GEO Environmental Engineering

REMEDIATION STRATEGY

PROPOSED RESIDENTIAL DEVELOPMENT

LAND AT IVY MILL, MAIN STREET

HENSINGHAM, WHITEHAVEN, CA28 8TP

FOR:

GLEESON REGENERATION LTD

GEO Environmental Engineering

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1.0 Introduction

GEO Environmental Engineering Ltd (GEO) has completed a Remediation Strategy for contamination identified on land at Ivy Mill which is located on Main Street in Hensingham, Whitehaven, Cumbria, CA28 8TP where it is proposed construct a series of residential properties with associated areas of car parking, private gardens and soft landscaping.

Geo Environmental Engineering Ltd has been commissioned to complete the report by the Client, Gleeson Regeneration Limited. It understood that the Client wishes to construct residential properties with further development details available from the Client. This Remediation Strategy (RS) is designed to appropriately remediate the contamination identified within the following reports with respect to Human Health (proposed end users) and to controlled waters (environment):

- Elliot Environmental Surveyors in March 2017, ref: EES16-131
- Phase 1: Desk Top Study (Preliminary Environmental Risk Assessment) Executive Summary Report for Land at Ivy Mill, Main Street, Hensingham, Whitehaven, CA28 8TP (ref: 2019-3732, dated June 2019).
- Phase 2: Ground Investigation Report (GIR) for the Proposed Residential Development, Land at Ivy Mill, Main Street, Hensingham, Whitehaven, CA28 8TP (Ref: 2019-3886, dated 10th December 2019) following completion of the ground gas monitoring.
- Soil Infiltration Tests for the Proposed Residential Development, for the Proposed Residential Development, Land at Ivy Mill, Main Street, Hensingham, Whitehaven, CA28 8TP (Ref: 2021-4625, dated 9th February 2021)

It is recommended that the above-mentioned reports are read in conjunction with this Remediation Strategy (RS).

2.0 Remediation Strategy

2.1 Remediation Strategy Aims and Objectives

The aims and objectives of this RS are to appropriately remediate the contamination identified on site during the GEO Ground Investigation to ensure that the development site is “fit for purpose”. It is understood that the site will be developed for residential end use and will incorporate private gardens and general areas of soft landscaping.

2.2 Remediation Statement Limitations of Use

Although every effort is made to ensure a full and comprehensive investigation has been completed it should always be considered that ground conditions have the potential to vary between the exploratory hole locations to those identified and it is always recommended that a prudent developer adopt a “watching brief” during the redevelopment works, to ensure that any potential variations encountered are identified and dealt with in an appropriate manner.

In addition, this RS and its contents are limited to the boundaries of the site, as indicated on the plan in Appendix I. No reliance, copying or use of this report (in part or whole) by any Third Party is permitted without prior Geo Environmental Engineering Ltd written approval, with intellectual copyright remaining the sole property of the author.

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3.0 Development Site Details and Proposals

The proposed development area is roughly triangular in shape and is not currently in use. It is located on Main Street in Hensingham, Whitehaven, Cumbria.

During the various phases of fieldworks, the site was absent of any above ground structures albeit for the Electricity Substation (ESS) located to the north of the site. There is a steep slope which rises c.2m-c.3m to the area of overgrown vegetation in the east. Several retaining structures are noted along the northern boundary.

The site development is to comprise the construction of 26 no. residential properties (i.e., houses) along with areas of general soft landscaping, private gardens and parking facilities. Further details associated with the full (proposed) scope of redevelopment can be obtained from the Client. A Proposed Development Plan in Appendix II.

The previously completed Generic Quantitative Risk Assessment (GQRA) within the GIR reports detail potential future risks to Human Health (proposed end users) from the made ground/contamination identified on site. For the Human Health Risk Assessment, it is considered that the future residents will be subjected to the greatest exposure periods and consequently the most risk. Therefore, in accordance with current guidance and legislation a CLEA end use classification of *residential* has been considered most appropriate.

As part of the GIR report, hydrocarbons were identified on site within both the soils and within the shallow perched groundwater with further details below.

- On the stockpile, TP's F & G identified the crushed demolition rubble to depths of c.2.20m and c.2.40m bgl with possible concrete slabs noted at these depths, with no further excavation possible. On top of the "possible slab" encountered in TPF was a black gravel which exhibited olfactory evidence of hydrocarbons.

- Within TPD, made ground was recorded to a depth of c.0.40m bgl and then identified a relatively thin layer of clay before encountering sandstone. The made ground (gravel) between c.0.23m to c.0.40m bgl was noted to exhibit slight olfactory evidence of hydrocarbons.

These excavations (TP's D, F & G) were all undertaken on the lower level (western portion of the site) which was the location of the former factory. No hydrocarbons were identified in the east of the site with this area having never been historically developed.

The above is in addition to the GEO DTS report which identified the following:

- The superficial deposits are classified by the EA as a Secondary Aquifer with the solid deposits recorded as a Secondary (A) Aquifer. They are unlikely to be considered as a significant strategic resource.
- No groundwater abstractions are recorded within c.2km of the site.
- No surface water abstractions are recorded within c.2km of the development area.
- No potable water abstraction licences are held within c.2km of the site.
- The site is not recorded as being within or within c.500m of a Source Protection Zone.
- The nearest surface water feature is a small stream / drain located c.217m west.

In addition to the above, anecdotal evidence suggested that a possible culvert runs through the site which "if" present on site may potentially be impacted from the identified and isolated hydrocarbons present on site in the soils which appear to be leachable and impacting the shallow perched groundwater (i.e. surface

infiltration). Given that this was the case, the Client instructed Site Scan Limited to complete a survey of the development area.

Following the survey, it was identified that the culvert (i.e., a surface water sewer) is shown to enter the northern / north-western boundary and trends southwest along the western boundary before exiting the site approximately halfway along the site's boundary and into Main Street. A copy of this survey (Drawing No. 21118-UM-01) is in Appendix IV. This is noted to be away from any observed on site contamination.

Although considered to pose a negligible to very low risk to the culvert, the presence of the hydrocarbons is considered as posing a potential risk to possible receptors and therefore some form of remediation (i.e. hydrocarbon removal) will be required.

4.0 Previous Ground Investigation

4.1 Extent of Intrusive Investigation Works

In summary, the initial GEO investigation works comprised the following;

- 4 no. Dynamic (Windowless) Sampling Boreholes (BH's 01 to 04) to depths of between c.1.50m and c.5.00m bgl.
- 10 no. Mechanically Excavated Trial Pits (TP's A to J) to depths of between c.1.10m and c.2.40m bgl.
- 4 no. Gas and Groundwater Monitoring wells installed at all borehole locations to depths of between c.1.00m and c.3.00m bgl.
- Gas and groundwater monitoring (6 No. visits completed). Site supervision by a suitably qualified and experienced Geo-Environmental Engineer.
- In-situ geotechnical testing (Standard Penetration Test (SPT).
- Laboratory based geotechnical and ground contamination testing.
- Level 1 Generic Quantitative Risk Assessment (GQRA) to determine potential ground contamination and ground gas risks to the proposed end users and controlled waters.

And the supplementary GIR (i.e., Soakaway Tests) completed by GEO comprised;

- 9 no. Mechanically Excavated Trial Pits (TP's 201 to 209) to depths of between c.0.65m and c.2.20m bgl.
- Completion of 4 no. soakaway tests (TP's 201 to 204).
- Site supervision by a suitably qualified and experienced Geo-Environmental Engineer.

4.2 Exploratory Hole Locations

All of the exploratory hole locations were positioned to provide an even site coverage (where access allowed) of the proposed development area by the Consulting Engineer for geotechnical and ground contamination purposes. Investigation works were undertaken in accordance with BS5930:1999, BS1377:1990 and Eurocode 7 (Part I and II) and the exploratory hole locations are presented on the plan in Appendix III. It should be noted that the plan provided is an existing site plan and is for orientation purposes only, as the locations are approximate and not to a standardised scale.

No topographical survey was requested or undertaken as part of the investigation works.

At each exploratory hole location, the surfacing type, made ground, natural ground and groundwater conditions were observed, with in-situ testing undertaken and samples recovered. It is recommended that reference be made to the reports mentioned within Section 1.0 of this RS.

5.0 Ground and Groundwater Conditions

5.1 Stratigraphy

Detailed exploratory hole logs are present in Appendix III giving an accurate description of the ground conditions at each individual location, with a summary of the stratigraphy noted in sub-sections 5.1.1 to 5.1.4 below.

The eastern portion was overgrown with historical plans indicating that this part of the site has remained undeveloped. This area has been targeted by TP's A – C, BH's 02 – 03 and TP's 201 to 202).

However, the western part was covered by demolition rubble with evidence of old floor slabs and areas of hardstanding associated with the former factory. This area has been targeted by TP's D – J, BH's 01 – 04 and TP's 203 to 209.

5.1.1 Made Ground and Topsoil

In the east of the site, 3 no. trial pits (TP's A – C) and 2 no. boreholes (BH's 02 – 03) were completed which identified:

- Unmanaged grass overlying soft brown slightly sandy clay soil with fine roots with occasional anthropogenic materials including glass, brick, re-bar and plastic wrapping to depths of between c.0.10m and c.0.40m bgl.
- Within TP's B and C, the initial topsoil was underlain by variable materials including firm slightly sandy clay with fine roots, a relict topsoil comprising soft to firm slightly sandy clay with fine roots, clayey sandstone gravel as well as possible slag gravel and cobbles exhibiting a strong sulphurous odour. These materials were recorded to depths of between c.0.85m and c.0.90m bgl.
- No visual and / or olfactory evidence of any hydrocarbon type or impacted materials were evident at any of the positions completed across this part of the site.
- The additional trial pits (TP's 201 to 202) undertaken across this area identified sandy gravelly soil to depths of c.0.40m and c.0.65m bgl. No anthropogenic debris or evidence of hydrocarbons was noted.

Across the remainder of the site (i.e., the western portion) 7 no. trial pits (TP's D – J) and 2 no. boreholes (BH's 01 & 04) were completed which identified:

- Not including the trial pits completed in the demolition stockpile (TP's F & G), the majority of this area was covered by demolition type rubble as well as slightly sandy slightly clay to depths of c.0.30m to c.1.25m bgl.
- On the stockpile, TP's F & G identified the crushed demolition rubble to depths of c.2.20m and c.2.40m bgl with possible concrete slabs noted at these depths, with no further excavation possible. On top of the "possible slab" encountered in TPF was a black gravel which exhibited olfactory evidence of hydrocarbons.
- Within TPD, made ground was recorded to a depth of c.0.40m bgl and then identified a relatively thin layer of clay before encountering sandstone. The made ground (gravel) between c.0.23m to c.0.40m bgl was noted to exhibit slight olfactory evidence of hydrocarbons.

- The trial pit (TPD) was extended in length and direction with limited penetration into the sandstone albeit for the made ground (c.9m from the northern boundary) which fell away to c.1.10m bgl where no further excavation was possible. This area will need further works to fully determine the ground conditions at this location.

- Borehole BH04 was positioned to target the historical Above-ground Storage Tank (AST), although no longer present on site. At this location, limited made ground (c.0.30m) was evident with no visual and/or olfactory evidence of hydrocarbons noted.

- The additional trial pits (TP's 203 to 209) undertaken across this area identified rubble fill and clay with occasional demolition rubble to depths of c.0.10m and c.1.30m bgl. No evidence of hydrocarbons was noted.

5.1.2 Natural Drift Deposits

Across the eastern portion of the site, the drift deposits comprised initially firm becoming stiff, occasionally soft, slightly sandy, slightly gravelly clay with occasional cobbles. This was proved to a maximum depth of c.5.00m bgl in BH02.

The remainder of the site (i.e., the western portion) comprised initially firm becoming stiff slightly sandy, slightly gravelly clay with occasional cobbles. This was proved to a maximum depth of c.4.20m bgl in borehole BH01. No drift deposits were identified within TP's D, F and G.

No visual or olfactory evidence of fuel/oil type contamination (no staining, odour or free product) was identified within the drift deposits recovered across the site.

5.1.3 Solid Geological Deposits (Bedrock)

Although at the time of the initial fieldworks, it was not possible to confirm if solid strata (bedrock) was not encountered, the additional trial pits undertaken in this area as part of the soakaway testing (TP's 205, 206, 207 and 209) identified possible bedrock of sandstone at depths of between c.0.65m to c.1.60m bgl.

5.1.4 Obstructions & Relict Structures

Although no relict foundations were identified during the initial phase of fieldworks, a possible slab was identified in TP's F & G below the demolition stockpile and therefore it may be the case that as well as the slab, former foundations may also be present on site with occasional relict foundations were also noted within TP's 206 and 207.

5.2 Groundwater

During the completion of the trial pits and boreholes in the east of the site, no groundwater ingresses were recorded with each pit being dry during, and upon completion.

However, across the remainder of the site, water ingresses were recorded in TP's D – G, J and 206 to 207 at depths of between c.0.40m and c.2.20m bgl. The groundwater was noted within the demolition rubble, former foundation runs and the interface of the made ground and natural clay deposits.

Groundwater monitoring of installations placed in the boreholes has been carried out on four occasions between September and December 2019. The borehole installations recorded standing groundwater at depths of c.0.35m to c.2.58m bgl with periods of being "dry" and "damp at the base".

Given the ground conditions (firm to stiff, occasionally soft sandy gravelly clay), it is likely that the water is perched within the boreholes and has originated from the surface or from minor deposits trapped within any sand lenses rather than a continuous shallow groundwater table.

During monitoring visits undertaken in October 2019 and following periods of heavy rainfall, the vegetated area in the east of the site was waterlogged with some surface run-off to the lower lying former factory.

It is recommended that allowance be made for some groundwater control measures (i.e. pumping equipment) particularly during wetter periods of the year, as the materials encountered may deteriorate following exposure to surface water.

5.3 Ground Contamination Summary – Soil & Water

The Human Health risk assessment (contaminated land) has identified the following contaminants within the on-site made ground that exceed the relevant target concentrations based on a residential end use:

- **Generic Contamination:** Lead at TPF (c.1.00m) and TPH (c.0.20m).
- **Organic Contamination:** Dibenz(ah)anthracene at TPJ (c.0.50m).
- **Asbestos fragments and fibres:** None identified in the soils.

Based on the above information, a number of elevated contaminants have been identified at various locations across the site. When taking into consideration the spatial distribution of the results the contamination is isolated to the western portion of the site which is the area of the site which has historically been developed with the contamination likely to be a result of these historical site activities.

No elevated contaminants were identified across the grassed area (eastern area) which has remained undeveloped although an isolated area of made ground was recorded at TPC with made ground recorded to a depth of c.0.90m bgl.

The materials present across the west of the site represent a potential risk and therefore remedial measures are required in the gardens across this area as well as extending to the area targeted by TPC where some limited made ground was identified. The remaining part of the site (eastern portion of the site) is not considered to require any remedial measures.

The general areas of soft landscaping, present along the southern boundary will require some form of clean soils.

All of these areas have been suitably delineated on the plan on Appendix VII.

With respect to the perched groundwater, although no visual evidence (iridescent sheen) was recorded the chemical results have identified elevated PAH's and TPH's across the western portion of the site. Although the hydrocarbon impacted water is not considered to be widespread across the site, the presence of the organic impacted perched groundwater may represent a potential risk to both on-site and off-site receptors including the culvert along the western boundary as well as the small stream / drain located c.217m west.

Although the risk to these sensitive receptors is considered to be restricted given natural clay soils are below the majority of the site which will restrict potential contamination movements to surrounding features it has been outlined by the EA that some form of remediation will be required to suitable protect the culvert and the small stream.

Based on the above it was considered likely that a Remediation Strategy would be required so that a suitable form of remediation for the site can be agreed with the Planning Authority prior to implementation

on site. Upon completion, a Validation/Verification Report will be required confirming that the remedial works have been completed in accordance with the agreed remedial strategy.

5.4 Ground Gas

The assessment completed by GEO has not identified elevated ground gases (i.e., a maximum CO_2 concentration of 3.6%v/v has been recorded as well as low concentrations of CH_4 (0.1%v/v) and therefore gas protection measures are not considered necessary in accordance with CIRIA C665 and BS8485.

The site is not located in an area that requires radon protection measures within buildings or extensions.

5.5 Supplementary Investigation Works

Taking in to account the findings of the fieldworks completed to date and as part of the Remediation Strategy the following will need to be considered.

- Watching brief during the removal of buried floor-slabs and hardstand to identify any unforeseen contamination, including the area of the former AST, formerly targeted by BH04.
- Removal of the hydrocarbon impacted soils and perched water, with appropriate verification testing and reporting.
- Once the remedial works have been completed, in the private gardens and areas of general soft landscaping (required across the western portion of the site only - see plan in Appendix VII), verification works including testing and reporting will be required to validate the successful completion of the required remedial works.

6.0 Remediation Strategy

6.1 Delineation & Removal of Hydrocarbon Impacted Soils and Groundwater

The hydrocarbons that were encountered in TP's D and F, have been identified as not posing a potential risk to the future residents given the results of the previous contamination testing.

However, elevated TPH levels were detected in the water samples collected at these locations and following consultation with the EA, the presence of the hydrocarbon impacted water may represent a risk to the culvert in the west of the site as well as offsite receptors.

Therefore, to suitably remove any potential risks to these features, it has been decided that the most appropriate course of action will be the delineation, excavation and disposal off-site of any hydrocarbon impacted soils as well as any hydrocarbon impacted water.

At this stage, the impacted soils identified in TP's D and F will require removal and should be relatively and easily identifiable as they comprised "black gravel which exhibited olfactory evidence of hydrocarbons" within TPF and "grey gravel which exhibiting slight olfactory evidence of hydrocarbons" within TPD.

Any water encountered during these excavations should be expected to contain some hydrocarbons and should be dealt with as such.

By removing the "source" of hydrocarbons from the established pollutant linkage model (*Source – Pathway – Receptor)* the risk to the proposed *Receptor (culvert and off-site water course) will be removed.* Where one or more of the links are missing then risk is negated. For the land to be classified as contaminated under Part IIa of the Environmental Protection Act (EPA) 1990 all three elements of the pollutant linkage must be present. The removal of the hydrocarbon impacted soil and water should verified by a Geo-Environmental Engineer.

6.2 Clean Cover System

Across the western portion of the site only, there is a possible risk to Human Health (future residents) in areas of private gardens where there is a potential for direct contact, inhalation or consumption of contaminants. The risk to Human Health is mitigated where the contaminated soils are covered by proposed buildings or areas of hardstand such as roads, car parks and pavements as the pathway between the source and the receptor will be broken.

If made ground is to remain below areas of any soft landscaping (i.e., lawns, planted borders, etc. that will include all proposed private gardens), it is considered appropriate to incorporate a clean cover system as a "capping" layer. This will allow the contaminated materials to remain on site but not to represent a risk to the proposed end users (i.e., the residents).

Given the presence of both front and rear gardens as well as general soft landscaping, two remedial options are recommended for the site which are detailed below:

6.2.1 Front Gardens and General Soft Landscaping (Western Portion)

For the front gardens and the areas of general soft landscaping, as less risk is perceived in these areas the clean cover system can comprise the following:

- Ground Level to minimum c.0.30m depth – Topsoil to act as a growing medium.
- 0.30m depth – Geosynthetics Alert Contamination Indicator (or similar) to act as a separator and contamination indicator.

6.2.2 Rear/Side Gardens (Western Portion)

There is a greater potential risk to the end users within the rear/side gardens of residential houses as it is conceivable that they may have homegrown produce for human consumption. Therefore, a robust clean cover system incorporating a "no-dig" layer, totalling a minimum 600mm (0.60m) in thickness should be utilised, which is summarised below:

- Ground Level to minimum c.0.30m depth – Topsoil to act as a growing medium.
- 0.30m to 0.50m depth – Inert materials (i.e. disturbed natural materials such as "clean" clay).
- 0.50m to 0.60m depth – Geosynthetics Alert Contamination Indicator (or similar) to act as a separator and contamination indicator overlain by c.0.10m (100mm) of compacted "clean" gravel, which will act as the "no-dig"/separation/drainage layer.

The above robust clean cover system will only be required across the western portion of the site and only in the rear / side gardens. A delineation plan is in Appendix VII.

The "robust" clean cover system and "marker" layer are designed to be in place for the life of the buildings/development and is present to ensure that future end users (i.e., residents) do not come into direct contact with the underlying contaminated made ground. The "marker layer" and "compacted stone" layer should be verified for their suitability and thickness during their installation so not to damage them when completing the validation works (i.e., once the topsoil has been added).

The above methodology has been formulated in parallel with the YALPAG "Verification Requirements for Cover Layers guidance, a copy of which is attached in Appendix VII.

As well as providing a barrier between the contaminated material and the end user, the clean cover layer also provides a suitable growing medium for plants and trees. Deepening of the clean cover is recommended where large plants and trees are proposed.

Following acceptance of this methodology by the Local Planning Authority the Quantity Surveyor can use the (finalised) Proposed Site Layout Plan to determine the physical extent of the proposed soft landscaping associated with the development. They will then be able to determine the volume of material required to construct the clean cover and thus the cost of the remedial method.

The Design Team will need to consider the impact to the development proposal and permission granted from raising site levels by c.600mm to accommodate the clean cover system. If site levels cannot be raised to sufficiently accommodate the clean cover system, then it would be necessary to reduce the thickness of made ground (contamination source) within the areas of soft landscaping/private gardens to accommodate the placement of the clean cover system.

Following the removal of made ground in areas of soft landscaping to accommodate the required clean cover system (i.e., 600mm), if no made ground remains then there is no requirement for the marker layer, compacted stone and topsoil to a depth of 600mm, although suitable validation screening or visual inspection of the natural soils may be required to validate that no residual contaminants remain. These will need to be verified on a plot by plot basis.

In addition to the above, the area of general soft landscaping located to the south of the access route off Main Street as this area is within the western portion of the site some form of remediation will be required. However, as this is general landscaping and not for private residential use, the clean cover in this area would be required to a depth of 300mm thick with a minimum of 100mm being topsoil. The remainder of the clean cover (between 100mm and 300mm bgl) may comprise clean clay, quarry stone or topsoil). All materials utilised in areas of soft landscaping both private and general soft landscaping will require validation testing prior to importation.

Any materials brought to site which are to be utilised as part of the clean cover system or areas of general soft landscaping across the site as a whole should be suitably stored where they can remain untouched (until required to be put into gardens / general soft landscaping) to avoid the risk of cross contamination and any mixing occurring (with general site construction waste materials).

Prior to delivery and storage, a membrane should be placed on the ground at the location of each material (i.e. topsoil, quarry stone, clay) that is to be stored on site to avoid cross contamination with the materials below and then suitably cordoned off and sign posted.

During the completion of these remedial works, monitoring and laboratory testing of the clean cover materials will be required prior to placement to ensure that contaminated materials are not brought to site, which will be the responsibility of the Client and Main Contractor.

Although no asbestos fibres or fragments have been identified to date and although a workplace risk assessment lies outside our scope of works the Client and main contractor should satisfy themselves with working procedures and PPE in accordance with Control of Asbestos Regulations (CAR 2012) and the recently published CIRIA guidance; Asbestos in Soil and Made Ground Good Practice Site Guide (C765).

Where asbestos fragments are identified on site, then these should be handpicked by personnel wearing suitable PPE with any asbestos fragments being bagged and labelled for disposal at a suitable waste facility.

If made ground removal is required to accommodate the clean cover system, then the excavated materials can either be disposed of at an appropriately licensed facility or it can be utilised as an engineered fill beneath areas of proposed hardstanding. If the intention is to maintain materials on site (i.e., beneath roads etc.) then it may be the case that the Highway Engineer needs to confirm the suitability of the made ground materials as sub-base although the hydrocarbon impacted soils should not be utilised elsewhere on site.

6.3 Remediation Overview

The proposed remediation comprises the following:

- Delineation and removal of hydrocarbon impacted soil/water for appropriate off-site disposal.
- The robust c.600mm clean cover system across the western portion of the site within proposed private side and rear gardens is designed to be in place for the life of the buildings/development and is present to ensure that future end users (i.e., residents/workers) do not come into contact with the underlying contaminated made ground.
- It is recommended that the developer import “clean” topsoil (as part of the clean cover system) to act as a future growing medium within proposed front gardens and general areas of soft landscaping. In this instance a minimum c.300mm of import topsoil would be considered appropriate, and contamination screening of those materials should be completed prior to their placement to ensure contaminated materials are not inadvertently being brought to site.

7.0 Soil Validation Works and Reporting

It will be necessary to complete validation works and reporting once the remedial measures are put in place. The delineation and removal of the hydrocarbon "hot spot" should take place as part of the stie enabling works. The clean cover system would normally be completed towards the end of the development as part of the landscaping phase, but prior to occupation. The validation works and reporting should be completed by a suitably qualified and experienced Geo-Environmental Engineer and it is the responsibility of the Client and the Main Contractor to ensure that the remediation and validation works are completed to the satisfaction of the Local Planning Authority, prior to the first occupation of the buildings. In summary, the following items should be detailed within the Validation Report (as a guide):

- Geographical location of the clean cover material source.
- Engineering description of the clean cover material in accordance with BS3882, BS5930 and Eu7.
- Laboratory confirmation testing of the following:
  - WAC Testing for the waste materials requiring off-site disposal prior to disposal at an appropriate facility.
  - Contamination screening to verify the appropriateness of the clean cover materials to be brought to site.
- Human Health Risk Assessment using the above-mentioned contamination testing results to ensure the materials brought to site are appropriate for use.
- Photographic records of the excavation work, waste materials separation and placement of clean cover.
- Plans and photographs detailing the storage of any clean cover materials on site.
- Plans showing the area of excavation and the placement of the clean cover.
- Waste Disposal Tickets for materials removed from site.
- Delivery notes for materials brought to site (i.e., clean cover).

All topsoil/subsoil to be imported to site for use within the clean cover system should be tested with results being evaluated against appropriate criteria at the time of sampling and laboratory testing and should be completed in accordance with the YALPAG guidance, a copy of which is on page 18.

During the completion of the works, monitoring and laboratory testing of the imported topsoil materials will be required prior to placement to ensure that contaminated materials are not brought to site, which will be the responsibility of the Client and Main Contractor. As discussed above, this should be undertaken in accordance with the above YALPAG guidance, which details the relationship between the number of soil tests required for the volume of material to be imported to site. It also details the suite of laboratory analysis required.

For greenfield/manufactured soils (assumed source) the site would require a minimum of three tests or one between per $50m^3$ to $250m^3$ (whichever is greatest). The suite of laboratory testing for greenfield/manufactured soils (assumed source) would be as follows:

- Standard metals/metalloids (Arsenic, Cadmium, Chromium, Chromium IV, Copper, Lead, Nickel, Selenium and Zinc), Speciated PAH and Asbestos. The testing should also include for total organic content.

For brownfield soils (assumed source) the site would require a minimum of six tests or one between per $50m^3$ to $100m^3$, whichever is the greater. The suite of laboratory testing for greenfield/manufactured soils (assumed source) would be as follows:

- Standard metals/metalloids (Arsenic, Cadmium, Chromium, Chromium IV, Copper, Lead, Nickel, Selenium and Zinc), Speciated PAH, Speciated TPH and Asbestos. The testing should also include for total organic content.

Where imported topsoil materials are to be brought on to site for use in areas of soft landscaping the laboratory results should be compared against the most appropriate end use target concentration, a copy of which is appended to this report and will be based on the SOM value of these soils. It should be noted that the end use target concentrations are subject to change and that the most appropriate values at the time of the assessment should be chosen.

Imported topsoil should also be as specified in BS 3882:2015 as 'suitable for their intended purpose'. BS3882:2015 relates to nutrient content of topsoil and phytotoxic contamination and does not consider contaminants that pose a risk specifically to human health. Soils should be tested for contaminants that are considered to pose a risk to human health in addition to BS3882:2015 to ensure that they are suitable for their intended use. All materials brought on to site should be tested with results being evaluated against the human health assessment criteria set out within the appended table (which is correct at the time of writing but may be subject to change) and is SOM specific.

It is considered appropriate to sample the materials at source and then again from stockpiles on site prior to placement into the garden/soft landscaped areas to ensure the materials are appropriate for use prior to placement.

This assessment criteria may change depending on the source of the materials brought to site. Prior to delivery, the materials should be tested at source to verify the materials are suitable for use in the intended residential development.

Once the works are completed and the above information is obtained, a Validation Report can be completed by GEO to confirm that the remedial measures have been completed in accordance with the agreed methodology. It is recommended that a representative of GEO be present during the works to ensure they are completed in accordance with this methodology.

Appendix 1a – Sampling & Testing Matrix

Type	Number of Samples	Testing Schedule	Assessment Criteria
	Please note that these guidelines apply to a typical residential development, and relaxation of the guidelines or more stringent requirements may apply dependent on local and site specific factors. Therefore, all parameters need to be agreed with the Local Authority.		
Virgin Quarried Material	1 or 2 depending on the type of stone utilised, to confirm the inert nature of the material.	Standard metals/metalloids (should include as a minimum As, Cd, Cr, CrVI, Cu, Hg, Ni, Pb, Se, Zn)	The assessment criteria need to be UK based, e.g. LQM S4ULs, Defra C4SLs or other similarly derived GACs.
Crushed Hardcore, Stone, Brick (excluding asphalt)	Minimum 1 per 500m^3	Standard metals/metalloids (as above), PAH (16 USEPA speciation), asbestos, total TPH. Any additional analysis dependant on the history of the donor site (e.g. phenol, total cyanide, BTEX, MTBE).	
Greenfield/ Manufactured Soils	Minimum 3 Dependent on source and receptor, between 1 per 50m^3 and 1 per 250m^3	Standard metals/metalloids (as above), PAH (16 USEPA speciation), asbestos, pH and soil organic matter (SOM) (or calculated from total organic carbon (TOC)).	
Brownfield/ Screened Soils	Minimum 6 Dependent on source and receptor, between 1 per 50m^3 and 1 per 100m^3	Standard metals/ metalloids (as above), PAH (16 USEPA speciation), TPH (CWG banded), asbestos, pH and SOM (or calculated from TOC). Any additional analysis dependant on the history of the donor site (e.g. phenol, total cyanide, BTEX, MTBE).	

Above – YALPAG Guidance Relating to Topsoil Testing Parameters

8.0 Construction Related Excavations and Off-Site Disposal

During the construction works it is likely that materials will be excavated on site (i.e., future foundations and buried utilities, etc.) that will not be able to be accommodated on site during to space and level constraints, ultimately requiring removal off site. During the construction works different materials should be kept separate, as it may be the case that uncontaminated natural materials can be classified as Inert and transferred to an Inert Landfill site. A separate assessment will be required for any topsoil and peat (naturally occurring organic materials) that may be encountered as they cannot be classified as inert due to their natural organic content.

Where made ground materials or disturbed natural strata is to be removed the results of the soil testing undertaken within this report can be used as a preliminary assessment and the anticipated waste disposal facility should be provided with a copy of the results for review. It may be the case that the waste facility requires additional contamination screening to aid the characterisation of the made ground for off-site disposal (i.e. Waste Acceptance Criteria – WAC).

During the construction phase, it may be the case that WAC screening is required to aid classification for disposal, and it is recommended that all materials are classified prior to excavation and disposal off site. Conversely, if materials are required to be brought to site to raise site levels or as part of a clean cover system then certification and/or soil testing results should be reviewed by a suitably experienced and qualified geo-environmental engineer to ensure that potentially contaminated materials are not being brought to site.

Any potentially contaminated water encountered during the redevelopment of the site i.e., exhibiting fuel/oil odour or sheen, should be appropriately disposed of.

Any potential ACM's remaining on site should be disposed of appropriately.

It is considered the responsibility of the Client and their appointed Main Contractor to ensure that any materials removed from site are disposed of at an appropriate facility and any materials brought to site are free from contamination.

Any material movements may require a Material Management Plan (MMP) in accordance with CL:AIRE, although this is not thought to be a legal obligation at present.

9.0 Supplementary Investigation Works

Taking in to account the findings of the fieldworks completed to date, it is recommended that a "watching brief" is undertaken primarily across the western portion of the site given that this is where historical development and contaminants have been identified to determine the presence of any further contamination and geohazards that may impact on the redevelopment of the site.

Due to the development of the site and most notably the presence of the hydrocarbons below the site and the historical presence of an AST in the south of the site, it is recommended that the site clearance works include the following:

- Removal of floor-slabs and hardstand
- Removal of former foundations
- Removal of any impacted hydrocarbon impacted soils as well as perched groundwater

These works should be overseen (i.e., a watching brief) by a suitably qualified Geo-Environmental Engineer so that the ground conditions can be verified across the remainder of the site potentially utilising machinery on site as part of the redevelopment works which would also facilitate in the delineation of the hydrocarbons already identified and any further "hotspots" of contamination that may be present on site.

Some further but limited delineation works may be considered necessary in and around where TPC was previously undertaken as some isolated made ground recorded to a depth of c.0.90m was identified. This made ground is not expected to be extensive.

During these supplementary fieldworks, additional sampling and laboratory testing may be required to suitably quantify the potential risks from contamination present on the site.

Any contaminated ground/groundwater encountered will require excavation and disposal to an appropriate waste facility with this undertaken by the Main Contractor. Protection measures would be required on site to prevent cross-contamination and any stockpiles should be appropriately bunded and covered.

A representative of GEO can be present to witness the site clearance works and undertake the supplementary investigation of the site and supervise any subsequent validation works.

10.0 General Comments

It is the responsibility of the Design Team to confirm the preferred method of remediation (in association with the Quantity Surveyor and Client), with the Local Planning Authority by way of this Remediation Strategy prior to implementation on site. It is also the responsibility of the Client to collate the below mentioned validation information (as a minimum) whilst the works are being completed:

- Photographic evidence of the site redevelopment works including any slab lifts and any earthworks incorporating the removal of made ground and/or placement of the clean cover.
- Off-site disposal tickets (including the chain of custody records) to confirm the appropriate disposal of any contaminated made ground and groundwater.
- Where required, validation and contamination test reports following sampling of base and sides of any excavations completed on site to remove any materials on site deemed unsuitable to remain on site.
- Contamination test reports for the clean cover materials brought to site to confirm that contaminated materials are not inadvertently being brought to site. A review of the contamination testing should be completed prior to the materials being brought to site.
- Based on the YALPAG document, depending on the source of the clean cover materials varying testing regimes can be implemented. The YALPAG states if soils sourced form a “greenfield / manufactured soils” should be sampled and screened with a minimum of three samples or one between per 50m^3 to 250m^3 (whichever is the greater). However, “brownfield / screened soils” should be sampled and screened with a minimum of six or one between per 50m^3 to 100m^3, whichever is the greater. Soils sourced from a brownfield site should also be screened for Speciated TPH in addition to the basic screening suite outlined above. A copy of the full YALPAG document is in Appendix VII.
- Either during emplacement or once the clean cover materials are in place, validation inspection pits should be completed in accordance with the following table to verify that the correct thickness of clean cover has been installed.

Site size	Nominal sampling frequency (Subject to minimum totals)	Suggested minimum total number of tests per site of each material used within the capping layer[1]
1 to 5 plots	1 test per plot	3
6 to 10 plots	1 test per 2 plots	5
11 to 20 plots	1 test per 2 plots	5
21 to 30 plots	1 test per 3 plots	7
31 to 40 plots	1 test per 4 plots	10
Over 40 plots	1 test per 4 plots	10

[1] If the cover system consists of subsoil and topsoil, both components require testing.

Source: NHBC Verification of Cover Systems: Testing Criteria for Subsoil and Topsoil

Imported topsoil should be as specified in BS 3882:2015 as 'suitable for their intended purpose'. BS3882:2015 relates to nutrient content of topsoil and phytotoxic contamination and does not consider contaminants that pose a risk specifically to human health. Soils should be tested for contaminants that are considered to pose a risk to human health in addition to BS3882:2015 to ensure that they are suitable for their intended use. All materials brought on to site that are to be used as part of the clean cover should also be tested with results being evaluated against the human health assessment criteria set out within the table within Appendix VI (which is correct at the time of writing but may be subject to change).

This assessment criteria may change depending on the source of the materials brought to site. Prior to delivery, the materials should be tested at source to verify the materials are suitable for use in the intended residential development.

Once the works are completed and the above information is obtained, a Validation Report can be completed by GEO to confirm that the remedial measures have been completed in accordance with the agreed methodology. It is recommended that a representative of GEO be present during the works to ensure they are completed in accordance with this Remediation Strategy.

In addition, it is recommended that a "watching brief" and "observational technique" be applied to this site to ensure that if ground conditions appear to vary from those identified within this investigation report then advice should be sought from a suitably qualified and experienced Engineering Geologist, Geotechnical or Geo-Environmental Engineer.

If any potential asbestos containing materials are identified on site during the redevelopment works (i.e. pieces of fragmented roof sheets etc.) then they should be dealt with appropriately (i.e. collected, contained and disposed of at an appropriately licensed facility).

In addition, the made ground materials identified may potentially pose a risk to future buried utilities (particularly water supplies) due to the presence of generic and organic contaminants and it may be the case that non-standard supply pipes are required. As a result, the design team should consult with the utility providers for their comments and recommendations.

The recommendations and opinions expressed in this report are based on the strata observed within the exploratory holes in addition to the results of the site and laboratory tests commissioned by GEO. Consequently, GEO takes no responsibility for conditions that have not been revealed or which occur between them. GEO takes no responsibility for the accuracy of third party information.

The conclusions and recommendations presented within this report are considered reasonable based on the available information. However, these cannot be guaranteed to gain regulatory approval. Therefore, the report should be passed to the appropriate regulatory authorities and/ or other key stakeholders in order to seek their approval of the findings prior to undertaking any works on site.

End of Report

Appendix I

- Site Location Plan

GEO Environmental Engineering

GEO2021-4986: Ivy Mill, Whitehaven, Cumbria – Site Location

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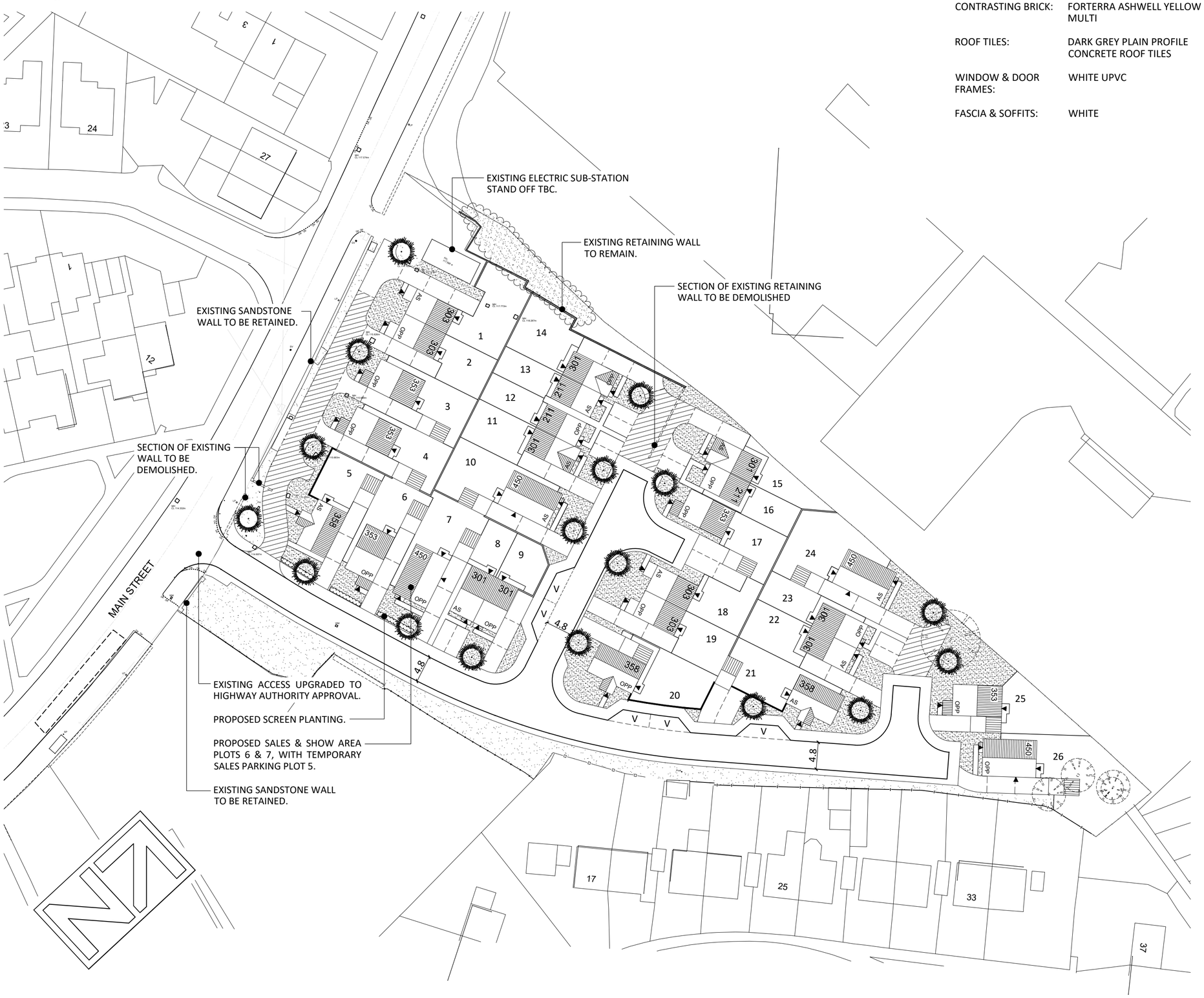
Appendix II

- Proposed Site Development Plan

0m 5m 10m 20m 30m 40m 50m 100m

SCALE BAR @ 1:500



IVY MILL, WHITEHAVEN

MATERIALS

MAIN BRICK:	FORTERRA ABBEY RED MULTI
CONTRASTING BRICK:	FORTERRA ASHWELL YELLOW MULTI
ROOF TILES:	DARK GREY PLAIN PROFILE CONCRETE ROOF TILES
WINDOW & DOOR FRAMES:	WHITE UPVC
FASCIA & SOFFITS:	WHITE

KEY

- 1.8m HIGH TIMBER SCREEN FENCE TO SEPARATE DETAIL
- 1.8m HIGH TIMBER SCREEN DIVISIONAL FENCE TO SEPARATE DETAIL
- 1.8m HIGH SCREEN WALL TO SEPARATE DETAIL
- PROPOSED TREE PLANTING
- EXISTING TREES TO BE REMOVED
- SHARED DRIVE
- DENOTES BIN COLLECTION POINT
- AS / OPP — 'AS' AND 'OPP' HANDINGS OF HTs

SCHEDULE OF ACCOMMODATION

TYPE		SQ.FT	No.
211	BOSTON	651	3
301	TYRONE	759	7
303	WICKLOW	772	4
353	-	904	5
358	-	984	3
450	-	1156	4
TOTAL		**22,450 SQ.FT**	**26No.**

GROSS SITE AREA	2.25 ACRES
UNDEVELOPABLE AREA (INC. SINGLE SIDED ROADS)	0.44 ACRES
NET SITE AREA	1.81 ACRES
GROSS DENSITY	11.55 U.P.A
GROSS FOOTAGE	9,977 SQ.FT/ACRE
NET DENSITY	14.36 U.P.A
NET FOOTAGE	12,403 SQ.FT/ACRE

NOTE: SITE TO BE RE-GRADED TO ENGINEER'S DETAILS.

REV	DESCRIPTION	DATE
F	VISITOR CAR PARKING SPACES ADDED.	OCT'21
E	REFUSE COLLECTION POINT ADDED.	SEP'21
D	MATERIALS ADDED.	AUG'21
C	315 & 401 REPLACED WITH 353 & 450.	MAY'21
B	HIGHWAYS COMMENTS ADDED.	FEB'21
A	BOUNDARY TREATMENT AND PARKING AMENDED.	JUL'20

gleeson

GLEESON HOMES & REGENERATION

DRAWING

PLANNING LAYOUT

PROJECT

IVY MILL, WHITEHAVEN

SCALE	1:500@A2	REV.	F	DRAWING No.
DATE	JULY '20			MJG/PL-110
DRAWN	TWENTY10			

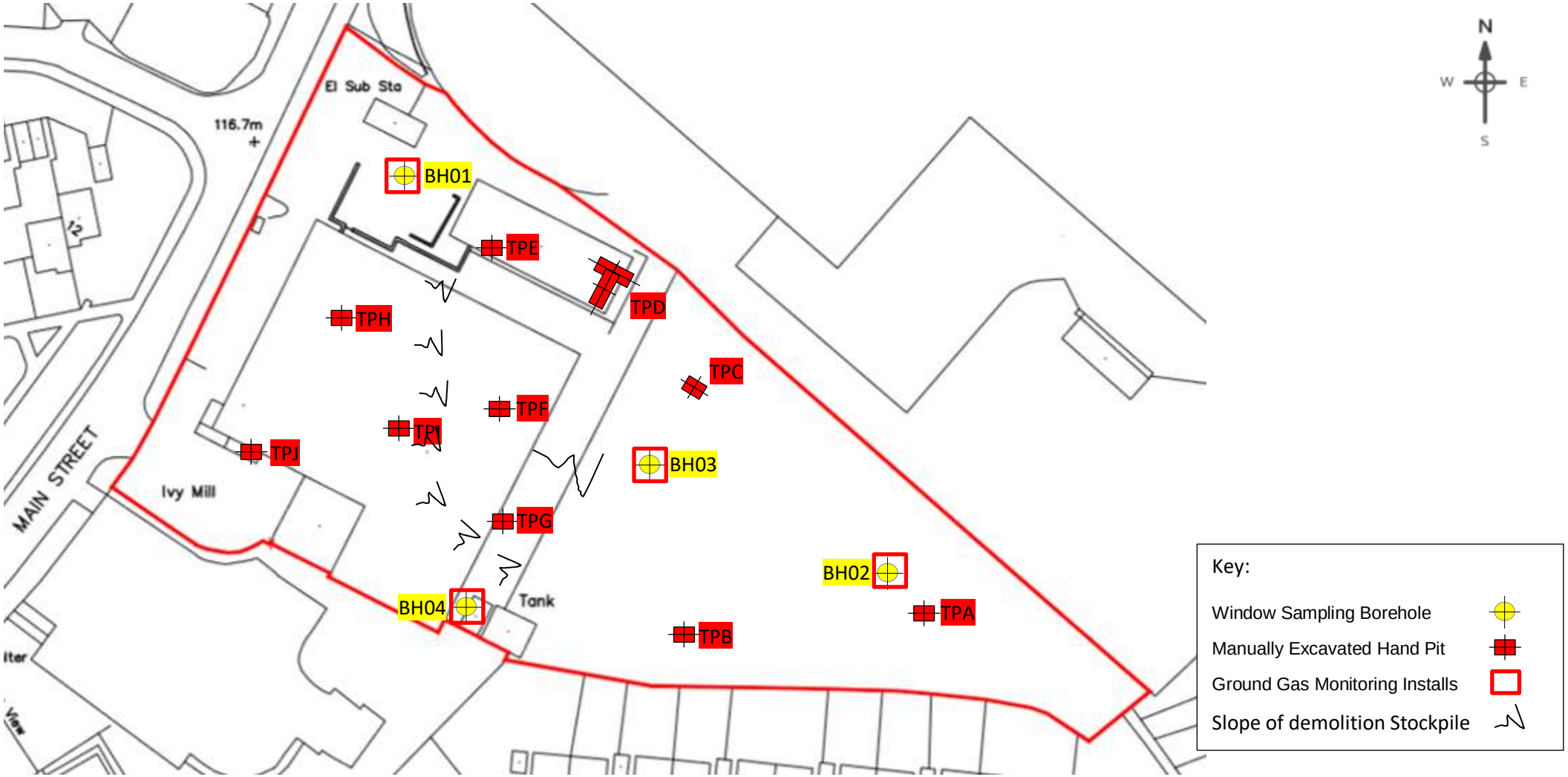
TWENTY 10
DESIGN AND PLANNING
Twenty10 Management Limited, 62 Hawkshead Avenue, Euxton, Chorley , Lancashire. PR7 6TE
Tel: (01257) 277 100 Email: info@twenty10.biz Fax: (01257) 266 911

Appendix III

- Exploratory Hole Location Plans & Record Sheets

GEO Environmental Engineering

GEO2019-3886: Exploratory Hole Location Plan – Ivy Mill, Hensingham (Approximate Locations – Not to Scale)



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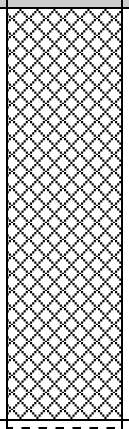
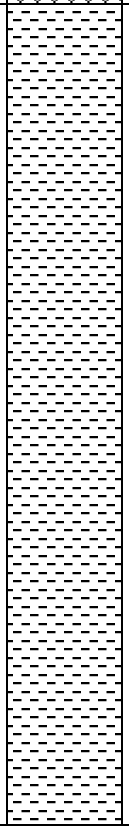
GEO Environmental Engineering

GEO2019-3886: Ivy Mill, Hensingham. BH01

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	1.40	MADE GROUND: Grey and brown sandy gravelly CLAY with gravel of concrete, brick, sandstone, glass and plastic. Some tarmac noted.		0.10-1.00 J 1.00-1.40 J 1.00-1.45 SPT = N19
1.40	4.20	Firm to stiff brown mottled grey slightly sandy slightly gravelly CLAY with occasional sandstone cobbles.		2.00-3.00 T 2.00-2.45 SPT = N15 3.00-3.45 SPT = N23 3.50-4.00 T 4.00-4.20 SPT = N50LP
End of borehole. Borehole stable and dry on completion. Ground gas monitoring well installed to c.2.75m.				

Site: Ivy Lane, Hensingham **Client:** Gleeson Regeneration Limited **Engineer:** CRE **Site Works Date:** 14/08/2019 **Plant:** Mini Percussion	**Log Key:** SPT = Standard Penetration Test (result as N value) HSV = Hand Shear Vane (result in kN/m^2) LP = Limited Penetration B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

GEO Environmental Engineering

GEO2019-3886: Ivy Mill, Hensingham. BH02

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.60	MADE GROUND?: Grass over brown sandy gravelly clayey TOPSOIL with some rootlets. Rare coal fragments noted.		0.00-0.60 J
0.60	1.40	Firm light grey brown sandy gravelly CLAY.		1.00-1.40 JT 1.00-1.45 SPT = N16
1.40	5.00	Firm to stiff dark grey brown sandy gravelly CLAY.		2.00-3.00 T 2.00-2.45 SPT = N23 3.00-4.00 T 3.00-3.45 SPT = N23 4.00-4.45 SPT = N 26
End of borehole. Borehole stable and dry on completion. Ground gas monitoring well installed to c.3.00m.				

Site: Ivy Lane, Hensingham **Client:** Gleeson Regeneration Limited **Engineer:** CRE **Site Works Date:** 14/08/2019 **Plant:** Mini Percussion	**Log Key:** SPT = Standard Penetration Test (result as N value) HSV = Hand Shear Vane (result in kN/m²) LP = Limited Penetration B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

GEO Environmental Engineering

GEO2019-3886: Ivy Mill, Hensingham. BH03

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.40	MADE GROUND?: Grass over brown sandy gravelly clayey TOPSOIL with some rootlets. Rare coal fragments noted.		0.00-0.40 J
0.40	2.50	Firm light grey brown sandy gravelly CLAY.		
End of borehole. Borehole stable and dry on completion. Ground gas monitoring well installed to c.1.20m.				

Site: Ivy Lane, Hensingham **Client:** Gleeson Regeneration Limited **Engineer:** CRE **Site Works Date:** 14/08/2019 **Plant:** Mini Percussion	**Log Key:** SPT = Standard Penetration Test (result as N value) HSV = Hand Shear Vane (result in kN/m^2) LP = Limited Penetration B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

GEO Environmental Engineering

GEO2019-3886: Ivy Mill, Hensingham. BH04

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.30	MADE GROUND?: Grass over brown sandy gravelly clayey TOPSOIL with some rootlets. Rare coal fragments noted.		0.00-0.30 J
0.30	1.50	Firm light grey brown sandy gravelly CLAY.		0.50-1.00 T
End of borehole. Borehole stable and dry on completion. Ground gas monitoring well installed to c.1.00m.				

Site: Ivy Lane, Hensingham **Client:** Gleeson Regeneration Limited **Engineer:** CRE **Site Works Date:** 14/08/2019 **Plant:** Mini Percussion	**Log Key:** SPT = Standard Penetration Test (result as N value) HSV = Hand Shear Vane (result in kN/m²) LP = Limited Penetration B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

GEO Environmental Engineering

GEO2019-3886: Ivy Mill, Hensingham. TPA

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.40	MADE GROUND: Unmanaged grass overlying soft brown slightly sandy clay soil with fine roots. Occasional glass pieces were noted. Pottery drain noted at c.0.40m.		0.10 J
0.40	1.00	Firm brown mottled grey slightly sandy slightly gravelly CLAY with occasional sandstone cobbles.		0.90 HSV: 40kN/m^2 0.90 B
1.00	2.00	Initially firm becoming stiff dark brown mottled grey slightly sandy slightly gravelly CLAY with occasional cobbles. Noted to be stiff at c.1.50m recovered as gravel size pieces.		1.75 B
		End of trial hole sides noted to be stable. Trial hole remained dry during and upon completion. Dimensions: L (2.50m) x W (0.90m) x D (2.00m)		

Site: Ivy Lane, Hensingham
Client: Gleeson Regeneration Limited
Engineer: AH
Site Works Date: 14/08/2019
Plant: Mechanical Excavtor (JCB 3cX)

Log Notes:
HSV = Hand Shear Vane (result in kN/m^2)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

GEO Environmental Engineering

GEO2019-3886: Ivy Mill, Hensingham. TPB

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.10	MADE GROUND: Unmanaged grass overlying soft brown sandy clay soil with fine roots and occasional brick fragments.		0.00 - 0.10 J
0.10	0.50	MADE GROUND: Firm orange brown / grey slightly sandy CLAY. No anthropogenic debris noted.		0.30 J
0.50	0.85	RELICT TOPSOIL: Soft to firm brown slightly sandy CLAY with fine roots.		0.60 J
0.85	1.30	Firm orange brown mottled grey slightly gravelly very sandy CLAY.		1.00 HSV: 36kN/m²
1.30	1.80	Firm occasionally soft brown mottled grey slightly sandy slightly gravelly CLAY with occasional sandstone cobbles.		1.50 B
1.80	2.25	Stiff dark brown mottled grey slightly sandy slightly gravelly CLAY with occasional cobbles. Recovered as gravel size pieces.		2.25 B
		End of trial hole sides noted to be stable. Trial hole remained dry during and upon completion. Dimensions: L (3.00m) x W (0.60m) x D (2.25m)		

Site: Ivy Lane, Hensingham
Client: Gleeson Regeneration Limited
Engineer: AH
Site Works Date: 14/08/2019
Plant: Mechanical Excavtor (JCB 3cX)

Log Notes:
HSV = Hand Shear Vane (result in kN/m²)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

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GEO Environmental Engineering

GEO2019-3886: Ivy Mill, Hensingham. TPC

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.35	MADE GROUND: Unmanaged grass overlying soft brown sandy clay soil with fine roots and occasional brick, glass, re-bar and plastic wrapping.		0.25 J
0.35	0.60	MADE GROUND: Red clayey sandstone GRAVEL.		0.40 J
0.60	0.90	MADE GROUND: Possible grey slag gravel and cobbles exhibiting a strong sulphurous odour.		0.60 J
0.90	1.60	Soft to firm light brown mottled grey slightly gravelly sandy CLAY.		1.20 HSV: 48kN/m^2 1.20 B
1.60	2.15	Firm to stiff dark brown mottled grey slightly sandy slightly gravelly CLAY with occasional cobbles. At c.1.90m, recovered as gravel size pieces.		1.80 B
		End of trial hole sides noted to be stable. Trial hole remained dry during and upon completion. Dimensions: L (2.60m) x W (0.60m) x D (2.15m)		

Site: Ivy Lane, Hensingham
Client: Gleeson Regeneration Limited
Engineer: AH
Site Works Date: 14/08/2019
Plant: Mechanical Excavtor (JCB 3cX)

Log Notes:
HSV = Hand Shear Vane (result in kN/m^2)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

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GEO Environmental Engineering

GEO2019-3886: Ivy Mill, Hensingham. TPD

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.23	MADE GROUND: Grey and brown sandy fine to coarse GRAVEL of concrete, brick, sandstone, glass and plastic.		0.20 J
0.23	0.40	MADE GROUND: Grey fine to medium GRAVEL exhibiting slight olfactory evidence of hydrocarbons.		0.30 – 0.40 J
0.40	0.65	Stiff brown slightly gravelly CLAY.		
0.65	1.10	Possible sandstone encountered so extended the trial pit in to a "T" trench. At c.8m from the northern boundary, saturated GRAVEL (possibly demolition rubble) comprising concrete, brick, sandstone) to a depth of c.1.10m where no further excavation was possible.		0.60 W
		End of trial hole sides noted to be stable. The majority of the trial hole remained dry during and upon completion. Saturated gravels (demolition rubble) were noted at end of the trench. Dimensions: L (5.70m & 7.70m) x W (0.80m) x D (0.40m & 1.10m)		

Site: Ivy Lane, Hensingham
Client: Gleeson Regeneration Limited
Engineer: AH
Site Works Date: 14/08/2019
Plant: Mechanical Excavtor (JCB 3cX)

Log Notes:
HSV = Hand Shear Vane (result in kN/m^2)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub, W = Water

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GEO2019-3886: Ivy Mill, Hensingham. TPE

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.50 / 1.25	MADE GROUND: Bare ground overlying red / brown sandy fine to coarse GRAVEL & COBBLES of brick, sandstone, concrete and pottery. Deeper made ground (c.1.25m) was noted where it was visible that a former foundation was once present.		0.25 J
0.50 / 1.25	1.50	Firm to stiff dark brown mottled grey slightly sandy slightly gravelly CLAY with occasional cobbles.		1.50 B
		End of trial hole sides noted to be stable. A water ingress was noted at c.1.00m within the infilled former foundation run. Dimensions: L (4.20m) x W (0.65m) x D (1.50m)		

Site: Ivy Lane, Hensingham
Client: Gleeson Regeneration Limited
Engineer: AH
Site Works Date: 14/08/2019
Plant: Mechanical Excavtor (JCB 3cX)

Log Notes:
HSV = Hand Shear Vane (result in kN/m²)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

GEO2019-3886: Ivy Mill, Hensingham. TPF

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	2.40	MADE GROUND: Bare ground overlying grey / brown sandy fine to coarse GRAVEL & COBBLES of brick, re-bar, concrete within a sandy matrix. Occasional wire, hosing, chipboard and plastic were also recovered.		1.00 J 2.30 W
2.40		At c.2.40m, noted as being hard with no further excavation, possibly a concrete slab. On the top of the "slab" was black GRAVEL which exhibited olfactory evidence of hydrocarbons.		2.40 J
		End of trial hole sides noted to be stable. A water ingress was noted at c.2.00m with a SWL at 2.30m. A visible iridescent sheen as noted on the surface. Dimensions: L (4.00m) x W (1.00m) x D (2.40m)		

Site: Ivy Lane, Hensingham
Client: Gleeson Regeneration Limited
Engineer: AH
Site Works Date: 14/08/2019
Plant: Mechanical Excavtor (JCB 3cX)

Log Notes:
HSV = Hand Shear Vane (result in kN/m^2)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

GEO2019-3886: Ivy Mill, Hensingham. TPG

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	2.20	MADE GROUND: Bare ground overlying grey / brown sandy fine to coarse GRAVEL & COBBLES of brick, re-bar, concrete within a sandy matrix. Occasional wire, hosing, chipboard and plastic were also recovered.		2.00 J
2.20		At c.2.20m, noted as being hard with no further excavation, possibly a concrete slab.		
		During and upon completion, trial hole sides noted to be unstable. A water ingress was noted at c.2.20m with a similar SWL upon completion. Dimensions: L (3.70m) x W (1.70m) x D (2.20m)		

Site: Ivy Lane, Hensingham
Client: Gleeson Regeneration Limited
Engineer: AH
Site Works Date: 14/08/2019
Plant: Mechanical Excavtor (JCB 3cX)

Log Notes:
HSV = Hand Shear Vane (result in kN/m^2)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

GEO Environmental Engineering

GEO2019-3886: Ivy Mill, Hensingham. TPH

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.30	MADE GROUND: Bare ground overlying soft brown / black gravelly SAND and sandy GRAVEL with angular cobbles. No visual or olfactory evidence noted.		0.20 J
0.30	0.70	Firm brown mottled grey slightly sandy slightly gravelly CLAY.		0.60 HSV: 50kN/m² 0.60 B
0.70	2.10	Stiff brown mottled grey slightly sandy slightly gravelly CLAY with occasional cobbles and fine sand partings.		1.50 HSV: 75kN/m² 1.75 B
		End of trial hole sides noted to be stable. Trial hole remained dry during and upon completion. Dimensions: L (3.20m) x W (0.60m) x D (2.10m)		

Site: Ivy Lane, Hensingham
Client: Gleeson Regeneration Limited
Engineer: AH
Site Works Date: 14/08/2019
Plant: Mechanical Excavtor (JCB 3cX)

Log Notes:
HSV = Hand Shear Vane (result in kN/m²)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

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GEO Environmental Engineering

GEO2019-3886: Ivy Mill, Hensingham. TPI

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.30	MADE GROUND: Bare ground overlying soft brown sandy GRAVEL of brick, concrete, glass, rubber pipe with angular cobbles. Noted to be saturated.		0.15 J
0.30	0.70	Firm brown mottled grey slightly sandy slightly gravelly CLAY.		
0.70	2.25	Initially firm becoming stiff dark brown slightly sandy slightly gravelly CLAY with occasional cobbles. Recovered as gravel size pieces.		1.00 B 2.00 B
		End of trial hole sides noted to be stable. Trial hole remained dry during and upon completion. Dimensions: L (3.00m) x W (0.60m) x D (2.25m)		

Site: Ivy Lane, Hensingham
Client: Gleeson Regeneration Limited
Engineer: AH
Site Works Date: 14/08/2019
Plant: Mechanical Excavtor (JCB 3cX)

Log Notes:
HSV = Hand Shear Vane (result in kN/m^2)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

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GEO Environmental Engineering

GEO2019-3886: Ivy Mill, Hensingham. TPJ

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.40 / 0.60	MADE GROUND: Bare ground overlying mix of saturated brown sandy GRAVEL and firm brown / grey slightly sandy slightly gravelly CLAY with re-bar, brick fragments and whole bricks.		0.50 J
0.40 / 0.60	1.00	Firm brown mottled grey slightly sandy slightly gravelly CLAY.		
1.00	2.00	Initially firm becoming stiff brown / grey slightly sandy slightly gravelly CLAY with occasional cobbles. Recovered as gravel size pieces.		1.00 B 2.00 B
		End of trial hole sides noted to be stable. Water ingress noted at c.0.40m at interface of gravel and clay deposits. Trial hole remained dry during and upon completion. Dimensions: L (3.60m) x W (0.60m) x D (2.00m)		

Site: Ivy Lane, Hensingham
Client: Gleeson Regeneration Limited
Engineer: AH
Site Works Date: 14/08/2019
Plant: Mechanical Excavtor (JCB 3cX)

Log Notes:
HSV = Hand Shear Vane (result in kN/m²)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

GEO Environmental Engineering

GEO2021-4625: Ivy Mill, Whitehaven, Cumbria – Exploratory Hole Location Plan

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GEO Environmental Engineering

GEO2021-4625: Ivy Mill, Whitehaven, Cumbria – TP201

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.65	TOPSOIL: Dark brown sandy gravelly LOAM.		
0.65	1.20	Firm to stiff light brown slightly sandy gravelly CLAY		
1.20	1.40	Stiff dark brown very gravelly CLAY.		
		End of trial hole at 1.40m – Soil Infiltration Test Completed. Trial hole remained open and dry on completion. Trial hole backfilled with arisings on completion. No evidence of hydrocarbon contamination.		

Engineer: J. Brock
Site Works Date: 08/02/2021
Plant: Tracked 360 Excavator

Log Notes:
HSV = Hand Shear Vane (kN/m^2)
LP = Limited Penetration (HSV/CBR)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

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GEO Environmental Engineering

GEO2021-4625: Ivy Mill, Whitehaven, Cumbria – TP202

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.40	TOPSOIL: Dark brown sandy gravelly LOAM.		
0.40	1.40	Firm to stiff light brown slightly sandy gravelly CLAY		
		End of trial hole at 1.40m – Soil Infiltration Test Completed. Trial hole remained open and dry on completion. Trial hole backfilled with arisings on completion. No evidence of hydrocarbon contamination.		

Engineer: J. Brock
Site Works Date: 08/02/2021
Plant: Tracked 360 Excavator

Log Notes:
HSV = Hand Shear Vane (kN/m^2)
LP = Limited Penetration (HSV/CBR)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

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GEO Environmental Engineering

GEO2021-4625: Ivy Mill, Whitehaven, Cumbria – TP203

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.15	MADE GROUND: Grey brown very silty/clayey GRAVEL and COBBLES of rubble.		
0.15	1.00	Stiff brown gravelly CLAY with occasional cobbles.		
		End of trial hole at 1.00m – Soil Infiltration Test Completed. Trial hole remained open and dry on completion. Trial hole backfilled with arisings on completion. No evidence of hydrocarbon contamination.		

Engineer: J. Brock
Site Works Date: 08/02/2021
Plant: Tracked 360 Excavator

Log Notes:
HSV = Hand Shear Vane (kN/m^2)
LP = Limited Penetration (HSV/CBR)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

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GEO Environmental Engineering

GEO2021-4625: Ivy Mill, Whitehaven, Cumbria – TP204

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.10	MADE GROUND: Brown silty sandy gravelly CLAY with occasional demolition rubble.		
0.10	0.40	Firm to stiff light brown slightly sandy gravelly CLAY.		
0.40	1.10	Stiff brown gravelly CLAY with occasional cobbles.		
		End of trial hole at 1.10m – Soil Infiltration Test Completed. Trial hole remained open and dry on completion. Trial hole backfilled with arisings on completion. No evidence of hydrocarbon contamination.		

Engineer: J. Brock
Site Works Date: 08/02/2021
Plant: Tracked 360 Excavator

Log Notes:
HSV = Hand Shear Vane (kN/m^2)
LP = Limited Penetration (HSV/CBR)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

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Telephone: 08456 768 895 / 07883 440 186

GEO Environmental Engineering

GEO2021-4625: Ivy Mill, Whitehaven, Cumbria – TP205

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.40	MADE GROUND: Dark grey brown sandy GRAVEL of aggregate and demolition rubble.		
0.40	0.65	Stiff brown gravelly CLAY with occasional cobbles.		
0.65	-	POSSIBLE BEDROCK: Yellow brown sandstone. Unable to excavate (possible large boulders?)		
		End of trial hole at 0.65m. Trial hole remained open and dry on completion. Trial hole backfilled with arisings on completion. No evidence of hydrocarbon contamination.		

Engineer: J. Brock
Site Works Date: 08/02/2021
Plant: Tracked 360 Excavator

Log Notes:
HSV = Hand Shear Vane (kN/m^2)
LP = Limited Penetration (HSV/CBR)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

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GEO Environmental Engineering

GEO2021-4625: Ivy Mill, Whitehaven, Cumbria – TP206

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.60	MADE GROUND: Dark grey brown sandy GRAVEL of aggregate and demolition rubble. Former foundation along western edge of pit.		
0.60	0.90	Stiff brown gravelly CLAY with occasional cobbles.		
0.90	-	POSSIBLE BEDROCK: Yellow and grey brown sandstone. Unable to excavate (possible large boulders?)		
		End of trial hole at 0.90m. Groundwater ingress from base of made ground. Trial hole backfilled with arisings on completion. No evidence of hydrocarbon contamination.		

Engineer: J. Brock
Site Works Date: 08/02/2021
Plant: Tracked 360 Excavator

Log Notes:
HSV = Hand Shear Vane (kN/m^2)
LP = Limited Penetration (HSV/CBR)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

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GEO Environmental Engineering

GEO2021-4625: Ivy Mill, Whitehaven, Cumbria – TP207

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	1.20	MADE GROUND: Dark grey brown sandy GRAVEL of aggregate and demolition rubble. Former foundation along southern edge of pit. Very unstable. 0.90 – Groundwater ingress from c.0.90m bgl.		
1.20	1.60	Stiff brown gravelly CLAY with occasional cobbles.		
1.60	-	POSSIBLE BEDROCK: Yellow and grey brown sandstone. Unable to excavate (possible large boulders?)		
		End of trial hole at 1.60m. Groundwater ingress from base of made ground. Trial hole backfilled with arisings on completion. No evidence of hydrocarbon contamination.		

Engineer: J. Brock
Site Works Date: 08/02/2021
Plant: Tracked 360 Excavator

Log Notes:
HSV = Hand Shear Vane (kN/m^2)
LP = Limited Penetration (HSV/CBR)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

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GEO Environmental Engineering

GEO2021-4625: Ivy Mill, Whitehaven, Cumbria – TP208

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	1.30	MADE GROUND: Dark grey brown sandy GRAVEL of aggregate and demolition rubble. Occasional timber.		
1.30	2.20	Stiff brown gravelly CLAY with occasional cobbles.		
		End of trial hole at 2.20m. Trial pit remained dry and stable. Trial hole backfilled with arisings on completion. No evidence of hydrocarbon contamination.		

Engineer: J. Brock
Site Works Date: 08/02/2021
Plant: Tracked 360 Excavator

Log Notes:
HSV = Hand Shear Vane (kN/m^2)
LP = Limited Penetration (HSV/CBR)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

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GEO Environmental Engineering

GEO2021-4625: Ivy Mill, Whitehaven, Cumbria – TP209

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.40	MADE GROUND: Dark grey brown loamy sandy GRAVEL of aggregate and demolition rubble. Occasional pocket sof gravelly clay.		
0.40	1.10	Stiff brown gravelly CLAY with occasional cobbles.		
1.10	-	POSSIBLE BEDROCK: Yellow and grey brown sandstone. Unable to excavate (possible large boulders?)		
		End of trial hole at 1.10m. Trial pit remained dry and stable. Trial hole backfilled with arisings on completion. No evidence of hydrocarbon contamination.		

Engineer: J. Brock
Site Works Date: 08/02/2021
Plant: Tracked 360 Excavator

Log Notes:
HSV = Hand Shear Vane (kN/m^2)
LP = Limited Penetration (HSV/CBR)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

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Appendix IV

- SiteScan – Culvert Survey (Drawing No. 21118-UM-01)

KEY

LINETYPES

- VERGE
- FENCE - CHAIN LINK
- FENCE - METAL
- FENCE - WOODEN
- FENCE - POST & RAIL
- HEDGE
- WALL
- BARRIER
- CHANNEL LINE
- CONCRETE EDGE
- FOOTPATH
- TRACK
- BUILDING
- TREE
- GATE
- SURVEY STATION
- EAVES

UTILITY KEY

LINETYPES

- BT BELOW GROUND
- BT ABOVE GROUND
- BT ASSUMED ROUTE
- CATV BELOW GROUND
- CATV ABOVE GROUND
- CATV ASSUMED ROUTE
- COMMS BELOW GROUND
- COMMS ABOVE GROUND
- COMMS ASSUMED ROUTE
- GAS BELOW GROUND
- GAS ABOVE GROUND
- GAS ASSUMED ROUTE
- ELECTRIC BELOW GROUND
- ELECTRIC ABOVE GROUND
- ELECTRIC ASSUMED ROUTE
- WATER BELOW GROUND
- WATER ABOVE GROUND
- WATER ASSUMED ROUTE
- UNKNOWN BELOW GROUND
- UNKNOWN ABOVE GROUND
- GPR BELOW GROUND
- COMBINED WATER SEWER
- ASSUMED COMBINED WATER SEWER ROUTE
- FOUL WATER SEWER
- ASSUMED FOUL WATER SEWER ROUTE
- STORM WATER SEWER
- ASSUMED STORM WATER SEWER ROUTE
- REINSTATEMENT SCAR
- SURVEY BOUNDARY

ABBREVIATIONS

(AC)	ASSUMED CONNECTION	INT	INTERCEPTOR
A/G	ABOVE GROUND	KV	KILO VOLT
(ARI)	ASSUMED ROUTE	LD	LOOP DETECTOR
ASB	ASBESTOS CEMENT	LH	LAMP HOLE
AV	AIR VALVE	LP	LAMP POST
BB	BELISHA BEACON	LV	LOW VOLTAGE
BD	BACK DROP	MK	MARKER
BL	BASE LEVEL	MH	MANHOLE
BO	BOLLARD	MT	MITER
BOL	BOLLARD LIGHT	MWELL	MONITORING WELL
BT	BRITISH TELECOM	OH	OVERHEAD
CATV	CABLE TELEVISION	PE	POLYETHYLENE
CB	CONTROL BOX	PTG	PIPE TO GROUND
CI	CAST IRON	PVC	POLYVINYL CHLORIDE
CL	COVER LEVEL	TPR	TAKEN FROM RECORDS
CR	CABLE RISER	RE	RODDING EYE
CWS	COMBINED WATER SEWER	RED	REDUNDANT SERVICE
d	DEPTH OF SERVICE	RWP	RAIN WATER PIPE
DCH	DRAINAGE CHANNEL	SC	STOP COCK
DI	DUCTILE IRON	SI	SPUN IRON
DIS	DISUSED	SOF	SOFFIT
EOT	END OF TRACE	SP	SOIL PIPE
EP	ELECTRIC POLE	SWS	SURFACE WATER SEWER
ER	EARTH ROD	SV	STOP VALVE
FPP	FUEL TANK FILL POINT	TL	TRAFFIC LIGHT
FH	FIRE HYDRANT	TLC	TRAFFIC LIGHT COVER
FWS	FOUL WATER SEWER	TP	TELECOM POLE
GPR	GROUND PENETRATING RADAR	UTL	UNABLE TO LIFT
GR	GAS RISER	UTS	UNABLE TO SURVEY
GV	GAS VALVE	UTT	UNABLE TO TRACE
GY	GULLY	VC	VITRIFIED CLAY
HV	HIGH VOLTAGE	VP	VENT PIPE
IC	INSPECTION COVER	WL	WATER LEVEL
id	INVERT DEPTH	WO	WASH OUT
IL	INVERT LEVEL	WR	WATER RISER

DISCLAIMER

Unless otherwise stated, all services shown on this plan have been surveyed using approved detectors and the connections between manholes, if not traced, are assumed to be direct.

No guarantee can be given that all services have been shown.
In ideal conditions the depth accuracies for the underground utilities located is +/- 10% of depth.

Utilities traced using CPR techniques show depths approximately from ground level to the top of the utility. Utilities traced using Electromagnetic techniques show depths approximately from ground level to the centre of the utility. Drainage and pipes traced using Sonde Electromagnetic techniques show depths at approximately the Invert Level.

Where services are shown as 'Taken From Records' on the drawing we are not liable for any loss that may arise due to a lack of accuracy in that quoted information.

Due to BT's policy we are not permitted to lift their inspection chamber covers.

Reference should be made to the methodology used on site as detailed within the latest version of SiteScan Procedures for Utility Location Surveys.

SiteScan recommend that all excavations are to be carried out in accordance with HSG 47 (Avoiding Danger from Underground Services).

Plan accuracies of the order of + or - 150mm may be achieved but this figure will depend on the depth of the service below ground level. Where similar services run in close proximity, separation may be impossible. Successful tracing of non-metallic pipes may be limited.

Existing record information showing underground services is often incomplete and of doubtful accuracy. It should be regarded only as an indication and cannot be guaranteed.

Rev	Description	Date

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SiteScan
Information to build on

PROJECT

Land at Ivy Mill, Whitehaven

TITLE

Culvert Survey

CLIENT

Gleeson Homes

DRAWN BY	CHECKED BY	DATE
GW	NG	19/11/21

SCALE (@ A1)	PROJECT NUMBER
1:500	P21118

DRAWING NUMBER	REV
21118-UM-01	A

Appendix V

- SOILS – Level 1 Human Health Generic Quantitative Risk Assessment (GQRA) – Maximum Value Test (MxVT)
- WATER – Water Environment Quantitative Risk Assessment (GQRA) – Maximum Value Test (MxVT)

GEO Environmental Engineering Limited
Level 1 Generic Quantitative Risk Assessment - Human Health (Soils) - Maximum Value Test (MxVT)

Lab number			80693-1	80693-2	80693-3	80693-4	80693-5	80693-6	80693-7	80693-8	80693-9	80693-10	80693-11	80693-12	80693-13	80693-14	80693-15	80748-1	80748-2	Generic Assessment Criteria Residential With Plant Uptake 2.5% SOM		
Sample id			BH01	BH03	BH04	BH04	TPA	TPB	TPC	TPC	TPD	TPF	TPF	TPG	TPH	TPI	TPJ	BH01	BH02	GAC	GAC Exceeded?	GAC Ref:
Depth (m)			0.10-1.00	0.00-0.40	0.00-0.30	0.50-1.00	0.10	0.60	0.60	1.20	0.30-0.40	1.00	2.40	2.00	0.20	0.15	0.50	1.00-1.40	0.00-0.60			
Date sampled			14/08/2019	14/08/2019	14/08/2019	14/08/2019	14/08/2019	14/08/2019	14/08/2019	14/08/2019	14/08/2019	14/08/2019	14/08/2019	14/08/2019	14/08/2019	14/08/2019	14/08/2019	14/08/2019	14/08/2019			
Test	**Method**	**Units**																				
Arsenic (total)	CE127 [M]	mg/kg As	11	13	13	8.1	21	21	6.6	-	5.0	9.3	-	5.9	11	9.2	9.6	15	14	37	No	LQM S4UL
Cadmium (total)	CE127 [M]	mg/kg Cd	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	0.3	0.4	-	0.2	0.7	0.4	0.3	<0.2	<0.2	11	No	LQM S4UL
Chromium (total)	CE127 [M]	mg/kg Cr	50	47	55	47	53	68	18	-	15	39	-	35	54	38	38	53	50	910	No	LQM S4UL
Chromium (III)	-	mg/kg CrIII	50	47	55	47	53	68	18	-	15	39	-	35	54	38	38	53	50	910	No	LQM S4UL
Chromium (VI)	CE146	mg/kg CrVI	<1	<1	<1	<1	<1	<1	<1	-	<1	<1	-	<1	<1	<1	<1	<1	<1	6	No	LQM S4UL
Copper (total)	CE127 [M]	mg/kg Cu	23	18	25	20	28	31	6.1	-	5.0	19	-	11	35	24	21	25	29	2400	No	LQM S4UL
Lead (total)	CE127 [M]	mg/kg Pb	18	42	38	15	65	82	13	-	9.8	239	-	51	341	113	89	18	28	200	Yes	LQM C4SL
Mercury (total)	CE127 [M]	mg/kg Hg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	40	No	LQM S4UL
Nickel (total)	CE127 [M]	mg/kg Ni	25	19	44	18	25	31	6.5	-	7.5	20	-	14	33	21	19	34	39	130	No	LQM S4UL
Selenium (total)	CE127 [M]	mg/kg Se	1.2	1.2	0.7	1.0	1.2	1.3	3.7	-	1.9	0.8	-	0.5	1.4	0.7	0.9	1.2	1.3	250	No	LQM S4UL
Zinc (total)	CE127 [M]	mg/kg Zn	34	26	43	18	57	55	9.3	-	<5	161	-	68	220	136	95	49	47	3700	No	LQM S4UL
pH	CE004 [N]	units	7.4	7.1	7.1	7.4	6.6	7.2	10.7	7.8	9.1	10.0	-	9.9	9.5	10.1	8.4	7.0	4.6	<6.5	Yes	BRE
Sulphate (2:1 water soluble)	CE061 [N]	mg/l SO_4	592	50	195	134	35	21	2679	114	84	478	-	49	519	347	189	57	16	>500	Yes	BRE
Cyanide (total)	CE077	mg/kg CN	<1	<1	<1	<1	<1	<1	<1	-	<1	<1	-	<1	<1	<1	<1	<1	<1	34	No	ATRISK SSV
Total Organic Carbon (TOC)	CE072 [M]	% w/w C	1.8	2.4	2.8	1.3	4.2	2.8	<0.1	-	1.0	1.2	-	0.7	4.2	1.3	2.6	1.6	2.3	-	-	-
PAH																						
Naphthalene	CE087 [N]	mg/kg	0.03	0.03	0.10	<0.02	<0.02	<0.02	0.05	-	0.12	0.07*	0.06	0.04	0.10	0.07	0.08	<0.02	0.09	5.6	No	LQM S4UL
Acenaphthylene	CE087 [N]	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.02	0.04*	<0.02	<0.02	<0.02	0.03	0.04	<0.02	<0.02	420	No	LQM S4UL
Acenaphthene	CE087 [N]	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.02	0.18*	<0.02	0.04	<0.02	0.29	0.36	<0.02	<0.02	510	No	LQM S4UL
Fluorene	CE087 [U]	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	0.27	0.15*	0.12	0.04	<0.02	0.32	0.33	<0.02	<0.02	400	No	LQM S4UL
Phenanthrene	CE087 [N]	mg/kg	0.24	0.10	0.16	0.02	0.09	0.15	0.12	-	0.64	1.52*	0.43	0.53	0.49	3.90	3.74	0.09	0.39	220	No	LQM S4UL
Anthracene	CE087 [U]	mg/kg	0.06	<0.02	<0.02	<0.02	<0.02	0.02	<0.02	-	0.24	0.86*	0.55	0.21	0.12	1.08	1.25	0.04	0.08	5400	No	LQM S4UL
Fluoranthene	CE087 [N]	mg/kg	0.35	0.07	0.10	0.02	0.07	0.20	0.07	-	<0.02	3.88*	0.66	1.56	1.01	5.53	6.18	<0.02	0.10	560	No	LQM S4UL
Pyrene	CE087 [N]	mg/kg	0.31	0.06	0.08	0.02	0.06	0.17	0.06	-	0.13	3.47*	1.01	1.46	0.89	4.31	4.72	<0.02	0.09	1200	No	LQM S4UL
Benzo(a)anthracene	CE087 [U]	mg/kg	0.20	0.04	0.06	<0.02	0.04	0.10	0.04	-	0.04	1.75*	0.28	0.78	0.52	2.19	2.66	<0.02	0.04	11	No	LQM S4UL
Chrysene	CE087 [N]	mg/kg	0.19	0.04	0.06	<0.03	0.04	0.11	0.05	-	0.06	1.70*	0.26	0.74	0.50	1.87	2.26	<0.03	0.04	22	No	LQM S4UL
Benzo(b)fluoranthene	CE087 [N]	mg/kg	0.26	0.05	0.08	0.02	0.06	0.14	0.04	-	0.04	1.91*	0.32	0.98	0.65	2.29	2.98	<0.02	0.02	3.3	No	LQM S4UL
Benzo(k)fluoranthene	CE087 [N]	mg/kg	0.09	<0.03	<0.03	<0.03	<0.03	0.06	<0.03	-	<0.03	0.82*	0.16	0.38	0.26	0.98	1.37	<0.03	<0.03	93	No	LQM S4UL
Benzo(a)pyrene	CE087 [U]	mg/kg	0.17	0.03	0.04	<0.02	0.03	0.09	0.02	-	0.02	1.29*	0.20	0.64	0.47	1.77	2.10	<0.02	<0.02	2.7	No	LQM S4UL
Indeno(123cd)pyrene	CE087 [N]	mg/kg	0.16	0.03	0.05	<0.02	0.03	0.08	0.02	-	<0.02	1.13*	0.20	0.55	0.39	1.33	1.84	<0.02	<0.02	36	No	LQM S4UL
Dibenz(ah)anthracene	CE087 [N]	mg/kg	0.04	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.02	0.24*	0.05	0.10	0.07	0.23	0.37	<0.02	<0.02	0.28	Yes	LQM S4UL
Benzo(ghi)perylene	CE087 [N]	mg/kg	0.14	0.03	0.04	<0.02	0.03	0.07	<0.02	-	<0.02	0.94*	0.18	0.45	0.34	1.09	1.51	<0.02	<0.02	340	No	LQM S4UL
PAH (total of USEPA 16)	CE087	mg/kg	2.24	0.49	0.76	<0.34	0.46	1.18	0.49	-	1.57	20.0*	4.48	8.50	5.82	27.3	31.8	<0.34	0.85	-	-	-
BTEX & TPH																						
MTBE	CE057 [U]	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	-	84	No	CL:AIRE GAC (2010)
Benzene	CE057 [U]	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	0.17	No	LQM S4UL
Toluene	CE057 [U]	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	290	No	LQM S4UL
Ethylbenzene	CE057 [U]	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	110	No	LQM S4UL
m & p-Xylene	CE057 [U]	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	-	130	No	LQM S4UL
o-Xylene	CE057 [U]	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	140	No	LQM S4UL
VPH Aromatic (>EC5-EC7)	CE067	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	140	No	LQM S4UL
VPH Aromatic (>EC7-EC8)	CE067	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	290	No	LQM S4UL
VPH Aromatic (>EC8-EC10)	CE067	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	-	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	-	-	83	No	LQM S4UL
EPH Aromatic (>EC10-EC12)	CE068	mg/kg	<1	<1	<1	<1	<1	<1	<1	-	<1	<1	<1	<1	<1	<1	<1	-	-	180	No	LQM S4UL
EPH Aromatic (>EC12-EC16)	CE068	mg/kg	<1	<1	<1	<1	<1	<1	<1	-	<1	<1	<1	<1	<1	<1	<1	-	-	330	No	LQM S4UL
EPH Aromatic (>EC16-EC21)	CE068	mg/kg	2	<1	<1	<1	<1	<1	<1	-	2	12	4	5	4	16	17	-	-	540	No	LQM S4UL
EPH Aromatic (>EC21-EC35)	CE068	mg/kg	2	<1	<1	<1	<1	<1	<1	-	<1	11	2	5	4	12	15	-	-	1500	No	LQM S4UL
EPH Aromatic (>EC35-EC44)	CE068	mg/kg	<1	<1	<1	<1	<1	<1	<1	-	<1	1	<1	<1	<1	2	3	-	-	1500	No	LQM S4UL
VPH Aliphatic (>C5-C6)	CE067	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	78	No	LQM S4UL
VPH Aliphatic (>C6-C8)	CE067	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	230	No	LQM S4UL
VPH Aliphatic (>C8-C10)	CE067	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	3.2	<0.1	0.5	<0.1	<0.1	<0.1	<0.1	-	-	65	No	LQM S4UL
EPH Aliphatic (>C10-C12)	CE068	mg/kg	<4	<4	<4	<4	<4	<4	<4	-	100	<4	135	<4	<4	<4	<4	-	-	330	No	LQM S4UL
EPH Aliphatic (>C12-C16)	CE068	mg/kg	7	<4	<4	<4	<4	<4	6	-	471	12	1614	9	5	11	8	-	-	2400	No	LQM S4UL
EPH Aliphatic (>C16-C35)	CE068	mg/kg	40	19	20	<4	24	31	106	-	857	564	6113	200	103	301	420	-	-	92000	No	LQM S4UL
EPH Aliphatic (>C35-C44)	CE068	mg/kg	20	14	<10	<10	15	14	24	-	16	215	2322	105	28	126	177	-	-	92000	No	LQM S4UL
PCB																						
PCB Congener 28	CE137 [N]	mg/kg	<0.004	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.004	No	LDL
PCB Congener 52	CE137 [N]	mg/kg	<0.004	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.004	No	LDL
PCB Congener 101	CE137 [N]	mg/kg	<0.008	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.008	No	LDL
PCB Congener 118	CE137 [N]	mg/kg	<0.006	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.006	No	LDL
PCB Congener 138	CE137 [N]	mg/kg	<0.006	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.006	No	LDL
PCB Congener 153	CE137 [N]	mg/kg	<0.009	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.009	No	LDL
PCB Congener 180	CE137 [N]	mg/kg	<0.008	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.008	No	LDL
PCB (total of ICES 7)	CE137 [N]	mg/kg	<0.045	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.045	No	LDL
Subcontracted analysis																						
Asbestos (qualitative)	$	-	NAD	NAD	NAD	NAD	NAD	NAD	NAD	-	NAD	NAD	-	NAD	NAD	NAD	NAD	NAD	NAD	Present	No	Presence

* Higher LOD reported due to sample interference.

Notes:

CT = Target Concentration CM = Maximum Concentration CM>CT (CM exceeds CT)

CT References:

C4SL = Category 4 Screening Levels (Residential with comsumption of homegrown produce End Use)

SGV = Clea Soil Guideline Value (Residential with Plant Uptake End Use)

LQM S4UL = LQM/CIEH 'Suitable 4 Use Levels' S4ULs (Residential with homegrown produce End Use based on 2.5% SOM) - 2015

Atkins = Atkins Atrisk Soil Screening Value (SSV - Residential with Plant Uptake End Use)

Asbestos - Present? - HSG248 Microscopy

BRE = Building Research Establishment Special Digest 1

GEO Environmental Engineering Limited
LEACHATES - Controlled Waters Generic Quantitative Risk Assessment (GQRA) – Maximum Value Test (MxVT)

Lab number			80693-16	80693-17	CT Concentration	CM Exceeds CT?	CT Ref:
Sample id			TPD	TPF			
Depth (m)			0.60	2.30			
Date sampled			14/08/2019	14/08/2019			
Time sampled			-	-			
Test	**Method**	**Units**					
PAH							
Naphthalene	CE051	µg/l	<0.1	<0.1	0.1	No	UK DWS
Acenaphthylene	CE051	µg/l	<0.1	<0.1	0.1	No	UK DWS
Acenaphthene	CE051	µg/l	<0.1	<0.1	0.1	No	UK DWS
Fluorene	CE051	µg/l	<0.1	<0.1	0.1	No	UK DWS
Phenanthrene	CE051	µg/l	<0.1	<0.1	0.1	No	UK DWS
Anthracene	CE051	µg/l	<0.1	<0.1	0.1	No	UK DWS
Fluoranthene	CE051	µg/l	0.5	0.9	0.1	Yes	UK DWS
Pyrene	CE051	µg/l	0.3	0.9	0.1	Yes	UK DWS
Benzo(a)anthracene	CE051	µg/l	<0.1	<0.1	0.1	No	UK DWS
Chrysene	CE051	µg/l	<0.1	<0.1	0.1	No	UK DWS
Benzo(b)fluoranthene	CE051	µg/l	<0.1	<0.1	0.1	No	UK DWS
Benzo(k)fluoranthene	CE051	µg/l	<0.1	0.2	0.1	Yes	UK DWS
Benzo(a)pyrene	CE051	µg/l	<0.1	<0.1	0.1	No	UK DWS
Indeno(123cd)pyrene	CE051	µg/l	<0.1	<0.1	0.1	No	UK DWS
Dibenz(ah)anthracene	CE051	µg/l	<0.1	<0.1	0.1	No	UK DWS
Benzo(ghi)perylene	CE051	µg/l	<0.1	<0.1	0.1	No	UK DWS
PAH (total of USEPA 16)	CE051	µg/l	<1.6	1.9	-	-	-
TPH							
VPH Aromatic (>EC5-EC7)	CE175	µg/l	<1	<1	10	No	UK DWS
VPH Aromatic (>EC7-EC8)	CE175	µg/l	<1	<1	10	No	UK DWS
VPH Aromatic (>EC8-EC10)	CE175	µg/l	<1	<1	10	No	UK DWS
EPH Aromatic (>EC10-EC12)	CE161	µg/l	<1	<1	10	No	UK DWS
EPH Aromatic (>EC12-EC16)	CE161	µg/l	<1	<1	10	No	UK DWS
EPH Aromatic (>EC16-EC21)	CE161	µg/l	1	4	10	No	UK DWS
EPH Aromatic (>EC21-EC35)	CE161	µg/l	<1	5	10	No	UK DWS
EPH Aromatic (>EC35-EC44)	CE161	µg/l	<1	<1	10	No	UK DWS
VPH Aliphatic (>C5-C6)	CE175	µg/l	<1	<1	10	No	UK DWS
VPH Aliphatic (>C6-C8)	CE175	µg/l	<1	<1	10	No	UK DWS
VPH Aliphatic (>C8-C10)	CE175	µg/l	<1	<1	10	No	UK DWS
EPH Aliphatic (>C10-C12)	CE161	µg/l	<1	3	10	No	UK DWS
EPH Aliphatic (>C12-C16)	CE161	µg/l	4	56	10	Yes	UK DWS
EPH Aliphatic (>C16-C35)	CE161	µg/l	36	389	10	Yes	UK DWS
EPH Aliphatic (>C35-C44)	CE161	µg/l	<1	16	10	Yes	UK DWS

Notes:
CT = Target Concentration
CM = Maximum Concentration
CM exceeds CT
UK DWS = UK Drinking Water Standard
EQS Fresh = Environmental Quality Standard Freshwater Standard
LDL = Laboratory Detection Limnit
BRE = Building Research Establishment Special Digest 1:2005

Appendix VI

- Soil Validation Criteria For Imported Soils

Soil Validation Criteria for Imported Soils

		Generic Assessment Criteria Residential With Plant Uptake			
Determinand	**Unit**	**GAC at 1% SOM**	**GAC at 2.5% SOM**	**GAC at 6% SOM**	**GAC Ref:**
Arsenic (total)	mg/kg	37	37	37	LQM S4UL
Cadmium (total)	mg/kg	10	10	10	CLEA SGV
Chromium (III)	mg/kg	910	910	910	LQM S4UL
Chromium (VI)	mg/kg	6	6	6	LQM S4UL
Copper (total)	mg/kg	2400	2400	2400	LQM S4UL
Lead (total)	mg/kg	200	200	200	LQM C4SL
Mercury (total)	mg/kg	40	40	40	LQM S4UL
Nickel (total)	mg/kg	130	130	130	LQM S4UL
Selenium (total)	mg/kg	250	250	250	LQM S4UL
Zinc (total)	mg/kg	3700	3700	3700	LQM S4UL
pH	N/A	<6.5	<6.5	<6.5	BRE
Sulphate (2:1 water soluble)	mg/l	>500	>500	>500	BRE
Cyanide (total)	mg/kg	34	34	34	ATRISK SSV
Phenols (total)	mg/kg	120	200	380	LQM S4UL
Total Organic Carbon (TOC)	% w/w C	-	-	-	-
PAH					
Naphthalene	mg/kg	2.3	5.6	13.0	LQM S4UL
Acenaphthylene	mg/kg	170	420	920	LQM S4UL
Acenaphthene	mg/kg	210	510	1100	LQM S4UL
Fluorene	mg/kg	170	400	860	LQM S4UL
Phenanthrene	mg/kg	95	220	440	LQM S4UL
Anthracene	mg/kg	2400	5400	11000	LQM S4UL
Fluoranthene	mg/kg	280	560	890	LQM S4UL
Pyrene	mg/kg	620	1200	2000	LQM S4UL
Benzo(a)anthracene	mg/kg	7	11	13	LQM S4UL
Chrysene	mg/kg	15	22	27	LQM S4UL
Benzo(b)fluoranthene	mg/kg	2.6	3.3	4	LQM S4UL
Benzo(k)fluoranthene	mg/kg	77	93	100	LQM S4UL
Benzo(a)pyrene	mg/kg	2.2	2.7	3.0	LQM S4UL
Indeno(123cd)pyrene	mg/kg	27	36	41	LQM S4UL
Dibenz(ah)anthracene	mg/kg	0.24	0.28	0.30	LQM S4UL
Benzo(ghi)perylene	mg/kg	320	340	350	LQM S4UL
PAH (total of USEPA 16)	mg/kg	-	-	-	-
BTEX & TPH					
MTBE	mg/kg	49	84	160	CL:AIRE GAC (2010)
Benzene	mg/kg	0.087	0.17	0.37	LQM S4UL
Toluene	mg/kg	130	290	660	LQM S4UL
Ethylbenzene	mg/kg	47	110	260	LQM S4UL
m & p-Xylene	mg/kg	56	130	310	LQM S4UL
o-Xylene	mg/kg	56	140	310	LQM S4UL
VPH Aromatic (>EC5-EC7)	mg/kg	70	140	300	LQM S4UL
VPH Aromatic (>EC7-EC8)	mg/kg	130	290	660	LQM S4UL
VPH Aromatic (>EC8-EC10)	mg/kg	34	83	190	LQM S4UL
EPH Aromatic (>EC10-EC12)	mg/kg	74	180	380	LQM S4UL
EPH Aromatic (>EC12-EC16)	mg/kg	140	330	660	LQM S4UL
EPH Aromatic (>EC16-EC21)	mg/kg	260	540	930	LQM S4UL
EPH Aromatic (>EC21-EC35)	mg/kg	1100	1500	1700	LQM S4UL
EPH Aromatic (>EC35-EC44)	mg/kg	1100	1500	1700	LQM S4UL
VPH Aliphatic (>C5-C6)	mg/kg	42	78	160	LQM S4UL
VPH Aliphatic (>C6-C8)	mg/kg	100	230	530	LQM S4UL
VPH Aliphatic (>C8-C10)	mg/kg	27	65	150	LQM S4UL
EPH Aliphatic (>C10-C12)	mg/kg	130	330	760	LQM S4UL
EPH Aliphatic (>C12-C16)	mg/kg	1100	2400	4300	LQM S4UL
EPH Aliphatic (>C16-C35)	mg/kg	65000	92000	110000	LQM S4UL
EPH Aliphatic (>C35-C44)	mg/kg	65000	92000	110000	LQM S4UL
Subcontracted analysis					
Asbestos (qualitative)	-	Present	Present	Present	Presence

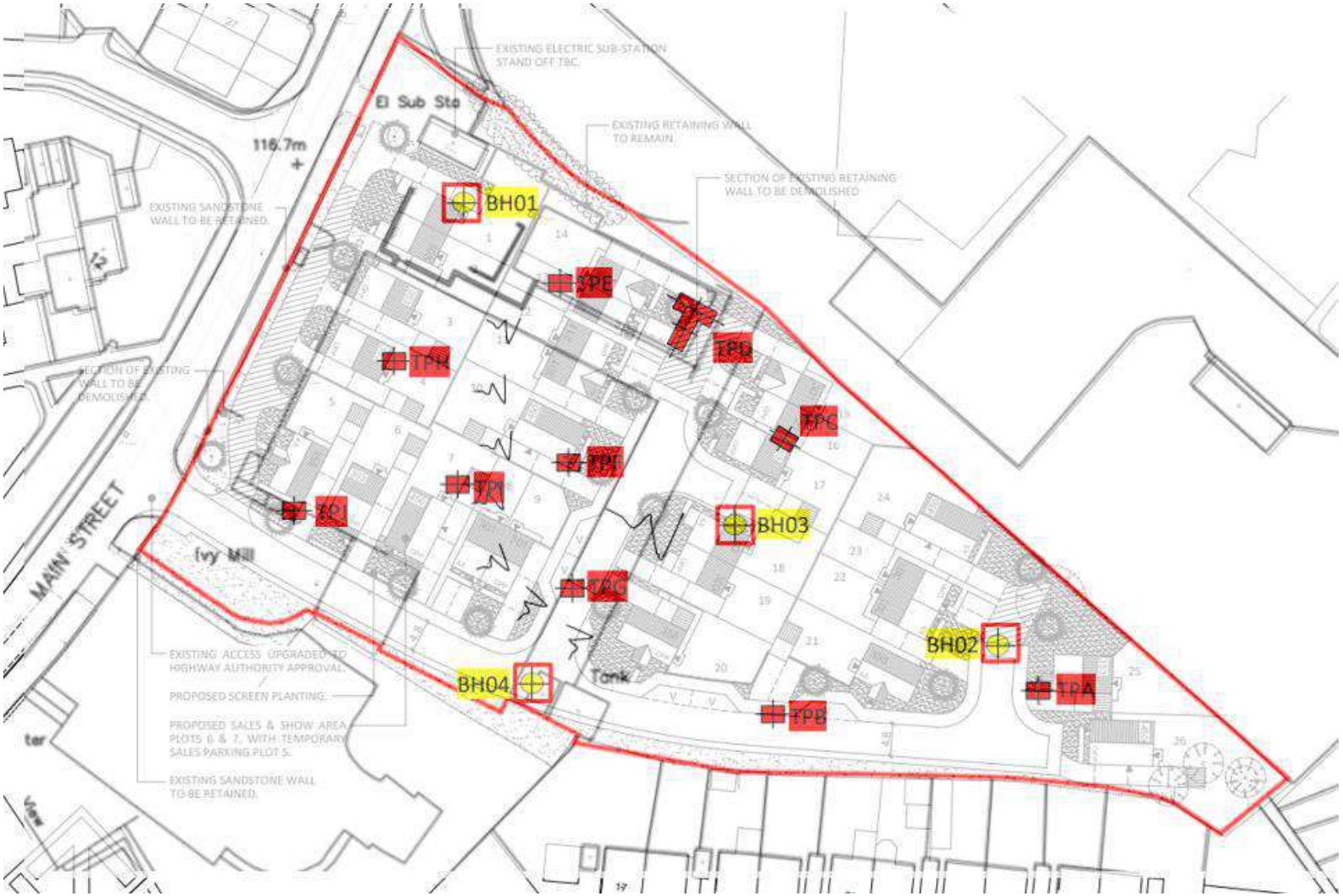
Notes: Results to be reviewed against approriate SOM value.

Appendix VII

- Proposed Site Development Plan With Exploratory Hole Locations
- Delineation Plan For Areas Requiring Remedial Measures
- YALPAG - Verification Requirement For Cover Systems; Technical Guidance For Developers, Landowners and Consultants (Version 4.1 dated June 2021)

GEO Environmental Engineering

GEO2021-4986: Ivy Mill, Whitehaven, Cumbria – Proposed Development Plan Overlaid with Exploratory Hole Locations



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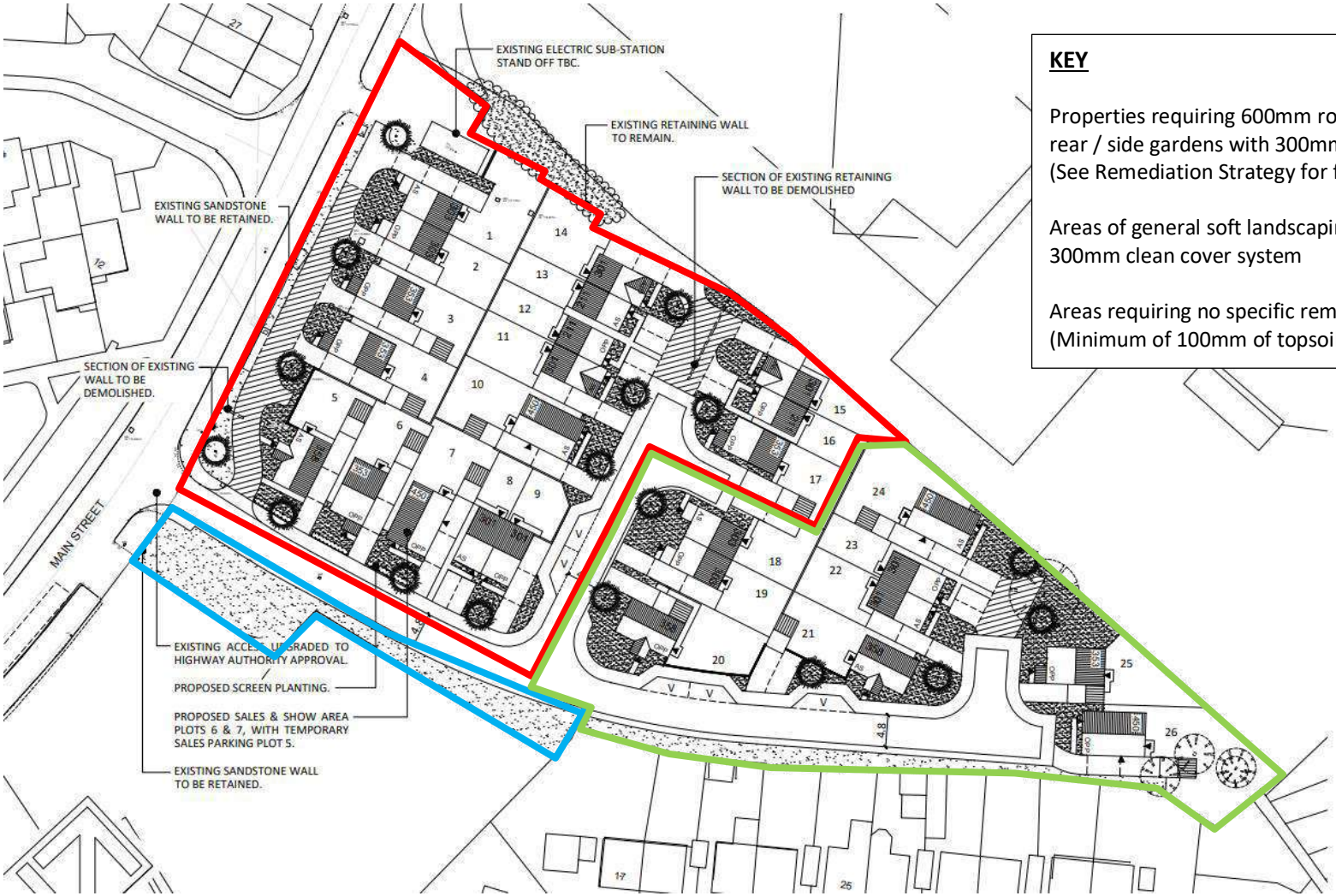
GEO Environmental Engineering

GEO2021-4986: Ivy Mill, Whitehaven, Cumbria – Delineation Plan For Gardens Requiring Remedial Measures



KEY

Properties requiring 600mm robust clean cover system in rear / side gardens with 300mm clean cover in front gardens (See Remediation Strategy for further details)

Areas of general soft landscaping requiring 300mm clean cover system

Areas requiring no specific remedial measures (Minimum of 100mm of topsoil)

N

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VERIFICATION REQUIREMENTS FOR COVER SYSTEMS

Technical Guidance for Developers, Landowners and Consultants

Yorkshire and Lincolnshire Pollution Advisory Group

Version 4.1 – June 2021

The purpose of this guidance is to promote consistency and good practice for development on land affected by contamination. The Local Authorities in Yorkshire, Lincolnshire, the North East of England, East Anglia, Greater Manchester and St Helens who have adopted this guidance are shown below:

Contents

Disclaimer

This guidance is intended to serve as an informative and helpful source of advice. YALPAG will review this guidance every three years, but readers must note that legislation, guidance and practical methods are inevitably subject to change and therefore should be aware of current UK policy and best practice. This note should be read in conjunction with prevailing legislation and guidance, as amended, whether mentioned here or not. Where legislation and documents are summarised this is for general advice and convenience, and must not be relied upon as a comprehensive or authoritative interpretation. Ultimately it is the responsibility of the person/company involved in the development or assessment of land to apply up-to-date working practices to determine the contamination status of a site and the remediation and verification requirements.

Acknowledgments

YALPAG would like to thank North Lincolnshire Council, Leeds City Council, City of Bradford Metropolitan District Council, Barnsley Metropolitan Borough Council, Rotherham Metropolitan Borough Council, Wakefield Council, and Tameside Metropolitan Borough Council, for producing this guidance.

YALPAG would also like to acknowledge Liverpool City Council's Contaminated Land Team, Coopers Consulting Engineers for allowing us to use their guidance document and photographs and WSP Environmental Ltd for also donating photographs.

Consultation

39 Local Authorities and 6 Environmental Consultants were consulted over a four week period in 2010 during the production of the initial guidance. At that time, consultation comments were considered by the review panel and a number of revisions were made to the guidance to reflect these comments.

49 Local Authorities and 25 Environmental Consultants were consulted in 2021, during the production of this version [4.1] of the guidance. Consultation comments were considered by the review panel and a number of revisions were made to the guidance to reflect these comments.

Introduction

This guidance has been produced to help developers ensure that they can demonstrate that material brought onto a development site for gardens or areas of soft landscaping are suitable for use and do not present harm to people, the environment and/or property. It is intended to improve the quality of reports submitted to Local Authorities on this matter and to give contractors/consultants a point of reference to obtain approval for such work from their client. This guidance does not cover the geotechnical suitability of soils or materials, chemical suitability that does not affect human health e.g. sulphates, or importing soils contaminated with invasive (or injurious) plants.

The verification of cover systems should be an integral part of the remediation project and agreed between developers and regulators at an early stage in the project.

UK guidelines for remediation verification are set out within Land Contamination Risk Management[1] (LCRM) and the document on Verification of Remediation of Land Contamination[2]. This guidance note should be considered as supplementary advice in conjunction with these documents.

This guidance relates to the remediation of land contamination by using cover systems; however, the verification of the quality of imported material is equally important in other situations, such as raising levels for flood prevention or general landscaping works. This guidance could also be used in such instances.

The Process of Verification

Implementation plans for remedial works should always be site specific. Where a cover system and potentially, excavation, is the main remedial method or a component of an overall site remediation, specific goals will need to be set that are linked directly to the risk management strategy for the site in question.

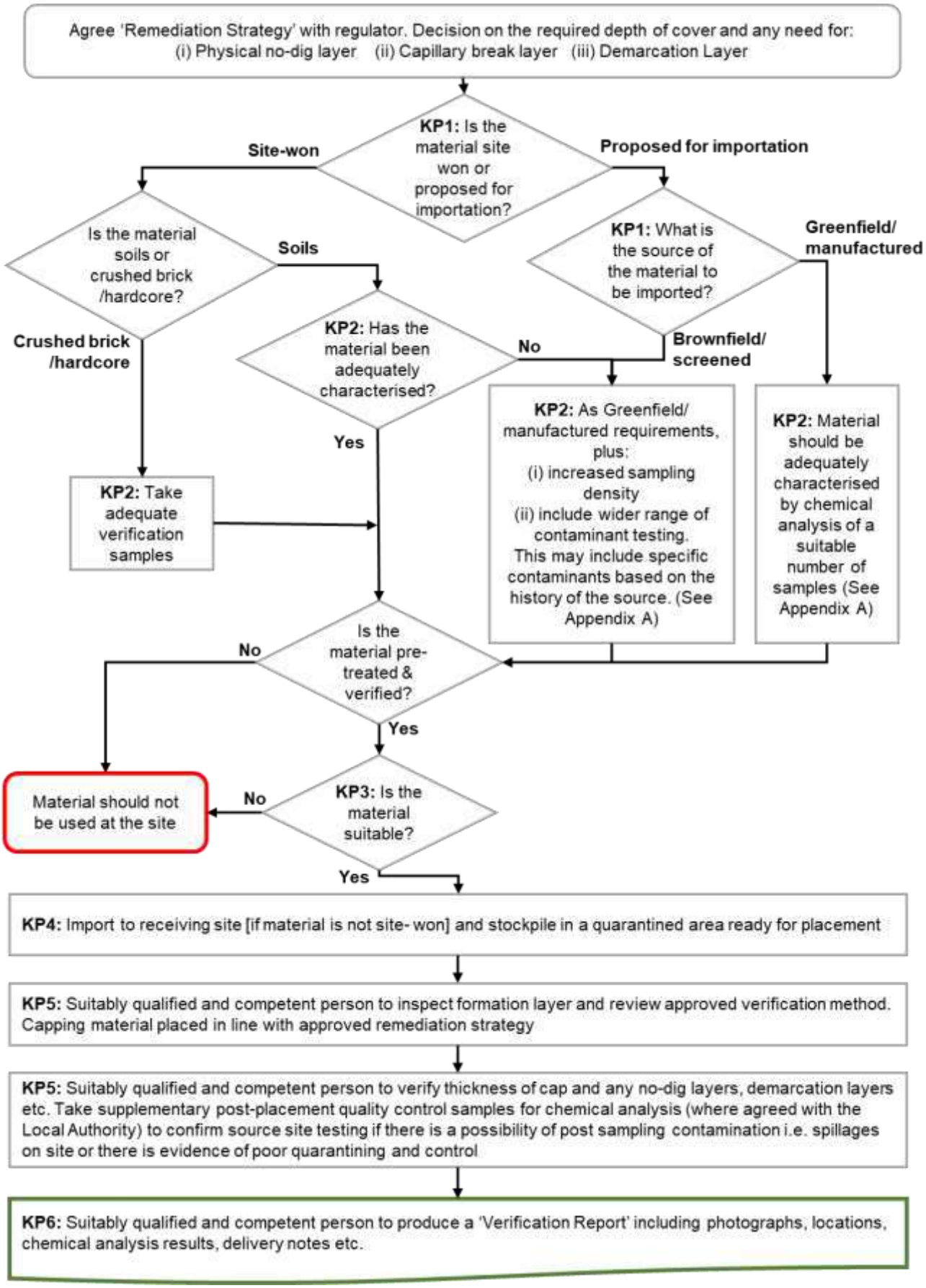
For cover and containment systems, verification will normally depend upon the provision of defensible measurements, observations and records. Critical factors to be considered are:

- What should be measured?
- When should they be measured?
- Where measurements need to be taken, what is the appropriate monitoring regime i.e. number and frequency of samples?
- Statistical constraints on sampling.

National Planning Policy Framework (NPPF) states that “planning policies and decisions should ensure that after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part 2A of the Environmental Protection Act 1990”. The Verification Report is a key document to demonstrate compliance with NPPF, and the responsibility rests with the developer/applicant to submit the required Verification Report to complete the remediation and to discharge any planning conditions.

[1] Land Contamination Risk Management, Environment Agency, Oct 2020
[2] Verification of Remediation of Land Contamination. Environment Agency, Feb 2010

Overview Flowchart



Key Points

KP1: Source of Material

Material can be sourced from site won material i.e. crushed brick/hardcore or site-won soils from existing open or landscaped areas. In the interest of sustainability, Local Authorities promote the use of such site-won material providing that they are suitable for the intended end use of the site.

Alternatively, material can be sourced from other developments and commercial companies. Dependent on the source of the material it can be classified as either from a 'Greenfield/Manufactured' or 'Brownfield/Screened' source.

Broadly speaking material can be classified as follows:

Greenfield – Where documentary evidence is provided confirming that the source site has not been developed and that no past contaminative uses have occurred. Should evidence not be provided or approved by the Local Authority, please note that the source would be expected to be assessed as though it were a brownfield source.

Manufactured – from a commercial company who manufacture material by mixing or blending mineral soils (subsoil or sand) with an organic amendment (compost). If other soil component sources are used, documentary evidence should be provided confirming that the source site has not been developed and that no past contaminative uses have occurred. Should documentary evidence not be provided or approved by the Local Authority, please note that the source would be expected to be assessed as though it were a brownfield source.

Brownfield – material from a donor site that has previously been developed

Screened – material from a company who deal with skip/demolition waste which is screened for unsuitable material i.e. bricks, wood, plastic etc.

KP2: Characterisation of Material

It is essential that material is suitable for its intended use. Documentary evidence of the source of the material should be provided to the Local Authority. This may include desk study or site investigation reports. A defensible method is required to ensure the verification proposals are site specific and that the level of sampling reflects the need to ensure that imported material are suitable for their intended use.

Due to the diminishing supply of suitable Greenfield topsoil sources it has been found that the chemical quality of Greenfield sources is less reliable in certain areas. As a result the recommended analytical rate for the intended use of the development may vary between Local Authorities [see **Appendix 1a**].

When should this be done?

Sampling of material should be undertaken as early as possible i.e. prior to placement [for site won material] and prior to importation [for imported material]. This is to avoid the costly exercise of re-excavating unsuitable material and the possibility of cross contamination. Where the assessor has confidence that the material is of sufficient quality (i.e. tested by supplier, used previously) it is acceptable to test the material on site. Although, if it is deemed unsuitable it would have to be either removed off site or pre-treated at the cost and time of the developer. It is recommended that some verification samples are also taken once this material has been delivered to site to confirm suitability for use. Soils can become contaminated during transportation or when stockpiled on site.

What about certificates from commercial suppliers?

Where the material is provided by a commercial company, certificates or other industry Quality Protocol compliance i.e. WRAP, DoWCoP, will normally be accepted. This is on the proviso that it: (i) relates to the actual material being imported to the site and the type and amount of analysis is in line with what is prescribed in Appendix 1a; and, (ii) the certificates are less than two months old.

It is recommended that some additional verification samples are taken once this material has been delivered to site. Soils can become contaminated during transportation or when stockpiled on site.

Extreme caution should be given to importing material that has been recycled from demolition or skip waste as they could easily be contaminated e.g. asbestos containing materials. Please refer to "questions you should be asking your supplier" in **Appendix 1b** and include the responses in your report.

British Standard

Imported soils should be as specified in BS 3882:2015 for topsoil and BS8601:2013 for subsoil as 'suitable for their intended purpose'. Both British Standards relate mostly to nutrient content of topsoil and phytotoxic contamination and they do not consider contaminants that pose a risk specifically to human health. Soils should be tested for contaminants that are considered to pose a risk to human health in addition to those specified in the relevant British Standards to ensure that they are suitable for their intended use.

Initial screening

A visual / olfactory inspection of the material should be carried out by a suitably qualified and competent person to ensure that:

- It is a suitable growing medium;
- It is free from obvious contamination i.e. staining/free product etc.;
- It has not come from areas where Japanese Knotweed or other invasive or injurious plants, as specified by the Environment Agency, are suspected to have been growing;
- It is not odorous (could be considered a statutory nuisance);
- It is free from unsuitable material i.e. bricks, brick ties, timber and glass etc.); and,
- There are no visible signs of asbestos containing material (ACMs).

Testing schedule & number of samples

Chemical testing will normally be required on any materials that are to be used as cover material, even where this includes first generation quarried material. This should be carried out by a suitably qualified and competent person.

Appendix 1a explains in detail the sampling and testing requirements for a typical residential development. These are only guidelines and it may be necessary to deviate away from them depending on local and site-specific factors. It is recommended that the developer discusses any deviation with the Local Authority.

The following criteria sets out the requirements for sampling and testing:

- **Virgin Quarried Material** sampling needs to be 1 or 2 samples depending on the type of stone utilised, to confirm the inert nature of the material. Testing to include standard metals/metalloids (should include as a minimum As, Cd, Cr, CrVI, Cu, Hg, Ni, Pb, Se, Zn).

- **Crushed Hardcore, Stone, Brick (excluding asphalt)** a minimum of 1 sample per 500m^3. Testing to include standard metals/metalloids (as above), PAH (16 USEPA speciation), asbestos, total TPH. Any additional analysis dependant on the history of the donor site (e.g. phenol, total cyanide, BTEX, MTBE).

- **Greenfield/ Manufactured Soils** a minimum of 3 samples or, dependent on source and receptor, between 1 per 50m^3 and 1 per 250m^3. Testing to include standard metals/metalloids (as above), PAH (16 USEPA speciation), asbestos, pH and soil organic matter (SOM) (or calculated from total organic carbon (TOC)).

- **Brownfield/ Screened Soils** a minimum of 6 samples or dependent on source and receptor, between 1 per 50m^3 and 1 per 100m^3. Standard metals/ metalloids (as above), PAH (16 USEPA speciation), TPH (CWG banded), asbestos, pH and SOM (or calculated from TOC). Any additional analysis dependant on the history of the donor site (e.g. phenol, total cyanide, BTEX, MTBE).

The assessment criteria need to be UK based, e.g. LQM S4ULs, Defra C4SLs or other similarly derived GACs.

KP3: Suitability of Material

Based on the characterisation of material above, the material should be either deemed suitable or unsuitable. Obviously unsuitable material should not be used (unless it is treated to reduce levels of contaminants below agreed target levels i.e. bioremediation – this would have to be agreed and included within the Remediation Strategy) and an alternative source of material should be sought by the developer. If the material is considered suitable it can be imported (if not site won) and stockpiled in a suitably quarantined area [refer to **KP4**].

KP4: Stockpiling & Quarantining of Material

It is essential that the 'suitable' material is either placed in its intended area straight away i.e. soft/landscaped areas or stockpiled in a suitable quarantine area to prevent on-site contamination.

In the event that an assessor finds material has been stored in an unsuitable area, samples should be taken to confirm that no cross contamination has occurred (including a visual/olfactory check of the material). The material should then be suitably quarantined or placed at its intended location immediately.

KP5: Verification of Required Depth

In line with the agreed Remediation Strategy, it is important to establish that the required depth has been achieved and is consistent across the site. There are two main ways to achieve this:

Depth testing in situ – small trial pit excavated to allow measurement of its depth by standardised tape measure or measuring staff.

Topographical surveys – accurate survey of the base and final formation layer height to establish the depth of cover.

Specific Local Authority Policy

Please check with the local Contaminated Land Officer to establish:

- Which type of method for testing depth is accepted; and,
- The number of verification areas per property, plot, landscaped area or garden area (some Local Authorities recommend at least 2 per plot for residential developments).

Important Note: Where demarcation, physical no-dig and capillary break layers exist they should be verified for their thickness and presence during the time of their installation. Details of the demarcation layer should be agreed with the Contaminated Land Officer prior to placement. This will include the design, type and strength of the geotextile separator or visual warning membrane. The verification of depth and confirmation of such layers should be carried out by a suitably qualified and competent person.

KP6: Reporting

The purpose of verification documentation is to provide transparent reasoning why the remediation was required, a methodology about how it was to be undertaken and proof that the specified works have been undertaken and to provide confirmation that the site is "suitable for its intended use".

The document is utilised not only to satisfy conditions of planning permissions but also is to be kept on record by the Local Authority should queries be raised during the lifetime of the development and to confirm to future purchasers that the site is suitable for use.

National Planning Policy Framework (NPPF) states that "planning policies and decisions should ensure that after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part 2A of the Environmental Protection Act 1990". The Verification Report is a key document to demonstrate compliance with NPPF, and the responsibility rests with the developer/applicant to submit the required Verification Report to complete the remediation and to discharge any planning conditions.

It is also essential that other supporting documentation is included within a report carried out by a suitably qualified and competent person e.g. laboratory analysis results, delivery tickets for material, certificates for imported material (or if unavailable, documented evidence of the source of the Greenfield material), trial pit logs etc. A checklist has been included in **Appendix 2** to give an idea on what information should be recorded.

Additionally, any reporting should include details of any measures required to maintain the cover system integrity in the future e.g. successive construction phases (management plans) and longer term (restrictive covenants on title deeds).

Photographic evidence for validating the depth of cover

The Local Authority ideally would recommend the following programme of photographs to be taken of the placement of inert cover:

- Photographs of any stockpiles and quarantine areas
- Proof that the depth of inert cover has been installed
- Proof of the quality of the material to be used as inert cover
- Proof there is a geotextile separator and visual warning membranes if used between the underlying material and suitable for use soils.
- Proof of the method of placement and different layers if appropriate
- Proof of the completed project
- Inclusion of background features which will aid locating the photograph
- Inclusion of site identification boards within the photos which show the date, position taken i.e. corner of plot 3 and the site name.
- Inclusion of photographs of site stockpiles and quarantine areas.

The presence of good quality photographs is essential to prove beyond doubt that the remediation has been done as specified both by method and position, and that the images have been taken from the specific area stated.

Refer to **Appendix 3** for examples of good photographic evidence.

Appendix 1a – Sampling & Testing Matrix

Type	Number of Samples	Testing Schedule	Assessment Criteria
	Please note that these guidelines apply to a typical residential development, and relaxation of the guidelines or more stringent requirements may apply dependent on local and site specific factors. Therefore, <u>all parameters need to be agreed with the Local Authority</u>.		
Virgin Quarried Material	1 or 2 depending on the type of stone utilised, to confirm the inert nature of the material.	Standard metals/metalloids (should include as a minimum As, Cd, Cr, CrVI, Cu, Hg, Ni, Pb, Se, Zn)	The assessment criteria need to be UK based, e.g. LQM S4ULs, Defra C4SLs or other similarly derived GACs.
Crushed Hardcore, Stone, Brick (excluding asphalt)	Minimum 1 per 500m^3	Standard metals/metalloids (as above), PAH (16 USEPA speciation), asbestos, total TPH. Any additional analysis dependant on the history of the donor site (e.g. phenol, total cyanide, BTEX, MTBE).	
Greenfield/ Manufactured Soils	Minimum 3 Dependent on source and receptor, between 1 per 50m^3 and 1 per 250m^3	Standard metals/metalloids (as above), PAH (16 USEPA speciation), asbestos, pH and soil organic matter (SOM) (or calculated from total organic carbon (TOC)).	
Brownfield/ Screened Soils	Minimum 6 Dependent on source and receptor, between 1 per 50m^3 and 1 per 100m^3	Standard metals/ metalloids (as above), PAH (16 USEPA speciation), TPH (CWG banded), asbestos, pH and SOM (or calculated from TOC). Any additional analysis dependant on the history of the donor site (e.g. phenol, total cyanide, BTEX, MTBE).	

Appendix 1b – Questions to Ask Your Soil Supplier Relating to Soil Quality

- What is the source of the material (refer to KP1)? If the source is Greenfield, can they provide evidence of this?
- Will all of the material be coming from the same source?
- Are you satisfied that the material is a suitable growing medium for the proposed end use?
- Has the supplier used an appropriate sampling protocol to ensure a representative sample is analysed? What volume of soil is represented by the analysis and does it comply with Appendix 1a?
- Does the testing include analysis of contaminants identified in Appendix 1a?
- Does the laboratory conducting the analysis have UKAS and MCERTS accreditation for the tests they are carrying out?
- Does the material comply with relevant waste regulations?
- Can I have a copy of the whole analysts report and does it include an interpretive section?
- Will the provided certificate be dated within the last 2 months?

Appendix 2 – Checklist for Verification Reports

Example only. Not to be considered as typical minimum requirements. Additional information should be included for non-cover systems aspects of the remediation i.e. gas protection measures etc.

Site Details	
Site Name / location	
Developer name	
Development use	
Plot No / description of landscaped area (inc plan of inspection areas)	
National Grid Reference	
Inspection visit date	
Supporting Evidence	
Description of remediation (as per agreed Remediation Method Statement including depths / thickness checks, topographical readings)	
Material tracking information (including way tickets etc.)	
Name of groundwork's remediation contractor	
Name of supervising environmental consultant	
Site Specific chemical analysis results	
Verification Photographs (inc. remarks)	
Recommendations	
Pass/fail	
If material fails, how will this be managed i.e. removed, treated	
Detail any further remedial works and/or inspection	
Signed off	

Failure to provide any of the above information may prevent planning conditions from being discharged.

Appendix 3 – Examples of Good Quality Photographs

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Photograph 1:
Depth check of inert cover within area of public open space. Physical break layer and topsoil visible.

© WSP

Photograph 2:
Depth check of inert cover with Site & Location Information Board.

© Coopers Consulting Engineers

Photograph 3:
Depth check of inert cover within areas of front gardens.

© Coopers Consulting Engineers

Photograph 4:
Depth check of inert cover within areas of front gardens.

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Photograph 5:
Depth check of inert cover within rear gardens. Taut string line spans across excavation.

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Photograph 6: Depth check of inert cover within rear gardens. Taut string line spans across excavation.

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Photograph 7: Shows the spatial location of the verification pit.

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Photograph 8: Excavation within public open space and verification pit showing the presence of a remediation break layer at the base, a crushed sandstone inert fill overlain by topsoil.

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Photograph 9: Inert crushed sandstone being delivered. The spatial area of the remediation can be observed from these photographs (old terrace housing).

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Photograph 10: Inert crushed sandstone being delivered with visible remediation break layer. The spatial area of the remediation can be observed from these photographs (traffic lights).

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Photograph 11:
Shows the remediation of the rear garden, with a significant depth (1.0m) of inert cover. This photograph has been stitched to form a panoramic photograph and hence there is slight distortion

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Photograph 12:
Shows the remediation of the rear garden, with a significant depth (1.0m) of inert cover. Remediation break layer visible at the base of the excavation.

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