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REMEDIAL STRATEGY
AND
VERIFICATION PLAN

FOR

PROPOSED DEVELOPMENT AT
45-49 STATION ROAD, HAMPTON VILLAGE, TW12 2BU

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Report Title: **Remedial Strategy & Verification Plan for 45-49 Station Road, Hampton Village, TW12 2BU**

Report Status: **Final**

Job No: **P9086J703b/RAY**

Date: **05/05/2023**

QUALITY CONTROL – REVISIONS

Version	Date	Issued By

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1 INTRODUCTION

1.1 Terms of Reference

1.1.1 Preston Park Development Ltd ("The Client"), has commissioned Jomas Associates Ltd ('Jomas') to produce a remedial strategy prior to the development of 45-49 Station Road, Hampton Village, TW12 2BU.

1.2 Site Information

1.2.1 The site is occupied by a vehicle sales and maintenance garage, comprising 3No. interconnected buildings. A single storey showroom, a two-storey office/reception building and a single storey garage/workshop. To the front and rear are forecourt areas used for car sales and cars awaiting work in the workshop. A small outbuilding stand in the corner of the front forecourt.

1.3 Proposed Development

1.3.1 The proposed development is to comprise the demolition of the northern section of the existing single-storey car showroom to allow construction of 2No detached buildings of brick construction, forming 4No residential units with associated access and landscaping. Private garden areas are understood to be proposed.

1.4 Previous Reports

1.4.1 The previous reports that have been utilised by Jomas for the purposes of this document comprise:

- Geo-environmental & Geotechnical Assessment Report for 45 – 49 Station Road, Hampton, TW12 2BU, ref P9086J703, 23rd November 2015, Jomas Associates Ltd.
- Desk Study/Preliminary Risk Assessment Report for 45-49 Station Road, Hampton Village, TW12 2BU, ref P9086J703b, 12th March 2021, Jomas Associates Ltd.
- Geo-environmental & Geotechnical Assessment Ground Investigation Report for 45 – 49 Station Road, Hampton, TW12 2BU, ref P9086J703b, 22nd March 2023, Jomas Associates Ltd.

1.5 Background

1.5.1 Development permission has been granted by London Borough of Richmond Upon Thames with a number of conditions relating to various requirements.

1.5.2 Planning Condition DV29F of application ref 21/1841/FUL, relate to land contamination matters, as reproduced below:

Condition DV29F:

1. No development shall take place until:

   a) a desk study detailing the history of the site, hazardous materials, substances used together with details of a site investigation strategy based on the information revealed in the desk study has been submitted to and approved in writing by the local planning authority

   b) an intrusive site investigation has been carried out comprising: sampling of soil, soil vapour, ground gas, surface water and groundwater to the satisfaction of the local

planning authority. Such work to be carried out by suitably qualified and accredited geoenvironmental consultants in accordance with the current U.K. requirements for sampling and testing.

c) written reports of i) the findings of the above site investigation and ii) a risk assessment for sensitive receptors together with a detailed remediation strategy designed to mitigate the risk posed by the identified contamination to sensitive receptors have been submitted to and approved in writing by the local planning authority Note: some demolition work, if required, could be allowed beforehand for enabling the above requirement (1b), subject to the agreement of the Local Planning Authority.

2. None of the dwellings/buildings hereby approved shall be occupied until:

a) the remediation works approved as part of the remediation strategy have been carried out in full and in compliance with the approved strategy. If during the remediation or development work new areas of contamination are encountered, which have not been previously identified, then the additional contamination should be fully assessed in accordance with condition [1(b, c)] above and an adequate remediation scheme shall be submitted to and approved in writing by the local planning authority and fully implemented thereafter.

b) a verification report, produced on completion of the remediation work, has been submitted to and approved in writing by the local planning authority. Such report to include i) details of the remediation works carried out and ii) results of verification sampling, testing and monitoring and iii)all waste management documentation showing the classification of waste, its treatment, movement and disposal in order to demonstrate compliance with the approved remediation strategy.

1.5.3 Condition DV29F Part 1a) has been addressed by the above referenced Desk Study report, with the ground investigation report addressing Part 1b) and Part 1c) i).

1.5.4 The purpose of this report is to satisfy Condition DV29F Part 1c) ii) by providing a remediation strategy to bring the site into a suitable condition for the proposed end use.

1.5.5 Condition DV29F Part 2) a) and Part 2) b) will be addressed by the production of a Verification Report on completion of the works set out within this strategy.

1.6 Objectives

1.6.1 The primary objectives of this document are as follows:

- To provide information on the site setting; identify ground conditions and potential environmental risks associated with the development.
- To provide an assessment of various options for remediation.
- To set out the remediation strategy that will provide a site that is suitable for the intended use and addresses any identified unacceptable risks.
- To provide relevant information to address planning conditions relating to contaminated land. A separate verification report will be required following the implementation of the remediation strategy.

1.6.2 The primary remediation objective is the mitigation of the risks associated with lead and polycyclic aromatic hydrocarbon (PAH) impacted soils.

1.6.3 This document provides an assessment of potential remedial strategies and describes the methodology for the proposed remedial action.

1.6.4 The remediation strategy and associated remediation criteria have been developed with reference to previous works carried out at the site. The remediation criteria used to develop the proposed remediation strategy will be used for the proposed verification works.

1.6.5 The Principal Contractor will be responsible for implementing the appropriate methodology and site management procedures to achieve the required outcome and comply with these principles.

1.6.6 The works will be undertaken by experienced personnel and will be managed in accordance with the Contractor's Construction Environmental Management Plan. Detailed construction method statements will be prepared for the impacted soil removal works. Jomas will be employed as Environmental Specialist, to supervise the works and undertake soil sampling and analysis as part of the validation process.

1.6.7 This document should be read in conjunction with the above reports.

1.7 Limitations

1.7.1 Jomas Associates Ltd ('Jomas') has prepared this report for the sole use of Preston Park development Ltd, in accordance with the generally accepted consulting practices and for the intended purposes as stated in the agreement under which this work was completed. This report may not be relied upon by any other party without the explicit written agreement of Jomas. No other third party warranty, expressed or implied, is made as to the professional advice included in this report. This report must be used in its entirety.

1.7.2 This report provides an overview of conclusions drawn from previous investigations, some of which has been conducted by others. Third party information used is assumed to be correct, and Jomas has not validated any of the data provided. Jomas is unable to guarantee the accuracy of the information provided by others.

2 LAND CONTAMINATION OVERVIEW

2.1 Desk Study Findings

2.1.1 A desk study was produced for the site (Jomas, March 2021), and issued separately. A brief overview of the findings is presented below;

- A review of earliest available (1865) historical maps indicates that the study site was occupied by 2No residential-style units in the northeast of the site, with what appears to be 3No glasshouses extending west. The remainder of the site appears to form part of a large garden area at this time, which extends offsite to the south. By 1896, one of the residential units appears to have been reconfigured and an additional, L-shaped, residential-style unit had been constructed in the southwest of the site. A unit is also shown to encroach onto the site from the west at this time.
- By the map dated 1934, the configuration of the unit in the southwest of the site had altered and an additional unit is shown to encroach onto the southeast corner of the site from the south. By 1956 the site had been redeveloped and the previous buildings demolished. A large unit identified as a garage is now shown in the east of the site, extending offsite to the south. A small unit is also shown adjacent to the western site boundary at this time. Few changes occur until the map dated 1985, by which time a small rectangular feature (possible fuel pump island) is indicated in the south of the site. The small unit adjacent to the western site boundary is no longer shown. The site appears to have remained in this configuration until present, with satellite imagery ranging 1999 to 2019 indicating the area of forecourt to the west of the garage/showroom unit being utilised for vehicle storage.
- The British Geological Survey indicates that the site is directly underlain by superficial deposits of the Kempton Park Gravel Member. These superficial deposits are underlain by solid deposits of the London Clay Formation. No artificial deposits are reported within the site.
- The superficial deposits underlying the site are identified as a Principal Aquifer with the underlying solid deposits identified as Unproductive.
- A review of the EnviroInsight Report indicates that there are no source protection zones within 500m of the site.
- There are 4No groundwater abstractions reported within 2km – closest identified as an active abstraction 684m NE for general use.
- There are 5No reported surface water abstractions reported within 2km – closest identified as an active abstraction for potable water supply (storage) 512m SW.
- There are 5No reported potable water abstractions reported within 2km – closest identified as an active abstraction 512m SW for potable water supply (storage).
- The nearest detailed river entry is reported 176m southeast of the site, identified as the River Thames. There are no Environment Agency Zone 2 or 3 floodplains reported within 50m of the site.

2.2 Intrusive Investigations

2.2.1 2No separate phases of ground investigation have been undertaken at the site.

2.2.2 The initial ground investigation was undertaken on 15th October 2015, and consisted of the following:

- 5 No. window sampling boreholes (WS1-WS5), drilled up to 4.0m below ground level (bgl), with associated in situ testing and sampling;
- 3 No. gas and groundwater monitoring standpipes, extending up to 3.8m bgl;
- Laboratory analysis for chemical and geotechnical purposes.

2.2.3 The results of the ground investigation revealed a ground profile comprising a variable thickness of Made Ground (up to 1.5mbgl depth), overlying deposits of sandy gravel to gravelly sand (likely representing the Kempton Park Gravel Member). These deposits were encountered to the base of boreholes WS1 – WS4, which refused due to the density of the granular deposits. Below the granular deposits within borehole WS5 brown clay was encountered to the base of the borehole (likely representing the London Clay Formation).

2.2.4 During intrusive works groundwater was reported at a depth of 1.6mbgl within borehole WS5. Groundwater was not reported within the remaining boreholes. During return monitoring, groundwater was reported at a depth of 1.68mbgl within the monitoring well installed within borehole WS5. Groundwater was not reported within the remaining monitoring wells WS2 and WS4, although the maximum depth to which the wells extended was 2.63mbgl.

2.2.5 A supplementary ground investigation was undertaken on 14th and 15th February 2023, to further assess data gaps which remained from the previous phase of investigation, and consisted of the following:

- 3 No. cable percussive boreholes (BH1-BH3), drilled up to 10.0m below ground level (bgl), with associated in situ testing and sampling;
- 3 No. gas and groundwater monitoring standpipes, extending up to 6.0mbgl;
- Laboratory analysis for chemical and geotechnical purposes.

2.2.6 The results of the ground investigation revealed a ground profile comprising a thickness of Made Ground (up to 1.0mbgl depth), overlying deposits of sand and gravel (likely representing the Kempton Park Gravel Member). These deposits were encountered to 5.80mbgl boreholes BH1 – BH3. Below the granular deposits within borehole BH1-BH3 grey clay was encountered to the base of the borehole (likely representing the London Clay Formation).

2.2.7 During intrusive works groundwater was not reported however, water was added from 1m-5.8m bgl to aid drilling which may have masked groundwater strikes. During return monitoring, groundwater was reported at a depth of between 2.59m -2.69mbgl within the monitoring well installed within borehole BH1-BH3. The maximum depth to which the wells extended was 6.22mbgl.

2.3 Soil Gas Risk Assessment

2.3.1 Following gas monitoring undertaken across both phases of intrusive investigation, the site can be considered as Characteristic Situation 2 (CS2) in terms of the gas screening value when calculated using worst case results. Therefore, basic gas protection methods are considered necessary.

2.4 Controlled Waters Risk Assessment

2.4.1 Groundwater sampling and analysis was undertaken as part of the supplementary phase of investigation. The samples were obtained from BH1 – BH3, which were positions to triangulate the underground storage tanks present onsite.

2.4.2 PAH, total petroleum hydrocarbon, and volatile organic compounds (VOC) concentrations were reported below laboratory detection limits within each of the 3No groundwater samples analysed at the laboratory.

2.4.3 Concentrations of copper, nickel and cyanide were found to exceed environmental water quality standard.

2.4.4 It should be noted that the EQS values of copper and nickel are based on the bioavailable concentrations of these metals, rather than the total dissolved concentrations reported by the laboratory. The bioavailable concentrations of the metals would be expected to be lower than the total concentration reported.

2.4.5 With regards to cyanide, it should be noted that the laboratory results report concentrations of total cyanide, whereas the EQS value relates to free cyanide. It is likely that the concentrations of free cyanide are much lower than the reported total concentrations. In addition, no soil source of cyanide has been identified onsite through laboratory analysis (the concentrations of total cyanide reported in the 4No soil samples were <1.0mg/kg). As no specific on-site source area of cyanide has been identified, remedial action is unlikely to be effective and is not considered necessary.

2.4.6 On the basis of the above, a significant risk of impact to controlled waters posed by the soils on site was not considered to exist.

2.4.7 It was also noted that, whilst no hydrocarbon compounds have been detected in groundwater, the known underground tanks on-site will be removed as part of development operations which will remove the primary source of contamination identified by the desk study.

2.5 Human Health Risk Assessment

2.5.1 Following a review of the Site Investigation reports, the following factors are noted:

- The proposed development is to comprise the demolition of the northern section of the existing single-storey car showroom to allow construction of 2No detached buildings of brick construction, forming 4No residential units with associated access and landscaping. Private garden areas are understood to be proposed.
- Following generic risk assessments and statistical analysis, elevated concentrations of lead and a number of PAH compounds were reported within the soils onsite. These soils are not considered suitable within soft landscaped areas.
- Health and Safety measures will be required for the protection of construction workers.

2.6 Impact to Neighbouring Properties and Buried Services

2.6.1 Screening of levels of determinands potentially affecting water pipes identified exceedances relating to 2No. bands of hydrocarbons (EC_{10}-EC_{16} & EC_{16}-EC_{40}), therefore upgraded pipework may be required.

2.6.2 Requirements for potable water supply pipework should be confirmed with the relevant utility provider at an early stage of the project life cycle.

2.7 Conceptual Site Model (CSM)

2.7.1 The updated CSM is presented in Table 2.1, overleaf.

Table 2.1: Plausible Pollutants Linkages Summary (Pre-Remediation, as updated for Remediation Strategy)

Source	Pathway	Receptor	Relevant Pollutant Linkage?	Comment

• Potential for contaminated ground associated with previous site use – on site (S1)
  ○ Garage (1956 – present)
• Potential for Made Ground associated with previous development operations – on site (S2)
• Underground fuel storage tanks (UST's) and associated infrastructure – on site (S3)
• Potential asbestos containing materials within existing buildings – on site (S4)
• Current and previous industrial use – offsite (S5)
  ○ Engine houses 50m S
  ○ Timber yard 70m NE
  ○ Joinery 20m NE
  ○ Engineering works 200m E
	• Ingestion and dermal contact with contaminated soil (P1)
	• Inhalation or contact with potentially contaminated dust and vapours (P2)
	• Permeation of water pipes and attack on concrete foundations by aggressive soil conditions (P6)
		• Construction workers (R1)
		• Maintenance workers (R2)
		• Neighbouring site users (R3)
		• Future site users (R4)
		• Building foundations and on site buried services (water mains, electricity and sewer) (R5)
			Y	Remedial measures considered necessary.
				The findings of this report should be included in the construction health and safety file, with adequate measures put in place for the protection of construction and maintenance workers.
				Contact should be made with relevant utility providers to confirm if upgraded materials are required.
				The concrete classification to protect buried concrete is discussed in Section 11.3 of the ground investigation report.

	• Accumulation and migration of soil gases (P5)		**Y**	In the absence of further monitoring, gas protection measures should be included in accordance with CS2 classification.
	• Leaching through permeable soils, migration within the vadose zone (i.e., unsaturated soil above the water table) and/or lateral migration within surface water, as a result of cracked hardstanding or via service pipe/corridors and surface water runoff. (P3) Horizontal and vertical migration of contaminants within groundwater (P4)	• Neighbouring site users (R3) • Building foundations and on site buried services (water mains, electricity and sewer) (R5) • Controlled waters – Principal Aquifer, River Thames 176m SE, potable water abstraction 512m SW (R6)	**N**	A significant risk of impact to controlled waters has not been identified. Contact should be made with relevant utility providers to confirm if upgraded materials are required. The concrete classification to protect buried concrete is discussed in Section 11.3 of the ground investigation report.

3 REMEDIAL OPTIONS APPRAISAL

3.1.1 Soil Screening

- A possible remedial option would be to undertake soil screening, comprising excavation of impacted soils, screening within the site to remove likely contaminative materials, and re-deposition of materials on site. Such an operation may include a variety of screening methodologies, including soil washing etc.
- Such an operation may be successful at removing materials responsible for elevated concentrations of PAH compounds but is unlikely to be successful at removing materials responsible for elevated concentrations of lead.

3.1.2 Excavation and disposal

- Made Ground displaying elevated concentrations of contaminants may be excavated for disposal off site. From a review of chemical testing data, excavations to a depth of the order of 1.0m bgl minimum would be required, with the importation of a respective thickness of certified clean material to restore site level.
- The costs and vehicle movements required for such an operation may render the costs associated with this method prohibitive.

3.1.3 Encapsulation

- In order to sever the identified pathways to the most sensitive receptors (human health), encapsulation of impacted materials below building footprints or areas of hard surfacing may be undertaken. This would have the effect of removing the potential pathways of direct contact and inhalation.
- In areas of soft landscaping, impacted soils can be encapsulated beneath a minimum 450mm thickness of clean imported sub/topsoil placed over a geotextile membrane or marker layer.

3.1.4 Dust control measures will be required during the undertaking of all the remedial options identified above for the protection of site workers.

3.1.5 When issues of cost effectiveness, requirements for vehicle movements etc. are taken into account, it is recommended that encapsulation of impacted soils is adopted as the preferred remedial methodology.

3.1.6 The requirements for the remedial methodology are presented within Section 4 of this report.

4 PROPOSED REMEDIATION STRATEGY

4.1 Introduction

4.1.1 The proposed remediation scheme serves to address the potential unacceptable risks identified in the context of the proposed redevelopment of the site.

4.1.2 The remedial measures comprise:

- Removal of the underground tanks, and associated infrastructure, with appropriate validation testing of the surrounding soils,
- A watching brief following demolition and during enabling works,
- Gas protection measures incorporated within the proposed buildings on-site,
- The encapsulation of impacted soils below areas of building footprint or hardstanding,
- Within areas of soft landscaping, a cover layer comprising a minimum 450mm thickness of clean subsoil/topsoil over a geotextile membrane/marker layer will be utilised.
- Where Made Ground is removed and the base of the Made Ground is encountered at shallower depth than the depth of the proposed clean cover, the depth of clean cover can be limited to the thickness of Made Ground removed, or thickness required for finished levels.
- Validation testing will be undertaken upon soils imported to site to confirm their suitability for use as a clean capping layer.

4.2 Remediation Strategy

Tank/Infrastructure Removal

4.2.1 Following the removal of hardstanding, excavations will be advanced in the anticipated fuel tank positions in order to expose the infrastructure. Such works should be undertaken under the supervision of a suitably qualified environmental consultant.

4.2.2 Measures to “make safe” potentially explosive tanks are likely to include filling with water to occupy headspace with water, displacing vapour and preventing further vapour build up. Once ready for removal tanks will be slightly drained of water to allow the tops to be cut open and peeled back, preventing further vapour build up. The contents will then be pumped out and disposed of by a specialist wastewater contractor prior to removal of the tank.

4.2.3 Once sufficient surrounding material has been removed and appropriately segregated, the tank(s) or pipe(s) will be removed from the ground and stored on site on an impermeable membrane awaiting appropriate disposal. Once the tank or pipes have been removed, surrounding soils will be examined for visual/olfactory evidence of contamination and subjected to headspace analysis using a photo-ionisation detector. Any soils considered unsuitable to remain on site from this semi-quantitative assessment will be stockpiled separately from clean soils, on an impermeable membrane to prevent cross contamination whilst awaiting removal to an appropriate licensed facility.

4.2.4 Additional trial pitting may be required in surrounding areas to demonstrate that no soils failing risk assessment remain.

4.2.5 Once the excavation(s) is/are complete, validation samples should be obtained from the base and sides of the excavation(s) and submitted to a UKAS and MCERTS accredited laboratory for analysis against an appropriate suite of contaminants and compared to screening criteria.

4.2.6 Sample frequency is anticipated to be a minimum of 1No sample per face, or 1No per 50m^2 of exposed face.

4.2.7 Once the excavation has been validated, it can be backfilled with verified clean site derived material or certified clean imported material as appropriate. Backfill materials should be chemically suitable for use, in accordance with the validation criteria set out below.

4.2.8 For the purposes of human health risk assessment, the samples will be screened against generic assessment criteria as set out in Table 4.2: Topsoil Requirements.

4.2.9 For the purposes of controlled waters risk assessment, a semi-quantitative assessment will be undertaken taking into account the measured concentrations of contaminants and the relative aqueous solubility and mobility of the contaminants, as published by CL:AIRE (2017).

4.2.10 Should the validation results indicate an unacceptable risk to human health or controlled waters remains, further soil removal and validation will take place until an acceptable result is achieved or no further excavation is possible (for example upon reaching the site boundary).

4.2.11 Should elevated concentrations of contaminants persist, further remedial measures may become necessary such as implementation of a cover layer, or derivation of site-specific remedial target criteria for the protection of controlled waters. Such measured would be subject to approval by the local planning authority and should be set out within an addendum remediation strategy.

Ground Gas Mitigation Measures

4.2.12 4No. return gas monitoring visits were undertaken during the initial phase of ground investigation (Jomas, November 2015) at the site. The results indicated the site should be designated Characteristic Situation 2 (CS2), whereby basic gas protection measures are necessary, due to elevated concentrations of carbon dioxide recorded in excess of 5%.

4.2.13 A single additional monitoring visit was undertaken as part of the supplementary ground investigation (Jomas, February 2023). Whilst this did not report significantly elevated gas concentrations, as only a single additional monitoring visit has been undertaken within the study site, and as carbon dioxide in excess of 5% has been reported in the previous ground investigation monitoring results (albeit outside the current study area), in the absence of further monitoring, it was recommended that the site is classified as CS2, whereby basic gas protection measures are required.

4.2.14 Type A buildings are defined as:

> *"Private ownership with no building management controls on alternations to the internal structure, the use of rooms, the ventilation of rooms or the structural fabric of the building. Some small rooms present. Probably conventional building construction (rather than civil engineering). Examples include private housing and some retail premises."*

4.2.15 Type A has been adopted as the relevant category for the proposed development.

4.2.16 The methodology set out in BS 8485 (2015) has been used for determining the required gas protection measures. For a Type A development on a CS2 site the gas protection measures must provide a minimum of 3.5 points.

4.2.17 This can be achieved in a number of ways, within BS8485 it is recommended that a range of protection measures are utilised with a minimum of two separate methods chosen from the three groupings (structural, ventilation and barrier).

Table 4.1: Recommended Gas Protection Measures

Protection Measures	BS 8485 Score
Structural Cast in situ monolithic reinforced ground bearing raft or reinforced cast in situ suspended floor slab with minimal penetrations	**1.5**
Barrier Gas resistant membrane meeting all of the following criteria: • sufficiently impervious to the gases with a methane gas transmission rate <40.0 ml/day/m2/atm (average) for sheet and joints (tested in accordance with BS ISO 15105-1 manometric method); • sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions; • sufficiently strong to withstand in-service stresses (e.g. settlement if placed below a floor slab); • sufficiently strong to withstand the installation process and following trades until covered (e.g. penetration from steel fibres in fibre reinforced concrete, penetration of reinforcement ties, tearing due to working above it, dropping tools, etc); • capable, after installation, of providing a complete barrier to the entry of the relevant gas; and • verified in accordance with CIRIA C735	**2**
MINIMUM REQUIRED TOTAL	**3.5**

4.2.1 As outlined in the table above, 1.5 gas protection points could be achieved through incorporation of a cast in situ monolithic reinforced ground bearing raft, or reinforced cast in situ suspended floor slab with minimal penetrations, as part of the proposed development.

4.2.2 Upgrading of the anticipated damp proof membrane to a gas resistant membrane meeting the specification criteria outlined above would achieve a further 2 gas protection points which, in addition to the reinforced cast in situ floor slab mentioned above, would achieve the minimum 3.5 gas protection points required for a Type A development on a CS2 site.

4.2.3 The above is considered to be the most appropriate solution in the context of the proposed development, however, as specified within BS8485, other measures such as a passive sub floor dispersal layer could be adopted as an alternative if preferred, and would be acceptable as long as a minimum total of 3.5 gas protection points are achieved.

4.2.4 During construction where personnel are required to enter excavations of greater than 1.2m the air quality (carbon dioxide, methane and oxygen concentrations as a minimum) should be regularly checked prior and during person entry. Appropriate precautions, including but not limited to, venting, PPE and gas alarms should be undertaken.

4.2.5 Any permanent excavations such as manholes, inspection chambers or other void spaces formed beneath the sites ground surface are potential ground gas traps and precautions, as per above, are considered the minimum necessary prior to person entry.

4.2.6 The installation of the ground gas protection measures shall be verified by a competent person in accordance with CIRIA C735.

Impacted Soils Encapsulation

4.2.7 Following removal of hardstanding etc, any visible asbestos materials are to be removed by a specialist contractor by a hand picking operation, and double bagged for disposal. Dust control measures will also be required. This may comprise the damping down of excavations. It is noted that asbestos fibres will not be visible to the naked eye.

4.2.8 Where buildings or hardstanding are proposed, no formal remedial works are considered necessary, beyond the hand picking discussed above, and the construction of the building/hardstanding, as this should provide an appropriate barrier to impacted soils. External hardstanding within private areas should be of a construction that discourages possible removal by future occupiers.

4.2.9 Within areas of soft landscaping, soils will be encapsulated below a cover layer of imported clean subsoil/topsoil. This should comprise a minimum 450mm laid over a geotextile membrane/marker layer.

4.2.10 Where topsoil and sub-soil is imported to the site, the soil should be chemically suitable for use. All imported soil should conform to the following chemical specification:

Table 4.2: Topsoil Requirements

Determinand	Unit	Screening Criteria	
Arsenic	mg/kg	S4UL	37
Boron	mg/kg	S4UL	290
Cadmium	mg/kg	S4UL	11
Chromium	mg/kg	S4UL	910
Lead	mg/kg	C4SL	200
Mercury	mg/kg	S4UL	40
Nickel	mg/kg	BS3882	110
Selenium	mg/kg	S4UL	250
Copper	mg/kg	BS3882	200
Zinc	mg/kg	BS3882	300
Total Cyanide	mg/kg	CLEA v1.06	33
Asbestos	%	S4UL	None Detected
pH	-	S4UL	5-9
Naphthalene	mg/kg	S4UL	2.3
Acenaphthylene	mg/kg	S4UL	170
Acenaphthene	mg/kg	S4UL	210

Determinand	Unit	Screening Criteria	
Fluorene	mg/kg	S4UL	170
Phenanthrene	mg/kg	S4UL	95
Anthracene	mg/kg	S4UL	2400
Fluoranthene	mg/kg	S4UL	280
Pyrene	mg/kg	S4UL	620
Benzo(a)anthracene	mg/kg	S4UL	7.2
Chrysene	mg/kg	S4UL	15
Benzo(b)fluoranthene	mg/kg	S4UL	2.6
Benzo(k)fluoranthene	mg/kg	S4UL	77
Benzo(a)pyrene	mg/kg	S4UL	2.2
Indeno(123-cd)pyrene	mg/kg	S4UL	27
Dibenzo(ah)anthracene	mg/kg	S4UL	0.24
Benzo(ghi)perylene	mg/kg	S4UL	320
TPH C_5-C_6	mg/kg	S4UL	42
TPH C_6-C_8	mg/kg	S4UL	100
TPH C_8-C_{10}	mg/kg	S4UL	27
TPH C_{10}-C_{12}	mg/kg	S4UL	74
TPH C_{12}-C_{16}	mg/kg	S4UL	140
TPH C_{16}-C_{21}	mg/kg	S4UL	260
TPH C_{21}-C_{35}	mg/kg	S4UL	1100

4.3 Health and Safety / PPE

4.3.1 Excavations will have suitable barriers and access points, with pedestrian routes clearly marked. Appropriate safety signage and instructions will be clearly visible, with accesses to be kept clear of debris, materials and cables.

4.3.2 Operatives will be briefed on sharps protection in order to ensure safety. Clean/dirty rooms will be provided for operatives working within contaminated areas.

4.3.3 Standard PPE will be required at all times, namely:

- Hard hat
- Safety spectacles
- Hi-viz waistcoat or jacket
- Gloves
- Boots or shoes with steel toe and midsole protection

4.3.4 Other items may be required as per detailed in the specific method statement, such as:

- Harness
- Dust protection
- Ear protection
- Other specialist equipment

4.3.5 A method statement will be produced by the chosen contractor.

4.4 Unexpected Contamination

4.4.1 To accord with best practice if, during the construction of the development, contamination and/or materials not previously identified are found to be present at the site, then no further development (unless otherwise agreed in writing with the Local Planning Authority) shall be carried out until Jomas' (or qualified environmental engineer) has been informed, and a suitable strategy implemented to the approval of the engineer and/or the Local Planning Authority.

4.4.2 Examples of such materials include:

- Suspected asbestos containing materials;
- Buried drums, tanks, pipework or containers;
- Soil or water with colour or odour;
- Non-natural materials and wastes;
- Other evidence of contamination, for example iridescent sheens (like oil or diesel) on soil or water.

4.5 Operational Standards – Summary

4.5.1 As a minimum, the following standards shall be employed during the full course of this remediation site works;

- All materials subject to excavation and disposal must be tracked throughout and evidence generated to provide an auditable trail.
- Any excavated soils will be stockpiled/stored in a designated area on site, with plastic sheeting placed at ground surface to prevent cross-contamination. The contractor shall be responsible for the removal of spoil from the site.
- Personal protective equipment shall be employed by all site remediation and ground worker personnel in accordance with site specific risk assessments. These are to be completed by all contractors following consideration of the potentially hazardous properties of contaminants within the site.
- A copy of this remediation statement together with all previous geo-environmental assessment reports shall be retained on site for reference during the full course of remediation activities.

5 VERIFICATION PLAN

5.1 Proposals for Validation & Verification

Tank Removal

5.1.1 Following tank removals and trial pitting/impacted soil removal, validation samples will be obtained from the void(s) and scheduled for testing at an accredited laboratory. Validation samples will be obtained from the exposed faces and base of the excavation. Visual and olfactory evidence from the excavation limits will also be recorded, along with screening by photo-ionisation detector (PID), in order to determine whether additional samples are required.

5.1.2 Samples will be obtained at a minimum frequency of one sample per 50m^2 or 1No per face, and the locations of all samples obtained will be justified within subsequent verification report based on the presence of visual/olfactory evidence of contamination within the excavation.

5.1.3 Validation samples will be scheduled for suite of laboratory testing to comprise as a minimum: TPHCWG, BTEX compounds, speciated PAHs and VOCs. Validation samples will be tested at a minimum frequency of 1 sample per 50m^3.

5.1.4 Should validation samples fail risk assessment, further excavation and re-sampling of new faces will be undertaken where feasible within the constraints posed by the site. Soils failing risk assessment will be removed offsite for disposal or treatment at an appropriately licensed facility.

5.1.5 The determination of whether soils can be retained on site or require off site removal will follow a lines of evidence approach including:

- Visual/olfactory evidence of contamination
- Photo-ionisation detector readings
- Comparison of analytical laboratory results from validation samples with the imported soil requirements in Table 4.1, and other published Generic Assessment Criteria including S4UL (LQM/ CIEH, 2014).
- The volatility and mobility in groundwater of hydrocarbon contaminants detected in the validation samples.
- Presence or otherwise of groundwater or free phase product.

5.1.6 Once validation of the excavations is confirmed, the voids may be backfilled with certified clean, inert material in line with the engineering requirements of the site.

Cover Layer

5.1.7 A qualified environmental engineer shall undertake the following tasks to monitor the remedial activities described in this statement.

- Following importation of subsoil/topsoil to site, representative samples will be obtained for laboratory testing. It is anticipated that 1No sample will be taken per 50m^3 of soil imported, 1No sample per private garden area, or a minimum of 3No samples total (whichever is greater).

- The thickness of the clean cover layer and the presence of a geotextile/marker layer will be verified by a series of hand dug pits in areas of soft landscaping, with accompanying photographs.
- These samples shall be sent directly to an MCERTS and UKAS accredited laboratory for testing.
- The results will be screened against the criteria given previously within Table 4.2, which comprise S4UL generic assessment criteria (suitable for use levels for human health risk assessment) published by the Chartered Institute of Environmental Health (CIEH). Where these are not available, other available general assessment criteria (GAC), including the Category 4 Screening Levels (C4UL) published by DEFRA have been used.

Gas Protection Measures

5.1.8 Gas protection measures should be independently verified by a suitably qualified specialist, in accordance with the methodology set out in CIRIA C735, with documentation provided for inclusion in the Verification Report. Structural element will be verified through the provision of "as constructed" drawings.

5.2 Remediation Verification/Completion Report

5.2.1 The Remediation Completion Report shall include the following information:

- Summary of all works undertaken
- Photographic log of the works.
- A full chemical soil analysis results schedule.
- Full details of any further contamination reported during construction works.
- Disposal documentation for any spoil or asbestos materials spoil.

5.3 Reporting

5.3.1 All activities will be documented (including photographs) to show compliance with the Remediation Strategy. This documentation will be kept on site at all times during the works and updated daily as part of a field record as the works progress, which would be available for regulatory inspection at any time. All documentation would be included in a final verification report to be presented to the Local Authority.

6 REFERENCES

- A possible approach for generating site specific assessment criteria for polycyclic aromatic hydrocarbons (draft internal HPA briefing note)
- CIEH & CL:AIRE (2008) *Guidance on comparing soil contamination data with a critical concentration*. London: Chartered Institute of Environmental Health (CIEH) and CL:AIRE
- Environment Agency (2020); Land Contamination Risk Management (LCRM). https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm
- Environment Agency, NHBC & CIEH (2008) *Guidance for the safe development of housing on land affected by contamination*. R & D Publication 66. London: Environment Agency
- Environment Agency Technical Report P45 “Polycyclic Aromatic Hydrocarbons (PAH): Priorities for Environment Quality Standard Development
- LQM/CIEH S4ULs. LQM, 2014
- National Planning Policy Framework. Department for Communities and Local Government, March 2012

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