PHASE 2
GROUND INVESTIGATION

Lidl Great Britain Ltd

Great North Road, Milford Haven

Client: Lidl Great Britain Ltd

Remada Ltd
www.remada.co.uk

798.02.01
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Executive Summary

Remada Ltd was commissioned by Lidl Great Britain Ltd ('the client') to undertake a Phase 2 Ground Investigation for the proposed rebuilding of the existing store at Great North Road, Milford Haven, Pembrokeshire SA73 2NA, at the location indicated in ***Figure 1****.*

Summary of Phase 1 Desk Study

The study site occupies an irregular plot to the east of the Great North Road, as indicated in Figure 2. It is presently separated into three distinct zones; comprising the Lidl retail store and associated car park in the central and southern area of the site, residential housing consisting of two bungalows (Nos. 61a and 61b) in the north-western area and an Enterprise vehicle rental premises in the north-eastern area.

The earliest available historic mapping from 1868 records the site to be occupied by a field, with Great North Road present along the eastern site boundary. By 1908, the central and southern area of the site were developed as a school. Between 1964 and 1968, a commercial garage with associated forecourt and fuel island were established in the north-eastern area of the site and remain in 2020 in modified form as the location of the Enterprise vehicle rental premises.

Geological mapping indicates the site is directly underlain by Milford Haven Group bedrock, a designated Secondary A Aquifer.

No superficial deposits are indicated to be present underlying the site. The bedrock directly underlying the site is formed of the Milford Haven Group. The BGS describes this bedrock as typically comprising 'hard, red calcareous marls with sporadic red and green sandstones. Basal beds of green marl, conglomerate and breccia are also present.' The bedrock is designed as a Secondary A Aquifer.

The site has been the subject of a previous intrusive investigation for Lidl in 2007, which investigated the area immediately surrounding the existing Lidl store. The store's existing pad and strip foundations were indicated to be bearing onto the natural strata at 0.8m depth.

Intrusive Investigation

The investigation comprised the drilling of eight (8 No) window sample holes (WS1 – WS10) and the execution of (4 No) CBR tests at locations indicated on ***Figure 2*** *on 23rd and 24th October 2020.*

The ground conditions encountered within Remada's investigation supported those encountered during the previous investigation on-site. A thin veneer of made ground (<1m thick) was encountered underlain by firm, variably sandy and gravelly clay, generally becoming stiffer and more gravelly with depth. Localised bands of clayey gravelly sand and clayey gravels were encountered in addition to borderline cohesive and granular soils. The natural deposits on-site are considered representative of weathered Milford Haven Group bedrock.

Human Health Assessment

The results of soil chemical analysis were compared to Human Health Generic Assessment Criteria for commercial land use. None of the analytes tested were detected at concentrations that exceeded the human health GAC protective of on-site workers.

Water Resources Assessment

The results of the soil chemical analysis undertaken has identified that concentrations of metals and inorganic contaminants are within the range of typical made ground. Detectable concentrations of TPH and PAHs were encountered in some samples. However, the contaminants identified are of low solubility and mobility and as such are unlikely to present a risk to groundwater beneath the site. In addition, it should be noted that the site will be predominantly covered with the building and areas of hardstanding. Therefore, the risk of leaching of contaminants as a result of infiltration of groundwater is likely to be limited.

However, the six USTs identified in the former garage area of the site will require removal and subsequent soil validation, to ensure there has been no soil / groundwater impaction. Detectable concentrations of hydrocarbons

were noted in the sub-base material (total TPH in the sample from WS10 at 0.15 – 0.4m bgl being 4100mg/kg). This exploratory hole was located adjacent to the former fuel dispensing island on the garage site, so is likely to represent low-level prolonged spillages during dispensing.

Waste Classification

In general, the results of the chemical analysis indicates that the material would be classified as non-hazardous waste. While Waste Acceptance Criteria (WAC) analysis has not been undertaken, the assessment has included determination of the fraction of organic carbon (foc) which can be converted to TOC by multiplying the result by 100. A TOC limit of 3% is placed on waste destined for disposal in an inert landfill. Six of the eight soil samples selected for analysis were below this limit and would be considered potentially suitable for disposal in an inert landfill. The two soil samples that were in exceedance (from WS7 and WS8) were of topsoil from the garden areas, which would need to be stripped and stockpiled separately during the proposed redevelopment of the site.

One sample of bituminous surfacing was analysed for concentrations of PAH compounds. The results indicated that the concentrations of PAHs were generally low (total PAH-17 concentration of 2.8mg/kg) and that the concentration of benzo(a)pyrene of <0.1 mg/kg was below the 50mg/kg limit defined in WM3. Therefore, the bituminous surfacing represented by this sample would be classified as non-hazardous waste and assigned the List of Wastes code 17 03 02 for bituminous mixtures other than those mentioned in 17 03 01.

In the former petrol filling station zone of the site, detectable concentrations of hydrocarbons were recorded in the sub-base material (WS10 at 0.15 – 0.4m bgl) at 4100mg/kg which is greater than 0.1% threshold for the waste to be classified as hazardous.

Geotechnical Assessment

Preliminary calculations indicate that for a traditional pad foundation (1.5m wide) at a minimum of 1.5m depth, bearing within the firm cohesive materials (with a minimum undrained shear strength of 60kN/m^2) or medium dense granular materials, a design bearing resistance of 130kN/m^2 will be appropriate in order to satisfy the ultimate and serviceable limit states in accordance with Eurocode 7 - Geotechnical Design. This is only applicable for foundations with loads that are applied vertically and centrally. To satisfy the serviceable limit state settlement has been limited to 25mm.

A plain slab or stiffened edge raft bearing directly on compacted Made Ground of minimum specified bearing capacity is a potential solution however for a 1.8m x 1.8m raft downstand with a pressure of 125 kPa bearing at 1m depth the estimated settlement is 30mm.

A Design Sulphate Class DS-1 is considered appropriate for buried concrete and an ACEC Class of AC-1 is considered appropriate for the location.

CBR values estimated from the DCP tests indicated that, near surface the CBR values were variable with several values of between 5 and 10% recorded.

Ground Gas

The results of four rounds of gas monitoring visits placed the site into Characteristic Situation 1 and therefore ground gas protection measures will not be required within the proposed buildings.

However, the site is located within a Higher Probability Radon Area as between 10% and 30% of properties are indicated to be at or above the Action Level. Therefore, full radon protection measures are considered necessary in the proposed development.

TABLES

Issue No /	*Date*	*Prepared By*	*Technical Review*	*Authorised*
01	*06.01.2021*	*P Dickinson*	*G Jones*	*G Jones*

1 INTRODUCTION

Remada Ltd was commissioned by Lidl Great Britain Ltd ('the client') to undertake a Phase 2 Ground Investigation for a proposed rebuild and extension of the existing store at Great North Road, Milford Haven, Pembrokeshire SA73 2NA at the location indicated in **Figure 1**.

1.1 Objectives

The objectives of this assessment are as follows:

- to examine whether there have been any potentially contaminative uses on the site or nearby land;
- to develop a conceptual model of the site to identify plausible pollutant linkages;
- to assess ground conditions in relation to the proposed development in relation to construction design issues including the presence, nature, likely severity and extent of soil and groundwater contamination, which may be present, its potential environmental impact and likely requirement for further work; and
- Provide preliminary foundation design recommendations for the proposed development.

1.2 Scope of Work

The scope of the investigation is generally in accordance with BS10175:2011+A2 2017 and layout of this report has been designed with the Environment Agency's CLR11[(1)] in mind and guidance issued by the Environment Agency for land contamination reports.

The scope of work comprised:

- 4 No window sample boreholes to target depths of 6m including SPTs;
- 6 No window sample boreholes to target depths of 3m including SPTs;
- 3 No combined groundwater and gas monitoring standpipes installed with window sample boreholes;
- 4 No California Bearing Ratio (CBR) tests;
- Suite of geotechnical classification and strength tests;
- 8 No soil sample suites for chemical analysis of CLEA metals, asbestos, speciated hydrocarbons, cyanide and phenols to delineate soil contamination;
- 4 No ground gas and groundwater monitoring visits to satisfy planning requirements; and
- Combined Factual & Interpretative Geoenvironmental Report.

1.3 Previous Reports

The following Phase 1 Desk Study had been previously prepared for the site:

- Phase 1 Site Investigation & Preliminary Risk Assessment. Remada Ltd Report 798.01.02, issued January 2021.

1.4 Limitations

The comments given in this report and the opinions expressed are based on the information reviewed and observations during site work. However, there may be conditions pertaining to the site that have not been disclosed by this assessment and therefore could not be taken into account.

2 SUMMARY OF PHASE 1 DESK STUDY

The Executive Summary and Conceptual Site Model presented within the Phase 1 Desk Study 798.02.01 are reproduced below:

Site Setting

The study site occupies an irregular plot to the east of the Great North Road, as indicated in ***Figure 2****. It is presently separated into three distinct zones; comprising the Lidl retail store and associated car park in the central and southern area of the site, residential housing consisting of two bungalows (Nos. 61a and 61b) in the north-western area and an Enterprise vehicle rental premises in the north-eastern area.*

Site History

The earliest available historic mapping from 1868 records the site to be occupied by a field, with Great North Road present along the eastern site boundary. By 1908, the central and southern area of the site were developed as a school. Between 1964 and 1968, a commercial garage with associated forecourt and fuel island were established in the north-eastern area of the site and remain in 2020 in modified form as the location of the Enterprise vehicle rental premises.

Petroleum Licensing Search

Information from the County's Contaminated Land Inspector indicates that there are six licenced USTs underlying the historic garage area of the site, as well as an above ground paraffin tank. The USTs were decommissioned in 2001 through the filling with RG22 Bacel Hardfoam and were left in-situ. There is some evidence to suggest that two of the USTs may have been uplifted circa 2004. Decommissioning details pertaining to the paraffin tank have not been provided and warrants further investigation on-site.

Geology / Hydrogeology

Published geological maps record that the site is directly underlain by Milford Haven Group bedrock, designated as a Secondary A Aquifer.

Mining

The site is not located within an area which may be affected by coal mining activity.

Radon

The site is located in a Higher Probability Radon Area as between 10% and 30% of properties are indicated to be at or above the Action Level. Therefore, full radon protection measures are considered necessary in the proposed development.

Environmental Risk Assessment

The desk study has identified a number of on-site and off-site potential sources of contamination that would require further investigation. The following is recommended:

- *Investigation of the lateral and vertical extent of made ground/fill beneath the proposed store;*
- *Collection of soil and groundwater samples from the areas identified above for contaminants of concern; and*
- *Ground gas monitoring.*

Geotechnical Assessment

It is recommended that a ground investigation is undertaken to enable preliminary foundation design.

Potential Source Areas	Potential Contaminant of Concern	Pathways	Potential Receptor	Exposure Route (Human unless otherwise stated)	Potential Identified Linkage (unmitigated)	Findings of Ground investigation	Risk (Un-mitigated)	Proposed Remediation (Mitigation) Measures	Residual Risk Estimation
On-site Sources **General Made Ground** **Historic School** **Operational Lidl store** **Operational Enterprise vehicle rental business** **Residential Properties** ***Off-site Sources*** **Garage** **Corporation Yard** **Fuel Filling Station**	Asbestos / Metals As, Be, Cd, Cu, Cr (VI), Cr (III) Hg, Ni, Se, Va, Zn, *Boron,* TPH /PAH.	Disturbance due to construction plant causing direct contact, dusts, vapours. Direct Contact with occupants of the proposed development Inhalation of fibres / vapours / gases by occupants of proposed development Permeation of water supply pipework	Occupants of the development / building fabric Adjacent residents during construction	• Direct Soil Ingestion	• Yes	To be assessed (TBA)	Potential risk	(To be assessed (TBA)	(To be assessed (TBA)
				• Indoor Dust ingestion	• Yes	As above	Potential risk	TBA	TBA
				• Skin Contact with Soils	• Yes	As above	Potential risk	TBA	TBA
				• Skin Contact with Dust	• Yes	As above	Potential risk	TBA	TBA
				• Inhalation of Outdoor Dust	• Yes	As above	Potential risk	TBA	TBA
				• Inhalation of Outdoor Vapours	• Yes	As above	Potential risk	TBA	TBA
				• Inhalation of Indoor Vapours	• Yes	As above	Potential risk	TBA	TBA
				• Inhalation of ground gas	• Yes	As above	Potential risk	TBA	TBA
				• Inhalation of radon gas	• Yes	Higher Probability Radon Area	High Risk	Full Radon Protection Measures	Negligible
				• Ingestion via permeated water supply pipework	• Yes	As above	Potential risk	TBA	TBA
		Leachate	Secondary A Aquifer	• In-direct contact with Secondary (A) Aquifer in bedrock	• Yes	As above	Potential risk	TBA	TBA

Table 1: Outline Conceptual Site Model

Direct contact with subsurface soil and/or groundwater during redevelopment works are not assessed as part of the CSM. It is considered that risks to workers will be managed as part of any the redevelopment works at the site through the application of health and safety procedures, where required.

3 ENVIRONMENTAL & GEOTECHNICAL INVESTIGATION METHODOLOGY

3.1 Investigation Strategy

In general accordance with Lidl Ground Investigation standard 04.2018, four (4 No). window sample holes were required beneath the proposed store footprint to a depth of 6m or refusal, and six (6 No) beneath the delivery bay, HGV access and car park. Four (4 No) CBR tests were conducted in the proposed car park. Four (4 No) ground gas monitoring visits were scheduled for the site to provide the minimum required by C665.

The investigation comprised the drilling of eight (8 No) window sample holes (WS1 – WS10) and the execution of (4 No) CBR tests at locations indicated on **Figure 2** on 23rd and 24th October 2020.

All exploratory holes were logged by a suitably qualified Geo-environmental Engineer in general accordance with the recommendations of BS5930:2015. Detailed descriptions, together with relevant comments, are given in the Exploratory Hole Logs.

3.2 Intrusive Investigation

3.2.1 Window Sample Holes

Window sample boreholes WS1, WS2, WS3 and WS6 were positioned within the proposed store footprint, whereas boreholes WS4, WS5, WS7 to WS10 were positioned within the proposed car park area. Borehole WS1 was positioned to also target the adjacent operation fuel filling station, whilst boreholes WS9 and WS10 were positioned within the historic garage area on-site to target the underground fuel tanks. The position of the above-ground paraffin tank could not be established on-site from the provided plans and no such feature was identified during the site walkover work.

Combined Groundwater and Ground Gas monitoring standpipes were installed in WS2, WS3 and WS9.

Standard Penetration Tests (SPTs) in the window samples were carried out at 1.0m intervals as recorded on the borehole logs to assess the relative density and consistency of soils.

SPTs were conducted in accordance with BS EN ISO 22476-3 and the recorded SPT N-values are summarised on the borehole logs and the SPT Calibration Certificates are presented at **Appendix A.**

3.2.2 Dynamic Cone Penetrometer (DCP) Tests

The DCP tests were conducted in order to determine California Bearing Ratio (CBR) values for near surface soils. A known mass is dropped through a known distance to drive a cone into the ground. The penetration distance per blow is recorded in order to enable the CBR value to be calculated. The results of the DCP tests are presented in **Appendix B**.

3.3 Soil Sampling

3.3.1 Environmental

Made ground and natural soils were selected by visual and olfactory means for subsequent analysis. Samples for chemical laboratory testing purposes were collected in amber glass jars, amber glass vials and plastic tubs and retained in a cool box for transport to the laboratory.

Soil samples were scheduled for a minimum standard suite of chemical analysis that comprised quantitative asbestos, fraction of organic carbon, pH, CLEA metals, TPHCWG, PAH(16) & (17), BTEX, phenols, sulphates and chlorides.

3.3.2 Geotechnical

Geotechnical samples were collected at depths indicated on the window sample logs with samples retrieved from within a sleeve line. The disturbed samples were placed in sealed and correctly labelled plastic tubs or bags as appropriate. All geotechnical samples were dispatched to the laboratory for testing with a completed chain of custody.

Soil samples were scheduled for geotechnical classification and strength testing as appropriate to recovered soils.

3.4 Gas and Groundwater Monitoring

3.4.1 Installations

Combined ground gas and groundwater monitoring standpipes were installed in three of the window sample boreholes. The standpipes consisted of high-density polyethylene (HDPE) pipe. A bentonite seal was made around the plain pipe and a clean gravel pack was placed around the slotted pipe. A summary of the installation construction is tabulated below:

Location and Depth	Internal Diameter Pipe	Response Zone (m bgl)	Targeted Strata
WS2 – 3.0m bgl	50mm HDPE	1.0 – 3.0	Natural Strata
WS3 – 3.0m bgl	50mm HDPE	1.0 – 3.0	Natural Strata
WS9 – 3.0m bgl	50mm HDPE	1.0 – 3.0	Natural Strata

Table 2: Monitoring Well Installation Details

3.4.2 Monitoring

Ground gas monitoring was undertaken using Geotech GA5000 gas analyser for the parameters reported below. Groundwater levels were measured with a GeoSense OWP30 oil water interface probe.

Permanent ground gas monitoring involved the measurement of the following in the prescribed order:

- Pressure difference between the monitoring well and the atmosphere,
- Peak and steady flow rates of gas into or out of the monitoring well;
- Peak and steady concentrations of carbon dioxide, methane, oxygen (minimum and steady recorded), carbon monoxide, hydrogen sulphide; and
- Depth to groundwater.

In total four monitoring visits were undertaken between 1st November 2020 and 19th November 2020. The results are presented on **Table 2.**

3.5 Quality Assurance and Quality Control

All samples were submitted to a United Kingdom Accredited Laboratory (UKAS) under a completed chain of custody. The laboratory carried out its own QA/QC programme to ensure that the quality of the analytical data conformed to the appropriate test method protocols.

3.6 Laboratory Testing

3.6.1 Soil Chemical Analysis

Eight (8 No) soil samples were scheduled for the analysis of asbestos, arsenic, barium, beryllium, cadmium, chromium (III & VI), copper, mercury, nickel, lead, selenium, zinc, fraction of organic carbon, Total Petroleum Hydrocarbons (TPHCWG), Polyaromatic Hydrocarbons (PAH), BTEX compounds (benzene, toluene, ethylbenzene and xylene) and phenols.

In addition, one sample of bituminous surfacing (from WS9 at 0.0 – 0.08m bgl) was analysed for PAH compounds.

The results of laboratory chemical analyses are presented at **Appendix C.**

It should be noted that some erroneous sampling depths have been allocated against a small number of the chemical samples. These are as follows:

- The sample from WS8 at 0.0 – 0.08m is incorrected listed as being from WS9 at the same depth;
- The sample from WS10 at 0.15 – 0.4m is incorrectly listed as being at 0.08 – 0.5m bgl;

3.6.2 Geotechnical

Samples recovered from the boreholes were submitted to an accredited laboratory for the following analyses in general accordance with BS1377:1990:

- 4 No Natural Moisture Contents
- 4 No Plasticity Indices
- 8 No Particle Size Distribution tests
- 7 No Quick Undrained Triaxial Compression Tests on disturbed samples for comparison only; and
- 2 No BRE SD1 suites.

The results of the geotechnical testing are presented at **Appendix C.**

4 GEOTECHNICAL & ENVIRONMENTAL INVESTIGATION FINDINGS

4.1 Ground Conditions

A brief description of the published geology is provided together with a summary of the ground conditions encountered during the intrusive investigation. Exploratory logs are presented at the end of the report.

4.1.1 Made Ground

Made ground was encountered within all exploratory holes on-site and was a thin veneer <1.0m thick; the maximum depth being 0.8m recorded in WS9, where proven.

Within the existing Lidl store car park area (WS1 – WS6), asphalt hardstanding was encountered to depths of between 0.08m and 0.12m bgl and underlain by brown sandy gravel sub-base.

In the former garage area (WS9 and WS10) hardstanding comprised reinforced concrete and asphalt surfacing, underlain by brown sandy gravel subbase of limestone and quartz. Within WS10 the concrete was encountered to a depth of 0.15m and was reinforced, whereas in WS9 the asphalt was 0.08m thick.

Suspected concrete obstructions were encountered within WS4 and WS5 at a depth of 0.5m. These are located within the footprint of the historic school building identified during Remada's Phase 1 investigation and suggest that relict foundations associated with this feature may still be present underlying the site.

4.1.2 Natural Deposits

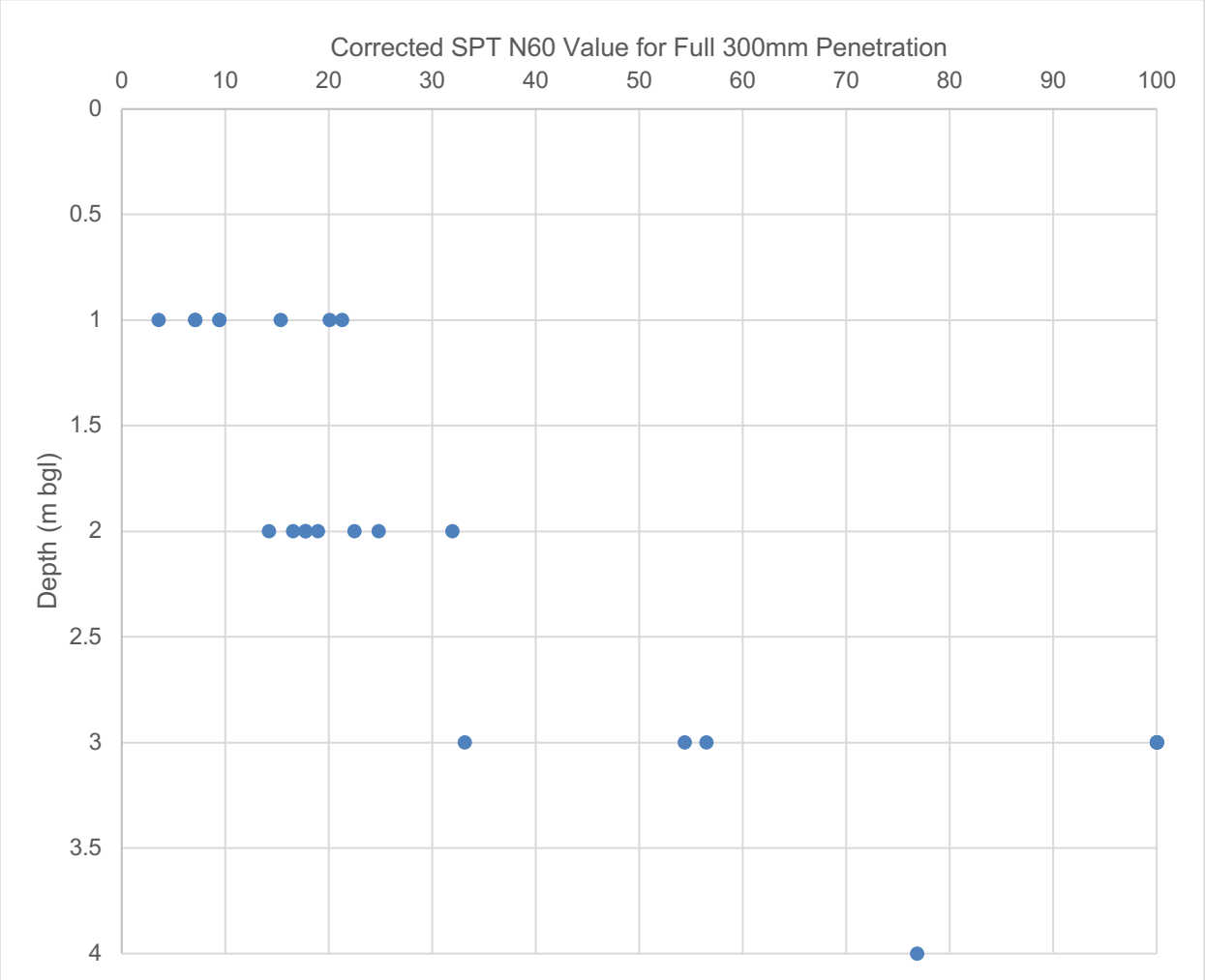
The natural deposits underlying the made ground typically comprised firm to stiff reddish brown / brown locally gravelly and sandy clays, with sporadic granular deposits of sandy clayey gravel, in addition to borderline cohesive and granular soils. The gravel components in all the exploratory holes predominantly comprised sandstone and mudstone.

Within the garden areas (WS7 and WS8), brown sand topsoil was encountered to a depth of 0.3m bgl and contained occasional rootlets and rare roots. For the purpose of this assessment, topsoil is defined as the upper darker and more fertile layer of the soil profile, which is a product of natural chemical, physical, biological and environmental processes. This does not imply compliance with BS 3882:2015.

In the absence of any superficial deposits indicated on the published geology, it is considered likely that the natural deposits encountered are representative of weathered Milford Haven Group bedrock.

4.2 In-situ Testing

In-situ SPTs were undertaken to assist with the interpretation of strata encountered. The SPT N-values have been corrected based on the Energy Ratio of 71% for the SPT hammer on the window sampling rig. The SPT Hammer Energy Test Reports, undertaken in accordance with BS EN ISO 22476-3:2005 are included in **Appendix D**. An arbitrary value of 100 has been used where the corrected SPT N-60 value was recorded in excess of this value. The results of corrected N-values versus depth are plotted in the graph below:



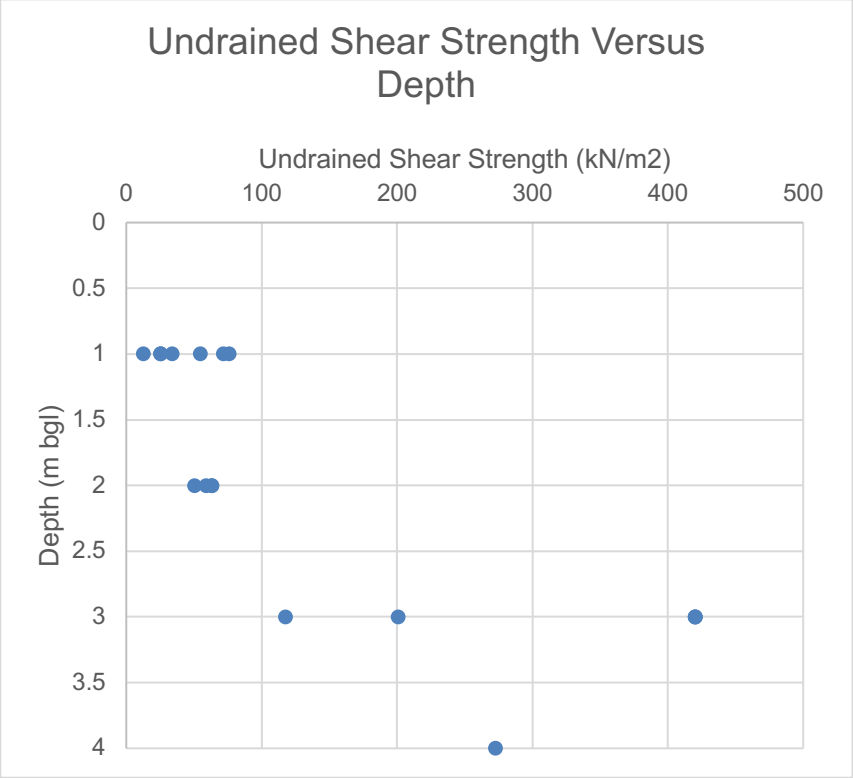
Graph 1: Plot of Corrected SPT N-Values Versus Depth

Undrained shear strengths have been estimated from SPT N values using the relationship developed by Stroud (*The standard penetration test in incentive clays and soft rocks*) and summarised in Tomlinson where:

$$\text{Mass shear strength} = f_1 \times N$$

Where f_1 is based on the plasticity index.

A Plasticity Index of 20% has been assumed (based on geotechnical laboratory testing) which equates to an f_1 factor of 5. An arbitrary value of 420kN/m2 (4.2 * N60 value of 100) has been used where the undrained shear strength is interpreted to be in excess of this value.



Graph 2: Plot of Mass Shear Strength Versus Depth

4.3 Soil Observations

Made Ground was recovered at all locations as a homogeneous granular material containing predominantly limestone and quartz.

There were no visible indicators of contamination including asbestos within the sampled soils.

4.4 Groundwater Observations

No groundwater strikes were recorded during the intrusive phase of this investigation.

4.5 Chemical Analysis

Results of the soil chemical analysis are presented in **Table 3** at the end of the report and full laboratory certificates are presented in **Appendix D**. Results of the chemical analyses are summarised as follows.

The average FOC and pH were 0.02 and 8.5 respectively. Asbestos was not detected in the samples analysed. Detectable concentrations of metals were identified, although these are generally within the range that would typically be expected for made ground.

Concentrations of TPH were detected above method detection limit (MDL) in four of the samples analysed (from WS7, WS8, WS9 and WS10). The hydrocarbons were generally heavy end hydrocarbons within the range C16 to C35 carbon range. However, hydrocarbons in the C8 to C16 carbon range were also encountered in the sample from WS8 at 0 – 0.08m and from WS10 at 0.15 – 0.4m bgl. These samples was taken from topsoil and made ground deposits respectively and there was no visual or olfactory evidence of contamination.

The maximum concentration of 4100mg/kg Total Petroleum Hydrocarbons was recorded in the sample from WS10 at 0.15 – 0.4m bgl, which was located within the former garage area of the site. No BTEX compounds were recorded above laboratory detection limits in any of the samples analysed.

Concentrations of PAHs were generally low (<2 mg/kg). A maximum concentration (excluding bituminous surfacing sample) of 28 mg/kg was encountered in WS7 at 0.0 – 0.3m bgl.

4.6 Geotechnical Testing

Results of the geotechnical testing are summarised as follows, whilst the full laboratory certificates and test amendment notices are presented in **Appendix E**. The Laboratory test results produced:

Four plasticity tests undertaken on the natural cohesive strata revealed that the clay is of intermediate plasticity, with corresponding plasticity indices of between 15% and 21%.

The Particle Size Distribution (PSD) tests revealed the following:

- The natural strata in WS2 at 0.4 – 0.5m comprised reddish brown gravelly very sandy CLAY.
- The natural strata in WS3 at 1.3 – 2.4m comprised reddish brown very sandy very clayey GRAVEL.
- The natural strata in WS6 at 1.5 – 2.0m comprised reddish brown very sandy very gravelly CLAY and at 2.0 – 3.0m similarly comprised brown very sandy very gravelly CLAY.
- The natural strata in WS7 at 1.0 – 1.5m comprised reddish brown very sandy clayey GRAVEL.
- The natural strata in WS8 at 2.0 – 3.0m comprised reddish brown very clayey very sandy GRAVEL.
- The natural strata in WS9 at 1.6 – 2.4m comprised brown slightly gravelly very clayey SAND.
- The natural strata in WS10 at 2.0 – 3.0m comprised reddish brown very gravelly very silty SAND.

Undrained shear strength tests revealed the following:

- The natural strata in WS1 at 2.55 – 3.0m had a moisture content of 16%, with a shear strength of 64kPa for a corresponding cell pressure of 50kPa. The sample failed on the first stage due to the material being too brittle.
- The natural strata in WS9 at 1.0 – 1.45m had a moisture content of 20%, with cohesion values of 23, 29 and 34kPa for corresponding respective cell pressure of 20, 40 and 80kPa.
- The natural strata in WS10 at 0.55 – 1.0m had a moisture content of 25%, with cohesion values of 37, 46 and 55kPa for corresponding respective cell pressures of 10, 20 and 40kPa.

The water-soluble sulphate contents varied from 0.088 to 0.096 g/l in the two soil samples analysed with pH varying from 8.3 to 8.8. The total sulphur content varied from 0.022 to 0.027% and acid soluble sulphate varied from 0.057 to 0.067%.

4.7 Ground Gas Monitoring Results

Ground gas monitoring was undertaken on 1st, 6th, 12th and 19th November 2020. Results are presented in **Table 2** and summarised below:

- Peak-state methane concentrations were recorded at concentrations equal to the instrument detection limit of 0.1 % v/v in WS2 and WS3 over the course of the monitoring programme. Steady state concentrations were recorded below the instrument detection limit of 0.1 % v/v in all monitoring wells.

- The maximum peak-state carbon dioxide concentrations were recorded at 2.2% v/v in WS2 on 1st November 2020. The maximum steady state concentration was recorded at 1.0% v/v in WS9 on 12th November 2020.
- Oxygen concentrations were recorded at a minimum concentration of 18.7% v/v in WS2 on 1st November 2020.
- Ground gas flow rates were recorded at a maximum of 0.6 litres per hour (l/hr) in all three standpipes over the course of the monitoring programme.
- Groundwater was recorded in the base of standpipes WS2 and WS3 throughout the monitoring programme. The water levels ranged between 46.45m and 47.13m AOD. The standpipe in WS9, installed to a depth of 45.83m AOD, remained dry throughout.
- Atmospheric pressure at the time of sampling varied between a high of 1029 millibar (mbar) on 19th November 2020 and a low of 989 mbar on 1st November 2020. The visits were undertaken during periods of rising and falling pressure.

5 GENERIC QUANTITATIVE RISK ASSESSMENT

5.1 Human Health Risk Assessment

In order to provide an up to date assessment of the risks to human health, Remada has adopted the most recent Generic Assessment Criteria (GAC) published by LQM/CIEH (S4ULs) and CL:AIRE/EIC/AGS for the assessment of potential risks to human health. The derivation of GAC, methodology, input parameters and technical guidance (CLEA) may be obtained upon request.

Default parameters have been adopted for sandy loam of pH 7 and commercial land use. FOC ranged from <0.001 to 0.071 giving a Soil Organic Matter (SOM) content range of between <0.172 to 12.2% with an average result of 3.6%. In order to present a conservative assessment, the SOM content of 2.5% has been adopted for the assessment.

The depth to potential sources of contamination for indoor air pathways has been assumed to be 0.5m below building foundation level. The source has been conservatively assumed to be at ground level for outdoor air and direct contact pathways.

For commercial land use the CLEA version 1.06 critical receptor is conservatively modelled as a female working adult with an exposure duration of 49 years. In accordance with the default parameters, it was assumed that employees spend most of their time indoors and that 80% of outdoor area is covered by hardstanding. As such, the potential exposure pathways have been assumed to be:

- Direct Soil and Indoor Dust Ingestion;
- Skin contact with soils and dusts;
- Inhalation of indoor and outdoor dusts and vapours.

Where GAC values for individual TPH fractions are not exceeded, the potential additive effect has been assessed by calculating overall TPH hazard index for each sample.

5.2 Comparison of Soil Analysis Results with Human Health GAC

A comparison of soil chemical analysis with GAC is presented as **Table 3**.

TPH, PAH & BTEX

None of the analytes tested were detected at concentrations that exceeded the human health GAC protective of on-site workers.

Metals & Inorganics Excluding Asbestos

None of the analytes tested were detected at concentrations that exceeded the human health GAC protective of on-site workers.

Asbestos

There was no asbestos detected in the samples selected for analysis.

5.3 Controlled Waters Risk Assessment

The site is not located within a designated Groundwater Source Protection Zone. The investigation has revealed that the site is directly underlain by cohesive and granular deposits associated with weathered Milford Haven Group bedrock, a Secondary A Aquifer.

Existing Store & Existing Residential Zones

The results of the soil chemical analysis undertaken has identified that concentrations of metals and inorganic contaminants are within the range of typical made ground. Detectable concentrations of TPH and PAHs were encountered in some samples. However, the contaminants identified are of low solubility and mobility and as such are unlikely to present a risk to groundwater beneath the site. In addition, it should be noted that the site will be predominantly covered with the building and areas of hardstanding. Therefore, the risk of leaching of contaminants as a result of infiltration of groundwater is likely to be limited.

Enterprise Rental Zone

There are six (6 No) decommissioned USTs within the former petrol filling station zone of the site. As the proposed use of this zone of the overall site is for continued car parking no further action is considered necessary, however redevelopment of the site does provide an opportunity to remove the USTs and ensure that neither the surrounding or underlying soils have been impacted with hydrocarbons. Detectable concentrations of hydrocarbons were noted in the sub-base material (total TPH in the sample from WS10 at 0.15 – 0.4m bgl being 4100mg/kg). This exploratory hole was located adjacent to the former fuel dispensing island on the garage site, so is likely to represent low-level prolonged spillages during dispensing.

5.4 Ground Gas Assessment

In order to understand the gassing regime at the site, a Characteristic Situation (as defined in CIRIA C665 and BS8576:2013) is determined for the site. CIRIA C665 and BS8576 provides definitions for each Characteristic Situation based on Gas Screening Values (GSV) which are calculated as follows:

GSV = Gas Concentration (% v/v) x Measured Borehole Flow Rate (l/hr)

BS8576 makes a distinction between the GSV and the Hazardous Gas Flow Rate (Q_{hg}) which is also calculated using the above calculation. BS8576 states that Q_{hg} is calculated for each individual borehole for each monitoring visit, whereas the GSV is taken as the representative value for the site or site zone.

As a worst case assessment, the GSV for the site is therefore taken as the maximum carbon dioxide/methane steady state concentration recorded in the boreholes which is multiplied by the maximum flow rate recorded during the same monitoring programme.

Methane GSV = 0.1 % x 0.6 l/hr = 0.0006 l/hr (methane concentration taken as equal to the instrument detection limit of 0.1%).

Carbon Dioxide GSV = 1.0 % x 0.6 l/hr = 0.006 l/hr

BS8485 states that for Characteristic Situation 1 the methane concentration would typically be less than 1% and carbon dioxide less than 5% and that if concentrations are above these limits then consideration should be given to placing the site into Characteristic Situation 2. As the concentrations of methane and carbon dioxide were both within these typical limits it is considered that the Characteristic Situation 1 classification is appropriate for the site. Therefore, gas protection measures are not deemed necessary for the proposed development.

However, the site is located within a Higher Probability Radon Area as between 10% and 30% of properties are indicated to be at or above the Action Level. Therefore, full radon protection measures are considered necessary in the proposed development.

5.5 Revised Conceptual Site Model

A revised Conceptual Site Model is presented as **Table 4** below.

5.6 Waste Classification

In general, the results of the chemical analysis indicates that the material would be classified as non-hazardous waste. While Waste Acceptance Criteria (WAC) analysis has not been undertaken, the assessment has included determination of the fraction of organic carbon (foc) which can be converted to TOC by multiplying the result by 100. A TOC limit of 3% is placed on waste destined for disposal in an inert landfill. Six of the eight soil samples selected for analysis were below this limit and would be considered potentially suitable for disposal in an inert landfill. The two soil samples that were in exceedance (from WS7 and WS8) were of topsoil from the garden areas, which would need to be stripped and stockpiled separately during the proposed redevelopment of the site.

One sample of bituminous surfacing was analysed for concentrations of PAH compounds. The purpose of this analysis was to determine if the sample contained coal tar as this would result in a hazardous waste classification. The Environment Agency Technical Guidance document WM3 states that *"where the concentration of benzo(a)pyrene is at or above 50ppm (mg/kg) in the black top alone (excluding other material) then the amount of coal tar should be considered to be sufficient (0.1% or more) for the material to be hazardous"*.

The results indicated that the concentrations of PAHs were generally low (total PAH-17 concentration of 2.8mg/kg) and that the concentration of benzo(a)pyrene of <0.1 mg/kg was below the 50mg/kg limit defined in WM3. Therefore, the bituminous surfacing represented by this sample would be classified as non-hazardous waste and assigned the List of Wastes code 17 03 02 for bituminous mixtures other than those mentioned in 17 03 01.

In the former petrol filling station zone of the site, detectable concentrations of hydrocarbons were recorded in the sub-base material (WS10 at 0.15 – 0.4m bgl) at 4100mg/kg which is greater than 0.1% threshold for the waste to be classified as hazardous.

5.7 Health & Safety Considerations

To ensure direct exposure of construction workers involved in the site redevelopment to any impacted contaminated shallow soils is minimised, the guidance stated in HSG 66 "Protection of Workers and the General Public During Redevelopment of Contaminated Land" should be followed.

Potential Source Areas	Potential Contaminant of Concern	Pathways	Potential Receptor	Exposure Route (Human unless otherwise stated)	Potential Identified Linkage (unmitigated)	Findings of Ground investigation	Risk (Un-mitigated)	Proposed Remediation (Mitigation) Measures	Residual Risk Estimation
On-site Sources **General Made Ground** **Historic School** **Operational Lidl store** **Operational Enterprise vehicle rental business** **Residential Properties** ***Off-site Sources*** **Garage** **Corporation Yard** **Fuel Filling Station**	Asbestos / Metals As, Be, Cd, Cu, Cr (VI), Cr (III) Hg, Ni, Se, Va, Zn, *Boron,* TPH /PAH.	Disturbance due to construction plant causing direct contact, dusts, vapours. Direct Contact with occupants of the proposed development Inhalation of fibres / vapours / gases by occupants of proposed development Permeation of water supply pipework	Occupants of the development / building fabric Adjacent residents during construction	• Direct Soil Ingestion	• Yes	<GAC	Negligible	None	Negligible
				• Indoor Dust ingestion	• Yes	<GAC	Negligible	None	Negligible
				• Skin Contact with Soils	• Yes	<GAC	Negligible	None	Negligible
				• Skin Contact with Dust	• Yes	<GAC	Negligible	None	Negligible
				• Inhalation of Outdoor Dust	• Yes	<GAC	Negligible	None	Negligible
				• Inhalation of Outdoor Vapours	• Yes	<GAC	Negligible	None	Negligible
				• Inhalation of Indoor Vapours	• Yes	<GAC	Negligible	None	Negligible
				• Inhalation of ground gas	• Yes	CS1	Negligible	None	None
				• Inhalation of radon gas	• Yes	Higher Probability Radon Area	High Risk	Full Radon Protection Measures	Negligible
				• Ingestion via permeated water supply pipework	• Yes	As above	Negligible	None	Negligible
		Leachate	Secondary A Aquifer	• In-direct contact with Secondary (A) Aquifer in bedrock	• Yes	Concentrations within typical range of made ground / minimal thickness of made ground	Low	No action to removed USTs	Low

Table 4: Refined Conceptual Site Model

Direct contact with subsurface soil and/or groundwater during redevelopment works are not assessed as part of the CSM. It is considered that risks to workers will be managed as part of any the redevelopment works at the site through the application of health and safety procedures, where required.

6 GEOTECHNICAL SITE ASSESSMENT

6.1 Geotechnical Considerations

An indicative site layout is provided in **Figure 3** with the proposed Lidl store occupying the southern area of the site. The existing access off Great North Road will be retained, albeit adjusted to suit the design standards to highway consultants' design details. Car parking is proposed for the central and northern areas of the site, with associated areas of soft landscaping around the perimeter.

Topographic levels on the site currently vary, with the existing Lidl car park being generally sloping from circa 50.2m AOD in the south-western site corner to circa 49.2m AOD in the north-eastern corner of the car park. A stone retaining wall separates the existing Lidl store site from the garage and residential properties in the north. The Enterprise (north-eastern) area of the site is generally level at circa 48.7 – 48.8m AOD. The two residential plots in the north-western area are topographically lower than the Lidl car park, and gradually slope towards the north and west from 49.0m AOD to circa 47.9m AOD. Although proposed elevations are not known at the time of writing, it is considered likely that reprofiling of the site will be required to achieve the required finished site levels.

The site was subject to a previous ground investigation by JPA in 2007, which targeted the area immediately surrounding the existing Lidl store building. The store's existing pad and strip foundations were indicated to be bearing onto the natural strata at 0.8m depth.

The ground conditions encountered within Remada's investigation supported those encountered during the previous investigation on-site. A thin veneer of made ground (<1m thick) was encountered underlain by firm, variably sandy and gravelly clay, generally becoming stiffer and more gravelly with depth. Localised bands of clayey gravelly sand and clayey gravels were encountered in addition to borderline cohesive and granular soils. Gravel within the clay was observed as mudstone or sandstone and the natural deposits on-site are considered representative of weathered Milford Haven Group bedrock.

Uncorrected SPT N-values within the proposed store footprint (WS1 – WS3 and WS6) at 1m bgl ranged between 8 and 13. The cohesive strata in the weathered bedrock is of intermediate plasticity, with corresponding plasticity indices of between 15% and 21%.

Details of the proposed permanent and variable design loads (actions) are not currently known although an indicative column load of 400kN has been provided.

6.2 Design Approach

Design calculations in accordance with BS EN 1997-1: 2004 require the establishment of design values for actions, ground properties and ground resistances, definition of the limits that must not be exceeded (usually a serviceability limit state), the setting up of calculation models for the relevant ultimate or serviceability limit state, and the showing by such calculation that these limits will not be exceeded.

Design values for such calculations are derived by applying partial factors to characteristic values for actions, ground properties and ground resistances, and based upon the geotechnical model and following requirements of Design Approach 1, Combination 2 calculations have been undertaken. Table 7 provides a summary of the partial factors applied to actions, soil parameters and resistance factors. To satisfy the serviceable limit state settlement has been limited to 25mm.

Geotechnical parameter			Symbol	Combination 1		Combination 2	
Partial factors[1] on actions (γ_F) or effects of actions (γ_E)	Permanent	Unfavourable[2]	γ_G	A1	1.35	A2	1.0
		Favourable[3]			1.0		1.0
	Variable[4]	Unfavourable	γ_Q		1.5		1.3
		Favourable[5]			0		0
Partial factors on soil parameters (γ_M)	Angle of shearing resistance[6]		$\gamma_{\phi'}$	M1	1.0	M2	1.25
	Effective cohesion		$\gamma_{c'}$		1.0		1.25
	Undrained shear strength		γ_{cu}		1.0		1.4
	Unconfined strength		γ_{qu}		1.0		1.4
	Weight density		$\gamma_{\gamma'}$		1.0		1.0
Partial resistance factors (γ_R) for spread foundations	Bearing		$\gamma_{R;v}$	R1	1.0	R1	1.0
	Slidings		$\gamma_{R;h}$		1.0		1.0

[1]These factors are given for buildings only. Different factors apply to bridges and other structures

[2]In this case the upper characteristic value ($G_{k,sup}$) of the permanent action is used

[3]In this case the lower characteristic value ($G_{k,inf}$) of the permanent action is used

[4]There may be more than one variable action. The partial factor is applied to the leading variable action and modified (reduced) values

[5]The UK National Annex states that when variable actions are favourable Q_k is zero, rather than g_Q is zero

[6]This is applied to tanϕ' or tanϕ_{cv}' although it might be more appropriate to determine the design value ϕ_{cv} directly

Table 6: Summary of Partial Factors Applied to Actions, Soil Parameters and Resistance Factors

In the absence of design loads the bearing capacity assessment has been undertaken for Design Approach 1, Combination 2 only, and a further assessment taking account of anticipated loadings (permanent and variable) will be required during detailed design in order to confirm the limit states are satisfied. All foundations will need to fully penetrate any made ground and be founded a minimum of 150mm into the founding stratum.

Preliminary calculations indicate that for a traditional pad foundation (1.5m wide) at a minimum of 1.5m depth, bearing within the firm cohesive materials (with a minimum undrained shear strength of 60kN/m^2) or medium dense granular materials, a design bearing resistance of 130kN/m^2 will be appropriate in order to satisfy the ultimate and serviceable limit states in accordance with Eurocode 7 - Geotechnical Design. This is only applicable for foundations with loads that are applied vertically and centrally. To satisfy the serviceable limit state settlement has been limited to 25mm. Foundations will need to fully penetrate any made ground including fill material used to raise site levels and extend a minimum of 150mm into the bearing stratum.

A plain slab or stiffened edge raft bearing directly on compacted Made Ground of minimum specified bearing capacity is a potential solution however for a 1.8m x 1.8m raft downstand with a pressure of 125 kPa bearing at 1m depth the estimated settlement is 30mm.

Finished floor levels are not known at the time of writing this report and it is assumed that these will be close to existing levels. It is important that any voids resulting from the removal of the USTs are compacted to an appropriate engineering standard prior to the construction of the car park.

It is recommended that further intrusive investigation is undertaken within the footprint of the existing Enterprise Rent-a-Car area, in order to ascertain the composition and depth of potential made ground within this area.

6.3 Imported Fill

All imported fill material should comply with an earthworks specification to be prepared by the engineer and not contain concentrations of contaminants at greater than the Generic Assessment Criteria (GAC) presented in **Table 3.**

6.4 Excavations and Temporary Works

During the intrusive investigations, the borehole walls remained open and no collapses were recorded. However, given the variation in the weathered bedrock (sands, gravels and clays), some excavations on-site may be unlikely to remain stable even in the short term without support or without being battered back to a safe slope gradient. A detailed inspection of the side slopes should be made during excavation and a risk assessment carried out to fully assess the support measures required.

No groundwater was encountered within the exploratory holes during the intrusive investigation, although water was recorded within two of the standpipes during the subsequent monitoring programme.

6.5 External Car Park Construction

CBR values estimated from the DCP tests indicated that, near surface the CBR values were variable with several values of between 5 and 10% recorded. Poorly compacted made ground backfill resulting from the demolition works should be excavated, processed as necessary to produce a 6F2 material and replaced in compacted layers in accordance with an engineering specification.

6.6 Protection of Buried Concrete

In accordance with BRE SD1 for buried concrete in a brownfield site with mobile groundwater, analyse of selected samples for water soluble sulphate returned values of up to 0.096 g/l and pH >8.3. Total potential sulphate values of up to 0.081% were calculated from the total sulphur results. Therefore a Design Sulphate Class DS-1 is considered appropriate for buried concrete and an ACEC Class of AC-1 is considered appropriate for the location. This classification supports the findings of the previous JPA investigation on-site.

6.7 General Construction Advice

All formations should be cleaned, and subsequently inspected, by a suitably qualified engineer prior to placing concrete. Should any soft, compressible or otherwise unsuitable materials be encountered they should be removed and replaced by blinding concrete.

Foundation concrete, or alternatively, a blinding layer of concrete, should be placed immediately after excavation and inspection in order to protect the formation against softening and disturbance.

Generally, all formations should be placed wholly within the same material type, unless specific geotechnical inspection and assessment have been undertaken.

Where applicable ground beneath the proposed building footprint and potentially car parking may require to be stripped to reveal localised areas of made ground and structures. Excavations should be backfilled with suitably re-compacted materials to achieve formation level.

During foundation excavation works arisings should be constantly monitored for the presence of contamination.

The existing drainage system and any tanks (including the identified UST) and associated pipework present after demolition are to be subject to controlled decontamination and removal in accordance with relevant guidance detailed within: ‘Groundwater Protection Code: Petrol Stations and Other Fuel Dispensing Facilities Involving Underground Storage Tanks’ (Defra, November 2002).

The contents of any tanks will be investigated and tested by suitably qualified specialist subcontractors. Demolition activities should take care to prevent the spills and leaks of oils, chemicals etc. that arise or may be stored in current buildings.

Validation soil sampling of the UST excavation will be required, with chemical analysis of samples recovered from the base and sides of the excavation. Once the excavation has been validated, the excavation should be backfilled in accordance with a geotechnical specification.

7 CONCLUSIONS & RECOMENDATIONS

7.1 Conclusions

The following conclusions have been made based on the findings of this investigation.

7.1.1 Phase 2 Site Investigation

The earliest available historic mapping from 1868 records the site to be occupied by a field, with Great North Road present along the eastern site boundary. By 1908, the central and southern area of the site were developed as a school. Between 1964 and 1968, a commercial garage with associated forecourt and fuel island were established in the north-eastern area of the site and remain in 2020 in modified form as the location of the Enterprise vehicle rental premises.

The ground conditions encountered within Remada's investigation supported those encountered during the previous investigation on-site. A thin veneer of made ground (<1m thick) was encountered underlain by firm, variably sandy and gravelly clay, generally becoming stiffer and more gravelly with depth. Localised bands of clayey gravelly sand and clayey gravels were encountered in addition to borderline cohesive and granular soils. The natural deposits on-site are considered representative of weathered Milford Haven Group bedrock, classified as a Secondary (A) Aquifer.

7.1.2 Human Health Risk Assessment Retail Zone

The results of soil chemical analysis were compared to Human Health Generic Assessment Criteria for commercial land use. None of the analytes tested were detected at concentrations that exceeded the human health GAC protective of on-site workers.

7.1.3 Water Resources Risk Assessment

The site is directly underlain by cohesive and granular deposits associated with weathered Milford Haven Group bedrock, a Secondary A Aquifer.

Existing Store & Existing Residential Zones

The results of the soil chemical analysis undertaken has identified that concentrations of metals and inorganic contaminants are within the range of typical made ground. Detectable concentrations of TPH and PAHs were encountered in some samples. However, the contaminants identified are of low solubility and mobility and as such are unlikely to present a risk to groundwater beneath the site. In addition, it should be noted that the site will be predominantly covered with the building and areas of hardstanding. Therefore, the risk of leaching of contaminants as a result of infiltration of groundwater is likely to be limited.

Enterprise Rental Zone

There are six (6 No) decommissioned USTs within the former petrol filling station zone of the site. As the proposed use of this zone of the overall site is for continued car parking no further action is considered necessary, however redevelopment of the site does provide an opportunity to remove the USTs and ensure that neither the surrounding or underlying soils have been impacted with hydrocarbons. Detectable concentrations of hydrocarbons were noted in the sub-base material (total TPH in the sample from WS10 at 0.15 – 0.4m bgl being 4100mg/kg). This exploratory hole was located adjacent to the former fuel dispensing island on the garage site, so is likely to represent low-level prolonged spillages during dispensing.

7.1.4 Waste Classification

In general, the results of the chemical analysis indicates that the material would be classified as non-hazardous waste. While Waste Acceptance Criteria (WAC) analysis has not been undertaken, the assessment has included determination of the fraction of organic carbon (foc) which can be converted to

TOC by multiplying the result by 100. A TOC limit of 3% is placed on waste destined for disposal in an inert landfill. Six of the eight soil samples selected for analysis were below this limit and would be considered potentially suitable for disposal in an inert landfill. The two soil samples that were in exceedance (from WS7 and WS8) were of topsoil from the garden areas, which would need to be stripped and stockpiled separately during the proposed redevelopment of the site.

One sample of bituminous surfacing was analysed for concentrations of PAH compounds. The results indicated that the concentrations of PAHs were generally low (total PAH-17 concentration of 2.8mg/kg) and that the concentration of benzo(a)pyrene of <0.1 mg/kg was below the 50mg/kg limit defined in WM3. Therefore, the bituminous surfacing represented by this sample would be classified as non-hazardous waste and assigned the List of Wastes code 17 03 02 for bituminous mixtures other than those mentioned in 17 03 01.

7.2 Recommendations

Preliminary calculations indicate that for a traditional pad foundation (1.5m wide) at a minimum of 1.5m depth, bearing within the firm cohesive materials (with a minimum undrained shear strength of 60kN/m^2) or medium dense granular materials, a design bearing resistance of 130kN/m^2 will be appropriate in order to satisfy the ultimate and serviceable limit states in accordance with Eurocode 7 - Geotechnical Design. This is only applicable for foundations with loads that are applied vertically and centrally. To satisfy the serviceable limit state settlement has been limited to 25mm. applied vertically and centrally. To satisfy the serviceable limit state settlement has been limited to 25mm. Foundations will need to fully penetrate any made ground including fill material used to raise site levels and extend a minimum of 150mm into the bearing stratum.

A Design Sulphate Class DS-1 is considered appropriate for buried concrete and an ACEC Class of AC-1 is considered appropriate for the location.

It is recommended that further intrusive investigation is undertaken within the footprint of the former garage area, in order to ascertain the composition and depth of potential made ground within this area.

7.3 Ground Gas

The results of four rounds of gas monitoring visits placed the site into Characteristic Situation 1 and therefore ground gas protection measures will not be required within the proposed buildings.

However, the site is located within a Higher Probability Radon Area as between 10% and 30% of properties are indicated to be at or above the Action Level. Therefore, full radon protection measures are considered necessary in the proposed development.

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STUDY LIMITATIONS

IMPORTANT. This section should be read before reliance is placed on any of the information, opinions, advice, recommendations or conclusions contained in this report.

1. This report has been prepared by Remada, Ltd with all reasonable skill, care and diligence within the terms of the Appointment and with the resources and manpower agreed with (the 'Client'). Remada does not accept responsibility for any matters outside the agreed scope.

2. This report has been prepared for the sole benefit of the Client unless agreed otherwise in writing.

3. Unless stated otherwise, no consultations with authorities or funders or other interested third parties have been carried out. Remada is unable to give categorical assurance that the findings will be accepted by these third parties as such bodies may have published, more stringent objectives. Further work may be required by these parties.

4. All work carried out in preparing this report has used, and is based on, Remada' professional knowledge and understanding of current relevant legislation. Changes in legislation or regulatory guidance may cause the opinion or advice contained in this report to become inappropriate or incorrect. In giving opinions and advice pending changes in legislation, of which Remada is aware, have been considered. Following delivery of the report Remada has no obligation to advise the Client or any other party of such changes or their repercussions.

5. This report is only valid when used in its entirety. Any information or advice included in the report should not be relied upon until considered in the context of the whole report.

6. Whilst this report and the opinions made are to the best of Remada' belief, Remada cannot guarantee the accuracy or completeness of any information provided by third parties.

7. This report has been prepared based on the information reasonably available during the project programme. All information relevant to the scope may not have received.

8. This report refers, within the limitations stated, to the condition of the site at the time of the inspections. No warranty is given as to the possibility of changes in the condition of the site since the time of the investigation.

9. The content of this report represents the professional opinion of experienced environmental consultants. Remada does not provide specialist legal or other professional advice. The advice of other professionals may be required.

10. Where intrusive investigation techniques have been employed they have been designed to provide a reasonable level of assurance on the conditions. Given the discrete nature of sampling, no investigation technique is capable of identifying all conditions present in all areas. In some cases the investigation is further limited by site operations, underground obstructions and above ground structures. Unless otherwise stated, areas beyond the boundary of the site have not been investigated.

11. If below ground intrusive investigations have been conducted as part of the scope, service tracing for safe location of exploratory holes has been carried out. The location of underground services shown on any drawing in this report has been determined by visual observations and electromagnetic techniques. No guarantee can be given that all services have been identified. Additional services, structures or other below ground obstructions, not indicated on the drawing, may be present on site.

12. Unless otherwise stated the report provides no comment on the nature of building materials, operational integrity of the facility or on any regulatory compliance issues.

13. Unless otherwise stated, samples from the site (soil, groundwater, building fabric or other samples) have NOT been analysed or assessed for waste classification purposes.

TABLES

Table 2: Gas Groundwater Monitoring Data

GAS & GROUNDWATER MONITORING DATA

Remada

SITE	Lidl, 58 Great N Road, Milford Haven, SA73 2NA
PROJECT No.	798.02
Carried Out by:	Idris Shafqat
Date:	01.11.2020
Instrument Details	GA 5000 G501261

Atmospheric & Ground Conditions

Atmospheric Pressure Variations During Visit	Ground Surface Conditions
989mb	Wet
Atmospheric Pressure Trend Over Previous 48hrs	**Weather Conditions**
Falling	Cloudy, wet, light rain

Well No.	Cover Height (m AOD)	Well Diameter (mm)	CH_4 (% v/v)		CH_4 Steady LEL (%)	CO_2 (% v/v)		O_2 (% v/v)		Duration (secs)^	Flow Rate (l/hr)	Relative Pressure (Pa)	PID (ppm)		Atmospheric Pressure (mb)	Water Level (m bgl)	Water Level (m AoD)	Depth of Pipe (m bgl)	Comments
			Peak	Steady		Peak	Steady	Minimum	Steady				Peak	Steady					
WS2	49.250	50	0.1	0.0	0.0	2.2	0.8	18.7	19.9	60	0.3	-0.03	-	-	989	2.750	46.500	3.000	
WS3	49.700	50	0.1	0.0	0.0	1.4	0.7	19.6	20.5	60	0.6	-0.19	-	-	989	2.570	47.130	3.000	
WS9	48.830	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.000	Unable to access due to vehicular obstruction

Notes: NR = Not Recorded ^ For measurement of gas concentrations > = Above LEL WST = Water Sample Taken GL = Ground Level

GAS & GROUNDWATER MONITORING DATA

Remada

SITE	Lidl, 58 Great N Road, Milford Haven, SA73 2NA
PROJECT No.	798.02
Carried Out by:	Idris Shafqat
Date:	06.11.2020
Instrument Details	GA 5000 G501261

Atmospheric & Ground Conditions

Atmospheric Pressure Variations During Visit	Ground Surface Conditions
1016mb	Wet
Atmospheric Pressure Trend Over Previous 48hrs	**Weather Conditions**
Falling	Cold, windy, light rain

Well No.	Cover Height (m AOD)	Well Diameter (mm)	CH_4 (% v/v)		CH_4 Steady LEL (%)	CO_2 (% v/v)		O_2 (% v/v)		Duration (secs)^	Flow Rate (l/hr)	Relative Pressure (Pa)	PID (ppm)		Atmospheric Pressure (mb)	Water Level (m bgl)	Water Level (m AoD)	Depth of Pipe (m bgl)	Comments
			Peak	Steady		Peak	Steady	Minimum	Steady				Peak	Steady					
WS2	49.250	50	0.1	0.0	0.0	1.3	0.6	18.9	19.6	60	0.4	-0.16	-	-	1016	2.800	46.450	3.000	
WS3	49.700	50	0.1	0.0	0.0	1.8	0.5	19.2	20.0	60	0.5	-0.35	-	-	1016	2.720	46.980	3.000	
WS9	48.830	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.000	Unable to access due to vehicular obstruction

Notes: NR = Not Recorded ^ For measurement of gas concentrations > = Above LEL WST = Water Sample Taken GL = Ground Level

GAS & GROUNDWATER MONITORING DATA

Remada

SITE	Lidl, 58 Great N Road, Milford Haven, SA73 2NA
PROJECT No.	798.02
Carried Out by:	Idris Shafqat
Date:	12.11.2020
Instrument Details	GA 5000 G501261

Atmospheric & Ground Conditions

Atmospheric Pressure Variations During Visit	Ground Surface Conditions
1006mb	Wet
Atmospheric Pressure Variations During Visit	**Weather Conditions**
Falling	Cold, windy, raining

Well No.	Cover Height (m AOD)	Well Diameter (mm)	CH_4 (% v/v)		CH_4 Steady LEL (%)	CO_2 (% v/v)		O_2 (% v/v)		Duration (secs)^	Flow Rate (l/hr)	Relative Pressure (Pa)	PID (ppm)		Atmospheric Pressure (mb)	Water Level (m bgl)	Water Level (m AoD)	Depth of Pipe (m bgl)	Comments
			Peak	Steady		Peak	Steady	Minimum	Steady				Peak	Steady					
WS2	49.250	50	0.0	0.0	0.0	1.1	0.7	19.5	20.1	60	0.6	-0.10	-	-	1006	2.750	46.500	3.000	
WS3	49.700	50	0.1	0.0	0.0	1.7	0.8	19.2	19.9	60	0.5	-0.19	-	-	1006	2.890	46.810	3.000	
WS9	48.830	50	0.0	0.0	0.0	1.7	1.0	19.7	20.3	60	0.5	-0.05	-	-	1006	DRY	-	3.000	

Notes: NR = Not Recorded ^ For measurement of gas concentrations > = Above LEL WST = Water Sample Taken GL = Ground Level

GAS & GROUNDWATER MONITORING DATA

Remada

SITE	Lidl, 58 Great N Road, Milford Haven, SA73 2NA
PROJECT No.	798.02
Carried Out by:	Idris Shafqat
Date:	19.11.2020
Instrument Details	GA 5000 G501261

Atmospheric & Ground Conditions

Atmospheric Pressure Variations During Visit	Ground Surface Conditions
1029mb	Wet
Atmospheric Pressure Trend Over Previous 48hrs	**Weather Conditions**
Rising	Cold, windy, raining

Well No.	Cover Height (m AOD)	Well Diameter (mm)	CH_4 (% v/v)		CH_4 Steady LEL (%)	CO_2 (% v/v)		O_2 (% v/v)		Duration (secs)^	Flow Rate (l/hr)	Relative Pressure (Pa)	PID (ppm)		Atmospheric Pressure (mb)	Water Level (m bgl)	Water Level (m AoD)	Depth of Pipe (m	Comments
			Peak	Steady		Peak	Steady	Minimum	Steady				Peak	Steady					
WS2	49.250	50	0.0	0.0	0.0	0.7	0.5	20.5	21.0	60	0.5	-0.05	-	-	1029	2.620	46.630	3.000	
WS3	49.700	50	0.0	0.0	0.0	0.9	0.7	19.0	20.3	60	0.5	-0.14	-	-	1029	2.710	46.990	3.000	
WS9	48.830	50	0.0	0.0	0.0	1.2	0.7	19.2	20.3	60	0.6	-0.05	-	-	1029	DRY	DRY	3.000	

Notes: NR = Not Recorded ^ For measurement of gas concentrations > = Above LEL WST = Water Sample Taken GL = Ground Level

Table 4: Comparison of Soil Chemical Analyses with GAC

Laboratory ID						20-29293	20-29293	20-29293	20-29293	20-29293	20-29293	20-29293	20-29293
Sample ID			Client Sample ID.:		Commercial GAC 2.5% SOM	1088537	1088538	1088540	1088541	1088542	1088544	1088545	1088546
Borehole			Sample Location:			WS1	WS2	WS5	WS6	WS7	WS9	WS9	WS10
Depth			Top Depth (m):			0.3 - 0.7	0.5 - 1.0	0.09 - 0.45	0.5 - 0.8	0 - 0.3	0 - 0.08	0 - 0.3	0.08 - 0.5
Sample Date			Date Sampled ($):			23-Oct-2020	23-Oct-2020	23-Oct-2020	23-Oct-2020	24-Oct-2020	25-Oct-2020	26-Oct-2020	27-Oct-2020
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	**[mg/kg unless stated]**								
ACM Type	U	2192		N/A		-	-	-	-	-	-	-	-
Asbestos Identification	U	2192	%	0.001		No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
ACM Detection Stage	U	2192		N/A		-	-	-	-	-	-	-	-
Moisture	N	2030	%	0.020		**14**	**13**	**5.9**	**14**	**13**	**2.4**	**18**	**2.3**
pH	M	2010		N/A		**8.3**	**8.4**	**9.4**	**8.4**	**7.8**	**9.3**	**8.3**	**8.3**
Arsenic	M	2450	mg/kg	1.0	640	< 1.0	< 1.0	6.5	4.6	13	23.0	8.7	4.5
Beryllium	U	2450	mg/kg	1.0	12	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	M	2450	mg/kg	0.10	190	< 0.10	< 0.10	< 0.10	< 0.10	0.84	0.27	0.3	0.2
Copper	M	2450	mg/kg	0.50	68000	9	5	94	20	73	4	10	7.5
Mercury	M	2450	mg/kg	0.10	58^{*90} (25.8)	< 0.10	< 0.10	< 0.10	0.11	0.44	< 0.10	< 0.10	< 0.10
Nickel	M	2450	mg/kg	0.50	980	16	9	29	23	42	10	17	15
Lead	M	2450	mg/kg	0.50	2300	7.2	4	13	27.0	320	6	11	9.3
Selenium	M	2450	mg/kg	0.20	12000	< 0.20	< 0.20	< 0.20	0.23	0.39	< 0.20	< 0.20	< 0.20
Vanadium	U	2450	mg/kg	5.0	9000	30.0	18	120	35	39	17	24	20
Zinc	M	2450	mg/kg	0.50	730000	28	17	62	44	750	17	54	40
Chromium (Trivalent)	N	2490	mg/kg	1.0	8600	19	12	45	25	36	13	14	11
Chromium (Hexavalent)	N	2490	mg/kg	0.50	33	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Fraction of Organic Carbon	M	2625		0.0010		0.0020	< 0.0010	0.0096	0.0120	0.0470	0.0710	0.0042	0.0017
Calculated SOM from FOC						***0.345***	***<0.172***	***1.655***	***2.069***	***8.103***	***12.241***	***0.724***	***0.293***
Calculated TOC from FOC						***0.200***	***<0.1***	***0.960***	***1.200***	***4.700***	***7.100***	***0.420***	***0.170***
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	5900sol (558)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	17000sol (322)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	4800vap (190)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	21	< 1.0	29
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	23000vap (118)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	8.4	< 1.0	13
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	82000sol (59)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	10	< 1.0	12
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	1700000	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	7.7	< 1.0	9.2
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0		< 1.0	< 1.0	< 1.0	< 1.0	18	42	38	230
Total Aliphatic Hydrocarbons:	N	2680	mg/kg	5.0		**< 5.0**	**< 5.0**	**< 5.0**	**< 5.0**	**18**	**120**	**38**	**340**
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	46000sol (2260)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	110000sol (1920)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	8100vap (1500)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	72	< 1.0	120
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	28000sol (899)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	30	< 1.0	50
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	37000	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	30	< 1.0	35
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	28000	< 1.0	< 1.0	< 1.0	< 1.0	3.8	37	< 1.0	40
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	28000	< 1.0	< 1.0	< 1.0	< 1.0	140	360	54	2700
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0		**< 5.0**	**< 5.0**	**< 5.0**	**< 5.0**	**150**	**740**	**54**	**3800**
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0		**< 10**	**< 10**	**< 10**	**< 10**	**170**	**860**	**91**	**4100**
Naphthalene	M	2700	mg/kg	0.10	460sol (183)	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene	M	2700	mg/kg	0.10	97000sol (212)	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthene	M	2700	mg/kg	0.10	97000sol (141)	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	M	2700	mg/kg	0.10	68000	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	M	2700	mg/kg	0.10	22000	< 0.10	< 0.10	< 0.10	< 0.10	1.3	< 0.10	< 0.10	< 0.10
Anthracene	M	2700	mg/kg	0.10	540000	< 0.10	< 0.10	< 0.10	< 0.10	0.19	< 0.10	< 0.10	< 0.10
Fluoranthene	M	2700	mg/kg	0.10	23000	< 0.10	< 0.10	< 0.10	< 0.10	3.2	< 0.10	< 0.10	0.59
Pyrene	M	2700	mg/kg	0.10	54000	< 0.10	< 0.10	< 0.10	< 0.10	3.9	< 0.10	< 0.10	0.69
Benzo[a]anthracene	M	2700	mg/kg	0.10	170	< 0.10	< 0.10	< 0.10	< 0.10	2.0	< 0.10	< 0.10	< 0.10
Chrysene	M	2700	mg/kg	0.10	350	< 0.10	< 0.10	< 0.10	< 0.10	2.9	< 0.10	< 0.10	< 0.10
Benzo[b]fluoranthene	M	2700	mg/kg	0.10	45	< 0.10	< 0.10	< 0.10	< 0.10	3.6	< 0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	M	2700	mg/kg	0.10	1200	< 0.10	< 0.10	< 0.10	< 0.10	3.2	< 0.10	< 0.10	< 0.10
Benzo[a]pyrene	M	2700	mg/kg	0.10	35	< 0.10	< 0.10	< 0.10	< 0.10	2.9	< 0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	M	2700	mg/kg	0.10	510	< 0.10	< 0.10	< 0.10	< 0.10	1.7	< 0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	M	2700	mg/kg	0.10	3.6	< 0.10	< 0.10	< 0.10	< 0.10	0.46	< 0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	M	2700	mg/kg	0.10	4000	< 0.10	< 0.10	< 0.10	< 0.10	2.1	< 0.10	< 0.10	< 0.10
Total Of 16 PAH's	M	2700	mg/kg	2.0		**< 2.0**	**< 2.0**	**< 2.0**	**< 2.0**	**28**	**< 2.0**	**< 2.0**	**< 2.0**
Benzene	M	2760	µg/kg	1.0	47	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Toluene	M	2760	µg/kg	1.0	110000vap (1920)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Ethylbenzene	M	2760	µg/kg	1.0	13000vap (1220)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
m-Xylene	M	2760	µg/kg	1.0	15000sol (1120)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
p-Xylene			µg/kg		14000vap (1470)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
o-Xylene	M	2760	µg/kg	1.0	14000sol (1350)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Total Phenols	M	2920	mg/kg	0.30	690dir (30000)	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30

Determinand concentration below the GAC

Determinand concentration in exceedance of GAC

Determinand concentration in exceedance of the vapour/solubility saturation limit.

NC: No published criteria

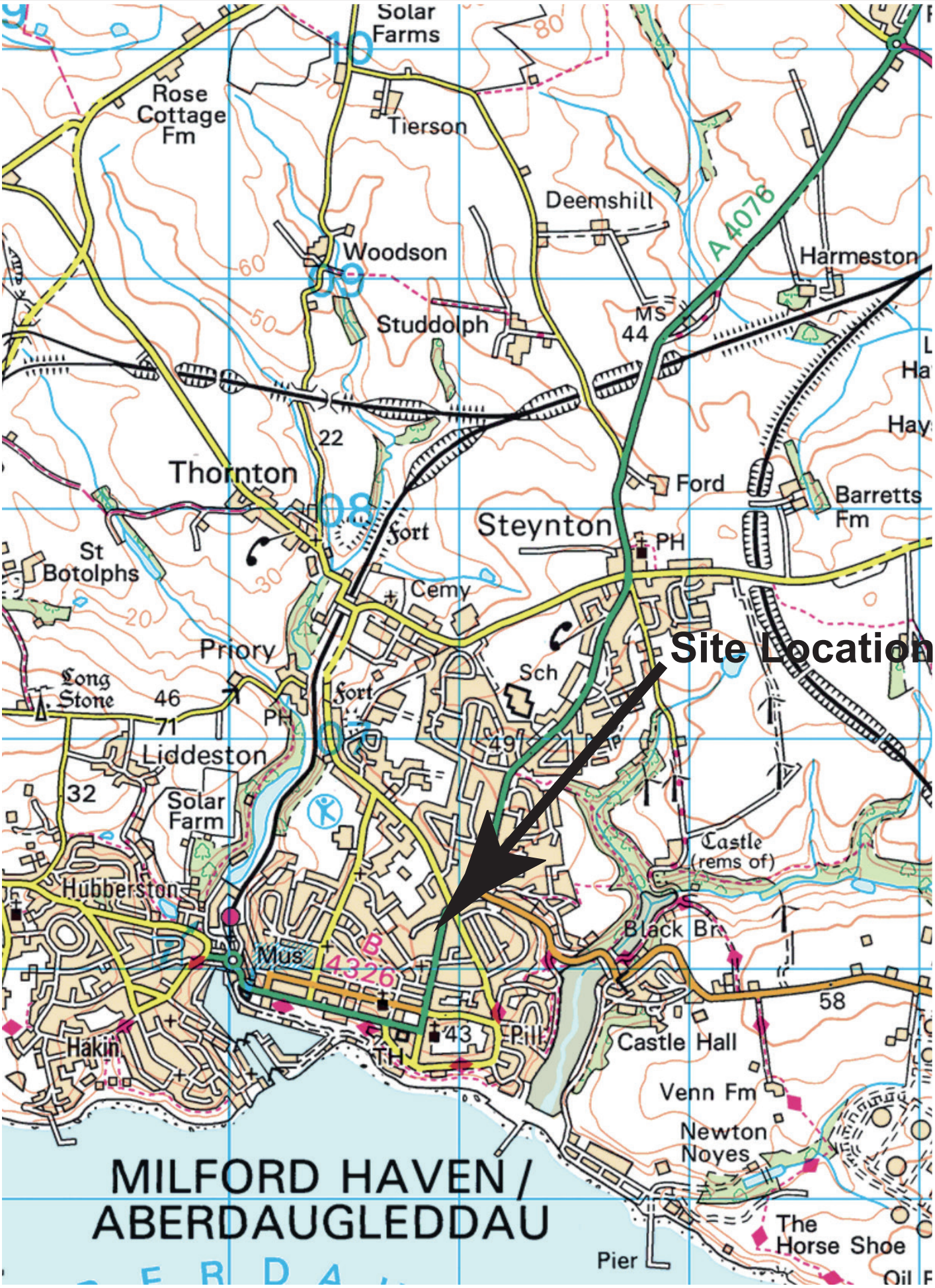
vap: Screening criteria presented exceed the vapour saturation limit, which is presented in brackets.

sol: Screening criteria presented exceed the solubility saturation limit, which is presented in brackets.

dir: Screening criteria based on threshold protective of direct skin contact (guideline in brackets based on health effects following long term exposure provided for illustration only).

(1): For assessment based on the use of the surrogate marker approach the GAC for Coal Tar must be used instead of benzo(a)pyrene.

FIGURES

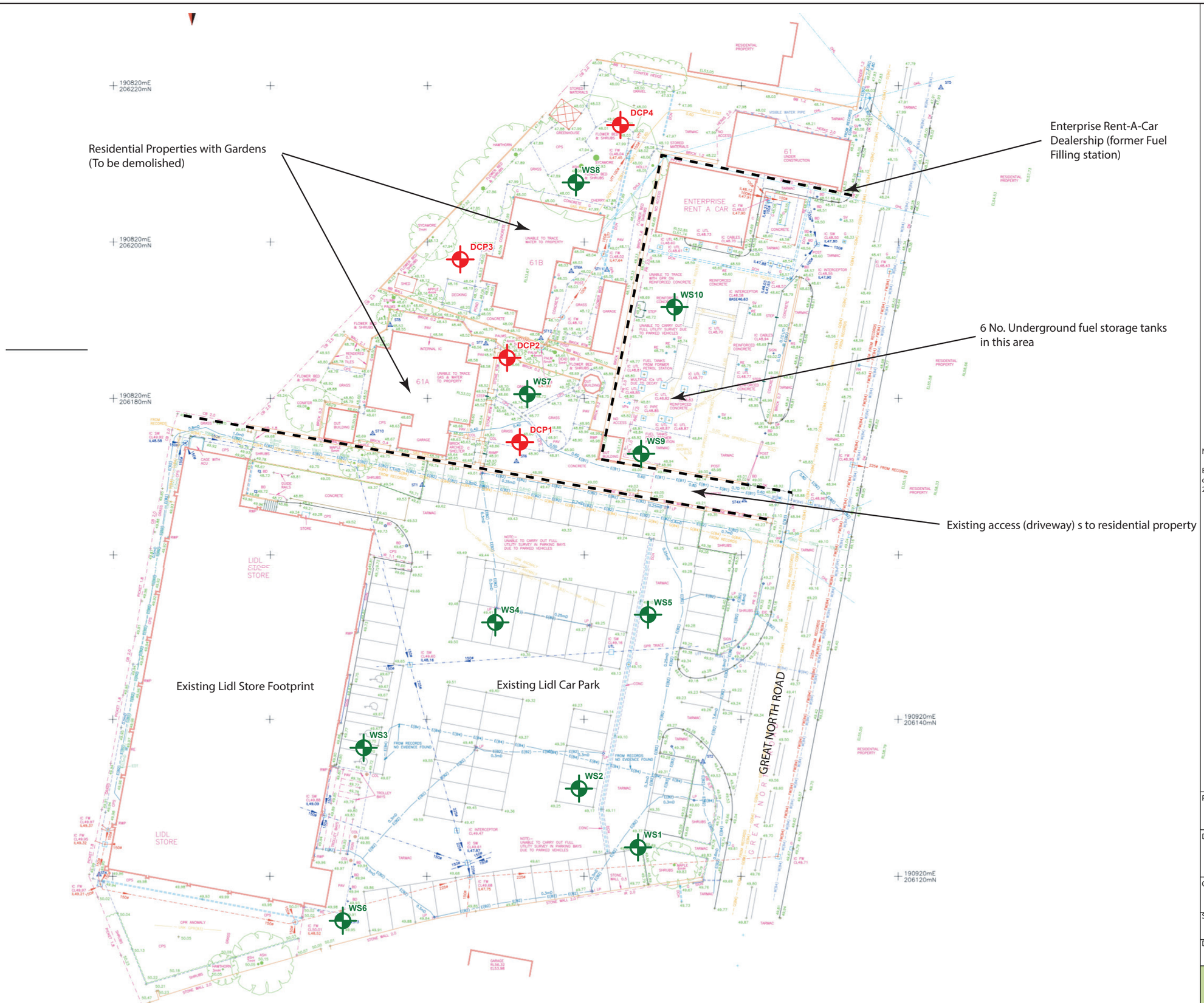


Notes

Map data

Project Title: Milford Haven	Scale: as shown	Drawn: GJ	Size: A4
Drawing Title: Site Location Plan	Date: 05.11.20	Job No.: 798	Drawing /Rev No.: Fig1
Client: Lidl Great Britain Ltd			

Remada



Legend

WS — Window Sample Borehole

DCP — Dynamic Cone Penetrometer Test

Notes

Existing layout reproduced from EDI Surveys Ltd drawing No. 19086/T/01-02, issued in October 2020.

Project Title	Lidl Milford Haven
Drawing Title	Figure 2: Existing Layout & Exploratory Hole Locations
Client	Lidl GB Limited

Scale	Drawn	Size
NTS	PD	A3
Date	Job No.	Drawing /Rev No
06.01.21	798.02	01

Remada

Legend

WS — Window Sample Borehole

DCP — Dynamic Cone Penetrometer Test

Project Title
Lidl Milford Haven

Drawing Title
Figure 3: Proposed Layout & Exploratory Hole Locations

Client
Lidl GB Limited

Scale	Drawn	Size
NTS	PD	A3
Date	Job No.	Drawing /Rev No
06.01.21	798	01

Remada

EXPLORATORY LOGS

Percussion Drilling Log

Project Name: Milford Haven	Client: Lidl Great Britian Ltd	Date: 22/10/2020
Location: Milford Haven	Contractor:	Co-ords: E190884.00 N206125.00
Project No. : 798	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
WS1	WS	49.53m AoD	WP	1:50	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.08	49.45		MADE GROUND. Asphalt.
		0.30 - 0.70	ES		0.30	49.23		MADE GROUND: Brown sandy angular to subrounded medium to coarse gravel.
		1.00	SPT	N=13 (2,2/3,3,3,4)				Reddish brown and brown slightly gravelly sandy CLAY. Gravel is fine subrounded of mudstone and sandstone.
					1.20	48.33		Firm becoming stiff reddish brown CLAY.
		2.00	SPT	N=16 (3,3/4,4,4,4)				*Pockets of light grey, orangeish brown and brown medium to coarse SAND encountered between 1.6m and 2.0m bgl.*
		2.55 - 3.00	U					
		3.00	SPT	N=32 (6,6/7,8,9,8)				
		3.55 - 4.00	U					
		4.00	SPT	N=50 (10,12/50 for 231mm)	4.00	45.53		End of Borehole at 4.000m

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation

Remarks

1.No groundwater encountered.
2. Backfilled with arisings upon completion.

Percussion Drilling Log

Project Name: Milford Haven	Client: Lidl Great Britian Ltd	Date: 22/10/2020
Location: Milford Haven	Contractor:	Co-ords: E190877.00 N206133.00
Project No. : 798	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
WS2	WS	49.25m AoD	WP	1:50	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.08	49.17		MADE GROUND. Asphalt.
					0.30	48.95		MADE GROUND: Brown sandy angular to subrounded medium to coarse gravel.
		0.40 - 0.50 0.50 - 1.00	D ES					Firm becoming stiff reddish brown slightly gravelly sandy CLAY.
		1.00	SPT	N=10 (1,2/2,2,3,3)				
		1.50 - 3.00	B					*Becoming sandy and gravelly below 1.5m bgl.*
		2.00	SPT	N=20 (4,4/5,5,4,6)				
		3.00	SPT	N=50 (7,8/50 for 245mm)	3.00	46.25		End of Borehole at 3.000m

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation

Remarks

1.No groundwater encountered.
2. Installation to 3.0m bgl; 1.0m plain pipe, 2.0m slotted pipe.

Percussion Drilling Log

Project Name: Milford Haven	Client: Lidl Great Britian Ltd	Date: 22/10/2020
Location: Milford Haven	Contractor:	Co-ords: E190850.00 N206138.00
Project No. : 798	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
WS3	WS	49.70m AoD	WP	1:50	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.10	49.60		MADE GROUND. Asphalt.
								MADE GROUND: Brown sandy angular to subrounded medium to coarse gravel.
		0.50 - 0.80	ES		0.50	49.20		Soft reddish brown slightly gravelly sandy CLAY.
		0.80 - 1.00	D					
		1.00	SPT	N=8 (1,1/1,2,2,3)				
		1.30 - 2.40	B		1.30	48.40		Medium dense reddish brown clayey sandy angular to subangular fine to coarse GRAVEL predominantly of sandstone.
		2.00	SPT	N=27 (3,4/6,6,7,8)				
					2.40	47.30		Medium dense to dense reddish brown slightly clayey gravelly fine SAND. Gravel is angular to subangular medium to coarse predominantly of sandstone.
		3.00	SPT	N=50 (8,10/12,13,15,10)	3.00	46.70		End of Borehole at 3.000m

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation

Remarks

1.No groundwater encountered.
2. Installation to 3.0m bgl; 1.0m plain pipe, 2.0m slotted pipe.

Remada

Percussion Drilling Log

Project Name: Milford Haven	Client: Lidl Great Britian Ltd	Date: 22/10/2020
Location: Milford Haven	Contractor:	Co-ords: E190866.00 N206154.00
Project No. : 798	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
WS4	WS	49.41m AoD	WP	1:50	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.12	49.29		MADE GROUND. Asphalt.
		0.50 - 0.80	ES		0.50	48.91		MADE GROUND: Brown sandy angular to subrounded medium to coarse gravel.
								End of Borehole at 0.500m

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation

Remarks

1.No groundwater encountered.
2. Backfilled with arisings upon completion.
3. Terminated on suspected concrete obstruction at 0.5m bgl.

AGS