



Resource & Environmental Consultants Ltd

Remediation Strategy, Enabling Works & Materials Management Plan

Proposed Low Rise Residential Development

**Barrow Brook Phase II
Barrow,
Clitheroe,
Lancashire
BB7 9WA**

**REC Report: 43933p3r0
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Prepared for



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QUALITY ASSURANCE

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1.0 INTRODUCTION

1.1 Site Details

Site Address	Barrow Brook, Barrow, Clitheroe, Lancashire BB7 9WA
National Grid Reference	N373830, E438190
Site Area	c. 10,000m ² (Residential Development Area)

The site is a currently unoccupied sparsely vegetated plot of land located to the west of the A59 in the village of Barrow, approximately 3.5km south of Clitheroe, Lancashire. The site is bound to the south by Barrow Brook, and is generally level with an embankment sloping towards the brook at the southern site boundary. An electricity substation is just outside the site at its north eastern corner.

The site is bordered to the west (at an elevation circa 1.50m below the subject site) by Phase I of the Rowland Homes residential development, where low rise residential units are currently being constructed.

The site was historically occupied by a printing works and a reservoir, which broadly covered the southeast and western sectors of the site respectively. The Owen Williams (OW) (2006) report states that since the demolition of the printing works the site was remediated by means of removal of contaminated material and replacement with inert fill to a depth of 2.0m across the entire development site.

It is believed that while the demolition and remediation works were not supervised by an independent consultant, however the intrusive investigation works completed by OW (2006) were intended to confirm that the site had been remediated to the required standard.

REC have subsequently completed a detailed GeoEnvironmental Investigation at the site, the findings of which are presented within the Report (ref: 43933p1r0/p2r0) dated March 2011; the salient features of which are summarised within Section 2 of this report.

1.2 Project Description

REC understands that Rowland Homes have been granted planning permission to develop the site by the name of Barrow Brook Phase II of the above site for a residential end use comprising low rise dwellings with associated gardens, driveways and access roads. The proposed Site Layout Plan is shown on Drawing No 43993/3/4 in Appendix I.

REC has been commissioned to develop a Remediation Strategy and Enabling Works Plan for the proposed residential development, the primary purpose of which is to ensure that all potential risk to the identified receptors are mitigated in full.

This strategy (as detailed within the later sections of this document) not only deals with the remediation of the identified pollutant linkages, but includes details of the site wide geotechnical engineering and construction phase environmental monitoring protocols devised to ensure that no unacceptable level of risk is generated to the wider environs.

With regard to the proposed development of the site, the main aims of the remedial works

are as follows:

- To provide a remediated site that is suitable for its proposed redevelopment i.e. residential housing with gardens with associated parking and localised soft landscaping etc;
- To provide a landform/ground surface which can accommodate the design levels and acceptable gradients for the proposed road layout, drainage systems and floor slab levels;
- To provide a geotechnically suitable development platform to facilitate the subsequent construction of roads, installation of drainage and the construction of the proposed buildings; and,
- To ensure that construction/ground workers are not put at an unacceptable short term risk during the remediation and/or redevelopment of the site.

To satisfy the requirements of the regulatory authorities (i.e. the Local Planning Authority, Environment Agency and National House Builders Council) that the remediated site will provide a site ready for development and that is safe and suitable for its proposed use.

1.3 Summary of Parties Involved

Name of Party	Function / Interest
Rowland Homes	Land Owner / Developer
Resource & Environmental Consultants (REC) Ltd	GeoEnvironmental Consultant
TBC	Remediation Contractor
Ribble Valley Borough Council	Regulator / Local Planning Authority
Environment Agency	Regulator

Prior to the implementation of the site enabling works and subsequent re-engineering, conformation from the Ribble Valley Borough Council, the NHBC and EA will be required.

2.0 Previous Investigations

REC Geo-Environmental have previously been commissioned by Rowland Homes to undertake a Phase I environmental site assessment and subsequently a series of detailed intrusive Geo-Environmental assessments of the entire site. The most recent findings of which are summarised within our report dated March 2011 (ref: 43933p2r0) and subsequent supporting correspondence. **The pertinent recommendations of the reports have been included below:**

2.1 Environmental Assessment

REC completed a Phase I environmental assessment of the entire site. The assessment identified the following:

- Historical Ordnance Survey mapping indicates that the site was occupied by a printing works from before 1848 with a reservoir covering the southeast of the site until after 1912. The printing works, covering mainly the west of the site, is not recorded after 1983, with the site remaining vacant until the last available map edition;
- The site is considered to be situated within a moderate to highly sensitive environmental setting due to Barrow Brook running along a site boundary. Additionally, residential properties and playgrounds are in close proximity and the underlying strata are classified as a Secondary A aquifer;
- The site was formally occupied by reservoirs (now in filled) and a print works, it is therefore considered that it is likely that significant obstructions will be present to depths of circa 4.0-5.0m bgl and as such a programme of enabling works will be required to create the necessary development platform; and,
- REC identified potential pollutant linkages and risks posed to future users and structures of a proposed residential development from potentially contaminated site soils, risks to controlled waters and risks posed by hazardous ground gases resulting from the former print works and former reservoir. Pathways identified include dermal contact and ingestion of soils, inhalation of contaminant vapours, ingress of gases via permeable strata and leaching and migration of mobile compounds in groundwater.

The location of Barrow Brook Phase II is shown on Drawing No 43933/3/1 Appendix I.

2.2 Ground Conditions

As part of the previous assessment, REC completed a number of exploratory trial pits and boreholes to accurately characterise ground conditions. These investigations identified the following ground conditions:

- Made Ground, comprising intermixed cohesive matrices, ash gravels and demolition materials with oversized cobbles and boulders has been identified within all exploratory locations with the thicknesses ranging from 0.10m to 4.50m bgl, generally increasing in depth from north to south;
- Numerous large cobbles, boulders and relict foundations were observed within a number of exploratory locations, a preliminary observation suggested that the majority of the buried obstructions were concentrated in the south and western sectors of the site. Natural deposits comprising soft to very stiff gravelly clay and occasional sands and gravels were recorded overlying an inferred bedrock horizon of grey mudstone;

The location of REC exploratory holes across the site and depth to Made Ground, are shown for information on Shown on Drawing No 43933/3/2 and 43933/3/5 Appendix I.

2.3 Human Health Risk Assessment

The Tier 1 Contaminated Land Risk Assessment has determined that the underlying made ground would pose a theoretical risk to chronic human health to the critical receptor (residential end use) when considering elevated concentrations of inorganic (arsenic & lead), found within TP104 and TP108 and organic polycyclic aromatic hydrocarbon compounds (BaP) within the underlying Made Ground across the entire development site, one exceedance within WS109 at 2.0m bgl.

Asbestos (chrysotile) fibres were detected in three soil samples from depths TP105 at 0.30m bgl, WS103 at 0.50m bgl and WS109 at 2.00m bgl.

When considering the rationale outlined above, it is considered that the site is suitable for use within the context of the proposed residential end use, subject to the implementation of the required remedial works to be documented within a Remediation Method Statement and Materials Management Plan.

2.4 Asbestos Containing Materials

REC's previous report identified the presence of asbestos in the southern part of the site within samples collected during the intrusive investigation.

REC proposes to undertake the following works during the excavation of the Made Ground within the southern sector of the site:

- Asbestos in air monitoring in accordance with HSG248 by UKAS accredited analyst;
- Watching brief by GeoEnvironmental Consultant;
- Validation sampling of 5 no. locations to confirm either absence or presence of fibres.

The validation samples will be analysed by a fully UKAS accredited laboratory to determine the type and percentage (by weight) of asbestos fibres within the soil matrix. Where concentrations are found to exceed the laboratory limit of detection (LOD), all soils will be removed from site in accordance with current UK Waste Management Legislation.

In addition to the works outlined above, REC will be present on-site throughout the majority of the site enabling works and as such will undertake a watching brief for any ACM within the wider Made Ground. If any potential ACM is identified, the necessary mitigation measures will be employed on-site prior to the implementation of the appropriate remediation works that will be agreed with the regulatory authorities.

2.5 Groundwater Risk Assessment

When considering the potential risk to controlled waters and the wider environment, the ICSM has identified Barrow Brook flowing adjacent to the southern boundary of the site as the critical controlled waters receptor with the underlying Secondary A aquifer also being identified as a viable receptor. The ICSM has no identified any potable drinking water extractions within influencing distance of the site.

Analysis of the Brook samples did not detect any hydrocarbons above the lower method reporting limits.

Within the context of the developed CSM for the site, the risk to surface water quality from the marginal low level inorganic and organic concentrations are not considered significant due to the following mitigating factor:

- The site is underlain in its largely by low permeability glacial boulder clay, which is likely to impede the vertical migration of any dissolved phase contaminants towards the underlying aquifer (identified as a receptor);
- The glacial clay will also act as a sorption mechanism which will significantly reduce the potential for lateral migration of potential contaminants which will bond with the clay minerals;
- REC has completed a programme of water quality monitoring within Barrow Brook over the past 12 months which has demonstrated that there is no impact to the watercourse (REC letter report 03c43709); and,
- No significant concentrations of either organic or inorganic contaminants have been identified at levels which would normally be expected to generate a dissolved phase plume capable of leaching towards the identified receptors.

Based on the data obtained to date, it is considered that the recorded concentrations of potential contaminants within the underlying soil would pose no unacceptable level of potential risk to controlled waters.

2.6 Ground Gas Assessment

Ground gas monitoring has identified marginally elevated concentrations of carbon dioxide originating from the in-filled reservoir. Based on current data this would suggest a classification of Amber 1 or Characteristic Situation 2 in the south eastern sector where low level ground gas protection measures comprising a ventilated sub-floor void and gas membrane may be required.

The remainder of the site would be currently classified as situation Green or Characteristic Situation 1.

The site enabling works (as detailed within Section 3 of this report) will comprise the wholesale removal of all deleterious content from within the backfilled reservoirs.

2.7 Conceptual Site Model

The Tier 1 Contaminated Land Risk Assessment and revised Conceptual Site Model (CSM) identified potential pollutant linkages associated with dermal contact and ingestion of impacted Made Ground within residential gardens. It is therefore recommended that suitable remediation and mitigation measures, including the construction of a 600mm cover system within all gardens, be developed to ensure that the site can be safely developed for the proposed residential end use.

It is considered necessary to develop a suitable Remediation Strategy to facilitate the installation of a 600mm cover system within all residential garden areas to mitigate the identified exposure pathways to the critical receptors.

2.8 Geotechnical

Strip foundations should be considered within the northern areas of the site where natural clay deposits have been encountered, however consideration should be given to the potential for localise buried obstructions.

The significant depth of Made Ground within the central, south-eastern and south western sectors of the site will require the implementation of a specialist foundation solution to support to proposed residential units. After consultation with the client and specialist ground improvement contractors, the following solution has been derived:

- A programme of site enabling works to excavate, screen and sort the underlying made ground to ensure all obstructions and oversized materials are removed prior to replacement and subsequent re-engineering using a specialist ground improvement technique such a Vibro Stone Columns (VSC) or Dynamic Compaction (DC);
- It may be possible to extend the use of deep mass trench fill foundations within the central and western sectors of the site, however it is considered that this option would be limited by the significant presence of buried obstructions and abnormal volumes of concrete required to gain the NHBC approval for the foundation.

The site enabling works will include all residential house footprints, driveways, private estate roads and adopted highways.

The adopted highway will be re-engineered in accordance with the detailed infrastructure specification included within Appendix III.

When considering the options presented above, REC would recommend that consideration be given to the implementation a site wide programme of remediation / enabling works designed to deliver the following key objective:

- Remove all relict foundations / obstructions;
- Screen and sort all made ground;
- Remove all organic (potential gas source) deleterious content;
- Vibro-compaction of all replaced material beneath plots, driveways and private access roads;
- Re-engineering of materials beneath all adopted estate roads; and,
- 'Winning' of topsoil / subsoil for placement in residential gardens.

All subsurface concrete should be designed in accordance with Design Sulphate Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1s in accordance with the recommendations provided in BRE Special Digest 1 (2005).

The NHBC will require suspended floors within all residential units to be constructed at this site.

2.9 Identified Development Constraints

A review of the previous investigation has identified a number of potential constraints to the redevelopment as proposed; these are as follows:

- Elevated inorganic contamination within the made ground deposits;

- Elevated BaP across the southern sector of the site within the made ground identified to 2.00mbgl to date;
- The presence of Chrysotile within the Made Ground across the site;
- The presence of below ground relict structures and foundations;
- The presence of buried services i.e. gas, water, electricity, surface water and foul water drains; and,
- The presence of geotechnically unsuitable made ground, across the site and at depth across the southern sector of the site;
- The presence of slightly elevated gas concentrations on the south eastern sector;

There may be a need to consult with the Environment Agency and complete a full and detailed Materials Management Plan (MMP) in accordance with CL:AIRE COP, when reusing materials on site.

3.0 SITE REMEDIATION & ENABLING WORKS

3.1 Overview

A summary of the proposed site enabling / remediation works, associated management activities and validation protocols are presented in detail later within Section 3.2; the salient features of which are outlined below:

The outline strategy for the site remediation and enabling works will comprise:

- General site clearance and legislatively compliant disposal of all surface vegetation, breaking out, excavation and removal of all slabs, hard-standing and buried structures to the base of the Made Ground;
- Removal of all obstructions (>150mm) within the underlying Made Ground within the areas of the site where in excess of 1.0m of Made Ground has been identified;
- Excavation and stockpiling of aggregates currently present within the site, prior to screening, grading and reprocessing for subsequent re-use as an engineered aggregate;
- Excavation and segregation of granular and cohesive soil matrices for subsequent re-use beneath remediated formation levels;
- Excavation, segregation, and processing of unsuitable material in the south western area of the site where the former reservoir was located;
- Placement of granular soils beneath residential plot footprints for future re-engineering by a specialist contractor;
- Placement of granular and cohesive deposits beneath private roadways and drives using a nominal method compaction;
- Re-engineering of all Made Ground beneath the adopted estate roads in accordance with the REC compaction specification and or using a specialist technique to be implemented by suitable contractor;
- Processing aggregates in accordance with the engineers specification with detailed validation testing;
- Management of all works so to ensure that no environmental nuisance is created through dust emissions, noise or vibration levels;
- Ensure that all works are completed in a manner so as not to create any structural risk to the adjacent highways and properties;
- Implement all temporary works as necessary to support excavations throughout the duration of the works (to be designed and implemented by the contractor);
- Inspection of all works by a qualified GeoEnvironmental Engineer to confirm the suitability of material for re-use, delineate any areas of previously unidentified contamination and to confirm the findings of the REC report;

- Provide suitable development platform to facilitate the construction of the proposed roadways, drainage infrastructure, pavements and areas of hard-standing; to be delivered in accordance with the engineers specification;
- Provide and place a soft cover system to all garden and landscaped areas within the proposed residential development; and,
- Removal of all soil wastes deemed unsuitable for use from site in accordance with UK Waste Management Legislation and in accordance with the UK Landfill Directive.

3.2 Remediation / Enabling Works

The rationale outlined below gives a synopsis of the proposed site enabling / remediation works required to provide a suitable platform for the construction of the proposed residential development. This is intended to demonstrate that the proposed activities are to be undertaken in full compliance with the relevant regulatory controls.

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 specification as detailed within Tables 3.1 & 3.2 (below):

Table 3.1 – Summary of Enabling Works

EW1	Pre-Commencement Works
	Rationale: Implementing the works with appropriate consultancy supervision so that the works can be fully validated, along with validation reporting to the satisfaction of the Local Planning Authority (LPA) and the Environment Agency (EA). Undertake any further site investigation and risk assessment to quantify the nature, degree and extent of the previously identified hydrocarbon contamination.
	Validation Requirements: Provide documented evidence to confirm acceptance of proposed methodologies
EW2	Site Clearance Operations
	Rationale: General site clearance & provision of welfare, offices and site security.
	Validation Requirements: Any disposal of materials of site (including vegetation) should be completed in accordance with UK Waste Management Legislation.
EW3	Removal of Surface Artificial Hard Materials
	Rationale: The hard standing currently present within localised areas of the site should be broken out, lifted in a controlled manner, screened, to remove any deleterious content (crushed to nominal 6F2 grading) and stockpiled for subsequent re-use as

	a recycled aggregate. Localised areas of hard-standing currently comprises concrete from the former building footprints, and bituminous surfaces where relict roadways are thought to be present. Stockpiles will be subject to the appropriate validation testing prior to the re-use as site won material where needed. Any material reused will comply with the 6F2 specification as detailed in Series 600. Bituminous areas and roadways will be removed during the site works. Bituminous materials will be stockpiled for reuse subject to regulatory approval. All material processing operations should be undertaken using fully licensed plant in accordance with current UK legislative requirements. Validation Requirements: Copies of correspondence confirming the registration of the mobile plant license for crushing should be held on-site by the Site Manager. Dust, noise and vibration should be monitored and recorded. The regarded aggregate will require testing to certify that it is chemically suitable for use on-site and PSD's will be taken to demonstrate suitability of use. The testing schedule is presented in Section 3.3.
EW4	Removal of Perched Water Rationale: Any (perched) waters encountered within the formation of earthworks excavations will be assessed and disposed of in a controlled and legislatively compliant manner. The Contractor will be responsible for ensuring that all earthworks can be completed in accordance with the requirements of the Enabling Works. The responsibility for safe and legislatively compliant disposal of waters will rest with the Principal Contractor. Validation Requirements: To be confirmed following assessment of results.
EW5	Excavation of historic reservoir area Rationale: The proposed house footprints within the southern and the central sectors of the site are thought to be underlain by an in-filled former reservoir and as such it will be necessary to implement a phase of enabling works to render the underlying stratum suitable for construction. It is therefore proposed to excavate the Made Ground (where necessary) beneath plots, roads and driveways within the central, southern and western sectors of the

	site with the resulting excavation to be backfilled with processed granular material (site derived) to allow future ground improvement works (VSC / DC). Validation Requirements: Site won arisings (processed granular material) will require testing to demonstrate that they are suitable for use with the proposed cover system for residential gardens. Areas will require appropriate geotechnical testing to demonstrate that the backfill material meets the required engineered standard
EW6	Excavation, breaking and processing of all sub-surface structures Rationale: All known major obstructions/foundations apart from live services previously identified are to be removed to the base of Made Ground. In these areas all artificially hard materials will be broken out and crushed. Stockpiles will be made, validation testing undertaken, and site won material reused on site where required. It is proposed that the footprints of Plots 72-101 are excavated, turned and processed to the base of the Made Ground where natural strata is encountered. Within all areas where it is proposed to construct adopted highway, estate roads and private drives will be excavated and cleared of any obstructions (>150mm) to a minimum depth of 1.0m from the underside of formation. Any obstructions/foundations/structures not previously encountered within the remainder of the site will be removed to the base of Made ground. Where any very loose or soft material is present at the base of excavations, removal of material will continue, and any material excavated will be re-engineered to a suitable specification to minimise the risk of future settlement. Validation Requirements: Site won arisings will require testing to demonstrate that they are suitable for use with the proposed development platform. Areas will require appropriate geotechnical testing to demonstrate that the backfill material meets the required engineered standard.
EW7	Excavation of Deleterious Material – Development Footprint Rationale: The proposed house footprints are known to be underlain circa 3.0m to 5.0m of Made Ground in the southern sector of the site. This material has been observed to be organic with a significant deleterious content and as such would be unsuitable bearing stratum to support foundation loadings. Furthermore, the requirement of the foundation solution at this site means that it will be necessary to implement a phase of enabling works to render the underlying stratum suitable for the development.

REC Ltd has prepared a series of drawings detailing the depth to base of Made Ground (extrapolated from ground conditions report) with a corresponding drawing detailing the proposed remediation works and subsequent extent of excavations.

Excavation Works

REC Drawing 43993/3/5 details a deep area of in-filled ground at the eastern, southern and western sector of the subject site. The EW strategy dictates that these areas should be excavated beneath the plot and 1m outside of the building perimeter, processed in accordance with the REC Materials Processing Strategy (MPS). The resulting excavation will be backfilled through the loose tipping with suitable granular aggregates manufactured from site excavations.

This backfilled material must be compliant with the Ground Improvement Contractors specification (to be issued as a separate document).

The Enabling works levels beneath all plots will be 700mm below FFL.

All excavations beneath residential houses are to be taken to the base of the Made Ground. Excavations will incorporate plot footprints (1.0m buffer at all elevations).

A 300mm piling mat must be provided beneath all residential plots. This must comprise certified 6F2 / 6F5 graded granular aggregate and be compliant with the Ground Improvement Contractors specification (to be issued as a separate document).

Adopted highways are to be re-engineered in accordance with the REC Compaction Specification to achieve a minimum CBR of 5%.

Driveways and non adopted estate roads are to be compacted to achieve a CBR design % >5 at 700mm below FFL.

Validation Requirements:

All import / site derived backfill materials will require chemical and geotechnical analysis to confirm suitability for use within the context of the proposed residential development.

Areas will require appropriate geotechnical testing to demonstrate that the backfill material meets the required engineered standard.

EW8

Backfill to Adopted Highways

Rationale:

On completion of the site enabling / remediation works all excavations beneath the proposed adopted highways will be backfilled with a suitable material that conforms to the engineer's specification.

Materials to be placed beneath proposed adopted estate roads will be compacted to a Method Compaction Specification in accordance with Section 6 of the highways design manual and the REC Ltd specification included within Appendix III.

	Alternatively, the material can be backfilled using a loose placement methodology for subsequent re-engineering by a specialist contractor. Any such works would require approval from the highways design engineer at Ribble Borough Council. Validation Requirements: Confirmation that the material is chemically and geotechnically suitable for re-use.
EW9	Excavation, Virgin Clay Rationale: The proposed units within the northern eastern and possibly the central sectors of the site are thought to possibly 'straddle' the high wall of the former reservoir and as such it will be necessary to implement a phase of enabling works to render the underlying stratum suitable for construction. It is therefore proposed to excavate the high wall and clays (where necessary) beneath the northern and southern sectors of the proposed residential units with the resulting excavation to be backfilled with granular material (site derived) to allow future vibro compaction. Within the southern sector of the site, a programme of 'soil inversion' is planned to ensure that the Made Ground where elevated concentrations of potential constituents of concern is placed at a depth where there is no risk to chronic human health or wider environment. Depending on the requirements for re-engineering beneath the reservoir high wall, these works may be extended to derive the necessary volume of sub-soil for the cover system. The resulting clays will be stockpiled on-site, pending validation analysis to confirm suitability for use as subsoil within the cover system to be installed within the residential gardens / landscaped areas.
EW10	Provision of Top-Soil as a growing medium Rationale: It will be necessary to import a chemically suitable top-soil forming material (150mm) for use within all garden and landscaped areas; to be placed on top of the 450mm of validated sub-soil. Validation Requirements: Imported top-soil will require testing in line with the schedule present within Section 3.7. The garden and landscaped areas will require depth validation (CML) in order to demonstrate that the appropriate thickness has been provided.

Table 3.2 - Summary of Materials Movements & Estimated Mass Balance

Material Movement	Volume (estimate) (m3)
Excavation & Movement (on-site)	
Excavation Units 96-101	11,500
Excavation Units 84-95	6,000
Excavation Units 79-83	2000
Excavation Units 75-78	2000
Excavation Units 72-74	2000
Reduced Level Excavation – Adopted Highway	2000
Excavation & Processing Materials in Gardens of Plots 89-95	2400
Sort / screen material to remove oversize (>150mm)	27,900
Crushing of oversize material	Variable
Total - estimated excavation (-)	27,900
Backfill / re-engineering	
Loose Placement of Granular Material (beneath plots)	23900
Re-engineering of Adopted Highway	N/A
Re-engineering of private estate road / driveway	N/A
Total - estimated importation (+)	TBC

The quantities as outlined above are for indicative purposes only and, contractors will be required to undertake their own volumetric assessment for the project.

The contractor will be able to obtain variable quantities of material from the processing of materials in-site in accordance with the REC Specification for Materials Processing & Recycling.

A further 3000m3 of virgin sub-soil will be source from the wider site, this material will be used within the garden areas to provide the necessary cover system as required by the Local Planning Authority (LPA).

3.3 Rationale for Material Movements

In accordance with the guidance presented within the CL:AIRE COP, REC has determined that the materials movements as described above are applicable to the MMP when considering the following rationale:

- The detailed human health risk assessment and Conceptual Site Model (CSM) has determined that subject to compliance testing, the imported material will pose no unacceptable level of risk to the identified receptors within the context of the proposed development;
- The imported material will conform to the required REC Ltd specification and will therefore be geotechnically suitable material for use as a bulk aggregate for emplacement beneath the proposed development;

- The proposed development plan has a definitive requirement for a bulk aggregate to be imported onto the site to increase levels to the required elevation and to provide a geotechnically suitable material to support the proposed structures and pavements;
- A planning application for the proposed works has been registered and approved by Ribble Valley Council; and,
- The materials will be moved in a controlled manner, as detailed within Section 6.0, to ensure that the material is geotechnically suitable and handled in accordance with the REC Environmental Management Protocol & Earthworks Specification.

3.4 Tracking System

The phasing of excavation works and subsequent material management programmes is currently estimated at five weeks; this programme may be subject to change depending on variances in the project and weather conditions.

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 REC Ltd Specification;
- Operatives will have instructions only to excavate and to emplace materials in specified areas as assigned by the Site Manager / Foreman;
- The Site Manager (employed by the Principal Contractor) will issue daily instructions to drivers regarding the placement of materials sourced from specific stockpiles or areas, ensuring that appropriate documentary evidence is collected that details which materials are going where and why;
- The strategy for each week's work will be agreed with the REC Consultant, who will be in part time attendance. Prior to the commencement of the works REC will:
 - o Inspect the excavation areas and certify that the correct materials are being excavated;
 - o Conduct spot checks on loaded vehicles to ensure compliance with this MMP; and,
 - o Ensure that any loads which fail visual, olfactory or spot checks either remain on the vehicle or if unloaded, are set aside. This material will be treated according to the recommendations of the REC site engineer;
- All material removed from site will have Duty of Care / Consignment Notes, copies of which will be retained on-site by the Site Manager; and,
- Materials directly reusable will be either incorporated into the earthworks, subject to operational conditions and phasing of excavations, or stockpiled prior to final placement.

3.5 Post Remediation Constraints

Post remediation constraints for the site will include:

- Gas protection measures will be required in building design, subject to validation monitoring results;
- Requirements for sulphate-resistant concrete may be required, subject to validation testing;

- Topsoil to be supplied by the developer, with appropriate quality checks;
- Capping with clean soil in soft landscaped areas must be a minimum of 600mm;
- Foundation strategies should take into account the properties of the strata left in-situ; and,
- Disposal of arisings for services and foundation trenches, if required.

Consultations will have to be completed with the Local Authority to enable the satisfactory completion of planning conditions associated with the planning consent for the site.

3.6 Tracking System

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;
- 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;
- All material removed from site will have Duty of Care / Consignment Notes, copies of which will be retained on-site by the Site Manager; and,
- Materials directly reusable will be incorporated into the earthworks, subject to operational conditions and phasing of excavations, in which case they will be stockpiled prior to final placement.

3.7 Validation Sampling Protocol

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

Soil samples destined for chemical analysis will be collected at regular intervals in appropriate sampling containers. All samples will subsequently be stored in cooled boxes prior to submission to Scientific Analysis Laboratories (SAL) for analysis in accordance with their UKAS accreditation where applicable.

All samples will be collected using appropriate PPE and sampling equipment that will be cleaned at each sampling location.

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

Where materials are found to contain concentrations of potential contaminants at levels in excess of the site specific screening criteria (as detailed within Appendix II), REC will

undertake further assessment and recommendations on the appropriate use for the material in question.

The sampling frequency for materials to be managed under the Remediation Strategy is presented within Table 3.2 (Overleaf).

Table 3.2 – Specification of Materials Validation Laboratory Analysis

Material Use	Testing Frequency	Suite of Analysis
Site excavated granular & cohesive backfill (made ground)	1 Sample Per 250m ³	G**
	1 Sample Per 500m ³	B
	1 Sample Per 1000m ³	A / B / C / D
Site Sourced & Imported Sub-Soil (450mm garden cover)	1 Sample Per 250m ³	A / B / C / D
Topsoil Cover	1 sample per 50m ³	A / B / C / D

Notes – Table3.2

Suites of Analysis

A) Speciated PAH

B) Banded TPH (C5-C35)

C) Asbestos (ID)

D) CLEA Inorganic

E) Asbestos Quantification (by weight)

F) Speciated (aliphatic / aromatic) TPH.

G) On-site PID/FID Headspace Analysis

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

* Dependent on size of excavation

** In the event that the PID exceeds 10ppm, the sample will be subjected to suite F

4.0 Environmental Monitoring and Validation

4.1. Site Management

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

- The Principal Contractor will have the responsibility for setting out areas of the site on the basis of the contract specification;
- Operatives will have instructions only to excavate and to emplace materials in specified areas as assigned by the Site Manager / Foreman;
- The Site Manager (employed by the Principal Contractor) will issue daily instructions to drivers regarding the placement of materials sourced from specific stockpiles or areas, ensuring that appropriate documentary evidence is collected that details which materials are going where and why;
- The strategy for each day's work will be agreed with the REC Consultant, who will be in full time attendance, prior to the commencement of the works. REC will:
 - o Inspect the excavation areas and certify that the correct materials are being excavated;
 - o Conduct spot checks on loaded vehicles to ensure compliance with this Remediation Strategy; and,
 - o Ensure that any loads which fail visual, olfactory or spot checks either remain on the vehicle or if unloaded are excavated and set aside. This material will be treated according to the recommendations of the REC site engineer.
- All material removed from site will have Duty of Care / Consignment Notes, copies of which will be retained on-site by the Site Manager; and,
- Materials directly reusable will be incorporated into the earthworks, subject to operational conditions and phasing of excavations, in which case they will be stockpiled prior to final placement.

5.0 RECORD KEEPING & VERIFICATION

Using the data collated below, REC Ltd will prepare a summary report clearly referencing the origin of the materials used and testing carried out to confirm its suitability for use, where required. REC 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;
- Site diary;
- Details of Materials Management Plan; and,
- Monitoring results (asbestos in air, gas ,water, if required etc.)

6.0 CONTINGENCY PLAN

6.1 Previously Unidentified Contaminants

Should any significantly impacted material be encountered during the development, then it should 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 should be undertaken to determine whether it can be retained on-site as part of the Material Management Operations or whether it should be disposed off-site.

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

7.0 GLOSSARY

TERMS

MMP	Material Management Plan
MM	Material Movement
FFL	Finished Floor Level
COP	Code of Practice
AST	Above ground Storage Tank
UST	Underground Storage Tank
EA	Environment Agency
CSM	Conceptual Site Model
GL	Ground Level
D	Not Detected
NR	Not Recorded
BSI	British Standards Institute
BGS	British Geological Survey
CLEA	Contaminated Land Exposure Assessment
SGV	Soil Guideline Value
GAC	General Assessment Criteria
CIEH	Chartered Institute of Environmental Health
PID	Photo Ionisation Detector
CIRIA	Construction Industry Research Association
GSV	Gas Screening Value
EQS	Environmental Quality Standard
DWS	Drinking Water Standard
PAH	Poly Aromatic Hydrocarbon
TPH (CWG)	Total Petroleum Hydrocarbon (Criteria Working Group)
VOC	Volatile Organic Compound
SVOC	Semi Volatile Organic Compound
SPT	Standard Penetration Test
VCCs	Vibro Concrete Columns
QA	Quality Assurance

UNITS

m	Metres
km	Kilometres
%	Percent
%v/v	Percent volume in air
mb	Milli Bars (atmospheric pressure)
l/hr	Litres per hour
µg/l	Micrograms per Litre (parts per billion)
ppb	Parts Per Billion
mg/kg	Milligrams per kilogram (parts per million)
ppm	Parts Per Million
mg/m ³	Milligram per metre cubed
m bgl	Metres Below Ground Level
m bcl	Metre Below Cover Level
mAOD	Metres Above Ordnance Datum (sea level)
kN/m ²	Kilo Newtons per metre squared
µm	Micro meter

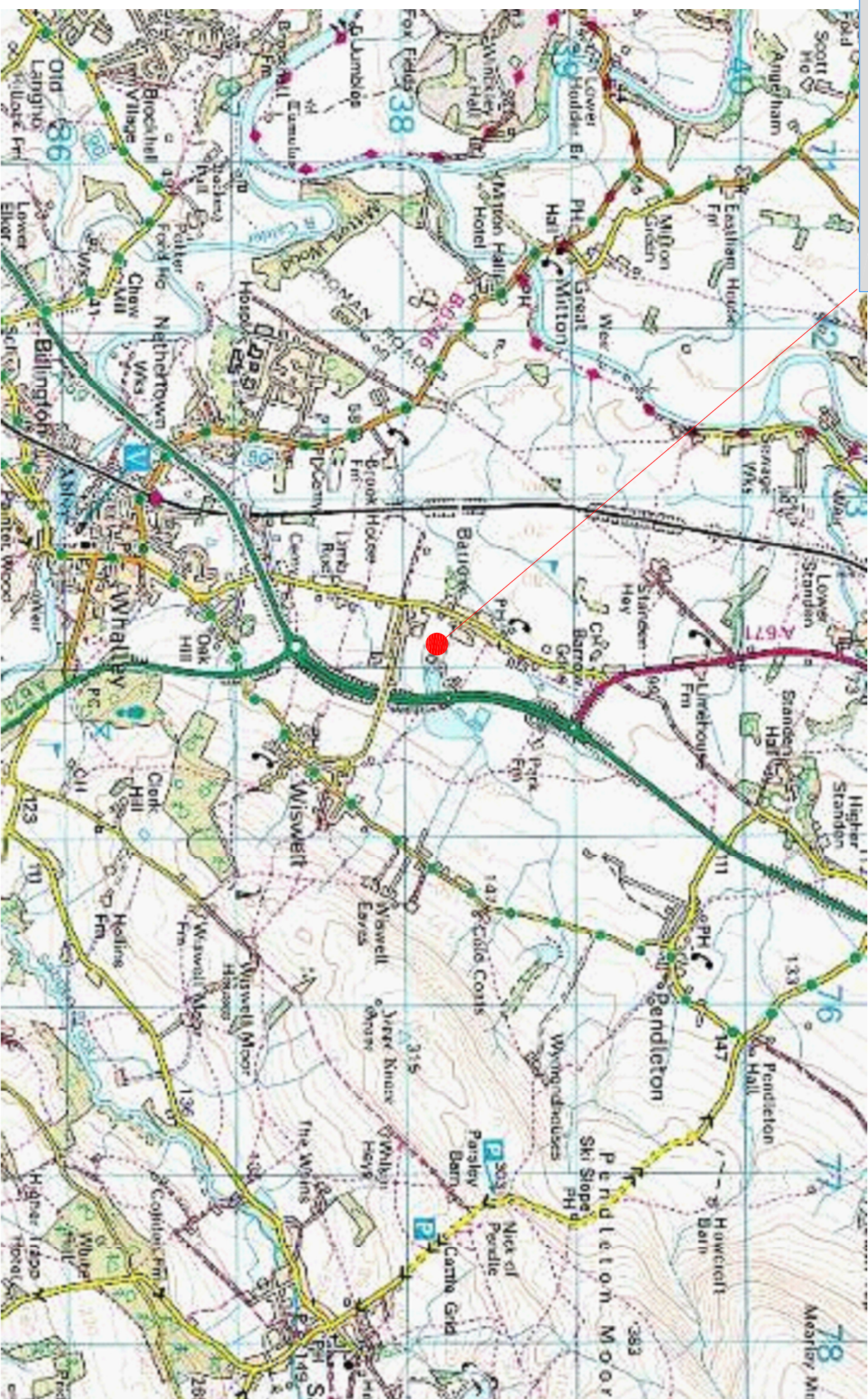
8.0 Limitations

1. This report and its findings should be considered in relation to the terms of reference and objectives agreed between REC Ltd and the Client.
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. In addition to the above REC Ltd note that when investigating, or developing, potentially contaminated land it is important to recognise that sub-surface conditions may vary spatially and also with time. The absence of certain ground, ground gas, and contamination or groundwater conditions at the positions tested is not a guarantee that such conditions do not exist anywhere across the site. Due to the presence of existing buildings and structures access could not be obtained to all areas. Additional contamination may be identified following the removal of the buildings or hard standing.
5. 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.
6. REC 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 REC 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 REC in this connection without their explicit written agreement there to by REC.

APPENDIX I

Drawing No 43933/3/1	Site Location Plan
Drawing No 43933/3/2	REC Exploratory Hole Location Plan
Drawing No 43933/3/3	BRE 365 Testing Location Plan
Drawing No 43933/3/4	Proposed Development Layout
Drawing No 43933/3/5	Projected Depth of Made Ground
Drawing No 43933/3/6	Historical Structure Location Plan
Drawing No 43933/3/7	Areas of Remediation and MMP

Site Location



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Job Title

Client



Clitheroe



Job No: 43933

Drawn by: D. Cox

Approved by: M.Dyer

Scale: NTS

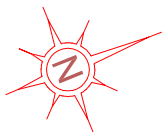
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11/03/11

Notes:

Drawing Title

43933-3-1

Site Location Plan

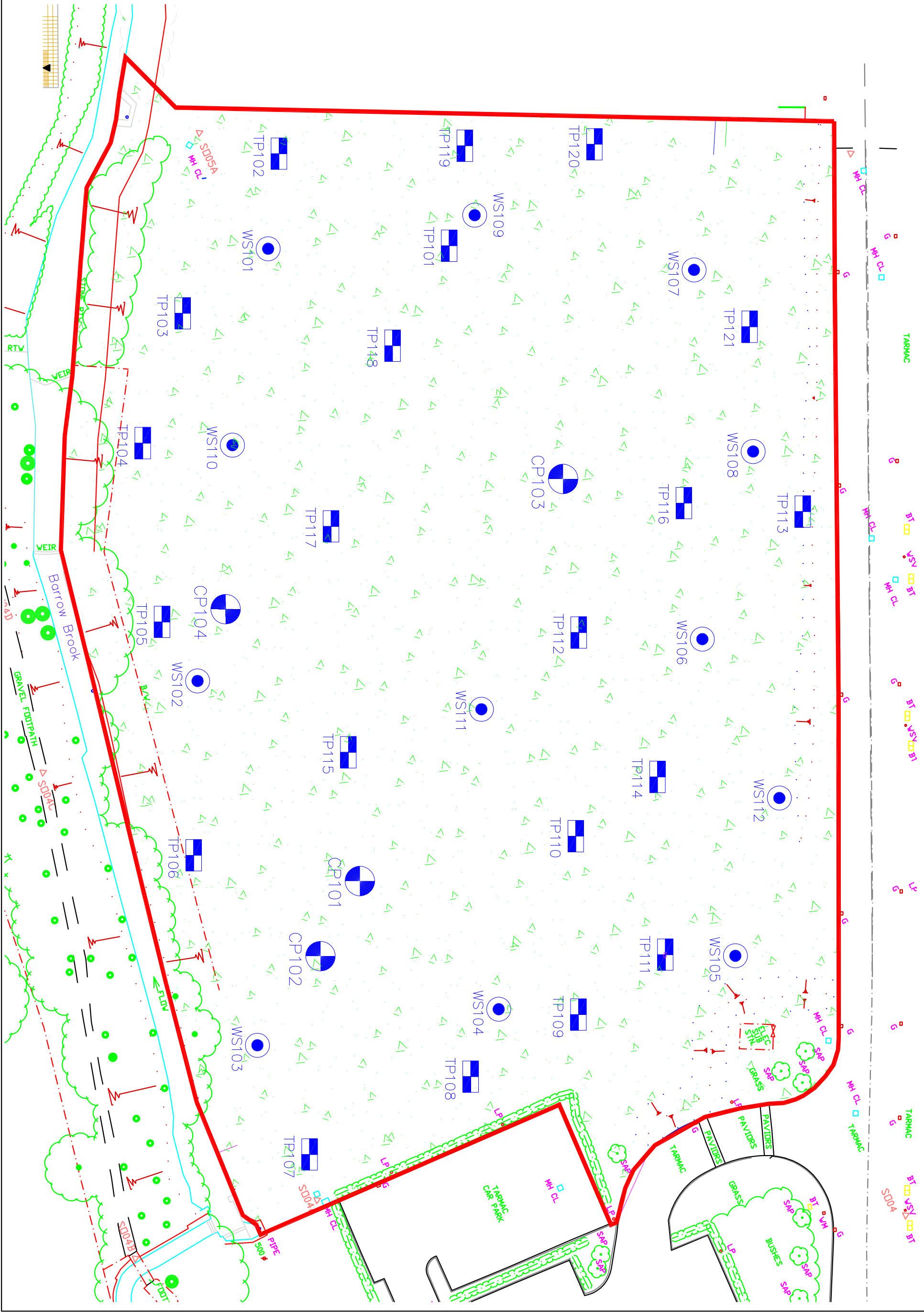


Key

- 
WS101 Window Sample Probe Location
- 
TP101 Trial Pit Location
- 
CP101 Cable Percussive Borehole Location

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Job Title

Barrow Brook (2nd Phase)

Client

Rowland

Job No: 43933

Drawn by: D. Cox

Approved by: M.Dyer

Scale: NTS

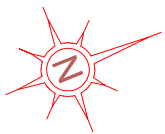
Date

4/11/11

Notes:

Drawing Title

43933-3-2
Exploratory Hole
Location Plan



Key

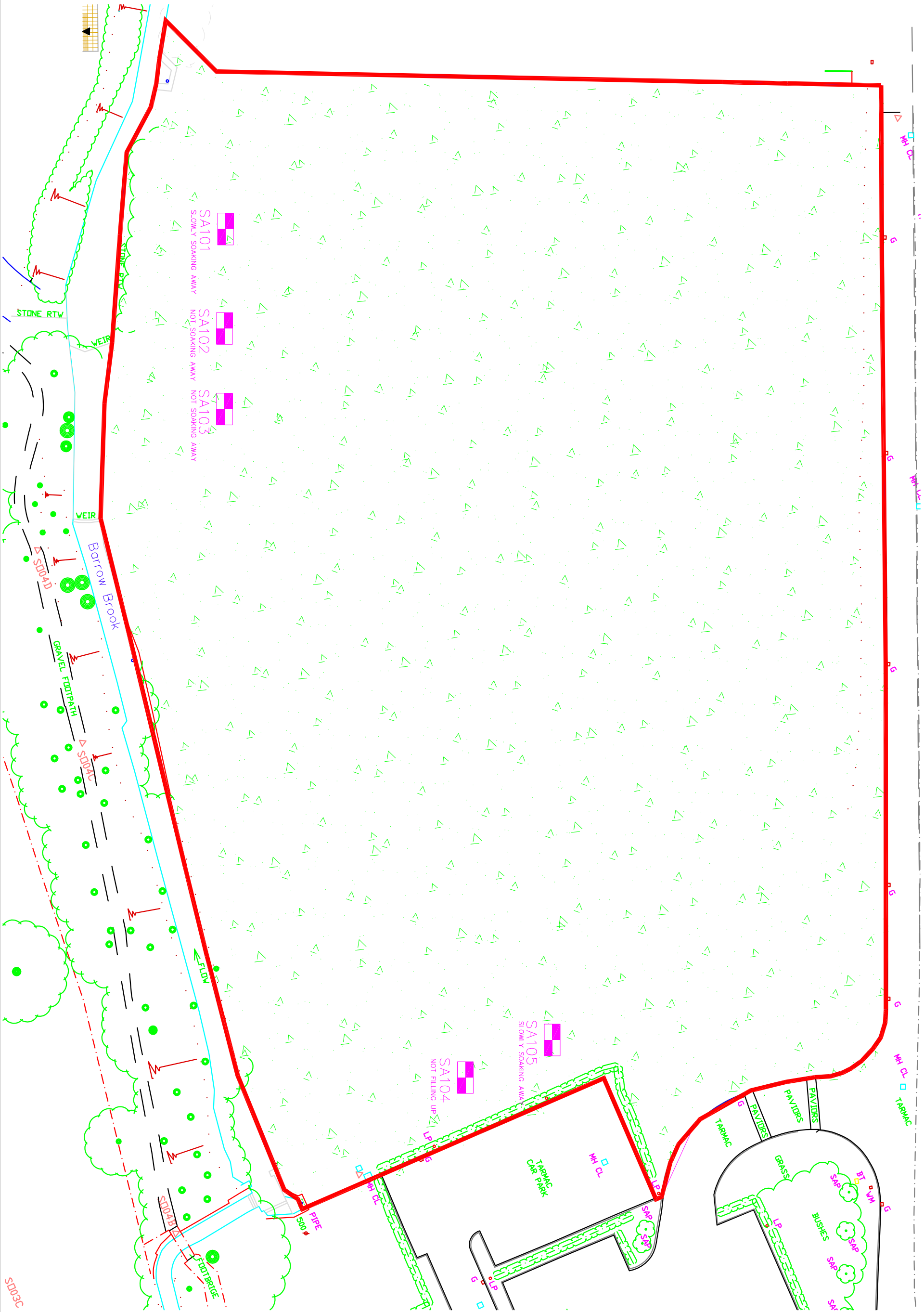
WS101 Window Sample
Prohibit Location

TP101 Trial Pit Location

CP101 Cable Percussive
Borehole Location

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Job Title

Barrow Brook (2nd Phase)

Clitheroe

Client



Job No: 43933

Drawn by: D. Cox

Approved by: M.Dyer

Scale: NTS

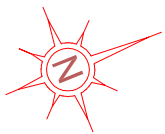
Date

4/11/11

Notes:

Drawing Title

43933-3-3
BRE 365 Testing
Location Plan



Key



WS101
Window Sample
Probehole Location
N: 1.10–3.00



TP101
Trial Pit Location
MG: N/A
N: 0.95–3.50



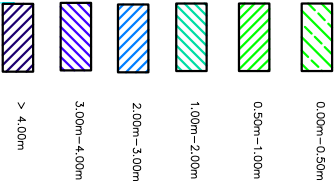
TP101
Trial Pit Location
MG: 2.30
N: N/A
OBSTRUCTION



CP101
Cable Percussive
Borehole Location
MG: 2.20
N: 2.20–9.00

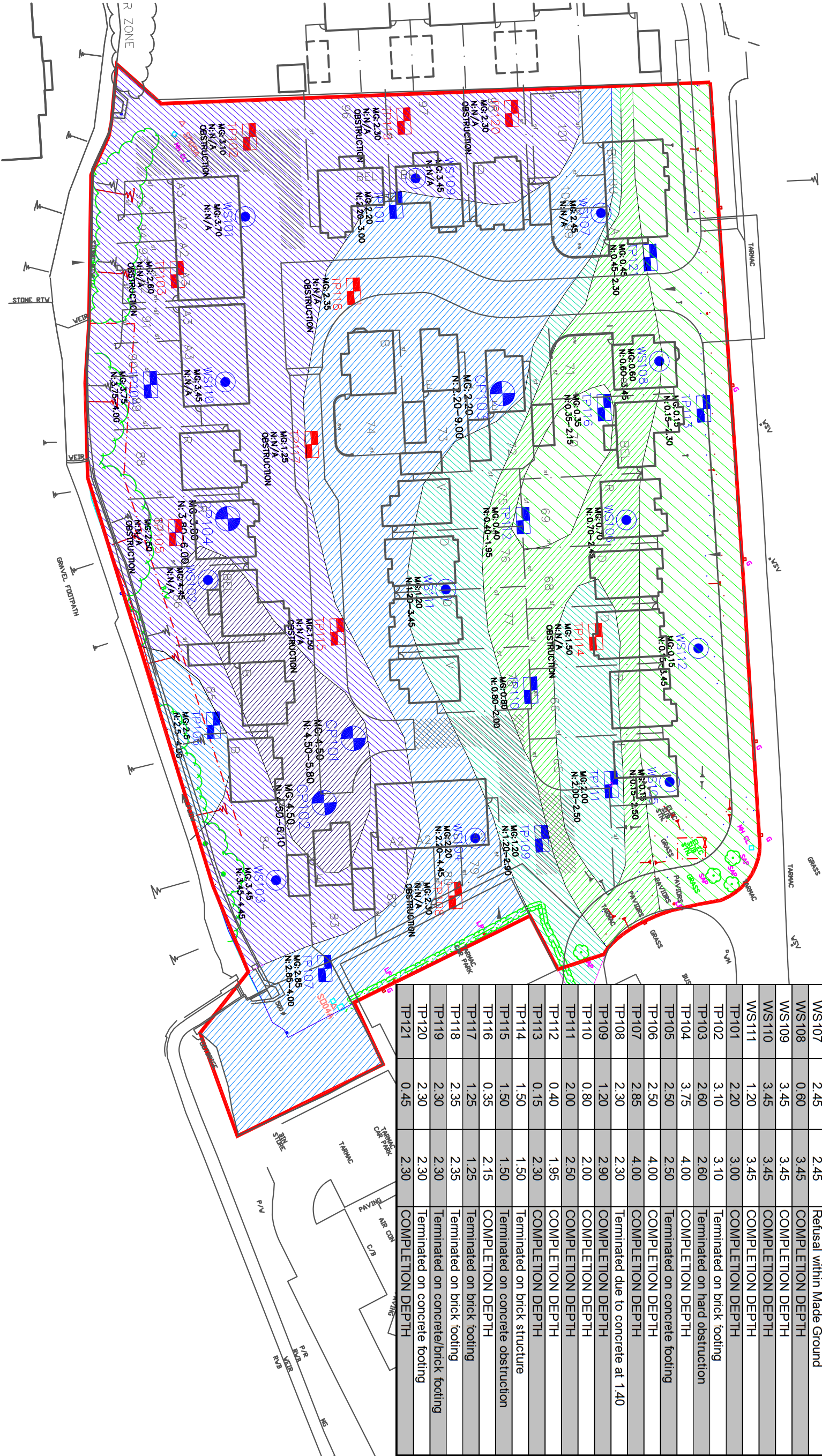
MG: Depth to MG
base
N: Natural Strata

Depth to Base of
MADE GROUND



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Location	MADE GROUND		Completion		Obstruction
	GROUND	Depth			
CP101	4.50	5.60	COMPLETION DEPTH		
CP102	4.50	6.10	COMPLETION DEPTH		
CP103	2.00	4.60	COMPLETION DEPTH		
CP104	3.80	6.00	Chiseled through obstruction at 3.30		
WS101	3.70	3.70	Refusal within Made Ground		
WS102	4.45	4.45	COMPLETION DEPTH		
WS103	3.50	4.45	COMPLETION DEPTH		
WS104	2.20	4.45	COMPLETION DEPTH		
WS105	0.15	2.50	COMPLETION DEPTH		
WS106	0.70	2.45	COMPLETION DEPTH		
WS107	2.45	2.45	Refusal within Made Ground		
WS108	0.60	3.45	COMPLETION DEPTH		
WS109	3.45	3.45	COMPLETION DEPTH		
WS110	3.45	3.45	COMPLETION DEPTH		
WS111	1.20	3.45	COMPLETION DEPTH		
TP101	2.20	3.00	COMPLETION DEPTH		
TP102	3.10	3.10	Terminated on brick footing		
TP103	2.60	2.60	Terminated on hard obstruction		
TP104	3.75	4.00	COMPLETION DEPTH		
TP105	2.50	2.50	Terminated on concrete footing		
TP106	2.85	4.00	COMPLETION DEPTH		
TP107	2.85	4.00	COMPLETION DEPTH		
TP108	2.30	2.30	Terminated due to concrete at 1.40		
TP109	1.20	2.90	COMPLETION DEPTH		
TP110	0.80	2.00	COMPLETION DEPTH		
TP111	2.00	2.50	COMPLETION DEPTH		
TP112	0.40	1.95	COMPLETION DEPTH		
TP113	0.15	2.30	COMPLETION DEPTH		
TP114	1.50	1.50	Terminated on brick structure		
TP115	1.50	1.50	Terminated on concrete obstruction		
TP116	0.35	2.15	COMPLETION DEPTH		
TP117	1.25	1.25	Terminated on brick footing		
TP118	2.35	2.35	Terminated on brick footing		
TP119	2.30	2.30	Terminated on concrete/brick footing		
TP120	2.30	2.30	Terminated on concrete footing		
TP121	0.45	2.30	COMPLETION DEPTH		

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Job Title

Barrow Brook (2nd Phase)

Clitheroe

Client



Job No: 43933

Drawn by: D. Cox

Approved by: M. Dyer

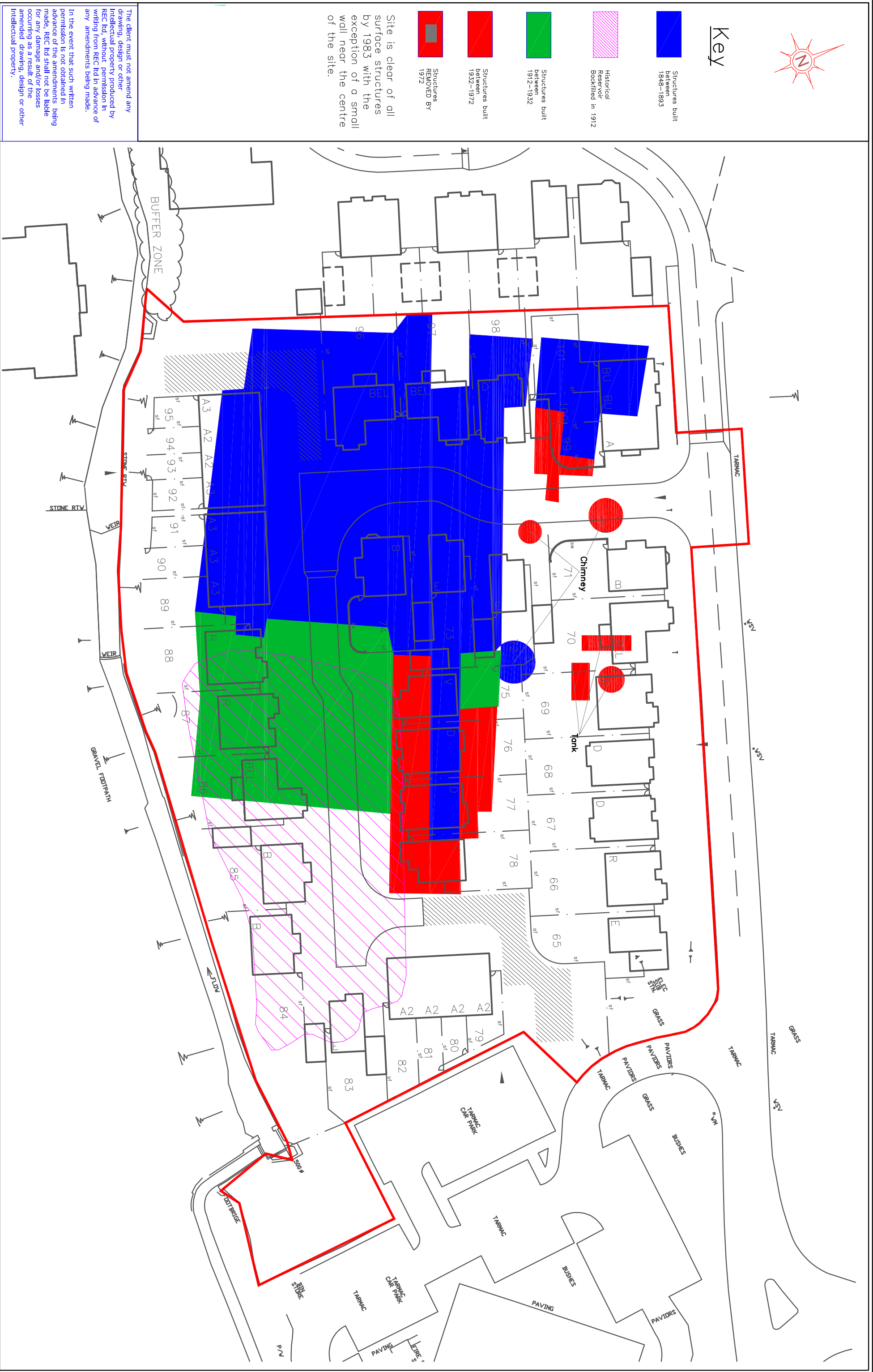
Scale: NTS

Date: 4/11/11

Notes:

Drawing Title

43933-3-5
Projected Depth
of MADE GROUND



The site plan illustrates a residential development with various building types and features. The key identifies the following categories:

- Structures built between 1848-1893:** Represented by blue areas, primarily located in the central and eastern parts of the site.
- Structures built between 1912-1932:** Represented by green areas, primarily located in the central and western parts of the site.
- Structures built between 1932-1972:** Represented by red areas, primarily located in the central and eastern parts of the site.
- Structures removed by 1972:** Represented by grey areas, primarily located in the central and eastern parts of the site.
- Historical Reservoir Backfilled in 1912:** Represented by pink hatched areas, primarily located in the central and western parts of the site.

The site plan also includes a north arrow, a scale bar (0 to 1500 feet), and a detailed site layout showing building footprints, parking areas, and surrounding infrastructure. The plan is divided into several sections, with building types and areas labeled with letters (A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z) and numbers (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100). The plan also shows a 'BUFFER ZONE' and a 'STONE RTV' area.

[illegible][illegible][illegible]

The site plan shows a residential development with various building types and features. The key indicates the following categories:

- Structures built between 1848-1893:** Represented by blue areas.
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- Structures removed by 1972:** Represented by grey areas.
- Historical Reservoir Backfilled in 1912:** Represented by pink hatched areas.

The site plan includes a north arrow, a scale bar (0 to 1500 feet), and a detailed layout of the development. The layout shows a central area with a large blue structure (A) and a green structure (B). To the right, there are several red structures (C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z) and a large pink hatched area (A1). The site is bounded by a red line, and there are various features like a chimney, tank, and a buffer zone. The plan also shows a gravel footpath, a stone RTV, and a weir. The site is adjacent to a tarmac area and a grassy area. The plan includes a detailed layout of the development with various building types and features.

[illegible]

Key

- Structures built between 1848-1893
- Structures built between 1912-1932
- Structures built between 1932-1972
- Structures removed by 1972
- Historical Reservoir Backfilled in 1912

Site is clear of all surface structures by 1983 with the exception of a small wall near the centre of the site.

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Site Plan Details:

- Streets:** TARMAC, GRASS, PAVING, BUSSES, PAVERS, GRASS, TARMAC, CAR PARK, PAVING, TARMAC, DUTY BRIDGE, 1500', 1000', 500', 100', 50', 25', 10', 5', 2.5', 1.25', 0.625', 0.3125', 0.15625', 0.078125', 0.0390625', 0.01953125', 0.009765625', 0.0048828125', 0.00244140625', 0.001220703125', 0.0006103515625', 0.00030517578125', 0.000152587890625', 0.0000762939453125', 0.00003814697265625', 0.000019073486328125', 0.0000095367431640625', 0.00000476837158203125', 0.000002384185791015625', 0.0000011920928955078125', 0.00000059604644775390625', 0.000000298023223876953125', 0.0000001490116119384765625', 0.00000007450580596923828125', 0.000000037252902984619140625', 0.0000000186264514923095703125', 0.00000000931322574615478515625', 0.000000004656612873077392578125', 0.0000000023283064365386962890625', 0.00000000116415321826934814453125', 0.000000000582076609134674072265625', 0.0000000002910383045673370361328125', 0.00000000014551915228366851806640625', 0.000000000072759576141834259033203125', 0.0000000000363797880709171295166015625', 0.00000000001818989403545856475830078125', 0.000000000009094947017729282379150390625', 0.0000000000045474735088646411895751953125', 0.00000000000227373675443232059478759765625', 0.000000000001136868377216160297393798828125', 0.0000000000005684341886080801486968994140625', 0.00000000000028421709430404007434844970703125', 0.000000000000142108547152020037174224853515625', 0.0000000000000710542735760100185871124267578125', 0.00000000000003552713678800500929355621337890625', 0.000000000000017763568394002500461778106689453125', 0.0000000000000088817841970012502308890533447265625', 0.00000000000000444089209850062511544452667236328125', 0.000000000000002220446049250312557722263336181640625', 0.0000000000000011102230246251578886111316680908203125', 0.00000000000000055511151231257894430556583340541015625', 0.0000000000000002775557561562894721527829167027053125', 0.00000000000000013877787807814473607639145835135265625', 0.000000000000000069388939039072368038195729175676328125', 0.0000000000000000346944695195361840190978645878381640625', 0.00000000000000001734723475976809200954893229391908203125', 0.000000000000000008673617379884046004774466146959541015625', 0.00000000000000000433680868994202300238723307347977053125', 0.000000000000000002168404344971011501193616536739885265625', 0.00000000000000000108420217248550575059680826836994265625', 0.000000000000000000542101086242752875298404134184971328125', 0.0000000000000000002710505431213764376492020670924856640625', 0.00000000000000000013552527156068821882460103354624283203125', 0.000000000000000000067762635780344109412300516773121416015625', 0.0000000000000000000338813178901720547061502583865607080078125', 0.00000000000000000001694065894508602735307512919328035400390625', 0.000000000000000000008470329472543013676537564596640177001953125', 0.0000000000000000000042351647362715068382687822983200885009765625', 0.00000000000000000000211758236813575341913439114916004425048828125', 0.000000000000000000001058791184067876709567195574580022125244140625', 0.0000000000000000000005293955920339383547835977872900110626220703125', 0.00000000000000000000026469779601696917739179889364500553131103515625', 0.000000000000000000000132348898008484588695899446822502765655517578125', 0.0000000000000000000000661744490042422943479497234112513828277587890625', 0.00000000000000000000003308722450212114717397486170562569141137939453125', 0.000000000000000000000016543612251060573586987430852812807055689697265625', 0.0000000000000000000000082718061255302867934937154264064035278448486328125', 0.00000000000000000000000413590306276514339674685771320320176392242431640625', 0.000000000000000000000002067951531382571698373428856601600881961212158203125', 0.0000000000000000000000010339757656912858491867144283008004409806060791015625', 0.00000000000000000000000051698788284564292459335721415040022049030303955078125', 0.00000000000000000000000025849394142282146229667860707520011

Key

- Structures built between 1848-1893
- Structures built between 1912-1932
- Structures built between 1932-1972
- Structures removed by 1972
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Site is clear of all surface structures by 1983 with the exception of a small wall near the centre of the site.

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In the event that such written permission is not obtained in advance of the amendments being made, REC Ltd shall not be liable for any damage and/or losses occurring as a result of the amended drawing, design or other intellectual property.

Site Plan Details:

- Streets:** TARMAC, GRASS, PAVING, BUSSES, PAVERS, GRASS, TARMAC, CAR PARK, PAVING, TARMAC, DUTY BRIDGE, 1500', 1000', 500', 100', 50', 25', 10', 5', 2.5', 1.25', 0.625', 0.3125', 0.15625', 0.078125', 0.0390625', 0.01953125', 0.009765625', 0.0048828125', 0.00244140625', 0.001220703125', 0.0006103515625', 0.00030517578125', 0.000152587890625', 0.0000762939453125', 0.00003814697265625', 0.000019073486328125', 0.0000095367431640625', 0.00000476837158203125', 0.000002384185791015625', 0.0000011920928955078125', 0.00000059604644775390625', 0.000000298023223876953125', 0.0000001490116119384765625', 0.00000007450580596923828125', 0.000000037252902984619140625', 0.0000000186264514923095703125', 0.00000000931322574615478515625', 0.000000004656612873077392578125', 0.0000000023283064365386962890625', 0.00000000116415321826934814453125', 0.000000000582076609134674072265625', 0.0000000002910383045673370361328125', 0.00000000014551915228366851806640625', 0.000000000072759576141834259033203125', 0.0000000000363797880709171295166015625', 0.00000000001818989403545856475830078125', 0.000000000009094947017729282379150390625', 0.0000000000045474735088646411895751953125', 0.00000000000227373675443232059478759765625', 0.000000000001136868377216160297393798828125', 0.0000000000005684341886080801486968994140625', 0.00000000000028421709430404007434844970703125', 0.000000000000142108547152020037174224853515625', 0.0000000000000710542735760100185871124267578125', 0.00000000000003552713678800500929355621337890625', 0.000000000000017763568394002500461778106689453125', 0.0000000000000088817841970012502308890533447265625', 0.00000000000000444089209850062511544452667236328125', 0.000000000000002220446049250312557722263336181640625', 0.0000000000000011102230246251578886111316680908203125', 0.00000000000000055511151231257894430556583340541015625', 0.0000000000000002775557561562894721527829167027053125', 0.00000000000000013877787807814473607639145835135265625', 0.000000000000000069388939039072368038195729175676328125', 0.0000000000000000346944695195361840190978645878381640625', 0.00000000000000001734723475976809200954893229391908203125', 0.000000000000000008673617379884046004774466146959541015625', 0.00000000000000000433680868994202300238723307347977053125', 0.000000000000000002168404344971011501193616536739885265625', 0.00000000000000000108420217248550575059680826836994265625', 0.000000000000000000542101086242752875298404134184971328125', 0.0000000000000000002710505431213764376492020670924856640625', 0.00000000000000000013552527156068821882460103354624283203125', 0.000000000000000000067762635780344109412300516773121416015625', 0.0000000000000000000338813178901720547061502583865607080078125', 0.00000000000000000001694065894508602735307512919328035400390625', 0.000000000000000000008470329472543013676537564596640177001953125', 0.0000000000000000000042351647362715068382687822983200885009765625', 0.00000000000000000000211758236813575341913439114916004425048828125', 0.000000000000000000001058791184067876709567195574580022125244140625', 0.0000000000000000000005293955920339383547835977872900110626220703125', 0.00000000000000000000026469779601696917739179889364500553131103515625', 0.000000000000000000000132348898008484588695899446822502765655517578125', 0.0000000000000000000000661744490042422943479497234112513828277587890625', 0.00000000000000000000003308722450212114717397486170562569141137939453125', 0.000000000000000000000016543612251060573586987430852812845705689697265625', 0.0000000000000000000000082718061255302867934937154264064228528448486328125', 0.00000000000000000000000413590306276514339674685771320321142642242431640625', 0.000000000000000000000002067951531382571698373428856601605713211212158203125', 0.0000000000000000000000010339757656912858491867144283008028566056060791015625', 0.00000000000000000000000051698788284564292459335721415040142833028031955078125', 0.00000000000000000000000025849394142282146229667860707520071

The site plan shows a residential development with various building types and features. The key indicates the following categories:

- Structures built between 1848-1893:** Represented by blue areas.
- Structures built between 1912-1932:** Represented by green areas.
- Structures built between 1932-1972:** Represented by red areas.
- Structures removed by 1972:** Represented by grey areas.
- Historical Reservoir Backfilled in 1912:** Represented by pink hatched areas.

The site plan includes a north arrow, a scale bar (0 to 1500 feet), and a detailed layout of the development. The layout shows a central area with a large blue structure (A) and a green structure (B). To the right, there is a row of smaller buildings (C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z). The site is bounded by a red line, and there are various features such as a chimney, tank, and a buffer zone. The plan also shows a gravel footpath, a stone RTV, and a weir. The site is surrounded by tarmac, grass, and bushes. The plan includes a detailed layout of the development, showing the location of each building and the surrounding features.

[illegible][illegible][illegible]

The site plan shows a residential development with various building types and historical features. The key indicates the following categories:

- Structures built between 1848-1893:** Represented by blue areas.
- Structures built between 1912-1932:** Represented by green areas.
- Structures built between 1932-1972:** Represented by red areas.
- Structures removed by 1972:** Represented by grey areas.
- Historical Reservoir Backfilled in 1912:** Represented by pink hatched areas.

The plan also includes a north arrow, a scale bar (0 to 1500 feet), and various site features such as roads, paths, and landscaping. The buildings are labeled with letters (A, B, C, D, E, R) and numbers (65, 66, 67, 68, 69, 70, 71, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95). The plan also shows a 'Chimney' and a 'Tank'.

The site plan shows a residential development with various building types and features. The key indicates the following categories:

- Structures built between 1848-1893:** Represented by blue areas.
- Structures built between 1912-1932:** Represented by green areas.
- Structures built between 1932-1972:** Represented by red areas.
- Structures removed by 1972:** Represented by grey areas.
- Historical Reservoir Backfilled in 1912:** Represented by pink hatched areas.

The site plan includes a north arrow, a scale bar (0 to 1500 feet), and a detailed layout of the development. The layout shows a central area with a large blue structure (A) and a green structure (B). To the right, there are several red structures (C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z) and a pink hatched area (A1). The site is bounded by a red line, and there are various features such as a chimney, tank, and a buffer zone. The plan also shows a gravel footpath, a stone RTV, and a weir. The site is adjacent to a tarmac area and a grassy area. The plan includes a detailed layout of the development with various building types and features.

The site plan shows a residential development with various building types and features. The key indicates the following categories:

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[illegible]

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The site plan includes a north arrow, a scale bar (0 to 1500 feet), and a detailed layout of the development. The layout shows a central area with a large blue structure (A) and a green structure (B). To the right, there are several red structures (C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z) and a large pink hatched area (A1). The site is bounded by a red line, and there are various features such as a chimney, tank, and a buffer zone. The plan also shows a gravel footpath, a stone RTV, and a weir. The site is surrounded by tarmac, grass, and bushes. The plan includes a detailed layout of the development with various building types and features.

[illegible]

The architectural site plan illustrates a residential development with buildings numbered 65 through 98. The buildings are color-coded according to their construction period or status:

- Blue:** Structures built between 1848–1893.
- Red:** Structures built between 1932–1972.
- Green:** Structures built between 1912–1932.
- Pink Hatched:** Historical Reservoir Backfilled in 1912.
- Grey:** Structures removed by 1972.

Key site features include:

- TARMAC:** Paved areas surrounding the site.
- GRASS:** Open grassy areas.
- BUSHS:** Areas designated for bushes.
- PAVING:** Areas designated for paving.
- STONE RTY:** Stone retaining wall.
- VEIR:** A small dam or weir.
- GRAVEL FOOTPATH:** Pathway along the bottom left.
- MUDL:** A drainage feature.
- DUTTYRIDE:** A specific area or road at the bottom.
- CAR PARK:** Designated parking areas.
- Chimney:** Located near building 70.
- Tank:** Located near building 70.
- ELEC SYSTEMS:** Electrical systems located near building 65.
- Buffer Zone:** Indicated on the left side of the plan.

A north arrow is present in the top right corner, pointing towards the upper right. The plan also shows various setbacks and boundary lines around the perimeter of the development.

[illegible]

The site plan shows a residential development with various building types and features. The key indicates the following categories:

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- Structures built between 1932-1972:** Represented by red areas.
- Structures removed by 1972:** Represented by grey areas.
- Historical Reservoir Backfilled in 1912:** Represented by pink hatched areas.

The site plan includes a north arrow, a scale bar (0 to 1500 feet), and a detailed layout of the development. The layout shows a central area with a large blue structure (A) and a green structure (B). To the right, there are several red structures (C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z). The site is bounded by a red line, and there are various features such as a chimney, tank, and a buffer zone. The plan also shows a gravel footpath, a stone RTV, and a weir. The site is surrounded by tarmac, grass, and bushes. The plan includes a detailed layout of the development, showing the location of each structure and the surrounding features.

The site plan shows a residential development with various building types and features. The key indicates the following categories:

- Structures built between 1848-1893:** Represented by blue areas.
- Structures built between 1912-1932:** Represented by green areas.
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The site plan shows a residential development with various building types and features. The key indicates the following categories:

- Structures built between 1848-1893:** Represented by blue areas.
- Structures built between 1912-1932:** Represented by green areas.
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- Structures removed by 1972:** Represented by grey areas.
- Historical Reservoir Backfilled in 1912:** Represented by pink hatched areas.

The site plan includes a north arrow, a scale bar (0 to 1500 feet), and a detailed layout of the development. The layout shows a central area with a large blue structure (A) and a green structure (B). To the right, there are several red structures (C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z). The site is bounded by a red line, and there are various features such as a chimney, tank, and a buffer zone. The plan also shows a gravel footpath, a stone RTV, and a weir. The site is surrounded by tarmac, grass, and bushes. The plan includes a detailed layout of the development, showing the location of each structure and the surrounding features.

[illegible]

The site plan illustrates a residential development with various building types and landscaping. The key identifies the following categories:

- Structures built between 1848-1893:** Represented by blue areas.
- Structures built between 1912-1932:** Represented by green areas.
- Structures built between 1932-1972:** Represented by red areas.
- Structures removed by 1972:** Represented by grey areas.
- Historical Reservoir Backfilled in 1912:** Represented by pink hatched areas.

The site plan includes a north arrow, a scale bar (0 to 1500 feet), and a detailed layout of the development. The plan shows a central area with a large blue structure (A) and a green structure (B). To the right, there is a row of smaller buildings (C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z). The plan also shows a 'Chimney' and a 'Tank'. The site is bounded by a 'TARMAC' area on the right and a 'GRASS' area on the left. A 'STONE RTV' and 'VEIR' are located on the left side. A 'GRAVEL FOOTPATH' runs along the bottom left. The plan includes a 'TARMAC CAR PARK' and a 'PAVING' area. The site is also shown with a 'DUTY BRIDGE' and a 'SIDE' area. The plan includes a 'TARMAC' area on the right and a 'GRASS' area on the left. A 'STONE RTV' and 'VEIR' are located on the left side. A 'GRAVEL FOOTPATH' runs along the bottom left. The plan includes a 'TARMAC CAR PARK' and a 'PAVING' area. The site is also shown with a 'DUTY BRIDGE' and a 'SIDE' area.

The site plan illustrates a residential development with various building types and landscaping. The key identifies the following categories:

- Structures built between 1848-1893:** Represented by blue areas.
- Structures built between 1912-1932:** Represented by green areas.
- Structures built between 1932-1972:** Represented by red areas.
- Structures removed by 1972:** Represented by grey areas.
- Historical Reservoir Backfilled in 1912:** Represented by pink hatched areas.

The site plan includes a north arrow, a scale bar (0 to 1500 feet), and a detailed layout of the development. The plan shows a central area with a large blue structure (A) and a green structure (B). To the right, there is a row of smaller buildings (C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z). The plan also shows a 'Chimney' and a 'Tank'. The site is bounded by a 'TARMAC' area on the right and a 'GRASS' area on the left. A 'STONE RTV' and 'VEIR' are located on the left side. A 'GRAVEL FOOTPATH' runs along the bottom left. The plan includes a 'TARMAC CAR PARK' and a 'PAVING' area. The site is also shown with a 'DUTY FREE' area and a 'P/W' (Public Works) area. The plan includes a 'TARMAC' area on the right and a 'GRASS' area on the left. A 'STONE RTV' and 'VEIR' are located on the left side. A 'GRAVEL FOOTPATH' runs along the bottom left. The plan includes a 'TARMAC CAR PARK' and a 'PAVING' area. The site is also shown with a 'DUTY FREE' area and a 'P/W' (Public Works) area.

The site plan shows a residential development with various building types and historical features. The key indicates the following categories:

- Structures built between 1848-1893:** Blue solid fill.
- Structures built between 1912-1932:** Green solid fill.
- Structures built between 1932-1972:** Red solid fill.
- Structures removed by 1972:** Red outline with a grey square in the center.
- Historical Reservoir Backfilled in 1912:** Pink diagonal hatching.

The plan also includes a north arrow, a scale bar (0 to 1500 feet), and a buffer zone. The site is bounded by a road to the north and a river to the south. The plan shows various building footprints, including a large central building complex and several smaller structures. The plan also shows the location of a chimney, a tank, and a well. The plan is divided into several sections, each labeled with a letter (A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z). The plan also shows the location of a car park, a gravel footpath, and a tarmac area. The plan is a detailed architectural drawing showing the layout of the development and the location of various features.

The site plan shows a residential development with various building types and historical features. The key indicates the following categories:

- Structures built between 1848-1893:** Blue solid fill.
- Structures built between 1912-1932:** Green solid fill.
- Structures built between 1932-1972:** Red solid fill.
- Structures removed by 1972:** Red outline with a grey square in the center.
- Historical Reservoir Backfilled in 1912:** Pink diagonal hatching.

The plan also includes a north arrow, a scale bar (0 to 1500 feet), and a buffer zone. The site is bounded by a road to the north and a river to the south. The plan shows various building footprints, including a large central building complex and several smaller structures. The plan also shows the location of a chimney, a tank, and a well. The plan is divided into several sections, each labeled with a letter (A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z). The plan also shows the location of a car park, a gravel footpath, and a gravel pit. The plan is a detailed architectural drawing showing the layout of the site and the location of various features.

The site plan shows a residential development with various building types and features. The key indicates the following categories:

- Structures built between 1848-1893:** Blue solid fill.
- Structures built between 1912-1932:** Green solid fill.
- Structures built between 1932-1972:** Red solid fill.
- Structures removed by 1972:** Red outline with a grey square in the center.
- Historical Reservoir Backfilled in 1912:** Pink diagonal hatching.

The site plan includes a north arrow pointing towards the top right. The layout shows a central area with several buildings, some of which are colored according to the key. A large blue area is labeled 'A', a green area is labeled 'B', and a red area is labeled 'C'. A pink hatched area is labeled 'D'. The plan also shows a 'TARMAC' area, a 'GRASS' area, and a 'PAVING' area. A 'STONE RTV' and 'VEIR' are also indicated. The plan is bounded by a 'BUFFER ZONE' on the left and a 'DUTY FREE' area on the right. The plan is numbered 1500 and 1501.

[illegible]

APPENDIX II

REC Ltd Chemical Testing Specification

Barrow Brook – Remediation Targets

Determinand	Units	Within 600mm Cover System (Garden)	Under Hard Standing and >600mm of cover system	Pathway
Arsenic	mg/kg	32	320 ⁽⁴⁾	1 ⁽⁵⁾
Cadmium	mg/kg	10	100 ⁽⁴⁾	1 ⁽⁵⁾
Chromium (Hexavalent)	mg/kg	4.3	43 ⁽⁴⁾	1 ⁽⁵⁾
Lead ⁽ⁱ⁾	mg/kg	225	4500 ⁽⁴⁾	1 ⁽⁵⁾
Elemental Mercury ⁽ⁱⁱⁱ⁾	mg/kg	1	1 ⁽⁴⁾	2
Nickel	mg/kg	130	1300 ⁽⁴⁾	1 ⁽⁵⁾
Selenium (New SGV)	mg/kg	350	1750 ⁽⁴⁾	1 ⁽⁵⁾
Copper	mg/kg	2330	23300 ⁽⁴⁾	1 ⁽⁵⁾
Zinc	mg/kg	3750	37500 ⁽⁴⁾	1 ⁽⁵⁾
Cyanide	mg/kg	791	7910 ⁽⁴⁾	1 ⁽⁵⁾
Phenol	mg/kg	210	210 ⁽⁴⁾	
Naphthalene	mg/kg	8.7 ⁽¹⁾	8.7 ⁽¹⁾	2
Acenaphthylene	mg/kg	160 ⁽¹⁾	690 ^(1,2)	3 ⁽⁵⁾
Acenaphthene	mg/kg	200 ⁽¹⁾	850 ^(1,2)	1 ⁽⁵⁾
Fluorene	mg/kg	160 ⁽¹⁾	670 ^(1,2)	1 ⁽⁵⁾
Phenanthrene	mg/kg	90 ⁽¹⁾	380 ^(1,2)	3 ⁽⁵⁾
Anthracene	mg/kg	2200 ⁽¹⁾	9500 ^(1,2)	3 ⁽⁵⁾
Fluoranthene	mg/kg	290 ⁽¹⁾	1300 ^(1,2)	3 ⁽⁵⁾
Pyrene	mg/kg	620 ⁽¹⁾	2700 ^(1,2)	3 ⁽⁵⁾
Benzo(a)Anthracene ^(c)	mg/kg	10 ⁽¹⁾	550 ^(1,2)	3 ⁽⁵⁾
Chrysene	mg/kg	12 ⁽¹⁾	580 ^(1,2)	3 ⁽⁵⁾
Benzo(b/k)Fluoranthene ⁽ⁱⁱⁱ⁾	mg/kg	13 ⁽¹⁾	35 ^(1,2)	3 ⁽⁵⁾
Benzo(a)Pyrene	mg/kg	0.86 ⁽¹⁾	14 ^(1,3)	3 ⁽⁵⁾
Indeno(123-cd)Pyrene	mg/kg	7.1 ⁽¹⁾	38 ^(1,2)	3 ⁽⁵⁾
Dibenzo(a,h)Anthracene	mg/kg	2.3 ⁽¹⁾	15 ^(1,2)	3 ⁽⁵⁾
Benzo(ghi)Perylene	mg/kg	160 ⁽¹⁾	1200 ^(1,2)	3 ⁽⁵⁾
Benzene ^(iv)	mg/kg	0.33	0.33	2
Toluene ^(iv)	mg/kg	610	610	2
Ethylbenzene ^(iv)	mg/kg	350	350	2
Xylenes ^{(iv) (v)}	mg/kg	230	230	2
TPH C ₅ -C ₆ (aliphatic)	mg/kg	110	110	2
TPH C ₆ -C ₈ (aliphatic)	mg/kg	370	370	2
TPH C ₈ -C ₁₀ (aliphatic)	mg/kg	110	110	2
TPH C ₁₀ -C ₁₂ (aliphatic)	mg/kg	283	283	2
TPH C ₁₂ -C ₁₆ (aliphatic)	mg/kg	3000	3000	1 ⁽⁵⁾
TPH C ₁₆ -C ₂₁ (aliphatic)	mg/kg	10,000	10,000	1 ⁽⁵⁾
TPH C ₂₁ -C ₃₅ (aliphatic)	mg/kg	10,000	10,000	1 ⁽⁵⁾
TPH C ₅ -C ₆ (aromatic)	mg/kg	280	280	2
TPH C ₆ -C ₈ (aromatic)	mg/kg	611	611	2
TPH C ₈ -C ₁₀ (aromatic)	mg/kg	151	151	2
TPH C ₁₀ -C ₁₂ (aromatic)	mg/kg	346	346	2
TPH C ₁₂ -C ₁₆ (aromatic)	mg/kg	593	593	1 ⁽⁵⁾
TPH C ₁₆ -C ₂₁ (aromatic)	mg/kg	770	770	1 ⁽⁵⁾
TPH C ₂₁ -C ₃₅ (aromatic)	mg/kg	1230	1230	1 ⁽⁵⁾

Notes 1

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 by 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).

Tier 1 GAC with a 6% Soil Organic Matter (SOM) have been utilised for the upper 600mm as it is assumed the material will contain a high organic.

Notes 2

- (1) Excludes matrices where free product is observed;
- (2) Assumes 10 x Tier 1 GAC for non volatile PAH screening criteria for residential garden & non separate phase with conservative TOC assessment of 2.5%;
- (3) Commercial Tier 1 GAC modelled to assume no exposure pathway; and,
- (4) Values for soils below 600mm cover system and beneath areas of hard standing with no vapour exposure pathway have been calculated as 10 x Tier 1 GAC for 2.5% SOM.
- (5) No viable exposure pathway beneath hard standing and cover system.

Notes 3

Main Exposure Pathways: 1 = Soil Ingestion, 2 = Vapour Inhalation (indoor), 3 = Dermal Contact & Ingestion, 4 = Dust Inhalation.

Abbreviations: GAC = General Assessment Criteria, n = number of samples, MC = Maximum Concentration; NA – Not Applicable (no exceedance of assessment criteria); Loc of MC = Location of Exceedances

*

- (i) Lead – Based on 50% SOM 2003 SGV because of proposed decrease in DWS and acceptable lead blood levels from 10µg/l to 5µg/l
- (ii) Mercury – Based on elemental Mercury
- (iii) Benzo (b) Fluoranthene (100mg/kg) Benzo (k) Fluoranthene (140mg/kg)
- (iv). BTEX is not SOM related due to inhalation pathway
- (v) Xylenes based on p-xylene (o-xylene 2600mg/kg, m-xylene 3500mg/kg) and is capped by its solubility

(vi) The Tier 1 GAC for the hydrocarbon fraction is derived from the CIEH assessment for petroleum hydrocarbons Criteria Working Group (CWG) for both aliphatic and aromatic compounds. REC has utilised the Tier 1 values for aliphatic compounds for the volatile and semi volatile fractions (C₅-C₁₂) and the Tier 1 values for aromatic compound for the non volatile fractions (C₁₂-C₃₅). The comparison of a total (aliphatic/aromatic) compounds to an individual fraction is considered to be a conservative approach and satisfactory for the protection of human health.

APPENDIX III

REC Compaction Specification

REC LTD GEOTECHNICAL EARTHWORKS SPECIFICATION

It is proposed to up-fill and level the site to form a working platform to the required working level in accordance with the proposed formation levels drawing to be submitted separately. This work will include, but not necessarily be limited to, the following elements.

The contractor should employ an experienced geotechnical 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 cut and fill process.

LOCALLY WON FILL MATERIAL

It is proposed to up-fill 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 site will be a mix between cohesive and granular matrixes. Because of the long term settlement associated with even well compacted cohesive soils due to elevated pore water pressures, it is essential that the cut and fill process is well controlled.

CLASSIFICATION OF FILL MATERIAL

This Specification should be read in conjunction with the following:

- The Manual of Contract Documents for Highway Works, Volume 1, Specification for Highway Works, Series 600, Earthworks as amended in November 2005; and,
- Soils for Civil Engineering Purposes, BS1377, 1999.

General Classification

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

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

Use of Fill Materials

In addition to any grading requirement the maximum particle size of any fill material shall be no more than two-thirds of the compacted layer thickness except that cobbles having an equivalent diameter of more than 150mm shall not be deposited within 1.5m of 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.

GENERAL REQUIREMENTS

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

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

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

Haulage of material to embankments or other areas of fill shall proceed only when sufficient spreading and compaction. Plant is operating at the place of deposition to ensure compliance with Clause 612 of the Highways specification.

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

Where the excavation reveals a combination of acceptable and unacceptable materials the Contractor shall carry out the excavation in such a manner that the acceptable materials are excavated separately for use in the Permanent Works without contamination by the unacceptable materials. Unless otherwise described in the Contract classes of fill material require3d to be deposited separately shall be excavated separately without contamination by other classes of material.

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

The Contractor shall ensure that he does not adversely affect the stability of excavations or fills by his methods of stockpiling materials, use of plant or sitting of temporary buildings or structures.

Topsoil shall wherever practicable be used immediately after its stripping and if not shall be stored in stockpiles of heights not exceeding 2.0m; topsoil shall not be stockpiled for more than two years. Topsoil shall not be unnecessarily trafficked either before stripping or when in a stockpile. Stockpiles shall not be surcharged or otherwise loaded and multiple handling shall be kept to a minimum.

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

The Contractor shall keep earthworks free of water including:

- (i) arranging the rapid removal of water:
 - (a) shed on to the earthworks
 - (b) entering the earthworks from any source
- (ii) provide where necessary temporary watercourses, drains, pumping and the like:
- (iii) discharge accumulated water and groundwater into the permanent outfalls of the drainage system where practicable

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

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

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

CONSTRUCTION OF FILLS

All fills shall be constructed:

- (i) in the locations as shown in the contract drawings to the lines and levels stated therein;
- (ii) of classes of material complying with this specification;
- (iii) by deposition, as soon as practicable after excavation, in layers to meet the compaction requirements as required for each Class of material as specified.
- (iv) To the requirements of this clause and any other requirements for fill in this Specification.

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

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

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

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

Temporary slopes within compacted and un-compacted backfill shall be formed at gradients which ensure stability.

COMPACTION OF FILLS

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

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

The Contractor shall obtain permission from the Overseeing Organisation before carrying out compaction requirements as listed in Table 6/1 for the Class of material being compacted.

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

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

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

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

Refer to Clause 612/10 of the Highway specification for definition of plant to be used in accordance with this specified works.

The Contractor will be responsible for assessing the Class of Fill in accordance with Table 6/1 of the Highways Specification. Table 6/4 of the Highways Specification should then be employed to assess the method of compaction to be employed. The test results and method statements shall be submitted to the Consulting Engineers for approval.

EARTHWORKS MATERIALS 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 following:

Test	Test Method
Liquid and plastic limits	BS1377: Part 2
Grading	BS1377: Part 2
Uniformity Co-efficient	Calculated from grading curve
Moisture content	BS1377: Part 2
Organic Matter (maximum 2.5% total organic content)	BS1377: Part 3
Water soluble sulphate	TRL Report 447 test No 1
Total sulphate content	TRL Report 447 Test No 4
Multi Point Moisture Condition Value (MCV) (to assess optimum moisture content)	Clause 632 (BS1377: Part 4)
Proctor compaction testing	BS1377: Part 4

During the construction of the fill the testing outlined above shall be undertaken at on suitable frequency of fill or when the source of the fill changes. The results of this work shall be submitted to the Consulting Engineer for approval.

EARTHWORK INSITU TESTS

Subsequent to the filling and compaction of the material a series of in-situ tests shall be undertaken to confirm the success of the compaction process. This testing shall include but not necessarily be limited to, the following:

Test	Test Method
Plate load tests (equivalent CBR of 3%)	BS1377: Part 9

DISPOSAL OF MATERIALS

The contractor shall be responsible for the safe disposal of any excess of unsuitable material found on the Site.

APPENDIX A

TABLES

EARTHWORKS

#601 Classification, Definitions and Uses of Earthworks Materials

General Classification

1 Earthworks materials shall fall into one or other of the following general classifications:

- (i) acceptable material: material excavated from within the Site or imported on to the Site which meets the requirements of Table 6/1 and Appendix 6/1 for acceptability for use in the Permanent Works;
- (ii) (11/04) unacceptable material Class U1A as defined in sub-Clauses 2(i)(a) and 2(i)(b) of this Clause: material excavated from within the Site which, unless processed so that it meets the requirements of Table 6/1 and Appendix 6/1, shall not be used in the Permanent Works;
- (iii) (11/04) unacceptable material Class U1B as defined in sub-Clause 2(ii)(a) of this Clause: material excavated from within the Site which, unless processed so that it meets the requirements of Table 6/1 and Appendix 6/1, shall not be used in the Permanent Works; and
- (iv) (11/04) unacceptable material Class U2 as defined in sub-Clause 3(i) of this Clause: material excavated from within the Site which shall not be used in the Permanent Works.

(11/04) Unacceptable Materials

2 (11/04) Unacceptable material Classes U1A and U1B:

- (i) (11/04) unacceptable material Class U1A shall be:
 - (a) (11/04) material which does not comply with the permitted constituents and material properties of Table 6/1 and Appendix 6/1 for acceptable material; and
 - (b) (11/04) material, or constituents of materials, composed of the following unless otherwise described in 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;
- material susceptible to spontaneous combustion except unburnt colliery spoil complying with sub-Clause 15 of this Clause;

(ii) (11/04) unacceptable material Class U1B shall be:

- (a) (11/05) 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 Appendix 6/14 or in Appendix 6/15, but excluding all hazardous wastes (as defined in the Hazardous Waste (England and Wales) Regulations 2005) and radioactive wastes (as defined in the Radioactive Substances Act 1993).

3 Unacceptable material Class U2 shall be:

- (i) (11/05) 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 (11/04) Where required in Appendix 6/1, 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 Appendix 6/1.

Definitions

5 Chalk shall mean:

- (i) any porous material of natural origin composed essentially of calcium carbonate

and identified as chalk on the maps produced by the British Geological Survey;

- (ii) material designated as Class 3 in Appendix 6/1.

6 Argillaceous rock shall mean shales mudstones siltstones slates and micaceous schists composed of particles of clay and silt and mica. It shall include unburnt colliery spoil.

7 Pulverised-fuel ash shall mean solid material extracted by electrostatic and mechanical means from the flue gases of furnaces fired with pulverised bituminous coal. It shall have a maximum particle size of 3 mm.

8 Furnace bottom ash shall mean agglomerated pulverised-fuel ash obtained from the bottom of the power station furnace and having particle size no larger than 10 mm.

9 Formation shall be the top surface of capping. Where no capping is required formation shall be the top surface of earthworks at the underside of sub-base, unless otherwise shown on the Drawings.

10 Sub-formation shall be the top surface of earthworks at the underside of capping.

11 (05/01) Stabilisation shall mean the spreading of cement or lime or both on a layer of deposited or intact granular or cohesive material, and the subsequent process of pulverising and mixing followed by appropriate compaction to form the whole or a constituent layer of a capping.

12 (11/07) Where 'recycled aggregate' is used in this Series, the material shall be aggregate resulting from the processing of material used in a construction process. The aggregate shall have been tested in accordance with Clause 710, and the content of other materials (Class X) including wood, plastic and metal shall not exceed 1% by mass. Where 'recycled aggregate except recycled asphalt' is used in this Series, the aggregate shall have been tested in accordance with Clause 710. Content of asphalt (mineral aggregate with a bituminous binder) shall not exceed 2% by mass, and the content of other materials (Class X) including wood, plastic and metal shall not exceed 1% by mass.

Use of Fill Materials

13 (05/01) In addition to any grading requirements 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 beneath verges or central reserves within 1.30 m of the finished surface.

14 (11/07) Material shall not be deposited within 500 mm, or other distances described in Appendix 6/3, of concrete, cement bound materials, other cementitious materials or stabilised capping forming part of the Permanent Works if, when tested in accordance with TRL Report 447 either:

- (i) (11/05) the water-soluble sulfate (WS) content exceeds 1500 mg of sulfate (as SO_4) per litre (Test No.1); or
- (ii) (11/07) the oxidisable sulfides (OS) content exceeds 0.3 % of sulfate (as SO_4) (Test Nos. 2 and 4).

(11/07) At least five samples of each material shall be tested for WS and OS. The mean of the highest two values shall be used for comparison with the limiting values. This also applies if six to nine results are available. If ten or more results are available, the mean of the highest 20% of the results shall be used for comparison with the limiting values.

15 (11/07) Material shall not be deposited within 500 mm, or other distances described in Appendix 6/3, of metallic structural elements forming part of the Permanent Works if, when tested in accordance with TRL Report 447 either:

- (i) (11/05) the water-soluble sulfate (WS) content exceeds 300 mg of sulfate (as SO_4) per litre (Test No.1); or
- (ii) the oxidisable sulfides (OS) content exceeds 0.06 % of sulfate (as SO_4) (Test Nos. 2 and 4).

(11/05) At least five samples of each material shall be tested for WS and OS. The mean of the highest two values shall be used for comparison with the limiting values. This also applies if six to nine results are available. If ten or more results are available, the mean of the highest 20% of the results shall be used for comparison with the limiting values.

(11/07) The requirements in (i) and (ii) above shall not apply to metallic items protected by concrete and ancillary metallic items such as the tops of chambers and gullies.

16 (05/01) Unburnt colliery spoil may be used as general fill provided it is compacted in compliance with Clause 612 and complies with the requirements of Appendix 6/1.

17 (05/01) Pulverised-fuel ash shall not be placed within the dimension described in Appendix 6/3, below sub-formation or formation.

18 (05/01) Where pulverised-fuel ash is used, the Contractor shall for each consignment, make available to the Overseeing Organisation a record of the type and

source of the material and the name of the power station from which it was obtained and a certificate of results of tests showing that the material complies with the requirements of Table 6/1.

602 General Requirements

1 The Contractor shall employ only plant and working methods which are suited to the materials to be handled and traversed. He shall be responsible for maintaining the nature of the acceptable material so that when it is placed and compacted it remains acceptable in accordance with the Contract. Acceptability shall be determined in accordance with Table 6/1 and any special requirements in Appendix 6/1.

2 Haulage of material to embankments or other areas of fill shall proceed only when sufficient spreading and compaction plant is operating at the place of deposition to ensure compliance with Clause 612.

3 (11/04) 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 unless indicated otherwise in Appendix 6/1. Material which is unacceptable only by reason of being frozen shall be retained on Site when in that condition. Where the Contractor is permitted to remove acceptable material, or unacceptable material required to be processed, from the Site to suit his operational procedure, then he shall make good any consequent deficit of material arising therefrom. Environmental requirements for processing of Class UIB material, in terms of limiting values of contaminants or other requirements, shall be set out in Appendix 6/1 in the earthworks Class for which the processed material is to be used.

4 If any acceptable material or unacceptable material required to be processed is, where permitted by Appendix 6/1, used by the Contractor for purposes other than for general fill, sufficient acceptable fill material to occupy, after full compaction, a volume corresponding to that which the excavated material occupied shall be provided by the Contractor.

5 (11/04) Acceptable material (other than Class 5A or any Class 5B material replacing Class 5A material in accordance with sub-Clause 3 of this Clause) surplus to the total requirements of the Permanent Works and all unacceptable material Class U1A not required to be processed shall, unless indicated otherwise in Appendix 6/1, be run to spoil in tips provided by the Contractor. In the case of unacceptable material, Class U1B and Class U2, the Contractor shall comply with any specific requirements for disposal described in Appendix 6/2.

6 Where the excavation reveals a combination of acceptable and unacceptable materials the Contractor shall, unless indicated otherwise in Appendix 6/3, 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.

7 The Contractor shall make his own arrangements for stockpiling of acceptable material, and unacceptable material to be processed, and for the provision of sites for the purpose.

8 The Contractor shall ensure that he does not adversely affect the stability of excavations or fills by his methods of stockpiling materials, use of plant or siting of temporary buildings or structures.

9 (05/01) Existing topsoil material shall, except where it is to be left in place in the locations described in Appendix 6/8, be stripped to depths as described in Appendix 6/8 for Class 5A material from all areas of cutting and from all areas to be covered by embankment or by other areas of fill. Where stated in Appendix 6/8 existing topsoil shall be stripped as turf in accordance with sub-Clause 3005.13.

10 (05/01) Topsoil shall wherever practicable be used immediately after its stripping and if not shall be stored in stockpiles of heights not exceeding 2 m or other heights stated in Appendix 6/8. Unless otherwise stated in Appendix 6/8, 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.

11 All Class 5A topsoil arising from the Site, or any Class 5B material replacing Class 5A material in accordance with sub-Clause 3 of this Clause, in excess of the requirements for topsoiling, shall be subject to the requirements described in Appendix 6/8.

12 Excavations for foundations and trenches shall be adequately supported at all times, and except where otherwise described in Appendix 6/3, shall not be battered. Where excavations are permitted to be battered they shall be benched as described in Appendix 6/3 prior to backfilling and compaction. The additional work and materials shall be provided by the Contractor. Sheet piling and other excavation supports shall be removed as filling proceeds except where they are required in Appendix 6/3 to be left in position.

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

- (i) Class 6N, 6P, 7A or 7B selected fill material complying with Clause 610 including compaction requirements;
- (ii) Class 6M selected fill material, deposited and compacted in accordance with Clause 623, above the foundation of arch profile corrugated steel buried structures;
- (iii) another class of selected fill or general fill complying with Table 6/1 deposited and compacted in compliance with Clauses 608 and 612 and in addition be subject to sub-Clauses 610.4 and 5.

612 Compaction of Fills

General

- 1 Except for dynamic compaction, which shall comply with Clause 630, and unless otherwise described in Appendix 6/3, the Contractor shall carry out compaction in compliance with this Clause, as soon as practicable after deposition, on all those Classes of fill in Table 6/1 which require to be compacted.
- 2 Compaction shall be either method or end-product as required for the Class of fill in Table 6/1, using plant appropriate to the Class of fill and the site conditions.
- 3 The Contractor shall obtain permission from the Overseeing Organisation before carrying out compaction outside normal working hours.

Method Compaction

- 4 Where method compaction is required to be adopted it shall comply with sub-Clauses 5 to 10 of this Clause.
- 5 Except as stated in sub-Clause 6 of this Clause, method compaction shall be undertaken using the plant and methods in Table 6/4 appropriate to the compaction requirements as listed in Table 6/1 for the Class of material being compacted.
- 6 Plant and methods not included in Table 6/4 shall only be used providing the Contractor demonstrates at site trials that a state of compaction is achieved by the alternative method equivalent to that obtained using the specified method.
- 7 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.

8 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 requires the greater compactive effort is being compacted.

9 The Contractor or Overseeing Organisation may carry out field dry density tests as described in sub-Clause 15 of this Clause on material compacted to method requirements at a frequency defined in Appendix 6/3. If the results of field tests show densities which indicate the state of compaction to be inadequate, then if this is due to failure of the Contractor to comply with the requirements of the Contract, the Contractor shall carry out such further work as is required to comply with the Contract.

10 For the purposes of Table 6/4 the following shall apply:

- (i) The minimum number of passes N is the minimum number of times that each point on the surface of the layer being compacted shall be traversed by the item of compaction plant in its operating mode, or struck by power rammers or falling weight compactors. D is the maximum depth of the compacted layer.
- (ii) In column headed N # the number of passes shown is to be doubled for material Classes 1A, 1B, 2A, 2B, 2C and 2D when such materials occur within 600 mm of sub-formation (if capping is required) or formation. Such extra compaction shall, unless otherwise described in Appendix 6/3, either be carried out for the full width of the embankment or, in other areas of fill which are to receive a pavement, between the outer extremities of the verges.
- (iii) The compaction plant in Table 6/4 is categorised in terms of static mass. The mass per metre width of roll is the total mass on the roll divided by the total roll width. Where a smooth wheeled roller has more than one axle the category of the machine shall be determined on the basis of the axle giving the highest value of mass per metre width.
- (iv) A grid roller is a machine with a compacting roll or rolls constructed of heavy steel mesh of square pattern.
- (v) A deadweight tamping roller is a machine with a roll or rolls from which 'feet' project and where the projected end area of each 'foot' exceeds 0.01 m² and the sum of the

areas of the feet exceeds 15% of the area of the cylinder swept by the ends of the feet. The requirements for tamping rollers apply to machines that have 2 rolls in tandem. If only one tamping roll traverses each point on the surface of the layer on any one pass of the machine, the minimum number of passes shall be twice the number given in Table 6/4 plus any further doubling required to satisfy (ii) above.

- (vi) For pneumatic-tyred rollers the mass per wheel is the total mass of the roller divided by the number of wheels. In assessing the number of passes of pneumatic-tyred rollers the effective width shall be the sum of the widths of the individual wheel tracks together with the sum of the spacings between the wheel tracks provided that each spacing does not exceed 230 mm. Where the spacings exceed 230 mm the effective width shall be the sum of the widths of the individual wheel tracks only.

- (vii) A vibratory tamping roller, which may be self-propelled or towed, is a machine having a means of applying mechanical vibration to one or more rolls. The roll or rolls have projecting feet where the height of each foot exceeds 10% of the radius of the roll drum, the projected end area of each foot exceeds 0.1% of the roll drum surface area, and the sum of the areas of the feet exceeds 10% of the area of the cylinder swept by the ends of the feet.

The requirements for the operation of vibratory tamping rollers shall be the same as those stated for vibratory rollers in sub-Clause (viii) except that vibratory tamping rollers operating without vibration will be classified as deadweight tamping rollers.

- (viii) Vibratory rollers are self-propelled or towed smooth-wheeled rollers having means of applying mechanical vibration to one or more rolls except that vibratory rollers employed for Method 5 compaction shall be single roll types.

Vibratory rollers operating without vibration will be classified as smooth-wheeled rollers.

The requirements for vibratory rollers are based on the use of the lowest gear on a self-propelled machine with mechanical transmission and a speed of 1.5 to 2.5 km/h for a towed machine, or a self-propelled machine with hydrostatic transmission. If higher gears or speeds are used an increased

number of passes shall be provided in proportion to the increase in speed of travel.

Where the mechanical vibration is applied to two rolls in tandem, the minimum number of passes shall be half the number given in Table 6/4 for the appropriate mass per metre width of one vibrating roll but if one roll differs in mass per metre width from the other the number of passes shall be calculated as for the roll with the smallest value. Alternatively the minimum number of passes may be determined by treating the machine as having a single vibrating roll with a mass per metre width equal to that of the roll with the higher value.

Vibratory rollers shall be operated with their vibratory mechanism operating only at the frequency of vibration recommended by the manufacturers. Where more than one amplitude setting is available and/or a range of frequencies is recommended, the machine shall be operated at the maximum amplitude setting and at the maximum recommended frequency for that setting.

Vibratory rollers shall be equipped or provided with devices indicating the frequency at which the mechanism is operating and the speed of travel. Both devices shall be capable of being read by an inspector alongside the machine.

- (ix) Vibrating-plate compactors are machines having a base-plate to which is attached a source of vibration consisting of one or two eccentrically weighted shafts and:

- (a) the mass per square metre of the base-plate of a vibrating-plate compactor is calculated by dividing the total mass of the machine in its working condition by its area in contact with compacted material;
- (b) vibrating-plate compactors shall be operated at the frequency of vibration recommended by the manufacturers. They shall normally be operated at travelling speeds of less than 1 km/h but if higher speeds are necessary the number of passes shall be increased in proportion to the increase in speed of travel.

- (x) Vibro-tampers are machines in which an engine-driven reciprocating mechanism acts on a spring system through which oscillations are set up in a base-plate.

- (xi) Power rammers are machines which are actuated by explosions in an internal combustion cylinder, each explosion being controlled manually by the operator.
- (xii) Dropping weight compactors are machines in which a dead weight is dropped from a controlled height using a hoist mechanism and they include self-propelled machines with mechanical traversing mechanisms capable of compacting soil in trenches and close to structures.
- (xiii) In the case of power rammers and dropping-weight compactors one pass will be considered as made when the compacting shoe has made one strike on the area in question.
- (xiv) For items marked * in the Method 3 column of Table 6/4 the roller shall be towed by track-laying tractors. Self-propelled rollers are unsuitable.
- (xv) Where combinations of different types or categories of plant are used, the following shall apply:
 - (a) the depth of layer shall be that for the type of plant requiring the least depth of layer; and
 - (b) the number of passes shall be that for the type of plant requiring the greatest number of passes.

End-product Compaction

11 Where end-product compaction is required it shall comply with sub-Clauses 12 to 15 of this Clause.

12 (05/01) The Contractor shall at least 7 days before commencement of end-product compaction make available the following to the Overseeing Organisation:

- (i) the values of maximum dry density and the optimum moisture content obtained in accordance with BS 1377 : Part 4 using the 2.5 kg rammer method or vibrating hammer method as appropriate for each of the fills he intends to use which meet the requirements of the permitted Class or Classes (where within any Class of material the fill contains material having different maximum dry densities and optimum moisture contents the Class shall be further sub-divided, by extending the identification system, in order to monitor the compacted density);
- (ii) a graph of density plotted against moisture content from which each of the values in (i) above of maximum dry density and optimum

moisture content were determined and, for Class 7A material, a plot of the 5% air voids curve for each sub-division.

13 Once the information contained in sub-Clause 12 of this Clause has been made available to the Overseeing Organisation it shall form the basis for compaction.

14 Fill compacted to end-product requirements shall have a field dry density, measured in accordance with sub-Clause 15 of this Clause, equal to or greater than the percentage given in Table 6/1 of the maximum dry density for the relevant Class of fill previously made available to the Overseeing Organisation in accordance with sub-Clause 12 of this Clause.

15 The field dry density referred to in sub-Clause 14 of this Clause shall be measured in accordance with BS 1377 : Part 9, except that nuclear methods shall only be used where required or permitted in Appendix 6/3. Where nuclear methods are used, the gauge shall be calibrated in accordance with BS 1377 : Part 9.

613 Sub-formation and Capping

1 (05/01) Capping shall be provided only in those locations, and to the extent, particularly stated in Appendix 6/7 to be constructed with capping. It shall comply with this Clause and in addition, for stabilised capping, with Clauses 614, 615 and 643 as appropriate.

2 (05/04) Capping shall be constructed with Class 6F1, 6F2, 6F3, 6F4, 6F5, 6S, 9A, 9B, 9C, 9D, 9E or 9F material as required or permitted in Appendix 6/7 and complying with Table 6/1.

3 (05/04) Unless otherwise described in Appendix 6/7, capping shall either consist of one Class of capping material throughout its depth laid in one or more layers of compacted thickness complying with Clause 612, or be formed of not more than two elements of different capping materials. Each element shall be formed of one or more layers of the same capping material, each of compacted thickness complying with Clause 612. Class 9D or 9E stabilised capping material shall not be placed or constructed above Class 6F granular capping material or Class 6S granular filter layer material.

4 Where required in Appendix 6/7, before commencing the construction of capping in the Permanent Works, the Contractor shall demonstrate the methods, equipment and materials he proposes to use by constructing an area, or areas as appropriate, of capping on a typical prepared sub-formation to the same thickness as required in the Permanent Works. The area of each capping construction demonstration shall be not less than 700 m².

TABLE 6/1: (11/05) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes)

Class	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)					Compaction Requirements in Clause 612	Class		
				Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:		1		A	-	
						Lower	Upper					
G E N E R A L	Well graded granular material	General Fill	Any material, or combination of materials, other than material designated as Class 3 in the Contract. (Properties (i), (ii) and (iv) in next column, shall not apply to chalk). Recycled aggregate	(i) grading	BS 1377 : part 2	Tab 6/2	Tab 6/2	Tab 6/4 Method 2	1	A	-	
				(ii) uniformity coefficient	See Note 5	10	-	-				
				(iii) mc	BS 1377 : Part 2	App 6/1	App 6/1	App 6/1				
				(iv) MCV	Clause 632	App 6/1	App 6/1	App 6/1				
				(v) IDD of chalk	Clause 634	-	App 6/1	App 6/1				
G R A N U L A R	Uniformly graded granular material	General Fill	Any material, or combination of materials, other than chalk. Recycled aggregate	(i) grading	BS 1377 : Part 2	Tab 6/2	Tab 6/2	Tab 6/4 Method 3	1	B	-	
				(ii) uniformity coefficient	See Note 5	-	10	-				
				(iii) mc	BS 1377 : Part 2	App 6/1	App 6/1	App 6/1				
				(iv) MCV	Clause 632	App 6/1	App 6/1	App 6/1				
F I L L	Coarse granular material	General Fill	Any material, or combination of materials, other than material designated as Class 3 in the Contract. (Properties (i) and (ii) in next column, shall not apply to chalk). Recycled aggregate	(i) grading	BS 1377 : Part 2	Tab 6/2	Tab 6/2	Tab 6/4 Method 5	1	C	-	
				(ii) uniformity coefficient	See Note 5	5	-	-				
				(iii) Los Angeles coefficient	Clause 635	-	50	-				

TABLE 6/1: (11/05) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued)

Class	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)					Compaction Requirements in Clause 612	Class
				Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:				
						Lower	Upper			
2 A G E N E R A L C O H E S I V E	Wet cohesive material	General Fill	Any material, or combination of materials, other than chalk.	(i) grading	BS 1377 : part 2	Tab 6/2	Tab 6/2	Tab 6/4 Method 1 except for materials with liquid limit greater than 50, determined by BS1377 : Part 2. only deadweight tamping or vibratory tamping rollers or grid rollers shall be used.	2 A -	
				(ii) plastic limit (PL)	BS 1377 : part 2	-	-			
				(iii) mc	BS 1377 : Part 2	PL -4%	App 6/1			
				(iv) MCV	Clause 632	App 6/1	App 6/1			
				(v) Undrained shear strength of remoulded material	Clause 633	App 6/1	App 6/1			
2 B F I L L	Dry cohesive material	General Fill	Any material, or combination of materials, other than chalk	(i) grading	BS 1377 : Part 2	Tab 6/2	Tab 6/2	Tab 6/4 Method 2	2 B -	
				(ii) plastic limit (PL)	BS 1377 : Part 2	-	-			
				(iii) mc	BS 1377 : Part 2	App 6/1	PL -4%			
				(iv) MCV	Clause 632	App 6/1	App 6/1			
				(v) undrained shear strength of remoulded material	Clause 633	App 6/1	App 6/1			

TABLE 6/1: Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued)

Class	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)					Compaction Requirements in Clause 612	Class
				Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:				
						Lower	Upper			
2	Stony cohesive material	General Fill	Any material, or combination of materials, other than chalk	(i) grading	BS 1377 : part 2	Tab 6/2	Tab 6/2	Tab 6/4 Method 2	2	C
				(ii) plastic limit (PL)	BS 1377 : part 2	-	-			
				(iii) mc	BS 1377 : Part 2	App 6/1	App 6/1			
				(iv) MCV	Clause 632	App 6/1	-			
				(v) Undrained shear strength of remoulded material	Clause 633	App 6/1	-			
2	Silty cohesive material	General Fill	Any material, or combination of materials, other than chalk	(i) grading	BS 1377 : Part 2	Tab 6/2	Tab 6/2	Tab 6/4 Method 3	2	D
				(ii) mc	BS 1377 : Part 2	App 6/1	App 6/1			
				(iii) MCV	Clause 632	App 6/1	App 6/1			
				(iv) undrained shear strength of remoulded material	Clause 633	App 6/1	App 6/1			
2	Reclaimed pulverised fuel ash cohesive material	General Fill	Reclaimed material from lagoon or stockpile containing not more than 20% furnace bottom ash	(i) mc	BS 1377 : Part 2	To enable compaction to Clause 612		End product 95% of maximum dry density of BS 1377 : Part 4 (2.5 kg rammer method)	2	E
				(ii) bulk density	BS 1377 : Part 9	App 6/1	App 6/1			
G E N E R A L C O H E S I V E F I L L										

TABLE 6/1: (11/05) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued)

Class	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)				Compaction Requirements in Clause 612	Class
				Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:			
						Lower	Upper		
GF EI NL L C H A L K	Chalk	General Fill	Chalk and associated materials all designated as Class 3 in the Contract	(i) mc	BS 1377 : Part 2	-	App 6/1	Tab 6/4 Method 4, or Method 1 if required in App 6/1. All types of vibratory rollers of Categories over 1800 kg shall not be used	3
				(ii) IDD	Clause 634	App 6/1	App 6/1		-
LF AI NL DL S C A P E	Various	Fill to landscape areas	See App 6/1	(i) grading	BS 1377 : Part 2	App 6/1	App 6/1	See Clause 620 and App 6/1	4
				(ii) mc	BS 1377 : Part 2	-	App 6/1		-
				(iii) MCV	Clause 632	App 6/1	App 6/1		-
TO PP S O I L	Topsoil, or turf, existing on site	Topsoiling	Topsoil or turf designated as Class 5A in the Contract	(i) grading	Clause 618	-	Clause 618	-	5 A
				-	-	-	-		5 B

TABLE 6/1: (11/05) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued)

Class	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)					Compaction Requirements in Clause 612	Class
				Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:		Upper		
						Lower	Upper			
6	Selected well graded granular material	Below water	Natural gravel, natural sand, crushed gravel, crushed rock other than argillaceous rock, crushed concrete, chalk, well burnt colliery spoil or any combination thereof. (Properties (i) and (ii) in next column, shall not apply to chalk.) Recycled aggregate	(i) grading	BS 1377 : Part 2 (On-site)	Tab 6/2	Tab 6/2	No compaction	6	A
				(ii) uniformity	See Note 5	10	-			
				(iii) SMC of chalk index	Clause 634	-	20%			
				(iv) plasticity index	BS 1377 : Part 2	Non-plastic				
6	Selected coarse granular material	Starter layer	Natural gravel, natural sand, crushed gravel, crushed rock, crushed concrete, chalk, well burnt colliery spoil, slag or any combination thereof. (Properties (ii) and (iii) in next column, shall not apply to chalk.) Recycled aggregate	(i) grading	BS 1377 : Part 2 (On-site)	Tab 6/2	Tab 6/2	Tab 6/4 Method 5	6	B
				(ii) plasticity index	BS EN 933-2 (Off-site)	Tab 6/5	Tab 6/5			
				(iii) Los Angeles coefficient	Clause 635	-	50			
S E L E C T E D G R A N U L A R F I L L										

TABLE 6/1: (11/05) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued)

Class	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)					Compaction Requirements in Clause 612	Class	
				Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:		6		C	
						Lower	Upper				
6 S E L E C T E D G R A N U L A R F I L L	Selected uniformly graded granular material	Starter layer	Natural gravel, natural sand, crushed gravel, crushed rock other than argillaceous rock, crushed concrete, chalk, well burnt colliery spoil, slag or any combination thereof. (Property (iii) in next column, shall not apply to chalk.) Recycled aggregate	(i) grading	BS 1377 : Part 2 (On-site)	Tab 6/2	Tab 6/2	Tab 6/4 Method 3	6	C	
				(ii) uniformity coefficient	See Note 5	-	10				
				(iii) plasticity index	BS 1377 : Part 2	Non-plastic					
				(iv) Los Angeles coefficient	Clause 635	-	50				
				(v) mc	BS 1377 : Part 2	App 6/1	App 6/1				
6 D	Selected uniformly graded granular material	Starter layer below pulverised fuel ash	Natural gravel, natural sand, crushed gravel, crushed rock other than argillaceous rock, crushed concrete, chalk, well burnt colliery spoil, slag or any combination thereof. Recycled aggregate	(i) grading	BS 1377 : Part 2 (On-site)	Tab 6/2	Tab 6/2	Tab 6/4 Method 4	6	D	
				(ii) uniformity coefficient	See Note 5	-	10				
				(iii) plasticity index	BS 1377 : Part 2	Non-plastic					
				(iv) mc	BS 1377 : Part 2	App 6/1	App 6/1				
				(v) MCV	Clause 632	App 6/1	App 6/1				

TABLE 6/1: (11/05) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued)

Class	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)					Compaction Requirements in Clause 612	Class
				Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:		Upper		
						Lower	Tab 6/2			
S E L E C T E D	Selected granular material (Class 9A)	For stabilisation with cement to form capping	Any material, or combination of materials, other than unburnt colliery spoil and argillaceous rock. (Properties (i), (ii) and (iii) in next column, shall not apply to chalk.) Recycled aggregate	(i) grading	BS 1377 : Part 2 (On-site)	Tab 6/2	Tab 6/2	Not applicable	6	
					BS EN 933-2 (Off-site)	Tab 6/5	Tab 6/5			
				(ii) mc	BS 1377 : Part 2	-	App 6/1			
				(iii) liquid limit	BS 1377 : Part 2	-	45			
				(iv) plasticity index	BS 1377 : Part 2	-	20			
				(v) organic matter	BS 1377 : Part 3	-	App 6/1			
				(vi) water soluble (WS) sulfate content	TRL Report 447, Test No. 1	-	3000 mg/l as SO ₄			
				(vii) oxidisable sulfides (OS) content	TRL Report 447, Tests No.2 and 4	-	0.6% as SO ₄			
				(viii) total potential sulfate (TPS) content	TRL Report 447, Test No. 4	-	1.2% as SO ₄			
F I L L				(ix) SMC of chalk	Clause 634	-	20%		E	

TABLE 6/1: (11/07) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued)

Class	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)					Compaction Requirements in Clause 612	Class	
				Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:		6		F	I
						Lower	Upper				
S E L E C T E D G R A N U L A R F I L L	Selected granular material (fine grading)	Capping	Any material, or combination of materials, other than unburnt colliery spoil argillaceous rock and chalk. Recycled aggregate. Property (vi) in the next column shall not apply if Class A (asphalt content is 20% or less.	(i) grading	BS 1377 : Part 2	Tab 6/2	Tab 6/2	Tab 6/4 Method 6	6	F	2
				(ii) optimum mc	BS 1377 : Part 4 (vibrating hammer method)	-	-				
				(iii) mc	BS 1377 : Part 2	Optimum mc - 2%	Optimum mc				
				(iv) Los Angeles coefficient	Clause 635	-	60				
				(v) Class A (asphalt) content	Clause 710	-	50%				
				(vi) bitumen content	BS 598 : Part 102	-	2.0%				
S E L E C T E D G R A N U L A R F I L L	Selected granular material (coarse grading)	Capping	Any material, or combination of materials, other than unburnt colliery spoil and argillaceous rock. (Property (i) in next column shall not apply to chalk.) Recycled aggregate. Property (vi) in the next column shall not apply if Class A (asphalt content is 20% or less.	(i) grading	BS 1377 : Part 2	Tab 6/2	Tab 6/2	Tab 6/4 Method 6	6	F	2
				(ii) optimum mc	BS 1377 : Part 4 (vibrating hammer method)	-	-				
				(iii) mc	BS 1377 : Part 2	Optimum mc - 2%	Optimum mc				
				(iv) Los Angeles coefficient	Clause 635	-	50				
				(v) Class A (asphalt) content	Clause 710	-	50%				
				(vi) bitumen content	BS 598 : Part 102	-	2.0%				

TABLE 6/1: (11/07) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued)

Class	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)				Compaction Requirements in Clause 612	Class
				Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:			
						Lower	Upper		
S E L E C T E D G R A N U L A R F I L L	Selected granular material	Capping	Recycled bituminous planings and granulated asphalt, but excluding materials containing tar or tar-bitumen binders. Recycled aggregate	(i) grading	BS 1377 : Part 2 (On-site)	Tab 6/2	Tab 6/2	Tab 6/4 Method 6 Maximum Compacted layer thickness shall be 200 mm	6 F 3
					BS EN 933-2 (Off-site)	Tab 6/5	Tab 6/5		
				(ii) optimum mc	Clause 613	-	-		
				(iii) mc	Clause 613	Optimum mc -2%	Optimum mc		
				(iv) Class A (asphalt) content	Clause 710	50%	-		
			(v) bitumen content	BS 598 : Part 102	-	-	10%		
6 F 4	Selected granular material (fine grading - imported on to the Site	Capping	Unbound mixtures complying with BS EN 13285 Any material or combination of materials - including recycled aggregate, but excluding unburnt colliery spoil, argillaceous rock and chalk. Property (x) in the next column shall not apply if the Class A (asphalt) content is 20% or less.	(i) Size designation and overall grading category	BS EN 13285 - 0/31.5 and G_E	Tab 6/5	Tab 6/5	Tab 6/4 Method 6	6 F 4
				(ii) Maximum fines and oversize categories	BS EN 13285 - UF_{15} and OC_{75}	Tab 6/5	Tab 6/5		
				(iii) Los Angeles coefficient	BS EN 13242 - LA_{60}	-	60		
				(iv) Volume stability of blast furnace slag	BS EN 13242 - free from dicalcium silicate and iron disintegration	-	-		

TABLE 6/1: (11/07) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued)

Class	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)				Compaction Requirements in Clause 612	Class
				Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:			
						Lower	Upper		
SELECTED GRANULAR FILL	(contd)			(v) Volume stability of steel (BOF) and EAF slag	BS EN 13242 - V_s	-	-		
				(vi) Other aggregate requirements	BS EN 13242 - Category α_g (no requirement)	-	-		
				(vii) Laboratory dry density and optimum water content	BS EN 13285, clause 5.3 - declared values	-	-		
				(viii) Water content	BS EN 1097-5	Optimum wc -2%	Optimum wc		
				(ix) Class A (asphalt) content	Clause 710	-	50%		
				(x) bitumen content	BS 598 : Part 102	-	2.0%		

TABLE 6/1: (11/07) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued)

Class	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)				Compaction Requirements in Clause 612	Class	
				Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:			6	5
						Lower	Upper			
6	Selected granular material (coarse grading) - imported on to the Site	Capping	Unbound mixtures complying with BS EN 13285 Any material or combination of materials - including recycled aggregate, but excluding unburnt colliery spoil, argillaceous rock and chalk. Property (x) in the next column shall not apply if the Class A (asphalt) content is 20% or less.	(i) Size designation and overall grading category	BS EN 13285 - 0/80 and G_E	Tab 6/5	Tab 6/5	Tab 6/4 Method 6	6	5
(ii) Maximum fines and oversize categories				BS EN 13285 - UF_{12} and OC_{15}	Tab 6/5	Tab 6/5				
(iii) Los Angeles coefficient				BS EN 13242 - LA_{10}	-	50				
(iv) Volume stability of blast furnace slag				BS EN 13242 - free from dicalcium silicate and iron disintegration	-	-				
(v) Volume stability of steel (BOF) and EAF slag				BS EN 13242 - V_5	-	-				
(vi) Other aggregate requirements				BS EN 13242 - Category NR (no requirement)	-	-				
(vii) Laboratory dry density and optimum water content				BS EN 13285, clause 5.3 - declared values	-	-				
(viii) Water content				BS EN 1097-5	Optimum w_c - -2%	Optimum w_c				
(ix) Class A (asphalt) content				Clause 710	-	50%				
(x) bitumen content				BS 598 : Part 102	-	2.0%				
S E L E C T E D G R A N U L A R F I L L										

TABLE 6/1: (11/05) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued)

Class	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)				Compaction Requirements in Clause 612	Class	
				Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:			6	G
						Lower	Upper			
S E L E C T E D	Selected granular material	Gabion filling	Natural gravel, crushed rock, crushed concrete or any combination thereof. None of these constituents shall include any argillaceous rock.	(i) grading	BS 1377 : Part 2 (On-site)	Tab 6/2	Tab 6/2	None	6	G
					BS EN 933-2 (Off-site)	Tab 6/5	Tab 6/5			
				(ii) Los Angeles coefficient	Clause 635	-	50			
G R A N U L A R	Selected granular material	Drainage layer to reinforced soil and anchored earth structures	Natural gravel, natural sand, crushed gravel, crushed rock, crushed concrete, chalk, well burnt colliery spoil or any combination thereof. None of these constituents shall include any argillaceous rock. (Properties (vi), (vii), (viii), (ix), (x), (xi) and (xii) in next column only apply when metallic reinforcing or anchor elements, facing units or fastenings are used.) (Properties (ii) and (v) in next column shall not apply to chalk.) Recycled aggregate except recycled asphalt	(i) grading	BS 1377 : Part 2 (On-site)	Tab 6/2	Tab 6/2	Tab 6/4 Method 3	6	H
					BS EN 933-2 (Off-site)	Tab 6/5	Tab 6/5			
				(ii) plasticity index	BS 1377 : Part 2	Non-plastic				
F I L L				(iii) Los Angeles coefficient	Clause 635	-	50			
				(iv) mc	BS 1377 : Part 2	App 6/1	App 6/1			
				(v) MCV	Clause 632	App 6/1	App 6/1			
				(vi) pH value	BS 1377 : Part 3	Tab 6/3	Tab 6/3			
				(vii) chloride ion content	BS EN 1744-1	-	Tab 6/3			
				(viii) water soluble (WS) sulfate content	TRL Report 447, Test No. 1	-	Tab 6/3			
				(ix) oxidisable sulfides (OS) content	TRL Report 447, Tests Nos. 2 and 4	-	Tab 6/3			
				(x) resistivity	Clause 637	Tab 6/3	-			
				(xi) redox potential	Clause 638	Tab 6/3	-			
				(xii) organic content	BS 1377 : Part 3	-	Tab 6/3			
				(xiii) microbial activity index	Table 6/3	-	Tab 6/3			

TABLE 6/1: (11/05) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued)

Class	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)				Compaction Requirements in Clause 612	Class
				Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:			
						Lower	Upper		
S E L E C T E D G R A N U L A R F I L L	Selected well graded granular material	Fill to reinforced soil and anchored earth structures	Natural gravel, natural sand, crushed gravel, crushed rock, crushed concrete, slag, chalk, well burnt colliery spoil or any combination thereof except that chalk shall not be combined with any other constituent. None of these constituents shall include any argillaceous rock. (Properties (i), (ii) and (v) in next column shall not apply to chalk.) (Properties (vii), (ix), (x), (xi), (xii), (xiii) and (xiv) only apply when metallic reinforcing or anchor elements, facing units or fastenings are used.) Recycled aggregate except recycled asphalt	(i) grading	BS 1377 : Part 2 (On-site)	Tab 6/2	Tab 6/2	Tab 6/4 Method 2	6 1 -
				(ii) uniformity coefficient	See Note 5	10	-		
				(iii) SMC of chalk	Clause 634	-	20%		
				(iv) mc	BS 1377 : Part 2	App 6/1	App 6/1		
				(v) MCV	Clause 632	App 6/1	App 6/1		
				(vi) effective angle of friction (ϕ') and effective cohesion (c')	Clause 636	App 6/1	-		
				(vii) coefficient of friction and adhesion (fill/elements)	Clause 639	App 6/1	-		
				(viii) pH value	BS 1377 : Part 3	Tab 6/3	Tab 6/3		
				(ix) chloride ion content	BS EN 1744-1	-	Tab 6/3		
				(x) water soluble (WS) sulfate content	TRL Report 447, Test No. 1	-	Tab 6/3		
				(xi) oxidisable sulfides (OS) content	TRL Report 447, Tests Nos. 2 and 4	-	Tab 6/3		
				(xii) resistivity	Clause 637	Tab 6/3	-		
				(xiii) redox potential	Clause 638	Tab 6/3	-		
				(xiv) organic content	BS 1377 : Part 3	-	Tab 6/3		
				(xv) microbial activity index	Table 6/3	-	Tab 6/3		

TABLE 6/1: (11/05) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued)

Class	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)				Compaction Requirements in Clause 612	Class	
				Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:			6	J
						Lower	Upper			
S E L E C T E D G R A N U L A R F I L L	Selected uniformly graded granular material	Fill to reinforced soil and anchored earth	Natural gravel, natural sand, crushed gravel, crushed rock, crushed concrete, slag, chalk, well burnt colliery spoil or any combination thereof, except that chalk shall not be combined with any other constituent. None of these constituents shall include any argillaceous rock. (Properties (viii), (ix), (x), (xi), (xii), (xiii) and (xiv) in next column only apply when metallic reinforcing or anchor elements, facing units or fastenings are used.) (Properties (i), (ii) and (v) in next column shall not apply to chalk.) Recycled aggregate except recycled asphalt	(i) grading	BS 1377 : Part 2 (On-site)	Tab 6/2	Tab 6/2	Tab 6/4 Method 3	6	J
				(ii) uniformity coefficient	See Note 5	5	10			
				(iii) SMC of chalk	Clause 634	-	20%			
				(iv) mc	BS 1377 : Part 2	App 6/1	App 6/1			
				(v) MCV	Clause 632	App 6/1	App 6/1			
				(vi) effective angle of friction (ϕ') and effective cohesion (c')	Clause 636	App 6/1	-			
				(vii) coefficient of friction and adhesion (fill/elements)	Clause 639	App 6/1	-			
				(viii) pH value	BS 1377 : Part 3	Tab 6/3	Tab 6/3			
				(ix) chloride ion content	BS EN 1744-1	-	Tab 6/3			
				(x) water soluble (WS) sulfate content	TRL Report 447, Test No. 1	-	Tab 6/3			
				(xi) oxidisable sulfides (OS) content	TRL Report 447, Tests Nos 2 and 4	-	Tab 6/3			
				(xii) resistivity	Clause 637	Tab 6/3	-			
				(xiii) redox potential	Clause 638	Tab 6/3	-			
				(xiv) organic content	BS 1377 : Part 3	-	Tab 6/3			
				(xv) microbial activity index	Table 6/3	-	Tab 6/3			

TABLE 6/1: (11/05) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued)

Class	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)				Compaction Requirements in Clause 612	Class
				Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:			
						Lower	Upper		
6 K S E L E C T E D G R A N U L A R F I L L	Selected granular material	Lower bedding for corrugated steel buried structures	Natural gravel, natural sand, crushed gravel, crushed rock, crushed concrete, well burnt colliery spoil or any combination thereof. None of these constituents shall include any argillaceous rock. Recycled aggregate except recycled asphalt	(i) grading	BS 1377 : Part 2 (On-site)	Tab 6/2	Tab 6/2	End product 90% of maximum dry density of BS 1377 : Part 4 (Vibrating hammer method)	6 K
				(ii) uniformity coefficient	See Note 5	5	-		
				(iii) plasticity index	BS 1377 : Part 2	-	6		
				(iv) optimum mc	BS 1377 : Part 4 (vibrating hammer method)	-	-		
				(v) mc	BS 1377 : Part 2	Optimum mc -2%	Optimum mc +1%		
				(vi) MCV	Clause 632	App 6/1	App 6/1		
				(vii) Los Angeles coefficient	Clause 635	-	40		
				(viii) resistivity	Clause 637	2000 ohm cm	-		
				(ix) water soluble (WS) sulfate content	TRL Report 447, Test No. 1	-	300 mg/l as SO ₄		
				(x) oxidisable sulfides (OS) content	TRL Report 447, Tests Nos 2 and 4	-	0.06% as SO ₄		
				(xi) chloride ion content	BS EN 1744-1	-	0.025%		
				(xii) pH value	BS 1377 : Part 3	6	9		
				(xiii) sulfide and hydrogen sulfide	Standard textbook of qualitative inorganic analysis	-	Rapid blackening of lead acetate paper		

TABLE 6/1: (11/05) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued)

Class	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)					Compaction Requirements in Clause 612	Class
				Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:				
S F E I L L E L C T I E D	Selected uniformly graded granular material	Upper bedding for corrugated steel buried structures	Natural gravel, natural sand, crushed gravel, crushed rock, crushed concrete, well burnt colliery spoil or any combination thereof. None of these constituents shall include any argillaceous rock. Recycled aggregate except recycled asphalt	(i) grading	BS 1377 : Part 2 (On-site)	Tab 6/2	Tab 6/2	None	6	L
					BS EN 933-2 (Off-site)	Tab 6/5	Tab 6/5			
				(ii) resistivity	Clause 637	2000 ohm cm	-			
				(iii) water soluble (WS) sulfate content	TRL Report 447, Test No. 1	-	300 mg/l as SO ₄			
				(iv) oxidisable sulfides (OS) content	TRL Report 447, Tests Nos. 2 and 4	-	0.06% as SO ₄			
				(v) chloride ion content	BS EN 1744-1	-	0.025%			
				(vi) pH value	BS 1377 : Part 3	6	9			
				(vii) sulfide and hydrogen sulfide	Standard textbook of qualitative inorganic analysis	-	Rapid blackening of lead acetate paper			
G R A N U L A R										

TABLE 6/1: (11/05) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued)

Class	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)				Compaction Requirements in Clause 612	Class	
				Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:			6	M
						Lower	Upper			
S E L E C T E D G R A N U L A R F I L L	Selected granular material	Surround to corrugated steel buried structures	Natural gravel, natural sand, crushed gravel, crushed rock, crushed concrete, well burnt colliery spoil or any combination thereof. None of these constituents shall include any argillaceous rock. Recycled aggregate except recycled asphalt	(i) grading	BS 1377 : Part 2 (On-site)	Tab 6/2	Tab 6/2	End product 90% of maximum dry density of BS 1377 : Part 4 (Vibrating hammer method) unless otherwise stated in App 6/1	6	M
				(ii) uniformity coefficient	See Note 5	5	-			
				(iii) plasticity index	BS 1377 : Part 2	-	6			
				(iv) optimum mc	BS 1377 : Part 4 (vibrating hammer method)	-	-			
				(v) mc	BS 1377 : Part 2	Optimum mc -2%	Optimum mc +1%			
				(vi) MCV	Clause 632	App 6/1	App 6/1			
				(vii) Los Angeles coefficient	Clause 635	-	40			
				(viii) resistivity	Clause 637	2000 ohm cm	-			
				(ix) water soluble (WS) sulfate content	TRL Report 447 Test No. 1	-	300 mg/l as SO ₄			
				(x) oxidisable sulfides (OS) content	TRL Report 447 Tests Nos. 2 and 4	-	0.06% as SO ₄			
				(xi) chloride ion content	BS EN 1744-1	-	0.025%			
				(xii) pH value	BS 1377 : Part 3	6	9			
				(xiii) sulfide and hydrogen sulfide	Standard textbook of qualitative inorganic analysis	-	Rapid blackening of lead acetate paper			

TABLE 6/1: (11/05) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued)

Class	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)					Compaction Requirements in Clause 612	Class
				Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:		Upper		
						Lower	Upper			
S F E I L L E L C T T E D G R A N U L A R	Selected well graded granular material	Fill to structures	Natural gravel, natural sand, crushed gravel, crushed rock, crushed concrete, slag, well burnt colliery spoil or any combination thereof. None of these constituents shall include any argillaceous rock. Recycled aggregate except recycled asphalt	(i) grading	BS 1377 : Part 2 (On-site)	Tab 6/2	Tab 6/2	End product 95% of maximum dry density of BS 1377 : Part 4 (vibrating hammer method)	6	N
				(ii) uniformity coefficient	See Note 5	10	-			
				(iii) Los Angeles coefficient	Clause 635	-	40			
				(iv) undrained shear parameters (c and ϕ)	Clause 633	App 6/1	-			
				(v) effective angle of internal friction (ϕ') and effective cohesion (c')	Clause 636	App 6/1	-			
				(vi) permeability	Clause 640	App 6/1	-			
				(vii) mc	BS 1377 : Part 2	App 6/1	App 6/1			
				(viii) MCV	Clause 632	App 6/1	App 6/1			
				(ix) slope stability test (where required in App 6/6)	Clause 610	App 6/6				

TABLE 6/1: (11/05) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued)

Class	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)				Compaction Requirements in Clause 612	Class	
				Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:			6	P
						Lower	Upper			
S E L E C T E D G R A N U L A R F I L L	Selected granular material	Fill to structures	Natural gravel, natural sand, crushed gravel, crushed rock, crushed concrete, slag, chalk, well burnt colliery spoil or any combination thereof. None of these constituents shall include any argillaceous rock. (Properties (i), (ii) and (ix) in next column shall not apply to chalk.) Recycled aggregate except recycled asphalt	(i) grading	BS 1377 : Part 2 (On-site)	Tab 6/2	Tab 6/2	End product 95% of maximum dry density of BS 1377 : Part 4 (vibrating hammer method)	6	P
				(ii) uniformity coefficient	See Note 5	5	-			
				(iii) ID ₆₀ of chalk	Clause 634	-	App 6/1			
				(iv) Los Angeles coefficient	Clause 635	-	60			
				(v) undrained shear parameters (c and ϕ)	Clause 633	App 6/1	-			
				(vi) effective angle of internal friction (ϕ') and effective cohesion (c')	Clause 636	App 6/1	-			
				(vii) permeability	Clause 640	App 6/1	-			
				(viii) mc	BS 1377 : Part 2	App 6/1	App 6/1			
				(ix) MCV	Clause 632	App 6/1	App 6/1			
				(x) slope stability test (where required in App 6/6)	Clause 610	App 6/6				

TABLE 6/1: (11/05) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued)

Class	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)				Compaction Requirements in Clause 612	Class		
				Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:					
						Lower	Upper				
6	Well graded uniformly graded or coarse granular material	Overlying fill for corrugated steel buried structures	As Class 1A, 1B or 1C granular fill materials, but not to include argillaceous rock, slag or PFA in any proportions. Recycled aggregate except recycled asphalt	As for Class 1A, 1B or 1C with the addition of the following:					6	Q	
				(i) water soluble (WS) sulfate content	TRL Report 447, Test No. 1	-	300 mg/l as SO ₄				
				(ii) oxidisable sulfides (OS) content	TRL Report 447, Tests Nos. 2 and 4	-	0.06% as SO ₄				
				(iii) chloride ion content	BS EN 1744-1	-	0.025%				
				(iv) pH value	BS 1377 : Part 3	6	9				
				(v) sulfide and hydrogen sulfide	Standard textbook of qualitative inorganic analysis	-	Rapid blackening of lead acetate paper				
6	Selected granular material	For stabilisation with lime and cement to form capping (Class 9F)	Any material, or combination of materials, other than unburnt colliery spoil and argillaceous rock. (Properties (i), (ii) and (iii) in next column, shall not apply to chalk.)	(i) grading	BS 1377 : Part 2 (On-site)	Tab 6/2	Tab 6/2	Tab 6/2	Not applicable	6	R
					BS EN 933-2 (Off-site)	Tab 6/5	Tab 6/5	Tab 6/5			
				(ii) mc	BS 1377 : Part 2	App 6/1	-	-			
				(iii) Liquid limit	BS 1377 : Part 2	-	45	-			
				(iv) plasticity index	BS 1377 : Part 2	-	20	-			
				(v) organic matter	BS 1377 : Part 3	-	App 6/1	-			
				(vi) water soluble (WS) sulfate content	TRL Report 447, Test No. 1	-	3000 mg/l as SO ₄	-			
				(vii) oxidisable sulfides (OS) content	TRL Report 447, Tests Nos. 2 and 4	-	0.6% as SO ₄	-			
				(viii) total potential sulfate (TPS) content	TRL Report 447, Test No. 4	-	1.2% as SO ₄	-			
				(ix) IDD of chalk	Clause 634	-	App 6/1	-			

S E L E C T E D G R A N U L A R F I L L

TABLE 6/1: (11/05) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued)

Class	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)				Compaction Requirements in Clause 612	Class	
				Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:			6	S
						Lower	Upper			
6	Selected well graded granular material	Filter layer below subbase	Crushed rock or sand	(i) grading	BS 1377 : Part 2 (On-site)	Tab 6/2	Tab 6/2	-	6	S
					BS EN 933-2 (Off-site)	Tab 6/5	Tab 6/5			
				(ii) plasticity index	BS 1377 : Part 2	-	Non-plastic			
S E L E C T E D G R A N U L A R F I L L										

TABLE 6/1: (11/05) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued)

Class	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)					Compaction Requirements in Clause 612	Class		
				Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:		7		A	-	
						Lower	Upper					
S F E I L L E L C T E D C O H E S I V E	Selected cohesive material	Fill to structures	Any material or combination of materials, other than argillaceous rock and materials designated as Class 3 in the Contract. If chalk is used it shall form 100% of constituents. (Properties (i) and (iii) shall not apply to chalk.) (Properties (vii) and (viii) may be increased to 54% and 31% respectively for Lias Clay only and subject to the requirements of Appendix 6/6)	(i) grading	BS 1377 : Part 2	Tab 6/2	Tab 6/2	End product: 100% of maximum dry density of BS 1377 : Part 4 (2.5 kg rammer method) or a dry density corresponding to 5% air voids at field mc whichever is lower	7	A	-	
				(ii) mc	BS 1377 : Part 2	App 6/1	App 6/1					
				(iii) MCV	Clause 632	App 6/1	App 6/1					
				(iv) undrained shear parameters (c and ϕ)	Clause 633	App 6/1	App 6/1					
				(v) effective angle of internal friction (ϕ') and effective cohesion (c')	Clause 636	App 6/1	App 6/1					
				(vi) IDD of chalk	Clause 634	App 6/1	App 6/1					
				(vii) liquid limit	BS 1377 : Part 2	-	45					
				(viii) plasticity index	BS 1377 : Part 2	-	25					

TABLE 6/1: Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued)

Class	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)				Compaction Requirements in Clause 612	Class
				Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:			
						Lower	Upper		
S F E I L L E L C T E D C O H E S I V E	Selected conditioned pulverised fuel ash cohesive material	Fill to structures and to reinforced soil	Conditioned material direct from power station dust collection system and to which a controlled quantity of water has been added	(i) mc	BS 1377 : Part 2	To enable compaction to Clause 612		End product: 95% of maximum dry density of BS 1377 : Part 4 (2.5 kg rammer method)	7
				(ii) bulk density	BS 1377 : Part 9	App 6/1	App 6/1		B
				(iii) undrained shear parameters (c and ϕ)	Clause 633	App 6/1	-		
				(iv) effective angle of internal friction (ϕ) and effective cohesion (c')	Clause 636	App 6/1	-		
				(v) coefficient of friction and adhesion (fill/elements)	Clause 639	App 6/1	-		
				(vi) permeability	Clause 640	App 6/1	-		
				(vii) slope stability test (where required in App 6/6)	Clause 610	App 6/6			

TABLE 6/1: (05/04) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued)

Class	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)				Compaction Requirements in Clause 612	Class
				Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:			
						Lower	Upper		
S E L E C T B E D C O H E S I V E F I L L	Selected wet cohesive material	Fill to reinforced soil	Any material, or combination of materials, other than unburnt colliery spoil, argillaceous rock and chalk. (Properties (viii) (ix), (x), (xi) and (xii) in next column only apply when metallic reinforcing elements, facing units or fastenings are used)	(i) grading	BS 1377 : Part 2	Tab 6/2	Tab 6/2	Tab 6/4 Method 1	7 C
				(ii) mc	BS 1377 : Part 2	App 6/1	App 6/1		
				(iii) MCV	Clause 632	App 6/1	App 6/1		
				(iv) effective angle of internal friction (ϕ') and effective cohesion (c')	Clause 636	App 6/1	-		
				(v) coefficient of friction and adhesion (fill/elements)	Clause 639	App 6/1	-		
				(vi) liquid limit	BS 1377 : Part 2	-	45		
				(vii) plasticity index	BS 1377 : Part 2	-	25		
				(viii) pH value	BS 1377 : Part 3	Tab 6/3	Tab 6/3		
				(ix) chloride ion content	BS EN 1744-1	-	Tab 6/3		
				(x) water soluble (WS) sulfate content	TRL Report 447, Test No. 1	-	Tab 6/3		
				(xi) oxidisable sulfides (OS) content	TRL Report 447, Tests Nos. 2 and 4	-	Tab 6/3		
				(xii) resistivity	Clause 637	Tab 6/3	-		
				(xiii) redox potential	Clause 638	Tab 6/3	-		

TABLE 6/1: (05/04) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued)

Class	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)				Compaction Requirements in Clause 612	Class	
				Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:			7	D
						Lower	Upper			
S E L E C T E D C O H E S I V E F I L L	Selected stony cohesive material	Fill to reinforced soil	Any material, or combination of materials, other than unburnt colliery spoil, argillaceous rock and chalk. (Properties (vi), (vii), (viii), (ix), (x), (xi) and (xii) in next column only apply when metallic reinforcing elements, facing units or fastenings are used)	(i) grading	BS 1377 : Part 2	Tab 6/2	Tab 6/2	Tab 6/4 Method 2	7	D
				(ii) mc	BS 1377 : Part 2	App 6/1	App 6/1			
				(iii) MCV	Clause 632	App 6/1	App 6/1			
				(iv) effective angle of internal friction (ϕ') and effective cohesion (c')	Clause 636	App 6/1	-			
				(v) coefficient of friction and adhesion (fill/elements)	Clause 639	App 6/1	-			
				(vi) liquid limit	BS 1377 : Part 2	-	45			
				(vii) plasticity index	BS 1377 : Part 2	-	25			
				(viii) pH value	BS 1377 : Part 3	Tab 6/3	Tab 6/3			
				(ix) chloride ion content	BS EN 1744-1	-	Tab 6/3			
				(x) water soluble (WS) sulfate content	TRL Report 447, Test No. 1	-	Tab 6/3			
				(xi) oxidisable sulfides (OS) content	TRL Report 447, Tests Nos. 2 and 4	-	Tab 6/3			
				(xii) resistivity	Clause 637	Tab 6/3	-			
				(xiii) redox potential	Clause 638	Tab 6/3	-			

TABLE 6/1: (11/03) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued)

Class	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)					Compaction Requirements in Clause 612	Class
				Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:				
						Lower	Upper			
7 S E L E C T E D C O H E S I V E	Selected cohesive material	For stabilisation with lime to form capping (Class 9D)	Any material, or combination of materials, other than unburnt colliery spoil	(i) grading	BS 1377 : Part 2	Tab 6/2	Tab 6/2	Not applicable	7	D
				(ii) mc	BS 1377 : Part 2	-	App 6/1			
				(iii) MCV	Clause 632	App 6/1	-			
				(iv) plasticity index	BS 1377 : Part 2	10	-			
				(v) organic matter	BS 1377 : Part 3	-	App 6/1			
				(vi) water soluble (WS) sulfate content	TRL Report 447, Test No. 1	-	App 6/1			
				(vii) oxidisable sulfides (OS) content	TRL Report 447, Tests Nos. 2 and 4	-	App 6/1			
				(viii) total potential sulfate (TPS) content	TRL Report 447, Test No. 4	-	App 6/1			
				(i) grading	BS 1377 : Part 2	Tab 6/2	Tab 6/2			
				(ii) uniformity coefficient	See Note 5	5	-			
7 F I L L	Selected silty cohesive material	For stabilisation with cement to form capping (Class 9B)	Any material, or combination of materials, other than chalk, unburnt colliery spoil and argillaceous rock	(iii) mc	BS 1377 : Part 2	App 6/1	App 6/1	Not applicable	7	F
				(iv) MCV	Clause 632	App 6/1	App 6/1			
				(v) liquid limit	BS 1377 : Part 2	-	45			
				(vi) plasticity index	BS 1377 : Part 2	-	20			
				(vii) organic matter	BS 1377 : Part 3	-	App 6/1			
				(viii) water soluble (WS) sulfate content	TRL Report 447, Test No. 1	-	App 6/1			
				(ix) oxidisable sulfides (OS) content	TRL Report 447, Tests Nos. 2 and 4	-	App 6/1			
				(x) total potential sulfate (TPS) content	TRL Report 447, Test No. 4	-	App 6/1			

TABLE 6/1: (11/05) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued)

Class	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)					Compaction Requirements in Clause 612	Class	
				Property (See exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:					
						Lower	Upper				
7	Selected conditioned pulverised fuel ash cohesive material	For stabilisation with cement to form capping (Class 9C)	Conditioned material direct from power station dust collection system and to which a controlled quantity of water has been added	(i) mc	BS 1377 : Part 2	App 6/1	App 6/1	Not applicable	7	G	
				(ii) water soluble (WS) sulfate content	TRL Report 447, Test No. 1	-	3000 mg/l as SO ₄				
				(iii) oxidisable sulfides (OS) content	TRL Report 447, Tests Nos. 2 and 4	-	0.6% as SO ₄				
				(iv) total potential sulfate (TPS) content	TRL Report 447, Test No. 4	-	1.2% as SO ₄				
7	Wet, dry, stony or silty cohesive material and chalk	Overlying fill for corrugated steel buried structures	As Class 2A, 2B, 2C, 2D general cohesive fill material or Class 3 chalk fill material, except that argillaceous rock, slag, PFA or any combination thereof shall not be used	As for Class 2A, 2B, 2C, 2D or 3 with the addition of the following						7	H
(i) water soluble (WS) sulfate content	TRL Report 447, Test No. 1	-	300 mg/l as SO ₄								
(ii) oxidisable sulfides (OS) content	TRL Report 447, Tests Nos. 2 and 4	-	0.06% as SO ₄								
(iii) chloride ion content	BS EN 1744-1	-	0.025%								
				(iv) pH value	BS 1377 : Part 3	6	9				

TABLE 6/1: (11/03) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued)

Class	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)					Compaction Requirements in Clause 612	Class
				Property (See exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:				
						Lower	Upper			
7 I S E L E C T E D C O H E S I V E F I L L	Selected cohesive material	For stabilisation with lime and cement to form capping (Class 9E)	Any material, or combination of materials, other than unburnt colliery spoil	(i) grading	BS 1377 : Part 2	Tab 6/2	Tab 6/2	Not applicable	7 I	
				(ii) mc	BS 1377 : Part 2	-	App 6/1			
				(iii) MCV	Clause 632	App 6/1	-			
				(iv) plasticity index	BS 1377 : Part 2	10	-			
				(v) organic matter	BS 1377 : Part 3	-	App 6/1			
				(vi) water soluble (WS) sulfate content	TRL Report 447, Test No. 1	-	App 6/1			
				(vii) oxidisable sulfides (OS) content	TRL Report 447, Tests Nos. 2 and 4	-	App 6/1			
				(viii) total potential sulfate (TPS) content	TRL Report 447, Test No. 4	-	App 6/1			

TABLE 6/1: Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued)

Class	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)					Compaction Requirements in Clause 612	Class
				Property (See exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:				
						Lower	Upper			
MF I I S L C L	Class 1, Class 2 or Class 3 material	Lower trench fill	Any; except there shall not be any stones or lumps of clay >40 mm nominal diameter. Recycled aggregate	(i) mc	BS 1377 : Part 2	App 6/1	App 6/1	Tab 6/4	8	-
				(ii) MCV	Clause 632	App 6/1	App 6/1			
9	Cement stabilised well graded granular material	Capping	Class 6E with addition of cement according to Clause 614	(i) pulverisation	BS 1924 : Part 2	60%	-	Tab 6/4 Method 6	9	A
				(ii) bearing ratio	BS 1924 : Part 2	App 6/1	-			
				(iii) mc	BS 1924 : Part 2	App 6/1	App 6/1			
9	Cement stabilised silty cohesive material	Capping	Class 7F with addition of cement according to Clause 614	(i) pulverisation	BS 1924 : Part 2	App 6/1	-	Tab 6/4 Method 7	9	B
				(ii) MCV immediately before compaction	Clause 632	App 6/1	12			
				(iii) bearing ratio	BS 1924 : Part 2	App 6/1	-			
				(iv) mc	BS 1924 : Part 2	App 6/1	App 6/1			
9	Cement stabilised conditioned pulverised fuel ash cohesive material	Capping	Class 7G with addition of cement according to Clause 614	(i) pulverisation	BS 1924 : Part 2	60%	-	End product 95% of maximum dry density of BS 1924 : Part 2 (2.5 kg rammer method)	9	C
				(ii) bearing ratio	BS 1924 : Part 2	App 6/1	-			
				(iii) mc	BS 1924 : Part 2	To enable compaction to Clause 612				
9	Lime stabilised cohesive material	Capping	Class 7E with addition of lime according to Clause 615	(i) pulverisation	BS 1924 : Part 2	30%	-	Tab 6/4 Method 7	9	D
				(ii) MCV immediately before compaction	Clause 632	App 6/1	App 6/1			
				(iii) bearing ratio	BS 1924 : Part 2	App 6/1	-			
				(iv) mc	BS 1924 : Part 2	App 6/1	App 6/1			

S T A B I L I S E D M A T E R I A L S

TABLE 6/1: (11/04) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued)

Class	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)					Compaction Requirements in Clause 612	Class
				Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:				
						Lower	Upper			
S M T A A T B E I R L I I A S L E S	Lime and cement stabilised cohesive material	Capping	Class 7I with addition of lime and cement according to Clause 643	(i) pulverisation	BS 1924 : Part 2	30%	-	Tab 6/4 Method 7	9	E
				(ii) MCV immediately before completion	Clause 632	App 6/1	App 6/1			
				(iii) bearing ratio	BS 1924 : Part 2	App 6/1	-			
				(iv) mc	BS 1924 : Part 2	App 6/1	App 6/1			
D	Lime and cement stabilised well graded granular material	Capping	Class 6R with addition of lime and cement according to Clause 643	(i) pulverisation	BS 1924 : Part 2	60%	-	Tab 6/4 Method 6	9	F
				(ii) bearing ratio	BS 1924 : Part 2	App 6/1	-			
				(iii) mc	BS 1924 : Part 2	App 6/1	App 6/1			

Footnotes to Table 6/1

1. App = Appendix
2. Tab = Table
3. Where in the Acceptable Limits column reference is made to App 6/1, only those properties having limits ascribed to them in Appendix 6/1 shall apply. Where Appendix 6/1 gives limits for other properties not listed in this Table such limits shall also apply.
4. (05/04) Where BS 1377 : Part 2 is specified for mc, this shall mean BS 1377 : Part 2 or BS EN 1097-5 as appropriate.
5. Uniformity coefficient is defined as the ratio of the particle diameters D_{60} to D_{10} on the particle-size distribution curve, where:
 D_{60} = particle diameter at which 60% of the soil by weight is finer
 D_{10} = particle diameter at which 10% of the soil by weight is finer
6. (11/04) The limiting values for Class U1B material are given in Appendix 6/14 and Appendix 6/15.

TABLE 6/4: Method Compaction for Earthworks Materials: Plant and Methods (Method 1 to Method 6)
(This Table is to be read in conjunction with sub-Clause 612.10)

Type of Compaction Plant	Ref No.	Category	Method 1		Method 2		Method 3		Method 4		Method 5		Method 6		
			D	N#	D	N#	D	N#	D	N	D	N	N for D = 110 mm	N for D = 150 mm	N for D = 250 mm
Smoothed wheeled roller (or vibratory roller operating without vibration)	1	Mass per metre width of roll: over 2100 kg up to 2700 kg over 2700 kg up to 5400 kg over 5400 kg	125	8	125	10	125	10*	175	4	unsuitable	unsuitable	unsuitable	unsuitable	unsuitable
	2		125	6	125	8	125	8*	200	4	unsuitable	unsuitable	unsuitable	unsuitable	unsuitable
	3		150	4	150	8	unsuitable	unsuitable	300	4	unsuitable	unsuitable	16	16	unsuitable
Grid roller	1	Mass per metre width of roll: over 2700 kg up to 5400 kg over 5400 kg up to 8000 kg over 8000 kg	150	10	unsuitable	12	150	10	250	4	unsuitable	unsuitable	unsuitable	unsuitable	unsuitable
	2		150	8	125	12	unsuitable	unsuitable	325	4	unsuitable	unsuitable	unsuitable	unsuitable	unsuitable
	3		150	4	150	12	unsuitable	unsuitable	400	4	unsuitable	unsuitable	20	20	unsuitable
Deadweight tamping roller	1	Mass per metre width of roll: over 4000 kg up to 6000 kg over 6000 kg	225	4	150	12	250	4	350	4	unsuitable	unsuitable	12	20	unsuitable
	2		300	5	200	12	300	3	400	4	unsuitable	unsuitable	8	12	20
Pneumatic-tyred roller	1	Mass per wheel: over 1000 kg up to 1500 kg over 1500 kg up to 2000 kg over 2000 kg up to 2500 kg over 2500 kg up to 4000 kg over 4000 kg up to 6000 kg over 6000 kg up to 8000 kg over 8000 kg up to 12000 kg over 12000 kg	125	6	unsuitable	12	150	10*	240	4	unsuitable	unsuitable	unsuitable	unsuitable	unsuitable
	2		150	5	unsuitable	12	unsuitable	unsuitable	300	4	unsuitable	unsuitable	unsuitable	unsuitable	unsuitable
	3		175	4	125	12	unsuitable	unsuitable	350	4	unsuitable	unsuitable	unsuitable	unsuitable	unsuitable
	4		225	4	125	10	unsuitable	unsuitable	400	4	unsuitable	unsuitable	unsuitable	unsuitable	unsuitable
	5		300	4	125	10	unsuitable	unsuitable	unsuitable	unsuitable	unsuitable	unsuitable	12	unsuitable	unsuitable
	6		350	4	150	8	unsuitable	unsuitable	unsuitable	unsuitable	unsuitable	unsuitable	12	unsuitable	unsuitable
	7		400	4	150	8	unsuitable	unsuitable	unsuitable	unsuitable	unsuitable	unsuitable	10	16	unsuitable
	8		450	4	175	6	unsuitable	unsuitable	unsuitable	unsuitable	unsuitable	unsuitable	8	12	unsuitable
Vibratory tamping roller	1	Mass per metre width of a vibrating roll: over 700 kg up to 1300 kg over 1300 kg up to 1800 kg over 1800 kg up to 2300 kg over 2300 kg up to 2900 kg over 2900 kg up to 3600 kg over 3600 kg up to 4300 kg over 4300 kg up to 5000 kg over 5000 kg	100	12	100	12	150	12	100	10	unsuitable	unsuitable	unsuitable	unsuitable	unsuitable
	2		125	12	125	12	175	12*	175	8	unsuitable	unsuitable	unsuitable	unsuitable	unsuitable
	3		150	12	150	12	200	12*	unsuitable	unsuitable	400	5	6	12	unsuitable
	4		150	9	150	9	250	12*	unsuitable	unsuitable	500	6	6	10	unsuitable
	5		200	9	200	9	275	12*	unsuitable	unsuitable	600	6	4	8	unsuitable
	6		225	9	225	9	300	12*	unsuitable	unsuitable	700	6	3	7	unsuitable
	7		250	9	250	9	300	9*	unsuitable	unsuitable	800	6	3	6	12
	8		275	9	275	9	300	7*	unsuitable	unsuitable	800	6	3	6	10

TABLE 6/4: Method Compaction for Earthworks Materials: plant and Methods (Method 1 to Method 6)
(This Table is to be read in conjunction with sub-Clause 612.10)

Type of Compaction Plant	Ref No.	Category	Method 1		Method 2		Method 3		Method 4		Method 5		Method 6		
			D	N#	D	N#	D	N#	D	N	D	N	N for D = 110 mm	N for D = 150 mm	N for D = 250 mm
Vibratory roller	1	Mass per metre width of a vibratory roll:	unsuitable		75	16	150	16	unsuitable		unsuitable		unsuitable	unsuitable	unsuitable
	2	over 270 kg up to 450 kg	unsuitable		75	12	150	12	unsuitable		unsuitable		unsuitable	unsuitable	unsuitable
	3	over 450 kg up to 700 kg	100	12	125	10	150	6	125	10	unsuitable		16	unsuitable	unsuitable
	4	over 700 kg up to 1300 kg	125	8	150	8	200	10*	175	4	unsuitable		6	unsuitable	unsuitable
	5	over 1300 kg up to 1800 kg	150	4	150	4	225	12*	unsuitable		unsuitable		4	12	12
	6	over 1800 kg up to 2300 kg	175	4	175	4	250	10*	unsuitable		400	5	3	5	11
	7	over 2300 kg up to 2900 kg	200	4	200	4	275	8*	unsuitable		500	5	3	5	10
	8	over 2900 kg up to 3600 kg	225	4	225	4	300	8*	unsuitable		600	5	2	4	8
	9	over 3600 kg up to 4300 kg	250	4	250	4	300	6*	unsuitable		700	5	2	4	7
	10	over 4300 kg up to 5000 kg	275	4	275	4	300	4*	unsuitable		800	5	2	3	6
Vibrating plate compactor	1	Mass per m ² of base plate:	unsuitable		unsuitable	unsuitable	75	6	unsuitable		unsuitable		unsuitable	unsuitable	unsuitable
	2	over 880 kg up to 1100 kg	unsuitable		75	10	100	6	75	10	unsuitable		unsuitable	unsuitable	unsuitable
	3	over 1100 kg up to 1200 kg	unsuitable		75	6	150	6	150	8	unsuitable		unsuitable	unsuitable	unsuitable
	4	over 1200 kg up to 1400 kg	100	6	125	6	150	4	unsuitable		unsuitable		8	unsuitable	unsuitable
	5	over 1400 kg up to 1800 kg	150	6	150	5	200	4	unsuitable		unsuitable		5	8	unsuitable
	6	over 1800 kg up to 2100 kg	200	6	200	5	250	4	unsuitable		unsuitable		3	6	12
Vibro-tamper	1	Mass:	100	3	100	3	150	3	125	3	unsuitable		4	8	unsuitable
	2	over 50 kg up to 65 kg	125	3	125	3	200	3	150	3	unsuitable		3	6	12
	3	over 65 kg up to 75 kg	150	3	150	3	225	3	175	3	unsuitable		2	4	10
	4	over 75 kg up to 100 kg	225	3	200	3	225	3	250	3	unsuitable		2	4	10
Power rammer	1	Mass:	150	4	150	6	unsuitable		200	4	unsuitable		5	8	unsuitable
	2	100 kg up to 500 kg over 500 kg	275	8	275	12	unsuitable		400	4	unsuitable		5	8	14
Dropping-weight compactor	1	Mass of rammer over 500 kg	600	4	600	8	450	8	unsuitable		unsuitable		unsuitable	unsuitable	unsuitable
	2	weight drop: over 1 m up to 2 m over 2 m	600	2	600	8	unsuitable		unsuitable		unsuitable		unsuitable	unsuitable	unsuitable

TABLE 6/4: Method Compaction for Earthworks Materials: Plant and Methods (Method 7)
(This Table is to be read in conjunction with sub-Clause 612.10)

Type of Compaction Plant	Ref No.	Category	Method 7	
			N for D = 150 mm	N for D = 250 mm
Smooth wheeled roller (or vibratory roller operating without vibration)	1	Mass per metre width of roll: over 2100 kg up to 2700 kg	unsuitable	unsuitable
	2	over 2700 kg up to 5400 kg	unsuitable	unsuitable
	3	over 5400 kg	12	unsuitable
Grid roller	1	Mass per metre width of roll: over 2700 kg up to 5400 kg	unsuitable	unsuitable
	2	over 5400 kg up to 8000 kg	16	unsuitable
	3	over 8000 kg	8	unsuitable
Deadweight tamping roller	1	Mass per metre width of roll: over 4000 kg up to 6000 kg	4	8
	2	over 6000 kg	3	6
Pneumatic-tyred roller	1	Mass per wheel: over 1000 kg up to 1500 kg	unsuitable	unsuitable
	2	over 1500 kg up to 2000 kg	12	unsuitable
	3	over 2000 kg up to 2500 kg	6	unsuitable
	4	over 2500 kg up to 4000 kg	5	unsuitable
	5	over 4000 kg up to 6000 kg	4	16
	6	over 6000 kg up to 8000 kg	unsuitable	8
	7	over 8000 kg up to 12000 kg	unsuitable	4
	8	over 12000 kg	unsuitable	4
Vibratory tamping roller	1	Mass per metre width of vibrating roll: over 700 kg up to 1300 kg	unsuitable	unsuitable
	2	over 1300 kg up to 1800 kg	unsuitable	unsuitable
	3	over 1800 kg up to 2300 kg	16	unsuitable
	4	over 2300 kg up to 2900 kg	12	unsuitable
	5	over 2900 kg up to 3600 kg	10	unsuitable
	6	over 3600 kg up to 4300 kg	8	16
	7	over 4300 kg up to 5000 kg	7	14
	8	over 5000 kg	6	12
Vibratory roller	1	Mass per metre width of vibrating roll: over 270 kg up to 450 kg	unsuitable	unsuitable
	2	over 450 kg up to 700 kg	unsuitable	unsuitable
	3	over 700 kg up to 1300 kg	unsuitable	unsuitable
	4	over 1300 kg up to 1800 kg	unsuitable	unsuitable
	5	over 1800 kg up to 2300 kg	12	unsuitable
	6	over 2300 kg up to 2900 kg	10	unsuitable
	7	over 2900 kg up to 3600 kg	10	unsuitable
	8	over 3600 kg up to 4300 kg	8	unsuitable
	9	over 4300 kg up to 5000 kg	8	unsuitable
	10	over 5000 kg	6	12
Vibratory plate compactor	1	Mass per m ² of base plate: over 880 kg up to 1100 kg	unsuitable	unsuitable
	2	over 1100 kg up to 1200 kg	unsuitable	unsuitable
	3	over 1200 kg up to 1400 kg	unsuitable	unsuitable
	4	over 1400 kg up to 1800 kg	10	unsuitable
	5	over 1800 kg up to 2100 kg	8	unsuitable
	6	over 2100 kg	6	unsuitable
Vibro-tamper	1	Mass: over 50 kg up to 65 kg	unsuitable	unsuitable
	2	over 65 kg up to 75 kg	unsuitable	unsuitable
	3	over 75 kg up to 100 kg	unsuitable	unsuitable
	4	over 100 kg	8	unsuitable
Power rammer	1	Mass: 100 kg up to 500 kg	8	unsuitable
	2	over 500 kg	6	10
Dropping weight compactor	1	Mass of rammer over 500 kg height drop: over 1 m up to 2 m	unsuitable	unsuitable
	2	over 2 m	unsuitable	unsuitable