

Site Investigation & Risk Assessment Report



Desk Studies | Risk Assessments | Site Investigations | Geotechnical | Contamination Investigations | Remediation Design and Validation

Site: Former Coach Depot, King Street, Brenzett, TN29 9UD

Client: Donforni Ltd

Report Date: 8th January 2018

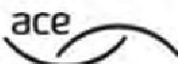
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SUMMARY

The site to the south of Kings Street, Brenzett, was a former transport depot. The buildings on site have been demolished leaving an open development plot. It is proposed to redevelop the site with eleven 2-3 storey houses with associated private gardens and parking areas.

Geological records indicate the site to be underlain by Tidal Flat Deposits and Alluvium over Hastings Beds.

A historical Ordnance Survey map search and desk study was carried out by Southern Testing in 2008 and more recently Sevenoaks Environmental Ltd. These indicate that the site has a history of agricultural use followed by light industrial use.

Two phases of intrusive investigation were carried out, the first in 2008 and latterly this current investigation.

The soils encountered comprised a clayey stiff crust of Made Ground over soft silty Clay with fibrous Peat bands. Below this the medium dense sand tending to loose fine sand and silt was encountered, with clay below 19m.

Groundwater levels were found at very shallow depths in all holes and return monitoring visits recorded depths within 1m of ground level.

The sulphate content of the fill and natural soil was found to fall within Class DS-1. The ACEC classification for the site is AC-1s.

Discussions regarding shallow spread foundations are given in our original 2008 report. This current report gives parameters for pile design. Initial estimates show that a 21m deep, 400mm diameter driven pile would have a safe working load of 670kN.

Suspended floor slabs incorporating a hydrocarbon vapour resistant membrane are recommended.

There is evidence of soil contamination within the Made Ground in the form of Lead and Benzo(a)pyrene. Preliminary recommendations are given for remediation of the site. The contamination screening values used are valid at the time of writing but may be subject to change and any such changes will have implications for the assessments based on them. Their validity should be confirmed at the time of site development.

A formal remediation strategy and verification plan should be agreed with the regulatory authorities prior to commencement of any remedial works.

The site investigation was conducted and this report has been prepared for the sole internal use and reliance of Donforni Ltd and their appointed Engineers. This report shall not be relied upon or transferred to any other parties without the express written authorization of Southern Testing Laboratories Ltd. If an unauthorised third party comes into possession of this report they rely on it at their peril and the authors owe them no duty of care and skill.

The findings and opinions conveyed via this Site Investigation Report are based on information obtained from a variety of sources as detailed within this report, and which Southern Testing Laboratories Ltd believes are reliable. Nevertheless, Southern Testing Laboratories Ltd cannot and does not guarantee the authenticity or reliability of the information it has obtained from others.



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STL: J13396
8 January 2018

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A INTRODUCTION

1 Authority

Our authority for carrying out this work is contained in a completed project order form from Donal Lucey of Donforni Ltd sent on 7th November 2017

2 Location

The site is located in the Village of Brenzett on the Romney Marshes, approximately 10km north-east of Rye and 8km to the north-west of Romney. The National Grid Reference of the site is TR 00269 27200.

3 Proposed Construction

It is proposed to construct 11 No. residential two to three storey houses with private gardens and parking.

For the purposes of the contamination risk assessment, the proposed development land use is classified as Residential with plant uptake. The gas sensitivity of the site is rated as High (CIRIA C665¹).

4 Object

This is a Phase 1 Desk Study and Walkover and Phase II geotechnical and contamination (risk estimation and evaluation) investigation (Tier 1).

The object of the investigation was to assess foundation bearing conditions and other soil parameters relevant to the proposed development, and to assess the likely nature and extent of soil, groundwater and soil gas contamination on the site.

5 Scope

This report presents previous desk study findings (prepared by others), our exploratory hole logs and test results and our interpretation of these data.

This report is in addition to our original report for the site dated 20 August 2008 (Ref J9672), to which the reader is referred.

As with any site there may be differences in soil conditions between exploratory hole positions.

This report is not an engineering design and the figures and calculations contained in the report should be used by the Engineer, taking note that variations will apply, according to variations in design loading, in techniques used, and in site conditions. Our figures therefore should not supersede the Engineer's design.

¹ CIRIA C665 (2006) Assessing risks posed by hazardous ground gases to buildings.

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The site investigation was conducted and this report has been prepared for the sole internal use and reliance of Donforni Ltd and their appointed Engineers. This report shall not be relied upon or transferred to any other parties without the express written authorization of Southern Testing Laboratories Ltd. If an unauthorised third party comes into possession of this report they rely on it at their peril and the authors owe them no duty of care and skill.

The recommendations contained in this report may not be appropriate to alternative development schemes. The contamination screening values used are valid at the time of writing but may be subject to change and any such changes will have implications for the assessments based on them. Their validity should be confirmed at the time of site development.

B REVIEW OF PREVIOUS REPORTS

Report 1. Titled Desk Study, Site Investigation and Risk Assessment Report conducted by Southern Testing (Ref: J9672) Dated August 2008:

At the time of this previous report, the site was occupied by the former Coach Depot buildings, with bituminous and concrete hardstanding. Drainage was noted to be via gullies and underground drainage which was speculated to discharge into ditches and soakaways. The buildings on site comprised of large garages/ workshops the roofs of which appeared to comprise asbestos cement sheeting. Furthermore an area of ground was identified to be stained by hydrocarbons which was assumed to relate to a former above ground fuel storage tank.

The preliminary phase site investigation proved Made Ground to 0.8m bgl over soft clays and peat (Tidal Flat Deposits & Marine Alluvium). Elevated metals were found in the Made Ground and some hydrocarbon contamination was recorded in the area of the former above ground fuel tank. Recommendations were made for further work once the whole site could be accessed.

Report 2. Titled Geo-Environmental Desk Study, conducted by Sevenoaks Environmental (Ref 2888) Dated September 2017:

This report was prepared in relation to a planning application to help satisfy conditions relating to potential ground conditions.

The report identifies the site's previous uses through historical mapping its use as a former coach depot with inspection pits and a former above ground fuel storage tank. It recommends a further intrusive investigation to confirm the current potential risk and remedial requirements, especially into the relation of the above ground tank area which may be the most contaminated area on the site.

C DESK STUDY & WALKOVER SURVEY

6 Desk Study

Southern Testing carried out a Ground Investigation Report in August 2008 which included a Desk Study. More recently Sevenoaks Environmental have carried out a Geo environmental desk study in September 2017 (reference 2888.). A summary of the findings is given below.

6.1 Geology

The British Geological Survey Map of the area indicates that the site geology consists of Tidal Flat Deposits and Alluvium over Hastings Beds.

Alluvium

Alluvium is, geologically speaking, a recent deposit found in association with streams, rivers and other watercourses. It usually consists of soft clays and silts and often has a high organic content. Lenses and bands of peat are commonly found.

It is inherently variable and rapid lateral transitions in soil type should be anticipated, even though borehole sampling may indicate fairly consistent soil conditions.

The soft and variable nature of the soil gives rise to many construction problems. Running sand or silt is often encountered when least expected. Excavations deeper than 1.5 to 2 m are often unstable and close sheeting and strutting is usually required. Bottom heave may be encountered in clayey soils below 3 m.

Hastings Beds

The Hastings Beds is a geological unit that includes interbedded clays, silts, siltstones, sands and sandstones in the High Weald of southeast England. These strata make up the component geological formations of the Ashdown Formation, the Wadhurst Clay Formation and the Tunbridge Wells Sand Formation. The term 'Hastings Beds' has been superseded and the component formations are included in the Wealden Group.

The sediments of the Weald, including the Hastings Beds, were deposited during the Early Cretaceous Period, which lasted for approximately 40 million years from 140 to 100 million years ago. The Hastings Beds are of Early Berriasian to Late Valanginian age.[1] The Group takes its name from the fishing town of Hastings in East Sussex.

Dinosaur remains are among the fossils that have been recovered from the included formations

6.2 Hydrology and Hydrogeology

Data from the Environment Agency and other information relating to controlled waters is summarised below.

Data		Remarks	Possible Hazard to/from Site Y/N
Aquifer Designation	Superficial Deposits	Minor Aquifer	N
	Bedrock	Secondary A Aquifer	N
Groundwater Vulnerability		The site is not identified to be within a Source Protection Zone.	N

Data	Remarks	Possible Hazard to/from Site Y/N
Abstractions	None on site. However there are 5 no. recorded water abstractions that were located within 1000m of the site relating to general agricultural spray irrigation	N
Source Protection Zones	The site is not located within a source protection zone.	N
Surface Water Features	There are no surface water features on site, however a network of drainage ditches are present in the area.	N
Marine/Fluvial Flood Risk	The site is in an area defined by the environment agency as a Flood Zone 2; Land having a less than 1 in 1,000 to 1 in 100 annual probability of river or sea flooding.	N
Surface Water Flood Risk	The site is within an Environment Agency flood warning area	N
Discharge Consents	No discharge consents recorded on site, However 25 no. were recorded within 1000m. The closet being a sewage discharge, 32m east of the site.	N

6.3 Historical Map Search

The Sevenoaks Report records the site as undeveloped until 1898 when a structure appears in the north-eastern part of the site. Further development is recorded in 1939 and between 1976 and 1978. This probably relates to the coach depot.

6.4 Environmental Databases

	Distance (m)	Direction	Details	Possible Hazard to site
Historical Industrial Land Uses	0	-	On site: Transport, Storage and Delivery depot.	Y
	25	N	Blacksmith (Smithy) 1872-1939	N
Current Industrial Land Uses	50	NW	Substation	N
	120	NE	Nursery (plant)	N
	150	NE	Tank (unknown)	N
Current and Historical Landfills	-	-	No current or historical landfills have been identified within 500m of this site.	N
Fuel Sites	416	SE	Two entries. One currently active.	N
Pollution Incidents	881	NW	A Category 3 – Minor incident located 881m north-west which involved the spillage of General Biodegradable: Sewage Septic Tank Effluent from a lorry, in 1999.	N

	Distance (m)	Direction	Details	Possible Hazard to site
Hazardous Substances Consents	-	-	No Hazardous Substance Consents were identified within 500m of the site.	N
Sensitive Land Use Designations	-	-	No Sensitive Land Use Designations were identified within or local area.	N

The Sevenoaks Environmental Report highlights potential sources of contamination associated with Made Ground on the site. They rate the potential risks from these on-site sources as moderate.

Potential off-site sources are listed as;

- Smithy – 25m to the north of the site (1872-1939)
- Substation – 50m to the north-west of the site (since 1976)
- Nursery – 120m to the north-east of the site (since 1976)
- Tank – 150m to the north-east of the site (since 1976)

Sevenoaks Environmental rate the potential risks from these off-site sources as low. These are discussed further in the preliminary conceptual model.

6.5 Radon Risk

With reference to BRE guidance: no radon protection is required on this site.

6.6 UXO Risk Assessment

A site specific UXO risk assessment was carried out for this site. The full assessment is included in Appendix F and indicated a low to medium risk for intrusive works.

7 Walkover Survey

A walkover survey was carried out by Southern Testing on 28 November 2017.

7.1 General Description and Boundaries

The site is located at a former coach depot which has recently been demolished. The site is bounded by residential houses and gardens to the north-east and south-west, Kings Street to the north-west and open fields to the south-east.

7.2 Topography and Drainage

The site is near level, however there are various stockpiles of crushed concrete along the south-eastern and south-western boundaries. There was no current evidence of engineered drainage.

7.3 Vegetation

The site is covered by brambles and scrub. Some areas are devoid of any vegetation. No significant trees were noted on site but semi-mature fir and sycamore trees were present on the south-eastern and south-western boundaries.

7.4 Buildings and Land Use on Site and Nearby

There were no longer any buildings on site. Residential properties either side of the site comprised brick built bungalows (circa 1975) and 2-storey period properties. The period cottage nearest to the site showed cracking to the chimney.

D PRELIMINARY CONCEPTUAL MODEL

8 Introduction

In the context of this report, the conceptual model summarises the potential pollutant linkages identified for the site and forms the basis of the risk assessment for the site. The preliminary model comprises the potential sources of contamination, receptors that could be harmed and exposure pathways identified from the desk study and walkover survey. These potential linkages form the basis upon which the investigation is designed and reported.

9 Potential Sources of Contamination

The site has a history of industrial use and is located within a residential / agricultural area.

A number of potentially contaminative uses have been identified, both on site and in the locality.

Potential contaminants associated with these uses have been compiled from our original ground investigation, the Sevenoaks Environmental Desk Study Report and our experience of such sites.

9.1 On Site Sources

Source	Potential Contaminants
Made Ground	Metals, PAH, asbestos
Natural Soils	Ground gas from peat.
Surface Hazards	TPH from former fuel tank and servicing of vehicles.

9.2 Off Site Sources

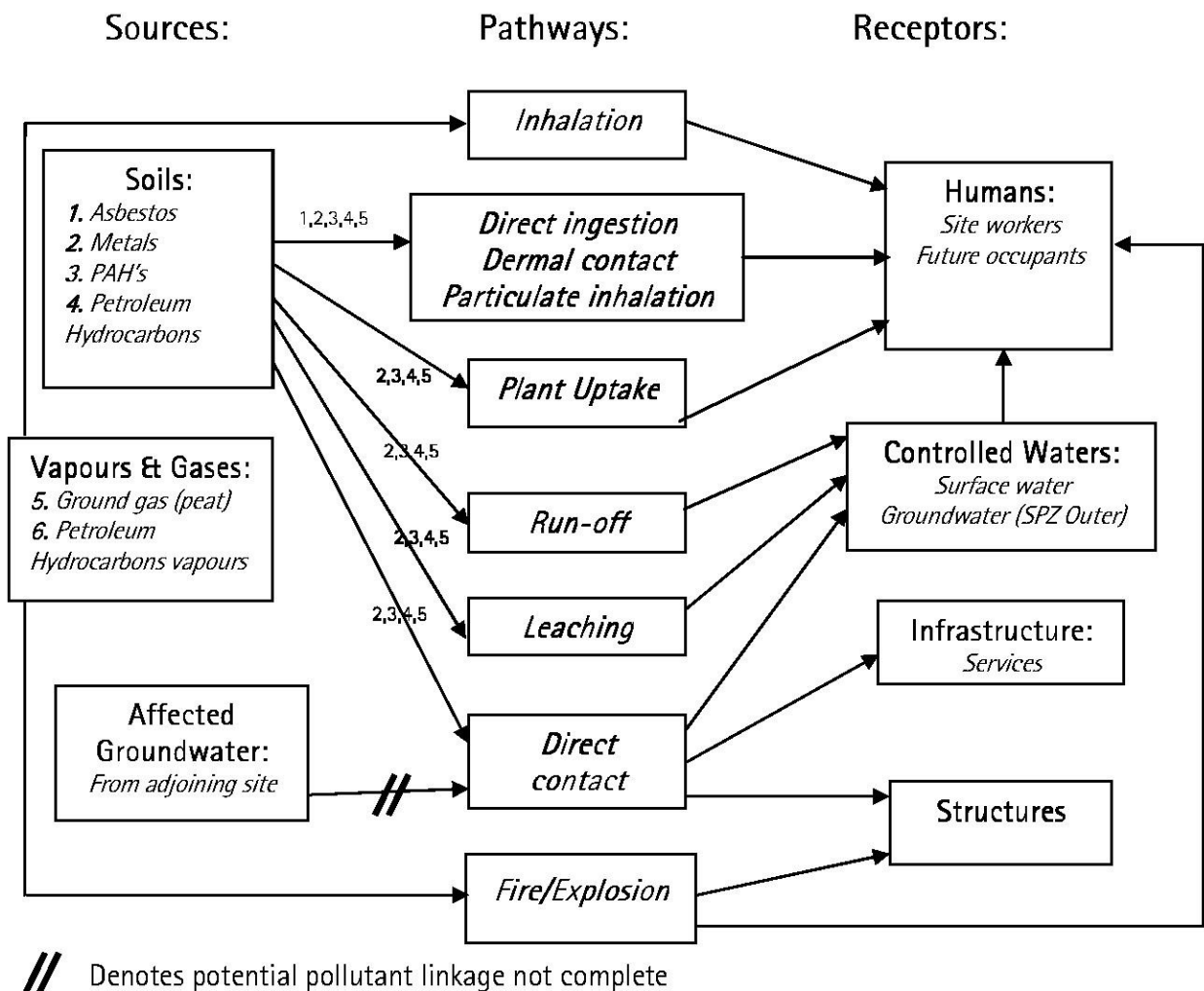
The site may be impacted by contamination migrating from beyond the site boundary. The following potential off-site sources have been identified.

Source	Distance from Site Boundary	Direction	Potential Contaminants	Likely Hazard to Site
Smithy (Blacksmiths)	25m	N	Metals	Negligible
Substation	50m	NW	TPH / PCB	Negligible
Nursery	120m	NE	Metals / pesticides / herbicides	Negligible
Tank	150m	NW	TPH	Negligible

Given the distance of the substation, nursery and the tank from the site, the off-site sources are considered to present a negligible risk to the site.

10 Pollutant Linkages and Model Summary

The following diagram shows the potential pollutant linkages identified for the site and summarises the preliminary conceptual model:



E SITE INVESTIGATION

11 Method

The strategy adopted for the intrusive investigation comprised the following:

- 2 No boreholes to 3 metres depth were drilled using a rotary flight auger drilling rig.
- 1 No cable percussive borehole to 25 metres, with in situ testing and sampling,
- 6 No trial pits was excavated up to 2.5m using a 5 tonne 360° excavator.

Exploratory hole locations are shown in Figure 1 in Appendix A.

The presence of stockpiles from demolition restricted the fieldwork area.

12 Weather Conditions

The fieldwork was carried out on the 28th November 2017 at which time the weather was generally cold and dry.

13 Soils as Found

The soils encountered are described in detail in the attached exploratory hole logs (Appendix A), but in general comprised a covering of Made Ground over soft Alluvium (peat, sand and clay). A summary is given below.

Depth	Thickness	Soil Type	Description
GL – 0.4/0.6m	0.4/0.6m	Made Ground	Loose grey and brown crushed brick concrete and flint gravel in a sandy silt matrix.
0.6–1.3m (TPC only)	0.7m	Made Ground	Loose red brown fine to coarse crushed brick and flint gravel with abundant glass, bottles and ceramics (c. 1940)
0.3/0.6 – 0.9/2.0m (TPA, TPB, WS3, WS5, WS6, WS7, WS7, BH1)	0.5–1.3m	Firm to stiff Clay crust	Firm and stiff dark yellow orange brown silty CLAY.
0.5/2.0–1.8/3.0m (All holes)	0.3–2.1m	Soft Clay	Soft and firm, blue grey slightly silty to silty CLAY (with hydrocarbon odour in TPB at 1.5m and TPC at 2.0m)
1.8/3.0–2.2/4.4m	1.2–1.4m	Peat	Black/brown fibrous and amorphous PEAT.
4.4–7.0m (BH1)	2.6m	Silty Clay	Very soft, blue/pale grey, very silty CLAY/ clayey SILT with rare roots.
7.0–7.5m (BH1)	0.5m	Sand	Loose grey clayey silty fine SAND with thin fibrous peat bands.
7.5–10.0m (BH1)	7.0m	Silty Sand	Loose, dark grey banded light grey slightly silty SAND. Sand is fine.
10.0–14.5m (BH1)	4m	Silty SAND	Medium dense dark grey banded light grey slightly silty fine SAND.
14.5–17.5m (BH1)	3.0m	Clayey Silt	Loose light grey, slightly sandy clayey SILT. Sand is fine.
17.5–19.0m (BH1)	1.5m	Silty, clayey Sand	Very soft dark grey, silty clayey SAND. Sand is fine.
19.0–25.0m (BH1)	6.0m	Sandy CLAY	Soft to becoming very stiff, pale grey mottled orange brown, slightly sandy CLAY.

13.1 Visual and Olfactory Evidence of Contamination

Olfactory evidence in the form of hydrocarbon odour was recorded in the soft clay in trial pit locations TPB and TPC. Old glass, ceramics and bottles were also present in TPC.

14 Groundwater Strikes

Water was struck in the exploratory holes as follows. The soils generally became damper with depth.

TP/BH	Water Strikes
TPA	Slight seepage at 1.3m Rapid at 2.1m. SWL at 2.2- after 15 minutes
TPB	Seepage at 2.2m
TPC	Seepage at 2.0m
TPD	Seepage at 2.0m
TPE	Slow seepage at 1.5m. Slight ponding at base.
TPF	Seepage at 1.2m. Ponding at base.
BHA	Standing water level 2.4m on completion and 0.35m in monitoring well on 19/12/17
SH1	Maximum recorded level in monitoring well 0.85m on 19/12/17.
SH2	Maximum recorded level in monitoring well 0.91m on 19/12/17.

F FIELD TESTING AND SAMPLING

The following in-situ test and sampling methods were employed. Descriptions are given in Appendix B together with the test results.

- Hand Penetrometer Testing
- Disturbed sampling
- Undisturbed U100 samples
- Standard Penetrometer Testing (SPT)
- Environmental Sampling.

G GEOTECHNICAL LABORATORY TESTS

The following tests were carried out on selected samples. Test method references and results are given in Appendix C.

- Moisture Content
- Plasticity Index
- Organic Content Loss on ignition
- Water Soluble Sulphate Content and Ph of soil
- Sulphate Content and Ph of water
- Quick Undrained Triaxial (100mm Single Stage)

H DISCUSSION OF GEOTECHNICAL TEST RESULTS AND RECOMMENDATIONS

15 Soil Classification and Properties

Soil Type	Depth	Compressi- bility	VCP	Permea- bility	Frost Susceptible	CBR	Remarks
Made Ground	GL to 0.5/1.3m	Variable		Variable	Yes	Variable	Not suitable for spread foundations
Marine Alluvium (Soft Clay and Peat, loose sand and silt)	1.3/4.4 to 19m	High	Medium in clay bands	Variable	Yes	Poor	Not suitable for spread foundations
Stiff clay.	19-25m	Moderate to low	Medium	Low	No	N/A	-

16 Swelling and Shrinkage

Plasticity Index tests have been carried out as part of our original investigation during 2008 and additional tests have been carried out as part of the current investigation. The tests showed the soils within the upper 4.0m to generally be clay and organic clay of intermediate to high plasticity.

Whilst one sample from BH1 at 2.0m gave a plasticity index result of 48%, the majority of plasticity index results were between 20% and 39%.

Therefore an NHBC volume change potential classification of MEDIUM is recommended for the site.

17 Groundwater Levels

Groundwater seepages were encountered in the exploratory holes at approximately 2.0m depth and monitoring wells recorded standing groundwater at less than 1m below ground level.

Groundwater levels vary considerably from season to season and year to year, often rising close to the ground surface in wet or winter weather, and falling in periods of drought.

Allowance should be made for a very shallow groundwater table during the wetter months of the year and dewatering of excavations is expected to be required.

18 Soakaways

Site specific soakaway testing does not form part of this report. As a general comment, natural groundwater levels appear to be at very shallow depth and on-site soakaways are likely to be difficult to construct and would only provide limited storage. In addition soakage in the clay soils would also be very poor. Therefore at this stage it is recommended that surface water be discharged off site.

19 Sulphates and Acidity

The recorded pH values are in the range 8.2–10.9.

The Design Sulphate Class is DS-1. Groundwater should be assumed to be mobile. The ACEC site classification is AC-1.

20 Bearing Capacity

The ground conditions found at the site comprised a layer of Made Ground over soft marine alluvium and peat over loose silts and fine sand with stiff clay below 19.0m. In some areas a thin crust of firm to stiff clay was found below the Made Ground although this wasn't continuous across the site.

The unconfined compressive strength of the shallow deposits, measured by hand penetrometer in both investigations, was 10–150kPa. This gives approximate shear strengths in the range 5–75 kPa. A single triaxial test carried out on a sample from BH1 at 2.5m gave an apparent cohesion (Cu) of 47kPa.

NHBC precautions for a medium volume change potential clay would require foundation depths of between 1.2m and 2.5m depending on proximity to trees. This would mean that footings would have to be taken down into the underlying very soft clays, which are not suitable for supporting traditional spread foundations. In addition the presence of peat at approximately 2.0m is likely to result in excessive settlement and long term creep of footings.

Shallow foundation options were given in our previous report, albeit with minimal allowable bearing pressures. An additional deep borehole was drilled as part of this current investigation to provide parameters for pile design.

20.1 Piling

Either bored, driven or CFA piles could be used at the site. We have undertaken a preliminary pile calculation, based upon the results of SPT tests and unconfined compressive strengths in the borehole BH1.

Our preliminary estimate assumes no shaft friction in the upper 4.4m within the soft clay and peat. Below this level SPT results have been used throughout the silt and sand layers to 19m. From 19m shear strengths in the clay have been assessed from hand penetrometer readings. An overall factor of safety of 2.5 has been applied.

Our preliminary pile calculations indicate that a 21m deep, 400mm diameter driven pile would have a safe working load of 670kN, and a similar sized CFA pile would provide a 515kN safe working load. The structural Engineer should take into account the presence of weak soils at the site and the implications for lateral stability of the pile.

With any piling scheme, discussions should be held with selected piling contractors to discuss the technical and financial merits of their various systems. With respect to overall resources, the equipment available should be appropriate for the ground described and anticipated and be able to achieve the depths and diameters considered with an appropriate safety margin.

The piles may be affected by negative skin friction should the site levels be raised and consolidation of the soft shallow soils take place. This should be taken account by the pile designer.

21 Floor Slabs

Floor slabs should be suspended. The provision of a hydrocarbon vapour resistant membrane is recommended.

22 Settlement

Careful analysis of settlement will be required for various foundation types. The degree of settlement from a raft foundation will depend on its rigidity and loading, and for piles will depend on the size and loading.

As well as consolidation settlement, there will be additional long-term creep, associated with degradation of organic material at depth (peat) and seasonal water level changes.

It is likely that differential settlements will result due to variations in the soil strata and loadings.

Therefore all foundations should be designed to resist differential settlement. In this regard settlement of piled foundations should be negligible, however allowance should be made for negative skin friction in pile design.

23 Excavations and Trenching

Statutory support will be required in all excavations where personnel must work.

The trial pits were unstable in areas of Made Ground and areas where backfilled waste was present. A significant depth of waste bottles glass and brick was encountered in TPC. This area, and any other similar areas of Made Ground should be excavated and replaced with clean engineered fill.

Considerable construction difficulties and collapse must be anticipated within excavations where soft soils or the groundwater are encountered. Provision should be made for close lateral support in all excavations.

Contamination in the form of Lead, Benzo(a)pyrene and Hydrocarbons has been identified on the site. This may have implications for earthworks and soils removed from site.

24 Road Construction

Based on in-situ mexecon tests and our knowledge of these soils, a CBR value of 1% appears appropriate for preliminary purposes. A design value should be established by the Engineer.

Clayey and silty soils are susceptible to loss of strength due to changes in moisture content and therefore the subgrade should be protected from the elements to avoid this. Given the formation soils are soft, a geotextile separating membrane may be beneficial in preventing excess stone loss in to the subgrade.

The construction should comprise a minimum of 450mm of non-frost-susceptible material.

The most important element of any road construction is drainage and attention must be given not only to the drainage of the subsoil, but to the various layers of construction. To this end the formation should be shaped to a camber or crossfall to allow water movement out of the sub-base. Silty soils soften extremely quickly if allowed to become wet or if they are excavated below the water table and this softening can give rise to a very substantial increase in costs.

Because of the variability of shallow soils, the formation should be proof rolled, and any soft spots found should be excavated and replaced with compacted granular material. The surface of the formation should then be compacted, prior to laying the road sub-base. Details of surface tolerances and formation compaction are given in the DOT Specification for Highway Works (1991 amended Aug. 1993), Clause 616.

Construction traffic should be kept off formations and it is often advisable to leave a protective layer of soil above formation level until the last moment before placing the sub-base.

I LAND QUALITY

25 Analytical Framework

There is no single methodology that covers all the various aspects of the assessment of potentially contaminated land and groundwater. Therefore, the analytical framework adopted for this investigation is made up of a number of procedures, which are outlined below. All of these are based on a Risk Assessment methodology centred on the identification and analysis of Source – Pathway – Receptor linkages.

The CLEA model² provides a methodology for quantitative assessment of the long term risks posed to human health by exposure to contaminated soils. Toxicological data is used to calculate a Soil Guideline Value (SGV) for an individual contaminant, based on the proposed site use; these represent minimal risk concentrations and may be used as screening values.

In the absence of any published SGVs for certain substances, Southern Testing have derived or adopted Tier 1 screening values for initial assessment of the soil, based on available current UK guidance including the LQM/CIEH³ S4UL's and CL:AIRE⁴ generic assessment criteria. In addition, in March 2014, DEFRA⁵ published the results of a research programme to develop screening values to assist decision making under Part 2A of the Environmental Protection Act. Category 4 screening levels were published for 6 substances, with reference to human health risk only. This guidance includes revisions of the CLEA exposure parameters, presenting parameters for public open space land use scenarios, and also of the toxicological approach. The screening levels represent a low risk scenario, based on a 'Low Level of Toxicological Concern' rather than the 'Minimal Risk' of CLEA, and the analytical results of this investigation may be considered relative to these levels.

The values used are valid at the time of writing but may be subject to change and any such changes will have implications for the assessments based upon them. Their validity should be confirmed at the time of site development.

Site-specific assessments are undertaken wherever possible and/or applicable.

CLEA requires a statistical treatment of the test results to take into account the normal variations in concentration of potential contaminants in the soil and allow comparisons to be made with published guidance.

Ground gases are assessed in accordance with the guidance given in CIRIA report C665.

² Environment Agency Publication SC050021/SR3 'Updated technical background to the CLEA Model' (2009).

³ The LQM/CIEH S4ULs for Human Health Risk Assessment. (2014).

⁴ The EIC/AGS/CL:AIRE Soil Generic Assessment Criteria for Human Health Risk Assessment (2009).

⁵ SP1010 Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination. DEFRA, 2014.

26 Site Investigation – Soil

26.1 Sampling Regime

The number of sample locations was limited and was partly targeted at potential sources present in the Made Ground and provide general coverage of the site. The previous tests conducted by Southern Testing in 2008 showed elevated levels of metals in the Made Ground. Furthermore elevated levels of hydrocarbons were present in the region of the former above ground Fuel Storage Tank (FST).

26.2 Testing

The potential for heavy metal and hydrocarbons contamination was identified in both the previous intrusive investigation and the preliminary conceptual model carried out by Sevenoaks Environmental, therefore, the following tests were selected.

Test Suite	Number of Samples	Soil Tested
STL Key Contaminant Suite	8	Made Ground & Natural Soils
Asbestos Identification	8	Made Ground & Natural Soils
Asbestos Quantification	3	Made Ground
EPH GCFID C10-40	6	Natural Soils

The test results are presented in full in Appendix D. A summary and discussion of the significance of the results and identified contamination sources is given below.

26.3 Test Results and Identified Contamination Sources

26.3.1 General Contaminants

The results of the key contaminant tests have been analysed in accordance with the CLEA methodology. The samples have been grouped into two populations comprising Made Ground and Natural Soil. For each parameter in each population the sample mean is calculated and compared to a Tier 1 screening value. If the sample mean exceeds the screening value, the soil may be regarded as contaminated and further assessment may be required. If neither the sample mean nor any single value exceeds the screening value, the soil may be regarded as not contaminated, though further confirmatory assessment may be required. Where any single parameter value exceeds the screening value but the sample mean does not, further statistical analysis may be applied to that parameter if the available data is suitable. Such analysis would include an assessment of the Normality of the distribution of the data, consideration of the presence of outliers, and the calculation of a UCL estimate of the mean.

Summary data is presented in the tables below and the laboratory analysis is included in Appendix D. The screening values and source notes are presented in Table 1 "Tier 1 Screening Values" at the front of Appendix D.

The results from the 2008 site investigation have been incorporated into the following tables:

Made Ground (TPA @ 0.2m, TPB @ 0.2m, TP D @ 0.5m, TPE @ 0.1m, and TPF @ 0.1m; and from the previous report WS4 @ 0.3 and WS7 @ 0.7m)

Contaminants	Units	No of Samples Tested	Range	Sample Mean	Residential with Home-grown Produce Consumption Tier 1 Screening Value
Arsenic (As)	mg/kg	7	9.4 - 30	19	37
Cadmium (Cd)	mg/kg	7	<0.3 - 1	0.47	11
Total Chromium (Cr)	mg/kg	7	12 - 25	20	910
Hexavalent Chromium (CrVI)	mg/kg	5	<1	1.0	6
Lead (Pb)	mg/kg	7	78 - 2300	714	200
Mercury (Hg)	mg/kg	7	<0.2 - 5.4	1.6	7.6
Selenium (Se)	mg/kg	7	<1	2.4	250
Nickel (Ni)	mg/kg	7	5.6 - 28	18	130
Copper (Cu)	mg/kg	7	20 - 350	97	2400
Zinc (Zn)	mg/kg	7	94 - 860	318	3700
Phenol	mg/kg	7	<1	1.9	120-380
Benzo[a]pyrene	mg/kg	7	0.2 - 72	12	1.7-2.4
Naphthalene	mg/kg	7	<0.005 - 0.49	0.20	2.3-13
Total Cyanide (CN)	mg/kg	7	<1	<1	/
Acidity (pH value)	Units	7	7.2 - 11.1	9.1	/
Soil Organic Matter	%	5	2.2 - 9.8	5.9	/

With the exception of elevated levels of Lead and Benzo(a)pyrene identified, the soils could be considered clean, however, the concentrations of Lead and Benzo(a)pyrene recorded significantly exceed the Tier 1 screening values.

The results show the Made Ground contains elevated levels of Lead and Benzo(a)pyrene and should be considered contaminated for the proposed site end use and should not remain in gardens or soft landscaped areas of the site. New topsoil would be required for the intended final use of this site.

Natural Soils: TPA @ 0.7m, TPC @ 1.8m, SH1 @ 1.0m from this investigation; and WS3 @ 0.4m, WS5 @ 0.8m, WS6 @ 1.0m, and WS7 @ 1.0m

Contaminants	Units	No of Samples Tested	Range	Sample Mean	Residential with Home-grown Produce Consumption Tier 1 Screening Value
Arsenic (As)	mg/kg	7	8 - 29	20	37
Cadmium (Cd)	mg/kg	7	<0.3 - 0.3	0.29	11
Total Chromium (Cr)	mg/kg	7	22 - 29	25	910
Hexavalent Chromium (CrVI)	mg/kg	3	<1	1.0	6
Lead (Pb)	mg/kg	7	54 - 150	108	200
Mercury (Hg)	mg/kg	7	<0.2	0.54	7.6
Selenium (Se)	mg/kg	7	<1	1.9	250
Nickel (Ni)	mg/kg	7	21 - 23	22	130
Copper (Cu)	mg/kg	7	<10 - 25	18	2400
Zinc (Zn)	mg/kg	7	67 - 220	132	3700
Phenol	mg/kg	3	<1	<1	120-380
Benzo[a]pyrene	mg/kg	3	<0.1-0.3	0.1	1.7-2.4
Naphthalene	mg/kg	3	<0.1	<0.1	2.3-13
Total Cyanide (CN)	mg/kg	3	<1	<1	/
Acidity (pH value)	Units	3	8.1-8.2	8.2	/
Soil Organic Matter	%	3	1-2.2	1.5	/

The concentrations of the determinants are all below our Tier 1 screening values for residential with plant up-take. The natural soils can be considered free from significant contaminants.

26.4 Asbestos

The site was formerly occupied by a coach depot, which involved the storage of Coaches and minor maintenance works. From a walkover inspection before demolition, the roofs to many of the buildings on site were presumed to be profile asbestos cement. These buildings have now been demolished.

Asbestos was not detected in any of samples taken as part of our initial intrusive investigation, however white asbestos fibres, (Chrysotile) were detected in three samples analysed in this latest investigation. These samples were analysed further and were quantified as having <0.001% of loose fibres present. At this concentration, asbestos is not considered to pose a significant risk to the proposed end users.

However, it should be noted that the exploratory holes are of small diameter. The investigation was constrained by site usage and the samples obtained may not reflect the full composition of the soils on the site. Therefore, there is always the potential for pockets of asbestos or for asbestos containing materials to be present, which have not been detected in the sampling.

26.4.1 Organic Contaminants

The following table summarises the results of the analysis for TPH undertaken during this investigation. The results from our initial intrusive investigation are also summarised below in the table

Sample ID	Unit	SH1 @ 2.0m	TPA @ 1.5m	TPB @ 0.9m	TPB @ 1.5m	TPC@ 1.8m	TPD @ 1.4m
TPH C10-C40	mg/kg	30	21	15	36	200	<10

With the exception of TPC @ 1.8m, the concentrations are only just slightly above the detection limit (10 mg/kg). The concentrations recorded in TPC @ 1.8m is not considered to be significant concentration, had a slight improvement on our initial findings, given the results of our initial testing in 2008. We would consider that this concentration is likely to be below the screening value for Total Petroleum Hydrocarbons, given that it is likely to be the heavier range carbons.

The results from this initial are summarised below in the table, these suggest that the initial elevated concentrations may have weathered over the past 8-9 years, and as the source (FST) has been removed, the potential risks associated with this naturally reducing.

Description	Depth (m)	Total Petroleum Hydrocarbons (mg/kg)	Carbon Range	Possible Fuel Types
WS 4	0.9	550	C10-C40	Diesel
WS 4	1.2	4400	C10-C40	Diesel
WS4	1.8	230	C10-C40	Diesel
WS7	1.0	20	C10-C40	-

At this stage, on the basis of the testing to date, there appears to have been a reduction in the potential contamination relating to the former FST.

27 Gas Sources

The desk study identified the potential land gas risk from natural methanogenic material (alluvium with peat layers) present beneath the site.

This type of source is moderate to low generation potential, after Wilson and Haines (2005)⁶. Gas monitoring to determine the potential risk is essential. Three gas monitoring wells have been installed to determine the concentrations of land gas present beneath the site and determine the risk posed to the proposed residential development.

⁶ Wilson, S and Haines, S. 2005. Site investigation and monitoring for ground gas assessment – back to basics. Land Contamination & Reclamation 13, 3, 211-222.

27.1 Sampling Strategy

The number and spacing of the gas monitoring wells was based on a targeted investigation of the Made Ground on site and to provide general coverage for the proposed development.

Monitoring wells were installed at strategic locations across the site, in accordance with the recommendations given in CIRIA C665.

27.2 Monitoring Programme and Results

The sensitivity of the proposed development is rated as High. As an initial survey 3 No. fortnightly visits have been scheduled. To date two of these visit have been undertaken. The results of the monitoring programme are given in full in Appendix E and are summarised below.

Borehole Gas Monitoring Results Summary			
Monitoring Well	SH1	SH2	BH 1
Response Zone/Stratum	1m – 3m bgl Organic Clay & Peat	1-3m bgl Organic Clay & Peat	1-3m bgl Made Ground & Peat
Evidence of contamination	organic 1.7m		
No. of monitoring events	2	2	2
Methane % range	0.0	0.0	0.0
Carbon Dioxide % range	1.9. – 2.1	0.4- 0.7	0.4- 0.5
Oxygen % range	18 – 19	16.2 – 18.6	18.9 – 19.5
Flow rate l/hr range	0.0	0.0	0.0
PID Ready (ppm)	0.1-1.5	0.0-1.3	0.0-0.4
BH Pressure range mb	0.0	0.0	0.0
Water level mbgl	0.85 – 1.26	0.91 – 1.2	0.35 – 0.86
Atmospheric pressure during monitoring mb	1038 – 1040	1037 – 1038	1038 – 1040

The sensitivity of the proposed development is rated as high and, therefore, nine rounds of gas monitoring should be taken over a period of six months (CIRIA C665, Table 5.5). However, given the low risk to the site from land gases, only three initial monitoring visits have been undertaken.

No flow rate were on the visits to date.

Results for carbon dioxide from SH1, SH2 & BH1 ranged between 0.4%v/v and 2.1% v/v. Levels of carbon dioxide that would be considered around natural background levels. Levels of carbon dioxide were all below 5%.

Methane was not detected in any of the three wells sampled over the two month monitoring period.

Negligible levels PID levels were recorded on indicating very low hydrocarbon concentrations.

27.3 Identified Gas Regime

From the results of gas monitoring visits undertaken to date, an initial assessment can be calculated using the NHBC Traffic light System for low rise housing, or CIRIA C665, December 2007.

The results have been assessed as NHBC Situation Green for low rise housing. This calculation is based on a maximum carbon dioxide concentration of 2.1% and 0.1ℓ/h flow rate (lowest measurable detection limit).

28 Summary of Identified Contamination

Significantly elevated concentrations of Lead and Benzo(a)pyrene were recorded in the Made Ground soils on site.

Initial laboratory analysis as part of the 2008 intrusive investigation identified the potential hydrocarbon contamination beneath the region of the above ground fuel storage tank. Subsequent testing within the same area, to the immediate north and south west of the tank has been undertaken and suggests concentrations have reduced since 2008. Further investigation with some testing during the groundworks phase of the development is essential to confirm this.

29 Risk Evaluation

The object of the risk evaluation is to assess the pollution linkages for specific contaminant groups considered in the conceptual model, identify any unacceptable risks and, therefore establish whether there is a need for further investigation and/or remedial action.

The risks are considered in the context of the specific development proposals for the site and, therefore, the conclusions may not be appropriate for alternative schemes.

29.1 Lead

Elevated levels of lead are recorded in the Made Ground soils on site, in four of the seven samples analysed (TPA @ 0.2, TPB @ 0.2m, TPE @ 0.1m, and WS7 @ 0.5m). Based on these results the Made Ground is considered unsuitable to remain in the proposed garden and landscaped areas and should be removed. Given the depth of Made Ground on site, we would recommend that the removal and replacement of 0.6m would be appropriate in the gardens.

Where Made Ground is present under the footprint of the proposed buildings it may be considered acceptable to remain.

29.2 Benzo (a)Pyrene

The concentration of Benzo (a)pyrene recorded in four of the seven Made Ground samples is considered significantly elevated and therefore poses a potential risk if this material is to be retained on site. Given the depth of Made Ground on site, we would recommend that the removal and replacement of 0.6m would be appropriate.

Again, where Made Ground is present under the footprint of the proposed buildings it may be considered acceptable to remain.

29.3 Revised Conceptual Model

The preliminary site model has been refined in light of the findings of this investigation and is summarised below.

<i>Metals</i>	<i>PAHs</i>	<i>Petroleum Hydrocarbons</i>	<i>Land Gas</i>	<i>Asbestos</i>	PATHWAYS	RECEPTORS
Y	Y	P	n/a	N	Ingestion and inhalation of contaminated soil and dust	Human Health
Y	Y	P	N	n/a	Dermal contact with contaminated soil and dust	
N	n/a	P	P	n/a	Inhalation of vapours or gases	
P	P	P	n/a	n/a	Uptake into edible fruit and vegetables	
P	P	P	n/a	n/a	Surface water run-off into surface water features	Water Environment
P	P	P	n/a	n/a	Migration through ground into surface water or groundwater	
N	N	P	N	n/a	Off-site migration of contaminated groundwater	
Y	Y	P	N	n/a	Vegetation on site growing in contaminated soil	Flora and Fauna
Y	N	P	n/a	n/a	Aquatic life in affected waters	
N	Y	P	n/a	n/a	Contact with contaminated soil	Building materials/ buried services
N	n/a	N	P	n/a	Fire or explosion	

Key:

Y	Pollutant linkage likely
N	Pollutant linkage not likely
P	Pollutant linkage possible
n/a	Pathway not applicable to contaminant

29.4 Relevant Pollutant Linkages

A number of Relevant Pollutant Linkages for which remedial action will be required have been identified in the revised conceptual model, as follows.

Contaminant/Source	Pathways	Receptors
<i>Lead and PAHs in Made Ground</i>	<i>Soil/dust Dermal exposure Soil/dust Ingestion/inhalation</i>	<i>Site/ Construction workers Future residents</i>
<i>Lead PAHs in Made Ground</i>	<i>Plant uptake</i>	<i>Future residents</i>
<i>Petroleum hydrocarbons in underlying peat soils in southern section of the site</i>	<i>Vapour Inhalation Direct contact</i>	<i>Site/ Construction Workers Future residents Structures/services</i>

30 Discussion and Conclusions

The recommendations for remedial options at the site are for removal and replacement of the Made Ground soils.

The Made Ground is contaminated with Lead and Polyaromatic Hydrocarbons (namely Benzo[a]pyrene). Therefore these soils are unsuitable to remain in the garden or soft landscaped areas. Allowance should be made for the removal of Made Ground to 600mm depth in garden areas and replacement with clean validated subsoils and topsoil (to include a minimum of 150mm of topsoil). Where the natural soils are encountered, no removal is required, however a growing medium of 150mm of clean, validated topsoil should be provided.

At present, the initial gas assessment suggests that there is a very low risk (NHBC Traffic light Green) of gas generation, however further monitoring is recommended to confirm this and to be in accordance with the guidance (gas protection measures based on CIRIA C665 and BS8485).

During the groundworks phase of the investigation we would suggest further inspection of the residual soils within this area of the former above ground fuel storage tank should be carried out to confirm no further areas or hotspots of significant contamination exist. At this stage allowance should be made for vapour resistant membranes to be installed in the ground floor slabs of the new properties to protect against the ingress of any hydrocarbon vapour.

Asbestos fibres were detected in the Made Ground soils on site, these were analysed further and found to be below the laboratory detection limit (<0.001%). The site was formerly occupied by industrial units that were visually identified to have Asbestos Containing Materials (ACMs) in their construction. These buildings have been demolished and removed. It is assumed that the ACMs were removed and disposed of in the appropriate manner, in accordance with the regulations. However there is still a potential risk relating to the potential presence of loose fibres and ACMs to be encountered on site.

Based on the asbestos found to date, it is not considered to pose a significant risk to construction workers, however appropriate PPE should be worn and good hygiene practices observed. It is possible that whilst ground works are being undertaken on site, pockets of buried ACMs may be encountered. Should this be the case, groundworks should be halted and further investigation and analysis will be required to assess the risk.

As with any site, areas of contamination not identified during site investigation works may come to light in the course of redevelopment. Accordingly, a discovery strategy must be in place during the redevelopment to ensure that any hitherto unknown contamination is identified and dealt with in an appropriate manner. Depending on the nature of any such contamination, it may prove necessary to reassess the remedial strategy for the site.

A formal remediation strategy and verification plan should be agreed with the regulatory authorities prior to commencement of any remedial works.

31 General Guidance

Allowance should be made for experienced verification of any remedial works.

It may be that specific local requirements apply to this site, of which we are not aware at this time.

In general terms, the workforce and general public should be protected from contact with contaminated material. There is a range of relevant documents published by the Health and Safety Executive, and organisations such as CIRIA, and the BRE.

Some soils will require removal from site and disposal to suitably licensed landfills. Different guidelines and charges will apply to different waste classification. As waste producers, the Developer holds responsibilities under the various governing regulations. The chemical analyses appended to this report should be forwarded to tip operators for their own assessment, to confirm classification of the soils for offsite disposal, and whether they can accept the material. Waste Acceptance Criteria (WAC) testing may be requested for confirmation of the material's classification.

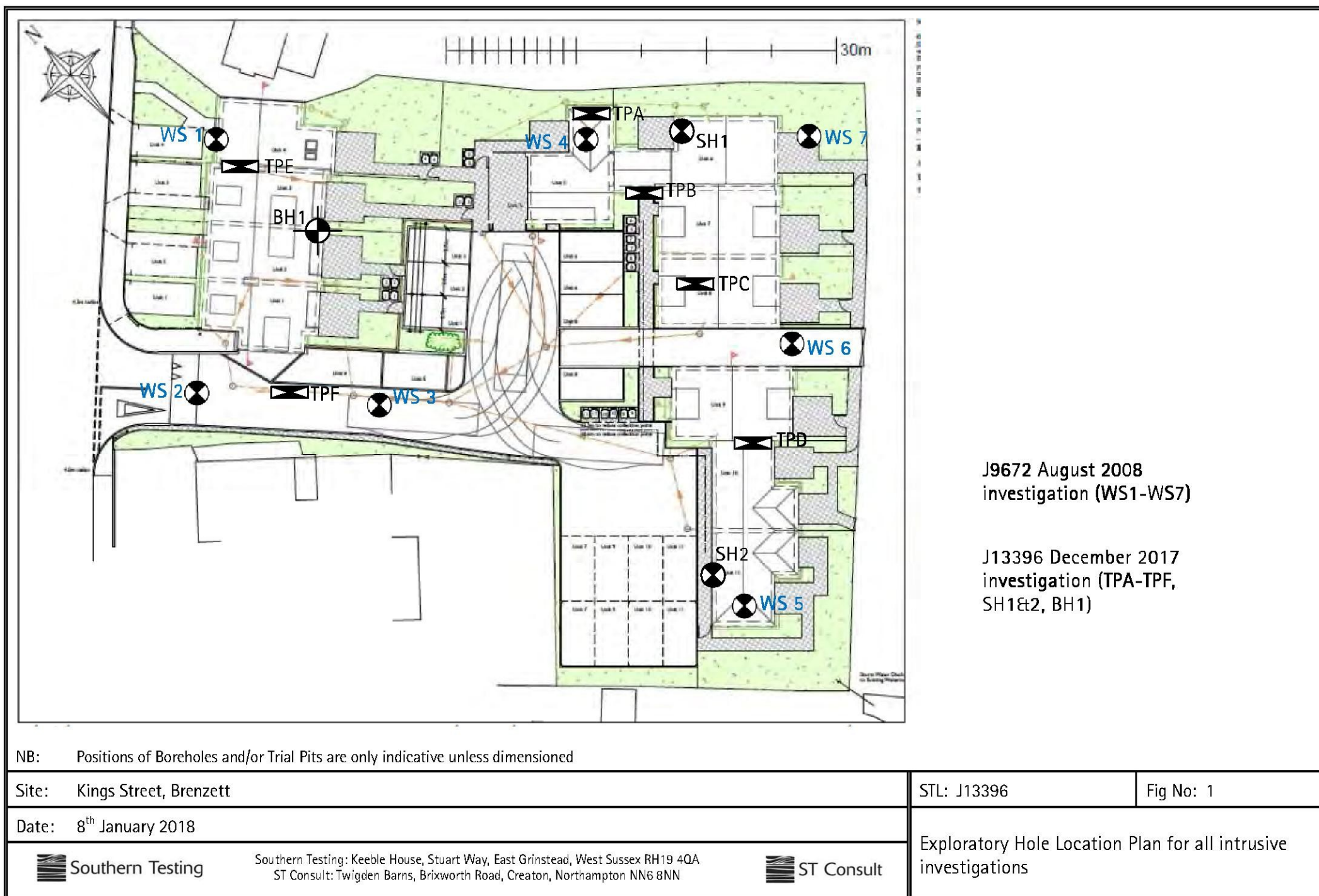
All hazardous and non-hazardous soils leaving site will need to be pre-treated. Waste minimisation by selective excavation is a recognised form of pre-treatment.

It should be noted that organic contaminants present in the soils could affect plastic underground service pipes (such as the types used by water and gas supply companies). Guidance should be sought from the relevant companies regarding any proposed plant in the affected area.

Many water supply companies now require higher specification pipe on contaminated sites, even following remediation.

APPENDIX A

Site Plans and Exploratory Hole Logs



Key to Exploratory Hole Logs

General

All soil & rock descriptions in general accordance with BS5930, BS EN ISO 14688 and BS EN ISO 14689
The Geology Code is only provided where positive identification of the sampled strata has been made.

Sampling

ES	Environmental Sample (taken in appropriate sampling container)
D	Disturbed Sample
B	Bulk Sample
LB	Large Bulk for Earthworks testing
C	Core Sample
U	Undisturbed Sample (number of blows indicated in results column)
SPTLS	SPT Liner Sampler
P	Piston Sample
W	Water Sample

In situ Tests

SPT	Standard Penetration Test in accordance with BS EN ISO 22476-3
SPT (C)	Cone Penetration Test in accordance with BS EN ISO 22476-3
PT	Penetration Test – STL documented equivalent SPT N Value
PPT	Perth Penetration Test – STL in house documented method (N Value)
UCS ()	Unconfined Compressive Strength measure by hand penetrometer (kN/m ²)
IVN	Hand Vane (kPa)
PID	Photo Ionisation Detector Results (ppm)
MEXE	Mexecone CBR Result

Drilling Records

Depth to standing water level	
Depth to water strike	
TCR	Total Core Recovery (%)
SCR	Solid Core Recovery (%)
RQD	Rock Quality Index (%)
FI	Fracture Index

Backfill Symbols

Arisings	
Concrete	
Blacktop	
Bentonite Seal	
Gravel Filter	
Sand Filter	

Pipe Symbols

Plain Pipe	
Slotted Pipe	
Filter Tip	

Principal Soil Types

Topsoil	
Made Ground	
Clay	
Silt	
Sand	
Gravel	
Peat	

Principal Rock Types

Mudstone/Claystone	
Siltstone	
Sandstone	
Limestone	
Chalk	

Project Name: Brenzett

Remarks:
Co-ordinates:
Level:
Logger:

PS

Location: Former Coach Depot, King Street,
Brenzett, TN29 9UD

Client: Donforni Ltd

Well	Water Strikes	Samples and Insitu Testing			Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description	
		Depth (m bgl)	Type	Results						
		0.50	HP	UCS(kPa)=140		{1.00}			Firm, dark brown to light brown mottled grey-orange slightly silty gravelly CLAY. Gravel is fine to medium sub angular brick, flint and black top (MADE GROUND).	
		1.00	HP	UCS(kPa)=120		{1.00}		1.00	Firm, light brown to dark brown mottled orange slightly silty, slightly gravelly CLAY. Gravel is fine brick fragments with brown organic staining (old roots).	1
		1.00	SPT(S)	N=6 {1,1/1,1,2,2}						
		2.00	HP	UCS(kPa)=100		{1.00}		2.00	Soft to firm dark grey/ green CLAY with rare fine brick fragments (POSSIBLE MADE GROUND).	2
		3.00	HP	UCS(kPa)=120				3.00	Soft, very dark brown/ dark red fibrous PEAT with wood fragments (organic odour).	3
		3.80	SPT(S)	N=0 {1,0/0,0,0,0}		{1.40}				4
								4.40	Very soft, blue,/ pale grey, very silty CLAY/ clayey SILT with rare roots.	5
		6.00	SPT(S)	N=9 {1,0/1,2,2,4}		{2.60}			With thin fibrous peat bands from 6m to 7m.	6
								7.00	Loose, grey clayey silty fine SAND with thin fibrous peat bands.	7
		7.50	SPT(S)	N=8 {2,2/2,2,2,2}		{0.50}		7.50	Loose, dark grey banded light grey slightly silty SAND. Sand is fine.	8
		9.00	SPT(S)	N=9 {1,0/1,2,3,3}		{2.50}			Becoming less silty at 9m	9
								10.00		10

Continued on next sheet.

Hole Details		Casing Details		Waterstrike (m bgl)						Standing/Chiselling (m bgl)			
Depth (m bgl)	Dia. (mm)	Depth (m bgl)	Dia. (mm)	Date	Depth Strike	Depth Casing	Depth Sealed	Rose to:	Time (mins)	From	To	Time	Remarks
25.00	150			28-11-2017	3.50	3.50		2.40	0 20				

Project Name: Brenzett

Remarks:
Co-ordinates:
Level:
Logger:

PS

Location: Former Coach Depot, King Street,
Brenzett, TN29 9UD

Client: Donforni Ltd

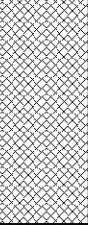
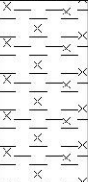
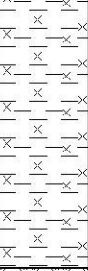
Well	Water Strikes	Samples and Insitu Testing			Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description	
		Depth (m bgl)	Type	Results						
		10.50	SPT(S)	N=14 (2,2/2,3,4,5)					Medium dense, dark grey banded light grey, slightly silty SAND. Sand is fine.	11
		12.00	SPT(S)	N=17 (1,2/3,3,4,7)		(4.00)				12
		13.80	SPT(S)	N=6 (2,2/2,3,0,1)						13
		15.00	SPT(S)	N=2 (1,0/1,0,0,1)		(3.50)		14.00	Very loose, light grey, slightly sandy clayey SILT	14
		16.50	SPT(S)	N=2 (1,0/0,1,1,0)					<i>Becoming more clayey with depth between from 14.5m</i>	15
		18.00	SPT(S)	N=1 (1,0/0,1,0,0)		(1.50)		17.50	Very loose, dark grey, silty clayey SAND. Sand is fine.	17
		19.50	SPT(S)	N=2 (1,0/1,0,1,0)				19.00	Soft to becoming very stiff, pale grey mottled orange brown, slightly sandy CLAY.	18
										19
										20

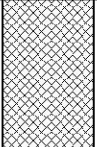
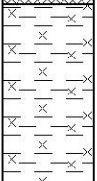
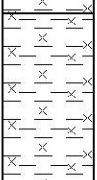
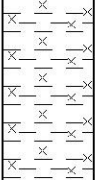
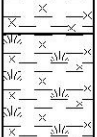
Continued on next sheet.

Hole Details		Casing Details		Waterstrike (m bgl)						Standing/Chiselling (m bgl)			
Depth (m bgl)	Dia. (mm)	Depth (m bgl)	Dia. (mm)	Date	Depth Strike	Depth Casing	Depth Sealed	Rose to:	Time (mins)	From	To	Time	Remarks
25.00	150			28-11-2017	3.50	3.50		2.40	0 20				

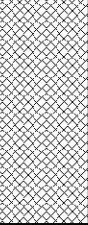
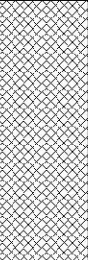
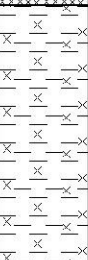
						Start - End Date 28/11/2017 - 29/11/2017		Project ID: J13396		Hole Type: CP		BH1 Sheet 3 of 3	
Project Name: Brenzett						Remarks:		Co-ordinates:		Level:		Logger: PS	
Location: Former Coach Depot, King Street, Brenzett, TN29 9UD													
Client: Donforni Ltd													
Well	Water Strikes	Samples and Insitu Testing			Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description				
		Depth (m bgl)	Type	Results									
		21.00	SPT(S)	N=30 {2,4/5,8,8,9}				Soft to becoming very stiff, pale grey mottled orange brown, slightly sandy CLAY.	21				
		22.50	SPT(S)	N=30 {5,5/8,7,7,8}			{6.00}		22				
		23.50	HP	UCS(kPa)=220			23						
		24.00 24.00	HP SPT(S)	UCS(kPa)=300 N=50 {6,9/12,13,11,14}			24						
		25.00	HP	UCS(kPa)=350			25						
							25.00	End of borehole at 25.00m	25				
									26				
									27				
									28				
									29				
									30				

Hole Details		Casing Details		Waterstrike (m bgl)						Standing/Chiselling (m bgl)			
Depth (m bgl)	Dia. (mm)	Depth (m bgl)	Dia. (mm)	Date	Depth Strike	Depth Casing	Depth Sealed	Rose to:	Time (mins)	From	To	Time	Remarks
25.00	150			28-11-2017	3.50	3.50		2.40	0 20				

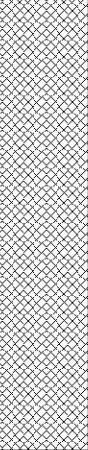
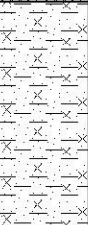
 Southern Testing ST Consult				Start - End Date: 28/11/2017		Project ID: J13396		Machine Type:		TPA Sheet 1 of 1	
www.southerntesting.co.uk tel:01342 333100 www.stconsult.co.uk tel:01604 500020											
Project Name: Brenzett				Remarks:		Co-ordinates:		Level (m AOD):		Logger: PJS	
Location: Former Coach Depot, King Street, Brenzett, TN29 9UD											
Client: Donforni Ltd											
Samples and Insitu Testing			Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description				
Depth (m)	Type	Results									
0.60		CBR=1%		(0.60)		0.60	Loose, black/dark grey slightly clayey SILT, with occasional brick and fine to coarse rounded flint gravel. MADE GROUND		1		
0.80	HP	UCS(kPa)=450		(0.50)		0.60	Stiff to very stiff, dark yellow orange brown, silty CLAY.				
1.00	HP	UCS(kPa)=350				1.10	Firm becoming very soft, blue grey mottled dark orange brown, slightly fissured slightly silty CLAY.		2		
1.20	HP	UCS(kPa)=150									
1.40	HP	UCS(kPa)=100							3		
1.60	HP	UCS(kPa)=100		(1.10)		2.20	Black brown, fibrous PEAT.				
1.80	HP	UCS(kPa)=70				2.30	Pit terminated at 2.30m.		4		
2.00	HP	UCS(kPa)=50		(0.10)							
Pit Dimension (m)			Pit Stability:				Water Strikes:				
Width:			Unstable				Slight seepage at 1.3m. Rapid seepage at 2.1m. SWL at 2.2m after 15 mins.				
Length:											
Depth:	2.30										

				Start - End Date: 28/11/2017		Project ID: J13396		Machine Type:		TPB Sheet 1 of 1	
Project Name: Brenzett				Remarks:		Co-ordinates:		Level (m AOD):		Logger: PJS	
Location: Former Coach Depot, King Street, Brenzett, TN29 9UD											
Client: Donforni Ltd											
Samples and Insitu Testing			Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description				
Depth (m)	Type	Results									
0.50 0.50	HP	UCS(kPa)=220 CBR=3%		(0.40)		0.40	Loose, pale brown and pale yellow, fine sandy SILT with abundant brick and flint gravels. MADE GROUND		1		
				(0.50)			Stiff, pale brown mottled dark orange, silty CLAY.				
1.00	HP	UCS(kPa)=110		(1.00)		0.90	Soft to firm, pale grey, silty CLAY with black staining.		2		
1.50	HP	UCS(kPa)=70				1.90	Very soft, pale grey, silty organic CLAY.				
2.00	HP	UCS(kPa)=40		(0.30)		2.20	Black brown, fibrous peat.		3		
				(0.10)		2.30	Pit terminated at 2.30m.				
									4		
Pit Dimension (m)			Pit Stability:				Water Strikes:				
Width:			Unstable. Some spalling of Made Ground.				Seepage at 2.2m.				
Length:											
Depth:	2.30										

 Southern Testing ST Consult				Start - End Date: 28/11/2017		Project ID: J13396		Machine Type:		TPC Sheet 1 of 1	
Project Name: Brenzett				Remarks:		Co-ordinates:		Level (m AOD):		Logger: PJS	
Location: Former Coach Depot, King Street, Brenzett, TN29 9UD											
Client: Donforni Ltd											

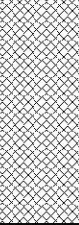
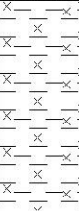
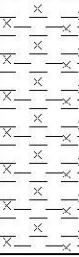
Samples and Insitu Testing			Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description	
Depth (m)	Type	Results						
1.40	HP	UCS(kPa)=110		(0.60)		0.60	Loose, pale grey, crushed brick and concrete in a silty fine to coarse SAND matrix. MADE GROUND	1
				(0.70)			Loose, red brown, crushed brick and fine to coarse flint GRAVEL with abundant glass, bottles and ceramics. MADE GROUND	
				(0.70)		1.30	Firm, pale grey mottled blue grey, silty CLAY with black stained fissures.	2
							Hydrocarbon odour	
				(0.20)		2.00	Black fibrous PEAT (moist).	
		2.20	Pit terminated at 2.20m.		3			
								4

Pit Dimension (m)		Pit Stability:		Water Strikes:	
Width:		Unstable.		Seepage at 2.0m.	
Length:					
Depth:	2.20				

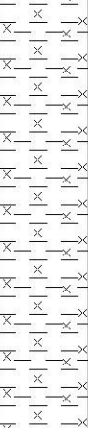
 Southern Testing ST Consult				Start - End Date: 28/11/2017		Project ID: J13396		Machine Type:		TPD Sheet 1 of 1	
Project Name: Brenzett				Remarks:		Co-ordinates:		Level (m AOD):		Logger: PJS	
Location: Former Coach Depot, King Street, Brenzett, TN29 9UD											
Client: Donforni Ltd											
Samples and Insitu Testing			Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description				
Depth (m)	Type	Results									
1.40	HP	UCS(kPa)=70		(1.20)		1.20	Loose, whole breeze and concrete blocks in a crushed concrete SILT matrix with occasional flint gravel. MADE GROUND		1 2 3 4		
1.70	HP	UCS(kPa)=30		(0.60)		1.80	Soft, creamy grey, slightly silty fine sandy CLAY with rare orange brown mottling.				
				(0.40)		2.20	Black/brown, fibrous PEAT.				
							Pit terminated at 2.20m.				
Pit Dimension (m)			Pit Stability:				Water Strikes:				
Width:			Unstable. Some spalling in Made Ground.				Slight seepage at 2.0m.				
Length:											
Depth:		2.20									

Logger:

Donforni Ltd

Samples and Insitu Testing			Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description	
Depth (m)	Type	Results						
0.60	HP	CBR=1%		(0.60)		0.60	Loose, orange brown, rounded fine to medium flint shingle in a black sandy SILT matrix. MADE GROUND	1 2 3 4
0.80		UCS(kPa)=120			Firm, blue/grey, slightly silty CLAY. Tightly fissured.			
1.20		HP		UCS(kPa)=110		Some orange brown mottling from 1.2m.		
1.50	HP	UCS(kPa)=90			2.00	Pit terminated at 2.00m.		
2.00	HP	UCS(kPa)=90						
								
								

2.00

 Southern Testing ST Consult				Start - End Date: 28/11/2017		Project ID: J13396		Machine Type:		TPF Sheet 1 of 1	
Project Name: Brenzett				Remarks:		Co-ordinates:		Level (m AOD):		Logger: PJS	
Location: Former Coach Depot, King Street, Brenzett, TN29 9UD											
Client: Donforni Ltd											
Samples and Insitu Testing			Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description				
Depth (m)	Type	Results									
0.60		CBR=1%		(0.15)		0.15	Loose, pale yellow grey, slightly silty SAND with fine rounded flint gravel.		1		
				(1.15)			Soft to Firm, light brown mottled dark brown, slightly silty CLAY. Tightly fissured with occasional dark orange staining along fissures.				
1.00	HP	UCS(kPa)=100									
1.20	HP	UCS(kPa)=100									
				(0.20)		1.30	Soft, pale brown mottled dark orange brown, fine sandy CLAY with occasional black iron stained speckles.		2		
1.50	HP	UCS(kPa)=50				1.50	Pit terminated at 1.50m.				
									3		
									4		
Pit Dimension (m)			Pit Stability:				Water Strikes:				
Width:			Unstable.				Slow seepage at 1.2m. Ponding at base.				
Length:											
Depth:		1.50									

APPENDIX B

Field Sampling and in-situ Test Methods & Results

Field Sampling and in-situ Test Methods

Disturbed Samples

Disturbed samples were taken from the trial holes at intervals and stored in sealed glass jars and polythene bags, as appropriate.

Undisturbed U100 Samples

Undisturbed U100 samples were taken in the clay soils at appropriate intervals. These samples are taken in a 100 mm diameter, 450 mm long, thin-walled steel tube, and are sealed with paraffin wax and tightly fitting end caps for transporting to the laboratory.

Standard Penetration Test

The Standard Penetration (SPT) Test is specified in BS EN ISO 22476-3:2005+A1:2011. In this test, a 51mm diameter open-ended tube is driven into the ground by a 63.5 kg hammer falling freely through 760 mm. The tube is seated by driving to a penetration of 150mm, or by 25 standard blows, whichever occurs first. It is then driven for a maximum of a further 300mm and the number of blows is termed the penetration resistance (N). If 300mm penetration cannot be achieved in 50 blows (100 blows in soft rock), the test drive is terminated.

When testing in gravels, a conical end piece is attached to the tube. The test is then called an SPT(C).

This test provides an indirect method of assessing the properties of cohesionless soils, and the following table (after Terzaghi and Peck) gives the approximate condition:-

Number Blows (N)	Density
0 – 4	Very Loose
4 – 10	Loose
10 – 30	Medium Dense
30 – 50	Dense
Over 50	Very Dense

Clay

An approximate value for the shear strength of clay may be obtained using Stroud (1974), which paper indicates that the cohesive strength is a function of plasticity and SPT 'N' value. The relation is:

$$C_u = f_i \times N \text{ kPa}$$

$$C_u = \text{undrained shear strength}$$

$$f_i = \text{factor related to plasticity index and ranging from 4 to more than 6}$$

The SPT test is not generally accepted as giving a reliable indication of the strength of cohesive soils but it does give a guide; often the following table:-

Number Blows (N)	Soil Strength
Less than 2	Very Soft (Very Low Strength)
2 – 5	Soft (Low Strength)
5 – 10	Firm (Medium Strength)
10 – 15	Stiff (High Strength)
15 – 30	Very Stiff (Very High Strength)

Perth Penetrometer Test

Perth Penetrometer tests were carried out. The Perth Penetrometer is a device used for measuring the relative density of sands. It consists of a 16 mm diameter hardened steel probe, which is driven into the soil by successive blows of a 9 kg weight, which freely falls over a distance of 600 mm. The number of blows required for each 50 mm of penetration is recorded, and the test is continued for a depth of 450 mm, according to soil type. Useful information can be obtained by carrying the test past the standard depth, and 2,000 mm and 3,000 mm extensions are used to probe the depth of loose fill or other soil, or to make an estimate of the strength of soils or rock in an auger hole or in the base of an unsupported test pit.

The energy input per square metre is roughly the same as the energy input from the Standard Penetration Test (SPT), and the blow counts recorded in sand are roughly the same as SPT blow counts (but this relationship does not hold for coarse soils). The SPT test is a similar type of test except that much heavier driving weights (63.5 kg) are used. The relative density relationship given for the SPT test is:

Number of Blows (N)	Density
0 – 4	Very Loose
4 – 10	Loose
10 – 30	Medium Dense
30 – 50	Dense
Over 50	Very Dense

APPENDIX C

Geotechnical Laboratory Results

Atterberg and Moisture Content Summary

BS1377-2 cl.3.2, 3.3, 4.2, 4.3 & BS EN ISO 17892-1

Project Name		King Street, Brenzett					Project Number		J13396	
Client		Donforni Ltd				PE	PJS	Date Issued		15-Dec-17
Location	Depth m	Sample Type	Visual Description	Comments	Natural MC %	Liquid Limit %	Plastic Limit %	Plasticity Index	Classi- fication	Passing 425 micron %
BH1	2.00	D	Firm grey patched brown slightly organic CLAY.		39	72	24	48	CVO	100
BH1	5.50	D	Very soft blue grey sandy SILT.		58	51	29	22	MH	100
TPD	1.70	D	Firm grey sandy organic CLAY.		33	44	24	20	CIO	100
TPE	1.20	D	Soft dark grey slightly sandy organic CLAY.		37	66	31	35	CHO	100

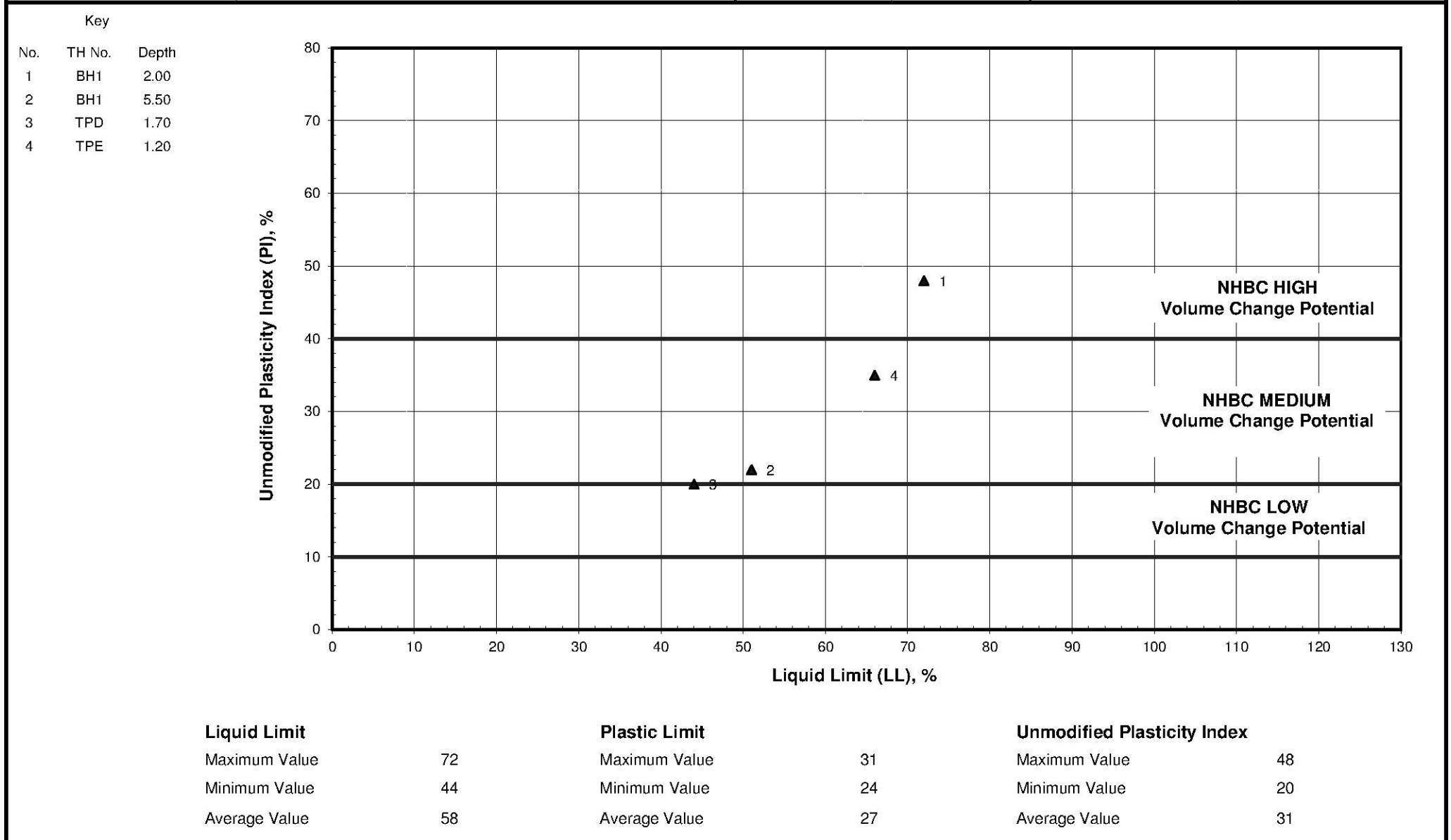
Southern Testing Laboratories Limited, East Grinstead is registered under BS EN ISO 9001:2008 BSI ref: FS29280

Jun 13

NHBC Classification for Volume Change Potential



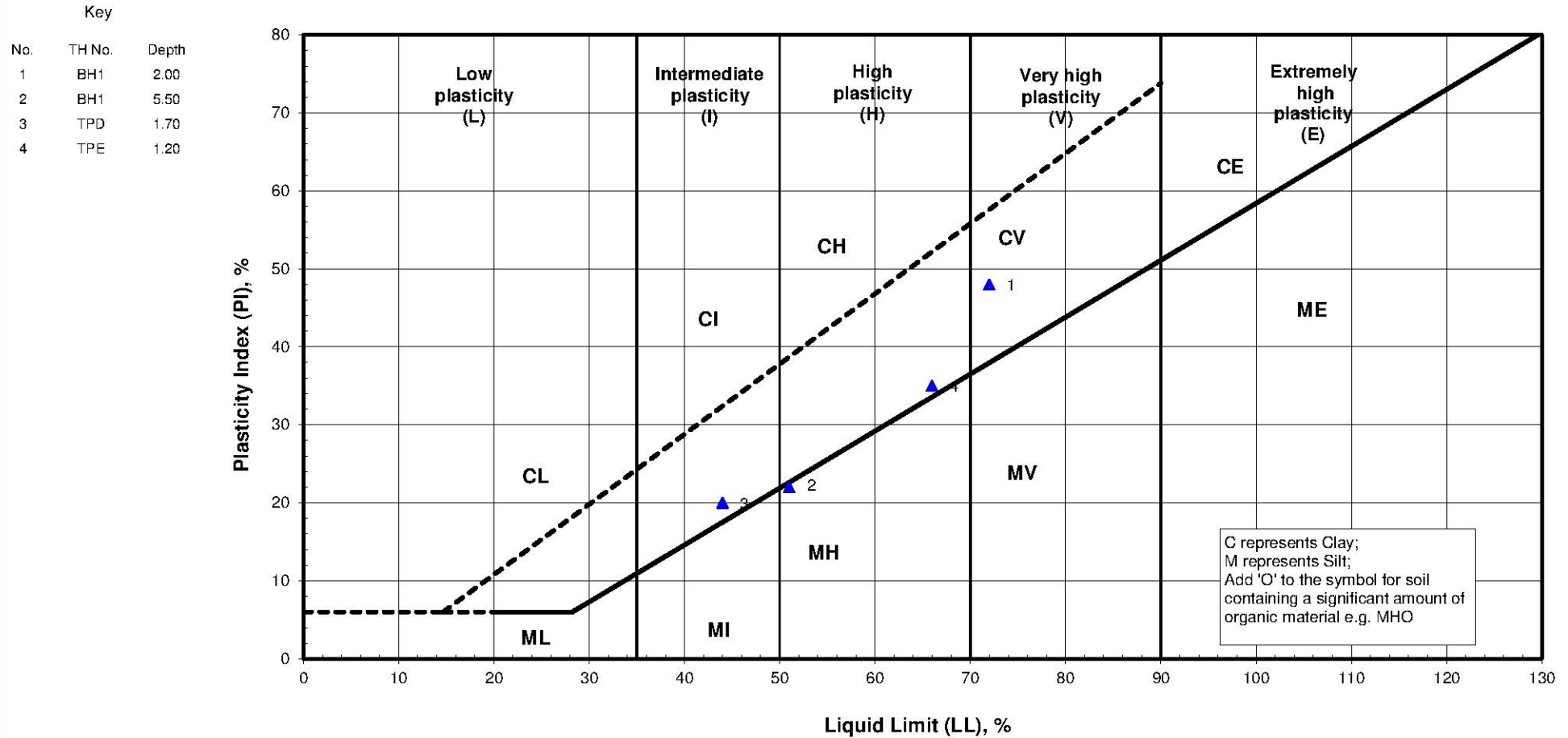
Project Name	King Street, Brenzett			Project Number	J13396
Client Name	Donforni Ltd	PE	PJS	Date Issued	15-Dec-17



Plasticity Chart for Atterberg Limit Tests



Project Name	King Street, Brenzett			Project Number	J13396
Client Name	Donforni Ltd	PE	PJS	Date Issued	15-Dec-17



Liquid Limit		Plastic Limit		Plasticity Index	
Maximum Value	72	Maximum Value	31	Maximum Value	48
Minimum Value	44	Minimum Value	24	Minimum Value	20
Average Value	58	Average Value	27	Average Value	31

 Southern Testing ST Consult  IMMEDIATE UNDRAINED TRIAXIAL SUMMARY To BS1377-7 											
Project Name			<i>King Street, Brenzett</i>					Project Number		<i>J13396</i>	
Client			<i>Donforni Ltd</i>			PE	<i>PJS</i>	Date Issued		<i>15-Dec-17</i>	
Location	Depth (m)	Sample Type	Visual Description	Comments	Test Type	UCS by Hand Pen. (KPa)	NMC (%)	Cell Press. (KPa)	Deviator Stress (KPa)	Apparent Cohesion C _u (KPa)	Bulk Density (Mg/m ³)
BH1	2.50	U	<i>Soft black pseudotibrous PEAT.</i>		<i>Single Stage</i>	<i>80</i>	<i>371.2</i>	<i>50</i>	<i>93</i>	<i>47</i>	<i>1.04</i>

Southern Testing Laboratories Limited, East Grinstead is registered under BS EN ISO 9001:2008 BSI ref: FS29280

CHEMICAL & ELECTROCHEMICAL TESTING SUMMARY

To BS1377-3 cl 5.6 & 9.5

Project Name		King Street, Brenzett					Project Number		J13396	
Client		Donforni Ltd				PE	PJS	Date Issued		15-Dec-17
TH No.	Depth m	Sample Type	Visual Description	Comments	Passing 2mm %	pH Value	Soil Sulphate 2:1 Water Extract		Groundwater Sulphate	
							g/l SO ₃	BRE mg/l SO ₄	g/l SO ₃	BRE mg/l SO ₄
BH1	2.00	D	Firm grey patched brown slightly organic CLAY.		100	8.1	0.10	115		
BH1	5.50	D	Very soft blue grey sandy SILT.		100	8.4	0.27	326		
BH1	7.00	D	Dark grey clayey/silty fine SAND.		100	8.5	0.22	269		

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The samples above may have been crushed to pass a 2mm sieve.

Jun 13

Page: 1

APPENDIX D

Contamination Laboratory Test Results

Table 1 – Tier 1 Screening Values

Contaminant	Units	Proposed Land Use					
		Residential with home-grown produce consumption	Residential without home-grown produce consumption	Open Space* (Residential)	Open Space* (Park)	Allotments	Commercial / Industrial
Arsenic (As) [2]	mg/kg	37	40	79	170	43	640
Cadmium (Cd) [2]	mg/kg	11	85	120	555	1.9	190
Trivalent Chromium (CrIII) [2]	mg/kg	910	910	1,500	33,000	18,000	8600
Hexavalent Chromium (CrVI) [2]	mg/kg	6	6	7.7	220	1.8	33
Lead (Pb) [3]	mg/kg	200	310	630	1300	80	2330
Mercury (Hg) [1,2,7]	mg/kg	7.6-11	9.2-15	40	68-71	6.0	29-320
Selenium (Se) [2]	mg/kg	250	430	1,100	1,800	88	12,000
Nickel (Ni) [2,4]	mg/kg	130	180	230	800	53	980
Copper (Cu) [2,4]	mg/kg	2,400	7,100	12,000	44,000	520	68,000
Zinc (Zn) [2,4]	mg/kg	3,700	40,000	81,000	170,000	620	730,000
Phenol [1,2]	mg/kg	120-380	440-1200	440-1300	440-1300	23-83	440-1300
Benzo[a]pyrene [1,5]	mg/kg	1.7-2.4	2.6	4.9	10	0.67-2.7	36
Naphthalene [1,2]	mg/kg	2.3-13	2.3-13	77-430 ⁺	77-430 ⁺	4.1-24	77-430 ⁺
Total Cyanide (CN) [6]	mg/kg	/	/	/	/	/	/
Free Cyanide [6]	mg/kg	/	/	/	/	/	/
Complex Cyanides [6]	mg/kg	/	/	/	/	/	/
Thiocyanate [6]	mg/kg	/	/	/	/	/	/

Notes:

* Open Space levels calculated on the basis of the exposure modelling developed in the C4SL research.

+ Screening values constrained to saturation limit. Higher values may be acceptable on a site specific basis.

[1] Where ranges of values are given for organic contaminants the screening value is dependant on the Soil Organic Matter.

[2] LQM/CIEH S4UL (2014). Copyright Land Quality Management Ltd reproduced with permission; Publication Number S4UL 3116. All rights reserved.

[3] C4SL (DEFRA 2014).

[4] Copper, Zinc and Nickel may have phototoxic effects at the given concentrations. Alternative criteria should be adopted for importation of Topsoil or other soils for cultivation. BS3882:2015 and BS8601:2013 suggest values of 200 to 300mg/kg for Zn, 100 to 200mg/kg for Cu, and 60 to 110mg/kg for Ni, for topsoil and subsoil, depending on pH.

[5] Based on the Surrogate Marker approach and modelled using the modified exposure parameters of C4SL but retaining 'minimal risk' HCV.

[6] Screening criteria derived on a site specific basis if test results indicate.

[7] S4UL for Methyl Mercury, higher concentrations may be tolerable if inorganic mercury is the only species present. Lower concentrations apply for elemental Mercury.

These screening values are valid at the time of writing but may be subject to change and any such changes will have implications for the assessments based on them. Their validity should be confirmed at the time of site development.

Concept Life Sciences

Certificate of Analysis

3 Crittall Drive
Springwood Industrial
Estate
Braintree
Essex
CM7 2RT
Tel : 01376 560120
Fax : 01376 552923

Report Number: 700425-1

Date of Report: 06-Dec-2017

Customer: Southern Testing Laboratories
Keeble House
Stuart Way
East Grinstead
West Sussex
RH19 4QA

Customer Contact: Mr Peter Sugden

Customer Job Reference: J13396

Customer Purchase Order: J13396_1 Peter

Customer Site Reference: King Street, Brenzett

Date Job Received at Concept: 30-Nov-2017

Date Analysis Started: 01-Dec-2017

Date Analysis Completed: 06-Dec-2017

The results reported relate to samples received in the laboratory and may not be representative of a whole batch.

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation

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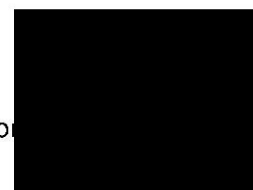
Tests covered by this certificate were conducted in accordance with Concept Life Sciences SOPs

All results have been reviewed in accordance with Section 25 of the Concept Life Sciences, Analytical Services Quality Manual



Report checked
and authorised by :
Christopher Payne
Customer Service Advisor

Issued by :
Christopher Payne
Customer Service Advisor



Customer Reference: J13396

Concept Reference					700425 002	700425 003	700425 005	700425 008	700425 009
Customer Sample Reference					TPA @ 0.20m	TPA @ 0.70m	TPB @ 0.20m	TPC @ 1.80m	TPD @ 0.50m
Date Sampled					28-NOV-2017	28-NOV-2017	28-NOV-2017	28-NOV-2017	28-NOV-2017
Matrix Class					Topsoil	Clay	Sandy Soil	Clay	Clay
Determinand	Method	Test Sample	LOD	Units					
Arsenic	T257	A40	2	mg/kg	24	29	17	8	19
Cadmium	T257	A40	0.1	mg/kg	0.8	0.3	0.4	0.3	0.5
Chromium	T257	A40	0.5	mg/kg	22	25	20	22	23
Copper	T257	A40	2	mg/kg	66	15	56	22	25
Lead	T257	A40	2	mg/kg	690	54	710	120	98
Mercury	T245	A40	1.0	mg/kg	<1.0	<1.0	1.3	<1.0	<1.0
Nickel	T257	A40	0.5	mg/kg	24	23	18	21	17
Selenium	T257	A40	3	mg/kg	<3	<3	<3	<3	<3
Zinc	T257	A40	2	mg/kg	340	67	260	220	420
Asbestos ID	T27	A40			Chrysotile Fibres Detected	Asbestos not detected	Chrysotile Fibres Detected	Asbestos not detected	Chrysotile Fibres Detected
Chromium VI	T6	A40	1	mg/kg	<1	<1	<1	<1	<1
Fraction Organic Carbon - F(oc)	T917	A40	0.001		0.048	0.008	0.057	0.006	0.013
pH	T7	A40			10.9	8.2	9.7	8.2	8.4
Soil Organic Matter	T287	A40	0.1	%	8.3	1.4	9.8	1.0	2.2
(Water Soluble) SO4-- expressed as SO4	T242	A40	0.01	g/l	0.14	0.07	0.19	0.08	0.05
Sulphide	T4	A40	10	mg/kg	21	<10	<10	<10	<10
Cyanide(Total)	T921	AR	1	mg/kg	<1	<1	<1	<1	<1
Phenols(Mono)	T921	AR	1	mg/kg	<1	<1	<1	<1	<1

Customer Reference: J13396

Concept Reference					700425 011	700425 012	700425 013
Customer Sample Reference					TPE @ 0.10m	TPF @ 0.10m	WLS4 @ 1.00m
Date Sampled					28-NOV-2017	28-NOV-2017	28-NOV-2017
Matrix Class					Clay	Clay	Clay
Determinand	Method	Test Sample	LOD	Units			
Arsenic	T257	A40	2	mg/kg	19	17	23
Cadmium	T257	A40	0.1	mg/kg	0.2	0.1	0.2
Chromium	T257	A40	0.5	mg/kg	17	22	29
Copper	T257	A40	2	mg/kg	350	20	25
Lead	T257	A40	2	mg/kg	2300	120	150
Mercury	T245	A40	1.0	mg/kg	5.4	<1.0	<1.0
Nickel	T257	A40	0.5	mg/kg	17	15	23
Selenium	T257	A40	3	mg/kg	<3	<3	<3
Zinc	T257	A40	2	mg/kg	140	94	110
Asbestos ID	T27	A40			Asbestos not detected	Asbestos not detected	Asbestos not detected
Chromium VI	T6	A40	1	mg/kg	<1	<1	<1
Fraction Organic Carbon - F(oc)	T917	A40	0.001		0.038	0.015	0.013
pH	T7	A40			8.0	8.1	8.1
Soil Organic Matter	T287	A40	0.1	%	6.6	2.6	2.2
(Water Soluble) SO4-- expressed as SO4	T242	A40	0.01	g/l	0.12	0.06	0.04
Sulphide	T4	A40	10	mg/kg	<10	<10	<10
Cyanide(Total)	T921	AR	1	mg/kg	<1	<1	<1
Phenols(Mono)	T921	AR	1	mg/kg	<1	<1	<1

Concept Reference: 700425									
Project Site: King Street, Brenzett									
Customer Reference: J13396									
Soil Analysed as Soil									
Total and Speciated USEPA16 PAH (SE) (MCERTS)									
Concept Reference					700425 002	700425 003	700425 005	700425 008	700425 009
Customer Sample Reference					TPA @ 0.20m	TPA @ 0.70m	TPB @ 0.20m	TPC @ 1.80m	TPD @ 0.50m
Date Sampled					28-NOV-2017	28-NOV-2017	28-NOV-2017	28-NOV-2017	28-NOV-2017
Matrix Class					Topsoil	Clay	Sandy Soil	Clay	Clay
Determinand	Method	Test Sample	LOD	Units					
Naphthalene	T16	AR	0.1	mg/kg	(2) <0.3	<0.1	(2) <0.3	<0.1	<0.1
Acenaphthylene	T16	AR	0.1	mg/kg	(2) <0.3	<0.1	(2) <0.3	<0.1	<0.1
Acenaphthene	T16	AR	0.1	mg/kg	(2) <0.3	<0.1	6.8	<0.1	<0.1
Fluorene	T16	AR	0.1	mg/kg	(2) <0.3	<0.1	5.6	<0.1	<0.1
Phenanthrene	T16	AR	0.1	mg/kg	15	<0.1	56	<0.1	0.2
Anthracene	T16	AR	0.1	mg/kg	(2) <0.3	<0.1	19	<0.1	<0.1
Fluoranthene	T16	AR	0.1	mg/kg	21	0.2	120	0.1	0.4
Pyrene	T16	AR	0.1	mg/kg	16	0.1	100	0.1	0.4
Benzo(a)Anthracene	T16	AR	0.1	mg/kg	7.1	<0.1	58	<0.1	0.2
Chrysene	T16	AR	0.1	mg/kg	8.6	<0.1	51	<0.1	0.2
Benzo(b)fluoranthene	T16	AR	0.1	mg/kg	7.5	<0.1	63	<0.1	0.2
Benzo(k)fluoranthene	T16	AR	0.1	mg/kg	5.8	<0.1	45	<0.1	0.2
Benzo(a)Pyrene	T16	AR	0.1	mg/kg	6.9	<0.1	72	<0.1	0.2
Indeno(123-cd)Pyrene	T16	AR	0.1	mg/kg	3.5	<0.1	31	<0.1	0.1
Dibenzo(ah)Anthracene	T16	AR	0.1	mg/kg	(2) <0.3	<0.1	14	<0.1	<0.1
Benzo(ghi)Perylene	T16	AR	0.1	mg/kg	4.2	<0.1	34	<0.1	0.2
PAH(total)	T16	AR	0.1	mg/kg	95	0.3	670	0.3	2.3

Concept Reference: 700425 Project Site: King Street, Brenzett Customer Reference: J13396							
Soil		Analysed as Soil					
Total and Speciated USEPA16 PAH (SE) (MCERTS)							
Concept Reference					700425 011	700425 012	700425 013
Customer Sample Reference					TPE @ 0.10m	TPF @ 0.10m	WLS4 @ 1.00m
Date Sampled					28-NOV-2017	28-NOV-2017	28-NOV-2017
Matrix Class					Clay	Clay	Clay
Determinand	Method	Test Sample	LOD	Units			
Naphthalene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1
Acenaphthylene	T16	AR	0.1	mg/kg	0.1	<0.1	<0.1
Acenaphthene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1
Fluorene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1
Phenanthrene	T16	AR	0.1	mg/kg	1.7	0.3	0.2
Anthracene	T16	AR	0.1	mg/kg	0.2	<0.1	<0.1
Fluoranthene	T16	AR	0.1	mg/kg	2.1	1.2	0.5
Pyrene	T16	AR	0.1	mg/kg	1.7	1.0	0.4
Benzo(a)Anthracene	T16	AR	0.1	mg/kg	0.9	0.5	0.2
Chrysene	T16	AR	0.1	mg/kg	0.8	0.5	0.2
Benzo(b)fluoranthene	T16	AR	0.1	mg/kg	0.9	0.7	0.3
Benzo(k)fluoranthene	T16	AR	0.1	mg/kg	0.8	0.5	0.2
Benzo(a)Pyrene	T16	AR	0.1	mg/kg	0.9	0.6	0.3
Indeno(123-cd)Pyrene	T16	AR	0.1	mg/kg	0.4	0.3	0.1
Dibenzo(ah)Anthracene	T16	AR	0.1	mg/kg	0.2	0.2	<0.1
Benzo(ghi)Perylene	T16	AR	0.1	mg/kg	0.4	0.4	0.1
PAH(total)	T16	AR	0.1	mg/kg	11	6.3	2.6

Concept Reference: 700425										
Project Site: King Street, Brenzett										
Customer Reference: J13396										
Soil TPH										
Analysed as Soil										
Concept Reference				700425 001	700425 004	700425 006	700425 007	700425 008	700425 010	
Customer Sample Reference				SH1 @ 2.00m	TPA @ 1.50m	TPB @ 0.90m	TPB @ 1.50m	TPC @ 1.80m	TPD @ 1.40m	
Date Sampled				28-NOV-2017	28-NOV-2017	28-NOV-2017	28-NOV-2017	28-NOV-2017	28-NOV-2017	
Matrix Class				Clay	Clay	Clay	Clay	Clay	Clay	
Determinand	Method	Test Sample	LOD	Units						
TPH (C10-C40)	T219	AR	10	mg/kg	(13) 30	(13) 21	(13) 15	(13) 36	(13) 200	(13) <10

Concept Reference: 700425										
Project Site: King Street, Brenzett										
Customer Reference: J13396										
Soil										
Analysed as Soil										
Misc										
Concept Reference					700425 001	700425 002	700425 003	700425 004	700425 005	
Customer Sample Reference					SH1 @ 2.00m	TPA @ 0.20m	TPA @ 0.70m	TPA @ 1.50m	TPB @ 0.20m	
Date Sampled					28-NOV-2017	28-NOV-2017	28-NOV-2017	28-NOV-2017	28-NOV-2017	
Matrix Class					Clay	Topsoil	Clay	Clay	Sandy Soil	
Determinand		Method	Test Sample	LOD	Units					
Moisture @105C		T162	AR	0.1	%	33	17	27	28	13
Retained on 2mm		T2	A40	0.1	%	11.3	16.8	<0.1	<0.1	43.0

Concept Reference: 700425										
Project Site: King Street, Brenzett										
Customer Reference: J13396										
Soil										
Analysed as Soil										
Misc										
Concept Reference					700425 006	700425 007	700425 008	700425 009	700425 010	
Customer Sample Reference					TPB @ 0.90m	TPB @ 1.50m	TPC @ 1.80m	TPD @ 0.50m	TPD @ 1.40m	
Date Sampled					28-NOV-2017	28-NOV-2017	28-NOV-2017	28-NOV-2017	28-NOV-2017	
Matrix Class					Clay	Clay	Clay	Clay	Clay	
Determinand		Method	Test Sample	LOD	Units					
Moisture @105C		T162	AR	0.1	%	27	28	31	21	21
Retained on 2mm		T2	A40	0.1	%	10.4	7.5	<0.1	<0.1	<0.1

Concept Reference: 700425 Project Site: King Street, Brenzett Customer Reference: J13396										
Soil Analysed as Soil Misc										
Concept Reference		700425 011	700425 012	700425 013						
Customer Sample Reference		TPE @ 0.10m	TPF @ 0.10m	WLS4 @ 1.00m						
Date Sampled		28-NOV-2017	28-NOV-2017	28-NOV-2017						
Matrix Class		Clay	Clay	Clay						
Determinand	Method	Test Sample	LOD	Units						
Moisture @105C	T162	AR	0.1	%	13	22	26			
Retained on 2mm	T2	A40	0.1	%	21.6	0.3	<0.1			

Index to symbols used in 700425-1

Value	Description
A40	Assisted dried < 40C
AR	As Received
13	Results have been blank corrected.
2	LOD Raised Due to Matrix Interference

S	Analysis was subcontracted
M	Analysis is MCERTS accredited
U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited

Notes

Asbestos subcontracted to REC Limited
Retained on 2mm is removed before analysis
Reported results on as received samples are corrected to a 105 degree centigrade dry weight basis
013 These samples were received in containers that are inappropriate for this parameter of interest. It is possible therefore that the results provided may be compromised for PAH

Method Index

Value	Description
T242	2:1 Extraction/ICP/OES (TRL 447 T1)
T2	Grav
T4	Colorimetry
T257	ICP/OES (SIM) (Aqua Regia Extraction)
T16	GC/MS
T917	OX/IR (SE)
T27	PLM
T219	GC/FID (SE)
T7	Probe
T162	Grav (1 Dec) (105 C)
T245	ICP/OES (Aqua Regia Extraction)
T287	Calc TOC/0.58
T921	Colorimetry (CF) (MCERT)
T6	ICP/OES

Accreditation Summary

Determinand	Method	Test Sample	LOD	Units	Symbol	Concept References
Arsenic	T257	A40	2	mg/kg	M	002-003,005,008-009,011-013
Cadmium	T257	A40	0.1	mg/kg	M	002-003,005,008-009,011-013
Chromium	T257	A40	0.5	mg/kg	M	002-003,005,008-009,011-013
Copper	T257	A40	2	mg/kg	M	002-003,005,008-009,011-013
Lead	T257	A40	2	mg/kg	M	002-003,005,008-009,011-013
Mercury	T245	A40	1.0	mg/kg	U	002-003,005,008-009,011-013
Nickel	T257	A40	0.5	mg/kg	M	002-003,005,008-009,011-013
Selenium	T257	A40	3	mg/kg	U	002-003,005,008-009,011-013
Zinc	T257	A40	2	mg/kg	M	002-003,005,008-009,011-013
Asbestos ID	T27	A40			SU	002-003,005,008-009,011-013
Chromium VI	T6	A40	1	mg/kg	N	002-003,005,008-009,011-013
Fraction Organic Carbon - F(oc)	T917	A40	0.001		N	002-003,005,008-009,011-013
pH	T7	A40			M	002-003,005,008-009,011-013
Soil Organic Matter	T287	A40	0.1	%	N	002-003,005,008-009,011-013
(Water Soluble) SO4-- expressed as SO4	T242	A40	0.01	g/l	M	002-003,005,008-009,011-013
Sulphide	T4	A40	10	mg/kg	N	002-003,005,008-009,011-013
Cyanide(Total)	T921	AR	1	mg/kg	M	002-003,005,008-009,011-013
Phenols(Mono)	T921	AR	1	mg/kg	M	002-003,005,008-009,011-013
Naphthalene	T16	AR	0.1	mg/kg	U	002-003,005,008-009,011-013
Acenaphthylene	T16	AR	0.1	mg/kg	U	002-003,005,008-009,011-013
Acenaphthene	T16	AR	0.1	mg/kg	M	002-003,005,008-009,011-013
Fluorene	T16	AR	0.1	mg/kg	M	002-003,005,008-009,011-013
Phenanthrene	T16	AR	0.1	mg/kg	U	002-003,005,008-009,011-013
Anthracene	T16	AR	0.1	mg/kg	M	002-003,005,008-009,011-013
Fluoranthene	T16	AR	0.1	mg/kg	N	002-003,005,008-009,011-013
Pyrene	T16	AR	0.1	mg/kg	N	002-003,005,008-009,011-013
Benzo(a)Anthracene	T16	AR	0.1	mg/kg	M	002-003,005,008-009,011-013
Chrysene	T16	AR	0.1	mg/kg	M	002-003,005,008-009,011-013
Benzo(b)fluoranthene	T16	AR	0.1	mg/kg	U	002-003,005,008-009,011-013
Benzo(k)fluoranthene	T16	AR	0.1	mg/kg	N	002-003,005,008-009,011-013
Benzo(a)Pyrene	T16	AR	0.1	mg/kg	M	002-003,005,008-009,011-013
Indeno(123-cd)Pyrene	T16	AR	0.1	mg/kg	M	002-003,005,008-009,011-013
Dibenzo(ah)Anthracene	T16	AR	0.1	mg/kg	M	002-003,005,008-009,011-013
Benzo(ghi)Perylene	T16	AR	0.1	mg/kg	M	002-003,005,008-009,011-013
PAH(total)	T16	AR	0.1	mg/kg	U	002-003,005,008-009,011-013

Determinand	Method	Test Sample	LOD	Units	Symbol	Concept References
TPH (C10-C40)	T219	AR	10	mg/kg	M	001,004,006-008,010
Moisture @105C	T162	AR	0.1	%	N	001-013
Retained on 2mm	T2	A40	0.1	%	N	001-013



Concept Life Sciences

Certificate of Analysis

Report Number: 703443-1

Date of Report: 19-Dec-2017

Customer: Southern Testing Laboratories
Keeble House
Stuart Way
East Grinstead
West Sussex
RH19 4QA

Customer Contact: Mr Peter Sugden

Customer Job Reference: J13396

Customer Purchase Order: J13396_1 Peter

Customer Site Reference: King Street, Brenzett

Date Job Received at Concept: 30-Nov-2017

Date Analysis Started: 13-Dec-2017

Date Analysis Completed: 19-Dec-2017

The results reported relate to samples received in the laboratory and may not be representative of a whole batch.

This report should not be reproduced except in full without the written approval of the laboratory

Tests covered by this certificate were conducted in accordance with Concept Life Sciences SOPs

All results have been reviewed in accordance with Section 25 of the Concept Life Sciences, Analytical Services Quality Manual

Report checked
and authorised by :
Christopher Payne
Customer Service Advisor

Issued by :
Christopher Payne
Customer Service Advisor

Concept Reference: 703443 Project Site: King Street, Brenzett Customer Reference: J13396									
Soil		Analysed as Soil							
Miscellaneous									
Concept Reference				703443 001		703443 002		703443 003	
Customer Sample Reference				TPA @ 0.20m		TPB @ 0.20m		TPD @ 0.50m	
Date Sampled				28-NOV-2017		28-NOV-2017		28-NOV-2017	
Determinand		Method	Test Sample	LOD	Units				
Asbestos Quantification Stage 3		T413	AR	0.001	%	Chrysotile Fibres Detected <0.001	Chrysotile Fibres Detected <0.001	Chrysotile Fibres Detected <0.001	

Index to symbols used in 703443-1

Value	Description
AR	As Received
S	Analysis was subcontracted
U	Analysis is UKAS accredited

Notes

Asbestos subcontracted to REC Limited

Method Index

Value	Description
T413	PLM/Grav

Accreditation Summary

Determinand	Method	Test Sample	LOD	Units	Symbol	Concept References
Asbestos Quantification Stage 3	T413	AR	0.001	%	SU	001-003

APPENDIX E

Monitoring Data

SOIL GAS AND GROUND WATER DAILY RECORD SHEET

Project Name: Former Coach Depot, King Street, Brenzett, TN29 9UD										Project Engineer: PJS			Date: 05-Dec-17		Project No: J13396	
Client: Donforri Ltd					Operative: GW					Day of the week: Tuesday						

Land Gas Data										Groundwater Data				Remarks			
Well / TH No.	Atmospheric Pressure (mb) and Ambient Temperature	PID	BH pressure	Flow Rate		CH ₄	CO ₂	O ₂	CO	H ₂ S	Depth to base of well	Water level	Height of Cover	Details of water samples (colour, clarity, odour etc)	Ground Conditions (soft, wet/dry, frozen etc) & Weather Conditions	General Remarks	
		ppm	mib	l/hr		%	%	%	ppm	ppm	m below top of cover	m below top of cover	m above GL				
SH1	11C / 1040	P	NA	3.0	2.7	P	0.0	1.9	19.0	0.0	0.0	3.15	1.26	GL		WET GROUND, OVERCAST AND DRY	
		S	NA	0.0	0.0	S	0.0	1.9	19.0	0.0	0.0						
		Time Of Readings:				Time Of Readings:				Time Of Readings:							
		1230				1231				1234							
SH2	11C / 1038	P	NA	0.0	0.0	P	0.0	0.4	16.2	68.0	0.0	3.05	1.20	GL		WET GROUND, OVERCAST AND DRY	
		S	NA	0.0	0.0	S	0.0	0.4	16.2	68.0	0.0						
		Time Of Readings:				Time Of Readings:				Time Of Readings:							
		1237				1238				1241							
BH1	11C / 1040	P	NA	218.0	27.8	P	0.0	0.4	19.5	0.0	0.0	3.05	0.86	GL		WET GROUND, OVERCAST AND DRY	CONCRETE ON BUNG, SO HAD TO REMOVE TO CLEAN. WAITED 40 MINS THEN GAS TESTED
		S	NA	0.0	0.0	S	0.0	0.4	19.5	0.0	0.0						
		Time Of Readings:				Time Of Readings:				Time Of Readings:							
		1333				1334				1245							
		P				P											
		S				S											
		Time Of Readings:				Time Of Readings:				Time Of Readings:							
		P				P											
		S				S											
		Time Of Readings:				Time Of Readings:				Time Of Readings:							
		P				P											
		S				S											
		Time Of Readings:				Time Of Readings:				Time Of Readings:							

P = Peak Reading, S = Steady reading

Equipment Used: Interface Meter, MiniRAE 2000, GFM435 Gas Analyser

Checked By

Project Name:	Former Coach Depot, King Street, Brenzett, TN29 9UD		Project Engineer:	PJS	Date:	19.12.17	Project No:
Client:	Donforni Ltd	Operative:	OS		Day of the week:	Invalid Date	

Land Gas Data											Groundwater Data			Remarks			
Well / TH No.	Atmospheric Pressure (mb) and Ambient Temperature		PID	BH pressure	Flow Rate		CH ₄	CO ₂	O ₂	CO	H ₂ S	Depth to base of well	Water level	Height of Cover	Details of water samples (colour, clarity, odour etc)	Ground Conditions (soft, wet/dry, frozen etc) & Weather Conditions	General Remarks
			ppm	mb	l/hr		%	%	%	ppm	ppm	m below top of cover	m below top of cover	m above GL			
SH1	1038 10 Degrees	P	1.5	36.0	13.0	P	0.0	2.1	18.0	0.0	0.0	3.14	0.85	GL		Damp, Sunny	
		S	1.5	0.0	0.0	S	0.0	2.1	18.0	0.0	0.0						
		Time Of Readings:				Time Of Readings:						Time Of Readings:					
		13:32		13:25		13:27		13:30				13:35					
SH2	1037.0	P	1.3	-112.0	-17.0	P	0.0	1.4	16.8	0.0	0.0	3.05	0.91	GL		Damp, Sunny	
		S	1.3	0.0	0.0	S	0.0	0.7	18.6	0.0	0.0						
		Time Of Readings:				Time Of Readings:						Time Of Readings:					
		13:46		13:40		13:41		13:44				13:50					
BH1	1037 10 Degrees	P	0.6	217.0	39.0	P	0.0	0.5	18.9	0.0	0.0	3.06	0.35	GL		Damp, Sunny	Stopped after 0.57 seconds as water was sucked up
		S	0.4	0.0	0.0	S	0.0	0.5	18.9	0.0	0.0						
		Time Of Readings:				Time Of Readings:						Time Of Readings:					
		13:58		13:53		13:54		13:55				14:00					
		P				P											
		S				S											
		Time Of Readings:				Time Of Readings:						Time Of Readings:					
		P				P											
		S				S											
		Time Of Readings:				Time Of Readings:						Time Of Readings:					
		P				P											
		S				S											
		Time Of Readings:				Time Of Readings:						Time Of Readings:					
P = Peak Reading, S = Steady reading																	
Equipment Used: Interface Meter, MiniRAE 2000, GFM435 Gas Analyser															Checked By		PS

P = Peak Reading, S = Steady reading

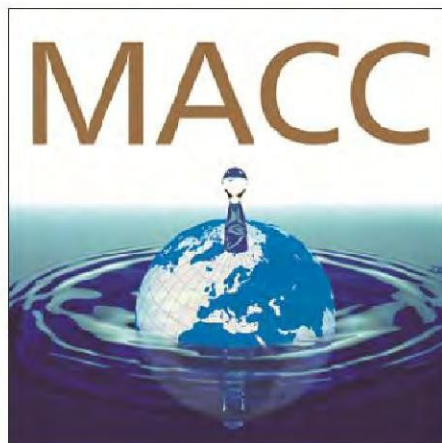
Equipment Used: Interface Meter, MiniRAE 2000, GFM435 Gas Analyser

Checked By

PS

APPENDIX F

UXO Risk Assessment



**PRELIMINARY
UNEXPLODED ORDNANCE
RISK ASSESSMENT**

**Former Coach Depot, King Street
Brenzett TN29 9UD**

Prepared for: Southern Testing Laboratories Ltd

Project Number: 4998

Version: 1.0

Dated: 20/11/2017

MACC International Limited
Camilla Court
Nacton Ipswich
IP10 0EU

Telephone Number: 01473 655127
Fax Number: 01473 655098
Email: macc@macc-eod.com

Registered in England Company Registration Number 3014471

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REFERENCES

Publications

Sources of information used in the compilation of this assessment included:

German Air Raids on Britain 1914-18. Morris 1925
Unexploded Ordnance (UXO) – A guide for the Construction Industry. CIRIA C681
Dangerous Energy. Cocroft 2000
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Internet Information

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Army EOD Incidents
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Latest News Reports

Project Information

Site and project information was provided by Southern Testing Laboratories Ltd.

TERMS AND DEFINITIONS

Anti Aircraft Ammunition (AAA)

High Explosive shells ranging from 30mm to 155mm used by air defence batteries to attack or deter enemy air attack.

Air Dropped Munition

A bomb or container dropped from an aircraft which is designed to detonate at a pre determined altitude, on impact or using a delay mechanism; after impact.

Air Dropped Sub-Munitions (Bomblet)

Small sub-munitions dispensed from a larger carrier which may be fixed to the aircraft or dropped as a single container munition which was designed to open above the target spreading its contents over a large area. Some designs are extremely dangerous and fitted with anti-handling devices.

Area Clearance

This is the term used for the systematic clearance of explosive ordnance from land, including military property, firing and bombing ranges, airfields and training areas. When the land is a former wartime battle ground, the term used is Battle Area Clearance (BAC)

Blast Zone

This term refers to the area around an explosive detonation where the explosive overpressure (Blast) can cause damage, injury or death.

Explosive Ordnance (EO)

All manufactured or improvised items designed to contain explosive, propellant, pyrotechnic and fissionable material or biological or chemical agents or pre-cursors which when coupled with an initiation or dispersal system are designed to cause damage, injury or death.

Explosive Ordnance Disposal (EOD)

A series of recognised procedures and protocols which are used by specialists in the detection, identification, evaluation, risk assessment, render safe, recovery and disposal of any item of explosive ordnance or improvised explosive device.

Fragmentation Zone

This is the term which refers to the danger area in which a piece of an item of explosive ordnance will travel on detonation. This zone is normally greater than the blast zone.

Geophysical Survey

The use of magnetometers, ground penetrating radar or other geophysical data gathering systems, which is then used for evaluation, risk assessment and to quantify further mitigation requirements.

High Explosive (HE)

High explosives react/detonate at a rate of around 9,000 metres per second, to all intents and purposes, instantaneously.

Incendiary Bomb (IB)

Incendiary bombs ranged from 1kg in size to 500kg the larger sizes were designated as Oil Bombs. Fills range from Thermite mixtures, Phosphorus, Kerosene or other pyrotechnic mixtures.

Intrusive Search

This term refers to the process of introducing a specialist magnetometer by pushing or drilling the sensor in to the ground to a pre determined depth, thus allowing construction activities such as: piling, soil testing and deep intrusive ground works to be conducted safely.

Land Service Ammunition (LSA)

LSA is a term that refers to all items containing explosives, pyrotechnic or noxious compounds which are placed, thrown or projected during land battles.

Oil Bomb (OB)

Large airdropped bomb or modified ordnance container containing flammable material and accelerant, these weapons normally range in weight from 250 – 500kg.

Parachute Mine (PM)

Air-dropped mine designed to detonate at a pre set altitude above the ground. Essentially a large blast bomb with an explosive content of 1600 kg commonly fitted with anti-handling or anti-removal fuzes.

Unexploded Bomb (UXB)

Any air dropped bomb that has failed to function as designed.

Unexploded Ordnance (UXO)

Explosive ordnance that has been primed, fused, armed or otherwise prepared for use or used. It may have been fired, dropped, launched or projected yet remains unexploded either through malfunction or design or for any other cause.

War Office (WO)

This was the United Kingdom Government department responsible for defence of the realm, forerunner of the Ministry of Defence (MoD).

White Phosphorus (WP)

Munitions filled with WP are designed for signalling, screening and incendiary purposes. They achieve their effect by dispersing WP, which burns on contact with the air.

1 INTRODUCTION

1.1 Instruction & Scope

MACC International Ltd was commissioned by Southern Testing Laboratories Ltd to conduct a Preliminary Unexploded Ordnance (UXO) Risk Assessment for the Former Coach Depot, King Street, Brenzett TN29 9UD (See Annex 'A'). The scope of the assessment is to determine the likelihood of an uncontrolled encounter with UXO within the context of ground investigations and any subsequent building works.

1.2 Methodology & Purpose

The methodology used in the assessment complies with the United Nations (IMAS) standards, the CIRIA C681 "Unexploded Ordnance (UXO) – A guide for the Construction Industry" and the recognised best practice advocated by the Health and Safety Executive (HSE). The quality and environmental aspects of the assessment comply with UKAS Accredited ISO 9001:2008 and ISO 14001:2004 standards. The purpose of the assessment is that of evaluation and to provide an aid in decision making by our client.

2 DETERMINING THE LIKELIHOOD OF ENCOUNTER

2.1 Aim, Research Restrictions & Indemnity

This assessment has drawn upon archive records which are within the public domain; however, these are acknowledged to be incomplete. Consequently, some incidents may have occurred where the records no longer exist or could not be located. The Secretary of State of the United Kingdom and MACC International Ltd does not accept responsibility for the accuracy or completeness of the information contained within the records. Some records regarding the UXO situation on some sites may not yet be within the public domain. Consequently, such information was not available for evaluation by MACC International Ltd.

2.2 Relevant Publications & Credible Internet Information

Published sources of information used in the compilation of this assessment are listed within the reference section of this assessment including those provided by the client. Additional information was provided through credible internet sites, their assistance is credited where appropriate and details are listed within the reference section of this assessment.

3 FUTURE DEVELOPMENT

Future intentions were not disclosed; however, it has been assumed that geo-environmental investigations will be undertaken prior to any subsequent building works.

4 HISTORICAL INFORMATION

4.1 British Archives

Prior to 1942 the United Kingdom did not operate a national recording system for EO/UXO incidents or military use of land. The records compiled during 1939-1942 were conducted under local arrangements and were only as detailed and accurate as the availability of time, personnel and the ease of access to information would allow. In April 1942 the Ministry of Home Security instigated a training programme for all personnel maintaining bomb census records, these standardised national records and greatly improved the accuracy of the information.

4.2 Manned Air Raids & Unmanned Rocket Attack Reports

The general area suffered HE and V1 flying bomb strikes during WWII. Although a strike within the site footprint was not confirmed, records indicate significant bombing to the south west of the site between Brooklands and Brenzett. Further bomb strikes were recorded near Snargate and Ivychurch. Consequently, this source of UXO contamination is considered to be credible.

4.3 Other Sources of UXO Contamination

RAF Brenzett was located between Brenzett and Ivychurch to the north-east of the site and primarily operated patrols against V1 flying bombs during WWII. Although there was a military presence in the area, records did not indicate that the site or adjacent land was used by the military. Consequently, military activity is not considered to be a credible source of additional UXO contamination.

HAA guns were located in the area to defend against air attack and it is a matter of record that combat engagements with enemy aircraft did take place. For example, on the 3rd of March 1941 a Messerschmitt Bf 109 was shot down at Brenzett. Consequently, this source of UXO contamination is considered to be credible.

5 DETERMINING THE NATURE OF RISK

5.1 General

While HE bombs are very unlikely to detonate if left undisturbed it remains inherently dangerous and may function if subjected to suitable stimuli. The most common of these stimuli is shock, friction or heat which may cause the fuze to function or unstable explosive materials (Picrate Acid) to explode. However, in the case of incendiary bombs containing White Phosphorus (WP) exposure of the WP to the air will result in its violent ignition and combustion.

5.2 Bomb Trajectory & Ground Penetration

During WWII the Ministry of Home Security undertook a major assessment on bomb penetration depths using 1,328 actual bomb impact events to provide statistical analysis of penetration potential. As a result they determined the expected behaviour of a range of bomb weights through different geological strata around the Capital. Their findings remain the only empirical gained figures to have been gathered to date for England. A number of factors will influence the behaviour of a bomb on impact with the target and its trajectory through the ground. Relevant factors include: Height and speed of release of the bomb, aerodynamic qualities of the bomb, the angle of flight and impact and the nature of impact surface and sub soil. In determining the potential bomb penetration depths into the ground, historic geotechnical information and typical bomb characteristics were used. The maximum bomb penetration depth is estimated at 10.5 metres from the 1941 ground levels.

5.3 Bombs have been known to strike outside a building footprint and travel below the surface coming to rest within the building footprint. As did the recent 250kg HE bomb found within a cellar in Bethnal Green. The expected offset from impact point is estimated to be 3.0-5.0 metres.

6 ENVIRONMENTAL IMPACT FROM UXO

6.1 Ground Contamination & Health Risk vectors

While it is acknowledged that there is a potential risk of ground contamination arising from explosive fillings which may leach from a damaged bomb casing into the surrounding soil. The amount of explosive material within the most common bombs is not considered sufficient to pose a significant environmental risk. Nevertheless it should be noted that the following components are commonly used in the manufacture of a high explosive bomb and may pose a localised contamination risk to health: metals including; Lead, Zinc, Brass, Copper, Steel, Mercury, Silver Fulminate and Aluminium. Other chemical Compounds including; Trinitrophenol, Trinitrotolulene, Trimethylene Trinitramine, Ammonium, Sodium Nitrate, Nitro-glycerine and White Phosphorus. It is recommended that specialist medical advice be sought to identify specific risks to health posed by these chemical compounds.

7 RISK ASSESSMENT

7.1 Risk Source

Records indicate that the surrounding area was struck by airdropped munitions. Records are acknowledged to be incomplete and may include omissions and errors; the possibility that items of UXO may have found their way onto the site and remain there to the present day is considered credible.

7.2 Risk Pathway

The risk pathway is considered to be any ground intrusive earth works carried out while undertaking geo-environmental investigations or building work.

7.3 Consequence

The consequences of a UXB detonation on site during construction works are considered to be a factor of the size of the blast and the proximity of assets and individuals to the point of detonation. These will include potential to kill or seriously injure personnel destroy or damage high value site assets, nearby public and private property and infrastructure.

7.4 Risk Rating

Table 1 Risk Level

PRELIMINARY UXO RISK RATING			
Hand Dug Excavations	$3 \times 1 = 3$	$1 \times 5 = 5$	$3 \times 5 = 15$
Limited Mechanical Excavations	$3 \times 2 = 6$	$2 \times 5 = 10$	$6 \times 10 = 60$
Drilling, Sampling, Piling or Bulk Excavations	$3 \times 3 = 9$	$3 \times 5 = 15$	$9 \times 15 = 135$
1= Minimal 5=significant LOW 0-100 MEDIUM 100-200 HIGH 200+			

8 ASSESSMENT FINDINGS

8.1 Risk Levels

The assessment has determined the preliminary UXO risk within the site boundary. When viewed from likelihood versus consequence standpoint; it is considered prudent to recommend a suitable degree of UXO mitigation to permit the work to proceed in the safest “acceptable” manner in compliance with current legislation and best practices.

9 RECOMMENDATIONS FOR RISK MITIGATION

9.1 It is recommended that a detailed UXO Desk Top Study is commissioned to more accurately define the risk level and to complete detailed assessment on the mitigation requirements over the project's lifetime.

9.2 Alternatively, the preliminary risk levels are accepted and the following mitigation measures are carried out as a minimum requirement:

All Risk Levels

- Risk Communication & Safety Planning: Stakeholders should be made aware of the UXO risk levels within the project boundary and the possible impact an encounter may have on the project and third parties.
- Safety Training: In keeping with CDM Regulations concerning all sub-surface hazards, UXO Safety Induction Training should be provided to everyone working or visiting the site. The training should be commensurate with the individual's responsibilities and duties on site. The training should be provided by a competent individual (preferably a trained EOD Engineer) and delivered as a separate module of the Site Safety Induction Course or as a Toolbox Talk.

Additional mitigation requirements for the medium risk activities:

- Drilling, Sampling or Bulk Excavations: These activities should be checked for UXO by an EOD Engineer equipped with specialist magnetometers ahead of the drilling/sampling bits. Where the ground conditions on land will not permit this; Then a UXO safety ‘watching brief’ should be in place during the work.
- Piling: All positions should be tested using a specialist ‘Mag Cone’ and be UXO safety certified prior to the commencement of piling.

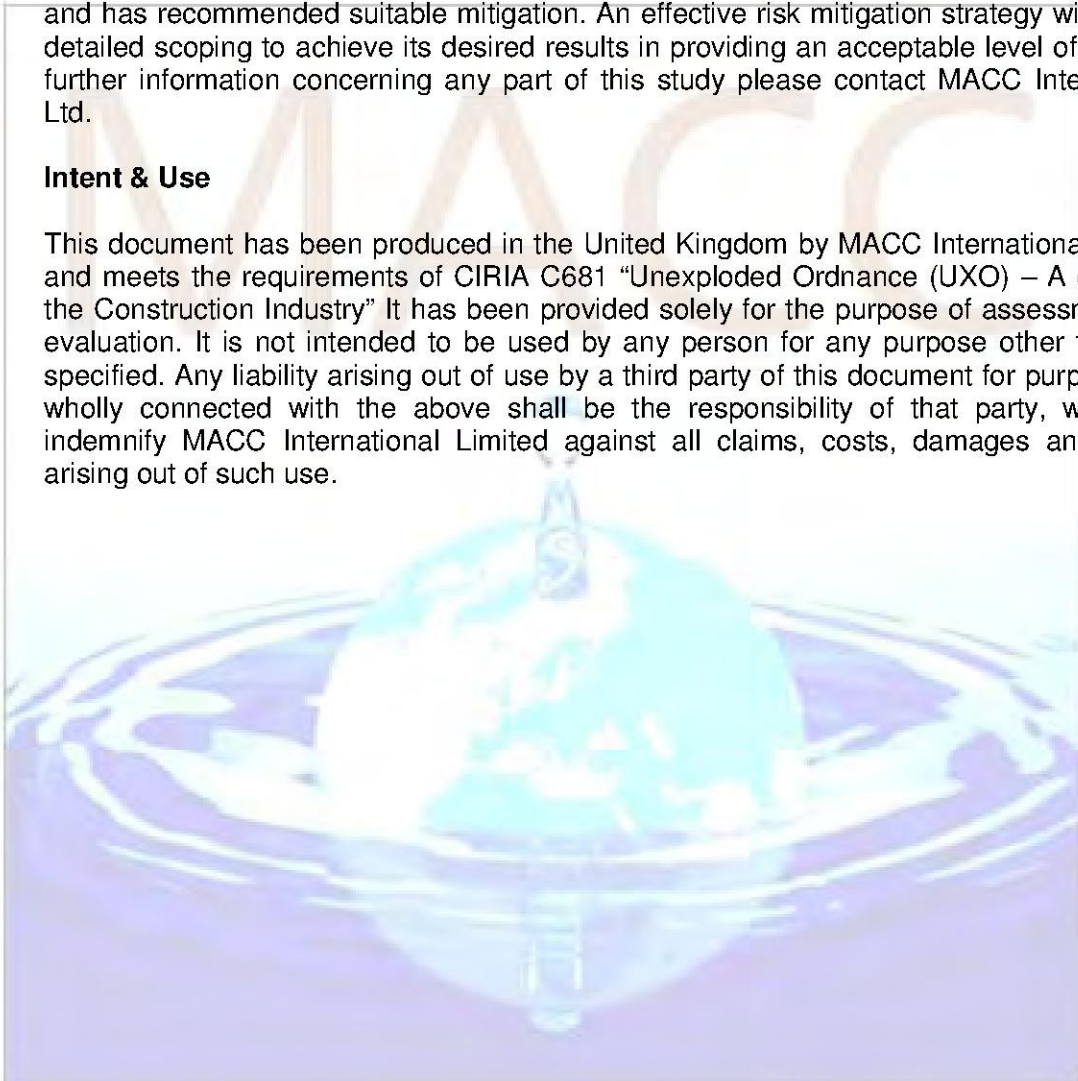
10 **POST MITIGATION RISK**

10.1 **Overview**

Prudent execution of the recommended risk mitigation strategy will reduce the risk, however it is emphasised that zero risk is not achievable given the possible variables. The study has confirmed the UXO risk level based on the nature of the work to be undertaken and has recommended suitable mitigation. An effective risk mitigation strategy will require detailed scoping to achieve its desired results in providing an acceptable level of risk. For further information concerning any part of this study please contact MACC International Ltd.

10.2 **Intent & Use**

This document has been produced in the United Kingdom by MACC International Limited and meets the requirements of CIRIA C681 "Unexploded Ordnance (UXO) – A guide for the Construction Industry" It has been provided solely for the purpose of assessment and evaluation. It is not intended to be used by any person for any purpose other than that specified. Any liability arising out of use by a third party of this document for purposes not wholly connected with the above shall be the responsibility of that party, who shall indemnify MACC International Limited against all claims, costs, damages and losses arising out of such use.



Site Drawing:

