



Radian

Campdown, Land off College Road, Purbrook, Waterloooville, PO7 8AA

Geo-environmental site assessment

28720 R01 (01)

OCTOBER 2016

RSK

RSK GENERAL NOTES

Project No.: 28720 R01 (01)

Title: Geo-environmental site assessment: Campdown, Waterloooville

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Date: October 2016

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Status: Final

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1 INTRODUCTION

RSK Environment Limited (RSK) was commissioned by Radian to carry out a geo-environmental assessment of the land off College Road, Purbrook, Waterlooville, Hampshire, PO7 8AA known as Campdown and hereafter referred to as 'the site'. It is understood the site is being considered for low-rise residential redevelopment with car parking and areas of soft landscaping and sports facilities.

This report is subject to the RSK service constraints given in Appendix A.

1.1 Objective

The objective of the work is to evaluate client liabilities as part of a due diligence process to support a planning application and also to provide information for foundation design and associated works.

1.2 Scope

The scope of the investigation and layout of this report has been designed with consideration of CLR11 (Environment Agency, 2014) and BS 10175: 2013 (BSI, 2013) and guidance on land contamination reports issued by the Environment Agency (EA) (2010a).

The project was carried out to an agreed brief as set out in RSK's proposal (ref. 28720T01 (02)/rs, dated 28th July 2016). The scope of works for the assessment included:

- a preliminary risk assessment (PRA) to include a review of existing reports, geological, hydrogeological and hydrological information, a commercially available environmental database, and historical plans; correspondence with regulatory authorities; and a site walkover – this information is used to develop an initial conceptual site model to consider any potentially complete pollutant linkages
- a review of published geological data to assess ground stability
- an intrusive investigation consisting of 18 boreholes with falling head tests, laboratory analysis plus subsequent groundwater and gas monitoring
- development of a refined conceptual site model followed by generic quantitative risk assessment (GQRA) to assess complete pollutant linkages that may require the implementation of mitigation measures to facilitate redevelopment
- identification of outline mitigation measures for complete pollutant linkages or recommendations for further work

- interpretation of ground conditions and geotechnical data to provide recommendations with respect to foundations and infrastructure design
- a factual and interpretative report with recommendations for further works (i.e. undertake a remedial options appraisal to identify appropriate mitigation measures/produce a remedial implementation and verification plan) and/or remediation as necessary

1.3 Existing reports

No existing reports were made available to RSK prior to completing this report.

1.4 Limitations

The comments given in this report and the opinions expressed are based on the ground conditions encountered during the site work and on the results of tests made in the field and in the laboratory. However, there may be conditions pertaining to the site that have not been disclosed by the investigation and therefore could not be taken into account. In particular, it should be noted that there may be areas of made ground not detected due to the limited nature of the investigation or the thickness and quality of made ground across the site may be variable. In addition, groundwater levels and ground gas concentrations and flows may vary from those reported due to seasonal, or other, effects.

2 THE SITE

2.1 Site location and description

The site is located south of South Downs College, College Road, Widley, Waterlooville, Hampshire PO7 8AA at National Grid reference 468760, 106730, as shown on **Figure 1**.

The area around the site is comprised of mixed land uses as detailed in **Table 1**.

Table 1: Site setting

To the north:	South Downs College, wooded land, some residential developments
To the east:	A3 Road, wooded land and residential developments.
To the south:	Open fields and a waste management company
To the west:	Residential developments.

The site covers approximately 26 hectares at an elevation of approximately 30-55m above Ordnance Datum (AOD) with large undulations across the site and comprises the following main attributes (some of which are shown on **Figure 2**):

- two large fields, with some disparate trees with hedgerows;
- the topography of the site falls generally to the east; and
- the fields are currently used for tenant pastoral farming for approximately 30 horses

2.2 Proposed development

The subject site is being considered for low-rise residential redevelopment with private gardens and car parking and sports facilities. The planned layout of the site is yet to be finalised.

3 PRELIMINARY RISK ASSESSMENT (PRA)

3.1 Site walkover

A site walkover was undertaken by RSK on the 2nd August 2016. Photographs and a site walkover checklist are provided in **Appendix C**. No potentially significant ground contamination was identified on or in the vicinity of the site. With respect to geotechnical issues, consideration will need to be given to construction on sloping ground and construction within the influencing distance of trees and hedgerows.

The site comprises of open undeveloped fields that are used as grazing land for horses. The west of the site is undulating with the east of the site sloping moderately down to the south. The south of the site is relatively flat lying. There are some moderately steep slopes present on site.

Japanese knotweed was not identified during the site visit although its absence cannot be discounted.

3.2 Ground conditions

3.2.1 Geology

Published records (British Geological Survey, 1998) for the area indicate the geology of the site to be characterised by the succession recorded in **Table 2**.

Table 2: Geology at the site

Geological unit	Description
Superficial Head Deposits	Polymict deposit: comprises gravel, sand and clay depending on upslope source and distance from source.
Wittering Formation (north east of the site only)	Greyish brown laminated clay; wavy- to lenticular-bedded sand interbedded with clay in equal proportions; and fine- to medium- grained sand and very silty clay above.
London Clay Formation	Bioturbated or poorly laminated, blue-grey or grey-brown, slightly calcareous, silty to very silty clay, clayey silt, with some layers of sandy clay.
Bognor Sand Member	Glauconitic bioturbated or cross-bedded fine and medium grained sands, partially cemented
Portsmouth Chalk Member	White Chalk with flints and any thin marly beds (out crops approximately 50m south of the site).

The site is located close to the feathering margin of the Ports Down anticline. It is of note that the historical maps indicate 'chalk pits' close to the southern boundary of the site and hence, the thickness of the geological stratum in **Table 1** are likely to be very thin or absent.

Based on the history of the site, made ground is not expected to be present at the site although its absence cannot be discounted.

3.2.2 Radon

An environmental database report (Envirocheck report, August 2016) indicates that the site is not located within a radon 'Affected Area' as defined by the Documents of the National Radiological Protection Board (Radon Atlas of England and Wales, NRPB-W26-2002). Therefore, the risk of significant ingress of radon into structures on-site is considered to be low and no radon protective measures are required within new dwellings at the site.

3.2.3 Mining and quarrying

Evidence has been sought to identify any mining and quarrying operations, past and present, which have taken place in the vicinity of the site. The sources of information referenced in this element of the desk study include:

- the Envirocheck report
- records held by local authority/EA
- old Ordnance Survey maps and plans
- geological maps

With reference to the above data, there are no recorded mines or quarries within a 250m radius of the site, although a number of small gravel and chalk pits were present historically in the surrounding area. These features do not appear to have been infilled and remain on current mapping as disused features.

3.2.4 Landfilling and land reclamation

Evidence has been sought to identify any landfilling or land reclamation operations, past and present, which have taken place in the vicinity of the site. The sources of information referenced in this element of the desk study include:

- the Envirocheck report
- records held by local authority/EA
- old Ordnance Survey maps and plans
- geological maps

There are no records of landfill sites (former or current) within 250m of the site (i.e. within the planning consultation zone). Furthermore, there are no records of landfills within a 0.5km radius of the site.

3.3 Hydrogeology

3.3.1 Aquifer characteristics

Based on the published geological map referred to above, the hydrogeology of the site is likely to be characterised by the presence of shallow head deposits with the Wittering Formation and Bognor Sand Member also shown to be at shallow depths.

The presence of low permeability clay at relatively shallow depths beneath the site, while restricting downwards migration, may increase the potential for lateral migration of shallow groundwater and therefore mobile contamination, if present.

3.3.2 Vulnerability of groundwater resources

The site has been classified by the EA website to overlie a:

- secondary A aquifer: permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers; and
- 'unproductive' strata: low permeability with negligible significance for water supply or river base flow.

The soils beneath the site are classified as having LOW (L) leaching potential.

L – soils where pollutants are unlikely to penetrate the soil layer either as a result of largely horizontal water movement or because the soil has the ability to attenuate diffuse pollutants. Lateral flow in these soils may contribute to groundwater recharge elsewhere in the catchment and generally have a high clay content.

3.3.3 Licensed groundwater abstraction

No groundwater abstractions have been identified within a 2km radius of the site.

In terms of aquifer protection, the EA generally adopts a three-fold classification of source protection zones (SPZ) for public supply abstraction wells. These are:

- zone 1 or 'inner protection zone' is located immediately adjacent to the groundwater source and is based on a 50-day travel time from any point below the water table to the source. It is designed to protect against the effects of human activity and biological/chemical contaminants that may have an immediate effect on the source

- zone 2 or 'outer protection zone' is defined by a 400-day travel time from a point below the water table to the source. The travel time is designed to provide delay and attenuation of slowly degrading pollutants.
- zone 3 or 'total catchment' is the area around the source within which all groundwater recharge is presumed to be discharged at the source.

Information available on the EA website indicates that the site lies within zone 1 and 1c of the groundwater SPZ.

3.4 Hydrology

3.4.1 Surface watercourses

The nearest identified surface feature is in the south west of the site. This is shown as a drainage ditch labelled as 'issues'.

3.4.2 Surface water abstractions

No surface water abstractions were identified within a 2km radius of the site.

3.4.3 Site drainage

Surface drainage from the site appears to be discharged into the drainage shown in the south and south west of the site. The site sloped to the south and so it is expected water will drain in this direction.

3.4.4 Preliminary flood risk assessment

The indicative floodplain map for the area, published by the EA, shows that the site does not lie within a designated floodplain.

3.4.5 Preliminary UXO risk assessment

Due to the location of the site, a preliminary Unexploded Ordnance (UXO) risk assessment was carried out for the site. The surrounding area suffered extensive bombing, however records were not found to confirm a strike within the site footprint. Records are acknowledged to be incomplete and may include omissions and errors. Therefore the site is considered to have a medium risk for UXO. A copy of the risk assessment is included in Appendix M.

3.5 History of site and surrounding area

The history of the land-use and development of the site and surrounding area has been assessed based on the following sources:

- historical maps within the environmental database from 1868 to 2016
- town plans
- internet search

Copies of OS and County Series maps are included in the environmental database report in Appendix L. Reference to historical maps provides invaluable information regarding the land use history of the site, but historical evidence may be incomplete for the period pre-dating the first edition and between successive maps.

The development history of the site and surrounding area from the above sources is detailed in Table 3.

Table 3: Summary of historical development

Date	Land use/features on site	Land use/features in vicinity of site (of relevance to the assessment)
1868-1870	Open fields and woodland towards the south and centre of site (Crookhorn Wood & Privet Wood).	Area around the site comprised predominately open undeveloped fields and woodland with several chalk pits and quarries, the closest of which was an old chalk pit adjacent to the southern boundary.
1898	The woodland was not longer present, with the site appearing to be occupied by open fields. A small pond was present in the south west of the site at this time and a larger pond and drainage ditch/stream present in the north west of the site.	No significant changes.
1932-1938	Site of ancient Roman villa and Roman road shown in the north of site. The pond in the south west of the site appeared to have been infilled.	Farlington Redoubt (a Victorian Fort) shown to be c. 250 m to the south west of the site.
1963	No significant changes	Morelands Camp constructed adjacent to the western boundary. Residential development c. 250 m to the east and south.
1982	By this time the large pond in the north west of the site appears to have been infilled along with part of the drainage ditch/stream. The remaining section of the stream concur with that remaining to the present day.	Further residential development to the east, south and west. The South Downs College shown adjacent to the northern boundary. City of Portsmouth Golf Course to the south west of the site.

		A3(M) road located adjacent to the eastern boundary. Commercial works buildings located c. 300 m to the north east.
2000	No significant changes	Farlington Reboubt labelled as a depot, believed to be a waste transfer station at this time.
2016	Site remains as open undeveloped land, with a drainage ditch in the south west.	The South Downs College is located adjacent to the northern boundary. Golf course along the southern boundary. A3(M) road along the eastern boundary. College Road along the western boundary with residential developments beyond.

3.6 Sensitive land uses

No national or internationally designated sensitive land uses such as sites of special scientific interest (SSSI) were identified in the vicinity of the site. There are five records shown on the Envirocheck report for Ancient and Semi-Natural Woodland within 250m of the site boundary. The site is also located within a nitrate vulnerable zone.

3.7 Local authority environmental health department information

An enquiry has been sent to the environmental health department of Havant Borough Council, however at the time of issue a response had not been received.

3.8 Initial conceptual model

The information presented in Sections 2 and 3.1 to 3.7, has been used to compile an initial conceptual model. The identified potential sources of contamination, associated contaminants and receptors have been considered with plausible pathways that may link them. The resulting potential pollutant linkages are considered in Section 3.8.4. The risk classification has been estimated in accordance with information in Appendix D.

3.8.1 Summary of potential contaminant sources

Potential sources and contaminants of concern are summarised in Table 4.

Table 4: Potential sources and types of contamination

Potential sources	Contaminants of concern
On-site historical	
Made ground associated with infilled ponds and drainage ditch.	Unknown fill material (but potentially including heavy metals, ash, clinker, sulphates, polycyclic aromatic hydrocarbons (PAHs), asbestos).
Off-site	
Historical developments and chalk pit adjacent to the site boundaries	Potential for unknown fill material (but potentially including heavy metals, ash, clinker, sulphates, polycyclic aromatic hydrocarbons (PAHs), asbestos).
Gas sources and gas generation potential in line with BS8576	
Onsite	
Made ground associated with infilled ponds and drainage ditch.	Carbon dioxide and methane
Off-site	
Potential off-site made ground - Old chalk pits in the surrounding area and golf course adjacent to the southern boundary	Carbon dioxide and methane

3.8.2 Sensitive receptors

Sensitive receptors at this site include:

- future site occupants
- adjacent site users
- vegetation
- potable water supply pipes
- groundwater beneath the site

Please note that construction workers have not been identified in the conceptual model as receptors because risks are considered to be managed through health and safety procedures including CDM regulations.

3.8.3 Summary of plausible pathways

The plausible pathways are summarised below:

- direct contact (soil, dust and vegetable ingestion, dermal contact, dust and fibre inhalation)
- ground gas and soil gas inhalation
- vertical and lateral migration including leaching

- root uptake
- chemical attack of infrastructure (including water supply pipes) and buildings.

3.8.4 Potentially complete pollutant linkages

An estimate of the risk associated with each linkage is summarised in Table 5. The risk classification has been undertaken in accordance with CIRIA C552 (Rudland et al., 2001), a summary of which is included in Appendix D.

Table 5: Risk estimation for potentially complete pollutant linkages

Potential Contaminant	Potential receptor	Possible pathway	Likelihood	Severity	Risk and justification
Contaminants of concern associated with potential on site and off site made ground infill materials	Future site users (Human health)	Ingestion of contaminated soil, dust, liquid Inhalation of contaminated dust and vapours/gases	Low likelihood	Medium	Moderate/Low If present, contaminants could affect future residents via direct contact pathways in areas of soft landscaping
	Adjacent site users		Unlikely	Medium	Low Potential for contamination at the site is considered relatively low based on the nature of the potential sources identified (infilled surface water features) and the anticipated cohesive nature of the underlying head deposits. Therefore the likelihood of adjacent users coming into contact with any contamination is considered low.
	Vegetation	Plant uptake	Low likelihood	Medium	Moderate/Low If present, contaminants could affect vegetation in areas of soft landscaping.
	Water supply pipes	Direct contact	Unlikely	Medium	Low If present, contaminants may affect plastic utilities via direct contact pathways.
	Secondary A Aquifer	Vertical migration-soil leaching	Unlikely	Medium	Low If present, contaminants may leach into underlying aquifer. However, given the cohesive nature of head deposits leaching of contaminants vertically and laterally would be expected to be limited.
Ground gases/ vapours (methane and carbon dioxide) associated with potential infill materials on	Building/ structures	Ingress into building structures	Unlikely	Severe	Moderate/Low Small quantities of potential made ground on site and off site may be producing ground gases, which have the potential to migrate and accumulate into buildings on site.

Potential Contaminant	Potential receptor	Possible pathway	Likelihood	Severity	Risk and justification
site and off site	Human health (future site users)	Inhalation of vapours/gases Ingress into building structures	Low likelihood	Medium	Moderate/Low Small quantities of potential made ground on site and off site may be producing soil and ground gases, which have the potential to migrate and accumulate in buildings on site, potentially causing harm to human health via inhalation.

The potential pollutant linkages with a risk of moderate/low or above that may drive site investigation works are:

- Contaminants of concern within soils across the site to future site user and vegetation
- Ground gas ingress into structures and buildings; and
- Inhalation of ground gases by future site users.

4 SITE INVESTIGATION METHODOLOGY

RSK carried out intrusive investigation work and subsequent ground gas and groundwater monitoring on 2nd, 4th and 19th August and 2nd and 16th September 2016 to further investigate the potential pollutant linkages identified in the outline conceptual model and to inform geotechnical constraints.

4.1 Sampling strategy and methodology

The techniques adopted for the investigation have been chosen considering the anticipated ground conditions, existing land use and the proposed development.

Drive-in sampler probeholes were drilled to provide information on underlying ground conditions at shallow depths and allow for installation of gas monitoring wells.

4.1.1 Investigation locations

The site work was carried out by RSK between 2nd and 4th August 2016, and comprised the activities summarised in Table 6, along with a justification for each exploratory hole location. The investigation and the soil descriptions were carried out in general accordance with BS5930: 2015 - Code of Practice for Ground Investigations. The exploratory hole logs and other site work records are presented in **Appendix E**.

The locations of the intrusive investigations are shown in Figure 2. The rationale for these locations is given in Table 6. The investigation was designed to provide information on the underlying ground conditions within the proposed areas of development.

Table 6: Exploratory hole and monitoring well location rationale

Investigation Type	Exploratory hole number	Response zone (m bTOC)	Rationale
Boreholes – by drive-in-sampler	BH1-BH18	NA	Non-targeted assessment to determine the contamination status of the ground and collect geotechnical samples
Monitoring well installations	BH1, BH3, BH5, BH7, BH9, BH13, BH15, BH16-BH18		Shallow ground gas and groundwater monitoring installations to assess the ground gas risk to the future site development

The investigation and the soil descriptions were carried out in general accordance with 'BS 5930:2015 Code of Practice for Ground Investigations' (BSI, 2015) and 8576. The exploratory hole records are presented in Appendix E.

The investigation points were located approximately by reference to a topographical survey.

4.1.2 Soil sampling, in-situ testing and laboratory analysis

Soils collected for laboratory analysis were collected in a variety of containers appropriate to the anticipated testing suite required. Samples were stored in accordance with the RSK quality procedures to maintain sample integrity and preservation and to minimise the chance of cross contamination.

Samples were taken and are recorded together with their depths on the exploratory hole records in Appendix E. The samples were transported to the laboratory in chilled cool boxes. Laboratory chain of custody forms can be provided if required. The rationale for soil sample chemical analysis is presented in Table 7.

Table 7: Scheduled analysis – soil

Exploratory hole no. and sample depth (m bgl)	Analyte	Rationale
BH1 at 0.10-0.20 BH3 at 0.10-0.20 BH5 at 0.50 BH7 at 1.10-1.20 BH8 at 0.10-0.20 BH10 at 0.10-0.20 BH12 at 0.10-0.20 BH14 at 0.10-0.20 BH15 at 0.10-0.20 BH16 at 0.10-0.20 BH17 at 0.10-0.20	Envirolab suite 2 (speciated PAHs, TPHCWG, pH, metals and sulphates)	General suite of contaminants
BH3 at 0.10-0.20 BH7 at 0.50 BH7 at 1.10-1.20 BH8 at 0.10-0.20 BH10 at 0.10-0.20 BH12 at 0.10-0.20 BH15 at 0.10-0.20 BH16 at 0.10-0.20 BH17 at 0.10-0.20	Asbestos screen	To assess for the presence of asbestos fibres

Standard penetration tests (SPTs) were carried out at 1m intervals in selected borehole locations. Test results are given on the borehole records presented in Appendix E. Disturbed samples were taken from each stratum encountered for subsequent geotechnical analysis.

4.1.3 Ground gas monitoring

In line with the conceptual model which indicating potential gas sources associated with on site and off site made ground infill materials, response zones were installed to target these sources and pathways as detailed in Table 5. Dual gas taps were installed in line with BS8576.

Three monitoring rounds have been undertaken to date to provide data to support the conceptual model. Monitoring included periods of falling atmospheric pressures and after/during rainfall.

An infrared gas meter was used to measure gas flow, concentrations of carbon dioxide (CO₂), methane (CH₄) and oxygen (O₂) in percentage by volume. Initial and steady state concentrations were recorded.

The atmospheric pressure before and during monitoring, together with the weather conditions, was recorded.

All monitoring results together with the temporal conditions are contained within Appendix F and discussed in Section 5.2.

4.1.4 In-situ infiltration testing

Borehole soakage (falling head) tests were undertaken within monitoring wells in BH1, BH5, BH7, BH9, BH15, BH16 and BH17 to ascertain the infiltration rate of the underlying strata. The results are presented in **Appendix N**.

5 GROUND CONDITIONS

The results of the intrusive investigation and subsequent laboratory analysis undertaken are detailed below. The descriptions of the strata encountered, notes regarding visual or olfactory evidence of contamination, list of samples taken, field observations of soil and groundwater, in-situ testing and details of monitoring well installations are included on the exploratory hole records presented in Appendix E.

5.1 Soil

The exploratory holes revealed that the site is underlain by a variable thickness of topsoil over Head Deposits with Bognor Sand Member and Lambeth Group also encountered at shallow depths. This appears to confirm the stratigraphical succession described within the initial conceptual model. For the purpose of discussion, the ground conditions are summarised in Table 8 and the strata discussed in subsequent subsections.

Table 8: General succession of strata encountered

Strata	Exploratory holes encountered	Depth to top of stratum m bgl	Thickness (m)
Topsoil	All locations	GL	0.20-0.35
Made ground	BH7	0.30	1.20
Head Deposits	BH1-BH7, BH9-BH18	0.20-1.50	0.70->3.25
Bognor Sand Member	BH8 and BH12	0.20-1.70	>3.25
Lambeth Group	BH13 and BH14	1.00-1.10	>2.45

5.1.1 Topsoil

The topsoil generally comprised of brown to orange brown sandy gravelly CLAY with gravel of flint. Brick was noted to be present in some locations. Topsoil comprising of sand was found to be present at BH8.

5.1.2 Made ground

Made ground was found to be present at BH7 only to a depth of 1.50m. This comprised of reworked orange brown clay with pockets of grey clay with brick and clinker encountered between 1.00-1.50m depth within a brown silty slightly gravelly clay.

5.1.3 Head deposits

This stratum was encountered from beneath the topsoil and made ground and comprised a layer of firm orange grey brown mottled sandy clay, with flint gravels in some locations, between 0.70m and >3.25m in thickness. The clay was assessed to be predominantly of medium shrinkage potential.

A summary of the in-situ and laboratory test results in this stratum is presented in **Table 9**.

Table 9: Summary of in-situ and laboratory test results for alluvial clay

Soil parameters	Range	Reference
Liquid limit (%)	35-68	Appendix K
Plasticity limit (%)	17-32	
Plasticity index (%)	18-40	
Modified plasticity index (%)	18-40	
Plasticity term	Intermediate to high	
Moisture content (%)	20-32	Appendix E
SPT 'N' values	7-24	
Stiffness term	Firm to stiff	

5.1.4 Bognor Sand Member

This stratum was encountered at a depth of between 0.2m and 1.7m below ground level and is greater than 3.25m in thickness. The Bognor Sand Member comprised of an orange brown silty sand.

5.1.5 Lambeth Group

Lambeth Group was encountered at a depth of 1.0m to 1.1m below ground level to the full depth of investigation in BH13 and BH14. Based on the site descriptions and in-situ testing carried out this stratum can be described as a firm to very stiff overconsolidated red grey mottled clay of medium plasticity.

A summary of the in-situ and laboratory test results in this stratum is presented in **Table 10**.

Table 10: Summary of in-situ and laboratory test results for London Clay

Soil parameters	Range	Reference
Liquid limit (%)	49	Appendix K
Plasticity limit (%)	23	
Plasticity index (%)	26	
Modified plasticity index (%)	23.4	
Plasticity term	Intermediate	
Moisture content (%)	16	
SPT 'N' values	8-16	Appendix E
Stiffness term	Firm to very stiff	

5.1.6 Groundwater

Groundwater was encountered during the investigation as detailed in Table 11.

Table 11: Groundwater results during investigation

BH	Stratum	Strike (m bgl)
BH4	Head deposits	1.20-1.25
BH15	Head deposits	2.00-2.50

It should be noted that groundwater levels might fluctuate for a number of reasons including seasonal variations. Ongoing monitoring would be required to establish both the full range of conditions and any trends in groundwater levels.

5.1.7 Results of soakaway testing

The results of soakaway testing are summarised in Table 12.

Table 12: Borehole soakage test results

Monitoring well	Geological unit	Test results (m/s)
BH1	Head Deposits	1.65×10^{-7}
BH5	Head Deposits	1.2×10^{-7}
BH7	Head Deposits	1.38×10^{-7}
BH9	Head Deposits	2.82×10^{-7}
BH15	Head Deposits	4.05×10^{-7}
BH16	Head Deposits	1.24×10^{-7}
BH17A (test 1)	Head Deposits	5.37×10^{-7}

Monitoring well	Geological unit	Test results (m/s)
BH17B (test 2)	Head Deposits	8.28×10^{-7}

The above results indicate that the Head Deposits are of low permeability i.e. poor drainage characteristics.

5.1.8 Visual/olfactory evidence of soil and groundwater contamination

No visual or olfactory evidence of soil and groundwater contamination was identified during the investigation.

5.2 Ground gas regime

The results of the ground gas monitoring and testing carried out are given in **Appendix F**. The minimum and maximum results are recorded in **Table 13**.

Table 13: Summary of ground gas monitoring results

Borehole	Response zone/strata	Number of monitoring visits	Methane (%)	Carbon dioxide (%)	Oxygen (%)	Flow rate (l/hr)	Water level (m b TOC)	Atmospheric pressure (mbar)
BH1	Head	3	0.1	2.7	18.9	0.1	1.78	999
BH3		3	0.1	4.0	18.3	<0.1	2.09	999
BH5		3	0.1	5.4	17.1	0.1	1.77	999
BH7		3	0.1	5.9	16.8	0.1	1.10	999
BH9		3	0.1	1.7	19.8	<0.1	1.00	999
BH13	Lambeth	3	0.1	1.3	19.5	<0.1	1.35	999
BH15	Head	3	0.1	0.9	20.2	0.1	0.17	999
BH16		3	0.1	1.5	19.8	0.1	1.58	999
BH17		3	0.1	2.3	17.2	0.1	DRY	999
BH18		3	0.1	2.5	18.1	0.1	1.95	999

5.3 Refinement of the initial conceptual site model

The investigation showed that the site is underlain with a variable thickness of topsoil underlain by Head Deposits across the majority of the site. The Bognor Sand Member

and Lambeth Group were also found to be present within the southern areas of the site. This confirms that described in the initial conceptual site model.

Groundwater was found to be present in two locations during the initial investigation and all but two monitoring well locations during the first gas monitoring round.

Based on the findings of the investigation the following pollutant linkages require further assessment:

- Direct contact with impacted soil by future residents
- Inhalation exposure of future residents to asbestos fibres
- Uptake of contaminants by vegetation potentially impacting plant growth
- Contaminants permeating potable water supply pipes
- Potential ground gas generation beneath the site.

6 QUANTITATIVE RISK ASSESSMENT

In line with CLR11 (EA, 2014), there are two stages of quantitative risk assessment, generic and detailed. The GQRA comprises the comparison of soil, groundwater, soil gas and ground gas results with generic assessment criteria (GAC) that are appropriate to the linkage being assessed. This comparison can be undertaken directly against the laboratory results or following statistical analysis depending upon the sampling procedure that was adopted.

6.1 Linkages for assessment

Section 5.3 presents the refined conceptual model which identified the linkages that required assessment after the findings of the site investigation had been considered. These linkages together with the method of assessment are presented in Table 14.

Table 14: Linkages for generic quantitative risk assessment

Potentially relevant pollutant linkage	Assessment method
1. Direct contact with impacted soil by future residents	Human health GAC in Appendix H for a proposed residential end use with private gardens since proposed end use includes residential gardens. Direct comparison to the GAC undertaken due to a number of different soil types tested across the site.
2. Inhalation exposure of future residents to asbestos fibres	Qualitative assessment based on the asbestos minerals present, their form, concentration, location and the nature of the proposed development.
3. Uptake of contaminants by vegetation potentially impacting plant growth	Comparison of soil data to GAC in Appendix I
4. Contaminants permeating potable water supply pipes	Comparison of soil data to GAC in Appendix J for plastic water supply pipes using UKWIR (2010) guidance.
5. Concentrations of methane and carbon dioxide in ground gas entering and accumulating in: depressions and excavations that could affect workers enclosed spaces or small rooms in new buildings, which could affect future residents. In the case of methane this could create a potentially explosive atmosphere, while	Gas screening values (GSV) have been calculated using maximum methane and carbon dioxide concentrations with maximum flow rates recorded at the site. The GSV have been compared with the generic Traffic Lights, as presented within the NHBC ground gases guide (Boyle and Witherington, 2007) and the aforementioned CIRIA report C665, owing to the development comprising low-rise housing with suspended floors.

Potentially relevant pollutant linkage	Assessment method
death by asphyxiation could result from carbon dioxide.	

6.2 Methodology and results

The methodology and results of the GQRA are presented for each relevant pollutant linkage in turn.

6.2.1 Direct contact with impacted soil by future residents

Due to the amount of different soil types tested across the site, results have been compared directly against the GAC for Human Health. A Soil Organic Matter (SOM) of 1% has been used as the most conservative approach.

All samples are below the GAC for Human Health at 1% SOM. This shows that the soils tested across the site are suitable for use.

Based on the above assessment, no potentially significant risks associated with the soil contamination have been identified and it is considered that the site may be regarded as suitable for the proposed end use.

6.2.2 Inhalation exposure of future residents to asbestos fibres

The visual inspection at the laboratory identified no materials suspected of potentially containing asbestos and the scheduled laboratory screening for asbestos found no detectable asbestos fibres within the samples of topsoil and made ground.

6.2.3 Uptake of contaminants by vegetation potentially inhibiting plant growth

The results have been compared with the GAC presented in Appendix I for this linkage. The results indicate that a relevant pollutant is unlikely to exist associated with phytotoxic effects.

6.2.4 Impact of organic contaminants on potable water supply pipes

For initial assessment purposes, the results of the investigation have been compared with the GAC presented in Appendix J for this linkage, which are reproduced from *UKWIR Report 10/WM/03/21. Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites* (UKWIR, 2010).

The results indicate that a relevant linkage is unlikely to exist associated with organic contaminants and therefore pollutant polyethylene (PE) and polyvinyl chloride (PVC) water supply pipes are expected to be suitable for use on the development.

It should be noted that at the time of this investigation the future routes of water supply pipes had not been established, hence the investigation and sampling strategy may not be fully compliant with UKWIR recommendations. Consequently, a targeted investigation and specific sampling/analytical strategy may be required at a later date once the route(s) of the supply pipe(s) is/are known. In addition, it is recommended that the relevant water supply company be contacted at an early stage to confirm its requirements for assessment, which may not necessarily be the same as those recommended by UKWIR.

6.2.5 Ground gas assessment

The results have been assessed in accordance with the guidance provided in BS8576, NHBC guidance and *CIRIA Report C665*. In the assessment of risks and selection of appropriate mitigation measures, both reports highlight the importance of the conceptual model.

6.2.5.1 General

CIRIA C665 identifies two types of development, termed Situation A (modified Wilson and Card method), appropriate to all development excluding traditional low-rise construction, and Situation B (National House-Building Council, NHBC) only appropriate to traditional low-rise construction with ventilated sub-floor voids.

Both methods are based on calculations of the limiting borehole gas volume flow for methane and carbon dioxide, renamed as the gas screening value (GSV). The GSV (litres of gas per hour) is calculated by multiplying borehole flow rate (litres per hour) and gas concentration (percent by volume).

In both situations, it is important to note that the GSV thresholds are guideline values and not absolute. The GSV thresholds may be exceeded in certain circumstances, if the site conceptual model indicates it is safe to do so. Similarly, consideration of additional factors such as very high concentrations of methane, should lead to consideration of the need to adopt a higher risk classification than the GSV threshold indicates.

The site is to be redeveloped with traditional low-rise residential housing and therefore falls under Situation B.

Situation B is a characterisation system developed by the NHBC (Boyle and Witherington, 2007), which relates only to low rise housing development constructed with a clear ventilated underfloor void. The system provides a risk-based approach that is designed to allow an identification of the required gas protection measures for low-rise housing by comparing the measured gas emission rates to generic "Traffic Lights". The Traffic Lights include typical maximum concentrations that are provided for initial screening purposes and risk-based GSVs for situations where the typical maximum concentrations are exceeded. Based on the typical maximum gas concentrations and the GSVs, the appropriate Traffic Light, ranging from Green through Amber 1 and Amber 2 to Red, is determined from Table 8.7 of CIRIA C665.

6.2.5.2 *Assessment of data*

The site is to be redeveloped with traditional low-rise residential housing and therefore falls under Situation B. The gas monitoring data to date has identified a maximum methane concentration of 0.1% and a maximum concentration of carbon dioxide of 5.9%. A maximum gas flow rate of 0.1l/hr has been recorded. The calculated GSV for methane is 0.0001 l/hr and the GSV for carbon dioxide is 0.59l/hr. Based on the GSVs the site has been characterised as Green due to the lack of flow recorded across the site.

6.3 **Environmental assessment conclusions**

The results of the GQRA indicate that relevant pollutant linkages are absent and therefore the site is suitable for the proposed end use.

7 GEOTECHNICAL SITE ASSESSMENT

7.1 Engineering considerations

It is understood that consideration is being given to redevelopment of the site with low-rise housing and associated infrastructure with sports facilities in the south. At this stage no specific information relating to building loads has been provided and therefore a wall loading of 100kN/m has been considered.

7.2 Geotechnical hazards

A summary of commonly occurring geotechnical hazards is given in **Table 15** together with an assessment of whether the site may be affected by each of the stated hazards.

Table 15: Summary of main potential geotechnical hazards that may affect site

Hazard category (excluding contamination issues)	Hazard status based on investigation findings and proposed development			Engineering considerations if hazard affects site
	Found to be present on site	Could be present but not found	Unlikely to be present and/or affect site	
Sudden lateral changes in ground conditions		X clay and sand		Likely to affect ground engineering and foundation design and construction
Shrinkable clay soils	X	sandy clay of medium shrinkage potential		Design to NHBC Standards Chapter 4.
Highly compressible and low bearing capacity soils, (including peat and soft clay)			X	Likely to affect ground engineering and foundation design and construction
Silt-rich soils susceptible to rapid loss of strength in wet conditions		X		Likely to affect ground engineering and foundation design and construction
Running sand at and below water table		X		Likely to affect ground engineering and foundation design and construction
Ground subject to or at risk from landslides	X			Likely to require special stabilisation measures
Ground subject to peri- glacial valley cambering			X	Likely to affect ground engineering and foundation

Hazard category (excluding contamination issues)	Hazard status based on investigation findings and proposed development			Engineering considerations if hazard affects site
	Found to be present on site	Could be present but not found	Unlikely to be present and/or affect site	
with gulls possibly present				design and construction
Ground subject to or at risk from coastal or river erosion			X	Likely to require special protection/stabilisation measures
High groundwater table (including waterlogged ground)		X		May affect temporary and permanent works
Rising groundwater table due to diminishing abstraction in urban area			X	May affect deep foundations, basements and tunnels
Karstic dissolution features (including 'swallow holes' in Chalk terrain). Chalk pits noted along the southern boundary		X		May affect ground engineering and foundation design and construction –
Underground mining (i.e. associated with chalk)			X	Unlikely but cannot be discounted. Likely to require special stabilisation measures
Existing sub-structures (e.g. tunnels, foundations, basements, and adjacent sub- structures)			X	Likely to affect ground engineering and foundation design and construction
Filled and made ground (including embankments, infilled ponds and quarries)			X	Likely to affect ground engineering and foundation design and construction
Adverse ground chemistry (including expansive slags and weathering of sulphides to sulphates)			X	May affect ground engineering and foundation design and construction

7.3 Foundations

7.3.1 General suitability

Given the presence of competent natural soils at a relatively shallow depth, it is considered that the ground conditions are suitable for the adoption of traditional, spread type foundations for low-rise housing.

7.3.2 Spread foundations

The recommendations for the design and construction of spread foundations in relation to the ground conditions are set out in **Table 16**.

Table 16: Design considerations

Design/construction considerations	Design/construction recommendations
Founding stratum	Head Deposit typically comprising firm sandy Clay (PI_m typically <40%) and sand.
Depth	Foundations must be taken down through any made ground (generally absent although to 1.5m depth in BH7) and founded at a minimum depth of 0.9m below finished ground level and at least 0.1m into the founding stratum or to any greater depth as required in respect of the special design considerations given below.
Special design considerations	Owing to the presence of shrinkable clay soils, foundations must be designed taking into account all the normal precautions, including minimum founding depths, to minimise the risk of future foundation movements in accordance with NHBC standards, Chapter 4.2, 'Building near trees'. The findings of the ground investigation indicate that foundations should be designed for shrinkable soils of medium volume change potential. There is the potential for lateral variation of ground condition i.e. clay and sand. Where variable ground conditions are encountered then nominal mesh reinforcement must be provided to foundations to overcome the potential for differential settlement. In the vicinity of BH7, beneath made ground to 1.5m depth, soft silty clay was encountered to the full depth of boring of 3mbgl. It is recommended that supplementary investigations i.e. trial pits be undertaken to assess more thoroughly ground conditions in this area. Piled foundations may prove to be a more viable option for affected plots in this area.
Bearing capacity	Spread foundations with a width of up to 1m and constructed on the firm sandy Clay at a minimum depth of 0.9m may be designed using a net allowable bearing pressure of 100kN/m². The allowable bearing capacity includes an overall safety factor of 3

Design/construction considerations	Design/construction recommendations
	against bearing capacity failure and with total settlements associated with the bearing pressure estimated to be less than 25mm.
Stability of excavations	Generally, the boreholes remained stable during drilling, however no trial pits have been undertaken so no comment can be made on the stability of excavations. Whilst no shallow groundwater seepages were encountered at the time of the investigation, the sides of excavations could potentially be unstable associated with any seepages and groundwater 'issues', see Section 7.3.7 .
Dewatering	The cohesive nature of the soils encountered across the majority of the site suggests that pumping from open sumps should be sufficient to keep the excavations reasonably dry.
Construction considerations	Proposed formation soils must be closely inspected. Should any made ground, soft organic or otherwise unsuitable materials be encountered then the foundation must be locally deepened to a suitable founding stratum.

7.3.3 Foundation works risk assessment

It is considered that a foundation works risk assessment report will not be because concentrations of contaminants of potential concern (COPC) within made ground and natural soils were typically below corresponding GAC.

7.3.4 Floor slabs

Whilst the shallow ground conditions are considered potentially suitable for the adoption of ground bearing floors, it is recommended that ground floors be suspended throughout. Suspended floors must be designed in accordance with NHBC standards, Chapter 5.2, 'Suspended ground floors'.

7.3.5 Roads, hardstanding and drainage

In the 1m to 1.5m below the proposed finished ground level, the boreholes have revealed a soil profile comprising topsoil over sandy clay and sand. In pavement design terms, the groundwater conditions are anticipated to comprise a low water table, i.e. at least 1m below the pavement formation level.

The potentially poorest sub-grade material within this profile is considered to be the sandy clay (PI_m typically <40%).

The estimated minimum, equilibrium soil-suction, California bearing ratio (CBR) value for the soils and groundwater conditions described above under a completed pavement is 2% to 3%, based upon Table C1 in TRRL (1984) Report LR1132. It is recommended that further assessment be carried out on the proposed formation soils to confirm CBR for pavement design.

7.3.6 Chemical attack on buried concrete

This assessment of the potential for chemical attack on buried concrete is based on current BRE guidance. The desk study and site walkover indicate that, for the purposes of this assessment of the aggressive chemical environment, the site should be considered as a Greenfield site where the underlying geology is not known to contain significant pyrite that could result in additional sulphate when disturbed during the earthworks phase of construction.

The "Characteristic value" is the highest result, or the mean of the two highest results if more than 5 results from the same stratum are available. The maximum water-soluble sulphate content in soil of 0.287g/l has been taken as the characteristic value. Result One for the Design Sulphate Class for the site is therefore DS-1. In the absence of shallow groundwater, there is no Result 2.

From consideration of the characteristic pH value and assuming static groundwater conditions, an Aggressive Chemical Environment for Concrete classification of AC-1, may be adopted for design purposes.

7.3.7 Slopes

The site comprises sloping land albeit relatively shallow slopes. It is recommended that once construction levels have been confirmed, a preliminary slope stability assessment is carried out. Should a more detailed slope stability assessment be required then supplementary investigations comprising boreholes and groundwater monitoring wells will be required.

It is noted the presence of 'issues' on the Envirocheck report 1:10,000 scale geological map (2000) that is indicative of groundwater seepages at the surface. Consideration will need to be given to the potential for groundwater seepages on slope stability, foundation construction and site drainage.

7.3.8 Soakaways

Based upon the results of the soakaway tests presented in **Section 5.1.7**, the ground conditions associated with the Head Deposits have relatively poor drainage characteristics (1.2×10^{-7} to 8×10^{-7} m/sec). Subject to further assessment, the more granular deposits encountered in the vicinity of BH8, BH12, BH15 could potentially be suitable.

8 REUSE OF MATERIALS AND WASTE

8.1 Reuse of suitable materials

Under the Waste Framework Directive naturally occurring soils are not considered waste if re-used on the site of origin for the purposes of development.

In accordance with the definition provided in the Waste Framework Directive, materials are only considered waste if 'they are discarded, intended to be discarded or required to be discarded, by the holder'. Thus, soils that are not of clean and natural origin, i.e. made ground (whether contaminated or not) and other materials such as recycled aggregate, do not become waste until the aforementioned criteria are met.

The Definition of Waste: Development Industry Code of Practice (CL:AIRE, 2011) (CoP) was developed in consultation with the Environment Agency and development industry to enable the re-use of materials under certain scenarios and subject to demonstrating that specific criteria are met. The current re-use scenarios covered by the CoP comprise:

- Re-use on the site of origin (with or without treatment)
- Direct transfer of clean and natural soils between sites
- Use in the development of land other than the site of origin following treatment at an authorised Hub site (including a fixed Soil Treatment Facility).

The importation of made ground soils (irrespective of contamination status) or crushed demolition materials is not currently permitted under the CoP and requires either a standard rules environmental permit or a U1 waste exemption (see below).

In the context of excavated materials used on sites undergoing development, four factors are considered to be of particular relevance in determining if the material is a waste or when it ceases to be waste:

- the aim of the Waste Framework Directive is not undermined, i.e. if the use of the material will create an unacceptable risk of pollution of the environment or harm to human health it is likely to be waste
- the material is certain to be used
- the material is suitable for use both chemically and geotechnically
- only the required quantity of material will be used.

The CoP requires the preparation of a materials management plan (MMP) that confirms the above factors will be met. This plan needs to be reviewed by a 'Qualified Person' (QP) who will then issue a declaration form to the EA. As the project progresses, data must be collated and on completion a verification report produced that shows the MMP was followed and describes any changes.

The MMP establishes whether specific materials are classified as waste and how excavated materials will be treated and/or re-used in line with the CoP. The MMP is likely to form part of the site waste management plan.

As the site has not been previously developed all excavation works are expected to generate only clean and naturally occurring soils. Under the Waste Framework Directive naturally occurring soils are not considered waste if re-used on the site of origin. However, if it is proposed to import clean and naturally occurring soils direct from another site, an MMP would need to be in place at the receiving site.

8.2 Treatment to meet suitable-for-use criteria

Where materials do not meet the suitable for use criteria it may be possible to treat them under an environmental permit (mobile treatment licence) to enable them to be reused onsite.

To enable the treatment options to be determined, an options appraisal and a remediation strategy document will be necessary to support discussion of the issues with regulators and third parties.

8.3 Reuse of waste materials

If material is discarded as waste then its reuse on site may still be possible. Waste soils and recycled aggregate can be reused on site under a standard rules environmental permit or a U1 waste exemption from the Environmental Permitting (England and Wales) Regulations 2010 provided that they are suitable for the proposed use, i.e. not cause harm to human health or the environment. However, it should be noted that these have strict limits on the quantity of material that can be reused.

8.4 Wastes for landfill disposal

Wastes require pre-treatment prior to disposal at landfill. Pre-treatment must be a physical, thermal, chemical or biological process (including sorting) that changes the characteristics of the waste to reduce its volume, reduce its hazardous nature, facilitate its handling and enhance its recovery.

The latest, edition of the EA's 'Technical Guidance WM3' (2015) Guidance on the classification and assessment of waste, requires that within a mixed waste the separately identifiable wastes are assessed separately. Mixing of different types of hazardous waste and hazardous waste with other waste substances is prohibited under the Waste Framework Directive. Wastes that have been mixed must be separated whenever possible.

It is best practice to provide your waste carrier (or the disposal site) with details of how the waste has been treated. Your waste carrier may provide a pre-treatment confirmation form or space on the waste transfer note to detail the pre-treatment.

The classification of waste soil is a two-stage process, the first being an assessment of whether the soil is considered hazardous or not following the guidance within Technical Guidance WM3. For off-site disposal to landfill the results of Waste Acceptance Criteria (WAC) testing must then be reviewed to establish if the soil is acceptable at the relevant class of landfill or requires pre-treatment to reduce specific hazardous properties.

8.4.1 Waste acceptance criteria

All inert, stable non-reactive hazardous and hazardous wastes have limit values (waste acceptance criteria) set out in legislation that must be met before that class of landfill can accept the waste. Currently, no WAC are in place for non-hazardous waste.

Soil and other materials that are found not to be hazardous may be classified as either non hazardous or inert. In order to determine whether they can be classed as inert the soil must be tested and found to be below the inert waste acceptance criteria.

8.4.2 Waste sampling plan

Technical Guidance WM3 sets out in Appendix D requirements for waste sampling. It is a legal requirement to correctly assess and classify waste. The level of sampling should be proportionate to the volume of waste and its heterogeneity. At this stage RSK consider that the level of soil sampling is/is not sufficient to robustly/fully categorise the material.

RSK recommends that a Sampling Plan be prepared to support any waste classifications and hazardous waste assessments, prior to development.

8.4.3 Preliminary waste assessment

Given the level of data obtained, scale of the development and heterogeneity of the site soils the following assessment should be considered indicative and further assessment should be undertaken following the preparation of a Waste Sampling Plan.

EnviroLab (an RSK company) has developed a waste soils characterisation assessment tool (HASWASTE), which follows the guidance within Technical Guidance WM3. The analytical results have been assessed using this tool for potential off-site disposal of materials in the future. The results are presented in Appendix O.

None of the samples were classified as hazardous waste. Therefore to determine whether waste might be classified as inert or non hazardous WAC testing will need to be undertaken.

8.4.4 Asbestos within waste soils

The latest, edition of Technical Guidance WM3, requires that within a mixed waste the separately identifiable wastes be assessed separately.

For instance, where waste soil contains identifiable pieces of asbestos (visible to the naked eye) the asbestos should, where feasible, be separated from the soil and classified separately.

Samples of potential asbestos containing material were collected from site and analysed for the presence of asbestos, the results of which are presented in Appendix G. Analysis confirmed that asbestos is not present within samples collected across the site.

8.5 Landfill tax

Waste producers disposing of material to landfill are required to pay landfill tax by HM Revenue and Customs.

The tax is chargeable by weight (tonnage) and two rates apply, either standard or lower rate. The lower rate only applies to those less polluting wastes as set out in the Landfill Tax (Qualifying Material) Order 2011, which include naturally occurring rock and soil, concrete, some minerals, some furnace slags and ash, and some low-activity organic compounds. Evidence confirming that the waste qualifies for the lower rate will be required, and standard rate tax will apply for the whole waste load for any loads of mixed waste.

Currently (since April 2016), standard rate landfill tax is £84.40 per tonne.

The lower rate of landfill tax applicable to less polluting wastes (i.e. 'inert' wastes) is £2.65 per tonne.

Material disposed of at a soil treatment centre will not be subject to landfill tax.

8.6 Groundwater

When there is an intention to discard groundwater, chemical test results will indicate the appropriate disposal options. This could include disposal to treatment facility, via consent (issued by the water authority) to foul sewer or via consent (issued by the EA) to a watercourse or land.

8.7 Waste recommendations

RSK recommends that consideration as to how potentially waste soils will be dealt with as part of this development/remediation is given as early in the project planning process as possible. Such planning can lead to cost savings where potentially waste soils are viewed as a resource and retained on-site as part of the development. We also recommend, where off-site disposal is being considered, that appropriate facilities are identified and discussions initiated to confirm suitability of the facility to take the material. Potentially, these may include soil treatment facilities as well as landfills.



RSK can provide specialist advice to assist in this process, which can be complex and subject to regular regulatory change.

9 CONCLUSIONS AND RECOMMENDATIONS

9.1 Environmental

The results of the GQRA indicate that relevant pollutant linkages are absent and therefore the site is suitable for the proposed end use.

The visual inspection at the laboratory identified no materials suspected of potentially containing asbestos and the scheduled laboratory screening for asbestos found no detectable asbestos fibres within the samples of topsoil and made ground.

Based on the GSVs the site has been characterised as Green due to the lack of flow recorded across the site. Therefore based on the data collected to date no gas mitigation measures are required at the site.

9.2 Reuse of materials and waste

None of the samples were classified as hazardous waste. Therefore, to determine whether waste might be classified as inert or non hazardous WAC testing will need to be undertaken.

RSK recommends that consideration as to how potentially waste soils will be dealt with as part of this development/remediation is given as early in the project planning process as possible. Such planning can lead to cost savings where potentially waste soils are viewed as a resource and retained on-site as part of the development. We also recommend, where off-site disposal is being considered, that appropriate facilities are identified and discussions initiated to confirm suitability of the facility to take the material. Potentially, these may include soil treatment facilities as well as landfills.

RSK can provide specialist advice to assist in this process, which can be complex and subject to regular regulatory change.

9.3 Geotechnical

The ground conditions typically comprise sandy clay of medium shrinkage potential and sand. Made ground is generally absent.

Given the presence of competent natural soils at a relatively shallow depth, it is considered that traditional spread foundations will be suitable for the majority of the site although consideration will need to be given to the relatively soft ground conditions encountered in the vicinity of BH7. Here supplementary investigation i.e. trial pits are recommended to assess more thoroughly ground conditions in this area. Piled foundations may prove to be a more viable proposition for affected plots in this area.

Spread foundations must be taken down through any made ground and founded in the underlying firm sandy clay or sand at a minimum depth of 0.9m below final or existing level whichever is lower. A maximum net allowable bearing pressure of 100kN/m^2 can be assumed. Nominal mesh reinforcement will be required for formations soil varying between clay and sand.

Once levels for the proposed construction platform have been established, it is recommended that consideration be given to slope stability. Further investigations comprising boreholes including groundwater monitoring may be required to provide a more detailed assessment.

It is recommended that buried concrete be designed assuming a Design Sulphate Class DS-1 and an Aggressive Chemical Environment for Concrete classification of AC-1_s.

The ground conditions associated with the Head Deposits underlying the site do not appear to be suitable for the use of borehole or pit soakaways. Further investigations comprising trial pit soakage tests are recommended to assess the infiltration characteristics of more granular stratum.

For pavement design, the potentially poorest sub-grade material is considered to be sandy clay of medium shrinkage potential. A California Bearing Ratio (CBR) of 2% to 3% can be assumed for preliminary design purposes. Further assessment is recommended once proposed sub-grade levels have been established.

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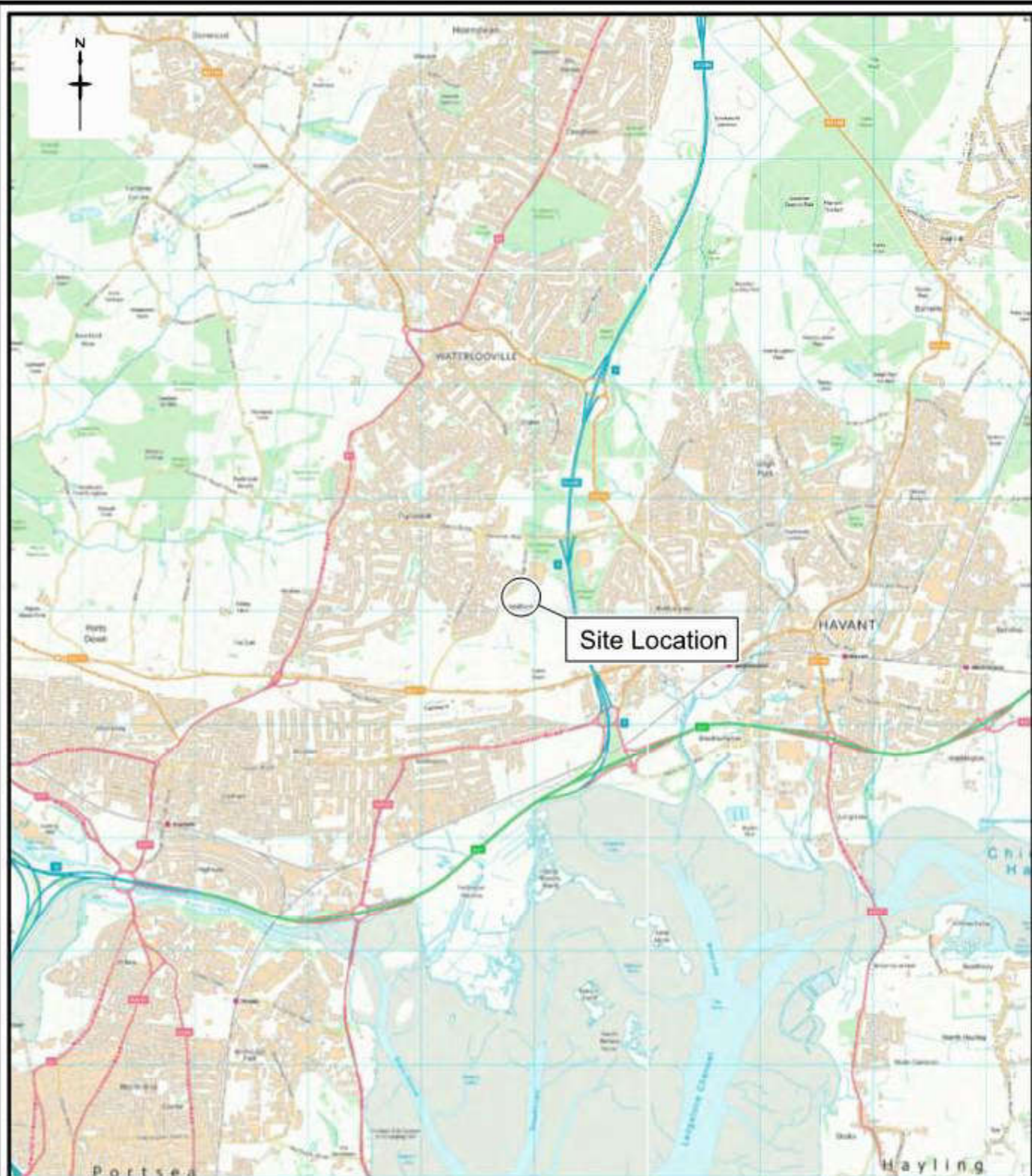
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FIGURES



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Client:

RADIAN

Project Title:

CAMPDOWN, WATERLOOVILLE

Drawing Title:

SITE LOCATION PLAN

Rev	Drawn	Scale	Checked	Date	Approved	Date
01	ASC	10.08.16	ARJ	10.08.16	ARJ	10.08.16
Dimensions		m	Scale		1:50,000	
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Project Number

28720 - R01 (00)

Drawing File

28720 - SLP.dwg

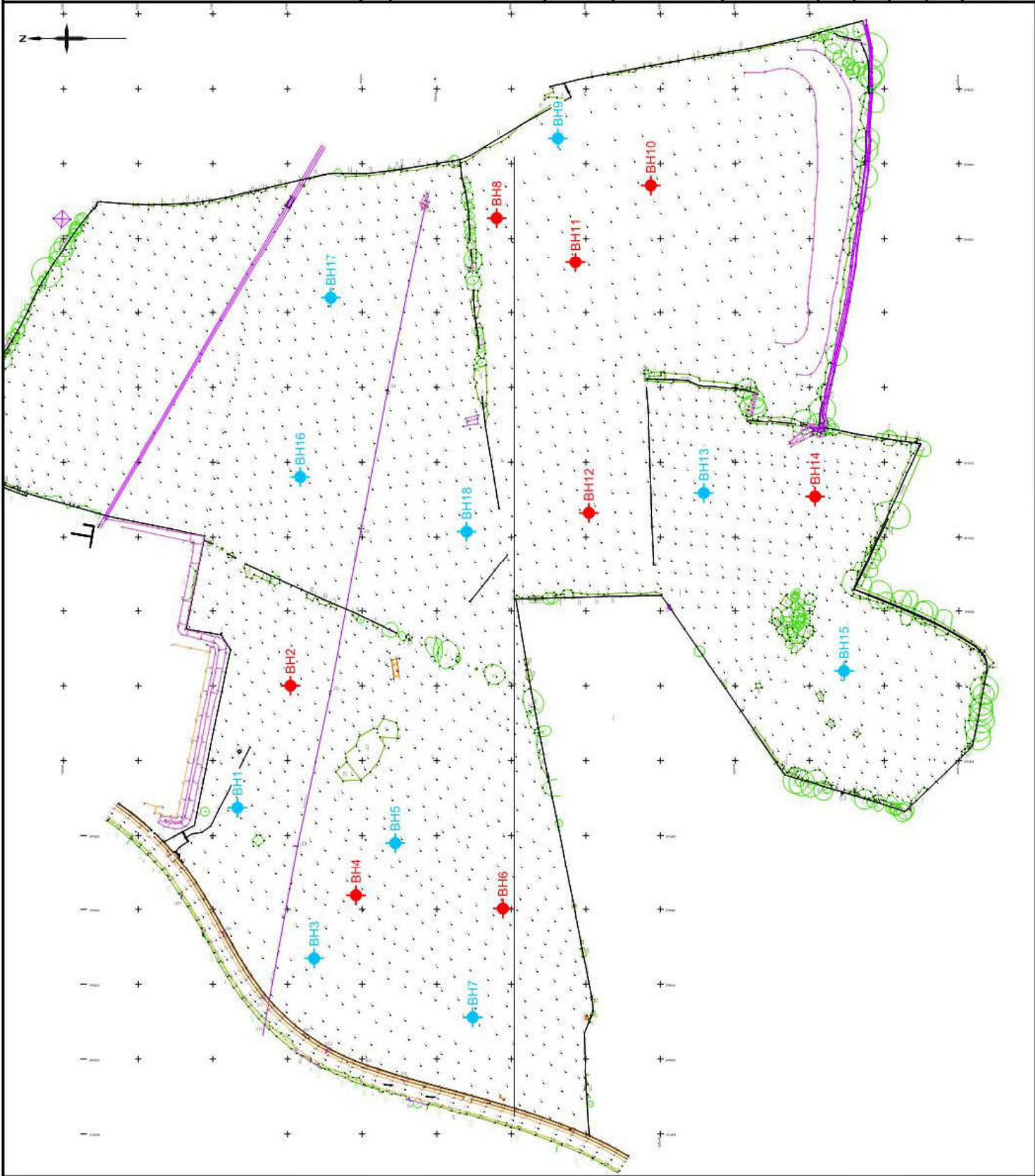
Drawing Number

FIGURE 1

LEGEND

● Borehole Location

● Borehole Location with Installation



Rev	Date	Amendment	Drawn	Chkd	Apptd



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Client

RADIAN

Project Title

CAMPDOWN,
WATERLOOVILLE

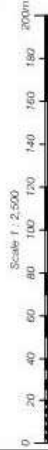
Drawing Title

EXPLORATORY HOLE LOCATION PLAN

Drawn	Scale	Checked	Date	Approved	Date
ASC	1:2500	ARJ	11.08.16	ARJ	11.08.16
Scale	1:2500	Orig Size	A3	Dimensions	m

Project No.	28720 - R01 (00)	Drawing File	28720 (R01-00) Fig 2.dwg
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Drawing No.	FIGURE 2	Rev	P1
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APPENDIX A

SERVICE CONSTRAINTS

1. This report and the site investigation carried out in connection with the report (together the "Services") were compiled and carried out by RSK Environment Limited (RSK) for Radian (the "client") in accordance with the terms of a contract between RSK and the "client", dated 28th July 2016. The Services were performed by RSK with the skill and care ordinarily exercised by a reasonable environmental consultant at the time the Services were performed. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the client.
2. Other than that expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services.
3. Unless otherwise agreed in writing the Services were performed by RSK exclusively for the purposes of the client. RSK is not aware of any interest of or reliance by any party other than the client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent or condone any party other than the client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and RSK disclaims any liability to such parties. **Any such party would be well advised to seek independent advice from a competent environmental consultant and/or lawyer.**
4. It is RSK's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances by the client without RSK's review and advice shall be at the client's sole and own risk. Should RSK be requested to review the report after the date of this report, RSK shall be entitled to additional payment at the then existing rates or such other terms as agreed between RSK and the client.
5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the report in the future shall be at the client's own and sole risk. Should RSK be requested to review the report in the future, RSK shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between RSK and the client.
6. The observations and conclusions described in this report are based solely upon the Services which were provided pursuant to the agreement between the client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, RSK did not seek to evaluate the presence on or off the site of asbestos, electromagnetic fields, lead paint, heavy metals, radon gas or other radioactive or hazardous materials.
7. The Services are based upon RSK's observations of existing physical conditions at the Site gained from a walk-over survey of the site together with RSK's interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The Services are also based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely. The Services clearly are limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the walk-over survey. Further RSK was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services. RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK and including the doing of any independent investigation of the information provided to RSK save as otherwise provided in the terms of the contract between the client and RSK.
8. The intrusive environmental site investigation aspects of the Services is a limited sampling of the site at pre-determined borehole and soil vapour locations based on the operational configuration of the site. The conclusions given in this report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition chemical analysis was carried out for a limited number of parameters [as stipulated in the contract between the client and RSK] [based on an understanding of the available operational and historical information,] and it should not be inferred that other chemical species are not present.
9. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan, but is (are) used to present the general relative locations of features on, and surrounding, the site. Features (boreholes, trial pits etc) annotated on site plans are not drawn to scale but are centred over the approximate location. Such features should not be used for setting out and should be considered indicative only.

APPENDIX B

SUMMARY OF LEGISLATION AND POLICY RELATING TO CONTAMINATED LAND

Part IIA of the Environmental Protection Act 1990 (EPA) and its associated Contaminated Land Regulations 2000 (SI 2000/227), which came into force in England on 1 April 2000, formed the basis for the current regulatory framework and the statutory regime for the identification and remediation of contaminated land. Part IIA of the EPA 1990 defines contaminated land as 'any land which appears to the Local Authority in whose area it is situated to be in such a condition by reason of substances in, on or under the land, that significant harm is being caused, or that there is significant possibility of significant harm being caused, or that pollution of controlled waters is being or is likely to be caused'. Controlled waters are considered to include all groundwater, inland waters and estuaries.

In August 2006, the Contaminated Land (England) Regulations 2006 (SI 2006/1380) were implemented, which extended the statutory regime to include Part IIA of the EPA as originally introduced on 1 April 2000, together with changes intended chiefly to address land that is contaminated by virtue of radioactivity. These have been replaced subsequently by the Contaminated Land (England) (Amendment) Regulations 2012, which now exclude land that is contaminated by virtue of radioactivity.

The intention of Part IIA of the EPA is to deal with contaminated land issues that are considered to cause significant harm on land that is not undergoing development (see Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance, April 2012). This document replaces Annex III of Defra Circular 01/2006, published in September 2006 (the remainder of this document is now obsolete).

Water Framework Directive (WFD)

The Water Framework Directive 2000/60/EC is designed to:

- enhance the status and prevent further deterioration of aquatic ecosystems and associated wetlands that depend on the aquatic ecosystems
- promote the sustainable use of water
- reduce pollution of water, especially by 'priority' and 'priority hazardous' substances
- ensure progressive reduction of groundwater pollution.

The WFD requires a management plan for each river basin be developed every six years.

Groundwater Directive (GWD)

The 1980 Groundwater Directive 80/68/EEC and the 2006 Groundwater Daughter Directive 2006/118/EC of the WFD are the main European legislation in place to protect groundwater. The 1980 Directive is due to be repealed in December 2013. The European legislation has been transposed into national legislation by regulations and directions to the Environment Agency.

Environmental Permitting Regulations (EPR)

The Environmental Permitting (England and Wales) Regulations 2010 provide a single regulatory framework that streamlines and integrates waste management licensing, pollution prevention and control, water discharge consenting, groundwater authorisations, and radioactive substances regulation. Schedule 22, paragraph 6 of EPR 2010 states: 'the regulator must, in exercising its relevant functions, take all necessary measures - (a) to prevent the input of any hazardous substance to groundwater; and (b) to limit the input of non-hazardous pollutants to groundwater so as to ensure that such inputs do not cause pollution of groundwater.'

Water Resources Act (WRA)

The Water Resources Act 1991 (Amendment) (England and Wales) Regulations 2009 updated the Water Resources Act 1991, which introduced the offence of causing or knowingly permitting pollution of controlled waters. The Act provides the Environment Agency with powers to implement remediation necessary to protect controlled waters and recover all reasonable costs of doing so.

Priority Substances Directive (PSD)

The Priority Substances Directive 2008/105/EC is a 'Daughter' Directive of the WFD, which sets out a priority list of substances posing a threat to or via the aquatic environment. The PSD establishes environmental quality standards for priority substances, which have been set at concentrations that are safe for the aquatic environment and for human health. In addition, there is a further aim of reducing (or eliminating) pollution of surface water (rivers, lakes, estuaries and coastal waters) by pollutants on the list. The WFD requires that countries establish a list of dangerous substances that are being discharged and EQS for them. In England and Wales, this list is provided in the River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions 2010. In order to achieve the objectives of the WFD, classification schemes are used to describe where the water environment is of good quality and where it may require improvement.

Planning Policy

Contaminated land is often dealt with through planning because of land redevelopment. This approach was documented in Planning Policy Statement: Planning and Pollution Control PPS23, which states that it remains the responsibility of the landowner and developer to identify land affected by contamination and carry out sufficient remediation to render the land suitable for use.

PPS23 was withdrawn early in 2012 and has been replaced by much reduced guidance within the National Planning Policy Framework (NPPF).

The new framework has only limited guidance on contaminated land, as follows:

- *“planning policies and decisions should also ensure that:*
 - *the site is suitable for its new use taking account of ground conditions and land instability, including from natural hazards or former activities such as mining, pollution arising from previous uses and any proposals for mitigation including land remediation or impacts on the natural environment arising from that remediation;*
 - *after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990; and*
 - *adequate site investigation information, prepared by a competent person, is presented”.*

APPENDIX C

SITE PHOTOGRAPHS AND WALKOVER CHECKLIST

PHOTOGRAPHIC LOG

Site Location: Campdown

Photo No.
1

Date:
02/08/16

View of
eastern
boundary



Photo No.
2

Date:
02/08/16

View west
from east



PHOTOGRAPHIC LOG

Site Location: Campdown

Photo No.
3

Date:
02/08/16

Southern
boundary
looking from
east



Photo No.
4

Date:
02/08/16

Looking
north from
the southern
boundary



PHOTOGRAPHIC LOG

Site Location: Campdown

Photo No.
5

Date:
02/08/16

Looking
south east
from central
region



Photo No.
6

Date:
02/08/16

View looking
south from
central
region



PHOTOGRAPHIC LOG

Site Location: Campdown

Photo No.
7

Date:
02/08/16

View of
southernmost
part of site



Photo No.
8

Date:
02/08/16

View looking
north west



PHOTOGRAPHIC LOG

Site Location: Campdown

Photo No.
9

Date:
02/08/16

Soils from
BH14



Photo No.
10

Date:
02/08/16

Soils from
BH8



PHOTOGRAPHIC LOG

Site Location: Campdown

Photo No.
11

Date:
02/08/16

Soils from
BH18



Photo No.
12

Date:
02/08/16

View
looking west
from central
region



WALKOVER SURVEY CHECKLIST

SITE NAME **Campdown**
NGR 468760, 106730

SITE REFERENCE 28720

These inspections can provide useful information on:

- Potential geotechnical hazards
- Suitable and appropriate locations for investigation
- The groundwater and surface water environments
- Potentially sensitive receptors (targets) including issues that require further investigation, e.g. ecology surveys
- Potential sources of contaminants
- Nature of contamination
- Potential migration routes (pathways)

Mark locations of features described on a map and give them a reference number.

Describe features in as much detail as possible. Continue on the back of the checklist if necessary, using the feature letter for reference. Take photos of site and relevant features in immediate surrounding area.

The walkover survey can also provide information for the environmental consultant in planning the site investigation.

Points that should be addressed in a walkover survey are as follows:

Features	Description	Photo no.	Map ref.
a) Describe materials exposed in nearby road or railway cuttings, in pits and quarries and natural exposures of soils and rocks near to the site. <i>This will give an indication of the geology beneath the site</i>	Brown clay		
b) Describe surrounding properties/land use <i>This will identify any potential sources of contamination from adjacent sites and any sensitive receptors</i>	South down college to north A3(M) to east Golf course to south Residential to west		
c) Describe present land use <i>Especially crops, for consideration of appropriate timing for further investigation, compensation and reinstatement. Also note hardstanding, obstructions etc. Note any old buildings/ivy covered trees as these may be used by owls or bats</i>	Undeveloped scrubland used for horse grazing		

WALKOVER SURVEY CHECKLIST Continued

NGR

Features	Description	Photo no.	Map ref.
d) Describe the site in terms of ground slopes and changes in slope. <i>Old scarps or hummocky ground may be evidence of previous landslips that could be reactivated. A terraced appearance may be indicative of superficial solifluction movement or cambering.</i>	Undulating with general trend sloping to south. Steeper slopes in central and western areas		
e) Describe the types and condition of surface vegetation. <i>Nettles may indicate an old cesspit for example or unhealthy vegetation may indicate the presence of phytotoxic fill or landfill gas. Note invasive weeds, e.g. Japanese knotweed.</i>	Grassland with trees and hedges.		
f) Note the number, location, height and species of trees and hedges. <i>This is important in terms of shrinking and swelling ground. Trees that are leaning may indicate instability or general slope movement. Trees and hedgerows may be protected; their condition should be noted along with any restrictions they will impose for site access.</i> <i>It is important to note any areas with the potential for nesting birds, roosting bats, water voles and badger setts.</i>	Mature trees across the site in along boundary with golf course in the south.		
g) Describe any evidence of animal activity. <i>For example obvious animal paths or areas of excavations and burrows.</i>	None		
h) Describe any damage to existing structures on site or adjacent to the site <i>For example, cracks in buildings both on the site and in the neighbourhood, and other evidence of settlement or differential settlement.</i> <i>Note presence of any suspected asbestos-containing materials (ACM)</i>	None		
i) Note the remains of structures that have been demolished. Look for evidence of remnants of any historical structures. <i>This will provide valuable information on the location of previous foundations, processes etc.</i> <i>Note presence of any suspected asbestos-containing materials (ACM)</i>	None		

WALKOVER SURVEY CHECKLIST Continued

NGR

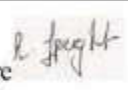
Features	Description	Photo no.	Map ref.
j) Note any abrupt changes in ground level. <i>May indicate that minerals have been worked in surface excavations.</i>	None		
k) Note any surface hollows. <i>Which may indicate the presence of solution features or swallow holes in rocks such as chalk limestone, gypsum and salt, or collapsed underground workings in these materials. May also indicate badger setts or other wildlife activity.</i>	None		
l) In areas of country underlain by coal or other minerals note any hummocky ground. <i>Which may be the remnants of spoil tips and surface depressions that may indicate collapsed shallow workings. Areas of general unevenness may be evidence of waste disposal activities.</i>	N/A		
m) Note any evidence of gas from nearby landfill sites <i>Can be indicated for example by poor vegetation or gas bubbles in water-filled trenches.</i>	None		
n) Note the location of streams, ponds, seepages and sinks and signs of previous flooding. <i>If ponds are present on site they may contain great crested newts. Ditches, streams and rivers that border or run through a site may contain water voles, otters or white-clawed crayfish. Presence of water features on site may prompt the need for a survey during a site investigation.</i>	None		
o) All surface waters should be examined for evidence of contamination. <i>For example, oil sheen, silt, solid matter, discoloured sediment.</i>	None identified		
p) Note any discoloured ground. <i>This may provide evidence of contamination.</i>	None		
q) Identify any old structures, pipework etc. wherever possible and, if safe, inspect for evidence of stored waste. <i>Old tanks may contain oil. Old electricity transformers should be noted. Asbestos risk should be assessed together with the need for a specialist hazardous materials survey.</i>	None		

WALKOVER SURVEY CHECKLIST Continued

NGR

Features	Description	Photo no.	Map ref
r) Examine surrounding areas for evidence of contamination which could migrate onto the site. <i>For example a leaking oil tank on an adjacent site.</i>	None		
s) Note the presence of any underground structures, services, mine workings, tunnels etc <i>From a safety point of view for development of the site and also as they may provide contaminant migration routes.</i>	None		
t) Note any anecdotal information in past uses of the site. <i>Local street names etc. can provide indicators of past industry or ground problems</i>	None		
u) Identify potential access routes to the site for plant for the site investigation <i>Excavators and drilling rigs may be required for the next stage of the investigation, or if the access is limited window sampling techniques may need to be specified. Note any specific obstructions such as unsafe/unstable ground, protected trees or hedgerows, or protected buildings.</i>	Via gate off College Road in north west of site		
v) Evidence of buried services (water, gas, electricity, telephone, cable, television, pipelines) <i>Both for safety considerations and in the case of water as supply for further investigation. As well as danger, there is the question of considerable expense, which can arise from an inadequate knowledge of the location of buried services. The locations and heights of overhead cables may be important when considering the movement of site equipment.</i>	None		

Walkover survey completed

Approved: _____ Signature 

Name Russell Speight

Date 02/08/16

Notes

APPENDIX D

RISK ASSESSMENT METHODOLOGY

CLR11 outlines the framework to be followed for risk assessment in the UK. The framework is designed to be consistent with UK legislation and policies including planning. Under CLR11, three stages of risk assessment exist: preliminary, generic quantitative and detailed quantitative. An outline conceptual model should be formed at the preliminary risk assessment stage that collates all the existing information pertaining to a site in text, tabular or diagrammatic form. The outline conceptual model identifies potentially complete (termed possible) pollutant linkages (contaminant–pathway–receptor) and is used as the basis for the design of the site investigation. The outline conceptual model is updated as further information becomes available, for example as a result of the site investigation.

Production of a conceptual model requires an assessment of risk to be made. Risk is a combination of the likelihood of an event occurring and the magnitude of its consequences. Therefore, both the likelihood and the consequences of an event must be taken into account when assessing risk. RSK has adopted guidance provided in CIRIA C552 for use in the production of conceptual models.

The likelihood of an event can be classified on a four-point system using the following terms and definitions based on CIRIA C552:

- highly likely: the event appears very likely in the short term and almost inevitable over the long term or there is evidence at the receptor of harm or pollution
- likely: it is probable that an event will occur or circumstances are such that the event is not inevitable, but possible in the short term and likely over the long term
- low likelihood: circumstances are possible under which an event could occur, but it is not certain even in the long term that an event would occur and it is less likely in the short term
- unlikely: circumstances are such that it is improbable the event would occur even in the long term.

The severity can be classified using a similar system also based on CIRIA C552. The terms and definitions relating to severity are:

- severe: short term (acute) risk to human health likely to result in 'significant harm' as defined by the Environment Protection Act 1990, Part IIA. Short-term risk of pollution of sensitive water resources. Catastrophic damage to buildings or property. Short-term risk to an ecosystem or organism forming part of that ecosystem (note definition of ecosystem in 'Draft Circular on Contaminated Land', DETR 2000)
- medium: chronic damage to human health ('significant harm' as defined in 'Draft Circular on Contaminated Land', DETR 2000), pollution of sensitive water resources, significant change in an ecosystem or organism forming part of that ecosystem

- mild: pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services ('significant harm' as defined in 'Draft Circular on Contaminated Land', DETR 2000). Damage to sensitive buildings, structures or the environment
- minor: harm, not necessarily significant, but that could result in financial loss or expenditure to resolve. Non-permanent human health effects easily prevented by use of personal protective clothing. Easily repairable damage to buildings, structures and services.

Once the probability of an event occurring and its consequences have been classified, a risk category can be assigned according to the table below.

		Consequences			
		Severe	Medium	Mild	Minor
Probability	Highly likely	Very high	High	Moderate	Moderate/low
	Likely	High	Moderate	Moderate/low	Low
	Low likelihood	Moderate	Moderate/low	Low	Very low
	Unlikely	Moderate/low	Low	Very low	Very low

Definitions of these risk categories are as follows together with an assessment of the further work that may be required:

- Very high: there is a high probability that severe harm could occur or there is evidence that severe harm is currently happening. This risk, if realised, could result in substantial liability; urgent investigation and remediation are likely to be required.
- High: harm is likely to occur. Realisation of the risk is likely to present a substantial liability. Urgent investigation is required. Remedial works may be necessary in the short term and are likely over the long term.
- Moderate: it is possible that harm could arise, but it is unlikely that the harm would be severe and it is more likely that the harm would be relatively mild. Investigation is normally required to clarify the risk and determine the liability. Some remedial works may be required in the longer term.
- Low: it is possible that harm could occur, but it is likely that if realised this harm would at worst normally be mild.
- Very low: there is a low possibility that harm could occur and if realised the harm is unlikely to be severe.

APPENDIX E

EXPLORATORY HOLE RECORDS

WINDOW SAMPLE LOG

Contract: Campdown		Client: Radian		Window Sample: BH1
Contract Ref: 28720	Start: 07.09.16 End: 02.08.16	Ground Level: ---	Co-ordinates: ---	Sheet: 1 of 1

Progress	Samples / Tests				Water Backfill & Instrumentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results				
	0.10-0.20	1	ES			MADE GROUND: (Firm) orange brown sandy slightly gravelly CLAY. Sand is fine. Gravel is subangular to subrounded fine to medium of brick. (Topsoil)	(0.35)	
	0.50	2	D			Firm medium strength orange brown mottled grey slightly sandy CLAY. Sand is fine. (HEAD DEPOSITS)	0.35	
	0.50		V	c _r =66				
	1.00-1.45	1	SPT	N=10				
	1.10		V	c _r =66				
	1.50	3	D					
	2.00-2.45	2	SPT	N=16				
	2.50	4	D					
	3.00-3.45	3	SPT	N=23		... Below 3.00m bgl, high strength		
							3.45	
						Borehole terminated at 3.45m depth.		

Drilling Progress and Water Observations						General Remarks	
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)		
						1. No groundwater was encountered 2. Gas and groundwater monitoring well installed to 3.00m depth	
All dimensions in metres						Scale:	1:25
Method Used:	Tracked window sampling		Plant Used:	Archway Competitor+		Drilled By:	ADavidson
						Logged By:	RSpeight
						Checked By:	

WINDOW SAMPLE LOG

Contract: Campdown		Client: Radian		Window Sample: BH2
Contract Ref: 28720	Start: 02.08.16 End: 02.08.16	Ground Level: ---	Co-ordinates: ---	Sheet: 1 of 1

Progress	Samples / Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
	0.10-0.20	1	ES				MADE GROUND: (Firm) orange brown sandy slightly gravelly CLAY. Sand is fine. Gravel is subangular to subrounded fine to medium of brick. (Topsoil)	(0.35)	
	0.50	2	D				Firm medium strength orange brown mottled grey sandy CLAY. Sand is fine. (HEAD DEPOSITS)	0.35	
	0.50		V	$c_u=57$					
	1.00		V	$c_u=67$					
	1.50	3	D					(2.65)	
							... Below 2.00m bgl, orange red brown mottled grey,		
	2.30		V	$c_u=80$			... Below 2.30m bgl, high strength		
	2.50	4	D					3.00	
							Borehole terminated at 3.00m depth.		

Drilling Progress and Water Observations						General Remarks	
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)		
						1. No groundwater was encountered 2. Borehole backfilled with arisings upon completion	
All dimensions in metres						Scale:	1:25
Method Used:	Tracked window sampling		Plant Used:	Archway Competitor		Drilled By:	Michael O'Shea
						Logged By:	RSpeight
						Checked By:	AGS

WINDOW SAMPLE LOG

Contract: Campdown		Client: Radian		Window Sample: BH3
Contract Ref: 28720	Start: 07.09.16 End: 02.08.16	Ground Level: ---	Co-ordinates: ---	Sheet: 1 of 1

Progress	Samples / Tests				Water	Backfill & Instrumentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
	0.10-0.20	1	ES				MADE GROUND: Grass over friable sandy gravelly CLAY. Sand is fine. Gravel is angular to subrounded fine to coarse of flint. (Topsoil)	(0.30)	
	0.50	2	D				Firm medium strength orange brown mottled grey slightly sandy gravelly CLAY. Sand is fine. Gravel is angular to subrounded fine to coarse of flint. (HEAD DEPOSITS)	(0.60)	
	0.60		V	c _v =45				0.90	
	1.00-1.45	1	SPT	N=11			Firm medium strength orange red brown mottled grey slightly sandy CLAY. Sand is fine. (HEAD DEPOSITS)	(1.10)	
	1.40		V	c _v =61				2.00	
	1.50	3	D						
	2.00-2.45	2	SPT	N=7			Firm medium strength orange brown mottled grey slightly sandy silty CLAY. (HEAD DEPOSITS)	(1.45)	
	2.30		V	c _v =41					
	2.50	4	D						
	3.00-3.45	3	SPT	N=7				3.45	
							Borehole terminated at 3.45m depth.		

Drilling Progress and Water Observations						General Remarks	
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)		
						1. No groundwater was encountered 2. Gas and groundwater monitoring well installed to 3.00m depth	
All dimensions in metres						Scale:	1:25
Method Used:	Tracked window sampling		Plant Used:	Archway Competitor+		Drilled By:	ADavidson
						Logged By:	RSpeight
						Checked By:	AGS

WINDOW SAMPLE LOG

Contract: Campdown		Client: Radian		Window Sample: BH4
Contract Ref: 28720	Start: 02.08.16 End: 02.08.16	Ground Level: ---	Co-ordinates: ---	Sheet: 1 of 1

Progress	Samples / Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
	0.10-0.20	1	ES				MADE GROUND: Grass over friable sandy gravelly CLAY. Sand is fine. Gravel is angular to subrounded fine to coarse of flint. (Topsoil)	(0.30)	
	0.50	2	D				Firm medium strength orange brown mottled grey sandy slightly gravelly CLAY. Sand is fine. Gravel is angular to subrounded fine to medium of flint. (HEAD DEPOSITS)	(0.70)	
	0.80		V	$c_u=44$			Firm grey brown slightly sandy CLAY with occasional flint gravel. Sand is fine. Gravel is angular to subrounded fine to medium. (HEAD DEPOSITS)	1.00	
	1.40	3	D				... Between 1.20 and 1.25m bgl, gravel band with water.	(1.00)	
							... Between 1.90 and 2.00m bgl, gravel band with water.	2.00	
	2.40	4	D				Firm orange grey brown mottled sandy silty CLAY. Sand is fine. (HEAD DEPOSITS)	(1.00)	
								3.00	
							Borehole terminated at 3.00m depth.		

Drilling Progress and Water Observations						General Remarks	
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)		
						1. Groundwater was encountered between 1.20-1.25m 2. Borehole backfilled with arisings upon completion	
All dimensions in metres						Scale:	1:25
Method Used:	Tracked window sampling		Plant Used:	Archway Competitor		Drilled By:	Michael O'Shea
						Logged By:	RSpeight
						Checked By:	AGS

WINDOW SAMPLE LOG

Contract: Campdown		Client: Radian		Window Sample: BH5
Contract Ref: 28720	Start: 07.09.16 End: 02.08.16	Ground Level: ---	Co-ordinates: ---	Sheet: 1 of 1

Progress	Samples / Tests				Water Backfill & Instru- mentation	Description of Strata	Depth (Thick- ness)	Material Graphic Legend
Window Run	Depth	No	Type	Results				
	0.10-0.20	1	ES			MADE GROUND: Grass over friable sandy gravelly CLAY. Sand is fine. Gravel is angular to subrounded fine to coarse of flint. (Topsoil)	(0.30)	
	0.50	2	D			Firm medium strength orange brown grey mottled silty CLAY. (HEAD DEPOSITS)	0.30	
	0.50		V	c _r =67				
						... Below 0.80m bgl, flint gravel with red orange clay band.		
	1.00-1.45	1	SPT	N=10				
						... Below 1.40m bgl, grey brown with occasional decomposed plant matter and flint gravel.		
	1.50	3	D					
	1.60		V	c _r =60				
	2.00-2.45	2	SPT	N=10				
	2.70	4	D					
	3.00-3.45	3	SPT	N=8				
						Borehole terminated at 3.45m depth.	3.45	

Drilling Progress and Water Observations						General Remarks	
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)		
						1. No groundwater was encountered 2. Gas and groundwater monitoring well installed to 3.00m	
All dimensions in metres						Scale:	1:25
Method Used:	Tracked window sampling		Plant Used:	Archway Competitor+		Drilled By:	ADavidson
						Logged By:	RSpeight
						Checked By:	

WINDOW SAMPLE LOG

Contract: Campdown		Client: Radian		Window Sample: BH6
Contract Ref: 28720	Start: 02.08.16 End: 02.08.16	Ground Level: ---	Co-ordinates: ---	Sheet: 1 of 1

Progress		Samples / Tests			Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
	0.10-0.20	1	ES				MADE GROUND: Grass over friable sandy gravelly CLAY. Sand is fine. Gravel is angular to subrounded fine to coarse of flint. (Topsoil)	(0.30)	
	0.50	2	D				Firm medium to high strength orange brown mottled grey slightly sandy CLAY. (HEAD DEPOSITS)	0.30	
	0.60		V	c _v =58					
	0.90		V	c _v =75					
	1.00-1.45	1	SPT	N=11					
	1.50		V	c _v =89			... At 1.60m bgl, single flint gravel, subrounded, coarse.		
	1.60	3	D						
	2.00-2.45	2	SPT	N=12			... Below 2.00m bgl, firm to stiff red orange brown grey mottled.	(3.15)	
	2.50		V	c _v =89					
	2.60	4	D						
	3.00-3.45	3	SPT	N=12					
								3.45	
							Borehole terminated at 3.45m depth.		

Drilling Progress and Water Observations						General Remarks			
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)				
						1. No groundwater was encountered 2. Rootlets to 1.00m depth 3. Borehole backfilled with arisings upon completion			
All dimensions in metres						Scale:	1:25		
Method Used: Tracked window sampling	Plant Used: Archway Competitor			Drilled By: Michael O'Shea	Logged By: RSpeight	Checked By:			

WINDOW SAMPLE LOG

Contract: Campdown		Client: Radian		Window Sample: BH7
Contract Ref: 28720	Start: 07.09.16 End: 02.08.16	Ground Level: ---	Co-ordinates: ---	Sheet: 1 of 1

Progress	Samples / Tests				Water	Backfill & Instrumentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
	0.10-0.20	1	ES				MADE GROUND: Grass over friable sandy gravelly CLAY. Sand is fine. Gravel is angular to subrounded fine to coarse of flint. (Topsoil)	(0.30)	
	0.50	2	ES				MADE GROUND: Orange brown sandy slightly gravelly CLAY with occasional pockets of grey clay. Sand is fine. Gravel is angular to subrounded fine to coarse of flint. (Reworked Natural)	(0.70)	
	1.10-1.20	3	ES				MADE GROUND: (Firm) grey brown silty slightly gravelly CLAY. Gravel is subrounded to subangular fine to coarse of brick and clinker.	(0.50)	
	1.70		V	c _u =35			Soft becoming firm low strength orange brown mottled grey silty CLAY. (HEAD DEPOSITS)	(1.50)	
	2.30	4	D					3.00	
							Borehole terminated at 3.00m depth.		

Drilling Progress and Water Observations						General Remarks	
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)		
						1. No groundwater was encountered 2. Gas and groundwater monitoring well installed to 3.00m	
All dimensions in metres						Scale:	1:25
Method Used:	Tracked window sampling		Plant Used:	Archway Competitor+		Drilled By:	ADavidson
						Logged By:	RSpeight
						Checked By:	AGS



WINDOW SAMPLE LOG

Contract: Campdown		Client: Radian		Window Sample: BH8
Contract Ref: 28720	Start: 03.08.16 End: 03.08.16	Ground Level: ---	Co-ordinates: ---	Sheet: 1 of 1

Progress	Samples / Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
	0.00-0.20	1	ES				TOPSOIL: Light brown slightly clayey SAND. Sand is fine.	0.20	
	0.50	2	D				Dense orange brown very silty clayey fine SAND. (BOGNOR SAND MEMBER) ... At 0.60m bgl, single subangular coarse flint gravel.		
	1.00-1.45	1	SPT	N=38					
	1.30	3	D						
	2.00-2.45	2	SPT	N=41					
	2.50	4	D						
	3.00-3.45	3	SPT	N=40					
							Borehole terminated at 3.45m depth.	3.45	

Drilling Progress and Water Observations						General Remarks			
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)				
						1. No groundwater was encountered 2. Borehole backfilled with arisings upon completion			
All dimensions in metres						Scale:	1:25		
Method Used:	Tracked window sampling		Plant Used:	Archway Competitor		Drilled By:	Michael O'Shea	Logged By:	RSpeight
						Checked By:			

WINDOW SAMPLE LOG

Contract: Campdown		Client: Radian		Window Sample: BH9
Contract Ref: 28720	Start: 07.09.16 End: 03.08.16	Ground Level: ---	Co-ordinates: ---	Sheet: 1 of 1

Progress		Samples / Tests			Water	Backfill & Instrumentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
	0.10-0.20	1	ES				TOPSOIL: Brown sandy gravelly CLAY. Sand is fine. Gravel is subangular to subrounded fine to coarse of flint.	(0.35)	
	0.50	2	D				Firm medium to high strength orange brown mottled grey silty CLAY. (HEAD DEPOSITS)	0.35	
	0.50		V	c _r =65					
	1.00-1.45	1	SPT	N=7			... Below 1.00m bgl, occasional orange brown silty sand parting.		
	1.15		V	c _r =66					
	1.40	3	D						
	1.80		V	c _r =76				(3.10)	
	2.00-2.45	2	SPT	N=8			... Below 2.00m bgl, red orange brown grey mottled.		
	2.60	4	D						
	3.00-3.45	3	SPT	N=17					
							Borehole terminated at 3.45m depth.	3.45	

Drilling Progress and Water Observations						General Remarks			
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)				
						1. No groundwater was encountered 2. Gas and groundwater monitoring well installed to 3.00m			
All dimensions in metres						Scale:	1:25		
Method Used:	Tracked window sampling		Plant Used:	Archway Competitor+		Drilled By:	ADavidson	Logged By:	RSpeight
						Checked By:			AGS

WINDOW SAMPLE LOG

Contract: Campdown		Client: Radian		Window Sample: BH10
Contract Ref: 28720	Start: 07.09.16 End: 03.08.16	Ground Level: ---	Co-ordinates: ---	Sheet: 1 of 1

Progress	Samples / Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
	0.10-0.20	1	ES				TOPSOIL: Brown sandy gravelly CLAY. Sand is fine. Gravel is subangular to subrounded fine to coarse of flint.	(0.30)	
	0.50	2	D				Firm medium strength orange brown mottled grey slightly gravelly silty CLAY. Gravel is subangular to subrounded fine to coarse of flint. (HEAD DEPOSITS)	0.30	
	0.50		V	c _r =52					
	1.30	3	D				Below 1.00m bgl, red brown orange grey mottled and no gravel.		
	1.30		V	c _r =53					
	2.50	4	D						
	2.50		V	c _r =63					
							Borehole terminated at 3.00m depth.	3.00	

Drilling Progress and Water Observations						General Remarks	
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)		
						1. No groundwater was encountered 2. Borehole backfilled with arisings upon completion	
All dimensions in metres						Scale:	1:25
Method Used:	Tracked window sampling		Plant Used:	Archway Competitor+		Drilled By:	ADavidson
						Logged By:	RSpeight
						Checked By:	

WINDOW SAMPLE LOG

Contract: Campdown		Client: Radian		Window Sample: BH11
Contract Ref: 28720	Start: 03.08.16 End: 03.08.16	Ground Level: ---	Co-ordinates: ---	Sheet: 1 of 1

Progress	Samples / Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
	0.10-0.20	1	ES				TOPSOIL: Brown sandy gravelly CLAY. Sand is fine. Gravel is subangular to subrounded fine to coarse of flint.	0.20	
	0.40	2	D				Firm brown sandy gravelly CLAY. Sand is fine. Gravel is subangular to subrounded fine to coarse of flint. (HEAD DEPOSITS)	(0.30) 0.50	
	0.70 0.80	3	V D	c _u =46			Firm medium strength orange grey brown mottled slightly sandy silty CLAY with occasional silty sand partings. (HEAD DEPOSITS)		
	1.00-1.45	1	SPT	N=8					
	1.50 1.60	4	V D	c _u =63					
	2.00-2.45	2	SPT	N=11			... Below 2.00m bgl, red orange grey brown mottled.	(2.95)	
	2.50 2.50	5	D V	c _u =64					
	3.00-3.45	3	SPT	N=13					
							Borehole terminated at 3.45m depth.	3.45	

Drilling Progress and Water Observations						General Remarks	
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)		
						1. No groundwater was encountered 2. Borehole backfilled with arisings upon completion	
All dimensions in metres						Scale:	1:25
Method Used:	Tracked window sampling		Plant Used:	Archway Competitor		Drilled By:	Michael O'Shea
						Logged By:	RSpeight
						Checked By:	



WINDOW SAMPLE LOG

Contract: Campdown		Client: Radian		Window Sample: BH12
Contract Ref: 28720	Start: 03.08.16 End: 03.08.16	Ground Level: ---	Co-ordinates: ---	Sheet: 1 of 1

Progress		Samples / Tests			Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
	0.10-0.20	1	ES				TOPSOIL: Red brown grey mottled sandy CLAY.	(0.30)	
	0.40	2	D				Firm medium strength orange brown grey mottled sandy CLAY. (HEAD DEPOSITS)	0.30	
	0.50		V	c _u =72					
	1.40	3	D					(1.40)	
	1.50		V	c _u =65				1.70	
	1.90	4	D				Orange brown silty SAND. (BOGNOR SAND MEMBER)		
	2.50	5	D				... Below 2.00m bgl, slightly damp.	(1.30)	
								3.00	
							Borehole terminated at 3.00m depth.		

Drilling Progress and Water Observations						General Remarks	
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)		
						1. No groundwater was encountered 2. Borehole backfilled with arisings upon completion	
All dimensions in metres						Scale:	1:25
Method Used: Tracked window sampling	Plant Used: Archway Competitor			Drilled By: Michael O'Shea	Logged By: RSpeight	Checked By:	

WINDOW SAMPLE LOG

Contract: Campdown		Client: Radian		Window Sample: BH13
Contract Ref: 28720	Start: 07.09.16 End: 03.08.16	Ground Level: ---	Co-ordinates: ---	Sheet: 1 of 1

Progress	Samples / Tests				Water Backfill & Instrumentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results				
	0.10-0.20	1	ES			TOPSOIL: Red brown grey mottled sandy CLAY.	(0.30)	
						Firm medium strength orange brown mottled grey slightly sandy silty CLAY. Sand is fine. (HEAD DEPOSITS)	0.30	
	0.50	2	D				(0.70)	
	0.50		V	c _v =50			1.00	
	1.00-1.45	1	SPT	N=8		Firm medium strength red orange brown grey mottled CLAY. (LAMBETH GROUP) ... Below 1.00m bgl, red orange brown grey mottled.		
	1.50	3	D					
	1.50		V	c _v =65				
	2.00-2.45	2	SPT	N=10			(2.45)	
	2.70	4	D			... Below 2.50m bgl, becoming fissured with no sand.		
	3.00-3.45	3	SPT	N=16			3.45	
						Borehole terminated at 3.45m depth.		

Drilling Progress and Water Observations						General Remarks	
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)		
						1. No groundwater was encountered 2. Gas and groundwater monitoring well installed to 3.00m	
All dimensions in metres						Scale:	1:25
Method Used:	Tracked window sampling		Plant Used:	Archway Competitor+		Drilled By:	ADavidson
						Logged By:	RSpeight
						Checked By:	



WINDOW SAMPLE LOG

Contract: Campdown		Client: Radian		Window Sample: BH14
Contract Ref: 28720	Start: 03.08.16 End: 03.08.16	Ground Level: ---	Co-ordinates: ---	Sheet: 1 of 1

Progress		Samples / Tests			Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
	0.10-0.20	1	ES				TOPSOIL: Red brown grey mottled sandy CLAY.	(0.30)	
	0.60	2	D				Orange brown slightly sandy gravelly CLAY. Sand is fine. Gravel is angular to subangular medium to coarse of flint. (HEAD DEPOSITS)	(0.80)	
	1.30	3	D				Firm high strength red grey mottled slightly sandy slightly gravelly CLAY. Sand is fine. Gravel is angular to rounded fine to coarse of flint. (LAMBETH GROUP)	1.10	
	1.60	V		$c_u \geq 120$			... Below 1.50m bgl, becoming stiff to very stiff with no gravel.	(1.90)	
	2.40	4	D					3.00	
							Borehole terminated at 3.00m depth.		

Drilling Progress and Water Observations						General Remarks	
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)		
						1. No groundwater was encountered 2. Borehole backfilled with arisings upon completion	
All dimensions in metres						Scale:	1:25
Method Used: Tracked window sampling	Plant Used: Archway Competitor			Drilled By: Michael O'Shea	Logged By: RSpeight	Checked By:	

WINDOW SAMPLE LOG

Contract: Campdown		Client: Radian		Window Sample: BH15
Contract Ref: 28720	Start: 07.09.16 End: 03.08.16	Ground Level: ---	Co-ordinates: ---	Sheet: 1 of 1

Progress	Samples / Tests				Water Backfill & Instru- mentation	Description of Strata	Depth (Thick- ness)	Material Graphic Legend
Window Run	Depth	No	Type	Results				
	0.10-0.20	1	ES			TOPSOIL: Red brown grey mottled sandy CLAY.	(0.30)	
	0.50	2	D			Soft orange grey brown mottled very sandy slightly gravelly CLAY. Sand is fine. Gravel is angular to subangular fine to medium of flint. (HEAD DEPOSITS)	(0.70)	
	1.00-1.45	1	SPT	N=24		Grey high strength orange mottled clayey SAND with rare flint gravel and occasional band of clay. Gravel is angular to subangular fine to coarse. (HEAD DEPOSITS)	1.00	
	1.40	3	D					
	2.00-2.45	2	SPT	N=16		... Below 2.00m bgl, medium strength.	(2.45)	
	2.70	4	D					
	3.00-3.45	3	SPT	N=9			3.45	
						Borehole terminated at 3.45m depth.		

Drilling Progress and Water Observations						General Remarks	
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)		
						1. Groundwater encountered between 2.00-2.50m 2. Gas and groundwater monitoring well installed to 3.00m depth.	
All dimensions in metres						Scale:	1:25
Method Used:	Tracked window sampling		Plant Used:	Archway Competitor+		Drilled By:	ADavidson
						Logged By:	RSpeight
						Checked By:	



WINDOW SAMPLE LOG

Contract: Campdown		Client: Radian		Window Sample: BH16
Contract Ref: 28720	Start: 07.09.16 End: 04.08.16	Ground Level: ---	Co-ordinates: ---	Sheet: 1 of 1

Progress	Samples / Tests				Water Backfill & Instru- mentation	Description of Strata	Depth (Thick- ness)	Material Graphic Legend
Window Run	Depth	No	Type	Results				
	0.10-0.20	1	ES			Grass over firm medium strength orange brown mottled grey slightly sandy silty CLAY with occasional silty sand partings. Sand is fine. (HEAD DEPOSITS)		
	0.50	2	D					
	0.50		V	$c_v=75$				
	1.00-1.45	1	SPT	N=10		... Below 1.00m bgl, becoming sandy silty clay.		
	1.20		V	$c_v=54$				
	1.40	3	D					
	2.00-2.45	2	SPT	N=18			(3.45)	
	2.50	4	D					
	3.00-3.45	3	SPT	N=18				
							3.45	
						Borehole terminated at 3.45m depth.		

Drilling Progress and Water Observations						General Remarks			
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)				
						1. No groundwater was encountered 2. Roots present to 0.80m 3. Gas and groundwater monitoring well installed to 3.00m			
All dimensions in metres						Scale:	1:25		
Method Used:	Tracked window sampling		Plant Used:	Archway Competitor+		Drilled By:	ADavidson	Logged By:	RSpeight
						Checked By:			



WINDOW SAMPLE LOG

Contract: Campdown		Client: Radian		Window Sample: BH17
Contract Ref: 28720	Start: 07.09.16 End: 04.08.16	Ground Level: ---	Co-ordinates: ---	Sheet: 1 of 1

Progress	Samples / Tests				Water Backfill & Instrumentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results				
	0.10-0.20	1	ES			TOPSOIL: Firm brown sandy gravelly CLAY. Sand is fine. Gravel is subangular to subrounded fine to medium of chalk and rare brick.	0.25	
	0.50	2	D			Firm medium to high strength orange brown slightly sandy CLAY. Sand is fine. Occasional mottled grey. (HEAD DEPOSITS)		
	0.50		V	c _r =64				
	1.00-1.45	1	SPT	N=10				
	1.20		V	c _r =71				
	1.30	3	D					
	1.60		V	c _r =86			(3.20)	
	2.00-2.45	2	SPT	N=13		Below 2.00m bgl, occasional pockets of fine to medium sand.		
	2.40	4	D					
	3.00-3.45	3	SPT	N=13				
							3.45	
						Borehole terminated at 3.45m depth.		

Drilling Progress and Water Observations						General Remarks	
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)		
						1. No groundwater was encountered 2. Gas and groundwater monitoring well installed to 3.00m depth	
All dimensions in metres						Scale:	1:25
Method Used:	Tracked window sampling		Plant Used:	Archway Competitor+		Drilled By:	ADavidson
						Logged By:	RSpeight
						Checked By:	

WINDOW SAMPLE LOG

Contract: Campdown		Client: Radian		Window Sample: BH18
Contract Ref: 28720	Start: 07.09.16 End: 04.08.16	Ground Level: ---	Co-ordinates: ---	Sheet: 1 of 1

Progress	Samples / Tests				Water Backfill & Instrumentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results				
	0.10-0.20	1	ES			TOPSOIL: Brown grey mottled slightly sandy silty CLAY.	0.25	
	0.40	2	D			Firm medium strength orange brown grey mottled sandy silty CLAY. Sand is fine. (HEAD DEPOSITS)		
	0.50		V	c _r =43				
	0.80		V	c _r =48				
	1.00-1.45	1	SPT	N=9		Below 1.00m bgl, red brown grey mottled, slightly sandy.		
	1.20	3	D					
	1.40		V	c _r =70				
	1.90		V	c _r =75				
	2.00-2.45	2	SPT	N=11				
	2.30	4	D					
	3.00-3.45	3	SPT	N=12				
						Borehole terminated at 3.45m depth.	3.45	

Drilling Progress and Water Observations						General Remarks	
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)		
						1. No groundwater was encountered 2. Gas and groundwater monitoring well installed to 3.00m depth	
All dimensions in metres						Scale:	1:25
Method Used:	Tracked window sampling		Plant Used:	Archway Competitor+		Drilled By:	ADavidson
						Logged By:	RSpeight
						Checked By:	

APPENDIX F

GROUND GAS MONITORING DATA

IN-SITU GAS MONITORING RESULTS

[Pressures] Previous During Start End Equipment Used & Remarks

Round 1 - - 999 999 GA2000 + Weather: Overcast with showers + Ground: Wet + Wind: Medium + Air Temp: 17DegC
 Round 2 - - 1011 1011 GA2000 + Weather: Overcast + Ground: Wet + Wind: Light + Air Temp: 19DegC
 Round 3 Rising Falling 1007 1004 GA2000 + Weather: Cloudy + Ground: Wet + Wind: Light + Air Temp: 18DegC

Exploratory Position ID	Monitoring Round	Measured Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	PID (ppm)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)
BH1	1	2.80	19/08/2016	-	999	0.0 _(SS)	1.78	0.0	0.1	21.2	1.0	-	-	-
BH1	1	---	15 secs	-	-	-	-	2.1	0.1	20.3	1.0	-	-	-
BH1	1	---	30 secs	-	-	-	-	2.1	0.1	20.3	1.0	-	-	-
BH1	1	---	60 secs	-	-	-	-	2.1	0.1	20.0	1.0	-	-	-
BH1	1	---	90 secs	-	-	-	-	2.1	0.1	20.2	1.0	-	-	-
BH1	1	---	120 secs	-	-	-	-	2.1	0.1	20.2	1.0	-	-	-
BH1	2	2.79	02/09/2016	-	1011	0.1 _(SS)	1.81	0.1	0.0	21.0	0.0	-	-	-
BH1	2	---	15 secs	-	-	-	-	1.7	0.0	20.6	0.0	-	-	-
BH1	2	---	30 secs	-	-	-	-	1.6	0.0	20.4	0.0	-	-	-
BH1	2	---	60 secs	-	-	-	-	1.6	0.0	20.3	0.0	-	-	-
BH1	2	---	90 secs	-	-	-	-	1.6	0.0	20.3	0.0	-	-	-
BH1	2	---	120 secs	-	-	-	-	1.6	0.0	20.3	0.0	-	-	-
BH1	2	---	180 secs	-	-	-	-	1.7	0.0	20.3	0.0	-	-	-
BH1	2	---	240 secs	-	-	-	-	1.7	0.0	20.3	0.0	-	-	-
BH1	3	1.82	15/09/2016	1004	1004	0.0 _(SS)	DRY	0.0	0.0	20.9	-	1.7	0.0	0.0
BH1	3	---	15 secs	-	-	-	-	2.7	0.0	20.0	-	-	0.0	0.0
BH1	3	---	30 secs	-	-	-	-	2.5	0.0	19.1	-	-	0.0	0.0
BH1	3	---	60 secs	-	-	-	-	2.5	0.0	19.0	-	-	0.0	0.0

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

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AGS

IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	PID (ppm)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)
BH1	3	---	90 secs	-	-	-	-	2.5	0.0	19.0	-	-	0.0	0.0
BH1	3	---	120 secs	-	-	-	-	2.5	0.0	19.0	-	-	0.0	0.0
BH1	3	---	180 secs	-	-	-	-	2.5	0.0	19.0	-	-	0.0	0.0
BH1	3	---	240 secs	-	-	-	-	2.5	0.0	18.9	-	-	0.0	0.0
BH1	3	---	300 secs	-	-	-	-	2.5	0.0	18.9	-	-	0.0	0.0
BH3	1	2.55	19/08/2016	-	999	0.0 _(SS)	2.39	0.1	0.1	21.2	1.0	-	-	-
BH3	1	---	15 secs	-	-	-	-	3.8	0.1	20.2	1.0	-	-	-
BH3	1	---	30 secs	-	-	-	-	4.0	0.1	19.7	1.0	-	-	-
BH3	1	---	60 secs	-	-	-	-	4.0	0.1	19.7	1.0	-	-	-
BH3	1	---	90 secs	-	-	-	-	4.0	0.1	19.7	1.0	-	-	-
BH3	1	---	120 secs	-	-	-	-	4.0	0.1	19.7	1.0	-	-	-
BH3	2	2.55	02/09/2016	-	1011	0.0 _(SS)	2.14	0.1	0.0	21.0	0.0	-	-	-
BH3	2	---	15 secs	-	-	-	-	3.8	0.0	19.8	0.0	-	-	-
BH3	2	---	30 secs	-	-	-	-	3.3	0.0	19.3	0.0	-	-	-
BH3	2	---	60 secs	-	-	-	-	3.4	0.0	19.2	0.0	-	-	-
BH3	2	---	90 secs	-	-	-	-	3.4	0.0	19.2	0.0	-	-	-
BH3	2	---	120 secs	-	-	-	-	3.4	0.0	19.2	0.0	-	-	-
BH3	2	---	180 secs	-	-	-	-	3.4	0.0	19.2	0.0	-	-	-
BH3	3	2.56	16/09/2016	1007	1007	0.0 _(SS)	2.09	0.0	0.0	20.9	0.0	0.4	0.0	-
BH3	3	---	15 secs	-	-	-	-	3.9	0.0	20.1	0.0	-	0.0	-
BH3	3	---	30 secs	-	-	-	-	3.7	0.0	18.9	0.0	-	0.0	-
BH3	3	---	60 secs	-	-	-	-	3.6	0.0	18.6	0.0	-	0.0	-
BH3	3	---	90 secs	-	-	-	-	3.6	0.0	18.6	0.0	-	0.0	-
BH3	3	---	120 secs	-	-	-	-	3.6	0.0	18.6	0.0	-	0.0	-

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

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IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	PID (ppm)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)
BH3	3	---	180 secs	-	-	-	-	3.7	0.0	18.3	0.0	-	0.0	-
BH3	3	---	240 secs	-	-	-	-	3.7	0.0	18.3	0.0	-	0.0	-
BH3	3	---	300 secs	-	-	-	-	3.7	0.0	18.3	0.0	-	0.0	-
BH5	1	2.73	19/08/2016	-	999	0.0 ^(SS)	DRY	0.1	0.1	21.3	1.0	-	-	-
BH5	1	---	15 secs	-	-	-	-	1.9	0.1	20.8	1.0	-	-	-
BH5	1	---	30 secs	-	-	-	-	2.2	0.1	20.4	1.0	-	-	-
BH5	1	---	60 secs	-	-	-	-	3.0	0.1	19.9	1.0	-	-	-
BH5	1	---	90 secs	-	-	-	-	4.1	0.1	19.3	1.0	-	-	-
BH5	1	---	120 secs	-	-	-	-	4.9	0.1	18.9	1.0	-	-	-
BH5	1	---	180 secs	-	-	-	-	5.0	0.1	18.9	1.0	-	-	-
BH5	2	2.71	02/09/2016	-	1013	0.1 ^(SS)	DRY	0.0	0.0	20.9	0.0	-	-	-
BH5	2	---	15 secs	-	-	-	-	3.6	0.0	19.5	0.0	-	-	-
BH5	2	---	30 secs	-	-	-	-	3.2	0.0	19.1	0.0	-	-	-
BH5	2	---	60 secs	-	-	-	-	3.3	0.0	19.0	0.0	-	-	-
BH5	2	---	90 secs	-	-	-	-	3.4	0.0	19.0	0.0	-	-	-
BH5	2	---	120 secs	-	-	-	-	3.4	0.0	19.0	0.0	-	-	-
BH5	2	---	180 secs	-	-	-	-	3.3	0.0	19.0	0.0	-	-	-
BH5	2	---	240 secs	-	-	-	-	3.3	0.0	19.0	0.0	-	-	-
BH5	3	1.83	16/09/2016	-	1004	0.0 ^(SS)	1.77	0.0	0.0	20.9	-	0.2	0.0	0.0
BH5	3	---	15 secs	-	-	-	-	5.4	0.0	19.5	-	-	0.0	0.0
BH5	3	---	30 secs	-	-	-	-	5.0	0.0	17.5	-	-	0.0	0.0
BH5	3	---	60 secs	-	-	-	-	5.0	0.0	17.1	-	-	0.0	0.0
BH5	3	---	90 secs	-	-	-	-	4.9	0.0	17.2	-	-	0.0	0.0
BH5	3	---	120 secs	-	-	-	-	4.9	0.0	17.2	-	-	0.0	0.0

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

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IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	PID (ppm)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)
BH5	3	---	180 secs	-	-	-	-	4.8	0.0	17.2	-	-	0.0	0.0
BH5	3	---	240 secs	-	-	-	-	4.7	0.0	17.3	-	-	0.0	0.0
BH5	3	---	300 secs	-	-	-	-	4.7	0.0	17.3	-	-	0.0	0.0
BH5	3	---	360 secs	-	-	-	-	4.6	0.0	17.4	-	-	0.0	0.0
BH5	3	---	420 secs	-	-	-	-	4.6	0.0	17.4	-	-	0.0	0.0
BH5	3	---	480 secs	-	-	-	-	4.6	0.0	17.4	-	-	0.0	0.0
BH7	1	2.44	19/08/2016	-	999	0.0 _(SS)	1.10	0.0	0.1	20.4	1.0	-	-	-
BH7	1	---	15 secs	-	-	-	-	4.5	0.1	19.3	1.0	-	-	-
BH7	1	---	30 secs	-	-	-	-	4.8	0.1	18.8	1.0	-	-	-
BH7	1	---	60 secs	-	-	-	-	5.0	0.1	18.7	1.0	-	-	-
BH7	1	---	90 secs	-	-	-	-	5.1	0.1	18.7	1.0	-	-	-
BH7	1	---	120 secs	-	-	-	-	4.8	0.1	19.0	1.0	-	-	-
BH7	1	---	180 secs	-	-	-	-	3.5	0.1	19.4	1.0	-	-	-
BH7	2	2.45	02/09/2016	-	1012	0.1 _(SS)	DRY	0.1	0.0	21.0	0.0	-	-	-
BH7	2	---	15 secs	-	-	-	-	2.4	0.0	20.1	0.0	-	-	-
BH7	2	---	30 secs	-	-	-	-	2.0	0.0	20.0	0.0	-	-	-
BH7	2	---	60 secs	-	-	-	-	2.2	0.0	20.0	0.0	-	-	-
BH7	2	---	90 secs	-	-	-	-	2.2	0.0	19.9	0.0	-	-	-
BH7	2	---	120 secs	-	-	-	-	2.2	0.0	19.9	0.0	-	-	-
BH7	2	---	180 secs	-	-	-	-	2.4	0.0	19.9	0.0	-	-	-
BH7	2	---	240 secs	-	-	-	-	2.4	0.0	19.8	0.0	-	-	-
BH7	3	1.52	16/09/2016	1004	1004	0.0 _(SS)	1.14	0.0	0.0	20.9	-	0.7	0.0	0.0
BH7	3	---	15 secs	-	-	-	-	5.2	0.0	19.6	-	-	0.0	0.0
BH7	3	---	30 secs	-	-	-	-	4.9	0.0	17.9	-	-	0.0	0.0

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

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IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	PID (ppm)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)
BH7	3	---	60 secs	-	-	-	-	4.9	0.0	17.5	-	-	0.0	0.0
BH7	3	---	90 secs	-	-	-	-	4.9	0.0	17.4	-	-	0.0	0.0
BH7	3	---	120 secs	-	-	-	-	5.0	0.0	17.4	-	-	0.0	0.0
BH7	3	---	180 secs	-	-	-	-	5.1	0.0	17.3	-	-	0.0	0.0
BH7	3	---	240 secs	-	-	-	-	5.3	0.0	17.2	-	-	0.0	0.0
BH7	3	---	300 secs	-	-	-	-	5.4	0.0	17.1	-	-	0.0	0.0
BH7	3	---	360 secs	-	-	-	-	5.5	0.0	17.0	-	-	0.0	0.0
BH7	3	---	420 secs	-	-	-	-	5.7	0.0	17.0	-	-	0.0	0.0
BH7	3	---	480 secs	-	-	-	-	5.8	0.0	16.9	-	-	0.0	0.0
BH7	3	---	540 secs	-	-	-	-	5.8	0.0	16.8	-	-	0.0	0.0
BH7	3	---	600 secs	-	-	-	-	5.9	0.0	16.8	-	-	0.0	0.0
BH9	1	2.94	19/08/2016	-	999	0.0 _(SS)	1.24	0.1	0.1	20.8	1.0	-	-	-
BH9	1	---	15 secs	-	-	-	-	1.6	0.1	20.1	1.0	-	-	-
BH9	1	---	30 secs	-	-	-	-	1.7	0.1	19.9	1.0	-	-	-
BH9	1	---	60 secs	-	-	-	-	1.7	0.1	19.8	1.0	-	-	-
BH9	1	---	90 secs	-	-	-	-	1.7	0.1	19.8	1.0	-	-	-
BH9	1	---	120 secs	-	-	-	-	1.7	0.1	19.8	1.0	-	-	-
BH9	2	2.92	02/09/2016	-	1013	0.0 _(SS)	1.00	0.0	0.0	21.1	0.0	-	-	-
BH9	2	---	15 secs	-	-	-	-	0.8	0.0	20.7	0.0	-	-	-
BH9	2	---	30 secs	-	-	-	-	0.7	0.0	20.6	0.0	-	-	-
BH9	2	---	60 secs	-	-	-	-	0.7	0.0	20.7	0.0	-	-	-
BH9	2	---	90 secs	-	-	-	-	0.7	0.0	20.7	0.0	-	-	-
BH9	2	---	120 secs	-	-	-	-	0.8	0.0	20.7	0.0	-	-	-
BH9	2	---	240 secs	-	-	-	-	0.8	0.0	20.7	0.0	-	-	-

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IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	PID (ppm)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)
BH9	2	---	300 secs	-	-	-	-	0.8	0.0	20.7	0.0	-	-	-
BH9	2	---	360 secs	-	-	-	-	0.8	0.0	20.8	0.0	-	-	-
BH9	3	2.99	16/09/2016	1004	1004	0.0 _(SS)	1.14	0.0	0.0	20.9	-	1.9	0.0	0.0
BH9	3	---	15 secs	-	-	-	-	0.7	0.0	20.6	-	-	2.0	0.0
BH9	3	---	30 secs	-	-	-	-	0.7	0.0	20.2	-	-	3.0	0.0
BH9	3	---	60 secs	-	-	-	-	0.7	0.0	20.2	-	-	3.0	0.0
BH9	3	---	90 secs	-	-	-	-	0.7	0.0	20.2	-	-	3.0	0.0
BH9	3	---	120 secs	-	-	-	-	0.7	0.0	20.2	-	-	3.0	0.0
BH9	3	---	180 secs	-	-	-	-	0.7	0.0	20.2	-	-	3.0	0.0
BH9	3	---	240 secs	-	-	-	-	0.7	0.0	20.2	-	-	3.0	0.0
BH9	3	---	300 secs	-	-	-	-	0.7	0.0	20.2	-	-	3.0	0.0
BH13	1	2.75	19/08/2016	-	999	0.0 _(SS)	2.50	0.1	0.1	20.7	1.0	-	-	-
BH13	1	---	15 secs	-	-	-	-	1.1	0.1	19.9	1.0	-	-	-
BH13	1	---	30 secs	-	-	-	-	1.2	0.1	19.7	1.0	-	-	-
BH13	1	---	60 secs	-	-	-	-	1.2	0.1	19.6	1.0	-	-	-
BH13	1	---	90 secs	-	-	-	-	1.3	0.1	19.6	1.0	-	-	-
BH13	1	---	120 secs	-	-	-	-	1.3	0.1	19.6	1.0	-	-	-
BH13	2	2.74	02/09/2016	-	1013	0.0 _(SS)	1.35	0.0	0.0	21.1	0.0	-	-	-
BH13	2	---	15 secs	-	-	-	-	1.1	0.0	20.6	0.0	-	-	-
BH13	2	---	30 secs	-	-	-	-	1.0	0.0	20.4	0.0	-	-	-
BH13	2	---	60 secs	-	-	-	-	1.0	0.0	20.3	0.0	-	-	-
BH13	2	---	90 secs	-	-	-	-	1.0	0.0	20.3	0.0	-	-	-
BH13	2	---	120 secs	-	-	-	-	1.0	0.0	20.3	0.0	-	-	-
BH13	2	---	180 secs	-	-	-	-	1.1	0.0	20.3	0.0	-	-	-

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IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	PID (ppm)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)
BH13	2	---	240 secs	-	-	-	-	1.1	0.0	20.3	0.0	-	-	-
BH13	2	---	300 secs	-	-	-	-	1.1	0.0	20.3	0.0	-	-	-
BH13	3	2.83	16/09/2016	1004	1004	0.0 _(SS)	1.56	0.0	0.0	20.9	-	1.3	0.0	0.0
BH13	3	---	15 secs	-	-	-	-	1.2	0.0	20.4	-	-	3.0	0.0
BH13	3	---	30 secs	-	-	-	-	1.1	0.0	19.7	-	-	3.0	0.0
BH13	3	---	60 secs	-	-	-	-	1.1	0.0	19.6	-	-	3.0	0.0
BH13	3	---	90 secs	-	-	-	-	1.1	0.0	19.6	-	-	3.0	0.0
BH13	3	---	120 secs	-	-	-	-	1.1	0.0	19.5	-	-	3.0	0.0
BH13	3	---	180 secs	-	-	-	-	1.2	0.0	19.5	-	-	3.0	0.0
BH13	3	---	240 secs	-	-	-	-	1.2	0.0	19.5	-	-	3.0	0.0
BH13	3	---	300 secs	-	-	-	-	1.2	0.0	19.5	-	-	3.0	0.0
BH15	1	2.60	19/08/2016	-	999	0.0 _(SS)	0.20	0.0	0.1	21.1	1.0	-	-	-
BH15	1	---	15 secs	-	-	-	-	0.0	0.1	21.1	1.0	-	-	-
BH15	1	---	30 secs	-	-	-	-	0.0	0.1	21.1	1.0	-	-	-
BH15	1	---	60 secs	-	-	-	-	0.0	0.1	21.1	1.0	-	-	-
BH15	1	---	90 secs	-	-	-	-	0.0	0.1	21.1	1.0	-	-	-
BH15	2	2.55	02/09/2016	-	1013	0.1 _(SS)	0.25	0.1	0.0	21.1	0.0	-	-	-
BH15	2	---	15 secs	-	-	-	-	0.3	0.0	20.9	0.0	-	-	-
BH15	2	---	30 secs	-	-	-	-	0.3	0.0	20.8	0.0	-	-	-
BH15	2	---	60 secs	-	-	-	-	0.3	0.0	20.8	0.0	-	-	-
BH15	2	---	90 secs	-	-	-	-	0.3	0.0	20.8	0.0	-	-	-
BH15	2	---	120 secs	-	-	-	-	0.3	0.0	20.8	0.0	-	-	-
BH15	2	---	180 secs	-	-	-	-	0.3	0.0	20.8	0.0	-	-	-
BH15	3	1.87	16/09/2016	1004	1004	0.0 _(SS)	0.17	0.0	0.0	20.9	-	1.3	0.0	0.0

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BH15	3	---	15 secs	-	-	-	-	0.9	0.0	20.6	-	-	6.0	0.0
BH15	3	---	30 secs	-	-	-	-	0.8	0.0	20.2	-	-	8.0	0.0
BH15	3	---	60 secs	-	-	-	-	0.8	0.0	20.2	-	-	8.0	0.0
BH15	3	---	90 secs	-	-	-	-	0.8	0.0	20.2	-	-	8.0	0.0
BH15	3	---	120 secs	-	-	-	-	0.8	0.0	20.2	-	-	8.0	0.0
BH15	3	---	180 secs	-	-	-	-	0.8	0.0	20.2	-	-	8.0	0.0
BH15	3	---	240 secs	-	-	-	-	0.8	0.0	20.2	-	-	8.0	0.0
BH15	3	---	300 secs	-	-	-	-	0.8	0.0	20.2	-	-	8.0	0.0
BH16	1	2.80	19/08/2016	-	999	0.0 ^(SS)	1.58	0.1	0.1	21.0	1.0	-	-	-
BH16	1	---	15 secs	-	-	-	-	0.8	0.1	20.8	1.0	-	-	-
BH16	1	---	30 secs	-	-	-	-	0.8	0.1	20.8	1.0	-	-	-
BH16	1	---	60 secs	-	-	-	-	1.0	0.1	20.7	1.0	-	-	-
BH16	1	---	90 secs	-	-	-	-	1.1	0.1	20.7	1.0	-	-	-
BH16	1	---	120 secs	-	-	-	-	1.3	0.1	20.6	1.0	-	-	-
BH16	1	---	180 secs	-	-	-	-	1.3	0.1	20.6	1.0	-	-	-
BH16	2	2.78	02/09/2016	-	1012	0.1 ^(SS)	1.59	0.1	0.0	21.0	0.0	-	-	-
BH16	2	---	15 secs	-	-	-	-	1.0	0.0	20.7	0.0	-	-	-
BH16	2	---	30 secs	-	-	-	-	0.8	0.0	20.5	0.0	-	-	-
BH16	2	---	60 secs	-	-	-	-	0.9	0.0	20.5	0.0	-	-	-
BH16	2	---	90 secs	-	-	-	-	0.9	0.0	20.5	0.0	-	-	-
BH16	2	---	120 secs	-	-	-	-	0.9	0.0	20.5	0.0	-	-	-
BH16	2	---	180 secs	-	-	-	-	0.9	0.0	20.5	0.0	-	-	-
BH16	3	1.86	16/09/2016	1003	1004	0.0 ^(SS)	1.67	0.0	0.0	20.9	-	0.4	0.0	-
BH16	3	---	15 secs	-	-	-	-	1.5	0.0	20.4	-	-	7.0	-

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Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	PID (ppm)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)
BH16	3	---	30 secs	-	-	-	-	1.4	0.0	19.9	-	-	9.0	-
BH16	3	---	60 secs	-	-	-	-	1.4	0.0	19.8	-	-	9.0	-
BH16	3	---	90 secs	-	-	-	-	1.4	0.0	19.8	-	-	9.0	-
BH16	3	---	120 secs	-	-	-	-	1.3	0.0	19.8	-	-	9.0	-
BH16	3	---	180 secs	-	-	-	-	1.3	0.0	19.8	-	-	8.0	-
BH16	3	---	240 secs	-	-	-	-	1.3	0.0	19.9	-	-	8.0	-
BH16	3	---	300 secs	-	-	-	-	1.2	0.0	19.9	-	-	8.0	-
BH16	3	---	360 secs	-	-	-	-	1.2	0.0	19.9	-	-	8.0	-
BH16	3	---	420 secs	-	-	-	-	1.2	0.0	19.9	-	-	7.0	-
BH17a	1	2.93	19/08/2016	-	999	0.0 ^(SS)	DRY	0.0	0.1	20.3	1.0	-	-	-
BH17a	1	---	15 secs	-	-	-	-	2.0	0.1	19.7	1.0	-	-	-
BH17a	1	---	30 secs	-	-	-	-	2.3	0.1	19.1	1.0	-	-	-
BH17a	1	---	60 secs	-	-	-	-	2.3	0.1	19.1	1.0	-	-	-
BH17a	1	---	90 secs	-	-	-	-	2.3	0.1	19.1	1.0	-	-	-
BH17a	1	---	120 secs	-	-	-	-	2.3	0.1	19.1	1.0	-	-	-
BH17a	2	2.92	02/09/2016	-	1013	0.1 ^(SS)	DRY	0.1	0.0	21.0	0.0	-	-	-
BH17a	2	---	15 secs	-	-	-	-	1.5	0.0	20.3	0.0	-	-	-
BH17a	2	---	30 secs	-	-	-	-	1.2	0.0	20.0	0.0	-	-	-
BH17a	2	---	60 secs	-	-	-	-	1.3	0.0	19.9	0.0	-	-	-
BH17a	2	---	90 secs	-	-	-	-	1.4	0.0	19.8	0.0	-	-	-
BH17a	2	---	120 secs	-	-	-	-	1.4	0.0	19.8	0.0	-	-	-
BH17a	2	---	180 secs	-	-	-	-	1.4	0.0	19.8	0.0	-	-	-
BH17a	2	---	240 secs	-	-	-	-	1.5	0.0	19.8	0.0	-	-	-
BH17a	2	---	300 secs	-	-	-	-	1.5	0.0	19.8	0.0	-	-	-

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BH17a	3	1.98	16/09/2016	1004	1004	0.0 _(SS)	DRY	0.0	0.0	20.9	-	0.5	0.0	-
BH17a	3	---	15 secs	-	-	-	-	2.1	0.0	19.4	-	-	0.0	-
BH17a	3	---	30 secs	-	-	-	-	1.9	0.0	17.7	-	-	0.0	-
BH17a	3	---	60 secs	-	-	-	-	2.0	0.0	17.5	-	-	0.0	-
BH17a	3	---	90 secs	-	-	-	-	2.0	0.0	17.4	-	-	0.0	-
BH17a	3	---	120 secs	-	-	-	-	2.0	0.0	17.4	-	-	0.0	-
BH17a	3	---	180 secs	-	-	-	-	2.0	0.0	17.3	-	-	0.0	-
BH17a	3	---	240 secs	-	-	-	-	2.0	0.0	17.3	-	-	0.0	-
BH17a	3	---	300 secs	-	-	-	-	2.0	0.0	17.2	-	-	0.0	-
BH18	1	2.94	19/08/2016	-	999	0.0 _(SS)	2.72	0.0	0.1	20.4	1.0	-	-	-
BH18	1	---	15 secs	-	-	-	-	2.0	0.1	19.4	1.0	-	-	-
BH18	1	---	30 secs	-	-	-	-	2.0	0.1	19.4	1.0	-	-	-
BH18	1	---	60 secs	-	-	-	-	2.0	0.1	19.3	1.0	-	-	-
BH18	1	---	90 secs	-	-	-	-	2.0	0.1	19.3	1.0	-	-	-
BH18	1	---	120 secs	-	-	-	-	2.0	0.1	19.3	1.0	-	-	-
BH18	2	2.93	02/09/2016	-	1013	0.1 _(SS)	2.21	0.1	0.0	21.2	0.0	-	-	-
BH18	2	---	15 secs	-	-	-	-	2.1	0.0	20.0	0.0	-	-	-
BH18	2	---	30 secs	-	-	-	-	1.9	0.0	19.8	0.0	-	-	-
BH18	2	---	60 secs	-	-	-	-	1.9	0.0	19.7	0.0	-	-	-
BH18	2	---	90 secs	-	-	-	-	1.9	0.0	19.7	0.0	-	-	-
BH18	2	---	120 secs	-	-	-	-	1.9	0.0	19.6	0.0	-	-	-
BH18	2	---	180 secs	-	-	-	-	2.0	0.0	19.6	0.0	-	-	-
BH18	2	---	240 secs	-	-	-	-	2.0	0.0	19.6	0.0	-	-	-
BH18	2	---	300 secs	-	-	-	-	2.0	0.0	19.6	0.0	-	-	-

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BH18	2	---	360 secs	-	-	-	-	2.0	0.0	19.6	0.0	-	-	-
BH18	3	2.03	16/09/2016	1004	1004	0.0 _(SS)	1.95	0.0	0.0	20.9	-	0.6	0.0	0.0
BH18	3	---	15 secs	-	-	-	-	2.5	0.0	19.6	-	-	0.0	0.0
BH18	3	---	30 secs	-	-	-	-	2.3	0.0	18.4	-	-	0.0	0.0
BH18	3	---	60 secs	-	-	-	-	2.3	0.0	18.2	-	-	0.0	0.0
BH18	3	---	90 secs	-	-	-	-	2.3	0.0	18.2	-	-	0.0	0.0
BH18	3	---	120 secs	-	-	-	-	2.3	0.0	18.2	-	-	0.0	0.0
BH18	3	---	180 secs	-	-	-	-	2.3	0.0	18.2	-	-	0.0	0.0
BH18	3	---	240 secs	-	-	-	-	2.3	0.0	18.2	-	-	0.0	0.0
BH18	3	---	300 secs	-	-	-	-	2.3	0.0	18.1	-	-	0.0	0.0

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APPENDIX G

LABORATORY CERTIFICATES FOR SOIL ANALYSIS
