e3p

Remediation and Enabling Works Strategy
New Smithfield Market, Manchester

Reference:12-757-R4-5
Date: November 2022

REMEDIATION AND ENABLING WORKS STRATEGY

New Smithfield Market
Whitworth Street East
Openshaw
Manchester
M11 2WJ

Prepared for:

Russell WBHO

Report Ref: 12-757-R4-5
Date Issued: November 2022

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EXECUTIVE SUMMARY

Site Address	Whitworth Street East, Manchester, M11 2WJ
National Grid Reference	E388490, N397100
Site Area	1.76Ha
Background	This document provides a comprehensive specification for the land remediation and subsequent enabling earthworks including geotechnical performance criteria required to ensure the construction of a development platform that will be geotechnically suitable for the proposed commercial and industrial end use. E3P have developed this strategy based on the following previous reports, which should be read as a precursor to this report: - **E3P –** *Supplementary Site Investigation Report*. Ref: Report No. 12-757-L5 dated 3rd March 2022 - **E3P –** *Supplementary Ground Investigation Report (Area 1)*. Ref: Report No. 12-757-L4 dated 15th December 2020 - **E3P –** *Phase II Geo-Environmental Site Assessment*. Ref: Report No. 12-757-r2 dated July 2020. - **E3P -** *Geoenvironmental Desk Study* Ref: 12-757r3 Dated July 2020 - **E3P -** *Phase II Geoenvironmental Site Assessment*: 12-757r2, dated November 2018 - **E3P -** *Phase 1 Geoenvironmental Desk Study* Ref: 12-757, dated August 2018 The specification defines the land remediation works required to ensure all potential unacceptable risk associated with identified contamination is addressed to ensure no complete pollution linkage upon completion of the development. This specification defines geotechnical parameters for the up-fill of soils as a structural fill, compaction of materials to construct a sub-base using stabilised and solidified recycled materials or imported aggregate and requirement for processing aggregates to ensure compliance with the necessary engineering properties.
Site History	Historical mapping indicates the site was occupied by a locomotive and carriage works up to the mid-1900s, including railway tracks, cranes and tanks. Since circa 1970s, the New Smithfield Market comprising a series of buildings for storage has occupied the site and surrounding area; the subject site is located within the vehicle access and parking area of the market. An electricity substation is shown on plans from pre 1978 until the present.
Proposed Development	Russell WBHO intends to construct a commercial development comprising two industrial steel frame units with ancillary office space with associated access, parking, service yard and landscaping including the replacement of the access roadway to the existing adjacent unit.

CONTAMINATED LAND ASSESSMENT

Human Health Risk Assessment	Due to the site currently being active, areas of the site could not be fully accessed. Therefore, it is recommended that when the site is vacant a series of trial pits and further chemical analysis is undertaken in order to fully appraise the site. One of the areas requiring further investigation is below the electricity substation for PCB analysis. A Tier I Human Health Risk Assessment has been undertaken using the chemical analysis results of the soils and comparing to the relevant Tier I criteria. This assessment has identified the presence of elevated lead (WS203 0.40m), asbestos (WS206 0.40 m, TP308 0.70 m), SVOCs (WS201 0.60 m, TP201 1.50 m TP202 1.00 m, TP306 1.20 m) and VOCs (TP306 1.20 m). Lead has a primary pathway of dermal contact and ingestion. The asbestos has a pathway of fibre inhalation and the SVOCs and VOCs through vapour inhalation. Lead has been identified within one location on the site (WS203 0.40m). The chronic risk to human health associated with the elevated concentrations of inorganic heavy metals can be mitigated through the construction of the proposed building and associated hard standing which will remove direct exposure between the contaminant source and site end user. Asbestos in the form of loose amosite fibres has been identified in the granular Made Ground in WS206 and has been quantified as <0.001 %. Asbestos in the form of loose chrysotile and amosite fibres has been identified in the granular Made Ground in TP308 at 0.70 m bgl and has been quantified as 0.006 %. No visual signs of ACM were encountered during the ground investigation; it is, therefore, likely that only trace fibres are present. Impacted soils should be managed according to the asbestos risk mitigation conceptual site model shown in Figure 2.1. The supplementary ground investigation identified the presence of elevated semi-volatile organic compounds (2-methylnaphthalene, dibenzofuran, carbazole and anthraquinone) within TP201 and TP202 in the south east corner of the site. TP201 and TP202 were targeted to investigate the previously identified elevated SVOCs within WS201. As these exceedances correlate with those encountered within WS201, it is confirmed that the elevated levels are present within one area of the site which can therefore be deemed to be a localised hotspot. As these present a potential indoor volatilisation risk, they will require a hotspot removal and validation to assess chemical suitability for retention on site in an area of no future sensitivity. With regards to the elevated SVOCs and VOCs at TP306 (these present a potential volatilisation to indoor air risk. These elevated concentrations have only been identified within one area (west of site) and are therefore potentially a hotspot and are likely sourced from a hydrocarbon/ coal tar source related to the former industry on the site. Therefore, during a process of cut/fill enabling works, further delineation, assessment and potential hotspot removal should be undertaken where these soils may be chemically validated to assess chemical suitability for retention on-site in an area of no future sensitivity. However, when considering the proposed development layout, the area identified is due to be car parking and covered in hardstanding, not beneath the building footprint. As such, there is a low/moderate risk to the end-user but controlled waters risk needs to be considered.

Human Health Risk Assessment	Chemical analysis of the natural CLAY drift deposits has identified these soils to be acceptable for use as subsoil within any proposed landscaping areas; however, further chemical validation samples will be required to confirm this. There are no suitable sources of topsoil available on the site.
Controlled Waters Risk Assessment	No water samples were able to be obtained as part of this assessment as only minimal amounts of water were present within the monitoring well positions when sampling was attempted. The assessment of the environmental sampling concentrations indicates that the data exceeds the EQS values for naphthalene, TPH Aromatic C10-C35 and zinc. It should be noted that leachate analysis is an aggressive test which may overstate the risk. The TPH carbon bands C16 to C35 identified within the leachate samples from both June 2020 and January 2022 are of a general low solubility, and therefore mobility, suggesting that these will not migrate to controlled water receptors. However, TPH C10-C12 have higher solubility and may pose a risk to the controlled water receptor. Marginally elevated levels of zinc have been recorded within TP201 when compared against the EQS values in the absence of DWS values. Given that the elevation is only marginal and is the only exceedance encountered including previous assessments, it is anticipated that the risk is low. Particularly given that the depth to bedrock is deemed to be circa 70m below current site levels, therefore there is a significant depth of low-permeability CLAY to reduce the downward migration to the underlying bedrock aquifer. Given the site is underlain by low-permeability, predominantly cohesive, glacial till deposits, which will afford protection to the underlying Principal aquifer, there is considered to be a low risk to controlled waters and the wider environment as no complete pollutant linkage can be determined. It should also be noted that the identified exceedances were found in WS201, TP201 and TP306 which is also where elevated VOCs and SVOCs were identified within the soil samples and will undergo further investigation and delineation as part of the remediation works. On this basis, it is anticipated that upon completion of the remediation works there will be no significant risk to the underlying principal aquifer and no further assessment is required at this stage.
Ground Gas	Ground gas monitoring suggests that the site can be classified as CS1, and that gas protection measures will not be required. This is due to the fact the elevated ground gas concentrations identified are not below the proposed structures, furthermore as part of the proposed development the site will undergo a Made Ground turnover which will result in any anthropogenic material being removed.
Coal Mining and Historical Workings	The site is not considered to be at risk from mining or quarrying-related issues.
Invasive Plants	The remediation contractor should review all ecological reports and undertake their own surveys to confirm whether there is any invasive plant species present. If so then they will need to deal with requirement for treatment and eradication as part of their works.

Potable Water Supply	The site investigation and contaminant risk assessment identified elevated concentrations of potentially volatile hydrocarbon compounds, which could permeate into the potable supply infrastructure. It will therefore be necessary to undertake appropriate remediation works with robust validation tests. Based on information to date it is likely that barrier pipe will be required.

GEOTECHNICAL ASSESSMENT

Relict Sub-Structures & Excavation of Made Ground	Concrete and brick obstructions have been encountered within the Made Ground across the site at the surface and more extensively in WS203, indicative of relict foundations from the former buildings and railway tracks. Furthermore, upon removal of the current buildings on the site, it is likely that further obstructions in the form of foundations and utilities infrastructure will be identified. During a phase of cut-and-fill enabling works to create a developable platform, all below-ground relict foundations, infrastructure and obstructions will require grubbing out in their entirety to enable the construction of proposed structures. The general enabling earthworks will require the excavation of Made Ground to the top of natural stratum or 1.20m below current ground level (whichever is the shallower). The sub-formation will be subject to inspection by the supervising geotechnical engineer and proof rolling prior to the replacement with materials in accordance with the E3P geotechnical design standard.
Adverse Ground Conditions	The underlying strata is likely to be disturbed during the removal and current foundations and infrastructure. Care must be taken during these processes to ensure the disturbance is minimal to the underlying natural cohesive deposits.
Proposed Structural Foundations	A phase of cut-and-fill enabling works will be required in order to create a proposed development platform suitable for a commercial development. Upon completion of these enabling works, it is likely that the most cost effective option for the majority of the site would be to utilise shallow pad foundations to support the portal frame of the proposed commercial/industrial building bearing at least 500mm below the stiff to very stiff medium to high strength cohesive soils. The previous report for the south eastern sector made recommendations for vibro stone columns but the location for the proposed structure has now been relocated to an area of more favourable ground conditions. It must be noted that if the foundations for the current buildings and infrastructure on-site are significant and during removal cause site wide disturbance to the underlying strata, it may be more cost effective to utilise vibro stone columns to support the pad foundations. However, disturbance of cohesive materials should be minimal and where clay soils are removed they must be re-engineered in accordance with an appropriate geotechnical specification. Trees are present on the site periphery. Foundations that are within influencing distance of these trees will require deepening to mitigate against the chance of heave.

Building Floor Slabs	A ground-bearing slab will be viable for the commercial structures; however, it will need to be constructed utilising a sub-base with the thickness designed by a structural engineer to ensure that settlement tolerances are taken into consideration. Due to the presence of substantial thickness of Made Ground across the site, is considered that ground-bearing floor slabs, whilst viable, will require detailed design to accommodate variability of the formation and account for differential settlement. In order achieve an ABP of ~30 kN/m² for the floor slab the underlying soils will need to be engineered. Firstly, the underlying obstructions will need to be removed and then the general underlying soils will need to be excavated, processed, placed and re-engineered to ensure the required design ABP for the floor slab. The design needs to consider the variable thicknesses of the Made Ground and that upon removal of the obstructions no differential settlement is apparent. Where a ground-bearing floor slab is to be constructed within the conjectured zone of tree influence, the clay will need to be removed to ensure that any desiccated soil cannot swell and induce heave to the structure. Alternatively, it may be possible to design the structure to resist the influence of clay heave using exaggerated sub-base and additional reinforcement within the slab to be designed by the structural engineer. Where it is necessary to undertake cut-and-fill works utilising site-derived cohesive soils, careful consideration must be given to seasonal climatic conditions, which will have a significant impact of moisture conditions and the ability to compact clay soils in the wetter winter months. It may be necessary to undertake an element of stabilisation works through the addition of lime to ensure the soils can be engineered to the required performance standards. Recycled aggregates generated from the demolition and processing of hard materials to produce 6F2 will be utilised in the construction of the engineered capping solution to ensure compliance with the design for the ground bearing slab.
Highways and Infrastructure	All proposed adopted roads will be constructed in accordance with the geotechnical engineering requirements as defined within the MCHW Series 600. Specific engineering and compaction of materials will be completed in strict accordance with the geotechnical specification contained within this report. All materials outside of structural/infrastructure development will be engineered and compacted to ensure consolidation associated with self-weight settlement is limited to < 50 mm in accordance with the E3P specification.

REMEDIATION AND ENABLING EARTHWORKS

Objectives	The remediation and enabling works will be delivered in a manner that will seek to ensure that the site is prepared to deliver the optimum foundation solution for the proposed structures, infrastructure and highways. The geotechnical foundation plan and structural engineer's drawings should be referenced to determine the proposed foundation solution.
Remediation and Enabling Works	This document provides a comprehensive specification for the regeneration of the land in a manner that will negate the identified pollutant and ensure the development is suitable for the proposed end use. The salient features of the Remediation & Enabling Works Strategy are summarised below: • Further investigation in areas that were inaccessible at the time of the site investigation (including PCB testing in the location of the substation). • Implementing of all works in strict accordance with UK Environmental Permitting and local planning authority requirements. • Controlled removal of all trees and vegetation. • Removal and treatment of all invasive plant species (as required) in accordance with specialist contractor method statement, validation and independent certification. • Excavation, and removal of all existing above and below ground structures beneath the proposed structural foundation. • Sorting, processing and segregation all deleterious materials. • Management of asbestos and lead impacted soils. • Materials deemed unsuitable for retention to be removed from site. • Location; isolation and management of any asbestos impacted soils. • Delineation of identified hotspots at WS201, TP201, TP202, TP306, removal of grossly contaminated soils and groundwater and subsequent disposal or treatment to ensure compliance; • Validation sampling to confirm all material retained on-site poses no risk to the identified receptors within the context of the CSM. • Processing of Made Ground to recycle aggregate as Class 6 Material. • Importation of chemically suitable materials (if required) to achieve the required development elevation. • Removal of any previously unidentified contamination hotspots. • Validation testing of materials placement to confirm suitability. • All works to be undertaken in strict accordance with UK Environmental Permitting and Local Planning Authority Requirements.

Geotechnical Engineering Requirements	The nominated earthworks and stabilisation contractor will be responsible for the placement and re-engineering of stiffened soil platform using engineered Class 1, 2 and 6 material to be capped with a 300mm engineered 6F2 capping and 150mm MOT 1 sub-base. This performance specification defines the geotechnical compaction requirements for engineered soils and sub-bases to ensure compliance with the project engineering requirements. **Preparation of Formation (all areas) -** Prior to the placement of any soils, the formation area (reduced level excavation) will be assessed and certified as suitable to ensure that all identifiable soft spots or areas of variable strata have been identified, and engineered with a suitable soil or aggregate that has been compacted in accordance with the Geotechnical Performance Specification. In general, all soils (excluding certified recycled and quarried aggregates) must be engineered to achieve the following performance criteria: - Compaction to excess of 95% of the Maximum Dry Density (4.5kg/rammer) or 100% of the MDD (2.5kg/rammer); - Maximum 5% air void ratio in engineered cohesive soils; - CBR in excess of the performance requirements for each and every engineered soil layer; - Maximum deformation under Plate Load using applicable loading for each and every layer must not exceed maximum settlement tolerance within engineered fill and sub-base replacement; - CBR in excess of 15% within engineered 6F2/5 capping beneath the building floor slab (underside of MOT 1); and, - CBR in excess of 15% on engineered MOT 1 sub-base beneath external hardstand. **Building Floor Slab –** Engineering of a stiffened soil platform to ensure a net safe Allowable Bearing Pressure in excess of 30kN/m2 to achieve the settlement requirements of the Structural Engineer which is nominally <25mm total and 10mm differential with a CBR >15% at formation (top of MOT 1). **External Hardstand –** Engineering of a stiffened soil platform to ensure total settlement of <25mm with differential settlement of <10mm to achieve a CBR of >15% at formation (top of MOT 1).

BUILD PHASE REQUIREMENTS

Summary of Build-Phase Mitigation Requirements	The developer's works will also include the completion of the following additional elements: - Provision of a 300 mm cover system using certified material with appropriate validation within proposed areas of public open space and soft landscaping. - Construction of appropriate potable water supply infrastructure.

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DRAWING LIST

12-757-R1-001 - Site Location Plan
12-757-R1-002 - Proposed Development Plan
12-757-R1-003 - Historical Features Plan
12-757-R1-004 - Site Features Plan
12-757-R1-005 - Exploratory Hole Location Plan
12-757-R1-006 - Depth of Made Ground Plan
12-757-R1-007 - Depth to Founding Strata Plan
12-757-R1-008 - Development Constraints Plan
12-757-R1-009 - Foundation Zoning Plan
12-757-R1-010 - Conceptual Site Model
12-757-R1-018 - Contaminant Exceedance Plan

1. INTRODUCTION

1.1. BACKGROUND

Following the recent site investigation completed, E3P has been instructed by Russells WBHO to develop a remediation strategy and enabling earthworks performance specification for the proposed commercial and industrial development at the site known as New Smithfield Market, Whitworth Street East, Openshaw, Manchester.

1.2. SITE DETAILS

The subject site is an irregular shaped parcel of land located to the south of Whitworth Street East, and is approximately 1.76 Ha in size.

The site is currently occupied by vehicle parking, industrial storage units and access associated with New Smithfield Market which is located immediately north. Storage of commercial material, including waste skips, is present on the site.

Hardstanding is present across the site with peripheral landscaping in the central sector and south boundary with small trees and bushes.

1.3. REPORT OBJECTIVES

The objectives of this report are to:

- Prepare overview of contaminated land remediation requirements;
- Evaluate feasible remedial technologies;
- Assess the most-appropriate earthworks solution to ensure the delivery of the optimum development platform;
- Define validation criteria to demonstrate the successful implementation of a site remediation and enabling works plan;
- Specify geotechnical engineering performance requirements; and
- Ensure the safe, cost effective and regulatory compliant redevelopment of the site.

1.4. SCOPE OF WORKS

The development of the risk management strategy for the subject site includes the following tasks:

- Identification of the relevant pollutant linkages;
- Review of site characteristics;
- Identification of geotechnical constraints;

- Development of remedial objectives;
- Selection of appropriate remedial technology; and
- Development of remedial strategy.

1.5. PREVIOUS WORKS

The following phases of Geoenvironmental investigations have previously been carried out at the site:

- **E3P –** *Supplementary Site Investigation Report*. Ref: Report No. 12-757-L5 dated 3rd March 2022
- **E3P –** *Supplementary Ground Investigation Report (Area 1)*. Ref: Report No. 12-757-L4 dated 15th December 2020
- **E3P** – *Phase II Geo-Environmental Site Assessment*. Ref: Report No. 12-757-r2 dated July 2020.
- **E3P -** *Geoenvironmental Desk Study* Ref: 12-757r3 Dated July 2020
- **E3P –** *Phase II Geoenvironmental Site Assessment*: 12-757r2, dated November 2018
- **E3P -** *Phase 1 Geoenvironmental Desk Study* Ref: 12-757, dated August 2018

To inform the assessment of the potential risk to contaminated land within the context of the proposed commercial development and to inform the preparation of the remediation strategy, the pertinent points from the above report are summarised within Section 2.

For the avoidance of any doubt, the E3P Geo-Environmental Site Investigation Report should be read both as a precursor to and in conjunction with this document.

1.6. REDEVELOPMENT PLAN

Russell WBHO intends to construct a commercial development comprising two industrial steel frame units with ancillary office space with associated access, parking, service yard and landscaping including the replacement of the access roadway to the existing adjacent unit. Drawing 12-757-002 (Appendix III) identifies the proposed development layout.

A snapshot of the proposed development layout is indicated in Figure 1.1.

FIGURE 1.1 SNAPSHOT OF PROPOSED DEVELOPMENT

1.7. SUMMARY OF PARTIES INVOLVED

Function/interest	Name of Party
Local Planning Authority	Manchester City Council
Developer	Russells WBHO
Geoenvironmental Consultant	E3P
Main Contractor	Russells WBHO
Remediation/Enabling Works Contractor	TBC
Human Health Regulator	Manchester City Council
Controlled Waters and Waste Regulator	Environment Agency
Highways Adoption Authority	Manchester City Council

1.8. REGULATORY CORRESPONDENCE

Russells WBHO are in the process of submitting a detailed planning application to the local planning authority for the proposed redevelopment of the site for a commercial / industrial development with associated adopted estate roads and infrastructure.

It is presumed that as part of the planning approval process, the planning authority will undertake consultation with the pertinent statutory consultees, which will include:

- Environmental health/contaminated land officer at the local authority (or external adviser);
- Environment Agency planning liaison; and
- The Coal Authority.

1.9. SITE DETAILS

Site Address	Whitworth Street East, Manchester, M11 2WJ
National Grid Reference	E388490, N397100
Site Area	1.76Ha

All acronyms used within this report are defined in the glossary presented in Appendix II.

A site location plan is presented in Appendix III as Drawing 12-757-001.

1.10. SITE SUMMARY

TABLE 1.1 SITE DESCRIPTION AND SETTING

Occupancy/Use	The site is currently occupied by vehicle parking, industrial storage units and access associated with New Smithfield Market which is located immediately north. Storage of commercial material, including waste skips, is present on the site. Hardstanding is present across the site with peripheral landscaping in the central sector and south boundary with small trees and bushes.	
Environmental Setting	**Drift Geology**	Glacial Till - BGS borehole logs indicate sandy silty Clay.
	Bedrock Geology	Chester Formation - Sandstone.
	Hydrogeology	Secondary A aquifer (Drift) overlying a principal aquifer (bedrock geology).
	Hydrology	The closest surface water feature is a small watercourse identified 136 m south and is unnamed. Corn Brook is 600 m west and the Ashton Canal is 1 km north of the site
	Flood Risk	The site is not within an area prone to fluvial flooding and there is limited potential for groundwater flooding to occur.
	Subsidence Hazard	Very low hazard identified in data searches.
Site History	Historical mapping indicates the site was occupied by a locomotive and carriage works up to the mid-1900s, including railway tracks, cranes and tanks. Since circa 1970s, the New Smithfield Market comprising a series of buildings for storage has occupied the site and surrounding area; the subject site is located within the vehicle access and parking area of the market. An electricity substation is shown on plans from pre 1978 until the present	

Landfill Sites and Ground Gases	There is one historical landfill site located 141m northeast which accepted inert waste and liquid sludge. No further details are available.
Radon	Very Low risk - No special precaution required.

1.11. SUMMARY OF REPORTED GROUND CONDITIONS

E3P has prepared a detailed Site Investigation Report (Ref: 12-757-r2, July 2020) and Supplementary Site Investigation Reports (Ref: 12-757-L5, 3rd March 2022 and Ref: 12-757-L4, 15th December 2020). The summary of reported ground conditions is given in Table 1.2.

TABLE 1.2 SUMMARY OF GROUND CONDITIONS

Topsoil	No topsoil that would be deemed suitable for reuse has been identified within any of the exploratory hole locations.
Made Ground	Made Ground was encountered within all exploratory hole locations to depths of between 0.55 m and 2.55 m bgl (WS203, where full depth could not be proven). The majority of exploratory holes were covered by concrete or asphalt hardstand which was in turn generally underlain by a thin band of grey or black sandy gravel as a form of sub-base layer. Made Ground depths and composition was relatively consistent across the site. Concrete was found to be circa 0.30 m thick and asphalt was 0.08 m thick, with the exception of WS201, where asphalt was thicker at 0.25 m in the existing storage area. WS201 and WS205 identified a reworked brown gravelly clay with gravel of concrete, asphalt and brick. At WS202, WS204 and WS207 asphalt was found to be underlain by concrete, followed by a subbase. WS203 could not prove the full depth of Made Ground. This is due to there being a potential brick structure in the borehole locations, the thickness of brick and the nature of the gravel meant that the hole collapsed and could not be advanced. Within the previous report which was undertaken in the south eastern corner of the subject, identified Made Ground to a maximum proven depth of 5.00m bgl. Made Ground typically comprised a layer of either asphalt or concrete overlying interbedded sands and gravels, in turn underlain by either a soft to firm dark coloured clay or a firm to stiff purple brown mottled grey gravelly clay. Black sandy gravel was encountered between 0.60 m bgl and 1.40 m bgl within TP201 with gravel of brick, asphalt and clinker. A strong hydrocarbon odour and visible sheen were also recorded within this stratum. TP201 was undertaken in a similar area to the previously undertaken WS201 which identified a gravelly reworked clay to 1.90m with a hydrocarbon odour and rare black staining. A reworked brown gravelly clay with gravel of brick, asphalt, concrete and pottery was encountered within TP203, to depths in excess of 2.50 m bgl where the full depth of Made Ground was not proven.

Drift	Drift deposits were generally consistent across the site, predominantly comprising stiff, high-strength, brown, slightly gravelly CLAY with mudstone. Depths ranged from 0.50 m to a proven depth of 20.39 m bgl (CP302). The CLAY was identified within all locations except WS203, where the full extent of Made Ground could not be proven. The clay identified is similar to that found during the first phase of investigation. WS201 identified a band of clayey SILT underlain by a brown, slightly clayey, slightly silty SAND beneath the Made Ground, however the stiff CLAY was encountered at 1.50 m to the base of the borehole. CP201 identified an isolated area of granular SAND between 7.30 m bgl to 7.60 m bgl, which was saturated. No further granular deposits were identified at the site. A brownish grey fine to medium SAND was encountered within TP202 at depths between 0.70 m bgl and 1.60 m bgl.
Bedrock	The solid bedrock geology was not encountered during this investigation, however, BGS boreholes infer bedrock at 76.20 m bgl (SJ89NE42).
Groundwater	Groundwater strikes were encountered as seepages from 0.40m with the shallow boreholes to 5.00m bgl. Within the deeper cable hole, a groundwater strike was encountered at 7.30m bgl within a sand band between two clay bands.

2. E3P CONTAMINATION RISK ASSESSMENT

2.1. BACKGROUND

E3P has completed a Tier 1 Qualitative Contaminated Land Risk Assessment to determine the potential risk to human health, controlled waters and the wider environ. This assessment is documented in full within the E3P Geoenvironmental Site Assessment reports and, for clarity, is summarised in the following sections of this document.

2.2. HUMAN HEALTH RISK SUMMARY

The results of this direct comparison indicates that the data exceeds the screening criteria for a commercial end use for the following contaminants:

- Lead – 1700mg/kg
- Amosite – <0.001%
- Chrysotile and Amosite – 0.006 %
- 4-Chloroaniline – 2.3 mg/kg
- 2-Methylnaphthalene – 170 mg/kg
- Dibenzofuran – 160 mg/kg
- 4-Nitroaniline – 0.9 mg/kg
- Carbazole – 21 mg/kg
- Anthraquinone – 9.1 mg/kg
- 1,3,5-Trimethylbenzene - 0.22 mg/kg
- 1,2,4-Trimethylbenzene – 0.6 mg/kg
- p-Isopropyltoluene – 0.028 mg/kg

No screening criteria is available for anthraquinone, 2-methylnaphthalene, carbazole, p-isopropyltoluene or 1,3,5-trimethylbenzene, however concentrations were identified above the limit of detection.

Asbestos in the form of loose amosite fibres has been identified in the granular Made Ground in WS206 and has been quantified as <0.001 %. Asbestos in the form of loose chrysotile and amosite fibres has been identified in the granular Made Ground in TP308 at 0.70 m bgl and has been quantified as 0.006 %.

The soil in WS201 was tested for SVOCs due to noting a hydrocarbon odour within the lithology. The results have identified the presence of several semi-volatile compounds in this location. The supplementary ground investigation identified the presence of elevated semi-volatile organic compounds (2-methylnaphthalene, dibenzofuran, carbazole and anthraquinone) within TP201 and TP202 in the south east corner of the site. TP201 and TP202 were targeted to investigate the previously identified elevated SVOCs within WS201. As these exceedances correlate with those encountered within WS201, it is confirmed that the elevated levels are present within one area of the site which can therefore be deemed to be a localised hotspot. As these present a potential indoor volatilisation risk, they will require a hotspot removal and validation to assess chemical suitability for retention on site in an area of no future sensitivity.

SVOCs and VOCs have been identified within TP306 at 1.20 m bgl within granular Made Ground. With regards to the elevated SVOCs and VOCs at TPP306, these present a potential volatilisation to indoor air risk. These elevated concentrations have only been identified within one area (west of site) and are therefore potentially a hotspot and are likely sourced from a hydrocarbon/ coal tar source related to the former industry on the site. Therefore, during a process of cut/fill enabling works, further delineation, assessment and potential hotspot removal should be undertaken where these soils may be chemically validated to assess chemical suitability for retention on-site in an area of no future sensitivity. However, when considering the proposed development layout, the area identified is due to be car parking and covered in hardstanding, not beneath the building footprint. As such, there is a low/moderate risk to the end-user but controlled waters risk needs to be considered.

The laboratory analysis confirms that the main constituents of concern are asbestos and heavy metals.

In relation to these exceedances, the following can be determined:

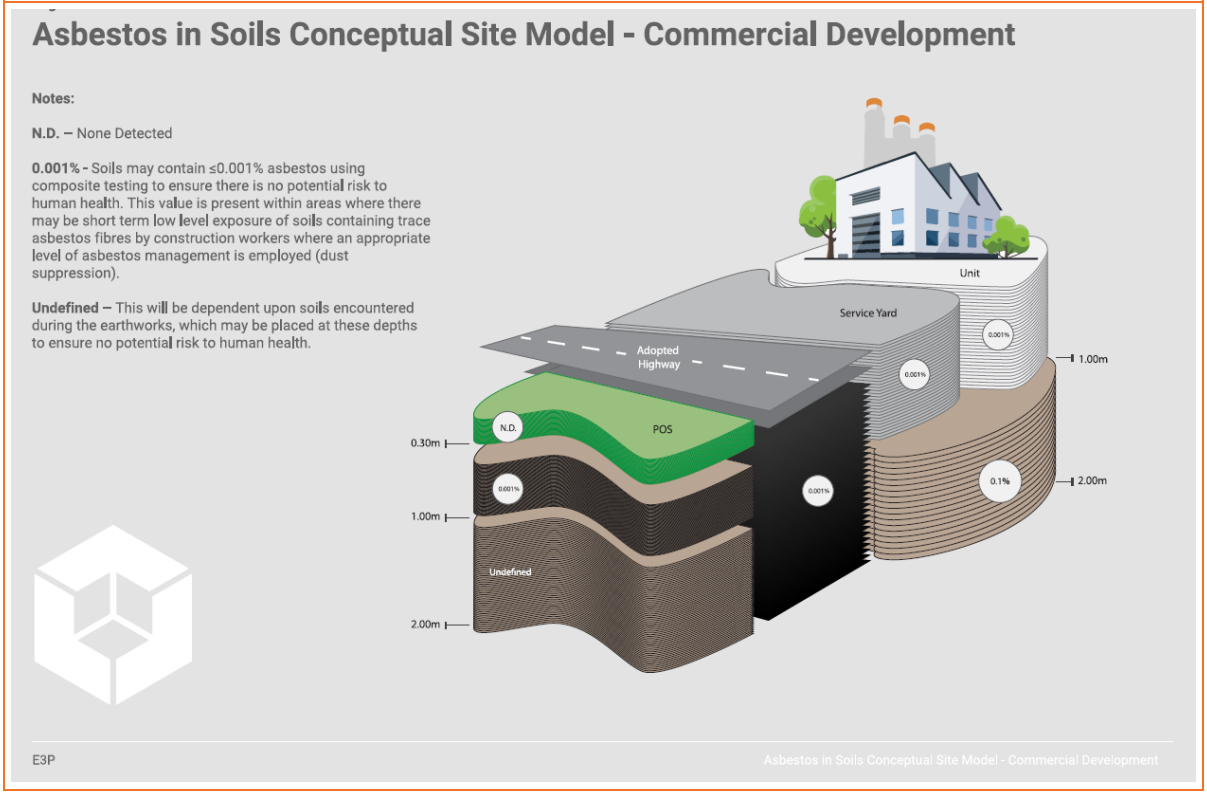
The main exposure pathways based on the Tier I exceedances are:

- Soil ingestion;
- Vapour inhalation (indoor);
- Dermal contact and ingestion;
- Consumption of homegrown vegetables; and
- Fibre/dust inhalation.

The exceedances for all determinands are associated with shallow Made Ground deposits within the upper 0.60.

No visual signs of ACM were encountered during the ground investigation; it is, therefore, likely that only trace fibres are present. Impacted soils should be managed according to the asbestos risk mitigation conceptual site model shown in Figure 2.1.

FIGURE 2.1 ASBESTOS RISK MITIGATION CONCEPTUAL SITE MODEL



Chemical analysis of the natural CLAY drift deposits has identified these soils to be acceptable for use as subsoil within any proposed landscaping areas; however, further chemical validation samples will be required to confirm this. There are no suitable sources of topsoil available on the site.

2.3. CONTROLLED WATERS CONTAMINATION RISK SUMMARY

No water samples were gathered as part of this assessment as only minimal amounts of water were present within the monitoring well positions when water sampling was attempted. Therefore, leachate analysis was completed.

This comparison indicates that the data exceeds the EQS values for the following inorganic compounds:

- Naphthalene
- TPH Aromatic C10-C12
- TPH Aromatic C12-C16
- TPH Aromatic C16-C35
- Zinc

It should be noted that leachate analysis is an aggressive test which may overstates the risk.

The TPH carbon bands C16 to C35 identified within the leachate samples from both June 2020 and January 2022 are of a general low solubility, and therefore mobility, suggesting that these will not migrate to controlled water receptors. However, TPH C10-C12 have higher solubility and may pose a risk to the controlled water receptor.

Marginally elevated levels of zinc have been recorded within TP201 when compared against the EQS values in the absence of DWS values. Given that the elevation is only marginal and is the only exceedance encountered including previous assessments, it is anticipated that the risk is low. Particularly given that the depth to bedrock is deemed to be circa 70 m below current site levels, therefore there is a significant depth of low-permeability CLAY to reduce the downward migration to the underlying bedrock aquifer.

Given the site is underlain by low-permeability, predominantly cohesive, glacial till deposits, which will afford protection to the underlying principal aquifer, there is considered to be a low risk to controlled waters and the wider environment as no complete pollutant linkage can be determined.

It should also be noted that the identified exceedances were found in WS201, TP201 and TP306 which is also where elevated VOCs and SVOCs were identified within the soil samples and will undergo further investigation and delineation as part of the remediation works.

On this basis, it is anticipated that upon completion of the remediation works there will be no significant risk to the underlying principal aquifer and no further assessment is required at this stage

2.4. GROUND GAS

Ground gas monitoring suggests that the site can be classified as CS1, and that gas protection measures will not be required. This is due to the fact the elevated ground gas concentrations identified are not below the proposed structures, furthermore as part of the proposed development the site will undergo a Made Ground turnover which will result in any anthropogenic material being removed.

2.5. POTABLE WATER SUPPLY INFRASTRUCTURE

This will need to be confirmed following the completion of a UKWIR risk assessment, however it is likely that barrier pipe will be required. Post-remediation and enabling works ground conditions may be different from those identified during this site investigation.

3. SITE REMEDIATION AND ENABLING WORKS

3.1. REMEDIATION TECHNOLOGY

Considering the site-specific conditions, including the nature of the identified impacts, the geology and the objectives of the remediation, the most-appropriate soil remedial technologies are considered to be:

- Delineation of hydrocarbon impact and risk based assessment to ensure all materials that are retained pose no risk to controlled waters risk assessment post treatment.
- Management of all soils impacted by trace asbestos fibres and heavy metals;
- Validation of soils to show that all residual soil concentrations are below the LQM S4ULs and other relevant screening values for commercial end use for the protection of human health, controlled waters and the wider environ;
- Construction of a suitable cover system within soft landscaping to mitigate the risk associated with non-volatile/insoluble compounds; and
- If required upon completion of the gas monitoring schedule, all buildings will need to be constructed with appropriate ground gas mitigation measures to ensure compliance with BS 8485 (2015)+A1(2019), with independent validation of each unit.

It is considered that these technologies and methodologies will address the identified active pollutant linkages, as detailed in the following subsections.

3.1.1. CONTAMINANTS OF CONCERN (COC)

METALS, PAH, NON-VOLATILE HYDROCARBON (PETROLEUM RANGE) COMPOUNDS

The human health risk drivers for the carcinogenic PAHs and metal are:

- Direct contact with the soil source by future on-site residents; and
- Ingestion of impacted soils by future on-site residents.

Therefore, a cover system is considered to be an appropriate remediation technique to address these impacts, as the installation of a cover system to unsurfaced areas of the site will sever the pathway of contact for human health receptors. A cover system is not considered to be required in future hardstanding areas or beneath buildings, as it can reasonably be assumed that the presence of a hardstanding will prevent direct contact.

SEMI-VOLATILE/VOLATILE HYDROCARBONS

Elevated SVOCs have been identified in the Made Ground in WS201, TP201, TP202 and TP306.

The soils have been determined to pose a potential risk through volatilisation of impacted soil to indoor air.

The exceedances are considered to be localised hotspots. Therefore, during the remediation and enabling works, a process of risk assessment, delineation and possible treatment of soil/groundwater should be undertaken to determine the materials suitability for retention in an area of low sensitivity or removal from site.

Any separate phase oil encountered on the site will require removal along with any semi-volatile/ volatile organic impact that will require delineation, validation and potential treatment.

It must be noted that odour control measures should be implemented if necessary.

ASBESTOS

Asbestos in the form of loose amosite fibres has been identified in the granular Made Ground in WS206 and has been quantified as <0.001 %. Asbestos in the form of loose chrysotile and amosite fibres has been identified in the granular Made Ground in TP308 at 0.70 m bgl and has been quantified as 0.006 %.

All ACM-impacted soils must be managed so as to ensure no airborne fibre release during construction or placement of impacted material in such a manner as to ensure no future exposure risk.

Soils will be placed in areas of no unacceptable future risk in accordance with the E3P validation method.

If any visible pieces of asbestos-containing material are identified during the site remediation and enabling work, this material must be dealt with in strict accordance with the Control of Asbestos Regulations (CAR) 2012, UK Waste Management Legislation and the Environmental Protection Act 1994.

Should off-site disposal be required, then additional asbestos quantification and waste classification testing should be undertaken to ensure that it is classified correctly and disposed at a suitably licensed facility.

An asbestos conceptual site model is shown within Figure 2.1.

SOLUBLE HYDROCARBON (TPH).

The Ground Investigation and controlled waters risk assessment identifies localised TPH and SVOC impact in the very south east and in the west of the site. It is considered that this represents a secondary pollution source (assuming any unknown tanks are now removed), therefore remediation works are likely to be required.

The proposed remediation of the identified 'hotspots' will ensure all unsuitable materials are either removed to a licensed facility or are alternatively treated using appropriate technologies.

Leachates samples will be required of the backfilled material to ensure no elevated levels of contaminants remain.

3.2. OVERVIEW OF WORKS

Prior to the commencement of works on site, the contractor must establish all necessary plant, equipment and site welfare facilities as is necessary to complete the contract within the agreed timescales to the rationale as outlined in the following subsections.

For the avoidance of any doubt, the proposed operations as set out herein document the required performance objectives and validation sampling protocols; however, the specific methods of work deployed to ensure the remediation objectives are achieved in a compliant manner on site will be the responsibility of the appointed contractor.

RE-1 – Pre-commencement Supplementary Site Investigation

Large areas of the site could not be fully accessed during the site investigation due to ongoing site activities and buildings. It is recommended that post demolition investigation is completed to confirm that there are no further contaminant sources other than those identified.

Once the buildings have been demolished and services have been disconnected further investigation is required within the soils beneath and surrounding these features to ensure the underlying soils are suitable for the proposed commercial end use. If any contaminants are identified, it is recommended that post demolition delineation sampling is completed to confirm the extent of the identified hotspots, to further increase the robustness of the contamination data set and to ensure development of the CSM.

In particular the potential for polychlorintated biphenyls (PCBs) impacted soils needs to be assessed in area of the current electricity substation on the north western boundary of the site.

All hotspots (WS201, TP201, TP202, TP306) should be identified as such, prior to remediation, in accordance with the strategy as set out herein. Where a potentially unacceptable degree of risk is identified, the impacted soils should be remediated by delineation, excavation and removal to a suitably licensed facility with subsequent validation sampling.

RE-2 – Pre-commencement Regulatory Compliance

Prior to commencement of any works on site, all reports relating to the assessment of risk to contaminated land should be submitted to the regulatory authorities to gain written approval.

All relevant Standard Rules Permits should be registered with the EA.

The LAPC Part B Notification for deployment of mobile crushing plant should be implemented prior to the establishment of equipment on site.

If the proposed volume of soils to be reused (excluding crushed materials) exceeds the parameters of the Standard Rules Permit, a CL:AIRE Materials Management Plan (MMP)-qualified declaration should be made by the contractor, having obtained full written approval for the remediation strategy from the LPA and Environment Agency.

It is anticipated that there will be a requirement to treat impacted materials on site (hydrocarbon-impacted soil or groundwater). The contractor must either notify E3P and, if appropriate, relevant regulators of their intention to complete a minor works operation or arrange for the deployment of the appropriate environmental permit for the specified operation.

RE-3 – Environmental and Nuisance Control

Management of all works is required so as to ensure that no environmental nuisance is created through dust emissions, noise or vibration levels.

All works are to be completed in a manner so as not to create any structural risk to the adjacent highways.

Temporary works are to be implemented as necessary to support excavations throughout the duration of the works.

In the event that a complaint is made in respect of dust emissions, noise or vibration levels, remedial measures and a programme of ongoing monitoring should be agreed with the local authority and implemented on site.

RE-4 – Risk to Infrastructure

Site works should be completed in a manner that ensures no risk of disturbance to the on-site and adjacent infrastructure. This includes but is not limited to the combined sewer pipe that crosses the site.

RE-5 – Identification, Isolation and Treatment of Invasive Plants

At this time no invasive plant species have been identified, however the remediation contractor must satisfy themselves with respect to the extent of all species deemed invasive prior to the commencement of works on site. The contractor shall employ a suitably qualified expert to investigate the presence of invasive plant species on or adjacent to the site. Once all invasive plant species are identified, these will be treated in strict accordance with an approved method statement to be submitted to the supervising consultant for review prior to the instigation of any works.

Where invasive plant species are identified at the site boundary, a suitable barrier shall be installed to prevent any future re-infestation of the subject site.

Upon completion of the eradication of all invasive species, a validation report should be prepared documenting all identified invasive plant species, their location and the treatment methodology. Where materials are removed from site, all waste transfer notes/duty of care certificates should be included within the validation statement.

RE-6 – Site Clearance Operations

The site has extensive above- and below-ground structures; this material should be removed in a controlled manner with full compliance with any ecological mitigation measures that are required for the works. Any such measures are outside the scope of this report.

Post-demolition general site clearance and provision of welfare, offices and site security are to be determined as per the contract requirements.

Any vegetation that is removed should either be stockpiled at a pre-agreed location or alternatively removed from site in accordance with waste permitting regulations.

RE-7 – Management of Asbestos Impacted Soils

Detectable asbestos fibres have been identified in two locations (WS206, TP308) however, due to the nature and age of the filled material, it must be assumed that trace fibres are present throughout the Made Ground. The E3P Developed Conceptual Site Model demonstrates a suitable method for management of soils to negate any future risk.

The contractor must ensure than all personnel working on site are trained in the identification of ACM and the risks associated with impacted soils.

Where any visual evidence of ACM is identified, these materials should be carefully segregated and removed from the soil matrices (if/where possible).

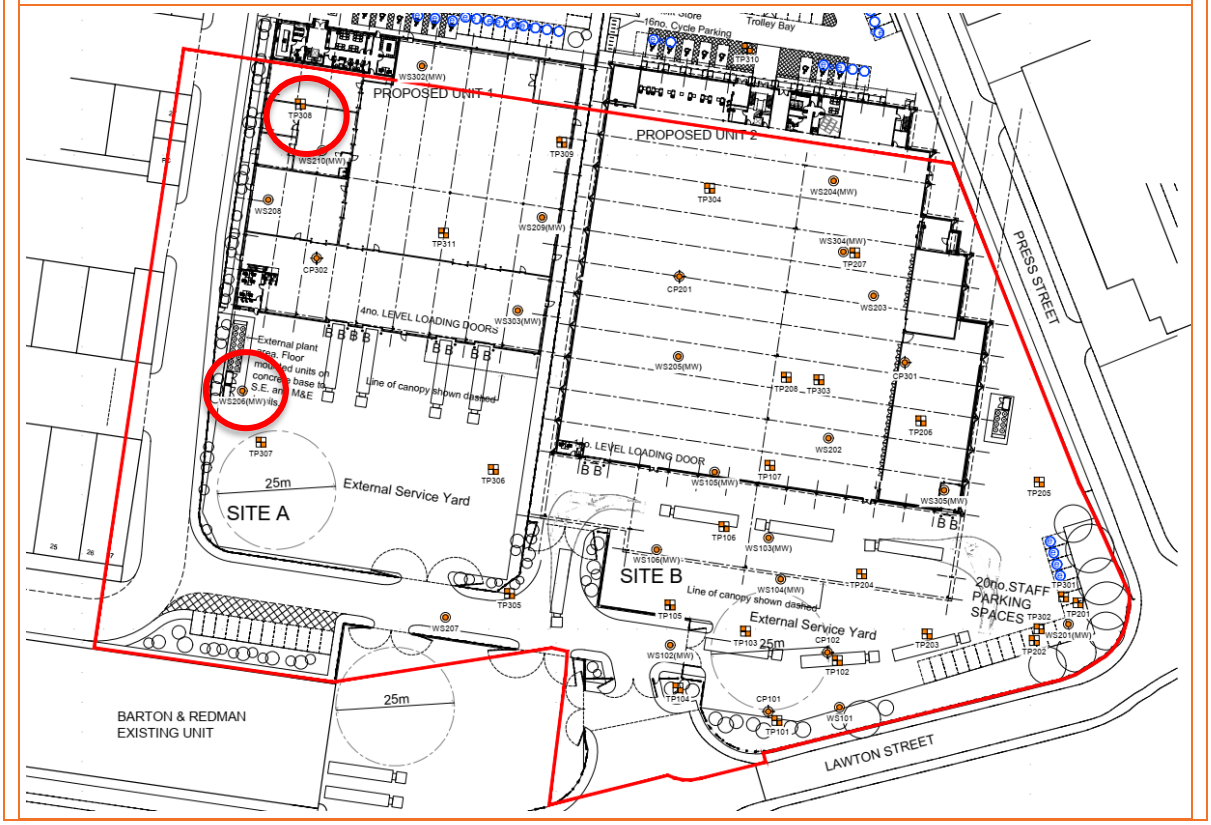
Validation sampling of the processed Made Ground should be completed to demonstrate compliance with the developed conceptual site model.

This process should be completed under strict controls to be devised and employed by the nominated contractor to ensure no potential for fibre release into ambient air.

As the asbestos levels identified at this time are low, asbestos air monitoring is not necessary. If higher concentrations of asbestos are identified, reassurance air testing in accordance with the requirements of HSG248 should be completed during the operation to move the soils to demonstrate the deployment of the required control procedures and safe working methods.

The location of known asbestos impacted soil are shown in Figure 3.1.

FIGURE 3.1 LOCATION OF IDENTIFIED ASBESTOS IMPACT



RE-8 – Delineation, Excavation, Treatment and Disposal of Known Visual and Olfactory Hydrocarbon-Impacted Material

The Ground Investigation and controlled waters risk assessment identifies localised TPH and SVOC impact in the very south east of the site (WS201, TP201, TP202) and in the west of the site (TP306). It is considered that this represents a secondary pollution source (assuming all tanks are now removed). This material represents an unacceptable risk associated with migration towards controlled waters receptor and odour nuisance that cannot be mitigated through the construction of a clean cover system.

The extent of the contamination will require delineation and further assessment. Upon completion of this assessment the material may require treatment to ensure the concentrations with the soil are suitable for human health with a proposed commercial end use and will not pose a risk to controlled waters receptors, alternatively the impacted soils could be removed in their entirety or treated.

If identified separate phase liquids should be collected in a controlled manner and removed from site to a suitably licensed treatment facility. An E3P engineer will monitor the material with a PID to determine the need for boundary monitoring (albeit not anticipated) during the works.

If the material is to be removed the sides and base of the resulting void(s) where impacted material is present will be chemically validated to confirm that no impacted materials remain in situ.

Validation samples will be collected at 5 linear metre centres from the side and base of the excavation.

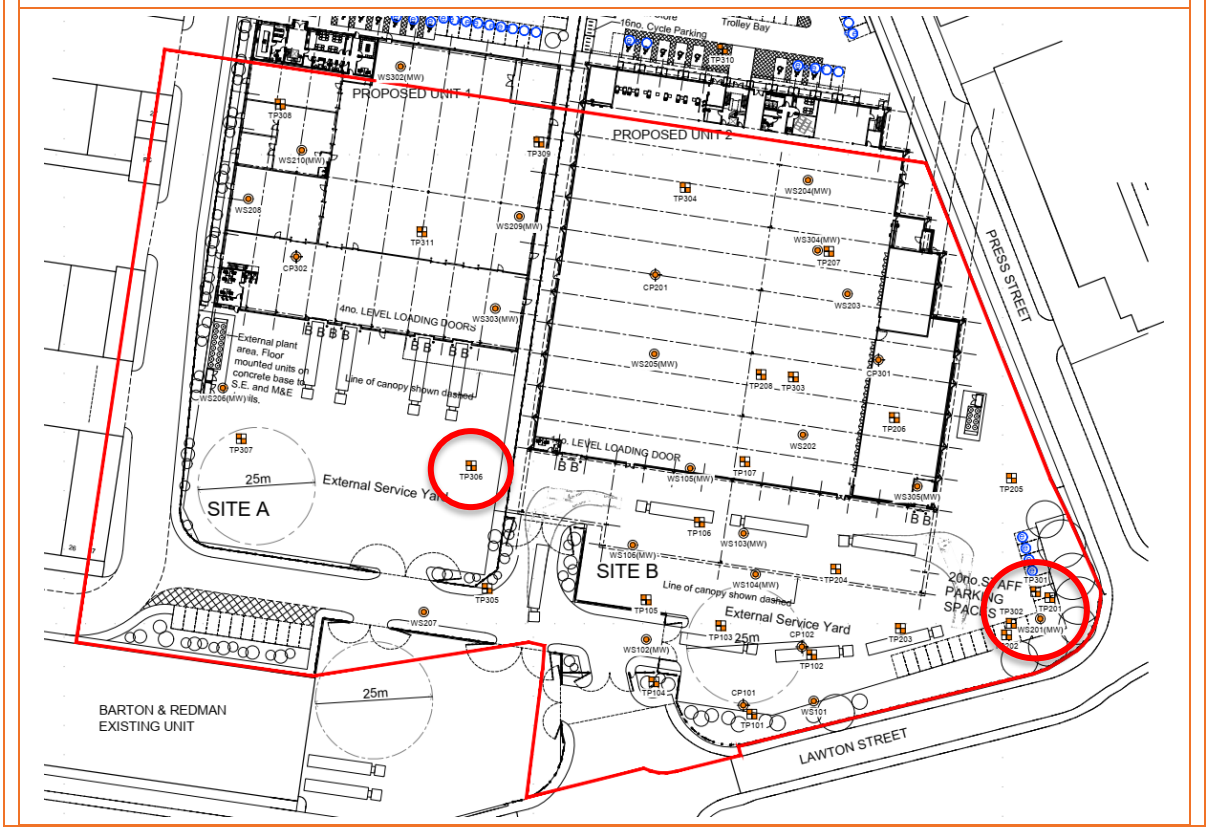
The results of this validation testing will be directly compared to the site-specific remediation targets (as defined within Appendix III of this report) to demonstrate that no unacceptable level of risk to human health, controlled waters or the wider environment remains.

The proposed remediation of the identified 'hotspots' will ensure all unsuitable materials are either removed to a licensed facility or are alternatively treated using appropriate technologies.

It must be noted that odour control measures should be implemented if necessary.

The location of known hydrocarbon impacted soils are shown in Figure 3.2.

FIGURE 3.2 LOCATION OF IDENTIFIED HYDROCARBON IMPACT



RE-9 – Delineation, Excavation, Treatment and Disposal of any as of yet Unknown Visual and Olfactory Hydrocarbon-Impacted Material

When considering the prior land use, as yet unidentified potentially volatile/soluble phase compounds cannot be discounted. The proposed remediation works will include the full depth turnover of all made ground under the supervision of an independent Geoenvironmental consultant from E3P.

In the likely event that any as yet unidentified contaminant is identified, this will be the subject of further investigation including laboratory analysis and subsequent assessment of risk within the context of the agreed parameters. Where a theoretical risk to either human health, controlled waters or the wider environs is identified, appropriate remediation works are to be instigated.

Material deemed to be impacted through either visual or olfactory observations or as a result of notable PID readings (> 50 ppm) will be excavated and stockpiled on an impermeable membrane. The membrane will be placed upon a clay containment bund and covered to negate the risk of soils leaching and dispersal of any odours and/or vapours.

An E3P engineer will regularly monitor the stockpiled material with a PID to determine the need for boundary monitoring (albeit not anticipated). This material will then be subject to detailed laboratory analysis to determine the suitability for reuse or the requirements for off-site disposal.

Upon completion of the delineation and excavation, the sides and base of the resulting void(s) where impacted material is present will be chemically validated to confirm that no impacted materials remain in situ.

Validation samples will be collected at 10 linear metre centres from the side and base of the excavation.

The results of this validation testing will be directly compared to the site-specific remediation targets (as defined within Appendix III of this report) to demonstrate that no unacceptable level of risk to human health, controlled waters or the wider environment remains.

RE-10 – Excavation, Breaking and Processing of All Above- and Below-Ground Structures

Obstructions, relict foundations and infrastructure (apart from live services) are to be removed from the areas of proposed development, adopted highway and utilities infrastructure (road box) in their entirety.

During a phase of cut-and-fill enabling works to create a developable platform, all below-ground relict foundations, infrastructure and obstructions will require grubbing out in their entirety to enable the construction of proposed structures.

The general enabling earthworks will require the excavation of Made Ground to the top of natural stratum or 1.20m below current ground level (whichever is the shallower).

The sub-formation will be subject to inspection by the supervising geotechnical engineer and proof rolling prior to the replacement with materials in accordance with the E3P geotechnical design standard.

Artificially hard materials should be broken out and crushed. Stockpiles will be made, validation testing undertaken, and site-won material reused on site where required. Materials will be processed as per the specifications provided in Section 5 using licensed plant.

The E3P drawings denote the extent of known historic features with obstructions; however, it will be the contractor's responsibility to remove all obstructions.

Obstructions encountered within the near-surface soils will be chased to their full depth and removed; if not possible, the obstruction must be surveyed with the location communicated to E3P, the client and the developer.

Where natural soils are present at a relatively shallow depth (northern sector), extreme care should be taken to ensure that the natural cohesive deposits remain undisturbed with a full reduced-level survey to be completed to map the depth of filled/processed material.

RE-11 – Removal of Deleterious Material

No deleterious materials have been identified during the E3P ground investigation. However, if identified during the remediation and enabling works all potentially deleterious materials will be delineated, stockpiled and removed from site by the contractor to a licensed waste facility. Prior to the commencement of the main works, the contractor, under the supervision of E3P, will undertake to complete further confirmatory ground investigations to satisfy themselves with regards to the extent of any buried anthropogenic deleterious materials that are unsuitable for retention.

RE-12 – Cut-And-Filling of MADE GROUND to Development Levels

Where the proposed enabling works levels require the current landform to be cut, extreme care should be taken so as not to disturb the underlying stratum prior to the placement of the appropriate platform, in compliance with the E3P Geotechnical Specification.

Where the development levels require material to be filled, site-derived MADE GROUND must be sorted in a controlled manner prior to replacement, in accordance with the requirements of this specification for the intended land use.

The maximum dry density must be determined in laboratory conditions utilising UKAS-accredited testing prior to the commencement of filling and compaction works. In-situ density testing us required to demonstrate compliance with the E3P Geotechnical Performance Specification.

RE-13 – Replacement of Materials, Geotechnical Engineering Requirements

Material is to be backfilled in strict compliance with the E3P Geotechnical Engineering Specification as presented in detail within Section 5 of this report, which generally requires the reinstatement and compaction criteria presented in Section 6.

RE-14 – Importation of Bulk Fill

Where there is a net shortfall of material required to achieve the proposed ground levels, it will be necessary to import natural inert soils and aggregate as per the engineering requirements (Section 6).

Imported material must be certified as suitable for use in strict accordance with the E3P chemical and geotechnical performance criteria (See Section 4 and 6) and in conjunction with the required duty of care notes and waste transfer exemption.

If recycled aggregates are imported, then laboratory testing should be completed to demonstrate compliance with the Waste and Resources Action Programme (WRAP) protocol.

Where inert soils are imported, laboratory testing should be completed in accordance with the requirements of the pertinent environmental permit (i.e. U1 Standard Rules) or CL:AIRE MMP for the reuse of clean, naturally occurring soils.

RE-15 – Independent Validation: Watching Brief

Given the site history and potential contamination sources identified within the ICSM, a degree of uncertainty remains with regard to the potential for as yet unidentified contamination impact within the near-surface soils and groundwater.

It will therefore be necessary to instigate the site-wide remediation and enabling works under the supervision of a suitably qualified and independent specialist. The specialist is required to attend site as and when appropriate to monitor works, record ground conditions and fully investigate all potential sources as of yet unidentified contamination.

RE-16 – Waste Soils Surplus to Requirements

In the event that a surplus of excavation material is present on site, this, in most cases, will be deemed to be a waste in accordance with the Waste Framework Directive (Article 3(1) Waste Framework Directive 2008/98/EE). The waste producer – but ultimately, the landowner – is responsible for the compliant disposal of such materials.

A formal waste classification assessment must be undertaken, irrespective of any future options or considerations for those materials that will removed from site. Waste classification should only be made following the Environment Agency *Technical Guidance WM3 – Guidance on the Classification and Assessment of Waste*.

To remove the surplus material from site it will either need to be sent to a disposal site (landfill), to a permitted treatment facility or, dependent on the waste classification assessment, it may be suitable for use on a permitted land improvement or restoration operation.

The preferred alternative approach would be to locate a site in the locality that requires soils to achieve required development levels. Subject to suitability, these soils can be transferred to the receiving site, subject to an approved permit or materials management plan following guidance in the CL:AIRE *Definition of Waste: Code of Practice*.

RE-17 – Validation of Materials for Potable Water Supply Infrastructure

A contaminant risk assessment, completed in accordance with the UKWIR assessment framework identified elevated concentrations of potentially volatile/soluble hydrocarbon compounds that necessitate the use of protected water supply pipe-work.

All materials where organic hydrocarbon impact is identified at concentrations above the UKWIR assessment criteria for a polyurethane pipe within the proposed locality of potable water supply infrastructure should be delineated and removed by the remediation contractor under the supervision of the geoenvironmental consultant.

Validation sampling should be completed at 10 m chainage at depths of 0.75 m and 1.50 m within the locality of the potable supply pipes where impacted material is removed, with samples analysed for all pertinent volatile and semi-volatile hydrocarbons and, where necessary, chlorinated/halogenated compounds.

Upon successful remediation of all impacted materials, the post-remediation validation testing will be reviewed by a qualified person to inform an updated UKWIR assessment to be reviewed and approved by the statutory adoption authority.

If unacceptable concentrations remain following remediation, then potable water infrastructure should be constructed in accordance with a suitably robust risk assessment and design compliant with UKWIR.

Where imported material is required to construct the potable water infrastructure pipework, this material will need to comply the requirements of UKWIR pipework thresholds for the specified pipework. For the avoidance of doubt, the PE thresholds are presented in Section 9.3. Failure to meet the required specification may necessitate further remedial works.

The site has been identified as suitable for PE pipework. It is essential that any materials imported to the site for the purpose of potable pipework installation meet the criteria of PE pipework as presented within UKWIR guidelines. The for avoidance of doubt these guidelines are presented in Section 9.3. Failure to meet the required specification may necessitate further remedial work.

RE-18 – Remedial Verification Report

Collation of information relating to site clearance, chemical testing, remedial works, remedial verification, material movements and waste transfer documentation is required, where appropriate.

Complete remedial validation is to be reported in line with regulatory guidance. This will include a detailed risk assessment. The report will be submitted to the local authority for approval following completion.

3.3. VALIDATION SAMPLING PROTOCOL

In accordance with the current requirements of the regulatory authorities, validation samples will be collected from all materials that are to be subject to movement under the protocols outlined within this remediation and enabling works strategy, or for materials to be imported onto site to facilitate the proposed development.

Soil samples destined for chemical analysis will be collected at regular intervals in appropriate sampling containers. All samples will subsequently be stored in cooled boxes prior to submission to a UKAS/MCERTS accredited laboratory.

All samples will be collected using appropriate personal protective equipment (PPE) and sampling equipment, which will be cleaned at each sampling location.

A detailed copy of E3P Ltd sampling methodology, QA procedures and laboratory chain of custody forms will be documented within the site records and presented with the final validation report for the site.

Where material is found to contain concentrations of potential contaminants at levels in excess of the site-specific screening criteria (as detailed within Appendix IV), E3P will undertake further assessment and recommendations on the appropriate use for the material in question, which may involve the disposal of such materials off site to a suitable waste management facility.

The sampling frequency for materials to be managed under the remediation strategy is presented within Table 3.1.

TABLE 3.1 SPECIFICATION OF CHEMICAL VALIDATION LABORATORY ANALYSIS

MATERIAL USE	TESTING FREQUENCY	SUITE OF ANALYSIS
Site-Generated		
Site-Generated 6F2	1 Sample per 1000 m^3	A/B/C/D
Site-Won MADE GROUND General Backfill	1 Sample per 250 m3 where visual and/or olfactory impact is identified	G
Site-Won MADE GROUND General Backfill	1 Sample per 1000 m^3	A/B/C/D
Site-Won MADE GROUND General Backfill	1 Sample per 2000 m^3	I
Site-Won Natural Backfill	1 Sample per 2000 m^3	A/B/C/D
Hotspot Validation Samples	1 Sample per 10 m of linear excavation to base and sidewall	E/G
Imported		
6F2	1 Sample per 1000 m^3	A/B/C/D
General Engineering Fill (Class 1 and 2 Soil)	1 Sample per 1000 m^3	A/B/C/D

Notes
Suites of Analysis:

A. Speciated PAH.
B. Speciated TPH (C5-C35).
C. Asbestos (ID).
D. CLEA Inorganic Heavy Metals.
E. Speciated PAH, Banded TPH and VOCs.
F. SVOC/Speciated TPH.
G. On-Site Screening for VOC Using Calibrated PID.
H. Leachate 2:1 Speciated PAH and Banded TPH.
I. Leachate Analysis of Inorganic Heavy Metals, TPH, Sulphate and PAH.

All analysis prescribed above to be completed by UKAS-accredited laboratory.

3.4. REMEDIATION CONTRACTORS SITE MANAGEMENT AND RESPONSIBILITY

The appointed remediation contractor will take full and overarching responsibility for all methods of work required to complete the site remediation and enabling operations to ensure the delivery of the site and the completion of the objectives in a safe, legislatively compliant manner that ensures no pollution to the subject site or the wider environs.

For individual remediation operations as set out within this performance specification, the contractor will provide site-specific methods of work for individual operations pertaining to the removal and treatment of contaminated liquids and soils. For each and every operation as set out herein, the contractor will provide a written methodology of works to be supplied to the supervising Geoenvironmental engineer prior to the instigation of operations on site.

The site manager will be responsible for documentation of each day's activities with a full recorded schedule of works completed and corresponding site-specific method statements that have been utilised to ensure the completion of the task to the required standard.

4. MATERIALS MANAGEMENT AND LEGISLATIVE COMPLIANCE

The processing of recycled aggregates will be completed using LAPC Part B licensed plant with the appropriate deployment notification to the local authority prior to commencement of works. All materials that are recovered as recycled aggregate will be compliant with the requirements of the WRAP protocol and the E3P validation testing requirements and as such would not be deemed to be a waste material.

A U1 Exemption will be registered for the site, which allows the reuse of up to 5000 T of prescribed material within construction, with up to 25,000 T of material permissible to be reused in the construction of roads. It should be noted that only 1000 T of material described as sand, stones or clay soil classified as waste can be reused with a U1.

A T5 Exemption, allowing for the screening and recovery of up to 5000 T of permissible material for subsequent reuse in construction will also be registered.

All materials that are recovered under the WRAP protocol, U1 or T5 exemptions must be analysed to demonstrate that they are both chemically and structurally suitable for use within the context of the development.

The relevant LAPC, U1, T5 and WRAP licences, exemptions and protocols provide the legislative framework for material compliance during the site remediation and enabling works to be completed by the specialist contractor under the supervision or E3P.

Where necessary, operations as outlined within the remediation enabling works rationale summarised in this report may be subject to regulation using the appropriate environmental permit, standard rules exemption and materials management plan, to be created in accordance with version 2 of the CL:AIRE *Definition of Waste: Code of Practice (DoW CoP)*.

It is noted that if material is to be imported utilising the CL:AIRE DoW CoP from an alternative development site, then only chemically certified, clean, naturally occurring material can be transferred.

If required, the MMP will be created with due consideration of all proposed remediation and enabling works operations prescribed within this document and will be undertaken by a qualified person with a signed declaration submitted to the EA prior to reuse of materials on the site.

The importation of material for use within the proposed construction of a development platform will be subject to the compliance with the E3P protocol for the importation of materials as set out within the specification for material import included within Appendix IV of this report.

5. ENVIRONMENTAL MONITORING AND VALIDATION

5.1. SITE MANAGEMENT

The tracking of materials will be based on the following hierarchy:

- The principal contractor will have the responsibility for setting out areas of the site on the basis of the contract specification.
- Operatives will have instructions only to excavate and to emplace materials in specified areas as assigned by the site manager/foreman.
- The site manager (employed by the principal contractor) will issue daily instructions to drivers regarding the placement of materials sourced from specific stockpiles or areas, ensuring that appropriate documentary evidence is collected that details which materials are going where and why.
- An E3P consultant, who will be in attendance as required, will:
    - Inspect the excavation areas and certify that the correct materials are being excavated;
    - Conduct spot checks on loaded vehicles to ensure compliance with this remediation strategy; and
    - Ensure that any loads that fail visual, olfactory or spot checks either remain on the vehicle or, if unloaded, are excavated and set aside. This material will be treated according to the recommendations of the E3P site engineer.
- E3P will conduct an audit of waste consignment notes. All material imported and removed from site will have duty of care/consignment notes, copies of which will be retained on site by the site manager.
- Materials directly reusable will be incorporated into the earthworks, subject to operational conditions and phasing of excavations, in which case they will be stockpiled prior to final placement.

5.2. COMPLETION

Following the completion of the remediation works, a report will be compiled by the environmental consultant detailing all site enabling works undertaken, waste consignment notes, and all site investigations, laboratory test certificates and validation testing undertaken.

A certificate of completion of earthworks should be included within the report which should then be issued to the local authority for their approval.

E3P considers that with the adoption of the above best practices the site can be safely redeveloped. The site enabling works process and presence of any residual contamination (if this is the case) should be recorded for future reference by landowners/occupiers. Future development at the site where this may result in penetration of new areas of hardstanding should be subject to no-less-stringent measures with respect to assessment and, where appropriate, monitoring, than those set out herein.

5.3. MITIGATION OF RISK FROM SOILS WITH ASBESTOS FIBRES

5.3.1. PRE-COMMENCEMENT WORKS

Prior to the commencement of works the following requirements must be satisfied:

- Induction of all people that will be involved with the proposed site works; and
- All methodologies must be agreed upon by all parties involved.

5.3.2. CONTROL, MONITORING AND REPORTING OF GENERAL AERIAL EMISSIONS FROM DUSTS AND PARTICULATES

DAMPING DOWN OF SOILS – MITIGATE PARTICULATE (DUST) EMISSION

During excavation, as outlined within the detailed working methodologies, soils will be regularly damped down using water to control the generation of dust (this may also comprise precipitation). The contractor will determine the best form of dust suppression to be used when a detailed programme has been issued.

If any previously unidentified asbestos-containing materials are identified, these should be dealt with in strict accordance with the *Control of Asbestos Regulations* (2012) and industry best practice as detailed in CIRIA 733.

GENERAL CONTROL OF DUST

The following control measures should be utilised to ensure that dust levels are kept to a minimum at all times:

- Where necessary, haul road, work areas and stockpiles will be damped down with water spray.
- The application of water to haul roads, work areas and stockpiles should be closely monitored by the resident engineer to ensure that soils are not saturated and, therefore, that the potential for water run-off is appropriately mitigated.
- Once completed, any stockpiles will be sealed by compacting at the surface.
- Vehicle speeds and movements on site will be kept to a minimum (< 5 mph) during civil excavation works to reduce the potential to generate dust.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

In accordance with the HSE *Guidance Note em6: Asbestos Essentials, Personal protective equipment (including RPE)*, E3P recommend that all site operatives present within the work area where potential asbestos-impacted soils are being excavated are supplied with the following personal protective equipment:

Overalls:

- Disposable overalls.
    - Type 5 (BS EN ISO 13982-1) are suitable.
    - Cotton overalls hold dust and need specialist laundering.
- Waterproof overalls for outdoor work.
- Use oversized overalls - this will help to prevent ripping at the seams.
- If the cuffs are loose, seal them with tape.
- Avoid wearing a long-sleeved shirt as these are difficult to cover properly.
- Wear the overall legs over footwear as tucking them in lets dust into footwear.
- Wear the hood over the RPE straps.

Failure to utilise and correctly employ PPE will result in immediate cessation of works. Works will not be permitted to recommence until the individual has undergone further training in the use of PPE or the individual is removed from the works area.

At this current time, with the levels of ACM identified within the soils, the above-listed PPE is not considered to be required for all site personnel during the entire management of these soils.

When handling asbestos-impacted soils during the enabling works, asbestos monitoring works should be conducted in accordance with, but not limited to, the following HSE legislation and guidance:

- *Health & Safety at Work Act* 1974;
- *The Control of Asbestos Regulations* 2012;
- CL:AIRE, 2016. *Control of Asbestos Regulations 2012 - Interpretation for Managing and Working with Asbestos in Soil and Construction and Demolition Materials: Industry guidance*;
- *Approved Code of Practice L143 Work with materials containing asbestos*;
- *Management of Health and Safety at Work Regulations 1999*;
- HSE *Guidance Note HSG248 Asbestos, the analysts guide to sampling and analysis*;
- HSE *Guidance Note HSG247 Asbestos: The licensed contractors' guide*; and
- *CIRIA 733 Asbestos in soil and made ground: a guide to understanding and managing risks*.

If required, air monitoring in accordance with HSG248 will be undertaken intermittently throughout the duration of the works at a frequency to be determined by the contractor, entirely dependent on whether asbestos-impacted soils are being handled at any given time. In general terms, during any one monitoring period, ten standard monitoring pumps will be run throughout the day, for the appropriate time period to achieve the required limit of detection. These slides will be analysed immediately by the on-site UKAS-accredited laboratory.

Once any monitoring has been analysed by the on-site UKAS-accredited laboratory, the results will be delivered to the resident engineer who will then follow the correct site procedure. The results will then be included within the verification report.

6. GEOTECHNICAL ENGINEERING SPECIFICATION

6.1. E3P GEOTECHNICAL ENGINEERING SPECIFICATION

- **Building Footprint** (+2.0m on all elevations) will be subject to a process of remediation works to remove all relict foundations, infrastructure and oversize material. The resulting excavation will be backfilled with material that will be suitable to facilitate the safe construction of the proposed pad foundations.

- **Building Floor Slab –** Completion of necessary cut / fill works, compaction of shallow granular soils and subsequent construction of a stiffened soil platform to ensure a net safe Allowable Bearing Pressure of 30kN/m2 to achieve the settlement requirements of the Structural Engineer (nominally <25mm with differential settlement of <10mm) with the construction of a 300mm 6F2/5 capping sub-base replacement layer or placement of suitable aggregate to ensure a CBR >15% to the top of 6F2 capping and>15% to MOT 1 sub-base.

- **Preparation of Formation (all other areas) -** Prior to the placement of any engineered soils, the formation area (reduced level excavation) will be assessed and certified as suitable to ensure the removal of all soft spots that would be defined as either soft / low strength cohesive or loose granular stratum to ensure all anthropogenic and natural stratum that remains in-situ exceeds the performance requirements.

  The contractor will be responsible for proof rolling and where necessary Ground Improvement in the sub-stratum to ensure it is compacted with all potential variable stratum or soft spots to be removed and replaced with material that is engineered in accordance with the requirements of this specification.

  In general, all soils (excluding certified recycled and quarried aggregates) must be engineered to achieve the following performance criteria:

  - Compaction in excess of 95% of the Maximum Dry Density (MDD) defined using a 4.5kg rammer or 100% of the MDD derived from a 2.5kg rammer laboratory simulation;
  - Maximum <5% air void ratio in engineered cohesive soils during uplift layers;
  - Moisture content to be within 2% (+/-) of the defined optimum / control value;
  - CBR to meet the required performance spec for the relevant stratum in each and every engineered soil layer; and,
  - Maximum deformation under Plate Load to meet the geotechnical specification within each and every compacted layer.

- Drainage Infrastructure location to be cleared of all relict foundations and infrastructure to a minimum of 1000mm from the underside of invert with material to be backfilled in compliance with E3P geotechnical specification;
- Placement of a minimum 300mm capping layer comprising certified graded 6F2 within all areas of proposed external hard-stand with a CBR 15% at formation.

During a phase of cut-and-fill enabling works to create a developable platform, all below-ground relict foundations, infrastructure and obstructions will require grubbing out in their entirety to enable the construction of proposed structures.

The general enabling earthworks will require the excavation of Made Ground to the top of natural stratum or 1.20m below current ground level (whichever is the shallower).

The sub-formation will be subject to inspection by the supervising geotechnical engineer and proof rolling prior to the replacement with materials in accordance with the E3P geotechnical design standard.

The contractor should employ a suitably experienced engineer to be present on site during earthwork operations to ensure soil suitability, placement, compaction and testing is undertaken in accordance with this specification and to ensure that any unforeseen circumstances, such as adverse weather, do not compromise the earthworks process.

Works should be halted during periods of intermittent or prolonged rainfall to ensure the materials are not placed in a manner that would result in softening of either the formation or the newly placed material. It will be the contractor's responsibility to determine appropriate weather conditions and determine the suitability of works.

Particular attention must be given to variable weather conditions when re-engineering fine grained soils as a moisture content fluctuation (3% +/-) of the tolerable limit will result in unacceptable degree of compaction loss without appropriate modification and stabilisation. The contractor will be responsible for extensive control testing to demonstrate that the optimum moisture content for all engineering material is within the pre-defined control limits.

Where relict structures / infrastructure has been removed, the reduced level excavation should be formed in a manner where the sides are graded at no greater than a 45° angle that will facilitate the resulting backfilling of the excavation with Class 1 / 2 or 6 soils that are to be engineered to achieve the required performance specification.

The contractor will be responsible for proof rolling and where necessary Ground Improvement in the sub-stratum to ensure it is compacted with all potential variable stratum or soft spots to be removed and replaced with material that is engineered in accordance with the requirements of this specification.

The contractor will undertake to provide a detailed survey of all reduced level excavations with survey positions of a maximum 25m grid increasing to 5m centres where a change in topography greater than 500mm occurs at any one point. The reduced level survey is to be provided to the supervising engineer for review and approval prior to the backfill of the excavation and placement of structural fill material.

In general, all soils (excluding certified recycled and quarried aggregates) must be engineered to achieve the following performance criteria:

- Moisture content to be within 3% (+/-) of the defined optimum / control value;
- CBR to meet the required performance spec for the relevant stratum in each and every engineered soil layer; and,
- Maximum deformation under Plate Load to meet the geotechnical specification within each and every compacted layer.

6.2. LOCALLY-WON FILL MATERIAL

It is proposed to upfill and level the site with material won from the development area. From the site-specific investigations undertaken to date, it is expected that the majority of the soils won from the processing of demolition material will be granular soil matrices.

Due to climatic weather conditions and variance in long-term differential settlement associated with even well-compacted granular soils, and the need to facilitate future re-engineering using vibro-replacement stone columns to support a shallow reinforced strip foundation, it is essential that the cut-and-fill process is well controlled and materials are placed/compacted in accordance with this specification.

Where site-won materials are to be used as fill to achieve the required development platform, they must be compacted to ensure in-situ densities that are in excess of 95% of the maximum dry density, as determined using a 4.5 kg laboratory Proctor test.

Materials should only be compacted when the actual moisture content is within 2% (±) of the optimum for the soil matrices as determined by laboratory bench testing.

6.3. CLASSIFICATION OF FILL MATERIAL

This specification should be read in conjunction with the following:

- The Manual of Contract Documents for Highway Works, Volume 1, Specification for Highway Works, Series 600, Earthworks as amended in February 2016; and
- BS 1377-1:2016 Methods of test for soils for civil engineering purposes. General requirements and sample preparation

6.3.1. GENERAL CLASSIFICATION

The contractor should ensure that all earthworks materials comply with Clause 601 of the *Specification for Highway Works and* shall fall into one of the following general classifications as defined in Table 6/1 of the *Specification for Highway Works*.

- General granular fill (Class 1);
- General cohesive fill (Class 2), excluding Class 2A and 2E; or
- Selected granular fill (Class 6).

Materials can be engineered in accordance with the Methods for General Cohesive Fill (Class 1 or 2) however it is essential the performance criteria of a Class 7A Material is achieved.

6.3.2. USE OF FILL MATERIAL

In addition to any grading requirement the maximum particle size of any fill material shall be no more than two-thirds of the compacted layer thickness except that cobbles having an equivalent diameter of more than 150mm shall not be deposited within the restored surface level unless directed otherwise by the Engineer.

Un-burnt colliery spoil, pulverised fuel ash or furnace bottom ash shall not be used as a fill material.

Prior to the additional of any stabilising agents, laboratory bench testing will be undertaken in accordance with the method and rationale as outlined within the DMRB HA74/07.

For any stabilisation works certain limiting factors must be considered by the contractor in their design:

- Soils can only be stabilised through the addition of lime/OPC when the ambient air temperature is >7 degrees; and,
- Ground temperatures cannot fall below 3 degrees.

In addition to any grading requirement for a material type the maximum particle size of any fill material shall be no more than two-thirds of the compacted layer thickness except that cobbles having an equivalent diameter of more than 150mm shall not be deposited within the restored surface level unless directed otherwise by the Engineer.

Prior to the commencement of any works, the following laboratory tests are to be completed by the contractor to demonstrate suitability of materials for use as a structural fill and where required to provide bench testing to confirm the applicability of stabilisation agents.

Pre-Commencement Earthworks Testing Frequency / Performance

To determine the geotechnical classifications of any material to be placed and compacted in layers, representative samples will be taken at a frequency of **1 per 2,000m³** and submitted for particle size distributions (PSDs). Maximum Dry Density and Natural and Optimum Moisture Content determinations.

To determine the geotechnical classifications of any cohesive material to be placed and compacted in layers, representative samples will be taken (following removal of any inclusions of oversize material, metal, timber, plastic, etc.) at a frequency of **1 per 1,000m³** and submitted for liquid and plastic limits, plasticity index and natural moisture content determinations. Organic matter determinations shall be prescribed at the discretion of the supervising consultant, dependent on visual observations.

Representative samples of all proposed backfill shall be taken at a frequency of **1 per 3000m³ (minimum 3nr)** and submitted for Dry Density / Optimum Moisture Content analysis using either a 4.5Kg or 2.5kg rammer to determine the optimum moisture content and maximum dry density for the engineering of structural fill.

For an unaltered fill material to be deemed suitable for use, the natural moisture content must be within 2% (+/-) of the optimum to achieve the required maximum dry density. Where the laboratory test indicates that the soil parameters are outside this requirements, stabilising agents should be added to assess suitability for use to the contractors own design.

6.4. GENERAL PERFORMANCE REQUIREMENTS – ENGINEERED FILL

The contractor shall employ only plant and working methods which are suited to the materials to be handled and traversed. The contractor shall be responsible for maintaining the nature of the acceptable material so that when it is placed and compacted it remains acceptable in accordance with the Contract.

For the purposes of this contract, the proposed earthworks requirements have been split into distinct end use categories with the corresponding requirements for the earthworks specification assigned to individual areas.

During a phase of cut-and-fill enabling works to create a developable platform, all below-ground relict foundations, infrastructure and obstructions will require grubbing out in their entirety to enable the construction of proposed structures.

The general enabling earthworks will require the excavation of Made Ground to the top of natural stratum or 1.20m below current ground level (whichever is the shallower).

The sub-formation will be subject to inspection by the supervising geotechnical engineer and proof rolling prior to the replacement with materials in accordance with the E3P geotechnical design standard.

Building Floor Slab – Completion of necessary cut / fill works, compaction of shallow granular soils and subsequent construction of a stiffened soil platform to ensure a net safe Allowable Bearing Pressure of 30kN/m2 to achieve the settlement requirements of the Structural Engineer (nominally <25mm with

differential settlement of <10mm) with the construction of a 300mm 6F2/5 capping layer and 150mm of MOT 1 ensure a CBR 15% to the top of capping and >15% at MOT 1.

Preparation of Formation (all other areas) - Prior to the placement of any engineered soils, the formation area (reduced level excavation) will be assessed and certified as suitable to ensure the removal of all soft spots that would be defined as either soft / low strength cohesive or loose granular stratum to ensure all anthropogenic and natural stratum that remains in-situ exceeds the performance requirements.

The contractor will be responsible for proof rolling and where necessary Ground Improvement in the sub-stratum to ensure it is compacted with all potential variable stratum or soft spots to be removed and replaced with material that is engineered in accordance with the requirements of this specification.

In general, all soils (excluding certified recycled and quarried aggregates) must be engineered to achieve the following performance criteria:

- Compaction in excess of 95% of the Maximum Dry Density (MDD) defined using a 4.5kg rammer or 100% of the MDD derived from a 2.5kg rammer laboratory simulation;
- Maximum <5% air void ratio in engineered cohesive soils during uplift layers;
- Moisture content to be within 3% (+/-) of the defined optimum / control value;
- CBR to meet the required performance spec for the relevant stratum in each and every engineered soil layer; and,
- Maximum deformation under Plate Load to meet the geotechnical specification within each and every compacted layer.

TABLE 6.1 SPECIFICATION FOR GEOTECHNICAL ENGINEERING WORKS - GROUND BEARING FLOOR SLAB

CONSTRUCTION DETAIL	MATERIAL	TEST TYPE	FREQUENCY / 1 PER:	PERFORMANCE REQUIREMENT
MOT Sub-Base (Engineers Drawing)	MOT – Type 1	Max Deformation & CBR by Plate Load	1000m^2	CBR to be >15% (structural engineer design)
		PSD	1000m^3	Type MOT 1 Grading
		Frost Susceptibility	5000m^3	<5% Heave
300mm Engineered Capping	Suitable Graded Aggregate	Max Deformation & CBR by Plate Load	2000m^2	15% & <5mm settlement 150kN/m2
		CBR by DCP	1000m^2	15%
		In-situ Density by NNDGT or SRD	625m2	>95% of Max DD (4.5kg)
Engineered Structural Up-Fill (Stabilised to control moisture as required)	Engineered Cohesive	In-situ Density by NNDGT or SRD	625m2	>100% of Max DD (2.5kg) <5% Air Voids >95% of Max DD (4.5kg) <5% Air Voids
		Max Deformation & CBR by Plate Load	4000m^2 (placed)	>3%
		CBR by DCP	1000m^3	>5%
		Odometer (core)	10,000m^3	<0.1 m^2/MN
	Engineered Granular	In-situ Density by NNDGT or SRD	650m2	>100% of Max DD (2.5kg) >95% of Max DD (4.5kg)
		Max Deformation & CBR by Plate Load	4000m^2 (placed)	>3%
		CBR by DCP	1000m^3	>3%
Base of Formation	Granular or Cohesive	CBR by DCP	4000m^2	>3%
		Hand Shear vane	500m^2	Cu >30kN/m2

TABLE 6.2 SPECIFICATION FOR GEOTECHNICAL ENGINEERING WORKS – EXTERNAL HARDSTAND

CONSTRUCTION DETAIL	MATERIAL	TEST TYPE	FREQUENCY / 1 PER:	PERFORMANCE REQUIREMENT
MOT Sub-Base (Engineers Drawing)	MOT – Type 1	Max Deformation & CBR by Plate Load	1000m2	CBR to be >15% (structural engineer design)
		PSD	1000m3	Type DOT 1 Grading
		Frost Susceptibility	5000m3	<5% Heave
300mm Engineered Capping	Suitable Aggregate	Max Deformation & CBR by Plate Load	1000m2	15% & <6mm settlement 100kN/m2
		CBR by DCP	1000m2	15%
		In-situ Density by SRD or NNDGT	650m2	>100% of Max DD (2.5kg) >95% of Max DD (4.5kg)
Base of Formation	Granular or Cohesive	CBR by DCP	1000m2	>3%

Notes:
Maximum dry density shall be determined by obtaining representative samples of all material that will be engineered using laboratory determinations to confirm the Optimum Moisture Content & Maximum Dry Density for soils in either the unaltered or modified (stabilised) state.

CBR by Plate Load will utilise a 450mm Plate with the test to be conducted in strict accordance with BS1377 (Part 9). Note this will mean the loading of the test until all movement of the plate has stopped, i.e. until the average settlement rate is less than 0.02mm per 5 minute interval. A minimum modelled load of 150Kn/m2 will be applied to all PLT Testing for the purposes of this contract.

In-situ density method to be selected by the contractor with written approval required from the supervising organisation in terms of appropriateness of application.

The depth of differing stratum as indicated within the E3P specification is for guide purposes only and the contractor must refer to the Structural Engineers drawings for specific build up requirements.

Where soil is to be stabilised and used as an engineered fill material the contractor will be required to provide a site specific method statement for the proposed works to be fully inclusive of laboratory bench testing to demonstrate the suitability for use.

TABLE 6.3 E3P EARTHWORKS GEOTECHNICAL COMPACTION SPECIFICATION

SOIL/MATERIAL TYPE	CLASS	DESCRIPTION	COMPACTION EQUIPMENT	LAYER THICKNESS	ROLLER PASSES
Granular Fill	1 A	Sandy Gravel with some cobbles	> 5000 kg vibrating roller	225 mm	4
(Sand and Gravel Matrices)	1 B	Sand or Gravel of same grading size	> 5000 kg vibrating roller	250 mm	10
	1 C	Coarse gravels with many cobbles	> 5000 kg vibrating roller	400 mm	5
Cohesive Fill	2 A	Wet Clays	> 100 kg metric ton vibrating tamping roller (sheep foot only)	100–225 mm	3
(Clay with Minor Sand and Gravel Component)	2 B	Dry Clay	> 5000 kg vibrating roller or 1400 kg tamping (trench roller)	225 mm or 125 mm	4 or 12
	2 C	Gravelly Clay	> 5000 kg vibrating roller or 1400 kg tamping (trench roller)	225 mm or 125 mm	4 or 12
	2 D	Silty/Sandy Clay	> 5000 kg vibrating roller or 1400 kg tamping (trench roller)	225 mm or 125 mm	4 or 12
Recycled Aggregate Crush **(< 125 mm Well Graded)**	6F2	Any combination of inert hard materials, other colliery spoil, or rock with substantial amounts of clay-like component	> 5000 kg vibrating roller	250 mm	6

6.4.1. USE OF FILL MATERIALS

In addition to any grading requirement the maximum particle size of any fill material shall be no more than two-thirds of the compacted layer thickness except that cobbles having an equivalent diameter of more than 150mm shall not be deposited within the restored surface level unless directed otherwise by the Engineer.

Un-burnt colliery spoil, pulverised fuel ash or furnace bottom ash shall not be used as a fill material.

Prior to the additional of any stabilising agents, laboratory bench testing will be undertaken in accordance with the method and rationale as outlined within the DMRB HA74/07.

For any stabilisation works certain limiting factors must be considered by the contractor in their design:

- Soils can only be stabilised through the addition of lime/OPC when the ambient air temperature is >7 degrees.
- Ground temperatures cannot fall below 3 degrees.

In addition to any grading requirement for a material type the maximum particle size of any fill material shall be no more than two-thirds of the compacted layer thickness except that cobbles having an equivalent diameter of more than 150mm shall not be deposited within the restored surface level unless directed otherwise by the Engineer.

Prior to the commencement of any works, the following laboratory tests are to be completed by the contractor to demonstrate suitability of materials for use as a structural fill and where required to provide bench testing to confirm the applicability of stabilisation agents.

6.4.2. PRE-COMMENCEMENT EARTHWORKS TESTING FREQUENCY / PERFORMANCE

To determine the geotechnical classifications of any material to be placed and compacted in layers, representative samples will be taken at a frequency of 1 per 1,000m³ and submitted for particle size distributions (PSDs). Maximum Dry Density and Natural and Optimum Moisture Content determinations.

To determine the geotechnical classifications of any cohesive material to be placed and compacted in layers, representative samples will be taken (following removal of any inclusions of oversize material, metal, timber, plastic, etc.) at a frequency of 1 per 1,000m³ and submitted for liquid and plastic limits, plasticity index and natural moisture content determinations. Organic matter determinations shall be prescribed at the discretion of the supervising consultant, dependent on visual observations.

For an unaltered fill material to be deemed suitable for use, the natural moisture content must be within 2% (+/-) of the optimum to achieve the required maximum dry density. Where the laboratory test indicates that the soil parameters are outside this requirements, stabilising agents should be added to assess suitability for use to the contractors own design.

6.5. GENERAL REQUIREMENTS

The contractor shall employ only plant and working methods that are suited to the materials to be handled and traversed. The contractor shall be responsible for maintaining the nature of the acceptable material so that when it is placed and compacted it remains acceptable in accordance with the contract.

For the purposes of this contract, the proposed earthworks requirements have been split into distinct end use categories, with the corresponding requirements for the earthworks specification assigned to individual areas.

TABLE 6.4 COMPACTION/BACKFILL REQUIREMENTS

LAND USE requirement	COMPACTION METHODOLOGY and GENERAL PERFORMANCE CRITERIA
Traditional Spread Foundation	Ensure no disturbance of natural soil at shallow depth.
Re-Engineering of Soils Using Vibro-Replacement Stone Column (VRSC)	Materials to be placed in a controlled manner to facilitate the construction of vibro-replacement stone columns (VRSC). to limit differential settlement and increase net Allowable Bearing Pressure (ABP) **These works are to be completed within the building structure footprint and +2 m of all elevations.** Material must be 90% granular in composition with less than 10% fines (which are classified as materials < 0.6 microns in size). No material greater than 125 mm in size is permitted, with 90% of the soils placed conforming to grading < 90 mm. Material is to be placed when actual moisture content is within tolerable limits of the optimum, with specific attention to soils that are notably wetter than the optimum. Material to be placed in a manner so as to ensure a minimum CBR of 5% at formation to facilitate machine movement and piling mat construction. Where site-won materials are used to upfill, levels must be compacted to an "end product" performance specification where the in-situ density exceeds 95% of the maximum (determined by laboratory conditions). Where rock is present at a shallow depth, the remediation contractor will ensure the substratum is prepared to ensure that a minimum of 1000 mm of appropriately graded granular material is present to the underside of the proposed doubly reinforced concrete strip foundation.

	The substratum must be prepared to ensure a vibro-stone column treatment depth is not less than 80% of the immediate adjacent profile.
Piled Foundation	All plot footprint (+ 2 m) must be free of any deleterious elements, tree roots and obstructions > 150 mm. Where upfill is proposed, material is to be placed using method compaction specification to achieve a CBR as required by the developer for piling mat construction. Piling mat is to be placed and constructed in accordance with the approved geotechnical engineer's temporary works design.
Adopted Highways (+ 2 m from Back of Footpath)	*Method Compaction – Highways Design Manual Series 600* is to be followed, with in-situ validation testing to meet requirement of adoptions authority. A CBR > 5% is required at subgrade formation (prior to placement of capping).
Estate Roads	*Method Compaction – Highways Design Manual Series 600* is to be followed to achieve a CBR > 5%.
Landscaping, POS and Other External Areas	Material is to be placed in layers not exceeding 300 mm and must be rolled using dedicated plant (no earth moving equipment) and in general compliance with the requirements of *Highways Design Manual Series 600*.

Acceptability shall be determined in accordance with Table 6/1 of the *Specification for Highway Works*.

Laboratory testing for the purposes of determining acceptability and compaction requirements will be conducted by the engineer.

Haulage of material to embankments or other areas of fill shall proceed only with sufficient spreading and compaction. Plant is operating at the place of deposition to ensure compliance with Clause 612 of the *Specification for Highway Works*.

No excavated acceptable material or unacceptable material required to be processed, other than surplus to the requirements of the contract, shall be removed from the site.

Where the excavation reveals a combination of acceptable and unacceptable materials, the contractor shall carry out the excavation in such a manner that the acceptable materials are excavated separately for use in the permanent works without contamination by the unacceptable materials. Unless otherwise described in the contract, classes of fill material required to be deposited separately shall be excavated separately without contamination by other classes of material.

The contractor shall make their own arrangements for the stockpiling of acceptable material, and unacceptable material to be processed, and for the provision of site for this purpose.

The contractor shall ensure that they do not adversely affect the stability of excavations or fills by their methods of stockpiling materials, use of plant or siting of temporary buildings or structures.

Topsoil shall, wherever practicable, be used immediately after its stripping and, if not, shall be stored in stockpiles of heights not exceeding 2 m. Topsoil shall not be stockpiled for more than two years. Topsoil shall not be unnecessarily trafficked, either before stripping or when in a stockpile. Stockpiles shall not be surcharged or otherwise loaded and multiple handling shall be kept to a minimum.

Excavations requiring backfilling shall remain open only for the minimum period necessary.

The contractor shall keep earthworks free of water, including:

- Arranging the rapid removal of water:
  - shed on to the earthworks; and
  - entering the earthworks from any source;
- Provide, where necessary, temporary watercourses, drains, pumping and the like;
- Discharge accumulated water and groundwater into the permanent outfalls of the drainage system where practicable; and
- Provide adequate means for trapping silt on temporary systems discharging into permanent drainage systems.

The contractor shall carry out and maintain groundwater lowering or other treatment as required.

Where materials are designated either Class U1B or Class U2 (according to the *Specification for Highway Works*), the contractor shall carry out any special requirements for their handling. Where such materials are encountered during the progress of the works, the contractor shall make all necessary arrangements for their safe handling and disposal after consultation with the appropriate environmental authority.

6.5.1. CONSTRUCTION OF FILLS – HIGHWAYS

All fills shall be constructed:

- In the locations as shown in the contract drawings to the lines and levels stated therein;
- Of classes of material complying with this specification;
- By deposition, as soon as practicable after excavation, in layers to meet the compaction requirements as required for each class of material as specified; and
- To the requirements of this clause and any other requirements for fill in this specification.

Before commencing work on any area of fill, the contractor shall ensure that:

- The base is sound and stable by excavating and removing any topsoil as soft subsoil;
- Base layers are not exposed until the fill layer is ready for placement; and
- Uncompacted material on the side slopes of previously backfilled zones shall be removed and benches of between 1.0 m and 1.5 m height cut in compacted fill immediately prior to deposition of the new fill to ensure that the new backfill placed against the slope is properly integrated.

Whenever fill is to be placed on surfaces inclined at 1 vertical to 7 horizontal or steeper, the surface shall be benched immediately prior to deposition of the fill in order to achieve horizontal basal surfaces. The benches shall be between 1.0 m and 1.5 m in height.

Areas of fill shall, unless otherwise permitted by the engineer, be constructed evenly over their fullest possible extent and the contractor shall carefully control and direct construction plant and other vehicular traffic uniformly over the area of compacted fill. The minimum plan dimensions of any one panel of backfilling shall be properly integrated with areas of previous backfilling. Damage by construction plant and other vehicular traffic shall be made good by the contractor with material having the same characteristics and strength as the material had before it was damaged.

Temporary slopes within compacted and uncompacted backfill shall be formed at gradients that ensure stability.

6.5.2. CONSTRUCTION OF FILLS – ADOPTED HIGHWAYS, ESTATE ROADS AND CAR PARK

The contractor shall carry out compaction upon the materials that require to be compacted, as soon as practicable after deposition.

Compaction shall be either method as required for the classes of fill in Table 6/1 that require to be compacted.

The contractor shall obtain permission from the overseeing organisation before carrying out compaction requirements as listed in Table 6/1 for the class of material being compacted.

Method compaction shall be undertaken using the plant and methods appropriate to the compaction requirements as listed in Table 6/1 for the class of material being compacted.

Earthmoving plant shall not be accepted as compaction equipment nor shall the use of a lighter category of plant to provide any preliminary compaction to assist the use of heavier plant be taken into account when assessing the amount of compaction required for any layer.

If more than one class of material is being used in such a way that it is not practicable to define the areas in which each class occurs, the contractor shall compact with plant operating as if only the material which required the greater compaction effort is being compacted.

If the results of field tests show densities that indicate the state of the compaction to be inadequate, then if this is due to failure of the contractor to comply with requirements of the contract, the contractor shall carry out such further work as is required to comply with the contract.

Refer to Clause 612/10 of the *Specification for Highway Works* for definition of plant to be used in accordance with these specified works.

The contractor will be responsible for assessing the class of fill in accordance with Table 6/1 of the *Specification for Highway Works*. Table 6/4 of the *Specification for Highway Works* should then be employed to assess the method of compaction to be employed. The test results and method statements shall be submitted to the consulting engineers for approval.

6.5.3. UNACCEPTABLE MATERIAL

The contractor is solely responsible for ensuring full and detailed analysis of all reported ground conditions and areas of risk in terms of the potential for unacceptable material to be present within the proposed earthworks. Limitations in the available information should be highlighted to the supervising engineer prior to the commencement of earthworks. The contractor is to make full and unequivocal arrangements to investigate the potential presence for unsuitable materials within the earthworks and construction of highway fill. All unsuitable materials are to be identified for removal in accordance with this specification.

Unacceptable material Class U1A shall be:

Material which does not comply with the permitted constituents and material properties of MCHW Table 6/1 and contract specific Appendix 6/1 for acceptable material; and;

Material, or constituents of materials, composed of the following unless otherwise described in contract specific Appendix 6/1:

- Peat, materials from swamps, marshes and bogs;
- Logs, stumps and perishable material;
- Materials in a frozen condition;
- Clay having a liquid limit determined in accordance with BS 1377: Part 2, exceeding 90 or plasticity index determined in accordance with BS 1377: Part 2, exceeding 65; and,
- Material susceptible to spontaneous combustion except unburnt colliery spoil complying with sub-Clause 15 of this Clause;(ii)unacceptable material

Unacceptable material Class U1B shall be:

Contaminated materials, including controlled wastes (as defined in the Environmental Protection Act 1990 Part IIA) whose level of contamination is above that given either in contract specific Appendix 6/14 or in contract specific Appendix 6/15, but excluding all hazardous wastes (as Volume 1 Series 600 Specification for Highway Works Earthworks W2 Amendment – February 2016 defined in the Hazardous Waste (England and Wales) Regulations 2005) and radioactive wastes (as defined in the Radioactive Substances Act 1993).3(02/16).

Unacceptable material Class U2 shall be:(i) hazardous waste (as defined in the Hazardous Waste (England and Wales) Regulations 2005) and radioactive waste (as defined in the Radioactive Substances Act 1993).4(02/16).

Where required in contract, unacceptable material (other than Class U2) shall be processed by mechanical, chemical or other means to render the material acceptable for use in the permanent works in accordance with the requirements of Table 6/1 and contract specific MCHW Appendix 6/1.

6.6. EARTHWORKS MATERIAL TESTS

Prior testing of the potential sources of fill shall be undertaken by the contractor and submitted to the consulting engineers for approval. This testing shall include, but not necessarily be limited to, the compaction and backfill requirements detailed in Table 6.5.

TABLE 6.5 COMPACTION/BACKFILL REQUIREMENTS

<table>
<tr><th>LAND USE</th><th>COMPACTION METHODOLOGY and GENERAL PERFORMANCE CRITERIA</th></tr>
<tr><td>Liquid and Plastic Limits</td><td>BS 1377: Part 2</td></tr>
<tr><td>Grading</td><td>BS 1377: Part 2</td></tr>
<tr><td>Uniformity Coefficient</td><td>Calculated from grading curve</td></tr>
<tr><td>Moisture Content
Multi-point moisture condition value (MCV) (to assess optimum moisture content).</td><td>BS 1377: Part 2</td></tr>
<tr><td>Organic Matter (Maximum 2.5% Total Organic Content)</td><td>BS 1377: Part 3</td></tr>
<tr><td>Water Soluble Sulphate</td><td>TRL Report 447 Test No 1</td></tr>
<tr><td>Total Sulphate Content</td><td>TRL Report 447 Test No 4</td></tr>
<tr><td>Earthwork In-situ Tests
Subsequent to the filling and compaction of the material, a series of in-situ tests shall be undertaken to confirm the success of the compaction process. This testing shall include, but necessarily be limited to, the following:
<table>
<tr><th>Test</th><th>Test Method</th></tr>
<tr><td>Plate Load Tests (Equivalent CBR)</td><td>BS 1377: Part 9</td></tr>
</table>
Disposal of Materials
The contractor shall be responsible for the safe disposal of any excess of unsuitable material found on the site.</td><td>Clause 632 (BS 1377: Part 4)</td></tr>
<tr><td>Max DD / OMC (Proctor) Compaction Testing</td><td>BS 1377: Part 4</td></tr>
</table>

The current and proposed site topography, changes in elevation and any existing or new slopes are beyond the scope of this specification. Where any earth slopes exceed a design gradient of 1(v) in 3(h) either on site or within the conjectured zone of structural influence, extreme care should be taken with a full and detailed geotechnical slope analysis to inform the retained design solution.

7. RECORD-KEEPING AND VERIFICATION

7.1. RECORD-KEEPING

During the course of the remediation and site enabling works, the on-site E3P consultant will undertake the following record-keeping protocols:

- Detailed daily site diary including material movements;
- Sampling register, testing results, photographs, details of locations of hydrocarbon-impacted soils (drawings), details of hotspot removals, details of consignment notes of any hydrocarbon-impacted material that is required to be disposed of off site; and
- Detailed surveys (volumes).

Record-keeping on site, in particular movements and analysis of specific material types, will be in the form of site diaries and a remediation excavation record. This record will remain on site and will be completed by the E3P on-site engineer during the course of the remediation and site enabling works.

7.2. VERIFICATION

The records listed above will then be compiled into a validation report produced by E3P on completion of the remediation and site enabling works, clearly referencing the origin of the materials used and testing carried out to confirm its suitability for use, where required. E3P will also prepare an as-built development drawing clearly detailing the materials present on site to be cross referenced with the supporting validation documentation.

The validation report will include the following:

- Remediation strategy (including copies of confirmation from regulatory authorities agreeing criteria);
- Detailed surveys of all excavations and production of as-built drawings for the earthworks;
- Copy of consignment notes relating to the movement of wastes to a licensed waste management facility;
- Detailed drawings showing all sampling locations for both chemical and geotechnical testing;
- Chemical test results;
- Geotechnical test results;
- Details of qualified persons signed declaration; and
- Monitoring results if undertaken (e.g. asbestos in air, gas water).

8. CONTINGENCY PLAN

8.1. PREVIOUSLY UNIDENTIFIED CONTAMINANTS

Should significantly impacted material be encountered during the development, then it will be excavated and stockpiled on an impermeable material and sampled and tested for an appropriate range of determinants.

Once the laboratory analysis of the material is available, an assessment will be undertaken to determine whether it can be retained on site as part of the material management plan or whether it should be disposed of off site.

Depending on the nature of any such impact, it may be necessary to undertake validation testing of the excavation faces in order to demonstrate that no such materials are left in situ.

9. SECOND PHASE MITIGATION AND MANAGEMENT – BUILD PHASE

This document details the construction works that are required to ensure full compliance with the remediation Strategy, Regulatory Authorities, Building Control & Warranty Providers;

The following should be implemented during the build phase of the development:

- Laboratory testing of the imported topsoil;
- Chemical validation of any additional subsoil imported for use within landscaping;
- Placement and validation of sub-soil (clean material) in a 150mm layer within landscaping where the material was not placed during the Remediation & Enabling works; and
- Placement and chemical validation of imported topsoil within soft landscaping.

The validation protocols are presented within the E3P Remediation and Enabling Works Strategy and are presented below.

9.1. PLACEMENT OF COVER SYSTEM

The Remediation and Enabling Works Strategy for the site, with respect to human health of the future site users includes the provision of a chemically suitable clean material to be installed in all landscaped areas; the construction of the clean cover / placement of clean material shall consist of:

- 150mm subsoil; and,
- 150mm topsoil.

In accordance with the current requirements of the regulatory authorities, validation samples will be collected from all materials that are to be imported or re-used on site to confirm the proposed development will pose no unacceptable risk to human health or the wider environ.

Subsoil and topsoil shall be free of any deleterious materials, such as buildings materials, timber, plastics etc and conform to the requirements of BS 3882:2007.

Initial testing of site won sub-soil to classify its re-use on site has been completed as part of the remediation works undertaken. Therefore, further analysis of sub-soil will be required to achieve the testing frequencies outlined within the remediation strategy and in the event of importation of additional material during construction.

Testing requirements for top-soil and sub-soil are presented in Table 9.1.

TABLE 9.1 SPECIFICATION FOR SOIL TESTING

MATERIAL USE	TESTING FREQUENCY	SUITE OF ANALYSIS
Subsoil Greenfield Source (150 mm Soft Cover)`	1 Sample per 200 m^3	A/B/C/D
Subsoil Brownfield Source (150 mm Soft Cover)	1 Sample per 150 m^3	A/B/C/D
Topsoil Greenfield Source (150 mm Soft Cover)	1 Sample per 200 m^3	A/B/C/D
Topsoil Brownfield Source (150 mm Soft Cover)	1 Sample per 150 m^3	A/B/C/D
General Engineering Fill (Class 1 and 2 Soil)	1 Sample per 200 m^3	A/B/C/D

Notes
Suites of Analysis:
A. Speciated PAH.
B. Speciated TPH (C5-C35).
C. Asbestos (ID).
D. CLEA Inorganic Heavy Metals.

9.1.1. PROCEDURE FOR PLACEMENT OF CHEMICALLY SUITABLE COVER SYSTEM

Landscaped areas need to be backfilled with 150mm chemically validated subsoil, with 150mm topsoil overlaying this. Topsoil is required to be confirmed as chemically suitable prior to placement. Where sub-soil is not placed during Remediation & Enabling works, E3P will be required to return to site and undertake independent validation of the correct placement of sub-soil.

The placement of 300mm of clean material will be undertaken during the build phase works of the project.

The placement of subsoil and corresponding validation will be documented within the landscape Validation Letters (to be issued on completion of the contractor's works).

If proposed utilities are to be placed within the cover system, the clean cover should be placed prior to installation of these utilities.

If natural drift deposits are encountered, excavation can cease here.

E3P will collect photographic evidence of the placement of 150mm of certified topsoil and 150mm of subsoil on completion of construction works. This element will also be checked by the Building Control Officer as part of the site completion prior to issuing of a CML certificate.

The soft cover validation procedure is detailed in Table 9.2.

TABLE 9.2 LANDSCAPE VALIDATION PROCEEDURE

PROCEDURE	METHOD
Chemical Validation	Imported sub-soils and topsoil will need to be chemically analysed to confirm suitability for use with the proposed cover system prior to installation and completion of the soft cover systems. If acceptable the materials can be installed to the required depth at which time the plot will be deemed complete following a validation procedure by a suitability qualified E3P engineer.
Trial Holes	Trial holes are deemed necessary for the all plots given that the 300mm cover system will need to be placed on each plot during the build phase.
Validation	Photographic evidence will be taken by E3P of the topsoil placement demonstrating the depth of topsoil and practical completion of works are required for each and every plot. For plots where sub-soil depths require validation by E3P during the build phase, photographs will be taken and collated by E3P.
Validation Certificate	Once the photographs of the placement of topsoil (over the clean material) have been provided, E3P will issue a plot specific validation certificate to demonstrate that the required subsoil and topsoil has been placed in the required soft cover areas along with the chemical analysis.
Completion Report	Upon completion of all landscaped areas within the development, a Completion Report will be issued providing the confirmation that all remediation requirements have been achieved.

Plate 1 provides an example of a landscape validation photographs that will be required.

PLATE 1 EXAMPLE PLOT COVER SYSTEM VALIDATION

Plot No: 4 (Car Park Landscaping)		
Depth of Strata (m bgl)	0.00-0.30	Validated TOPSOIL
Depth of Cover System Materials	***Depth of Cover System Materials***	
Depth of Cover System at Ground Level and in Relation to Unit / Structure		

9.2. POTABLE WATER SUPPLY – CONTAMINANT ASSESSMENT CRITERIA

Contaminant Group	PE-threshold[A]	Maximum Permissible concentration at proposed pipeline depth[A]	Maximum permissible site concentration[A]
Total VOC	0.5	N/A	N/A
Total BTEX And MTBE	0.1	N/A	N/A
Total SVOCs (Excluding PAH and those substances marked with an *)	2	N/A	>2
EC5-EC10 Aliphatic and Aromatic Hydrocarbons	2	< 0.1	< 0.1
EC10-EC16- Aliphatic and Aromatic Hydrocarbons	10	104	297
EC16-EC40 Aliphatic and Aromatic Hydrocarbons	500	49	1590
Phenols (From SVOC Analysis)*	2	< 0.3	< 0.3
Cresols and Chlorinated Phenols (From SVOC Analysis)	2	< 0.3	< 0.3

Notes

A. All concentrations in mg/kg.

END OF REPORT

APPENDIX I
LIMITATIONS

1. This report and its findings should be considered in relation to the terms of reference and objectives agreed between E3P and the Client as indicated in Section 1.2.

2. For the work, reliance has been placed on publicly available data obtained from the sources identified. The information is not necessarily exhaustive and further information relevant to the site may be available from other sources. When using the information it has been assumed it is correct. No attempt has been made to verify the information.

3. This report has been produced in accordance with current UK policy and legislative requirements for land and groundwater contamination which are enforced by the local authority and the Environment Agency. Liabilities associated with land contamination are complex and requires advice from legal professionals.

4. During the site walkover, reasonable effort has been made to obtain an overview of the site conditions. However, during the site walkover, no attempt has been made to enter areas of the site that are unsafe or present a risk to health and safety, are locked, barricaded, overgrown, or the location of the area has not been made known or accessible.

5. Access considerations, the presence of services and the activities being carried out on the site limited the locations where sampling locations could be installed and the techniques that could be used.

6. Site sensitivity assessments have been made based on available information at the time of writing and are ultimately for the decision of the regulatory authorities.

7. Where mention has been made to the identification of Japanese Knotweed and other invasive plant species and asbestos or asbestos-containing materials, this is for indicative purposes only and do not constitute or replace full and proper surveys.

8. The executive summary, conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full.

9. E3P cannot be held responsible for any use of the report or its contents for any purpose other than that for which it was prepared. The copyright in this report and other plans and documents prepared by E3P is owned by them and no such plans or documents may be reproduced, published or adapted without written consent. Complete copies of this may, however, be made and distributed by the client as is expected in dealing with matters related to its commission. Should the client pass copies of the report to other parties for information, the whole report should be copied, but no professional liability or warranties shall be extended to other parties by E3P in this connection without their explicit written agreement there to by E3P.

10. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part.

APPENDIX II
GLOSSARY

TERMS

ACM	Asbestos-containing material	**MMP**	Materials management plan
ADS	Acoustic design statement	**ND**	Not detected
AST	Above-ground storage tank	**NDP**	Nuclear density probe
BGS	British Geological Survey	**NMP**	Noise management plan
BSI	British Standards Institute	**NPSE**	Noise policy statement for England
BTEX	Benzene, toluene, ethylbenzene, xylenes	**NR**	Not recorded
CA	Coal Authority	**PAH**	Polycyclic aromatic hydrocarbon
CBR	California bearing ratio	**PCB**	Polychlorinated biphenyl
CIEH	Chartered Institute of Environmental Health	**PI**	Plasticity index
CIRIA	Construction Industry Research Association	**PID**	Photo ionisation detector
CLEA	Contaminated land exposure assessment	**POS**	Public open space
CML	Council of Mortgage Lenders	**PPE**	Personnel protective equipment
CoC	Contaminants of concern	**ProPG**	Professional practice guidance
CSM	Conceptual site model	**QA**	Quality assurance
DNAPL	Dense non-aqueous phase liquid (chlorinated solvents, PCB)	**SGV**	Soil guideline value
DWS	Drinking water standard	**SPH**	Separate-phase hydrocarbon
EA	Environment Agency	**SPT**	Standard penetration test
EQS	Environmental quality standard	**SVOC**	Semi-volatile organic compound
FFL	Finished floor level	**TPH**	Total and speciated petroleum hydrocarbon
GAC	General assessment criteria	**TPH CWG**	Total Petroleum Hydrocarbon (Criteria Working Group)
GL	Ground level	**UKWIR**	United Kingdom Water Infrastructure Risk
GSV	Gas screening value	**UST**	Underground storage tank
HCV	Health criteria value	**VCC**	Vibro-concrete column
ICSM	Initial conceptual site model	**VOC**	Volatile organic compound
LEL	Lower explosive limit	**VRSC**	Vibro-replacement stone columns
LMRL	Lower method reporting limit	**VSC**	Vibro-stone columns
LNAPL	Light non-aqueous phase liquid (petrol, diesel, kerosene)	**WHO**	World Health Organisation
MCV	Moisture condition value	**WRAP**	Waste and Resources Action Programme
MIBK	Methyl isobutyl ketone	**WTE**	Water table elevation
m	Metres	**ppm**	Parts per million

km	Kilometres	**mg/m^3**	Milligram per metre cubed
% v/v	Percent volume in air	**m bgl bgl**	Metres below ground level
mb	Millibars (atmospheric pressure)	**m bcl**	Metre below cover level
l/hr	Litres per hour	**mAOD**	Metres above ordnance datum (sea level)
µg/l	Micrograms per litre (parts per billion)	**kN/m^2**	Kilonewtons per metre squared
ppb	Parts per billion	**µm**	Micrometre
mg/kg	Milligrams per kilogram (parts per million)	**SSRT**	Site Specific Remediation Target
PSD	Particle Size Distribution	**DD**	Dry Density
CL:AIRE	Contaminated Land: Applications in Real Environments	**Mc**	Moisture Content
ρ	Bulk Density	**GPR**	Ground Penetrating Radar
NDP	Nuclear Density Probe	**FFL**	Finished Floor Level
LEL	Lower Explosive Limit	**UKWIR**	UK Water Industry Research
CIRIA	Construction Industry Research and Information Association	**LOD**	Limit of Detection

APPENDIX III
DRAWINGS

APPENDIX IV
E3P REMEDIATION/ VALIDATION CRITERIA

HUMAN HEALTH REMEDIATION TARGETS – INDUSTRIAL / COMMERCIAL USE

DETERMINAND	UNITS	WITHIN 300 mm COVER SYSTEM (POS)	UNDER HARD STANDING AND >300 mm TO 1.0M BELOW COVER SYSTEM	PATHWAY
Arsenic (vii)	mg/kg	79	640	1
Cadmium (vii)	mg/kg	120	190	1
Chromium (Hexavalent)	mg/kg	7.7	33	1
Lead (vii)	mg/kg	200	1100	1
Elemental Mercury	mg/kg	16	58	2
Nickel	mg/kg	230	980	1
Selenium	mg/kg	1100	12000	1
Copper	mg/kg	12000	68000	1
Zinc	mg/kg	81000	730000	1
Cyanide	mg/kg	791	791	1
Phenol	mg/kg	210	210	2
Asbestos	Fibres	NFD	≤0.001	4
Naphthalene	mg/kg	4900	190	2
Acenaphthylene	mg/kg	15000	83000	3
Acenaphthene	mg/kg	15000	84000	1
Fluorene	mg/kg	9900	63000	1
Phenanthrene	mg/kg	3100	22000	3
Anthracene	mg/kg	74000	520000	3
Fluoranthene	mg/kg	3100	23000	3
Pyrene	mg/kg	7400	54000	3
Benzo(a)Anthracene(	mg/kg	29	170	3
Chrysene	mg/kg	57	350	3
Benzo(b)Fluoranthene	mg/kg	7.1	44	3
Benzo(k)Fluoranthene	mg/kg	190	1200	3
Benzo(a)Pyrene	mg/kg	5.7	35	3
Indeno(123-cd)Pyrene	mg/kg	82	500	3
Dibenzo(a,h)Anthracene	mg/kg	0.57	3.5	3
Benzo(ghi)Perylene	mg/kg	640	3900	3
TPH C5-C6 (aliphatic)	mg/kg	570000	3200	2
TPH C6-C8 (aliphatic)	mg/kg	600000	7800	2
TPH C8-C10 (aliphatic)	mg/kg	13000	2000	2
TPH C10-C12 (aliphatic)	mg/kg	13000	9700	2
TPH C12-C16 (aliphatic)	mg/kg	13000	59000	1
TPH C16-C35 (aliphatic)	mg/kg	250000	1600000	1
TPH C5-C7 (aromatic)	mg/kg	56000	26000	1
TPH C7-C8 (aromatic)	mg/kg	56000	56000	2
TPH C8-C10 (aromatic)	mg/kg	5000	3500	2
TPH C10-C12 (aromatic)	mg/kg	5000	16000	2
TPH C12-C16 (aromatic)	mg/kg	5100	36000	2
TPH C16-C21 (aromatic)	mg/kg	3800	28000	1
TPH C21-C35 (aromatic)	mg/kg	3800	28000	1
1.2 Dichloroethene	mg/kg	29	0.67	1
Trichloroethane	mg/kg	140000	660	1
1122 Tetrachloroethane	mg/kg	1400	270	1
1112 Tetrachloroethane	mg/kg	1400	110	1
Tetrachloroethene	mg/kg	1400	19	1
Tetrachloromethane	mg/kg	890	2.9	1
Trichloroethene (TCE)	mg/kg	120	1.2	1

Trichloromethane	mg/kg	2500	99	1
Chloroethene	mg/kg	3.5	0.059	1

Notes 1

NFD = No Fibres Detected

Asbestos will be screened visually on site by a qualified environmental consultant and where potential ACM is identified, representative samples will be subject to quantitative analysis of % volume by weight.

Should any ACM be identified within the soil matrices, further detailed % assessment would be required when the reported laboratory result exceeds the limit of detection for the analytical method at 0.01% by volume (weight).

Notes 2
Excludes matrices where free product is observed.

Tier 1 values for POS (resi) used for any imported soils used for cover system;

Commercial Tier 1 GAC modelled to assume no exposure pathway; and,

No viable exposure pathway beneath hard standing and cover system. Exceedance of target level should be subject to further risk assessment.

Notes 3
Main exposure pathways: 1 = soil ingestion, 2 = vapour inhalation (indoor), 3 = dermal contact and ingestion, 4 = dust inhalation.

Abbreviations: GAC = general assessment criteria, n = number of samples, MC = maximum concentration, N/A = Not Applicable (no exceedance of assessment criteria), Loc of MC = location of exceedances.

i. Value derived from LQM Suitable 4 Use Levels (S4ULs) for commercial end use with plant uptake.
ii. Value derived from LQM Suitable 4 Use Levels (S4ULs) for commercial end use without plant uptake – these levels used below 300 mm cover system within commercial landscaping as soils will be present within a commercial setting yet soils will not be disturbed and garden plants will not reach these soils.
iii. Value derived from LQM Suitable 4 Use Levels (S4ULs) for public open space (POS) commercial .
iv. Value derived from LQM Suitable 4 Use Levels (S4ULs) for public open space (POS) park – these levels used below 300 mm POS cover system as soils will not be disturbed by any future site users and exposure to these soils will be similar to a park end use.
v. Value derived from LQM Suitable 4 Use Levels (S4ULs) alongside assessment with WM3 to ensure that materials remaining on site do not exceed the WM3 toxicity criteria for hazardous waste.
vi. Value derived from Category 4 Screening Levels (C4SL) for commercial land use with homegrown produce.
vii. Value derived from Category 4 Screening Levels (C4SL) for commercial land use without homegrown produce.
viii. Value derived from Category 4 Screening Levels (C4SL) for public open space (POS) commercial .
ix. Value derived from Category 4 Screening Levels (C4SL) for public open space (POS) park.
x. Mercury – based on elemental mercury.
xi. PAH and TPH levels used are for 1% SOM.
xii. Xylenes based on p-xylene (o-xylene 2600 mg/kg, m-xylene 3500 mg/kg) and is capped by its solubility.
xiii. Value derived from LQM Suitable 4 Use Levels (S4ULs) for commercial end use with plant uptake due to the volatilisation risk.
xiv. BTEX is not SOM-related due to inhalation pathway.

REMEDIATION TARGETS – COMPARISON OF GROUNDWATER / LEACHATE ANALYSIS WITH TIER 1 SCREENING LEVELS

DETERMINAND	UNIT	EQS SCREENING VALUE[1, 2, 3]	DWS [3,4,5]
		AA	
Arsenic	µg/l	50	10
Cadmium	µg/l	0.08-0.25	5
Chromium (VI)	µg/l	3.4	–
Chromium (III)	µg/l	4.7	50
Copper	µg/l	1	2000
Total Cyanide	µg/l	1	50
Lead	µg/l	1.2	10
Mercury	µg/l	–	1.0
Nickel	µg/l	4	20
Selenium	µg/l	–	10
Zinc	µg/l	10.9	–
pH		6–9	
Naphthalene	µg/l	2	10*
Anthracene	µg/l	0.1	
Benzo[b]fluoranthene	µg/l	0.00017*	
Benzo[k]fluoranthene	µg/l	0.00017*	
Benzo(a)pyrene	µg/l	0.00017*	
Indeno(123-cd)pyrene	µg/l	0.00017*	
Benzo(ghi)pyrene	µg/l	0.00017*	
Fluoranthene	µg/l	0.0063	
Benzo(ghi)perylene	µg/l	1.7–4	
TPH C5-C6 (benzene)	µg/l	10	1
TPH C6-C8 (toluene)	µg/l	74	700
TPH C8-C10 (ethyl benzene)	µg/l	20	300
TPH C10-C12 (xylene)	µg/l	30	500
TPH C12-C16	µg/l	2	90[5]
TPH C16-C35	µg/l	50#	90[5]
TPH C5-C6	µg/l	–	15000
TPH C6-C8	µg/l	–	15000
TPH C8-C10	µg/l	–	300
TPH C10-C12	µg/l	–	300
TPH C12-C16	µg/l	–	300

DETERMINAND	UNIT	EQS SCREENING VALUE[1, 2, 3]	DWS [3,4,5]
		AA	
TPH C16 – C21	µg/l	–	300**
TPH C21-C35	µg/l	–	300**
Tetrachloroethylene	µg/l	0.4	10
Trichloroethylene	µg/l	10	10
Trichlorobenzene	µg/l	0.4	–
Trichloromethane	µg/l	2.5	–
Dichloromethane	µg/l	20	200
Carbon Tetrachloride	µg/l	12	3
Vinyl Chloride	µg/l	–	0.3

Notes
Solubility <0.01µg/l
AA – Annual Average
* Polyaromatic hydrocarbons (PAH) - Benzo(a)pyrene (BaP), Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(g,h,i)-perylene and Indeno(1,2,3-cd)-pyrene. Benzo(a)pyrene can be considered as a marker for the other PAHs, hence only benzo(a)pyrene needs to be monitored for comparison with the biota EQS or the corresponding AA-EQS in water
** There are no WHO Guideline Values for aliphatic fractions C16-C21 and C21-C35, therefore the guideline value for aliphatic fractions inclusive of C8-C16 (300µg/l) has been applied.
1. The Water Environment (Water Framework Directive) (England and Wales) (Amendment) Regulations (2015)
2. Directive establishing a framework for Community action in the field of water policy (Water Framework Directive)
3. Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (Dangerous Substances Directive) - List II substances
4. Council Directive on the quality of water intended for human consumption (Drinking Water Directive)
5. WHO Guidelines for Drinking Water Quality. Third edition (2004)

APPENDIX V
E3P MATERIAL IMPORT CRITERIA

SITE OF IMPORTATION ADDRESS		**E3P** HELIPORT BUSINESS PARK, LIVERPOOL ROAD, ECCLES, MANCHESTER, M30 7RU +44 (0) 161 707 9612 info@e3p.co.uk
Client		
Main Contractor		
Earthworks Contractor		
Haulier		
Date of Planned Import		

Overview of Planned Material Import	
Material Source (Site of Origin) and Postcode	
Site Investigation Report	**Report Title and Reference:** **Date:** **Information Supplied By:**
Reason for Generation of Excess Material at Site of Origin	
Chemical Test Results for Stockpile at Site of Origin	**Date:** **Laboratory Certificate Ref:** **Organisation Responsible for Stockpile Sampling:**
Geotechnical Material Classification and Testing	**Delete as Appropriate:** Class 1 / Class 2 / Class 6 / Topsoil
Pictures of Material Stockpile Pending Transportation	**Delete as Appropriate:** Yes / No
Person or Organisation Responsible for Ensuring Quality Control at Site of Origin	
Quantity of Material to Be Imported (m^3)	
Proposed Area of Deposition (Site of Reuse)	
Waste Exemption/Permit or CL:AIRE MMP	**Delete as Appropriate:** U1 Standard Rules / CL:AIRE MMP (Direct Transfer) / Bespoke

APPENDIX VI CONTRACTOR PRE-COMMENCEMENT CHECK SHEET

GEOTECHNICAL ENABLING WORKS PRE-START FORM

Prior to the commencement of any site remediation or enabling works, this form will be completed by E3P, in the presence of the appointed contractor, to ensure that all pertinent remediation and enabling works activities are fully discussed and understood.

Activity	Testing Responsibility	Contractors Method Statement Required (Y/N)	Comment/Action
Deployment of Environmental Permit			Ref No:
Deployment of LAPC Part B – Mobile Plant Permit			Ref No:
CL:AIRE MMP and Qualified Person Declaration			Ref No:
Identification of All Invasive Plant Species and Production of Eradication Plan with Appropriate Supervision by Specialist			Appointed specialist:
Removal of All Vegetation			Note disposal location:
Removal of All Root Bulbs and Root Networks			Note disposal location:
Identification of Contamination Hotpots, Removal of Material and Stockpile			Rationale:
Legislatively Compliant Procedure to Deal with Contamination Excavated from Hotspot			Rationale:
Processing and Recycling of Aggregate with Geotechnical and Chemical Validation Testing			Note stockpile location and anticipated volume:
Stockpiling of Subsoil and Certification of Suitability for Reuse			Stockpile location:
Decommission of All Redundant Drainage Infrastructure			
Decommission of All Former Interceptors			
Decommission of All Former Above- and Below-Ground Tanks			
Removal of All Asbestos to a Licensed Facility			
Engineering of Plots for Shallow Spread Foundation in Accordance with E3P Geotechnical Specification			Plot Numbers

Activity	Testing Responsibility	Contractors Method Statement Required (Y/N)	Comment/Action
Engineering of Plots for VSC in Accordance with E3P Geotechnical Specification			Plot Numbers.
Engineering of Plots for Pile Foundation in Accordance with E3P Geotechnical Specification			Plot Numbers
Engineering of Plots for Raft Foundation in Accordance with E3P Geotechnical Specification			Plot Numbers
Stockpiling of Topsoil and Certification of Suitability for Reuse			Stockpile location
Engineering of Highways Bulk Upfill in Accordance with E3P Specification with Compliant Validation Testing			Upfill specification
Engineering of Highways Subgrade in Accordance with E3P Specification with Compliant Validation Testing			Upfill specification
Engineering of Highways Capping in Accordance with E3P Specification with Compliant Validation Testing			Upfill specification
Cut-and-Fill the Development Site to Clients' Required Elevation with As-Built Survey			Required formation elevations

APPENDIX VI CONTRACTOR COMPLETION CHECK SHEET

GEOTECHNICAL ENABLING WORKS COMPLETION FORM

Upon completion of all site remediation and enabling works, this form will be completed by E3P, in the presence of the appointed contractor, to ensure that all pertinent geotechnical enabling works activities are complete or, where a deviation from the specification has occurred, all future limitations and issues are documented for the client's records.

Activity	Complete			Signature
	Yes	No	N/A	(initial)
Eradication of all invasive plant species				
Removal of all vegetation				
Removal of all root bulbs and root networks				
Stockpiling of topsoil and certification of suitability for reuse				
Stockpiling of subsoil and certification of suitability for reuse				
Stockpile all recycled aggregate with geotechnical and chemical validation testing				
Removal of all relict foundations and infrastructure in their entirety				
Decommission of all redundant drainage infrastructure				
Decommission of all former interceptors				
Decommission of all former above- and below-ground tanks				
Removal of all waste materials to a licensed facility				
Removal of all asbestos to a licensed facility				
Engineering of all plots for shallow spread foundation in accordance with E3P Geotechnical Specification				
Engineering of all plots for VSC in accordance with E3P Geotechnical Specification				
Engineering of all plots for pile foundation in accordance with E3P Geotechnical Specification				
Engineering of all plots for raft foundation in accordance with E3P Geotechnical Specification				
Engineering of highways bulk upfill in accordance with E3P Specification with compliant validation testing				
Engineering of highways subgrade in accordance with E3P Specification with compliant validation testing				
Engineering of highways capping in accordance with E3P Specification with compliant validation testing				
Cut-and-fill the development site to client's required elevation with as-built survey				

POST-REMEDIATION AND ENABLING LIMITATIONS

All and every deviation from the approved specification for works should be documented by the remediation and enabling works contractor below.