HPK/2011/0378



Daineswell
remediation is a fine art

# PHASE I PRELIMINARY RISK ASSESSMENT OF LAND AT WEST DRIVE, TINTWISTLE

## ISSUE 1.0

Prepared by Daineswell Ltd in association with Tier Environmental Ltd

C2315

T/11/1000/PRA

JULY 2011

James Blyth

| Prepared for: | By: | In association with: |
|---|---|---|
| MR Ian Nicholson | Daineswell | Tier Environmental |
| | Daineswell House, | Elm House Farm, |
| | Worsley, | Saighton, |
| | Manchester, | Chester, |
| | M28 7UY | CH3 6EN |

Tier Consult

PHASE I PRELIMINARY RISK ASSESSMENT OF LAND AT WEST DRIVE, TINTWISTLE

## CONTENTS

Tier Consult

**PHASE I PRELIMINARY RISK ASSESSMENT OF LAND AT WEST DRIVE, TINTWISTLE**

## TABLES




## APPENDICES

Tier Consult

**PHASE I PRELIMINARY RISK ASSESSMENT OF LAND AT WEST DRIVE, TINTWISTLE**

## EXECUTIVE SUMMARY

| | |
|---|---|
| Introduction | Daineswell ltd* was commissioned by Mr Ian Nicholson to prepare a Phase I Desktop Site Investigation report (geoenvironmental appraisal - preliminary risk assessment) of land at West Drive, Tintwistle. The purpose of the investigation was undertake a preliminary tree survey and to identify previous on site and off site land uses, so as to characterise the risk to current Site users and other receptors within the vicinity and propose any Phase II Site Investigation that would be necessary for redeveloping the land for the Tintwistle Sports and Community Building. |
| Site location | To the south of West Drive, adjacent to the Tintwistle football pitch (the "Site"). A site location plan is included as Drawing No. T/11/1000/PRA/1 within Appendix A. |
| Site history | The Site has been used for a village tip and there has been no other recorded significant development of the Site. |
| Ground conditions | The published geology suggests that the Site is underlain by Glacial Till and the Kinderscout Grit Formation at depth (Primary Aquifer). Made Ground is anticipated due to anecdotal evidence that the past use of the Site was a village tip, which is backed up by 2 No. trial hole photos which have been provided by the client. |
| Ground stability | No ground stability issues have been recorded, other than a significant depth of variable Made Ground soils. |
| Contamination | There has been no significant structural development of the Site; however, it has been used for agricultural fields and then a village tip (although the period of time during tipping is unknown. Consequently, metals, sulphates, PAHs, petroleum hydrocarbons and asbestos fibres may be present in soils and may affect both human health and controlled waters. |
| Gas protection | The Site is understood to be underlain by Made Ground and there are areas of potential infilled ground within 250m of the Site and, as such, a hazardous gas risk assessment is required. A site specific radon report is recommended. |
| Tree Survey | A number of trees have been identified during the survey. Initial conversations with High Peak Borough Council Aboricultural Officer suggests that a TPO lies within the vicinity of the site and, as such, a TPO search is recommended. |
| Further works | A hazardous gas risk assessment and Phase II geoenvironmental assessment of the Site is recommended. |

* Tier Environmental Ltd carries out data research on behalf of Daineswell Ltd. Interpretation of the data, recommendations for further investigatory work and any costings are prepared by Daineswell Ltd

**PHASE I PRELIMINARY RISK ASSESSMENT OF LAND AT WEST DRIVE, TINTWISTLE**

# 1. INTRODUCTION

Daineswell Ltd was commissioned by Mr Ian Nicholson to undertake a Phase I Preliminary Risk Assessment of Land at West Drive, located to the south of the Tintwistle football pitch, Tintwistle, Derbyshire (the "Site"). At present, it is proposed that the Site is redeveloped as a sports facility and car park, associated with the adjacent football pitch.

The objectives of this appraisal were:

- To determine the land use history from review of available historical documentation and maps.
- Undertake a site walkover and preliminary tree survey.
- To establish the environmental setting of the Site.
- To determine soil and groundwater conditions from the published geology, including whether significant contamination could have resulted from past or current land use(s).
- To determine the potential risks posed by any ground contamination and provide recommendations on remedial measures to manage such risks.
- To determine risks posed to the Site from hazardous ground gases.
- To evaluate whether past mining or other extractive industries could have an influence on the Site.

The desk-study part of this investigation included the assessment of information provided by GroundSure Ltd. The information provided by this organisation is provided in Appendix C.

This report, which was designed to meet the requirements of all relevant current guidance including the CLR series of reports, presents the factual information available during this appraisal, interpretation of the data obtained and recommendations relevant to the defined objectives.

Tier Consult

**PHASE I PRELIMINARY RISK ASSESSMENT OF LAND AT WEST DRIVE, TINTWISTLE**

It has been assumed in the production of this report that the Site is to redeveloped as the Tintwistle Sports and Community Building. In addition, it is assumed that ground levels will not change significantly and as described in this report. If this is not the case, then amendments to the recommendations made in this report may be required.

DAINESWELL is the trading name of Daineswell Ltd. This report is confidential to the client, and DAINESWELL accepts no responsibility to third parties to whom the report, or any part thereof, becomes known. Any such party using any information contained within the report does so at their own risk. The report should be used only for the purpose intended, and must not be used in any contract without the express permission of DAINESWELL. This report has been prepared by Tier Environmental Ltd with an overview and quality check by DAINESWELL, and prepared with reasonable skill, care and diligence. DAINESWELL disclaims any responsibility to the client and others in respect of any matters outside the scope of the report.

The report should be read in its entirety. Any apparent conflict in the information or absence of information against the stated scope should be brought to the attention of DAINESWELL. No liability will be accepted for misinterpretation based on apparent conflicts or silence. The report remains the property of DAINESWELL until the full amount of the agreed fee for its preparation has been paid to DAINESWELL Ltd.

## 2. SITE DETAILS AND DESCRIPTION

Table 2.1 Current Site Overview.

| | |
|---|---|
| Site name | Land at West Drive |
| Site address | Tintwistle Football Pitch, Tintwistle, Derbyshire, (the "Site"). A site location plan is included as Drawing No. T/11/1000/PRA/1 within Appendix A. |
| Grid Reference | 401538, 396880 |
| Location description | The Site is currently scrub land, with a small path transecting from east to west, with playing fields to the north, east and west and scrub land to the south. Access to the Site is to the north, from West Drive. West Drive runs parallel to the northern boundary of the adjacent football pitch. |
| Approximate Site area | 1000m$^2$ |
| Site shape | The Site is broadly rectangular in shape |
| General topography and ground levels | The Site slopes relatively steeply to the south east. |
| Current land use | The Site is currently scrub land |
| Existing structures | NR |
| Sub-surface structures | Although no services are known, unrecorded services should be anticipated. |
| Invasive plant species | NR |

The main Site features are shown on Drawing No. T/11/1000/GA/2 within Appendix A. Relevant Site photographs are presented in Appendix E.

# 3. ENVIRONMENTAL SETTING

## 3.1. Site History

Extracts of Ordnance Survey (OS) plans dated from 1872 to 2011 were reviewed. These were obtained as part of the GroundSure report for the Site, which is presented in Appendix C.

Table 3.1 presents a summary of the main aspects of the Site from 1872, relevant to the current land uses. It is not the intention of this report to describe in detail all of the changes that have occurred on or adjacent to the Site, where these are not relevant to the land use.

**Table 3.1** Site History.

| Source (Map edition, scale) | On-Site features | Off-Site features |
|---|---|---|
| 1872, 1:2,500 | • The Site appears to be open agricultural ground. | • A small quarry is located 350m east of the Site. |
| 1879, 1:2,500 | • No significant changes. | • A gasometer is located 320m southeast of the Site; however, the Site is across the River Etherow and topographically higher than the gasometer and not considered to be at risk. |
| 1880, 1:2,500 | • Site not shown. | • North of site not shown.<br>• No significant changes to the south. |

Tier Consult

**PHASE I PRELIMINARY RISK ASSESSMENT OF LAND AT WEST DRIVE, TINTWISTLE**

| | | |
|---|---|---|
| 1897, 1:10,560 | • No significant changes. | • Bridge Mill is located 320m east of the Site.<br>• A railway is located 230m east of the Site. |
| 1898, 1:2,500 | • No significant changes. | • A small cutting is shown 210m south of the Site |
| 1899, 1:10,560 | • No significant changes. | • No significant changes. |
| 1907, 1:10,560 | • No significant changes. | • Filter Beds are shown 160m north of the Site. |
| 1910, 1:2,500 | • No significant changes. | • No significant changes. |
| 1911, 1:10,560 | • No significant changes. | • No significant changes. |
| 1919, 1:10,560 | • No significant changes. | • A mill pond is shown 290m east of the Site. |
| 1924, 1:10,560 | • No significant changes. | • No significant changes. |
| 1938, 1:10,560 | • No significant changes. | • Filter Beds are shown 240m south of the Site. |
| 1948, 1:10,560 | • No significant changes. | • No significant changes. |
| 1951, 1:10,560 | • No significant changes. | • No significant changes. |
| 1971, 1:2,500 | • No significant changes. | • A sewage works is shown 180m east of the Site. |
| 1975, 1:1,250 | • No significant changes. | • The football pitch is not located adjacent to the north of the Site. |

| | | |
|---|---|---|
| 1980, 1:10,000 | • No significant changes. | • No significant changes. |
| 1992, 1:1,250 and 1:2,500 | • No significant changes. | • No significant changes. |
| 2002, 1:10,000 | • No significant changes. | • A car park is shown to the western boundary. |
| 2011, 1:10,000 and 1:1,250 | • No significant changes. | • No significant changes. |

## 3.2. Geology

Table 3.2 Geological Summary.

| | |
|---|---|
| **Made Ground** | Anecdotal evidence from the client suggests that this site has previously been used as the village tip. 2. No trial holes have been excavated, photos of which are presented in Appendix E of this report. These photos appear to present demolition type rubble material, as opposed to household waste type material. Made Ground is therefore anticipated. |
| **Drift geology** | Glacial Till |
| **Solid geology** | Kinderscout Grit Formation |
| **Dip of solid strata** | NR |
| **Faults** | None recorded on or in the immediate vicinity of the Site |
| **Coal seams** | None shown to outcrop or subcrop on or in the immediate vicinity of the Site |

## 3.3. Mining and Quarrying

Table 3.3 Coal Mining Activities.

| | Yes/No | Comments |
|---|---|---|
| Is the Site in an area of potential shallow coal workings? | No | The Site is not listed on the Coal Authority Gazetteer as being at risk from shallow mineworkings. |
| Are there any known shafts, adits, tips, lagoons, or opencast workings likely to affect the Site? | No | |
| Is exploratory work required to investigate the potential risk from shallow mining or quarrying? | No | |

Table 3.4 Other Extractive Industries.

| | Yes/No | Comments |
|---|---|---|
| **Superficial drift deposits** | | |
| Evidence of extraction on or within 250 m of the Site? | No | |
| Action required? | No | |
| **Solid Strata** | | |
| Any evidence of mineral extraction on or within 250 m of the Site? | No | |
| Action required? | No | |

Other, undocumented mineral workings on or close to the Site cannot be completely dismissed.

## 3.4. Hydrogeology

Table 3.5 Groundwater Occurrence and Abstraction.

| | Presence/location | Comments |
|---|---|---|
| Depth(s) | Principal Aquifer | Kinderscout Grit Formation at shallow depth |
| Licensed abstractions | 491m southeast of the Site | Associated with general cooling or process water at a site in Hadfield. |
| Private wells | NR | |
| Source Protection Zones | NR | |
| Springs | NR | |

NR - none recorded.

For definition of Source Protection Zones, see Appendix G.

## 3.5. Hydrology

**Table 3.6** Surface Water Features.

| | Presence/location | Comments |
|---|---|---|
| Environment Agency GQA classified watercourses | 79m south of the Site | The River Etherow (GQA Biological and Chemical Assessment B) |
| Unclassified watercourse(s) | 10m south of the Site | The record relates to Carrington Moss Brook which is culverted. |
| Licensed abstractions | 450m northwest of the Site | Associated with the Arnfield Reservoir, not considered to be at risk from the Site. |
| Canals, ponds, lakes, etc. | NR | |
| Flood risk status | The Site is not within a Zone II or III floodplain. | |

NR - none recorded

Environment Agency GQA assessments: A = very good to E = poor

## 3.6. Ecological Features

Table 3.7 Ecological Features.

| | Presence/location | Comments |
|---|---|---|
| Designated locations | NR | |
| Other sensitive locations | 268m northwest of the Site. | The North Peak Environmentally Sensitive Area is located to the northwest; however, this is topographically higher than the Site and at considerable distance and, as such, is not thought to be at risk. |
| Land use controls | NR | |
| Invasive plants | NR | |
| Trees and shrubs | NR | |

NR - none recorded

## 3.7. Landfill and Waste Management Activity

Table 3.8 Waste Management Activities.

| | Presence/location | Comments |
|---|---|---|
| Local authority recorded landfills | NR | |
| BGS recorded landfills | • 83m south of the Site<br>• 208m east of the Site | • Woolley Bridge Road, Hadfield, Glossop, Derbyshire - Inert landfill site (closed)<br>• Bridge Mill, Derbyshire - Inert landfill site (closed) |
| Other licensed waste management facilities within 250 m | NR | |
| Is there evidence of other landfilling on or within 250 m of Site? | On site | Anecdotal evidence from the client suggests that this site has previously been used as the village tip. 2. No trial holes have been excavated, photos of which are presented in Appendix E of this report. These photos appear to present demolition type rubble material, as opposed to household waste type material. |
| Walkover evidence of fly-tipping on Site? | NR | |
| Is a landfill/ground gas risk assessment required? | Yes | The presence of a historic village tip at the Site suggests that there is a risk of hazardous soil gas generation. |

NR - none recorded

## 3.8. Local Potentially Contaminative Activities

Other potentially contaminative activities are shown in Table 3.. The entries relate to activities within *circa* 250 m of the Site, with the exception of COMAH facilities where the assessment is extended to a distance of *circa* 1 km from the Site.

**Table 3.9** Other Potentially Contaminative Processes in the Locality.

| | Location | Comments |
|---|---|---|
| **Discharge Consents** | 16 No. discharge consents are within 500m of the Site. | These are all discharging onto the River Etherow and are not considered to pose a risk to the Site. |
| **Prosecutions relating to controlled waters** | NR | |
| **Substantiated pollution incidents** | NR | |
| **IPPC permits/air pollution controls** | NR | |
| **Registered radioactive substances** | NR | |
| **Prosecutions relating to authorised processes** | NR | |
| **Enforcement and prohibition notices** | NR | |
| **Planning - hazardous substances consents and enforcements** | NR | |

| | | |
|---|---|---|
| COMAH sites | NR | |
| NIHHS sites | NR | |
| Fuel station entries | NR | |
| Pertinent contemporary trade directory entries | 6 No. are located within 250m of the Site. | These are not considered to pose a risk to the Site. |

NR - none recorded

COMAH - Control of Major Accident Hazards (regulations); NIHHS - Notification of Installations Handling Hazardous Substances (regulations)

## 3.9. Radon Risk

**Table 3.10** Radon Risk Status.

| | Radon protection measures required? (Yes/No) | Comments |
|---|---|---|
| **BRE (1999), Report 211** | Yes | The Site is within an area in which 1-3% of homes are above the action level. Basic Radon Protection Measures may be required. |
| **BGS Site-specific report** | Not Requested | |

## 3.10. Summary

The following points are considered pertinent when assessing the environmental setting of the Site:

- The published geology suggests that the Site is underlain by Glacial Till and the Kinderscout Grit Formation which is a Principal Aquifer; however, 2 No. trial pit photos provided by the client show the presence of Made Ground and that Glacial Till is limited.
- There has been no significant development of the Site, which has been used for agricultural fields or playing fields since the earliest mapping; however, anecdotal evidence suggests that the Site has been used as the village tip. Photographs of the Made Ground suggests that it is general demolition waste type material and not household waste.
- There are no significant potentially contaminative land uses within the vicinity of the Site.
- The Site walkover has not revealed any other potential sources of contamination.



# 4. PRELIMINARY CONCEPTUAL MODEL

Based on the desk study, a combined preliminary conceptual site model and conceptual exposure model has been developed for the current land use. This summarises the understanding of surface and sub-surface features, the potential contaminant sources, transport pathways and receptors. In assessing the likely contaminants present at the Site, reference has also been made to CLR 8 (Defra and Environment Agency, 2002b) and supporting documentation. A preliminary qualitative risk assessment has also been made of the likelihood of the linkage operating and its potential significance.

The potential pollutant linkages identified and the qualitative risk assessment for these are presented in Table 4.1. The terms used in the preliminary qualitative risk assessment are defined in Appendix G.

## 4.1. Justification

The following factors are considered pertinent in defining the conceptual model.

- The published geology suggests that the Site is underlain by Glacial Till and the Kinderscout Grit Formation which is a Principal Aquifer; however, 2 No. trial pit photos provided by the client show the presence of Made Ground and that Glacial Till is limited.
- There has been no significant development of the Site, which has been used for agricultural fields or playing fields since the earliest mapping; however, anecdotal evidence suggests that the Site has been used as the village tip. Photographs of the Made Ground suggest that it is general demolition waste type material and not household waste.
- There are no significant potentially contaminative land uses within the vicinity of the Site.
- The Site walkover has not revealed any other potential sources of contamination.

## Potential Sources

- Potential Metal, Sulphate, PAH, petroleum hydrocarbon and asbestos contamination within Made Ground soils on Site;
- Hazardous soil gas generation from on site Made Ground and off Site sources;
- Leachable metal, sulphate, PAH and petroleum hydrocarbon concentrations from potential contamination within Made Ground soils on Site;

## Potential Pathways

- Dermal contact, ingestion and inhalation of contaminants on site;
- Vertical and horizontal migration of contaminants through the Made Ground and granular natural soils;
- Migration of hazardous soil gases and vapours through soil pore spaces;
- Migration of mobile contaminants via services and man made conduits;

## Potential Receptors

- Future, current and adjacent users of the Site;
- Buildings, hardstanding and services;
- Site investigation staff and future underground service maintenance workers, from hazardous short term exposure;
- Primary Aquifer at depth;
- The River Etherow

## Uncertainties

The following uncertainties exist in the preliminary conceptual model.

- The presence of any features unrecorded services by the historical maps.
- Any unrecorded geological features.
- Any unreported pollution events during the Sites history.

**Table 4.1.** Preliminary Assessment of Potential Pollutant Linkages.

| Pollutant linkage | | | | Qualitative risk assessment |
|---|---|---|---|---|
| | Source | Pathway(s) | Receptor(s) | |
| 1 | Metal, sulphate, TPH, PAH and asbestos contamination within Made Ground soils. | Dermal contact, ingestion and inhalation of contaminants on Site. | Future, current and adjacent users of the Site. | High |
| | | | Site investigation, demolition, construction and future maintenance staff. | High |
| | | | Buildings and services. | Moderate |
| 2 | Metal, sulphate, PAH and petroleum hydrocarbon contamination within Made Ground soils. | Leaching and migration of mobile contaminants through the granular Made Ground and natural soils. | Future, current and adjacent users of the Site. | Low |
| | | | Buildings and services. | Low |
| | | Horizontal migration along services and manmade conduits. | Controlled Waters | Moderate |
| 3 | Hazardous soil and gas generation from off and on site sources. | Migration and accumulation into buildings via soil pore spaces. | Future, current and adjacent users of the Site. | High |
| | | | Buildings and services. | High |

For definition of the terms used in the qualitative risk assessment, please see Appendix F.

## 5. PRELIMINARY TREE SURVEY

Tier Environmental have been supplied with a measured plan of the Site with all tree positions already plotted. Where applicable, additional trees were plotted according to measurements taken on site.

This survey was designed to accompany a planning application for current development proposals at the Site. The report is based upon a visual inspection. The consultant will not be responsible for events that happen after the date of the report due to factors that were not apparent at the time.

This report should not be seen as a substitute for a full tree risk assessment or management plan which is specifically designed to minimise risk and liability associate with responsibility for trees. The survey was carried out on the 1st July 2011. Weather conditions during the Site visit were fine with good visibility.

There do not appear to be any trees with high amenity value due to their size and prominence in the local landscape. The Site itself has become overgrown with scrub, shrubs and a number of trees; however, the majority are considered to be insignificant specimens, largely hidden from public view and their removal would have a negligible impact on local amenity. Initial conversations with the High Peak Borough Council Aboricultural Officer suggest that a TPO lies within the vicinity of the site and, as such, a TPO search is recommended.

In total, 25 No. trees were surveyed; however, much of the plant life at the Site was scrub and, as such, could not be surveyed with any accuracy. This survey has been designed to provide a guide to the Site owner as to the location and speciation of their existing tree stock, and should be regarded as such. The results of the survey are presented in Table 5.1 below and locations are presented in Drawing No. T/11/1000/PRA/2 within Appendix A of this report. The majority of trees for removal have been classified as low retention value and should not be seen as a constraint to development and there loss is considered to be mitigated by the presence of neighbouring trees that are to be retained as part of proposals.

**Table 5.1 Survey Results**

| Tree Reference | Species | Age | Height (m) | Crown Width (m) | Notes | Amenity Value / Retention Category |
|---|---|---|---|---|---|---|
| T1 | Goat Willow | Semi Mature | 7 | 5.5 | | Low |
| T2 | Oak | Semi Mature | 4 | 3 | Evidence of powdery mildew on leaves | Low |
| T3 | Birch | Semi Mature | 8.5 | 4 | | Low |
| T4 | Oak | Semi Mature | 3 | 5 | Evidence of powdery mildew on leaves | Low |
| T5 | Birch | Semi Mature | 9 | 5 | | Low |
| T6 | Hawthorn | Semi Mature | 5 | 7 | | Low |
| T7 | Oak | Semi Mature | 6 | 4 | Evidence of powdery mildew on leaves | Low |
| T8 | Oak | Semi Mature | 7 | 5 | Evidence of powdery mildew on leaves | Low |
| T9 | Oak | Semi Mature | 9 | 5 | Evidence of powdery mildew on leaves | Low |
| T10 | Oak | Semi Mature | 6 | 3.5 | Evidence of powdery mildew on leaves | Low |
| T11 | Oak | Semi Mature | 7 | 7 | Evidence of powdery mildew on leaves | Low |
| T12 | Birch | Early Mature | 11 | 4 | | Low |
| T13 | Birch | Early Mature | 13 | 4 | | Low |
| T14 | Hawthorn | Semi Mature | 8 | 4.5 | | Low |
| T15 | Birch | Early Mature | 11.5 | 5.5 | | Low |

| | | | | | | |
|---|---|---|---|---|---|---|
| T16 | Oak | Semi Mature | 9 | 4.5 | Evidence of powdery mildew on leaves | Low |
| T17 | Oak | Semi Mature | 8 | 7 | Evidence of powdery mildew on leaves | Low |
| T18 | Hawthorn | Semi Mature | 2 | 5.5 | | Low |
| T19 | Hawthorn | Semi Mature | 3 | 6 | | Low |
| T20 | Birch | Early Mature | 13 | 5 | | Low |
| T21 | Oak | Semi Mature | 9 | 6 | Evidence of powdery mildew on leaves | Low |
| T22 | Oak | Semi Mature | 6 | 11 | Evidence of powdery mildew on leaves | Low |
| T23 | Birch | Early Mature | 8 | 13.5 | | Low |
| T24 | Goat Willow | Early Mature | 9 | 7 | | Low |
| T25 | Goat Willow | Early Mature | 8 | 10 | | Low |

## 6. CONCLUSIONS, RECOMMENDATIONS AND REGULATORY APPROVALS

It is considered that the Made Ground soils at the Site pose a risk to receptors and, as such, a Phase II Geoenvironmental Appraisal should be undertaken at the Site. In addition, a Phase II site investigation should also include a geotechnical assessment of the site, due to possible significant depths of Made Ground soils which are unlikely to be suitable for founding. Initial conversations with High Peak Borough Council Aboricultural Officer suggests that a TPO lies within the vicinity of the site and, as such, a TPO search is recommended.

The conclusions and recommendations presented above are considered reasonable based on the findings of the Site investigation. However, these cannot be guaranteed to gain regulatory approval and, therefore, the report should be passed to the appropriate regulatory authorities and/or other organisations for their comment and approval prior to undertaking any works on site.

It is recommended that conditions placed on any planning permission are discharged prior to commencement of site works.




## 7. REFERENCES

BRE (1999). Radon: Guidance on Protective Measures for New Dwellings. IHS BRE Press, Bracknell.

BRE (2005). Concrete in Aggressive Ground. Special Digest 1 (revised edition). IHS BRE Press, Bracknell.

BS 10175:2001 Investigation of Potentially Contaminated Sites - Code of Practice. British Standards Institution, London.

BS EN 1997-1:2004 Eurocode 7. Geotechnical Design. General Rules. British Standards Institution, London.

BS EN 1997-2:2007 Eurocode 7. Geotechnical Design. Ground Investigation and Testing. British Standards Institution, London.

BS EN ISO 14688-1:2002 Geotechnical Investigation and Testing. Identification and Classification of Soil. Identification and Description. British Standards Institution, London.

BS EN ISO 14688-2:2004 Geotechnical Investigation and Testing. Identification and Classification of Soil. Principles for a Classification. British Standards Institution, London.

BS EN ISO 14689-1:2003 Geotechnical Investigation and Testing. Identification and Classification of Rock. Identification and Description. British Standards Institution, London.

CIRIA (1983) Trenching Practice. Report 097, 2nd edition, CIRIA, London.

CIRIA (1995a) Protecting Development from Methane. Report 149, CIRIA, London.

CIRIA (1995b) Methane Investigation Strategies. Report 150, CIRIA, London.

CIRIA (1995c) Interpreting Measurement of Gas in the Ground Report 151, CIRIA, London.

CIRIA (1995d) Risk Assessment for Methane and Other Gases from the Ground. Report 152, CIRIA, London.

CIRIA (1996) A Guide for Safe Working on Contaminated Sites. Report 132, CIRIA, London.

CIRIA (2006) Assessing Risks Posed by Hazardous Ground Gases to Buildings. Report 659, CIRIA, London.

DEFRA and Environment Agency (2002a) Assessment of Risks to Human Health from Land Contamination: An Overview of the Development of Soil Guideline Values and Related Research. R&D Report CLR7, Environment Agency, Bristol.

DEFRA and Environment Agency (2002b) Potential Contaminants for the Assessment of Land. Report CLR8, Environment Agency, Bristol.

DEFRA and Environment Agency (2002c) Contaminants in Soil: Collation of Toxicological Data and Intake Values for Humans. Report CLR9, Environment Agency, Bristol.

DEFRA and Environment Agency (2002d) The contaminated land exposure assessment (CLEA) model: technical basis and algorithms. Report CLR10, Environment Agency, Bristol.

DEFRA and Environment Agency (2002e) Model Procedures for the Management of Land Contamination. Report CLR11, Environment Agency, Bristol.

Environment Agency (2000) Technical Aspects of Site Investigation. Report P5-065/TR, Environment Agency, Bristol.

Environment Agency (2002) Guidance on Monitoring Landfill Leachate, Groundwater and Surface Water. Report LFTGN02, Environment Agency, Bristol.

Environment Agency (2007) Evaluation of Models for Predicting Plant Uptake of Chemicals from Soil. Report SC050021/SR, Environment Agency, Bristol.

Gibbons, R. (1994) Statistical Methods for Groundwater Monitoring. Wiley, New York.

Highways Agency (2006) Design of Pavement Foundations. Document HD 25/IAN 73/06.

HSE (1991) Protection of Workers and the General Public During the Development of Contaminated Land. HMSO, London.

HSE (2005) Occupational Exposure Limits. HSE report EH40/2005, HMSO, London.

ICRCL (1986) Notes on the Fire Hazards of Contaminated Land. Guidance Note 61/84, 2nd Edition, Interdepartmental Committee on the Redevelopment of Contaminated Land, London.

LQM Ltd (2007) Generic Assessment Criteria for Human Health Risk Assessment. Land Quality Press, Nottingham.

NHBC (2007) Guidance on Evaluation of Development Proposals on Sites Where Methane and Carbon Dioxide are Present. Report edition no.: 04, NHBC, Amersham.

NRA (1994) Protocol for a Leaching Test to Assess the Leaching Potential for Soils from Contaminated Sites. R&D Note 181.

WHO (2000) Air Quality Guidelines for Europe. 2nd edition, WHO Regional Office for Europe, Copenhagen.

Wilson, S.A. and Card, G.B. (1999) Reliability and Risk in Gas Protection Design. Ground Engineering, Feb. 1999, 32-36.