



Remediation and Enabling Works Strategy  
Well Street, Buckley

Reference:14-278-R3  
Date: October 2020



# REMEDIATION AND ENABLING WORKS STRATEGY

Proposed Residential Development  
Well Street  
Buckley  
Wales  
CH7 2PQ

Prepared for:  
**Alan Johnston Partnership Ltd**

**Report Ref: 14-278-R3**  
**Date Issued: October 2020**



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## EXECUTIVE SUMMARY

<b>Site Address</b>	Land at Well Street, Buckley, Wales, CH7 2PQ
<b>National Grid Reference</b>	E 326750, N 363630
<b>Site Area</b>	5.31 Hectares
<b>Background</b>	<p>E3P has been instructed by AJP to develop a remediation and enabling works strategy for the proposed residential development at the site located to the west of Well Street, Buckley.</p> <p>The E3P Remediation and Enabling Earthworks Strategy has been produced in due consideration of the geoenvironmental site investigation and contaminated land assessments undertaken by E3P.</p>

## CONTAMINATED LAND RISK ASSESSMENT

<b>Human Health Risk Assessment</b>	<p>The Tier I Human Health Risk Assessment has identified the presence of elevated concentrations of lead within shallow topsoil deposits. The shallow topsoil deposits are therefore not suitable for use within proposed “soft” areas, where a direct exposure pathway exists.</p> <p>Lead is identified at 0.10m bgl in TP123 and TP111. The concentrations have primary exposure pathways related to dermal contact and ingestion, soil ingestion and consumption of homegrown produce. These exceedances can be mitigated by the installation of a chemically suitable cover system within proposed gardens in these areas. Alternatively, these hotspots can be excavated and delineated through chemical validation during remedial works and placed in a future low sensitivity area within the proposed development, after which cover systems will no longer be required.</p> <p>Asbestos, petroleum hydrocarbons and poly aromatic hydrocarbons have not been identified within any of the samples submitted for assessment</p> <p>Chemical analysis of the natural drift deposits have identified these soils to be acceptable for use as subsoil within the proposed garden areas; however, further chemical validation samples will be required to confirm this in accordance with sampling frequencies herein.</p> <p>In addition, topsoil at the site (with the exception of the two locations noted above) will be suitable for reuse.</p>
<b>Controlled Waters Risk Assessment</b>	<p>The Tier I Controlled Waters Risk Assessment has been completed for the site utilising leachate analysis of soils and groundwater samples obtained during and after the ground investigation site works. Three locations within two discrete areas of the site confirm the presence of zinc and one location (WS111) identifies the presence of TPH C5-6.</p> <p>All three groundwater samples obtained identify Methylphenol which is considered to be a potential vapour risk. However, in context of the controlled waters, the risk is considered low in the absence of a viable receptor, significant source and the presence of low permeability cohesive stratum.</p>



<b>Ground Gas</b>	<p>Current assessment based on initial monitoring visit confirms one area of the site (WS108) identified levels of CO<sub>2</sub> that would require CS2/Amber 1 classification. Given the absence of a significant source in this area it is likely that this is the degradation/decomposition of carbonate minerals within the natural stratum.</p> <p>The full phase of ground gas monitoring should be completed to inform the full and detailed assessment and therefore level of risk. Currently an allowance for CS2/Amber 1 mitigation measures should be retained.</p>
<b>Coal Mining and Historical Workings</b>	<p>A review of the coal mining geology confirmed the presence of two coal seams (Half Yard Carl and Premier Coal Seams) as a subcrop within the site, dipping north towards the site boundary. A series of rotary boreholes were advanced to assess the potential presence of shallow workings within the Premier Coal Seam and the potential for ground instability in relation to the future proposed development.</p> <p>The rotary borehole locations did not provide evidence of any historic mine workings to the base of the boreholes (30m bgl). The potential seam thickness of the Premier Coal seam is ~530mm, there is therefore sufficient rock thickness above any workings at a greater depth than 30m bgl, in order to achieve a 10x seam thickness.</p>
<b>Invasive Plants</b>	<p>No invasive plant species were identified within the site boundary.</p>
<b>Potable Water Supply</b>	<p>This will need to be confirmed following the completion of a UKWIR risk assessment. Post-remediation and enabling works ground conditions may be different to those identified during the site investigation works. It will therefore be necessary to undertake appropriate remediation works with robust validation tests. However, it is most likely that the site will be suitable for PE pipeline.</p>

## GEOTECHNICAL ASSESSMENT

<b>Relict Sub-Structures</b>	<p>Made Ground has not been identified to contain any obstructions and given the site history, anthropogenic obstructions are not expected.</p> <p>In addition, natural boulders and obstructions have not been encountered during the site investigations to date.</p>
<b>Adverse Ground Conditions</b>	<p>All potentially infilled historical features where deleterious/putrescible material is identified should be located and subject to the necessary remediation works.</p>
<b>Proposed Foundations</b>	<p>Due to the existing large variances in the site topography, a phase of cut-and-fill enabling works will be required in order to create a proposed development platform suitable for a residential development. This will generally comprise of stepping levels through the site as the road to the south and property to the north currently tie into the site at the boundaries.</p> <p>Therefore, upon completion of these enabling works, it is likely that the most cost-effective option for the majority of the site would be to construct plots utilising a shallow strip, spread foundation or mass trench fill.</p> <p>Peat was not encountered during the E3P site investigation. However, where this is recorded in previous investigation, E3P identified a soft clay. As such, foundations may require deepening to a structural engineering design to tolerate risks associated with the compressibility of the materials and to tolerate total and differential settlement across the plot footprint.</p>



<p><b>Proposed Foundations Continued...</b></p>	<p>Subject to finished levels, it is expected that &lt;5% of the site may require a deep mass trench or driven pile foundation solution.</p> <p>Foundation depths within the conjectured influence of former, existing and proposed trees will need to be deepened to ensure that structural loading bears within the underlying target stratum, which cannot be subject to volumetric instability associated within fluctuation in moisture content.</p>
<p><b>Highways and Infrastructure</b></p>	<p>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.</p> <p>All materials outside of structural/infrastructure development will be engineered and compacted to ensure consolidation associated with self-weight settlement is limited to &lt; 50 mm in accordance with the E3P specification.</p>

## REMEDICATION AND ENABLING WORKS

<p><b>Objectives</b></p>	<p>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.</p> <p>The geotechnical foundation zoning plan and structural engineer's drawings should be referenced to determine the proposed foundation solution.</p>
<p><b>Remediation and Enabling Works</b></p>	<p>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:</p> <ul style="list-style-type: none"> <li>✦ Implementing of all works in strict accordance with UK Environmental Permitting and local planning authority requirements.</li> <li>✦ Controlled removal of all trees and vegetation (Where required).</li> <li>✦ Removal and treatment of all invasive plant species (as required) in accordance with specialist contractor method statement, validation and independent certification.</li> <li>✦ Delineation and removal of lead-impacted soil, validation testing of material that remains and removal of all unsuitable soils.</li> <li>✦ Segregation of organic topsoil deemed unsuitable for use within a residential garden and placement in an area of no sensitivity or removal from site in accordance with UK waste management legislation.</li> <li>✦ Identification, delineation and removal of organic materials within infilled ponds or saturated areas.</li> <li>✦ Removal of all materials considered geotechnically deleterious.</li> <li>✦ Excavation and processing of Made Ground in a controlled manner with the sorting, processing and segregation of identified deleterious materials to geotechnical specification.</li> <li>✦ Validation sampling and leachate testing to confirm material retained on site poses no unacceptable risk to the residential end users, controlled waters or wider environ.</li> </ul>



<b>Remediation and Enabling Works Continued...</b>	<ul style="list-style-type: none"><li>✦ Importation of suitable material (if required) to achieve the required development levels.</li><li>✦ Replacement of material in accordance with the E3P enabling specification and engineering requirements.</li></ul>
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## **BUILD PHASE REQUIREMENTS**

<b>Summary of Build-Phase Mitigation Requirements</b>	<p>The developer's works will also include the completion of the following additional elements:</p> <ul style="list-style-type: none"><li>✦ Provision of a 300 mm growing medium (150mm topsoil, 150mm subsoil or natural strata wherever shallower) using certified material with appropriate validation within proposed areas of public open space, soft landscaping and private gardens.</li><li>✦ Construction of specific dwellings with appropriate gas mitigation to be compliant with CS2/Amber 1 for elevated CO<sub>2</sub> in isolated areas.</li><li>✦ Construction of appropriate potable water supply infrastructure.</li></ul>
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## **1. INTRODUCTION**

### **1.1. BACKGROUND**

E3P has been instructed by AJP to develop a remediation strategy and enabling works strategy for the proposed residential development at the site to the west of Well Street, Buckley.

### **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:



- ✦ **Smith Grant** –Phase I & II Contaminated Land & Geotechnical Assessment. Ref: R2458-R01-v1, dated September 2017. Prepared for Flintshire County Council.
- ✦ **E3P** – Phase I Geo-Environmental Site Assessment. Ref: Report No. 14-278-R1, dated August 2020, Prepared for Alan Johnston Partnership Ltd.
- ✦ **E3P** – Phase II Geo-Environmental Site Assessment. Ref: Report No. 14-278-R2, dated October 2020, Prepared for Alan Johnston Partnership Ltd.

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

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

## 1.5. REDEVELOPMENT PLAN

E3P understands that the proposed development will comprise a residential end use of 154 units (through a mix of apartment, detached, semi-detached, terraced property) with associated estate roads, utility infrastructure, private gardens and areas of landscaping.

A proposed development plan has been included in Appendix III (Ref 14-278-002) and is shown 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	Flintshire County Council
Developer	TBC
Geoenvironmental Consultant	E3P
Main Contractor	TBC
Remediation/Enabling Works Contractor	TBC
Human Health Regulator	Flintshire County Council
Controlled Waters and Waste Regulator	Environment Agency
Highways Adoption Authority	Flintshire County Council

## 1.7. REGULATORY CORRESPONDENCE

AJP are in the process of 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);
- ✳ Environment Agency planning liaison; and
- ✳ The Coal Authority.

## 1.8. SITE DETAILS

Site Address	Land at Well Street, Buckley, Wales, CH7 2PQ.
National Grid Reference	E 326750, N 363630.
Site Area	5.31 Hectares.

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

A site location plan is presented in Appendix VII as Drawing 14-278-001.



## 1.9. SITE SUMMARY

TABLE 1.1 SITE DESCRIPTION AND SETTING

<b>Occupancy/Use</b>	The site is currently utilised as agricultural land with evidence of silage production. The site is split north west to south east by a hedgerow.	
	There are no structures present within the site boundary. The site slopes from a high level in the western corner that falls towards the eastern boundary and the northern corner of the site. Gentle undulation is present throughout the site.	
<b>Environmental Setting</b>	<b>Drift Geology</b>	Glacial Till (Devensian) – Diamicton, CLAY.
	<b>Bedrock Geology</b>	Gwepsyr SANDSTONE (East). Pennine Lower Coal Measures – MUDSTONE, SILTSTONE and SANDSTONE (West). Bowland Shale Formation – MUDSTONE (South).
	<b>Hydrogeology</b>	Secondary A Aquifer (Bedrock). Secondary Undifferentiated (Drift).
	<b>Hydrology</b>	A large pond is present 31m south and a number of tributaries of the River Alyn are present in the immediate (30 m) surrounding area.
	<b>Flood Risk</b>	Low lying areas of the site are considered to be at risk from surface water flooding. However, no risk of fluvial flooding has been identified in the data searches.
	<b>Subsidence Hazard</b>	Low to no hazard identified within the data searches.
<b>Site History</b>	A review of the historical mapping indicated the site has always comprised two undeveloped fields, split in half by a field boundary. On the 1872 mapping, a pond is noted on the northern boundary, however this was infilled by 1899. A hedgerow is noted to be present between 1982 and 1987. No changes have occurred to the site since.	
<b>Landfill Sites and Ground Gases</b>	<p>No currently active or historical landfills are identified within 250m of the site.</p> <p>A historical pond is noted to the north of the site and has since been infilled. Historic hedgerows are noted in the south since removed. The Made Ground infilled materials used in each location could be a source of ground gas generation.</p> <p>One area of peat was noted within the previously completed site investigation that could also present a source of ground gas generation.</p>	
<b>Radon</b>	<p>The southwestern area of the site is within an intermediate probability radon area where 5-10% of homes will be affected. The remainder of the site is considered to be in a lower probability area whereby 1% of homes will be affected.</p> <p>Basic radon protective measures may be necessary within the site.</p>	



## 1.10. SUMMARY OF REPORTED GROUND CONDITIONS

E3P has prepared a detailed Site Investigation Report (Ref: 14-278-R2, dated October 2020). The summary of reported ground conditions is given in Table 1.2.

TABLE 1.2 SUMMARY OF GROUND CONDITIONS

<b>MADE GROUND</b>	<p>Made Ground has been identified in two discrete areas of the site (TP121 at 0.50m and TP123 at 0.30m) as reworked topsoil with clay pipe fragments and as reworked natural clay with fragments of a land drain present. Not considered significant sources of potential contaminants and are likely due to agricultural practices at the site.</p> <p>The depth of Made Ground across the site has been illustrated on drawing 14-278-006 (Appendix III). The full depth of Made Ground has been proven in both instances.</p>
<b>Topsoil</b>	<p>Topsoil has been identified in all exploratory locations with the exception of the two Made Ground areas. Topsoil is encountered as a slightly gravelly sandy clay with frequent rootlets and gravel of fine to coarse subangular to subrounded mudstone. Topsoil has been identified to depths between ground level and 0.30m bgl.</p>
<b>Drift</b>	<p>Natural drift deposits have been identified within all exploratory locations. Predominantly throughout the site a gravelly sandy CLAY with gravel of mudstone and sandstone is identified. Clay stratum has been noted as highly friable and so hand shear vane tests could not be completed in some cases.</p> <p>Occasionally a grey gravel of mudstone is identified at the base of excavations (TP116, TP117, TP121, WS105, WS106 and WS106A) circa 2.00-3.00m bgl and within RBH103 between 4.00m and 7.60m bgl. Mudstone bedrock is noted through the site and this could therefore be representative of a weathered layer of bedrock stratum.</p> <p>In rare locations (TP120, 124, WS110, RBH102 and RBH105) a clayey sand is identified at similar depths.</p> <p>Within the previous site investigation, a 'highly localised' area of peat was identified to the south west of the site. E3P advanced a number of locations in this area that has not identified peat.</p>
<b>Bedrock</b>	<p>The solid bedrock geology was identified throughout the site in rotary positions at depths between 3.30m and 8.10m bgl. Bedrock was identified as interbedded grey siltstone, sandstone and mudstone with occasional marl. Bedrock strata was encountered to a maximum proven depth of 30.00m bgl.</p>
<b>Groundwater</b>	<p>Groundwater was encountered at six locations through the site as perched water within cohesive strata and above bedrock strata at depths between 2.00m and 4.00m bgl.</p>



## 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:

- ☛ Lead.

The elevated concentrations have a primary exposure pathway related to ingestion of soils. The risk to chronic human health associated with the elevated concentrations on inorganic heavy metals can be mitigated through the installation of a suitable cover system in proposed private gardens, landscaping and public open space in the area of the isolated impact to remove any potential for direct exposure to impacted soils.

Alternatively, given that the exceedance is localised it could be treated as an isolated hotspot and removed during a phase of remedial works with validation sampling to ensure future placement within a low risk area. On completion, a 600mm cover system would not be a requirement and a 300mm growing medium (comprising 150mm topsoil and 150mm subsoil/clean natural soils) would be suitable.

The specific design and installation process for the appropriate cover systems will be clearly defined within the site remediation and enabling works strategy herein.

Chemical analysis of the natural drift deposits have identified these soils to be acceptable for use as subsoil within the proposed garden areas. In addition, topsoil at the site (with the exception of TP111 and TP123) will be suitable for reuse. Once the two minor hotspots have been removed from the topsoil at the site a cover system will not be necessary as the potential risk will be managed by this process. Following a topsoil scrape the clean natural stratum will be exposed and can be capped with 150mm (site generated) topsoil to complete the landscaping and garden areas.

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

- ☛ Management of soils to ensure that all materials impacted by lead 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 with ground gas mitigation measures that conform to CS2/Amber 1 requirements of BS 8485 / pending completion of the full phase of ground gas monitoring.





## 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 has identified elevated concentrations of inorganic compounds that would exceed the screening criteria for drinking water standards.
- ✳ Heavy metals have been identified in three samples positioned in two discrete low-lying areas of the site. The low lying nature and prolonged periods of standing water could encourage decomposition of plant matter releasing zinc into the near surface and shallow groundwater. These areas are also low pH which encourages the bioavailability of zinc.
- ✳ Elevated levels of TPH C5-C6, as well as Toluene, Benzene, Phenol and Isopropyltoluene within WS111 can be also linked to varying quantities of Methylphenol identified within all three water samples. These semi-volatile/volatile hydrocarbons have a low solubility in water, and can all be associated with a localised spill of oil/fuel/degreasing agents/pesticides that could all be linked to the agricultural uses and machinery utilised at the site.

Given that the site is underlain by low-permeability, predominantly cohesive glacial till deposits, which will afford protection to the underlying Secondary A Aquifer, and in the absence of a groundwater abstraction within influencing distance of the site, there is considered to be a low risk to controlled waters and the wider environ as no complete pollutant linkage can be determined.

## 2.4. GROUND GAS

Ground gas has been assessed by E3P as part of the E3P Geoenvironmental Site Assessment. The assessment was completed in accordance with the methodology outlined with the CIRIA publication C665, 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 CO <sub>2</sub> (% v/v)	GSV (l/hr)	MAX CH <sub>4</sub> (% v/v)	GSV (l/hr)	CLASSIFICATION
WS101	0.10	0.00052	0.60	0.00312	Green/CS1
WS102	0.10	0.00096	2.20	0.02112	Green/CS1
WS103	0.10	0.00026	0.70	0.00182	Green/CS1
WS104	0.10	0.00026	2.80	0.00728	Green/CS1
WS105	0.10	0.00026	3.70	0.00962	Green/CS1
WS106	0.10	0.00052	0.60	0.00312	Green/CS1
WS107	0.10	0.00026	1.90	0.00494	Green/CS1
WS108	0.10	0.00013	7.20	0.00936	Amber 1/CS2
WS109	0.10	0.00010	2.20	0.00220	Green/CS1
WS110	0.10	0.00340	1.70	0.05780	Green/CS1
WS111	0.10	0.00176	4.60	0.08096	Green/CS1
WS112	0.10	0.00180	1.80	0.03240	Green/CS1



The GSV has been compared to the criteria outlined with CIRIA C665 to determine the level of risk to the proposed development and to ensure the appropriate remedial options are incorporated into any future building design in this area.

Preliminary ground gas monitoring 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, a localised area of the site have been assessed as being CS2 and properties within this area may require specialist protection measures as detailed below.

Upon completion of the full phase of ground gas monitoring at the site, it may be possible to appropriately regard the site as Characteristic Situation 1 and plots within the proposed future development may not require the installation of ground gas mitigation measures however at this stage an allowance for CS2 mitigation measures should be retained.

## **2.5. 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 and it will be necessary to delineate the impacted soils where present at locations that could potentially impact the potable water infrastructure should be suitable to remediation with robust validation testing.

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 TECHNOLOGY

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

- ✦ Management of all soils impacted by lead (where this is not completed a 600mm cover system will be required);
- ✦ Validation of soils to show that all residual soil concentrations are below the site-specific remediation targets site specific remediation targets (SSRT) for the protection of human health, controlled waters and the wider environ;
- ✦ Characteristic Situation 2 ground gas mitigation measures selected units at WS211 and WS208 to ensure compliance with BS 8485 (2015)+A1(2019), with independent validation of each unit.

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

##### 3.1.1. CONTAMINANTS OF CONCERN (COC)

###### METALS COMPOUNDS

The human health risk drivers for the 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.

#### 3.2. OVERVIEW OF WORKS

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

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



### **RE-1 – Pre-commencement Regulatory Compliance**

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

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

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

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

It is 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 operation or arrange for the deployment of the appropriate environmental permit for the specified operation.

### **RE-2 – 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-3 – Risk to Infrastructure**

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

Where a risk is identified works should be halted and an alternative method sought.



#### **RE-4 – Identification, Isolation and Treatment of Invasive Plants**

Invasive plant species have not been identified on site. The remediation contractor must satisfy themselves with respect to the extent of any species deemed invasive prior to the commencement of works on site. The contractor shall employ a suitably qualified expert to investigate the presence of invasive plant species on or adjacent to the site. 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-5 – Site Clearance Operations**

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

The site is currently grassland with self-seeded vegetation and a single hedgerow through the centre; where required 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-6 – Recovery of Natural Topsoil**

The site investigation report confirms natural organic soils (topsoil) present at the near surface throughout the site. With the exception of two locations with contaminant issues the topsoil is likely to be suitable for reuse within the proposed development. 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-7 – Delineation, Excavation and Treatment of Lead Impacted Topsoil

The elevated concentrations of lead within the topsoil deposits have a primary exposure pathway related to ingestion of soils at two discrete locations (TP111 at 0.10m bgl and TP123 at 0.10m bgl).

Given that the exceedances are localised, they could be treated as an isolated hotspot and removed, with validation sampling to ensure future placement within a low risk area. On completion, a 600mm cover system would no longer be a requirement and a 300mm growing medium (comprising 150mm topsoil and 150mm subsoil) would be suitable.

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

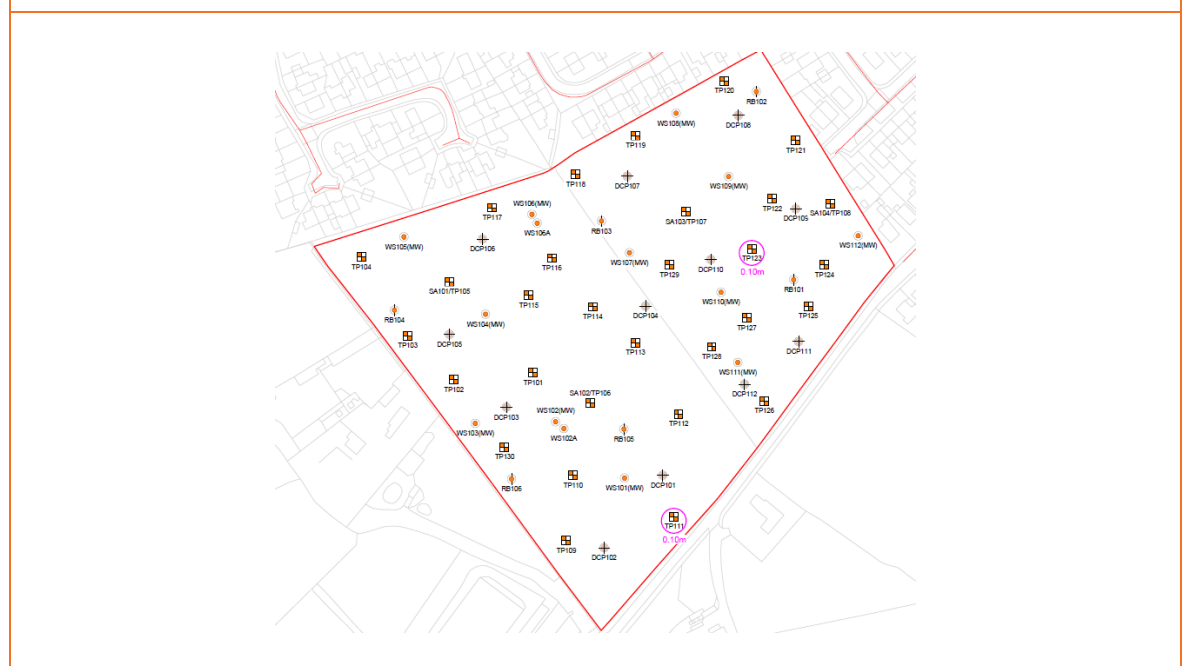
Validation samples will be collected at 10 linear meter centres from the side and base of the excavation.

In the 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.

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 location of known lead impacted soil are shown in Figure 3.1 and included in Drawing 14-278-013 in appendix III.

FIGURE 3.1 LOCATION OF IDENTIFIED LEAD IMPACT



**RE-8 – Delineation, Excavation and Treatment of Infilled Historical Ponds**

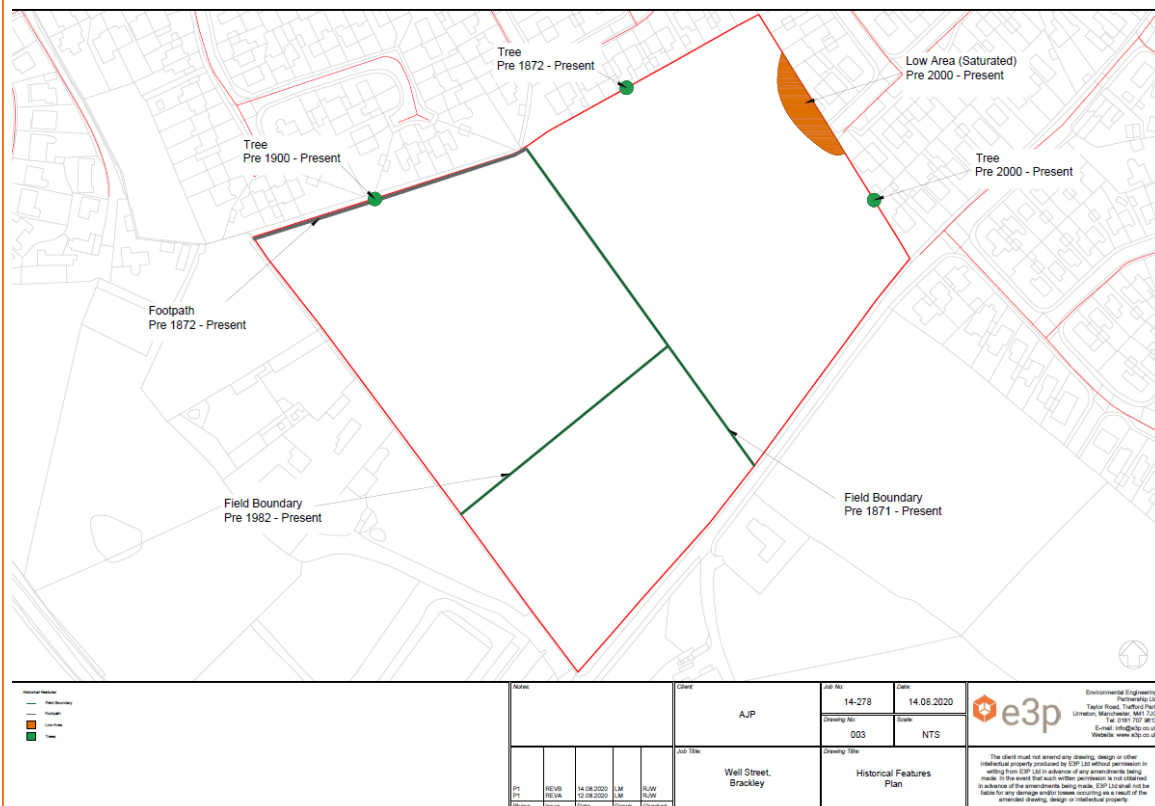
Prior to the commencement of the main earthworks (where possible), all known former infilled ponds should be clearly identified and demarked and investigated to assess the nature of materials and extent of any deleterious elements.

Historic infilled ponds have not been identified within the E3P desk study; however, an area of saturated land has been identified and is shown on the Historical Features Plan (Drawing 14-278-003 in Appendix III and in Figure 3.2.

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.

**FIGURE 3.2 LOCATION OF IDENTIFIED SATURATED AREAS**





### RE-9 – Removal of Deleterious Material

The E3P Ground Investigation has not identified any deleterious wastes across the site. However, if they are encountered, all potentially deleterious materials should 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-10 – Replacement of Materials, Geotechnical Engineering Requirements

Given the site topography, it is considered likely that a certain element of cut and fill will be required to facilitate the production of a level development platform.

Material is to be backfilled in strict compliance with the E3P Geotechnical Engineering Specification as presented in detail within Section 5 of this report, which generally requires the reinstatement and compaction criteria presented in 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 1.50 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
<b>Footprint of Proposed Structure (2 m on All Elevations)</b>	Traditional Spread Foundation	Ensure no disturbance of natural soil at shallow depth.
<b>Highways</b>	Adopted Estate Road/Drainage	Manual of Contract Documents for Highways Works (MCHW) Series 600 ensuring CBR > 5% in subgrade (engineered fill).
<b>Driveways</b>	Private Drives and Car Parking	Method compaction to CBR > 5%.
<b>Gardens and Public Open Space</b>	N/A	Method compaction to ensure no settlement.



### RE-11 – 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 5).

Imported material must be certified as suitable for use in strict accordance with the E3P chemical and geotechnical performance criteria (See Section 5) 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-12 – Preparation of Garden for Cover System

Where the lead impacted soils are **not** segregated and validated as part of the land remediation works, garden areas will be prepared in a manner that will facilitate the placement of a 600mm 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.

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 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-13 – Provision of Subsoil

The shallow natural drift deposits (predominantly cohesive soils) are deemed suitable for use within the lower 150 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.

### RE-14 – Provision of Topsoil

Topsoil stockpiled from the site strip will be chemically validated and utilised as the upper 150mm of the growing medium, overlying the subsoil (see RE 6, 7 and 13).

Topsoil will require testing in line with the schedule present within Section 3.3 and Table 3.2.



### **RE-15 – 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-16 – Validation of Materials for Potable Water Supply Infrastructure**

A contaminant risk assessment completed in accordance with the UKWIR assessment framework did not identify any elevated concentrations of potentially volatile/soluble hydrocarbon compounds that necessitate the use of protected water supply pipework.

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, with samples analysed for all pertinent volatile and semi-volatile hydrocarbons and, where necessary, chlorinated/halogenated compounds.

Upon successful remediation, 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.

Where imported material is required to construct the potable water infrastructure pipework, this material will need to comply with 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-17 – Remedial Verification Report**

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

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



### 3.3. VALIDATION SAMPLING PROTOCOL

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

Upon removal of the hotspot of unsuitable Made Ground in the northern sector, 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 III), 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
<b>Site-Generated</b>		
Site-Generated 6F2	1 Sample per 1000 m <sup>3</sup>	A/B/C/D
Site-Won MADE GROUND General Backfill	1 Sample per 250 m <sup>3</sup>	G
Site-Won MADE GROUND General Backfill	1 Sample per 1000 m <sup>3</sup>	A/B/C/D
Site-Won MADE GROUND General Backfill	1 Sample per 2000 m <sup>3</sup>	I
Site-Won Natural Backfill	1 Sample per 2000 m <sup>3</sup>	A/B/C/D
Site-Generated Subsoil (450 mm Garden Cover)	1 Sample per 250 m <sup>3</sup>	A/B/C/D
Site-Generated Topsoil Cover (150 mm Garden Cover)	1 Sample per 50 m <sup>3</sup>	A/B/C/D
Hotspot Validation Samples	1 Sample per 10 m of linear excavation to base and sidewall	E/G
<b>Imported</b>		
6F2	1 Sample per 1000 m <sup>3</sup>	A/B/C/D
Subsoil Greenfield Source	1 Sample per 200 m <sup>3</sup>	A/B/C/D



<b>(450 mm Garden Cover)</b>		
<b>Subsoil Brownfield Source (450 mm Garden Cover)</b>	1 Sample per 50 m <sup>3</sup>	A/B/C/D
<b>Topsoil Greenfield Source (150 mm Garden Cover)</b>	1 Sample per 200 m <sup>3</sup>	A/B/C/D
<b>Topsoil Brownfield Source (150 mm Garden Cover)</b>	1 Sample per 50 m <sup>3</sup>	A/B/C/D
<b>General Engineering Fill (Class 1 and 2 Soil)</b>	1 Sample per 1000 m <sup>3</sup>	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.

### **3.4. REMEDIATION CONTRACTORS SITE MANAGEMENT AND RESPONSIBILITY**

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

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

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



## 4. MATERIALS MANAGEMENT AND LEGISLATIVE COMPLIANCE

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

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

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

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

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

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

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

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

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



## 5. ENVIRONMENTAL MONITORING AND VALIDATION

### 5.1. SITE MANAGEMENT

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

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

### 5.2. COMPLETION

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

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

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





### 5.3. MITIGATION OF RISK FROM SOILS WITH ASBESTOS FIBRES

#### 5.3.1. PRE-COMMENCEMENT WORKS

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

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

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

##### DAMPING DOWN OF SOILS – MITIGATE PARTICULATE (DUST) EMISSION

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

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

##### GENERAL CONTROL OF DUST

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

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



## PERSONAL PROTECTIVE EQUIPMENT (PPE)

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

Overalls:

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

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

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

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

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



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

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



## 6. GEOTECHNICAL ENGINEERING SPECIFICATION

### 6.1. E3P GEOTECHNICAL ENGINEERING SPECIFICATION

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

- 📦 Preparation of plots to be suitable for construction with 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.
- 📦 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).



TABLE 6.1 E3P EARTHWORKS GEOTECHNICAL COMPACTION SPECIFICATION

SOIL/MATERIAL TYPE	CLASS	DESCRIPTION	COMPACTION EQUIPMENT	LAYER THICKNESS	ROLLER PASSES
<b>Granular Fill</b>  <b>(Sand and Gravel Matrices)</b>	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
<b>Cohesive Fill</b>  <b>(Clay with Minor Sand and Gravel Component)</b>	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
<b>Recycled Aggregate Crush</b>  <b>(&lt; 125 mm Well Graded)</b>	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



### **6.3.2. USE OF FILL MATERIALS**

In addition to any grading requirement, the maximum particle size of any fill material shall be no more than two-thirds of the compacted layer thickness except that cobbles having an equivalent diameter of more than 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.







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

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				
<b>Liquid and Plastic Limits</b>	BS 1377: Part 2				
<b>Grading</b>	BS 1377: Part 2				
<b>Uniformity Coefficient</b>	Calculated from grading curve				
<b>Moisture Content</b> Multi-point moisture condition value (MCV) (to assess optimum moisture content).	BS 1377: Part 2				
<b>Organic Matter (Maximum 2.5% Total Organic Content)</b>	BS 1377: Part 3				
<b>Water Soluble Sulphate</b>	TRL Report 447 Test No 1				
<b>Total Sulphate Content</b>	TRL Report 447 Test No 4				
<p><b>Earthwork In-situ Tests</b> 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:</p> <table border="1" data-bbox="199 1164 885 1288"> <thead> <tr> <th>Test</th> <th>Test Method</th> </tr> </thead> <tbody> <tr> <td>Plate Load Tests (Equivalent CBR of 5%)</td> <td>BS 1377: Part 9</td> </tr> </tbody> </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				
<p><b>Disposal of Materials</b> The contractor shall be responsible for the safe disposal of any excess of unsuitable material found on the site.</p>					
<b>Proctor Compaction Testing</b>	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

<p><b>Step 1</b></p>	<p>Carefully segregate materials excavated during civil engineering works (on site and import) into the following soil types:</p> <ul style="list-style-type: none"> <li>✦ Sand/granular soils;</li> <li>✦ Dry sandy clay;</li> <li>✦ Wet clay soil; and</li> <li>✦ Silt.</li> </ul> <p>Ensure all stockpiles are sealed to minimise water ingress in approved locations.</p>
<p><b>Step 2</b></p>	<p>Analyse bulk sample from each (site-won or imported) soil matrix as per the requirements of the E3P specification for:</p> <ul style="list-style-type: none"> <li>✦ Dry density/optimum moisture content (Procter); and</li> <li>✦ Particle size grading coefficient.</li> </ul>
<p><b>Step 3</b></p>	<p>On-site observations in conjunction with particle size distribution (PSD) grading will confirm the classification of material and thus the corresponding method for compaction.</p>
<p><b>Step 4</b></p>	<p>The dry density/moisture content testing should be used to ensure that the material is within <math>\pm 3\%</math> of the optimum to ensure compaction can be achieved.</p>
<p><b>Step 5</b></p>	<p>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.</p>
<p><b>Step 6</b></p>	<p>Once placed and compacted, the required validation testing should be completed at formation to demonstrate compliance.</p> <p>The testing will include:</p> <ul style="list-style-type: none"> <li>✦ In-situ density and air void ratio;</li> <li>✦ Moisture condition value; and</li> <li>✦ Undrained shear strength.</li> </ul>



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

REQUIRED PARAMETERS	THE COMPACTION MUST ACHIEVE THE FOLLOWING MATERIAL PARAMETERS:	
<b>Verification Testing and Report</b>	<b>Bulk Density (<math>\rho</math>)</b>	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:	
	<b>In-situ Density (<math>\rho</math>)</b>	Approved methods of in-situ testing (i.e. calibrated nuclear density probe (NDP), sand replacement test).
	<b>Moisture Content</b>	Moisture content test.
In-situ density testing on every 500 m <sup>3</sup> 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 offsite; 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 any imported materials;
- ✦ Chemical validation of any additional topsoil/subsoil imported for use within gardens;
- ✦ Where impacted hotspots are **not** validated during remedial works; Placement and validation of topsoil / subsoil (clean material) in a 600mm layer within all plots in the area of TP111 and TP123; and,
- ✦ Installation and validation of ground gas protection measures in accordance with the completed phase of ground gas monitoring (currently on going).

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 <sup>3</sup>	A/B/C/D
Subsoil Brownfield Source (450 mm Garden Cover)	1 Sample per 50 m <sup>3</sup>	A/B/C/D
Topsoil Greenfield Source (150 mm Garden Cover)	1 Sample per 200 m <sup>3</sup>	A/B/C/D
Topsoil Brownfield Source (150 mm Garden Cover)	1 Sample per 50 m <sup>3</sup>	A/B/C/D
General Engineering Fill (Class 1 and 2 Soil)	1 Sample per 1000 m <sup>3</sup>	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

<b>PROCEDURE</b>	<b>METHOD</b>
<b>Chemical Validation</b>	<p>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.</p> <p>E3P will issue an email to the appropriate party with an assessment of the chemical suitability of both sub soils and topsoils.</p> <p>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.</p>
<b>Trial Holes</b>	<p>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.</p>
<b>Validation</b>	<p>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.</p> <p>For plots where sub-soil depths require validation by E3P during the build phase, photographs will be taken and collated by E3P.</p>
<b>Validation Certificate</b>	<p>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.</p>
<b>Completion Report</b>	<p>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.</p>

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



**PLATE 1 EXAMPLE PLOT COVER SYSTEM VALIDATION**

<b>Plot No: 70</b>		
<b>Depth of Strata (m bgl)</b>	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 areas of the site will fall into the bracket for Characteristic Situation 2 / Amber which will require specialist mitigation measures to be constructed in accordance with BS8485 (2015)+A1(2019).

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

Examples of gas membrane verification photographs provided in Plate 2.

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



PLATE 2 EXAMPLE GAS MEMBRANE VERIFICATION

Plot – 236

General Condition of Membrane-Good Condition



Verification of Joints and Seals-Good Condition



Verification of Service Penetrations-Good Condition



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



# **APPENDIX II**

# **GLOSSARY**

**TERMS**

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



**Well Street, Buckley**

## Remediation and Enabling Works Strategy

October 2020

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





# APPENDIX III DRAWINGS



Notes:

Client:  
**AJP**

Job No:  
**14-278**

Date:  
**22.09.2020**

Drawing No:  
**002**

Scale:  
**NTS**

P1	REVA	22.09.2020	HM	VW
Phase	Issue	Date	Drawn	Checked

Job Title:  
**Well Street,  
Brackley**

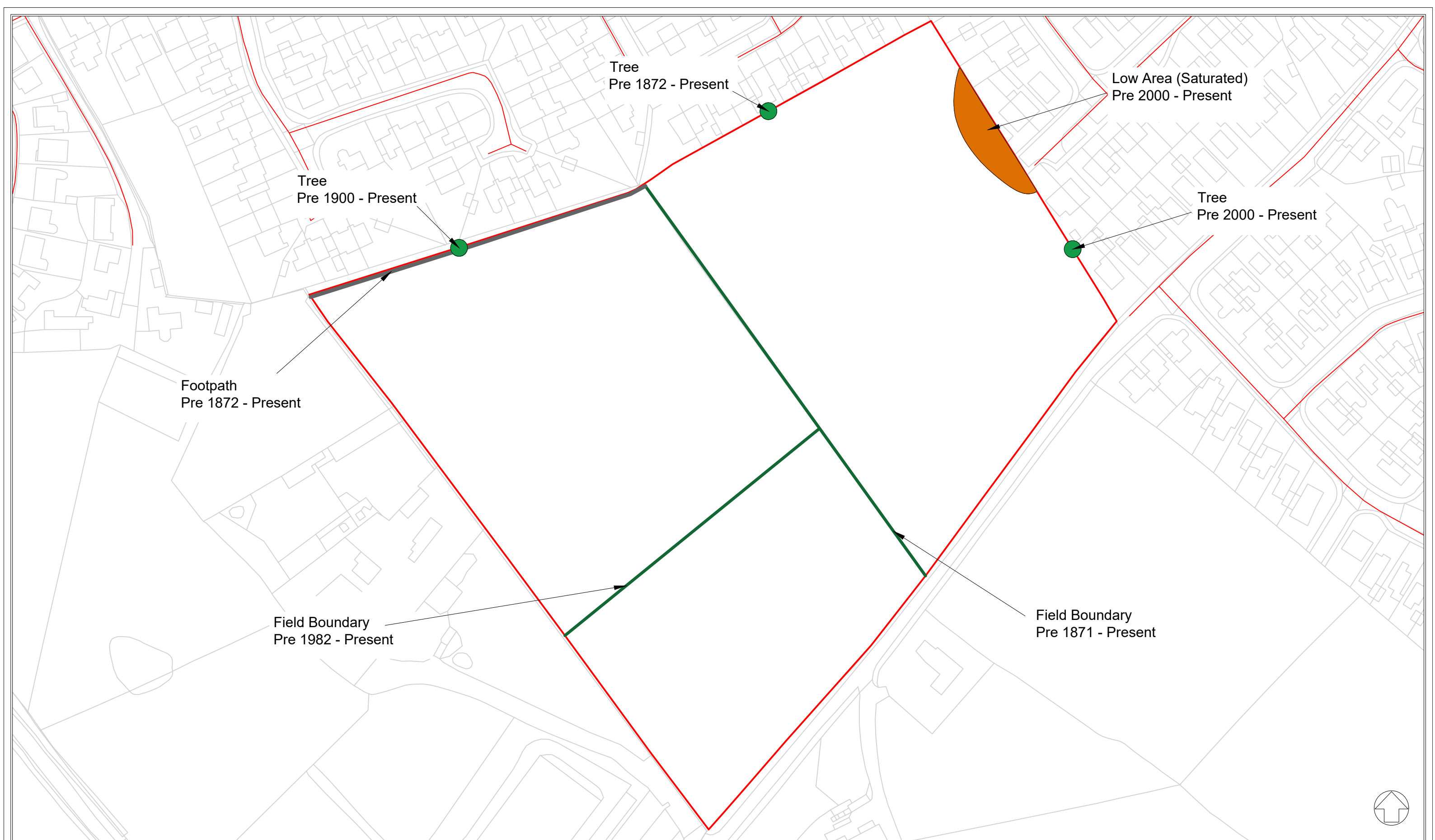
Drawing Title:  
**Proposed  
Development Plan**



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**Historical Features**

- Field Boundary
- Footpath
- Low Area
- Trees

**Notes:**

**Client:**  
AJP

**Job No:**  
14-278

**Drawing No:**  
003

**Date:**  
14.08.2020

**Scale:**  
NTS



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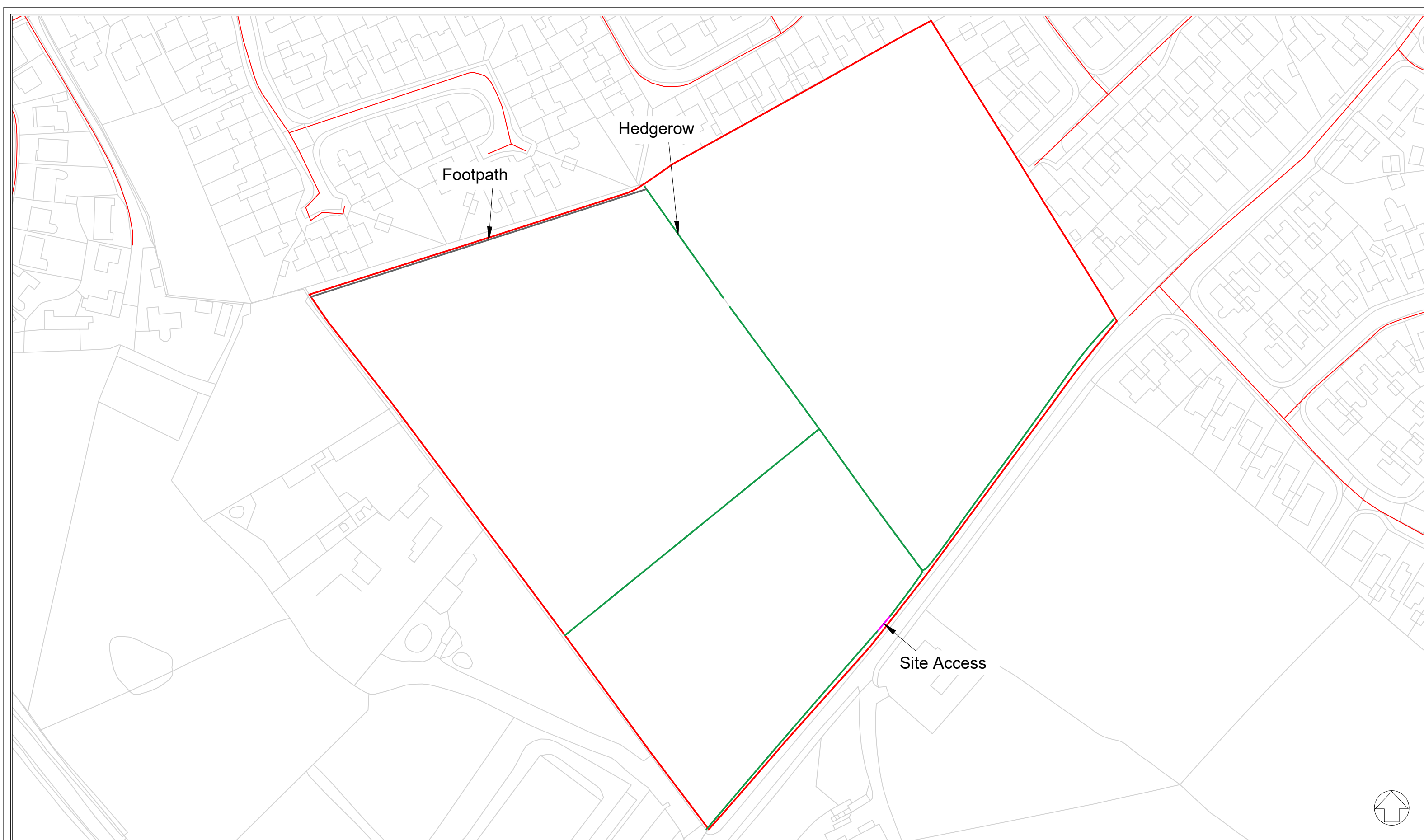
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P1	REVA	12.08.2020	LM	RJW
Phase	Issue	Date	Drawn	Checked

**Job Title:**  
Well Street, Brackley

**Drawing Title:**  
Historical Features Plan

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**Historical Features**  
 — Field Boundary  
 — Footpath  
 — Site Access

**Notes:**

**Client:**  
 AJP

**Job No:**  
 14-278

**Drawing No:**  
 004

**Date:**  
 18.09.2020

**Scale:**  
 NTS



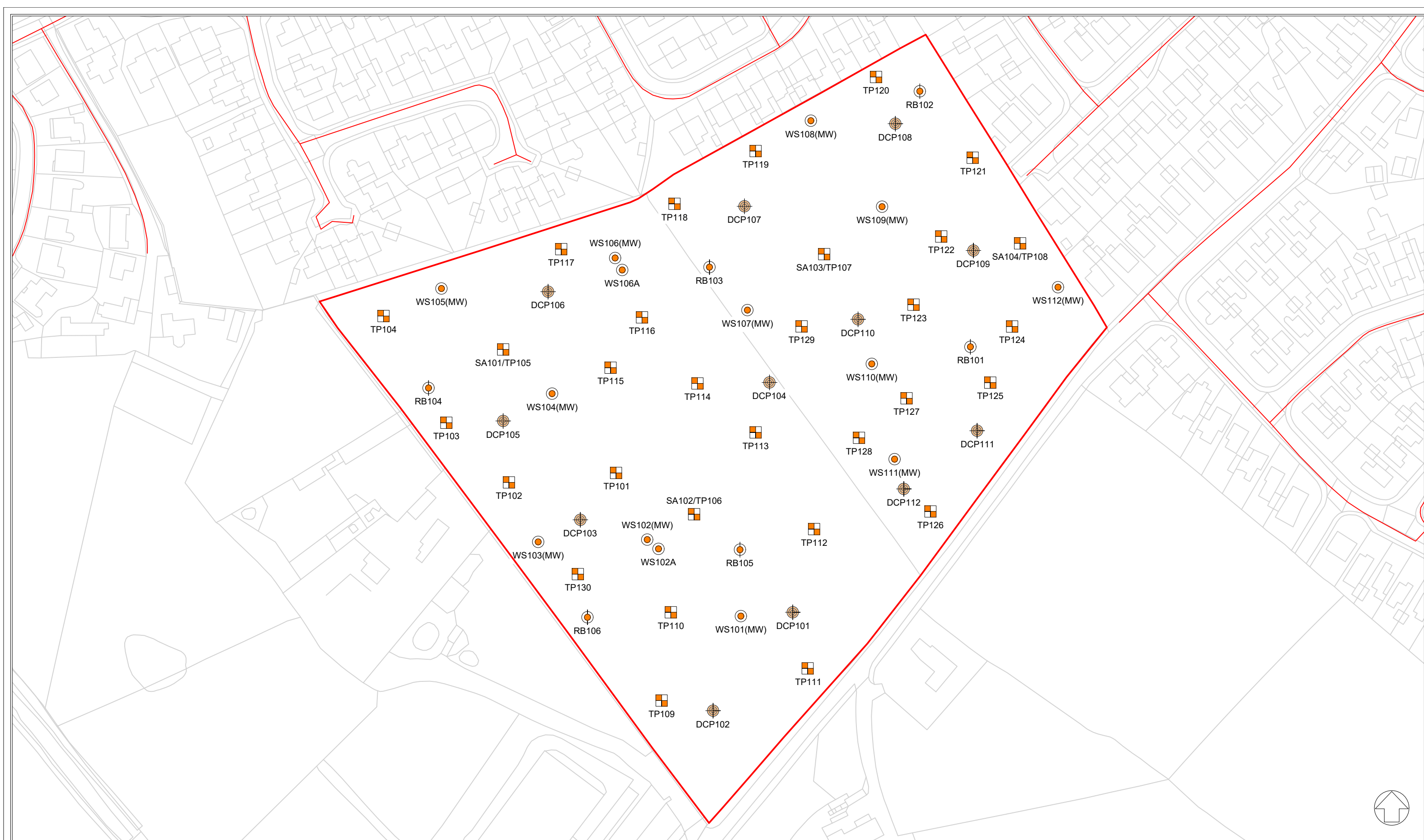
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 Website: www.e3p.co.uk

P1	REVA	18.09.2020	HM	RJW
Phase	Issue	Date	Drawn	Checked

**Job Title:**  
 Well Street,  
 Brackley

**Drawing Title:**  
 Site Features Plan

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- Location Symbols**
- Approximate Window Sample Probehole Location
  - Approximate Window Sample Probehole Location with Install
  - Approximate Trial Pit Location
  - Approximate Soakaway Test Location
  - Approximate Rotary Borehole Location

<b>Notes:</b>				
P1	REVA	17.09.2020	CB	RJW
Phase	Issue	Date	Drawn	Checked

<b>Client:</b>	AJP
<b>Job Title:</b>	Well Street, Brackley

<b>Job No:</b>	14-278
<b>Drawing No:</b>	005

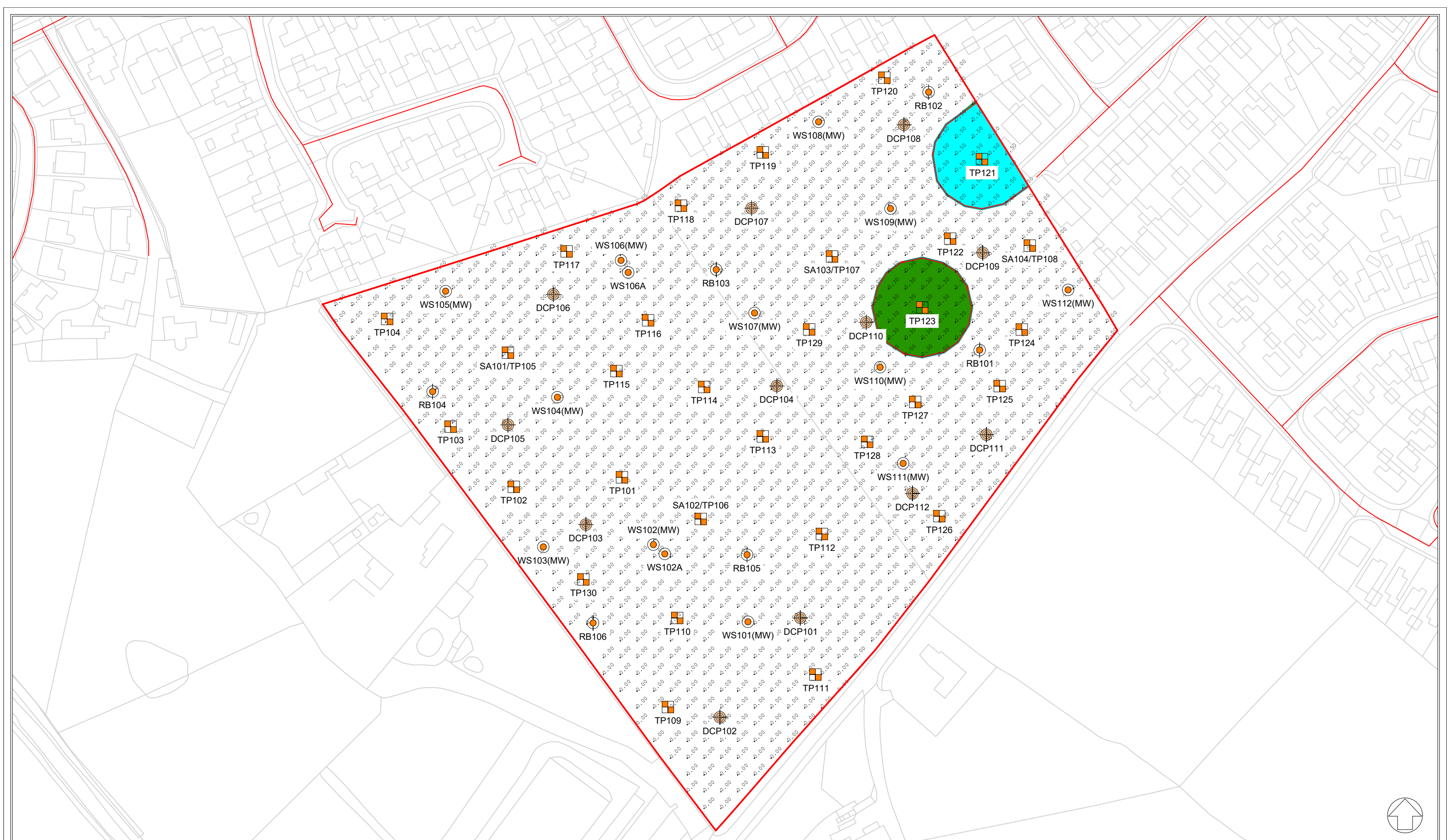
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- Location Symbols**
- Approximate Window Sample Probehole Location
  - Approximate Window Sample Probehole Location with Install
  - Approximate Trial Pit Location
  - Approximate Soakaway Test Location
  - Approximate Rotary Borehole Location

- Made Ground Depth (m)**
- Depth of Made Ground 0.00 - 0.19m
  - Depth of Made Ground 0.20 - 0.39m
  - Depth of Made Ground 0.40 - 0.59m
  - Depth of Made Ground 0.60 - 0.79m
  - Depth of Made Ground 0.80 - 0.99m
  - Depth of Made Ground 1.00 - 1.19m
  - Depth of Made Ground 1.20 - 1.39m
  - Depth of Made Ground 1.40 - 1.59m
  - Depth of Made Ground >1.60m

**Notes:**

Phase	Issue	Date	Drawn	Checked
P1	REVC	09.10.2020	HM	RJW
P1	REVB	08.10.2020	HM	RJW
P1	REVA	29.09.2020	HM	VW

**Client:**  
AJP

**Job Title:**  
Well Street,  
Brackley

**Job No:**  
14-278

**Drawing No:**  
006

**Date:**  
09.10.2020

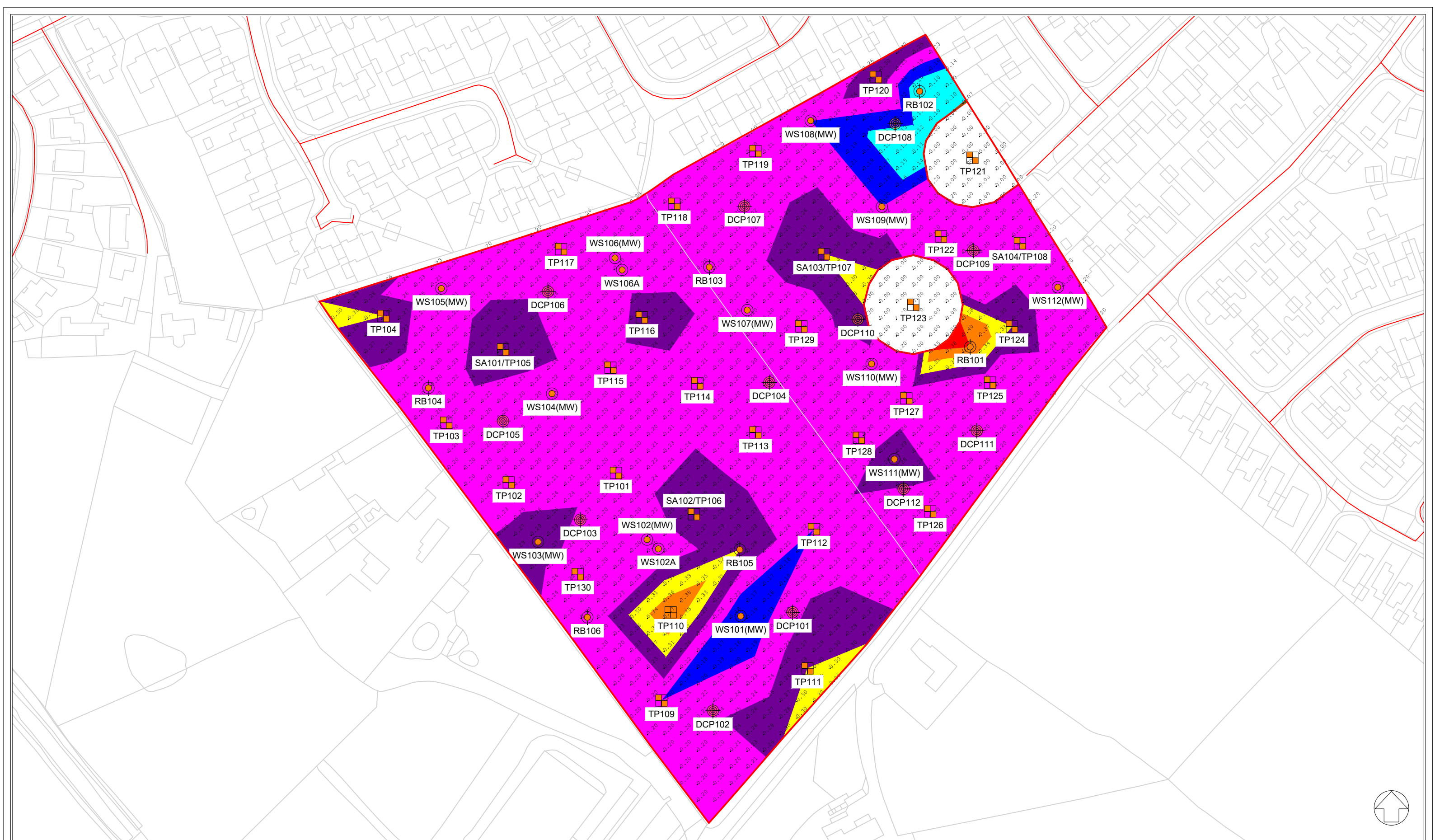
**Scale:**  
NTS



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E-mail: info@e3p.co.uk  
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**Drawing Title:**  
Depth of Made  
Ground Plan

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- Location Symbols**
- Approximate Window Sample Probeground Location
  - Approximate Window Sample Probeground Location with Install
  - Approximate Trial Pit Location
  - Approximate Soakaway Test Location
  - Approximate Rotary Borehole Location

- Topsoil Depth (m)**
- Depth of Topsoil 0.00 - 0.049m
  - Depth of Topsoil 0.05 - 0.099m
  - Depth of Topsoil 0.10 - 0.14m
  - Depth of Topsoil 0.15 - 0.19m
  - Depth of Topsoil 0.20 - 0.24m
  - Depth of Topsoil 0.25 - 0.29m
  - Depth of Topsoil 0.30 - 0.34m
  - Depth of Topsoil 0.35 - 0.39m
  - Depth of Topsoil >0.40m

**Notes:**

**Client:**

**Job No:**

**Date:**

AJP

14-278

09.10.2020

**Drawing No:**

**Scale:**

Phase	Issue	Date	Drawn	Checked
P1	REVC	09.10.2020	HM	RJW
P1	REVB	08.10.2020	HM	RJW
P1	REVA	22.09.2020	HM	VW

**Job Title:**

**Drawing Title:**

Well Street,  
Brackley

Depth of Topsoil Plan

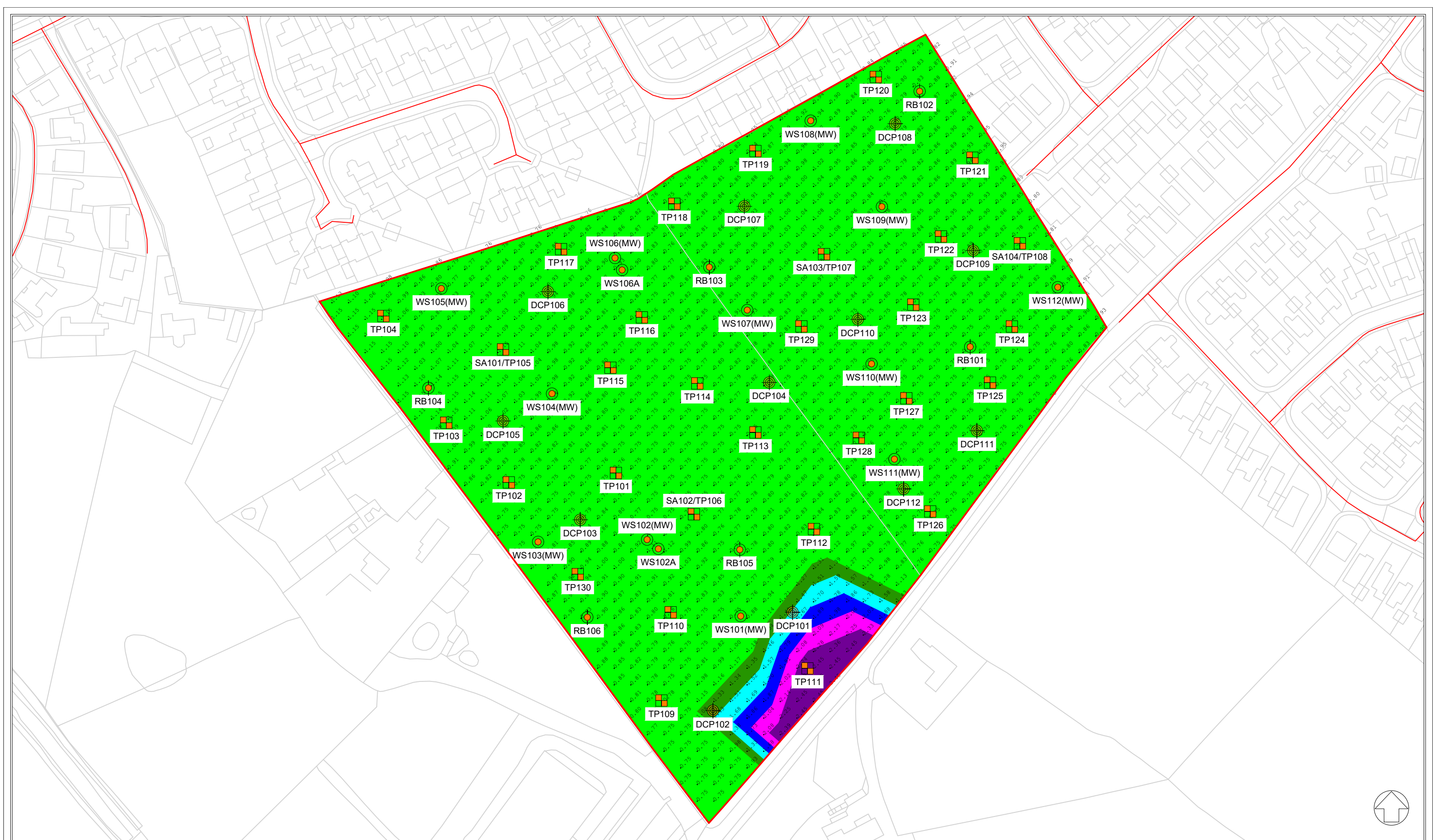


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- Location Symbols**
- Approximate Window Sample Probehole Location
  - Approximate Window Sample Probehole Location with Install
  - Approximate Trial Pit Location
  - Approximate Soakaway Test Location
  - Approximate Rotary Borehole Location
- Shallow 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:**

**Client:**

**Job No:**

**Date:**

AJP

14-278

28.09.2020

**Drawing No:**

**Scale:**

P1	REVA	28.09.2020	HM	VW
Phase	Issue	Date	Drawn	Checked

**Job Title:**

Well Street,  
Brackley

008

NTS

**Drawing Title:**

Depth to Founding  
Strata Plan



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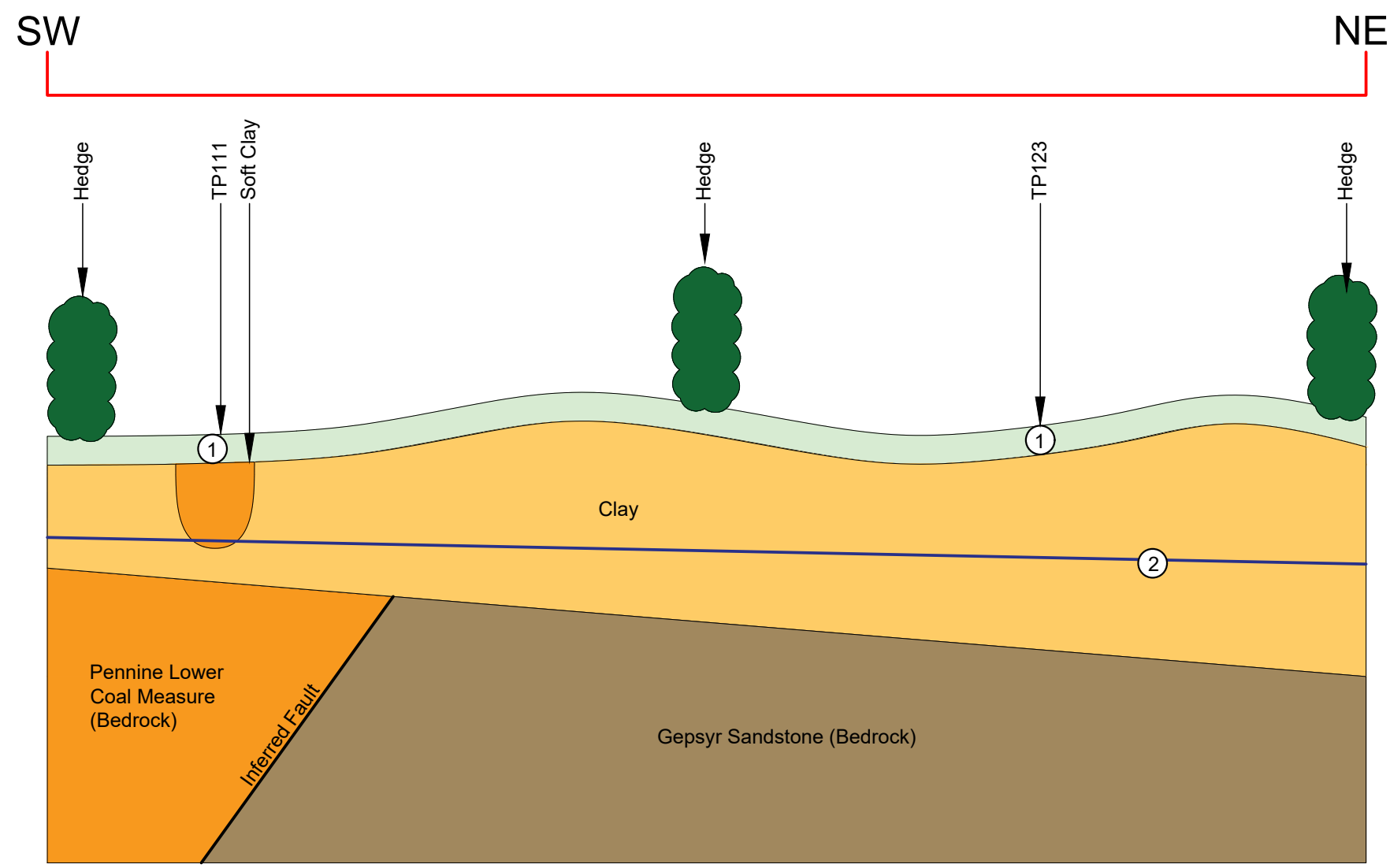
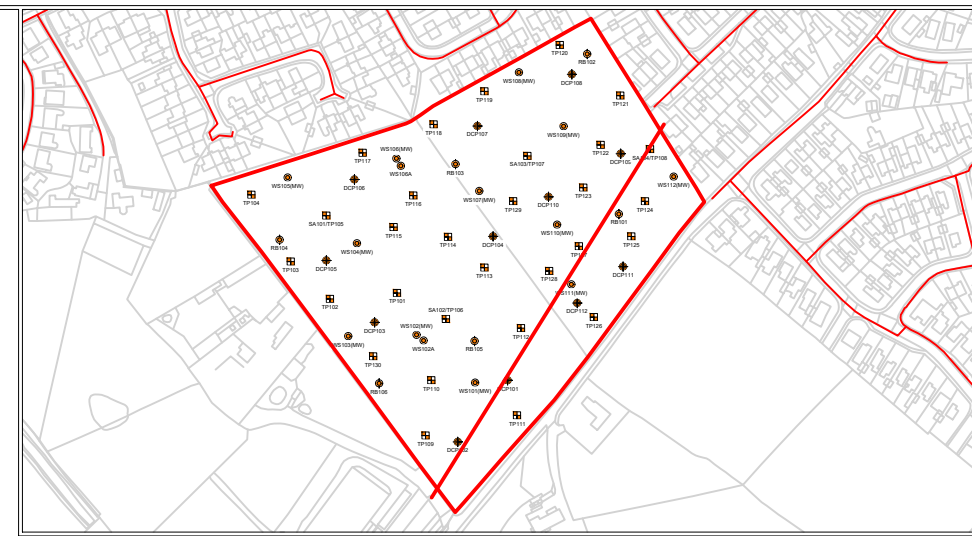
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ID	CONTAMINANT ACTIVITY	CONTAMINANTS	MIGRATION / EXPOSURE PATHWAY	RECEPTORS
<b>HUMAN HEALTH</b>				
1	Agricultural Activity	Heavy Metals (Lead)	Soil Ingestion	Future Site Users
2	Off-Site Commercial Activity	Mobile Contaminants (Methylphenol, phenol, benzene, toluene, isopropyltoluene)	Vertical Migration	Secondary A Aquifer



- Geological Features**
- Topsoil
  - Clay
  - Soft Clay
  - Gwepsyr Sandstone (Bedrock)
  - Pennine Lower Coal Measure (Bedrock)
  - Inferred Fault
  - Groundwater

**Notes:**

P1	REVA	28.09.2020	HM	VW
Phase	Issue	Date	Drawn	Checked

**Client:**

AJP

**Job Title:**

Well Street,  
Brackley

**Job No:**

14-278

**Drawing No:**

010

**Date:**

28.09.2020

**Scale:**

NTS

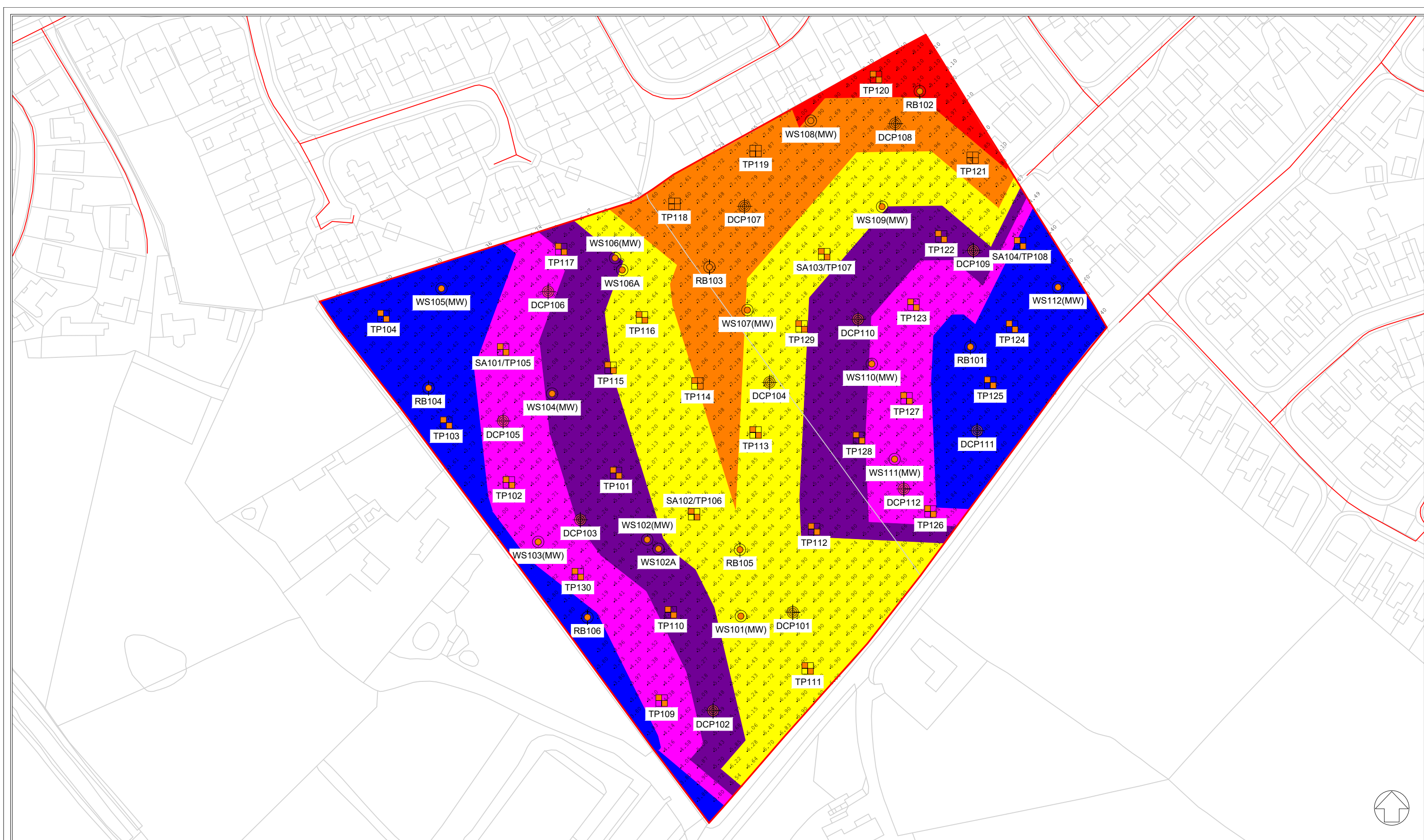
**Drawing Title:**

Conceptual Site  
Model

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Location Symbols		Bedrock Depth (m)	
	Approximate Window Sample Probeghole Location		Depth of Bedrock 0.00 - 0.99m
	Approximate Window Sample Probeghole Location with Install		Depth of Bedrock 1.00 - 1.99m
	Approximate Trial Pit Location		Depth of Bedrock 2.00 - 2.99m
	Approximate Soakaway Test Location		Depth of Bedrock 3.00 - 3.99m
	Approximate Rotary Borehole Location		Depth of Bedrock 4.00 - 4.99m
			Depth of Bedrock 5.00 - 5.99m
			Depth of Bedrock 6.00 - 6.99m
			Depth of Bedrock 7.00 - 7.99m
			Depth of Bedrock >8.00m

Notes:				
P1	REVA	22.09.2020	HM	VW
Phase	Issue	Date	Drawn	Checked

Client:	AJP
Job Title:	Well Street, Brackley

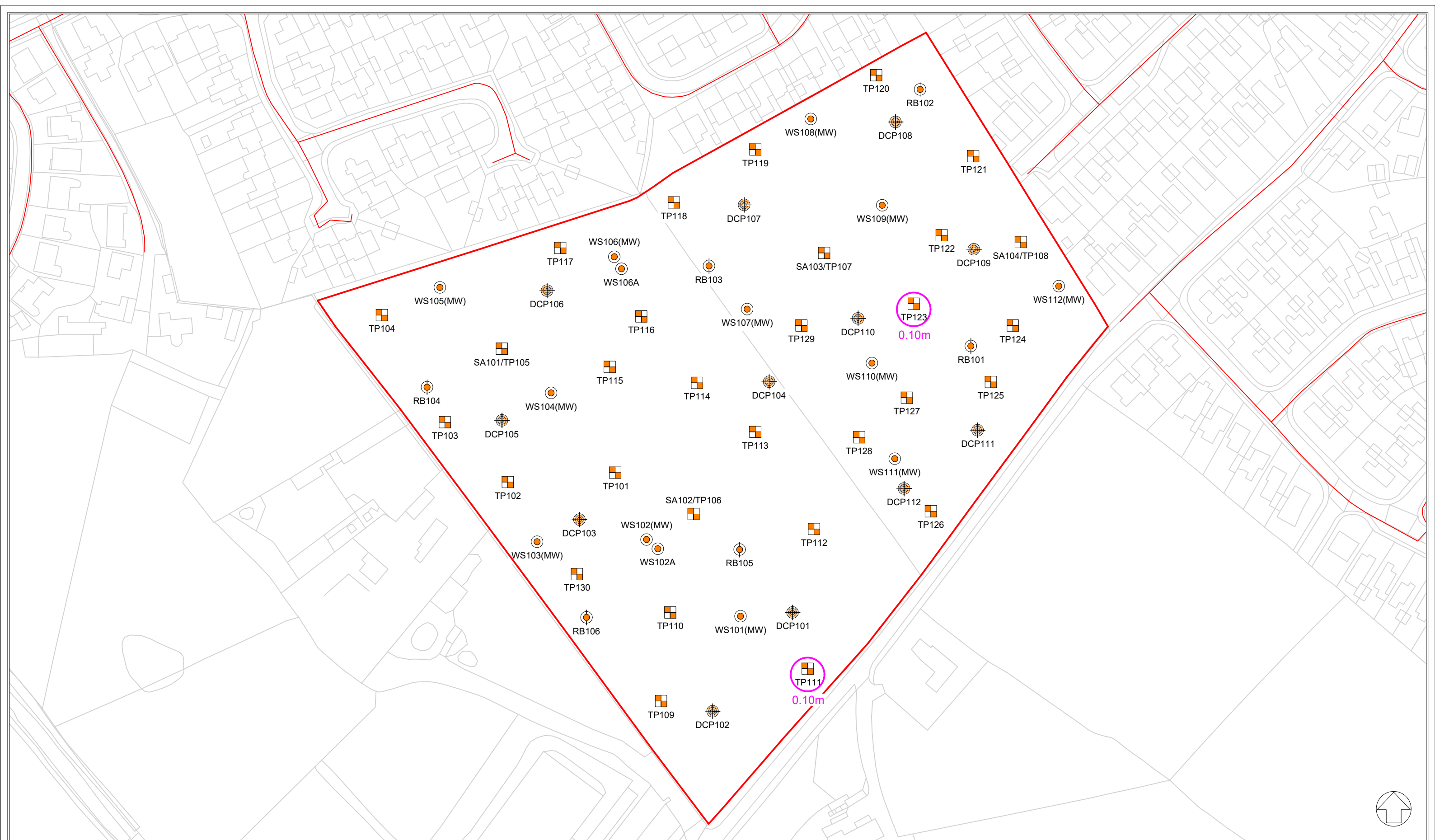
Job No:	14-278
Drawing No:	012

Date:	22.09.2020
Scale:	NTS

Drawing Title:	Depth to Bedrock Plan
----------------	-----------------------

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Location Symbols		Remediation Issues	
	Approximate Window Sample Probehole Location		Lead Impact in Topsoil
	Approximate Window Sample Probehole Location with Install		
	Approximate Trial Pit Location		
	Approximate Soakaway Test Location		
	Approximate Rotary Borehole Location		

Notes:

Client:

Job No:

Date:

AJP

14-278

26.10.2020

Drawing No:

Scale:

013

NTS

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Phase	Issue	Date	Drawn	Checked
P1	REVA	26.10.2020	CB	RJW

Job Title:  
**Well Street, Brackley**

Drawing Title:  
**Remediation Issues Plan**

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**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 <sup>(i)</sup>	40 <sup>(ii)</sup>	79 <sup>(iii)</sup>	640 <sup>(iv)</sup>	1
Cadmium	mg/kg	11 <sup>(i)</sup>	85 <sup>(ii)</sup>	120 <sup>(iii)</sup>	532 <sup>(iv)</sup>	1
Chromium (Hexavalent)	mg/kg	6 <sup>(i)</sup>	6 <sup>(ii)</sup>	7.7 <sup>(iii)</sup>	220 <sup>(iv)</sup>	1
Lead	mg/kg	210 <sup>(vi)</sup>	330 <sup>(vii)</sup>	760 <sup>(viii)</sup>	760 <sup>(viii)</sup>	1
Elemental Mercury	mg/kg	1.2 <sup>(i)</sup>	1.2 <sup>(ii)</sup>	16 <sup>(iii)</sup>	30 <sup>(iv)</sup>	2
Nickel	mg/kg	180 <sup>(i)</sup>	180 <sup>(ii)</sup>	230 <sup>(iii)</sup>	3400 <sup>(iv)</sup>	1
Selenium	mg/kg	250 <sup>(i)</sup>	430 <sup>(ii)</sup>	1100 <sup>(iii)</sup>	1800 <sup>(iv)</sup>	1
Copper	mg/kg	2400 <sup>(i)</sup>	7100 <sup>(ii)</sup>	12,000 <sup>(iii)</sup>	44,000 <sup>(iv)</sup>	1
Zinc	mg/kg	3700 <sup>(i)</sup>	40,000 <sup>(ii)</sup>	81,000 <sup>(iii)</sup>	170,000 <sup>(iv)</sup>	1
Phenol	mg/kg	280 <sup>(i)(xi)</sup>	280 <sup>(xiv)(xi)</sup>	760 <sup>(iii)(xi)</sup>	760 <sup>(iv)(xi)</sup>	2
Naphthalene	mg/kg	2.3 <sup>(i)(xi)</sup>	2.3 <sup>(xiv)(xi)</sup>	1200 <sup>(iv)(xi)</sup>	1200 <sup>(iv)(xi)</sup>	2
Acenaphthylene	mg/kg	170 <sup>(i)(xi)</sup>	500 <sup>(iv)</sup>	15,000 <sup>(iii)(xi)</sup>	29,000 <sup>(iv)(xi)</sup>	3
Acenaphthene	mg/kg	210 <sup>(i)(xi)</sup>	500 <sup>(iv)</sup>	15,000 <sup>(iii)(xi)</sup>	29,000 <sup>(iv)(xi)</sup>	1
Fluorene	mg/kg	170 <sup>(i)(xi)</sup>	500 <sup>(iv)</sup>	9900 <sup>(iii)(xi)</sup>	20,000 <sup>(iv)(xi)</sup>	1
Phenanthrene	mg/kg	95 <sup>(i)(xi)</sup>	500 <sup>(iv)</sup>	3100 <sup>(iii)(xi)</sup>	6200 <sup>(iv)(xi)</sup>	3
Anthracene	mg/kg	500 <sup>(i)(xi)</sup>	500 <sup>(iv)</sup>	74,000 <sup>(iii)(xi)</sup>	150,000 <sup>(iv)(xi)</sup>	3
Fluoranthene	mg/kg	280 <sup>(i)(xi)</sup>	500 <sup>(iv)</sup>	3100 <sup>(iii)(xi)</sup>	6300 <sup>(iv)(xi)</sup>	3
Pyrene	mg/kg	500 <sup>(i)(xi)</sup>	500 <sup>(iv)</sup>	7400 <sup>(iii)(xi)</sup>	15,000 <sup>(iv)(xi)</sup>	3
Benzo(a)Anthracene	mg/kg	7.2 <sup>(i)(xi)</sup>	11 <sup>(ii)(xi)</sup>	29 <sup>(iii)(xi)</sup>	49 <sup>(iv)(xi)</sup>	3
Chrysene	mg/kg	15 <sup>(i)(xi)</sup>	30 <sup>(ii)(xi)</sup>	57 <sup>(iii)(xi)</sup>	93 <sup>(iv)(xi)</sup>	3
Benzo(b)Fluoranthene	mg/kg	2.6 <sup>(i)(xi)</sup>	3.9 <sup>(ii)(xi)</sup>	7.1 <sup>(iii)(xi)</sup>	13 <sup>(iv)(xi)</sup>	3
Benzo(k)Fluoranthene	mg/kg	77 <sup>(i)(xi)</sup>	110 <sup>(ii)(xi)</sup>	190 <sup>(iii)(xi)</sup>	370 <sup>(iv)(xi)</sup>	3
Benzo(a)Pyrene	mg/kg	2.2 <sup>(i)(xi)</sup>	3.2 <sup>(ii)(xi)</sup>	5.7 <sup>(iii)(xi)</sup>	11 <sup>(iv)(xi)</sup>	3
Indeno(123-cd)Pyrene	mg/kg	27 <sup>(i)(xi)</sup>	45 <sup>(ii)(xi)</sup>	82 <sup>(iii)(xi)</sup>	150 <sup>(iv)(xi)</sup>	3
Dibenzo(a,h)Anthracene	mg/kg	0.24 <sup>(i)(xi)</sup>	0.31 <sup>(ii)(xi)</sup>	0.57 <sup>(iii)(xi)</sup>	1.1 <sup>(iv)(xi)</sup>	3
Benzo(ghi)Perylene	mg/kg	320 <sup>(i)(xi)</sup>	360 <sup>(ii)(xi)</sup>	640 <sup>(iii)(xi)</sup>	1400 <sup>(iv)(xi)</sup>	3
TPH C <sub>5</sub> -C <sub>6</sub> (aliphatic)	mg/kg	42 <sup>(i)(xi)</sup>	42 <sup>(ii)(xi)</sup>	42 <sup>(ii)(xi)</sup>	10,000 <sup>(xiv)(xi)</sup>	2
TPH C <sub>6</sub> -C <sub>8</sub> (aliphatic)	mg/kg	100 <sup>(i)(xi)</sup>	100 <sup>(ii)(xi)</sup>	100 <sup>(ii)(xi)</sup>	10,000 <sup>(xiv)(xi)</sup>	2
TPH C <sub>8</sub> -C <sub>10</sub> (aliphatic)	mg/kg	27 <sup>(i)(xi)</sup>	27 <sup>(ii)(xi)</sup>	27 <sup>(ii)(xi)</sup>	10,000 <sup>(xiv)(xi)</sup>	2
TPH C <sub>10</sub> -C <sub>12</sub> (aliphatic)	mg/kg	130 <sup>(i)(xi)</sup>	130 <sup>(ii)(xi)</sup>	130 <sup>(ii)(xi)</sup>	10,000 <sup>(xiv)(xi)</sup>	2
TPH C <sub>12</sub> -C <sub>16</sub> (aliphatic)	mg/kg	1000 <sup>(xiv)(xi)</sup>	1000 <sup>(xiv)(xi)</sup>	1000 <sup>(xiv)(xi)</sup>	10,000 <sup>(xiv)(xi)</sup>	1
TPH C <sub>16</sub> -C <sub>21</sub> (aliphatic)	mg/kg	1000 <sup>(xiv)(xi)</sup>	1000 <sup>(xiv)(xi)</sup>	1000 <sup>(xiv)(xi)</sup>	10,000 <sup>(xiv)(xi)</sup>	1
TPH C <sub>21</sub> -C <sub>35</sub> (aliphatic)	mg/kg					1
TPH C <sub>5</sub> -C <sub>7</sub> (aromatic)	mg/kg	70 <sup>(i)(xi)</sup>	370 <sup>(ii)(xi)</sup>	370 <sup>(ii)(xi)</sup>	10,000 <sup>(xiv)(xi)</sup>	2
TPH C <sub>7</sub> -C <sub>8</sub> (aromatic)	mg/kg	130 <sup>(i)(xi)</sup>	860 <sup>(ii)(xi)</sup>	860 <sup>(ii)(xi)</sup>	10,000 <sup>(xiv)(xi)</sup>	2
TPH C <sub>8</sub> -C <sub>10</sub> (aromatic)	mg/kg	34 <sup>(i)(xi)</sup>	47 <sup>(ii)(xi)</sup>	47 <sup>(ii)(xi)</sup>	10,000 <sup>(xiv)(xi)</sup>	2
TPH C <sub>10</sub> -C <sub>12</sub> (aromatic)	mg/kg	74 <sup>(i)(xi)</sup>	250 <sup>(ii)(xi)</sup>	250 <sup>(ii)(xi)</sup>	10,000 <sup>(xiv)(xi)</sup>	2



<b>TPH C<sub>12</sub>-C<sub>16</sub> (aromatic)</b>	mg/kg	140 <sup>(i)(xi)</sup>	1800 <sup>(ii)(xi)</sup>	1800 <sup>(ii)(xi)</sup>	10,000 <sup>(xiv)(xi)</sup>	1
<b>TPH C<sub>16</sub>-C<sub>21</sub> (aromatic)</b>	mg/kg	260 <sup>(i)(xi)</sup>	1900 <sup>(ii)(xi)</sup>	1900 <sup>(ii)(xi)</sup>	10,000 <sup>(xiv)(xi)</sup>	1
<b>TPH C<sub>21</sub>-C<sub>35</sub> (aromatic)</b>	mg/kg	1000 <sup>(xiv)(xi)</sup>	1900 <sup>(ii)(xi)</sup>	1900 <sup>(ii)(xi)</sup>	10,000 <sup>(xiv)(xi)</sup>	1
<b>Asbestos</b>	Fibres Volume Weight (%)	NFD	0.001%	NFD	0.001	4

#### Notes 1

NFD = No Fibres Detected

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

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

#### Notes 2

Excludes matrices where free product is observed.

No viable exposure pathway beneath hardstanding and cover system.

#### Notes 3

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

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

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



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

DETERMINAND	UNIT	EQS SCREENING VALUE <sup>1,2,3</sup>		DWS <sup>3,4,5</sup>
		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	
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 <sup>5</sup>
TPH C16-C35	µg/l	50#	50#	90 <sup>5</sup>
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





**Well Street, Buckley**

## Remediation and Enabling Works Strategy

October 2020

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

**Notes**

# Solubility &lt;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.
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**

<b>SITE OF IMPORTATION ADDRESS</b>		<b>E3P</b>	
<b>Client</b>		HELIPORT	
<b>Main Contractor</b>		BUSINESS PARK, LIVERPOOL ROAD,	
<b>Earthworks Contractor</b>		ECCLES, MANCHESTER,	
<b>Haulier</b>		M30 7RU	
<b>Date of Planned Import</b>		+44 (0) 161 707 9612 info@e3p.co.uk	
<b>Overview of Planned Material Import</b>			
<b>Material Source (Site of Origin) and Postcode</b>			
<b>Site Investigation Report</b>	<b>Report Title and Reference:</b> <b>Date:</b> <b>Information Supplied By:</b>		
<b>Reason for Generation of Excess Material at Site of Origin</b>			
<b>Chemical Test Results for Stockpile at Site of Origin</b>	<b>Date:</b> <b>Laboratory Certificate Ref:</b> <b>Organisation Responsible for Stockpile Sampling:</b>		
<b>Geotechnical Material Classification and Testing</b>	<b>Delete as Appropriate:</b> Class 1 / Class 2 / Class 6 / Topsoil		
<b>Pictures of Material Stockpile Pending Transportation</b>	<b>Delete as Appropriate:</b> Yes / No		
<b>Person or Organisation Responsible for Ensuring Quality Control at Site of Origin</b>			
<b>Quantity of Material to Be Imported (m<sup>3</sup>)</b>			
<b>Proposed Area of Deposition (Site of Reuse)</b>			
<b>Waste Exemption/Permit or CL:AIRE MMP</b>	<b>Delete as Appropriate:</b> 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



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





**APPENDIX VI  
CONTRACTOR  
COMPLETION  
CHECK SHEET**

## GEOTECHNICAL ENABLING WORKS COMPLETION FORM

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

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



## **POST-REMEDATION AND ENABLING LIMITATIONS**

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



