



Geo-Environmental

REMEDIATION STRATEGY AND VERIFICATION PLAN

for land at

BOORLEY GARDENS, WINCHESTER ROAD

HEDGE END, SOUTHAMPTON, SO32 2UA

on behalf of

BELLWAY HOMES & MILLER HOMES



Report:	REMEDIATION STRATEGY AND VERIFICATION PLAN
Site:	BOORLEY GARDENS, WINCHESTER ROAD, HEDGE END, SOUTHAMPTON, SO32 2UA
Client:	BELLWAY HOMES & MILLER HOMES
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1.0 INTRODUCTION

1.1 General

Following intrusive investigations undertaken by third parties and two phases of investigation undertaken by Geo-Environmental Services Limited ('Geo-Environmental'), Geo-Environmental was appointed by Jackson Rowe on behalf of Bellway Homes and Miller Homes to formulate a Remediation Strategy and Verification Plan in relation to the proposed development of land at Boorley Gardens, Winchester Road, Hedge End, Southampton, SO32 2UA herein referred to as 'the site' (Figure 1).

The site has been subject to a desk study and two phases of intrusive investigations undertaken by third parties and two further phases of intrusive investigation by Geo-Environmental including a Detailed Quantitative Gas Risk Assessment. Details and an overview of the findings of these reports are summarised in Section 2.1.

The remediation strategy has been developed to reflect the findings from the assessments undertaken to date on this site.

1.2 Objectives

The Remediation Strategy and Verification Plan (RSVP) sets out the proposed remedial works to be undertaken on the subject site to support its development for a proposed residential end use (houses with gardens, apartments, new access roads and parking, new local centre, land for a new school, open space and sports provision, and associated infrastructure).

1.3 Planning Permission

It is understood that outline planning permission was granted at appeal for the site under Application Number O/15/75953 (appeal ref. APP/W1715/W/15/3130073 dated 30th November 2016). The following conditions relating to land contamination were attached to the permission:

Condition 18.

No work shall commence on site until the following has been submitted to, and approved in writing by the LPA:

- a) A Report of Preliminary Investigation comprising a Desk Study, Conceptual Site Model, and Preliminary Risk Assessment documenting previous and existing land uses of the site and adjacent land in accordance with national guidance and as set out in Contaminated Land Report Nos. 11, CLR11, and BS 10175:2011+A1:2013 Investigation of potentially contaminated sites - Code of Practice, and, unless otherwise agreed with the LPA;*
- b) A Report of a site investigation documenting the ground conditions of the site and incorporating chemical and gas analysis identified as appropriate by the Preliminary Investigation and in accordance with BS 10175:2011+A1:2013, and BS 8576:2013 and unless otherwise agreed with the LPA;*
- c) A detailed site specific scheme for remedial works and measures to be undertaken to avoid the risk from contaminants and/or gases when the site is developed and proposals for future maintenance a [sic] and monitoring.*

Such a scheme shall include nomination of a competent person to oversee the implementation of the works.



Condition 19.

The development hereby permitted shall not be occupied / brought into use until there has been submitted to the LPA verification by the competent person approved under the provisions of condition 18(c) that any remediation scheme required and approved under the provisions of condition 18(c) has been implemented fully in accordance with the approved details (unless varied with the written permission of the LPA in advance of implementation).

Unless agreed in writing with the LPA such verification shall comply with the guidance contained in CLR11 and EA Guidance for the Safe Development of Housing on Land Affected by Contamination - R&D Publication 66: 2008. Typically, such a report would comprise:

- *A description of the site and its background, and summary of relevant site information;*
- *A description of the remediation objectives and remedial works carried out;*
- *Verification data, including - data (sample locations/analytical results, as built drawings of the implemented scheme, photographs of the remediation works in progress, etc;*
- *Certificates demonstrating that imported and / or material left in situ is free from contamination, gas / vapour membranes have been installed correctly.*

Thereafter the scheme shall be monitored and maintained in accordance with the scheme approved under condition 21(c) [sic].

It is understood that a Reserved Matters Application has been approved by Eastleigh Borough Council (ref. RM/17/81628, dated 16th January 2019) for Phase 1 of the development (equating to 301No. residential dwellings with associated parking, road infrastructure, landscaping, open space, surface water drainage networks, on-site waste water treatment works, provision of additional vehicular parking for Hedge End Railway Station and bus only connection to Shamblehurst Lane North).

It is understood that a Reserved Matters Application (ref. RM/18/84466 dated 9th April 2021) has also been approved for Phase 2 of the development (equating to 143 dwellings with associated parking, landscaping, open space and works, including diversion of a drainage ditch).

It is understood that a Reserved Matters Application (ref. RM/19/86658 dated 5th April 2022) has also been approved for Phase 3 of the development (equating to development of 236 residential dwellings with associated parking, landscaping and open space).

No conditions relating to land contamination were noted to be attached to these Reserved Matters approvals. However, it should be noted that the lack of planning conditions applied to the development in relation to contamination would not remove the developer's responsibility to deal with contamination identified in line with current guidance, regulations and duty of care.

This Remediation Strategy and Verification Plan has been prepared to address Condition 18c of the outline planning permission for the site.



2.0 BACKGROUND

This Remediation Strategy and Verification Plan (RSVP) has been developed following a review and assessment of the findings of two phases of third party intrusive investigations undertaken for the site, details of which are provided below:

- Desk Study Report, Ref. E-E1589/LJE/CDS, dated November 2014, prepared by Opus International Consultants (UK) Ltd for Gleeson Developments, Miller Homes and Welbeck Strategic Land LLP;
- Geo Environmental Site Investigation Report, Ref. BRD2924-OR1-C, dated 21st July 2017, prepared by BRD Environmental for Gleeson Strategic Land and Miller Homes;
- Geo-Environmental Report, Ref. CRM.1668.012.GE.R.001.A, dated January 2021, prepared by Enzygo Geoenvironmental for Bellway Homes;
- Detailed Quantitative Gas Risk Assessment, dated 30th June 2022, prepared by Geo-Environmental for Bellway Homes & Miller Homes, Ref. GE20584/DQGRA/JUN22;
- Ground Appraisal Report, dated 9th March 2023, prepared by Geo-Environmental for Bellway Homes & Miller Homes, Ref. GE20584/GARv2/MAR23.

An overview of salient findings of the investigations pertaining to the site to date is presented below. For further information, the original reports should be referred to directly. The factual correctness of third party information is assumed and no liability can be accepted for errors, omission or inaccuracies in such information within the data reported, or assessment undertaken and based on any such erroneous information. It is assumed that the Client has formal reliance on these third party reports.

2.1 Previous Reports

Opus (2014)

The report comprised a review of historical mapping and environmental dataset information pertaining to the site, an account of a site walkover and a preliminary risk assessment for the proposed development at the site (stated as up to 680 dwellings, a local centre, a primary school and public open space).

The report identified the underlying geology at the site to comprise Wittering Formation or Earnley Sand in the southern portion of the site. Superficial Alluvium was recorded along the northern site boundary. Reference to the environmental information indicated no radon protection measures were required at the site.

The Wittering Formation and Earnley Sand were classified as Secondary 'A' aquifers. An aquifer status was not reported for the Alluvium. The site was noted to lay outside any Source Protection Zone (SPZ). No groundwater abstractions were recorded within 1km.

The nearest surface water was reportedly a tertiary river running along the northern boundary. The nearest surface water abstraction was recorded c.310m east of the site. The nearest discharge consent was recorded c.45m west and comprised public sewage to a freshwater stream/river. The nearest pollution incident occurred in 1998, c.15m west of the site involving the release of petrol into a storm drain recorded as a minor (Category 3) incident.

No historic or active landfills or waste treatment sites were recorded within 1km of the site. Nine contemporary trade entries were recorded within 100m of the site including general engineers, joinery, road haulage, door manufacturers, macadam laying contractors, gate manufacturers, and pet food and animal feeds.

Historically, the site was reported as predominantly farmland with a railway line on the western boundary



throughout the mapping editions reviewed. Park Farm, a complex of farm buildings, was located in the east of the site from the 1960s. Hedge End and Boorley Green became increasingly expanded with predominantly residential developments over the mapped period.

A site walkover was undertaken as part of the desk study. At that time, the site largely comprised grazing pasture for sheep and horses. A number of drainage ditches were noted within the site. A stream was reported on the northern boundary. Park Farm in the east comprised a farmhouse with garden, a milking parlour and various barns utilised for livestock housing and haylage and straw storage. Several of the barns were noted to be roofed and clad with what was potentially asbestos cement. Three old 205 litre storage drums were noted adjacent to a lean-to. An above ground oil tank in a concrete bund was noted in the front garden of the farmhouse. An above ground diesel storage tank with integrated bund was recorded adjacent to one of the farm buildings. No visual or olfactory evidence of hydrocarbon contamination was reportedly observed at either tank location. During the walkover survey, Opus were advised that a horse was buried in one of the paddocks at Park Farm.

The Preliminary Risk Assessment identified the oil and diesel tanks, agrochemicals, manure piles, and asbestos within buildings as potential on-site sources of contamination. The adjacent railway and Braxell Cottage haulage vehicle repair to the east were identified as potential off-site sources. Risk rating of low to medium were generally assigned to receptors, with a medium risk assigned to future site users in relation to soil contamination, and a medium to high risk assigned in terms of the asbestos containing materials in the farm buildings.

The report recommended a ground investigation including laboratory analysis of soil samples was undertaken.

BRD Environmental (2017)

BRD Environmental's intrusive investigation at the site comprised 31No. machine excavated trial pits to depths of up to 3.00m bgl and 15No. windowless sample boreholes to depths of 3.00m to 5.00m bgl. Soakage testing was undertaken in 6No. trial pits. Combined gas and groundwater monitoring boreholes were installed to 4m bgl in 10No. of the boreholes. Ground gas and groundwater monitoring was undertaken on 6No. occasions during August and September 2017.

The investigation reportedly encountered a mantle of Topsoil or Topsoil containing very low proportions of anthropogenic materials (brick and charcoal) overlying clay soils of the Wittering Formation and London Clay Formation. Made Ground to depths of between 0.20m and 0.25m bgl was reported in two locations (WS5 and WS6) within the yard area of Park Farm in the east of the site. During the return monitoring, groundwater was reported at depths ranging between 0.75m to 2.76m bgl.

A human health risk assessment of the results of geochemical laboratory testing undertaken on soil samples obtained during this investigation reported elevated concentrations of PAH compounds (Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(a)pyrene and Dibenzo(a,h)anthracene) in one location (WS6 at 0.20m bgl) and chrysotile asbestos fibres in two locations (WS5 at 0.10m bgl and WS6 at 0.20m bgl). All elevated contaminant concentrations were recorded within the Made Ground soils encountered in the Park Farm yard. Recommendations were made for further investigation in the Park Farm area of the site to assess the extent of contaminated soils followed by a reduced dig and off-site disposal of impacted soils or re-used under hardstanding (if/where deemed to be suitable).

The BRD Environmental report indicated the only source of ground gases to be natural soils with low organic content and identified the risk as negligible. Nevertheless, ground gas monitoring was undertaken in 10No. boreholes across the site on 6No. occasions between August and September 2017. The monitoring reported methane at concentrations between 0.0% and 0.2%, carbon dioxide between 0.5% and 13.1% and oxygen between 5.2% and 20.3%. Flow rates were recorded between <0.0l/hr and 0.5l/hr. Atmospheric pressure was recorded



between 1006mb and 1021mb. Based on the maximum concentrations of carbon dioxide recorded, the report stated the gas regime of the Park Farm area of the site was NHBC Amber 1, for which gas protection measures would be required. The report stated that the area of the site outside Park Farm could be classified Green as elevated carbon dioxide was only recorded in three boreholes (WS3, WS5 and WS6) in or near Park Farm. Recommendations were made for further investigation and gas monitoring in the area of Park Farm to 'delineate' the extent of elevated carbon dioxide concentrations. Zonation of the site in terms of the recorded ground gas concentrations alone is not in line with best practice and a detailed ground gas risk assessment has now been undertaken for the site. It should be noted that the Opus International Consultants (UK), November 2014 desk study report for the site has not been provided to allow a separate review of the potential source of ground gases identified as part of the Phase 1 assessment of the site.

The report stated that, the soil contaminant concentrations recorded at the site were not considered to present any significant risk to groundwater.

Enzygo Geoenvironmental (2021)

The report gave an account and interpretation of a supplementary investigation undertaken at the site. The investigation was undertaken in two fields which BRD Environmental were unable to access in 2017 and in the area around Park Farm including additional ground gas monitoring.

The investigation comprised 12No. window sampler boreholes to a maximum depths of up to 5.0m bgl five in which were in the area surrounding Park Farm. Five boreholes were installed with combined gas and groundwater monitoring standpipes, three of which were in the fields immediately surrounding Park Farm. Ground gas and groundwater monitoring was undertaken on 6No. occasions during January and February 2021. Borehole WS6 from the BRD investigation was also monitored of 4No. occasions.

The investigation recorded Made Ground to between 0.20m to 0.90m bgl in all locations, formed of sandy clay with occasional brick and ash. Clay and sand-based soil of the Wittering Formation were encountered below the Made Ground. Groundwater was recorded at between 2m and 4m bgl during the investigation and between 0.11m and 1.15m bgl during the return monitoring.

Twelve samples of Made Ground were submitted for laboratory testing for a suite of common brownfield contaminants. No elevated contaminants were identified when screening against Tier 1 assessment criteria by Enzygo, but the report referenced the elevated PAH and asbestos reported within the BRD report. The report recommended removal of the impacted Made Ground identified by BRD in the Park Farm area where soft landscaping is proposed.

The Enzygo report initially identified a negligible risk of ground gases at the site. However, ground gas monitoring was undertaken on 6No. occasions over a 1 month period. The monitoring recorded methane at <0.1% throughout, carbon dioxide ranging between 0.9% and 16.9% and oxygen between 5.2% and 20.3%. Flows were recorded between <0.0009l/hr and <0.0172l/hr. Atmospheric pressure ranged between 986mb and 1035mb. Carbon dioxide was noted to be recorded in excess of 5% in WS101, WS103, WS105 and WS6. These were attributed to the potential presence of a former cesspit at Park Farm, although no evidence for such a feature was presented. Recommendations were made for the site to be zoned as Characteristic Situation 1 in areas outside of Park Farm and Characteristic Situation 2 within the area of Park Farm, which would require gas protection measures. Again, zonation of the site in terms of the recorded ground gas concentrations alone is not in line with best practice and a detailed ground gas risk assessment has now been undertaken for the site.



Geo-Environmental Ground Appraisal Report and Detailed Quantitative Gas Risk Assessment

Two phases of intrusive investigation were undertaken in the Park Farm area of the site by Geo-Environmental and detailed in the Ground Appraisal Report (GE20584/GARv2/MAR23).

Initially an intrusive investigation comprising 5No. dynamic sampler boreholes was undertaken in May 2022. The investigation was undertaken to support the Detailed Quantitative Gas Risk Assessment for the site but also to undertake a contamination assessment of soils. The boreholes were drilled to 5.00m bgl and installed with ground gas monitoring standpipes. Geochemical testing of soil and groundwater samples was undertaken. Three return ground gas and VOC monitoring visits were undertaken between 26th May and 15th June 2022.

The initial investigation revealed ground conditions comprising a mantle of Made Ground or Topsoil overlying clay soils of the Wittering Formation with London Clay Formation at depth. Faint or mild diesel odours and possible staining was recorded to 3.50m bgl on WS202 adjacent to the above ground diesel storage tank (also the location of a former steel single skin tank). Groundwater was recorded at between 0.59m and 3.51m bgl during return monitoring.

No elevated soil contaminants in terms of human health were recorded during the May 2022 investigation. Minor hydrocarbon impact was observed in soils in WS202 adjacent to an above ground diesel tank, with some potential hydrocarbon breakdown products identified in soils analysed. A groundwater sample from this location recorded elevated metal compounds and three volatile organic compounds (VOCs). The metal concentrations were considered representative of general background groundwater quality in the area of the site. The VOCs were potentially associated with the natural breakdown and degradation of minor spillages of fuels at the site. Further localised investigation was recommended in the area of the diesel tank following demolition and site clearance.

The Detailed Quantitative Gas Risk Assessment (GE20584/DQGRA/JUN22) concluded that the site should be considered a Characteristic Situation 1 classification, with no requirement for gas protection measures.

A post demolition investigation was undertaken in February 2023 following demolition and removal of the buildings and hardstanding at Park Farm. The investigation comprised 13No. trial pits to a maximum depth of 2.50m bgl targeting areas below former buildings and hardstanding. Four trial pits also targeted the area surrounding the diesel tanks which had been removed.

The 2023 investigation revealed up to 0.55m depth of Made Ground overlying clay soils of the Wittering Formation. Groundwater was recorded at depths between 1.30m and 1.80m bgl. Slight hydrocarbon odours were noted with two trial pits (TP102 and TP103) in the area of the former diesel tank to a maximum 2.30m bgl.

The contamination testing recorded elevated PAH and Lead concentrations within a sample of Made Ground from TP107 in terms of human health. Fragments of asbestos cement were recorded on the site surface in two locations and within Made Ground soil in TP112. A reduced dig exercise to remove the Lead, PAH and asbestos containing Made Ground from within proposed private gardens and areas of soft landscaping was recommended.

Slightly elevated TPH concentrations were recorded within soils sampled in the area of the former diesel tank. However, as the contamination source had been removed and minor soil based impact would be expected to degrade over time, such that no remediation in terms of groundwater protection is considered to be required.

2.2 Site Context

At the time of the third party investigation works in 2014, 2017 and 2021 the site reportedly comprised a broadly triangular shaped parcel of land located at NGR 450266E, 114818N and extended to approximately 46Ha.



The site comprised a number of open fields, mainly grazing pasture, bounded by hedgerows and post and wire fencing with a cattle farm (Park Farm) located in the east. A ditch bisected the site running in a concave upwards curve from the centre of the eastern boundary to the north-western corner of the site. To the north of this ditch, the land sloped gently downhill in a southeast direction. To the south of the ditch, the ground was broadly flat with a gently sloping ridge in the south falling away to the north and south.

The site boundaries comprised hedgerows and fences. A railway line ran alongside the southwestern boundary. A ditch was present alongside the northern site boundary. Beyond the railway and ditch, open fields were present to the north and south. Residential land use was located to the west, beyond the railway line, and to the east, with Winchester Road and more residential development present further east.

An updated site walkover has not currently been undertaken by Geo-Environmental for the wider site as investigation has focused on Park Farm.

At the time of Geo-Environmental's initial investigation (May 2022), the Park Farm area comprised a farmyard, farmhouse and adjoining grass fields utilised for cattle farming. Topographically, the site sloped very gently downhill to the west.

The farmyard comprised six barns with associated lean-to structures surrounded by concrete hardstanding. The barns were predominantly empty apart from hay bales, containers of Ad-Blue urea, tractor and other farm machinery noted. Asbestos cement was noted to form the roofs, cladding and rainwater goods on some barns. In the west of the farmyard was the partially broken floor slab of a former barn, understood to have been recently removed by the farmer. The external yard areas contained a stack of haylage/silage bales, metal gates, trailers, various agricultural implements and stacks of wooden pallets. To the east of the northernmost barn were several stacks of corrugated asbestos cement sheets, presumably removed from the demolished barn in the west of the farmyard. To the west of the farmyard stood a two storey brick house surrounded by a garden laid to lawn with a number of small trees and shrubs.

To the northwest of the farmhouse a steel single skin heating oil above ground storage tank raised on brick piers was noted. The tank volume was estimated to be approximately 1,200 litres. No staining or leakage was visually evident on the tank, the piers or the underlying ground surface. To the northeast of the two easternmost barns, a diesel above ground storage tank (AST) was observed. The tank was approximately 2,000 litres in volume, self-bunded and constructed from plastic. Some staining on the tank was noted below the access panel on the front of the tank. It is understood from the farmer that the tank replaced a steel single skin AST which was present from the 1950s. The farmer also indicated a former cesspit to the west of the farmhouse which overflowed into a septic tank further west which discharged to a drain running through the yard to a ditch to the north of the farmyard. The current septic tank serving the site was located in the field in the south of the site and discharged to a ditch on the southern boundary.

The site boundaries comprised semi-mature and mature trees and hedgerows to the south, east and west with timber close-boarded fencing to the north. Winchester Road was located to the east of the site. A residential development was present to the north. Grass fields, part of the wider Boorley Gardens site, were located to the northwest and west. A construction site, also part of the wider Boorley Gardens site, with parking area, site offices and compound, was located to the south.

At the time of Geo-Environmental's post demolition intrusive investigation (February 2023), the Park Farm area comprised an approximately rectangular shaped area of land which sloped gently downhill to the southwest. The site surface comprised predominantly bare soil with areas covered by gravel and cobble sized fragment of brick, concrete and natural stone. A limited area of hardstanding remained in the east of the site giving access to



Winchester Road. An area in the centre of the site, approximately 5.0m by 2.5m, was secured with mesh fencing and indicated by signage to be soft ground. A stockpile of crushed demolition material was located in the east of the site.

The site boundaries comprised a hedgerow with Heras fencing within it to the east, timber garden fencing in the eastern half of the northern boundary, and Heras fencing for the remaining boundaries. Timber hoarding was present to the southeast around the Bellway sales area adjacent to the site.

The site's history apparently comprised undeveloped agricultural land with the exception of Park Farm which was developed around the 1960s. The layout of the farm altered over time until it reached its current configuration.

The ground conditions encountered on site comprised a mantle of Topsoil or Topsoil containing very low proportions of anthropogenic materials (brick and charcoal) overlying clay and sand soils of the Wittering Formation and clay soils of the London Clay Formation. Made Ground to depths of between 0.10m and 0.55m bgl was recorded within the area of Park Farm in the east of the site. This material typically comprised clay with varying proportions of silt, sand and gravel with low proportions of occasional brick, concrete, metal timber, ceramic tile, tarmac and charcoal fragments. Further Made Ground, which could be considered as Topsoil containing very low proportions of anthropogenic material, was recorded to a depth of up to 0.90m bgl in some areas. Groundwater was recorded at depths ranging between 0.59m to 2.98m bgl during return monitoring.

The Wittering Formation was recorded as a Secondary 'A' Aquifer. The London Clay Formation was recorded as Unproductive Strata. The site was located outside any identified Source Protection Zone.

Investigation and testing of the soils at the site identified contaminant concentrations of concern within the Made Ground located in the Park Farm area of the site. Asbestos (chrysotile fibres) was identified within two samples of Made Ground (WS5 at 0.10m bgl and WS6 at 0.20m bgl) with asbestos cement identified in Made Ground in TP112. Elevated concentrations of PAH compounds (Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(a)pyrene and Dibenzo(a,h)anthracene) were recorded in two locations (WS6 at 0.20m bgl & TP107 at 0.10m bgl). An elevated Lead concentration was also recorded in TP107 at 0.10m bgl. It is considered that remedial action would be warranted to protect end users of a residential development in this area of the site (see Figure 2). No contaminant concentrations of concern within soils in other areas of the site were identified by the investigation and testing.

Third party ground gases monitoring of 10No. standpipes on 6No. occasions between August and September 2017 and a further 12No. standpipes between January and February 2021 recorded elevated carbon dioxide concentrations in five boreholes (WS3, WS5, WS6, WS101, WS103 and WS105) within or close to the Park Farm area of the site. No elevated gas concentrations were recorded in the remaining 9No. boreholes during the monitoring undertaken. Further monitoring, undertaken by Geo-Environmental, targeted potential ground gas sources in the Park Farm area (WS201 to WS205). This monitoring recorded methane between 0.1% and 4.6%. Carbon dioxide was recorded between 0.0% and 6.3%. Borehole flows were measured at 0.0l/hr throughout. VOCs were recorded up to 19.2ppm during the monitoring. The Detailed Quantitative Gas Risk Assessment concluded that the site should be considered a Characteristic Situation 1 classification, with no requirement for gas protection measures.

2.3 Proposed Site Use

It is understood that the site is proposed to be developed for a residential land use with, together with a primary school and open space leisure areas.



2.4 Conceptual Site Model

Assessment of the investigation findings has identified potential hazards which were considered to require intervention (remediation) to mitigate the risk of harm in one section of the site. Remediation works are proposed to break the identified plausible pollutant linkages associated with the contaminant of concern identified within proposed gardens and soft landscaped areas thereby mitigating the associated risk of harm to human health.

This would be undertaken as by a reduced dig (i.e. excavation/stripping of upper soil layers) and off-site disposal of impacted Made Ground to sufficient depth to remove the full depth of Made Ground within private gardens and areas of soft landscaping with validation and testing to verify the Made Ground removal (as requested by the Local Authority Environmental Health Officer).

It is proposed that clean naturally occurring soils present across the wider site would be re-used under the CL:AIRE Definition of Waste Code of Practice, Site of Origin scenario, to raise the levels at the site where the materials are demonstrated to be suitable for the proposed use. A Material Management Plan will be produced for the site and a Qualified Person Declaration will be submitted to CL:AIRE. Following consultation with the Local Authority, the asbestos, lead and PAH impacted Made Ground identified in the vicinity of Park Farm only, excavated as part of the reduced dig remediation exercise will not be re-used on site and will be disposed of under appropriate duty of care.

The aim of the remediation is not necessarily to remove all contamination identified on site but to reduce the identified risk to an acceptable level with respect to human health.

Remediation measures are only required within a certain area of the site (Park Farm, see Figure 2).

This Remediation Strategy and Verification Plan for the site will be updated and amended in response to any unexpected contamination uncovered as part of the discovery strategy for the site in line with Section 7.0. However, it is not proposed to re-use Made Ground materials on site, only clean naturally occurring materials.



3.0 SOILS

3.1 Background

The ground conditions within the site have been established through third party intrusive investigations and two subsequent phases of intrusive investigation by Geo-Environmental. Soils comprised a mantle of Topsoil or Topsoil containing very low proportions of anthropogenic materials (brick and charcoal) overlying clay and sand soils of the Wittering Formation and clay soils of the London Clay Formation. Made Ground to depths of between 0.10m and 0.55m bgl was recorded within the area of Park Farm in the east of the site. This material typically comprised clay with varying proportions of silt, sand and gravel with low proportions of occasional brick, concrete, metal timber, ceramic tile, tarmac and charcoal fragments. Further Made Ground, which could be considered as Topsoil containing very low proportions of anthropogenic material, was recorded to a depth of up to 0.90m bgl in some areas.

A summary of the elevated concentrations of contaminants of concern recorded in soil samples is presented in Table 3.1 below.

Determinand	Location	Depth (m bgl)	Tier 1 Criteria (mg/kg)	Concentration (mg/kg)	Geology
Asbestos	WS5*	0.10	-	0.002% w/w chrysotile fibre bundle	Made Ground
	WS6*	0.20		0.001% w/w small chrysotile fibre bundle	Made Ground
	West of TP104 ref. ACM1	Surface		Asbestos cement (chrysotile)	-
	TP112 ref. ACM3	0.00 – 0.30		Asbestos cement (chrysotile)	Made Ground
Lead	TP107	0.10	200 – C4SL 201 – SSAC	432	Made Ground
Benzo(b)fluoranthene	TP107	0.10	3.3 – S4UL 4.94 – SSAC	12.4	Made Ground
Benzo(a)pyrene			2.7 – S4UL 4.96 – SSAC	10.3	
Dibenzo(ah)anthracene			0.28 – S4UL 0.393 – SSAC	1.25	
Benzo(a)anthracene	WS6*	0.20	S4UL – 7.2	20.9	Made Ground
Chrysene			S4UL – 15	20.2	
Benzo(b)fluoranthene			S4UL – 2.6	27	
Benzo(a)pyrene			S4UL – 2.2 C4SL – 4.95	21.8	
Dibenzo(a,h)anthracene			S4UL – 0.24	1.94	

NOTE: S4ULs for PAH are Soil Organic Matter (SOM) content dependent and the S4UL was selected based on the SOM recorded in the relevant sample

Table 3.1 Summary of Elevated Contaminant Concentrations Identified as part of the 2017 BRD Environmental Investigation (indicated by a *) and 2022 & 2023 Geo-Environmental Investigations

Based on the above, it is considered that remedial action would be warranted to protect end users of a residential development within the Park Farm area of the site.



3.2 Site Workers

It is the responsibility of the Principal Contractor and their appointed sub-contractors to implement and manage safe systems of work and prepare their own risk assessments in accordance with Health and Safety legislation in order to protect persons in their employ, as well as mitigate the risk of harm to others due to works in their control. Special consideration should be given to the provisions of the Construction (Design & Management) Regulations 2015, Health and Safety at Work Act and the Control of Substances Hazardous to Human Health regulations to protect the safety of persons in their employment. Additional guidance can be sought from the CIRIA publications entitled "A Guide for Safe Working on Contaminated Sites" and "Environmental Good Practice on Site Guide (fourth edition)".

Given the presence of asbestos within the Made Ground soils, the contractor should also ensure their compliance with the Control of Asbestos Regulations 2012. All work with asbestos containing materials and asbestos containing soils should be undertaken by a suitably competent contractor who should prepare an asbestos specific risk assessment and plan of work detailing the control measures to be applied when working with the asbestos containing materials/soils. The contractor should also assess whether the work would be considered licensable and/or notifiable under the Control of Asbestos Regulations 2012.

In addition to the safe systems of works to be implemented alongside appropriate risk assessments and method statements, all site personnel shall benefit from on-site hygiene facilities including wash area, toilets and drying room. Separate canteen areas and welfare facilities should be provided. All eating and drinking should be restricted to the canteen area and only once site personnel have removed outer PPE and washed exposed skin.

In the event of dry spells, or where the exposed surface becomes dry, regular damping down of the surface of the site will be required to prevent the release of soil dust which could impact on site operatives or migrate off-site, thereby mitigating both off-site exposure and nuisance for neighbours.

3.3 End Users

A contamination assessment has identified one area of the site (Park Farm, see Figure 2) where asbestos (fibres and visible fragments), lead and PAH (Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(a)pyrene and Dibenzo(a,h)anthracene) were recorded above respective Tier 1 screening values and Site Specific Assessment Criteria within the Made Ground.

Given the nature of the contaminants identified within these soils, and following consultation with the Local Authority (LA) Environmental Health Officer (EHO), the impacted soils will be removed entirely back to natural ground within proposed garden and landscaped areas in the Park Farm area.

Any soils imported onto the site will need to be verified free from contamination with chemical testing undertaken to confirm their suitability for use within areas of soft landscaping. Soil importation is discussed further in Section 6.2.

Where contaminated soils are located in an area of permanent hard cover and are to remain undisturbed (i.e. not excavated and subsequently re-used), e.g. building footprint, road, car park, driveway or the like, then the hard cover would break the pollutant linkage and remediation would not be required in terms of the risk to human health, however limited works may be required in these areas to provide a suitable working platform for development to proceed and in relation to any longer term maintenance for any service runs located in this area. No Made Ground will however be re-used on the site, where excavated this will be disposed of under the appropriate duty of care as requested following consultation with the Local Authority Environmental Health Officer.



3.4 Inspection/Validation (Soils)

Verification of remediation measures shall be required through regular inspection at key stages of the works to include:

- Excavation/removal of soils from a reduced dig (where required) and subsequent validation of removal;
- Inspection and validation testing of the exposed formation where Made Ground soils are completely removed.

Verification will include inspection and sampling of exposed formation levels following the reduced dig. Photographic evidence will also be recorded including during the reduced dig and exposure of the sub-grade.

Details of these works will be presented within a Verification Report for the site and submitted to the Local Planning Authority. The Verification Report will also include details of the clean naturally occurring soils re-use on site as proposed/detailed in a MMP for the site under the site of re-use scenario and be submitted to the Environment Agency and CL:AIRE under the Definition of Waste Code of Practice (DoWCoP).

3.5 Built Environment

The current guidance on selection of materials for water supply pipes to be laid in contaminated land is contained in UK Water Industry Research's (UKWIR) report reference 10/WM/03/21 (re-issued 2010). However, the guidance is not mandatory and there have been concerns raised by various industry technical associations regarding the document and the methodologies proposed. Although there are concerns regarding the document, in lieu of any further guidance, in the first instance the results of the previous third party investigation have been compared with the proposed thresholds published in UKWIR Table 3.1.

The analysis undertaken has identified barrier pipe would be required within the area of WS202, TP101, TP102, TP103 and TP104 due to recorded TPH in the C11-C20 range and SVOC concentrations. This is likely associated with the former diesel AST in this location. The remaining analysis indicates that PE pipework would likely be suitable in other areas of the site. This should be confirmed with the appropriate utility provider. As a matter of good practice and to maximise the protection to maintenance workers, it is recommended that clean, granular backfill is used in service runs and that marker tapes are used for all buried services.

Documentary evidence of the liaison undertaken with the water utility company and records of the installation of the agreed type of supply pipework should be provided for inclusion within the Verification Report.



4.0 CONTROLLED WATERS

The site overlies a Secondary 'A' Aquifer (Wittering Formation) and Unproductive Strata (London Clay Formation). The site is not identified as being located within a Source Protection Zone.

No evidence of gross soil impact or significant potentially mobile contaminants was recorded during the investigations, with the exception of diesel odour and potential staining to a depth of 3.50m bgl in WS202 located directly adjacent to the current and historic diesel ASTs. Geochemical testing of soil samples in this location recorded TPH concentrations above the laboratory limit of detection at 1.00m bgl with TPH concentrations below the limit of detection at 3.70m bgl. During the 2023 post demolition investigation, following removal of the tank, slight hydrocarbon odours were noted in TP102 and TP103 to depths of 1.60m and 2.30m bgl respectively. Trial pits TP101-TP104 were located in the area surrounding the former tank location to assess the lateral extent of any hydrocarbon impact. Geochemical testing of soil samples from these trial pits recorded TPH concentrations above the laboratory limit of detection (albeit it at relatively low concentrations) in TP101 at 1.50m bgl, TP102 at 1.80m bgl, TP103 at 1.50m bgl and TP104 at 1.50m bgl. TPH concentrations were recorded below the laboratory limit of detection at 2.40m bgl in TP103 from soils below the highest recorded TPH concentrations. These results are likely to be representative of historic long term minor diesel spillage associated with the former diesel tank, which has now been removed, and thus the residual soil impact would be expected to degrade naturally over time.

A groundwater sample was obtained from WS202 on 8th June 2022 to assess the groundwater quality in the area of the diesel AST.

The results of the groundwater analyses were compared against the Environmental Quality Standards for freshwater (EQS), Water Framework Directive and the Water Supply (Water Quality) Regulations 2000. A summary of contaminant concentrations encountered above the respective EQS, WFD and DWS guideline values, where values are set, or where concentrations were above the limit of detection and no guideline value is available are presented in Table 4.1 below.

Determinand	Guideline Value (µg/l)	Location	Concentration (µg/l)
Arsenic	50 ^{EQS}	WS202	93
Cadmium	5 ^{EQS}		14
Nickel	50 ^{EQS}		360
Lead	50 ^{EQS}		1000
Selenium	10 ^{EQS}		84
Isopropylbenzene	NGV		100
N-Propylbenzene	NGV		61
1,2,4-Trimethylbenzene	NGV		50

NOTES: EQS - Environmental Quality Standards for freshwater; NGV – no guideline value available

Table 4.1 Contaminant exceedances within Groundwater analysis

Assessment of the groundwater results has identified elevated Arsenic, Cadmium, Nickel, Lead and Selenium against the relevant guideline values. Three VOC compounds were also recorded above the laboratory limit of detection for which no guideline values were available. No other VOC or SVOC compounds were recorded above the limit of detection in the groundwater sample tested. TPH was also not recorded above the limit of detection.

The elevated metal concentrations are considered to be representative of general background groundwater quality in the area of the site. No source of gross metal contamination has been identified within the Park Farm area or the wider Boorley Gardens site and no elevated metal concentrations were recorded in soil samples to date. The recorded VOC compounds are potentially associated with the natural breakdown and degradation of



minor spillages of fuels at the site, including the recorded diesel usage, but also including potential historical usage of more volatile petrol and petrol paraffin oil mixtures (tractor vaporising oil).

The former tanks identified on site have been removed from the site as part of the demolition works prior to redevelopment. As such, the potential sources of continuing groundwater contamination from the site are no longer present and it is considered that natural attenuation of organic contamination would also continue. Therefore, it is considered that no specific remediation is required in terms of risks to groundwater at this stage.

Should significant hydrocarbon contamination within the soils or free product be identified beneath the site as part of the ongoing site clearance and development works, it is recommended that this be removed and/or treated to reduce the presence of an ongoing potential source on the site. Any such identified further contamination would be dealt with under the discovery strategy in place for the site as detailed in Section 7.0

4.1 Monitoring Well Decommissioning

Where gas and groundwater monitoring wells have been installed on the site as part of the ground investigation works these should be decommissioned in line with best practice and in line with Environment Agency guidance as they become redundant and prior to any development works where they are situated on site. The decommissioning should comprise the removal of the well and back filling of the location with bentonite, in order to ensure that a pollution pathway does not remain on the site.



5.0 GROUND GASES

The BRD Environmental report (2017) reported that the only potential source of ground gases on site was related to be natural soils with low organic content and identified the risk as negligible. The Enzygo report (2021) identified Made Ground as a potential gas source but considered the risk to be negligible. The third party ground investigations undertaken and reviewed to date did not identify a significant thickness of Made Ground or highly organic material that could be considered to present a potential gas risk.

Notwithstanding the above, ground gas monitoring was undertaken in 10No. boreholes across the site on 6No. occasions during August and September 2017 and a further 12No. standpipes between January and February 2021. The monitoring recorded methane at concentrations between 0.0% and 0.2%, carbon dioxide between 0.5% and 16.9% and oxygen between 5.2% and 20.3%. Flow rates were recorded between <0.0 l/hr and 0.5l/hr. Atmospheric pressure was recorded between 986mb and 1035mb. Based on the maximum concentrations of carbon dioxide recorded, the BRD report stated the gas regime of the Park Farm area of the site was NHBC Amber 1, for which gas protection measures would be required. The report stated that the area of the site outside Park Farm could be classified Green as elevated carbon dioxide was only recorded in three boreholes (WS3, WS5 and WS6) in or near Park Farm. The Enzygo report also made recommendations for the site to be zoned as Characteristic Situation 1 in areas outside of Park Farm and Characteristic Situation 2 within the area of Park Farm, which would require gas protection measures.

Subsequent to two third party investigations, Geo-Environmental undertook further investigation (May 2022) and monitoring in the Park Farm area followed by a Detailed Quantitative Gas Risk Assessment. The assessment was based on the findings of the third party and Geo-Environmental Investigations. Geo-Environmental's ground gas monitoring within 5No. boreholes in Park Farm recorded methane between 0.1% and 4.6% and carbon dioxide between 0.0% and 6.3%. Oxygen was recorded in the range 0.2% to 21.0%. Borehole flows were measured at 0.0l/hr throughout. VOCs were recorded up to 19.2ppm during the monitoring.

The Detailed Quantitative Gas Risk Assessment considered that no potential sources of bulk gas generation were present at the site and that the recorded methane and carbon dioxide by monitoring undertaken to date was resultant from the presence of localised hydrocarbon contamination (WS202) and the long-term use of the site for livestock farming which did not represent a risk to the proposed development.

The assessment concluded that the site should be considered a Characteristic Situation 1 classification, with no requirement for gas protection measures. For further details reference should be made to the DQGRA report.



6.0 WASTE

6.1 Waste Classification and Segregation

The natural soils at the site are proposed to be re-used under the Definition of Waste Code of Practice re-use on the site or origin scenario in line with a MMP for the site, with the Made Ground soils present being disposed of off-site where there is a requirement for them to be excavated.

Waste may be defined as any substance or object in Annex 1 of the Waste Framework Directive which the holder discards, intends to discard, or is required to discard. The holder of waste is anyone in possession of waste or generates it and therefore both the contractor and ultimately the developer are responsible for safe disposal of waste.

Asbestos fibres were detected in samples of Made Ground from WS5 at 0.10m bgl and WS6 at 0.20m bgl at concentrations of 0.002% and 0.001% respectively. Based on this asbestos concentration, these soils would be considered non-hazardous waste (in terms of asbestos only). However, there is the potential for further asbestos to be present within the Made Ground soils. Where visible asbestos containing materials or loose fibres at a concentration of 0.1% w/w or more are present with soils, such soils would comprise hazardous waste.

The soil analyses from both phases of Geo-Environmental's investigations (pre and post demolition) were assessed using HazWasteOnline software. An asbestos cement fragment was recorded within Made Ground soils in TP112. The concentration of fibres within the cement may be up to 25% (based on Appendix 2 of HSG264 Asbestos: The Survey Guide) and this concentration was used for the assessment.

The following samples were indicated as hazardous waste or hazardous mixed waste:

- WS202 at 1.00m bgl, natural soils – due to the recorded TPH concentration (List of Waste (LoW) Code 17 05 03* *Soil and stones containing hazardous substances* (hazardous waste);
- TP112 at 0.10m bgl, Made Ground – due to the recorded asbestos cement fragment observed (LoW Code 17 05 04 *Soil and stones other than those mentioned in 17 05 03** (non-hazardous waste) and LoW Code 17 06 05* *Construction materials containing asbestos* (hazardous waste) for the visible asbestos cement within the soils.

None of the other samples of Made Ground and natural soils assessed were indicated to represent potentially hazardous waste. The LoW Code for these soils is considered to be 17 05 04 *Soil and stones other than those mentioned in 17 05 03** (non-hazardous waste).

It must be noted that fragments of asbestos cement were noted on the site surface in two locations during the 2023 investigation (TP104 and TP112). These fragments would comprise hazardous waste and where entrained within soils, would render those soils a hazardous mixed waste. Further asbestos containing materials may be present on the site surface and within soils which were not readily observable or between points of investigation. Hand picking of visible asbestos containing materials may reduce the volume of hazardous mixed waste present. However, this activity should be carried out by a suitably competent contractor who should prepare an asbestos specific risk assessment and plan of work detailing the control measures to be applied when working with the asbestos containing materials/soils. The contractor should also assess whether the work would be considered licensable and/or notifiable under the Control of Asbestos Regulations 2012.

It must be noted that any waste classification assessment is indicative only and actual classification would depend on permit status of the final disposal facility. Once soils for disposal have been identified it is recommended that



further testing waste characterisation and WAC testing of these specific soils be undertaken in order to confirm the above assessment.

6.2 Re-use of Soils

In accordance with CL:AIRE Code of Practice (2011) materials are only considered waste if 'they are discarded, intended to be discarded or required to be discarded by the holder'. Current guidance recommends the retention and re-use of site won soils where there is a need for the materials and where the risk is acceptable.

The Code of Practice therefore allows soils to be re-used on site where the following criteria are met:

- The re-use of the soils will not present an unacceptable or increased risk to controlled waters, the environment and human health;
- The soils are suitable both in terms of chemical and geotechnical properties for the intended use without prior treatment;
- Only the required volume is used, and no more;
- There is a required use and a certainty of use, not just a possibility.

In order to comply with the Code of Practice, a Material Management Plan (MMP) that confirms the above criteria are met has to be prepared in advance of excavation of soils. The material management plan must be reviewed by a 'Qualified Person' who then issues a declaration to the Environment Agency. Where a Remediation Strategy and Verification Plan is in place on the receiver site, the agreement of the use of the DOWCOP and of the RSVP would be required from the regulators (Environment Agency and Local Authority). Any associated planning conditions in this respect would also need to be complied with. Consultation with the Local Authority Environmental Health Office in this respect is such that it is only proposed to re-use clean naturally occurring materials under a MMP for the site. The re-use of Made Ground or soils containing elevated contaminants of concern is not proposed.

Where materials do not meet the required criteria, it may be possible to treat them under an environmental permit so that they may be re-used on site.

In accordance with the Definition of Waste Code of Practice, the re-use of materials will need to be fully documented and included within the Verification Report produced on completion of the works.

In addition, any variation or deviation from the Materials Management Plan, where developed for the site, including change in volumes, change in materials or proposed source areas or area of re-use will need to be clearly documented for inclusion in the validation report for the site.

Failure to document and fully record the works may result in the EA and HMRC determining that waste has been deposited on site illegally, which may be subject to large fines and the requirement to subsequently remove the material from the site.

Should excess clean naturally occurring materials be identified on site, it may be possible for these to be re-used on other sites through the CL:AIRE register of materials, as opposed to these materials being considered waste.

6.3 Importation of Soils

Subsoil and Topsoil shall not be imported to site without prior acceptance of provenance and chemical suitability. Import suitability criteria are presented in Appendix A. Where materials are to be imported on to the site for use as subsoil and Topsoil, these shall be derived from one of two sources, i.e. natural or processed. Where natural



sourcing is proposed, the provenance of the material shall be determined by confirmation of the source site's history to confirm no previous potentially contaminative use, coupled with analysis of soils at a minimum rate of 3No. samples per source site (up to 250m³) and 1 sample per 250m³ thereafter. Where topsoil or subsoil are derived from a manufactured source, testing would be undertaken at a rate of 1 sample per 50m³ up to 10No. samples and then at one sample per 150m³ thereafter if the source and initial sample results remain consistent. Use of an additional source would require repetition of this stepped sampling frequency. With regard to physical and nutritional composition, a minimum testing regime of 1 sample per 250m³ is recommended for either source.



7.0 DISCOVERY STRATEGY

Whilst an intrusive investigation has been undertaken on the site, it remains possible that unexpected soil ground and/or groundwater conditions may be encountered during the process of construction.

Should previously undiscovered contamination or unforeseen ground conditions be encountered during construction, this must be reported to the site manager immediately in order that the consultant is notified. Where deemed necessary, the consultant shall attend the site to inspect the discovery and provide recommendations on the further actions required, if any. Where necessary the regulatory authority shall be informed. Post any additional investigation or laboratory testing the results and any proposed remedial measures shall be reported to the regulatory authority or other appropriate organisation for consent, before proceeding or implementing the remedial measures.

A copy of the discovery strategy must be lodged on site, and provisions made to ensure that all workers are made aware of their responsibility to observe, report, and act on any potentially suspicious, abnormal unforeseen or contaminated soils ground and/or groundwater conditions they may encounter.

Depending on the type, nature and extent of any such 'discovery', it may be necessary to halt works in that location until such time as the assessment has been completed. This shall be reviewed on a 'discovery' specific basis and in conjunction with regulatory consultation with the client, other technical personnel and/or regulatory/appraisal organisations.

As a general guide, where such unexpected conditions are encountered the following approach is required as a minimum:

- All discoveries are to be reported to the Site Manager immediately and works at that location are to halt until further notice;
- The Site Manager is to report any such discoveries to the Client and the Consultant;
- Following notification from the Site Manager, the Consultant shall discuss the discovery with the Local Authority and/or other relevant parties and if considered necessary, arrange to meet an Officer on site to view the discovery;
- The Consultant shall attend the site to record the location, extent and nature of the discovery and implement an appropriate sampling and analysis regime, taking due account of the type and nature of the discovery, known and probable land uses in that area of the site;
- Where remedial action is required, regulatory consultation and approval will be sought;
- A record will be produced by the Consultant and held on site (with copies held by the Consultant, Client and Local Authority/other relevant organisation), detailing the discovery, assessment works undertaken, findings thereof, confirmation either of no action required or detailing the remedial action taken and validation thereof.

The process is shown below.

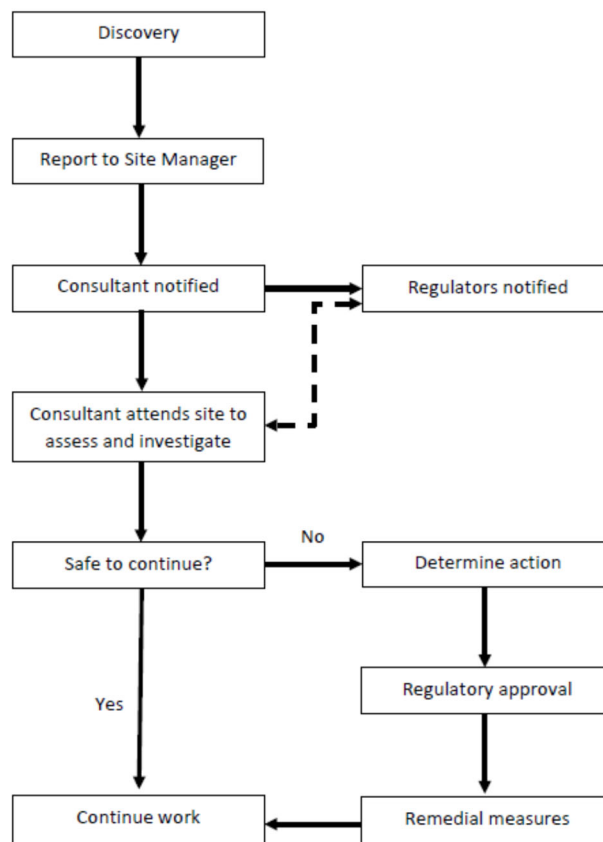


Chart 1 Discovery Strategy Process

A copy of this strategy will be lodged on site, and provisions made to ensure that all workers are made aware of their responsibility to observe, report, and act on any potentially suspicious or contaminated materials they may encounter.



8.0 VERIFICATION

Verification is required to be undertaken throughout the course of the remediation works. The Verification Report will be submitted to the Client, NHBC and Local Authority for formal approval and the Environment Agency if requested as part of any works completed under a Materials Management Plan (MMP) in line with the Definition of Waste Code of Practice.

The Verification Report will refer to the works as set out within this remediation strategy and verification plan and as required by any relevant planning conditions. The report will include records from site inspections including:

- Locations where the Made Ground was excavated and subsequent validation inspections and testing undertaken.
- Photographic evidence of the Made Ground removal.
- An audit trail for any imported subsoil and topsoil, including source, provenance, analytical results, placement location and thickness (should subsoil and/or topsoil be imported).
- Documentary evidence confirming the installed water supply pipework including agreement from the water utility company.
- Validation of any works undertaken under a MMP (If/where utilised on site). It is noted that at the time of writing it is proposed to utilise an MMP in relation to the site and proposed development.
- Details of any discovery made under the Discovery Strategy on site and subsequent works undertaken in relation to these discoveries.

A summary of verification proposals is presented in Table 8.1 below.

The Contractor will be required to deploy a competent person to manage the works and ensure that relevant records are kept in relation to the movement of materials around the site, disposal of any waste soils and pre-important compliance testing for any imported soils. In addition, the remedial works will be inspected and validated on behalf of the Client by Geo-Environmental in order to present independent verification.



Reference	Principal requirements	Design or construction related	Site visit required by Qualified Geo-Environmental Engineer	Supporting documentation
1.0 Verification general principles	Geo-Environmental will be supervising remedial works for the site at Boorley Gardens, Winchester Road, Hedge End, Southampton, SO32 2UA. These works require a reduced dig within proposed gardens and areas of communal landscaping within the Park Farm area of the site (Figure 2). The aforementioned work is in line with the findings from site investigations and risk assessments previously undertaken by BRD Environmental (2017), Enzygo Geoenvironmental (2021) and Geo-Environmental (2022 & 2023) in respect of the development.	Design and Construction	Yes – See below	Details of construction programme to be provided by client/contractor.
2.0 Reduced dig of Made Ground	Excavation of Made Ground to clean natural soils and off-site disposal.	Construction	Yes – 5 days' notice required	Regular visits to site required to confirm works being undertaken. Verification analysis of the exposed natural formation level will be required.
3.0 Waste Management	Any waste soils will be disposed of appropriately. Waste tickets for the removal of arisings should be compiled for submission as part of the verification report for each phase of the development. The waste tickets will be required to demonstrate that the approximate amount of material being removed	Design and Construction	No (unless further testing required where 5 days' notice required)	Chemical test results (Waste classification & WAC) Waste tickets



Reference	Principal requirements	Design or construction related	Site visit required by Qualified Geo-Environmental Engineer	Supporting documentation
	is equal to the summed volume on the waste tickets. If soils are to be re-used on site under the Definition of Waste Code of Practice under a Materials Management Plan for the site records of daily soil movements (volumes) should be kept.			Records of material movements on site to be provided for inclusion in the validation report. (Assumed to be recorded by ground workers, if not then independent inspections will be required).
4.0 Imported Soils	In-situ testing of any soils imported onto site for placement in gardens or landscaped areas will be carried out after placement in line with the frequencies detailed in Section 6.2 with comparison of results to assessment criteria for residential end use.	Construction	Yes	Pre-import certification verifying the chemical quality of the topsoil and subsoil to be provided to Geo-Environmental for review prior to Importation.
5.0 Water Supply Pipework	Confirmation of liaison with the water utility company and confirmation of the agreed pipework installed at the site.	Design and Construction	No	Documentary evidence of consultation with water utility company. Records of supply pipework installed.

Table 8.1 Details of Verification Visits Required on Site

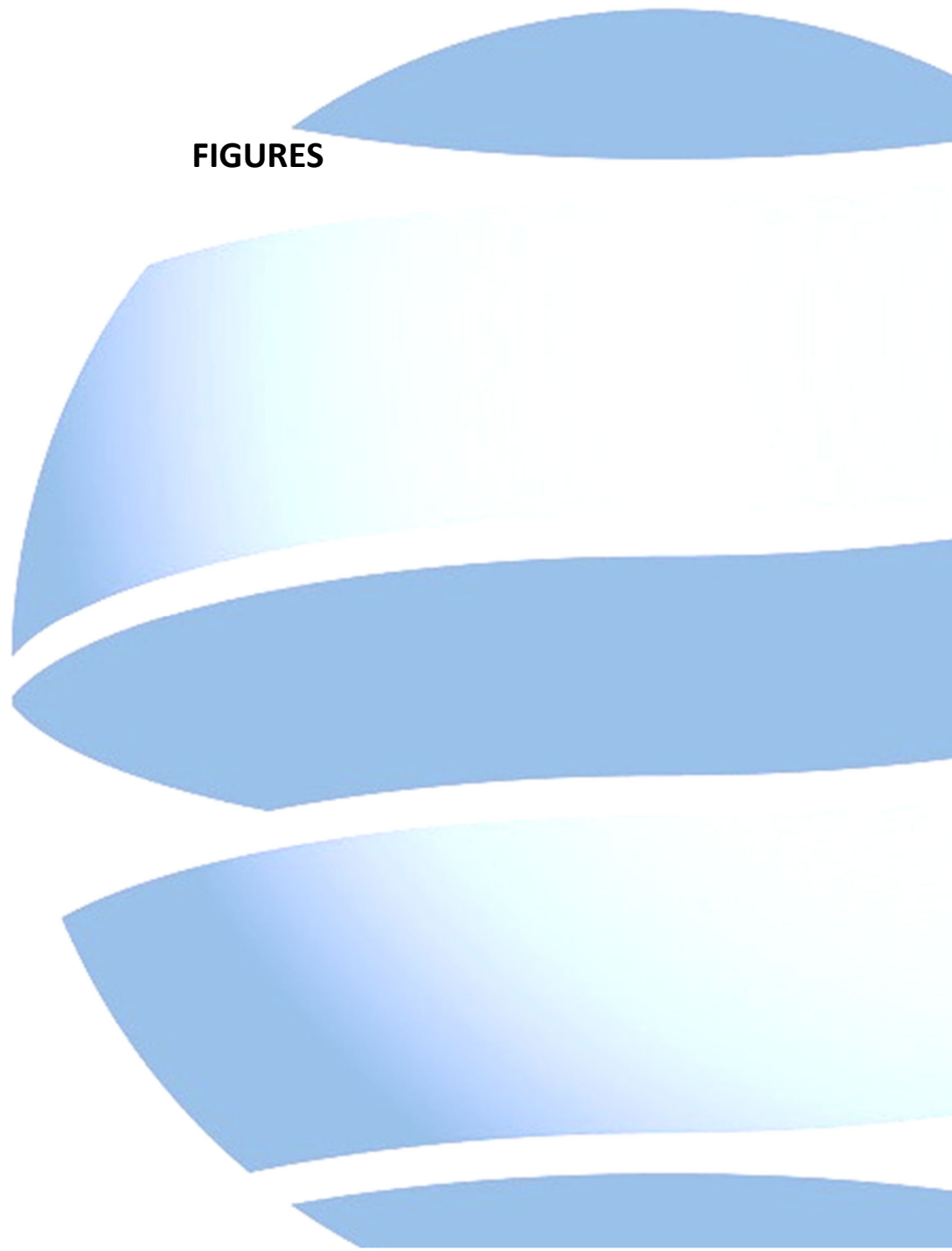
9.0 CONDITIONS

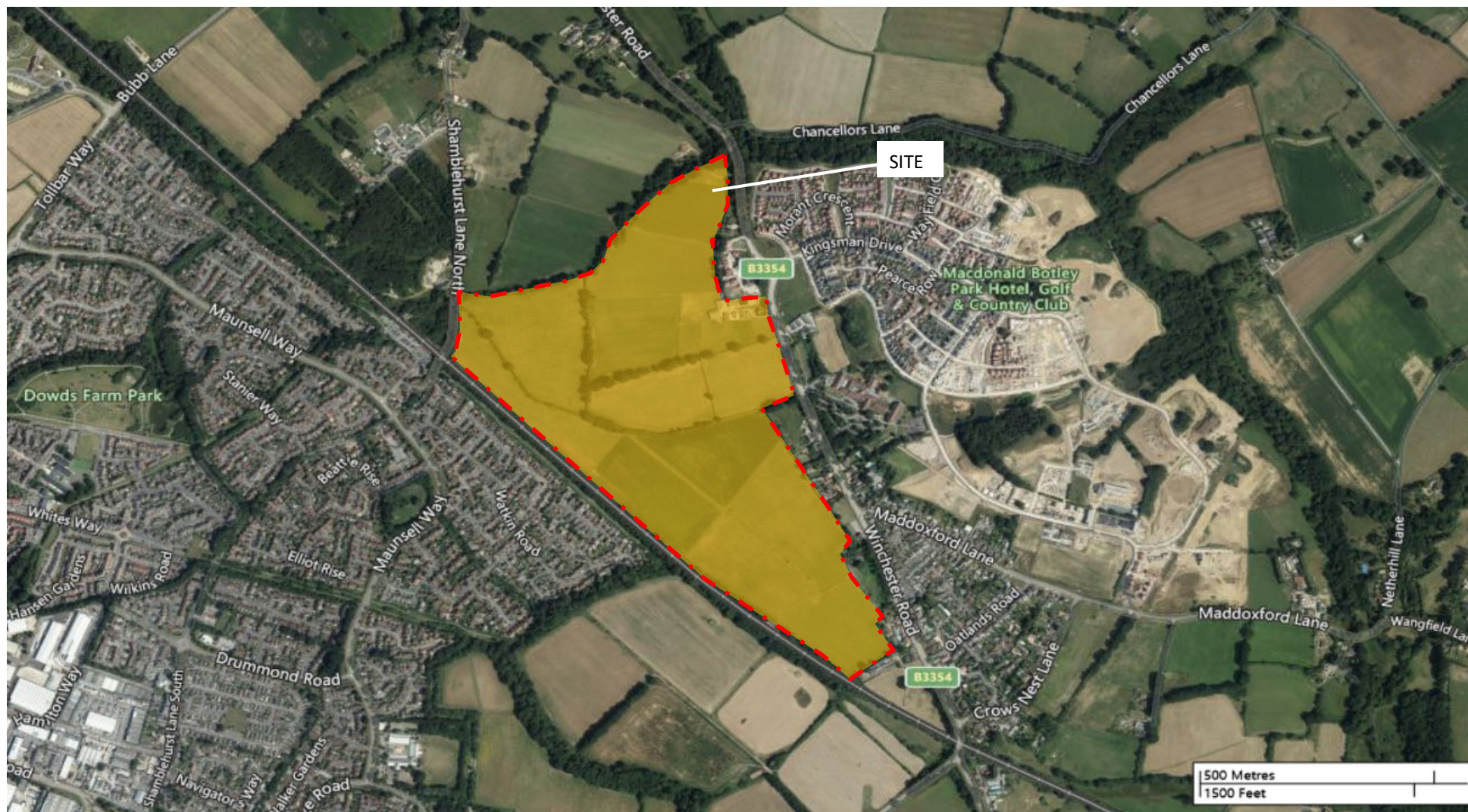
Information contained in this report is intended for the use of the Client and Geo-Environmental can take no responsibility for the use of this information by any party for uses other than that described in this report. Geo-Environmental makes no warranty or representation whatsoever express or implied with respect to the use of this information by any third party. Geo-Environmental does not indemnify the Client or any third parties against any dispute or claim arising from any finding or other result of this investigation report or any consequential losses.

Assessment criteria or other parameters developed for the evaluation of contamination on this site are based on a number of assumptions regarding exposure and toxicology. Exposure to contaminants and levels of adverse effects may therefore vary. Whilst reasonable care and expertise has been employed in the development of such criteria, no liability is accepted in this respect. Other criteria or guidance on the development of assessment criteria may be published in the future and no liability is accepted in this respect.

This report remains the property of Geo-Environmental and the Client has no rights to, or reliance upon this document or supporting documents until such time as payment has been received in full for all invoices for works undertaken in connection with this report.

FIGURES

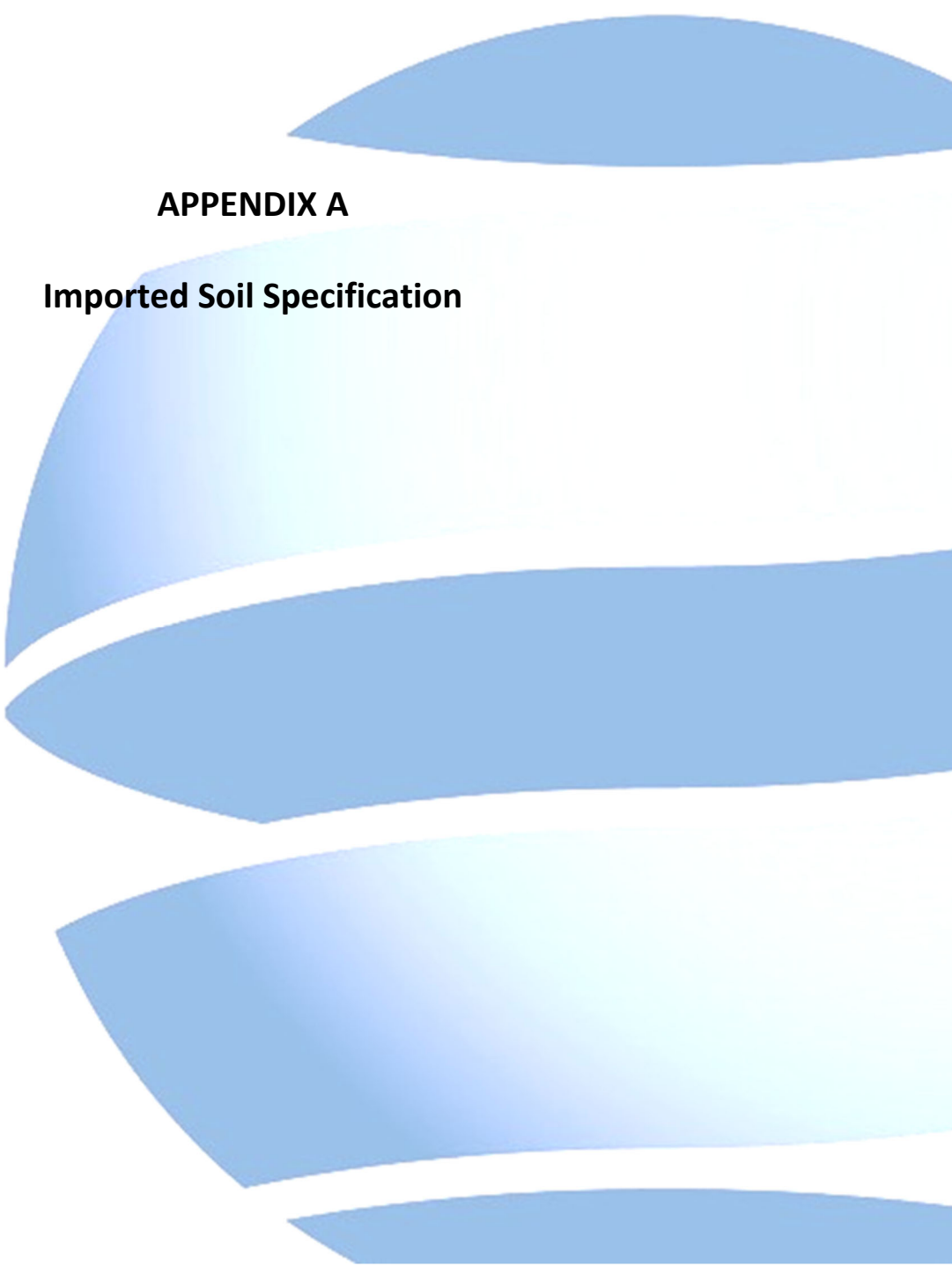




Project:	Boorley Gardens, Winchester Road, Hedge End			Title	Site Location Plan	
Client:	Bellway Homes & Miller Homes			Geo-Environmental Services Ltd Unit 7 Danworth Farm, Cuckfield Road Hurstpierpoint, West Sussex BN6 9GL +44(0)1273 832972 www.gesl.net	 Geo-Environmental	
Ref No:	GE20346	Revision:	0			
Drawn:	SA	Date:	09/11/2021			
Figure:	1	Scale:	Not To Scale			



Project:	Boorley Gardens, Winchester Road, Hedge End			Title	Constraints Plan (Soils)	
Client:	Bellway Homes & Miller Homes			Geo-Environmental Services Ltd Unit 7 Danworth Farm, Cuckfield Road Hurstpierpoint, West Sussex BN6 9GL +44(0)1273 832972 www.gesl.net  Geo-Environmental		
Ref No:	GE20346	Revision:	1			
Drawn:	SA	Date:	09/03/2023			
Figure:	2	Scale:	Not To Scale			



APPENDIX A

Imported Soil Specification

IMPORTED SOIL SPECIFICATION

for the site at

BOORLEY GARDENS, WINCHESTER ROAD

HEDGE END, SOUTHAMPTON, SO32 2UA

on behalf of

BELLWAY HOMES & MILLER HOMES



Report:	IMPORTED SOIL SPECIFICATION	
Site:	BOORLEY GARDENS, WINCHESTER ROAD, HEDGE END, SOUTHAMPTON, SO32 2UA	
Client:	BELLWAY HOMES & MILLER HOMES	
Date:	15/11/2021	
Reference:	GE20346/ISS/NOV21	
Revision:	1.0	
Prepared by:	[Redacted]	
	[Redacted]	
Reviewed by:	[Redacted]	
	[Redacted]	
Approved by:	[Redacted]	
	[Redacted]	

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AMENDMENT RECORD



Revision ref.	Date	Reasons for amendment	Author's initials	Reviewer's initials	Approver's initials
1.0	15/11/2021	First issue	SA	LL	LL



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1.0 Introduction

This document sets out the requirements for imported subsoil and Topsoil materials for any project undergoing redevelopment or other works where capping work is required in line with a residential with plant up take land use.

Within the specification reference has been made to topsoil and subsoil. Topsoil relates to the top layer of natural soil that can support healthy vegetation growth. Subsoil relates to the layer of soil immediately below the topsoil to the depth of the underlying broken rock or geological parent material.

The specification considers the chemical, nutritional and physical properties of soils that are to be imported onto site in order to ensure materials used are suitable for their intended use and do not introduce any new hazard or pollutant linkage on to the site.

Where there is any discrepancy between this specification and BS3882:2015 or BS8601:2013, the latter documents shall take precedence unless otherwise formally confirmed by the relevant regulator.

2.0 Chemical Composition

The chemical criteria listed below are based on the published Category 4 Screening Levels (C4SLs) by DEFRA and/or the relevant Suitable for Use Levels (S4ULs) published by LQM, for a residential end use with plant uptake. From time to time these values may change in line with regulatory or UK policy changes. Such changes will require revision and re-issue of this document.

Where C4SLs or S4ULs are published for a range of Soil Organic Matter (SOM) values, these ranges and their respective SOM values have been presented and would be considered when assessing compliance with this Specification. Where additional guidance comes in which supersedes that information presented here in, this will be assessed at the time when considering acceptability of materials being imported to site.

2.1 Method of Analysis

Samples should be analysed using UKAS or MCERTS accredited laboratories. For TPH analysis sample preparation must not include air drying.

2.1.1 Poly Aromatic Hydrocarbon (PAH)

The PAH analysis must include the EPA priority 16.

2.1.2 Total Petroleum Hydrocarbons (TPH)

The analysis for TPH should be undertaken on the 'as received' sample and not be subject to any pre-treatment and shall include aliphatic and aromatic carbon banding split.

2.2 Topsoil (0-300mm depth)

Tables 1, 1a, 1b and 1c provide a list of the maximum acceptable concentrations for a range of determinants for imported topsoil.



Imported Soil Specification

Determinant	Maximum concentration (mg/kg)
Inorganic	SOM 6%
Arsenic (total)	37
Boron (water soluble)	290
Cadmium (total)	11
Chromium (total)	130
Copper (total)	2400
Cyanide (total)	250
Lead (total)	200
Mercury (total inorganic)	40
Nickel (total)	180
pH	5.5 – 8.5
Selenium (total)	250
Zinc (total)	3700
Asbestos	Absent
Organic	
Phenols (total)	110
Poly Aromatic Hydrocarbon (speciated)	See Table 1a
Total Petroleum Hydrocarbon (speciated)	See Table 1b

Table 1 Chemical Specification for Topsoil

Determinant	Maximum Concentration (mg/kg)		
	1% SOM	2.5% SOM	6% SOM
Acenaphthene	210	510	1100
Acenaphthylene	170	420	920
Anthracene	2400	5400	11000
Benz(a)anthracene	7.2	11	13
Benzo(a)pyrene	2.2	2.7	3.0
Benzo(b)fluoranthene	2.6	3.3	3.7
Benzo(ghi)perylene	320	340	350
Benzo(k)fluoranthene	77	93	100
Chrysene	15	22	27
Dibenz(ah)anthracene	0.24	0.28	0.30
Fluoranthene	280	560	890
Fluorene	170	400	860
Indeno(1,2,3CD)pyrene	27	36	41
Naphthalene	2.3	5.6	13.0
Phenanthrene	95	220	440
Pyrene	620	1200	2000

Table 1a Topsoil Specification for Speciated PAH

Determinant	Maximum Concentration (mg/kg)		
	1% SOM	2.5% SOM	6% SOM
Aliphatic			
EC 5-6	42	78	160
EC >6-8	100	230	530
EC >8-10	27	65	150
EC >10-12	130	330	760
EC >12-16	1100	2400	4300



Determinant	Maximum Concentration (mg/kg)		
	1% SOM	2.5% SOM	6% SOM
EC >16-35	65000	92000	110000
EC >35-44	65000	92000	110000
Aromatic			
EC 5-7 (benzene)	70	140	300
EC >7-8 (toluene)	130	290	660
EC >8-10	34	83	190
EC >10-12	74	180	380
EC >12-16	140	330	660
EC >16-21	260	540	930
EC >21-35	1100	1500	1700
EC >35-44	1100	1500	1700

Table 1b Topsoil Specification for Speciated TPH

Determinant	Phytotoxicity GAC (mg/kg)		
	pH <6.0	pH 6.0-7.0	pH >7.0
Zinc	200	200	300
Copper	100	135	200
Nickel	60	75	110

Table 1c Topsoil Specification for phytotoxicity

2.3 Subsoil (300-1000mm depth)

Tables 2, 2a, 2b and 2c provide a list of the maximum acceptable concentrations for a range of determinants for imported subsoil.

Determinant	Maximum concentration (mg/kg)
Inorganic	SOM 6%
Arsenic (total)	37
Boron (water soluble)	290
Cadmium (total)	11
Chromium (total)	130
Copper (total)	2400
Cyanide (total)	250
Lead (total)	200
Mercury (total inorganic)	40
Nickel (total)	180
pH	5.5 – 8.5
Selenium (total)	250
Zinc (total)	3700
Asbestos	Absent
Organic	
Phenols (total)	110
Poly Aromatic Hydrocarbon (speciated)	See Table 2a
Total Petroleum Hydrocarbon (speciated)	See Table 2b

Table 2 Chemical Specification for Subsoil



Determinant	Maximum Concentration (mg/kg)		
	1% SOM	2.5% SOM	6% SOM
Acenaphthene	210	510	1100
Acenaphthylene	170	420	920
Anthracene	2400	5400	11000
Benz(a)anthracene	7.2	11	13
Benzo(a)pyrene	2.2	2.7	3.0
Benzo(b)fluoranthene	2.6	3.3	3.7
Benzo(ghi)perylene	320	340	350
Benzo(k)fluoranthene	77	93	100
Chrysene	15	22	27
Dibenz(ah)anthracene	0.24	0.28	0.30
Fluoranthene	280	560	890
Fluorene	170	400	860
Indeno(1,2,3CD)pyrene	27	36	41
Naphthalene	2.3	5.6	13.0
Phenanthrene	95	220	440
Pyrene	620	1200	2000

Table 2a Subsoil Specification for Speciated PAH

Determinant	Maximum Concentration (mg/kg)		
	1% SOM	2.5% SOM	6% SOM
Aliphatic			
EC 5-6	42	78	160
EC >6-8	100	230	530
EC >8-10	27	65	150
EC >10-12	130	330	760
EC >12-16	1100	2400	4300
EC >16-35	65000	92000	110000
EC >35-44	65000	92000	110000
Aromatic			
EC 5-7 (benzene)	70	140	300
EC >7-8 (toluene)	130	290	660
EC >8-10	34	83	190
EC >10-12	74	180	380
EC >12-16	140	330	660
EC >16-21	260	540	930
EC >21-35	1100	1500	1700
EC >35-44	1100	1500	1700

Table 2b Subsoil Specification for Speciated TPH

Determinant	Phytotoxicity GAC (mg/kg)		
	pH <6.0	pH 6.0-7.0	pH >7.0
Zinc	200	200	300
Copper	100	135	200
Nickel	60	75	110

Table 2c Subsoil Specification for phytotoxicity



3.0 Nutritional Composition

The nutritional criteria listed below are based on BS3882:2015 for topsoil and BS8601:2013 for subsoil. In the absence of published criteria, current guidance and best practice has been applied to derive appropriate criteria.

3.1 Topsoil & Subsoil

Table 3 details the minimum acceptable concentrations for imported topsoil and subsoil. The nutrient concentrations set out in Table 3 for Topsoil are based on those set out in BS3882:2015 which states “*Multipurpose topsoil is the grade suited to most situations where topsoil is required; however, there can be situations where specific purpose topsoil is required*”. In the event that an alternative specific Topsoil grade is required, i.e. acidic; calcareous; low fertility; low fertility acidic; or low fertility calcareous, the compliance criteria set out in BS3882:2015 shall be applicable in place of those set out in Table 3 below.

Topsoil/Subsoil	Parameter	Concentration
Topsoil (multipurpose grade only)	Phosphorous	16 – 140 mg/l
	Potassium	121 – 1500 mg/l
	Magnesium	51 – 600 mg/l
	Nitrogen	0.15 % m/m
	Carbon:nitrogen ratio	<20:1
Subsoil	Phosphorous	16 mg/l
	Potassium	121 mg/l
	Magnesium	51 mg/l
	Nitrogen	0.15 %
	Carbon:nitrogen ratio	<20:1

Table 3 Nutritional Specification for Topsoil and Subsoil

Where the nutritional values for subsoil are not strictly in accordance with Table 3 but comply with the current British Standards, then these soils may also be deemed to be acceptable for importation.

4.0 Physical Composition

The physical criteria listed below are based on BS3882:2015 Specification for Topsoil. In the absence of published criteria, current guidance and best practice has been applied to derive appropriate criteria.

4.1 Topsoil

Table 4 details the physical suitability requirements for imported topsoil and subsoil. Table 4 sets out acceptability criteria from BS3882:2015 for multipurpose Topsoil. In the event that an alternative specific Topsoil grade is required, i.e. acidic; calcareous; low fertility; low fertility acidic; or low fertility calcareous, the compliance criteria set out in BS3882:2015 shall be applicable in place of those set out in Table 4 below.

Topsoil/Subsoil	Parameter	Specification requirements
Topsoil (multipurpose Topsoil only)	Textural Classification	Sandy clay loam, sandy loam, loamy sand, sandy silt loam (as defined in BS3882:2015, Figure 1)
	Loss on Ignition	3 - 20% (for 5-20% clay soil) 5 - 20% (for 20-35% clay soil)
	Maximum Stone content:	>2mm = 30% >20mm = 10% >50mm = 0%



Topsoil/Subsoil	Parameter	Specification requirements
Subsoil	Textural Classification	Refer to BS8601:2013 Figure 1
	Loss on Ignition	2%
	Maximum Stone content:	>2mm = 40% >20mm = 20% >75mm = 0%

NB: Topsoil and Subsoil must be free from glass, brick fragments, plastic, metal, asbestos and other deleterious materials.

Table 4 Physical Specification for Topsoil & Subsoil

5.0 Source Requirements

5.1 Topsoil and Subsoil

The following will be required to be provided with all soils imported to site:

- A site plan detailing the location and address of the source site, including grid reference.
- Location description of source material, including historic and current site uses.
- Sample analysis results of material at source, including details of laboratory, date of sampling, date samples received by laboratory etc.

5.2 Manufactured soils

Where natural soils are unavailable manufactured soils may be utilised, and the following should be provided:

- Details of the soil manufacturing process, including criteria for received soils, quality control procedure and validation protocol.
- Soils should be tested at a minimum ratio of one sample per 50m³.

6.0 Testing Rates and Compliance

Sampling shall be undertaken in accordance with BS3882:2015 and BS8601:2013.

6.1 Topsoil

Where natural sourcing is proposed, the provenance of the material shall be determined by analysis of the soils at a minimum rate of 3No. samples per source site (up to 250m³) and 1 sample per 250m³ thereafter. Imported soils should be sampled once it has been laid on the site to support the analysis provided by the source supplier.

Where Topsoil is derived from a manufactured source, testing would be undertaken at a rate of 1 sample per 50m³, with a minimum of 3No. tests for any given potential source material (or production batch).

6.2 Subsoil

Where the source of the material is known validation sampling should be undertaken at a minimum rate of 3 samples per source (up to 250m³) and 1 sample per 250m³ thereafter. Imported soils should be sampled once it has been laid on the site to support the analysis provided by the source supplier.

Where subsoil is derived from a manufactured source, testing would be undertaken at a rate of 1 sample per 50m³, with a minimum of 3No. tests for any given potential source material (or production batch)



Where the source of the material is not known the validation sampling should be undertaken in-line with the testing rates as set out for cover systems to ensure the materials are suitable for their intended use. Further guidance on minimum testing under this scenario is presented in Section 6.3 below.

6.3 Cover Systems

Where a cover system/ capping layer is proposed as part of the required remedial measures, sampling frequency will follow the guidance set out by the NHBC in their guidance for clean cover systems (2010), outlined below:

- Sites with more than 30 plots testing should be conducted at a rate of one plot in four;
- Sites with between 20 – 30 plots testing should be conducted at a rate of one plot in three;
- Sites with between 5 -20 plots testing should be conducted at a rate of one plot in two;
- Sites with fewer than 5 plots testing should be conducted in every plot.

Where larger sites are broken down into smaller areas in terms of validation the higher rates of validation frequency may be required to allow earlier signoff by the Regulators/Warranty Providers in relation to these specific areas of the wider development.

6.4 Sample failure

In the event that a sample fails to meet the specified criteria for any parameter the Environmental Consultant should be contacted for advice on the suitability of the materials.

Further testing may be required to provide reassurance that the exceedances are not representative of the soil and to provide clarification whether the soil is suitable for importation and/or proposed use.

6.5 Timing

Sampling and analysis undertaken by a manufactured topsoil supplier shall be no earlier than two weeks from the date of import, any results which are older than two weeks will be deemed not to be representative of the soils to be imported and rejected. Results showing consistency of batching may be requested to demonstrate consistency of the physical, chemical and nutritional composition of the material.

Imported soil suppliers and groundwork contractors are required to take reasonably practicable measures to ensure that compliance with this Specification does not hinder formal completion of individual plots or developments.

6.6 General Compliance

All analytical suites shall correspond with the chemical, nutritional and physical compliance criteria (as set out in Tables 1 to 4). The soil supplier shall ensure that the analytical limits of detection are equal or lower than the compliance values presented within this Specification. Where either testing suites or limits of detection do not comply with this Specification, the entire set of results shall be rejected.