Report No: 5848/3
Date: October 2005

REMEDIAL STRATEGY
for land at
BURTON ROAD, BARNSLEY

Prepared for
BEN BAILEY HOMES

ENCIA CONSULTING LIMITED
ENCIA House
Audby Lane
Wetherby
West Yorkshire
LS22 7RD

Tel: 01937 589955
Fax: 01937 589944

TABLE OF CONTENTS

1 INTRODUCTION 1
1.1 The Commission and Brief 1
1.2 The Proposed Development 1

2 BACKGROUND 2
2.1 Site Description 2
2.2 Ground Investigation 2

3 RISK ASSESSMENT & TARGET CONCENTRATIONS 5

4 REMEDIAL STRATEGY (GENERAL) 5
4.1 Aims 5
4.2 Overview 5
4.3 Site Set-up, Organisation and Safety 6
4.4 Contractor's Responsibilities 6
4.5 Engineering Supervision and Verification 7

5 REMEDIAL STRATEGY (SPECIFIC OBJECTIVES) 9
5.1 Introduction 9
5.2 Site Clearance (All Site Areas) 9
5.3 Asbestos (Areas A, C & D) 9
5.4 Demolition (Areas A, C & D) 9
5.5 Removal of Below Ground Obstructions (Areas A, C & D) 10
5.6 Processing of Arisings 10
5.7 Excavation of Contaminated Fill (Areas A and D) 10
5.8 Control of Water (All Areas) 11
5.9 Export to Landfill (Areas A and D) 11
5.10 Backfill of Excavations (Areas A, C & D) 12
5.11 Earthworks Levels\Regrade (All Areas) 12
5.12 Engineering of Fill Materials (All Areas) 12
5.13 Placement of Stone Blankets (All Areas) 13
5.14 Surveying (All Areas) 14
5.15 Placement of Soil Cover (Areas A & D) 14
5.16 Hazardous Gas Protection (All Areas) 14
5.17 Contingency for Unknowns (All Areas) 15
5.18 Supplementary Investigation (Area D) 15

APPENDICES

Appendix A Correspondence

From	To	Date	Content
Environment Agency	Encia	05/09/05	Comment on CW QRA & SI Report
Encia	Environment Agency	30/08/05	Response to EA comments
Barnsley MBC	Encia	23/08/05	Acceptance of HH QRA
Environment Agency	Encia	12/08/05	Comment on CW QRA & SI Report

Appendix B Drawings

5848/1 Site Location Plan
5848/2 Site Features

Appendix C Encia Protocol for Importation & Use of Soil Cover

Appendix D Encia General Specification for Engineered Fills

Appendix E Suggested Protocol for Validation of Gas Protection Measures

REMEDIAL STRATEGY
for land at
BURTON ROAD, BARNSLEY

1 INTRODUCTION

1.1 The Commission and Brief

1.1.1 Encia Consulting Limited (Encia), have been commissioned by Ben Bailey Homes Ltd to prepare a Remedial Strategy for land off Burton Road, Barnsley.

1.1.2 Encia Consulting have already issued the following reports:

- Geoenvironmental Appraisal of land at Burton Road, Barnsley. Report No. 5848/1, dated March 2004.
- Quantitative Risk Assessment. Report No. 5848/2, dated May 2005.

1.1.3 Correspondence relating to regulatory approval of the Geoenvironmental Appraisal and Quantitative Risk Assessment is presented in Appendix A.

1.1.4 This document outlines the remediation objectives necessary to protect environmental receptors, and render the site suitable for the proposed development.

1.1.5 A Method Statement will be required from the Contractor appointed to undertake the remedial and preparatory works. The Method Statement will detail how the objectives outlined in this Strategy are to be achieved. The Method Statement should be submitted to, and approved by, the Engineer, NHBC and the Local Authority.

1.2 The Proposed Development

1.2.1 Ben Bailey Homes have supplied a proposed layout which shows the proposed development to comprise approximately 220 traditional 2 storey domestic dwellings with associated gardens, POS, adoptable roads and sewers.

1.2.2 The houses will be founded on a mixture of strip/trench fill, rafts on engineered fill and possibly piles, the final foundation solution will be determined by the depth of filled ground.

1.2.3 Access to the development will be from Burton Road, which runs along the northern boundary.

1.2.4 The Local Planning Authority has agreed full planning permission for redevelopment of this site.

1.2.5 Barnsley Metropolitan Borough Council and Environment Agency have requested that a supplementary site investigation be undertaken within areas of the site, which were not accessible during the initial site investigation. This supplementary investigation has been undertaken and will be reported in mid of October 2005.

2 BACKGROUND

2.1 Site Description

2.1.1 The site location is shown on Drawing 5848/1 presented in Appendix B to this report. Site features referenced below are indicated on Drawing No. 5848/2, presented in Appendix B.

2.1.2 The site is located off Burton Road, Barnsley (centred at NGR SE 377 084) and consists of four parcels of land (Areas A to D) covering a total area of approximately 7.5 hectares (18.45 acres).

2.1.3 The site is split into four areas of ownership. **Area A** is occupied by a vehicle servicing garage, two residential properties, vehicle storage yard, derelict nurseries and overgrown fields. **Area B** consists of overgrown fields and an area of concrete hardstand (demolished playground). **Area C** consists of small garage/car sales yard, residential house and an area of open ground. **Area D** was occupied by a scrap yard, which did contain approximately 300 cars, large stockpiles of metal, a crusher, offices, above ground fuel tanks and a warehouse building.

2.1.4 Each site area is described separately below and is summarised in the table below.

Summary of Site Areas

Site Area	Size/Hectares	Current /Former Status
Area A (divided into 5 sub-areas)	3.4	Derelict Nursery, Overgrown Land, Car Garage, Open Yard, Landfill Site and Two Houses
Area B	1.8	Open fields/Overgrown Ground
Area C	0.2	Car Garage and House
Area D	2.1	Scrap Yard

2.2 Ground Investigation

2.2.1 Encia undertook a geoenvironmental investigation in December 2003, Report 5848/1, dated March 2004. This report included the investigation of five individual areas off Burton Road, with one area off site, which is not included in the proposed development.

2.2.2 A second investigation was undertaken as part of the Quantitative Risk Assessment, Report 5848/2, dated May 2005. This report only related to Area D. It has been agreed with the Environment Agency that the QRA can be adopted for the all areas of the site, see correspondence in Appendix B.

2.2.3 The ground investigation works relating to this site comprised:

- 23 window sample holes drilled between 0.7 and 3.3m bgl.
- 32 trial pits excavated between 0.4m and 3.3m bgl.
- 9 probeholes drilled between 10m and 30m bgl.
- 9 boreholes drilled between 1.47m and 5.0m bgl.
- Monitoring wells were installed in PHs 1, 5, 7 and 8 and WSs 9, 10, 16, 101 and 107 and BHs 1, 2, 4, 5, 6, 7, 8 and 9 with response zones sealed in either made or natural ground.
- Geotechnical classification tests (Atterberg limits, pH, soluble sulphate etc).

- Chemical laboratory tests (including total and leachable metals, PAH, PCBs, TPH, asbestos and calorific value).
- Gas monitoring; 6 visits between 18th December 2003 and 11th March 2004 and a further 6 visits between 15th April and 27th June 2005 (Area D only).

Made Ground

2.2.4 **Area A** – Two distinct areas of made ground have been identified; former landfill site (sand/demo rubble fill to 3.0m) in north and filled ground (ash/demo rubble fill to 2.7m) in the south. No made ground was encountered within the field in the east.

2.2.5 **Area B** – Made ground was not encountered within this area.

2.2.6 **Area C**. Made ground was encountered across this area and consisted of topsoil or tarmac over granular fill to a maximum depth of 1.0m bgl.

2.2.7 **Area D** – Made ground was encountered across this area and consisted of a concrete hardstand over granular fill underlain, by gravel and ash and clinker. The maximum depth encountered was 2.5m, the average depth was 1.2m.

Natural Ground

2.2.8 Natural ground across all areas comprised a firm to stiff brown clay (weathered mudstone) over mudstone bedrock, sandstone was encountered in the north of the site.

2.2.9 Depths to rock head within the trial pits, where encountered, varied between 1.5 and 3m across the site. Rockhead was encountered within the probeholes between 1.2 and 3.1m bgl, this is in general accordance with the trial pits and window samples holes.

Contamination

2.2.10 **Area A** – Made ground within the south west of this area contains potentially combustible ash and clinker, elevated TPH and metals.

2.2.11 **Area B** – No significant contamination was encountered within this area.

2.2.12 **Area C** – No significant visual or olfactory evidence of contamination was encountered within this area.

2.2.13 **Area D** – Made ground within this area contains elevated TPH, metals and combustible materials (ash). Elevated levels of PCBs were also encountered in the made ground.

2.2.14 In terms of the proposed redevelopment plausible pollutant linkages, and feasible remediation options, are summarised overleaf:

Receptors	Pathways	Contaminant Source	Remediation Options
Human Health (Future residents) ◇	Consumption of contaminated vegetables	Metals, Hydrocarbons in the made ground	Removal or remediation of organic contamination - Area D only Placement of capping layer over made ground in Areas A and D will remove potential pathway of contamination The presence of road pavements, plots and driveways will act a natural barrier in other parts of the site.
	Ingestion		
	Inhalation (dust and\or vapours)		
	Dermal contact		
	Migration & accumulation of explosive gas	Methane, Hydrocarbons in the made ground	Provision of gas membrane within all dwellings
	Infiltration of water supply pipes	Hydrocarbons in the made ground	Removal or remediation of localised organic contamination
Buildings	Migration & accumulation of explosive gas	Methane, Hydrocarbons in the made ground	Removal or remediation of localised organic contamination
	Contact with "aggressive" soil and\or groundwater	Sulphate in the made ground	Concrete in accordance with BRE SD1, the Design Sulphate Class for the site is DS-1 with an ACEC Class of AC-1.
Plants	Uptake of phytotoxic elements	Cu, Ni, Zn & B in the made ground	Placement of capping layer over made ground in Areas A and D will remove potential pathway of contamination
Groundwater surfacewater	Migration of leachable components	Metals, Hydrocarbons in the made ground	Removal or remediation of localised organic contamination Placement of low permeability clay within capping will reduce leaching of remaining components
	Surface water run-off		

◇ transient risks to construction workers will be addressed by the adoption of appropriate health and safety measures in accordance with the Health and Safety at Work Act 1974, and regulations made under the Act including for example the COSHH Regulations.

3 RISK ASSESSMENT & TARGET CONCENTRATIONS

3.1.1 Quantitative risk assessment (QRA), Report 5848/2, dated May 2005, has been undertaken to derive site-specific clean-up criteria for the contaminants of concern (TPH, PAH and PCB).

3.1.2 The results of the qualitative risk assessment (i.e. source-pathway-target assessment) show that the site does not pose a risk to controlled waters.

3.1.3 The human health quantitative risk assessment shows that if the site is capped with 1000mm of soil, including a 300mm layer of clay, then no risks are posed to human health from PAH and TPH in the made ground.

3.1.4 Clearly, soils grossly contaminated with TPH cannot remain on site, therefore a TPH clean-up value of 5,000 mg/kg will be adopted for this site.

3.1.5 PCBs have been identified in Area D, but the concentrations present are below the target concentration for Human Health. In order to screen Area D, additional samples will be taken, to determine the requirement for any PCB remediation, further details are in Section 5.18.

3.1.6 Remedial target concentrations for remaining contaminants of concern in soil are:

Contaminant of concern	Target Concentrations (mg/kg)
PCBs (Area D only)	8.8
TPH (Site Wide)	5,000

4 REMEDIAL STRATEGY (GENERAL)

4.1 Aims

4.1.1 Remediation aims are:

- Resolve contamination issues in order to protect environmental receptors, and render the site suitable for the proposed development.
- Provide a stable development platform (to agreed levels and gradients) for subsequent construction of the proposed development and associated infrastructure.
- Satisfy requirements of the Local Planning Authority and the National House Building Council (NHBC).

4.2 Overview

4.2.1 The following remedial works are required:

- Demolition of buildings and removal of below ground obstructions.
- Break-up of slabs and hardstand.
- Crushing of all suitable artificial hard material (i.e. concrete/brick etc).
- Excavation/treatment of localised PCB contamination (if encountered by the additional testing, see Section 5.18).
- Excavation/treatment of TPH contamination.
- Provision of a 1000mm soil cover, including 300mm of clay.

4.3 Site Set-up, Organisation and Safety

4.3.1 Site works shall be supervised throughout by a suitably qualified Engineer, who will report to a Project Manager. Supervision may be part-time for certain activities, but must be full-time during the removal of any grossly contaminated soil\fill and any placement of fill to an engineering specification.

4.3.2 Site cabins and welfare facilities are to be established at a location to be agreed with the Engineer. All welfare facilities must be established in accordance with the relevant health & safety statutory requirements. Provision shall be provided on site for car parking for all site employees

4.3.3 All site personnel shall undergo a site-specific health and safety induction prior to commencement of work on site.

4.3.4 The Engineer shall be informed prior to any proposed entry of a confined space or deep excavation. Entry must be restricted to suitably qualified and equipped personnel.

4.3.5 Works will be carried out with proper regard to current statutory requirements. Reference could be made to Encia Group's Safety Management Systems, Procedure SP2 (Legal Requirements).

4.3.6 During the remediation works, all personnel on site will comply with guidance provided in the Health and Safety Executive (HSE) document "Protection of Workers and the General Public during the Redevelopment of Contaminated Land". In summary, the following shall be provided:

- Protective clothing, footwear and gloves. (Personnel should be instructed in why and how they are to be used).
- Hand-washing and boot-washing facilities.
- Smoking shall be limited to designated areas.

4.3.7 If at any time during the works personnel begin to feel unwell, they are to inform the Engineer, who will determine appropriate action.

4.3.8 All visitors to site must enter and register at the main Site Office.

4.4 Contractor's Responsibilities

4.4.1 Prior to the commencement of any works the Contractor, in agreement with the Engineer, shall:

- Any requirements of Client's contract documentation.
- Establish the boundaries of the site and the working areas.
- Undertake a dilapidation survey of site boundaries, adjacent properties and highways, via dated photographs or video footage.
- Liaise with the Local Authority regarding working hours, noise\dust\odour control, and protected trees.
- Liaise with the Local Water Company regarding any proposed discharge to sewer.
- Liaise with the Environment Agency regarding any work in close proximity to the stream on the southern boundary.
- Complete a full services search and liaise with all relevant utility companies regarding work in close proximity to their apparatus.
- Undertake a CCTV survey to record the condition of the sewer.

- Obtain a Type III asbestos survey report for all buildings to be demolished.
- Prepare a detailed Method Statement outlining how the objectives of this Remedial Strategy will be achieved (and obtain approvals).
- Inform the Engineer of any risk, identified and assessed, which could impact upon the Engineer's activities.
- Prepare the necessary COSHH statements and Health & Safety Plan in accordance with CDM regulations.

4.4.2 The Contractor shall satisfy the Health & Safety Executive with regard to all matters concerning the health, safety and welfare of persons on the site.

4.4.3 The Contractor shall ensure that:

- Personnel, plant, materials and other equipment related to the contract are confined within the boundaries of the site.
- Any live services lying within the site boundary are marked and protected, or appropriate arrangements made to truncate them.
- Good practices relating to personal hygiene are adopted.
- Suitable precautions are implemented at all times to prevent off-site migration of pollutants via airborne dust and vapours.
- Suitable precautions are taken to prevent the spread of mud and debris on public highways.
- Refuelling of mobile plant is undertaken in a designated area. Above ground oil storage tanks shall comply with the requirements of Pollution Prevention Guideline PPG2. A spill kit shall be kept on site, adjacent to the designated refuelling area.

4.4.4 The Contractor must have reviewed and acknowledged the Encia Group Ltd 'Standard Rules for Sub-Contractors on Safety, Health & Environment' GOP 2; a copy of which can be obtained from Encia Group's Health & Safety Manager.

4.5 Engineering Supervision and Verification

4.5.1 The Engineer will ensure that the requirements of this Remedial Strategy are complied with in a safe and orderly manner.

4.5.2 The responsibilities of the Engineer shall include, but not be limited to, the following:

- Ensuring that all site personnel are suitably qualified and given an appropriate induction at the beginning of their first day.
- Supervision of the remedial and ground preparatory works.
- Advice on the correct handling of materials and conditions encountered.
- Guidance on the appropriate protective clothing and safety equipment that is to be made available and used.
- Ensuring that personal hygiene arrangements are adequate.
- Retrieval of soil and water samples and the subsequent scheduling of appropriate laboratory analysis to enable validation of various aspects of the works, and to advise the Project Manager of progress.
- Liaison with statutory authorities as required.

4.5.3 The Engineer will maintain records of the works to include the following:

- Daily record sheets to include a summary of the day's activities.

- Date and weather conditions.
- Plant, personnel and visitors present.
- Aspects relating to Health and Safety, Environmental Control, or non-compliance with either this Remedial Strategy or the Contractor's Method Statement.
- Site surveys as necessary to record the locations of demolition, excavation and filling activity.
- Test results.

4.5.4 On satisfactory completion of all the works the Engineer will prepare a Verification Report. Copies of the Verification Report will be issued to the Ben Bailey Homes, the Local Authority and NHBC.

4.5.5 The Verification Report will stand as certification that the remedial and ground preparatory works have been carried out in accordance with this Remedial Strategy.

4.5.6 The Verification Report will include:

- A summary of the preparatory & remedial works undertaken, including any works associated with unforeseen ground conditions
- Validation test results associated with "hot-spot" treatment, including plans showing sample locations & levels, and the extent of any "hot-spot" excavations
- Details of the fate of any arisings excavated from "hot-spot"
- Validation test results associated with proposed source materials for clean cover
- Moisture content and plate bearing test results associated with ground improvement beneath proposed highways and dwellings
- Copies of any correspondence with Regulators relating to specific aspects of the remedial works

4.5.7 For reasons of practicality, detailed daily records prepared by the Engineer during the works will not be appended to the Verification Report, but copies will be submitted to the Local Authority under separate cover.

4.5.8 The Verification Report also provide recommendations with respect to:

- Foundation Solution(s)
- Gas Measures
- Placement of Soil Cover
- Handling of Contaminated Soils

4.5.9 The above recommendations will take account of the actual remedial works undertaken, and may differ significantly from recommendations originally presented in the site investigation report.

5 REMEDIAL STRATEGY (Specific Objectives)

5.1 Introduction

5.1.1 The site is split into four areas, with each area requiring varying degrees of remedial work.

5.1.2 The specific objectives for remedial works, with reference to the site areas requiring action, are detailed in the following sections.

5.2 Site Clearance (All Site Areas)

5.2.1 Any trees currently under a preservation order shall be identified and agreed with relevant authorities prior to the commencement of the works. All trees subject to a TPO shall be clearly identified and protected by chestnut paling with fluorescent tape.

5.2.2 The site shall then be cleared of all residual debris, any vegetation, shrubs, bushes and unprotected trees as instructed by the Client.

5.3 Asbestos (Areas A, C & D)

5.3.1 Current legislation requires a Type III asbestos survey to be undertaken, immediately prior to demolition of any building. The Contractor shall request a copy of the Type III survey report from the Client or Engineer. If no survey report is available, the Contractor will instruct a Type III asbestos survey.

5.3.2 The licensed contractor shall submit a Method Statement detailing how the works will be carried out in accordance with: *Control of Asbestos at Work Regulations (CAWR), 2002.*

5.3.3 Localised fragments of asbestos cement sheeting may be encountered during the site remedial and preparatory works. All suspected asbestos-containing material should be recovered by hand and placed in double sealed bags, within a sealed skip for off-site disposal at a suitably licensed landfill site. Personnel involved in this activity should be equipped with appropriate personal protective equipment, including dust masks (3M Type 8810 or equivalent).

5.4 Demolition (Areas A, C & D)

5.4.1 Demolition works will commence on completion of any asbestos removal and a "soft-strip" of the existing buildings.

5.4.2 Existing buildings will be demolished in a safe and controlled manner and any concrete slabs will be broken out.

5.4.3 All demolition operations shall conform to BS 6187:2000 Code of Practice for Demolition. All personnel working on these operations shall be fully qualified to do so.

5.4.4 A detailed Method Statement specific to the project must be prepared by the Contractor and submitted to the Engineer and Ben Bailey Homes. The Method Statement should be submitted to, and approved by, the Engineer and the Local Authority.

5.5 Removal of Below Ground Obstructions (Areas A, C & D)

5.5.1 All foundations associated with existing buildings and other relict structures will be chased out and grubbed-up, in order to remove potential obstructions to new foundations and infrastructure.

5.5.2 Where relict structures are found to retain fluid contaminants, they shall be drained first.

5.5.3 Deep excavations for the removal of structures etc will be unstable in the short term and continuous side support will be necessary.

5.5.4 Where significantly deep foundations (e.g. piles) cannot be removed by conventional means, they are to be cut at a depth to be agreed with the Engineer and the position of the remaining lower section is to be accurately recorded by survey.

5.5.5 Suitable materials derived from grubbing-up shall be stored in a location on site, to be agreed with the Engineer, prior to crushing (see Section 5.6). Any unsuitable materials shall be removed to a suitably licensed landfill site (see Section 5.9).

5.6 Processing of Arisings

5.6.1 Generation of a selected granular fill, Class 6 material as defined in the Highways Agency Specification (Series 600), should be possible.

5.6.2 The crushed product shall be screened to remove any unsuitable elements and stockpiled for reuse during the subsequent construction works.

5.6.3 The Engineer shall check the suitability of crushed product for re-use, instruct the removal of any unsuitable material and schedule appropriate confirmatory geotechnical or chemical testing.

5.7 Excavation of Contaminated Fill (Areas A and D)

5.7.1 Contaminated material shall be excavated under the full time supervision of the Engineer, who will be equipped with an on-site test kit to assist with delineation.

5.7.2 Contaminated material shall be excavated under the full time supervision of the Engineer.

5.7.3 Following excavation of the grossly contaminated ground, the Engineer will inspect and sample the resultant excavations.

5.7.4 A minimum of 5 validation samples shall be taken from the excavation sidewalls and base.

5.7.5 The Engineer will instruct continued removal of soil\fill if validation samples yield concentrations in excess of the clean-up criteria outlined in Section 3.

5.7.6 Contaminated fill shall be placed in temporary stockpiles on hardstand or polythene sheeting and be suitably covered to prevent surface water run-off.

5.7.7 Excavations should not be left open for longer than is necessary, and should be securely cordoned-off using 2m high Herras-type fencing, with appropriate warning signs whenever excavation works are suspended.

5.7.8 On completion of any fill removal, excavations are to be backfilled (see Section 5.10).

5.8 Control of Water (All Areas)

5.8.1 Groundwater shall be controlled in accordance with CIRIA report 113 "Control of Groundwater for Temporary Works".

5.8.2 It is anticipated that perched groundwater will be encountered in the made ground in Area D and possibly Area A.

5.8.3 Arrangements should be made to prevent ponding in any excavation "hollows"; the Contractor shall ensure that ground levels are of sufficient gradient to enable the collection of surface water run-off in sumps or grips.

5.8.4 Any potentially contaminated water shall not be allowed to escape to other areas until the results of the analysis are available and, if required, a suitable means of water treatment has been agreed.

5.8.5 Pumping from over-excavated sumps may be required to maintain satisfactory working conditions

5.8.6 Water collected in sumps should be passed through a series of oil/water separators to remove any oily contamination. Oils trapped in the absorbent medium that shall be disposed of a suitably licensed landfill site (see Section 5.9).

5.8.7 Treated water shall then be tankered off-site, or be discharged to sewer, subject to local water treatment company consent.

5.9 Export to Landfill (Areas A and D)

5.9.1 Any material exported from site to landfill should be hauled by a registered waste carrier in accordance with the requirements of the Duty of Care Regulations, 1991 and the Landfill (England & Wales) Regulations 2002.

5.9.2 A transfer note should be completed, signed and retained by the parties involved. The transfer note should include the volume of waste, the nature of the material and a statement of its chemical composition, details of the source and destination sites, and details of the haulier.

5.9.3 In order to protect the general public from dust and vapour emissions, wagons that are to be used for the haulage of the contaminated material from the site must be sheeted. In addition, the Contractor must ensure that no fluids seep from the wagons.

5.9.4 In order to provide the landfill facility with information regarding chemical composition of the waste, analysis of any material that requires removal from site will be undertaken.

5.9.5 A minimum of 6 samples per material\waste type will be scheduled for: *pH, total metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc), PAH, BTEX and TPH.*

5.10 Backfill of Excavations (Areas A, C & D)

5.10.1 Excavations (to remove tanks, relict structures, contamination etc) should be backfilled as necessary to achieve the desired levels, with suitable materials and subjected to nominal compaction, to be agreed with the Engineer.

5.11 Earthworks Levels\Regrade (All Areas)

5.11.1 Final site levels will be agreed with Ben Bailey Homes, via an External Works Drawing, which should show:

- proposed finished floor levels
- proposed finished road levels
- garden & driveway levels and gradients

5.11.2 It is anticipated that the volume of cut will broadly equate to the volume of fill. However, there may be a need to export some soil\fill off-site.

5.12 Engineering of Fill Materials (All Areas)

5.12.1 Final foundation solutions are to be agreed with Ben Bailey Homes following earthworks, finished levels and drainage requirements.

5.12.2 In areas where raft foundations are proposed, the uppermost thickness of made ground shall be excavated, screened and placed in engineered layers (turned over). Excavations below proposed new-build should extend at least 3.0m beyond the footprint of structures. Excavation and screening will enable the removal of all relict foundations, oversize material and any grossly contaminated soil/fill.

5.12.3 Any excavated and screened material that needs to be stockpiled temporarily shall be placed in areas designated by the Engineer. Any stockpile of made ground should be assumed to contain elevated concentrations of inorganic contaminants, and it should be ensured that such materials are not allowed to cross-contaminate any clean soils or controlled waters.

5.12.4 Prior to placement of engineered fill, the excavation base shall be inspected by the Engineer, and then surveyed.

5.12.5 Given the nature of the made ground at this site (including a significant proportion of material coarser than 37.5mm), a method specification based on site trials, is proposed for compaction works.

5.12.6 On-site trials, in accordance with Section 6 of Encia's General Specification will be required prior to the commencement of any compaction works. A copy of which is presented in Appendix D.

5.12.7 The Contractor shall allow the Engineer at least 5 working days to assess the trial data and associated laboratory test results. The Engineer will then provide the Contractor with the following information:

- number of passes with the specified compaction plant
- maximum and minimum layer thickness
- acceptable moisture content range
- proposed control testing

5.12.8 In areas where raft foundations are not proposed uppermost 1.5m of made ground shall be subjected to "turnover", except where "chasing-out" of relict foundations or structures necessitates deeper excavation. Deeper excavation may be required in order to:

- "chase out" relict foundations and structures.
- remove contaminated soil\fill (see Section 5.7)

5.12.9 The screened material shall generally be placed with nominal compaction, comprising at least 2 passes with a towed vibratory roller of at least 2,900 kg per metre width.

5.12.10 All buried structures, foundations and any contaminated soil/fill shall be chased out to their full extent.

5.12.11 The site surface shall be initially left 1000mm below proposed finished garden levels to allow for placement of the cover. In areas of highways the ground surface will be left approximately 600mm below finished road level.

5.12.12 To prevent damage to the engineered fill, a granular running layer using crushed material (125mm down), shall be placed at formation beneath highways and haulage routes as directed by the Engineer. This running layer shall have a minimum CBR of 2% and extend 1.0m beyond proposed curb lines. This granular running layer shall not constitute a capping layer in terms of highway construction.

5.12.13 Crushed product derived from screening and crushing the relict foundations, concrete slabs and oversize materials will yield good quality granular material which does not require a site trial to confirm the method specification for its compaction in accordance with Encia's Specification for Engineered Fill, which is presented in Appendix D.

5.13 Placement of Stone Blankets (All Areas)

5.13.1 Any engineered fill containing more than 10% fines will require protection to ensure that climatic factors do not cause deterioration of the near surface. Protection shall be provided by the placement of a 450mm thick blanket of non-frost susceptible granular sub-base, within 48 hours of placement of the final layer of fill. The granular sub-base shall extend at least 1.0m beyond the footprint of all dwellings to be founded on rafts.

5.13.2 If this is not possible, the Engineer may instruct the excavation of up to 450mm of fill from beneath the plot footprint (and if suitable re-engineered), prior to placement of the granular sub-base.

5.13.3 Granular sub-base shall be placed in accordance with Table 8/1 of the DoT Specification for Highway Works (1993).

5.13.4 Crushed brick may be considered a suitable granular sub-base, provided it is:

- not frost susceptible
- does not contain significant amounts of plaster

5.14 Surveying (All Areas)

5.14.1 The Contractor shall arrange for the following survey work as directed by the Engineer:

- Establishment of profile boards
- Setting-out of estate roads
- Depth and extent of localised areas of overdig (such as those required to remove tanks)
- Depth and extent of excavations associated with removal of contaminated soil\fill
- The ground surface prior to placement of fill to raise site levels/provide clean cover in garden/landscaped areas
- The finished surface

5.14.2 The Contractor should supply the results of this survey work (disc & hard copy) to the Engineer for inclusion in Encia's Validation Report.

5.15 Placement of Soil Cover (Areas A & D)

5.15.1 Clean inert fill will be placed over the made ground in proposed garden and landscaped areas (but not beneath hardstanding). This cover layer is to comprise 1000mm of "clean" subsoil plus 150mm of topsoil. In addition a 300mm layer of clay will be incorporated into the cover.

5.15.2 The 300mm clay layer will act as an impermeable barrier to any downward percolation of water through into the underlying made ground.

5.15.3 It is considered unlikely that a significant volume of subsoil suitable for use as cover material will be sourced on site. Consequently, there will be a need for soil import.

5.15.4 Any material imported for use as cover should be validated in accordance with Encia's Protocol for Soil Importation, copied in Appendix C.

5.15.5 This work may be undertaken as part of the contract for the preparatory & remedial works, in which case imported soils should be stockpiled in a location agreed with the Engineer. Alternatively, the developer may choose to import soil at a later stage in the development.

5.16 Hazardous Gas Protection (All Areas)

5.16.1 Based on worst-case maximum values, the site would be classed as Characteristic Situation 2 (Wilson & Card, 1999).

5.16.2 Based on the soil-gas regime and the resultant site characterisation and the proposed foundation solution the following gas protection measures are recommended:

Characteristic Situation (Wilson & Card, 1999)	Protective Measures			
	Floor Slab	Sub-floor ventilation	Membrane	
			Type	Product Examples
2	suspended	Min. 200mm clear void. Min. ventilation = 2,000 mm^2/m (via air bricks on each of 2 opposite sides). Any sub-floor sleeper walls should be honeycombed.	Waterproof DPM. Lapped & sealed in accordance with BR 414	2000g polyethylene

Footnotes:

1. Report BR 414 (2001) - "*Protective Measures for housing on gas-contaminated land*". The membrane should be continuous across cavity walls, and there should be a cavity tray in external walls.
2. In all cases there should be minimum penetration of floor slab by services; any penetrations should be suitably sealed.
3. Integral garages with occupied rooms above, or direct access through a doorway from the garage to the house, should be provided with the same protective measures as the rest of the dwelling.

5.16.3 Independent quality control of works associated with provision of the required gas measures is required to ensure that the appropriate level of gas mitigation is provided. Encia's Protocol for the Inspection of Gas Measures, copied in Appendix E.

5.17 Contingency for Unknowns (All Areas)

5.17.1 Even after an appropriate preliminary investigation and ground investigation, with exploratory holes on a closely spaced grid (say trial pits at 30m centres), a geoenvironmental appraisal is typically based on inspection of the ground underlying less than 0.5% of the total site area (and much less at depths in excess of about 3.5m). Consequently, there is always a possibility that unanticipated ground conditions will be encountered during the remedial works.

5.17.2 If unanticipated ground is encountered during the remedial works, the Contractor should immediately seek further advice from the Resident Engineer.

5.18 Supplementary Investigation (Area D)

Area D

5.18.1 A site specific target level of 8.8mg/kg has been calculated for PCBs within the made ground in Area D.

5.18.2 Soil sample results undertaken to-date, do not exceed this site specific target level for PCBs. However, a more rigorous testing regime, on a 20m grid network, is required to analyse for PCBs in made ground.

5.18.3 If concentrations exceed the risk based target level derived from PCBs, appropriate action, detailed in see Section 5.7, should be undertaken.

APPENDIX A
CORRESPONDENCE

RECEIVED - 8 SEP 2005

creating a better place

Environment Agency

John Harrison
Encia Consulting Limited
Encia House
Audby Lane
Wetherby
LS22 7RD

Our ref: CL-2005-110
Your ref: 5848/JWH
Date: 5 September 2005

Dear John

Burton Road, Barnsley

Prepared by Encia Consulting Limited on behalf of Ben Bailey Homes Ltd.

Further to your letter dated 30th August, I have had chance to review your reply to my points from my previous letter with regard for current legislation regarding controlled waters, I am still referring to the previous numbering:

5. The use of the QRA for Area D is satisfactory for use in Area A, given the similar geology and contamination identified.
9. I will review the remediation statement when you submit this to the Agency and provide comment regarding your proposed scheme and the extent of your proposed works.
10. A surface water sample further up stream, than has currently been taken, should provide conclusive evidence as to whether the elevated concentrations that have been identified in the surface water samples are from, on site sources, or, an off site source. The first surface water sample that has been taken from the plan is parallel with the site and not upstream of the site.

I acknowledge points 1, 2, 3, 4, 6, 7, 8, 11 and I am satisfied with your comments.

If you would like to discuss any of the above my contact details are set out below.

Please note that the Local Authority is the principal regulator for human health issues and the planning regime in general. The Environment Agency is able to give advice to the Local Authority on issues relating to Controlled Waters (surface waters and groundwater).

Yours

Jonathan Dalton
Technical Officer, Groundwater & Contaminated Land, Ridings Area
Direct dial 0113 213 4731
E-mail: jonathan.dalton@environment-agency.gov.uk

cc. John Scott, Contaminated Land Officer, Barnsley MBC

Environment Agency
Phoenix House Global Avenue Leeds LS11 8PG
Tel: 08708 506 506

Our ref: 5848/JWH

30th August 2005

Mr Jonathan Dalton
Environment Agency
Phoenix House
Global Avenue
Leeds
LS11 8PG

ENCIA CONSULTING LIMITED

Please reply to:

North West
Stone Cross Place,
Stone Cross Lane North, Lowton
WARRINGTON WA3 2SH
T 01942 824406 F 01942 824030

Yorkshire
Encia House,
Audby Lane,
WETHERBY LS22 7RD
T 01937 589955 F 01937 589944

North East
7 Eggleston Court,
Riverside Park,
MIDDLESBROUGH TS2 1RU
T 01642 809088 F 01642 809066

E info@enciagroup.co.uk W enciagroup.co.uk

Dear Jonathan

Burton Road Barnsley

Thank you for your letter dated 12th August 2005 (ref: CL-2005-110) regarding your comments on the Geoenvironmental Appraisal and Quantitative Risk Assessment.

Further to our recent telephone conversation today, please find below our comments for each of the issues raised in your aforementioned letter.

1. Agreed

2. Site investigation will be undertaken in Area C, once the existing buildings are demolished. This is likely to comprise 5-7 trial pits and relevant lab testing. It is the intention that the trial pits be excavated at the beginning of the remedial works, with the BMBC and EA being informed immediately of the findings. If significant contamination is encountered, this will result in amendment to the remedial strategy.

   Area E is not part of the development.

3. The parts of Area, A which were not accessible during the initial fieldwork, will be subject to further trial pits. If significant contamination is encountered this will, again, result in amendment to the remedial strategy.

4. Agreed, following approval of the SI and QRA, a remedial strategy will be issued to the BMBC and EA for approval.

5. It is the intention that the QRA undertaken in Area D be adopted for Area A, as the environmental setting, ground conditions and contamination are similar.

6. Agreed, the foundations details have not been finalised by the developer, in the meantime we will make them aware of your comment.

7. Agreed, the BMBC and EA will be informed of the results of any supplementary investigation.

8. Agreed

9. The remedial works have been designed to be protective of both human health and controlled waters. This will include excavation/treatment of significantly contaminated material. Any perched water encountered during the earthworks will be intercepted in sumps and treated prior to disposal through tankering or consented sewer discharge.

Following this, the entire site will be capped with 1000mm, which will incorporate a 300mm layer of low permeability clay. The clay layer will reduce infiltration through the made ground therefore preventing the migration of leachate to the stream. Further details of the remediation will be provided in a remedial strategy.

10. Surface water results for the stream show elevated PAH concentrations both upstream and downstream of the site as detailed in the table below. It is considered that the further testing would yield the same results.

Sample Location	SW 1 (upstream)	SW 2 (before SW outfall)	SW 3 (after SW outfall)	SW 4 (downstream)
PAH (ug/l)	335	214	454	291

11. Agreed, this will be detailed in a remedial strategy.

As requested please find enclosed a copy of BMBC letter detailing their acceptance of the Human Health risk assessment.

We trust the above and enclosed satisfies your present requirements, but please contact the undersigned with any queries.

Yours sincerely

John Harrison
Senior Engineer

For and on behalf of
ENCIA CONSULTING LIMITED

BARNSLEY
Metropolitan Borough Council

RECEIVED 25 AUG 2005

Regulatory Services
Assistant Director: Ken Eastwood, BSc (Hons), MCIEH
Central Offices, Kendray Street, Barnsley. S70 2TN.

My Ref: JSC/109479 Your Ref: 5848/JWH Date: 23 August 2005

Enquiries To: Mr J Scott Dial Direct: (01226) 772456 Fax: (01226) 775699
Johnscott@barnsley.gov.uk

Dear Sir

Re: Land off Burton Road, West Green, Barnsley - B/05/0307/BA & B/04/0769/BA

Following the submission of the further supporting information to the Quantitative Risk Assessment (Report No 5848/2), I am pleased to inform you of the acceptance of the findings regarding the risks posed to human health on the site. However, I have concerns regarding the water quality issues that exist on the site, following the Environment Agencies comments regarding the risk assessment. As I highlighted within our meeting regarding the site, I would be looking to the comments made by the Agency regarding any controlled water contamination that may exist on the site.

Within the Environment Agency's comments (ref CL-2005-110), they have stated that they are 'not satisfied with the conclusion reached in the QRA that there is no risk to the controlled waters from the contamination identified' on Area D. They have highlighted several points that require further consideration, and these will have to be addressed to satisfy their concerns.

In previous correspondence, May 04, following the submission of the original investigation to support the outline application, I highlighted several areas of the entire site which had not been investigated to assess contamination levels. These areas included Area C, the buildings within Area A, the Old Playground and a couple of fields/paddocks. I appreciate that access may be an issue on these areas, but further investigations will be required at some point to support any remediation options.

With regards the remediation for the site, there will be the requirement to submit a remediation strategy to highlight the measures that have been proposed. This will have to be agreed with the Council, before the works can begin on the site. Obviously the concerns raised by the Environment Agency regarding controlled water contamination will require consideration before any scheme can be finalised. Until this scheme has been agreed, then I will not be able to advise the planning department that sufficient information has been submitted to satisfy the condition.

Should you wish to discuss this correspondence further, please don't hesitate to contact me.

Mr R Meredith
ENCIA Consulting Ltd
Encia House
Audby lane
Wetherby
LS22 7RD

Yours faithfully

John Scott
Contaminated Land Officer

cc Jonathon Dalton, Environment Agency

RECEIVED 17 AUG 2005

creating a better place

Environment Agency

John Harrison
Encia Consulting Ltd
Encia House
Audby Lane
Wetherby
LS22 7RD

Our ref: CL-2005-110
Your ref: 5848/JWH
Date: 12 August 2005

Dear John

Burton Road, Barnsley

Prepared by Encia on behalf of Ben Bailey Homes Ltd

Thank you for supplying me with the Geoenvironmental appraisal and Quantitative Risk Assessment (Area D). I have reviewed these documents in relation to current legislation regarding controlled waters. Based on the information provided I consider that the Geoenvironmental Appraisal currently does not adequately characterise the ground condition or site sensitivity across the entire site but does characterise certain areas of the site. In relation to the Geoenvironmental Appraisal I would like to give the following comments, many of which you have acknowledged in the Appraisal:

1. I am satisfied with the desk study and the conceptual models produced for each area.
2. Further site investigation is required in areas C and E to characterise these areas and to ensure that controlled waters are protected and remediated where necessary.
   - 2a. The site investigation should provide good overall characterisation as well as targeting any potential areas of contamination in these areas.
   - 2b. I would recommend that site investigation is undertaken following demolition of any structures or buildings in these areas.
3. Are you proposing to further investigate area A once the buildings have been demolished (e.g.: MOT building)? If you are not proposing this can you please provide justification for not doing this.
4. Following further site investigation, risk assessment is required and where necessary a remediation statement and validation report will be required.
5. The Geoenvironmental Appraisal identified significant organic contamination in area A. However, this area has not been considered in the QRA, will a QRA or remediation proposals be produced for this area?
6. If piling foundations are to be used a method statement should be provided to ensure that the foundation will not create a preferential pathway for contaminants. This should be approved by the Planning Authority.
7. On completion of any further site investigation/QRA the details should be forwarded to the Environment Agency for comment in order to protect/remediate controlled waters.

Environment Agency
Phoenix House Global Avenue Leeds LS11 8PG
Tel: 08708 506 506

With regard to the QRA I would like to give the following comments:

8. I am satisfied that Area D has been fully characterised with the additional trial pit and borehole investigation.
9. I am not satisfied with the conclusion reached in the QRA that there is no risk to controlled waters from the contamination identified on site and in relation to this my comments are as follows:

   9a. I agree that the contamination identified in the perched groundwater maybe in isolation of the deeper groundwater due to the confining layer of clay. However, the confining layer of clay will be limiting the potential pathway and will not be preventing potential migration to the stream. This maybe evident from the isolated elevated Chromium result which has been observed in the surface water sample 4 (SW4)

   9b. The groundwater perched in the made ground is considered controlled waters and as such remediation of this material can be required by the Environment Agency.

   9c. It is evident from the reports that made ground in area D is significantly contaminated and is acting as a source to controlled waters and remediation of this material is required as a minimum. Where encountered this may involve treatment of perched groundwater.

   9d. Further consideration and risk assessment of area D is advised to determine clean up criteria. There is need that in line with Contaminated Land Report 11 (CLR11) that Options Appraisal is undertaken.

10. It maybe advisable to obtain a surface water sample up stream of the site to identify whether the identified PAH contamination in the surface water is a result of onsite migration of groundwater or is a result of activities further upstream.
11. Following further risk assessment and remediation it will be necessary to ensure that any remaining contamination in soil or groundwater does not pollute/contaminate controlled waters further during development works.

I am happy to attend site/meet in the future if you feel this will help with progression of this development and should you wish to discuss any of the above my contact details are set out below

Please note that the Local Authority is the principal regulator for human health issues and the planning regime in general. The Environment Agency is able to give advice to the Local Authority on issues relating to Controlled Waters (surface waters and groundwater).

Yours

J. L. Dalton

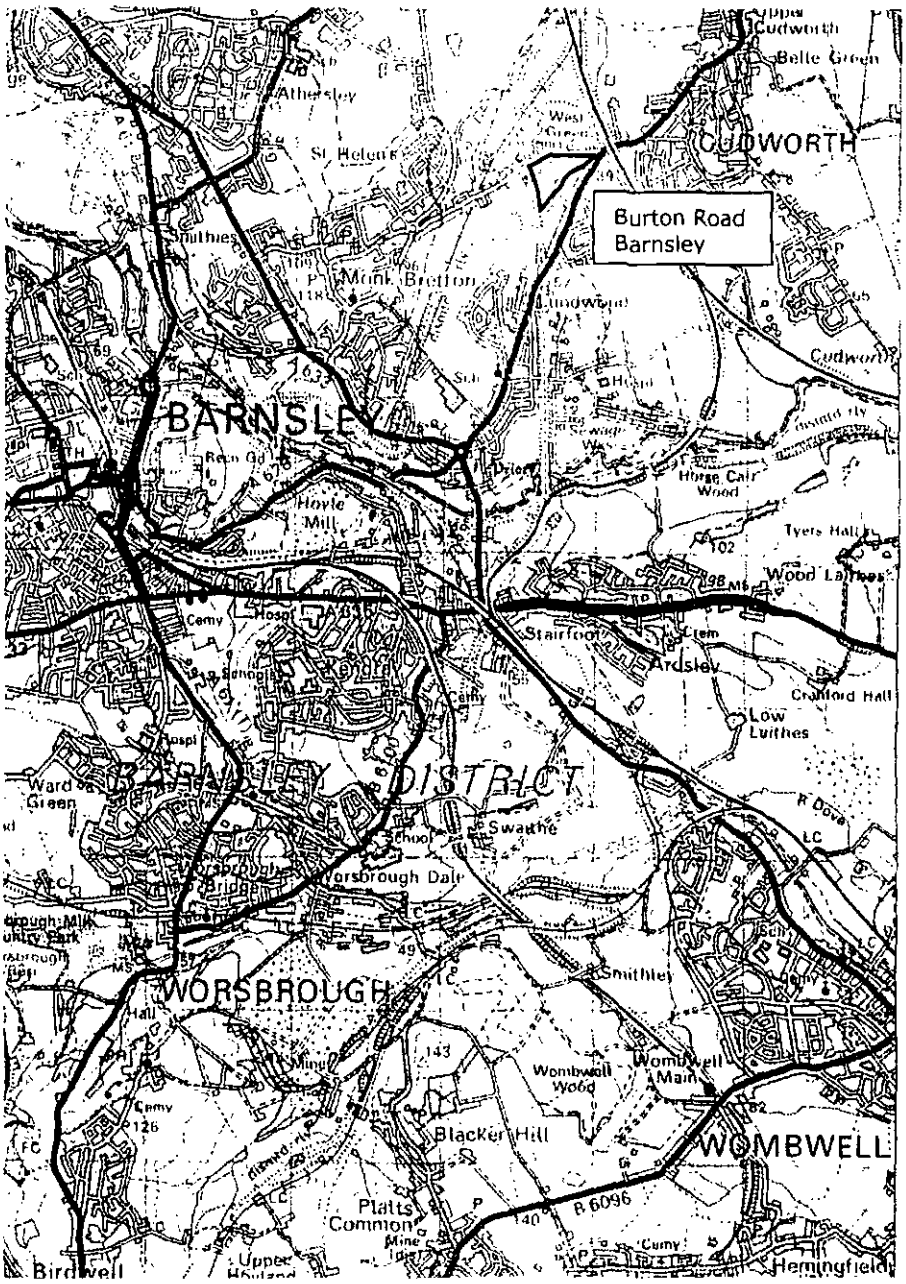
Jonathan Dalton
Technical Officer, Groundwater & Contaminated Land, Ridings Area
Direct dial 0113 213 4731 *Direct fax* 0113 213 4871
E: jonathan.dalton@environment-agency.gov.uk

cc. John Scott, Contaminated Land Officer, Barnsley MBC

Chairman's Office
Environment Agency
Millbank Tower, 25th Floor, 21-24 Millbank, London, SW1P 4XL
Tel: 0207 863 8720 Fax: 0207 863 8722

APPENDIX B
DRAWINGS

ENCIA CONSULTING LTD ENCIA HOUSE AUDBY LANE WETHERBY W.YORSHIRE LS22 7RD TEL: 01937 589955 FAX: 01937 589944



Reproduced from [*OS Landranger 110 map (Sheffield & Huddersfield) 1:50 000 scale*] by permission of Ordnance Survey® on behalf of The Controller of Her Majesty's Stationery Office. © Crown copyright. All rights reserved. Licence number [100011718].

ENCIA CONSULTING LIMITED

CLIENT	**Ben Bailey Homes**
JOB TITLE	**Burton Road, Barnsley**
DRAWING TITLE	**Site Location Plan**

DRAWN BY	SIGNATURE	DATE	STATUS	
JWH		**26/09/05**	**Final**	
APPROVED	SIGNATURE	DATE	SCALE	DRG NO.
RLM		**26/09/05**	**1:50,000**	**5848/1**

APPENDIX C
ENCIA PROTOCOL FOR IMPORTATION & USE OF SOIL COVER

ENCIA
CONSULTING LIMITED

Protocol for Importation & Use of Soil Cover (Capping)

Introduction.

Isolation of made ground in garden and landscaped areas beneath a cover of "clean" subsoil, and topsoil is often recommended on residential developments where made ground is left in-situ. Most notably when the made ground contains some inorganic contaminants at concentrations above guidance threshold values for an end use that includes domestic gardens. A cover solution is not generally appropriate for organic contamination (fuels, solvents etc); removal or treatment will probably be required.

The cover blocks potential linkages between the contaminated fill and future residents. Such a cover is only required in proposed garden and landscaped areas underlain by made ground (i.e. not beneath plots or hardstand).

The thickness of cover is dependant on the nature and degree of contamination (and often the Local Authority whose area the site lies within), but typically between 600mm and 1,000mm is required. However, if the made ground is essentially "clean", but contains materials generally considered undesirable as a near-surface material in garden areas (colliery spoil, construction\demolition rubble etc) then a 300mm thick cover, in accordance with NHBC Standards, Chapter 9.2, should be adequate. If the made ground is essentially "clean" and comprises reworked natural soil, the only cover likely to be required is topsoil.

The **CML initiative**, which came into force on 1st April 2003, requires house builders to submit to NHBC (or other warranty providers) a validation report confirming the thickness and quality (ie contaminant-free) of the soil cover. Validation reports are normally prepared by independent geoenvironmental consultants.

Soil **quality** is best determined by sampling of the **source** at least 6 working days before importation to the development site. Further, on-site (post-placement) quality testing should not usually be necessary.

Soil **thickness** can only be checked after placement, but should be done before turfing, fencing etc. Thickness could be checked via the excavation of an appropriate number of inspection pits (say every 5th garden) or by survey carried out prior to and immediately after the placement of cover material.

Soil cover is usually placed towards the end of the construction phase, usually many weeks after completion of the preparatory\remedial works, and issue of the associated Validation\Completion Report. Consequently, site visits to generate supplementary letter reports are typically required immediately after soil cover is placed in the gardens of each plot, or set of plots.

Failure to submit cover validation reports (a **RED** item) promptly will delay NHBC finalling plots – this will delay the release of mortgage funds and hence legal completion – ie the financial implications are very significant.

Cover material can sometimes be sourced on-site from foundation\drainage excavations in natural in-situ strata. However, it is often necessary to import cover material and where this is necessary, the following protocol is recommended.

ENCIA
CONSULTING LIMITED

Protocol (Testing at Source)

The materials should be inspected by a suitably qualified Geoenvironmental Engineer at source.

Soil material should:

- be clean and free of foreign debris, building waste materials or contaminants;
- not have a stone content of greater than 20% by dry weight and
- have a maximum stone size of 150mm in any one direction.
- not have been sourced from an area within 7m laterally, or 3m vertically, of Japanese Knotweed plants, and not contain any Japanese Knotweed fragments (rhizomes, leaves, stems etc).

The Geoenvironmental Engineer should take representative samples of the subsoil material from the proposed source. The number of samples taken will be dependant on the nature of the source and the quantity of material to be imported. However, as a guide, a **minimum** of 6 samples of each subsoil type should be tested, with a further sample for each 300m^3 where the quantity exceeds 1,800m^3.

A less frequent sampling rate may be appropriate for soils from a greenfield source or where large volumes (say > 5,000m^3) of soil are imported from a single, relatively homogenous source.

Each sample taken should be forwarded to an analytical laboratory for testing in accordance with the following schedule:

pH, total metals (copper, nickel, zinc, chromium, arsenic, mercury, selenium, cadmium, and lead), water soluble boron and water-soluble sulphate.

Additional determinands could be scheduled, although if considered necessary, would probably suggest the material is unlikely to be suitable for use as clean cover in gardens.

The analytical testing should be undertaken on a 3 or 5-day turnaround and the Client\Contractor should be notified of the soil's suitability (or otherwise) immediately after receipt of the results. Chemical assessment (Tier 1) criteria for imported soils are tabulated on page iv.

On receipt of written confirmation from the Geoenvironmental Engineer, the Client should instruct his Contractor to commence importation. It will probably be necessary to stockpile the cover prior to placement in garden\landscaped areas. The Geoenvironmental Engineer should inspect the stockpiled material prior to placement, to confirm that it is the same material as previously tested, or the Contractor should provide the Client with appropriate haulage notes. Further, on-site quality testing should not normally be necessary.

Validation letter reports should be issued by the Geoenvironmental Engineer as each plot, or set of plots, is completed.

Imported **topsoil** should be subject to the above protocol, wherever it is *not* being sourced from an approved supplier. In addition, some analysis in accordance with BS3882 may be appropriate.

ENCIA
CONSULTING LIMITED

Protocol (Testing after Placement)

Clearly, if soil cover is imported and placed before confirmation of its suitability, we cannot guarantee that our validation work will yield the desired results. In which case, it may be necessary to excavate and export the placed soil cover and\or import further "clean" soil.

The materials should be inspected by a suitably qualified Geoenvironmental Engineer via inspection pits excavated through the entire thickness of placed cover material. Pits should be excavated at an interval of approximately one pit per $300m^3$ of soil cover placed. For a standard residential garden comprising a total area of $100m^2$ (front and rear), with a soil cover thickness of 600mm, one pit per 5 plots is required.

Soil material should:

- be clean and free of foreign debris, building waste materials or contaminants;
- not have a stone content of greater than 20% by dry weight and
- have a maximum stone size of 150mm in any one direction.
- *not have been sourced from an area within 7m laterally, or 3m vertically, of Japanese* Knotweed plants, and not contain any Japanese Knotweed fragments (rhizomes, leaves, stems etc).

The Geoenvironmental Engineer should take representative samples of the subsoil material from each pit.

Each sample taken should be forwarded to an analytical laboratory for testing in accordance with the following schedule:

pH, total metals (copper, nickel, zinc, boron, chromium, arsenic, mercury, selenium, cadmium, and lead), and water-soluble sulphate.

Additional determinands could be scheduled, although if considered necessary, would probably suggest the material is unlikely to be suitable for use as clean cover in gardens.

The analytical testing should be undertaken on a 3 or 5-day turnaround and the Client/Contractor should be notified of the soil's suitability (or otherwise) immediately after receipt of the results. Chemical assessment (Tier 1) criteria for imported soils are tabulated on page iv.

Validation letter reports should be issued by the Geoenvironmental Engineer as each plot, or set of plots, is completed.

Placed **topsoil** should be subject to the above protocol, wherever it is *not* being sourced from a reputable supplier able to provide analytical certificates, in accordance with BS3882.

ENCIA
CONSULTING LIMITED

Chemical assessment criteria for imported soils to the above site to create the soil cover system

Contaminant	Source	Tier 1 Assessment Criteria (mg/kg) Resi with gdns	Comments/Notes
pH	CLEA		Initial assessment only
As	CLEA	20	-
Cd	CLEA	1, 2 & 8	pH variable
Cr	CLEA	130	-
Pb	CLEA	450	-
Hg	CLEA	8	-
Ni	CLEA	50	Assessment of human health risk only
Se	CLEA	35	-
B	ICRCL	3	-
Cu	MAFF	80 to 200	pH variable
Zn	MAFF	200 to 300	pH variable
Water soluble sulphate	BRE SD1	1.2	Units are g/l

APPENDIX D
ENCIA SPECIFICATION FOR ENGINEERED FILLS

ENCIA GENERAL SPECIFICATION FOR ENGINEERED FILLS

1 Introduction

1.1 This model specification is intended to be used in connection with the construction of low-rise buildings on engineered fill. The specification is believed to be suitable for most purposes but there may be special conditions existing at some sites which are not treated in this document and which should be taken into account in arriving at a properly engineered fill. It is emphasised that clay fills can be at least as susceptible to settlement or heave due to climatic, vegetation or other effects, as naturally occurring cohesive soils.

1.2 This specification is for contracts which are designed and supervised by Encia Consulting Limited.

1.3 It is assumed that a site investigation will have been performed prior to the works and that the geotechnical properties of relevance to enforcing the specification will have been measured.

1.4 Note should be taken of the requirements of the Construction (Design and Management) Regulations:1994 to the extent that they may be relevant to the works.

1.5 This specification has been prepared by Encia Consulting Ltd based on the suitably modified "Model Specification for Engineered fills to Support Low Rise Structures", written by N A Trenter and J A Charles, Paper 10819, Proceedings of the Institution of Civil Engineers, Geotechnical Engineering, October 1996.

2 Engineered Fill

2.1 Engineered fill is defined as fill which is selected, placed and compacted to an appropriate specification so that it will exhibit the required engineering behaviour.

2.2 Grading limits for the most common types of general fill are presented in the Appendix to this specification. The remaining fill types are specified in the DoT Specification.

2.3 Fill shall be classified as follows:-

- Unsuitable fill
- General fill
- Restricted fill
- Special fill

2.3 Unsuitable Fill:-

2.3.1 Unsuitable fill shall comprise any material so designated by the Engineer and shall include:-

- Cohesive soils having a liquid limit in excess of 90% or Plasticity Index in excess of 65%
- Chalk having a fine fraction (<400μm) in excess of 10% at the borrow pit.
- Any material containing topsoil, wood, peat or lignite.
- Any material containing biodegradables.
- Any material containing scrap metal.
- Frozen or waterlogged substances.
- Material defined as unsuitable by the Engineer because of its type or level of contamination.
- Material which, by virtue of its particle size or shape, cannot be properly and effectively compacted (eg oversize material, gravels which are tabular and some slate wastes).
- Expansive steel slag.

Unsuitable fill shall not be used at any structurally load bearing location or part of the site but may be used under landscaped areas with the agreement of the Engineer.

2.4 General Fill

2.4.1 General fill shall comprise all fill except unsuitable fill, restricted fill and special fill.

2.5 Restricted Fill

2.5.1 Restricted fill shall comprise material which would otherwise be classified as general fill but which contains minerals hostile to the built environment and shall include:-

- Pyritic shales
- Gypsiferous clays
- Burnt colliery discard
- Pulverised fuel ash
- Spent oil shale
- Incinerator waste
- Demolition and construction industry waste, at the discretion of the Engineer.

2.5.2 Such fill shall be precluded from use in designated zones, including locations where groundwater may rise to the level of the underside of the deepest foundation and where its use will be condemned by the appropriate authorities on pollution grounds. Such fill shall not be placed to a depth less than one metre from the underside of the deepest foundation.

2.6 Special Fill

2.6.1 Special fill shall comprise material which would otherwise be classed as general fill but which contains durable well graded natural sand and natural gravel or crushed rock, other than argillaceous rock, or durable clean crushed demolition rubble of similar particle size and free from any contaminants. Such fill may be employed as capping layers beneath structure foundations, beneath roads or as backfill to retaining walls.

3 Type of Compaction Specification

3.1 The fill shall be compacted to either an end product specification or a method specification.

3.2 If the grading of the fill is such as to permit laboratory compaction tests to be conducted on it then an end product specification may be used.

3.3 If laboratory compaction tests cannot be carried out on the fill (because of the large size of particles that it contains) then a method specification shall be employed and site compaction trials shall be carried out to confirm the proposed method.

3.4 Notwithstanding that laboratory compaction tests may be possible on the fill, the Engineer may instruct at his discretion that a method specification shall be employed and that site compaction trials shall be carried out to confirm the proposed method.

4 Selection of End Product Requirements

4.1 If an end product specification is to be used then on the basis of the results of a site investigation which he/she shall have carried out, the Engineer shall provide the Contractor with the following:-

a) The results of the tests shown below for each type of fill on site:-

- Natural moisture content (BS1377: Part2:1990:Section 3)
- Liquid and plastic limits for cohesive soils (BS1377:Part 2:1990:Sections 4 and 5).
- Compaction tests to determine maximum dry density and optimum moisture content at the appropriate compactive effort (2.5 and 4.5kg rammer) (BS1377:Part 4:1990:Section 3).
- Particle density (specific gravity) to assist in evaluating the compaction test (BS1377:Part 2:1990:Section 8).
- Particle size distribution by wet sieving method to give the distribution of particle sizes down to fine sand and the percentage of fines (BS1377:Part 2:1990:Section 9.2).

b) A graph such as that illustrated in Figure 1.
The graph will show the dry density plotted against moisture content for the 2.5kg rammer method compaction tests, the corresponding optimum moisture contents and maximum dry densities and the 0%, 5% and 10% air voids lines. The 4.5kg rammer method compaction test should only be carried out and quoted in addition to the 2.5kg rammer method compaction test for developments having the following buildings:

- buildings with large windows or large open areas.
- mixed single and 2 storey buildings.
- long load bearing walls without regular construction joints.
- buildings with heavily loaded floor areas.
- buildings with heavily loaded column bases because of wide spans.

4.3 By reference to the shaded area illustrated on Figure 1, the required level of compaction will be indicated by selecting appropriate moisture content and dry density values. This level of compaction shall form the basis of the end product compaction specification.

5 Method Specification

5.1 If a method specification is to be used for the compaction of the fill then site trials shall be carried out to confirm the method.

5.2 On the basis of the results of a site investigation which has been carried out, the Engineer shall provide the Contractor with the results of the following tests for each type of fill on site.

- Natural moisture content (BS1377:Part 2:1990:Section 3).
- Liquid and plastic limits for cohesive soils (BS1377:Part 2:1990:Section 4 and 5).
- Particle density (specific gravity) to assist in evaluating compaction results.
- Particle size distribution by wet sieving method to give the distribution of particle sizes down to fine sand and the percentage of fines (BS1377:Part 2:1990:Section 9.2).

5.3 A separate compaction trial shall be carried out for each type of fill to be used on the site.

5.4 Crushed product derived from the screening and crushing of relict foundations, concrete slabs and oversize materials should yield good quality granular Type 6F2 material (125mm to dust) which at the discretion of the Engineer does not require a site trial to confirm the method specification for its compaction and the method given in Table 1 shall be adopted.

6 Compaction Site Trials

6.1 Sufficient of each type of material shall be excavated and screened of deleterious material to lay a 10m x 4m x approximately 0.25m thick trial pad on a previously rolled horizontal area of the site. Any soft spots in the subgrade below the trial pad should be removed and replaced with compacted granular material. A guide to the thickness of layer that may be suitable may be obtained from Table 1 in this specification (Table 1 is an extract from Tables 6/1-4 DoT Specification for Highway Works Series 600 Earthworks).

6.2 The trial shall be conducted using the same compaction plant as is proposed for the main compaction works. A guide to the size and type of plant that may be suitable may be obtained from Table 1 in this specification.

6.3 The bulk density and moisture content of the fill in the trial pad shall be determined by sand replacement test and oven-drying in two locations immediately after placement and spreading by the dozer but before any rolling.

6.4 Bulk density and moisture content determinations shall be carried out at different locations after subsequent passes by the roller to give density and moisture content determinations after 0, 1, 2, 4, 6, 8 and 10 passes of the roller.

Note: This will give a total of 14 no tests for each material.

6.5 Two laboratory determinations of particle density, grading and Atterberg Limits (if applicable), shall be carried out for each type of material.

6.6 The graph of dry density against number of passes shall be drawn and the number of passes required to achieve more than 95% of the maximum dry density in the field trial

and less than 5% air voids at the in-situ moisture content shall be determined (see *Figure 2*).

6.7 As a guide, the number of passes derived in 6.6 above should be equal to or greater than the number derived from Table 1 in this specification. The number of passes derived from the site trial shall form the method specification for site compaction of that type of material at the in-situ moisture content.

6.8 If it is shown that 5% or less air voids cannot be achieved during the site trial, then the site trial shall be repeated with different conditions, ie heavier or different type of roller and/or increased/decreased moisture content and/or thinner layer.

6.9 If it is required to calibrate a Nuclear Density Meter (NDM) then measurements of bulk density and moisture content shall be made using the NDM at locations adjacent to those carried out by sand replacement tests in Section 6.4. The calibration shall then be carried out in accordance with the Encia standard method as detailed in the Encia Staff Handbook, Section 6.

6.10 If the source for the fill material alters, and a new material is therefore proposed for use, then a site trial shall be performed on this material to demonstrate that it can be compacted satisfactorily before this material is used in the works.

7 Preparation of Site

7.1 Drainage grips or trenches shall be excavated, as necessary, uphill of the area to be filled to prevent the area becoming flooded. Drainage shall be effected without causing siltation or erosion and water shall be disposed of in a manner to be agreed by the Engineer.

7.2 The area to be filled, whether an existing excavation or otherwise undisturbed ground, shall be graded to falls, and sump pumping or other suitable dewatering facilities shall be provided as necessary by the Contractor to keep the base of the excavation dry at all times.

7.3 Where the area to be filled comprises an existing excavation, the excavation shall be inspected and subsequently monitored by the Contractor, to ensure that there is no danger of its collapse during the works with consequences for safety, for existing buildings or for other construction adjoining.

7.4 All topsoil shall be stripped and, where required for further use, stockpiled in an area provided by the Contractor and agreed by the Engineer.

7.5 All soft and compressible soils or existing fill shall be removed and run to spoil in dumps provided by the Contractor and agreed by the Engineer. The works shall be accomplished in such a way that there is no undercutting of the sides of existing excavations.

7.6 Existing foundations or ledges of hard rock, roots of trees or former pipelines or services at the base of the area to be filled shall be excavated and replaced with compacted general fill which shall be compacted to the same specification as adopted for subsequent compaction works.

Note: *No tree roots greater than 5mm diameter, no root balls and no masses of fibrous roots shall remain at the base of the excavation.*

7.7 The base of the area to be filled shall be proof rolled with a dead weight roller and all soft materials removed and replaced with compacted fill. Where unsuitable material has been excavated, the underlying natural ground shall be compacted to the same specification as adopted for subsequent compaction works.

8 Disposition of Fill

8.1 Where construction is required upon fill placed over sloping natural ground, and where fill thickness is less than 5m, the natural ground shall be benched, with the maximum vertical height of each bench not exceeding 500mm and providing that the fill depth below any building does not vary by more than 15% (see Figure 3).

8.2 Where, because of the method of working, previously engineered fill placed during the current works has to be benched as in Section 8.1 to allow new fill to be placed adjacent to it, then the benches only require to be 0.5m high by 1.0m wide, even where these occur beneath plots providing that the fill is the same material throughout the plot.

8.3 Where a development contains landscaped areas on which no structures are proposed, the underlying fill shall be selected, placed and compacted in the same way as the engineered fill, unless otherwise directed by the Engineer. Where some relaxation of the specification for fill compaction underlying landscaped areas is permitted, there shall be a transition zone between the fill underlying the landscaped area and the fill underlying the structure (see Figure 4). The dimensions of the transition zone will depend on the degree to which fill compaction was relaxed for the fill in the landscaped area. The location and extent of fill placed to a reduced standard of compaction shall be recorded.

9 Placing and Compacting Fill

9.1 Fill shall be placed and compacted in near-horizontal layers of the thicknesses required to achieve the specified end product or in accordance with the approved method specification, and shall, as far as practicable, be brought up at a uniform rate so that all parts of the site or particular sections of the site reach finished (formation) level at the same time.

9.2 The compaction plant selected, the number of passes made and the fill layer thickness and moisture content used shall have regard either to the specified end product and the means and manner of control testing or the specified method and the means and manner of control testing.

9.3 Where several different types of fill material (all meeting the requirements of Section 2 of this specification) are to be employed, they shall be deposited in such a way that all parts or particular sections of the site receive roughly equal amounts of a given material, in roughly the same sequence, thus ensuring a uniform distribution of fill types over the whole fill thickness.

9.4 The Contractor shall take all necessary steps to ensure that the fill is placed at the moisture content necessary to achieve the specified level of compaction and shall, where necessary, add water to or dry the fill, in order to obtain this value. Where it is necessary to add water, this shall be done as a fine spray and in such a way that there is time for the water to be absorbed into the fill before being rolled by the plant.

9.5 Cobbles, boulders, rock or waste fragments, the largest dimension of which is greater than two-thirds of the compacted layer thickness, shall not be incorporated into the fill.

9.6 No fill shall be placed and left uncompacted at the end of the working day. Compacted fill shall be graded to falls to ensure free run-off of rainwater without ponding.

9.7 Compaction plant and compaction method shall be selected having regard to the proximity of existing trenches, excavations, retaining walls or other structures and all work shall be performed in such a way as to ensure that their existing stability is not impaired.

9.8 If weather conditions are such that the specified moisture content and density values cannot be achieved, the Contractor shall cease work until such time as the fill can be placed and compacted to meet specification requirements.

9.9 If the results of control tests (Section 10) indicate that the fill is being placed and compacted in such a way that the desired level of compaction is not being achieved, the Contractor shall further compact or, if necessary, shall excavate the affected work and replace with new fill, compacted to meet the specification requirements.

9.10 If the results of control tests (Section 10) indicate that antecedent weather conditions (such as frost or heavy rain) have caused deterioration of finished work such that the work no longer meets with the specification, the Contractor shall, at his or her own cost, take such steps as are necessary to bring the fill to specification requirements.

10 Control Testing

10.1 The end product requirements shall be controlled by in-situ and laboratory testing as follows:-

- In-situ-dry density (BS1377:Part 9:1990, Section 2)
- moisture content determinations (BS1377:Part2:1990, Section 3) shall be performed as soon as is practical after placement so as to prevent changes in moisture content that can be caused by the weather being reported as compaction moisture contents.
- Control tests shall be performed by the Engineer throughout the fill at such frequency and at such locations as shall be deemed necessary by the Engineer at no cost to the Contractor.
- The minimum frequency of testing shall be 1 test per 500m^3 of fill placed with a maximum frequency of 1 test per 200m^3 of fill placed. Extra testing will be required in visually doubtful areas or previously failed areas.

10.2 The method specification requirements shall be controlled by in-situ and laboratory testing as follows:-

- moisture content determinations (BS1377:Part2:1990, Section 3).
- The minimum frequency of testing shall be 1 test per 500m^3 of fill placed with a maximum frequency of 1 test per 200m^3 of fill placed. Extra testing will be required in visually doubtful areas or previously failed areas.
- It is expected that a minimum of 3no moisture content determinations shall be performed each working day as soon as is practical after placement so as to prevent changes in moisture content that can be caused by the weather being reported as compaction moisture contents.

- In-situ-dry density (BS1377:Part 9:1990, Section 2).
- These tests shall be performed at a rate of approximately 1 per 2000m^2 every fourth or fifth compacted layer. The tests are required as a confirmation that the methods of compaction being used are producing the desired results.

- Control tests shall be performed by the Engineer throughout the fill at such frequency and at such locations as shall be deemed necessary by the Engineer at no cost to the Contractor.

10.3 The Engineer shall make available a plot of in-situ dry densities against in situ moisture content results on a graph such as illustrated in Figure 1, showing that the results lie within or above the shaded area. Should any results lie outside the shaded area, the Contractor shall agree with the Engineer proposals for rectifying the existing situation and for improving future performance.

10.4 The compacted layer thickness shall be checked by the Engineer using profile boards installed by the Contractor at his own cost or by laser level supplied by the Contractor at his own cost.

10.5 The numbering system to be adopted for Quality Control testing shall be decided by the Engineer at the start of the works. The system adopted shall enable the location of each test to be identified in the works ie plan location and level beneath final formation level. The date of test shall also be included.

eg Plot24/1.2/25May would indicate a test under Plot 24 at a depth of 1.2m below final formation level carried out on 25th May. The testing laboratory shall be informed of the number of each test they perform and shall report that number on the results sheet.

11 Monitoring of Fill Performance

11.1 If instructed by the Engineer, the Contractor shall make arrangements for the performance of the fill, once placed, to be monitored. Monitoring may take one or more of the following forms:-

- Optical levelling of surface monuments
- Standpipes or piezometers
- Load tests
- Other methods as directed by the Engineer

Note: *Monitoring of fill performance shall only be carried out if specifically required by the Client and then only after consultation with the Geotechnical Manager. Properly compacted fill using this specification should not require to meet criteria at the end of the fill operations. The only useful purpose for carrying out such monitoring is to obtain allowable bearing pressures and settlement parameters.*

11.2 The Contractor shall, within twenty one working days of receiving notification of the Engineer's intention to monitor fill performance, arrange for the procurement and supply of the equipment to the Engineer's written specification and shall inform the Engineer of the date on which the equipment installation shall commence. The specification shall include:-

- A full description of the nature and type of instrument and the purpose it fulfils
- The number required and the locations and/or depths at which it is to be installed
- The frequency, accuracy and duration for which any readings are to be taken

APPENDIX E
SUGGESTED PROTOCOL FOR VALIDATION OF GAS PROTECTION MEASURES

ENCIA
CONSULTING LIMITED

Suggested Protocol for Validation of Gas Protection Measures

Introduction

Hazardous gases, most notably radon, methane and carbon dioxide can pose a significant risk to dwellings. Consequently, site investigation reports consider risks associated with such gases and where appropriate recommend a programme of gas monitoring. Typically 50mm diameter wells, installed in boreholes, are monitored over a number of months under a variety of atmospheric conditions that should include periods of falling and low atmospheric pressure. The monitoring period is dependant on the perceived risk (and often the Local Authority whose area the site lies within), but typically between 3 and 12 months.

On completion of the monitoring programme, a gas risk assessment report is issued. This report characterizes the soil\gas regime and provides recommendations with respect to appropriate gas protection measures.

Validation of installed gas measures

Independent quality control of the construction works is recommended (and sometimes stipulated in the relevant planning permission) to ensure that the appropriate level of gas mitigation is provided.

Details of the necessary validation to be provided by suitably qualified Encia Engineer are site-specific and dependant on the actual scope of gas protection measures recommended. However, typically there are two key stages during construction:

1. Creation of the sub-floor void.
2. Placement of the gas resistant membrane.

With respect to the actual flow of information etc between Client and Consultant, the following protocol is recommended.

1. Client's site agent\manager to inform Encia, by fax, of need for an inspection. The fax should state:
   - which plot(s) require inspection,
   - for which stage of construction (sub-floor void, membrane etc), and
   - when the visit is required (ideally 2 working days' notice is required).
2. The Consultant should confirm by fax (to site & copied to office) that he has visited site and undertaken all necessary validation, within 1 working day of his visit. The fax should state:
   - when the visit was undertaken,
   - which plot(s) were inspected,
   - for which stage(s) of construction, and
   - confirm that the details inspected were satisfactory.

   If any details were not satisfactory, the Consultant should inform the Client's agent of the necessary remedial measures on site and then detail these in writing on his subsequent fax (clearly an additional visit will be necessary to inspect the remedial works).

The above protocol is considered important to ensure *all* plots are inspected at *all* relevant stages of construction, in order that Encia can issue a robust Validation Report.

ENCIA
CONSULTING LIMITED

Validation of Gas Protection Measures

Plot No.	Inspection dates	Inspected by	Hgt of void space > 200mm	Sleeper walls[1]	Air bricks[2]	DPC[3]	Membrane[4]	Membrane penetrations[5]	Remarks

Notes:

1 – Checked for ventilation allowance ie honeycombed, or with min. 100mm dia. pipes in line with external air vents.

2 – Checked for mm^2 ventilation, obstructions, spacing, alignment, connection to telescopic vents (if required).

3 – Checked for material; integrity; unnecessary creasing.

4 – Checked for material; unnecessary creases; underlying floor slab clear of debris that could cause puncture; damage; overlap & seal with DPC (min. 150mm), using correct double-sided tape; curled edges stuck down.

5 - Checked for top hat suitably sealed, with a sufficient length of pipe to allow fitting of connection collar.