0.25	TOPSOIL with local MADE GROUND: (comprising soft brown slightly sandy slightly gravelly very silty Clay with limestone. Frequent roots and rootlets. Localised brick fragments and metal).
0.2/0.25 to 0.8/1.8	Firm becoming firm to stiff yellow brown slightly sandy slightly gravelly silty CLAY with limestone. (HIGHLY WEATHERED UPPER RAGS & BATH OOLITE)
0.8 to 1.9 (TP4 only)	Medium dense beige and yellow brown GRAVEL of limestone with medium cobble content in a clayey sandy Silt matrix. (WEATHERED UPPER RAGS & BATH OOLITE)
1.8/1.9 to 3.0/4.0	Dense yellow brown and beige COBBLES and BOULDERS of tabular limestone with some gravel and a silty clay infill between cobbles/boulders. (WEATHERED UPPER RAGS & BATH OOLITE)
3.0/4.0 to 10.0/12.0	Inferred as 'backstowed' material and voided stone mine workings.
10.0/12.0 to 18.0+	Inferred as Limestone bedrock.

B) Middle Terrace (TPI & 2 and RP3 & 5)

<u>Depth (m)</u>	<u>Description</u>
GL to 0.1	MADE GROUND: (comprising soft light brown silty sandy gravelly Clay with limestone, brick, tile fragments and metal).
0.1 to 0.2/0.25	MADE GROUND: (comprising loose brown slightly clayey sandy gravelly Silt with limestone and brick. Frequent roots and rootlets [Buried Topsoil]).
0.2/0.25 to 9.0/11.0	MADE GROUND: (comprising loose to medium dense beige and pale brown Gravel and Cobbles of tabular limestone with rare boulders in a sandy Silt matrix).
9.0/11.0 to 10.0/12.0+	Inferred as Limestone bedrock.

C) Lower Terrace (TP5 & 6 and RP4)

<u>Depth (m)</u>	<u>Description</u>
GL to 0.2/0.3	TOPSOIL with MADE GROUND: (comprising loose brown slightly gravelly clayey sandy Silt with limestone, brick, metal and rags. Occasional roots and rootlets).
0.3 to 0.7 (TP5 only)	MADE GROUND: (comprising loose to medium dense beige and cream Gravel and Cobbles of tabular limestone with rare boulders in a sandy Silt matrix. Occasional roots and rootlets).

0.2 to 7.0/8.0 MADE GROUND: (comprising medium dense pale cream silty Sand and Gravel of limestone with low cobble content).

7.0/8.0 to 10.0+ Inferred as Limestone bedrock.

As shown in Figure 2, deep Made Ground comprising backfill was encountered across the site. The rotary probing boreholes indicate that the backfill includes boulders and therefore defining the base of the former quarry/backfill is challenging. Figure 3 attempts to put the findings into the regional geological context in order to define which strata are represented and the depths to anticipated underlying strata. This cross-section has been produced based approximately on OS 1:25,000 topographical contours and geological mapping on sheet ST76SE at 1:10,000 scale. Using this with the rotary probe logs has assisted in tentatively defining the boundary between backfill and the underlying bedrock.

4.2 Strata Properties

4.2.1 Made Ground and Topsoil

Made Ground was proven in all of the exploratory positions and can be categorised as:

Made Ground Type/Location	Topsoil/Made Ground Across Site	Quarry Spoil/Backfill Middle and Lower Terrace (Upper terrace: 'Backstowed' mine stone workings inferred as similar material)
Min/Max. thickness (m)	0.1/0.3	6.8/10.8+
Main Constituents	Brown clayey Silt, limestone, bricks, metal, rags, tile fragments.	Gravel, Cobbles and Boulders of limestone.
Properties	Granular, loose, saturated.	Granular, loose to medium dense, dry.
Visual Contamination/Odours	Rubbish/debris.	-

4.2.2 Weathered Upper Rags & Bath Oolite

For the purposes of this report the uppermost horizons of the natural ground have been defined as Highly Weathered where they are clay and Weathered where they are gravel or cobbles and boulders. The properties can be summarised as:

Stratum	Highly Weathered Upper Rags & Bath Oolite (Clay)	Weathered Upper Rags & Bath Oolite (Gravel)	Weathered Upper Rags & Bath Oolite (Cobbles and Boulders)
Min / Max Thickness (m)	0.6/1.5	1.1	0.3/0.7
Soil Strength /Properties	Firm becoming firm to stiff Cohesive	Medium dense Granular	Dense Granular
Occurrence	Proven in upper terrace only	Proven in upper terrace only	Proven in upper terrace only
Sulphate /pH	SO ₄ <0.01 g/l 8.6pH	-	-
Visual Contamination/Odours	None	None	None

4.3 Groundwater

Groundwater was not proven in any of the exploratory positions.

4.4 Ground Gas

The monitoring indicates elevated carbon dioxide and depressed oxygen present in TP3. A maximum flow rate of 0.3l/hr was recorded. Summary results are detailed below with full information provided in Appendix G.

Exploratory Location	TP1	TP2	TP3	TP5
Response Zone (m) / Strata	1.3-1.8	1.2-1.7	1.25-1.75	0.75-1.25
Evidence of Contamination	None	None	None	None
Monitoring Visits (No.)	6	6	6	6
Methane (%)	0.0-0.1	0.0-0.1	0.1-0.2	0.0-0.1
Carbon Dioxide (%)	0.3-0.4	0.2-0.4	4.8-9.1	0.2-1.3
Oxygen (%)	20.5-21.5	21.0-21.6	6.9-19.6	20.4-21.7
VOC (ppm)	0.0	0.0	0.0-0.1	0.0
Gas Flow (litres/hr)	0.1-0.2	0.1-0.3	0.1-0.3	0.0-0.2
Water levels (m)	DRY	DRY	DRY	DRY
Atmospheric Pressure Range (mb)	984-1027	984-1027	984-1027	984-1027

5.0 GEOTECHNICAL CONSIDERATIONS

5.1 Scheme Details & Structural Loadings

The proposed housing development will be constructed in up to 3m of cutting. Detailed design is not currently available however it is assumed to be of timber framed and/or light load bearing masonry construction.

Foundation line loads could be between 75-125 kN/m run. Combined 'dead' and 'live' loading on the ground floor slabs will be less than 10 kN/m².

The development will also include access, car parking and conventional gardens.

5.2 Slope Stability

5.2.1 Background

A planning condition asks whether land stability could be adversely affected by the proposed works.

5.2.2 Topography and Vegetation

The site can be broadly subdivided into the following three zones:

1. There is a steep, regular, 5-7m plan width slope facet, alongside and upslope of Warminster Road, the north-eastern boundary. The facet supports 15-20 significant trees, most of which grow from the crest of that slope. Elsewhere there is a dense ground cover of ivy; it seems likely that the ivy was planted to minimise soil-creep/loss of topsoil, and prevent debris ravelling on this bank adjacent to the busy highway. It seems likely that this **Lowest Slope Facet** will be directly underlain by (well graded by highway works) Quarry Backfill.
2. Across the central area, from North to South, is an irregular more complex shallower gradient topography, typically with a plan width of 10-12m, supporting rough undergrowth and some scattered trees. It seems likely that this **Intermediate Zone** will be underlain by (poorly or ungraded) Quarry Backfill also.
3. In the Western corner of the site, is a triangular (10-25m wide) plot with complex, relatively low gradient ground surface topography. Much of this **Uppermost Zone** is probably underlain by Limestone Bedrock including very old, shallow depth, largely backfilled, Pillar and Stall stone mine workings.

Some of the trees, particularly those at the crest of the Lowest Slope Facet, have curved trunks which is evidence of ongoing soil creep. This suggests that the Factor of Safety Against Instability (FoS) must be only marginally greater than unity, for shallow slope instability.

The main features described above can be seen by following the footpath along the North West site boundary, downslope.

5.2.3 Preliminary Slope Analyses

Four typical modes of slope failure have been modelled. Circular slips A & B are shown on Section 1, and non-circular Slips C & D on section 2 of Figure 2, encompassing the Lowest Slope Facet at a gradient of between 40-45 degrees. Slips A and C are shallower (1-2m) than Slips B and D (3-5m).

The Factors of Safety Against Instability (FoS) were interrogated for each of the slips, assuming no standing groundwater within the Quarry Backfill, and that the Effective Angle of Internal Friction (Phi') was likely to be in the range 30-40 degrees.

The stability runs were made using SLOPE software, developed and offered under licence by Oasys Limited; further details can be provided on request. The results of the stability runs are as follows:

Section 1	ϕ' (°)					
	30	35	36	37	38	40
Slip A (Existing)	0.80	0.99	1.02	1.05	1.10	1.20
Slip B (Existing)	2.0	2.4	2.5	2.6	2.7	2.9
Slip A (Proposed)	0.79	0.96	1.00	1.03	1.07	1.15
Slip B (Proposed)	1.49	1.81	1.88	1.95	2.02	2.17

Section 2	ϕ' (°)					
	30	35	36	37	38	40
Slip C (Existing)	0.75	0.95	0.95	1.00	1.05	1.10
Slip D (Existing)	1.85	2.2	2.30	2.40	2.50	2.70
Slip C (Proposed)	0.72	0.87	0.90	0.93	0.97	1.04
Slip D (Proposed)	1.74	2.11	2.19	2.28	2.36	2.53

Bulk Unit Weight 18.0kN/m³

Cohesion 0kPa

All considered without

Factors of Safety rounded to nearest 0.05, where appropriate

Slips B and D are not considered further, since they compute FoF's of between c.2.5 and c.3.0. That cannot be realistic for the reasons given above, the curved tree trunks indicating it must be close to unity.

Slips A and C compute FoS in the range c.0.95-1.0 for effective friction of 35°, and c.1.1 – 1.2 for 40°, with the current topography. With the proposed regraded topography there is little (usually slight reduction) additional stability. Slips A and C are much more realistic for design purposes.

5.2.4 Options for Improving Slope Stability

Depending on the method of working finally chosen, each of the following should be considered;

Install Check Fence at the foot of the slope alongside Warminster Road, to preclude raveling debris during construction finding its way down onto the highway in an uncontrolled manner.

To ensure that the steep Lowest Slope Facet maintains an FoS of at least 1.4-1.5 (generally considered to be the minimum appropriate for granular soils), it will be necessary to consider either:

- Regarding Slope to 'marry-up' the development elevation of the proposed houses. Where space is at a premium, it may be necessary to,
- Install a system of Soil Nails with ground surface support being provided by an adequate layer of Geo-Grid. These options have been shown schematically on the sections of figure 2.
- Another solution may be to dig deep trench drains-up-and-down the slope at a close enough spacing to result in an adequate Effective Friction for the Lowest Slope Facet.

Consideration should be given to reducing the height of the trees within an influencing distance of Warminster Road, and implementing a long-term programme of tree management.

5.3 Site Preparation and Earthworks

Topsoil, typically 200-300mm thick and any localised areas of particularly poor quality Made Ground should be removed from beneath proposed building and hardstanding areas. Many excavations to at least 2-3m depth are likely to be feasible with conventional soils excavating machinery. Those in the western area in particular will encounter bedrock and pneumatic tools will be required to break out rocky boulders and bedrock. Measures may be required to ensure arisings cannot roll downhill onto Warminster Road below.

Some of the spoil resulting from excavations in the existing Made Ground may well be suitable for reuse as structural fill with careful selection/screening.

Most excavations to 3m depth should remain dry, although locally could encounter perched infiltration seepage. However, that should soak away through the granular fill. Localised intermittent pumping from a convenient sump could be necessary.

Temporary excavations in the existing Made Ground will probably stand unsupported in the short term at gradients of about 1 on 1.5 to 1 on 2. Those in bedrock can be steeper. Excavations below approximately 1m depth will require sheeting and shoring, particularly if personnel are to enter.

Most formations should be relatively non-susceptible to deterioration due to site traffic and weather. However, the oolitic limestone and spoil will be frost susceptible, necessitating 350mm cover.

5.4 Foundations and Ground Floor Slabs

5.4.1 Typical Ground Conditions

The combined investigations to date have established deep (opencast) quarry backfill to c.8-10m in the eastern and central area (more easterly and part of the westerly house) and shallow depth, reasonably well 'backstowed' stone mine workings (between 3m to 10/12m depth) beneath the western area (other part of the westerly house).

The proposed development levels suggest that the roof-rock beneath the western house will need to be removed and the formation will be on stone mine backfill.

5.4.2 Foundations

All foundations and other substructures must be in line with the recommendations and guidance given in NHBC Chapter 4.2 'Building near Trees'.

In view of the poor quality, loose and variable deep mine and quarry backfill at this site, conventional strip footings (for the development levels being chosen) will be unsuitable, due to the high risk of unacceptable differential settlement.

In view of the above, consideration could be given to the adoption of either a 'flexible' or a 'stiff' flat-slab foundation raft.

The term flexible raft can apply to a substructure, where there is continuity of reinforcement, poured monolithically, but where the intensity of loading on the underside varies. This type of raft is relatively inexpensive. A stiff flat-slab raft requires adequate reinforcement so as to produce a uniform intensity of loading on its underside and is usually much more expensive.

Foundation rafts may be suitable and could be considered once the foundation loads are known.

Consideration may be given to ground improvement of the deep quarry backfill by the application of vibro replacement (stone columns) of these relatively granular, but boulder obstructed, poor quality quarry

backfill soils to reduce the anticipated settlement beneath an appropriate foundation raft, as recommended by NHBC.

Specialist vibro contractors should be provided with a copy of this report and asked to substantiate proposals for adequate ground improvement to support a foundation raft. Intégrale can give further guidance on request. They may think that the boulder inclusions are sufficiently frequent to preclude this option; or that vibro-treatment could destabilise the current slope stability.

In view of the above, consideration has also been given to the adoption of piled foundations. A wide range of drilled and/or bored piles could be suitable in the ground conditions proven at this site. Driven piles will be unsuitable in the boulder obstructed fill.

Traditional rotary or percussion bored cast insitu concrete piles, continuous flight auger (cfa) bored piles, or rotary drilled high capacity mini bored piles could be taken down through the quarry backfill, (perhaps localised roof rock) and mine backfill and designed as 'rock sockets' into the limestone bedrock beneath.

It is Intégrale's opinion that a piled, flexible raft could prove to be the most technically and economically attractive solution for dealing with the complex ground conditions proven at this site.

5.4.3 Ground Floor Slabs

In line with NHBC guidelines, suspended ground floor slabs (eg 'beam and block' type or similar) should be adopted because the slab will be underlain by 600mm or more of 'non-engineered' Made Ground.

In view of the significant thickness of 'poor' ground, a piled ground floor slab should be considered.

5.4.4 Formations and Inspections

All foundations, ground slab and substructure formations, plus pile socket depths, and measures for ensuring continued slope stability should be checked and approved by a suitably qualified and experienced geotechnical specialist. Intégrale can provide a fee estimate for these inspections, on request.

5.5 Pavement Design

The equivalent CBR strength of anticipated pavement formations has been determined using a Mexecon Penetrometer and judged on the basis of past experience in similar materials. The following (tentative) design values are given for guidance:

Stratum	Design CBR	Typical Depth (m) BEGL
Quarry/Mine Backfill	4-5%	0.5-2.0m (East and Central)
Weathered Upper Rags & Bath Oolite	4-5%	0.5-2.0m (West)

It would be prudent to allow a contingency for treating 'soft-spots' equivalent to 25% of the proposed hardstanding area to a depth of typically 350mm. All soft spots should be excavated and replaced with suitable well compacted granular material.

Where there could be rapid variations in formation strength, consideration should be given to a sandwiched geogrid construction which will help even out those variations to within acceptable limits. Intégrale can give further guidance on request.

5.6 Earth Pressures and Retaining Walls

Foundations for retaining walls can be based on the allowable design bearing pressures given in section 5.4.2. Earth pressures may be calculated assuming the following effective shear strength parameters:

Stratum	Effective Cohesion C' (kN/m ²)	Effective Angle of Friction Ø' (degrees)	Bulk Density (Mg/m ³)
Quarry/Mine Backfill	Zero	35°	1.85
Bedrock	Zero	35°	2.00

5.7 Protection of Buried Concrete

In line with BRE Special Digest 1:2005 'Concrete in Aggressive Ground', 2 No. samples of quarry backfill Made Ground and 1 No. sample of highly weathered Upper Rags & Bath Oolite were tested for water soluble sulphate and pH. The results are reported in Appendix I.

The desk study and ground investigation indicate the site can be categorised as being:

- Brownfield location including aggressive materials or leachates, but without pyrites;
- Mobile groundwater conditions, as water will flow into excavations or is percolating slowly through the ground.

The results show a highest water soluble sulphate of <0.01mg/l. The lowest value for pH was 8.5. It is therefore recommended that a Design Sulphate Class of DSI and an ACEC Class of AC-I be adopted for budgeting purposes.

5.8 Drainage Considerations

The client requested soakaway trials in two investigation locations. A tractor towed water bowser was used to fill trial pits TP1 and TP4 between 1.0-1.6m and 1.25-1.6m depth, respectively. The drop in water level was recorded over time and the results are included in Appendix E.

At TP1, within 2 minutes, the water had fully drained away in all three tests, resulting in a calculated Design Infiltration Rate of $\sim 3 \times 10^{-3}$ m/s. Testing was completed in the variably compact and granular Made Ground.

In TP4, two tests were completed within the variably weathered natural strata, with water draining away within 10 minutes, resulting in an infiltration rate of $\sim 3 \times 10^{-4}$ m/s.

The observations made during the intrusive works, past experience of similar strata and infiltration testing completed to date suggest that soakaway testing may be successful at this site. It will, however, be important to ensure that the design of the soakaway system does not result in loss of fines/piping, and 'single point' type systems should be avoided. Drainage over a larger area is likely to be the preferred option. Intégrale can provide further advice on this aspect on request.

6.0 GENERIC QUANTITATIVE CONTAMINATION ASSESSMENT

6.1 Summary of Soils Results with Respect to Human Health

The conceptual model based on the source-pathway-receptor linkages is summarised as:

SOURCE		PATHWAY		RECEPTOR
Contaminated soils	→	Dermal exposure	→	On-site female child
Contaminated soils	→	Inhalation of soil dust	→	On-site female child
Contaminated soils	→	Indoor inhalation of soil vapour	→	On-site female child
Contaminated soils	→	Outdoor inhalation of soil vapour	→	On-site female child
Contaminated soils	→	Direct ingestion of soil	→	On-site female child
Contaminated soils	→	Ingestion of home-grown produce and soil attached to vegetables	→	On-site female child

A generic risk assessment has been undertaken by comparing proven concentrations of contaminants against generic assessment (or screening) criteria (AC).

The AC adopted are the published LQM/CIEH Suitable For Use Levels (S4UL's), for a generic residential with plant uptake end-use, adopted under licence no. 3580. These provide a precautionary approach, based on the principle of minimal or tolerable risk, but relying on conservative values for soil type (sandy loam) and organic matter contents of 1, 2.5 or 6% as appropriate. Where no S4UL is published, e.g. lead, the alternative AC is the most recently published industry standard value.

If the proven contaminant concentration is less than the respective AC, it is considered there is no significant risk to human health from these substances.

6.1.1 Generic Human Health Assessment

The soil samples where contaminants exceed the relevant assessment criteria are:

Standard	Substance	Stratum	Depth mBEG	Area / Zone
Assessment Criteria for Residential Use & Plant Uptake	Benzo[b]fluoranthene (3.1mg/kg, AC=2.6mg/kg) Benzo[a]pyrene (2.3mg/kg, AC=2.2mg/kg) Dibenz[a,h]anthracene (0.49mg/kg, AC=0.24mg/kg)	Made Ground	0.1	TP4

Localised, slightly elevated priority PAH's have been identified. However, given the wider results, it is considered unlikely to be a widespread or significant contamination risk at this site; the elevated PAH's may simply have occurred from a bonfire or similar.

Also, given that the area around TP4 will be beneath proposed driveways (i.e. permanent and robust hardstanding) the risk to human health is considered negligible and this aspect is not considered further.

6.2 Summary of Soils Results with Respect to Phytotoxicity

No substances were present in the analysed samples in excess of the phytotoxic criteria.

6.3 Summary of Soils Results with Respect to WRAS

The soil samples which exceeded the Water Regulations Advisory Scheme (WRAS) guidance on water supply pipes are:

Standard	Substance	Stratum	Depth BEGL	Area / Zone
WRAS	pH, Arsenic total TPH	Made Ground	GL -0.5m	Elevated pH & Arsenic found site wide. Elevated TPH found only in TP4.

This suggests that new water pipes will need to be protected against chemical attack. Requirements should be confirmed with the water supply company.

6.4 Controlled Waters

6.4.1 Conceptual Model

The assessment of risks to controlled waters follows guidance provided by the Environment Agency, including their Remedial Targets Methodology: Hydrogeological Risk Assessment for Land Contamination (2006). The conceptual site model has been developed based on the source-pathway-receptor linkages identified during the desk study and fieldworks. Possible sources, pathways and receptors have been assessed which identifies the potential pollutant linkages as:

SOURCE	PATHWAY	RECEPTOR
Contaminated soils	→ Leaching from soils or migration of liquid contaminants through the unsaturated zone.	→ Perched water (although none encountered in recent GI)
Contaminated soils	→ Leaching from soils or migration of liquid contaminants through the unsaturated zone.	→ Groundwater (Principal Aquifer)
Contaminated soils	→ Leaching from soils or migration of liquid contaminants through service runs	→ River Avon
Perched water contamination	→ Transport in groundwater	→ River Avon
Groundwater contamination	→ Transport in groundwater	→ River Avon

The conceptual site model indicates that the Principal Aquifer (limestone bedrock) is the most sensitive controlled waters receptor. Groundwater has not been proven in the recent investigation with boreholes taken down to 10-15m depth. Actual groundwater is anticipated to be at several tens of metres depth with springs in the hillside to the northwest at ~60mAOD (the site being at ~120mAOD).

A leachate result has been compared against UK Drinking Water Standards (UKDWS). In the absence of UKDWS values, then World Health Organisation (WHO) Guidelines for Drinking Water Quality health criteria, Surface Water Abstraction Directive (SWAD) values, freshwater Environmental Quality Standards (EQS) and DEFRA Freshwater Standards have been adopted, in priority order.

6.4.2 Summary of Leachate Results

No substances were present in the analysed leachate samples in excess of the criteria.

The risk from this site to controlled waters is therefore considered as negligible and this aspect is not considered further.

6.5 Gas Mitigation

The gas monitoring results to date have found only background trace levels of methane (0.0-0.1%) and VOCs (maximum 0.1ppm). Carbon dioxide (perhaps unsurprisingly) has been found to be locally elevated with maximum reading of 7%. A maximum gas flow of 0.3l/hr has been recorded, resulting in worst case gas screening value of 0.02l/hr.

The above would therefore result in CIRIA R149 Characteristic Situation I (i.e. very low risk) and NHBC Traffic Light System classification of 'Green' and it is the latter which relates more closely to the 'low rise' housing proposed. However, given the thick quarry backfill, standpipes installed in trial pits and proposed cutting into slope, it is recommended this be upgraded to 'Amber 1'. Protection measures based on this data should include:

"Low to intermediate gas regime identified, which requires low-level gas protection measures, comprising a membrane and ventilated sub-floor void to create a permeability contrast to limit the ingress of gas into buildings. Gas protection measures should be as prescribed in BRE Report 414. Ventilation of the sub-floor void should facilitate a minimum of one complete volume change per 24 hours."

It will also be necessary to incorporate the above measures in retaining walls within proposed structures.

Although to conform to CIRIA C665 further monitoring of borehole installations would be required, the ground gas readings to date are likely to be sufficient evidence to support these results as typical and the mitigation measures described above are considered suitable to adequately protect site users.

6.6 Conceptual Exposure Model & Risk Assessment

The potential hazards and risks from soils, water and gas contamination have been developed as a Conceptual Exposure Model based on desk studies, proven ground conditions, analytical and monitoring results and the proposed redevelopment. Substances actually proven, or strongly suspected present, have been assessed against potential exposure pathways and available receptors.

The following hazard-pathway-receptor linkages are therefore established for this site:

- WRAS Contaminant Threshold Concentrations are exceeded in the majority of the Made Ground;
- Carbon dioxide present beneath proposed buildings, may potentially pose a risk to future occupiers of the building(s).

6.7 Recommendations

6.7.1 For Protection of Human Health

Based on the generic screening assessment undertaken to date, the following remedial works and measures will be necessary to protect the health of groundworkers, neighbours, future occupiers and visitors:

- a) Design and installation of passive anti-gas measures for all new houses and garages;
- b) Advice and protection to groundworkers during excavations
- c) In view of the lack of sufficient depth of practically recoverable topsoil, it seems likely to be necessary to import certified uncontaminated topsoil for all garden and soft landscaped areas.

6.7.2 For Protection of Groundwater / Surface Water

No particular measures are anticipated to be required for the protection of controlled waters.

6.7.3 For Protection of Building Materials & Services

To protect new building materials the following precautions will be necessary:

- a) Specification of appropriate concrete protection for the sulphate/pH environment, as detailed in Section 5;
- b) Use of protective pipework for all water supplies.

6.7.4 For Protection of New Vegetation

No particular measures are anticipated to be required for the protection of new vegetation.

6.7.5 Reuse and Disposal of Surplus Spoil

Should soils need removal to a suitably licensed tip, waste characterisation and classification in accordance with the Environment Agency's Technical Guidance will need to be undertaken to comply with the Duty of Care. Consideration should be given to whether it will be a requirement to prepare a Materials Management Plan for all soils excavation, reuse or disposal.

6.7.6 Recommended Further Assessment

A watching brief should be kept at all times while groundworks are occurring. Should any signs of unforeseen contamination be found during groundworks, Intégrale should be contacted immediately to determine the best course of action.

To discharge the planning condition copies of this report should be provided to the local authority to confirm their agreement with the findings and recommendations.

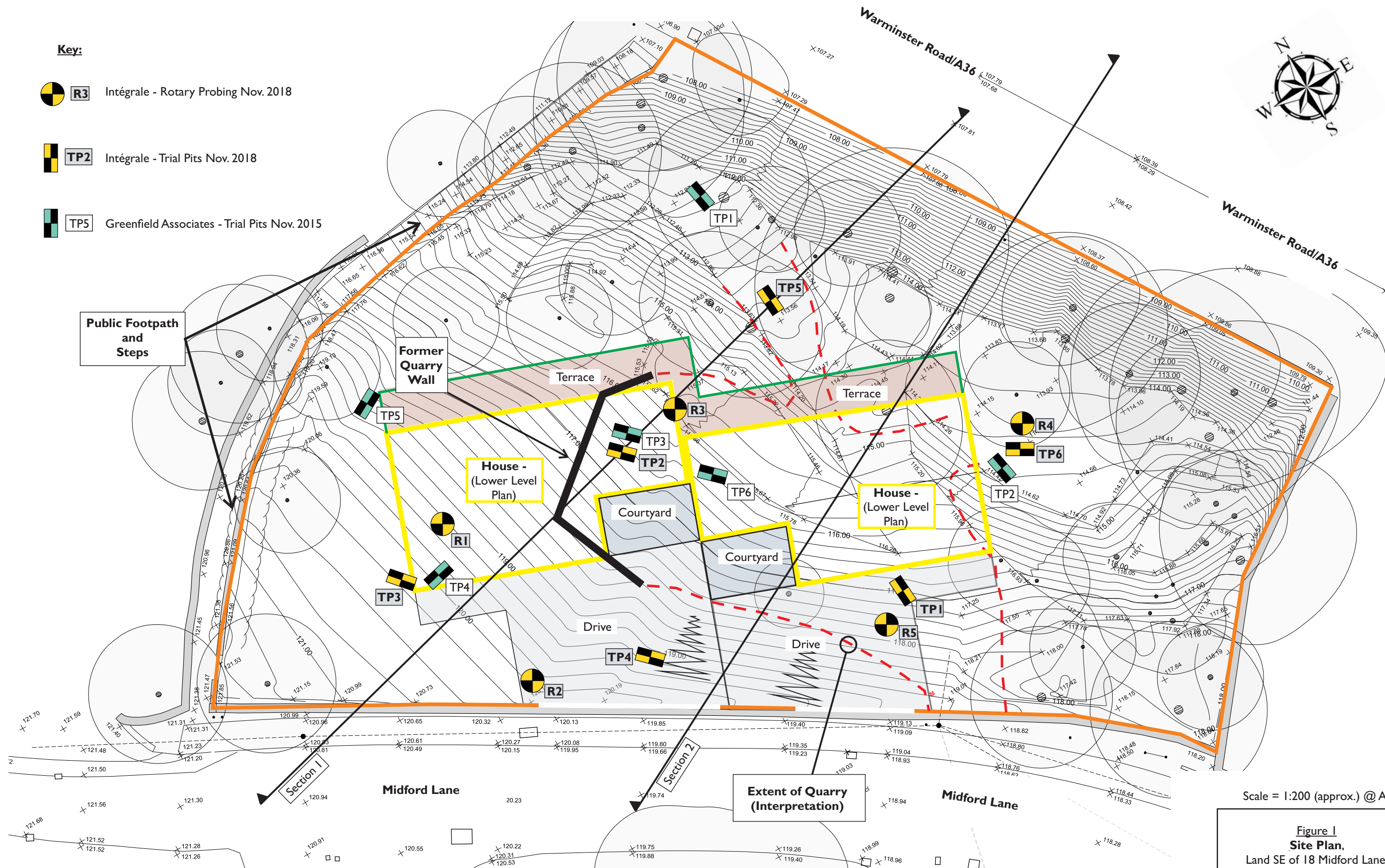
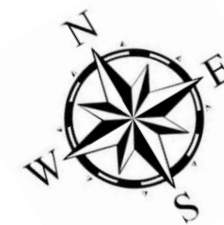
Given the low risks identified to human health, it is considered that formal specification of remedial measures is not necessary, and the recommendations in this report should be sufficient.

Key:

 **R3** Intégrale - Rotary Probing Nov. 2018

 **TP2** Intégrale - Trial Pits Nov. 2018

 **TP5** Greenfield Associates - Trial Pits Nov. 2015

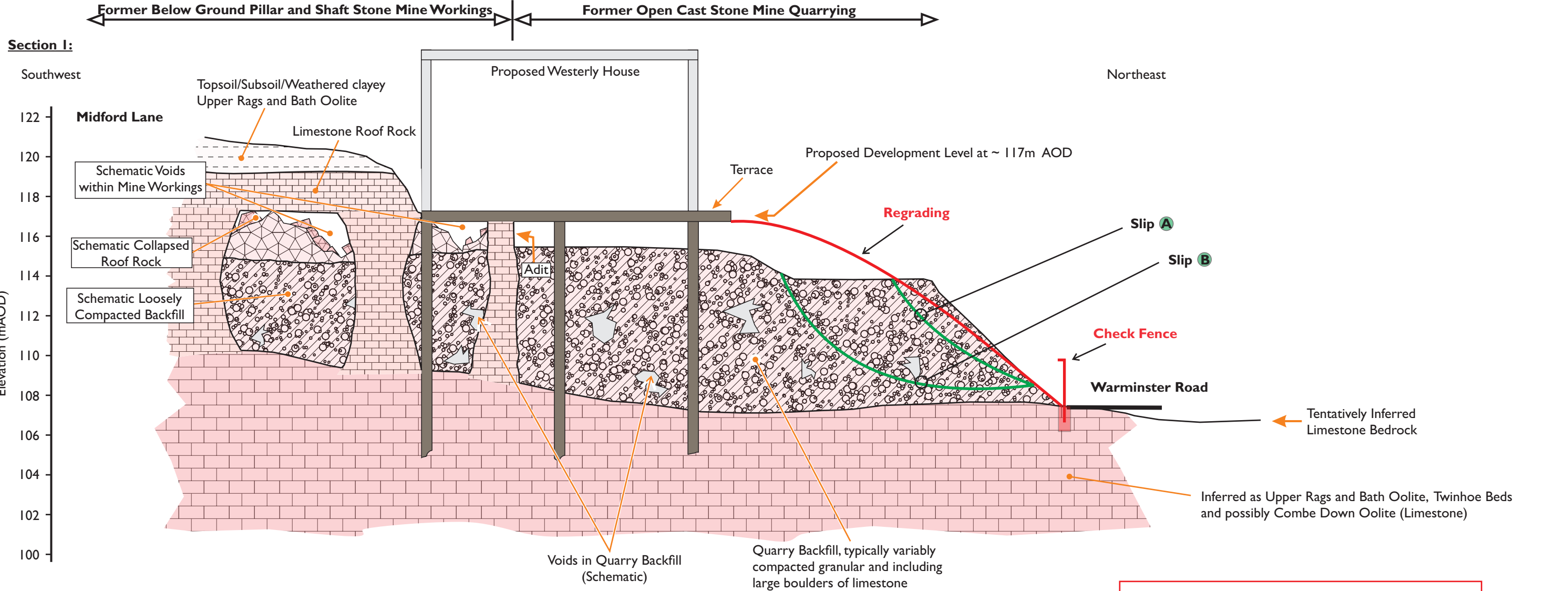


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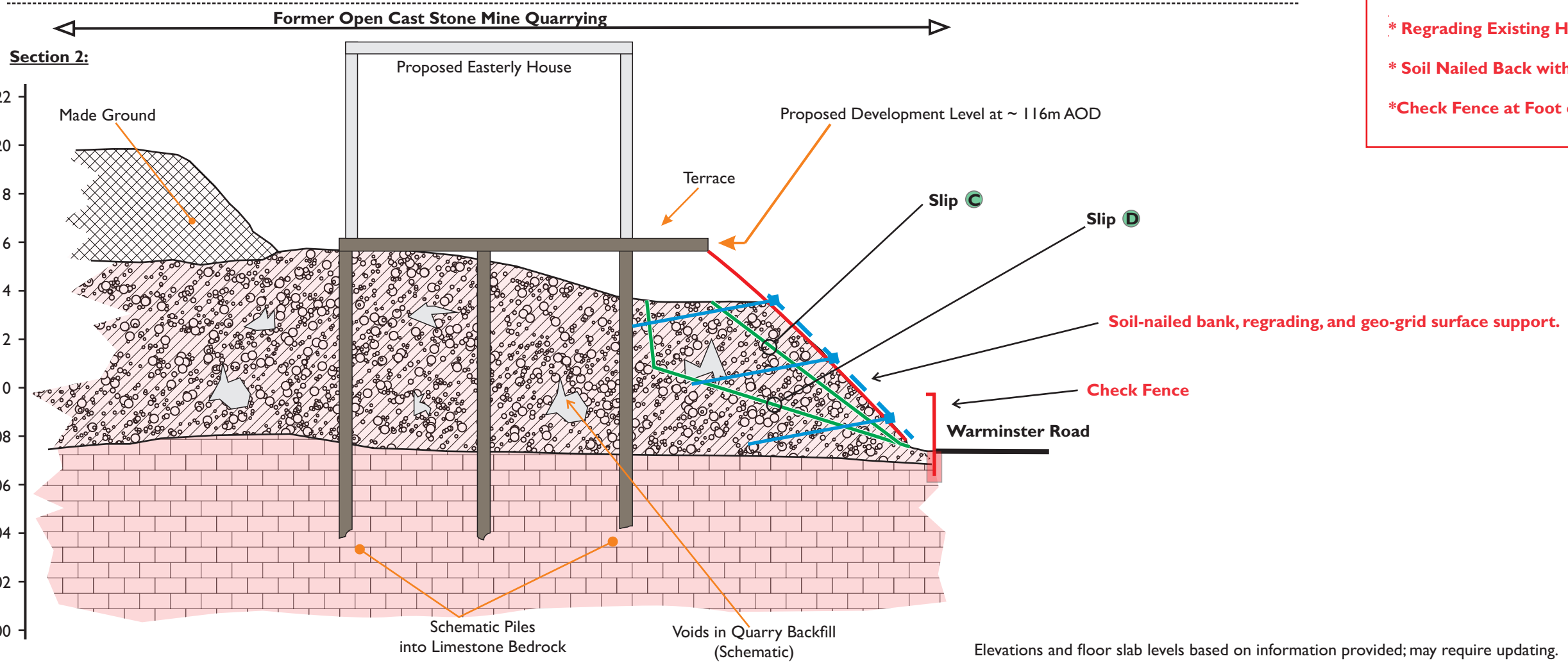
Figure 1
Site Plan,
 Land SE of 18 Midford Lane,
 Limpley Stoke,
 Bath,
 BA2 7GP

Job No: 18022
 January 2019





- Possible Methods to Improve Slope Stability:**
- * Regrading Existing Highway Bank
 - * Soil Nailed Back with Geo-Grid Surface Support
 - * Check Fence at Foot of Slope



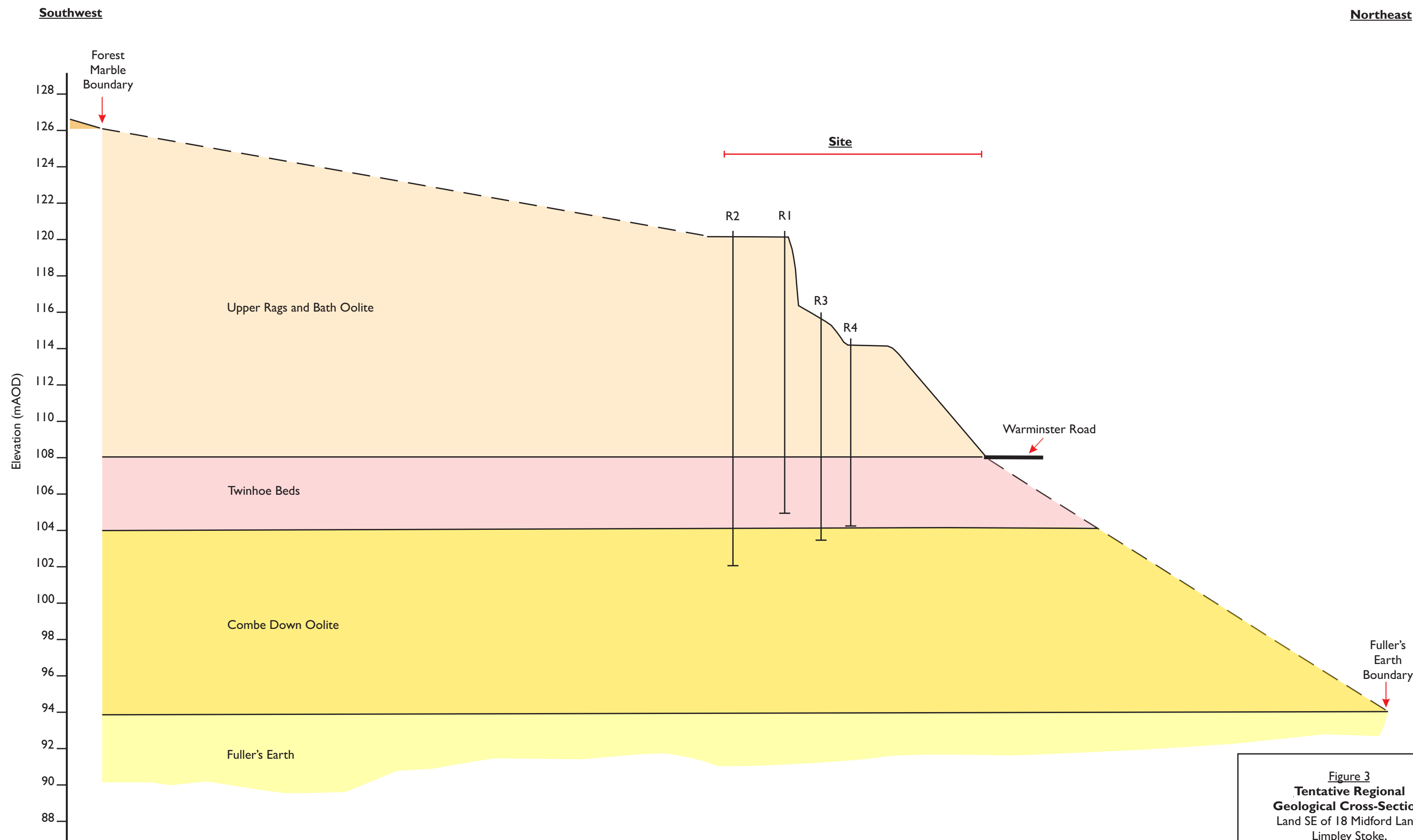
Scale = 1:200 (Vertical and Horizontal) @ A3

Figure 2

Tentative Geological Cross-Section,
Land SE of 18 Midford Lane,
Limpley Stoke,
Bath,
BA2 7GP

Job No: 18022
January 2019

Intégrale
Understanding Ground Conditions



This tentative section is based approximately on OS 1:25,000 topographical contours and geological mapping on sheet ST76SE at 1:10,000 scale.

Scale @ A3 = 1:200 (Vertical)/1:500 (Horizontal)

Figure 3
Tentative Regional
Geological Cross-Section,
 Land SE of 18 Midford Lane,
 Limpley Stoke,
 Bath,
 BA2 7GP

Job No: 18022
 January 2019



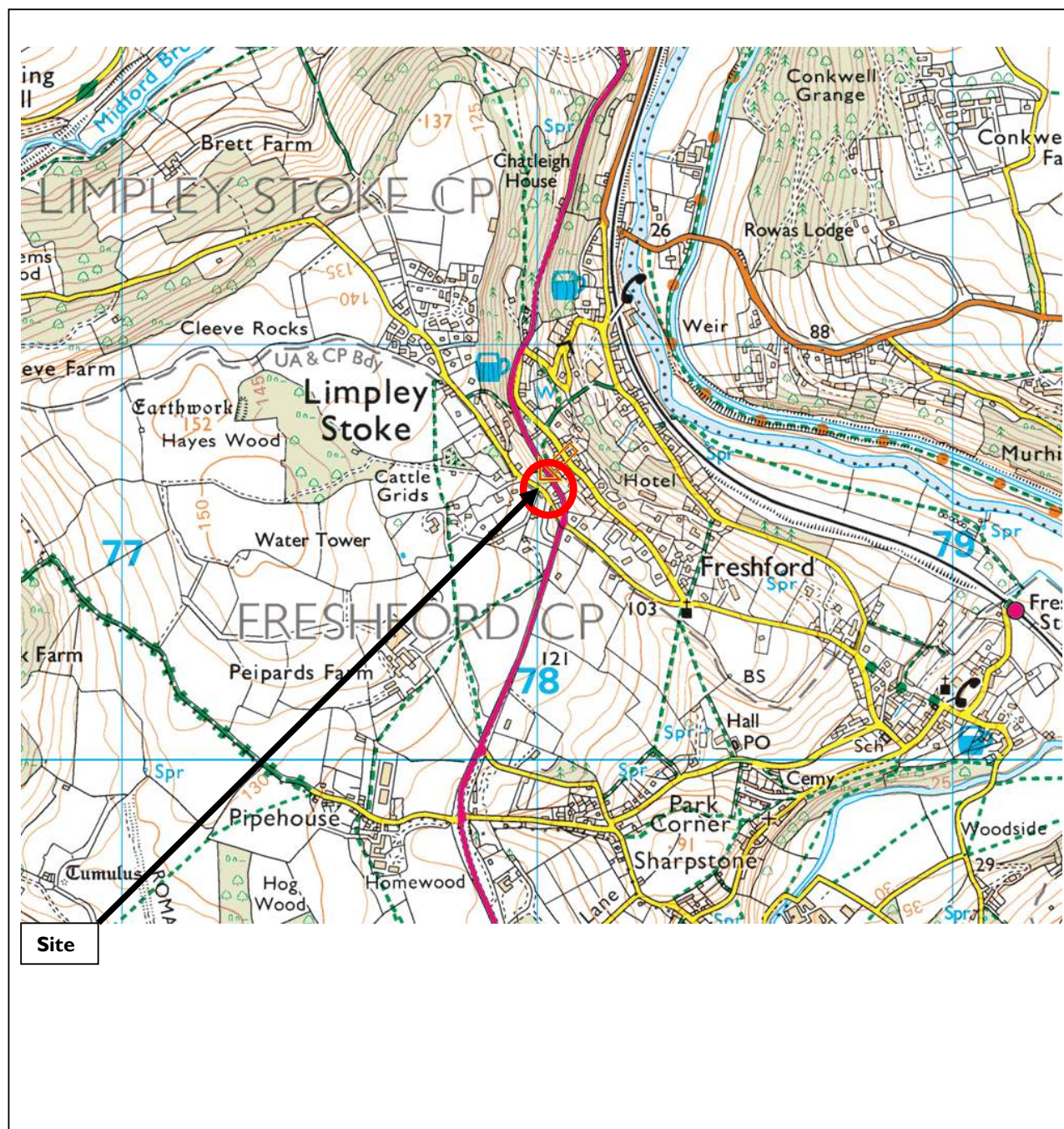
Appendix A

Site Location

Project: Land to South East of 18 Midford Lane, Limpley Stoke, BA2 7GP

Job No: 18022

Site Location Plan



GEOLOGICAL • GEOTECHNICAL • ENVIRONMENTAL • ENGINEERING

Appendix B

Site Description / Photographs

REFERENCES	
Project No.	I8022.
Site Address	Land south east of 18 Midford Lane, Limpley Stoke, Bath, BA2 7GP.
Grid Reference	E377953 N160704.
Date of Visit	19 th September 2018.
Names of site owners/ developers/ engineers met with on site	Swinhay Limited.
Prepared by	Tom Foll.
SITE – GENERAL	
Plan of site	See Figure 1.
Site size (area)	c. 015Ha 100% Soft landscaped unoccupied/overgrown.
Current use (occupants and operations)	Unused.
Maximum Dimensions	25-53m NE-SW x 45m NW-SE.
Boundaries	Walls and open boundaries.
Any access limitations	Section of wall needs removing to allow access. Steep slopes need grading to allow access for drill rig.
Any specific Health and Safety hazards/ considerations	Working on sloping and uneven ground.
Water supply/ Power supply on site?	No.
SITE – BUILDINGS	
Age of building(s)	No buildings on site.
SITE – EXTERNAL	
Hard surfacings	No hard surfacings.
Landscaped areas/ soft landscaping:	Overgrown.
Invasive species noted (e.g. Japanese Knotweed). Note: absence indicated here by non-specialist does not infer that JKn is not present.	None noted.
Can investigation be in landscaped areas. Specific reinstatement required.	All in soft landscaped areas, no reinstatement required.
Site topography – flat/ sloping, Level compared to surroundings & mAOD.	Sloping from W-E (c.121-108m AOD) with two sharp breaks in slope and a near vertical quarry face.
Evidence of filling or earthworks	Backfilled quarry, creating three terraces, no evidence of slope instability.
Soil drainage – marshy/ marsh vegetation/ dry/ surfaces cracked/ surface rutting etc.	Relatively well drained.
Trees – effects on buildings, condition, species and height; location; maturity; leaning/ upright; rotated trees?	Multiple semi mature and mature trees of unknown species, particularly to E and N.
Rock/ soil exposures	Former quarry face c.2.5-3m tall exposing fractured limestone.
Other evidence of Services, e.g. overhead cables, Gas 'yellow headstone'.	Overhead cables along SW boundary and known electric cable buried along northern boundary.

SURROUNDING LAND USES	
General site context – industrial, commercial, urban, agricultural etc.	Rural residential.
Land use – north (give distances)	Warminster Road and residential properties.
Land use – south (give distances)	Residential properties.
Land use – east (give distances)	Warminster Road and residential properties.
Land use – west (give distances)	Bath Stone – Stone supplier.
Local ground profiles and signs of instability.	Hilly region with areas of extensive landslip.
Evidence of structural distress on nearby buildings.	-
Evidence of mining history (colliery spoil heap, miners cottage).	Recorded stone mining/quarrying in local area.



Plate 1 – View N of upper terrace



Plate 2 – View SE from upper terrace



Plate 3 – View E of middle terrace



Plate 4 – View S of middle terrace



Plate 5 – View N of middle terrace



Plate 6 - View N of middle terrace



Plate 7 – Quarry face



Plate 8 - Quarry face



Plate 9 – Adit in quarry face



Plate 10 – View N of lower terrace



Plate 11 – View SE of lower terrace



Plate 12 – Access



Plate 13 – TP1



Plate 14 – TP1 spoil



Plate 15 – TP2



Plate 16 – TP2 spoil



Plate 17 – TP3



Plate 18 – TP3 spoil



Plate 19 – TP4



Plate 20 – TP4 spoil



Plate 21 – TP5



Plate 22 – TP5 spoil



Plate 23 – TP6



Plate 24 – TP6 spoil

Appendix C

Desk Study Information

ACTION

NON-COAL MINING TECHNICAL REPORT

PASSED

Mine Entries	There are no recorded mine entries within the Site boundary, however, unrecorded entries could be present.	ADVISORY
Surface/ Shallow Mine Workings	There are no recorded shallow mine workings within the Site boundary, however, unrecorded surface/shallow mine workings could exist.	ADVISORY
Deep Mine Workings	No evidence to suggest deep (over 30 metres) underground mine workings exist within the vicinity of the property.	PASSED
Planning Permissions	Stoke Hill / Hayes Wood Mine is currently active and operated by Bath Stone Co Ltd. The operators are based to the west of the Site on the western side of Midford Lane. Please contact the local council or Bath Stone Co Ltd for further information. The Site is also within a limestone Mineral Conservation Area. Please contact the local council for further information.	ADVISORY

Report on:

**18 Midford Lane, Limpley
Stoke, Bath, BA2 7GP**

Date:

31/10/2018

Our Ref:

**TFC20181023153449-
BA27GP**

Client Ref:

PO No. 18022/0533

Professional Opinion

Within the scope of this assessment, mining activity is considered unlikely to impact the value or security of the Site for normal lending purposes.

Mining features have been identified within the influence of the Site, resulting in a susceptibility to past, present and/or future ground movement and prudent enquiries may be undertaken to provide further assurances, relating to the stability of the Site.

Further Actions

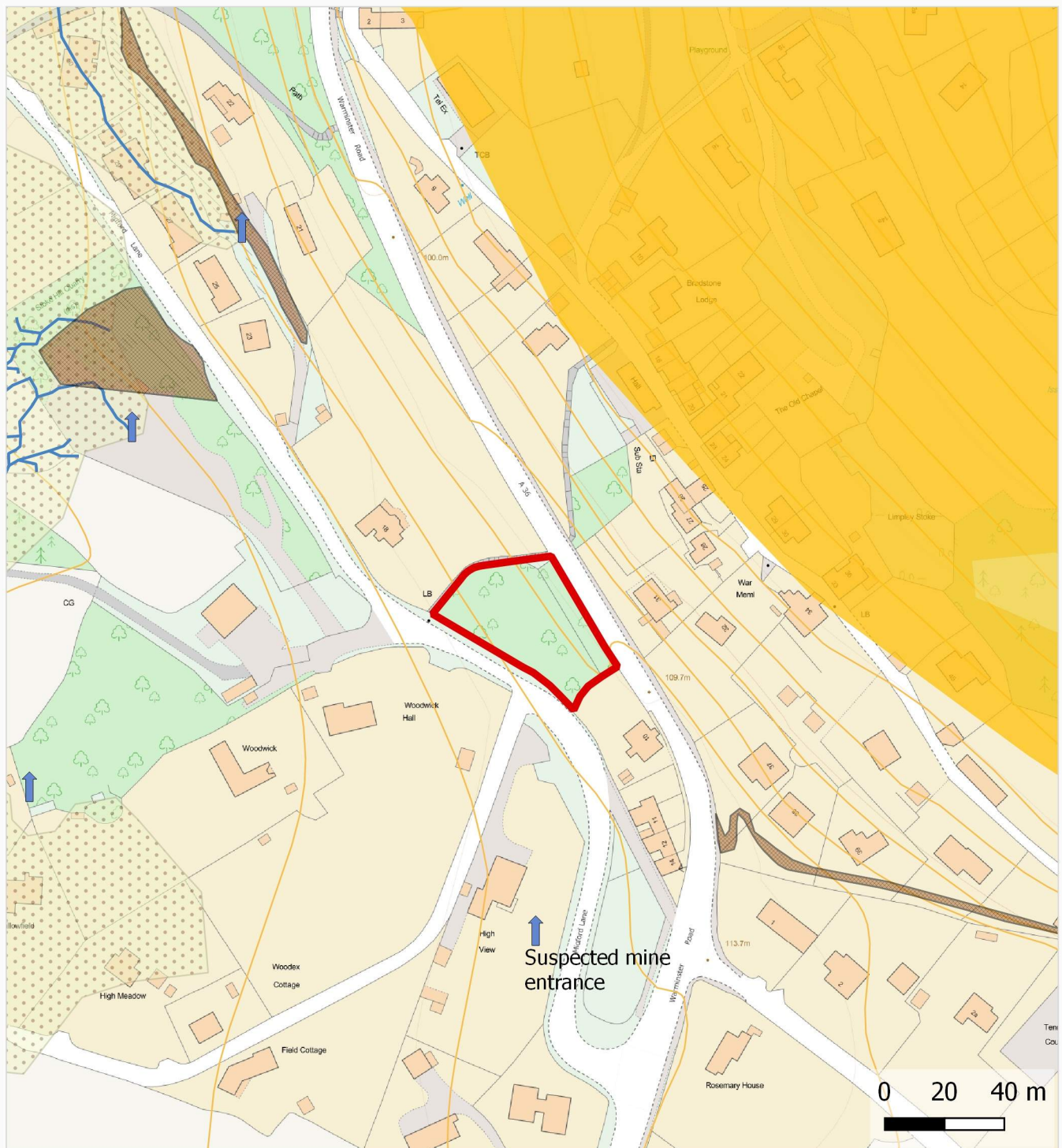
It is recommended that a site walkover is undertaken by a mining geologist/engineer (see recommendations on page 5).

Contact the report author, Maura Partridge BSc, directly by contacting: 0330 900 7500

TerraSearch® Action is a comprehensive 'Con29m-Compliant' mining hazard review, which aims to quantify the risk of mining-related subsidence or collapse to the site from historical, present and planned mineral extraction.

The report blends supporting information, site-specific and expert interpretation with full hazard data to professionally conclude the risk. Detailed recommendations are also provided based on the level of mining risk identified. The report is accepted by all major UK lenders and Terraforma's terms & conditions provide liability cover of £10m per report. All TerraSearch® reports adhere to The Search Code, monitored by the Property Code Compliance Board.

Mining Hazard Map



Site Address

18 Midford Lane, Limpley Stoke, Bath, BA2 7GP

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understand the ground

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Hazard Map Key

 Site Boundary	<u>Mining Features</u>	<u>Other</u>
	 Mine Level	 Historical Landslide
	 Adit	 Topographic Contours
	 Stone Quarry	
	 Underground Workings	

Conclusions and Expert Interpretation

Ongoing Current Use:

PASSED

Historical Mining & Site Context

The Site is underlain by the Chalfield Oolite Formation (Limestone) which has been widely used as a building stone throughout history. The rise in demand for this resource during the 18th Century led to the development of underground mines in the area.

Extraction for Bath Stone initially began along the exposed outcrop of Chalfield Oolite and where natural fissuring of the stone allowed for easy exploitation. The earliest access points for underground quarries were from existing surface quarries and from levels driven laterally into the hillside, mining the shallow dipping strata. By 1800 there were three large established underground quarries in Limpley Stoke that were worked by the Pillar and Stall method: Hayes Wood, Stoke Hill and Freshford. These quarries are located to the west of the Site and do not underlie the Site.

The Chalfield Oolite is underlain by the Fuller's Earth Clay, which is locally highly susceptible to deformation and therefore cannot support the heavier Chalfield Oolite above. This has resulted in ground instability along the slope upon which the Site is located. Mass movement features, such as landslides and cambering of the limestone strata, are common in areas where these geological conditions are present and are found across Limpley Stoke and the hills bordering the River Avon. Additionally, cambering of the limestone produces naturally forming fissures or gullies that are recorded to have been historically extracted for stone in the area.

Subsidence Risk Analysis

There are no recorded mine workings beneath the Site, however, due to the potential cambering of the limestone bedrock, enabling mining in fissures and gullies, the presence of small-scale unrecorded workings cannot be discounted.

A quarry face entrance to Stoke Hill Quarry, located approximately 100 metres north of the Site, is situated upon the same topographical level as the western part of the Site. Another suspected mine entrance is located approximately 70 metres south of the Site on similar topography. There may be small scale unrecorded mining features, trial pits or mine levels in the hillside beneath and/ or in the vicinity of the Site given the suitable geological and topographical conditions. Such features, given the conditions beneath the Site, would likely be surface/shallow underground.

The Site is situated on a slope that is susceptible to landslides. The nearest recorded historic landslide/landslip is 55 metres north-east of the Site, however, it is possible that further unrecorded landslides or mass movements have occurred historically. The potential for future landslides and cambering increases the risk of mining-related ground instability, as the disturbance of any present unrecorded workings could result in upward void migration, localised subsidence or collapse.

Conclusions

There are no recorded historical mining features within the Site boundary, however, due to the geological and topographical conditions on Site, the presence of unrecorded small-scale mining features cannot be entirely discounted.

understand the ground

Professional Recommendations

Considering the ongoing current use of the Site, it is recommended that a site walkover is undertaken by a mining geologist/engineer to identify any signs ground movement or historical mining features (such as mine entries or mined fissures/gullies) that may be present and to provide recommendations on any next steps required.

Considering future development, a Site Investigation should be undertaken by a mining geologist or engineer prior to any future development. This could include sinking boreholes in the areas to be developed to ensure that there are no unrecorded mine workings or voids, or a foundation inspection.

References

Forster, A.; Hobbs, P.R.N.; Monkhouse, R.A.; Wyatt, R.J. (1985). Environmental geology study: parts of west Wiltshire and south-east Avon. Nottingham, UK, British Geological Survey.

Hawkins, D. (2011). Bath stone quarries. Monkton Farleigh, Folly Books.

Report Limitations

This TerraSearch® Action report has been carried out with reference to Terrafirma's bespoke GIS and an extensive collection of abandoned mine plans, maps, records and archives in our possession. The report does not consider natural ground stability hazards, such as subsidence (other than mining-related), landslide or coastal erosion.

From this material, we have endeavoured to provide as accurate a report as possible. It should be realised that totally unrecorded or unindicated workings can exist between known workings and therefore Terrafirma cannot be held responsible for any settlement or subsidence problems as a result of a Site being affected by unrecorded mining features or natural ground cavities.

It is a 'remote' investigation and reviews only information provided by the client and from the databases of publicly available information that have been chosen to enable a desk based environmental assessment of the Site. The report does not include a Site Investigation, nor does Terrafirma make specific information requests of the regulatory authorities for any relevant information they may hold.

This report is concerned solely with the Site searched and should not be used in connection with adjacent properties as only relevant known mining features have been mentioned and any known features that could potentially have a direct influence upon the target Site. Other features which may be present in the general area may have been omitted for clarity.

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The Property Ombudsman scheme, Milford House, 43-55 Milford Street, Salisbury, Wiltshire SP1 2BP, Tel: 01722 333306, Fax: 01722 332296, Email: admin@tpos.co.uk, Web site: www.tpos.co.uk.

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- Normally deal with it fully and provide a final response, in writing, within 20 working days of receipt.
- Keep you informed by letter, telephone or e-mail, as you prefer, if we need more time.
- Provide a final response, in writing, at the latest within 40 working days of receipt.
- Liaise, at your request, with anyone acting formally on your behalf.

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TRIAL PIT LOG

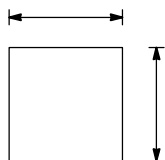
Project Midford Lane			TRIAL PIT No TP 1
Job No RT/ML/101	Dates start 26-11-15 finish 26-11-15	Ground Level (m)	
Client Robert Thorpe		Co-Ordinates ()	Sheet 1 of 1

STRATA			SAMPLES & TESTS		
Legend	Depth (elev)	DESCRIPTION	Depth	No	Remarks/Tests
	0.35	Probable made ground - topsoil: Dark brown organic slightly clayey sandy SILT with occasional fine to coarse angular/subangular and tabular limestone gravel, and roots and rootlets	0		
	1.30	Probable quarry waste/discards made ground - light brown and beige fine to coarse angular/subangular and tabular limestone GRAVEL and COBBLES with occasional boulders with some to much light brown sandy clay matrix. ...beige/buff fine to coarse limestone gravel with a sandy clay matrix to 0.4m in the east, 0.65m in south of the trial pit beneath the topsoil layer	1		
	2.25	Probable quarry waste/discards made ground - beige/buff brashy fine to coarse angular/subangular and tabular limestone GRAVEL and COBBLES with occasional boulders with some slightly clayey sand matrix. Loose - easy digging ...becoming loose with increasing depth	2		
			3		

TRIAL PIT PHOTOS:



Shoring/Support:
Stability:



GENERAL REMARKS

Some spalling at 1m on west side of trial pit
No groundwater encountered

All dimensions in metres
Scale 1:37.5

Engineer

Stonewood Design

Method/
Plant Used

Hitachi Zaxis 85 USB

Logged By

T.Wallis

TRIAL PIT LOG

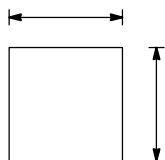
Project Midford Lane			TRIAL PIT No TP 2	
Job No RT/ML/101	Dates start 26-11-15 finish 26-11-15	Ground Level (m)		
Client Robert Thorpe		Co-Ordinates ()	Sheet 1 of 1	

STRATA			SAMPLES & TESTS		
Legend	Depth (elev)	DESCRIPTION	Depth	No	Remarks/Tests
	0.40	Probable made ground - topsoil: Dark brown organic slightly clayey slightly sandy SILT with occasional fine to medium angular/subangular limestone gravel and roots and rootlets	0		
	1.05	Probable quarry waste/discards made ground - light brown, beige and buff sandy SILT with occasional fine to medium angular/subangular limestone gravel and roots and rootlets	1		
	3.20	...probable buried topsoil layer at 0.8-0.9m Possible quarry waste/discards made ground - light brown and beige fine to coarse angular/subangular and tabular limestone GRAVEL with occasional cobbles and some light brown silty sand matrix with roots and rootlets. ...loose material, but harder digging due to increasing block size	2		
			3		
			4		

TRIAL PIT PHOTOS



Shoring/Support:
Stability:



GENERAL REMARKS

Some spalling east and west side of trial pit between 1-2.5m
No groundwater encountered

AGS3 UK TP PHOTO MIDFORD LANE TP LOGS - REV2018.GPJ AGS 3 1.GDT 9/3/18

All dimensions in metres
Scale 1:50

Engineer

Stonewood Design

Method/
Plant Used

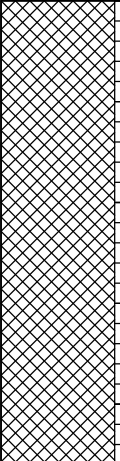
Hitachi Zaxis 85 USB

Logged By

T.Wallis

TRIAL PIT LOG

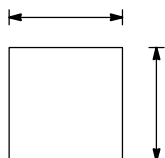
Project Midford Lane			TRIAL PIT No TP 3
Job No RT/ML/101	Dates start 26-11-15 finish 26-11-15	Ground Level (m)	
Client Robert Thorpe		Co-Ordinates ()	Sheet 1 of 1

STRATA			SAMPLES & TESTS		
Legend	Depth (elev)	DESCRIPTION	Depth	No	Remarks/Tests
	2.30	Quarry waste/discards made ground - light brown/buff and beige COBBLES & BOULDERS of limestone with fine to coarse angular/subangular and tabular limestone gravel and some sandy clay matrix	0 1 2 3		

TRIAL PIT PHOTOS:



Shoring/Support:
Stability:



GENERAL REMARKS

Some spalling within the quarry waste
No groundwater encountered
Pit extended under overhanging rock slab, evidence of undermining to ~2.5m back from back-face of quarry, tooling marks visible on some blocks in underlying face, possible mine entrance/adit.

AGS3 UK TP PHOTO MIDFORD LANE TP LOGS - REV2018.GPJ AGS 3.1.GDT 9/3/18

All dimensions in metres
Scale 1:37.5

Engineer

Stonewood Design

Method/
Plant Used

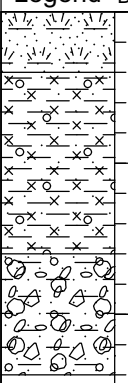
Hitachi Zaxis 85 USB

Logged By

T.Wallis

TRIAL PIT LOG

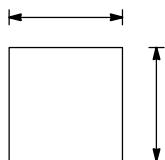
Project Midford Lane			TRIAL PIT No TP 4	
Job No RT/ML/101	Dates start 26-11-15 finish 26-11-15	Ground Level (m)		
Client Robert Thorpe		Co-Ordinates ()	Sheet 1 of 1	

STRATA			SAMPLES & TESTS		
Legend	Depth (elev)	DESCRIPTION	Depth	No	Remarks/Tests
	0.20	Topsoil: Dark brown organic slightly sandy very clayey SILT with occasional fine angular/subangular limestone gravel and roots and rootlets	0		
		Light brown slightly silty sandy CLAY with occasional fine to coarse angular/subangular and tabular limestone gravel and roots and rootlets ...gravel content increases near base of stratum			
	0.80	Light brown coarse GRAVEL and COBBLES of limestone with some to much fine to medium limestone gravel and some light brown sandy clay matrix. ...End on hard digging on limestone boulders	1		
	1.20		2		

TRIAL PIT PHOTOS:



Shoring/Support:
Stability:



GENERAL REMARKS

Stable
No groundwater encountered

All dimensions in metres
Scale 1:25

Engineer

Stonewood Design

Method/
Plant Used

Hitachi Zaxis 85 USB

Logged By

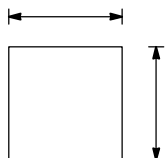
T.Wallis

TRIAL PIT LOG

Project Midford Lane			TRIAL PIT No TP 5
Job No RT/ML/101	Dates start 26-11-15 finish 26-11-15	Ground Level (m)	
Client Robert Thorpe		Co-Ordinates ()	Sheet 1 of 1

STRATA			SAMPLES & TESTS		
Legend	Depth (elev)	DESCRIPTION	Depth	No	Remarks/Tests
		Topsoil	0		
	0.15	Brashy material: silty CLAY with limestone gravel and cobbles			
	0.40	Intact bedded LIMESTONE			
	0.55	...0.48m to top of brick tiles, electrical cable at 0.55m			
			1		

Shoring/Support:
Stability:



GENERAL REMARKS

Depths estimated
Pit abandoned as electric cable struck/broken
Brick marker tiles at 0.48m, electrical cable at 0.55m depth on W side of pit, but at 0.45m on E side with no tiles visible

All dimensions in metres
Scale 1:6.25

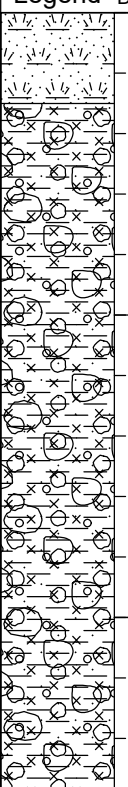
Engineer **Stonewood Design**

Method/
Plant Used

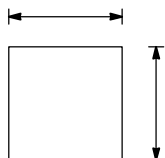
Hitachi Zaxis 85 USB

Logged By **T.Wallis**

Project Midford Lane			TRIAL PIT No TP 5a
Job No RT/ML/101	Dates start 27-11-15 finish 27-11-15	Ground Level (m)	
Client Robert Thorpe		Co-Ordinates ()	Sheet 1 of 1

STRATA			SAMPLES & TESTS		
Legend	Depth (elev)	DESCRIPTION	Depth	No	Remarks/Tests
	0.15	Topsoil	0		
	1.30	Brashy material: silty CLAY with limestone gravel, cobbles and boulders ...end on hard limestone outcrop	1		
			2		

Shoring/Support:
Stability:



GENERAL REMARKS

Trench excavated by Scottish & Southern Electric to expose electric cable for repair
Rockhead ~1.3m, limestone outcrop drops down by around 1.5-2m at east end of trench - possible quarry back-face
No groundwater encountered

AGS3 UK TP NO SKETCH MIDFORD LANE TP LOGS - REV2018.GPJ AGS 3.1 GDT 9/3/18

All dimensions in metres
Scale 1:12.5

Engineer **Stonewood Design**

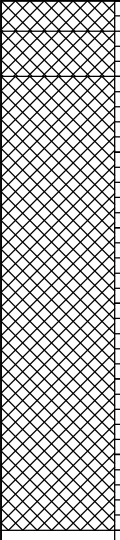
Method/
Plant Used

Hitachi Zaxis 85 USB

Logged By **T.Skailes**

TRIAL PIT LOG

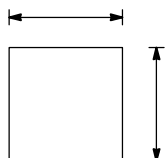
Project Midford Lane			TRIAL PIT No TP 6
Job No RT/ML/101	Dates start 27-11-15 finish 27-11-15	Ground Level (m)	
Client Robert Thorpe		Co-Ordinates ()	Sheet 1 of 1

STRATA			SAMPLES & TESTS		
Legend	Depth (elev)	DESCRIPTION	Depth	No	Remarks/Tests
	0.20	Made ground plateau material - soft light brown with occasional beige sandy CLAY with occasional to some fine to coarse angular/subangular and tabular limestone gravel, occasional cobbles and rootlets	0		
	0.50	Buried made ground topsoil - dark brown slightly sandy slightly clayey SILT with occasional fine to coarse angular/subangular and tabular limestone gravel, occasional fine to medium gravel sized coal pieces, occasional glass and roots and rootlets	1		
		Quarry waste/discards made ground - light brown and buff fine to coarse angular/subangular and tabular limestone GRAVEL and COBBLES with occasional boulders with some very sandy clay matrix	2		
	3.50	...loose, spalling below 0.75m ...with more cobbles and boulders from 1.40m, hard digging at 1.80m ...largest boulder size 700x300x550mm	3		

TRIAL PIT PHOTOS:



Shoring/Support:
Stability:



GENERAL REMARKS

Some spalling on the east and west sides of the trial pit between 1-3.5m
West side of trial pit collapsed during backfilling
No groundwater encountered

All dimensions in metres
Scale 1:50

Engineer

Stonewood Design

Method/
Plant Used

Hitachi Zaxis 85 USB

Logged By

T.Wallis

Appendix D

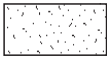
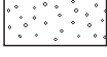
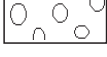
Trial Pits

EXPLORATORY HOLE EXPLANATION SHEET

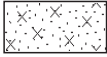
SAMPLES AND TESTS

AMAL	Amalgamated sample	J	Jar sample	HVP	Hand-held shear vane test
B	Bulk disturbed sample	LB	Large bulk disturbed sample	HSV	Hand-held shear vane test
BLK	Block sample	M	Mazier type sample	MEX	Mexicone penetrometer test
C	Core sample	SPTLS	Standard penetration sample	PID	Photoionization detector (gas)
CBR	CBR mould sample	TW	Thin-walled push in sample		
D	Small disturbed sample	U	Undisturbed sample - open drive		
ES	Environmental sample	UT	Thin wall open drive tube sampler		
EW	Environmental water sample	W	Water sample		
G	Gas sample				

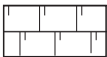
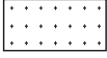
SOILS

	Topsoil
	Concrete
	Made Ground (Fill)
	Peat
	Clay
	Silt
	Sand
	Gravel
	Cobbles
	Boulders

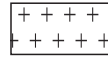
Note: composite soil types will be signified by combined soil types e.g.

	Silty Sand
--	------------

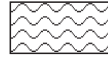
SEDIMENTARY

	Chalk
	Limestone
	Conglomerate
	Breccia
	Sandstone
	Siltstone
	Mudstone
	Shale
	Coal
	Pyroclastic (Volcanic Ash)
	Gypsum, Rocksalt, etc.
	Void/Broken Ground

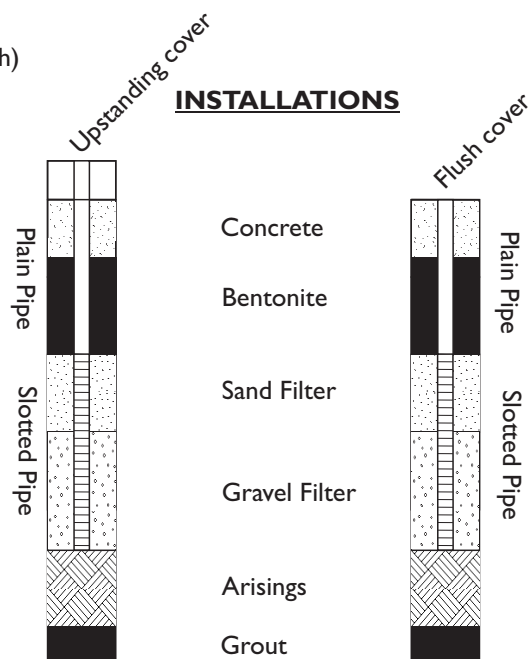
IGNEOUS

	Coarse Grained Igneous
	Medium Grained Igneous
	Fine Grained Igneous

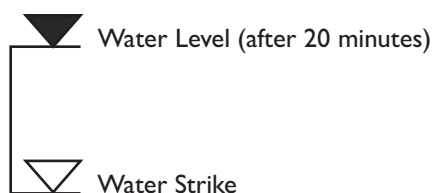
METAMORPHIC

	Coarse Grained Metamorphic
	Medium Grained Metamorphic
	Fine Grained Metamorphic

INSTALLATIONS



WATER SYMBOLS



GEOLOGICAL • GEOTECHNICAL • ENVIRONMENTAL • ENGINEERING

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STANDARD METHODOLOGY FOR MECHANICAL TRIAL PITTING

Trial pits are mechanically excavated using a wheeled or tracked backhoe or mini-excavator, typically fitted with toothed buckets. The trial pit locations are selected using information on the proposed redevelopment, existing buried services and structures, ongoing site use, reinstatement requirements and time constraints. Those positions are shown on Figure 1 and the trial pit records included as a separate appendix.

Trial pitting was directed and supervised full-time by an experienced engineering geologist who carried out insitu testing, kept a record of the strata encountered, noted the pit side stability and ease of digging, any water ingresses, took photographs and recovered representative disturbed samples.

Insitu testing comprised hand shear vane measurement in appropriate cohesive strata to provide a direct reading of insitu undrained shear strength. Tests were completed from within the pit to depths of approximately 1.2m below ground level and within excavated spoil below this. The hand shear vane is inserted into cohesive soil and rotated at an even speed equivalent to one rotation per 60 seconds. Three tests are typically taken and the average result used as the undrained shear strength in kN/m².

Mexicone penetrometer testing was undertaken either from ground level or at shallow depth within trial pits and the test results are included in the trial pit records. The mexicone penetrometer is a simple, hand-held device which gives a direct read out of equivalent CBR strength, on a cylindrical gauge. Readings are recorded for each 75mm penetration and where suitable soils are present, successive readings up to 0.6m total penetration can be achieved. However, the test can abort on coarse granular soils or other obstructions and in this case the term 'refusal' is given in the test records.

On completion the pits were backfilled with their spoil, compacted with the excavator bucket and the surplus left mounded to allow for subsequent consolidation settlement. If specific reinstatement has been requested by the client, this is confirmed in the main text of this report.

The trial pit records have been prepared using Gint software, taking into account both site descriptions and subsequent laboratory testing.



Intégrale

Understanding Ground Conditions

Trial Pit Log

Trialpit No

TP1

Sheet 1 of 1

Project Name: Land SE of 18 Midford Lane, Limpley Stoke

Project No.
18022

Co-ords: -
Level:

Date
12/11/2018

Location: Limpley Stoke, Bath, BA2 7GP

Dimensions (m):

2.5

Depth
2.10

0.55

Scale
1:15

Logged
TF

Client: Swinhay Limited

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.20	ES		0.10 0.25			MADE GROUND: (comprising soft light brown silty sandy gravelly Clay. Sand is fine to coarse. Gravel is angular to subangular fine to coarse limestone and brick. Occasional tile fragments and metal). MADE GROUND: (comprising loose brown slightly clayey sandy gravelly Silt. Sand is fine to medium. Gravel is angular to subangular fine to coarse limestone and brick. Frequent roots and rootlets [Buried Topsoil]). MADE GROUND: (comprising loose beige and pale brown sandy gravelly Silt with medium cobble content. Sand is fine to medium. Gravel is angular to subangular fine to coarse of tabular limestone. Cobbles are subangular of tabular limestone).
	0.50 0.60	ES D		0.70			MADE GROUND: (comprising loose to medium dense beige and pale brown angular to subangular fine to coarse Gravel and Cobbles of tabular limestone with rare boulders in a clayey sandy Silt matrix. Boulders are subangular of limestone).
	1.00	ES					Boulder content increases with depth.
	1.30 1.30 - 1.60	D B					Below 1.7m, matrix becomes silty sandy Clay.
				2.10			At 2.1m, excavation terminated on probable limestone boulder. End of pit at 2.10 m

Remarks: Mexecone: 0.6m - Refusal.
No groundwater encountered.
Infiltration test completed at 1.6m.
Monitoring well installed at 2.0m.

Stability: Spalling below 1.2m.



Intégrale

Understanding Ground Conditions

Trial Pit Log

Trialpit No

TP2

Sheet 1 of 1

Project Name: Land SE of 18 Midford Lane, Limpley Stoke

Project No.
18022

Co-ords: -
Level:

Date
12/11/2018

Location: Limpley Stoke, Bath, BA2 7GP

Dimensions (m):

2.7

Depth
2.30

1.3

Scale
1:15

Logged
TF

Client: Swinhay Limited

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.15	ES		0.10			MADE GROUND: (comprising soft light brown silty sandy gravelly Clay. Sand is fine to coarse. Gravel is angular to subangular fine to coarse limestone and brick. Rare metal). MADE GROUND: (comprising loose brown slightly clayey sandy gravelly Silt. Sand is fine to medium. Gravel is angular to subangular fine to coarse limestone. Frequent roots and rootlets [Buried Topsoil]). MADE GROUND: (comprising loose beige and pale brown angular to subangular fine to coarse Gravel and Cobbles of tabular limestone with low boulder content in a sandy Silt matrix. Boulders are subangular of limestone. Occasional roots and rootlets).
	0.30 - 0.50	B		0.20			
	1.30 - 1.60	B		2.30			
							Between 1.0m to 1.6m, less matrix. Below 1.2m, medium boulder content. End of pit at 2.30 m

1

2

3

Remarks: Mexecon: 0.5m - Refusal.
No groundwater encountered.
Monitoring well installed at 2.0m.

Stability: Very unstable below 0.2m and collapsing.



Trial Pit Log

Trialpit No

TP3

Sheet 1 of 1

Project Name: Land SE of 18 Midford Lane, Limpley Stoke

Project No.
18022

Co-ords: -

Level:

Date

12/11/2018

Location: Limpley Stoke, Bath, BA2 7GP

Dimensions (m):

2.6

Depth
2.10

0.75

Scale

1:15

Logged
TF

Client: Swinhay Limited

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.10	ES		0.25			TOPSOIL: (comprising soft brown slightly sandy slightly gravelly silty CLAY. Sand is fine. Gravel is subangular to subrounded fine to coarse limestone. Frequent roots and rootlets).	
	0.50	D	HVP=52	0.80			Firm yellow brown slightly sandy silty CLAY with rare gravel. Sand is fine. Gravel is subangular to subrounded fine to coarse of limestone. (HIGHLY WEATHERED UPPER RAGS AND BATH OOLITE)	
	1.00	D	HVP=76	1.80			Firm to stiff yellow brown slightly silty slightly sandy slightly gravelly CLAY. Sand is fine. Gravel is subangular fine to coarse of limestone. (WEATHERED UPPER RAGS AND BATH OOLITE)	1
	1.60	D		2.10			<u>Below 1.6m, medium cobble and boulder content.</u> Dense yellow brown and beige subangular COBBLES and BOULDERS of tabular limestone with some gravel in a sandy clay matrix. Gravel is subangular fine to coarse of limestone. (WEATHERED UPPER RAGS AND BATH OOLITE)	2
							<u>At 2.1m, excavation terminated on probable limestone boulder.</u> End of pit at 2.10 m	3

Remarks: Mexecon: 0.6m - 2, 2.5, 3, 5, 11, 7, 8, Refusal.
No groundwater encountered.
Monitoring well installed at 2.0m.

Stability: Stable.



Intégrale

Understanding Ground Conditions

Trial Pit Log

Trialpit No

TP4

Sheet 1 of 1

Project Name: Land SE of 18 Midford Lane, Limpley Stoke

Project No.
18022

Co-ords: -

Level:

Date

12/11/2018

Location: Limpley Stoke, Bath, BA2 7GP

Dimensions (m):

2.4

Depth
2.60

0.6

Scale

1:15

Logged
TF

Client: Swinhay Limited

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.10	ES	HVP=70	0.20			Topsoil over MADE GROUND: (comprising soft brown slightly sandy slightly gravelly very silty Clay. Sand is fine to coarse. Gravel is angular to subangular fine to coarse brick and limestone. Occasional roots and rootlets and rare metal).	
	0.50	D					Firm yellow brown slightly silty slightly sandy gravelly CLAY with low cobble content. Sand is fine to medium. Gravel is subangular fine to coarse of limestone. Cobbles are subangular of limestone). (HIGHLY WEATHERED UPPER RAGS AND BATH OOLITE)	
	1.00	D		0.80			Medium dense beige and yellow brown angular to subangular fine to coarse GRAVEL of tabular limestone with medium cobble content in a clayey sandy Silt matrix. Sand is fine to medium. Cobbles are subangular of tabular limestone. (WEATHERED UPPER RAGS AND BATH OOLITE)	1
	1.40 - 1.70	B		1.90			Dense beige and yellow brown angular to subangular COBBLES of limestone with some gravel with a silty clay matrix infill between cobbles. Gravel is angular to subangular fine to coarse of limestone. (WEATHERED UPPER RAGS AND BATH OOLITE)	2
				2.60			At 2.6m, excavation terminated on probable limestone bedrock. End of pit at 2.60 m	3

Remarks: Mexecon: 0.5m - 7, 10, Refusal.
No groundwater encountered.
Infiltration test completed at 1.7m.

Stability: Stable.



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Understanding Ground Conditions

Trial Pit Log

Trialpit No

TP5

Sheet 1 of 1

Project Name: Land SE of 18 Midford Lane, Limpley Stoke

Project No.
18022

Co-ords: -
Level:

Date
12/11/2018

Location: Limpley Stoke, Bath, BA2 7GP

Dimensions (m):

2.6

Depth
1.40

0.6

Scale
1:15

Logged
TF

Client: Swinhay Limited

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.20	ES		0.30			Topsoil over MADE GROUND: (comprising loose brown slightly gravelly sandy clayey Silt. Sand is fine to medium. Gravel is angular to subangular fine to coarse limestone and rare brick. Occasional roots and rootlets).
	0.40	D					MADE GROUND: (comprising loose to medium dense beige and cream angular to subangular fine to coarse Gravel and Cobbles of tabular limestone with rare boulders in a sandy Silt matrix. Boulders are subangular of limestone. Occasional roots and rootlets).
	1.00	D		0.70			MADE GROUND: (comprising dense pale cream/white silty fine to medium Sand and subangular to subrounded fine to coarse Gravel of limestone with low cobble content. Cobbles are subangular of limestone).
				1.40			At 1.4m, excavation terminated on probable limestone boulder. End of pit at 1.40 m

1

2

3

Remarks: No groundwater encountered.
Monitoring well installed at 2.0m.

Stability: Stable.



Trial Pit Log

Trialpit No

TP6

Sheet 1 of 1

Project Name: Land SE of 18 Midford Lane, Limpley Stoke

Project No.
18022

Co-ords: -
Level:

Date
12/11/2018

Location: Limpley Stoke, Bath, BA2 7GP

Dimensions (m):

2.6

Depth
3.00

0.6

Scale
1:15

Logged
TF

Client: Swinhay Limited

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.10	ES		0.20			Topsoil over MADE GROUND: (comprising loose brown slightly gravelly sandy clayey Silt. Sand is fine to medium. Gravel is angular to subangular fine to coarse limestone and brick. Occasional roots and rootlets. Rare rags and metal).
	0.50	D		0.70			MADE GROUND: (comprising medium dense pale cream silty very gravelly fine to medium Sand with low cobble content. Gravel is subangular to subrounded fine to coarse of limestone. Cobbles are subangular of limestone).
	1.20	D					MADE GROUND: (comprising medium dense becoming more dense with depth pale cream silty fine to medium Sand and subangular to subrounded fine to coarse Gravel of limestone with low cobble content. Cobbles are subangular of limestone).
	2.30 - 2.60	B		3.00			Below 1.5m, medium cobble content.
							End of pit at 3.00 m

Remarks: No groundwater encountered.

Stability: Stable.

Appendix E

Soakaway Analyses

STANDARD METHODOLOGY FOR SOAKAWAY TESTING

Some trial pits also include soakaway testing in order to assess the soils permeability for design of stormwater drainage. The soakaway tests were completed in accordance with BRE Digest 365 (September 1991). This included excavation of pits to generally 1-2m depth, which were then filled with water on one to three occasions depending on the rate of infiltration. The water was supplied by a water bowser and discharged into the pits using a centrifugal pump. The falling head was recorded and therefore the rate of infiltration into the soils beneath.

The soakaway results have been prepared using a Microsoft Excel spreadsheet.



Job No:	18022	Soil Infiltration Rate Test			
		BRE 365 (2007) Soakaway Design			
Job Name:	Land SE of 18 Midford Lane, Limpley Stoke			Hole:	TPI
Prepared By:	TF	Date:	14/11/2018	Sheet:	1 of 1
Checked By:	AH	Date:	27/11/2018		

Date of Test: 12th November 2018

Length (m): 2.50

Width (m): 0.55

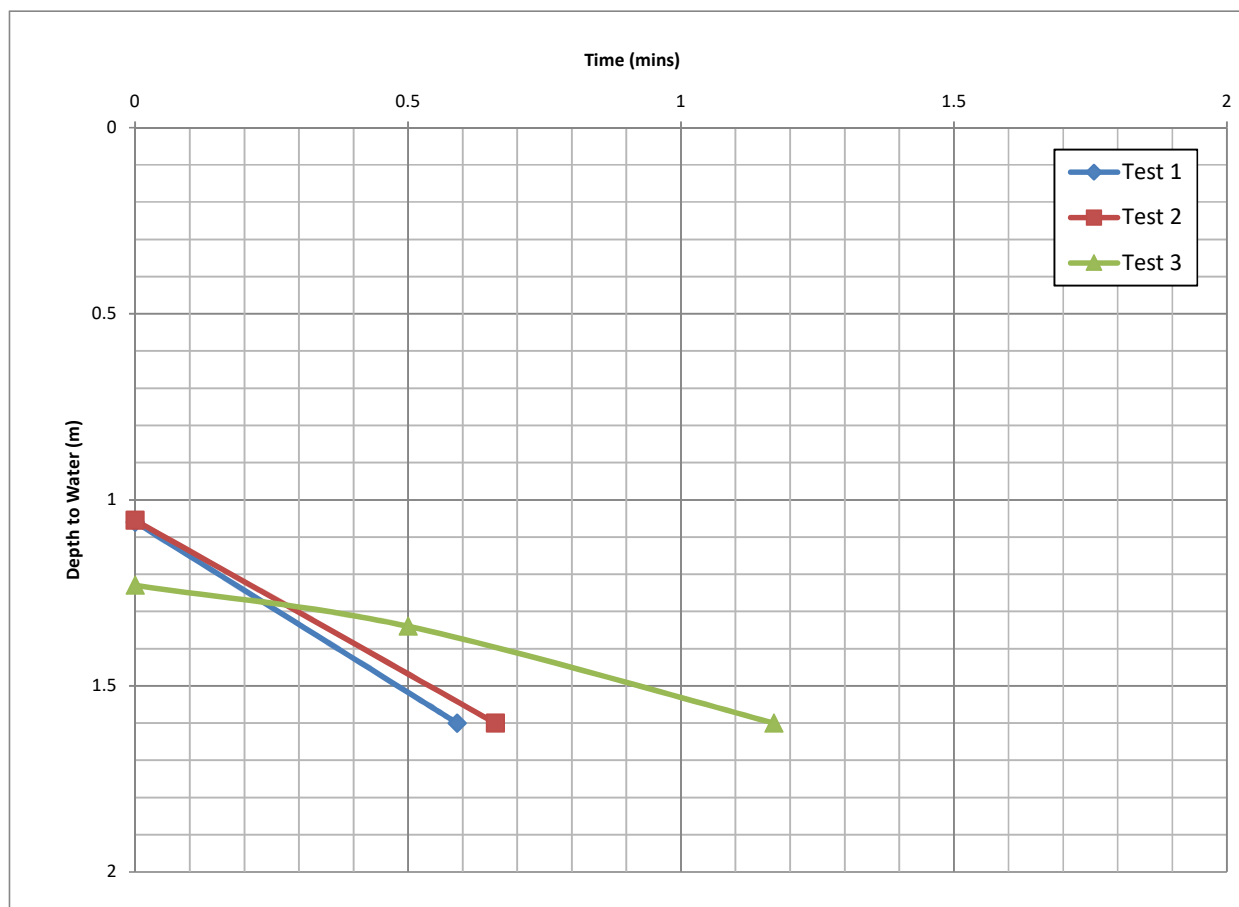
Depth (m): 1.60

Remarks: Test completed within quarry backfill

	Test 1	Test 2	Test 3
Effective Storage Depth _{75-25%} (m)	0.27	0.27	0.185
A = Surface Area _{50%} (m ²)	3.02	3.04	2.50
V = Effective Storage Volume _{75-25%} (m ³)	0.37	0.37	0.25
t = Time _{75-25%} (mins)	0.3	0.3333332	0.51115
Soil Infiltration Rate (m/s)	6.94E-03	6.17E-03	3.31E-03

Design Soil Infiltration Rate (m/s)

3.31E-03





Job No:	18022	Soil Infiltration Rate Test			
		BRE 365 (2007) Soakaway Design			
Job Name:	Land SE of 18 Midford Lane, Limpley Stoke			Hole:	TP4
Prepared By:	TF	Date:	14/11/2018	Sheet:	I of I
Checked By:	AH	Date:	27/11/2018		

Date of Test: 12th November 2018

Length (m): 2.40

Width (m): 0.60

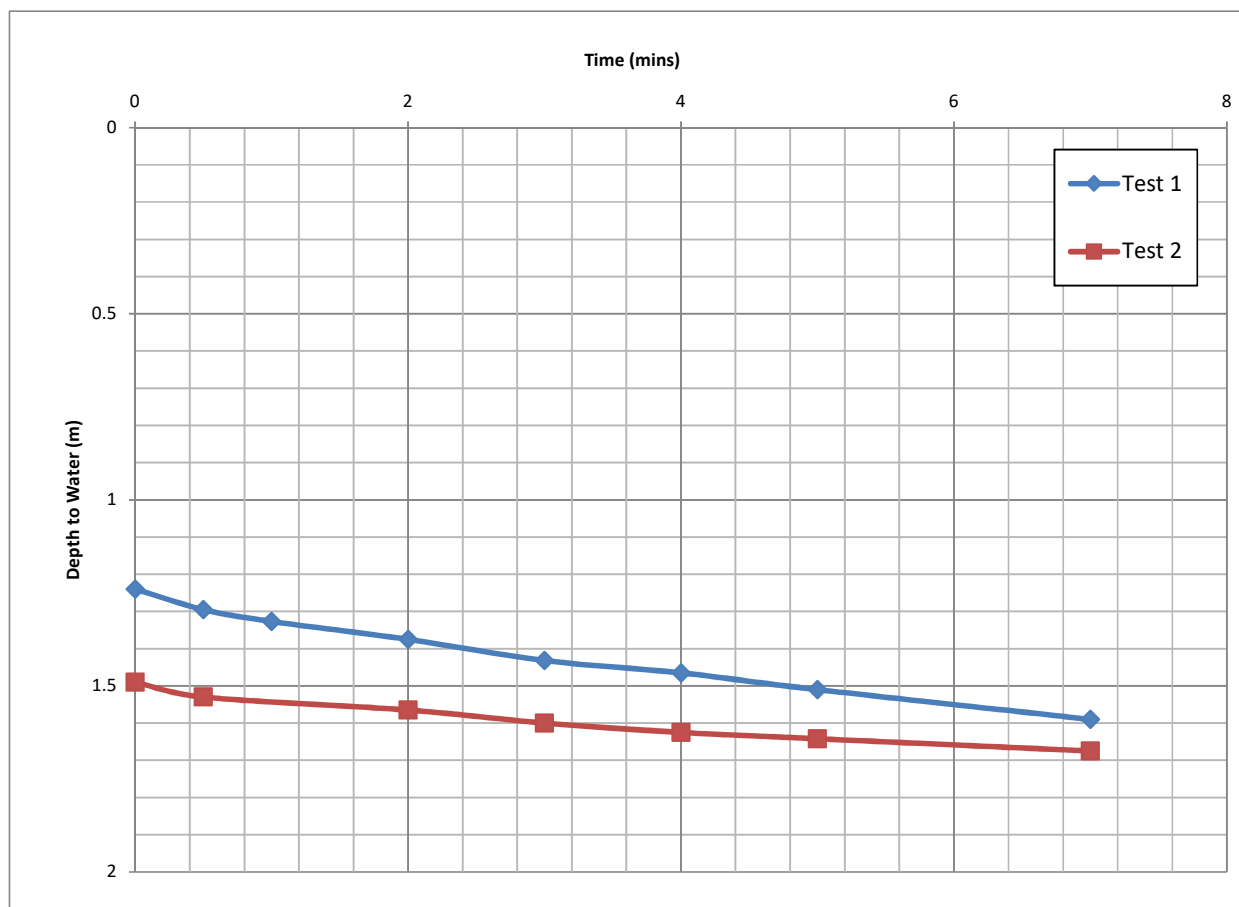
Depth (m): 1.70

Remarks: Test completed within weathered insitu strata. Only 2 tests possible due to volume of water used.

	Test 1	Test 2	Test 3
Effective Storage Depth _{75-25%} (m)	0.23	0.11	-
A = Surface Area _{50%} (m ²)	2.82	2.07	-
V = Effective Storage Volume _{75-25%} (m ³)	0.33	0.15	-
t = Time _{75-25%} (mins)	5.3	4.12	-
Soil Infiltration Rate (m/s)	3.70E-04	2.95E-04	-

Soil Infiltration Rate (m/s)

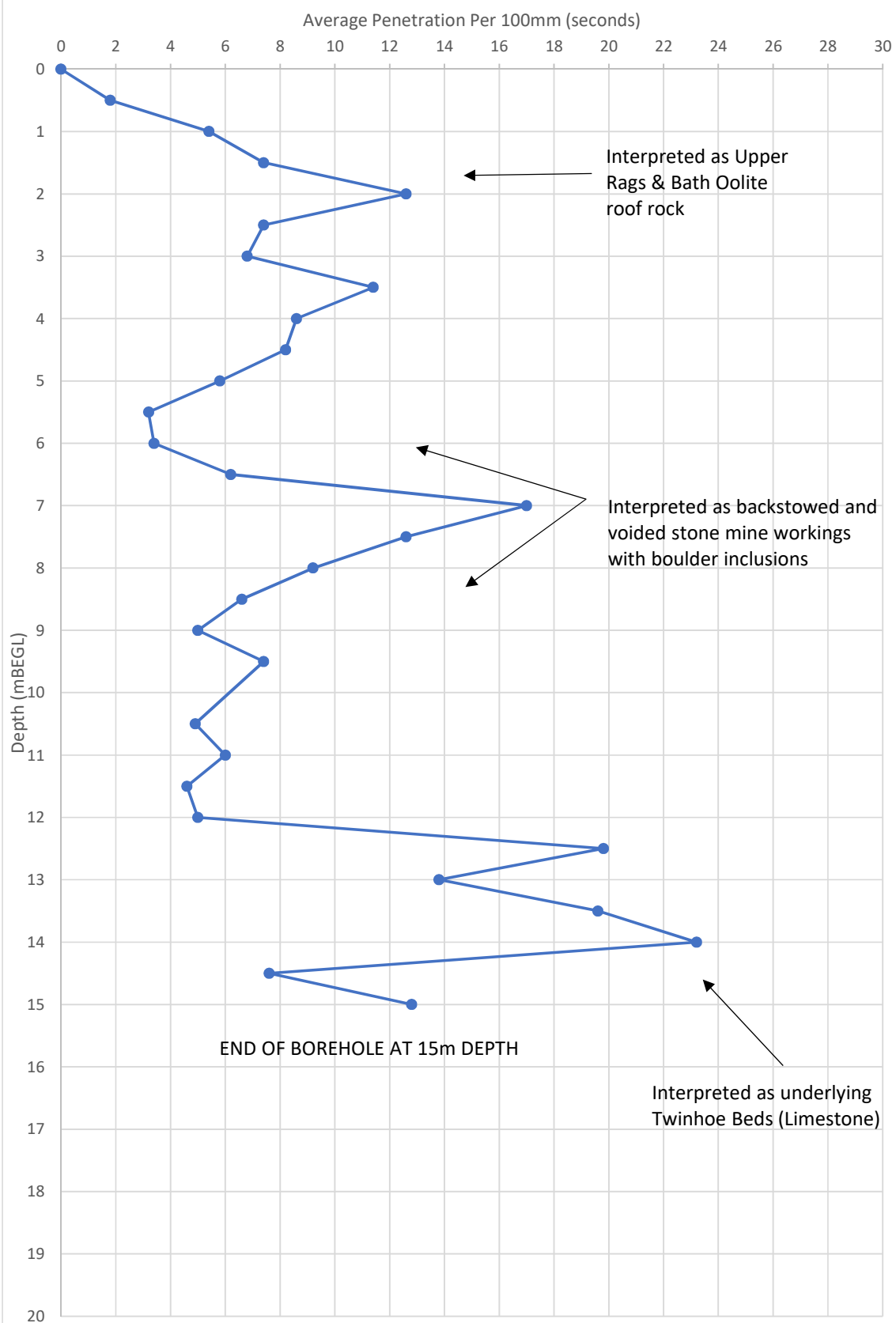
2.95E-04



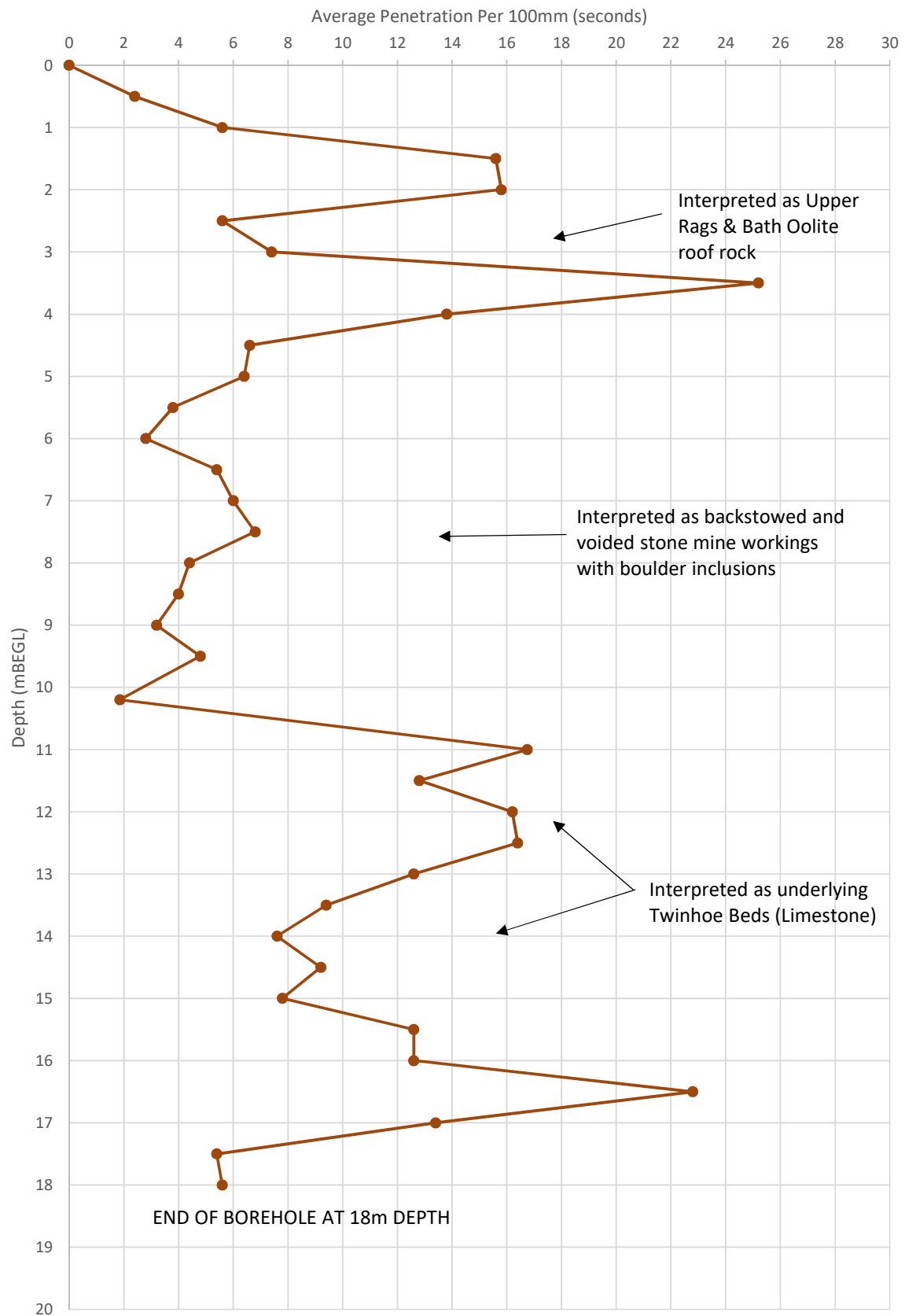
Appendix F

Boreholes

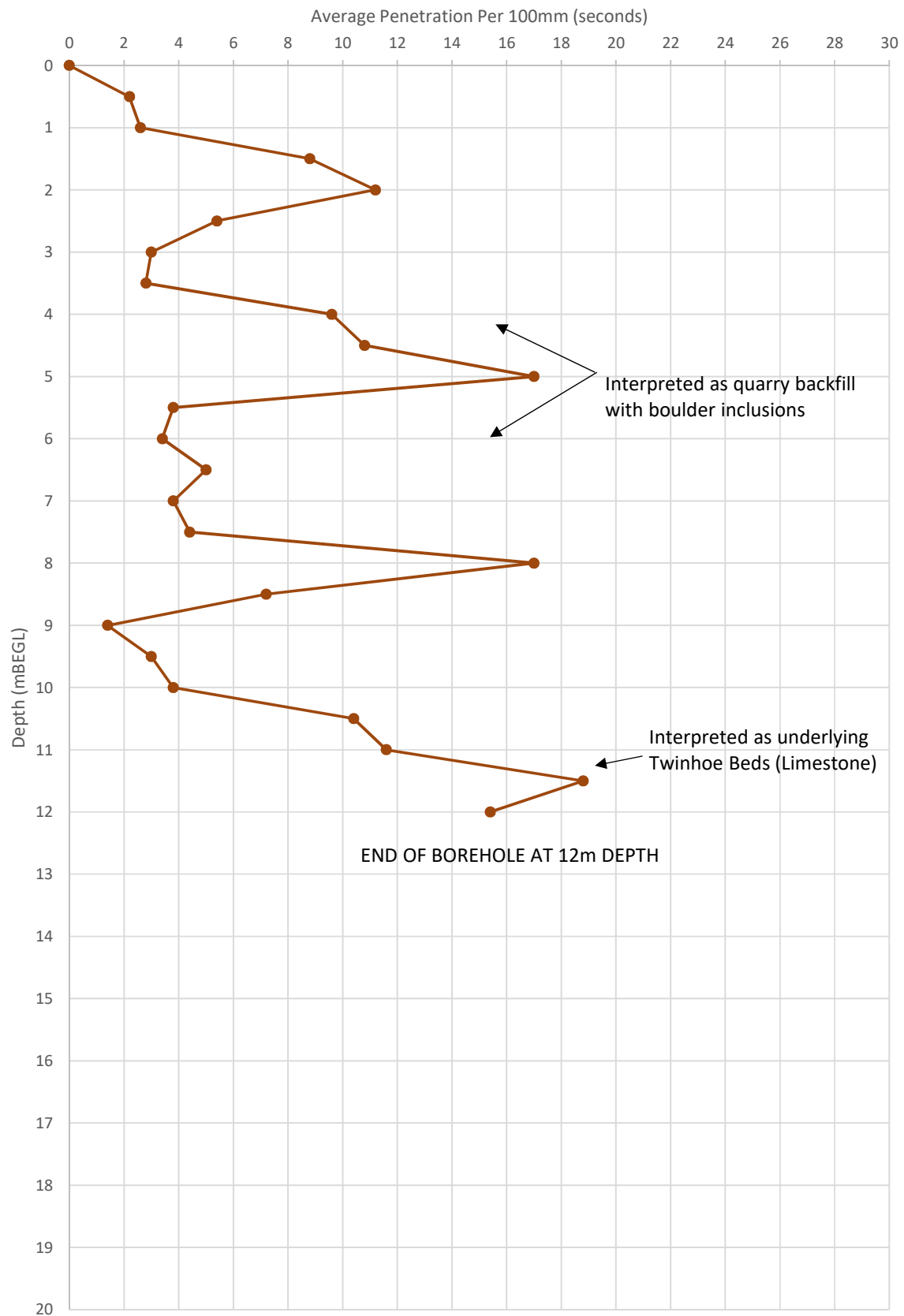
Average Penetration Rate/100mm: RP1



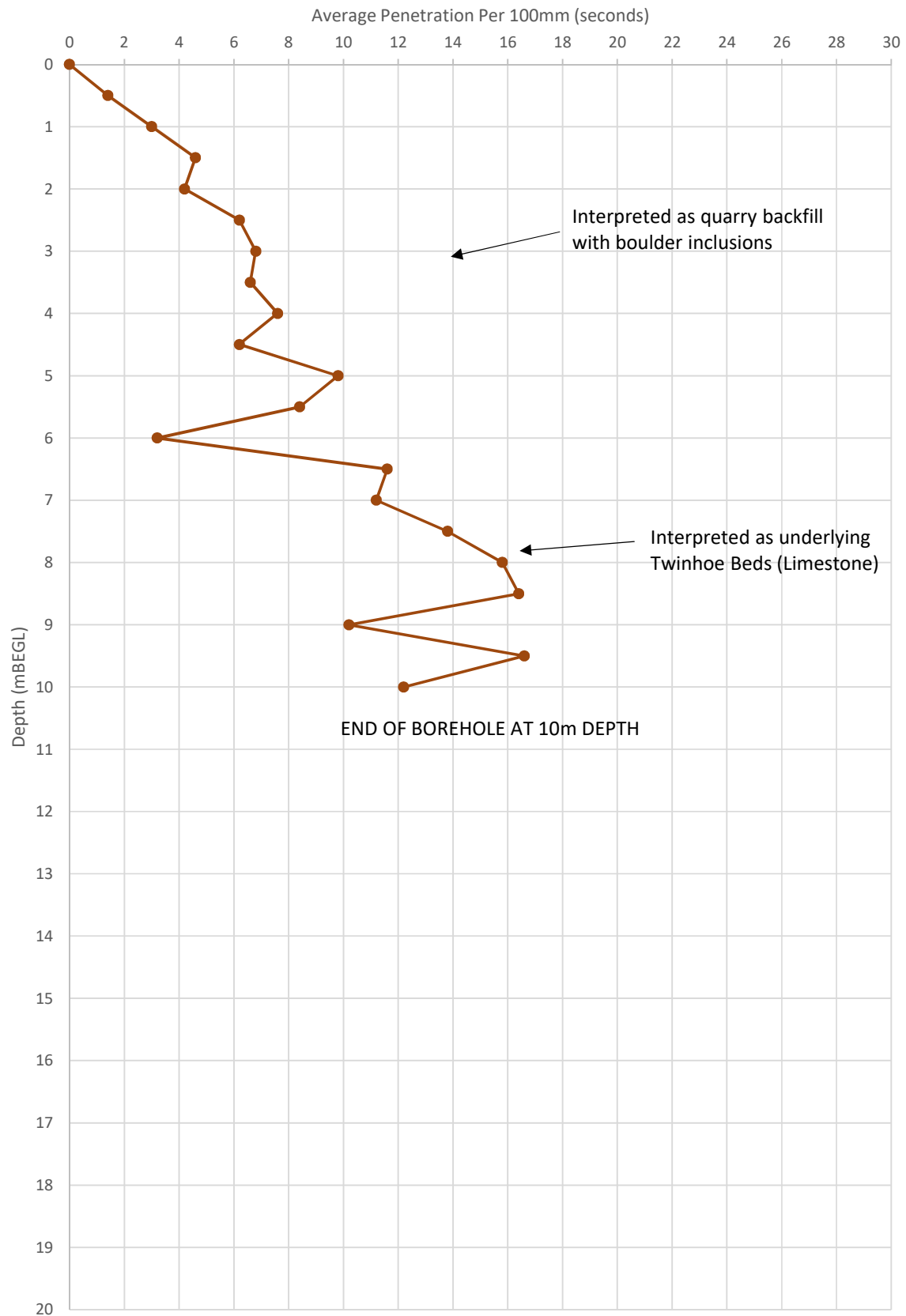
Average Penetration Rate/100mm: RP2



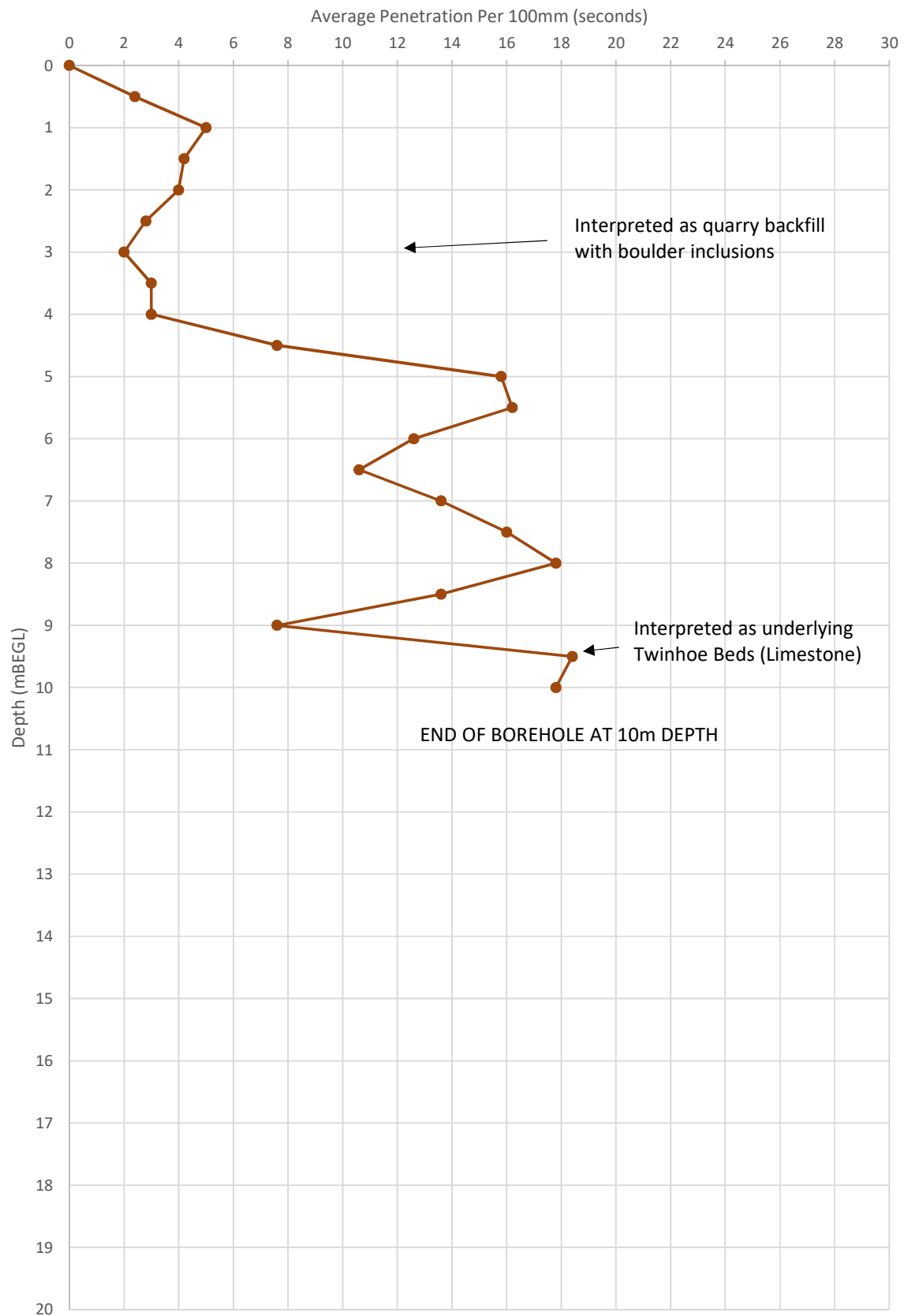
Average Penetration Rate/100mm: RP3



Average Penetration Rate/100mm: RP4



Average Penetration Rate/100mm: RP5



Appendix G

Gas & Groundwater Monitoring



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Atmospheric Pressure (mbar)	991
Ground Conditions	Damp

Position ID	Time Elapsed (secs)	Gas Flow (l/hr)	%LEL	Methane (%/vol)	Carbon Dioxide (%/vol)	Oxygen (%/vol)	VOC (ppm)	Depth to Product (mbgl)	Depth to Water (mbgl)	Product Thickness (mm)	Well Depth (mbgl)
TP1	0	NR	2.0	0.1	0.4	21.1	0.0	-	DRY	-	1.79
	30	NR									
	60	NR									
Comments:											
TP2	0	NR	2.0	0.1	0.2	21.6	0.0	-	DRY	-	1.68
	30	NR									
	60	NR									
Comments:											
TP3	0	NR	2.0	0.1	4.8	19.6	0.0	-	DRY	-	1.75
	30	NR									
	60	NR									
Comments:											
TP5	0	NR	2.0	0.1	0.5	21.2	0.0	-	DRY	-	1.25
	30	NR									
	60	NR									
Comments:											



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Job No.	18022
Monitored By	IL
Visit No	2

Atmospheric Pressure (mbar)	984
Ground Conditions	Wet

Position ID	Time Elapsed (secs)	Gas Flow (l/hr)	%LEL	Methane (%/vol)	Carbon Dioxide (%/vol)	Oxygen (%/vol)	VOC (ppm)	Depth to Product (mbgl)	Depth to Water (mbgl)	Product Thickness (mm)	Well Depth (mbgl)
TP1	0	NR	2.0	0.1	0.3	21.0	0.0	-	DRY	-	1.79
	30	NR									
	60	NR									
Comments:											
TP2	0	NR	0.0	0.0	0.2	21.2	0.0	-	DRY	-	1.68
	30	NR									
	60	NR									
Comments:											
TP3	0	NR	2.0	0.1	5.7	16.4	0.0	-	DRY	-	1.75
	30	NR									
	60	NR									
Comments:											
TP5	0	NR	0.0	0.0	1.3	20.6	0.0	-	DRY	-	1.25
	30	NR									
	60	NR									
Comments:											



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Job No.	18022
Monitored By	IL
Visit No	3

Atmospheric Pressure (mbar)	1007
Ground Conditions	Wet

Position ID	Time Elapsed (secs)	Gas Flow (l/hr)	%LEL	Methane (%/vol)	Carbon Dioxide (%/vol)	Oxygen (%/vol)	VOC (ppm)	Depth to Product (mbgl)	Depth to Water (mbgl)	Product Thickness (mm)	Well Depth (mbgl)
TP1	0	NR	2.0	0.1	0.3	21.5	0.0	-	DRY	-	1.79
	30	NR									
	60	NR									
Comments:											
TP2	0	NR	2.0	0.1	0.3	21.5	0.0	-	DRY	-	1.68
	30	NR									
	60	NR									
Comments:											
TP3	0	NR	2.0	0.1	7.0	11.4	0.1	-	DRY	-	1.75
	30	NR									
	60	NR									
Comments:											
TP5	0	NR	2.0	0.1	0.9	21.2	0.0	-	DRY	-	1.25
	30	NR									
	60	NR									
Comments:											



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Atmospheric Pressure (mbar)	1013
Ground Conditions	Damp

Position ID	Time Elapsed (secs)	Gas Flow (l/hr)	%LEL	Methane (%/vol)	Carbon Dioxide (%/vol)	Oxygen (%/vol)	VOC (ppm)	Depth to Product (mbgl)	Depth to Water (mbgl)	Product Thickness (mm)	Well Depth (mbgl)
TP1	0	0	2.0	0.1	0.3	21.4	0.0	-	DRY	-	1.79
	30	0.1									
	60	0.1									
Comments:											
TP2	0	0.1	2.0	0.1	0.4	21.3	0.0	-	DRY	-	1.68
	30	0.2									
	60	0.3									
Comments:											
TP3	0	0.1	4.0	0.2	9.1	6.9	0.1	-	DRY	-	1.75
	30	0.3									
	60	0.3									
Comments:											
TP5	0	0.1	2.0	0.1	1.0	20.8	0.0	-	DRY	-	1.25
	30	0.2									
	60	0.2									
Comments:											



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Atmospheric Pressure (mbar)	992
Ground Conditions	Wet

Position ID	Time Elapsed (secs)	Gas Flow (l/hr)	%LEL	Methane (%/vol)	Carbon Dioxide (%/vol)	Oxygen (%/vol)	VOC (ppm)	Depth to Product (mbgl)	Depth to Water (mbgl)	Product Thickness (mm)	Well Depth (mbgl)
TP1	0	0.0	2.0	0.1	0.3	20.5	0.0	-	DRY	-	1.79
	30	0.1									
	60	0.1									
Comments:											
TP2	0	0.1	2.0	0.1	0.3	21	0.0	-	DRY	-	1.68
	30	0.2									
	60	0.3									
Comments:											
TP3	0	0.0	4.0	0.2	8.4	11.9	0.0	-	DRY	-	1.75
	30	0.2									
	60	0.2									
Comments:											
TP5	0	0.0	2.0	0.1	1.2	20.4	0.0	-	DRY	-	1.25
	30	0.2									
	60	0.2									
Comments:											



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Atmospheric Pressure (mbar)	1027
Ground Conditions	Damp

Position ID	Time Elapsed (secs)	Gas Flow (l/hr)	%LEL	Methane (%/vol)	Carbon Dioxide (%/vol)	Oxygen (%/vol)	VOC (ppm)	Depth to Product (mbgl)	Depth to Water (mbgl)	Product Thickness (mm)	Well Depth (mbgl)
TP1	0	0.1	0.0	0.0	0.3	21.2	-	-	DRY	-	1.79
	30	0.2									
	60	0.2									
Comments:											
TP2	0	0.1	0.0	0.0	0.3	21.6	-	-	DRY	-	1.68
	30	0.3									
	60	0.2									
Comments:											
TP3	0	0.1	0.0	0.0	9.1	12.4	-	-	DRY	-	1.75
	30	0.3									
	60	0.3									
Comments:											
TP5	0	0.0	0.0	0.0	0.2	21.7	-	-	DRY	-	1.25
	30	0.1									
	60	0.1									
Comments:											

Appendix H

Results of Geotechnical Laboratory Testing

STANDARD METHODOLOGY FOR GEOTECHNICAL SAMPLING

Soil samples are recovered from trial pits or borehole samples using a stainless steel trowel and immediately placed into airtight plastic tubs or bags, as appropriate for the testing. If required the soil samples may be wrapped in cling film, particularly in suspected desiccated soils. Samples are labelled with the site name, investigation location and depth and placed into either cool boxes or large bulk bags for transit from site. An analytical schedule is drawn up in line with the actual ground conditions proven, proposed site use and likely design parameters.

Samples are sent to a specialist testing laboratory. Testing is completed in line with BS1377 as far as possible and details of the test method and UKAS accreditation are provided by the laboratory on the results sheets in a separate appendix.



Summary of Classification Test Results

Unit 3 Brooklands,
Howden Road,
Tiverton,
Devon
EX16 5HW



8260
Accredited to
ISO/IEC
17025:2005

Project No.	Project Name
10831	Midford Lane, Limpley Stoke
Client Job No.	Client
18022	Integrale

Hole No.	Sample				Soil Description	mc	Passing 425µm	LL	PL	PI	Particle density	Remarks
	Type	Top	Base	Ref		CI.3.2			CI5.3	CI5.4		
						%	%	%	%	%	Mg/m3	
TP3	D	1.00		-	Light brown slightly gravelly slightly sandy CLAY	24	94 - Sieved	65	22	43	-	
TP4	D	0.50		-	Light brown sandy very clayey GRAVEL	11	36 - Sieved	49	19	30	-	
						-	-	-	-	-	-	
						-	-	-	-	-	-	
						-	-	-	-	-	-	
						-	-	-	-	-	-	
						-	-	-	-	-	-	
						-	-	-	-	-	-	
						-	-	-	-	-	-	
						-	-	-	-	-	-	
						-	-	-	-	-	-	

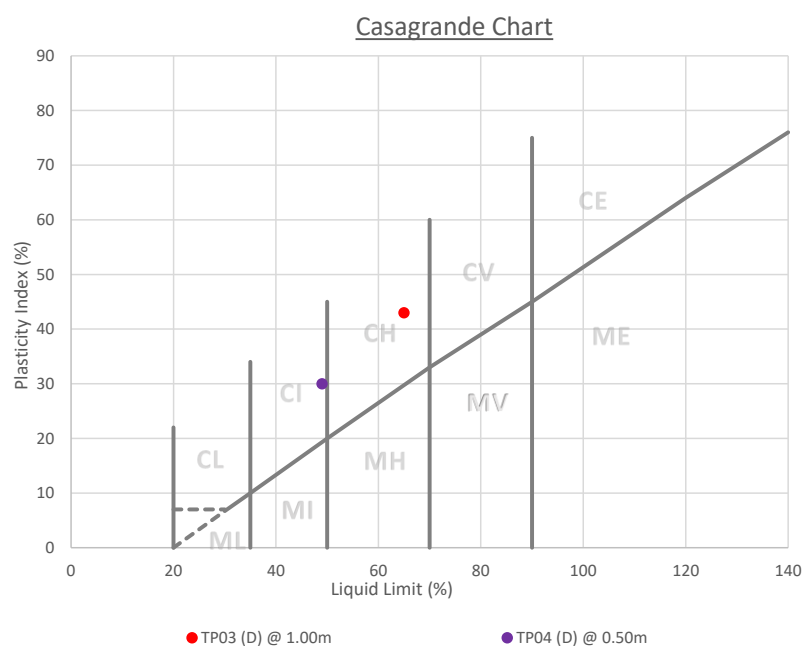
Preparation Clauses: Particle Density (BS1377:Part 1: 1990: CL7.4.4) Atterberg Limits (BS1377:Part 1: 1990: CL7.4.3) Moisture Content (BS1377: Part 1: 1990: CL7.3.3 & 7.4.2)

Key		Date	Approved By	Page No.	1
Atterberg Limits BS1377-2:1990 4pt cone (CL.4.3) unless : 1pt - single point test (CL.4.4) 4.2.3 - Natural 4.2.4 - Sieved Moisture Content (mc) %		30/11/2018	David Trowbridge - Laboratory Manager	KL001R Index Summary	
Particle density BS1377-2:1990 sp - small pyknometer CL.8.3 gj - gas jar CL.8.2					

Graphical Summary of Atterberg Test Results

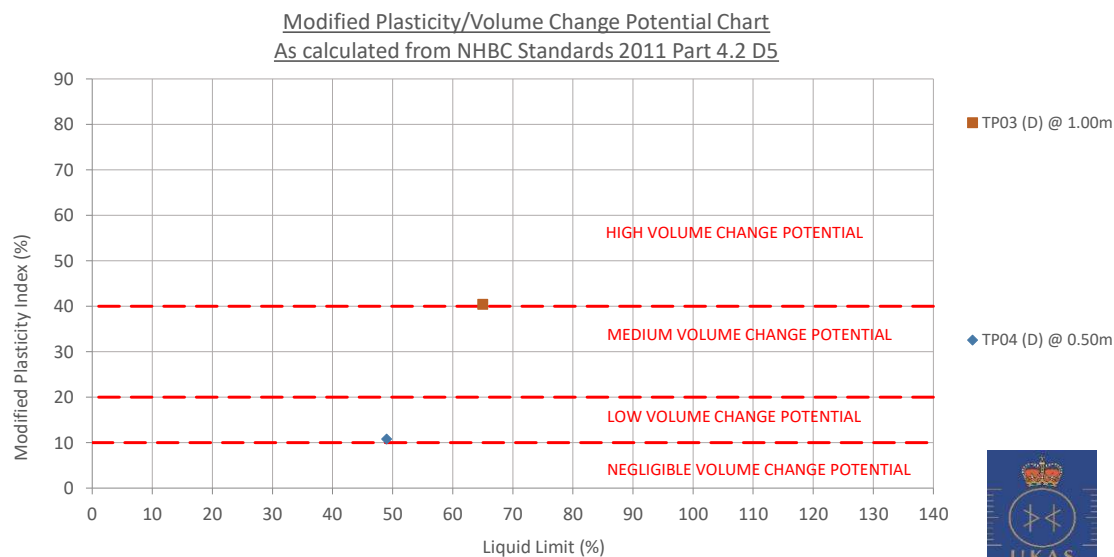
Unit 3 Brooklands,
Howden Road,
Tiverton,
Devon
EX16 5HW

Project No.	Project Name
10831	Midford Lane, Limpley Stoke
Client Job No.	Client
18022	Integrale



Sample ID	Plasticity Index (%)	Modified Plasticity Index (%)
TP03 (D) @ 1.00m	43	40
TP04 (D) @ 0.50m	30	11
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

The Modified Plasticity Index (I'_p) is defined as the Plasticity Index (I_p) of the soil multiplied by the percentage of particles less than $425\mu\text{m}$.
ie. $I'_p \times \% \text{ less than } 425\mu\text{m} / 100\%$



8260
Accredited to ISO/IEC
17025:2005

KL001a Index Graphical Summary	Approved By	Date	Page No.
	David Trowbridge - Laboratory Manager	30/11/2018 15:09	1

Appendix I

Results of Contamination Analyses

BRIEFING NOTE - SOIL CONTAMINANT GUIDELINE VALUES

Intégrale Limited has produced a suite of generic Soil Guideline Values to enable quantitative assessment of risks to human health for various Conceptual Models. The CLEA v1.06 model was used to generate a robust database of guideline values for preliminary quantitative risk assessments. Intégrale believe that CLEA v1.06 can be used with caution to derive Generic and Site Specific Assessment Criteria. All CLEA v1.06 assessments have been based on the series of reports published by DEFRA and the Environment Agency (EA), including Science report(s): SC050021/SR2, /SR3, /SR4 and /SR7.

Generic Assessment Criteria (GAC) have been generated for:

- Metals and semi-metals: arsenic, beryllium, cadmium, chromium, copper, mercury, nickel, selenium, vanadium and zinc. The previously published CLEA 2002 SGV for lead has been retained.
- Aliphatic TPH (C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44).
Aromatic TPH's (C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35 and C35-C44).
- Priority PAHs: Naphthalene, Benzo(a)pyrene, Fluorene, Dibenzo(a,h)anthracene.
- Dioxins, furans and dioxin-like PCBs
- Benzene, toluene, ethylbenzene, xylenes.
- Cyanide, phenol.
- Chlorinated solvents: 1,2 dichloroethane, tetrachloroethanes, tetrachloroethene, 1,1,1-trichloroethane, trichloroethene, vinyl chloride.

Default library values provided within CLEA v1.06 have been used where available. The contaminant library physio-chemical data has been updated where necessary. All new physio-chemical and toxicological data has been obtained from Soil Guideline Value (SGV) & TOX reports, EA and DEFRA published Science Reports and LQM ClEH where possible; otherwise, data has been sourced from other accredited sources.

Generic AC have been calculated for generic land uses, based on CLEA default building types, receptor types and characteristics, age classes, exposure pathways and averaging periods, and site characteristics.

Intégrale have calculated generic AC's for typical housing with homegrown produce and without homegrown produce, primary school's and commercial end uses, using CLEA v1.06 default sandy loam soils, with an organic matter content of 6% and a pH value of 7.0.

Evaluation of health risks from petroleum hydrocarbons has been based on the US Total Petroleum Hydrocarbon Working Group (TPHCWG) approach, extensively used in the UK, as developed in 'The UK Approach for Evaluating Human Health Risks From Petroleum Hydrocarbons in Soils, EA 2005' and 'Principals for Evaluating the Human Health Risks for Petroleum Hydrocarbons in Soils, EA 2003'. The TPHCWG method uses a combination of indicator compounds (surrogates) and 13 petroleum hydrocarbon fractions, representing a range of aliphatic and aromatic TPH's. The indicator compounds represent the most toxic contaminants and those found most frequently at petroleum-hydrocarbon contaminated sites. Priority is given to the assessment of non-threshold indicator compounds likely to be present, including benzene and individual Polyaromatic Hydrocarbons.

Intégrale also employ ICRCL 59/83 target values for phytotoxic contaminants boron, copper and zinc as well as Water Regulations Advisory Scheme (WRAS) guidance for the selection of materials for water supply pipes to be laid in contaminated land.

Defra Category 4 Screening Levels are also listed and referred to where appropriate within the planning regime.

May 2015

STANDARD METHODOLOGY FOR CONTAMINATION SAMPLING & SCHEDULING

Soil samples for contamination analyses are recovered from trial pits or borehole samples using a stainless steel trowel and immediately placed into airtight amber glass jars, vials, or plastic tubs, as appropriate for the testing. These samples are labelled with the site name, investigation location and depth and placed into cool boxes for transit from site. Groundwater samples recovered during subsequent monitoring visits are similarly treated.

An analytical schedule is drawn up in line with the desk study findings, guidance given in CLR 8 and any relevant industry information, the actual ground conditions proven and proposed site use.

Samples are sent via overnight courier to the specialist testing laboratory. Testing is scheduled for MCERTS accredited analyses as far as possible and details of the test method are provided by the laboratory on the results sheets in a separate appendix. A standard turnaround of 10 working days is adopted unless otherwise agreed with the client at the time of instruction.



2183

Amended Report

Report No.:	18-35873-2		
Initial Date of Issue:	28-Nov-2018	Date of Re-Issue:	07-Dec-2018
Client	Integrale Limited		
Client Address:	Fieldworks Office Unit 7 Westway Farm Business P Wick Road Bishops Sutton BS39 5XP		
Contact(s):	Tom Foll		
Project	18022 Midford Lane, Limpley Stoke		
Quotation No.:		Date Received:	16-Nov-2018
Order No.:	18022/0586	Date Instructed:	19-Nov-2018
No. of Samples:	8		
Turnaround (Wkdays):	14	Results Due:	06-Dec-2018
Date Approved:	07-Dec-2018		
Approved By:			
Details:	Martin Dyer, Laboratory Manager		

Results - Leachate

Client: Integrale Limited	Chemtest Job No.:				18-35873
Quotation No.:	Chemtest Sample ID.:				725588
	Client Sample ID.:				ES4
	Sample Location:				TP1
	Sample Type:				SOIL
	Top Depth (m):				1.00
	Date Sampled:				12-Nov-2018
Determinand	Accred.	SOP	Units	LOD	
pH	U	1010		N/A	7.2
Sulphate	U	1220	mg/l	1.0	< 1.0
Cyanide (Total)	U	1300	mg/l	0.050	< 0.050
Sulphide	U	1325	mg/l	0.050	< 0.050
Hardness	U	1415	mg/l	15	630
Arsenic (Dissolved)	U	1450	µg/l	1.0	1.8
Boron (Dissolved)	U	1450	µg/l	20	53
Barium (Dissolved)	U	1450	µg/l	5.0	9.8
Beryllium (Dissolved)	U	1450	µg/l	1.0	< 1.0
Cadmium (Dissolved)	U	1450	µg/l	0.080	< 0.080
Chromium (Dissolved)	U	1450	µg/l	1.0	2.4
Copper (Dissolved)	U	1450	µg/l	1.0	< 1.0
Mercury (Dissolved)	U	1450	µg/l	0.50	< 0.50
Nickel (Dissolved)	U	1450	µg/l	1.0	2.4
Lead (Dissolved)	U	1450	µg/l	1.0	< 1.0
Selenium (Dissolved)	U	1450	µg/l	1.0	< 1.0
Vanadium (Dissolved)	U	1450	µg/l	1.0	1.8
Zinc (Dissolved)	U	1450	µg/l	1.0	2.3
Chromium (Trivalent)	N	1490	µg/l	20	< 20
Chromium (Hexavalent)	U	1490	µg/l	20	< 20
Naphthalene	U	1700	µg/l	0.10	< 0.10
Acenaphthylene	U	1700	µg/l	0.10	< 0.10
Acenaphthene	U	1700	µg/l	0.10	< 0.10
Fluorene	U	1700	µg/l	0.10	< 0.10
Phenanthrene	U	1700	µg/l	0.10	< 0.10
Anthracene	U	1700	µg/l	0.10	< 0.10
Fluoranthene	U	1700	µg/l	0.10	< 0.10
Pyrene	U	1700	µg/l	0.10	< 0.10
Benzo[a]anthracene	U	1700	µg/l	0.10	< 0.10
Chrysene	N	1700	µg/l	0.10	< 0.10
Benzo[b]fluoranthene	U	1700	µg/l	0.10	< 0.10
Benzo[k]fluoranthene	U	1700	µg/l	0.10	< 0.10
Benzo[a]pyrene	U	1700	µg/l	0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	1700	µg/l	0.10	< 0.10
Dibenz(a,h)Anthracene	U	1700	µg/l	0.10	< 0.10
Benzo[g,h,i]perylene	U	1700	µg/l	0.10	< 0.10
Total Of 16 PAH's	U	1700	µg/l	2.0	< 2.0
Total Phenols	U	1920	mg/l	0.030	< 0.030

Results - Soil

Client: Integrale Limited	Chemtest Job No.:				18-35873	18-35873	18-35873	18-35873	18-35873	18-35873	18-35873	18-35873
Quotation No.:	Chemtest Sample ID.:				725587	725588	725589	725590	725591	725592	725593	725594
	Client Sample ID.:				ES2	ES4	ES2	B3	D2	ES1	ES1	D3
	Sample Location:				TP1	TP1	TP2	TP2	TP3	TP4	TP5	TP5
	Sample Type:				SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				0.50	1.00	0.40	1.40	0.50	0.10	0.20	1.00
	Date Sampled:				12-Nov-2018	12-Nov-2018	12-Nov-2018	12-Nov-2018	12-Nov-2018	12-Nov-2018	12-Nov-2018	12-Nov-2018
	Asbestos Lab:				DURHAM	DURHAM	DURHAM	DISPOSED	DISPOSED	DURHAM	DURHAM	DISPOSED
Determinand	Accred.	SOP	Units	LOD								
ACM Type	U	2192		N/A	-	-	-			-	-	
Asbestos Identification	U	2192	%	0.001	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected			No Asbestos Detected	No Asbestos Detected	
Moisture	N	2030	%	0.020	7.5	9.2	15	13	15	21	17	6.5
pH	U	2010		N/A	8.7	8.5	8.5	8.6	8.5	8.2	8.4	8.8
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	0.86	0.68	1.1			1.6	0.99	
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010				< 0.010	< 0.010			< 0.010
Sulphur (Elemental)	U	2180	mg/kg	1.0	5.8	< 1.0	< 1.0			84	91	
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50			< 0.50	< 0.50	
Sulphide (Easily Liberatable)	N	2325	mg/kg	0.50	31	3.3	2.2			5.3	3.1	
Sulphate (Total)	U	2430	%	0.010	0.070	0.066	0.063			0.18	0.061	
Arsenic	U	2450	mg/kg	1.0	11	11	14			35	11	
Barium	U	2450	mg/kg	10	39	28	35			200	40	
Beryllium	U	2450	mg/kg	1.0	< 1.0	< 1.0	< 1.0			1.0	< 1.0	
Cadmium	U	2450	mg/kg	0.10	0.16	< 0.10	0.15			0.89	0.18	
Chromium	U	2450	mg/kg	1.0	3.4	3.3	4.4			20	3.3	
Copper	U	2450	mg/kg	0.50	4.5	3.7	4.0			21	6.7	
Mercury	U	2450	mg/kg	0.10	< 0.10	< 0.10	< 0.10			0.12	< 0.10	
Nickel	U	2450	mg/kg	0.50	5.4	5.3	7.1			32	5.8	
Lead	U	2450	mg/kg	0.50	16	13	15			94	35	
Selenium	U	2450	mg/kg	0.20	< 0.20	< 0.20	< 0.20			0.30	< 0.20	
Vanadium	U	2450	mg/kg	5.0	13	8.1	11			36	12	
Zinc	U	2450	mg/kg	0.50	48	38	37			290	89	
Chromium (Trivalent)	N	2490	mg/kg	1.0	3.4	3.3	4.4			20	3.3	
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50			< 0.50	< 0.50	
Organic Matter	U	2625	%	0.40	2.1	2.2	2.8			7.1	6.0	
Total TPH >C6-C40	U	2670	mg/kg	10	< 10	< 10	< 10			100	< 10	
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0						< 1.0		
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0						< 1.0		
Aliphatic TPH >C8-C10	U	2680	mg/kg	1.0						< 1.0		
Aliphatic TPH >C10-C12	U	2680	mg/kg	1.0						< 1.0		
Aliphatic TPH >C12-C16	U	2680	mg/kg	1.0						< 1.0		
Aliphatic TPH >C16-C21	U	2680	mg/kg	1.0						< 1.0		
Aliphatic TPH >C21-C35	U	2680	mg/kg	1.0						40		
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0						< 1.0		
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0						40		
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0						< 1.0		
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0						< 1.0		

Results - Soil

Client: Integrale Limited	Chemtest Job No.:				18-35873	18-35873	18-35873	18-35873	18-35873	18-35873	18-35873	18-35873
Quotation No.:	Chemtest Sample ID.:				725587	725588	725589	725590	725591	725592	725593	725594
	Client Sample ID.:				ES2	ES4	ES2	B3	D2	ES1	ES1	D3
	Sample Location:				TP1	TP1	TP2	TP2	TP3	TP4	TP5	TP5
	Sample Type:				SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				0.50	1.00	0.40	1.40	0.50	0.10	0.20	1.00
	Date Sampled:				12-Nov-2018	12-Nov-2018	12-Nov-2018	12-Nov-2018	12-Nov-2018	12-Nov-2018	12-Nov-2018	12-Nov-2018
	Asbestos Lab:				DURHAM	DURHAM	DURHAM	DISPOSED	DISPOSED	DURHAM	DURHAM	DISPOSED
Determinand	Accred.	SOP	Units	LOD								
Aromatic TPH >C8-C10	U	2680	mg/kg	1.0						< 1.0		
Aromatic TPH >C10-C12	U	2680	mg/kg	1.0						< 1.0		
Aromatic TPH >C12-C16	U	2680	mg/kg	1.0						< 1.0		
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0						7.3		
Aromatic TPH >C21-C35	U	2680	mg/kg	1.0						49		
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0						1.1		
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0						58		
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0						97		
Naphthalene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			< 0.10	< 0.10	
Acenaphthylene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			0.60	< 0.10	
Acenaphthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			1.5	< 0.10	
Fluorene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			< 0.10	< 0.10	
Phenanthrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			1.2	< 0.10	
Anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			0.36	< 0.10	
Fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			3.6	0.69	
Pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			3.9	0.89	
Benzo[a]anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			1.6	< 0.10	
Chrysene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			2.4	< 0.10	
Benzo[b]fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			3.1	< 0.10	
Benzo[k]fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			1.5	< 0.10	
Benzo[a]pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			2.3	< 0.10	
Indeno(1,2,3-c,d)Pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			1.7	< 0.10	
Dibenz(a,h)Anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			0.49	< 0.10	
Benzo[g,h,i]perylene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			1.2	< 0.10	
Total Of 16 PAH's	U	2700	mg/kg	2.0	< 2.0	< 2.0	< 2.0			26	< 2.0	
Total Phenols	U	2920	mg/kg	0.30	< 0.30	< 0.30	< 0.30			< 0.30	< 0.30	

SOP	Title	Parameters included	Method summary
1010	pH Value of Waters	pH	pH Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1300	Cyanides & Thiocyanate in Waters	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Continuous Flow Analysis.
1325	Sulphide in Waters	Sulphides	Automated colorimetric analysis by 'Aquakem 600' Discrete Analyser using N,N-dimethyl-p-phenylenediamine.
1415	Cations in Waters by ICP-MS	Sodium; Potassium; Calcium; Magnesium	Direct determination by inductively coupled plasma - mass spectrometry (ICP-MS).
1450	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1490	Hexavalent Chromium in Waters	Chromium [VI]	Automated colorimetric analysis by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazine.
1700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Waters by GC-FID	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenz[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Pentane extraction / GC FID detection
1920	Phenols in Waters by HPLC	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2180	Sulphur (Elemental) in Soils by HPLC	Sulphur	Dichloromethane extraction / HPLC with UV detection
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2300	Cyanides & Thiocyanate in Soils	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Alkaline extraction followed by colorimetric determination using Automated Flow Injection Analyser.
2325	Sulphide in Soils	Sulphide	Steam distillation with sulphuric acid / analysis by 'Aquakem 600' Discrete Analyser, using N,N-dimethyl-p-phenylenediamine.
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by ICP-OES.
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazine.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.

SOP	Title	Parameters included	Method summary
2670	Total Petroleum Hydrocarbons (TPH) in Soils by GC-FID	TPH (C6–C40); optional carbon banding, e.g. 3-band – GRO, DRO & LRO*TPH C8–C40	Dichloromethane extraction / GC-FID
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8, >C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35–C44 Aromatics: >C5–C7, >C7–C8, >C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35–C44	Dichloromethane extraction / GCxGC FID detection
2700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-FID	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenzo[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Dichloromethane extraction / GC-FID
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and Trimethylphenols Note: chlorophenols are excluded.	60:40 methanol/water mixture extraction, followed by HPLC determination using electrochemical detection.

Report Information

Key

- U UKAS accredited
- M MCERTS and UKAS accredited
- N Unaccredited
- S This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
- SN This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
- T This analysis has been subcontracted to an unaccredited laboratory
- I/S Insufficient Sample
- U/S Unsuitable Sample
- N/E not evaluated
- < "less than"
- > "greater than"

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

Uncertainty of measurement for the determinands tested are available upon request

None of the results in this report have been recovery corrected

All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis

All Asbestos testing is performed at the indicated laboratory

Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

- A - Date of sampling not supplied
- B - Sample age exceeds stability time (sampling to extraction)
- C - Sample not received in appropriate containers
- D - Broken Container
- E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt

All water samples will be retained for 14 days from the date of receipt

Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:

customerservices@chemtest.com

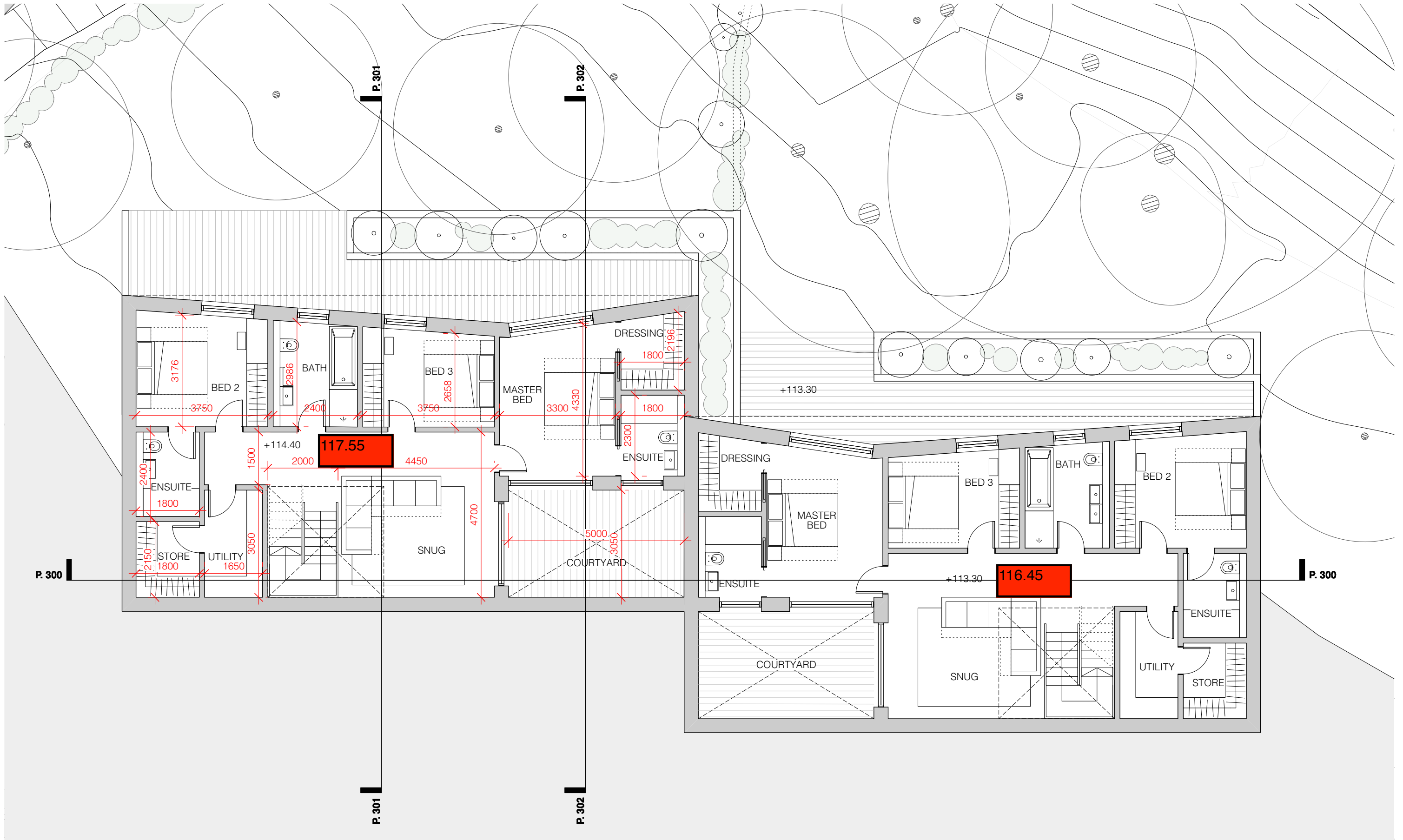
Project: 18022 Midford Lane, Limpley Stoke

Client: Integrale Limited	Chemtest Job No.:									
Quotation No.:	Chemtest Sample ID.:									
	Client Sample ID.:	ES2	ES4	ES2	B3	D2	ES1	ES1	D3	
	Sample Location:	TP1	TP1	TP2	TP2	TP3	TP4	TP5	TP5	
	Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	
	Top Depth (m):	0.50	1.00	0.40	1.40	0.50	0.10	0.20	1.00	
	Date Sampled:	12-Nov-2018	12-Nov-2018	12-Nov-2018	12-Nov-2018	12-Nov-2018	12-Nov-2018	12-Nov-2018	12-Nov-2018	
	Asbestos Lab:	DURHAM	DURHAM	DURHAM	DISPOSED	DISPOSED	DURHAM	DURHAM	DISPOSED	
Determinand	Accred.	SOP	Units	LOD						
ACM Type	U	2192		N/A	-	-	-	-	-	
Asbestos Identification	U	2192	%	0.001	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	
Moisture	N	2030	%	0.020	7.5	9.2	15	13	15	21
pH	U	2010		N/A	8.7	8.5	8.5	8.6	8.5	8.2
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	0.86	0.68	1.1			1.6
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010				< 0.010	< 0.010	
Sulphur (Elemental)	U	2180	mg/kg	1.0	5.8	< 1.0	< 1.0			84
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50			< 0.50
Sulphide (Easily Liberatable)	N	2325	mg/kg	0.50	31	3.3	2.2			5.3
Sulphate (Total)	U	2430	%	0.010	0.070	0.066	0.063			0.18
Arsenic	U	2450	mg/kg	1.0	11	11	14			35
Barium	U	2450	mg/kg	10	39	28	35			200
Beryllium	U	2450	mg/kg	1.0	< 1.0	< 1.0	< 1.0			1.0
Cadmium	U	2450	mg/kg	0.10	0.16	< 0.10	0.15			0.89
Chromium	U	2450	mg/kg	1.0	3.4	3.3	4.4			20
Copper	U	2450	mg/kg	0.50	4.5	3.7	4.0			21
Mercury	U	2450	mg/kg	0.10	< 0.10	< 0.10	< 0.10			0.12
Nickel	U	2450	mg/kg	0.50	5.4	5.3	7.1			32
Lead	U	2450	mg/kg	0.50	16	13	15			94
Selenium	U	2450	mg/kg	0.20	< 0.20	< 0.20	< 0.20			0.30
Vanadium	U	2450	mg/kg	5.0	13	8.1	11			36
Zinc	U	2450	mg/kg	0.50	48	38	37			290
Chromium (Trivalent)	N	2490	mg/kg	1.0	3.4	3.3	4.4			20
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50			< 0.50
Organic Matter	U	2625	%	0.40	2.1	2.2	2.8			7.1
Total TPH >C6-C40	U	2670	mg/kg	10	< 10	< 10	< 10			100
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0						< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0						< 1.0
Aliphatic TPH >C8-C10	U	2680	mg/kg	1.0						< 1.0
Aliphatic TPH >C10-C12	U	2680	mg/kg	1.0						< 1.0
Aliphatic TPH >C12-C16	U	2680	mg/kg	1.0						< 1.0
Aliphatic TPH >C16-C21	U	2680	mg/kg	1.0						< 1.0
Aliphatic TPH >C21-C35	U	2680	mg/kg	1.0						40
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0						< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0						40
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0						< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0						< 1.0
Aromatic TPH >C8-C10	U	2680	mg/kg	1.0						< 1.0
Aromatic TPH >C10-C12	U	2680	mg/kg	1.0						< 1.0
Aromatic TPH >C12-C16	U	2680	mg/kg	1.0						< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0						7.3
Aromatic TPH >C21-C35	U	2680	mg/kg	1.0						49
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0						1.1
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0						58
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0						97
Naphthalene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			< 0.10
Acenaphthylene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			0.60
Acenaphthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			1.5
Fluorene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			< 0.10
Phenanthrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			1.2
Anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			0.36
Fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			3.6
Pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			3.9
Benzo[a]anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			1.6
Chrysene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			2.4
Benzo[b]fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			3.1
Benzo[k]fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			1.5
Benzo[a]pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			2.3
Indeno[1,2,3-c,d]Pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			1.7
Dibenz[a,h]Anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			0.49
Benzo[g,h,i]perylene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			1.2
Total Of 16 PAH's	U	2700	mg/kg	2.0	< 2.0	< 2.0	< 2.0			26
Total Phenols	U	2920	mg/kg	0.30	< 0.30	< 0.30	< 0.30			< 0.30

Exceeds GAC Value
Exceeds WRAS Value
Exceeds PHYTO Value

Appendix J

Proposed Development



NOTES:

NOTES:

All dimensions in millimetres unless otherwise stated.

Any variations or supplementary drawings are to be approved by the architect.

All dimensions and conditions are to be checked on site prior to preparing drawings or commencing any work.

STONEWOOD
design

West Yatton Lane
Castle Combe
Wiltshire SN14 7EY
01249 782512
stonewooddesign.co.uk

Drawing Number:
1619.P.111

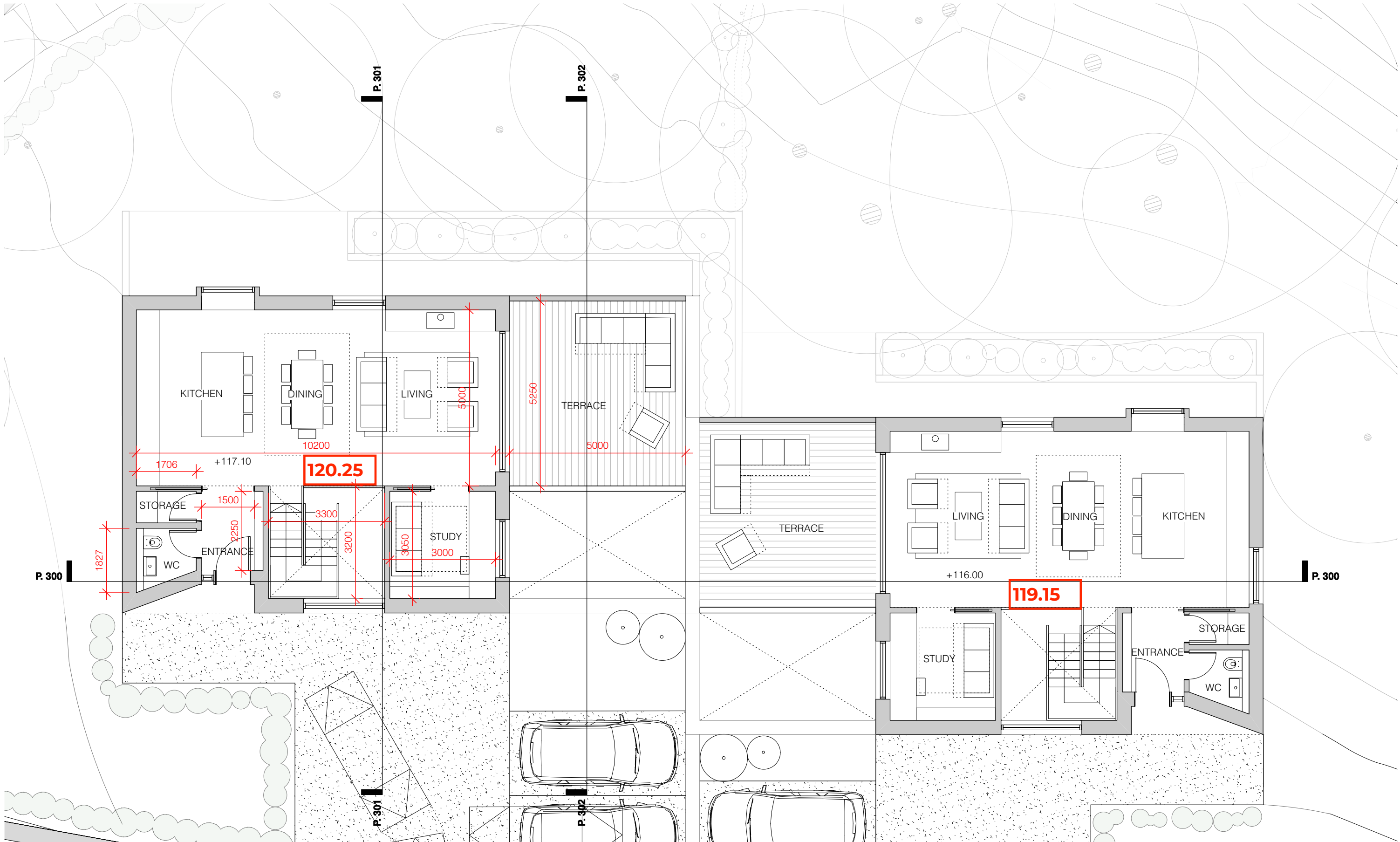
Status:
PLANNING
Project:

**MIDFORD LANE,
LIMPLEY STOKE**

Title:
PROPOSED LOWER LEVEL
FLOOR PLAN

Revision:
A

Drawn by: JS
Date drawn: DEC 17
Scale @ A3: 1:100



NOTES:

A 22.03.18 PLANNING ISSUE
Rev: Date: Description:

NOTES:

All dimensions in millimetres unless otherwise stated.

Any variations or supplementary drawings are to be approved by the architect.

All dimensions and conditions are to be checked on site prior to preparing drawings or commencing any work.

STONEWOOD
design

West Yatton Lane
Castle Combe
Wiltshire SN14 7EY
01249 782512
stonewooddesign.co.uk

Drawing Number:
1619.P.110
Status:
PLANNING
Project:
**MIDFORD LANE,
LIMPLEY STOKE**
Title:
PROPOSED GROUND
FLOOR PLAN

Revision:
A
Drawn by: JS
Date drawn: DEC 17
Scale @ A3: 1:100

Appendix K

Selected Results of Stability Analyses



Midford Lane, Limpley Stoke
Section 1 - Existing Stability

Job No.	Sheet No.	Rev.
18022		
Drg. Ref.		
Made by TF	Date 24-Jan-2019	Checked

General Parameters

Direction of slip: DOWNHILL
Minimum slip weight [kN/m] : 0
Type of analysis : STATIC

Analysis Options

Factor of safety on : SHEAR STRENGTH
Minimum number of slices: 25
Method: Janbu (Variably inclined interslice forces)
Maximum number of iterations: 5000
Reinforcement: NOT ACTIVE

Method Partial Factors

Current selection: SLS
Factor on DEAD LOAD: 1.0
Factor on LIVE LOAD: 1.0
Factor on SOIL UNIT WEIGHT: 1.0
Factor on DRAINED SOIL COHESION: 1.0
Factor on UNDRAINED SOIL COHESION: 1.0
Factor on SOIL FRICTION ANGLE: 1.0
Moment correction factor: 1.00
Factor on reinforcement pullout: 1.00
Economic ramification of failure: 1.00
Sliding along reinforcement: 1.00

Material properties

No	Description	Unit Weight		Shear Strength Condition	Phi or Phi0 [°]	c or c0' [kN/m²]
		Above GWL [kN/m3]	Below GWL [kN/m3]			
1	Quarry Backfill	18.00	18.00	Drained - linear strength	40.00	0.0

Coordinates of top of soil strata

The units of the following coordinates are in m

Stratum	X	Y	Z	X	Y	Z
1	0.0	0.8000	2.600	4.010	4.600	4.700
Slip 1	0.0	-0.2000	-0.4000	.	-1.000	.
Slip 2	.	.	.	-0.8230	.	-2.400
Stratum	X	Y	Z	X	Y	Z
1	6.900	8.400	9.372	9.400	9.900	11.20
Slip 1	.	.	-1.145	.	-1.200	.
Slip 2	-5.100	-6.200	.	.	-3.600	.
Stratum	X	Y	Z	X	Y	Z
1	13.60	16.20	17.05	17.19	17.60	22.60
Slip 1	-5.400	-6.800	-6.865	.	-7.400	-7.400
Slip 2	.	-7.000	.	-7.000	.	.

Stratum-linked data

No.	Material	Water table	Piezo Set/ Ru value
1	Quarry Backfill	-	-

RESULTS OF ANALYSIS

Slip Description	Slip Centre	Slip Weight	Comment/ FoS	Disturbing Moment	Soil Strength Restoring Moment	Reinforcement Restoring Moment
	x [m]	y [m]	[kN/m]	[kNm/m]	[kNm/m]	[kNm/m]
Slip A	20.71	6.054	199.5	1.185	1570.	1861.
Slip B	13.77	2.860	836.4	2.922	2437.	7121.

WORST CASE

Slip A
Iterations: 12
Net vertical force [kN/m]: 0.1247
Net horiz force [kN/m]: 0.1689
Horiz acceleration [%]: 0.0
Slip weight [kN/m]: 199.5
Disturbing moment [kNm/m]: 1570.
Restoring moment [kNm/m]: 1861.
Reinf.Rest.Moment [kNm/m]: 0.0
Factor of Safety: 1.185

The system of interslice and base forces are in equilibrium when the strengths available at the bases are divided by the computed factor of safety. The interslice forces shown in the following table are in equilibrium with the factored strengths of the soil at the bases of slices.

Slip surface coordinates		Pore Pressure		Interslice forces [kN/m]		
Point	x [m]	y [m]	L [kN/m²]	R [kN/m²]	T	E (u)
1	9.372	-1.145	.	0.0	0.0	0.0
2	9.400	-1.200	0.0	0.0	-0.02572	0.02102
3	9.580	-1.440	0.0	0.0	-0.1112	0.2275
4	9.760	-1.680	0.0	0.0	0.03136	0.6051
5	9.940	-1.920	0.0	0.0	0.4020	1.154
6	10.12	-2.160	0.0	0.0	1.001	1.873
7	10.30	-2.400	0.0	0.0	1.827	2.764
8	10.48	-2.640	0.0	0.0	2.882	3.826
9	10.66	-2.880	0.0	0.0	4.165	5.059
10	10.84	-3.120	0.0	0.0	5.676	6.463
11	11.02	-3.360	0.0	0.0	7.415	8.038
12	11.20	-3.600	0.0	0.0	9.382	9.783
13	11.44	-3.780	0.0	0.0	9.259	10.07
14	11.68	-3.960	0.0	0.0	9.130	10.35
15	11.92	-4.140	0.0	0.0	8.998	10.62
16	12.16	-4.320	0.0	0.0	8.860	10.88
17	12.40	-4.500	0.0	0.0	8.719	11.14
18	12.64	-4.680	0.0	0.0	8.572	11.40
19	12.88	-4.860	0.0	0.0	8.421	11.64
20	13.12	-5.040	0.0	0.0	8.266	11.89
21	13.36	-5.220	0.0	0.0	8.105	12.12
22	13.60	-5.400	0.0	0.0	7.941	12.35
23	13.86	-5.540	0.0	0.0	7.035	11.19
24	14.12	-5.680	0.0	0.0	6.167	10.11
25	14.38	-5.820	0.0	0.0	5.336	9.087
26	14.64	-5.960	0.0	0.0	4.542	8.137
27	14.90	-6.100	0.0	0.0	3.785	7.255
28	15.16	-6.240	0.0	0.0	3.065	6.443
29	15.42	-6.380	0.0	0.0	2.382	5.699
30	15.68	-6.520	0.0	0.0	1.736	5.025
31	15.94	-6.660	0.0	0.0	1.128	4.419
32	16.20	-6.800	0.0	0.0	0.5559	3.882
33	16.48	-6.822	0.0	0.0	0.3502	1.839
34	16.77	-6.843	0.0	0.0	0.2065	0.6017
35	17.05	-6.865	0.0	.	0.1247	0.1689

Slice No.	Strength Parameters	Average Pore Pressure	Slice Weight	Forces on base [kN/m]		
	c' [kN/m²]	Tan phi	Pressure [kN/m²]	[kN/m]	Normal	Shear (capacity)
1	0.0	0.8391	0.0	0.01359	0.03617	0.03035
2	0.0	0.8391	0.0	0.5567	0.5499	0.4614
3	0.0	0.8391	0.0	1.317	1.006	0.8440
4	0.0	0.8391	0.0	2.077	1.462	1.227
5	0.0	0.8391	0.0	2.836	1.918	1.609
6	0.0	0.8391	0.0	3.596	2.374	1.992
7	0.0	0.8391	0.0	4.356	2.830	2.374
8	0.0	0.8391	0.0	5.116	3.286	2.757
9	0.0	0.8391	0.0	5.876	3.742	3.140
10	0.0	0.8391	0.0	6.636	4.198	3.522
11	0.0	0.8391	0.0	7.396	4.654	3.905
12	0.0	0.8391	0.0	10.25	8.473	7.110
13	0.0	0.8391	0.0	10.03	8.292	6.958

	Shear (mobilised)
1	0.02561
2	0.3894
3	0.7123
4	1.035
5	1.358
6	1.681
7	2.004
8	2.327
9	2.649
10	2.972
11	3.295
12	6.000
13	5.871



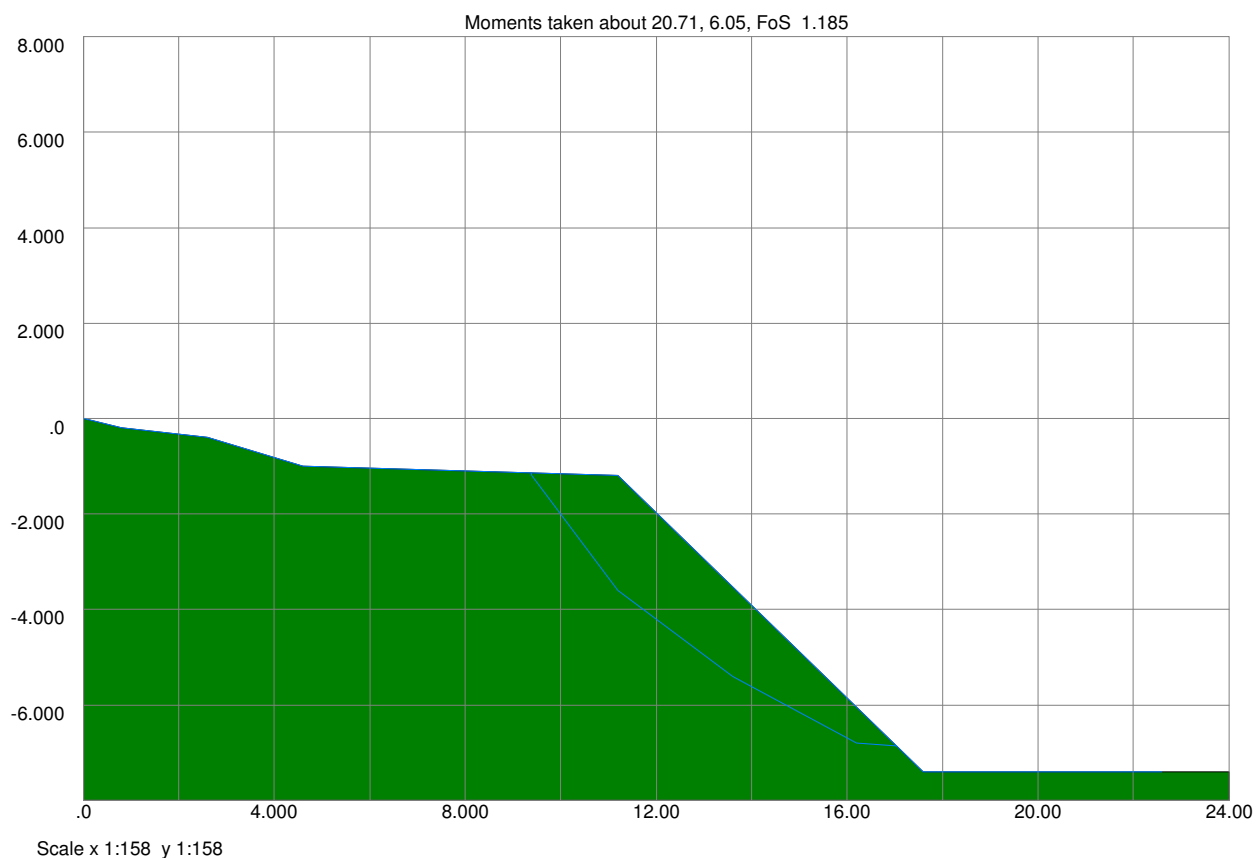
Midford Lane, Limpley Stoke
Section 1 - Existing Stability

Job No.	Sheet No.	Rev.
18022		
Drg. Ref.		
Made by TF	Date 24-Jan-2019	Checked

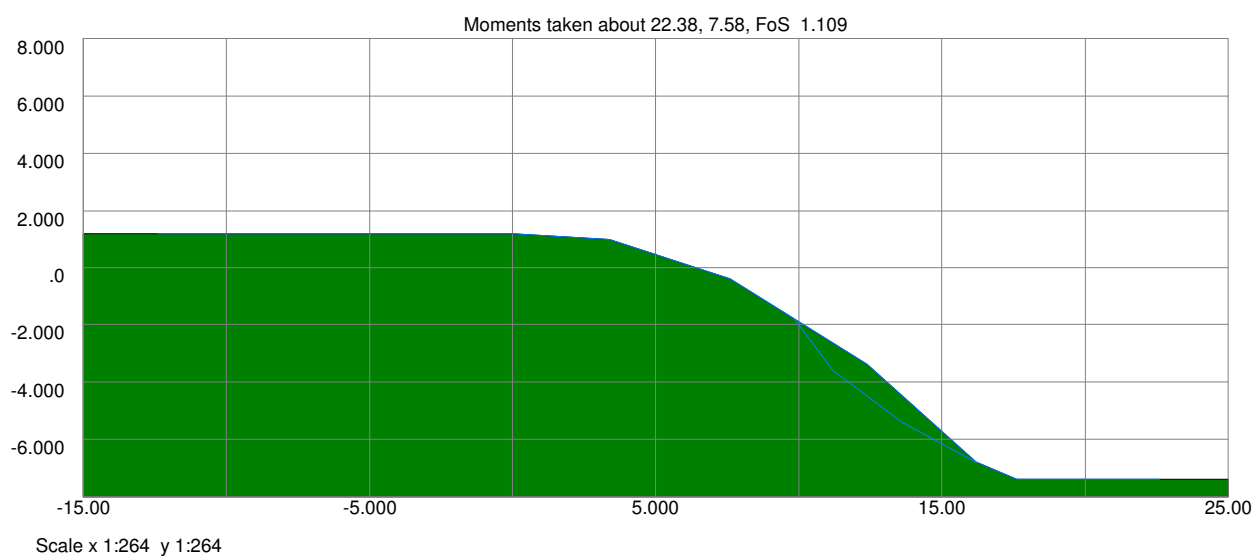
14	0.0	0.8391	0.0	9.801	8.110	6.805	5.743
15	0.0	0.8391	0.0	9.574	7.929	6.653	5.614
16	0.0	0.8391	0.0	9.347	7.747	6.501	5.486
17	0.0	0.8391	0.0	9.121	7.566	6.349	5.357
18	0.0	0.8391	0.0	8.894	7.385	6.196	5.229
19	0.0	0.8391	0.0	8.667	7.203	6.044	5.100
20	0.0	0.8391	0.0	8.440	7.022	5.892	4.972
21	0.0	0.8391	0.0	8.213	6.840	5.740	4.844
22	0.0	0.8391	0.0	8.513	7.745	6.499	5.484
23	0.0	0.8391	0.0	7.990	7.284	6.112	5.158
24	0.0	0.8391	0.0	7.466	6.823	5.725	4.831
25	0.0	0.8391	0.0	6.943	6.362	5.338	4.505
26	0.0	0.8391	0.0	6.419	5.901	4.951	4.178
27	0.0	0.8391	0.0	5.895	5.440	4.565	3.852
28	0.0	0.8391	0.0	5.372	4.979	4.178	3.526
29	0.0	0.8391	0.0	4.848	4.518	3.791	3.199
30	0.0	0.8391	0.0	4.325	4.057	3.404	2.873
31	0.0	0.8391	0.0	3.801	3.596	3.017	2.546
32	0.0	0.8391	0.0	3.206	3.246	2.723	2.298
33	0.0	0.8391	0.0	1.924	1.967	1.650	1.393
34	0.0	0.8391	0.0	0.6413	0.6879	0.5772	0.4871

Slice No.	Surface Load [kN/m_hor/m]		Point Load [kN/m]		Water Pressure on ground surface [kN/m_hor/m]	
	Vert	Horiz	Vert	Horiz	Vert	Horiz
1	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0

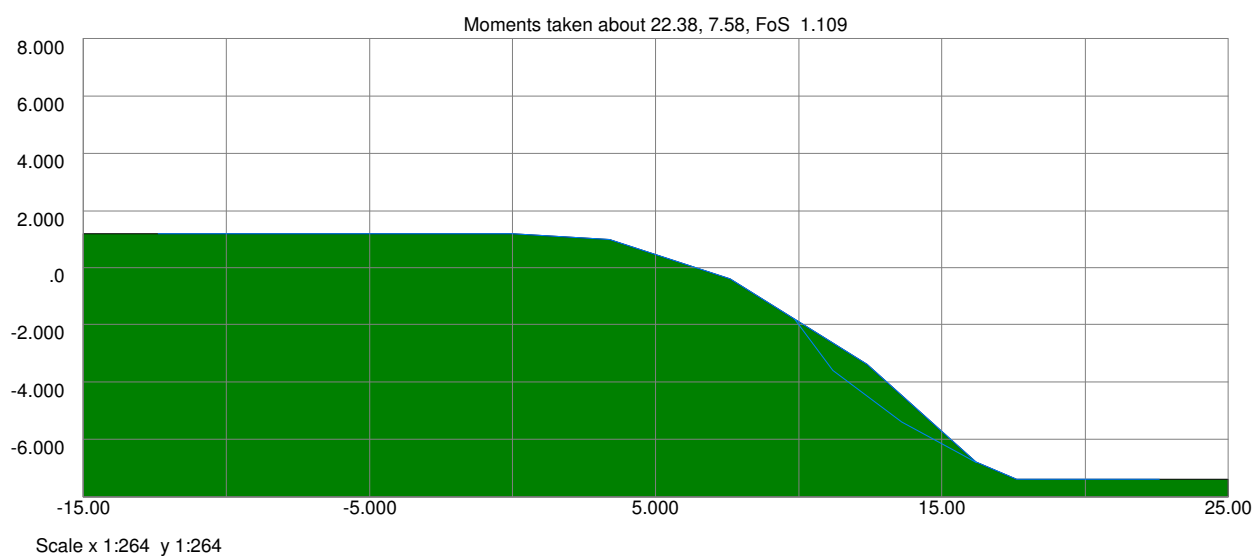
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18022		
Drg. Ref.		
Made by	Date	Checked
TF	24-Jan-2019	



Job No.	Sheet No.	Rev.
18022		
Drg. Ref.		
Made by	Date	Checked
TF	24-Jan-2019	



Job No.	Sheet No.	Rev.
18022		
Drg. Ref.		
Made by	Date	Checked
TF	24-Jan-2019	





Midford Lane, Limpley Stoke
Section 2 - Existing Stability

Job No.	Sheet No.	Rev.
18022		
Drg. Ref.		
Made by U	Date 24-Jan-2019	Checked

General Parameters

Direction of slip: DOWNHILL
Minimum slip weight [kN/m] : 0
Type of analysis : STATIC

Analysis Options

Factor of safety on : SHEAR STRENGTH
Minimum number of slices: 25
Method: Janbu (Variably inclined interslice forces)
Maximum number of iterations: 5000
Reinforcement: NOT ACTIVE

Method Partial Factors

Current selection: SLS
Factor on DEAD LOAD: 1.0
Factor on LIVE LOAD: 1.0
Factor on SOIL UNIT WEIGHT: 1.0
Factor on DRAINED SOIL COHESION: 1.0
Factor on UNDRAINED SOIL COHESION: 1.0
Factor on SOIL FRICTION ANGLE: 1.0
Moment correction factor: 1.00
Factor on reinforcement pullout: 1.00
Economic ramification of failure: 1.00
Sliding along reinforcement: 1.00

Material properties

No	Description	Unit Weight		Shear Strength Condition	Parameters	
		Above GWL	Below GWL		Phi or Phi0	c or c0'
		[kN/m3]	[kN/m3]		[°]	[kN/m²]
1	Quarry Backfill	18.00	18.00	Drained - linear strength	40.00	0.0

Coordinates of top of soil strata

The units of the following coordinates are in m

Stratum	X -->						
1	0.0	0.6015	0.8000	1.000	3.268	5.400	10.60
Slip 1	0.0	.	.	-0.2000	.	-0.3000	.
Slip 2	.	-0.1203	-2.800	.	-0.2515	.	-5.800
Stratum	X -->						
1	10.86	10.87	11.00	12.00	16.60		
Slip 1	.	.	-6.000	-6.200	-6.200		
Slip 2	-5.857	.	.	.	.		

Stratum-linked data

No.	Material	Water table	Piezo Set/ Ru value
1	Quarry Backfill	-	-

RESULTS OF ANALYSIS

Slip Description	Slip Centre	Slip Weight	Comment/ FoS	Disturbing Moment	Soil Strength Restoring Moment	Reinforcement Restoring Moment
	x [m]	y [m]	[kN/m]	[kNm/m]	[kNm/m]	[kNm/m]
Slip 1	128.2	160.9	113.5	1.114	13920.	15500.
Slip 2	11.03	6.481	465.5	2.696	1645.	4436.

WORST CASE

Slip 1
Iterations: 5
Net vertical force [kN/m]: 0.001274
Net horiz force [kN/m]: 0.001724
Horiz acceleration [%]: 0.0
Slip weight [kN/m]: 113.5
Disturbing moment [kNm/m]: 13920.
Restoring moment [kNm/m]: 15500.
Reinf.Rest.Moment [kNm/m]: 0.0
Factor of Safety: 1.114

The system of interslice and base forces are in equilibrium when the strengths available at the bases are divided by the computed factor of safety. The interslice forces shown in the following table are in equilibrium with the factored strengths of the soil at the bases of slices.

Slip surface coordinates		Pore Pressure		Interslice forces [kN/m]	
Point x [m]	y [m]	L	R	T	E (u)
		[kN/m²]	[kN/m²]		
1	3.268	-0.2515	0.0	0.0	0.0
2	3.505	-0.4308	0.0	0.0	797.5E-6
3	3.742	-0.6101	0.0	0.0	0.003174
4	3.979	-0.7893	0.0	0.0	0.007129
5	4.216	-0.9686	0.0	0.0	0.01266
6	4.452	-1.148	0.0	0.0	0.01978
7	4.689	-1.327	0.0	0.0	0.02847
8	4.926	-1.506	0.0	0.0	0.03874
9	5.163	-1.686	0.0	0.0	0.05059
10	5.400	-1.865	0.0	0.0	0.06401
11	5.636	-2.044	0.0	0.0	0.07792
12	5.873	-2.223	0.0	0.0	0.09126
13	6.109	-2.401	0.0	0.0	0.1041
14	6.345	-2.580	0.0	0.0	0.1163
15	6.582	-2.759	0.0	0.0	0.1280
16	6.818	-2.938	0.0	0.0	0.1391
17	7.055	-3.117	0.0	0.0	0.1496
18	7.291	-3.296	0.0	0.0	0.1596
19	7.527	-3.475	0.0	0.0	0.1690
20	7.764	-3.654	0.0	0.0	0.1779
21	8.000	-3.832	0.0	0.0	0.1862
22	8.236	-4.011	0.0	0.0	0.1940
23	8.473	-4.190	0.0	0.0	0.2012
24	8.709	-4.369	0.0	0.0	0.2078
25	8.945	-4.548	0.0	0.0	0.2139
26	9.182	-4.727	0.0	0.0	0.2194
27	9.418	-4.906	0.0	0.0	0.2244
28	9.655	-5.085	0.0	0.0	0.2288
29	9.891	-5.263	0.0	0.0	0.2326
30	10.13	-5.442	0.0	0.0	0.2359
31	10.36	-5.621	0.0	0.0	0.2386
32	10.60	-5.800	0.0	0.0	0.2408
33	10.87	-5.867	0.0	-0.001274	0.001724

Slice Strength Parameters		Average Pore Pressure		Slice Weight		Forces on base [kN/m]	
No.							
	c'	Tan phi					
	[kN/m²]		[kN/m²]	[kN/m]	Normal	Shear (capacity)	Shear (mobilised)
1	0.0	0.8391	0.0	0.3707	0.2987	0.2506	0.2250
2	0.0	0.8391	0.0	1.112	0.8898	0.7467	0.6704
3	0.0	0.8391	0.0	1.853	1.481	1.243	1.116
4	0.0	0.8391	0.0	2.595	2.072	1.739	1.561
5	0.0	0.8391	0.0	3.336	2.663	2.235	2.007
6	0.0	0.8391	0.0	4.077	3.254	2.731	2.452
7	0.0	0.8391	0.0	4.819	3.846	3.227	2.897
8	0.0	0.8391	0.0	5.560	4.437	3.723	3.343
9	0.0	0.8391	0.0	6.302	5.028	4.219	3.788
10	0.0	0.8391	0.0	6.526	5.207	4.369	3.923
11	0.0	0.8391	0.0	6.264	4.998	4.194	3.766
12	0.0	0.8391	0.0	6.001	4.789	4.018	3.608
13	0.0	0.8391	0.0	5.739	4.579	3.842	3.450
14	0.0	0.8391	0.0	5.476	4.370	3.667	3.292
15	0.0	0.8391	0.0	5.214	4.160	3.491	3.135
16	0.0	0.8391	0.0	4.951	3.951	3.315	2.977
17	0.0	0.8391	0.0	4.689	3.742	3.140	2.819
18	0.0	0.8391	0.0	4.426	3.532	2.964	2.661
19	0.0	0.8391	0.0	4.163	3.323	2.788	2.504
20	0.0	0.8391	0.0	3.901	3.114	2.613	2.346
21	0.0	0.8391	0.0	3.638	2.904	2.437	2.188



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22	0.0	0.8391	0.0	3.376	2.695	2.261	2.030
23	0.0	0.8391	0.0	3.113	2.485	2.086	1.873
24	0.0	0.8391	0.0	2.851	2.276	1.910	1.715
25	0.0	0.8391	0.0	2.588	2.067	1.734	1.557
26	0.0	0.8391	0.0	2.325	1.857	1.559	1.399
27	0.0	0.8391	0.0	2.063	1.648	1.383	1.242
28	0.0	0.8391	0.0	1.800	1.439	1.207	1.084
29	0.0	0.8391	0.0	1.538	1.229	1.031	0.9261
30	0.0	0.8391	0.0	1.275	1.020	0.8558	0.7684
31	0.0	0.8391	0.0	1.013	0.8105	0.6801	0.6106
32	0.0	0.8391	0.0	0.5029	0.4895	0.4108	0.3688
Slice Surface Load [kN/m_hor/m] Point Load [kN/m] Water Pressure on							
No.	Surface Load [kN/m_hor/m]		Point Load [kN/m]		ground surface [kN/m_hor/m]		
	Vert	Horiz	Vert	Horiz	Vert	Horiz	
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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Section 2 - Existing Stability

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General Parameters

Direction of slip: DOWNHILL
Minimum slip weight [kN/m] : 0
Type of analysis : STATIC

Analysis Options

Factor of safety on : SHEAR STRENGTH
Minimum number of slices: 25
Method: Janbu (Variably inclined interslice forces)
Maximum number of iterations: 5000
Reinforcement: NOT ACTIVE

Method Partial Factors

Current selection: SLS
Factor on DEAD LOAD: 1.0
Factor on LIVE LOAD: 1.0
Factor on SOIL UNIT WEIGHT: 1.0
Factor on DRAINED SOIL COHESION: 1.0
Factor on UNDRAINED SOIL COHESION: 1.0
Factor on SOIL FRICTION ANGLE: 1.0
Moment correction factor: 1.00
Factor on reinforcement pullout: 1.00
Economic ramification of failure: 1.00
Sliding along reinforcement: 1.00

Material properties

No	Description	Unit Weight		Shear Strength Condition	Parameters	
		Above GWL	Below GWL		Phi or Phi0	c or c0'
		[kN/m3]	[kN/m3]		[°]	[kN/m²]
1	Quarry Backfill	18.00	18.00	Drained - linear strength	40.00	0.0

Coordinates of top of soil strata

The units of the following coordinates are in m

Stratum	X	Y	Z	X	Y	Z
1	-11.80	0.0	0.003141	0.6000	0.8000	1.409
Slip 1	1.800	1.800	.	.	1.800	1.800
Slip 2	.	.	1.800	-0.1000	-2.800	.
Stratum	X	Y	Z	X	Y	Z
1	3.200	10.60	10.85	10.86	11.00	12.00
Slip 1	-0.2000	-5.800	.	-5.866	-6.200	-6.200
Slip 2	.	.	-5.855	.	.	.

Stratum-linked data

No.	Material	Water table	Piezo Set/ Ru value
1	Quarry Backfill	-	-

RESULTS OF ANALYSIS

Slip Description	Slip Centre	Slip Weight	Comment/ FoS	Disturbing Moment	Soil Strength Restoring Moment	Reinforcement Restoring Moment
	x [m]	y [m]	[kN/m]	[kNm/m]	[kNm/m]	[kNm/m]
Slip 1	43.25	43.73	165.2	1.040	6157.	6405.
Slip 2	9.862	4.257	589.6	2.533	1767.	4477.

WORST CASE

Slip 1
Iterations: 5
Net vertical force [kN/m]: -0.03841
Net horiz force [kN/m]: -0.04740
Horiz acceleration [%]: 0.0
Slip weight [kN/m]: 165.2
Disturbing moment [kNm/m]: 6157.
Restoring moment [kNm/m]: 6405.
Reinf.Rest.Moment [kNm/m]: 0.0
Factor of Safety: 1.040

The system of interslice and base forces are in equilibrium when the strengths available at the bases are divided by the computed factor of safety. The interslice forces shown in the following table are in equilibrium with the factored strengths of the soil at the bases of slices.

Slip surface coordinates		Pore Pressure		Interslice forces [kN/m]		E(u)
Point x [m]	y [m]	L	R	T	E	
		[kN/m²]	[kN/m²]			
1	1.409	1.800	0.0	0.0	0.0	0.0
2	1.636	1.546	0.0	0.0	0.03484	0.07898
3	1.864	1.292	0.0	0.0	0.2296	0.3012
4	2.091	1.039	0.0	0.0	0.5844	0.6667
5	2.318	0.7848	0.0	0.0	1.099	1.175
6	2.545	0.5310	0.0	0.0	1.774	1.827
7	2.773	0.2771	0.0	0.0	2.608	2.623
8	3.000	0.02333	0.0	0.0	3.603	3.561
9	3.200	-0.2000	0.0	0.0	4.556	4.457
10	3.496	-0.4240	0.0	0.0	4.276	4.155
11	3.792	-0.6480	0.0	0.0	4.005	3.865
12	4.088	-0.8720	0.0	0.0	3.741	3.585
13	4.384	-1.096	0.0	0.0	3.486	3.316
14	4.680	-1.320	0.0	0.0	3.239	3.058
15	4.976	-1.544	0.0	0.0	3.001	2.811
16	5.272	-1.768	0.0	0.0	2.771	2.575
17	5.568	-1.992	0.0	0.0	2.548	2.350
18	5.864	-2.216	0.0	0.0	2.335	2.136
19	6.160	-2.440	0.0	0.0	2.129	1.933
20	6.456	-2.664	0.0	0.0	1.932	1.741
21	6.752	-2.888	0.0	0.0	1.743	1.559
22	7.048	-3.112	0.0	0.0	1.562	1.389
23	7.344	-3.344	0.0	0.0	1.390	1.229
24	7.640	-3.560	0.0	0.0	1.226	1.081
25	7.936	-3.784	0.0	0.0	1.070	0.9431
26	8.232	-4.008	0.0	0.0	0.9224	0.8164
27	8.528	-4.232	0.0	0.0	0.7831	0.7006
28	8.824	-4.456	0.0	0.0	0.6520	0.5958
29	9.120	-4.680	0.0	0.0	0.5292	0.5019
30	9.416	-4.904	0.0	0.0	0.4147	0.4189
31	9.712	-5.128	0.0	0.0	0.3085	0.3468
32	10.01	-5.352	0.0	0.0	0.2105	0.2857
33	10.30	-5.576	0.0	0.0	0.1208	0.2355
34	10.60	-5.800	0.0	0.0	0.03943	0.1963
35	10.86	-5.866	0.0	-	-0.03841	-0.04740

Slice No.	Strength Parameters		Average Pore Pressure		Slice Weight		Forces on base [kN/m]	
	c' [kN/m²]	Tan phi	[kN/m²]	[kN/m]	Normal	Shear (capacity)	Shear (mobilised)	
1	0.0	0.8391	0.0	0.5192	0.3821	0.3206	0.3082	
2	0.0	0.8391	0.0	1.558	1.075	0.9019	0.8671	
3	0.0	0.8391	0.0	2.596	1.768	1.483	1.426	
4	0.0	0.8391	0.0	3.634	2.460	2.064	1.985	
5	0.0	0.8391	0.0	4.673	3.153	2.646	2.544	
6	0.0	0.8391	0.0	5.711	3.846	3.227	3.102	
7	0.0	0.8391	0.0	6.750	4.538	3.808	3.661	
8	0.0	0.8391	0.0	6.447	4.332	3.635	3.495	
9	0.0	0.8391	0.0	9.445	7.573	6.354	6.109	
10	0.0	0.8391	0.0	9.101	7.298	6.124	5.887	
11	0.0	0.8391	0.0	8.757	7.024	5.894	5.666	
12	0.0	0.8391	0.0	8.412	6.749	5.663	5.445	
13	0.0	0.8391	0.0	8.068	6.475	5.433	5.223	
14	0.0	0.8391	0.0	7.724	6.200	5.203	5.002	
15	0.0	0.8391	0.0	7.380	5.926	4.972	4.780	
16	0.0	0.8391	0.0	7.036	5.651	4.742	4.559	
17	0.0	0.8391	0.0	6.691	5.377	4.512	4.338	
18	0.0	0.8391	0.0	6.347	5.103	4.282	4.116	
19	0.0	0.8391	0.0	6.003	4.828	4.051	3.895	



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20	0.0	0.8391	0.0	5.659	4.554	3.821	3.673
21	0.0	0.8391	0.0	5.315	4.279	3.591	3.452
22	0.0	0.8391	0.0	4.970	4.005	3.360	3.231
23	0.0	0.8391	0.0	4.626	3.730	3.130	3.009
24	0.0	0.8391	0.0	4.282	3.456	2.900	2.788
25	0.0	0.8391	0.0	3.938	3.181	2.669	2.566
26	0.0	0.8391	0.0	3.594	2.907	2.439	2.345
27	0.0	0.8391	0.0	3.250	2.632	2.209	2.124
28	0.0	0.8391	0.0	2.905	2.358	1.979	1.902
29	0.0	0.8391	0.0	2.561	2.083	1.748	1.681
30	0.0	0.8391	0.0	2.217	1.809	1.518	1.459
31	0.0	0.8391	0.0	1.873	1.535	1.288	1.238
32	0.0	0.8391	0.0	1.529	1.260	1.057	1.017
33	0.0	0.8391	0.0	1.184	0.9857	0.8271	0.7951
34	0.0	0.8391	0.0	0.4481	0.4511	0.3785	0.3639
Slice Surface Load [kN/m_hor/m] Point Load [kN/m] Water Pressure on							
No.	Surface Load [kN/m_hor/m]		Point Load [kN/m]		Water Pressure on ground surface [kN/m_hor/m]		
	Vert	Horiz	Vert	Horiz	Vert	Horiz	
1	0.0		0.0		0.0		0.0
2	0.0		0.0		0.0		0.0
3	0.0		0.0		0.0		0.0
4	0.0		0.0		0.0		0.0
5	0.0		0.0		0.0		0.0
6	0.0		0.0		0.0		0.0
7	0.0		0.0		0.0		0.0
8	0.0		0.0		0.0		0.0
9	0.0		0.0		0.0		0.0
10	0.0		0.0		0.0		0.0
11	0.0		0.0		0.0		0.0
12	0.0		0.0		0.0		0.0
13	0.0		0.0		0.0		0.0
14	0.0		0.0		0.0		0.0
15	0.0		0.0		0.0		0.0
16	0.0		0.0		0.0		0.0
17	0.0		0.0		0.0		0.0
18	0.0		0.0		0.0		0.0
19	0.0		0.0		0.0		0.0
20	0.0		0.0		0.0		0.0
21	0.0		0.0		0.0		0.0
22	0.0		0.0		0.0		0.0
23	0.0		0.0		0.0		0.0
24	0.0		0.0		0.0		0.0
25	0.0		0.0		0.0		0.0
26	0.0		0.0		0.0		0.0
27	0.0		0.0		0.0		0.0
28	0.0		0.0		0.0		0.0
29	0.0		0.0		0.0		0.0
30	0.0		0.0		0.0		0.0
31	0.0		0.0		0.0		0.0
32	0.0		0.0		0.0		0.0
33	0.0		0.0		0.0		0.0
34	0.0		0.0		0.0		0.0

Job No.	Sheet No.	Rev.
18022		
Drg. Ref.		
Made by	Date	Checked
U	24-Jan-2019	

