



Remediation and Enabling Works Strategy
Cherryfield Drive, Kirkby

Reference:15-280-R2-2
Date: December 2022



REMEDIATION AND ENABLING WORKS STRATEGY

Cherryfield Drive
Kirkby
Liverpool
L32 8RX

Prepared for:
Barratt and David Wilson Homes

Report Ref: 15-280-R2-2
Date Issued: December 2022



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EXECUTIVE SUMMARY

Site Address	Cherryfield Drive, Kirkby, Liverpool, L32 8RX
National Grid Reference	E 341100 N 398150
Site Area	22.51 Ha
Background	E3P has been instructed by Barrett and David Wilson Homes to develop a remediation and enabling works strategy for the proposed residential development at the site located south of Cherryfield Drive, Kirkby. The E3P Remediation and Enabling Earthworks Strategy has been produced in due consideration of the Geoenvironmental site investigation and contaminated land assessments previously undertaken by E3P on behalf of Barrett and David Wilson Homes.

CONTAMINATED LAND RISK ASSESSMENT

Human Health Risk Assessment	Elevated concentrations of heavy metals, mercury, non-volatile PAHs, naphthalene, asbestos and SVOCs have been identified within the soil analysis completed to date. Heavy metals and non-volatile PAHs can be mitigated through the installation of a cover system within garden and landscaping areas. Mercury, naphthalene and Dibutyl phthalate have been noted to be elevated in isolated locations across the site, and present a vapour risk to future end users. It is recommended that a hotspot removal is completed and the materials either placed in an area of low sensitivity or removed from the site. Asbestos, quantified between <0.001% and 0.005% has been identified within three locations at the site. As only trace fibres have been encountered, impacted soils and Made Ground will need to be placed in accordance with the asbestos conceptual site model with a suitable cover system placed in all garden and landscaped areas to prevent exposure to future site users. A hotspot removal should be completed in areas in which asbestos quantification is greater than 0.001%. There is the potential for localised TPH impact in the vicinity of the USTs, associated pipework and filling pumps related to the former garage/fuel station. The USTs will be removed during the remediation and enabling works along with any impacted materials. There is the potential for localised as yet unidentified impact to be encountered during the remediation and enabling works, however, the site will undergo a full scale turnover where any impact will be identified and dealt with accordingly.
Controlled Waters Risk Assessment	The Tier 1 Controlled Waters Risk Assessment has not identified any significant source of potential contamination or dissolved phase impact/leachate within the groundwater samples. The developed conceptual site model did not identify a potentially complete pollutant linkage and, as such, the site is deemed to pose a low significant risk to controlled waters or the wider environ.



Ground Gas	Preliminary ground gas monitoring has characterised the site as CS1 with areas of Made Ground material adhering to a CS2 / Amber 1 / Amber 2 classification. It is recommended an allowance of CS2 protection measures are allowed for until the ground gas monitoring regime has been completed.
Coal Mining and Historical Workings	The site is not considered to be at risk from mining or quarrying-related issues.
Invasive Plants	Invasive species have not been identified on-site to date.
Potable Water Supply	The site investigation and contaminant risk assessment identified elevated concentrations of potentially volatile hydrocarbon compounds, which could permeate into the potable supply infrastructure. It will therefore be necessary to undertake appropriate remediation works with robust validation tests or PE Barrier Pipe will be required for the proposed development.

GEOTECHNICAL ASSESSMENT

Relict Sub-Structures	Extensive relict substructures, infrastructure and materials deemed geotechnically deleterious are identified. All such materials will require removal from beneath proposed structures and infrastructure to the depths and extents as defined within this specification.
Adverse Ground Conditions	All potentially infilled ponds and historical features where deleterious/putrescible material is identified should be located and subject to the necessary remediation works. A defined area of historical deposition of incinerated materials from the late 1950s and early 1960s is present across the central and northern sectors of the site. The materials will need to be lifted, sorted and replaced in accordance with the specified engineering methodology to ensure unsuitable anthropogenic elements are removed in their entirety.
Proposed Foundations	A site wide process of remediation and enabling works will be required, to lift, sort and process the Made Ground in order to remove unacceptable material (timber, glass, plastic wood and organic materials) and process relict obstructions within the former development areas to create a suitable redevelopment platform. Within the historical deposition areas, pockets of Made Ground which are found to contain any putrescible content which will degrade and induce consolidation and potential subsidence at the surface will be unsuitable for retention and reuse within the context of a residential development and will therefore require removal as it is not possible to model or predict the potential for future consolidation, therefore such material cannot remain beneath areas of adopted highway, drives, garden or service infrastructure. It is likely that due to the gas generation potential of this material it will not be suitable beneath plots in the event a plot structure was piled. It is anticipated that on completion of the proposed site remediation the ground will generally comprise circa 0.50 to <5.00m of Made Ground overlying CLAY or Granular soils or weathered bedrock. Therefore, upon completion of these enabling works, it is likely that the most cost effective option for the majority of the site would be a combination of shallow strip foundations, mass trench foundations and to re-engineer the Made Ground using vibro stone columns (VSCs) to support a doubly reinforced shallow strip spread foundation.



Proposed Foundations	Localised areas of the site have been noted to have soft low strength CLAYS: TP116, TP129, TP131, TP133, TP141, TP146, TP157, TP163, TP171, TP185, TP197, TP1103, TP1116, TP1123, WS103 and WS105. Where the Cu is <30kPa, the use of VSC will not be permitted as the materials would provide limited lateral support for the construction of VSC. As such, there will be a requirement to utilise a driven piled foundation; alternatively, the materials may be removed and replaced with suitable granular fill to allow the use of VSC. Driven piled foundations may be required in areas of infilled ponds should these remain. Foundation depths should take account of the presence of existing and proposed trees, with foundations deepened locally to mitigate the potential for volumetric instability attributed to fluctuations in moisture content, in accordance with the requirements of NHBC standards.
Highways and Infrastructure	All proposed adopted roads will be constructed in accordance with the geotechnical engineering requirements as defined within the MCHW Series 600. Specific engineering and compaction of materials will be completed in strict accordance with the geotechnical specification contained within this report. All materials outside of structural/infrastructure development will be engineered and compacted to ensure consolidation associated with self-weight settlement is limited to < 50 mm in accordance with the E3P specification.

REMEDIATION AND ENABLING WORKS

Objectives	The remediation and enabling works will be delivered in a manner that will seek to ensure that the site is prepared to deliver the optimum foundation solution for the proposed structures, infrastructure and highways. The geotechnical foundation zoning plan and structural engineer's drawings should be referenced to determine the proposed foundation solution.
Remediation and Enabling Works	The site remediation and enabling works strategy provides a comprehensive specification for the regeneration of the land to negate identified pollutant linkages and construct a development platform that will be geotechnically suitable for the proposed end use. The salient features of the remediation and enabling works strategy are summarised as follows: ✿ Implementing of all works in strict accordance with UK Environmental Permitting and local planning authority requirements. ✿ Controlled removal of all trees and vegetation. ✿ Removal and treatment of all invasive plant species (as required if identified) in accordance with a specialist contractor method statement, validation and independent certification. ✿ Further analysis of soils for PCBs in the vicinity of Electricity Substation when access is safe to do so. ✿ Segregation of organic topsoil deemed unsuitable for use within a residential garden and placement in an area of no sensitivity or removal from the site in accordance with UK waste management legislation. ✿ Decommission of all tanks and active drainage infrastructure in accordance with the contractor method statement and ensuring no environmental impact.



	✳ Removal of materials locally impacted by TPH compounds within the immediate vicinity of the USTs filling infrastructure associated with the former garage/ fuel station. ✳ Management of all anthropogenic material impacted by trace asbestos fibre in a controlled and legislatively compliant manner. ✳ Mercury speciation to determine if elevated concentrations are deemed to be a volatile risk. ✳ Delineation and hotspot removal of naphthalene and Dibutyl phthalate impacted soils. ✳ Identification, delineation and removal of organic materials within infilled ponds. ✳ Removal of all structures, relict foundations and buried features in their entirety. ✳ Removal of all materials considered geotechnically deleterious. ✳ Excavation and processing of Made Ground in a controlled manner with the sorting, processing and segregation of identified deleterious materials to geotechnical specification specifically the lifting, processing and sorting of Made Ground within the area of historically deposited materials (ash / incinerated materials). ✳ Validation sampling and leachate testing to confirm material retained on-site poses no unacceptable risk to the residential end-users controlled waters or the wider environment. ✳ Importation of suitable material (if required) to achieve the required development levels. ✳ Replacement of material in accordance with the E3P enabling specification and engineering requirements for the specific end use.
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BUILD PHASE REQUIREMENTS

Summary of Build-Phase Mitigation Requirements	The developer's works will also include the completion of the following additional elements: ✳ Provision of a 600 mm cover system using certified material with appropriate validation within proposed garden areas, comprising 450 mm subsoil (potentially site-won natural drift deposits) overlain by 150 mm topsoil. ✳ Provision of a 300 mm cover system using certified material with appropriate validation within proposed areas of public open space and soft landscaping. ✳ Construction of dwellings with appropriate gas mitigation to be compliant with CS2 pending completion of ground gas monitoring. ✳ Construction of appropriate potable water supply infrastructure.
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1. INTRODUCTION

1.1. BACKGROUND

E3P has been instructed by Barratt and David Wilson Homes to develop a remediation and enabling works strategy for the proposed residential development at the site south of Cherryfield Drive, in Kirkby.

1.2. REPORT OBJECTIVES

The objectives of this report are to:

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

1.3. SCOPE OF WORKS

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

- ✳ Identification of the relevant pollutant linkages;
- ✳ Review of site characteristics;
- ✳ Identification of geotechnical constraints;
- ✳ Development of remedial objectives;
- ✳ Selection of appropriate remedial technology; and
- ✳ Development of remedial strategy.

1.4. PREVIOUS WORKS

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

- ✳ **E3P** – *Phase I & II Geoenvironmental Site Assessment*. Ref: Report 15-280-R1-2, dated December 2022, Prepared for Barratt and David Wilson Homes. .

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

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



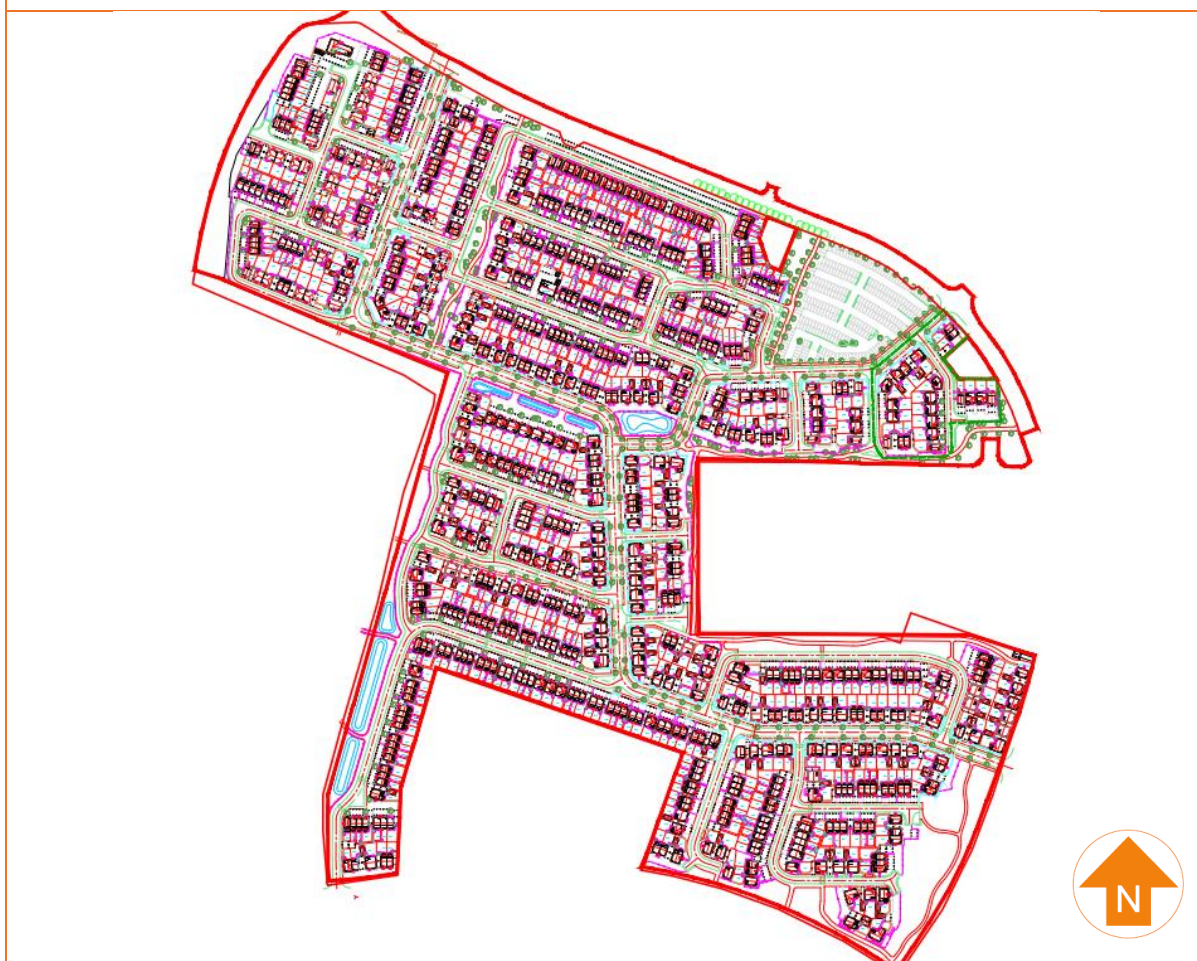
A series of historical site investigations have been completed on the subject site, and are summarised within the E3P Phase I & II Geoenvironmental Site Assessment and are referenced where necessary however this strategy is based upon the E3P report as it is considered the most up to date assessment of the site and E3P are of the understanding that the client does not have reliance on the previous reports.

1.5. REDEVELOPMENT PLAN

Barratt and David Wilson Homes propose to construct low-rise residential dwellings with associated access roads, parking, landscaping and adopted drainage infrastructure.

E3P has been provided with a draft planning layout a snapshot of which is indicated in Figure 1.1.

FIGURE 1.1 SNAPSHOT OF PROPOSED DEVELOPMENT



1.6. SUMMARY OF PARTIES INVOLVED

Function/interest	Name of Party
Local Planning Authority	Knowsley Council
Developer	Barrett and David Wilson Homes
Geoenvironmental Consultant	E3P
Main Contractor	Barrett and David Wilson Homes
Remediation/Enabling Works Contractor	TBC
Human Health Regulator	Knowsley Council
Controlled Waters and Waste Regulator	Environment Agency
Highways Adoption Authority	Knowsley Council

1.7. REGULATORY CORRESPONDENCE

Barratt and David Wilson Homes are in the process of preparing a bid for the site. In due course the client will be submitting a detailed planning application to the local planning authority for the proposed redevelopment of the site for low-rise residential housing with associated adopted estate roads and infrastructure.

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

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

1.8. SITE DETAILS

Site Address	Cherryfield Drive, Kirkby, Liverpool, L32 8RX
National Grid Reference	E 341100 N 398150
Site Area	22.51 Ha

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

A site location plan is presented in Appendix III as Drawing 15-280-001.



1.9. SITE SUMMARY

TABLE 1.1 SITE DESCRIPTION AND SETTING

Occupancy/Use	The subject site is an irregular shaped parcel of land located to the south of Cherryfield Drive in Kirkby. The southern sector of the site comprises maintained grassland with an area in the south east of the site having recently undergone the felling of semi-mature and mature trees. The central sector of the site is current unmaintained vacant grassland. Within the north of the site, is an area of active car park and former roadways and hardstanding associated with former development. Within the north-west of the site is Knowsley community College and a Covid-19 Walk-through Testing Centre. There is an additional area of vacant land with areas of hardstanding associate with former development, with a small building against Cherryfield Drive.	
Environmental Setting	Drift Geology	None recorded in North-West of the site Glacial Till across majority of the site Shirley Hill Sand Formation – Northern boundary
	Bedrock Geology	Chester Sandstone Formation – SANDSTONE.
	Hydrogeology	Secondary Undifferentiated Aquifer (drift) across the majority of the site with a Secondary A drift aquifer within the north and north-west of the site. Bedrock comprises a Principal Aquifer (solid). No groundwater abstractions have been identified within a 1 km radius.
	Hydrology	The Kirkby Brook is located 52m west to the site.
	Flood Risk	Unaffected by flooding from rivers.
	Subsidence Hazard	No hazard to low risk identified in data searches.
Site History	Historical mapping indicates that the site was undeveloped until the 1960s, with the subsequent construction of the college campus in the north western sector and a school in the south-eastern sector. Circa 1961, historical mapping shows earthworks associated with the adjacent landfill site, by 1976 the landfill is no longer shown. There is evidence of level changes in the 1950s and 1960s in the central sector of the site from historical mapping showing changes in contours, likely attributed to the levelling of the site for use as playing fields. Residential dwellings and retail buildings, including a fuel station and electrical substations, are shown at the northern site boundary pre-1961. Aerial imagery indicates the south-eastern sector of the site was cleared pre-2011; the hotel pre-2012; the residential housing pre-2015, the college in the north-west pre-2016; with the remainder of buildings in the north of the site demolished by pre-2019 and pre-2021. There is currently no evidence of the petrol filling station above ground however it is understood the underground storage tanks are still present. At present, the site is largely vacant, with the former roads and hardstanding at the north of the site and areas of car parking associated with the now demolished school and college. A building associated with the former college remains in the north-western sector.	



Landfill Sites and Ground Gases	A historical landfill site is located adjacent to the south western boundary of the site. Three further historical landfills have been identified between 271m and 810m of the site. The site has two infilled ponds, with areas of historical deposition taken place across the site.
Radon	Unaffected – no special precautions required.

1.10. SUMMARY OF REPORTED GROUND CONDITIONS

E3P has prepared a detailed Site Investigation Report (Ref: 15-280-R1-2, dated December 2022). The summary of reported ground conditions is given in Table 1.2.

TABLE 1.2 SUMMARY OF GROUND CONDITIONS

MADE GROUND	Made Ground deposits were encountered within the majority of exploratory hole locations to depths of between 0.00m and 5.50 bgl. The depth of Made Ground was not proven in 20 locations due to either underground obstructions, collapse of the trial pit, or the ingress of water. Made Ground deposits generally comprised a reworked topsoil of dark grey slightly gravelly clayey fine to coarse sand or gravelly sandy to very sandy clay with frequent rootlets with gravel of brick, mudstone, sandstone and ceramic. TP164 was overlain by asphalt and concrete associated with the former garage / petrol station, with TP168 overlain by ceramic tiles overlying concrete indicative of the former residential dwellings in this area of the site. Furthermore, WS150, TP188 and TP196 in the north-east of the site was overlain by asphalt, with WS144, WS146, WS148, TP190, TP192 and TP194 overlain by concrete with rebar. TP197 and WS147 in the north-west of the site was overlain by asphalt and concrete. Underlying the reworked topsoil or hardstanding, deeper Made Ground deposits comprised of reworked brown very sandy gravelly clays or gravelly sands. Within TP160 the exploratory hole location was dug down the side of a former foundation which showed the slab to be 1.10m thick and the foundation going down to 2.80mbgl. Within the vicinity of the 1950s-1960s historical deposition to create a level platform within the central and northern sectors of the site Made Ground deposits comprised a clayey very gravelly fine to coarse ashy sand with gravel of ash, glass, ceramic, textiles, clinker, wood, timber, brick, metal, mudstone and cardboard. Within the north-western sector of the site, there is considered to have been further level raising in order to construct the college; further investigation is required when access is available. However, where investigation has been able to be completed, Made Ground deposits in this area comprised the reworked topsoil or concrete deposits as described above, underlain with either the ash fill described above in the southern area of this sector, or a gravelly sand with gravel of brick or sandy gravel with gravel of sandstone, ash, concrete, mudstone and occasional glass and ceramic.
Topsoil	No topsoil that would be deemed suitable for reuse has been identified within any of the exploratory hole locations.



Drift	Drift deposits were encountered within the majority of exploratory locations with the exception from locations where the full depth of Made Ground could not be proven. The drift deposits are varied, generally comprising a soft to very stiff, medium to very high strength, slightly gravelly sandy brown CLAY with gravel of sandstone and mudstone or a slightly gravelly to gravelly slightly, slightly clayey to very clayey fine to medium SAND with gravel of sandstone and mudstone.
Bedrock	The solid bedrock geology was first encountered between 4.70 mbgl and 6.10mbgl. and comprised of SANDSTONE. A number of window sample probeholes terminated on or within weathered sandstone bedrock which was recovered as gravelly SANDs from 1.20mbgl. to in excess of 5.45mbgl
Groundwater	Groundwater was encountered as perched water, strikes and seepages at depths of between 0.40mbgl. and 4.00mbgl.



2. E3P CONTAMINATION RISK ASSESSMENT

2.1. BACKGROUND

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

2.2. HUMAN HEALTH RISK SUMMARY

The E3P Tier 1 Qualitative Human Health Risk Assessment identified concentrations of the following determinants at or above the screening criteria for the assessment of no unacceptable degree of risk to human health:

-  Arsenic
-  Lead
-  Mercury
-  Nickel
-  Zinc
-  Naphthalene
-  Benzo(a)Anthracene
-  Chrysene
-  Benzo(b)Fluoranthene;
-  Benzo(a)Pyrene
-  Dibenzo(a,h)Anthracene
-  Asbestos (Chrysotile, Crocidolite and Amosite)
-  Dibutyl phthalate

In the case of heavy metals and non-volatile PAH compounds, the viable exposure pathway is associated direct contact, inhalation of particulates, consumption of homegrown vegetables and ingestion of soil. The proposed development of the site will include hard cover and the importation of certified subsoil and topsoil in areas of private gardens and landscaping, thus removing this pathway.

Elevated mercury has been identified within TP118 at 0.50m bgl and TP141 1.00m bgl within Made Ground deposits. This presents a potential volatilisation to indoor air risk and are considered to be localised hotspots within this Made Ground strata. Speciation testing should be completed to confirm the type of mercury present and whether it presents a vapour risk. Should it be volatile a hotspot removal should be undertaken to delineate the extent of impact and soils should be chemically validated to assess chemical suitability for retention on site in an area of no future sensitivity.



Naphthalene has been noted to be elevated within TP1101 0.90m. During remediation and enabling works the area should undergo a hotspot removal with the area delineated with the impacted materials either removed from site or placed in an area of low sensitivity.

Asbestos in the form of chrysotile, crocidolite and amosite has been identified within shallow Made Ground deposits. Out of 51 samples tested, three samples had a positive identification for asbestos where quantification has confirmed soils to contain between <0.001% and 0.005% by hand picking weight. It is considered that asbestos loose fibres will be present throughout the Made Ground across the site due to the nature of the fill materials on-site. However, levels of asbestos identified above <0.001% are considered to be localised and should undergo a hotspot removal.

Visual signs of ACM were encountered within various exploratory hole locations, likely to be associated with the historical deposition Made Ground materials. During the remediation and enabling works these should be removed from site by a licensed asbestos removal contractor. Impacted soils should be managed according to the asbestos risk mitigation conceptual site model shown in Figure 2.1.

The site will have a large-scale enabling works package to achieve the development platform and to allow for the installation of clean cover within all soft landscaped areas. These works will be extended to construct “road boxes” and infrastructure corridors and as such, the material will be managed in such a way as to ensure no future exposure.

FIGURE 2.1 ASBESTOS CONCEPTUAL SITE MODEL



Within the soils analysis no elevated concentrations of TPH or BTEX in the area of the former petrol filling station were identified to date. A hydrocarbon odour was identified within WS142 in this vicinity within SAND deposits underlying Made Ground. The tanks are understood to still be in-situ and the presence of contamination cannot be ruled out as this stage.



Historical site investigation identified hydrocarbon odours and staining in the vicinity of the petrol filling station with TPHs within soil analysis and BTEX, MTBE, TPHs and Phenols identified within groundwater analysis. The area will be fully remediated with the tanks removed and validated to ensure that no impact poses a risk to future end users or the wider environ.

All proposed garden and landscaped areas within the development are to be installed with a 600 mm chemically suitable cover system, which will ensure that future site users will be at no unacceptable risk from the identified contaminant exceedances.

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

- ✳ Supplementary sampling upon removal of the substation to demonstrate absence of any unacceptable risk from PCB impact.
- ✳ Further investigation of inaccessible areas in the north-west of the site due to current active nature.
- ✳ Speciation of Mercury to confirm requirement for hotspot removal.
- ✳ Hotspot removal and delineation of naphthalene and Dibutyl phthalate hotspots.
- ✳ UST along with associated pipework and any impacted materials to be removed;
- ✳ Management of soils to ensure that all materials impacted by asbestos fibres are placed in areas of low sensitivity during the site enabling works.
- ✳ Use of potable water supply infrastructure that will be compliant with United Kingdom Water Infrastructure Risk (UKWIR) assessment criteria.
- ✳ Construction of selected dwellings (vicinity of WS206) with ground gas mitigation measures that conform to CS2 requirements of BS 8485.
- ✳ Construction of a 600 mm clean cover system to all areas of private garden in accordance with the detailed methodologies herein.

2.3. CONTROLLED WATERS CONTAMINATION RISK SUMMARY

A Tier 1 Controlled Water Risk Assessment was completed by E3P as part of the E3P Geo-Environmental Site Assessment, the findings of which are summarised as follows:

- ✳ The direct comparison of groundwater samples recovered from dedicated monitoring wells identified elevated concentrations of heavy metals and TPH Aromatic C10-C12 against EQS screening values.
- ✳ Nickel was noted to be elevated against DWS screening values from groundwater samples.
- ✳ Leachate analysis identified elevated heavy metals against EQS and DWS screening values however the test is considered to overstate the risk and reliance should be upon groundwater samples.
- ✳ The Made Ground and former garage with associated underground fuel tanks are considered to be the sources of on-site potential contamination.
- ✳ The primary receptor is considered to be the underlying principal aquifer however there is not considered to be a complete pollutant linkage given the absence of a groundwater abstraction point within 1 km of the subject site.



- ✳ The closest surface water feature is located 56m west of the site, and is considered to not be a significant receptor given its distance from the site, and presence of a road between the site and the brook which would intercept any potential run-off from the site.
- ✳ There is considered to be a low risk to controlled waters.

2.4. GROUND GAS

Ground gas has been assessed by E3P as part of the E3P Geoenvironmental Site Assessment. Ground gas monitoring is currently on-going. The assessment to date was completed in accordance with the methodology outlined with the BS8485, utilising the results of the ground gas monitoring surveys to calculate a tentative gas screening value (GSV). The GSVs for the monitoring positions are summarised in Table 2.1.

TABLE 2.1 GAS RISK PROFILE AND LOCATION

LOCATION	MAX CH ₄ (% v/v)	GSV (l/hr)	MAX CO ₂ (% v/v)	GSV (l/hr)	CHARACTERISTIC SITUATION	NHBC TRAFFIC LIGHT
WS101	6.8	0.0068	8.5	0.0085	CS2	Amber 2
WS102	3.7	0.0037	10.8	0.0108	CS2	Amber 2
WS105	0.1	0.0001	6.9	0.0069	CS2	Amber 1
WS106	0.4	0.0004	7.7	0.0077	CS2	Amber 1
WS108	46.1	0.0461	10.3	0.0103	CS2	Red
WS110	0.1	0.0001	1.5	0.0015	CS1	Green
WS111	6.2	0.0062	5.3	0.0053	CS2	Amber 2
WS113	0.1	0.0164	3.1	0.1984	CS2	Green
WS115	0.1	0.0001	0.1	0.1	CS1	Green
WS117	0.1	0.0001	4.7	0.0047	CS1	Green
WS118	0.1	0.0001	0.3	0.0003	CS1	Green
WS119	0.1	0.0001	2.1	0.0021	CS1	Green
WS120	0.1	0.0001	0.2	0.0002	CS1	Green
WS121	0.1	0.0001	2.2	0.0022	CS1	Green
WS123	0.1	0.0001	0.1	0.0001	CS1	Green
WS124	13.7	0.0137	5.4	0.0054	CS2	Amber 2
WS125	0.1	0.0001	2.1	0.0021	CS1	Green
WS126	0.4	0.0016	1.0	0.0010	CS1	Green
WS128	0.1	0.0001	1.5	0.0015	CS1	Green
WS130	0.1	0.0001	0.1	0.0001	CS1	Green
WS132	0.1	0.0001	0.4	0.0004	CS1	Green
WS133	0.1	0.0001	2.3	0.0023	CS1	Green
WS135	0.1	0.0001	0.1	0.0001	CS1	Green
WS136	0.1	0.0001	0.8	0.0008	CS1	Green
WS137	0.1	0.0001	1.6	0.0016	CS1	Green
WS138	0.1	0.0253	1.4	0.3542	CS2	Green



LOCATION	MAX CH ₄ (% v/v)	GSV (l/hr)	MAX CO ₂ (% v/v)	GSV (l/hr)	CHARACTERISTIC SITUATION	NHBC TRAFFIC LIGHT
WS140	0.1	-0.0003	0.8	0.0008	CS1	Green
WS141	0.1	0.0001	2.4	0.0024	CS1	Green
WS142	0.1	0.0001	1.1	0.0011	CS1	Green
WS144	0.1	0.0001	0.8	0.0008	CS1	Green
WS147	0.1	0.0033	0.1	0.0033	CS1	Green
WS149A	0.1	0.0001	0.8	0.0008	CS1	Green
WS151	0.1	0.0001	0.8	0.0008	CS1	Green
WS152	0.8	0.0008	4.8	0.0048	CS1	Green
WS153A	0.1	0.0001	0.7	0.0007	CS1	Green
WS157	0.1	0.0001	0.2	0.0002	CS1	Green
WS161	0.1	0.0001	0.5	0.0005	CS1	Green
WS169	0.1	0.0001	0.1	0.0001	CS1	Green
WS171	0.1	0.0001	1.3	0.0013	CS1	Green
CP/RB101	4.4	0.0044	9.5	0.0095	CS2	Amber 1
CP/RB102	0.1	0.0001	4.1	0.0041	CS1	Green
CP/RB103	0.3	0.0003	6.0	0.0060	CS2	Amber 1

E3P has assessed the previous variables and come to the following conclusions based on preliminary ground gas monitoring:

- ✿ Ground gas monitoring thus far suggests that the site can be predominantly classified as CS1, and in these areas it is considered that gas protection measures will not be required.
- ✿ However, areas of the site have been classified as CS2 / Amber 1 or CS2 / Amber 2 associated with Made Ground and historically deposited materials based on elevated concentrations predominately detected on the 1st and 18th visits monitoring visit where lower atmospheric pressures which were falling or rising were noted.
- ✿ The site is predominantly underlain by glacial till of SAND and CLAY at depths of 0.10 m bgl to 6.10 m bgl.
- ✿ Made Ground has been encountered across the site, with deeper deposits within the southern half of the site associated with former infilling.
- ✿ WS108 has been noted to be classified as CS2 or Red in line with NHBC guidance. This was only noted on the first monitoring visit. On one further occasion it was noted to be of a CS2 / Amber 2 classification and on all other monitoring visits gas levels were recorded as <0.1 % v/v (Green). The final ground gas regime will be confirmed within WS108 following the completion of all 24 visits.
- ✿ Minor ground gas flows have been identified within the monitoring to date, with the exception of higher flows during the first monitoring visit which may be due to pressurisation of the monitoring well from the collection of groundwater causing a piston effect along with the build up of gas since the installation of the monitoring well.
- ✿ There is not considered to be a significant migration of ground gases from the neighbouring landfill, and locations on the south-western boundary where elevated ground gases have



been identified are likely due to the Made Ground on-site rather than migration from off-site however this will require confirmation following remediation works to determine if there is an off-site source migrating onto site through the completion of post-remediation ground gas monitoring.

- It is considered by E3P that the site can be classified as CS1 in areas in which Made Ground is not present, and therefore no gas protection measures are required. Within areas of Made Ground precautionary CS2 measures should be allowed for until the complete ground gas monitoring programme has been completed.

It is recommended that the full ground gas assessment and recommended protection measures (if applicable) are agreed with the local authority prior to their adoption on site. Furthermore, all protection measures adopted should be validated by a suitably qualified engineer.

2.5. POTABLE WATER SUPPLY INFRASTRUCTURE

A contaminant risk assessment completed in accordance with the UKWIR assessment framework will be required as part of the proposed development. Soil analysis completed to date identified elevated concentrations of potentially volatile/soluble hydrocarbon compounds and as such current site conditions infer it is likely that barrier pipe will be required at the proposed development.

In order for the development to be constructed with PE pipe it will be necessary to delineate the impacted soils were present at locations that could potentially impact the potable water infrastructure.

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



3. SITE REMEDIATION AND ENABLING WORKS

3.1. REMEDIATION OPTIONS APPRAISAL

A remediation options appraisal has been completed in accordance with the principals as set out within Environment Agency publication Land Contamination: Risk Management (LC:RM)(updated May 2020).

The LC:RM requires that the following tiered assessments are followed to ensure sufficiently detailed and robust appraisal of remediation options to inform the selection of the preferred approach and utilisation of the correct technologies to promote safe and sustainable land remediation:

- ✚ Identification of feasible remediation technologies;
- ✚ Detailed evaluation of viable options; and,
- ✚ Selection of appropriate remediation option.

3.2. DETERMINATION OF SUFFICIENCY OF INFORMATION

Prior to the commencement of the tiered assessment of remediation options, it is a requirement to assess the sufficiency of available information and validity of the risk based assessment on which the remediation options appraisal is based.

Intrusive ground investigation works completed to date is considered sufficient across the majority of the site in order to fully understand the risks to future end users, controlled waters and the wider environ. However, due to the access limitations in the north-west of the site there is considered to be a requirement to update this remediation strategy once intrusive investigation works have been completed in this area.

In this instance it is considered that there is sufficient information to inform the detailed site characterisation which has determined that the primary pollution risk is associated with the presence of Made Ground and a former garage / petrol station. Further works will also be required following demolition of the electricity substation on-site.

3.3. REQUIREMENT FOR REGULATORY CONTROL

The LC:RM requires that due consideration be given to the following key issues which will impact the appropriate selection of suitable remediation options.

- ✚ Requirement for regulatory permits;

The proposed remediation works may be covered by a specific Environmental Permit, it is considered that the processes outlined below will be applicable to the project.

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

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

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



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

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

3.4. HISTORICALLY DEPOSITED MATERIALS

Historically deposited wastes have been identified across the site, which previous reports inferred as being associated with the historical landfill adjacent to the south-western boundary of the site.

The historical landfill was filled pre COPA 1974 due to the possibility of filling of a former clay pit and then raising to present levels.

The materials on-site should be referred to as Made Ground deposits that were historically deposited and are not classified as landfill. As such these materials should be treated as Made Ground as per other Made Ground deposits across the site and will not be subject to any specific Environmental Permits in the processing and re-use other than under a CL:AIRE Materials Management Plan.

3.5. CONTAMINANTS OF CONCERN (COC)

3.5.1. METALS AND PAH COMPOUNDS

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

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

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

3.5.2. ASBESTOS

Asbestos has been identified in three locations. Asbestos in the form of loose chrysotile and crocidolite fibres have been identified in the granular Made Ground in TP132 at 0.20 bgl. Chrysotile loose fibrous debris have been identified in the reworked topsoil in TP140 at 0.10m bgl. Loose amosite fibres have been identified in the granular Made Ground in TP118 at 0.50m.

It should be assumed that asbestos fibres are present throughout the Made Ground on site. The risk to chronic human health associated with the elevated concentrations of loose chrysotile and fibres (<0.001%) can be mitigated through the installation of a suitable cover system in all proposed landscaping and hardstanding to remove any potential for direct exposure to impacted soils.

Where asbestos is identified at concentrations above <0.001%, a hotspot excavation will be required and the impacted Made Ground will require placement >1.00m beneath an area of low sensitivity such as a public open space in accordance with the E3P conceptual site model (Figure 2.1).

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



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

Visual signs of ACM were encountered within various exploratory hole locations; where visible pieces of asbestos-containing material are identified during the site remediation and enabling work, this material must be dealt with in strict accordance with the Control of Asbestos Regulations (CAR) 2012, UK Waste Management Legislation and the Environmental Protection Act 1994. Due to the close proximity of residential dwellings, asbestos in air monitoring in accordance with HSG248 may be required to confirm that no asbestos fibres have been generated from the enabling works activities.

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

3.5.3. VOLATILE MERCURY, NAPHTHALENE AND SVOC

Volatile naphthalene, mercury and Dibutyl phthalate have been identified which present potential volatilisation to indoor air risk; the locations are summarised below:

-  TP118 at 0.50m – Mercury
-  TP141 at 1.00m – Mercury
-  TP1101 at 0.90m – Naphthalene
-  WS111 at 2.50 m - Dibutyl phthalate

3.5.4. DISCUSSION OF VOLATILE CONTAMINANTS

Mercury, naphthalene, and Dibutyl phthalate present a potential volatilisation to indoor air risk. All elevated concentrations are considered to be isolated hotspots.

During a process of cut & fill enabling works, a hotspot removal should be undertaken where these soils may be chemically validated to assess chemical suitability for retention on site in an area of no future sensitivity or for further treatment / off-site disposal if required.

In addition to the above, in regard to the elevated concentrations of Mercury identified, it is also recommended that speciation is completed in order to determine the type of mercury and if it does indeed present a vapour risk. Further risk assessment should be completed to determine its placement on site, and should it be volatile a hotspot removal should be undertaken to delineate the extent of impact and soils should be chemically validated to assess chemical suitability for retention on-site in an area of no future sensitivity.

Within the vicinity of the petrol fuel station in the north of the site, a hydrocarbon odour was identified within WS142 within SAND deposits underlying Made Ground. Historical site investigation identified hydrocarbon odours and staining in the vicinity of the petrol filling station with TPHs within soil analysis and BTEX, MTBE, TPHs and Phenols identified within groundwater analysis. During the removal of the USTs and associated infrastructure, confirmation of no further elevated TPH compounds will be required and any impacted materials will be removed.

Due to the historical site use, there is a potential for further elevated concentrations of volatile contaminants to be identified. Where a potentially unacceptable degree of risk is identified, the impacted soils should either be remediated or alternatively the proposed dwellings should be designed with appropriate mitigation measures to remove the potential pollution linkage.



3.6. IDENTIFICATION OF FEASIBLE REMEDIATION OPTIONS

3.6.1. OBJECTIVES

The remediation works must be completed in a safe and sustainable manner that ensures that the post-remediation condition of the site poses no unacceptable risk to controlled waters or the wider environs. The developed Conceptual Site Model must ensure no complete pollutant linkage to ensure successful implementation.

The remediation works must be completed in a manner that promotes sustainable re-use of material in a manner that minimises waste and maximises retention of material on-site.

The works should be designed and implemented in a manner that ensure no risk to an identified receptor during the works in terms of odour, air quality or noise impact.

Works should be designed, planned and implemented in a manner that ensures full compliance with all pertinent waste management and environmental permit legislation.

3.7. SUMMARY OF PREFERRED REMEDIATION OPTIONS

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

- ✿ **Capping** of site with a suitable certified clean cover system comprising 150mm topsoil and 450mm subsoil will remove any future direct exposure pathways to future end users.
- ✿ **Excavation and off site removal** of hazardous materials which cannot be treated will be required, this operation needs to be limited to materials that cannot be treated on-site to promote sustainability and ensure viable regeneration.
- ✿ **Excavation of hotspot materials** for placement in areas of low sensitivity or removal off-site.
- ✿ **Removal of impacted materials surrounding petrol filling station off-site.**



3.8. OVERVIEW OF WORKS

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

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

RE-1 – Pre-commencement Supplementary Site Investigation

When access is available in the north-west of the site, and ideally following demolition of existing buildings, a further phase of site investigation will be required.

It is recommended a series of window sample probeholes and mechanically excavated trial pits will be advanced with additional chemical analysis of the soils completed to confirm no unacceptable risk to human health and controlled waters.

If any as yet unidentified contamination is identified, this will be the subject of further investigation including laboratory analysis and subsequent assessment of risk within the context of the agreed parameters. Where a theoretical risk to either human health, controlled waters or the wider environs is identified, appropriate remediation works are to be instigated by the placement of clean cover systems to break the pathway or delineation and source removal where required.

This remediation strategy will be updated following the supplementary intrusive works.

RE-2 – Pre-commencement Regulatory Compliance

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

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

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

The proposed remediation and enabling works for the re-use of the materials on site will require a CL:AIRE Materials Management Plan (MMP)-qualified declaration to be made by the contractor, having obtained full written approval for the remediation strategy from the LPA and Environment Agency.

It is not anticipated that there will be any requirement to treat any materials on site (such as hydrocarbon-impacted soil or groundwater); however, should any previously unidentified contamination be encountered, the contractor must either notify E3P and, if appropriate, relevant regulators of their intention to complete a minor works/treatment trials operation or arrange for the deployment of the appropriate environmental permit for the specified operation.



RE-3 – ENVIRONMENT AND NUISANCE CONTROL

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

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

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

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

RE-4 – Risk to Infrastructure

Site works should be completed in a manner that ensures no risk of disturbance to the adjacent infrastructure.

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

Invasive plant species have been not been identified on site to date. However, the remediation contractor must satisfy themselves with respect to the extent of all species deemed invasive, if present, prior to the commencement of works on site. The contractor shall employ a suitably qualified expert to investigate the presence of invasive plant species on or adjacent to the site. Once all invasive plant species are identified, these will be treated in strict accordance with an approved method statement to be submitted to the supervising consultant for review prior to the instigation of any works.

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

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

RE-6 – Site Clearance Operations

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

The site is currently overgrown with self-seeded vegetation with extensive below-ground structures within the north and south-east of the site; this material should be removed in a controlled manner with full compliance with any ecological mitigation measures that are required for the works. Any such measures are outside the scope of this report.



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

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

RE-7 – Recovery of Natural Topsoil

The site investigation report and subsequent surveys identifies limited areas of the subject site where natural organic soils (topsoil) are present at the near surface. The contractor should seek to maximise the recovery of this material to promote sustainable construction through careful segregation and subsequent stockpiling of the natural soils.

All recovered topsoil should be covered with a suitable geotextile to limit cross-contamination from anthropogenic elements during remediation, enabling and construction. This will significantly contribute to maximising the recovery and reuse of material.

All material will be subject to validation testing by the supervising consultant in accordance with the testing specification set out herein.

RE-8 – Delineation, Excavation and Treatment of Identified Asbestos Impact

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

Within the vicinity of TP1180 at 0.50m and TP140 at 0.10m, quantification identified asbestos at 0.002% and 0.005% respectively, and as such these locations should undergo a hotspot removal to delineate and excavate the impacted materials, with the sides and base of the resulting void(s) where impacted material is present will be chemically validated to confirm that no impacted materials remain in situ.

Suspected asbestos sheeting was identified within WS141 and this will require hand picking and removal by a licenced waste contractor.

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

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

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

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

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



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

If necessary, reassurance air testing in accordance with the requirements of HSG248 should be completed during the operation to move the soils to demonstrate the deployment of the required control procedures and safe working methods.

RE-9 – Delineation, Excavation, Treatment and Disposal of Naphthalene and Dibutyl phthalate

Elevated Naphthalene has been identified within TP1101 at 0.90m and elevated Dibutyl phthalate within WS111 at 2.50 m.

It is considered that this material represents an unacceptable risk associated with volatilisation to indoor air.

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

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

Material deemed to be impacted through either visual or olfactory observations or as a result of notable PID readings (> 50 ppm) will be excavated and stockpiled on an impermeable membrane. The membrane will be placed upon a clay containment bund and covered to negate the risk of soils leaching and dispersal of any odours and/or vapours. This material will then be subject to detailed laboratory analysis to determine the suitability for reuse or the requirements for off-site disposal.

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

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

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

RE-10 – Excavation, Delineation & Validation of Mercury Hotspots

Elevated concentrations of mercury have been identified within TP118 0.50 m and TP141 1.00 m.

This presents a potential volatilisation to indoor air risk and are considered to be localised hotspots within this Made Ground strata.

Further speciation testing should be completed to confirm the type of mercury present and whether it presents a vapour risk. Should it be volatile a hotspot removal should be undertaken to delineate the extent of impact and soils should be chemically validated to assess chemical suitability for retention on site in an area of no future sensitivity.



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

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

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

RE-11 – Excavation, Breaking and Processing of All Above- and Below-Ground Structures

Obstructions, relict foundations and infrastructure (apart from live services) are to be removed from the areas of proposed residential development, to include plot footprints, rear gardens, private driveways, adopted highway and utilities infrastructure (road box) in their entirety.

Artificially hard materials should be broken out and crushed. Stockpiles will be made, validation testing undertaken, and site-won material reused on site where required. Materials will be processed as per the specifications provided in Section 6 using licensed plant.

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

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

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

RE-12 – Delineation, Excavation and Treatment of Infilled Historical Ponds

Prior to the commencement of the main earthworks (where possible), all known former infilled ponds should be clearly identified and demarked and investigated to assess the nature of materials and extent of any deleterious elements.

The location of known historic infilled ponds are identified within the E3P Historical Features Plan (Drawing 15-280-003 in Appendix III).

All materials that are deemed to be organic – and thus exhibiting unsatisfactory geotechnical properties – must be removed, with the resulting excavation to be backfilled with materials deemed compliant with the E3P Geotechnical Performance Specification with appropriate compaction for the intended land use.

A suitably qualified geotechnical engineer will need to monitor the works and confirm when all unsuitable material has been excavated and removed from beneath any proposed structure or infrastructure.



RE-13 – Removal of Deleterious Material

The E3P Ground Investigation identified plastic, timber and other potentially deleterious materials within Made Ground across the site. All potentially deleterious materials will be delineated, stockpiled and removed from site by the contractor to a licensed waste facility. Prior to the commencement of the main works, the contractor, under the supervision of E3P, will undertake to complete further confirmatory ground investigations to satisfy themselves with regards to the extent of any buried anthropogenic deleterious materials that are unsuitable for retention within a low-rise residential development.

RE-14 – Investigation and Removal of Historic USTs

During the remediation and enabling works, further investigation within the areas of historically mapped tanks will be required to confirm the presence and the exact location of any underground storage tanks (USTs). It is understood one tank has been filled with concrete with six filled with RG22 hard foam.

It is proposed to break out all hardstanding around the tanks and inspect their integrity. If the tank is found to be intact, hydraulic shears should be utilised to open the tank along the top and peel back the steel, thus rendering the tank an open vessel and no longer a tank form. The tanks should be checked for vapours using a lower explosive limit (LEL) meter. If they are deemed to be free of vapours, a 24-hour certificate will be issued, during which time the tanks should be rendered unusable (by cold cutting). Should the tanks contain any residual liquids, they should then be uplifted by the vacuum tanker or a surface-mounted pump (peristaltic or double-diaphragm).

Any tank backfill material will be broken up and removed from the tank structure by the excavator until the tank is sufficiently light to be lifted and emptied. All oversize materials will be stockpiled and checked for hydrocarbon impact pending chemical validation analysis. It is likely the material present inside the tanks will require disposal off-site, in accordance with UK waste management legislation. Any surrounding locally impacted materials will be excavated, removed and validated.

The sides and bases of excavations will need to be chemically validated to ensure that soils are below the site-specific remedial validation criteria for the protection of human health and controlled waters. All waste transfer certificates will be required to be retained and included within the remediation validation report.

RE-15 – Electricity Substation

Following demolition of the current Electricity Substations and when access allows, soils in the vicinity of the electricity substations should undergo chemical analysis for PCBs.

RE-16 – Historically Deposited Ash Fill

The review of desk study information and site investigation has identified an area of the central and northern sectors of the site to have been backfilled in the 1950s and 1960s with incinerated ash deposits.

This material needs to be lifted and sorted with unsuitable and deleterious elements to be segregated and removed.



The material will be subject to analysis and testing to confirm the engineering type in accordance with the geotechnical specification.

We need to have this as a specific and detailed operation so it is understood that this material will all be processed and engineered.

RE-17 – Cut-And-Filling of Made Ground to Development Levels

The Made Ground is noted to be present to substantial depth in some areas of the site (> 2 m). It is considered that it will be possible to utilise vibro stone columns (VSC) within areas of segregated and placed granular Made Ground to treat the currently unknown potential for differential settlement and ensure a uniform safe allowable bearing pressure (ABP) in the order of 125 kN/m².

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

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

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

RE-18 – Placement and Compaction of Uppill Material to Facilitate Ground Improvement by VSC

Where plots are to be prepared in a manner that will facilitate ground improvement by Vibro-stone column, materials must be either compliant with the specified grading requirements for a nominally placed and tracked granular aggregate, or alternatively, they should be engineered to a defined geotechnical standard.

Materials compliant with VSC grading for granular backfill: granular matrices are to be graded with all particles < 125 mm with no more than 10% fines (0.063mm).

Non-compliant material requiring engineering to geotechnical design: material is to be placed and engineered in accordance with the correct method for the Series 600 classification (1, 2 or 6) with moisture contents to be controlled within acceptable design limits. In-situ density to be confirmed to be > 95% of the laboratory determined maximum (2.5 kg) with < 5% air void ratio.

RE-19 – Construction of Temporary Working Platform

Where plots are to be prepared in a manner that will facilitate ground improvement by Vibro-stone column or a driven pile, a temporary working platform will be constructed.

The specific design for such a platform should be obtained from E3P; however, as a minimum, this will comprise:



- ✳️ Proof rolling of the subgrade to ensure a California bearing ratio (CBR) > 3%; and
- ✳️ Placement of 300 mm of certified 6F2 to be rolled and compacted to ensure a CBR > 6%.

RE-20 – Replacement of Materials, Geotechnical Engineering Requirements

Material is to be backfilled in strict compliance with the E3P Geotechnical Engineering Specification as presented in detail within Section 6 of this report, which generally requires the reinstatement and compaction criteria presented in Table 3.1.

Unless specific instruction is issued from the client, plots should be prepared for a strip foundation where the target founding stratum is identified to be present at a depth of 1.5 m below finished floor level (FFL). Consideration is to be given to the need to construct a strip foundation ~200–400 mm into the natural stratum and the contractor remediation elevations.

TABLE 3.1 GEOTECHNICAL ENGINEERING WORKS SCHEDULE

Land Use	Construction Requirement	Requirement
Footprint of Proposed Structure (2 m on All Elevations)	Pile Foundation	Backfill using general method compaction to CBR of 5%.
	Vibro-Stone Column	Particle size distribution (PSD confirmed as < 125 mm with no more than 10% fines (0.063 mm). Or Compaction to achieve > 95% of the laboratory determined maximum dry density (DD) with < 5% air void ratio. CBR > 6% with suitable pile mat. PSD testing of backfill material at 1 sample per 2000 m ³ to confirm.
	Traditional Spread Foundation	Ensure no disturbance of natural soil at shallow depth.
Highways	Adopted Estate Road/Drainage	Manual of Contract Documents for Highways Works (MCHW) Series 600 ensuring CBR > 5% in subgrade (engineered fill).
Driveways	Private Drives and Car Parking	Method compaction to CBR > 5%.
Gardens and Public Open Space	N/A	Method compaction to ensure no settlement.

RE-21 – Preparation of Ground for Vibro-Stone Columns Within Tree Influence

Where trees are present, or within their total zone of influence, the contractor must ensure that all cohesive soils are removed to the required depth with the subsequent replacement with a granular blanket to fully mitigate the potential for volumetric instability in the clay soils.



The zone of tree influence will be indicated within the foundation zoning plan and all resultant excavations and subsequent backfilling must be inspected and approved by E3P.

The depth of the granular blanket required will be determined prior to the commencement of the works and in full agreement of the client, but will nominally be equal to or in excess of $2.5 \times$ foundation width.

RE-22 – Importation of Bulk Fill

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

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

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

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

RE-23 – Preparation of Garden for Cover System

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

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

Excavated soil will be stockpiled pending the results of the appropriate validation testing (to be completed in accordance with this specification) prior to reuse in an area of no sensitivity or, where necessary, this material will be removed from the site in accordance with UK waste management legislation.

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

RE-24 – Provision of Subsoil

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



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

RE-25 – Provision of Topsoil

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

Topsoil will require testing in line with the schedule present within Section 3.9 and Table 3.2.

The garden and landscaped areas will require depth validation to satisfy the requirements of the CML in order to demonstrate that the appropriate thickness has been provided.

RE-26 – Independent Validation: Watching Brief

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

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

RE-27 – Waste Soils Surplus to Requirements

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

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

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

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



RE-28 – Validation of Materials for Potable Water Supply Infrastructure

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

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

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

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

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

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

RE-29 – Remedial Verification Report

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

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

3.9. VALIDATION SAMPLING PROTOCOL

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

Upon removal of the hotspot of unsuitable Made Ground associated with elevated concentrations of contaminants of concern, validation samples will be collected from the base (two samples) and sidewalls (four samples) of the excavation to reasonably demonstrate no residual impact to the underlying strata.

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



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

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

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

The sampling frequency for materials to be managed under the remediation strategy is presented within Table 3.2.



TABLE 3.2 SPECIFICATION OF CHEMICAL VALIDATION LABORATORY ANALYSIS

MATERIAL USE	TESTING FREQUENCY	SUITE OF ANALYSIS
Site-Generated		
Site-Generated 6F2	1 Sample per 1000 m ³	A/B/C/D
Site-Won MADE GROUND General Backfill	1 Sample per 250 m ³ where visual and/or olfactory impact is identified	G
Site-Won MADE GROUND General Backfill	1 Sample per 1000 m ³	A/B/C/D
Site-Won MADE GROUND General Backfill	1 Sample per 2000 m ³	I
Site-Won Natural Backfill	1 Sample per 2000 m ³	A/B/C/D
Site-Generated Subsoil (450 mm Garden Cover)	1 Sample per 250 m ³	A/B/C/D
Site-Generated Topsoil Cover (150 mm Garden Cover)	1 Sample per 50 m ³	A/B/C/D
Hotspot Validation Samples	1 Sample per 10 m of linear excavation to base and sidewall	E/G
Imported		
6F2	1 Sample per 1000 m ³	A/B/C/D
Subsoil Greenfield Source (450 mm Garden Cover)	1 Sample per 200 m ³	A/B/C/D
Subsoil Brownfield Source (450 mm Garden Cover)	1 Sample per 50 m ³	A/B/C/D
Topsoil Greenfield Source (150 mm Garden Cover)	1 Sample per 200 m ³	A/B/C/D
Topsoil Brownfield Source (150 mm Garden Cover)	1 Sample per 50 m ³	A/B/C/D
General Engineering Fill (Class 1 and 2 Soil)	1 Sample per 1000 m ³	A/B/C/D

Notes

Suites of Analysis:

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

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



3.10. REMEDIATION CONTRACTORS SITE MANAGEMENT AND RESPONSIBILITY

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

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

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



4. MATERIALS MANAGEMENT AND LEGISLATIVE COMPLIANCE

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

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

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

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

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

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

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

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

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



5. ENVIRONMENTAL MONITORING AND VALIDATION

5.1. SITE MANAGEMENT

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

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

5.2. COMPLETION

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

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

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



5.3. MITIGATION OF RISK FROM SOILS WITH ASBESTOS FIBRES

5.3.1. PRE-COMMENCEMENT WORKS

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

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

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

DAMPING DOWN OF SOILS – MITIGATE PARTICULATE (DUST) EMISSION

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

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

GENERAL CONTROL OF DUST

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

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



PERSONAL PROTECTIVE EQUIPMENT (PPE)

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

Overalls:

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

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

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

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

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



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

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



6. GEOTECHNICAL ENGINEERING SPECIFICATION

6.1. E3P GEOTECHNICAL ENGINEERING SPECIFICATION

The overarching philosophy of the site enabling works will be the delivery of the following:

- ✚ Preparation of plot footprint (+ 2 m on all elevations) to be suitable for ground improvement by vibro-stone column or driven piled foundations, where depth of stiff clay/medium-dense sands exceeds 2.50 m from proposed finished floor level (FFL).
- ✚ Preparation of plot footprint (+ 2 m on all elevations) to be suitable for driven piled foundations, where soft CLAYs have been identified.
- ✚ Preparation of plots to be suitable for construction with a shallow spread foundation where firm to stiff clay and medium-dense sands are present at a depth < 1.5 m from proposed FFL across the complete plot.
- ✚ Preparation of plots to be suitable for construction with mass trench where firm to stiff clay and medium dense sands are present at a depth of between 1.50m and 2.50mbgl. from proposed FFL across the complete plot or in areas of tree influence
- ✚ Engineer all areas of proposed adopted road and private drive to be compliant with the E3P Geotechnical Specification with CBR and elevation defined by the client.

In the event that it is not possible to prepare the site in a manner that will achieve the required foundation solution, the supervising engineer and client should be contacted at the first available opportunity.

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

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

Particular attention must be given to variable weather conditions when re-engineering clay soils as a moisture content fluctuation ($\pm 2\%$) of the tolerable limit will result in an unacceptable degree of compaction loss.

6.2. LOCALLY-WON FILL MATERIAL

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

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



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

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

6.3. CLASSIFICATION OF FILL MATERIAL

This specification should be read in conjunction with the following:

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

6.3.1. GENERAL CLASSIFICATION

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

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

6.3.2. PRE-COMMENCEMENT EARTHWORKS TESTING FREQUENCY / PERFORMANCE

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

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

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

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



TABLE 6.1 E3P EARTHWORKS GEOTECHNICAL COMPACTION SPECIFICATION

SOIL/MATERIAL TYPE	CLASS	DESCRIPTION	COMPACTION EQUIPMENT	LAYER THICKNESS	ROLLER PASSES
Granular Fill (Sand and Gravel Matrices)	1 A	Sandy Gravel with some cobbles	> 5000 kg vibrating roller	225 mm	4
	1 B	Sand or Gravel of same grading size	> 5000 kg vibrating roller	250 mm	10
	1 C	Coarse gravels with many cobbles	> 5000 kg vibrating roller	400 mm	5
Cohesive Fill (Clay with Minor Sand and Gravel Component)	2 A	Wet Clay	> 1000 kg vibrating tamping roller (sheep foot only)	100–225 mm	3
	2 B	Dry Clay	> 5000 kg vibrating roller or 1400 kg tamping (trench roller)	225 mm or 125 mm	4 or 12
	2 C	Gravelly Clay	> 5000 kg vibrating roller or 1400 kg tamping (trench roller)	225 mm or 125 mm	4 or 12
	2 D	Silty/Sandy Clay	> 5000 kg vibrating roller or 1400 kg tamping (trench roller)	225 mm or 125 mm	4 or 12
Recycled Aggregate Crush (< 125 mm Well Graded)	6F2	Any combination of inert hard materials, other colliery spoil, or rock with substantial amounts of clay-like component	> 5000 kg vibrating roller	250 mm	6



6.3.3. USE OF FILL MATERIALS

In addition to any grading requirement, the maximum particle size of any fill material shall be no more than two-thirds of the compacted layer thickness except that cobbles having an equivalent diameter of more than 150 mm shall not be deposited within the restored surface level unless directed otherwise by the engineer. Un-burnt colliery spoil, pulverised fuel ash or furnace bottom ash shall not be used as a fill material.

6.4. GENERAL REQUIREMENTS

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

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



TABLE 6.2 COMPACTION/BACKFILL REQUIREMENTS

LAND USE REQUIREMENT	COMPACTION METHODOLOGY AND GENERAL PERFORMANCE CRITERIA
Traditional Spread Foundation	Ensure no disturbance of natural soil at shallow depth.
Re-Engineering of Soils Using Vibro-Replacement Stone Column (VRSC)	Materials to be placed in a controlled manner to facilitate the construction of vibro-replacement stone columns (VRSC). to limit differential settlement and increase net Allowable Bearing Pressure (ABP) These works are to be completed within the building structure footprint and +2 m of all elevations. The material must be 90% granular in composition with less than 10% fines (which are classified as materials < 0.6 mm in size). No material greater than 125 mm in size is permitted, with 90% of the soils placed conforming to grading < 90 mm. Material is to be placed when the actual moisture content is within tolerable limits of the optimum, with specific attention to soils that are notably wetter than the optimum. Material to be placed in a manner so as to ensure a minimum CBR of 5% at formation to facilitate machine movement and piling mat construction. Where site-won materials are used to upfill, levels must be compacted to an “end product” performance specification where the in-situ density exceeds 95% of the maximum (determined by laboratory conditions). Where rock is present at a shallow depth, the remediation contractor will ensure the substratum is prepared to ensure that a minimum of 1000 mm of appropriately graded granular material is present on the underside of the proposed doubly reinforced concrete strip foundation. The substratum must be prepared to ensure a vibro-stone column treatment depth is not less than 80% of the immediate adjacent profile.
Piled Foundation	All plot footprints (+ 2 m) must be free of any deleterious elements, tree roots and obstructions > 150 mm. Where upfill is proposed, the material is to be placed using method compaction specification to achieve a CBR as required by the developer for piling mat construction. The piling mat is to be placed and constructed in accordance with the approved geotechnical engineer’s temporary works design.



Adopted Highways (+ 2 m from Back of Footpath)	<i>Method Compaction – MCHW Specification For Highway Works Series 600</i> is to be followed, with in-situ validation testing to meet the requirement of adoptions authority. A CBR > 5% is required at subgrade formation (prior to placement of capping).
Estate Roads	<i>Method Compaction – MCHW Specification For Highway Works Series 600</i> is to be followed to achieve a CBR > 5%.
Gardens, POS and Other External Areas	Material is to be placed in layers not exceeding 300 mm and must be rolled using a dedicated plant (no earth moving equipment) and in general compliance with the requirements of <i>MCHW Specification For Highway Works Series 600</i> .

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

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

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

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

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

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

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

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

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



The contractor shall keep earthworks free of water, including:

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

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

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

6.4.1. CONSTRUCTION OF FILLS – HIGHWAYS

All fills shall be constructed:

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

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

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

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



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

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

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

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

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

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

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

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

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

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

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

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

6.4.3. UNACCEPTABLE MATERIAL

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



construction of highway fill. All unsuitable materials are to be identified for removal in accordance with this specification.

Unacceptable material Class U1A shall be:

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

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

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

Unacceptable material Class U1B shall be:

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

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

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



6.5. EARTHWORKS MATERIAL TESTS

Prior testing of the potential sources of fill shall be undertaken by the contractor and submitted to the consulting engineers for approval. This testing shall include, but not necessarily be limited to, the compaction and backfill requirements detailed in Table 6.3.

TABLE 6.3 COMPACTION/BACKFILL REQUIREMENTS

LAND USE	COMPACTION METHODOLOGY and GENERAL PERFORMANCE CRITERIA				
Liquid and Plastic Limits	BS 1377: Part 2				
Grading	BS 1377: Part 2				
Uniformity Coefficient	Calculated from grading curve				
Moisture Content Multi-point moisture condition value (MCV) (to assess optimum moisture content).	BS 1377: Part 2				
Organic Matter (Maximum 2.5% Total Organic Content)	BS 1377: Part 3				
Water Soluble Sulphate	TRL Report 447 Test No 1				
Total Sulphate Content	TRL Report 447 Test No 4				
Earthwork In-situ Tests Subsequent to the filling and compaction of the material, a series of in-situ tests shall be undertaken to confirm the success of the compaction process. This testing shall include, but necessarily be limited to, the following: <table><tr><td>Test</td><td>Test Method</td></tr><tr><td>Plate Load Tests (Equivalent CBR of 5%)</td><td>BS 1377: Part 9</td></tr></table>	Test	Test Method	Plate Load Tests (Equivalent CBR of 5%)	BS 1377: Part 9	Clause 632 (BS 1377: Part 4)
Test	Test Method				
Plate Load Tests (Equivalent CBR of 5%)	BS 1377: Part 9				
Disposal of Materials The contractor shall be responsible for the safe disposal of any excess of unsuitable material found on the site.					
Proctor Compaction Testing	BS 1377: Part 4				

6.6. SPECIFICATION FOR GROUND IMPROVEMENT BY VIBRO-STONE COLUMN

The over-arching method and specification for the placement and compaction of non-compliant material where the fine constituent (< 0.63 micron) exceeds the standard requirements for ground improvement by VSC is given in Table 6.4 & 6.5.



TABLE 6.4 OVERVIEW OF WORKS OPERATIONS

Step 1	Carefully segregate materials excavated during civil engineering works (on-site and import) into the following soil types: ✿ Sand/granular soils; ✿ Dry sandy clay; ✿ Wet clay soil; and ✿ Silt. Ensure all stockpiles are sealed to minimise water ingress in approved locations.
Step 2	Analyse bulk sample from each (site-won or imported) soil matrix as per the requirements of the E3P specification for: ✿ Dry density/optimum moisture content (Procter); and ✿ Particle size grading coefficient.
Step 3	On-site observations in conjunction with particle size distribution (PSD) grading will confirm the classification of material and thus the corresponding method for compaction.
Step 4	The dry density/moisture content testing should be used to ensure that the material is within $\pm 3\%$ of the optimum to ensure compaction can be achieved.
Step 5	The classified material should be placed and compacted in accordance with the corresponding method for the material under conditions where the moisture content is within the tolerable limits.
Step 6	Once placed and compacted, the required validation testing should be completed at formation to demonstrate compliance. The testing will include: ✿ In-situ density and air void ratio; ✿ Moisture condition value; and ✿ Undrained shear strength.



TABLE 6.5 COMPACTION AND VALIDATION OF NON-STANDARD MATERIAL BACKFILL TO VSC

REQUIRED PARAMETERS	THE COMPACTION MUST ACHIEVE THE FOLLOWING MATERIAL PARAMETERS:	
Verification Testing and Report	Bulk Density (ρ)	95% of the maximum dry density and must be within 3% of the optimum moisture content.
	All materials used for upfilling must be durable and inert.	
	In order to verify that the aforementioned material parameters have been attained, representative sampling and testing must be undertaken. All testing will be in accordance with BS EN ISO 17892-1:2014 and BS EN ISO 17892-2:2014. All testing is to be undertaken by a laboratory with the relevant UKAS accreditation. The following tests are required:	
	In-situ Density (ρ)	Approved methods of in-situ testing (i.e. calibrated nuclear density probe (NDP), sand replacement test).
	Moisture Content	Moisture content test.
	In-situ density testing on every 500 m ³ and in each layer of upfill well-spread over site within and around the proposed structures’ footprint.	
	Testing must be from a range of depths throughout the treated fill. A minimum of six samples must be taken and tested.	
	A drawing depicting the location of each sample and test point must be provided along with a list of each point and the relevant test/sample depth. A list of all geotechnical testing results for each sample and test must be provided along with the relevant test certificates.	
	If the soils are not suitable, due to the moisture content being higher than the optimum moisture content, then lime modification may also be required.	
	The above is given strictly on the basis that it does not conflict with other elements of the project-specific requirements.	

6.7. CURRENT AND PROPOSED SITE TOPOGRAPHY AND SLOPE INTERACTION

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



7. RECORD-KEEPING AND VERIFICATION

7.1. RECORD-KEEPING

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

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

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

7.2. VERIFICATION

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

The validation report will include the following:

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



8. CONTINGENCY PLAN

8.1. PREVIOUSLY UNIDENTIFIED CONTAMINANTS

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

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

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



9. SECOND PHASE MITIGATION AND MANAGEMENT – BUILD PHASE

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

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

- ✚ Laboratory testing of the imported topsoil;
- ✚ Chemical validation of any additional subsoil imported for use within gardens;
- ✚ Placement and validation of sub-soil (clean material) in a 450mm layer within any plots where the material was not placed during the Remediation & Enabling works;
- ✚ Placement and chemical validation of imported topsoil within all gardens; and,
- ✚ Installation and validation of ground gas protection measures.

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

9.1. PLACEMENT OF COVER SYSTEM

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

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

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

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

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

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



TABLE 9.1 SPECIFICATION FOR SOIL TESTING

MATERIAL USE	TESTING FREQUENCY	SUITE OF ANALYSIS
Subsoil Greenfield Source (450 mm Garden Cover)	1 Sample per 200 m ³	A/B/C/D
Subsoil Brownfield Source (450 mm Garden Cover)	1 Sample per 50 m ³	A/B/C/D
Topsoil Greenfield Source (150 mm Garden Cover)	1 Sample per 200 m ³	A/B/C/D
Topsoil Brownfield Source (150 mm Garden Cover)	1 Sample per 50 m ³	A/B/C/D
General Engineering Fill (Class 1 and 2 Soil)	1 Sample per 1000 m ³	A/B/C/D

Notes

Suites of Analysis:

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

9.1.1. PROCEDURE FOR PLACEMENT OF CHEMICALLY SUITABLE COVER SYSTEM

Garden and landscaped areas need to be backfilled with 450mm chemically validated subsoil, with 150mm topsoil overlaying this. Topsoil is required to be confirmed as chemically suitable prior to placement. Where sub-soil is not placed during Remediation & Enabling works, E3P will be required to return to site and undertake independent validation of the correct placement of sub-soil.

The placement of 600mm of clean material will be undertaken during the build phase works of the project.

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

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

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

E3P will collect photographic evidence of the placement of 150mm of certified topsoil and 450mm of subsoil on completion of construction works. This element will also be checked by the Building Control Officer as part of the site completion prior to issuing of a CML certificate.

The garden validation procedure is detailed in Table 9.2.



TABLE 9.2 GARDEN VALIDATION PROCEEDURE

PROCEDURE	METHOD
Chemical Validation	Imported sub-soils and topsoil will need to be chemically analysed to confirm suitability for use with the proposed cover system prior to installation and completion of the garden systems. E3P will issue an email to the appropriate party with an assessment of the chemical suitability of both sub soils and top soils. If acceptable the materials can be installed to the required depth at which time the plot will be deemed complete following a validation procedure by a suitability qualified E3P engineer.
Trial Holes	Trial holes are deemed necessary for all plots given that the 600mm cover system will need to be placed on each plot during the build phase.
Validation	Photographic evidence will be taken by E3P of the topsoil placement demonstrating the depth of topsoil and practical completion of works are required for each and every plot. For plots where sub-soil depths require validation by E3P during the build phase, photographs will be taken and collated by E3P.
Validation Certificate	Once the photographs of the placement of topsoil (over the clean material) have been provided, E3P will issue a plot specific validation certificate to demonstrate that the required subsoil and topsoil has been placed in the required garden plots along with the chemical analysis.
Completion Report	Upon completion of all garden and landscaped areas within the development, a Completion Report will be issued providing the confirmation that all remediation requirements have been achieved.

Plate 1 provides an example of a garden validation photographs that will be required for each plot.



PLATE 1 EXAMPLE PLOT COVER SYSTEM VALIDATION

Plot No: 70		
Depth of Strata (m bgl)	0.00-0.15	Validated TOPSOIL
	0.15-0.60	Validated SUBSOIL
Depth of Cover System Materials		Depth of Cover System Materials
		
Depth of Cover System at Ground Level		Depth of Cover System in Relation to Plot
		



9.2. GROUND GAS PROTECTION MEASURES

Ground gas monitoring to date suggests that the site will fall into the bracket for Characteristic Situation 2 / Amber 1 / Amber 2 which will require specialist mitigation measures to be constructed in accordance with BS8485 (2015)+A1(2019). The final ground gas regime should be confirmed upon the completion of all monitoring.

The validation inspection is to include the items that are detailed within Table 9.3.

TABLE 9.3 GROUND GAS MITIGATION MEASURES VALIDATION ITEMS

INSPECTION	METHOD
Product Verification	Confirmation that suitable products have been installed to consist of photographs of product types, labels on packaging and delivery tickets.
Wall Cavity Inspection	Confirmation that gas membrane spans the external wall cavity above the periscopic vents.
General Condition	The membrane is to be inspected to ensure there are no tears, punctures or rips.
Jointing	The engineer is to check the overlaps between membranes are correctly sealed with sufficient overlaps.
Service Entry Points	Verification of the presence of preformed tophats sealed to the pipe and membrane as per the construction detail.
Passive Venting Systems	The engineer should verify the presence of vents at 2m centres on at least 3 of the external walls. Verification of the stone venting layer and presence of pipes to be supplied by photographic records from the site.

Examples of gas membrane verification photographs are provided in Plate 2.

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



PLATE 2 EXAMPLE GAS MEMBRANE VERIFICATION

Plot – 236

General Condition of Membrane-Good Condition



Verification of Joints and Seals-Good Condition



Verification of Service Penetrations-Good Condition



9.3. POTABLE WATER SUPPLY – CONTAMINANT ASSESSMENT CRITERIA

Table 9.4 provides a summary of the threshold concentrations that must not be exceeded within remediated ground at pipeline depth in order to PE pipe works to be acceptable for the proposed development.

TABLE 9.4 PIPELINE SELECTION PE THRESHOLD CONCENTRATIONS

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

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

END OF REPORT



APPENDIX I

LIMITATIONS

1. This report and its findings should be considered in relation to the terms of reference and objectives agreed between E3P and the Client as indicated in Section 1.2.
2. For the work, reliance has been placed on publicly available data obtained from the sources identified. The information is not necessarily exhaustive and further information relevant to the site may be available from other sources. When using the information it has been assumed it is correct. No attempt has been made to verify the information.
3. This report has been produced in accordance with current UK policy and legislative requirements for land and groundwater contamination which are enforced by the local authority and the Environment Agency. Liabilities associated with land contamination are complex and requires advice from legal professionals.
4. During the site walkover, reasonable effort has been made to obtain an overview of the site conditions. However, during the site walkover, no attempt has been made to enter areas of the site that are unsafe or present a risk to health and safety, are locked, barricaded, overgrown, or the location of the area has not been made known or accessible.
5. Access considerations, the presence of services and the activities being carried out on the site limited the locations where sampling locations could be installed and the techniques that could be used.
6. Site sensitivity assessments have been made based on available information at the time of writing and are ultimately for the decision of the regulatory authorities.
7. Where mention has been made to the identification of Japanese Knotweed and other invasive plant species and asbestos or asbestos-containing materials, this is for indicative purposes only and do not constitute or replace full and proper surveys.
8. The executive summary, conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full.
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10. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part.



APPENDIX II

GLOSSARY

TERMS

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



Cherryfield Drive

Remediation and Enabling Works Strategy

December 2022

m	Metres	ppm	Parts per million
km	Kilometres	mg/m³	Milligram per metre cubed
% v/v	Percent volume in air	m bgl bgl	Metres below ground level
mb	Millibars (atmospheric pressure)	m bcl	Metre below cover level
l/hr	Litres per hour	mAOD	Metres above ordnance datum (sea level)
µg/l	Micrograms per litre (parts per billion)	kN/m²	Kilonewtons per metre squared
ppb	Parts per billion	µm	Micrometre
mg/kg	Milligrams per kilogram (parts per million)	SSRT	Site Specific Remediation Target
PSD	Particle Size Distribution	DD	Dry Density
CL:AIRE	Contaminated Land: Applications in Real Environments	Mc	Moisture Content
ρ	Bulk Density	GPR	Ground Penetrating Radar
NDP	Nuclear Density Probe	FFL	Finished Floor Level
LEL	Lower Explosive Limit	UKWIR	UK Water Industry Research
CIRIA	Construction Industry Research and Information Association	LOD	Limit of Detection



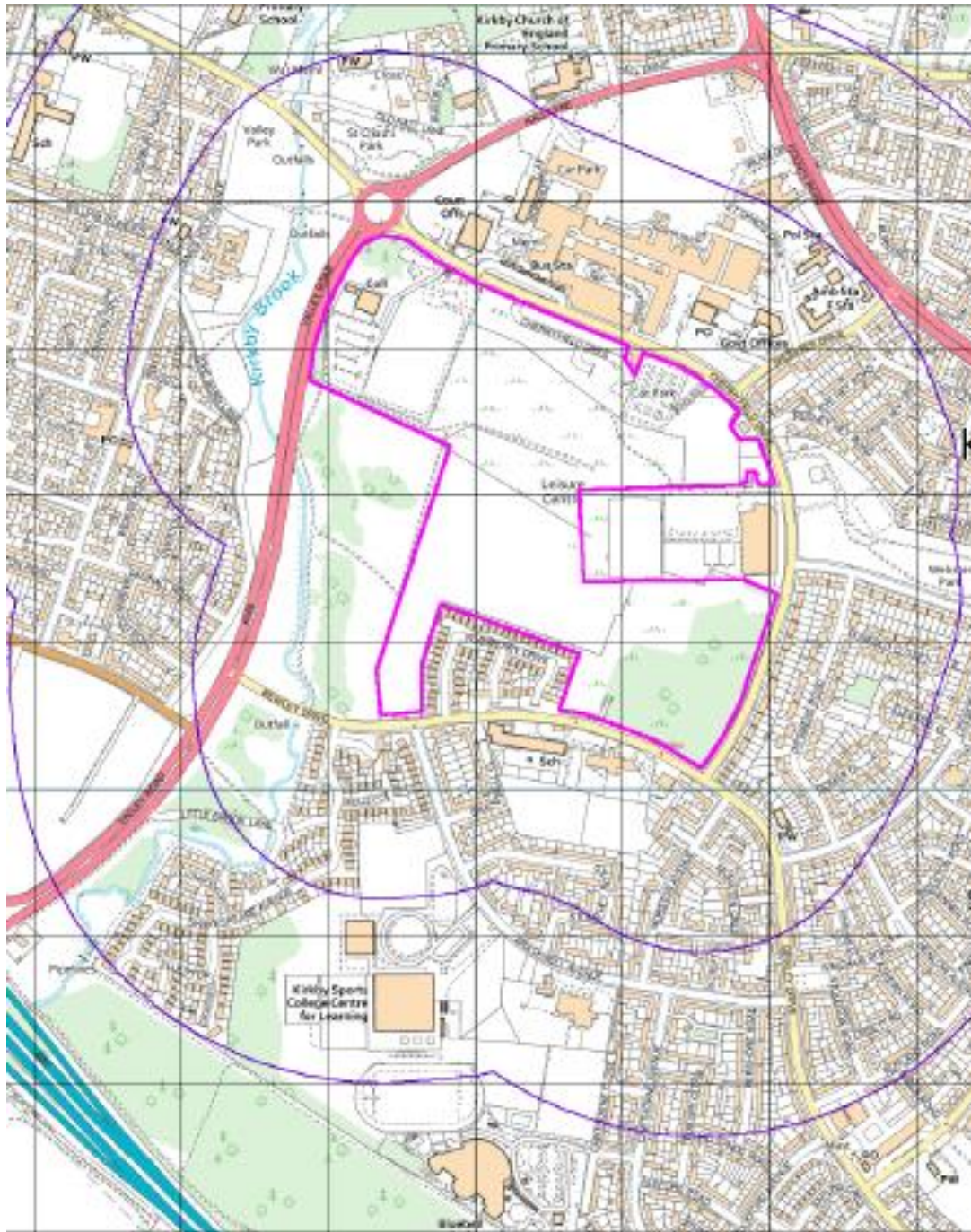
APPENDIX III

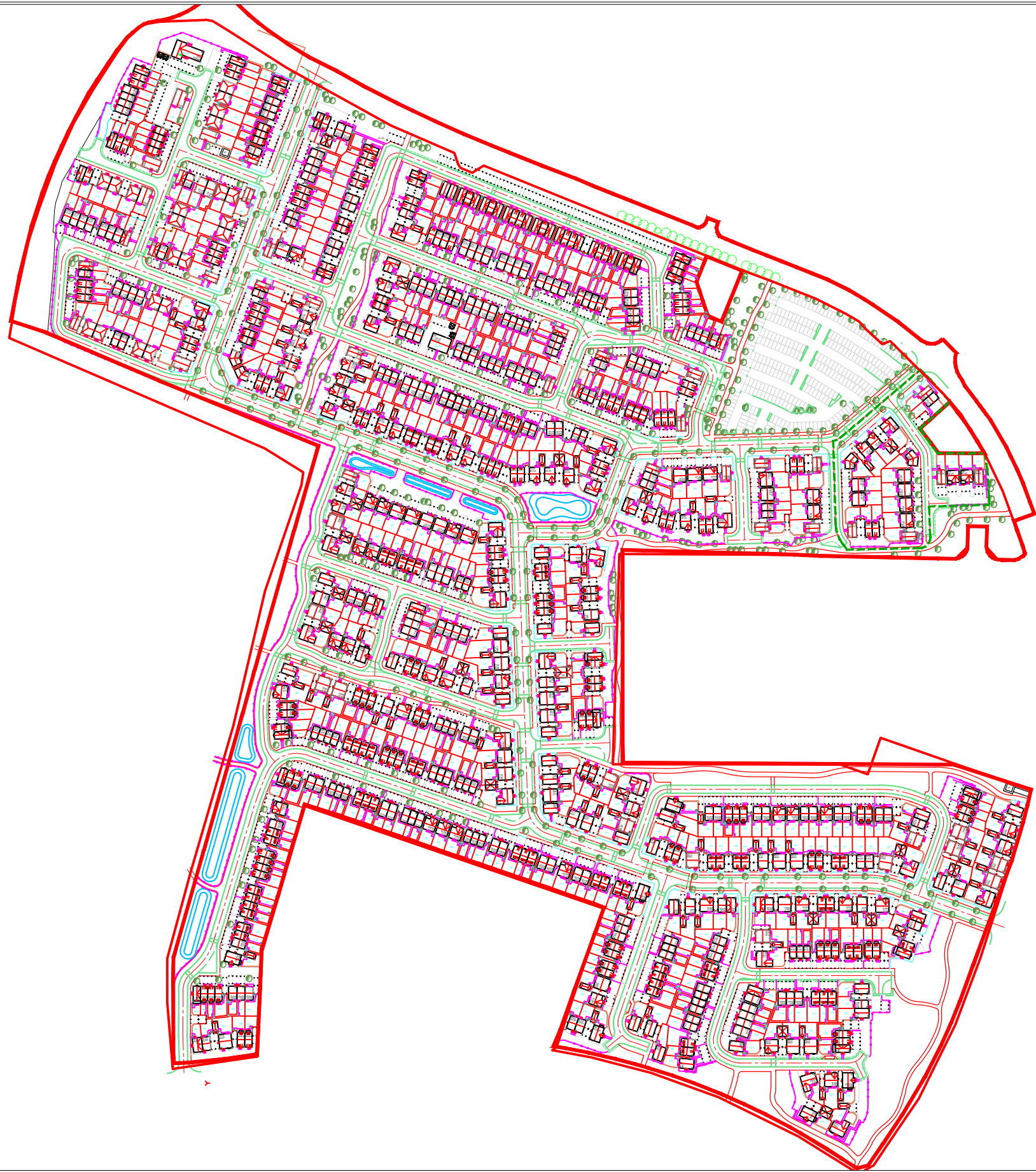
DRAWINGS

Cherryfield Drive

Remediation and Enabling Works Strategy
December 2022

DRAWING 15-280-001 – SITE LOCATION PLAN





Notes:				
P1	REVB	14.12.2022	LM	BH
P1	REVA	20.04.2022	LM	BH
Phase	Issue	Date	Drawn	Checked

Client:	DWH
	Cherryfield Drive, Kirkby
Job Title:	

Job No:	15-280	Date:	14.12.2022
Drawing No:	002	Scale:	NTS @ A3
Drawing Title:		Proposed Development Plan	



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Historical Features

Former Residential Buildings

Former School / College Buildings

Former Buildings

Former Tennis Courts

Former Running Track

Former Footpath

Former Car Park

Former Woodland

Former Pond

Former Garage / Petrol Filling Station

Substations

Former Track

Former Embankment

Former Tennis Courts

Former Gravel Pit

Notes:

P1	REVD	25.04.2022	LM	RH
P1	REVC	22.04.2022	LM	RH
P1	REVB	07.12.2021	LM	RH
P1	REVA	02.12.2021	LM	JB
Phase	Issue	Date	Drawn	Checked

Client:

DWH

Job Title:

Cherryfield Drive, Kirkby

Job No:

15-280

Drawing No:

003

Job Title:

Historical Features Plan

Date:

25.04.2022

Scale:

1:1000 @ A3



Environmental Engineering Partnership Ltd

Taylor Road, Trafford Park

Urmston, Manchester, M41 7JQ

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Historical Features

Overgrown Vegetation	Seven Underground Storage Tanks	Pallisade Fencing
Short grass	Covid-19 walkthrough testing site	Footpath
Trees	Gas Substation Buildings	Metal Fencing
Dense Trees (Recently Removed)	Bollards	Gate
Dense Trees	Electrical Substations	Locked Gate
Road	Fly Tipped Material	Slope
Car Parks	Brambles	
Hardstanding	Former Housing Slabs	
Knowsley Community College	Wooden Fence	

Notes:

P1	REVC	25.04.2022	LM	BH
P1	REVB	21.04.2022	LM	BH
P1	REVA	20.04.2022	LM	BH
Phase	Issue	Date	Drawn	Checked

Client:

DWH

Job Title:

Cherryfield Drive, Kirkby

Job No:

15-280

Drawing No:

004

Date:

25.04.2022

Scale:

1:1000 @ A3

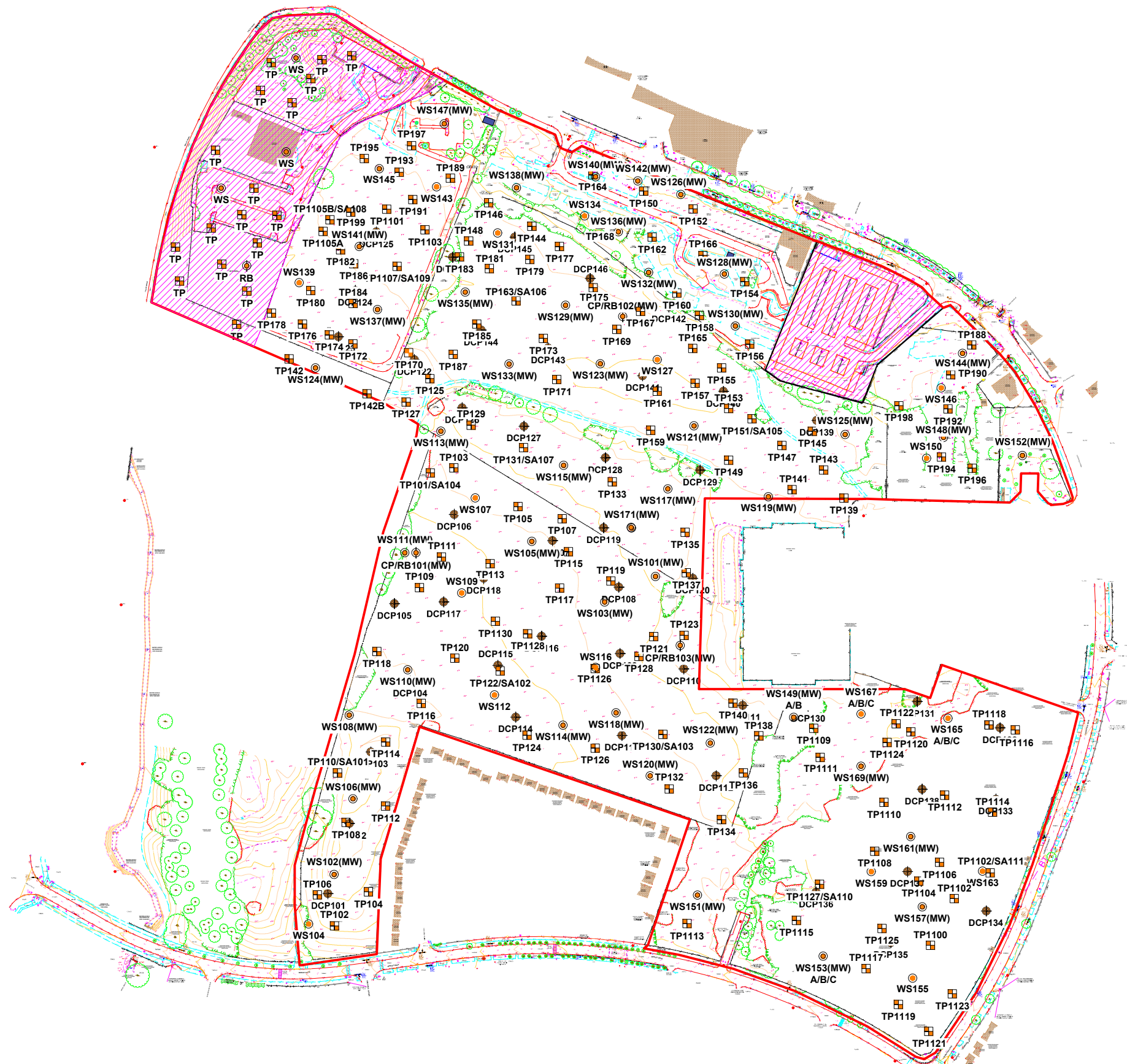
Drawing Title:

Site Features Plan



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- Location Symbols
- WS101 Approximate Window Sample Probehole Location
 - TP101 Approximate Trial Pit Location
 - RB101 Approximate Rotary Borehole Location
 - Uninvestigated Area

Notes:				
P1	REVJ	25.04.2022	LM	RH
P1	REVJ	22.04.2022	LM	RH
P1	REVI	20.04.2022	LM	JB
P1	REVI	04.03.2022	LM	NG
P1	REVI	24.02.2022	LM	NG
P1	REVI	03.02.2022	LM	JB
P1	REVI	28.01.2022	LM	NG
P1	REVI	26.01.2022	LM	NG
P1	REVI	19.01.2022	LM	NG
P1	REVI	07.01.2022	EB	EB
P1	REVI	07.12.2021	LM	JB
Phase	Issue	Date	Drawn	Checked

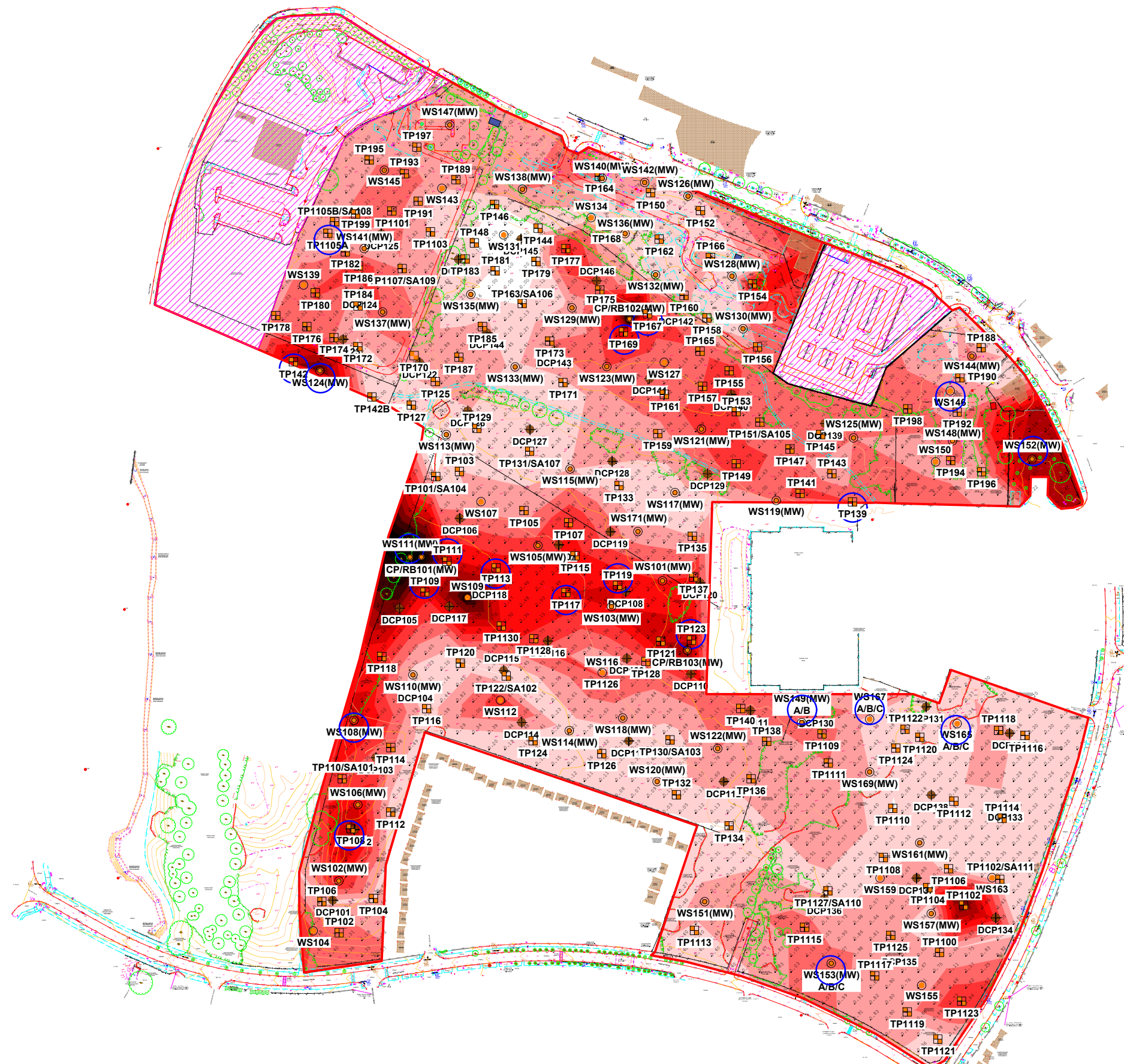
Client:	DWH
Job Title:	Cherryfield Drive, Kirkby

Job No:	15-280
Drawing No:	005
Date:	25.04.2022
Scale:	NTS@ A3
Drawing Title:	Exploratory Hole Location Plan



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Location Symbols

- Approximate Window Sample Probehole Location
- Approximate Trial Pit Location
- Approximate Rotary Borehole Location
- Uninvestigated Area
- Full extent not Proven

Made Ground Depth (m)

- Depth of Made Ground 0.00
- Depth of Made Ground 0.01 - 0.49m
- Depth of Made Ground 0.50 - 0.99m
- Depth of Made Ground 1.00 - 1.49m
- Depth of Made Ground 1.50 - 1.99m
- Depth of Made Ground 2.00 - 2.49m
- Depth of Made Ground 2.50 - 2.99m
- Depth of Made Ground 3.00 - 3.49m
- Depth of Made Ground 3.50 - 3.99m
- Depth of Made Ground 4.00 - 4.49m
- Depth of Made Ground 4.50 - 4.99m
- Depth of Made Ground >5.00m

Notes:				
P1	REVB	25.04.2022	LM	BH
P1	REVA	27.01.2022	LM	NG
Phase	Issue	Date	Drawn	Checked

Client:

DWH

Job Title:

Cherryfield Drive, Kirkby

Job No:

15-280

Drawing No:

006

Date:

25.04.2022

Scale:

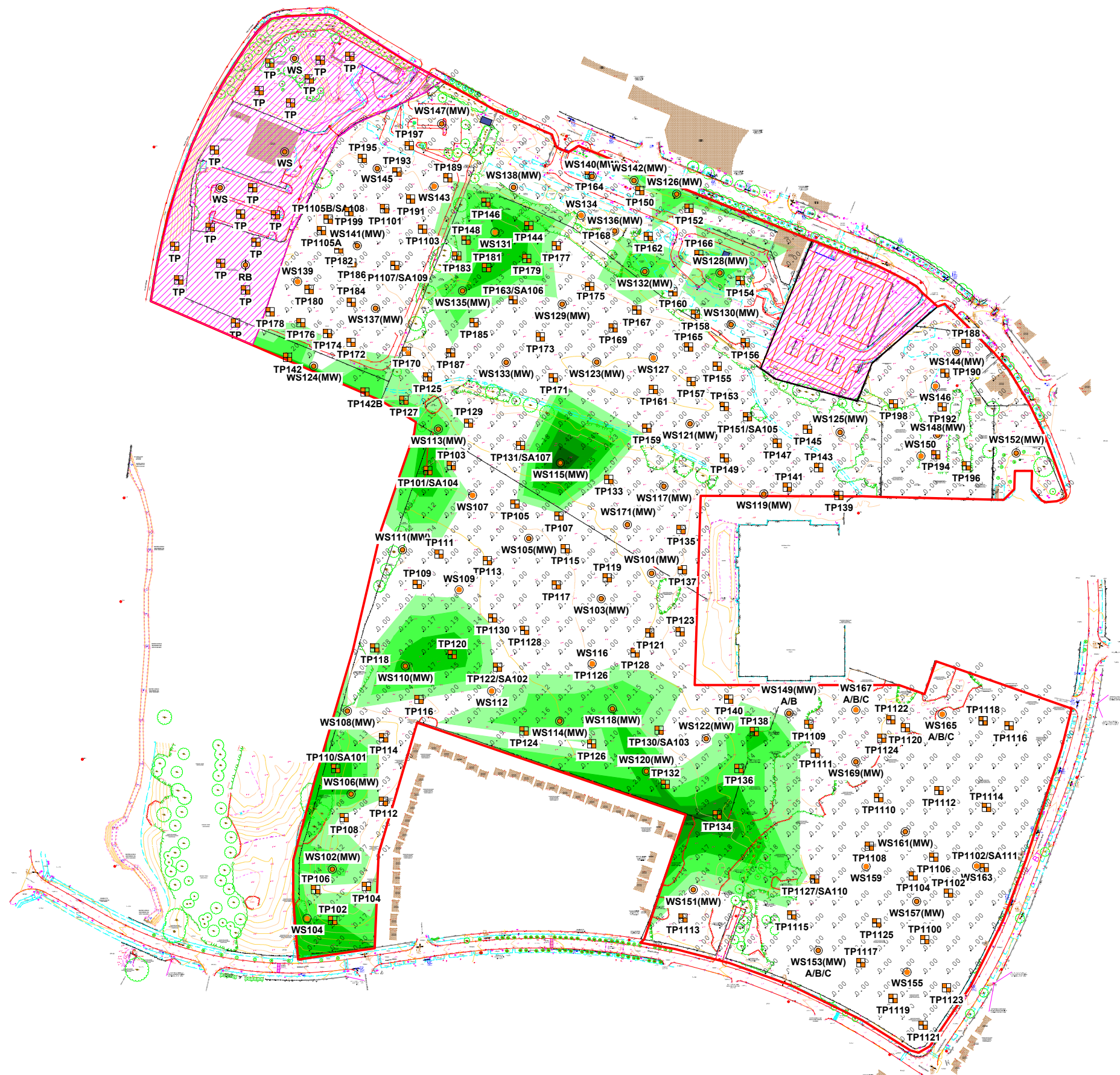
NTS @ A3

Drawing Title:

Depth of Made Ground Plan

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- Location Symbols**
- WS101 Approximate Window Sample Probehole Location
 - TP101 Approximate Trial Pit Location
 - RB101 Approximate Rotary Borehole Location
 - Uninvestigated Area

- Natural Topsoil Depth (m)**
- Depth of Natural Topsoil 0.00
 - Depth of Natural Topsoil 0.01 - 0.09m
 - Depth of Natural Topsoil 0.10 - 0.19m
 - Depth of Natural Topsoil 0.20 - 0.29m
 - Depth of Natural Topsoil 0.30 - 0.39m
 - Depth of Natural Topsoil >0.40

Notes:				
P1	REVB	25.04.2022	LM	JB
P1	REVA	31.01.2022	LM	NG
Phase	Issue	Date	Drawn	Checked

Client:

DWH

Job Title:

Cherryfield Drive, Kirkby

Job No:

15-280

Drawing No:

007

Date:

25.04.2022

Scale:

NTS @ A3

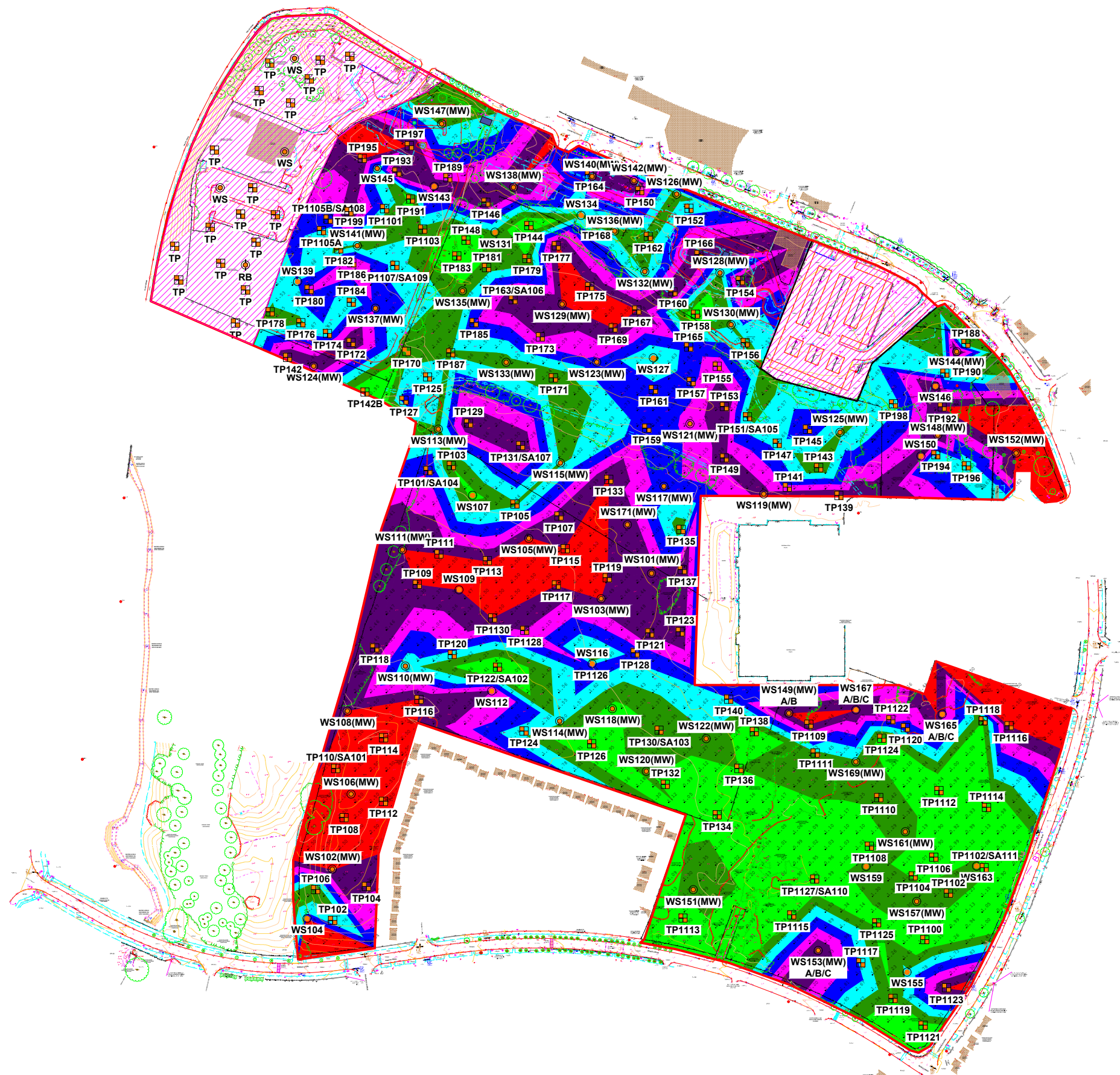
Drawing Title:

Depth of Natural Topsoil Plan



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Location Symbols

- Approximate Window Sample Probehole Location
- Approximate Trial Pit Location
- Approximate Rotary Borehole Location
- Uninvestigated Area

Shallow Spread Footings

- Depth to Founding Strata 0.00 - 1.24m
- Depth to Founding Strata 1.25 - 1.49m

Mass Trench Fill Footings

- Depth to Founding Strata 1.50 - 1.74m
- Depth to Founding Strata 1.75 - 1.99m
- Depth to Founding Strata 2.00 - 2.24m

Engineered Footings

- Depth to Founding Strata 2.25 - 2.49m
- Depth to Founding Strata >2.50m

Notes:

P1	REVB	25.04.2022	LM	BH
P1	REVA	21.04.2022	LM	BH
Phase	Issue	Date	Drawn	Checked

Client:

DWH

Job Title:

Cherryfield Drive, Kirkby

Job No:

15-280

Drawing No:

008

Date:

25.04.2022

Scale:

NTS @ A3

Drawing Title:

Depth to Founding
Strata Plan



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Summary of Heave Precaution Requirements								
Volume Change Potential	Required Foundation Depth (m)	Minimum Void Dimensions for Foundations, Ground Beams & Suspended In-Situ Concrete Ground Floors		Minimum Void Dimensions Under Pre-Cast Concrete & Suspended Timber Floors				
		Thickness of Void Former Against Side of Foundation of Ground Beam (mm)	Thickness of Void Former on Underside of Edge Beam & Floor Slab (mm)	Void Dimension (mm)				
Low Volume Change Potential (<20%)	>2.00	No Special Precautions			200			
	2.00-2.50	-	50					
Medium Volume Change Potential (20-40%)	1.50-2.00	25	50	250				
	2.00-2.50	25	100					
	>2.50	Engineer Design		Engineer Design				
High Volume Change Potential (>40%)	1.50-2.00	25	75	300				
	2.00-2.50	35	150					
	>2.50	Engineer Design		Engineer Design				
Minimum Width of Strip Footings								
Type of Ground (including Engineered Fill)	Condition of Ground	Total Load of Load-Bearing Walling more than 6kN/linear metre						
		20	30	40	50	60	70	
		Minimum Width of Strip Foundation (mm)						
Gravel	Sand	Medium Dense to Dense	250	300	400	500	600	650
Clay	Sandy Clay	Stiff	250	300	400	500	600	650
Clay	Sandy Clay	Firm	300	350	450	600	750	850
Items Considered								
Bearing Capacity			TBC					
Trees			TBC					
Historical			TBC					
Groundwater Table			TBC					
FFL			TBC					
Contamination			TBC					
Remediation			TBC					
Volume Change Potential			TBC					
Root Protection Areas			TBC					
Residual Risks								
Foreseeable Risks That Cannot be Avoided	Applicable (Y/N)	Action to Reduce Risk				Justification for Design Decision		
Deep Excavations	Y	Identify locations on drawing and depths on schedule				Lesser risk than other alternatives		
Trench Collapse	Y	Risk highlighted on drawing				Lesser risk than other alternatives		
Use of Working Platform for Pile/Vibro Operations	Y	Compliance with working platform directive required				Pile/Vibro foundation less risky than other alternatives		

Anticipated Foundation Types

- TS

Traditional Strip Foundations
Minimum depth 250mm below proposed Final Finished Level.
Maximum safe bearing pressure limited to 150kN/m².
- MT

Mass Trench Fill Foundations
Minimum depth 1200mm below proposed Final Finished Level.
Maximum safe bearing pressure limited to 150kN/m².
- V

Vibro Stone Ground Compaction
In accordance with NBSIC Chapter 4.2.
- P

Piled Foundations
Where the maximum foundation depth exceeds 2.50m a piled foundation option rather than a trench fill / deep reinforced strip foundations may be adopted. Columns or tie heads supported by ground beams.
- R

Raft Foundations
Maximum safe bearing pressure limited to 150kN/m² or approved equivalent gradeable fill. Raft foundations to be designed by a structural engineer in accordance with Chapter 4.5 of NBSIC 2013. Raft foundations are considered suitable to mitigate against potential influence of clay heave / deterioration in accordance with Section 4.2, sub-section D10.
- TB

Traditional Strip / Trench Block Foundations
Traditional strip founded at 450mm below connect base with built up in Trench Block and subsequent backfill to development level.
- Colours on Plot Corners to be Used When Referring to Foundation Schedule.
(Showing Final Level & Limits).

Depth to Target Founding Strata

- Footings 0.75 - 0.90m Deep
From Final Finished Level
In accordance with NBSIC Chapter 4.2
- Footings 0.90 - 1.25m Deep
From Final Finished Level
In accordance with NBSIC Chapter 4.2
- Footings 1.25 - 1.50m Deep
From Final Finished Level
In accordance with NBSIC Chapter 4.2
- Footings 1.50 - 1.75m Deep
From Final Finished Level
In accordance with NBSIC Chapter 4.2
- Footings 1.75 - 2.00m Deep
From Final Finished Level
In accordance with NBSIC Chapter 4.2
- Footings 2.00 - 2.25m Deep
From Final Finished Level
In accordance with NBSIC Chapter 4.2
- Footings 2.25 - 2.50m Deep
From Final Finished Level
In accordance with NBSIC Chapter 4.2

Engineered Foundation Solutions

- Footings >2.50m Deep
From Final Finished Level
In accordance with NBSIC Chapter 4.2
- Vibro
From Final Finished Level
In accordance with NBSIC Chapter 4.2
- Low Volume Change Potential Clay
Heave precautions required to underside of cast in-situ floor slab (with no sub-floor void) within congested zone of tree influence. Heave precautions not required to foundation.

Tree Influence (Retained / Removed)

- 0.90 - 1.25m
- 1.25 - 1.50m
- 1.50 - 1.75m
- 1.75 - 2.00m
- 2.00 - 2.25m
- 2.25 - 2.50m
- >2.50m

Notes:

P1	REVB	14.12.2022	EB	BH
P1	REVA	25.04.2022	LM	BH
Phase	Issue	Date	Drawn	Checked

Client:

DWH

Job Title:

Cherryfield Drive, Kirkby

Job No:

15-280

Drawing No:

009

Date:

14.12.2022

Scale:

NTS@ A1

Drawing Title:

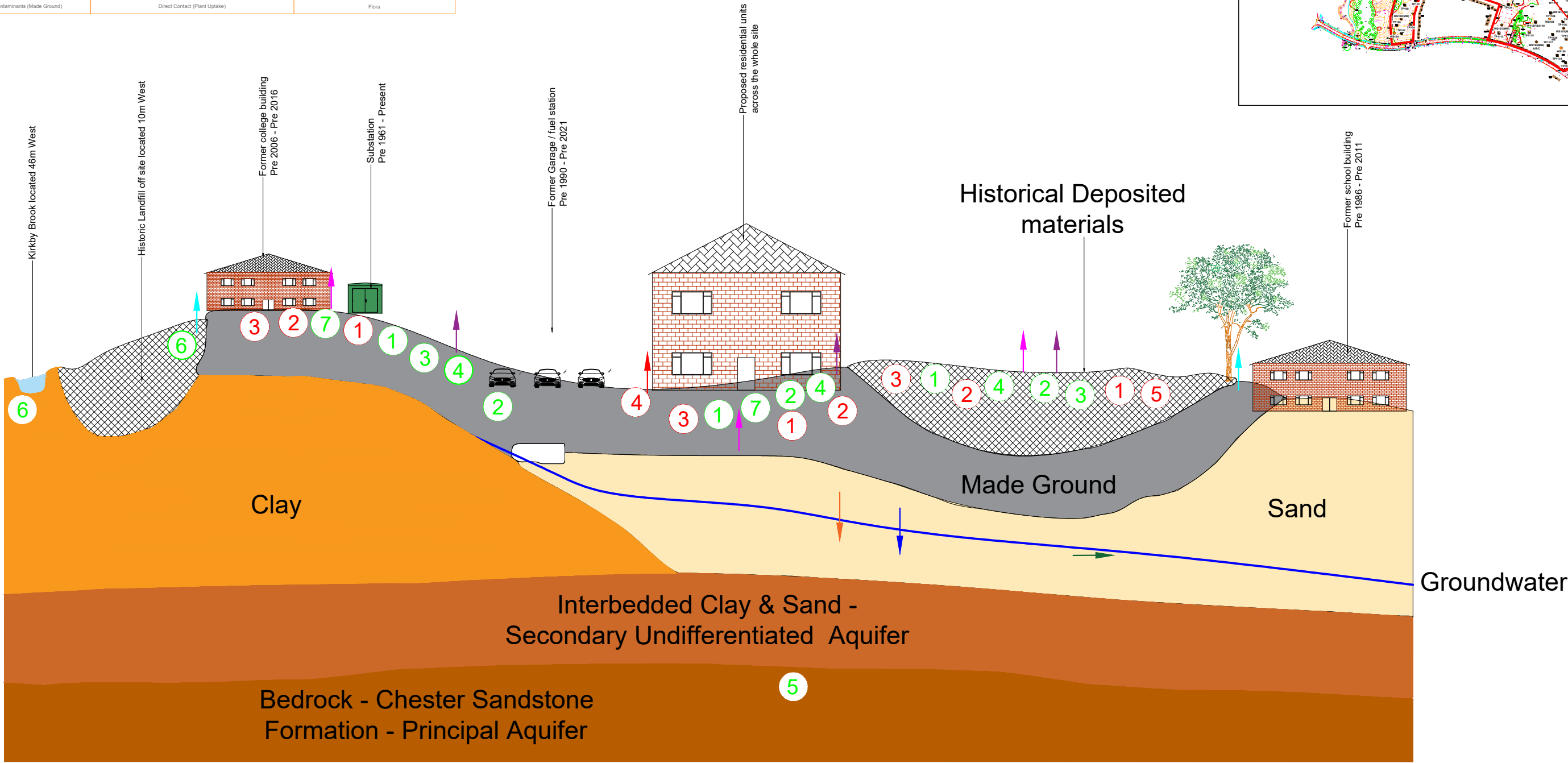
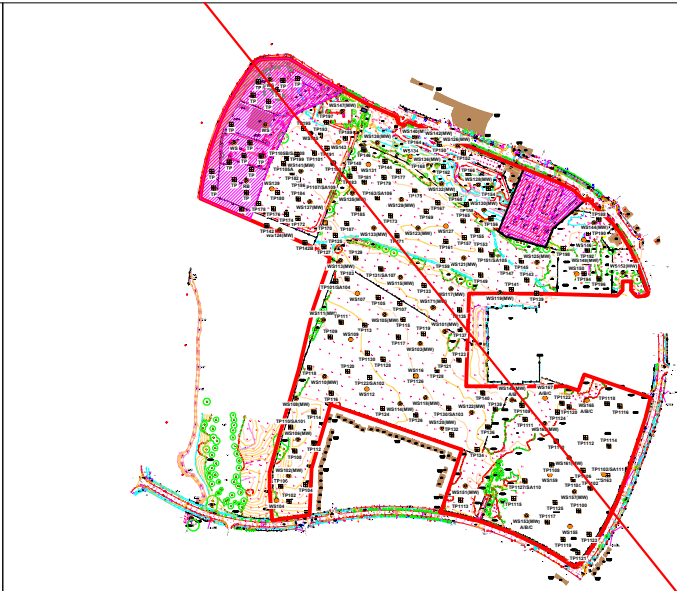
Concept Foundation
Zoning Plan



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Pollutant Linkage	Contaminant (Source)	Pathway	Receptor
PL1 PL2	Heavy Metals, Non Volatile PAH (Made Ground)	Dermal Contact	Future Site Users
		Dermal Contact and Ingestion	Off-site Receptors
PL3	ACM in Made Ground	Inhalation of Dust	Future Site and Off-site Users
			Buildings
PL4	Volatile Contaminants such as Mercury (Made Ground)	Inhalation of Vapours	Future Site Users
		Migration through permeable strata and preferential pathways	Off-site Receptors
PL5	Methane, Carbon Dioxide (Made Ground)	Inhalation of Gas	Future Site Users
		Migration through permeable strata and preferential pathways	Buildings
PL6	Mobile contaminants such as metals, PAHs, hydrocarbons, volatile compounds (Made Ground)	Explosion in Confined Spaces	Off-site Land Users
		Surface Runoff	Groundwater (Principal Aquifer)
		Migration through permeable strata and preferential pathways	
PL7	Sulphate (potential ash within Made Ground)	Perched waters migration	Building Structure
		Sulphate attack on concrete	
PL8	Organic contaminants such as hydrocarbons, solvents (Made Ground)	Ingestion of tainted water supply	Future Site Users
			Water Pipes
PL9	Phytotoxic Contaminants (Made Ground)	Direct Contact (Plant Uptake)	Flora



Geology Key Made Ground Clay Sand Interbedded Clay & Sand Bedrock Suspected Landfill Groundwater	Sources ① Heavy Metals, Non volatile PAH (MG) ② Asbestos (MG) ③ Volatile Contaminants (MG) ④ Sulphates (MG) ⑤ Methane, Carbon dioxide (MG)	Receptors ① Future End Users ② Construction Works ③ Vegetation & Landscaping ④ Buildings ⑤ Principal Aquifer ⑥ Off Site Receptors ⑦ Water Pipes	Pathways Inhalation / Accumulation Dermal Contact / Ingestion Plant Uptake Tainted Water Supply Vertical Migration Horizontal Migration Sulphate Attack on Concrete	Notes:					Client: DWH		Job No: 15-280	Date: 25.04.2022	e3p Environmental Engineering Partnership Ltd Taylor Road, Trafford Park Urmston, Manchester, M41 7JQ Tel: 0161 707 9612 E-mail: info@e3p.co.uk Website: www.e3p.co.uk	
											Drawing No: 010	Scale: NTS@ A3		
									Job Title: Cherryfield Drive, Kirkby		Drawing Title: Conceptual Site Model			The client must not amend any drawing, design or other intellectual property produced by E3P Ltd without permission in writing from E3P Ltd in advance of any amendments being made. In the event that such written permission is not obtained in advance of the amendments being made, E3P Ltd shall not be liable for any damage and/or losses occurring as a result of the amended drawing, design or intellectual property.
				P1	REVB	25.04.2022	LM	JB						
P1	REVA	16.03.2022	EB	NG										
Phase	Issue	Date	Drawn	Checked										



- Location Symbols**
- WS101: Approximate Window Sample Probehole Location
 - TP101: Approximate Trial Pit Location
 - RB101: Approximate Rotary Borehole Location
- Contamination Exceedances**
- Heavy Metals
 - Mercury
 - Asbestos
 - Naphthalene
 - PAHs
 - Dibutyl phthalate

Notes:				
P1	REVA	20.04.2022	LM	BH
Phase	Issue	Date	Drawn	Checked

Client:

DWH

Job Title:

Cherryfield Drive, Kirkby

Job No:

15-280

Drawing No:

018

Date:

20.04.2022

Scale:

NTS@ A3

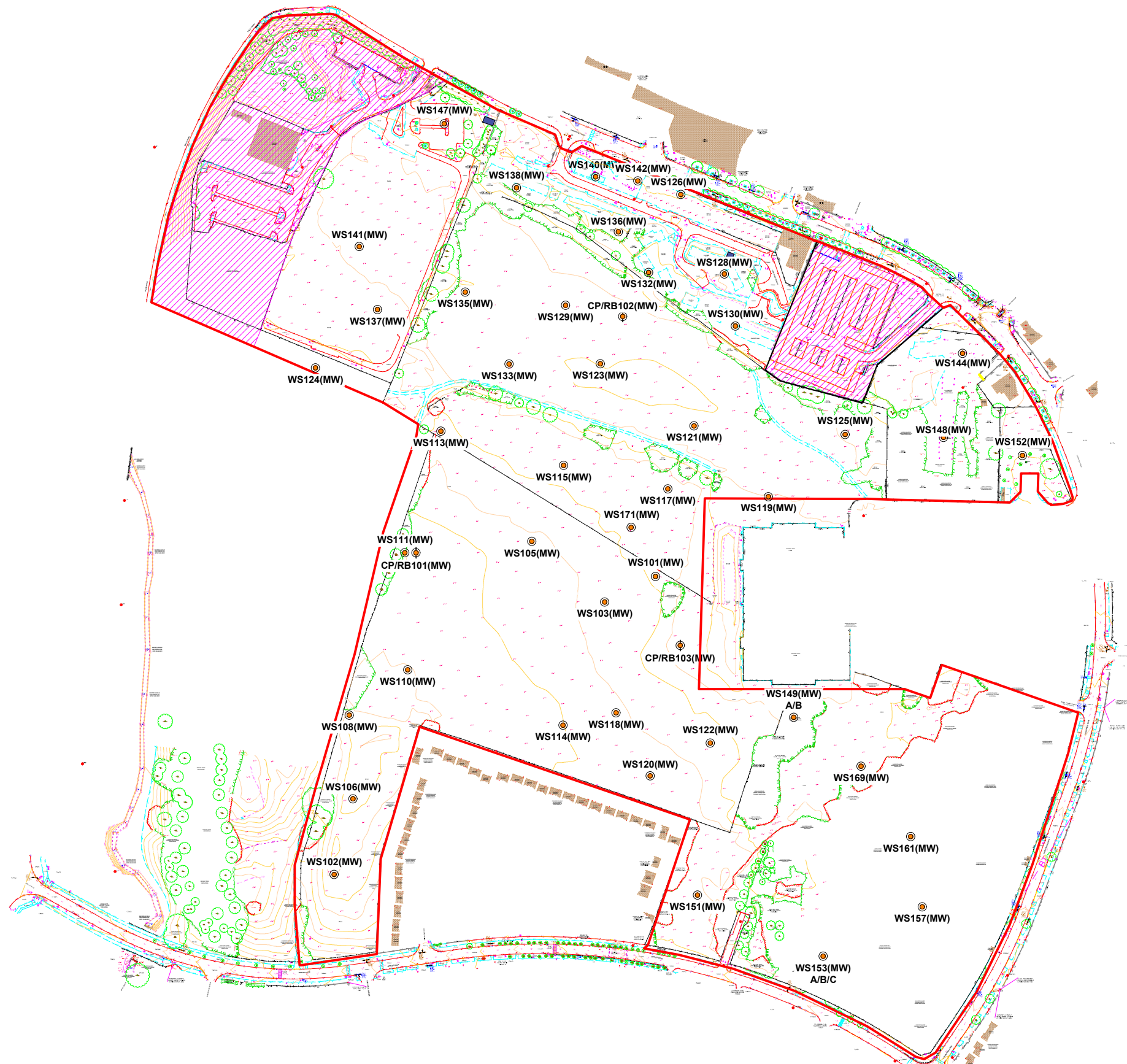
Drawing Title:

Contamination Exceedances Plan



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- Location Symbols
- Window Sample with Monitoring Well
 - Cable Percussive / Rotary Boreholes Location
 - Uninvestigated Area

Notes:

P1	REVD	18.08.2022	EB	BH
P1	REVC	04.03.2022	LM	BH
P1	REVB	09.02.2022	LM	BH
P1	REVA	08.02.2022	LM	BH
Phase	Issue	Date	Drawn	Checked

Client:

DWH

Job Title:

Cherryfield Drive, Kirkby

Job No:

15-280

Drawing No:

027

Date:

18.08.2022

Scale:

NTS@ A3

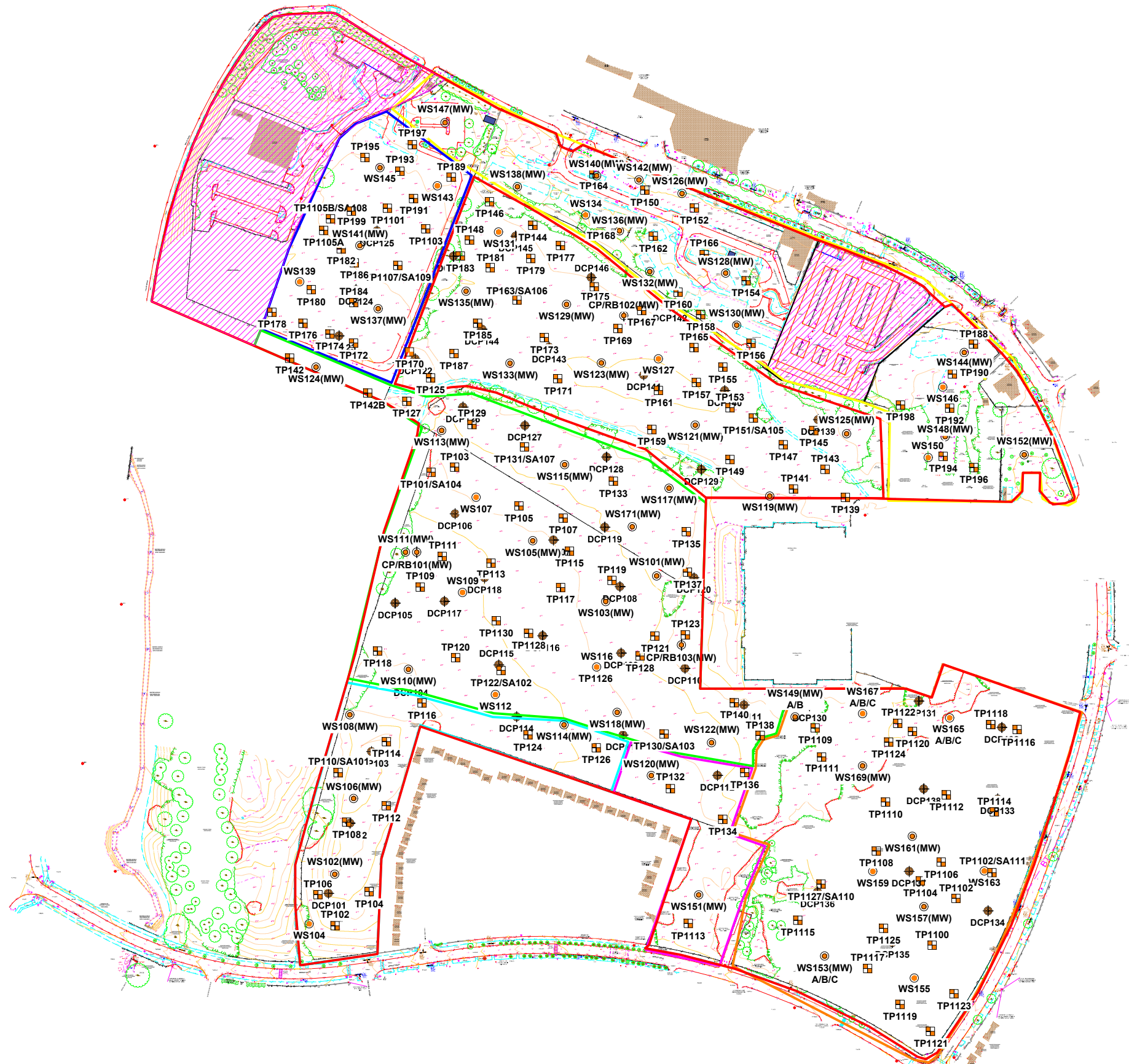
Drawing Title:

Window Sample with
Monitoring Well Location Plan



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- Location Symbols
- WS101 Approximate Window Sample Probehole Location
 - TP101 Approximate Trial Pit Location
 - RB101 Approximate Rotary Borehole Location
 - Uninvestigated Area

Notes:

P1	REVA	16.03.2022	EB	NG
Phase	Issue	Date	Drawn	Checked

Client:

DWH

Job Title:

Cherryfield Drive, Kirkby

Job No:

15-280

Drawing No:

028

Date:

16.03.2022

Scale:

NTS@ A3

Drawing Title:

Exploratory Hole
Location Zoned Plan



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Location Symbols

• Approximate Dynamic Cone Penetrometer Test Location

Uninvestigated Area

Notes:				
P1	REVA	05.01.2022	EB	BH
Phase	Issue	Date	Drawn	Checked

Client:

DWH

Job Title:

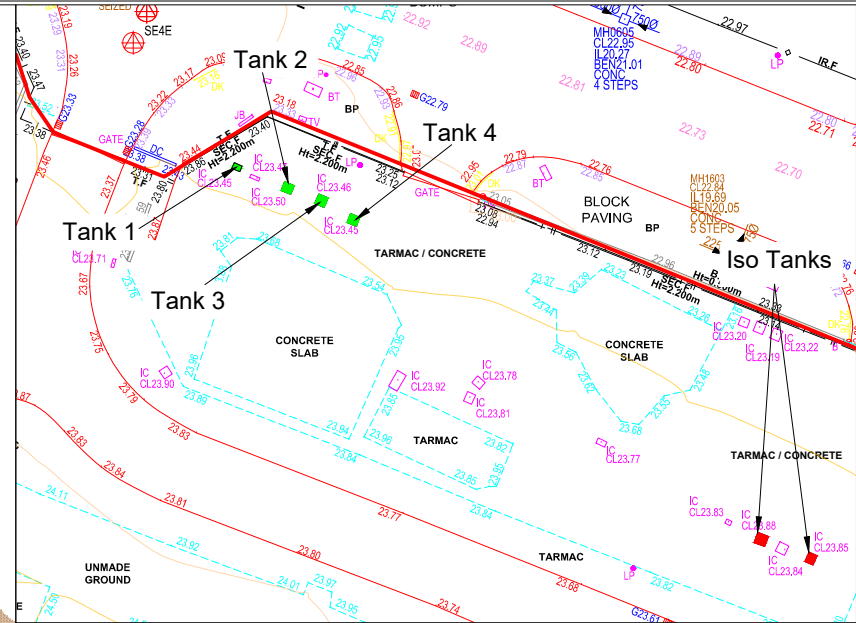
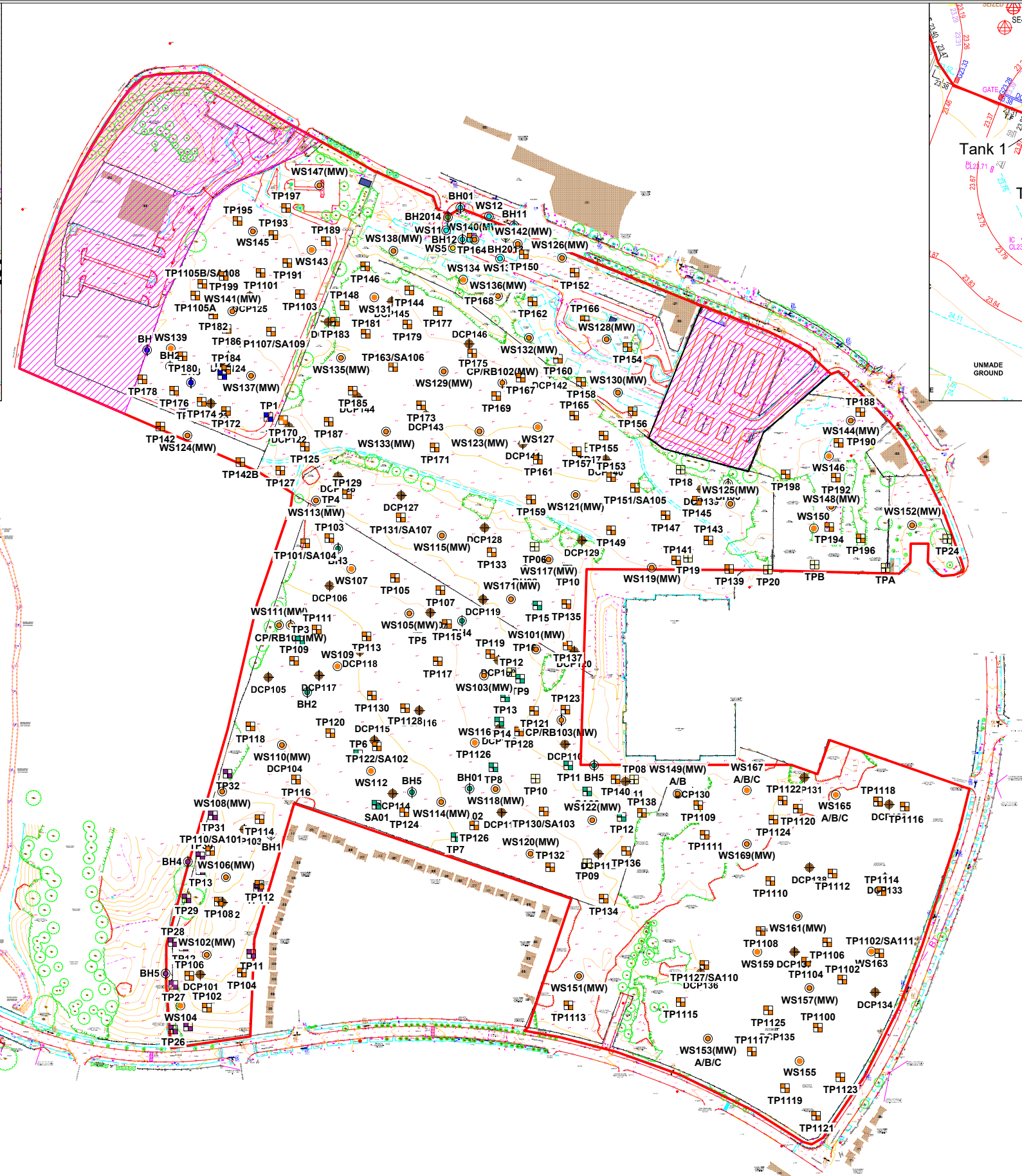
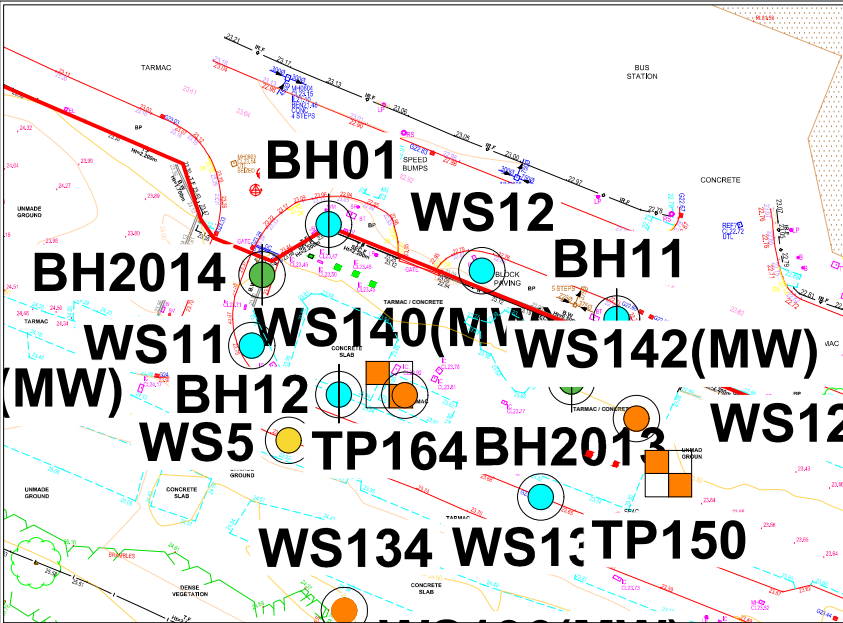
Cherryfield Drive, Kirkby

Job No:	15-280	Date:	05.01.2022
Drawing No:	029	Scale:	NTS@ A3
Drawing Title:			
Exploratory Hole Location Plan - DCP			



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Location Symbols				Tanks		Notes:	Client:	Job No:	Date:	 Environmental Engineering Partnership Ltd Taylor Road, Trafford Park Urmston, Manchester, M41 7JQ Tel: 0161 707 9612 E-mail: info@e3p.co.uk Website: www.e3p.co.uk									
	Approximate Window Sample Probehole Location		Approximate Rotary Borehole Location (Abatec 2006)		Tanks						15-280	25.04.2022							
	Approximate Trial Pit Location		Approximate Trial Pit Location (Abatec 2006)		Iso Tank			Drawing No:	Scale:										
	Approximate Rotary Borehole Location		Approximate Rotary Borehole Location (Atkins Rotary holes)			<table><tr><td>P1</td><td>REVA</td><td>25.04.2022</td><td>LM</td><td>BH</td></tr><tr><td>Phase</td><td>Issue</td><td>Date</td><td>Drawn</td><td>Checked</td></tr></table>	P1	REVA	25.04.2022	LM	BH	Phase	Issue	Date	Drawn	Checked	Job Title:	Drawing Title:	
P1	REVA	25.04.2022	LM	BH															
Phase	Issue	Date	Drawn	Checked															
	Approximate Trial Pit Location (Knowsley Community College 1995)		Approximate Window Sample Probehole Location (Atkins Rotary holes)	031	NTS@ A3														
	Approximate Rotary Borehole Location (Knowsley Community College 1997)		Approximate Window Sample Probehole Location (Clancy Consulting)			Cherryfield Drive, Kirkby	Garage and Petrol Filling Station Area Plan												
	Approximate Trial Pit Location (Cooper Associates 1998-2002)		Approximate Rotary Borehole Location (Baro Happold Boreholes)							The client must not amend any drawing, design or other intellectual property produced by E3P Ltd without permission in writing from E3P Ltd in advance of any amendments being made. In the event that such written permission is not obtained in advance of the amendments being made, E3P Ltd shall not be liable for any damage and/or losses occurring as a result of the amended drawing, design or intellectual property.									
	Approximate Rotary Borehole Location (Cooper Associates 1998-2002)																		
	Approximate Trial Pit Location (Waterman 2002-2004 (no logs available))																		
	Approximate Window Sample Probehole Location (Waterman 2002-2004 (no logs available))																		

APPENDIX IV E3P REMEDIATION/ VALIDATION CRITERIA

HUMAN HEALTH REMEDIATION TARGETS – LOW-RISE RESIDENTIAL END USE

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



TPH C₁₂-C₁₆ (aromatic)	mg/kg	140 ^{(i)(xi)}	1800 ^{(ii)(xi)}	1800 ^{(ii)(xi)}	10,000 ^{(xiv)(xi)}	1
TPH C₁₆-C₂₁ (aromatic)	mg/kg	260 ^{(i)(xi)}	1900 ^{(ii)(xi)}	1900 ^{(ii)(xi)}	10,000 ^{(xiv)(xi)}	1
TPH C₂₁-C₃₅ (aromatic)	mg/kg	1000 ^{(xiv)(xi)}	1900 ^{(ii)(xi)}	1900 ^{(ii)(xi)}	10,000 ^{(xiv)(xi)}	1
Asbestos	Fibres Volume Weight (%)	NFD	0.001%	NFD	0.001	4

Notes 1

NFD = No Fibres Detected

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

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

Notes 2

Excludes matrices where free product is observed.

No viable exposure pathway beneath hardstanding and cover system.

Notes 3

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

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

- i. Value derived from LQM Sutable 4 Use Levels (S4ULs) for residential end use with plant uptake.
- ii. Value derived from LQM Sutable 4 Use Levels (S4ULs) for residential end use without plant uptake – these levels used below 600 mm cover system within residential gardens as soils will be present within a residential setting yet soils will not be disturbed and garden plants will not reach these soils.
- iii. Value derived from LQM Sutable 4 Use Levels (S4ULs) for public open space (POS) residential.
- iv. Value derived from LQM Sutable 4 Use Levels (S4ULs) for public open space (POS) park – these levels used below 300 mm POS cover system as soils will not be disturbed by any future site users and exposure to these soils will be similar to a park end use.
- v. Value derived from LQM Sutable 4 Use Levels (S4ULs) alongside assessment with WM3 to ensure that materials remaining on site do not exceed the WM3 toxicity criteria for hazardous waste.
- vi. Value derived from Category 4 Screening Levels (C4SL) for residential land use with homegrown produce.
- vii. Value derived from Category 4 Screening Levels (C4SL) for residential land use without homegrown produce.
- viii. Value derived from Category 4 Screening Levels (C4SL) for public open space (POS) residential.
- ix. Value derived from Category 4 Screening Levels (C4SL) for public open space (POS) park.
- x. Mercury – based on elemental mercury.
- xi. PAH and TPH levels used are for 1% SOM.
- xii. Xylenes based on p-xylene (o-xylene 2600 mg/kg, m-xylene 3500 mg/kg) and is capped by its solubility.
- xiii. Value derived from LQM Sutable 4 Use Levels (S4ULs) for residential end use with plant uptake due to the volatilisation risk.
- xiv. BTEX is not SOM-related due to inhalation pathway.



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

DETERMINAND	UNIT	EQS SCREENING VALUE ^{1, 2, 3}		DWS ^{3,4,5}
		AA	MAC	
Arsenic	µg/l	50	–	10
Cadmium	µg/l	0.08-0.25	0.45-1.5	5
Chromium (VI)	µg/l	3.4	–	–
Chromium (III)	µg/l	4.7	–	50
Copper	µg/l	1	–	2000
Total Cyanide	µg/l	1	–	50
Lead	µg/l	1.2	14	10
Mercury	µg/l	–	0.07	1.0
Nickel	µg/l	4	34	20
Selenium	µg/l	–	–	10
Zinc	µg/l	10.9	–	–
pH		6–9		
Naphthalene	µg/l	2	130	10*
Anthracene	µg/l	0.1	0.1	
Benzo[b]fluoranthene	µg/l	0.00017*	0.017	
Benzo[k]fluoranthene	µg/l	0.00017*	0.017	
Benzo(a)pyrene	µg/l	0.00017*	0.27	
Indeno(123-cd)pyrene	µg/l	0.00017*	5*	
Benzo(ghi)pyrene	µg/l	0.00017*	5*	
Fluoranthene	µg/l	0.0063	0.12	
Benzo(ghi)perylene	µg/l	1.7–4	8.2–3	
TPH C5-C6 (benzene)	µg/l	10	50	1
TPH C6-C8 (toluene)	µg/l	74	–	700
TPH C8-C10 (ethyl benzene)	µg/l	20	–	300
TPH C10-C12 (xylene)	µg/l	30	–	500
TPH C12-C16	µg/l	2	130	90 ⁵
TPH C16-C35	µg/l	50#	50#	90 ⁵
TPH C5-C6	µg/l	–	–	15000
TPH C6-C8	µg/l	–	–	15000
TPH C8-C10	µg/l	–	–	300
TPH C10-C12	µg/l	–	–	300
TPH C12-C16	µg/l	–	–	300



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

Notes

Solubility <0.01µg/l

AA – Annual Average

MAC- Maximum Admissible Concentration

* Polyaromatic hydrocarbons (PAH) - Benzo(a)pyrene (BaP), Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(g,h,i)-perylene and Indeno(1,2,3-cd)-pyrene. Benzo(a)pyrene can be considered as a marker for the other PAHs, hence only benzo(a)pyrene needs to be monitored for comparison with the biota EQS or the corresponding AA-EQS in water

** There are no WHO Guideline Values for aliphatic fractions C16-C21 and C21-C35, therefore the guideline value for aliphatic fractions inclusive of C8-C16 (300µg/l) has been applied.

1. The Water Environment (Water Framework Directive) (England and Wales) (Amendment) Regulations (2015)
2. Directive establishing a framework for Community action in the field of water policy (Water Framework Directive)
3. Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (Dangerous Substances Directive) - List II substances
4. Council Directive on the quality of water intended for human consumption (Drinking Water Directive)
5. WHO Guidelines for Drinking Water Quality. Third edition (2004)



APPENDIX V

E3P MATERIAL IMPORT CRITERIA

SITE OF IMPORTATION ADDRESS		E3P +44 (0) 161 707 9612 info@e3p.co.uk 
Client		
Main Contractor		
Earthworks Contractor		
Haulier		
Date of Planned Import		
Overview of Planned Material Import		
Material Source (Site of Origin) and Postcode		
Site Investigation Report	Report Title and Reference: Date: Information Supplied By:	
Reason for Generation of Excess Material at Site of Origin		
Chemical Test Results for Stockpile at Site of Origin	Date: Laboratory Certificate Ref: Organisation Responsible for Stockpile Sampling:	
Geotechnical Material Classification and Testing	Delete as Appropriate: Class 1 / Class 2 / Class 6 / Topsoil	
Pictures of Material Stockpile Pending Transportation	Delete as Appropriate: Yes / No	
Person or Organisation Responsible for Ensuring Quality Control at Site of Origin		
Quantity of Material to Be Imported (m³)		
Proposed Area of Deposition (Site of Reuse)		
Waste Exemption/Permit or CL:AIRE MMP	Delete as Appropriate: U1 Standard Rules / CL:AIRE MMP (Direct Transfer) / Bespoke	



APPENDIX VI CONTRACTOR PRE- COMMENCEMENT CHECK SHEET

GEOTECHNICAL ENABLING WORKS PRE-START FORM

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

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



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



APPENDIX VII CONTRACTOR COMPLETION CHECK SHEET

GEOTECHNICAL ENABLING WORKS COMPLETION FORM

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

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



POST-REMEDIATION AND ENABLING LIMITATIONS

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



