

Ref: 17-011-L1-1
Date: 24th August 2023

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BY Email

Dear Martin

REMEDIATION STRATEGY INNINGS WAY, CASTLETON

1. BACKGROUND

E3P has been instructed by Olive Group (UK) Ltd (the Client) to develop a remediation strategy for the proposed residential development on a parcel of semi-derelict land to the east of Innings Way, Castleton; herein referred to as the site.

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

1.1. PREVIOUS WORKS

The following phases of geoenvironmental investigation have previously been carried out at the site:

-  **E3P** – Phase II Geoenvironmental Site Assessment – Innings Way, Castleton. Report Ref: 117-011-R2-1, dated August 2023. Prepared for Olive Group (UK) Ltd.

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 Geoenvironmental Site Assessment report are summarised within Section 1.2 below.

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



1.2. SITE SUMMARY

TABLE 1.1 SITE SUMMARY

Site Address	Innings Way, Castleton, Rochdale, OL11 3DE	
Proposed Development	Olive Group (UK) Limited intends to construct a low-rise residential development comprising three residential dwellings with associated gardens.	
Occupancy/Use	The subject site is an irregularly shaped parcel of land located to the south of 3 Innings Way and northeast of 7 Innings Way, Castleton. The site is currently unoccupied and comprises soft standing with areas of brambles, semi-mature and mature trees. A steep vegetated slope / mound approximately 5 m in height is located along the central eastern site boundary and leads up to an area of off-site allotments.	
Environmental Setting	Drift Geology	Glaciofluvial Deposits (Sand and Gravel)
	Bedrock Geology	Pennine Lower Coal Measures (SANDSTONE, MUDSTONE and SILTSTONE).
	Hydrogeology	Secondary A aquifer (drift) overlaying Secondary A aquifer (solid)
	Hydrology	Rochdale Canal is located approximately 580 m southeast of the site
	Flood Risk	The site is unaffected by flooding from rivers.
	Subsidence Hazard	None recorded.
Site History	Historical mapping indicates the site comprised part of Castleton Moor Cricket Ground (cricket pitch) from circa 1885 to circa 1913. Between circa 1937 and circa 1955, an old gravel pit was present on-site. Post 1955, the old gravel pit was no longer present, indicating it had been backfilled with unknown materials (potentially from an off-site source or development). At some point between 1955 and 2000, a mound was placed along the eastern boundary of the site. It is not known where the mound materials were sourced from (potentially an off-site source or development). Post 2013, a residential development with associated gardens and infrastructure was constructed to the north, west and south of the site, with an area of allotments located to the east. No further changes have occurred on-site since 2013.	
Landfill Sites and Ground Gases	No historical or current landfills have been identified on-site. A historical landfill (Land South of Chadwick Lane) is located approximately 550 m west of the site and was operational between 1984 and 1986. The presence of peat / organic-rich pond-like material identified within the underlying natural strata during the ground investigation may be a potential source of ground gases.	
Radon	The UK Radon website indicates the Site is situated in an area where 1-3% of homes are above the "Action Level" and that full radon protective measures are not necessary for the construction of new dwellings or extensions.	



Ground Conditions	<u>Topsoil:</u> No topsoil identified on-site. <u>Made Ground:</u> Granular Made Ground encountered across site between 0.00 m and 4.30 metres below ground level (m bgl); comprised light brown to black sandy gravel or sandy gravel with occasional cobbles and boulders. Made Ground inclusions comprised of brick, ash, concrete, metal, sandstone, mudstone, and fragments/pieces of wood, glass, textile, and ceramic. The deepest Made Ground was encountered in eastern part of site, with the full depth not proven in south/southeast part of site. Cohesive Made Ground encountered in central and northern parts of site between 0.60 m and 3.80 m bgl, comprised soft to firm black silty very gravelly clay with gravel of brick, timber, mudstone, and sandstone, with occasional fragments of ash, plastic, and tile <u>Drift Deposits:</u> Granular deposits encountered across the site between 3.10 m and 5.45 m bgl; comprised grey very silty SAND. Cohesive deposits encountered in centre of site adjacent to steep vegetated slope / mound between 3.80 m and 4.60 m bgl; comprised very stiff very high strength black mottled grey silty sandy CLAY. <u>PEAT / Potential Pond Deposits:</u> PEAT deposits and potential pond-like materials were identified across the site. Typically interbedded with a grey silty SAND as pockets of blackish brown fibrous PEAT, with a strong organic odour at depths > 3.00 m bgl. Occasionally, PEAT deposits were encountered interbedded with very soft very silty CLAY between 2.30 m and > 2.60 m bgl in the northern part of the site. In the far northern part of the site, a firm dark brown fibrous PEAT was encountered between 3.00 m and 3.80 m bgl, overlying the grey silty SAND which included pockets of PEAT. <u>Bedrock:</u> Not encountered during this phase of intrusive ground investigation. No BGS borehole logs are located within 250 m of the site <u>Groundwater:</u> Perched groundwater was encountered within Made Ground deposits as slow seepage within one trial pit and five window sample probeholes between 1.50 m and 3.80 m bgl. Groundwater was encountered within the natural drift deposits as moderate ingress with trial pit TP106 at 3.40 m bgl (northern part of site), however this may be attributed to weather conditions at the time of the investigation (i.e., heavy rainfall and surface water run-off).
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Human Health Risk Assessment	The Tier 2 human health risk assessment has identified localised concentrations of non-volatile insoluble heavy metals that would present unacceptable degrees of theoretical risk to the identified receptors associated with direct exposure pathways. It is noted that all of the identified elevated concentrations were recorded within samples taken from material within the steep vegetated slope / mound located along the central eastern site boundary. As this material is proposed to be removed from site during a process of cut/fill, no exposure pathways should remain on-site. However, given the presence of deep Made Ground across the site, there is the potential for elevated concentrations of inorganic heavy metals to be present within the ground beneath the steep vegetated slope / mound. As such, it will be necessary to design and construct the proposed development in a manner that will ensure suitably validated cover systems to all areas of private gardens, soft landscaping and public open space.
Controlled Waters Risk Assessment	The results of the data review and Tier 2 qualitative risk assessment has allowed E3P to draw the following conclusions in respect to the risk to controlled waters: ✳ The primary receptors are identified as the underlying Secondary A aquifers (drift and bedrock); ✳ Perched groundwater was encountered within the Made Ground as slow seepage within the trial pits between 1.50 m and 3.10 m bgl, with true groundwater being encountered in one location within the natural drift deposits at 3.40 m bgl. As no significant source of groundwater has been identified on-site, it is considered the overall risk of contamination leaching into the underlying aquifer is significantly reduced; ✳ Chemical analysis has not identified any mobile phase contaminants within Made Ground deposits or natural stratum alike. ✳ The controlled waters assessment has identified elevated heavy metals within leachate samples. However, as these are not mobile contaminants, it is considered unlikely that metalloid impact to the underlying aquifers will occur through migration of perched groundwater vertically through granular drift deposits; ✳ As the site is currently open space, with little hardstanding surface cover, rainfall is not being intercepted and subsequently infiltrates freely into the underlying Made Ground, potentially mobilising the identified contaminants; ✳ However, the proposed development will create hardstanding cover across the majority of the site, thus reducing the amount of infiltration generated. This will, in turn, reduce the number of contaminants present in leachate migrating off the site and reduce the risk to the underlying aquifers; ✳ Additionally, ground conditions beneath the steep vegetated slope /mound along the central eastern site boundary are currently unknown, presenting a potential for cohesive stratum to be present which would further reduce the movement of identified contaminants into the underlying aquifers.



Controlled Waters Risk Assessment <i>Continued...</i>	 Given that no exceedances for Copper, Nickel and Zinc have been identified within the soil samples, the site is not located within a Groundwater Source Protection Zone, no potable water abstractions are located within 1 km of the site, and that no exceedances above the DWS thresholds have been recorded, the overall risk to the underlying aquifers is considered to be low.
Ground Gas	A full ground gas risk assessment was beyond the scope of this phase of intrusive ground investigation. However, an RB17 assessment has been undertaken. The RB17 assessment suggests Characteristic Situation 2 (CS2) would apply for the site. As such, it is considered that gas protection measures will be required for the proposed development on the site.
Potable Water Supply	Based on the assessment of current site conditions, it is likely that PE pipe will be suitable for the proposed development. However, this will need to be confirmed with a UKWIR risk assessment post remediation. Post remediation and enabling works ground conditions may be different from those identified during this phase of ground investigation.

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

-  Management of soils to ensure that all materials impacted by heavy metals are either removed from the site or placed in areas of low sensitivity during the site enabling works.
-  Construction of all dwellings with ground gas mitigation measures that conform to CS2/Amber 1 requirements of BS 8485.
-  Construction of a 600 mm cover system using certified material, with appropriate validation within proposed private rear garden areas, comprising 150 mm topsoil overlying 450 mm subsoil.
-  Construction of a 300 mm cover system using certified material, with appropriate validation within proposed areas of public open space and soft landscaping, including front gardens, comprising 150 mm topsoil overlying 150 mm subsoil.
-  Use of potable water supply infrastructure that will be compliant with United Kingdom Water Infrastructure Risk (UKWIR) assessment criteria.

2. SITE REMEDIATION AND ENABLING WORKS

2.1. SUMMARY OF REMEDIATION OPTIONS

It is considered that the following combination of remediation technologies provides the most sustainable, viable and economic solutions that will ultimately result in the successful remediation for the site:

-  Installation of a suitable **cover system** in all proposed private rear gardens, public open space and soft landscaping areas, including front gardens, to remove any potential for direct exposure to impacted soils.
-  Construction of dwellings with **gas mitigation measures** to ensure no ingress of hazardous ground gases into a dwelling.



2.2. 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 and 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 – SITE CLEARANCE OPERATIONS

General site clearance and provision of welfare, offices and site security are to be determined as per the contract requirements.

The site is currently unoccupied and comprises soft standing with areas of brambles, semi-mature and mature trees. A steep vegetated slope / mound approximately 5 m in height, is located along the central eastern site boundary and leads up to an area of off-site allotments

Vegetation 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 letter.

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

All root networks are to be removed in accordance with the requirements of the NHBC/LABC.

RE-2 – POST SITE CLEARANCE SUPPLEMENTARY GROUND INVESTIGATION

During the E3P intrusive ground investigation, access could not be gained along the eastern site boundary due to dense vegetation, and the steep vegetated slope / mound. As such, further investigations will be required in these areas post-clearance in order to confirm the chemical and geotechnical nature of the soils beneath these areas.

Chemical sampling of the underlying Made Ground should be carried out to confirm there is no residual risk to end users within the soils. Samples should be sent for a full suite of analysis to include heavy metals, asbestos, hydrocarbons and speciated PAHs. Any exceedances within soils should be highlighted and the soils should be dealt with, in accordance with this remediation strategy letter.

If any as yet unidentified contamination 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 by the placement of clean cover systems to break the pathway or delineation and source removal where required.



RE-3 – EXCAVATION, BREAKING AND PROCESSING OF ALL ABOVE- AND BELOW-GROUND STRUCTURES

Any obstructions, relict foundations, and infrastructure (apart from live services) are to be removed from the areas of proposed residential developments, to include plot footprints and landscaping in their entirety.

It will be the contractor's responsibility to remove all obstructions from the sites.

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, 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-4 – CUT-AND-FILLING OF MADE GROUND TO DEVELOPMENT LEVELS

Minimal cut-and-fill works will be required to prepare the development platform, with the exception of along the central eastern site boundary, where a maximum proposed cut of 3.80 m will be required to remove the steep vegetated slope / mound.

Made Ground is noted to be present across the site to a maximum proven depth of 4.30 m bgl (WS106). Made Ground deposits are not considered a suitable founding stratum due to the unquantifiable potential for long term and differential settlement.

Highly compressible PEAT deposits are also present across the site. These deposits are not considered to be a suitable founding stratum due to the consolidation potential to induce settlement >25 mm. No safe ABP can be attributed to the PEAT soils across much of the site.

It has not been possible to accurately define the foundation types due to the absence of finished floor levels (FFLs) or structural loadings; however, due to the variable depths of Made Ground levels and interbedded peat deposits recorded across the site, it is considered likely that all proposed plots will require driven pile foundations.

The final foundation solution will be dependent on the structural loadings, elevation and should be designed by a suitably qualified structural engineer.

RE-5 – PREPARATION OF LANDSCAPED AREAS FOR COVER SYSTEM

As part of the land remediation works, landscaped areas will be prepared in a manner that will facilitate the placement of the clean cover system during the development phase of the works. 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 within private rear gardens, the area will be subject to a reduced-level dig to remove unsuitable material to a minimum depth of 600 mm below finished landscaped area level or verified natural stratum (whichever is the shallower).



Where Made Ground is deemed unsuitable for retention within areas of public open space and soft landscaping, including front gardens, the area will be subject to a reduced-level dig to remove unsuitable material to a minimum depth of 300 mm below finished landscaped area 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 subsoil and topsoil will be completed as part of the development works/build-phase mitigation plan. All landscaped areas where a cover system is required, will be subject to independent validation.

RE-6 – PROVISION OF SUBSOIL

The natural drift deposits (predominantly granular soils) are deemed suitable for use within the upper 600 mm of clean cover to all areas of private rear gardens, and the upper 300 mm of clean cover to all areas of public open space and soft landscaping, including front gardens.

It is therefore deemed viable to re-use materials through a soil inversion (regulated by an MMP) to generate the required volumes of material. However, given that minimal cut/fill works are proposed for the site, and that the natural drift deposits are located at depths >3.00 m bgl, this is not considered to be a feasible option. As such, there will be a requirement to import suitable subsoil materials for use within the proposed development.

Subsoil (site-won and imported) will require testing in line with the schedule presented within Section 2.3 and Table 2.1 of this letter.

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

RE-7 – PROVISION OF TOPSOIL

No material that would be deemed suitable for use as topsoil is present on-site; and as such, there will be a requirement to import suitable topsoil material for use within the proposed development.

Topsoil will require testing in line with the schedule presented within Section 2.3 and Table 2.1 of this letter. The landscaped areas will require depth validation to satisfy the requirements of the CML in order to demonstrate that the appropriate thickness has been provided as a growing medium.

RE-8 – 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/ unexpected contamination 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 of as yet unidentified contamination.

RE-9 – 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 be 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.

Subject to suitability, these soils can be transferred to a receiving site, subject to an approved permit or materials management plan following guidance in the CL:AIRE *Definition of Waste: Code of Practice*.

RE-10 – VALIDATION OF MATERIALS FOR POTABLE WATER SUPPLY INFRASTRUCTURE

A contaminant risk assessment completed in accordance with the UKWIR assessment framework has not identified any elevated concentrations of potentially volatile/soluble hydrocarbon compounds that necessitate the use of protected water supply pipework. However, this will need to be confirmed with a UKWIR risk assessment post remediation. Post-remediation and enabling works ground conditions may be different from those identified during the ground investigation.

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.



RE-11 – 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.

2.3. 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 strategy letter, 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 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 the enclosed appendices), 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 2.1.



Remediation Strategy Letter

Innings Way, Castleton

August 2023

TABLE 2.1 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 m ³ 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
Site-Generated Subsoil (150 mm Landscaped Cover)	1 Sample per 200 m ^{3*}	A/B/C/D
Site-Generated Topsoil Cover (150 mm Landscaped Cover)	1 Sample per 50 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
Subsoil Greenfield Source (150 mm Landscaped Cover)	1 Sample per 200 m ^{3*}	A/B/C/D
Subsoil Brownfield Source (150 mm Landscaped Cover)	1 Sample per 50 m ^{3*}	A/B/C/D
Topsoil Greenfield Source (150 mm Landscaped Cover)	1 Sample per 200 m ^{3*}	A/B/C/D
Topsoil Brownfield Source (150 mm Landscaped Cover)	1 Sample per 50 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

* Minimum of three samples per source.

Suites of Analysis:

- A. Speciated PAH.
- B. Speciated TPH (C5-C35).
- C. Asbestos (ID) and Quantification (if required).
- 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.



2.4. 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 geo-environmental 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.

3. ENVIRONMENTAL MONITORING AND VALIDATION

3.1. 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.



3.2. 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.

3.3. MITIGATION OF RISK FROM SOILS WITH ASBESTOS FIBRES

3.3.1. 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.

3.3.2. 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.

4. RECORD-KEEPING AND VERIFICATION

4.1. 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.

4.2. 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).

5. CONTINGENCY PLAN

5.1. 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.

6. 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 areas;
- ✿ Placement and validation of subsoil (clean material) in a 450 mm layer, and at least 150 mm imported topsoil within all private rear gardens;
- ✿ Placement and validation of subsoil (clean material) in a 150 mm layer, and at least 150 mm imported topsoil within all areas of public open space and soft landscaping, including front gardens;
- ✿ Installation and validation of ground gas protection measures.

The validation protocols are presented within this E3P Remediation Strategy letter and are presented below.



6.1. PLACEMENT OF COVER SYSTEM

The Remediation 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:

Private Rear Gardens:

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

Public Open Space and Soft Landscaping, including Front Gardens:

- ✳ 150 mm subsoil; and,
- ✳ 150 mm 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.

Testing requirements for topsoil and subsoil are presented in Table 6.1.

TABLE 6.1 SPECIFICATION FOR SOIL TESTING

MATERIAL USE	TESTING FREQUENCY	SUITE OF ANALYSIS
Subsoil Greenfield Source (150 mm Landscaping Cover)	1 Sample per 200 m ³ *	A/B/C/D
Subsoil Brownfield Source (150 mm Landscaping Cover)	1 Sample per 50 m ³ *	A/B/C/D
Topsoil Greenfield Source (150 mm Landscaping Cover)	1 Sample per 200 m ³ *	A/B/C/D
Topsoil Brownfield Source (150 mm Landscaping Cover)	1 Sample per 50 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

* Minimum of three samples per source.

Suites of Analysis:

- A. Speciated PAH.
- B. Speciated TPH (C5-C35).
- C. Asbestos (ID) and Quantification (if required).
- D. CLEA Inorganic Heavy Metals.



6.1.1. PROCEDURE FOR PLACEMENT OF CHEMICALLY SUITABLE COVER SYSTEM

Made Ground soils are to be stripped from beneath proposed areas of private rear gardens to a minimum of 600 mm bgl.

Made Ground soils are to be stripped from beneath proposed areas of public open space and soft landscaping, including front gardens, to a minimum of 300 mm bgl.

Private rear gardens need to be backfilled with 450 mm chemically validated subsoil, with 150 mm topsoil overlying this.

Areas of public open space and soft landscaping, including front gardens, need to be backfilled with 150 mm chemically validated subsoil, with 150 mm topsoil overlaying this.

Topsoil is required to be confirmed as chemically suitable prior to placement. Where subsoil is not placed during Remediation & Enabling works, E3P will be required to return to site and undertake independent validation of the correct placement of subsoil.

The placement of 600 mm of clean material within private rear gardens or 300 mm of clean material within areas of public open space and soft landscaping, including front gardens, will be undertaken during the build phase works of the project.

The placement of subsoil and corresponding validation will be documented within the Landscaping 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 within the 600 mm strip in private rear gardens, or 300 mm strip in areas of public open space and soft landscaping, including front gardens, then excavations can cease here.

E3P will collect photographic evidence of the placement of 150 mm of certified topsoil and 450 mm of certified subsoil within private rear gardens; and 150 mm of certified topsoil and 150 mm of certified subsoil within areas of public open space and soft landscaping, including front gardens, 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 landscaping validation procedure is detailed in Table 6.2.



TABLE 6.2 LANDSCAPING VALIDATION PROCEEDURE

PROCEDURE	METHOD
Chemical Validation	Imported subsoils 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 landscaping systems. E3P will issue an email to the appropriate party with an assessment of the chemical suitability of both subsoil and topsoil. If acceptable the materials can be installed to the required depth at which time the landscaping areas will be deemed complete following a validation procedure by a suitability qualified E3P engineer.
Trial Holes	Trial holes are deemed necessary for all landscaping areas given that the 600 mm cover system within private rear gardens and the 300 mm cover system within areas of public open space and soft landscaping, including front gardens, will need to be placed on each landscaping area 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 landscaping area. For landscaping areas where subsoil 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 validation certificate to demonstrate that the required subsoil and topsoil has been placed in the required landscaped areas along with the chemical analysis.
Completion Report	Upon completion of all landscaping 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 validation photographs that will be required for each area of landscaping.



PLATE 1 EXAMPLE COVER SYSTEM VALIDATION

Plot No: 70

Depth of Strata (m bgl)	0.00-0.15	Validated TOPSOIL
	0.15-0.60	Validated SUBSOIL

Depth of Cover System Materials



Depth of Cover System Materials



Depth of Cover System at Ground Level



Depth of Cover System in Relation to Plot



6.2. GROUND GAS PROTECTION MEASURES

RB17 assessments for the site suggests that the site will fall into the bracket for Characteristic Situation 2 / Amber 1 which will require specialist mitigation measures to be constructed in accordance with BS8485 (2015)+A1(2019).

British Standard BS8485:2015+A1(2019) provides two types of residential property that require assessment. These building types are:

-  **Type A Building** – Private ownership with no building management controls on alterations to the internal structure, the use of rooms, the ventilation of rooms or the structural fabric of the building. Some small rooms are present. Probably conventional building construction (rather than civil engineering). Examples include private housing and some retail premises.
-  **Type B Building** – Private or commercial property with central building management control of any alterations to the building or its uses but limited or no central building management control of the maintenance of the building, including the gas protection measures. Multiple occupancy. Small to medium sized rooms with passive ventilation of rooms and other internal spaces throughout ground floor and basement areas. May be conventional building or civil engineering construction. Examples include managed apartments, multiple occupancy offices, some retail premises and parts of some public buildings (such as schools, hospitals, leisure centres) and parts of hotels.

Based on the ground gas risk assessment and the proposed Type A Building, it is envisaged that a point score of 3.5 will be required for proposed new structures, in accordance with Table 4 of BS8485:2015+A1(2019).

One example of a combination of measures which can be used with a suspended floor to achieve the required score would be:

-  Passive sub-floor dispersal layer of very good performance which meets all criteria set out in Paragraph B.6 of BS8485:2015 (minimum 150 mm clear void space and with correct frequency of side ventilation) – Score 2.5.
-  Lapped and taped gas resistant membrane in the floor slab construction which meets all the criteria as set out in Table 7 of BS8485:2015 – Score 2.0.

In addition to the BS8485:2015+A1(2019), the NHBC Traffic Light guidance can still be used where the development proposals are based on the 'typical house' used in the modelling for the traffic light classification system.

A typical house is defined as a house (up to three storeys) with <100m² footprint and minimum 150mm depth clear ventilated void achieving sub slab ventilation of one complete air exchange per day.

The validation inspection is to include the items that are detailed within Table 6.3.

TABLE 6.3 GROUND GAS MITIGATION MEASURES VALIDATION ITEMS

INSPECTION	METHOD
Product Verification	Confirmation that suitable products have been installed to consist of photographs of product types, labels on packaging and delivery tickets.
Wall Cavity Inspection	Confirmation that gas membrane spans the external wall cavity above the periscopic vents.
General Condition	The membrane is to be inspected to ensure there are no tears, punctures, or rips.



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INSPECTION	METHOD
Jointing	The engineer is to check the overlaps between membranes are correctly sealed with sufficient overlaps.
Service Entry Points	Verification of the presence of preformed tophats sealed to the pipe and membrane as per the construction detail.
Passive Venting Systems	The engineer should verify the presence of vents at 2m centres on at least 3 of the external walls. Verification of the stone venting layer and presence of pipes to be supplied by photographic records from site.

NHBC expectations for verification to satisfy the Traffic Light gas regime classifications for an Amber I classification will include the following:

- Construction drawings – showing position of membrane; sealing details and ventilation points to be provided;
- Membrane specification – technical data sheet(s) for gas membrane (including gas permeability data) to be provided; and
- Installation – photographic evidence of installed membrane may be requested.

Examples of gas membrane verification photographs provided in Plate 2.

It should be noted that these are for illustrative purposes only as each site will have a site-specific gas membrane specification.



PLATE 2 EXAMPLE GAS MEMBRANE VERIFICATION

Plot – 236

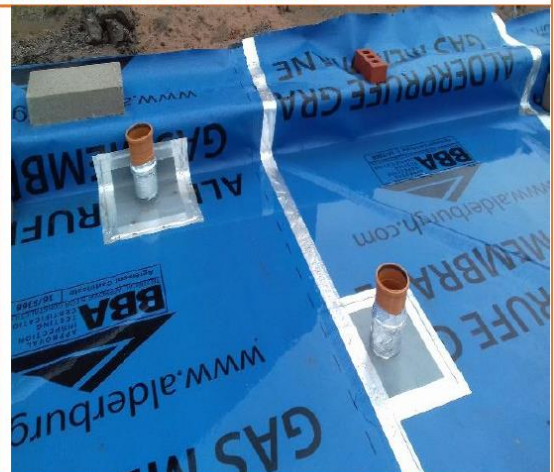
General Condition of Membrane-Good Condition



Verification of Joints and Seals-Good Condition



Verification of Service Penetrations-Good Condition



6.3. POTABLE WATER SUPPLY – CONTAMINANT ASSESSMENT CRITERIA

Table 6.4 provides a summary of the threshold concentrations that must not be exceeded within remediated ground at pipeline depth in order to PE pipe works to be acceptable for the proposed development.

TABLE 6.4 PIPELINE SELECTION PE THRESHOLD CONCENTRATIONS

Contaminant Group	PE-threshold
Total VOC	0.5
Total BTEX And MTBE	0.1
Total SVOCs (Excluding PAH and those substances marked with an *)	2
EC5-EC10 Aliphatic and Aromatic Hydrocarbons	2
EC10-EC16- Aliphatic and Aromatic Hydrocarbons	10
EC16-EC40 Aliphatic and Aromatic Hydrocarbons	500
Phenols (From SVOC Analysis)*	2
Cresols and Chlorinated Phenols (From SVOC Analysis)	2
Ethers*	0.5
Nitrobenzene*	0.5
Ketones*	0.5
Aldehydes*	0.5
Amines	Fail

Upon completion of the remedial works a full UKWIR Risk Assessment should be undertaken.

We trust this information is satisfactory to your requirements, and should I be able to be of any further assistance, please do not hesitate to contact me.

Yours sincerely,

For and on behalf of E3P Ltd

Written by:

Mark Wilson
Senior Geoenvironmental Consultant

Reviewed by:

Brad Hall
Associate Director



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Enclosed

Appendix I

Drawings

17-011-002 – Proposed Development Plan – Innings Way, Castleton

17-011-023 – Isopachyte from Topographical Survey to Proposed Plateau Plan

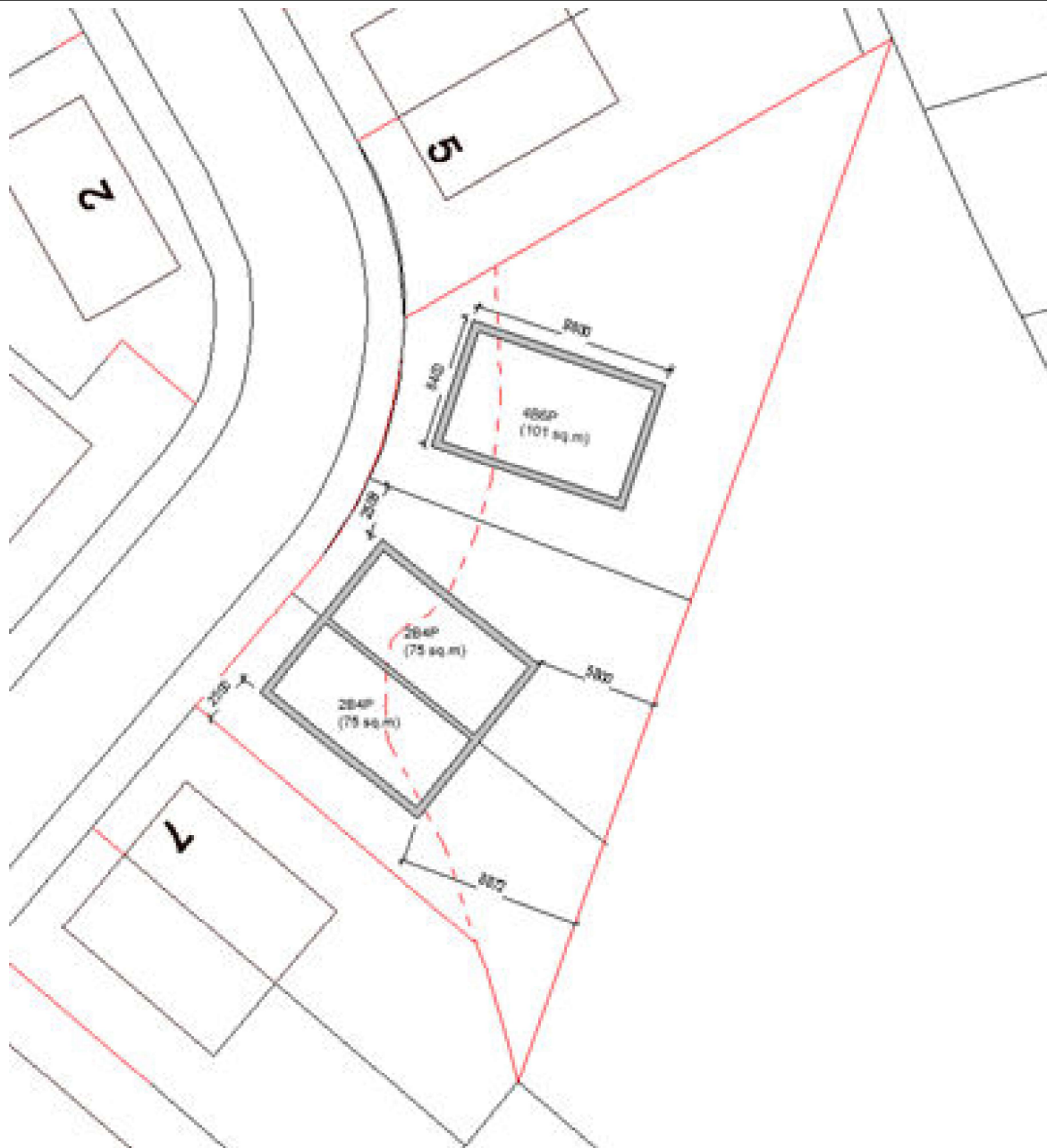
Appendix II

E3P Remediation / Validation Criteria

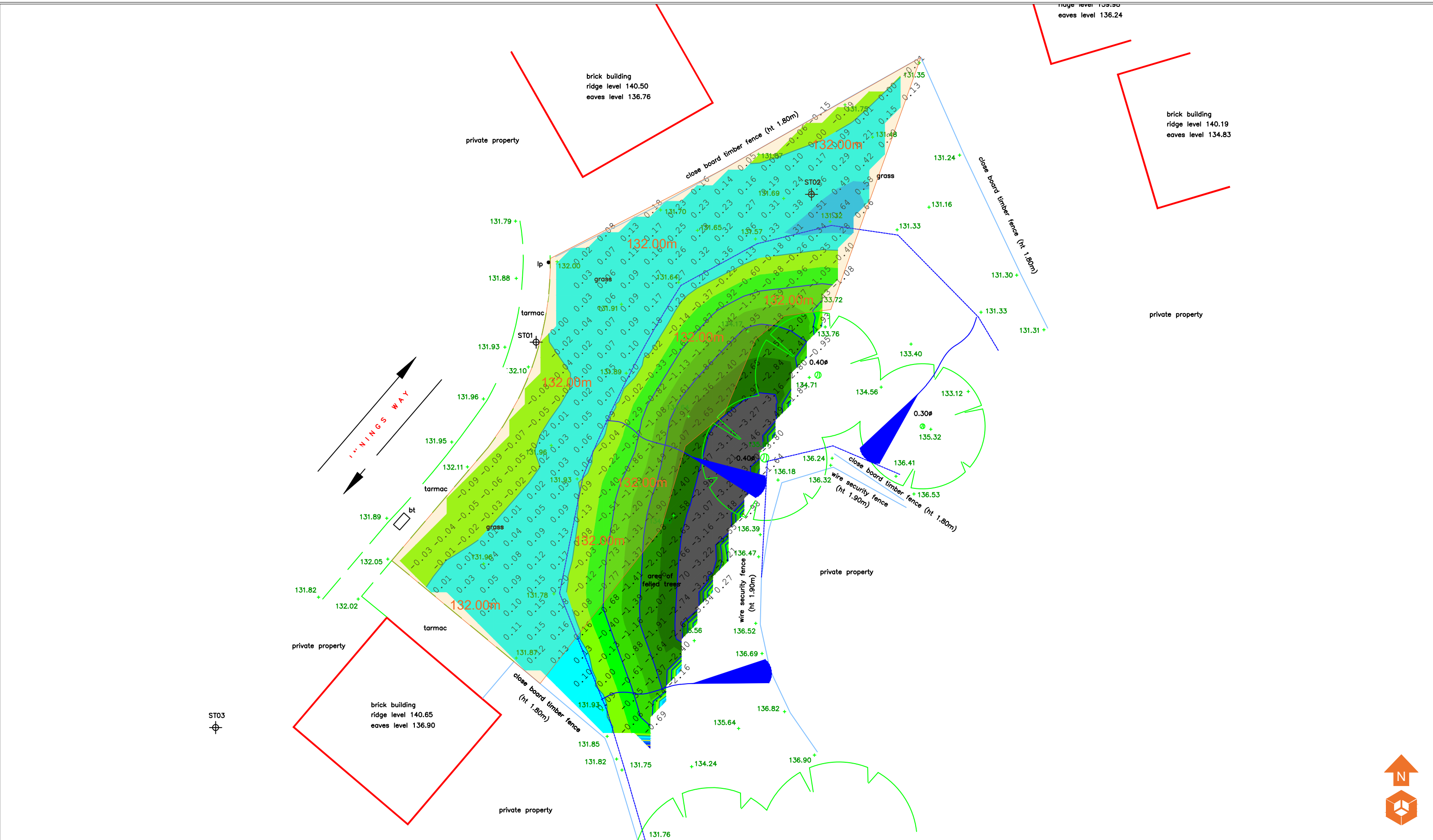


APPENDIX I

DRAWINGS



						Client:	Olive Group UK	Job No: 17-011	Date: 18.07.2023	 Environmental Engineering Partnership Ltd Taylor Road, Trafford Park Urmston, Manchester, M41 7JQ Tel: 0161 707 9612 E-mail: info@e3p.co.uk Website: www.e3p.co.uk	
								Drawing No: 002	Scale: 1:1000 @ A3		
						Job Title: Innings Way, Castleton		Drawing Title: Proposed Development Plan		The client must not amend any drawing, design or other intellectual property produced by E3P Ltd without permission in writing from E3P Ltd in advance of any amendments being made. In the event that such written permission is not obtained in advance of the amendments being made, E3P Ltd shall not be liable for any damage and/or losses occurring as a result of the amended drawing, design or intellectual property.	
	P1	REVA	18.07.2023	OW	ID						
						Phase	Issue	Date	Drawn	Checked	



Volumetrics

>3.00m (Fill)	0.00 - 0.49m (Cut)
2.50 - 2.99m (Fill)	0.50 - 0.99m (Cut)
2.00 - 2.49m (Fill)	1.00 - 1.49m (Cut)
1.50 - 1.99m (Fill)	1.50 - 1.99m (Cut)
1.00 - 1.49m (Fill)	2.00 - 2.49m (Cut)
0.50 - 0.99m (Fill)	2.50 - 2.99m (Cut)
0.00 - 0.49m (Fill)	>3.00m (Cut)

Cut Fill Volumes					
Volumes (m³)			Areas (m²)		
Cut (Material)	Fill (Void)	Balance	Cut	Fill	Total
481.163	-49.95	431.213	337.98	286.215	624.2030
0	0	0	80		
481.1630	-49.9500	431.2130	337.9880	286.2150	624.2030

Notes:

A proposed plateau of 132.00m has been used for this model.

P1	REVB	20.06.2022	CB	MD
P1	REVA	06.06.2022	CB	MD
Phase	Issue	Date	Drawn	Checked

Client:

Olive Group

Job Title:

Innings Way, Rochdale

Job No:

17-011

Drawing No:

023

Date:

25.07.2023

Scale:

1:1000 @ A3



Environmental Engineering Partnership Ltd
Taylor Road, Trafford Park
Urmston, Manchester, M41 7JQ
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Website: www.e3p.co.uk

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APPENDIX II

E3P REMEDIATION/ VALIDATION CRITERIA

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HUMAN HEALTH REMEDIATION TARGETS – LOW-RISE RESIDENTIAL END USE

DETERMINAND	UNITS	WITHIN 600 mm COVER SYSTEM (GARDEN)	HARD STANDING AND >600 mm OF COVER	PUBLIC OPEN SPACE 300 mm COVER	PUBLIC OPEN SPACE > 300 mm	PATH- WAY
Arsenic	mg/kg	37 ⁽ⁱ⁾	40 ⁽ⁱⁱ⁾	79 ⁽ⁱⁱⁱ⁾	170 ^(iv)	1
Cadmium	mg/kg	11 ⁽ⁱ⁾	85 ⁽ⁱⁱ⁾	120 ⁽ⁱⁱⁱ⁾	532 ^(iv)	1
Chromium (Hexavalent)	mg/kg	6 ⁽ⁱ⁾	6 ⁽ⁱⁱ⁾	7.7 ⁽ⁱⁱⁱ⁾	220 ^(iv)	1
Lead	mg/kg	200 ^(vi)	310 ^(vii)	630 ^(viii)	1300 ^(viii)	1
Elemental Mercury	mg/kg	1.2 ⁽ⁱ⁾	1.2 ⁽ⁱⁱ⁾	16 ⁽ⁱⁱⁱ⁾	30 ^(iv)	2
Nickel	mg/kg	130 ⁽ⁱ⁾	180 ⁽ⁱⁱ⁾	230 ⁽ⁱⁱⁱ⁾	800 ^(iv)	1
Selenium	mg/kg	250 ⁽ⁱ⁾	430 ⁽ⁱⁱ⁾	1100 ⁽ⁱⁱⁱ⁾	1800 ^(iv)	1
Copper	mg/kg	2400 ⁽ⁱ⁾	7100 ⁽ⁱⁱ⁾	12,000 ⁽ⁱⁱⁱ⁾	44,000 ^(iv)	1
Zinc	mg/kg	3700 ⁽ⁱ⁾	40,000 ⁽ⁱⁱ⁾	81,000 ⁽ⁱⁱⁱ⁾	170,000 ^(iv)	1
Phenol	mg/kg	120 ^{(i)(xi)}	440 ^{(xiv)(xi)}	440 ^{(iii)(xi)}	440 ^{(iv)(xi)}	2
Naphthalene	mg/kg	2.3 ^{(i)(xi)}	2.3 ^{(xiv)(xi)}	1200 ^{(iv)(xi)}	1200 ^{(iv)(xi)}	2
Acenaphthylene	mg/kg	170 ^{(i)(xi)}	500 ^(v)	15,000 ^{(iii)(xi)}	29,000 ^{(iv)(xi)}	3
Acenaphthene	mg/kg	210 ^{(i)(xi)}	500 ^(v)	15,000 ^{(iii)(xi)}	29,000 ^{(iv)(xi)}	1
Fluorene	mg/kg	170 ^{(i)(xi)}	500 ^(v)	9900 ^{(iii)(xi)}	20,000 ^{(iv)(xi)}	1
Phenanthrene	mg/kg	95 ^{(i)(xi)}	500 ^(v)	3100 ^{(iii)(xi)}	6200 ^{(iv)(xi)}	3
Anthracene	mg/kg	500 ^{(i)(xi)}	500 ^(v)	74,000 ^{(iii)(xi)}	150,000 ^{(iv)(xi)}	3
Fluoranthene	mg/kg	280 ^{(i)(xi)}	500 ^(v)	3100 ^{(iii)(xi)}	6300 ^{(iv)(xi)}	3
Pyrene	mg/kg	500 ^{(i)(xi)}	500 ^(v)	7400 ^{(iii)(xi)}	15,000 ^{(iv)(xi)}	3
Benzo(a)Anthracene	mg/kg	7.2 ^{(i)(xi)}	11 ^{(ii)(xi)}	29 ^{(iii)(xi)}	49 ^{(iv)(xi)}	3
Chrysene	mg/kg	15 ^{(i)(xi)}	30 ^{(ii)(xi)}	57 ^{(iii)(xi)}	93 ^{(iv)(xi)}	3
Benzo(b)Fluoranthene	mg/kg	2.6 ^{(i)(xi)}	3.9 ^{(ii)(xi)}	7.1 ^{(iii)(xi)}	13 ^{(iv)(xi)}	3
Benzo(k)Fluoranthene	mg/kg	77 ^{(i)(xi)}	110 ^{(ii)(xi)}	190 ^{(iii)(xi)}	370 ^{(iv)(xi)}	3
Benzo(a)Pyrene	mg/kg	2.2 ^{(i)(xi)}	3.2 ^{(ii)(xi)}	5.7 ^{(iii)(xi)}	11 ^{(iv)(xi)}	3
Indeno(123-cd)Pyrene	mg/kg	27 ^{(i)(xi)}	45 ^{(ii)(xi)}	82 ^{(iii)(xi)}	150 ^{(iv)(xi)}	3
Dibenzo(a,h)Anthracene	mg/kg	0.24 ^{(i)(xi)}	0.31 ^{(ii)(xi)}	0.57 ^{(iii)(xi)}	1.1 ^{(iv)(xi)}	3
Benzo(ghi)Perylene	mg/kg	320 ^{(i)(xi)}	360 ^{(ii)(xi)}	640 ^{(iii)(xi)}	1400 ^{(iv)(xi)}	3
TPH C ₅ -C ₆ (aliphatic)	mg/kg	42 ^{(i)(xi)}	42 ^{(ii)(xi)}	42 ^{(ii)(xi)}	10,000 ^{(xiv)(xi)}	2
TPH C ₆ -C ₈ (aliphatic)	mg/kg	100 ^{(i)(xi)}	100 ^{(ii)(xi)}	100 ^{(ii)(xi)}	10,000 ^{(xiv)(xi)}	2
TPH C ₈ -C ₁₀ (aliphatic)	mg/kg	27 ^{(i)(xi)}	27 ^{(ii)(xi)}	27 ^{(ii)(xi)}	10,000 ^{(xiv)(xi)}	2
TPH C ₁₀ -C ₁₂ (aliphatic)	mg/kg	130 ^{(i)(xi)}	130 ^{(ii)(xi)}	130 ^{(ii)(xi)}	10,000 ^{(xiv)(xi)}	2
TPH C ₁₂ -C ₁₆ (aliphatic)	mg/kg	1000 ^{(xiv)(xi)}	1000 ^{(xiv)(xi)}	1000 ^{(xiv)(xi)}	10,000 ^{(xiv)(xi)}	2
TPH C ₁₆ -C ₂₁ (aliphatic)	mg/kg	1000 ^{(xiv)(xi)}	1000 ^{(xiv)(xi)}	1000 ^{(xiv)(xi)}	10,000 ^{(xiv)(xi)}	1
TPH C ₂₁ -C ₃₅ (aliphatic)	mg/kg					1
TPH C ₅ -C ₇ (aromatic)	mg/kg	70 ^{(i)(xi)}	370 ^{(ii)(xi)}	370 ^{(ii)(xi)}	10,000 ^{(xiv)(xi)}	2
TPH C ₇ -C ₈ (aromatic)	mg/kg	130 ^{(i)(xi)}	860 ^{(ii)(xi)}	860 ^{(ii)(xi)}	10,000 ^{(xiv)(xi)}	2
TPH C ₈ -C ₁₀ (aromatic)	mg/kg	34 ^{(i)(xi)}	47 ^{(ii)(xi)}	47 ^{(ii)(xi)}	10,000 ^{(xiv)(xi)}	2
TPH C ₁₀ -C ₁₂ (aromatic)	mg/kg	74 ^{(i)(xi)}	250 ^{(ii)(xi)}	250 ^{(ii)(xi)}	10,000 ^{(xiv)(xi)}	2
TPH C ₁₂ -C ₁₆ (aromatic)	mg/kg	140 ^{(i)(xi)}	1800 ^{(ii)(xi)}	1800 ^{(ii)(xi)}	10,000 ^{(xiv)(xi)}	1



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TPH C ₁₆ -C ₂₁ (aromatic)	mg/kg	260 ^{(i)(xi)}	1900 ^{(ii)(xi)}	1900 ^{(ii)(xi)}	10,000 ^{(xiv)(xi)}	1
TPH C ₂₁ -C ₃₅ (aromatic)	mg/kg	1000 ^{(xiv)(xi)}	1900 ^{(ii)(xi)}	1900 ^{(ii)(xi)}	10,000 ^{(xiv)(xi)}	1
Asbestos	Fibres Volume Weight (%)	NFD	0.001%	NFD	0.001	4

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.

No viable exposure pathway beneath hardstanding and cover system.

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 residential end use with plant uptake.
- ii. Value derived from LQM Suitable 4 Use Levels (S4ULs) for residential end use without plant uptake – these levels used below 600 mm cover system within residential gardens as soils will be present within a residential 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) residential.
- 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 residential land use with homegrown produce.
- vii. Value derived from Category 4 Screening Levels (C4SL) for residential land use without homegrown produce.
- viii. Value derived from Category 4 Screening Levels (C4SL) for public open space (POS) residential.
- 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 residential end use with plant uptake due to the volatilisation risk.
- xiv. BTEX is not SOM-related due to inhalation pathway.

