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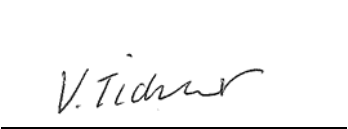
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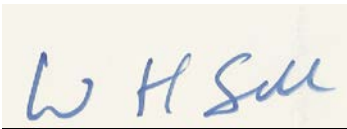
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**ALUMINIUM SIZING FACILITY, RED JACKET WORKS,
MILLAND ROAD, NEATH SA11 1NJ**

REPORT ON GROUND INVESTIGATION

Contract: 2270010-2(00)

Date: November 2019

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REPORT ON GROUND INVESTIGATION

carried out at

**ALUMINIUM SIZING FACILITY, RED JACKET WORKS,
MILLAND ROAD, NEATH SA11 1NJ**

Prepared for

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Milland Road
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SA11 1NJ**

Contract No: 2270010-2(00)

Date: November 2019

EXECUTIVE SUMMARY

It is understood that the proposed development comprises of an aluminium sizing facility and a smaller storage area and lift hatch.

On the instructions of Sandvik Osprey, an investigation was undertaken to determine ground conditions to enable foundation and hard standing design to be carried out, together with a contamination risk assessment and a review of gas emissions.

The proposed aluminium sizing facility, storage area and lift hatch are situated in the north west of Red Jacket Works, south and east of the Neath Canal and may be located by Grid Reference SS 748 973.

The site was occupied by an area of concrete and asphalt hardstanding with some plant located in the north of the site. The Neath Canal and some trees are located on the northern boundary of the site and the River Neath is located 100m to the north west.

The 1:50000 British Geological Map Sheet 247 indicates the site to be underlain by Glaciofluvial Sheet Deposits overlying Hughes Member of the South Wales Coal Field. The Glaciofluvial Deposits generally consist of sand and gravel and the Hughes Member consists of sandstone and mudstone with thin coal seams.

Made ground was encountered to 2.60m in WS2 and to 2.50m in WS3. The made ground generally consisted of 200mm of asphalt overlying dark brown and black gravelly sand with fragments of brick concrete and clinker or soft grey and black gravelly silt and clay with fragments of brick, clinker and sandstone.

Firm green grey gravelly sandy clay was present below the made ground in WS2 and WS3 which continued to the full depths of both boreholes at 2.80m and 3.00m respectively where the tools could not be driven deeper.

On the basis of observations made on site and the results of the in-situ and laboratory tests it is considered that the made ground and alluvial clay is too soft and variable for the proposed loads.

Ground water stood at 1.95m in standpipes in WS2 and WS3, however, ground water stood at 0.40m in BH2 in 2011 and ground water was also present at 0.40m in WS1 in 2019. It is therefore considered that ground water may be encountered from 0.40m during excavations for foundations.

It is recommended that consideration be given to the adoption of piled foundations. Guidelines for the design of piles are given in Appendix 5, which may be used with the Standard Penetration Test N values in the borehole records. It is likely that the piles will end bear onto the sand and gravel which was encountered at between 2.80m and 3.20m below ground level.

The carrying capacity of piles depends not only on their size and the ground conditions but also on their method of installation. Therefore, it is recommended that specialist Piling Contractors be contacted as to the suitability and carrying capacity of their piles in the ground conditions pertaining to the site.

The results of the soil analyses, with the exception of lead, have been compared to the published S4ULs (Suitable 4 Use Levels) determined by LQM and CIEH. As the CLEA SGV for lead was withdrawn in 2014, DEFRA have produced C4SLs (Category 4 Screening Levels) for lead and a number of other contaminants. As no S4UL has been produced for lead, the C4SL has been adopted.

The assessment identified the presence of asbestos, together with possible risks to plastic potable water supply pipes associated with concentrations of TPH within the Made Ground in borehole WS2.

In areas that are to be covered by buildings or hard standing, no pathway is likely to exist between any source of contamination and the human receptors by ingestion or dermal contact, therefore no further remedial action is likely to be required. Consequently, as the site is to be entirely capped with permanent hard standing and building cover, the risk to end users from exposure to the asbestos identified within the Made Ground in borehole WS2 is considered to be low. The risk of exposure to ground workers during construction may be mitigated via the implementation of appropriate health and safety measures.

In order to minimise the impact on future maintenance workers, where services are to be placed at a depth that puts them at or below the level of the source of contamination, it would be prudent to line the trenches and surround the services with clean inert material.

It is not known whether any new potable water supplies are proposed for the new facility, or at what depth or locations these would be placed. Therefore, further testing or the precautionary use of barrier pipe may be required if and when the placement of new services is confirmed

The Local Authority should be consulted as to whether any further works will be required to confirm the absence of pollutant linkages on completion of the development.

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1.0 INTRODUCTION

- 1.1 It is understood that the proposed development comprises an aluminium sizing facility and a smaller storage area and lift hatch.
- 1.2 On the instructions of Sandvik Osprey, an investigation was undertaken to determine ground conditions to enable foundation and hard standing design to be carried out, together with a contamination risk assessment and a review of gas emissions.
- 1.3 This report should be read in conjunction with the Preliminary Investigation, which was reported under reference 2270010-1(00) in October 2019.
- 1.4 It is recommended that a copy of this report be submitted to the relevant authorities to enable them to carry out their own site assessments and provide any comments.
- 1.5 This report has been prepared for the sole use of the Client for the purpose described and no extended duty of care to any third party is implied or offered. Third parties using any information contained within this report do so at their own risk.
- 1.6 The comments given in this report and the opinions expressed herein are based on the information received, the conditions encountered during site works, and on the results of tests made in the field and laboratory. However, there may be conditions prevailing at the site which have not been disclosed by the investigation and which have not been taken into account in the report.
- 1.7 The comments on groundwater conditions are based on observations made at the time the site work was carried out. It should be noted that groundwater levels vary owing to seasonal or other effects.

2.0 SITE SETTING

2.1 Site Location

2.1.1 The proposed aluminium sizing facility, storage area and lift hatch are situated in the north west of Red Jacket Works, south and east of the Neath Canal and may be located by Grid Reference SS 748 973.

2.1.2 A site location plan is included in Appendix 1, Figure A1.1.

2.2 Site Description

2.2.1 The area of the proposed aluminium sizing facility, storage area and lift hatch is 0.03 hectares and is generally level.

2.2.2 The site was occupied by an area of concrete and asphalt hardstanding with some plant located in the north of the site. The Neath Canal and some trees are located on the northern boundary of the site and the River Neath is located 100m to the north west.

2.2.3 Sandvik Osprey manufacture components by moulding various powders under pressure and heat on the site. A workshop is located south west of the site and a powder store is present to the south east. A foundry is located to the east of the site and an above ground storage tank is present to the south west. The buildings were generally of frame construction with steel cladding on the walls and roofs.

2.3 Geological Setting

2.3.1 The 1:50000 British Geological Map Sheet 247 indicates the site to be underlain by Glaciofluvial Sheet Deposits overlying Hughes Member of the South Wales Coal Field. The Glaciofluvial Deposits generally consist of sand and gravel and the Hughes Member consists of sandstone and mudstone with thin coal seams.

3.0 SUMMARY DESK STUDY FINDINGS

- 3.1 A Preliminary Investigation in the form of a desk study and site reconnaissance was carried out in October 2019 in order to assess the potential hazards on and adjacent to the site and prepare a risk assessment for further consideration.
- 3.2 The site was part of the canal up until between 1884 and 1899 when the canal appears to have been backfilled and railway lines crossed the site. the railway lines appeared to have remained on the site until between 1965 and 1970 when the site appeared to have been vacant. By 1989 an access road was located in the north of the site and the west of the site was occupied by small buildings or plant
- 3.3 The report from the Coal Authority is included in Appendix 5 which indicates that the property is not within a surface area that could be affected by past recorded mining and no mine entries are locate in the vicinity of the site.
- 3.4 There is a risk from the operations on site to be a risk to site workers however the site is a modern properly run operation and the risk is considered to be low.
- 3.5 There is the potential for the migration of explosive gases from the backfilling of the canal and taking into account the underlying geology the risk is considered to be high.
- 3.6 There is also a risk from the material used to back fill the canal, the railway lines on the site and the adjacent smelting works, coal yard, engineering work and oil and grease works. The risk is considered to be high.
- 3.7 The site is located next to the Neath Canal and the River Neath is 100m to the west. Given the relatively permeable nature of the geological conditions anticipated on site, there is considered to be a high risk to this water body.
- 3.8 The following scope of works is suggested in order to collect the required data:
- The sinking of boreholes for the recovery of samples for geotechnical and chemical contamination analysis
 - The installation and monitoring of gas and groundwater monitoring standpipes

4.0 SITE WORK

- 4.1 The site work was carried out on the 4th November 2019. The locations of exploratory holes have been planned, where possible, in general accordance with CLR 4, ref. 10.1 and the site work carried out on the basis of the practices set out in BS 10175:2011, ref. 10.2, BS 5930:2015, ref. 10.3, and ISO 1997:2007, ref. 10.4.
- 4.2 Three boreholes, designated WS1 to WS3, were undertaken by tracked windowless sampler technique at the positions shown on the site plan, Appendix 1, Figure A1.1. The depths of boreholes, descriptions of strata encountered and comments on groundwater conditions are given in the borehole records, Appendix 2, Figures A2.1 to A2.3.
- 4.3 One borehole was carried out nearby by cable percussion methods in January 2011 as part of another investigation. The location of this borehole is also indicated on the site plan and the borehole record is included in Fig A2.4.
- 4.4 Representative disturbed samples were taken at the depths shown on the borehole records and despatched to the laboratory. Standard (split-barrel and cone) penetration tests, ref. 10.5, were carried out in the boreholes in the various strata to assess the relative density or consistency. The values of penetration resistance are given in the borehole records.
- 4.5 Samples for environmental purposes were collected in amber glass jars and kept in a cool box.
- 4.6 Standpipes were installed in selected boreholes as detailed in the table below:

Borehole N°	Response Zone (mbgl)	Nominal Pipe Diameter (mm)	Gas Valve/Lockable Cover
WS2	1.00 – 2.80	50	Yes
WS3	1.00 – 3.00	50	Yes

- 4.7 The ground levels at the borehole locations were not determined.
- 4.8 Groundwater and gas monitoring visits were undertaken on the 4th, 14th and 25th November 2019, as detailed in Figure A2.5.

5.0 LABORATORY TESTS

5.1 Geotechnical Testing

5.1.1 Geotechnical soil analysis was undertaken of samples obtained during the investigation as follows:

- 3 No. Water Content Tests
- 3 No. Plasticity Index Tests
- 2 No. pH Values
- 2 No. Sulphate Contents (Water Soluble)
- 1 No. Total Sulphate
- 1 No. Total Sulphur

5.1.2 The laboratory test reports are given in Appendix 3, Figures 2270010/1 and 19/10589.

5.2 Chemical Testing

5.2.1 The suite of chemical analyses has been based upon the findings of the preliminary investigation, along with any on-site observations, to investigate the potential sources of contamination identified in the conceptual model. The chemical analyses were carried out on five samples of soil, three of which were representative of the Made Ground, and two of which were representative of the natural strata. The nature of the analyses is detailed below:

5.2.2 **Metals Suite** - arsenic, water soluble boron, cadmium, chromium, hexavalent chromium, copper, lead, mercury, nickel, selenium and zinc.

5.2.3 **Organic Suite** - petroleum hydrocarbons – TPH CWG speciated analysis and benzene, toluene, ethylbenzene and xylenes (BTEX), polycyclic aromatic hydrocarbons (PAH) – USEPA 16 suite, methyl tertiary butyl ether (MTBE), total phenols and polychlorinated biphenyls (PCBs).

5.2.4 **Inorganics Suite** – total cyanide.

5.2.5 **Others** - pH, organic matter content and asbestos.

5.2.6 The results of these tests are shown in Appendix 4, Figure 19/10820.

6.0 GROUND CONDITIONS ENCOUNTERED

6.1 Made Ground

- 6.1.1 Made ground was encountered to the full depth of WS1 at 0.40m where concrete was present which could not be broken out. Underlying a 250mm thick slab at ground level, grey sand and gravel with fragments of asphalt and concrete was encountered.
- 6.1.2 Made ground was encountered to 2.60m in WS2 and to 2.50m in WS3. The made ground generally consisted of 200mm of asphalt overlying dark brown and black gravelly sand with fragments of brick concrete and clinker or soft grey and black gravelly silt and clay with fragments of brick, clinker and sandstone.

6.2 Alluvium

- 6.2.1 Firm green grey gravelly sandy clay was present below the made ground in WS2 and WS3 which continued to the full depths of both boreholes at 2.80m and 3.00m respectively where the tools could not be driven deeper.

6.3 Groundwater

- 6.3.1 Groundwater was not encountered in WS2 or WS3 during drilling but was present at 0.40m in WS1.
- 6.3.2 Groundwater stood at 1.95m in the standpipes in WS2 and WS3 on 25th November 2019.

7.0 GEOTECHNICAL ASSESSMENT AND RECOMMENDATIONS IN RELATION TO THE PROPOSED DEVELOPMENT

7.1 Structural Details

- 7.1.1 It is understood that the proposed development is to consist of an aluminium sizing facility and a smaller storage area and lift hatch. Precise structural details were not available at the time of preparation of this report.

7.2 Assessment of Soil Condition

- 7.2.1 Laboratory testing for the silty made ground and the alluvial clay recorded natural moisture contents of between 18% and 27%, liquid limits of between 40% and 55%, plastic limits of between 25% and 50% and plasticity indices of between 5% and 15%.
- 7.2.2 These results indicate the silty made ground and the alluvial clay is of intermediate to high plasticity and generally of low volume change potential as defined by the National House Building Council, ref. 10.13. However, the clay is an alluvial normally consolidated clay and volume changes due to the action of trees is unlikely to be significant.
- 7.2.3 The plasticity index results indicate that the clay is likely to become very soft if exposed to ground water or rainwater.
- 7.2.4 Standard Penetration Tests in the made ground were 5 or 7 indicating that the made ground was soft.
- 7.2.5 The Standard Penetration Test results at 2.80m and 3.00m in WS2 and WS3 were greater than 50 indicating a very dense stratum at these depths. BH2 carried nearby in 2011 indicated that very dense sand and gravel was present from 3.20m to at least 4.45m below ground level.
- 7.2.6 Ground water stood at 1.95m in the standpipes in WS2 and WS3. Ground water was also encountered at 0.40m whilst WS1 was being excavated on 4th November 2019. Ground water stood at between 0.40m and 0.63m in the standpipe in BH2 in November and December 2011.

7.3 Foundation Options

- 7.3.1 On the basis of observations made on site and the results of the in-situ and laboratory tests it is considered that the made ground and alluvial clay is to soft and variable for the proposed loads.
- 7.3.2 Ground water stood at 1.95m in standpipes in WS2 and WS3, however, ground water stood at 0.40m in BH2 in 2011 and ground water was also present at 0.40m in WS1 in 2019. It is therefore considered that ground water may be encountered below 0.40m during excavations for foundations.
- 7.3.3 It is recommended that consideration be given to the adoption of piled foundations. Guidelines for the design of piles are given in Appendix 5, which may be used with the Standard Penetration Test N values in the borehole records. It is likely that the piles will end bear onto the sand and gravel which was encountered at between 2.80m and 3.20m below ground level.
- 7.3.4 The carrying capacity of piles depends not only on their size and the ground conditions but also on their method of installation. Therefore, it is recommended that specialist Piling Contractors be contacted as to the suitability and carrying capacity of their piles in the ground conditions pertaining to the site.

7.4 Ground Floor Slabs

- 7.4.1 On the basis of observations on site together with the results of laboratory tests, it is recommended that the floor slabs should be suspended.

7.5 Excavations

- 7.5.1 The safety of all excavations should be assessed and managed in accordance with Regulation 22 of CDM 2015 Managing Health and Safety in Construction, ref 10.6.
- 7.5.2 Groundwater could be expected in excavations taken to depths in excess of 0.40m deep.
- 7.5.3 On the basis of observations on site together with the results of in-situ and laboratory tests, it is considered that shallow excavations for services encountering the made ground are likely to be unstable even in the short term. Side support should be provided to all excavations. Excavations below 1.00m are likely to require close side support and also dewatering with a sump pump.

7.6 Hard Standing Design

- 7.6.1 The structural design of a hard standing is based on the strength of the subgrade, which is assessed on the California Bearing Ratio, CBR, scale from which the subgrade surface modulus can be estimated. Experience has indicated that the measurement of the in-situ CBR value tends to give unreliable results because of the influence of the moisture content of the materials. In practice, the correlation given by the Highways Agency, ref. 10.7, is usually more appropriate than direct determination of the CBR.
- 7.6.2 The process of design given in the guidance notes requires an estimate of CBR and subgrade stiffness modulus to be made at the design stage and in-situ measurement prior to construction.
- 7.6.3 On the basis of laboratory classification tests, it is recommended that for formation prepared in the made ground, a subgrade CBR value of 3% be adopted for design purposes. The assessment assumes there to be a high water table, average construction conditions and a thin pavement construction. Any areas of soft or deleterious material in the Made Ground should be excavated and replaced with a properly compacted granular fill.
- 7.6.4 The results of the laboratory tests indicate that the made ground is likely to be frost susceptible.

7.7 Chemical Attack on Buried Concrete

- 7.7.1 The site has been classified in accordance with BRE Special Digest 1, ref. 10.8, as brownfield that contains pyrite and laboratory testing undertaken accordingly. It is recommended that the guidelines given in BRE Special Digest 1, ref. 10.8, be adopted.
- 7.7.2 It is recommended that for conventional shallow foundations the groundwater should be regarded as mobile.
- 7.7.3 On the basis of the laboratory test results it is considered that a Design Sulphate Class may be taken as DS-2. The site conditions would suggest that an ACEC class for the site of AC-2 would be appropriate.

8.0 ENVIRONMENTAL RISK ASSESSMENT IN RELATION TO PROPOSED DEVELOPMENT

8.1 Contaminated Land

8.1.1 The statutory definition of contaminated land is defined in the Environmental Protection Act 1990, ref. 10.9, which was introduced by the Environment Act 1995, ref. 10.10, as;

8.1.2 'Land which appears to the Local Authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that –

- significant harm is being caused or there is a significant possibility of such harm being caused; or
- significant pollution of controlled waters is being caused, or there is a significant possibility of such pollution being caused.'

8.2 Risk Assessment

8.2.1 The definition of contaminated land is based on the principles of risk assessment. Risk is defined as a combination of:

- The probability, or frequency of exposure to a substance with the potential to cause harm, and:
- The seriousness of the consequence.

8.3 Pollutant Linkage

8.3.1 The basis of an environmental risk assessment involves identifying a 'source' of contamination, a 'pathway' along which the contamination may migrate and a 'receptor' at risk from the contamination.

8.3.2 Current legislation defines the various elements of the pollution linkage as:

- A contaminant is a substance, which is in or under the ground and which has the potential to cause harm or to cause pollution of controlled waters.
- A pathway is one or more routes through which a receptor is being exposed to, or affected by, a contaminant, or could be so affected.
- A receptor is either a living organism, an ecological system, a piece of land or property, or controlled water.

8.3.3 A pollutant linkage indicates that all three elements have been identified. The site can only be defined as 'Contaminated Land' if a pollutant linkage exists and the contamination meets the criteria in Section 8.1 above.

8.3.4 The guidance proposes a four-stage approach for the assessment of contamination and the associated risks. The four stages are listed below:

- Hazard Identification
- Hazard Assessment
- Risk Assessment
- Risk Evaluation

8.3.5 The hazard identification and hazard assessment have been based upon the Preliminary Investigation and formed the conceptual site model, detailed in our report, reference 2270010-1(00), dated October 2019.

8.3.6 The risk assessment and evaluation stages are presented in this phase 2 interpretive report, after an intrusive ground investigation has taken place.

8.4 Risk Assessment – Human Health

8.4.1 The proposed development consists of an aluminium sizing facility and a smaller storage area and lift hatch. The risk assessment has therefore been based on guidelines for a commercial/industrial end use. It should also be noted that it is envisaged that the entire site footprint will be capped with permanent hard standing and building cover. Should the proposed development be changed in the future then further risk assessment may be required, particularly should a more sensitive end-use be envisaged.

8.4.2 The results of the soil analyses, with the exception of lead, have been compared to the recently published S4ULs (Suitable 4 Use Levels) determined by LQM and CIEH, ref. 10.13. As the CLEA SGV for lead was withdrawn in 2014, DEFRA have produced C4SLs (Category 4 Screening Levels), ref. 10.15, for lead and a number of other contaminants. As no S4UL has been produced for lead, the C4SL has been adopted.

8.4.3 The Generic Assessment Criteria (GAC) used within this contamination assessment have been tabulated and are detailed within Appendix 6.

8.4.4 The results of chemical analyses have been processed in accordance with recommendations set out in the CIEH and CL:AIRE document ‘Guidance on Comparing Soil Contamination Data with a Critical Concentration’, ref. 10.16. Where the concentrations determined on site are at or below the respective Generic Assessment Criteria, they are considered not to pose a risk and are removed from further consideration, unless otherwise stated.

8.4.5 All of the results were below the GAC.

8.5 Risk Assessment - Asbestos

8.5.1 Asbestos including Asbestos Containing Soils (ACS) only presents a risk to health if fibres are released into the air. It is generally assumed that only near surface ACS would contribute airborne fibres. However, in instances where gardens are proposed, then there is a risk that ACS could be exposed to the atmosphere through the action of digging.

8.5.2 Although no assessment criteria (AC) has been proposed in the new CIRIA C733, ref. 10.19, if asbestos is identified within soil then further sampling and testing can be undertaken to quantify the amount and type of asbestos present.

8.5.3 Asbestos was identified within the soil samples as follows:

Location	Depth (mbgl)	Comments
WS2	1.00	Chrysotile – loose fibres

8.6 Risk Assessment - Controlled Waters

8.6.1 The site is situated above Secondary A and Secondary Undifferentiated aquifers. The Neath Canal is located on the north western boundary of the site and the River Neath is located 100m to the west.

8.6.2 Whilst the site is situated within a relatively sensitive setting with regard to controlled waters, given the generally low chemical concentrations identified in the shallow soils, both Made Ground and natural strata, and the proposed construction which will predominantly cap the site footprint, therefore limiting infiltration and potential leaching of contaminants, the site is not considered to represent a significant risk to sensitive receptors. Consequently, no further assessment of the risks to controlled waters is considered necessary for the proposed development.

8.7 Gas Generation

8.7.1 Gas monitoring visits were undertaken on the 4th, 14th and 25th November 2019, with atmospheric pressure ranging between 995mb and 1001mb. The results of the gas monitoring are included within Appendix 2, Figure A2.5.

8.7.2 Methane concentrations of less than 0.1% by volume (v/v, limit of detection) were recorded during the monitoring, together with carbon dioxide concentrations of up to 2.3% v/v. Variable oxygen concentrations were recorded ranging from near atmospheric to depleted, 20.3% to 11.5% v/v.

8.7.3 Concentrations of carbon monoxide and hydrogen sulphide were found to be below the detection limit of the monitoring equipment.

8.7.4 Flow rates were recorded over a three minute period during the various return monitoring visits. The maximum of the three minute average flows was recorded at less than 0.1l/hr (limit of detection).

- 8.7.5 In accordance with the methodology published in CIRIA Document C665, ref. 10.33, the maximum recorded values were taken to calculate a Gas Screening Value (GSV) for the site of 0.0023l/hr. This value indicates the site to be Characteristic Situation (CS) 1 (Appendix 7, Table A7.2).
- 8.7.6 On the basis of these results, gas protection measures should not be required for the proposed construction.
- 8.7.7 Radon - The BRE guidance on Radon producing areas within the UK, (BR211:2007), indicates that the site lies within an area where radon protective measures are not required.

8.8 Protection of Services

- 8.8.1 Due to the increasing number of developments being undertaken on potentially contaminated land, the Water Supply Industry has identified the need to protect newly laid water supply pipes. They are likely to impose constraints on the nature of water supply pipes that are to be laid in contaminated land. Current guidance on the selection of materials for water pipes is provided by the UK Water Industry Research Limited, ref. 10.20, which superseded the previous guidance provided by Water Regulations Advisory Scheme, ref. 10.21.
- 8.8.2 The House Builders Federation, in collaboration with Water UK, ref. 10.22, have subsequently provided guidance, part of which includes a basic risk assessment, which is tabulated in Appendix 6, Figure A6.1, and based on the contamination test results reviewed above. Concentrations of TPH within the Made Ground exceeded the basic risk assessment criteria for plastic pipes in location WS2 at 1.00mbgl and therefore, the local water supply company should be consulted as to whether barrier pipe or selection of an alternative material to plastic would be required for any new potable services proposed on the site.
- 8.8.3 However, it is not known whether any such new services are proposed for the new facility, or at what depth or locations these would be placed. Therefore, further testing or the precautionary use of barrier pipe may be required if and when the placement of new services is confirmed.

8.9 Risk Evaluation

8.9.1 The conceptual model formed within the Preliminary Investigation has been updated to reflect the findings of the contamination risk assessment and the revised conceptual model, detailing the relevant pollutant linkages, is tabulated below:

Potential Contamination Sources	Potential Contaminants of Concern	Potential Pathways	Receptor Group
Made Ground/backfilled canal, railway lines smelting works, coal yard, engineering works, oil and grease works	Asbestos (WS2)	Inhalation of fibres	Human Health • Site occupants • Site users • Construction workers • Maintenance workers • Neighbouring site users/general public
	TPH (WS2)	Direct contact of contaminants with building materials	Plastic pipes and services

8.10 Summary of Risk Evaluation

8.10.1 The above assessment identifies that the ‘source – pathway – receptor’ linkage potentially occurs with asbestos and TPH in borehole WS2 impacting upon the identified receptors. Therefore, it would be necessary to manage the risk at this location by either eliminating one of the links or by minimising the potential effects.

8.10.2 Given the proposed capping of the site with permanent hard standing and building cover, the risk to end users from exposure to the asbestos identified within the Made Ground in borehole WS2 are considered to be low. The risk of exposure to ground workers during construction may be mitigated via the implementation of appropriate health and safety measures.

8.10.3 It is not known whether any new potable water supplies are proposed for the new facility, or at what depth or locations these would be placed. Therefore, further testing or the precautionary use of barrier pipe may be required if and when the placement of new services is confirmed.

8.11 Waste

- 8.11.1 An initial assessment of the likely waste classification for any material to be disposed of has been conducted on the basis of the chemical test results obtained as part of the contamination risk assessment.
- 8.11.2 This assessment has been conducted using the HazWasteOnline™ tool, ref. 10.23, the summary output sheets from which are included within Appendix 4, Figure A4.1.
- 8.11.3 This initial assessment indicates that a number of samples may be classified as potentially hazardous due to Hazard Property HP3(i): Flammable. However, maximum TPH concentrations were measured at less than 0.1% and it is unlikely that at these level materials would be flammable.
- 8.11.4 The assessment indicates that the following samples may be classified as hazardous.

Location	Depth (mbgl)	Hazardous Properties	Notes
WS1	0.40	HP8: Corrosive	Due to pH
WS2	1.00	HP7: Carcinogenic	Due to nickel

- 8.11.5 A number of other samples were initially classified as potentially hazardous due to Hazard Property HP3(i): Flammable. However, maximum TPH concentrations were measured at less than 0.1% and it is unlikely that at these levels materials would be flammable. Therefore, the criteria has been altered to indicate total TPH concentrations less than 1000mg/kg in solid samples as non-hazardous.
- 8.11.6 Any samples found to contain asbestos may also be classified as hazardous waste, if the mass of asbestos in the sample tested exceeds 0.1%. The mass of the asbestos identified in the sample from borehole WS2 at 1.00mbgl has not been quantified, however, this sample is already indicated as likely having a hazardous waste classification due to the identified concentration of nickel, as indicated in the table above. Given that the asbestos was identified in the form of fibres, rather than fragments or solid material, it is unlikely that the mass will have exceeded 0.1%.
- 8.11.7 It should be noted that individual tips might require further analysis prior to the disposal of any material from the site. Any such requirements should be clarified with the tip prior to any further analysis being undertaken.
- 8.11.8 Natural arisings which are not contaminated can be disposed of at an inert landfill based on being classified as a natural soil and a listed waste with no requirement for WAC testing.

9.0 MANAGEMENT OF CONTAMINATION

9.1 Remediation and Verification

- 9.1.1 The risk management framework set out in the Model Procedures for the Management of Land Contamination, CLR 11, ref. 10.24, is applicable to the redevelopment of sites that may be affected by contamination.
- 9.1.2 The risk management process set out in the Model Procedures has three main components:
- Risk assessment
 - Options appraisal
 - Implementation
- 9.1.3 The risk assessment has identified the presence of asbestos, together with possible risks to plastic potable water supply pipes associated with concentrations of TPH within the Made Ground in borehole WS2. Relevant pollutant linkages have been identified, as demonstrated in the updated conceptual model.
- 9.1.4 An important part of the risk management process is identifying and informing all stakeholders with an interest in the outcome of the risk management project. To this end, if the regulators have not yet been contacted with regard to the redevelopment of this site, it is recommended that they be supplied with a copy of both the Preliminary Investigation report and this Phase 2 Ground Investigation report in order to enable liaison to be undertaken with them.
- 9.1.5 In areas that are to be covered by buildings or hard standing, no pathway is likely to exist between any source of contamination and the human receptors by ingestion or dermal contact, therefore no further remedial action is likely to be required. Consequently, as the site is to be entirely capped with permanent hard standing and building cover, the risk to end users from exposure to the asbestos identified within the Made Ground in borehole WS2 is considered to be low. The risk of exposure to ground workers during construction may be mitigated via the implementation of appropriate health and safety measures, see Section 9.4 for further details.
- 9.1.6 In order to minimise the impact on future maintenance workers, where services are to be placed at a depth that puts them at or below the level of the source of contamination, it would be prudent to line the trenches and surround the services with clean inert material.
- 9.1.7 It is not known whether any new potable water supplies are proposed for the new facility, or at what depth or locations these would be placed. Therefore, further testing or the precautionary use of barrier pipe may be required if and when the placement of new services is confirmed

- 9.1.8 Given that the limited pollutant linkages identified will be broken on completion of the proposed development, a detailed remediation strategy may not be required. However, following liaison with the relevant regulatory bodies, if required, a remediation strategy could be formulated, which should incorporate an options appraisal and summarise in detail the chosen remedial approach, along with the verification proposals. The remediation strategy should then be approved by the relevant regulatory authorities prior to implementation.
- 9.1.9 The remediation strategy will need to review methods of reducing or controlling the identified unacceptable risks. This could be done by removing or treating the sources of contamination, removing or modifying the pathways or removing or modifying the behaviour of the receptors, to ensure there is no significant risk of significant harm to either human health or controlled waters from the identified contamination, in relation to the proposed end use.
- 9.1.10 Where remediation is required, a verification report will need to be formulated following implementation of the remediation strategy, which should provide a complete record of all remedial activities conducted on site and include all the data obtained to support the remedial objectives and demonstrate that the remediation has been effective. Any unexpected conditions encountered during the remedial works should also be detailed within the verification report.
- 9.1.11 The Local Authority should be consulted as to whether any further works will be required to confirm the absence of pollutant linkages on completion of the development.

9.2 Management of Unidentified Sources of Contamination

- 9.2.1 There is the possibility that sources of contamination may be present on the site, which were not detected during the investigation. Should such contamination be identified or suspected during the site clearance or ground works, these should be dealt with accordingly. A number of options are available for handling this material, which include:
- The removal from site and disposal to a suitably licensed tip of all material suspected of being contaminated. The material would need to be classified prior to disposal.
 - Short-term storage of the suspected material while undertaking verification testing for potential contamination. The storage area should be a contained area to ensure that contamination does not migrate and affect other areas of the site. Depending upon the amounts of material under consideration, this could be either a skip or a lined area.
 - Having a suitably experienced environmental engineer either on-call or with a watching brief for the visual and olfactory assessment of the material, and sampling for verification purposes.

9.3 Consultation

9.3.1 During the development of a site, consultation may be required for a number of reasons with a number of regulatory Authorities. The following provides an indication as to the most likely Authorities with which consultation may be required.

- **Local Authority.** There may be a planning condition regarding contamination and consultation will be required with a designated Contaminated Land Officer within the Environmental Health Department. The Local Authority is generally concerned with human health risks. Some Authorities now require 'Completion Certificates' to be signed off following remediation works.
- **Environment Agency.** Where a site is situated above an aquifer, within a groundwater protection zone or has been designated as a special site, the Environment Agency is likely to be involved to ensure that controlled waters are protected.

9.3.2 Based on the results of any consultation, there may be specific remediation requirements imposed by one or more of the Authorities.

9.4 Risk Management During Site Works

9.4.1 During ground works, some simple measures may have to be put in place to mitigate the risk of any known or previously unidentified contamination affecting the site workers and the environs. The majority of the proposed measures represent good practice for the construction industry and include:

- Informing the site workers of the contamination on site and the potential health effects from exposure.
- Where appropriate, the provision of suitable Personal Protective Equipment (PPE) for workers who may be potentially impacted by working in areas of the contamination.
- Ensuring good hygiene is enforced on site and washing facilities are maintained on the site. Workers are discouraged from smoking, eating or drinking without washing their hands first.
- Dust monitoring, and if necessary, suppression measures should be put into practice where contamination is becoming airborne. Specialist advice should be sought regarding safeguarding of workers from possible exposure to asbestos whilst undertaken excavations through the Made Ground.
- Site drainage should be prevented from entering any nearby watercourse, ref. 10.25.

- 9.4.2 Where contaminated materials are being removed from the site they should be disposed of at a suitably licensed landfill, with a 'duty of care' system in place and maintained throughout the disposal operations.

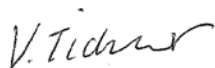
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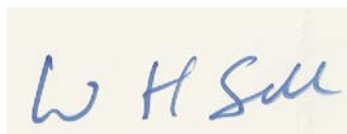
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For and on behalf of Ian Farmer Associates (1998) Limited



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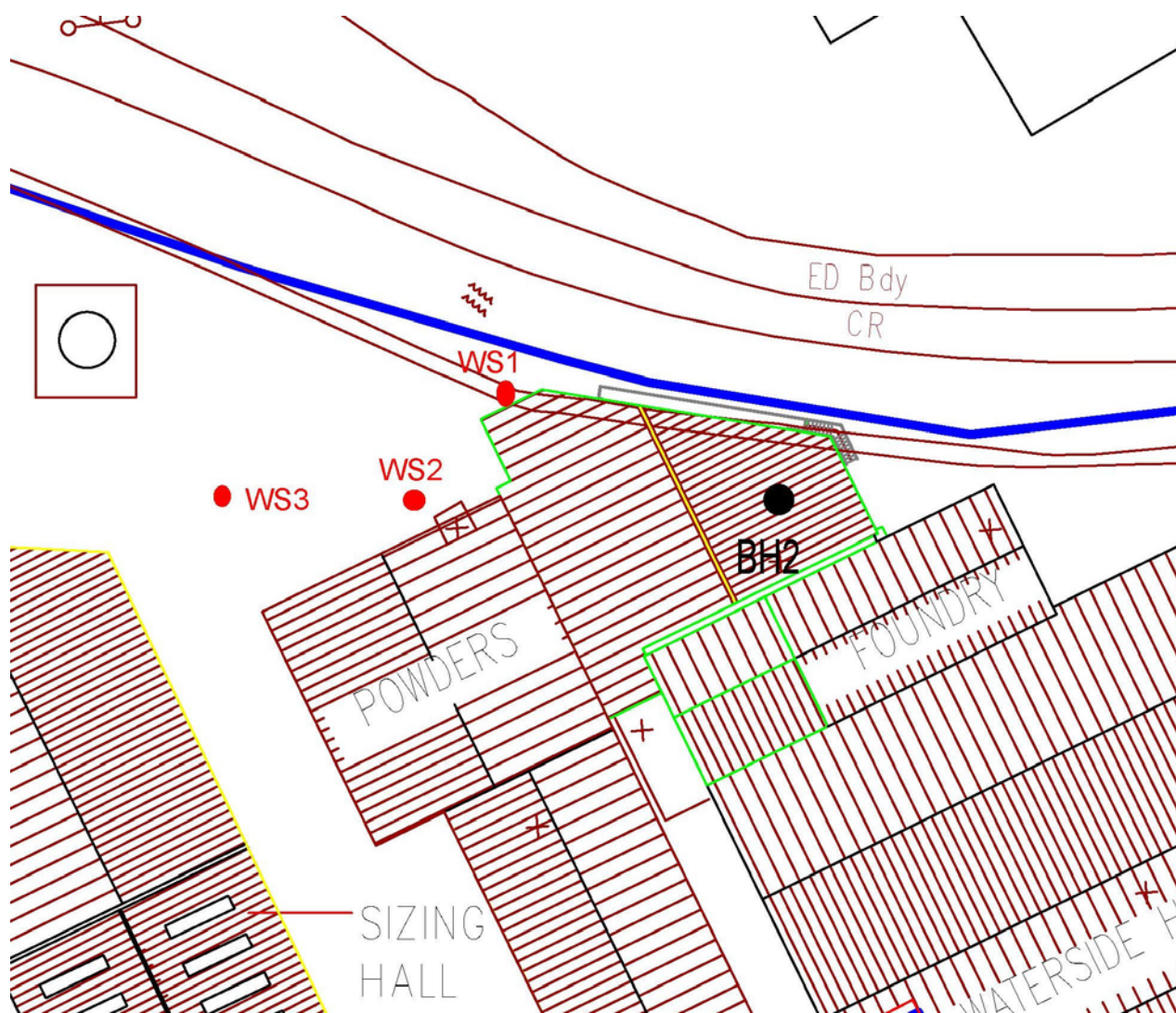


William H Sell
BSc (Hons) FGS
Principal Geotechnical Engineer

APPENDIX 1
DRAWINGS

Job No: 2270010

Site: Sandvik Osprey, Neath



Site Plan

**Figure
A1.1**



APPENDIX 2

SITE WORK



Plant used:	Project: Sandvik, Neath			Location ID: WS1	
Dates: 04/11/2019	Client: Sandvik				
Dynamic Sample Borehole Log	Location:	Ground level:	Logged by:	Vertical scale: 1:50	Sheet 1 of 1
					Project ID: 2270010

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Water Strike	Backfill/ Installation
0.25 - 0.40 0.40	B1 ES2			0.25 0.40	MADE GROUND Concrete slab MADE GROUND grey silty sand and gravel. Gravel is fine to coarse shale, asphalt and concrete MADE GROUND concrete sleeper (breaking concrete for 1.5hrs no progress) End of Borehole at 0.40m			
							1	
							2	
							3	
							4	
							5	
							6	
							7	
							8	
							9	
							10	

Dynamic Sample Recovery					Remarks:									
Top (m)	Base (m)	Dia (mm)	Recovery %	Remarks	Ground water encountered at 0.40m.									
					Water Strikes					Monitoring Installations				
					Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)
					0.40			0	0.00					
Checked by:		IFA DS v01.01								Fig A2.1				
Log status: DRAFT														

Plant used:	Project: Sandvik, Neath			Location ID: WS2
Dates: 04/11/2019	Client: Sandvik			
Location:	Ground level:	Logged by:	Vertical scale: 1:50	Sheet 1 of 1 Project ID: 2270010

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Water Strike	Backfill/ Installation
0.20 - 0.50	B1	SPT(S) N=5 (1,1/1,1,2,1)		0.20	MADE GROUND Asphalt			
0.50 - 1.00	B2			0.40	MADE GROUND Brown mottled grey silty gravelly fine to coarse sand. Gravel is fine to coarse asphalt, concrete, limestone and sandstone			
1.00	ES5			(1.00)	MADE GROUND soft dark brown mottled black and red very sandy very gravelly silt. Gravel is fine to coarse brick, flint , sandstone and asphalt.			
1.00 - 2.00	C3			1.40	MADE GROUND Firm brown mottled red and black sandy gravelly clay. Gravel is fine to coarse brick and clinker.			
1.20	C4	SPT(S) N=7 (1,2/1,2,1,3)		1.80	MADE GROUND brown orange and black slightly clayey fine to coarse sand and gravel. Gravel is clinker and brick.		2	
2.00				(0.80)				
2.00 - 2.80								
2.60	ES6	SPT(S) N=50 (10,15/50 for 245mm)		2.60	Firm green grey brown sandy gravelly CLAY. Gravel is fine to coarse sandstone.			
2.80				2.80				
					End of Borehole at 2.80m		3	
							4	
							5	
							6	
							7	
							8	
							9	
							10	

Dynamic Sample Recovery					Remarks:									
Top (m)	Base (m)	Dia (mm)	Recovery %	Remarks	Ground water not encountered									
					Standpipe with response zone 1.00m to 3.00m installed fitted with a gas valve and stop cock box									
					SPT Hammer: N/R, Energy Ratio: N/R									
					Water Strikes					Monitoring Installations				
					Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)
Checked by:			IFA DS v01.01	 Fig A2.3										
Log status:	DRAFT													



Boring Method Cable Percussion	Casing Diameter 200mm cased to 4.00m	Ground Level (mOD)	Client	Job Number 70104
	Location SS 749 972	Dates 24/01/2011- 25/01/2011	Engineer	Sheet 1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.30	B1					(0.30) 0.30	MADE GROUND Concrete slab		
0.70	B2					(0.90)	MADE GROUND grey brown fine to coarse sand and gravel with some fragments of concrete and brick and occasional cobbles		
1.00-1.45 1.00 1.30 1.30	SPT(C) N=27 B3 B4 B5	1.00		19,10/14,7,3,3		1.20 (0.40) 1.60	MADE GROUND Dense grey fine to coarse gravel with sandy clay and occasional cobbles		
1.70	B6						Soft grey sandy CLAY		
2.00-2.45 2.00	SPT(C) N=6 B7	2.00		1,0/3,2,1,0		(1.60)			
3.00	U8 No recovery			24/11/2011:		3.20			
3.30	B9			25/11/2011:			Very dense brown fine to coarse SAND AND GRAVEL with occasional cobbles.		
3.50-3.95	SPT(C) N=56	3.50		5,18/18,14,24		(0.80) 4.00			
4.00-4.45	SPT(C) N=55	4.00		8,13/19,36			Complete at 4.00m		

Remarks

Ground water seepage encountered at 1.0m unable to seal out.
Ground water stood at 2.60m at start of 25/11/11.
Chiselling 1hr from 1.0m to 1.3m.
Chiselling 2hrs from 3.5m to 4.0m.
Dayworks 1.5hrs digging inspection pit.
Dayworks 1hr moving from abandoned BH4 location to BH3.
Standpipe installed with response zone between 0.9m and 4.0m and fitted with stopcock cover.

Scale (approx)

1:50

Logged By

WHS

Figure No.

A2.4

2270010

Sandvik, Milland Road, Neath

Date	Location	Methane (%)	Carbon Dioxide (%)	Oxygen (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	Flow (l/h)	Pressure (mb)	Pressure Trend
4/11/19	WS2	0.0	2.0	12.3	0	0	0.0	1001	Rising
	WS3	0.0	0.0	20.0	0	0	0.0	1001	Rising
14/11/19	WS2	0.0	2.3	11.5	0	0	0.0	995	Rising
	WS3	0.0	0.0	20.1	0	0	0.0	996	Rising
25/11/19	WS2	0.0	0.0	20.0	0	0	0.0	998	Falling
	WS3	0.0	0.0	20.3	0	0	0.0	998	Falling

Date	Location	Depth to Water (m)
25/11/19	WS2	1.95
	WS3	1.95
28/11/11	BH2	0.60
13/12/11		0.40
9/1/12		0.63

**Results of Gas and Ground
Water Monitoring**

**Figure
A2.5**



APPENDIX 2

GENERAL NOTES ON SITE WORKS

A2.1 SITE WORK

A2.1.1 General

Site work is carried out in general accordance with the guidelines given in ISO 1997, 10.4 and BS 5930, ref. 10.3.

A2.1.2 Percussive Window Sampling Rig

The percussive sampler consists of a track mounted window sampler, ref. 10.26, with tube sizes varying in diameter from 98mm to 86mm. The sample tube is driven by a drop weight, which can also be used for dynamic probing and standard SPT tests. A cutting shoe is fitted to the bottom of each tube, whilst the sample is collected in a plastic sleeve.

The borehole is extended by using progressively smaller diameter tubes.

A2.2 IN-SITU TESTS

A2.2.1 Standard Penetration Test

The Standard Penetration Test is carried out in accordance with the proposals recommended by ISO 1997, ref. 10.4, BS 1377, Part 9, 1990 ref. 10.5.

The standard penetration test, **SPT**, covers the determination of the resistance of soils to the penetration of a split barrel sampler. A 50mm diameter split barrel sampler is driven 450mm into the soil using a 63.5kg hammer with a 760mm drop. The penetration resistance is expressed as the number of blows required to obtain 300mm penetration below an initial seating drive of 150mm through any disturbed ground at the bottom of the borehole. The number of blows to achieve the standard penetration of 300mm is reported as the 'N' value.

The test is generally carried out in fine soils, however, it may also be carried out in coarse granular soils, weak rocks and glacial tills using the same procedure as for the SPT but with a 50mm diameter, 60° apex solid cone replacing the split spoon sampler, **CPT**.

When attempting the standard penetration test in very dense material or weathered rocks it may be necessary to terminate the test before completion to prevent damage to the equipment. In these circumstances it is important to distinguish how the blow count relates to the penetration of the sampler. This may be achieved in the following manner:

- Where the seating drive has been completed, the test drive is terminated if 50 blows are reached before the full penetration of 300mm is achieved. The penetration for 50 blows is recorded and an approximate N value obtained by linear extrapolation of the number of blows for the partial test drive.
- If the seating drive of 150mm is not achieved within the first 25 blows, the penetration after 25 blows is recorded and the test drive then commenced.
- For tests in soft rocks, the test drive should be terminated after 100 blows where the penetration of 300mm has not been achieved.

The N-value obtained from the Standard Penetration Test may be used to assess the relative density of sands and gravels as follows:

Term	SPT N-Value : Blows/300mm Penetration
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	Over 50

A2.3 SAMPLES

A2.3.1 General

Samples have been recovered and stored in accordance with the guidelines given in ISO 22475-1:2006, ref. 10.26 and BS 5930, ref. 10.3.

The undisturbed samples recovered from the percussive sampler were of varying diameters depending upon the depth taken and the ground conditions encountered.

In accordance with EN ISO 22475, ref. 10.26, and BS 5930, ref. 10.3, the thick walled U100 sample is considered as a Class B sampling technique and will only produce Class 3 to 5 quality samples in accordance with EN 1997-2:2007, ref. 10.4. A similar assumption can be made from samples tested from the percussive window sample probing.

Laboratory strength and consolidation testing can only be carried out on Class 1 quality samples, which can be obtained from a Class A sampling technique, ref. 10.4. This is due to possible disturbance during sampling, giving a weaker strength in testing.

Therefore values for c_u and m_v derived for use in this report can only be used as guidance and not used to determine the shear strength properties of the clay and is not used to give a descriptive strength in the borehole records.

- ES represents sample recovered in an amber jar, generally for environmental analysis
- B represents large bulk disturbed samples
- D represents small disturbed sample
- W represents water sample
- ▽ represents water strike
- ▼ represents level to which water rose

A2.4 DESCRIPTION OF SOILS

A2.4.1 General

The procedures and principles given in ISO 14688 Parts 1 and 2, ref. 10.27, supplemented by section 6 of BS 5930, ref. 10.3 have been used in the soil descriptions contained within this report.

APPENDIX 3
LABORATORY TESTS

F.A.O.

Final Test Report - 2270010 / 1

Site: Sandvik, Neath

Job Number: 2270010

Originating Client: Sandvik

Originating Reference: 2270010

Date Sampled: Not Given

Date Scheduled: 11/11/2019

Date Testing Started: 14/11/2019

Date Testing Finished: 19/11/2019

Previous Reports		Amendments	Date Issued

Amendments:

Authorised By:



Tim Robinson
Quality Technician

Report Issue Date: 19/11/2019

Page: 2



Final Test Report - 2270010 / 1

Site: Sandvik, Neath

Job Number: 2270010

Originating Client: Sandvik

All opinions and interpretations contained within this report are outside of our Scope of Accreditation.

This test report shall not be reproduced, except in full and only with the written permission of Ian Farmer Associates Ltd.

Samples will be retained for 28 days from date of issue of the final test report before being disposed of, unless we receive written instruction to the contrary.

Report Issue Date: 19/11/2019

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 19/10859
Issue Number: 1

Date: 25 November, 2019

Client: Ian Farmer Associates (Newcastle)
Unit 4, Faraday Close
Pattinson North Industrial Estate
Washington
Tyne and Wear
NE38 8QJ

Project Manager: Paul Cathcart; washington@ianfarmer.co.uk
Project Name: Sandvik, Neath
Project Ref: 2270010
Order No: n
Date Samples Received: 15/11/19
Date Instructions Received: 15/11/19
Date Analysis Completed: 25/11/19

Prepared by:



Melanie Marshall
Laboratory Coordinator

Approved by:



Danielle Brierley
Client Manager

Envirolab Job Number: 19/10859

Client Project Name: Sandvik, Neath

Client Project Ref: 2270010

Lab Sample ID	19/10859/1	19/10859/2						Units	Limit of Detection	Method ref
Client Sample No	2	4								
Client Sample ID	WS2	WS2								
Depth to Top	0.50	2.00								
Depth To Bottom										
Date Sampled										
Sample Type	Soil - B	Soil - C								
Sample Matrix Code	6A	6A								
% Stones >10mm _A	17.8	23.9						% w/w	0.1	A-T-044
pH BRE _D ^{M#}	8.33	6.73						pH	0.01	A-T-031s
Sulphate BRE (water sol 2:1) _D ^{M#}	30	52						mg/l	10	A-T-026s
Sulphate BRE (acid sol) _D ^{M#}	-	0.05						% w/w	0.02	A-T-028s
Sulphur BRE (total) _D	-	0.12						% w/w	0.01	A-T-024s

REPORT NOTES

General

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The results reported herein relate only to the material supplied to the laboratory.

The residue of any samples contained within this report, and any received with the same delivery, will be disposed of six weeks after initial scheduling. For samples tested for Asbestos we will retain a portion of the dried sample for a minimum of six months after the initial Asbestos testing is completed.

Analytical results reflect the quality of the sample at the time of analysis only.

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A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.

The Client Sample No, Client Sample ID, Depth to Top, Depth to Bottom and Date Sampled were all provided by the client.

Soil chemical analysis:

All results are reported as dry weight (<40°C).

For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.

For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any "A" subscripts.

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TPH analysis of water by method A-T-007:

Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

Electrical Conductivity of water by Method A-T-037:

Results greater than 12900µS/cm @ 25°C / 11550µS/cm @ 20°C fall outside the calibration range and as such are unaccredited.

Asbestos:

Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.

Stones etc. are not removed from the sample prior to analysis.

Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Predominant Matrix Codes:

1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER, 8 = Asbestos bulk ID sample.

Samples with Matrix Code 7 & 8 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations, with the exception of bulk asbestos which are BSEN 17025 accredited.

Secondary Matrix Codes:

A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal,

E = contains roots/twigs.

Key:

IS indicates Insufficient Sample for analysis.

US indicates Unsuitable Sample for analysis.

NDP indicates No Determination Possible.

NAD indicates No Asbestos Detected.

N/A indicates Not Applicable.

Superscript # indicates method accredited to ISO 17025.

Superscript "M" indicates method accredited to MCERTS.

Subscript "A" indicates analysis performed on the sample as received.

Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve

Please contact us if you need any further information.

Envirolab Deviating Samples Report

Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR
Tel. 0161 368 4921 email. ask@envlab.co.uk

Client: Ian Farmer Associates (Newcastle), Unit 4, Faraday Close, Pattinson North
Industrial Estate, Washington, Tyne and Wear, NE38 8QJ

Project: Sandvik, Neath

Clients Project No: 2270010

Project No: 19/10859

Date Received: 15/11/2019 (am)

Cool Box Temperatures (°C): 9.0

Lab Sample ID	19/10859/1	19/10859/2
Client Sample No	2	4
Client Sample ID/Depth	WS2 0.50m	WS2 2.00m
Date Sampled		
Deviation Code		
E (no date)	✓	✓

Key

E (no date)

No sampling date provided (all results affected if not provided)

If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3, ISO 18400-102:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

APPENDIX 3

GENERAL NOTES ON LABORATORY TESTS ON SOILS

A3.1 GENERAL

- A3.1.1 Where applicable all tests are carried out in accordance with the relevant British Standard. The laboratory test procedures are given in the laboratory test reports.
- A3.1.2 Any discussion in this report is based on the values and results obtained from the appropriate tests. Due allowance should be made, when considering any result in isolation, of the possible inaccuracy of any such individual result. Details of the accuracy of results are included in this section, where applicable.

A3.2 SOIL CLASSIFICATION

- A3.2.1 Classification of soils is usually undertaken by means of the Plasticity Classification Chart, sometimes called the A-Line Chart. This is graphical plot of PI against LL with the A-Line defined as $PI = 0.73(LL - 20)$.
- A3.2.2 This line is defined from experimental evidence and does not represent a well-defined boundary between soil types, but forms a useful reference datum. When the values of LL and PI for inorganic clays are plotted on the chart they generally lie just above the A-Line in a narrow band parallel to it, while silts and organic clays plot below this line.
- A3.2.3 Clays and silts are divided into five zones of plasticity:
- | | |
|-------------------------------|----------------------|
| Low Plasticity (L) | LL less than 35 |
| Intermediate Plasticity (I) | LL between 35 and 50 |
| High Plasticity (H) | LL between 50 and 70 |
| Very High Plasticity (V) | LL between 70 and 90 |
| Extremely High Plasticity (E) | LL greater than 90 |
- A3.2.4 In general, clays of high plasticity are likely to have a lower permeability, are more compressible and consolidate over a longer period of time under load than clays of low plasticity. Clays of high plasticity are more difficult to compact as fill material.

APPENDIX 4
CHEMICAL TESTS

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 19/10820

Issue Number: 1

Date: 25 November, 2019

Client: Ian Farmer Associates (Harpenden)
1A Batford Mill
Lower Luton Road
Harpenden
Hertfordshire
UK
AL5 5BZ

Project Manager: Victoria Tickner
Project Name: Sandvik Osprey, Milland Road
Project Ref: 2270010
Order No: 60674
Date Samples Received: 12/11/19
Date Instructions Received: 14/11/19
Date Analysis Completed: 25/11/19

Prepared by:



Sophie France
Admin Assistant

Approved by:



Richard Wong
Client Manager

Envirolab Job Number: 19/10820

Client Project Name: Sandvik Osprey, Milland Road

Client Project Ref: 2270010

Lab Sample ID	19/10820/1	19/10820/2	19/10820/3	19/10820/4	19/10820/5			Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	WS1	WS2	WS2	WS3	WS3					
Depth to Top	0.40	1.00	2.60	0.50	2.70					
Depth To Bottom										
Date Sampled	04-Nov-19	04-Nov-19	04-Nov-19	04-Nov-19	04-Nov-19					
Sample Type	Solid	Soil - ES	Soil - ES	Soil - ES	Soil - ES					
Sample Matrix Code	7	5ABE	5A	4A	5AB					
% Stones >10mm _A	<0.1	<0.1	3.2	34.6	20.4			% w/w	0.1	A-T-044
pH _D ^{M#}	11.98	8.44	7.09	8.28	7.89			pH	0.01	A-T-031s
Cyanide (total) _A ^{M#}	<1	<1	<1	<1	<1			mg/kg	1	A-T-042sTCN
Phenols - Total by HPLC _A	<0.2	0.4	<0.2	<0.2	<0.2			mg/kg	0.2	A-T-050s
Organic matter _D ^{M#}	9.6	17.5	1.7	32.3	1.2			% w/w	0.1	A-T-032 OM
Arsenic _D ^{M#}	4	33	9	51	10			mg/kg	1	A-T-024s
Boron (water soluble) _D ^{M#}	<1.0	<1.0	1.9	<1.0	1.8			mg/kg	1	A-T-027s
Cadmium _D ^{M#}	0.7	2.1	2.1	2.6	1.8			mg/kg	0.5	A-T-024s
Copper _D ^{M#}	13	213	12	353	6			mg/kg	1	A-T-024s
Chromium _D ^{M#}	19	371	38	29	20			mg/kg	1	A-T-024s
Chromium (hexavalent) _D	<1	<1	<1	<1	<1			mg/kg	1	A-T-040s
Lead _D ^{M#}	11	120	16	329	10			mg/kg	1	A-T-024s
Mercury _D	0.92	0.39	<0.17	0.77	<0.17			mg/kg	0.17	A-T-024s
Nickel _D ^{M#}	15	479	34	31	21			mg/kg	1	A-T-024s
Selenium _D ^{M#}	<1	4	2	3	2			mg/kg	1	A-T-024s
Zinc _D ^{M#}	84	297	71	643	53			mg/kg	5	A-T-024s

Envirolab Job Number: 19/10820

Client Project Name: Sandvik Osprey, Milland Road

Client Project Ref: 2270010

Lab Sample ID	19/10820/1	19/10820/2	19/10820/3	19/10820/4	19/10820/5			Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	WS1	WS2	WS2	WS3	WS3					
Depth to Top	0.40	1.00	2.60	0.50	2.70					
Depth To Bottom										
Date Sampled	04-Nov-19	04-Nov-19	04-Nov-19	04-Nov-19	04-Nov-19					
Sample Type	Solid	Soil - ES	Soil - ES	Soil - ES	Soil - ES					
Sample Matrix Code	7	5ABE	5A	4A	5AB					
Asbestos in Soil (inc. matrix)										
Asbestos in soil [#]	NAD	Chrysotile	NAD	NAD	NAD					A-T-045
Asbestos Matrix (microscope) _D	-	Loose fibres	-	-	-					A-T-045
Asbestos ACM - Suitable for Water Absorption Test? _D	N/A	N/A	N/A	N/A	N/A					A-T-045

Envirolab Job Number: 19/10820

Client Project Name: Sandvik Osprey, Milland Road

Client Project Ref: 2270010

Lab Sample ID	19/10820/1	19/10820/2	19/10820/3	19/10820/4	19/10820/5			Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	WS1	WS2	WS2	WS3	WS3					
Depth to Top	0.40	1.00	2.60	0.50	2.70					
Depth To Bottom										
Date Sampled	04-Nov-19	04-Nov-19	04-Nov-19	04-Nov-19	04-Nov-19					
Sample Type	Solid	Soil - ES	Soil - ES	Soil - ES	Soil - ES					
Sample Matrix Code	7	5ABE	5A	4A	5AB					
PAH-16MS										
Acenaphthene _A ^{M#}	0.02	0.02	<0.01	0.01	<0.01			mg/kg	0.01	A-T-019s
Acenaphthylene _A ^{M#}	<0.01	0.02	<0.01	0.03	<0.01			mg/kg	0.01	A-T-019s
Anthracene _A ^{M#}	0.04	0.09	<0.02	0.09	<0.02			mg/kg	0.02	A-T-019s
Benzo(a)anthracene _A ^{M#}	0.14	0.67	<0.04	0.34	<0.04			mg/kg	0.04	A-T-019s
Benzo(a)pyrene _A ^{M#}	0.09	0.48	<0.04	0.27	<0.04			mg/kg	0.04	A-T-019s
Benzo(b)fluoranthene _A ^{M#}	0.18	0.79	<0.05	0.47	<0.05			mg/kg	0.05	A-T-019s
Benzo(ghi)perylene _A ^{M#}	<0.05	0.20	<0.05	0.17	<0.05			mg/kg	0.05	A-T-019s
Benzo(k)fluoranthene _A ^{M#}	<0.07	0.29	<0.07	0.15	<0.07			mg/kg	0.07	A-T-019s
Chrysene _A ^{M#}	0.18	0.68	<0.06	0.50	<0.06			mg/kg	0.06	A-T-019s
Dibenzo(ah)anthracene _A ^{M#}	<0.04	0.06	<0.04	0.04	<0.04			mg/kg	0.04	A-T-019s
Fluoranthene _A ^{M#}	0.24	0.94	<0.08	0.56	<0.08			mg/kg	0.08	A-T-019s
Fluorene _A ^{M#}	0.03	0.04	<0.01	0.02	<0.01			mg/kg	0.01	A-T-019s
Indeno(123-cd)pyrene _A ^{M#}	0.05	0.27	<0.03	0.18	<0.03			mg/kg	0.03	A-T-019s
Naphthalene _A ^{M#}	0.03	0.05	<0.03	0.06	<0.03			mg/kg	0.03	A-T-019s
Phenanthrene _A ^{M#}	0.18	0.41	<0.03	0.28	<0.03			mg/kg	0.03	A-T-019s
Pyrene _A ^{M#}	0.19	0.83	<0.07	0.55	<0.07			mg/kg	0.07	A-T-019s
Total PAH-16MS _A ^{M#}	1.37	5.84	<0.08	3.72	<0.08			mg/kg	0.01	A-T-019s

Envirolab Job Number: 19/10820

Client Project Name: Sandvik Osprey, Milland Road

Client Project Ref: 2270010

Lab Sample ID	19/10820/1	19/10820/2	19/10820/3	19/10820/4	19/10820/5			Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	WS1	WS2	WS2	WS3	WS3					
Depth to Top	0.40	1.00	2.60	0.50	2.70					
Depth To Bottom										
Date Sampled	04-Nov-19	04-Nov-19	04-Nov-19	04-Nov-19	04-Nov-19					
Sample Type	Solid	Soil - ES	Soil - ES	Soil - ES	Soil - ES					
Sample Matrix Code	7	5ABE	5A	4A	5AB					
Speciated PCB-EC7 & WHO12										
PCB BZ 28 _A ^{M#}	<0.002	<0.020	<0.002	<0.020	<0.002			mg/kg	0.002	A-T-004s
PCB BZ 52 _A ^{M#}	<0.002	<0.020	<0.002	<0.020	<0.002			mg/kg	0.002	A-T-004s
PCB BZ 81 _A	<0.005	<0.050	<0.005	<0.050	<0.005			mg/kg	0.005	A-T-004s
PCB BZ 101 _A ^{M#}	<0.004	<0.040	<0.004	<0.040	<0.004			mg/kg	0.004	A-T-004s
PCB BZ 105 _A	<0.005	<0.050	<0.005	<0.050	<0.005			mg/kg	0.005	A-T-004s
PCB BZ 114 _A	<0.005	<0.050	<0.005	<0.050	<0.005			mg/kg	0.005	A-T-004s
PCB BZ 118 _A ^{M#}	<0.007	<0.070	<0.007	<0.070	<0.007			mg/kg	0.007	A-T-004s
PCB BZ 123 _A	<0.005	<0.050	<0.005	<0.050	<0.005			mg/kg	0.005	A-T-004s
PCB BZ 126 _A	<0.005	<0.050	<0.005	<0.050	<0.005			mg/kg	0.005	A-T-004s
PCB BZ 138 _A ^{M#}	<0.006	<0.060	<0.006	<0.060	<0.006			mg/kg	0.006	A-T-004s
PCB BZ 153 _A ^{M#}	<0.004	<0.040	<0.004	<0.040	<0.004			mg/kg	0.004	A-T-004s
PCB BZ 156 _A	<0.005	<0.050	<0.005	<0.050	<0.005			mg/kg	0.005	A-T-004s
PCB BZ 157 _A	<0.005	<0.050	<0.005	<0.050	<0.005			mg/kg	0.005	A-T-004s
PCB BZ 167 _A	<0.005	<0.050	<0.005	<0.050	<0.005			mg/kg	0.005	A-T-004s
PCB BZ 169 _A	<0.005	<0.050	<0.005	<0.050	<0.005			mg/kg	0.005	A-T-004s
PCB BZ 180 _A ^{M#}	<0.004	<0.040	<0.004	<0.040	<0.004			mg/kg	0.004	A-T-004s
PCB BZ 189 _A	<0.005	<0.050	<0.005	<0.050	<0.005			mg/kg	0.005	A-T-004s
PCB BZ 77 _A	<0.005	<0.050	<0.005	<0.050	<0.005			mg/kg	0.005	A-T-004s
Total Speciated PCB-EC7 & WHO12 _A	<0.007	<0.070	<0.007	<0.070	<0.007			mg/kg	0.002	A-T-004s

Envirolab Job Number: 19/10820

Client Project Name: Sandvik Osprey, Milland Road

Client Project Ref: 2270010

Lab Sample ID	19/10820/1	19/10820/2	19/10820/3	19/10820/4	19/10820/5			Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	WS1	WS2	WS2	WS3	WS3					
Depth to Top	0.40	1.00	2.60	0.50	2.70					
Depth To Bottom										
Date Sampled	04-Nov-19	04-Nov-19	04-Nov-19	04-Nov-19	04-Nov-19					
Sample Type	Solid	Soil - ES	Soil - ES	Soil - ES	Soil - ES					
Sample Matrix Code	7	5ABE	5A	4A	5AB					
TPH CWG										
Ali >C5-C6 _A [#]	<0.02	<0.02	<0.01	<0.04	<0.01			mg/kg	0.01	A-T-022s
Ali >C6-C8 _A [#]	<0.02	<0.02	<0.01	<0.04	<0.01			mg/kg	0.01	A-T-022s
Ali >C8-C10 _A	<1	<1	<1	<1	<1			mg/kg	1	A-T-055s
Ali >C10-C12 _A ^{M#}	<1	<1	<1	<1	<1			mg/kg	1	A-T-055s
Ali >C12-C16 _A ^{M#}	<1	14	<1	1	<1			mg/kg	1	A-T-055s
Ali >C16-C21 _A ^{M#}	<1	97	<1	2	<1			mg/kg	1	A-T-055s
Ali >C21-C35 _A	8	212	<1	223	<1			mg/kg	1	A-T-055s
Total Aliphatics _A	8	324	<1	228	<1			mg/kg	1	A-T-055s
Aro >C5-C7 _A [#]	<0.02	<0.02	<0.01	<0.04	<0.01			mg/kg	0.01	A-T-022s
Aro >C7-C8 _A [#]	<0.02	<0.02	<0.01	<0.04	<0.01			mg/kg	0.01	A-T-022s
Aro >C8-C10 _A	2	1	<1	2	<1			mg/kg	1	A-T-055s
Aro >C10-C12 _A ^{M#}	1	2	<1	2	<1			mg/kg	1	A-T-055s
Aro >C12-C16 _A	2	17	<1	6	<1			mg/kg	1	A-T-055s
Aro >C16-C21 _A ^{M#}	2	100	<1	20	<1			mg/kg	1	A-T-055s
Aro >C21-C35 _A ^{M#}	9	92	<1	219	<1			mg/kg	1	A-T-055s
Total Aromatics _A	17	213	<1	249	<1			mg/kg	1	A-T-055s
TPH (Ali & Aro >C5-C35) _A	25	536	<1	477	3			mg/kg	1	A-T-055s
BTEX - Benzene _A [#]	<0.02	<0.02	<0.01	<0.04	<0.01			mg/kg	0.01	A-T-022s
BTEX - Toluene _A [#]	<0.02	<0.02	<0.01	<0.04	<0.01			mg/kg	0.01	A-T-022s
BTEX - Ethyl Benzene _A [#]	<0.02	<0.02	<0.01	<0.04	<0.01			mg/kg	0.01	A-T-022s
BTEX - m & p Xylene _A [#]	<0.02	<0.02	<0.01	<0.04	<0.01			mg/kg	0.01	A-T-022s
BTEX - o Xylene _A [#]	<0.02	<0.02	<0.01	<0.04	<0.01			mg/kg	0.01	A-T-022s
MTBE _A [#]	<0.02	<0.02	<0.01	<0.04	<0.01			mg/kg	0.01	A-T-022s

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TPH analysis of water by method A-T-007:

Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

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Results greater than 12900µS/cm @ 25°C / 11550µS/cm @ 20°C fall outside the calibration range and as such are unaccredited.

Asbestos:

Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.

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Samples with Matrix Code 7 & 8 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations, with the exception of bulk asbestos which are BSEN 17025 accredited.

Secondary Matrix Codes:

A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal,

E = contains roots/twigs.

Key:

IS indicates Insufficient Sample for analysis.

US indicates Unsuitable Sample for analysis.

NDP indicates No Determination Possible.

NAD indicates No Asbestos Detected.

N/A indicates Not Applicable.

Superscript # indicates method accredited to ISO 17025.

Superscript "M" indicates method accredited to MCERTS.

Subscript "A" indicates analysis performed on the sample as received.

Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve

Please contact us if you need any further information.

Envirolab Deviating Samples Report

Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR
Tel. 0161 368 4921 email. ask@envlab.co.uk

Client: Ian Farmer Associates (Harpenden), 1A Batford Mill, Lower Luton Road,
Harpenden, Hertfordshire, UK, AL5 5BZ

Project: Sandvik Osprey, Milland Road

Clients Project No: 2270010

Project No: 19/10820

Date Received: 14/11/2019 (am)

Cool Box Temperatures (°C): 10.5

NO DEVIATIONS IDENTIFIED

If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3, ISO 18400-102:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

Waste Classification Report



5FKVA-LW4UV-9ZE3B

Job name

2270010 Milland Road, Neath

Description/Comments

Project

Site

Related Documents

#	Name	Description
None		

Waste Stream Template

Example waste stream template for contaminated soils

Classified by

Name:
Victoria Tickner
Date:
26 Nov 2019 15:09 GMT
Telephone:
01582 460018

Company:
Ian Farmer Associates
1A Baford Mill
Lower Luton Road
Harpenden
AL5 5BZ

Report

Created by: Victoria Tickner
Created date: 26 Nov 2019 15:09 GMT

Job summary

#	Sample Name	Depth [m]	Classification Result	Hazard properties	Page
1	WS1	0.40	Hazardous	HP 8	2
2	WS2	1.00	Hazardous	HP 7	5
3	WS2[2]	2.60	Non Hazardous		8
4	WS3	0.50	Non Hazardous		11
5	WS3[2]	2.70	Non Hazardous		14

Appendices	Page
Appendix A: Classifier defined and non CLP determinands	17
Appendix B: Rationale for selection of metal species	18
Appendix C: Version	19

Classification of sample: WS1

 **Hazardous Waste**
 Classified as **17 05 03 ***
 in the List of Waste

Sample details

Sample Name:	LoW Code:
WS1	Chapter:
Sample Depth:	17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
0.40 m	Entry:
	17 05 03 * (Soil and stones containing hazardous substances)

Hazard properties

HP 8: Corrosive "waste which on application can cause skin corrosion"

pH; pH "Assumed to be irritant/corrosive because of pH value"

Because of determinand:

pH: (conc.: 11.98 pH)

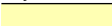
Determinands

Moisture content: 0% No Moisture Correction applied (MC)

#	Determinand			CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
	CLP index number	EC Number	CAS Number									
1	arsenic { arsenic trioxide }	033-003-00-0	215-481-4	1327-53-3	4	mg/kg	1.32	5.281	mg/kg	0.000528 %		
2	boron { diboron trioxide; boric oxide }	005-008-00-8	215-125-8	1303-86-2	<1	mg/kg	3.22	<3.22	mg/kg	<0.000322 %		<LOD
3	cadmium { cadmium oxide }	048-002-00-0	215-146-2	1306-19-0	0.7	mg/kg	1.142	0.8	mg/kg	0.00008 %		
4	chromium in chromium(III) compounds { chromium(III) oxide }	215-160-9	1308-38-9		19	mg/kg	1.462	27.77	mg/kg	0.00278 %		
5	chromium in chromium(VI) compounds { chromium(VI) oxide }	024-001-00-0	215-607-8	1333-82-0	<1	mg/kg	1.923	<1.923	mg/kg	<0.000192 %		<LOD
6	copper { dicopper oxide; copper (I) oxide }	029-002-00-X	215-270-7	1317-39-1	13	mg/kg	1.126	14.637	mg/kg	0.00146 %		
7	lead { lead chromate }	082-004-00-2	231-846-0	7758-97-6	1	11	mg/kg	1.56	17.158	mg/kg	0.0011 %	
8	mercury { mercury dichloride }	080-010-00-X	231-299-8	7487-94-7	0.92	mg/kg	1.353	1.245	mg/kg	0.000125 %		
9	nickel { nickel sulfate }	028-009-00-5	232-104-9	7786-81-4	15	mg/kg	2.637	39.55	mg/kg	0.00396 %		
10	selenium { selenium compounds with the exception of cadmium sulphoselenide and those specified elsewhere in this Annex }	034-002-00-8			<1	mg/kg	2.554	<2.554	mg/kg	<0.000255 %		<LOD
11	zinc { zinc sulphate }	030-006-00-9	231-793-3 [1] 231-793-3 [2]	7446-19-7 [1] 7733-02-0 [2]	84	mg/kg	2.469	207.421	mg/kg	0.0207 %		
12	TPH (C6 to C40) petroleum group		TPH		25	mg/kg		25	mg/kg	0.0025 %		

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
	CLP index number	EC Number	CAS Number								
13	confirm TPH has NOT arisen from diesel or petrol				☒						
14	tert-butyl methyl ether; MTBE; 2-methoxy-2-methylpropane				<0.02 mg/kg		<0.02 mg/kg	<0.000002 %			<LOD
	603-181-00-X	216-653-1	1634-04-4								
15	benzene				<0.02 mg/kg		<0.02 mg/kg	<0.000002 %			<LOD
	601-020-00-8	200-753-7	71-43-2								
16	toluene				<0.02 mg/kg		<0.02 mg/kg	<0.000002 %			<LOD
	601-021-00-3	203-625-9	108-88-3								
17	ethylbenzene				<0.02 mg/kg		<0.02 mg/kg	<0.000002 %			<LOD
	601-023-00-4	202-849-4	100-41-4								
18	xylene				<0.02 mg/kg		<0.02 mg/kg	<0.000002 %			<LOD
	601-022-00-9	202-422-2 [1] 203-396-5 [2] 203-576-3 [3] 215-535-7 [4]	95-47-6 [1] 106-42-3 [2] 108-38-3 [3] 1330-20-7 [4]								
19	cyanides { salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex }				<1 mg/kg	1.884	<1.884 mg/kg	<0.000188 %			<LOD
	006-007-00-5										
20	pH				11.98 pH		11.98 pH	11.98 pH			
			PH								
21	naphthalene				0.03 mg/kg		0.03 mg/kg	0.000003 %			
	601-052-00-2	202-049-5	91-20-3								
22	acenaphthylene				<0.01 mg/kg		<0.01 mg/kg	<0.000001 %			<LOD
		205-917-1	208-96-8								
23	acenaphthene				0.02 mg/kg		0.02 mg/kg	0.000002 %			
		201-469-6	83-32-9								
24	fluorene				0.03 mg/kg		0.03 mg/kg	0.000003 %			
		201-695-5	86-73-7								
25	phenanthrene				0.18 mg/kg		0.18 mg/kg	0.000018 %			
		201-581-5	85-01-8								
26	anthracene				0.04 mg/kg		0.04 mg/kg	0.000004 %			
		204-371-1	120-12-7								
27	fluoranthene				0.24 mg/kg		0.24 mg/kg	0.000024 %			
		205-912-4	206-44-0								
28	pyrene				0.19 mg/kg		0.19 mg/kg	0.000019 %			
		204-927-3	129-00-0								
29	benzo[a]anthracene				0.14 mg/kg		0.14 mg/kg	0.000014 %			
	601-033-00-9	200-280-6	56-55-3								
30	chrysene				0.18 mg/kg		0.18 mg/kg	0.000018 %			
	601-048-00-0	205-923-4	218-01-9								
31	benzo[b]fluoranthene				0.18 mg/kg		0.18 mg/kg	0.000018 %			
	601-034-00-4	205-911-9	205-99-2								
32	benzo[k]fluoranthene				<0.07 mg/kg		<0.07 mg/kg	<0.000007 %			<LOD
	601-036-00-5	205-916-6	207-08-9								
33	benzo[a]pyrene; benzo[def]chrysene				0.09 mg/kg		0.09 mg/kg	0.000009 %			
	601-032-00-3	200-028-5	50-32-8								
34	indeno[123-cd]pyrene				0.05 mg/kg		0.05 mg/kg	0.000005 %			
		205-893-2	193-39-5								
35	dibenz[a,h]anthracene				<0.04 mg/kg		<0.04 mg/kg	<0.000004 %			<LOD
	601-041-00-2	200-181-8	53-70-3								
36	benzo[ghi]perylene				<0.05 mg/kg		<0.05 mg/kg	<0.000005 %			<LOD
		205-883-8	191-24-2								
37	phenol				<0.2 mg/kg		<0.2 mg/kg	<0.00002 %			<LOD
	604-001-00-2	203-632-7	108-95-2								
38	polychlorobiphenyls; PCB				<0.007 mg/kg		<0.007 mg/kg	<0.0000007 %			<LOD
	602-039-00-4	215-648-1	1336-36-3								
Total:									0.0344 %		

Key

	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
	Hazardous result
	Determinand defined or amended by HazWasteOnline (see Appendix A)
	Speciated Determinand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
CLP: Note 1	Only the metal concentration has been used for classification

Supplementary Hazardous Property Information

HP 3(i): Flammable "flammable liquid waste: liquid waste having a flash point below 60°C or waste gas oil, diesel and light heating oils having a flash point > 55°C and ≤ 75°C"

Force this Hazardous property to non hazardous because Solid, not liquid. Not deemed hazardous at concentrations observed. Concentrations below 1000mg/kg considered non-hazardous.

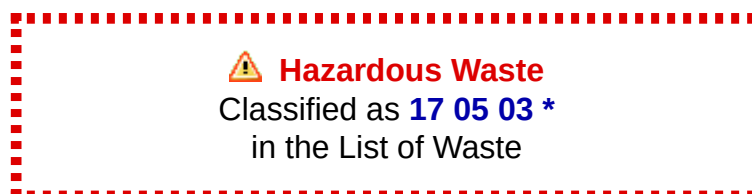
Hazard Statements hit:

Flam. Liq. 3; H226 "Flammable liquid and vapour."

Because of determinand:

TPH (C6 to C40) petroleum group: (conc.: 0.0025%)

Classification of sample: WS2



Sample details

Sample Name:	LoW Code:
WS2	Chapter:
Sample Depth:	17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
1.00 m	Entry:
	17 05 03 * (Soil and stones containing hazardous substances)

Hazard properties

HP 7: Carcinogenic "waste which induces cancer or increases its incidence"

Hazard Statements hit:

Carc. 1A; H350i "May cause cancer by inhalation."

Because of determinand:

nickel sulfate: (compound conc.: 0.126%)

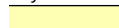
Determinands

Moisture content: **0%** No Moisture Correction applied (MC)

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
	CLP index number	EC Number	CAS Number								
1	arsenic { arsenic trioxide }				33 mg/kg	1.32	43.571 mg/kg	0.00436 %			
	033-003-00-0	215-481-4	1327-53-3								
2	boron { diboron trioxide; boric oxide }				<1 mg/kg	3.22	<3.22 mg/kg	<0.000322 %			<LOD
	005-008-00-8	215-125-8	1303-86-2								
3	cadmium { cadmium oxide }				2.1 mg/kg	1.142	2.399 mg/kg	0.00024 %			
	048-002-00-0	215-146-2	1306-19-0								
4	chromium in chromium(III) compounds { chromium(III) oxide }				371 mg/kg	1.462	542.237 mg/kg	0.0542 %			
		215-160-9	1308-38-9								
5	chromium in chromium(VI) compounds { chromium(VI) oxide }				<1 mg/kg	1.923	<1.923 mg/kg	<0.000192 %			<LOD
	024-001-00-0	215-607-8	1333-82-0								
6	copper { dicopper oxide; copper (I) oxide }				213 mg/kg	1.126	239.814 mg/kg	0.024 %			
	029-002-00-X	215-270-7	1317-39-1								
7	lead { lead chromate }			1	120 mg/kg	1.56	187.178 mg/kg	0.012 %			
	082-004-00-2	231-846-0	7758-97-6								
8	mercury { mercury dichloride }				0.39 mg/kg	1.353	0.528 mg/kg	0.0000528 %			
	080-010-00-X	231-299-8	7487-94-7								
9	nickel { nickel sulfate }				479 mg/kg	2.637	1262.972 mg/kg	0.126 %			
	028-009-00-5	232-104-9	7786-81-4								
10	selenium { selenium compounds with the exception of cadmium sulphoselenide and those specified elsewhere in this Annex }				4 mg/kg	2.554	10.214 mg/kg	0.00102 %			
	034-002-00-8										
11	zinc { zinc sulphate }				297 mg/kg	2.469	733.381 mg/kg	0.0733 %			
	030-006-00-9	231-793-3 [1] 231-793-3 [2]	7446-19-7 [1] 7733-02-0 [2]								
12	TPH (C6 to C40) petroleum group				536 mg/kg		536 mg/kg	0.0536 %			
			TPH								

#		Determinand			CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
		CLP index number	EC Number	CAS Number									
13	confirm TPH has NOT arisen from diesel or petrol												
14	tert-butyl methyl ether; MTBE; 2-methoxy-2-methylpropane	603-181-00-X	216-653-1	1634-04-4		<0.02 mg/kg			<0.02 mg/kg	<0.000002 %		<LOD	
15	benzene	601-020-00-8	200-753-7	71-43-2		<0.02 mg/kg			<0.02 mg/kg	<0.000002 %		<LOD	
16	toluene	601-021-00-3	203-625-9	108-88-3		<0.02 mg/kg			<0.02 mg/kg	<0.000002 %		<LOD	
17	ethylbenzene	601-023-00-4	202-849-4	100-41-4		<0.02 mg/kg			<0.02 mg/kg	<0.000002 %		<LOD	
18	xylene	601-022-00-9	202-422-2 [1] 203-396-5 [2] 203-576-3 [3] 215-535-7 [4]	95-47-6 [1] 106-42-3 [2] 108-38-3 [3] 1330-20-7 [4]		<0.02 mg/kg			<0.02 mg/kg	<0.000002 %		<LOD	
19	cyanides { salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex }	006-007-00-5				<1 mg/kg	1.884		<1.884 mg/kg	<0.000188 %		<LOD	
20	pH			PH		8.44 pH			8.44 pH	8.44 pH			
21	naphthalene	601-052-00-2	202-049-5	91-20-3		0.05 mg/kg			0.05 mg/kg	0.000005 %			
22	acenaphthylene		205-917-1	208-96-8		0.02 mg/kg			0.02 mg/kg	0.000002 %			
23	acenaphthene		201-469-6	83-32-9		0.02 mg/kg			0.02 mg/kg	0.000002 %			
24	fluorene		201-695-5	86-73-7		0.04 mg/kg			0.04 mg/kg	0.000004 %			
25	phenanthrene		201-581-5	85-01-8		0.41 mg/kg			0.41 mg/kg	0.000041 %			
26	anthracene		204-371-1	120-12-7		0.09 mg/kg			0.09 mg/kg	0.000009 %			
27	fluoranthene		205-912-4	206-44-0		0.94 mg/kg			0.94 mg/kg	0.000094 %			
28	pyrene		204-927-3	129-00-0		0.83 mg/kg			0.83 mg/kg	0.000083 %			
29	benzo[a]anthracene	601-033-00-9	200-280-6	56-55-3		0.67 mg/kg			0.67 mg/kg	0.000067 %			
30	chrysene	601-048-00-0	205-923-4	218-01-9		0.68 mg/kg			0.68 mg/kg	0.000068 %			
31	benzo[b]fluoranthene	601-034-00-4	205-911-9	205-99-2		0.79 mg/kg			0.79 mg/kg	0.000079 %			
32	benzo[k]fluoranthene	601-036-00-5	205-916-6	207-08-9		0.29 mg/kg			0.29 mg/kg	0.000029 %			
33	benzo[a]pyrene; benzo[def]chrysene	601-032-00-3	200-028-5	50-32-8		0.48 mg/kg			0.48 mg/kg	0.000048 %			
34	indeno[123-cd]pyrene		205-893-2	193-39-5		0.27 mg/kg			0.27 mg/kg	0.000027 %			
35	dibenz[a,h]anthracene	601-041-00-2	200-181-8	53-70-3		0.06 mg/kg			0.06 mg/kg	0.000006 %			
36	benzo[ghi]perylene		205-883-8	191-24-2		0.2 mg/kg			0.2 mg/kg	0.00002 %			
37	phenol	604-001-00-2	203-632-7	108-95-2		0.4 mg/kg			0.4 mg/kg	0.00004 %			
38	polychlorobiphenyls; PCB	602-039-00-4	215-648-1	1336-36-3		<0.07 mg/kg			<0.07 mg/kg	<0.000007 %		<LOD	
Total:											0.35 %		

Key

	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
	Hazardous result
	Determinand defined or amended by HazWasteOnline (see Appendix A)
	Speciated Determinand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
CLP: Note 1	Only the metal concentration has been used for classification

Supplementary Hazardous Property Information

HP 3(i): Flammable "flammable liquid waste: liquid waste having a flash point below 60°C or waste gas oil, diesel and light heating oils having a flash point > 55°C and <= 75°C"

Force this Hazardous property to non hazardous because Solid, not liquid. Not deemed hazardous at concentrations observed. Concentrations below 1000mg/kg considered non-hazardous.

Hazard Statements hit:

Flam. Liq. 3; H226 "Flammable liquid and vapour."

Because of determinand:

TPH (C6 to C40) petroleum group: (conc.: 0.0536%)

Classification of sample: WS2[2]

 **Non Hazardous Waste**
 Classified as **17 05 04**
 in the List of Waste

Sample details

Sample Name:	LoW Code:
WS2[2]	Chapter:
Sample Depth:	17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
2.60 m	Entry:
	17 05 04 (Soil and stones other than those mentioned in 17 05 03)

Hazard properties

None identified

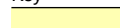
Determinands

Moisture content: 0% No Moisture Correction applied (MC)

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
	CLP index number	EC Number	CAS Number								
1	arsenic { arsenic trioxide }	033-003-00-0	215-481-4	1327-53-3	9 mg/kg	1.32	11.883	mg/kg	0.00119 %		
2	boron { diboron trioxide; boric oxide }	005-008-00-8	215-125-8	1303-86-2	1.9 mg/kg	3.22	6.118	mg/kg	0.000612 %		
3	cadmium { cadmium oxide }	048-002-00-0	215-146-2	1306-19-0	2.1 mg/kg	1.142	2.399	mg/kg	0.00024 %		
4	chromium in chromium(III) compounds { chromium(III) oxide }		215-160-9	1308-38-9	38 mg/kg	1.462	55.539	mg/kg	0.00555 %		
5	chromium in chromium(VI) compounds { chromium(VI) oxide }	024-001-00-0	215-607-8	1333-82-0	<1 mg/kg	1.923	<1.923	mg/kg	<0.000192 %		<LOD
6	copper { dicopper oxide; copper (I) oxide }	029-002-00-X	215-270-7	1317-39-1	12 mg/kg	1.126	13.511	mg/kg	0.00135 %		
7	lead { lead chromate }	082-004-00-2	231-846-0	7758-97-6	16 mg/kg	1.56	24.957	mg/kg	0.0016 %		
8	mercury { mercury dichloride }	080-010-00-X	231-299-8	7487-94-7	<0.17 mg/kg	1.353	<0.23	mg/kg	<0.000023 %		<LOD
9	nickel { nickel sulfate }	028-009-00-5	232-104-9	7786-81-4	34 mg/kg	2.637	89.647	mg/kg	0.00896 %		
10	selenium { selenium compounds with the exception of cadmium sulphoselenide and those specified elsewhere in this Annex }	034-002-00-8			2 mg/kg	2.554	5.107	mg/kg	0.000511 %		
11	zinc { zinc sulphate }	030-006-00-9	231-793-3 [1] 231-793-3 [2]	7446-19-7 [1] 7733-02-0 [2]	71 mg/kg	2.469	175.32	mg/kg	0.0175 %		
12	TPH (C6 to C40) petroleum group		TPH		<1 mg/kg		<1	mg/kg	<0.0001 %		<LOD
13	confirm TPH has NOT arisen from diesel or petrol				☒						
14	tert-butyl methyl ether; MTBE; 2-methoxy-2-methylpropane	603-181-00-X	216-653-1	1634-04-4	<0.01 mg/kg		<0.01	mg/kg	<0.000001 %		<LOD

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
	CLP index number	EC Number	CAS Number							
15	benzene				<0.01 mg/kg		<0.01 mg/kg	<0.000001 %		<LOD
	601-020-00-8	200-753-7	71-43-2							
16	toluene				<0.01 mg/kg		<0.01 mg/kg	<0.000001 %		<LOD
	601-021-00-3	203-625-9	108-88-3							
17	ethylbenzene				<0.01 mg/kg		<0.01 mg/kg	<0.000001 %		<LOD
	601-023-00-4	202-849-4	100-41-4							
18	xylene				<0.01 mg/kg		<0.01 mg/kg	<0.000001 %		<LOD
	601-022-00-9	202-422-2 [1] 203-396-5 [2] 203-576-3 [3] 215-535-7 [4]	95-47-6 [1] 106-42-3 [2] 108-38-3 [3] 1330-20-7 [4]							
19	cyanides { salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex }				<1 mg/kg	1.884	<1.884 mg/kg	<0.000188 %		<LOD
	006-007-00-5									
20	pH				7.09 pH		7.09 pH	7.09 pH		
			PH							
21	naphthalene				<0.03 mg/kg		<0.03 mg/kg	<0.000003 %		<LOD
	601-052-00-2	202-049-5	91-20-3							
22	acenaphthylene				<0.01 mg/kg		<0.01 mg/kg	<0.000001 %		<LOD
		205-917-1	208-96-8							
23	acenaphthene				<0.01 mg/kg		<0.01 mg/kg	<0.000001 %		<LOD
		201-469-6	83-32-9							
24	fluorene				<0.01 mg/kg		<0.01 mg/kg	<0.000001 %		<LOD
		201-695-5	86-73-7							
25	phenanthrene				<0.03 mg/kg		<0.03 mg/kg	<0.000003 %		<LOD
		201-581-5	85-01-8							
26	anthracene				<0.02 mg/kg		<0.02 mg/kg	<0.000002 %		<LOD
		204-371-1	120-12-7							
27	fluoranthene				<0.08 mg/kg		<0.08 mg/kg	<0.000008 %		<LOD
		205-912-4	206-44-0							
28	pyrene				<0.07 mg/kg		<0.07 mg/kg	<0.000007 %		<LOD
		204-927-3	129-00-0							
29	benzo[a]anthracene				<0.04 mg/kg		<0.04 mg/kg	<0.000004 %		<LOD
	601-033-00-9	200-280-6	56-55-3							
30	chrysene				<0.06 mg/kg		<0.06 mg/kg	<0.000006 %		<LOD
	601-048-00-0	205-923-4	218-01-9							
31	benzo[b]fluoranthene				<0.05 mg/kg		<0.05 mg/kg	<0.000005 %		<LOD
	601-034-00-4	205-911-9	205-99-2							
32	benzo[k]fluoranthene				<0.07 mg/kg		<0.07 mg/kg	<0.000007 %		<LOD
	601-036-00-5	205-916-6	207-08-9							
33	benzo[a]pyrene; benzo[def]chrysene				<0.04 mg/kg		<0.04 mg/kg	<0.000004 %		<LOD
	601-032-00-3	200-028-5	50-32-8							
34	indeno[123-cd]pyrene				<0.03 mg/kg		<0.03 mg/kg	<0.000003 %		<LOD
		205-893-2	193-39-5							
35	dibenz[a,h]anthracene				<0.04 mg/kg		<0.04 mg/kg	<0.000004 %		<LOD
	601-041-00-2	200-181-8	53-70-3							
36	benzo[ghi]perylene				<0.05 mg/kg		<0.05 mg/kg	<0.000005 %		<LOD
		205-883-8	191-24-2							
37	phenol				<0.2 mg/kg		<0.2 mg/kg	<0.00002 %		<LOD
	604-001-00-2	203-632-7	108-95-2							
38	polychlorobiphenyls; PCB				<0.007 mg/kg		<0.007 mg/kg	<0.0000007 %		<LOD
	602-039-00-4	215-648-1	1336-36-3							
Total:								0.0381 %		

Key

	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
	Determinand defined or amended by HazWasteOnline (see Appendix A)
	Speciated Determinand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
CLP: Note 1	Only the metal concentration has been used for classification

Classification of sample: WS3

✔ **Non Hazardous Waste**
Classified as **17 05 04**
in the List of Waste

Sample details

Sample Name:	LoW Code:
WS3	Chapter:
Sample Depth:	17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
0.50 m	Entry:
	17 05 04 (Soil and stones other than those mentioned in 17 05 03)

Hazard properties

None identified

Determinands

Moisture content: 0% No Moisture Correction applied (MC)

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
	CLP index number	EC Number	CAS Number							
1	arsenic { arsenic trioxide }				51 mg/kg	1.32	67.337 mg/kg	0.00673 %		
	033-003-00-0	215-481-4	1327-53-3							
2	boron { diboron trioxide; boric oxide }				<1 mg/kg	3.22	<3.22 mg/kg	<0.000322 %		<LOD
	005-008-00-8	215-125-8	1303-86-2							
3	cadmium { cadmium oxide }				2.6 mg/kg	1.142	2.97 mg/kg	0.000297 %		
	048-002-00-0	215-146-2	1306-19-0							
4	chromium in chromium(III) compounds { chromium(III) oxide }				29 mg/kg	1.462	42.385 mg/kg	0.00424 %		
		215-160-9	1308-38-9							
5	chromium in chromium(VI) compounds { chromium(VI) oxide }				<1 mg/kg	1.923	<1.923 mg/kg	<0.000192 %		<LOD
	024-001-00-0	215-607-8	1333-82-0							
6	copper { dicopper oxide; copper (I) oxide }				353 mg/kg	1.126	397.439 mg/kg	0.0397 %		
	029-002-00-X	215-270-7	1317-39-1							
7	lead { lead chromate }			1	329 mg/kg	1.56	513.179 mg/kg	0.0329 %		
	082-004-00-2	231-846-0	7758-97-6							
8	mercury { mercury dichloride }				0.77 mg/kg	1.353	1.042 mg/kg	0.000104 %		
	080-010-00-X	231-299-8	7487-94-7							
9	nickel { nickel sulfate }				31 mg/kg	2.637	81.737 mg/kg	0.00817 %		
	028-009-00-5	232-104-9	7786-81-4							
10	selenium { selenium compounds with the exception of cadmium sulphoselenide and those specified elsewhere in this Annex }				3 mg/kg	2.554	7.661 mg/kg	0.000766 %		
	034-002-00-8									
11	zinc { zinc sulphate }				643 mg/kg	2.469	1587.758 mg/kg	0.159 %		
	030-006-00-9	231-793-3 [1] 231-793-3 [2]	7446-19-7 [1] 7733-02-0 [2]							
12	TPH (C6 to C40) petroleum group				477 mg/kg		477 mg/kg	0.0477 %		
			TPH							
13	confirm TPH has NOT arisen from diesel or petrol				☑					
14	tert-butyl methyl ether; MTBE; 2-methoxy-2-methylpropane				<0.04 mg/kg		<0.04 mg/kg	<0.000004 %		<LOD
	603-181-00-X	216-653-1	1634-04-4							

#	Determinand			CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
	CLP index number	EC Number	CAS Number									
15	benzene				<0.04	mg/kg		<0.04	mg/kg	<0.000004 %		<LOD
	601-020-00-8	200-753-7	71-43-2									
16	toluene				<0.04	mg/kg		<0.04	mg/kg	<0.000004 %		<LOD
	601-021-00-3	203-625-9	108-88-3									
17	ethylbenzene				<0.04	mg/kg		<0.04	mg/kg	<0.000004 %		<LOD
	601-023-00-4	202-849-4	100-41-4									
18	xylene				<0.04	mg/kg		<0.04	mg/kg	<0.000004 %		<LOD
	601-022-00-9	202-422-2 [1] 203-396-5 [2] 203-576-3 [3] 215-535-7 [4]	95-47-6 [1] 106-42-3 [2] 108-38-3 [3] 1330-20-7 [4]									
19	cyanides { salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex }				<1	mg/kg	1.884	<1.884	mg/kg	<0.000188 %		<LOD
	006-007-00-5											
20	pH				8.28	pH		8.28	pH	8.28 pH		
			pH									
21	naphthalene				0.06	mg/kg		0.06	mg/kg	0.000006 %		
	601-052-00-2	202-049-5	91-20-3									
22	acenaphthylene				0.03	mg/kg		0.03	mg/kg	0.000003 %		
		205-917-1	208-96-8									
23	acenaphthene				0.01	mg/kg		0.01	mg/kg	0.000001 %		
		201-469-6	83-32-9									
24	fluorene				0.02	mg/kg		0.02	mg/kg	0.000002 %		
		201-695-5	86-73-7									
25	phenanthrene				0.28	mg/kg		0.28	mg/kg	0.000028 %		
		201-581-5	85-01-8									
26	anthracene				0.09	mg/kg		0.09	mg/kg	0.000009 %		
		204-371-1	120-12-7									
27	fluoranthene				0.56	mg/kg		0.56	mg/kg	0.000056 %		
		205-912-4	206-44-0									
28	pyrene				0.55	mg/kg		0.55	mg/kg	0.000055 %		
		204-927-3	129-00-0									
29	benzo[a]anthracene				0.34	mg/kg		0.34	mg/kg	0.000034 %		
	601-033-00-9	200-280-6	56-55-3									
30	chrysene				0.5	mg/kg		0.5	mg/kg	0.00005 %		
	601-048-00-0	205-923-4	218-01-9									
31	benzo[b]fluoranthene				0.47	mg/kg		0.47	mg/kg	0.000047 %		
	601-034-00-4	205-911-9	205-99-2									
32	benzo[k]fluoranthene				0.15	mg/kg		0.15	mg/kg	0.000015 %		
	601-036-00-5	205-916-6	207-08-9									
33	benzo[a]pyrene; benzo[def]chrysene				0.27	mg/kg		0.27	mg/kg	0.000027 %		
	601-032-00-3	200-028-5	50-32-8									
34	indeno[123-cd]pyrene				0.18	mg/kg		0.18	mg/kg	0.000018 %		
		205-893-2	193-39-5									
35	dibenz[a,h]anthracene				0.04	mg/kg		0.04	mg/kg	0.000004 %		
	601-041-00-2	200-181-8	53-70-3									
36	benzo[ghi]perylene				0.17	mg/kg		0.17	mg/kg	0.000017 %		
		205-883-8	191-24-2									
37	phenol				<0.2	mg/kg		<0.2	mg/kg	<0.00002 %		<LOD
	604-001-00-2	203-632-7	108-95-2									
38	polychlorobiphenyls; PCB				<0.07	mg/kg		<0.07	mg/kg	<0.000007 %		<LOD
	602-039-00-4	215-648-1	1336-36-3									
Total:										0.301 %		

Key

	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
■	Determinand defined or amended by HazWasteOnline (see Appendix A)
■	Speciated Determinand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
CLP: Note 1	Only the metal concentration has been used for classification

Supplementary Hazardous Property Information

HP 3(i): Flammable "flammable liquid waste: liquid waste having a flash point below 60°C or waste gas oil, diesel and light heating oils having a flash point > 55°C and ≤ 75°C"

Force this Hazardous property to non hazardous because Solid, not liquid. Not deemed hazardous at concentrations observed. Concentrations below 1000mg/kg considered non-hazardous.

Hazard Statements hit:

Flam. Liq. 3; H226 "Flammable liquid and vapour."

Because of determinand:

TPH (C6 to C40) petroleum group: (conc.: 0.0477%)

Classification of sample: WS3[2]

 **Non Hazardous Waste**
 Classified as **17 05 04**
 in the List of Waste

Sample details

Sample Name:	LoW Code:
WS3[2]	Chapter:
Sample Depth:	17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
2.70 m	Entry:
	17 05 04 (Soil and stones other than those mentioned in 17 05 03)

Hazard properties

None identified

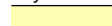
Determinands

Moisture content: 0% No Moisture Correction applied (MC)

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
	CLP index number	EC Number	CAS Number								
1	arsenic { arsenic trioxide }	033-003-00-0	215-481-4	1327-53-3	10 mg/kg	1.32	13.203	mg/kg	0.00132 %		
2	boron { diboron trioxide; boric oxide }	005-008-00-8	215-125-8	1303-86-2	1.8 mg/kg	3.22	5.796	mg/kg	0.00058 %		
3	cadmium { cadmium oxide }	048-002-00-0	215-146-2	1306-19-0	1.8 mg/kg	1.142	2.056	mg/kg	0.000206 %		
4	chromium in chromium(III) compounds { chromium(III) oxide }		215-160-9	1308-38-9	20 mg/kg	1.462	29.231	mg/kg	0.00292 %		
5	chromium in chromium(VI) compounds { chromium(VI) oxide }	024-001-00-0	215-607-8	1333-82-0	<1 mg/kg	1.923	<1.923	mg/kg	<0.000192 %		<LOD
6	copper { dicopper oxide; copper (I) oxide }	029-002-00-X	215-270-7	1317-39-1	6 mg/kg	1.126	6.755	mg/kg	0.000676 %		
7	lead { lead chromate }	082-004-00-2	231-846-0	7758-97-6	10 mg/kg	1.56	15.598	mg/kg	0.001 %		
8	mercury { mercury dichloride }	080-010-00-X	231-299-8	7487-94-7	<0.17 mg/kg	1.353	<0.23	mg/kg	<0.000023 %		<LOD
9	nickel { nickel sulfate }	028-009-00-5	232-104-9	7786-81-4	21 mg/kg	2.637	55.37	mg/kg	0.00554 %		
10	selenium { selenium compounds with the exception of cadmium sulphoselenide and those specified elsewhere in this Annex }	034-002-00-8			2 mg/kg	2.554	5.107	mg/kg	0.000511 %		
11	zinc { zinc sulphate }	030-006-00-9	231-793-3 [1] 231-793-3 [2]	7446-19-7 [1] 7733-02-0 [2]	53 mg/kg	2.469	130.873	mg/kg	0.0131 %		
12	TPH (C6 to C40) petroleum group		TPH		3 mg/kg		3	mg/kg	0.0003 %		
13	confirm TPH has NOT arisen from diesel or petrol				☒						
14	tert-butyl methyl ether; MTBE; 2-methoxy-2-methylpropane	603-181-00-X	216-653-1	1634-04-4	<0.01 mg/kg		<0.01	mg/kg	<0.000001 %		<LOD

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
	CLP index number	EC Number	CAS Number							
15	benzene				<0.01 mg/kg		<0.01 mg/kg	<0.000001 %		<LOD
	601-020-00-8	200-753-7	71-43-2							
16	toluene				<0.01 mg/kg		<0.01 mg/kg	<0.000001 %		<LOD
	601-021-00-3	203-625-9	108-88-3							
17	ethylbenzene				<0.01 mg/kg		<0.01 mg/kg	<0.000001 %		<LOD
	601-023-00-4	202-849-4	100-41-4							
18	xylene				<0.01 mg/kg		<0.01 mg/kg	<0.000001 %		<LOD
	601-022-00-9	202-422-2 [1] 203-396-5 [2] 203-576-3 [3] 215-535-7 [4]	95-47-6 [1] 106-42-3 [2] 108-38-3 [3] 1330-20-7 [4]							
19	cyanides { salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex }				<1 mg/kg	1.884	<1.884 mg/kg	<0.000188 %		<LOD
	006-007-00-5									
20	pH				7.89 pH		7.89 pH	7.89 pH		
			PH							
21	naphthalene				<0.03 mg/kg		<0.03 mg/kg	<0.000003 %		<LOD
	601-052-00-2	202-049-5	91-20-3							
22	acenaphthylene				<0.01 mg/kg		<0.01 mg/kg	<0.000001 %		<LOD
		205-917-1	208-96-8							
23	acenaphthene				<0.01 mg/kg		<0.01 mg/kg	<0.000001 %		<LOD
		201-469-6	83-32-9							
24	fluorene				<0.01 mg/kg		<0.01 mg/kg	<0.000001 %		<LOD
		201-695-5	86-73-7							
25	phenanthrene				<0.03 mg/kg		<0.03 mg/kg	<0.000003 %		<LOD
		201-581-5	85-01-8							
26	anthracene				<0.02 mg/kg		<0.02 mg/kg	<0.000002 %		<LOD
		204-371-1	120-12-7							
27	fluoranthene				<0.08 mg/kg		<0.08 mg/kg	<0.000008 %		<LOD
		205-912-4	206-44-0							
28	pyrene				<0.07 mg/kg		<0.07 mg/kg	<0.000007 %		<LOD
		204-927-3	129-00-0							
29	benzo[a]anthracene				<0.04 mg/kg		<0.04 mg/kg	<0.000004 %		<LOD
	601-033-00-9	200-280-6	56-55-3							
30	chrysene				<0.06 mg/kg		<0.06 mg/kg	<0.000006 %		<LOD
	601-048-00-0	205-923-4	218-01-9							
31	benzo[b]fluoranthene				<0.05 mg/kg		<0.05 mg/kg	<0.000005 %		<LOD
	601-034-00-4	205-911-9	205-99-2							
32	benzo[k]fluoranthene				<0.07 mg/kg		<0.07 mg/kg	<0.000007 %		<LOD
	601-036-00-5	205-916-6	207-08-9							
33	benzo[a]pyrene; benzo[def]chrysene				<0.04 mg/kg		<0.04 mg/kg	<0.000004 %		<LOD
	601-032-00-3	200-028-5	50-32-8							
34	indeno[123-cd]pyrene				<0.03 mg/kg		<0.03 mg/kg	<0.000003 %		<LOD
		205-893-2	193-39-5							
35	dibenz[a,h]anthracene				<0.04 mg/kg		<0.04 mg/kg	<0.000004 %		<LOD
	601-041-00-2	200-181-8	53-70-3							
36	benzo[ghi]perylene				<0.05 mg/kg		<0.05 mg/kg	<0.000005 %		<LOD
		205-883-8	191-24-2							
37	phenol				<0.2 mg/kg		<0.2 mg/kg	<0.00002 %		<LOD
	604-001-00-2	203-632-7	108-95-2							
38	polychlorobiphenyls; PCB				<0.007 mg/kg		<0.007 mg/kg	<0.0000007 %		<LOD
	602-039-00-4	215-648-1	1336-36-3							
Total:								0.0266 %		

Key

	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
	Determinand defined or amended by HazWasteOnline (see Appendix A)
	Speciated Determinand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
CLP: Note 1	Only the metal concentration has been used for classification

Supplementary Hazardous Property Information

HP 3(i): Flammable "flammable liquid waste: liquid waste having a flash point below 60°C or waste gas oil, diesel and light heating oils having a flash point > 55°C and ≤ 75°C"

Force this Hazardous property to non hazardous because Solid, not liquid. Not deemed hazardous at concentrations observed. Concentrations below 1000mg/kg considered non-hazardous.

Hazard Statements hit:

Flam. Liq. 3; H226 "Flammable liquid and vapour."

Because of determinand:

TPH (C6 to C40) petroleum group: (conc.: 0.0003%)

Appendix A: Classifier defined and non CLP determinands

■ **chromium(III) oxide** (EC Number: 215-160-9, CAS Number: 1308-38-9)

Conversion factor: 1.462

Description/Comments: Data from C&L Inventory Database

Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>

Data source date: 17 Jul 2015

Hazard Statements: Aquatic Chronic 1 H410 , Aquatic Acute 1 H400 , Repr. 1B H360FD , Skin Sens. 1 H317 , Resp. Sens. 1 H334 , Skin Irrit. 2 H315 , STOT SE 3 H335 , Eye Irrit. 2 H319 , Acute Tox. 4 H302 , Acute Tox. 4 H332

■ **TPH (C6 to C40) petroleum group** (CAS Number: TPH)

Description/Comments: Hazard statements taken from WM3 1st Edition 2015; Risk phrases: WM2 3rd Edition 2013

Data source: WM3 1st Edition 2015

Data source date: 25 May 2015

Hazard Statements: Aquatic Chronic 2 H411 , Repr. 2 H361d , Carc. 1B H350 , Muta. 1B H340 , STOT RE 2 H373 , Asp. Tox. 1 H304 , Flam. Liq. 3 H226

■ **confirm TPH has NOT arisen from diesel or petrol**

Description/Comments: Chapter 3, section 4b requires a positive confirmation for benzo[a]pyrene to be used as a marker in evaluating Carc. 1B; H350 (HP 7) and Muta. 1B; H340 (HP 11)

Data source: WM3 1st Edition 2015

Data source date: 25 May 2015

Hazard Statements: None.

■ **ethylbenzene** (EC Number: 202-849-4, CAS Number: 100-41-4)

CLP index number: 601-023-00-4

Description/Comments:

Data source: Commission Regulation (EU) No 605/2014 – 6th Adaptation to Technical Progress for Regulation (EC) No 1272/2008. (ATP6)

Additional Hazard Statement(s): Carc. 2 H351

Reason for additional Hazards Statement(s)/Risk Phrase(s):

03 Jun 2015 - Carc. 2 H351 hazard statement sourced from: IARC Group 2B (77) 2000

■ **salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex**

CLP index number: 006-007-00-5

Description/Comments: Conversion factor based on a worst case compound: sodium cyanide

Data source: Commission Regulation (EC) No 790/2009 - 1st Adaptation to Technical Progress for Regulation (EC) No 1272/2008. (ATP1)

Additional Hazard Statement(s): EUH032 >= 0.2 %

Reason for additional Hazards Statement(s)/Risk Phrase(s):

14 Dec 2015 - EUH032 >= 0.2 % hazard statement sourced from: WM3, Table C12.2

■ **pH** (CAS Number: PH)

Description/Comments: Appendix C4

Data source: WM3 1st Edition 2015

Data source date: 25 May 2015

Hazard Statements: None.

■ **acenaphthylene** (EC Number: 205-917-1, CAS Number: 208-96-8)

Description/Comments: Data from C&L Inventory Database

Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>

Data source date: 17 Jul 2015

Hazard Statements: Skin Irrit. 2 H315 , STOT SE 3 H335 , Eye Irrit. 2 H319 , Acute Tox. 1 H310 , Acute Tox. 1 H330 , Acute Tox. 4 H302

■ **acenaphthene** (EC Number: 201-469-6, CAS Number: 83-32-9)

Description/Comments: Data from C&L Inventory Database

Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>

Data source date: 17 Jul 2015

Hazard Statements: Aquatic Chronic 2 H411 , Aquatic Chronic 1 H410 , Aquatic Acute 1 H400 , Skin Irrit. 2 H315 , STOT SE 3 H335 , Eye Irrit. 2 H319

• **fluorene** (EC Number: 201-695-5, CAS Number: 86-73-7)

Description/Comments: Data from C&L Inventory Database
 Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>
 Data source date: 06 Aug 2015
 Hazard Statements: Aquatic Chronic 1 H410 , Aquatic Acute 1 H400

• **phenanthrene** (EC Number: 201-581-5, CAS Number: 85-01-8)

Description/Comments: Data from C&L Inventory Database
 Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>
 Data source date: 06 Aug 2015
 Hazard Statements: Skin Irrit. 2 H315 , Aquatic Chronic 1 H410 , Aquatic Acute 1 H400 , Skin Sens. 1 H317 , Carc. 2 H351 , STOT SE 3 H335 , Eye Irrit. 2 H319 , Acute Tox. 4 H302

• **anthracene** (EC Number: 204-371-1, CAS Number: 120-12-7)

Description/Comments: Data from C&L Inventory Database
 Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>
 Data source date: 17 Jul 2015
 Hazard Statements: Aquatic Chronic 1 H410 , Aquatic Acute 1 H400 , Skin Sens. 1 H317 , Skin Irrit. 2 H315 , STOT SE 3 H335 , Eye Irrit. 2 H319

• **fluoranthene** (EC Number: 205-912-4, CAS Number: 206-44-0)

Description/Comments: Data from C&L Inventory Database
 Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>
 Data source date: 21 Aug 2015
 Hazard Statements: Aquatic Chronic 1 H410 , Aquatic Acute 1 H400 , Acute Tox. 4 H302

• **pyrene** (EC Number: 204-927-3, CAS Number: 129-00-0)

Description/Comments: Data from C&L Inventory Database; SDS Sigma Aldrich 2014
 Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>
 Data source date: 21 Aug 2015
 Hazard Statements: Aquatic Chronic 1 H410 , Aquatic Acute 1 H400 , STOT SE 3 H335 , Eye Irrit. 2 H319 , Skin Irrit. 2 H315

• **indeno[123-cd]pyrene** (EC Number: 205-893-2, CAS Number: 193-39-5)

Description/Comments: Data from C&L Inventory Database
 Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>
 Data source date: 06 Aug 2015
 Hazard Statements: Carc. 2 H351

• **benzo[ghi]perylene** (EC Number: 205-883-8, CAS Number: 191-24-2)

Description/Comments: Data from C&L Inventory Database; SDS Sigma Aldrich 28/02/2015
 Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>
 Data source date: 23 Jul 2015
 Hazard Statements: Aquatic Chronic 1 H410 , Aquatic Acute 1 H400

• **polychlorobiphenyls; PCB** (EC Number: 215-648-1, CAS Number: 1336-36-3)

CLP index number: 602-039-00-4
 Description/Comments: Worst Case: IARC considers PCB Group 1; Carcinogenic to humans; POP specific threshold from ATP1 (Regulation 756/2010/EU) to POPs Regulation (Regulation 850/2004/EC). Where applicable, the calculation method laid down in European standards EN 12766-1 and EN 12766-2 shall be applied.
 Data source: Regulation 1272/2008/EC - Classification, labelling and packaging of substances and mixtures. (CLP)
 Additional Hazard Statement(s): Carc. 1A H350
 Reason for additional Hazards Statement(s)/Risk Phrase(s):
 29 Sep 2015 - Carc. 1A H350 hazard statement sourced from: IARC Group 1 (23, Sup 7, 100C) 2012

Appendix B: Rationale for selection of metal species

arsenic {arsenic trioxide}

Reasonable case CLP species based on hazard statements/molecular weight and most common (stable) oxide of arsenic. Industrial sources include: smelting; main precursor to other arsenic compounds (edit as required)

boron {diboron trioxide; boric oxide}

Reasonable case CLP species based on hazard statements/ molecular weight, physical form and low solubility. Industrial sources include: fluxing agent for glass/enamels; additive for fibre optics, borosilicate glass (edit as required)

cadmium {cadmium oxide}

Reasonable case CLP species based on hazard statements/molecular weight, very low solubility in water. Industrial sources include: electroplating baths, electrodes for storage batteries, catalysts, ceramic glazes, phosphors, pigments and nematocides. (edit as required) Worst case compounds in CLP: cadmium sulphate, chloride, fluoride & iodide not expected as either very soluble and/or compound's industrial usage not related to site history (edit as required)

chromium in chromium(III) compounds {chromium(III) oxide}

Reasonable case species based on hazard statements/molecular weight. Industrial sources include: tanning, pigment in paint, inks and glass (edit as required)

chromium in chromium(VI) compounds {chromium(VI) oxide}

Worst case CLP species based on hazard statements/molecular weight. Industrial sources include: production stainless steel, electroplating, wood preservation, anti-corrosion agents or coatings, pigments (edit as required)

copper {dicopper oxide; copper (I) oxide}

Reasonable case CLP species based on hazard statements/molecular weight and insolubility in water. Industrial sources include: oxidised copper metal, brake pads, pigments, antifouling paints, fungicide. (edit as required) Worst case copper sulphate is very soluble and likely to have been leached away if ever present and/or not enough soluble sulphate detected. (edit as required)

lead {lead chromate}

Worst case CLP species based on hazard statements/molecular weight (edit as required)

mercury {mercury dichloride}

Worst case CLP species based on hazard statements/molecular weight (edit as required)

nickel {nickel sulfate}

No Cr VI present to form compounds.

selenium {selenium compounds with the exception of cadmium sulposelenide and those specified elsewhere in this Annex}

Harmonised group entry used as most reasonable case. Pigment cadmium sulposelenide not likely to be present in this soil. No evidence for the other CLP entries: sodium selenite, nickel II selenite and nickel selenide, to be present in this soil. (edit as required)

zinc {zinc sulphate}

No Cr VI present to form compounds.

cyanides {salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex}

Harmonised group entry used as most reasonable case as complex cyanides and those specified elsewhere in the annex are not likely to be present in this soil: [Note conversion factor based on a worst case compound: sodium cyanide] (edit as required)

Appendix C: Version

HazWasteOnline Classification Engine: **WM3 1st Edition v1.1, May 2018**

HazWasteOnline Classification Engine Version: 2019.316.4053.8153 (12 Nov 2019)

HazWasteOnline Database: 2019.316.4053.8153 (12 Nov 2019)

This classification utilises the following guidance and legislation:

WM3 v1.1 - Waste Classification - 1st Edition v1.1 - May 2018

CLP Regulation - Regulation 1272/2008/EC of 16 December 2008

1st ATP - Regulation 790/2009/EC of 10 August 2009

2nd ATP - Regulation 286/2011/EC of 10 March 2011

3rd ATP - Regulation 618/2012/EU of 10 July 2012

4th ATP - Regulation 487/2013/EU of 8 May 2013

Correction to 1st ATP - Regulation 758/2013/EU of 7 August 2013

5th ATP - Regulation 944/2013/EU of 2 October 2013

6th ATP - Regulation 605/2014/EU of 5 June 2014

WFD Annex III replacement - Regulation 1357/2014/EU of 18 December 2014

Revised List of Wastes 2014 - Decision 2014/955/EU of 18 December 2014

7th ATP - Regulation 2015/1221/EU of 24 July 2015

8th ATP - Regulation (EU) 2016/918 of 19 May 2016

9th ATP - Regulation (EU) 2016/1179 of 19 July 2016

10th ATP - Regulation (EU) 2017/776 of 4 May 2017

HP14 amendment - Regulation (EU) 2017/997 of 8 June 2017

13th ATP - Regulation (EU) 2018/1480 of 4 October 2018

POPs Regulation 2004 - Regulation 850/2004/EC of 29 April 2004

1st ATP to POPs Regulation - Regulation 756/2010/EU of 24 August 2010

2nd ATP to POPs Regulation - Regulation 757/2010/EU of 24 August 2010

APPENDIX 5
DESIGN CONSIDERATIONS

APPENDIX 5

GUIDELINES FOR THE DESIGN OF PILES

FIRST APPROXIMATION OF WORKING LOAD

A5.1 GENERAL

The ultimate carrying capacity, Q_u , of a particular pile is taken as the sum of the ultimate shaft friction resistance, Q_s , and the ultimate end bearing resistance, Q_b . This may be expressed as follows:-

$$\begin{aligned} Q_u &= Q_s + Q_b \\ &= f.A_s + q.A_b \end{aligned}$$

where f = unit shaft resistance
 A_s = embedded surface area of pile
 q = unit end bearing resistance
 A_b = effective cross-sectional area of pile base

A5.2 COHESIVE SOILS

A5.2.1 Shaft Resistance

The ultimate shaft resistance, f , for piles in both compression or tension in cohesive soils is determined by applying a factor to the undrained shear strength, C_s , which exists in the soils along the embedded length of the pile, and is given by:-

$$f = \alpha.C_s$$

Where α is an adhesion factor, which for straight-shafted bored piles may be taken as 0.45 to 0.60.

Ultimate unit shaft friction should not exceed 100kPa.

A5.2.2 End Bearing

For piles terminating in cohesive soils, the ultimate unit end bearing resistance q , is given by:-

$$q = N_c.C_b$$

where C_b is the undrained shear strength at the base of the pile
and N_c is a bearing capacity factor

The value of N_c for a cohesive material is variable, depending on the depth of the penetration of the pile into the bearing stratum. Generally, N_c could be taken to have a value of 9, except in the case of large diameter short piles where a lesser value should be used.

A5.3 COHESIONLESS SOILS

A5.3.1 Shaft Resistance

For piles driven in cohesionless soils the ultimate unit shaft resistance, f , may be calculated using the following method, which gives:-

$$f = 0.5\gamma' (D+d) K_s \tan \delta$$

where

γ'	=	average effective unit weight of soil surrounding the pile
D	=	depth to the pile toe or to the base of the granular stratum whichever is the lesser
d	=	depth to the top of the granular stratum
δ	=	angle of friction between pile and soil (see below)
K_s	=	a coefficient (see below)

VALUES OF K_s AND δ

Pile Type	δ	K_s		
		Relative Density		Tension Piles
		Low	High	
Steel	20°	0.5	1.5	0.5
Concrete	0.75 ϕ	1.0	2.0	0.5

The value of ϕ may be interpreted from standard penetration tests, see Figure A5.1.

For bored and cast-in-place piles, $\delta = 22^\circ$ and $K_s = 1$ should be used to allow for loosening of the soil during boring.

It has been found that the ultimate unit shaft resistance does not exceed 100kPa and therefore this value should not be exceeded in design.

A5.3.2 End Bearing

The unit ultimate end bearing resistance (q) of piles in cohesionless soils may be calculated as follows:-

$$q = \gamma' \cdot D \cdot N_q$$

where γ' = average effective unit weight of soil surrounding the pile

D = depth to pile toe

N_q = bearing capacity factor

Values for N_q , where piles penetrate the bearing stratum by more than five diameters, are given in Figure A5.2. In addition, the ultimate unit base resistance should not exceed a value of 11,000kPa. For bored and cast-in-place piles the value of N_q used should correspond to loose soil conditions.

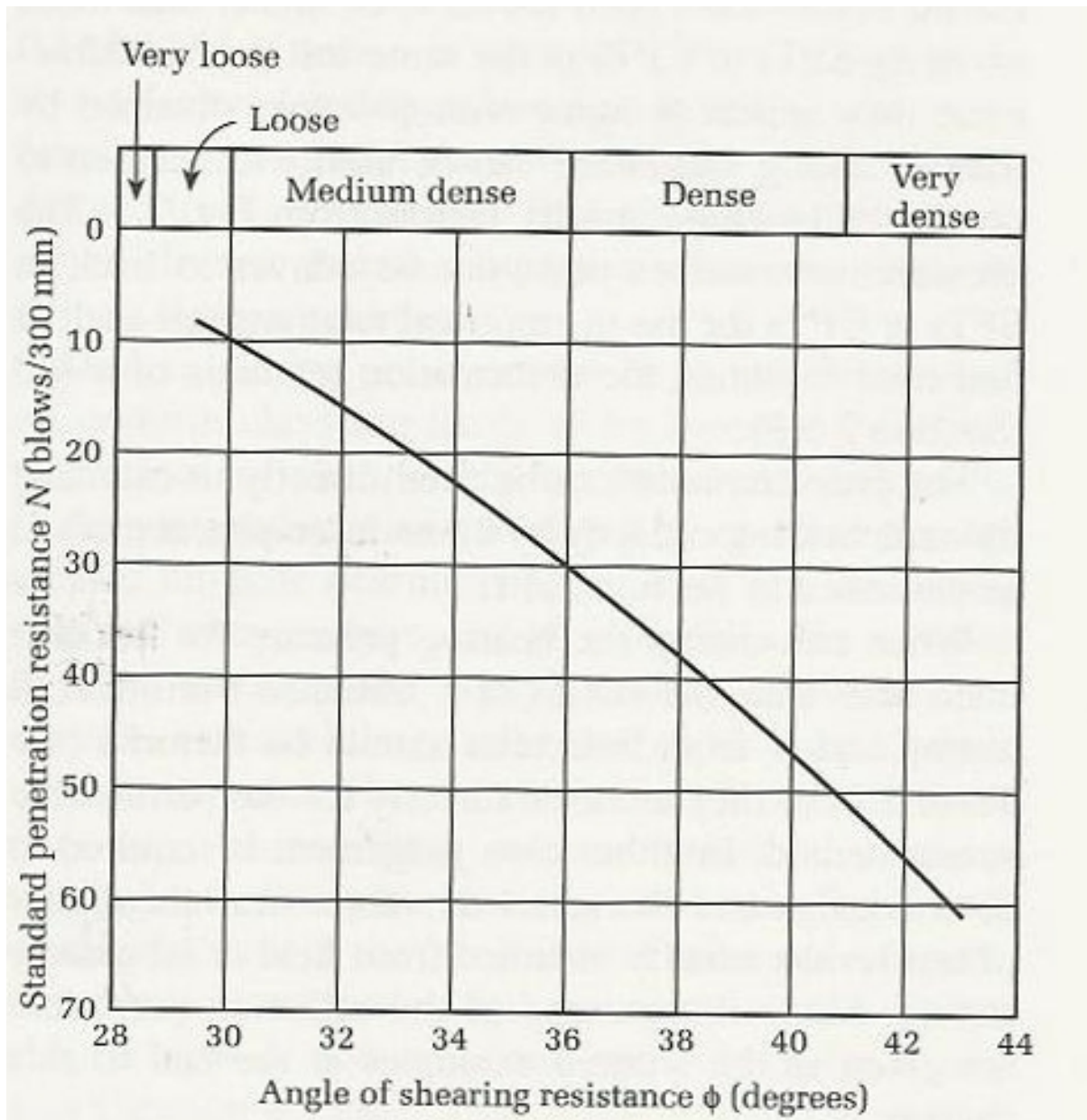
A5.4 FACTORS OF SAFETY

A5.4.1 Cohesive and Non-cohesive Soils

For cohesive and non-cohesive soils a factor of safety of 3 may be used to obtain the allowable or safe carrying capacity of piles from the ultimate carrying capacity.

Job No: 2270010

Site: Sandvik, Neath



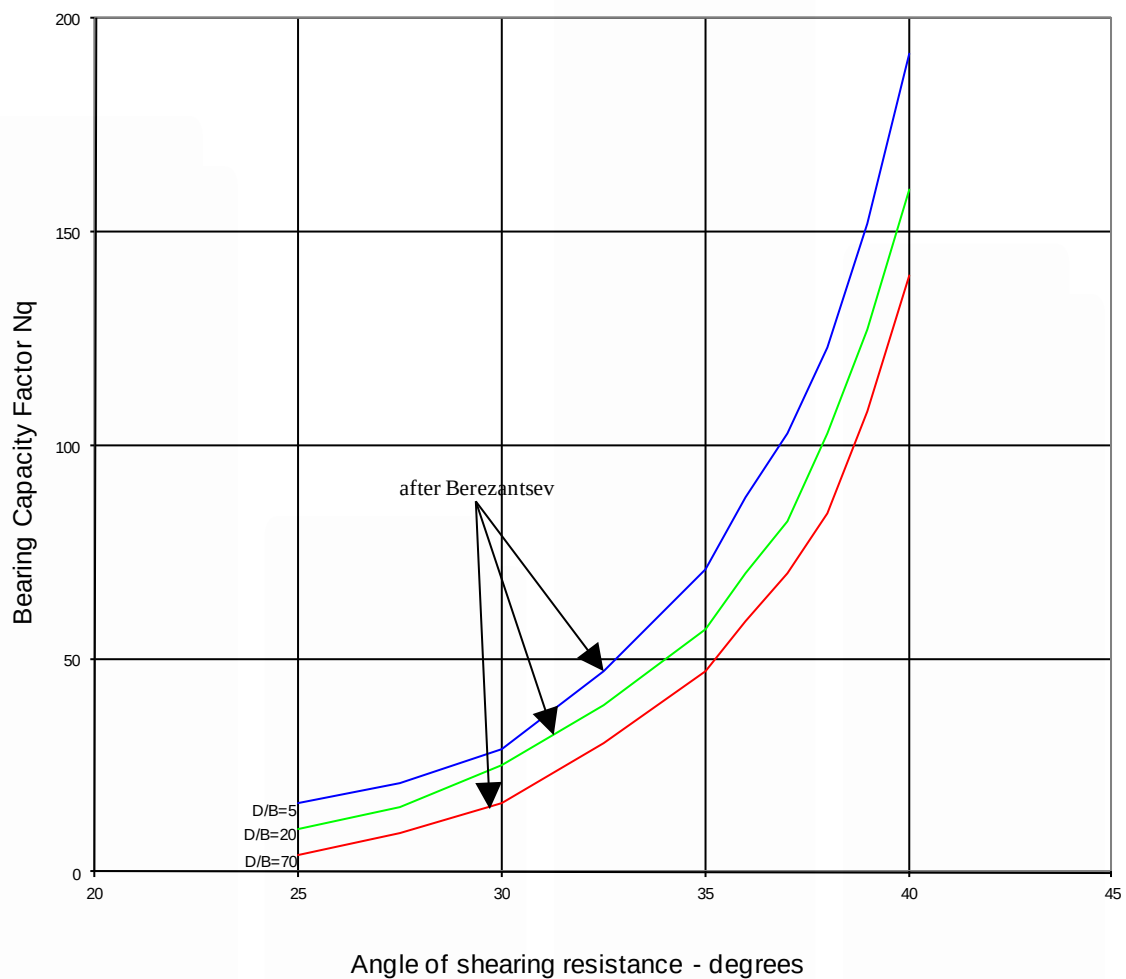
Angle of Shearing Resistance

**Figure
A5.1**



Job No: 2270010

Site: Sandvik, Neath



D = Penetration of bearing stratum
B = Pile diameter or least width

Bearing Capacity Factor

**Figure
A5.2**



APPENDIX 6
CONTAMINATION ASSESSMENT

[illegible]

APPENDIX 6

GENERAL NOTES ON CONTAMINATION ASSESSMENT

A6.1 STATUTORY FRAMEWORK AND DEFINITIONS

A6.1.1 The statutory definition of contaminated land is defined in the Environmental Protection Act 1990, ref. 10.9, which was introduced by the Environment Act 1995, ref. 10.10;

‘Land which appears to the local authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that –

(a) significant harm is being caused or there is a significant possibility of such harm being caused; or

(b) pollution of controlled waters is being, or is likely to be, caused.’

A6.1.2 The UK guidance on the assessment of contaminated has developed as a direct result of the introduction of these two Acts. The technical guidance supporting the new legislation has been summarised in a number of key documents collectively known as the Contaminated Land Reports (CLRs), a proposed series of twelve documents. Seven were originally published in March 1994, four more were published in April 2002, while the last remaining guidance document, CLR 11, ref. 10.24 was published in 2004. In 2008 CLR reports 7 to 10 were withdrawn by DEFRA and the Environment Agency and updated version of CLR 9 and 10 were produced in the form of Science Reports SR2, ref. 10.17 and SR3, ref. 10.11.

A6.1.3 In establishing whether a site fulfils the statutory definition of ‘contaminated land’ it is necessary to identify, whether a pollutant linkage exists in respect of the land in question and whether the pollutant linkage:

- is resulting in significant harm being caused to the receptor in the pollutant linkage,
- presents a significant possibility of significant harm being caused to that receptor,
- is resulting in the pollution of the controlled waters which constitute the receptor, or
- is likely to result in such pollution.

A6.1.4 A ‘pollutant linkage’ may be defined as the link between a contaminant ‘source’ and a ‘receptor’ by means of a ‘pathway’.

A6.2 ASSESSMENT METHODOLOGY

A6.2.1 The guidance proposes a four-stage assessment process for identifying potential pollutant linkages on a site. These stages are set out in the table below:

No.	Process	Description
1	Hazard Identification	Establishing contaminant sources, pathways and receptors (the conceptual model).
2	Hazard Assessment	Analysing the potential for unacceptable risks (what linkages could be present, what could be the effects).
3	Risk Estimation	Trying to establish the magnitude and probability of the possible consequences (what degree of harm might result and to what receptors, and how likely is it).
4	Risk Evaluation	Deciding whether the risk is unacceptable.

- A6.2.2 Stages 1 and 2 develop a '*conceptual model*' based upon information collated from desk based studies, and frequently a walkover of the site. The walkover survey should be conducted in general accordance with CLR 2, ref. 10.28. The formation of a conceptual model is an iterative process and as such, it should be updated and refined throughout each stage of the project to reflect any additional information obtained.
- A6.2.3 The extent of the desk studies and enquiries to be conducted should be in general accordance with CLR 3, ref. 10.29. The information from these enquiries is presented in a desk study report with recommendations, if necessary, for further work based upon the conceptual model. CLR 8, ref. 10.30, together with specific DoE 'Industry Profiles' provides guidance on the nature of contaminants relating to specific industrial processes. Although CLR 8 has been withdrawn, no replacement guidance has been published that lists the contaminants likely to be present on contaminated sites and as such the guidance relating to this issue of CLR 8 is considered to still be relevant.
- A6.2.4 If potential pollutant linkages are identified within the conceptual model, a Phase 2 site investigation and report will be recommended. The investigation should be planned in general accordance with CLR 4, ref. 10.1. The number of exploratory holes and samples collected for analysis should be consistent with the size of the site and the level of risk envisaged. This will enable a contamination risk assessment to be conducted, at which point the conceptual model can be updated and relevant pollutant linkages can be identified.
- A6.2.5 A two-stage investigation may be more appropriate where time constraints are less of an issue. The first stage investigation being conducted as an initial assessment for the presence of potential sources, a second being a more refined investigation to delineate wherever possible the extent of the identified contamination.
- A6.2.6 All site works should be in general accordance with the British Standards, BS 5930:1999, ref. 10.3, ISO 1997, ref. 10.4 and BS 10175:2001, ref. 10.2.
- A6.2.7 The generic contamination risk assessment screens the results of the chemical analysis against generic guidance values which are dependent on the proposed end-use of the development.
- A6.2.8 The end-use may be defined as one of the following ref. 10.15;
- Residential with homegrown produce – domestic low rise and low density housing with gardens where vegetable may be grown for home consumption
 - Residential without homegrown produce – domestic low density and low density housing where no gardens are present.
 - Allotments – specific areas where vegetables are grown for home consumption.
 - Public open space in close proximity to residential housing – includes the predominantly grassed area adjacent to high density housing and the central green area around which houses are developed. This land-use includes the smaller areas commonly incorporated in newer developments as informal grassed areas or more formal landscaped areas with a mixture of open space and covered soil with planting.

- Public open space in use as general parkland – provided for recreational use and may be used for family visits and picnics, children’s play area, sports grounds and dog walking.
- Commercial – industrial premises where there is limited exposure to soil.

A6.2.9 Exposure pathways for each type of end-use are given below:

Standard Land Use	Oral Routes			Dermal Routes		Inhalation Routes			
	Direct soil & dust ingestion	Consumption of homegrown produce	Soil attached to homegrown produce	Indoor	Outdoor	Indoor dust	Outdoor dust	Indoor vapour	Outdoor vapour
Residential with homegrown produce	✓	✓	✓	✓	✓	✓	✓	✓	✓
Residential without homegrown produce	✓	X	X	✓	✓	✓	✓	✓	✓
Allotments	✓	✓	✓	X	✓	X	✓	✓	✓
Public open space – adjacent to dwellings	✓	X	X	✓	✓	✓	✓	X	✓
Public open space – parkland	✓	X	X	X	✓	X	✓	X	✓
Commercial	✓	X	X	✓	X	✓	X	✓	X

A6.2.10 Soils will be compared to Suitable 4 Use Levels (S4ULs) published by LQM ref. 10.13 Assessment Criteria. However, no S4UL has been produced for lead and, therefore, the DEFRA C4SL has been adopted ref. 10.15. Where no S4UL or C4SL is available, the assessment criteria (AC) are generated using the Contaminated Land Exposure Assessment (CLEA) Software Version 1.071, ref. 10.14. Toxicological and physico-chemical/fate and transport data used to generate the AC has been derived from a hierarchy of data sources as follows:

1. Environment Agency or Department of Environment Food and Rural Affairs (DEFRA) documents;
2. Other documents produced by UK Government or state organisations;
3. European institution documents;
4. International organisation documents;
5. Foreign government institutions.

A6.2.11 In the case of the majority of contaminants considered, the toxicological data has been drawn from the relevant CLR 9 TOX report, or updated toxicological data published by the Environment Agency (2009), ref. 10.12, where available. Where no TOX report is available reference has been made to the health criteria values, derived for use in Land Quality Press (2006), ref. 10.18, as this is considered to represent a peer reviewed data source. Similarly, fate and transport data has been derived in the first instance from Environment Agency (2003), ref. 10.31 and for contaminants not considered in this document the fate and transport data used in previous versions of the CLEA model has been used.

- A6.2.12 Chemical laboratory test results are processed as follows. Analysis of the results is conducted, as detailed in CIEH and CL:AIRE 'Guidance on Comparing Soil Contamination Data with a Critical Concentration', ref. 10.13. Individual concentrations are compared to the selected guideline values to identify concentrations of contaminants that are above the selected screening criteria.
- A6.2.13 Where the risk estimation identifies significant concentrations of one or more contaminants, a further risk evaluation needs to be undertaken.
- A6.2.14 The risk evaluation will address the potential pollutant linkages between an identified source of contamination and the likely receptors both on and off site.
- A6.2.15 The potential receptors include:
- 1) Humans – current site occupants, construction workers, future site users and neighbouring site users.
 - 2) Controlled Waters – surface water and groundwater resources
 - 3) Plants – current and future site vegetation
 - 4) Building materials
- A6.2.16 The potential hazards to be considered in relation to contamination are:
- a) Ingestion and inhalation.
 - b) Uptake of contaminants via cultivated vegetables.
 - c) Dermal contact
 - d) Phytotoxicity (the prevention or inhibition of plant growth)
 - e) Contamination of water resources
 - f) Chemical attack on building materials and services
 - g) Fire and explosion
- A6.2.17 Dependent on the outcome of the initial, generic contamination risk assessment, further detailed assessment of the identified risks may be required.

A6.3 Generic Guidance Values Used Within Contamination Risk Assessment

Commercial End Use

Commercial	Determinant	Guidance Value (mg/kg)	Guidance Value (mg/kg)	Guidance Value (mg/kg)	Primary Data Source
		1% SOM	2.5% SOM	6% SOM	
PAH	Acenaphthene	84000	97000	100000	LQM/CIEH S4UL
	Acenaphthylene	83000	97000	100000	LQM/CIEH S4UL
	Anthracene	520000	540000	540000	LQM/CIEH S4UL
	Benzo(a)anthracene	170	170	180	LQM/CIEH S4UL
	Benzo(a)pyrene	35	35	36	LQM/CIEH S4UL
	Benzo(b)fluoranthene	44	44	45	LQM/CIEH S4UL
	Benzo(ghi)perylene	3900	4000	4000	LQM/CIEH S4UL
	Benzo(k)fluoranthene	1200	1200	1200	LQM/CIEH S4UL
	Chrysene	350	350	350	LQM/CIEH S4UL
	Dibenzo(ah)anthracene	3.5	3.6	3.6	LQM/CIEH S4UL
	Fluoranthene	23000	23000	23000	LQM/CIEH S4UL
	Fluorene	63000	68000	71000	LQM/CIEH S4UL
	Indeno(123-cd)pyrene	500	510	510	LQM/CIEH S4UL
	Naphthalene	190	460	1100	LQM/CIEH S4UL
	Phenanthrene	22000	22000	23000	LQM/CIEH S4UL
	Pyrene	54000	54000	54000	LQM/CIEH S4UL
Other Organics	Phenol	760	1500	3200	LQM/CIEH S4UL
Metals	Arsenic	640	640	640	LQM/CIEH S4UL
	Beryllium	12	12	12	LQM/CIEH S4UL
	Boron	240000	240000	240000	LQM/CIEH S4UL
	Cadmium	190	190	190	LQM/CIEH S4UL
	Chromium (III)	8600	8600	8600	LQM/CIEH S4UL
	Chromium (VI)	49	49	49	LQM/CIEH S4UL
	Copper	68000	68000	68000	LQM/CIEH S4UL
	Lead	2330	2330	2330	DEFRA C4SL
	Mercury	58	58	58	LQM/CIEH S4UL
	Nickel	980	980	980	LQM/CIEH S4UL
	Selenium	12000	12000	12000	LQM/CIEH S4UL
	Vanadium	9000	9000	9000	LQM/CIEH S4UL
	Zinc	730000	730000	730000	LQM/CIEH S4UL

Commercial	Guidance Value (mg/kg)	Guidance Value (mg/kg)	Guidance Value (mg/kg)	Primary Data Source
	1% SOM	2.5% SOM	6% SOM	
Aliphatic				
EC 5-6	3200 (304)	5900 (558)	12000 (1150)	LQM/CIEH S4UL
EC >6-8	7800 (144)	17000 (322)	40000 (736)	LQM/CIEH S4UL
EC >8-10	2000 (78)	4800 (190)	11000 (451)	LQM/CIEH S4UL
EC >10-12	9700 (48)	23000 (118)	47000 (283)	LQM/CIEH S4UL
EC >12-16	59000 (24)	82000 (59)	90000 (142)	LQM/CIEH S4UL
EC >16-35	1600000	1700000	1800000	LQM/CIEH S4UL
EC >35-44	1600000	1700000	1800000	LQM/CIEH S4UL
Aromatic				
EC 5-7 (benzene)	26000 (1220)	46000 (2260)	86000 (4710)	LQM/CIEH S4UL
EC >7-8 (toluene)	56000 (869)	110000 (1920)	180000 (4360)	LQM/CIEH S4UL
EC >8-10	3500 (613)	8100 (1500)	17000 (3580)	LQM/CIEH S4UL
EC >10-12	16000 (364)	28000 (899)	34000 (2150)	LQM/CIEH S4UL
EC >12-16	36000 (169)	37000	38000	LQM/CIEH S4UL
EC >16-21	28000	28000	28000	LQM/CIEH S4UL
EC >21-35	28000	8000	28000	LQM/CIEH S4UL
EC >35-44	28000	28000	28000	LQM/CIEH S4UL
Aliphatic and Aromatic				
EC >44-70	28000	28000	28000	LQM/CIEH S4UL
BTEX				
Benzene	27	47	90	LQM/CIEH S4UL
Toluene	56000	110000	180000	LQM/CIEH S4UL
Ethylbenzene	5700	13000	27000	LQM/CIEH S4UL
m/p Xylenes	5900	14000	30000	LQM/CIEH S4UL
o Xylene	17000	24000	33000	LQM/CIEH S4UL

SOM = Soil Organic Matter

Values in brackets indicate the vapour saturation limit where this is exceeded by the GAC or SGV

APPENDIX 7
GAS GENERATION

APPENDIX 7

GENERAL NOTES ON GAS GENERATION

A7.1 GENERAL

- A7.1.1 In the past, a series of guidance documents were published by CIRIA, ref. 10.32, providing advice on hazards associated with methane. This earlier guidance was consolidated in CIRIA Document C659 to provide a risk based approach to gas contaminated land. This was subsequently re-issued as CIRIA Document C665, ref. 10.33. In 2015, British Standard, BS8485, ref. 10.34, dealing with ground gas was published. It is recommended that guidance in C665 and BS8485 is adopted to provide a consistent approach in dealing with ground gas contamination, the principal details being as follows.
- A7.1.2 This guidance is based on a similar approach to that for dealing with contaminated soil. The presence of hazardous gases could be deemed to be the 'source' in a 'pollutant linkage' that could lead to the conclusion that significant harm is or could be caused to people, buildings or the environment. In such circumstances the land could be deemed 'contaminated', ref. 10.9.
- A7.1.3 Should a potential source of gas be identified in the conceptual model, a gas risk assessment should be carried out, sufficient to demonstrate to the local authority that the proposals mitigate any hazards associated with ground gas. The authority enforces compliance with Approved Document Part C of the Building Regulations, ref. 10.35.
- A7.1.4 The following is a summary of the key points from the guidance and should not be taken in isolation, thus a full understanding can only be made by reading the guidance documents in full.

A7.2 APPROACH

- A7.2.1 A flow chart detailing the approach to assessing and characterising a site is given in BS8485, Figure 3. This may be summarised as follows.
- Undertake Preliminary Investigation (desk study and site reconnaissance);
 - Develop Conceptual Site Model (CSM);
 - Design and undertake Ground Investigation;
 - Refine CSM;
 - Calculate hazardous gas flow rate for methane and carbon dioxide;
 - Assess Gas Screening Value (GSV);
 - Assign Characteristic Situation (CS);
 - Design gas protective measures based on CS.

A7.3 POLLUTANT LINKAGE ASSESSMENT

- A7.3.1 A pollutant linkage assessment is presented in Appendix 3 of the Preliminary Investigation Report.
- A7.3.2 Using the risk model in the desk study, the pollutant linkage can be identified and a preliminary estimate of risk undertaken. If there is no relevant pollutant linkage identified there is no risk. If there is a very low risk, it is likely that no further assessment is required. If further assessment is necessary, then gas monitoring is required.

A7.4 SITE MONITORING

- A7.4.1 For sites with low generation potential, giving consistently low concentrations of soil gas under the worst-case conditions, a limited programme of monitoring would be appropriate. Where high or variable concentrations are anticipated or recorded, an extended programme of monitoring would be appropriate. The following guideline has been proposed, ref. 10.37.

Table A7.1

Sensitivity of development		Generation potential of source				
		Very low	Low	Moderate	High	Very high
	Low (Commercial)	4/1	6/2	6/3	12/6	12/12
	Moderate (Flats)	6/2	6/3	9/6	12/12	24/24
	High (Residential with gardens)	6/3*	9/6	12/6	24/12	24/24

Notes

1. First number is minimum number of readings and second number is minimum period in months, for example 4/1 – Four sets of readings over 1 month.
2. At least two sets of readings must be at low and falling atmospheric pressure (but not restricted to periods below <1000mb) known as worst case conditions (see Boyle and Witherington, 2006).
3. The frequency and period stated are considered to represent typical minimum requirements. Depending on specific circumstances fewer or additional readings may be required (e.g. any such variation subject to site specific justification). * The NHBC guidance is also recommending these periods/frequency of monitoring (Boyle and Witherington, 2006)
4. Historical data can be used as part of the data set.
5. Not all sites will require gas monitoring however, this would need to be confirmed with demonstrable evidence.
6. Placing high sensitivity end use on a high hazard site is not normally acceptable unless the source is removed or treated to reduce its gassing potential. Under such circumstances long-term monitoring may not be appropriate or required.

- A7.4.2 Before taking any readings, zero the instrument, record atmospheric pressure and temperature.
- A7.4.3 Gas flow should be recorded, giving the range of pressures, ensuring positive or negative flow is recorded.
- A7.4.4 Record gas levels, recording peak and steady. Where steady state not obtained within 3 minutes, record change in concentration, where concentrations are decreasing, always record peak value. For very high concentrations, record for longer period of up to 10 minutes.

A7.5 ASSESSMENT OF RISK AND RECOMMENDATIONS

- A7.5.1 The main method of characterising a site is the method described by Wilson and Card, ref. 10.38 and is termed Situation A. This can be used for all types of development except conventional low-rise housing with suspended ground floor and ventilated underfloor void.
- A7.5.2 Low rise housing, Situation B, was developed by Boyle and Witherington, ref. 10.39 and was developed for the NHBC for classifying gassing sites for houses with suspended ground floor slab with ventilated void.
- A7.5.3 Although the Code of Practice, ref. 10.34, assesses the characteristic gas situation as CIRIA recommend for Situation A, see Table A7.2 below, their solution for gas protection systems is different, see section A7.10.

A7.6 SITUATION A - ASSESSMENT

- A7.6.1 This system proposed by Wilson and Card, ref. 10.38 was originally developed in CIRIA Report 149, ref. 10.32.
- A7.6.2 The method uses both gas concentrations and borehole flow rate for methane and carbon dioxide to define a Characteristic Situation for a site.
- A7.6.3 Gas Screening Value (litre/hr) = borehole flow rate (litre/hr) x (gas concentration (%))/100. The GSV is determined for methane and carbon dioxide and the worst case adopted. The Characteristic Situation can then be determined from the table below. The GSV can be exceeded if the conceptual model indicates it is safe to do so, and other factors may lead to a change in the Characteristic Situation.
- A7.6.4 This method of site characterisation is also given in BS8485, ref. 10.34, and is summarised below.

Table A7.2

Characteristic Situation	Risk Classification	Gas screening value (CH ₄ or CO ₂ (1/hr) ¹	Additional factors	Typical source of generation
1	Very low risk	<0.07	Typically methane ≤1% and/or carbon dioxide ≤5%. Otherwise consider increase to Situation 2	Natural soils with low organic content “Typical” Made Ground
2	Low risk	<0.7	Borehole air flow rate not to exceed 70l/hr. Otherwise consider increase to Characteristic Situation 3	Natural soil, high peat/organic content. “Typical” Made Ground
3	Moderate risk	<3.5		Old landfill, inert waste, mineworking flooded
4	Moderate to high risk	<15	Quantitative risk assessment required to evaluate scope of protective measures	Mineworking – susceptible to flooding, completed landfill (WMP 26B criteria)
5	High risk	<70		Mineworking unflooded inactive with shallow workings near surface
6	Very high risk	>70		Recent landfill site

Notes

1. Site characterisation should be based on gas monitoring of concentrations and borehole flow rates for the minimum periods defined in Table A7.1
2. Source of gas and generation potential/performance must be identified.
3. If there is no detectable flow use the limit of detection of the instrument.

A7.7 SITUATION A – SOLUTION

A7.7.1 Appropriate gas protection measures should be selected based on the CS and building type, which are used to produce a minimum level of gas protection (score) in the range 0 to 7.5, as summarised in the following tables, ref. 10.34.

A7.7.2 Guidance on radon and VOCs is given in Annex G and Annex H of BS8485.

A7.7.3 When the minimum gas protection score has been determined for the building as a whole, or for each part of the building, then a combination of two or more of the following three types of protection measures should be used to achieve that score.

- The structural barrier of the floor slab, or of the basement slab and walls if a basement is present;
- Ventilation measures; and
- Gas resistant membrane.

Table A7.3

	Building Types			
	Type A	Type B	Type C	Type D
Ownership	Private	Private or commercial/ public, possible multiple	Commercial/public	Commercial/ industrial
Control (change of use, structural alterations, ventilation)	None	Some but not all	Full	Full
Room sizes	Small	Small/ medium	Small to large	Large industrial/ retail park style

Table A7.4

CS	Minimum Gas Protection Score (Points)			
	High Risk	Medium Risk		Low Risk
	Type A Building	Type B Building	Type C Building	Type D Building
1	0	0	0	0
2	3.5	3.5	2.5	1.5
3	4.5	4	3	2.5
4	6.5 ^A	5.5 ^A	4.5	3.5
5	— ^B	6.5 ^A	5.5	4.5
6	— ^B	— ^B	7.5	6.5

^A Residential buildings should not be built on CS4 or higher sites unless the type of construction or site circumstances allow additional levels of protection to be incorporated, e.g. high-performance ventilation or pathway intervention measures, and an associated sustainable system of management of maintenance of the gas control system, e.g. in institutional and/or fully serviced contractual situations.

^B The gas hazard is too high for this empirical method to be used to define the gas protection measures.

A7.7.4 Having determined the minimum gas protection score for the building, or each different part of the building, the element or combination of elements to achieve that required score should be chosen from those listed in the guidance, ref. 10.34, Table 5, Table 6 and Table 7. No more than one element from each type/table should be combined to achieve the recommended gas protection score.

A7.7.5 Details of the acceptable measures and corresponding scores are given in BS8485, ref. 10.34, which should be referred to for completion of the assessment and design.

A7.7.6 The following stages are not included within the scope of services provided by Ian Farmer Associates, however, details of the design may be included in a Remediation Method Statement (RMS) for a site.

- Detailed design;
- Implementation;
- Validation.

A7.8 SITUATION B -ASSESSMENT

- A7.8.1 The NHBC has developed a characterisation system that is similar to Situation A but is specific to low-rise housing development with a clear ventilated underfloor void. The gas emission rates are compared to generic 'Traffic Lights'.
- A7.8.2 The Traffic Lights include a Typical Maximum Concentration that is used for initial screening purposes. Where the Typical Maximum Concentration is exceeded the risk-based Gas Screening Value, GSV, should be adopted. The GSVs are determined for the 'model' low rise development and where they differ from this model, the GSV should be reassessed, ref. 10.33.
- A7.8.3 The calculations should be made for both methane and carbon dioxide, and the worst case adopted. The GSV is only a guideline.

Table A7.5

Traffic light	Methane		Carbon dioxide	
	Typical maximum concentration ² (% v/v)	Gas screening value (GSV) ³ (litres per hour)	Typical maximum concentration ² (% v/v)	Gas screening value (GSV) ^{1,2} (litres per hour)
Green				
Amber 1	1	0.16	5	0.78
Amber 2	5	0.63	10	1.56
Red	20	1.56	30	3.13

- Generic GSVs are based on guidance contained within latest revision of Department of the Environment and the Welsh Office (2004 edition) "The Building Regulations: Approved Document C" and used a sub-floor void of 150mm thickness.
- The Typical Maximum Concentrations can be exceeded in certain circumstances should the conceptual site model indicate it is safe to do so. This is where professional judgement will be required, based on a thorough understanding of the gas-regime identified at the site where monitoring in the worst temporal conditions has occurred.
- The GSV thresholds should not generally be exceeded without completion of a detailed gas risk assessment taking into account site-specific conditions.

A7.9 SITUATION B – SOLUTION

A7.9.1 On the basis of this Traffic Light classification the following protection should be applied to low-rise housing.

Table A7.6

Traffic Light Classification	Protection measures required
Green	Negligible gas regime identified and gas protection measures are not considered necessary.
Amber 1	Low to intermediate gas regime identified, which requires low-level gas protection measures, comprising a membrane and ventilated sub-floor void to create a permeability contrast to limit the ingress of gas into buildings. Gas protection measures should be as prescribed in BRE Report 414. Ventilation of the sub-floor void should facilitate a minimum of one complete volume change per 24 hours.
Amber 2	Intermediate to high gas regime identified, which requires high-level gas protection measures, comprising a membrane and ventilated sub-floor void to create a permeability contrast to prevent the ingress of gas into buildings. Gas protection measures should be as prescribed in BRE Report 414. A specialist contractor should always fit membranes. As with Amber 1, ventilation of the sub-floor void should facilitate a minimum of one complete volume change per 24 hours. Certification that these passive protection measures have been installed correctly should be provided.
Red	High gas regime identified. It is considered that standard residential housing would not normally be acceptable without a further Gas Risk Assessment and/or possible remedial mitigation measures to reduce and/or remove the source of gas.

A7.10 CODE OF PRACTICE – SOLUTIONS

- A7.10.1 The Characteristic Gas Situation is determined in a similar manner to that recommended by CIRIA, see Table A7.2 above.
- A7.10.2 Having selected the Characteristic Gas Situation, the appropriate gas protection could be selected for the building. The tables below give a guide as to the relative performance of the various designs and systems.
- A7.10.3 A guidance value for the required gas protection, in the range 0 to 7 should be obtained from Table A7.7 below. Then, a combination of ventilation and/or barrier system should be chosen from Table A7.8 to meet that requirement.

Table A7.7

Characteristic gas situation, CS	NHBC traffic light	Required gas protection			
		Non-managed property, e.g. private housing	Public building ^{A)}	Commercial buildings	Industrial buildings ^{B)}
1	Green	0	0	0	0
2	Amber 1	3	3	2	1 ^{C)}
3	Amber 2	4	3	2	2
4	Red	6 ^{D)}	5 ^{D)}	4	3
			6 ^{E)}	5	4
				7	6

NOTE: Traffic light indications are taken from NHBC Report no.: 10627-R01 (04) [3] and are mainly applicable to low-rise residential housing. These are for comparative purposes but the boundaries between the traffic light indications and CS values do not coincide.

A) Public buildings include, for example, managed apartments, schools and hospitals.

B) Industrial buildings are generally open and well ventilated. However, areas such as office pods might require a separate assessment and may be classified as commercial buildings and require a different scope of gas protection to the main building.

C) Maximum methane concentration 20% otherwise consider an increase to CS3.

D) Residential building on higher traffic light/CS sites is not recommended unless the type of construction or site circumstances allow additional levels of protection to be incorporated, e.g. high-performance ventilation or pathway intervention measures, and an associated sustainable system of management of maintenance of the gas control system, e.g. in institutional and/or fully serviced contractual situations.

E) Consideration of issues such as ease of evacuation and how false alarms will be handled are needed when completing the design specification of any protection scheme.

A7.10.4 Having determined the appropriate guidance value from Table A7.7, an element or combination of elements from a), b), c) or d) in Table A7.8, should be chosen to achieve the required level of protection.

Table A7.8

PROTECTION ELEMENT/SYSTEM		SCORE	COMMENTS
a) Venting/dilution			
Passive sub floor ventilation (venting layer can be a clear void or formed using gravel, geocomposites, polystyrene void formers, etc.) ^{A)}	Very good performance	2.5	<i>Ventilation performance in accordance with Annex A, ref. 10.34</i>
	Good performance	1	<i>If passive ventilation is poor this is generally unacceptable and some form of active system will be required</i>
Subfloor ventilation with active abstraction/pressurization (venting layer can be a clear void or formed using gravel, geocomposites, polystyrene void formers, etc.) ^{A)}		2.5	<i>There have to be robust management systems in place to ensure the continued maintenance of any ventilation system. Active ventilation can always be designed to meet good performance. Mechanically assisted systems come in two main forms: extraction and positive pressurization.</i>
Ventilated car park (basement or undercroft)		4	<i>Assumes car park is vented to deal with car exhaust fumes, designed to Building Regulations Document F and IstructE guidance</i>
b) Barriers			
Floor slabs			
Block and beam floor slab		0	<i>It is good practice to install ventilation in all foundation systems to effect pressure relief as a minimum. Breached in floor slabs such as joints have to be effectively sealed against gas ingress in order to maintain these performances</i>
Reinforced concrete ground bearing floor slab		0.5	
Reinforced concrete ground bearing foundation raft with limited service penetrations that are cast into slab		1.5	
Reinforced concrete cast in situ suspended slab with minimal service penetrations and water bars around all slab penetrations and at joints		1.5	
Fully tanked basement		2	

PROTECTION ELEMENT/SYSTEM		SCORE	COMMENTS
c) Membranes			
Taped and sealed membrane to reasonable levels of workmanship/in line with current good practice with validation ^{B), C)}		0.5	The performance of membranes is heavily dependent on the quality and design of the installation, resistance to damage after installation, and the integrity of joints
Proprietary gas resistant membrane to reasonable levels of workmanship/in line with current good practice under independent inspection (CQA) ^{B), C)}		1	
Proprietary gas resistant membrane installed to reasonable levels of workmanship/in line with current good practice under CQA with integrity testing and independent validation		2	
d) Monitoring and detection (not applicable to non-managed property, or in isolation)			
Intermittent monitoring using hand held equipment		0.5	Where fitted, permanent monitoring systems ought to be installed in the underfloor venting/dilution system in the first instance but can also be provided within the occupied space as a fail-safe.
Permanent monitoring and alarm system ^{A)}	Installed in the underfloor venting/dilution system	2	
	Installed in the building	1	
e) Pathway intervention			
Pathway intervention		-	This can consist of site protection measures for off-site or on-site sources (see Annex A, ref. 10.34)
NOTE: In practice the choice of materials might well rely on factors such as construction method and the risk of damage after installation. It is important to ensure that the chosen combination gives an appropriate level of protection			

A) It is possible to test ventilation systems by installing monitoring probes for post installation validation.

B) If a 1200 g DPM material is to function as a gas barrier it should be installed according to BRE 414, ref. 10.36 being taped and sealed to all penetrations.

C) Polymeric Materials >1200g can be used to improve confidence in the barrier. Remember that their gas resistance is little more than the standard 1200g (proportional to thickness) but their physical properties mean that they are more robust and resistant to site damage.