REMEDIATION & ENABLING WORKS STRATEGY

Barrel Yard
Moss Lane West
Manchester

Prepared for:

Alan Johnston Partnership LLP

alan johnston partnership LLP
CONSULTING STRUCTURAL & CIVIL ENGINEERS

E3P Report: 11-419-R2
Issued: December 2016



e3p | Environmental | Energy | Engineering

E3P

Heliport Business Park,
Liverpool Road,
Eccles,
Manchester,
M30 7RU

Tel : + 00 (0) 161 707 9612
http:\\www. e3p.co.uk

Registered in England
No.: 807255262

QUALITY ASSURANCE

REMARKS	Final
DATE	December 2016
PREPARED BY	S. Cox
QUALIFICATIONS	BSc, FGS, AIEMA, AMI EnvSci
SIGNATURE	
CHECKED BY	D. Cox
QUALIFICATIONS	BSc, FGS, AIEMA, AMI EnvSci
SIGNATURE	
AUTHORISED BY	M Dyer
QUALIFICATIONS	BSc, FGS, AIEMA, MIEnvSc, CEnv
SIGNATURE	
PROJECT NUMBER	11-337
IMS Template Reference: QR005-1	

EXECUTIVE SUMMARY	
Site Address	Barrel Yard, Moss Lane West, Manchester, M15 5PQ
National Grid Reference	E383207, N395868
Site Area	0.51Ha
Background	E3P has been instructed by Alan Johnston Partnership LLP on behalf of Forshaw Land and Property Group to develop a Remediation and Enabling Works Strategy for the proposed residential development at land off Moss Lane West in Manchester. The E3P Remediation & Enabling works strategy has been produced in due consideration of the Geo-Environmental Site Investigation and Contaminated Land Assessments previously undertaken by GeoCon. The subject site is currently a disused open land, following former use as a barrel yard for the adjacent brewery. It is understood that consideration is being given to redevelopment of the site with 17 No. domestic dwellings, associated gardens, Public Open Space (POS) areas and adoptable roads and sewers.
Contaminated Land Assessment	
Human Health Risk Assessment	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 heavy metals and non-volatile PAHs. All the identified elevated concentrations have primary exposure pathways related to dermal contact and ingestion, soil ingestion and consumption of homegrown produce. These exceedances can be mitigated by the installed of a 600mm chemically suitable cover system within all proposed garden areas. The natural clay drift deposits are likely to be acceptable for use as subsoil within the proposed garden 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	There is no unacceptable risk to the controlled water receptors and the wider environ.
Ground Gas	Ground gas monitoring has indicated the site would be classed as Characteristic Situation 2 or Amber 1, suggesting low level gas protection measures will be required.
Invasive Plants	Invasive species have not been identified on site during works carried out to date.
Geotechnical Considerations	The remediation and enabling works will be delivered in a manner that will seek to ensure: • *Where shallow stratum suitable of supporting a shallow spread foundation, care should be taken to protect to minimise the disturbance to natural drift deposits;* • *Where deep Made Ground is present (>1.50m) the stratum should be prepared in a manner that will facilitate re-engineering using a Vibro Stone Column (VSC); and,* • *Engineer all up-filled materials beneath highways to sub-grade in accordance with the requirements of this specification to ensure a CBR >5% in the sub-grade.*

EXECUTIVE SUMMARY	
Summary of Site Remediation & Enabling Works	The site Remediation / Enabling Works Strategy provides a comprehensive specification for the regeneration of the land to negate identified pollutant linkages and construct a development platform that will be geotechnically suitable for the proposed end use. The salient features of the Remediation & Enabling Works Strategy are summarised below: • Implement all works in strict accordance with UK Environmental Permitting and Local Planning Authority Requirements. • Controlled removal of all trees and vegetation; • Removal of all relict foundations and buried features in their entirety; • Excavation and processing of Made Ground in a controlled manner with the sorting, processing and segregation of identified deleterious materials; • Importation of suitable material (if required) to achieve the required development levels; and, • Replacement of material in accordance with the E3P enabling specification & engineering requirements.
Summary of Build Phase Mitigation Requirements	The developer's works will also include the completion of the following additional elements: • Provision of a 600mm cover system using certified material with appropriate validation within proposed garden areas, comprising 450mm subsoil (potentially site won natural drift deposits) overlain by 150mm topsoil; • Provision of a 300mm cover system using certified material with appropriate validation within proposed areas of Public Open Space and soft landscaping; • Installation of ground gas protection measures in accordance with Characteristic Situation 2 / Amber 1; and, • Installation of polyethylene pipeline for the proposed potable water infrastructure.

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Drawing No 11-416-007 – Remediation Issues Plan

Appendix IV E3P Remediation / Validation Criteria

1. INTRODUCTION

1.1 Background

E3P has been instructed by Alan Johnston Partnerships LLP to develop a Remediation and Enabling Works Strategy for the proposed residential development at a parcel of semi derelict former industrial land to the east of Moss Lane West, Manchester.

1.2 Report Objectives

The objectives of this report are to:

- Prepare an 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 & Enabling works plan;
- Specify Geotechnical Engineering Performance Requirements; and,
- Ensure the safe, cost effective and regulatory compliant redevelopment of the site.

1.3 Scope of Works

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

- Identification 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.

1.4 Previous Works

The following phases of Geo-Environmental investigations have previously been carried out at the site:

Geocon – *Geo-Environmental Site Investigation Report, Phase I Preliminary Risk Assessment of land off Moss Lane West, Manchester.* Ref: E0189 IW(GSI0397) P1 Report JS FG 190115, dated January 2015.

Geocon – *Ground Investigation Report, Phase II Geoenvironmental Site Investigation and Interpretive Report on Land at Moss Lane West, Manchester.* Ref: Report No. E0189 IW (GS10397) GI Report JS FG 130715, dated July 2015.

E3P: *Phase II Geotechnical Site Assessment (ref:11-416-R1) dated October 2016 Prepared for: Alan Johnston Partnership.*

To inform the assessment of the potential risk to contaminated land within the context of the proposed residential development and to inform the preparation of the Remediation Strategy the pertinent points from the above reports are summarised within Section 2.0.

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

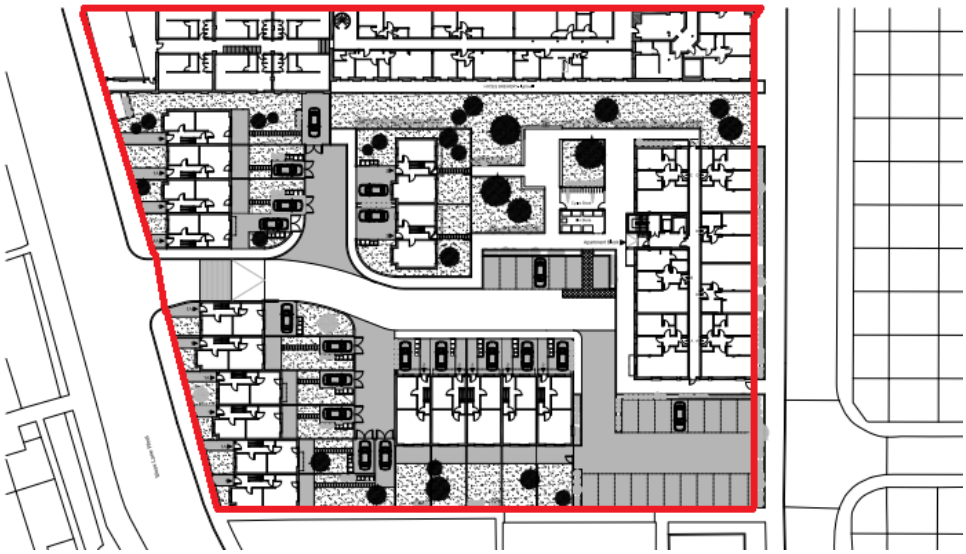
1.5 Redevelopment Plan

E3P understands that AJP are assisting their client for the future redevelopment of the subject site for a low rise residential development. A proposed development layout (Drawing 11-416-002, Appendix III) has indicated the proposed development will comprise 17 No. low rise residential dwellings and one residential apartment block with associated private gardens, landscaping, estate roads, driveways and utility infrastructure.

It is understood that the former brewery along the eastern side has recently been refurbished and partly redeveloped as part of the wider scheme.

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

Figure 1.1 Snapshot of Proposed Development



1.6 Summary of Parties Involved

FUNCTION / INTEREST	NAME OF PARTY
Local Planning Authority	Manchester City Council
Developer	Forshaw Land & Property Group
Geo-Environmental Consultant	E3P
Main Contractor	TBC
Remediation / Enabling Works Contractor	TBC
Human Health Regulator	Manchester City Council
Controlled Waters & Waste Regulator	Environment Agency

1.7 Regulatory Correspondence

A detailed Planning Application is in the process of being submitted to Manchester City Council for the proposed redevelopment of the site for low rise residential housing 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 advisor); and,
- Environment Agency Planning Liaison.

1.8 Site Details

Site Address	Barrel Yard, Moss Lane West, Manchester, M15 5PQ
National Grid Reference	E383207, N395868
Site Area	0.51Ha

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

A site location map is presented in Appendix III as Drawing 11-416-001.

1.9 Site Summary

SITE DESCRIPTION & SETTING		
Occupancy/use	The site is effectively open land that appears to have been used for storage associated with the adjacent brewery. There are some above ground cylinders on the site and areas of waste mainly associated with the adjacent brewery such as empty beer barrels. This part of the site is covered with hardcore at the surface. The topography of the site is generally flat. The site is bound by Moss Lane West to the north, government offices to the west, and residential properties to the east, and south. Access to the site is via Moss Lane West from the north.	
Environmental Setting	*Drift Geology*	Glaciofluvial Deposits (Sands and Gravel).
	Bedrock Geology	Wilmslow Sandstone Formation (Sandstone).
	Hydrogeology	Secondary A Aquifer in the drift deposits with a Principal Aquifer in the underlying bedrock. There are three groundwater abstractions on the site for process water for the brewery. There are no potable water abstractions within 2km of the site.
	Surface Water	There are no surface watercourses within 500m of the site.
	Source Protection Zone	None
	Groundwater Sensitivity	Principal Aquifer with three extractions on site for process water in the brewery.
	Surface Water Safeguarding Zone	None

SITE DESCRIPTION & SETTING	
Site History	Historical mapping indicates the site was developed almost entirely with residential housing from pre 1891 with the Queen Arms public house constructed in 1949 alongside residential housing becoming demolished. By 1972, the entire site was unoccupied.
Landfill Sites & Ground Gases	A historical landfill site registered to Demolition Services Ltd is located 242m north east of the site accepting inert and industrial wastes.

1.10 Summary of Reported Ground Conditions

E3P has prepared a detailed Site investigation report (Ref: 11-416-R1) dated October 2016, the summary of reported ground conditions is summarised below:

SUMMARY OF GROUND CONDITIONS	
Made Ground	Made Ground was encountered within all exploratory hole locations from ground level to depths of between 0.20m and 2.30m bgl (TP104). The majority of exploratory hole locations were covered with asphalt or concrete hardstanding which was in turn underlain by a brown sandy gravel with brick and concrete in the majority of locations. The concrete in localised areas were found to encounter further concrete and brick obstructions within the Made Ground and caused excavation to be very slow throughout Made Ground deposits. Soft reworked clay was noted within three of the exploratory hole locations to a maximum depth of 2.20m bgl.
Topsoil	No topsoil that would be deemed suitable for re-use has been identified within any of the exploratory hole locations.
Drift	The drift deposits were encountered within all exploratory hole locations with the exception of TP105 where the full depth of Made Ground could not be penetrated due to the presence of obstructions. Drift deposits generally comprised a firm medium strength, locally soft low strength orange mottled grey sandy CLAY with localised gravel of sandstone and mudstone, encountered to a maximum proven depth of 2.50m bgl. These cohesive drift deposits were in turn underlain by a brown gravelly fine to medium SAND with mudstone and sandstone, which was encountered at the base of the majority of exploratory trial pits.
Bedrock	The solid geology was not encountered during the Ground Investigation however BGS boreholes indicate the bedrock is present at circa 17.00m bgl.
Groundwater	No groundwater was encountered during the Ground Investigation.

2. CONTAMINATION RISK ASSESSMENT

2.1 Background

A Tier 1 Qualitative Contaminated Land Risk Assessment has been completed by GeoCon during their intrusive site investigation works to determine the potential risk to human health, controlled waters and the wider environ. This assessment is documented in full within the GeoCon Ground Investigation Report (Ref: E0189 IW (GS10397) GI Report JS FG 130715, dated July 2015 and for clarity is summarised below:

2.2 Human Health Risk Summary

The GeoCon Tier 1 Qualitative Human Health Risk Assessment was undertaken for the protection of human health however following a review of the results and assessment, Tier 1 screening values utilised are stated in the report as being significantly greater than the current LQM Suitable 4 Use Levels (S4ULs). Therefore, E3P has reviewed the chemical analysis results in detail and updated the human health risk assessment:

At a Tier 1 stage the long term (chronic) human health toxicity of the soil has been assessed by comparing the on-site concentrations of organic and inorganic compounds with reference values published by the EA (Contaminated Land Exposure Assessment (CLEA) Soil Guideline Values (SGV)) and where absent, Generic Assessment Criteria (GACs) published by LQM/CIEH (2nd edition).

The results of this comparison have been summarised within Table 2.1 (overleaf).

Table 2.1 Summary of Inorganic and Hydrocarbon Toxicity Assessment for a Residential End Use

DETERMINANT	UNIT	GAC	N	MC	LOC. OF EX	PATH-WAY	ASSESSMENT
Arsenic	mg/kg	37	8	9	N/A	1	No Further Action
Cadmium	mg/kg	17	8	0.8	N/A	1	No Further Action
Lead	mg/kg	200	8	1680	WS08 0.20m	1	**Further Action**
Mercury	mg/kg	11	8	2.63	N/A	2	No Further Action
Nickel	mg/kg	180	8	17	N/A	1	No Further Action
Selenium	mg/kg	250	8	<1	N/A	1	No Further Action
Copper	mg/kg	2400	8	36	N/A	1	No Further Action
Zinc	mg/kg	3700	8	484	N/A	1	No Further Action
Cyanide - Total	mg/kg	791	8	<1	N/A	1	No Further Action
Phenols - Total.	mg/kg	210	8	<0.2	N/A	1	No Further Action
Asbestos	Fibres	NFD	8	N/A	N/A	4	No Further Action
Naphthalene	mg/kg	2.3	8	0.74	N/A	2	No Further Action
Acenaphthylene	mg/kg	170	8	0.05	N/A	3	No Further Action
Acenaphthene	mg/kg	210	8	3.97	N/A	1	No Further Action
Fluorene	mg/kg	170	8	2.62	N/A	1	No Further Action
Phenanthrene	mg/kg	95	8	20.4	N/A	3	No Further Action
Anthracene	mg/kg	2400	8	6.41	N/A	3	No Further Action
Fluoranthene	mg/kg	280	8	29.9	N/A	3	No Further Action
Pyrene	mg/kg	620	8	26.5	N/A	3	No Further Action
Benzo(a)Anthracene	mg/kg	7.2	8	7.96 12.4	WS06 0.30m WS05 0.30m	3	**Further Action**
Chrysene	mg/kg	15	8	12.7	N/A	3	No Further Action
Benzo(b)Fluoranthene	mg/kg	2.6	8	7.21 10.7	WS06 0.30m WS05 0.30m	3	**Further Action**
Benzo(k)Fluoranthene	mg/kg	77	8	9.51	N/A		No Further Action
Benzo(a)Pyrene**	mg/kg	2.2	8	2.40 7.85 12.2	WS12 0.10m WS06 0.30m WS05 0.30m	3	**Further Action**
Indeno(123-cd)Pyrene	mg/kg	27	8	7.44	N/A	3	No Further Action
Dibenzo(a,h)Anthracene	mg/kg	0.24	8	0.37 1.17 1.66	WS12 0.10m WS06 0.30m WS05 0.30m	3	**Further Action**
Benzo(ghi)Perylene	mg/kg	320	8	6.32	N/A	3	No Further Action
TPH C5-C6 (aliphatic)*	mg/kg	42	8	<0.01	N/A	2	No Further Action
TPH C6-C8 (aliphatic)*	mg/kg	100	8	<0.01	N/A	2	No Further Action
TPH C8-C10 (aliphatic)*	mg/kg	27	8	<0.01	N/A	2	No Further Action
TPH C10-C12 (aromatic)*	mg/kg	74	8	1.8	N/A	2	No Further Action
TPH C12-C16 (aromatic)*	mg/kg	140	8	17.1	N/A	2	No Further Action
TPH C16-C21 (aromatic)*	mg/kg	260	8	104	N/A	1	No Further Action
TPH C21-C35 (aromatic)*	mg/kg	1100	8	300	N/A	1	No Further Action

Notes
Main Exposure Pathways: 1 = Soil Ingestion, 2 = Vapour Inhalation (indoor), 3 = Dermal Contact & Ingestion, 4 = Dust Inhalation.
Abbreviations: GAC = General Assessment Criteria, n = number of samples, MC = Maximum Concentration; Loc of Ex = Location of Exceedance; NFD = No Fibres Detected
* The Tier 1 GAC for the hydrocarbon fraction is derived from the CIEH assessment for petroleum hydrocarbons Criteria Working Group (CWG) for both aliphatic and aromatic compounds. E3P has utilised the Tier 1 values for aliphatic compounds for the volatile and semi volatile fractions (C_5-C_{12}) and the Tier 1 values for aromatic compound for the non-volatile fractions (C_{12}-C_{35}). The comparison of a total (aliphatic/aromatic) compounds to an individual fraction is considered to be a conservative approach and satisfactory for the protection of human health.

Referring to Table 2.1, the results of this direct comparison indicates that the data exceeds the screening criteria for a residential end use for the following contaminants:

- *Lead*
- *Benzo(a)anthracene*
- *Benzo(b)flouranthene*
- *Benzo(a)pyrene*
- *Dibenzo(a,h)Anthracene*

Asbestos was not identified within any of the samples analysed.

Made Ground soils were also analysed for PCBs which did not identify any concentrations above the Limit of Detection (LOD).

No significant concentrations of BTEX or MTBE were identified in the soils submitted for chemical analysis.

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

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

    1. Soil Ingestion
    2. Dermal Contact and Ingestion
    3. Consumption of Homegrown Vegetables

- The exceedances for all determinands are associated with shallow Made Ground deposits (<0.50m).

Risk Assessment and Mitigation

All the identified elevated concentrations have primary exposure pathways related to dermal contact and ingestion of soils and consumption of home-grown vegetables. The risk to chronic human health associated with the elevated concentrations on inorganic heavy metals and non-volatile PAH compounds can be mitigated through the installation of a suitable cover system in all proposed private gardens, landscaping and Public Open Space to remove any potential for direct exposure to impacted soils.

The specific design and installation process for the appropriate cover systems will be clearly defined within the Site remediation & Enabling Works Strategy, however industry best practice (as outlined within BRE 465) will require the following minimum depths of certified clean cover:

- Private Gardens where home-grown vegetables can be cultivated – **600mm**
- Landscaped areas within private dwellings – **300mm**
- Public Open Space – **300mm**

It is likely that the natural drift deposits are chemically suitable for use as subsoil within the proposed garden areas, however to date it doesn't appear chemical analysis has been undertaken and confirmatory chemical validation analysis will be required to determine suitability. There are no suitable sources of topsoil available on the site.

2.3 Controlled Waters Contamination Risk Summary

The site sensitivity with respect to controlled waters is summarised within Table 2.2 overleaf:

Table 2.2 Summary of Controlled Water Sensitivity

RISK PROFILE	DISCUSSION	SENSITIVITY RATING & RATIONALE
Source Protection Zone (SPZ)	No	**Low**
Distance to the closest groundwater abstraction point.	On site	**Moderate-High -** There are three licensed groundwater abstraction points located on the site, for breweries / wine process water. These are considered to be associated with the former brewery on site and are therefore no longer applicable.
Aquifer classification in Superficial Drift Deposits	Secondary A	**Low**
Aquifer classification in Bedrock.	Principal	**High**
Surface water or Groundwater Vulnerability Area.	None	**None**
Viability for Anthropogenic soil in direct contact with aquifer (drift or bedrock).	Yes	**Yes –** The site is underlain by shallow Made Ground deposits with low level heavy metals and PAH concentrations.
Is the site located within 50m of a surface water course	No	**No –** The risk to a surface water is negligible given the absence of a viable receptor within influencing distance of the site.
Summary The ICSM developed within the context of the site setting has only identified a single viable pollutant risk which would be the downward migration of potentially mobile phase soluble contaminants towards the underlying Principal Aquifer. However, the overall sensitivity of this receptor is reduced given the absence of any potable water abstraction within 500m and thus the potential for the creation of a complete pollutant linkage.		

During the intrusive site investigation undertaken by GeoCon, insufficient groundwater was encountered therefore no chemical analysis was possible of the groundwater.

However, based on the above, the results of the soil chemical analysis, the ground conditions encountered and given that natural attenuation, dilution and dispersion will take place in addition to the presence of low permeability drift deposits limiting the vertical migration of any mobile contaminants to the underlying aquifer, the risks to groundwater are considered to be negligible.

There is therefore considered to be no unacceptable level of risk to controlled waters and no further assessment is required.

2.4 Ground Gas

The ground gas risk assessment completed by GeoCon identified marginally elevated concentrations of methane (up to 3.30% v/v) and flow rates, placing the site in the bracket for Characteristic Situation 2 / Amber 1.

Ground gas measures in accordance with Characteristic Situation 2 will require construction in line with BS8485 which requires a minimum of 3.5 points be achieved by installation of a suitable combination of measures detailed overleaf:

Table 2.3 BS8485 (2015) Point Score Summary

GAS PROTECTION SCORES FOR THE STRUCTURAL BARRIER	SCORE
a) **Floor and substructure design**	
Precast suspended segmental subfloor (i.e. beam and block).	0
Cast in situ ground bearing floor slab (with only nominal mesh reinforcement.	0.5
Cast in situ monolithic reinforced ground bearing raft or reinforced cast in situ suspended floor slab with minimal penetrations.	1 or 1.5
Basement floor and walls conforming to BS 8102:2009, Grade 2 waterproofing.	2
Basement floor and walls conforming to BS 8102:2009, Grade 3 waterproofing.	2.5

PROTECTION ELEMENT SYSTEM		SCORE	COMMENTS
Gas protection scores for ventilation protection measures			
(a) Pressure relief pathway (usually formed of low fines gravel or with a thin geocomposite blanket or strips terminating in a gravel trench external to the building)		0.5	Whenever possible a pressure relief pathway (as a minimum) should be installed in all gas protection measures systems. If the layer has a low permeability and / or is not terminated in a venting trench (or similar), then the score is zero.
(b) Passive sub floor dispersal layer: Media used to provide the dispersal layer are: • *Clear void* • *Polystyrene void former blanket* • *Geocomposite void former blanket* • *No-fines gravel layer with gas drains* • *No-fines gravel layer*	Very good performance	2.5	The ventilation effectiveness of different media depends on a number of different factors including the transmissivity of the medium, the width of the building, the side ventilation spacing and type and the thickness of the layer. The selected score should be assigned taking into account the recommendations in Annex B of BS8485:2015. Passive ventilation should be designed to meet at least "good performance".
	Good performance	1.5	
(c) Active dispersal layer, usually comprising fans with active abstraction (suction) from a sub floor dilution layer, with roof level vents. The dilution layer may comprise a clear void or be formed of geocomposite or polystyrene void formers.		1.5 to 2.5	This system relies on continued serviceability of the pumps, therefore alarm and response systems should be in place. There should be robust management systems in place to ensure the continued maintenance of the system, including pumps and vents. Active ventilation should always be designed to meet at least "good performance".
(d) Active positive pressurization by the creation of a blanket of external fresh air beneath the building floor slab by pumps supplying air to points across the central footprint of the building into a permeable layer, usually formed of a thin geocomposite blanket.		1.5 to 2.5	This system relies on continued operation of the pumps, therefore alarm and response systems should be in place. The score assigned should be based on the efficient "coverage" of the building footprint and the redundancy of the system. Active ventilation should always be designed to meet at least "good performance".

PROTECTION ELEMENT SYSTEM	SCORE	COMMENTS
(e) Ventilated car park (floor slab of occupied part of the building under consideration is underlain by a basement or undercroft car park)	4	Assumes that the car park is vented to deal with car exhaust fumes, designed to *Buildings Regulations 2000, Approved Document F [9].*
Gas protection score for the gas resistant membrane		
Gas resistant membrane meeting all of the following criteria: • *Sufficiently impervious to the gases with a methane gas transmission rate <40.0 ml/day/m²/atm (average) for sheet and joints (tested in accordance with BS ISO 15105-1 manometric method_;* • *Sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions;* • *Sufficiently strong to withstand in-service stresses (eg settlement if placed below a floor slab);* • *Sufficiently strong to withstand the installation process and following trades until covered (eg penetration from steel fibres in fibre reinforced concrete, penetration of reinforcement ties, tearing due to working above it, dropping tools etc);* • *Capable, after installation, of providing a complete barrier to the entry of the relevant gas; and,* • *Verified in accordance with CIRIA C735.*	2	The performance of membranes is heavily dependent on the quality and design of the installation, resistance to damage after installation and integrity of joints. For example, a minimum 0.40mm thickness (equivalent to 370g/m² for polyethylene) reinforced membrane (virgin polymer) meets the performance criteria opposite. If a membrane is installed that does not meet all the criteria opposite then the score is zero.

It is concluded that the site will be suitable for the proposed residential end use subject to the completion of the afore mentioned supplementary assessments and the following build phase mitigation items:

- Use of potable water supply infrastructure that will be compliant with UKWIR assessment criteria;
- Construction of all dwellings with ground gas mitigation measures that conform to CS2 requirements of BS8485; and,
- Construction of a 600mm clean cover system to all areas of private garden and 300mm to all areas of landscaping in accordance with the detailed methodologies herein.

3. SITE REMEDIATION & ENABLING WORKS

3.1 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 Table 3.1 (below).

Table 3.1 Enabling Works Schedule

RE-1	**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 re-used (excluding crushed materials) exceeds the parameters of the Standard Rules Permit, a CL:AIRE 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 not anticipated that there will be any requirement to treat any materials on-site (such as hydrocarbon impact soil or groundwater), however should any previously unidentified contractor must either notify the EA of their intention to complete a minor works operation or arrange for the deployment of the appropriate Environmental Permit for the specified operation.
RE-2	**Environment & Nuisance Control** Management of all works so as to ensure that no environmental nuisance is created through dust emissions, noise or vibration levels. Ensure that all works are completed in a manner so as not to create any structural risk to the adjacent highways. Implement all temporary works 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-3	**Identification, Isolation and Treatment of Invasive Plants** At this time no invasive plant species have been identified, however the contractor must satisfy themselves with respect to the absence of any 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. If invasive plant species are identified, these will be treated in strict accordance with an approved method statement. If 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. If any invasive species are treated, 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-4	**Site Clearance Operations** General site clearance & provision of welfare, offices and site security as per the contract requirements. The site is currently overgrown with self-seeded vegetation; 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. All vegetation should either be stockpiled at a pre-agreed location or alternatively removed from site in accordance with Waste Permitting Regulations.
RE-5	**Excavation, Breaking and Processing of All Above & Below Ground Structures** Obstructions, relict foundations and infrastructure (apart from live services) are to be removed from the areas of proposed residential development to include plot footprints, rear gardens, private driveways, adopted highway and utilities infrastructure (road box) in their entirety. 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 E3P chemical and geotechnical specification 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-6	**Cut & Filling of Made Ground to Development Levels** The entire site is covered by a layer of Made Ground which will require lifting, sorting and processing due to the presence of obstructions throughout, however dependent on levels, upon completion of these works it is likely <1.00m of Made Ground is present across the site. Therefore given the presence of shallow stiff medium strength clays and localised medium dense sands across the site, it is likely the majority of the proposed plots can be constructed on traditional strip or mass trench fill in areas requiring a greater level of excavation. 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-7

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 6 of this report which generally requires the following reinstatement and compaction criteria:

LAND USE	CONSTRUCTION REQUIREMENT	REQUIREMENT
Footprint of proposed structure (2.0m on all elevations).	Pile Foundation	Backfill using general Method Compaction to CBR of 5%
	Vibro Stone Colum	Granular backfill with suitably graded granular aggregate with <10% fines. CBR >5% with suitable pile mat.
	Traditional Spread Foundation	Ensure no disturbance of natural soil at shallow depth.
Highways	Adopted Estate Road / Drainage	Method Compaction using DOT ensure CBR >5% in sub-grade (engineered fill)
Driveways	Private Drives & Car Parking	Method Compaction to CBR >5%
Gardens & POS	N/A	Method Compaction to ensure no settlement.

RE-8

Preparation of Garden for Cover System

As part of the land remediation works, garden areas will be prepared in a manner that will facilitate the placement of the clean cover system during the development phase of the woks. The preparation of the areas requiring clean cover is critical in ensuring delivery of the site in a manner that will ensure no risk to the proposed end users.

Where Made Ground is deemed unsuitable for retention in a garden, the area will be subject to a reduced level dig to remove unsuitable material to a minimum depth of 600mm below finished garden level or verified natural stratum (whichever is the shallower).

Excavated soil will be stockpiled pending the results of the appropriate validation testing (to be completed in accordance with this specification) prior to re-use in an area of no sensitivity or where necessary, this material will be removed from site in accordance with UK Waste Management Legislation.

The placement of certified sub-soil and topsoil will be completed as part of the developer works / build phase mitigation plan. All garden areas where a cover system is required will be subject to plot specific independent validation.

RE-9

Provision of Subsoil

The shallow natural drift deposits (predominantly cohesive soils) are deemed suitable for use within the upper 600mm of clean cover to residential gardens and areas of soft landscaping. It is therefore deemed viable to re-use and materials that are cut as part of the wider earthworks or through a soil inversion (regulated by an MMP) to generate the requited volumes of material.

The garden and landscaped areas will require depth validation to satisfy the requirement of the Council Mortgage Lenders (CML) in order to demonstrate that the appropriate thickness has been provided as a growing medium.

RE-10	**Provision of Topsoil** No material that would be deemed suitable for use as topsoil is present on-site and as such there will be requirement to import suitable material for use within the proposed development. Topsoil will require testing in line with the schedule present within Section 3.4 and Table 3.2. The garden and landscaped areas will require depth validation to satisfy the requirement of CML in order to demonstrate that the appropriate thickness has been provided.
RE-11	**Remedial Verification Report** Collation of information relating to site clearance, chemical testing, remedial works, remedial verification, material movements and waste transfer documentation where appropriate. Complete remedial validation 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.

3.2 Second Phase Mitigation & Management – Build Phase

A second post Remediation & Enabling phase of works will be required to ensure the proposed development is constructed in a manner that incorporates the required mitigation measures to ensure the development is compliant with UK Building Regulations and the Local Authority Planning requirements.

Once the ground has been stabilised and rendered suitable for development, the builder will be required to undertake a second phase of remediation works to mitigate the identified theoretical risk to human health.

- Provision of a 600mm cover system over made ground encountered across the site, using certified material with appropriate validation within proposed garden areas. Natural drift deposits encountered within the upper 600mm of finished ground levels can be directly overlain with a suitable cover (minimum 150mm topsoil).
- Provision of 300mm certified cover system to all areas of soft landscaping and POS.
- Provision of appropriately assessed water supply pipes.
- Construction of all dwellings with the appropriate ground gas mitigation measures and corresponding independent validation in accordance with Characteristic Situation 2.

3.3 Materials Management & 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 Standard Rules Permit will be registered for the site which allows the re-use of up to 3000m3 of material within construction with up to 25,000m3 of material permissible to be re-used in the construction of roads.

A T5 Standard Rules permit allows the screening and recovery of up to 3000m3 of material for sub-sequent re-use 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 Licenses, Exemption and Protocols provides 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 in detailed within the Remediation Enabling Works Rationale summarised above may be subject to regulation using the appropriate Environmental Permit, Standard Rules Exemption and 'Materials Management Plan' (MMP) to be created in accordance with Version 2 of the CL:AIRE Definition of Waste - Industry Code of Practice.

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

3.4 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 Strategy, or for materials to be imported onto site to facilitate the proposed residential 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 PPE and sampling equipment that 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 within 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 3.2.

Table 3.2 Specification of Chemical Validation Laboratory Analysis

MATERIAL USE	TESTING FREQUENCY	SUITE OF ANALYSIS
Site Generated		
Site Generated 6F2	1 Sample Per 1000m³	A / B / C / D
Site generated Sub-Soil *(450mm garden cover)*	1 Sample Per 250m³	A / B / C / D
Imported		
6F2	1 Sample Per 1000m³	A / B / C / D
Subsoil Greenfield Source *(450mm garden cover)*	1 Sample per 200m³	A / B / C / D
Subsoil Brownfield Source *(450mm garden cover)*	1 Sample per 50m³	A / B / C / D
Topsoil Greenfield Source *(150mm garden cover)*	1 Sample per 200m³	A / B / C / D
Topsoil Brownfield Source *(150mm garden cover)*	1 Sample per 50m³	A / B / C / D
General Engineering Fill (Class 1 & 2 Soil)	1 Sample Per 1000m³	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) Lechate 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.

4. ENVIRONMENTAL MONITORING AND VALIDATION

4.1 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;
- The strategy for each day's work will be agreed with the E3P Consultant, who will be in attendance as required, prior to the commencement of the works. E3P 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;
    - Ensure that any loads which 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.
- 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; and,
- 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.

4.2 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 hard-standing should be subject to no less stringent measures with respect to assessment, and, where appropriate, monitoring than those set out above.

5. GEOTECHNICAL ENGINEERING SPECIFICATION

5.1 E3P Geotechnical Engineering Specification

The contractor should employ a suitably experienced engineer to be present on site during these 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 clay soils as a moisture content fluctuation (2%+/-) of the tolerable limit will result in unacceptable degree of compaction loss.

5.2 Locally Won Fill Material

It is proposed to cut and fill the site to achieve the proposed development platform. 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 and cohesive soil matrixes.

Due to climatic weather conditions and variance in long term differential settlement associated with even well compacted granular soils 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 4.5KG laboratory Procter 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.

5.3 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 November 2005; and,
- Soils for Civil Engineering Purposes, BS1377, 1999.

5.3.1 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 other 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,
- Selected granular fill (Class 6).

Table 5.1 Specification for Backfill Compaction

E3P EARTHWORKS GEOTECHNICAL COMPACTION SPECIFICATION					
SOIL / MATERIAL TYPE	**CLASS**	**DESCRIPTION**	**COMPACTION EQUIPMENT**	**LAYER THICKNESS**	**ROLLER PASSES**
Granular Fill (**Sand** & gravel Matrices)	**1 A**	Sandy Gravel with some cobbles	>5000kg Vibrating Roller	225mm	4
	1 B	Sand or Gravel of same grading size	>5000kg Vibrating Roller	250mm	10
	1 C	Coarse gravels with many cobbles	>5000kg Vibrating Roller	400mm	5
Cohesive Fill (**Clay** with minor sand and gravel component)	**2 A**	Wet Clays	>100kg Metric Ton Vibrating Tamping Roller **(Sheep Foot ONLY)**	100-225mm	3
	2 B	Dry Clay	>5000kg Vibrating Roller or 1400kg Tamping (Trench Roller)	225mm or 125mm	4 or 12
	2 C	Gravelly Clay	>5000kg Vibrating Roller or 1400kg Tamping (Trench Roller)	225mm or 125mm	4 or 12
	2 D	Silty / sandy Clay	>5000kg Vibrating Roller or 1400kg Tamping (Trench Roller)	225mm or 125mm	4 or 12
Recycled Aggregate Crush. (<125mm Well Graded)	**6F2**	Any combination of inert hard materials other colliery spoil or rock with substantial amounts of clay like component.	>5000kg Vibrating Roller	250mm	6

5.3.2 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.

5.4 General Requirements

The contractor shall employ only plant and working methods which are suited to the materials to be handled and traversed. He 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 5.2 Compaction / Backfill Requirements

LAND USE	COMPACTION METHODOLOGY & 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) to limit differential settlement and increase net Allowable Bearing pressure (ABP). **Building Structure Footprint** **+2.0m on all elevations**	Materials to be placed in a controlled manner to facilitate the construction of **Vibro Replacement Stone Columns (VRSC).** Material must be 90% granular in composition with less than 10% fines which are classified as materials <0.60micron's in size. No material greater than 125mm in size is permitted with 90% of the soils placed conforming to grading <90mm. Material to be placed when actual moisture content is within tolerable limits of the optimum with specific attention to and soils which are notably wet of 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 up-fill levels must be compacted to an 'end product' performance specification where the in-situ density exceeds 95% of the maximum (determined by laboratory conditions).
Piled Foundation	Piled foundations will be required within plots that are sited within the 'stand-off' zone at the crown of the newly profiled site embankment. Backfill of material using method Compaction Specification to achieve CBR as required by developer for piling mat construction.
Adopted Highways (+2.0m from back of footpath).	Method Compaction – Highways Design Manual Series 600 with in-situ Validation Testing to meet requirement of adoptions authority. CBR >5% at sub-grade formation (prior to placement of Capping).
Estate Roads	Method Compaction – Highways Design Manual Series 600 with CBR >5%.
Gardens, POS & Other External Areas	Material is to be placed in layers not exceeding 300mm 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 Highway Specification.

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 when sufficient spreading and compaction. Plant is operating at the place of deposition to ensure compliance with Clause 612 of the Highways specification.

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 his own arrangements for stockpiling of acceptable material, and unacceptable material to be processed, and for the provision of site for purpose.

The Contractor shall ensure that he does not adversely affect the stability of excavations or fills by his methods of stockpiling materials, use of plant or sitting 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 2.0m; 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:

(i) Arranging the rapid removal of water:
  (a) shed on to the earthworks
  (b) entering the earthworks from any source

(ii) Provide where necessary temporary watercourses, drains, pumping and the like:

(iii) Discharge accumulated water and groundwater into the permanent outfalls of the drainage system where practicable

(iv) Provide adequate means for trapping silt on temporary systems discharging into permanent drainage systems.

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

Where materials are designated either Class U1B or Class U2 (according to the Highways Specification), 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.

5.4.1 Construction of Fills – Highways

All fills shall be constructed:

(i) In the locations as shown in the contract drawings to the lines and levels stated therein;

(ii) Of classes of material complying with this specification;

(iii) By deposition, as soon as practicable after excavation, in layers to meet the compaction requirements as required for each Class of material as specified.

(iv) 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:

(i) The base is sound and stable by excavating and removing any topsoil as soft subsoil.

(ii) Base layers are not exposed until the fill layer is ready for placement.

(iii) Un-compacted material on the side slopes of previously backfilled zones shall be removed and benches of between 1.0m and 1.5m 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 1.0m and 1.5m 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 un-compacted backfill shall be formed at gradients which ensure stability.

5.4.2 Construction of Fills – Adopted Highways, Estate Roads & Car Park

The Contractor shall carry out compaction upon the materials which 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 which requires 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 to 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 which indicate the state of the compaction to be inadequate, if this is due to failure on 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 Highway specification for definition of plant to be used in accordance with this specified works.

The Contractor will be responsible for assessing the Class of Fill in accordance with Table 6/1 of the Highways Specification. Table 6/4 of the Highways Specification 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.

5.5 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 5.3.

Table 5.3 Compaction / Backfill Requirements

<table>
<tr><th>LAND USE</th><th>COMPACTION METHODOLOGY & GENERAL PERFORMANCE CRITERIA</th></tr>
<tr><td>Liquid and plastic limits</td><td>BS1377: Part 2</td></tr>
<tr><td>Grading</td><td>BS1377: Part 2</td></tr>
<tr><td>Uniformity Co-efficient</td><td>Calculated from grading curve</td></tr>
<tr><td>Moisture content</td><td>BS1377: Part 2</td></tr>
<tr><td>Organic Matter (maximum 2.5% total organic content)</td><td>BS1377: 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 of 5%)</td><td>BS1377: 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.
Multi Point Moisture Condition Value (MCV) (to assess optimum moisture content)</td><td>Clause 632 (BS1377: Part 4)</td></tr>
<tr><td>Proctor compaction testing</td><td>BS1377: Part 4</td></tr>
</table>

6. RECORD KEEPING & VERIFICATION

6.1 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.

6.2 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 (i.e. asbestos in air, gas water etc.)

7. CONTINGENCY PLAN

7.1 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 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.

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 be 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.

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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

AST	Above Ground Storage Tank	**SGV**	Soil Guideline Value
BGS	British Geological Survey	**SPH**	Separate Phase Hydrocarbon
BSI	British Standards Institute	**TPH CWG**	Total Petroleum Hydrocarbon (Criteria Working Group)
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes	**SPT**	Standard Penetration Test
CIEH	Chartered Institute of Environmental Health	**SVOC**	Semi Volatile Organic Compound
CIRIA	Construction Industry Research Association	**UST**	Underground Storage Tank
CLEA	Contaminated Land Exposure Assessment	**VCCs**	Vibro Concrete Columns
CSM	Conceptual Site Model	**VOC**	Volatile Organic Compound
DNAPL	Dense Non-Aqueous Phase Liquid (chlorinated solvents, PCB)	**WTE**	Water Table Elevation
DWS	Drinking Water Standard	**m**	Metres
EA	Environment Agency	**km**	Kilometres
EQS	Environmental Quality Standard	**%**	Percent
GAC	General Assessment Criteria	**%v/v**	Percent volume in air
GL	Ground Level	**mb**	Milli Bars (atmospheric pressure)
GSV	Gas Screening Value	**l/hr**	Litres per hour
HCV	Health Criteria Value	**µg/l**	Micrograms per Litre (parts per billion)
ICSM	Initial Conceptual Site Model	**ppb**	Parts Per Billion
LNAPL	Light Non-Aqueous Phase Liquid (petrol, diesel, kerosene)	**mg/kg**	Milligrams per kilogram (parts per million)
ND	Not Detected	**ppm**	Parts Per Million
LMRL	Lower Method Reporting Limit	**mg/m^3**	Milligram per metre cubed
NR	Not Recorded	**m bgl**	Metres Below Ground Level
PAH	Polycyclic Aromatic Hydrocarbon	**m bcl**	Metre Below Cover Level
PCB	Poly-Chlorinated Biphenyl	**mAOD**	Metres Above Ordnance Datum (sea level)
PID	Photo Ionisation Detector	**kN/m^2**	Kilo Newtons per metre squared
QA	Quality Assurance	**µm**	Micro metre
SGV	Soil Guideline Value		