VOLUME 5 **CONTRACT DOCUMENTS FOR SPECIALIST ACTIVITIES**

SECTION 3 **GROUND INVESTIGATION**

PART 2

SA 9/97

GROUND INVESTIGATION PROCEDURE

SUMMARY

This Advice Note complements SD 13/97, Documentation Requirements for Ground Investigation Contracts. It gives guidance on the planning and execution of ground investigations for trunk roads and motorways and gives advice on documentation.

INSTRUCTIONS FOR USE

This is a new document to be inserted into the manual.

1. Insert SA 9/97 into Volume 5, Section 3.

2. Archive this sheet as appropriate.

Note: A quarterly index with a full set of Volume Contents Pages is available separately from the Stationery Office Ltd.

THE HIGHWAYS AGENCY

THE SCOTTISH OFFICE DEVELOPMENT DEPARTMENT

THE WELSH OFFICE
Y SWYDDFA GYMREIG

THE DEPARTMENT OF THE ENVIRONMENT FOR NORTHERN IRELAND

Ground Investigation Procedure Part 2: Advice Note

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Volume 5 home page

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Contents

1. INTRODUCTION

General

1.1 The investigation of sub-surface conditions and factual reporting is referred to as 'Ground Investigation' and is the main area covered by this Advice Note. Site investigation is also covered but only where it complements the gathering of information on the ground conditions at the site concerned.

1.2 TRL Project Report 60 'Study of the Efficiency of Site Investigation Practices' has highlighted the predominant geotechnical difficulties which result in cost increases of highway schemes. These were:

(a) seepage and groundwater related problems in cuttings;

(b) classification of materials not as anticipated;

(c) removal and replacement of additional unsuitable material below formation.

In order to reduce the effect of these difficulties the following major recommendations were given:

(a) more geological input at the planning and interpretation stages, particularly with regard to superficial materials and features, and glacial influences;

(b) improved investigation of cutting sites with regard to soil properties and groundwater;

(c) adequate investigation of scheme changes, and review after major delay to a scheme.

It is important that these points are addressed throughout the site investigation.

1.3 Associated documents include:

(a) Specification for Ground Investigation for Highway Works published by the Stationery Office Ltd (MCHW 5.3);

(b) Method of Measurement for Ground Investigation for Highway Works published by the Stationery Office Ltd (MCHW 5.3);

(c) Notes for Guidance for the Specification of Ground Investigation for Highway Works published by the Stationery Office Ltd (MCHW 5.3);

(d) SD 13 'Documentation Requirements for Ground Investigation Contracts' published by the Stationery Office Ltd (MCHW 5.3);

(e) Model Contract Document (MCD) for Ground Investigation Contracts for Highways published by the Stationery Office Ltd (MCHW 5.3);

(f) HA 44 'Earthworks - Design and Preparation of Contract Documents' published by the Stationery Office Ltd (DMRB 4.1.1);

(g) HD 22 'Ground investigation and earthworks: procedures for Geotechnical Certification' (DMRB 4.1.2);

(h) HA 73 'Site investigation for highway works on contaminated land' (DMRB 4.1.7);

(i) HA 74 'Design and construction of lime stabilised capping' (DMRB 4.1.6);

(j) HA 43 'Geotechnical Considerations and Techniques for Widening Highway Earthworks' (DMRB 4.1.7);

(k) HA 68 'Design Methods for the Reinforcement of Highway Slopes by Reinforced Soil and Soil Nailing Techniques' (DMRB 4.1.4).

The following reports by the Transport Research Laboratory are also relevant:

(a) Perry, J and G West (1996). Preliminary sources of information for site investigation in Britain. (Revision of TRL Laboratory Report 403). *TRL Project Report 192*. Transport Research Laboratory, Crowthorne;

(b) Mott MacDonald and Soil Mechanics Ltd (1993). Study of the efficiency of site investigation practices . *TRL Project Report 60. Transport* Research Laboratory, Crowthorne;

(c) Dumbleton, MJ (1983). Air photographs for investigating natural changes, past use and present condition of engineering sites. *TRRL Laboratory Report 1085*. Transport Research Laboratory, Crowthorne;

(d) Dumbleton, MJ and G West (1970). Air photograph interpretation for road engineers in Britain. TRRL Laboratory Report 369. Transport Research Laboratory, Crowthorne;

(e) Dumbleton, MJ and G West (1976). A guide to site investigation procedure for tunnels. TRRL Laboratory Report 740. Transport Research Laboratory, Crowthorne.

(f) Crabb GI (1997). Ground classification systems in tunnel construction. Transport Research Report 280, Transport Research Labratory, Crowthorne.

Scope

1.4 Guidance is given on the planning and execution of ground investigations for highway schemes. This Advice Note is applicable to all ground investigation contracts which are carried out for the Overseeing Organisations, both directly and by others acting on their behalf. For ground investigation contracts to be carried out by other parties for their own purposes, this Advice Note provides guidance on good ground investigation practice. Procedures and guidance for investigations carried out directly for the Overseeing Organisations are given in the associated documents listed in 1.3.

Definitions and Abbreviations

1.5 The following definitions apply to the terms used in this document and in SD 13 (MCHW 5.3). For ground investigations not carried out directly for the Overseeing Organisations, alternative Conditions of Contract and Forms of Tender and Agreement (where applicable) may be used in conjunction with the Specification, Method of Measurement and Bill of Quantities, provided that the relevant amendments are listed in Schedule 4 of the Specification to ensure compatibility between documents.

1.6 Site investigation (SI) encompasses preliminary sources study (desk study), planning and supervision of the ground investigation contract and interpretation of factual data for design of a scheme.

1.7 Ground investigation (GI) is the examination of a site required to provide geotechnical data which are representative of the ground conditions and relevant to the scheme considered. This includes surface and subsurface investigation, laboratory work and factual reporting.

1.8 Specification for Ground Investigation is the Overseeing Organisations' Specification for Ground Investigation for Highway Works published by the Stationery Office Ltd.

1.9 Method of Measurement (MoM) for Ground Investigations is the Overseeing Organisations' MoM for Ground Investigation for Highway Works published by the Stationery Office Ltd.

1.10 Both the Specification, the MoM, and their Notes for Guidance are included in the Manual of Contract Documents for Highway Works, Volume 5, Section 3 (MCHW 5.3).

1.11 Specification for Highway Works (SHW) is the Overseeing Organisations' Specification for Highway Works published, with its amendments, by the Stationery Office Ltd in the Manual of Contract Documents for Highway Works, Volume 1 (MCHW 1) .

1.12 Conditions of Contract are the Institution of Civil Engineers (ICE) Conditions of Contract (CoC) for Ground Investigations published by Thomas Telford Ltd, London, 1983 as amended by the Model Contract Document (MCD) for Ground Investigation Contracts (MCHW 5.3).

Implementation

1.13 This Advice Note should be used forthwith for all schemes currently being prepared, provided that, in the opinion of the Overseeing Organisation this would not result in significant additional expense or delay progress. Design Organisations should confirm its application to particular schemes with the Overseeing Organisation.

UKAS Accreditation

1.14 The Overseeing Organisations' requirements for the accreditation of certain laboratory and field tests are contained in the Specification for Ground Investigation (MCHW 5.3) Appendix V. The accreditation body should either be United Kingdom Accreditation Service (UKAS) or EC equivalent.

CDM Regulations

1.15 The majority of ground investigations for highway schemes will come within the scope of the Construction (Design and Management) Regulations 1994 (CDM Regulations). In Northern Ireland, the statutory Rule of Northern Ireland introduced the CDM Regulations in 1995. The Regulations place duties on all parties to contribute to the avoidance, reduction and control of health and safety risks faced by site operatives and others. The CDM Regulations and the Approved Code of Practice published by the Health and Safety Executive (1995) should be consulted at an early stage in the planning of the ground investigation. The Design Organisation should liaise with the Overseeing Organisation concerning the implementation of the CDM Regulations.

2. PLANNING AND EXECUTION OF GROUND INVESTIGATIONS

General

2.1 In a ground investigation, the quality of the work is largely determined by the quality of the personnel carrying it out. It is therefore important that all work is carried out by suitably qualified and experienced personnel, in the Client's Organisation, the Design Organisation and the Site Investigation Contractor's Organisation. The appropriate levels of qualification and experience for personnel engaged in site investigation are contained in the Specification for Ground Investigation for Highway Works (MCHW 5.3).

2.2 The scope of ground investigation that is required will be site-specific and will depend, among other factors, on the amount and quality of existing information, the stage of the scheme, the complexity of the design and any special features of the scheme. Site investigation for a highway scheme usually involves a staged approach. The initial stage of site investigation work is undertaken during the route appraisal phase of the scheme and comprises a preliminary sources study of the route corridor(s). This involves a detailed desk study and site reconnaissance (walkover survey). The need or otherwise for a preliminary ground investigation would be identified at this stage. Further stages of site investigation are normally undertaken during assessment of the preferred route alignment, and will involve a main ground investigation, with a possible requirement for supplementary or additional ground investigations depending on the outcome of any public inquiry. This section follows this general format, though it is recognised that other formats may be appropriate depending on the nature of the scheme. The activities carried out at each stage are not mutually exclusive, and the investigations for most schemes should include most of those described below. Similar considerations apply to investigations of failures or for maintenance.

Study of Available Records and Information

2.3 Perry and West (1996) 'Sources of Information for Site Investigations in Britain (Revision of TRL Report LR 403)' provides comprehensive details of sources of information for use in the desk study.

2.4 Preliminary information on ground conditions at the site of a proposed new road or improvement of an existing road is obtainable from geological maps and memoirs issued by the British Geological Survey (BGS). Mineral Assessment Reports, Hydrogeological Reports, Economic Geology Reports and other publications may also yield useful information. In addition to published information the BGS maintain records of strata encountered in boreholes, shafts etc and these can be inspected by arrangement at their libraries in Keyworth (Nottinghamshire), Edinburgh and Belfast. Universities which have a department of geology or civil engineering may have specialised knowledge of ground conditions in their area and are therefore another possible source of information. The British Regional Geology booklets produced by the British Geological Survey and published by the HMSO provide a good deal of information on local geology and are suggested as good starting points for a desk study. From these, and the local maps and memoirs (where available), sufficient information can be obtained to plot the approximate geological structure on a longitudinal section of a route.

2.5 Maps and information are published by the Soil Survey and Land Research Centre in England and Wales and the Macaulay Land Use Research Institute in Scotland. These deal with surface soils mainly from the agricultural point of view. However, the information may be useful where drift maps are not available. These surveys can be a valuable guide on aspects such as soil drainage and particle size characteristics, topography, groundwater regime and soil acidity.

2.6 BS 5930 'Code of Practice for Site Investigations' (British Standards Institution) and CIRIA Special Publication No 25 'Site Investigation Manual' (Construction Industry Research and Information Association, 1983) should be used as a general guide for planning and execution of site work.

2.7 Information from any previous ground investigations carried out in the general area may be relevant. Any interpretative reports from these investigations should be treated with caution, but the factual reports may give the Design Organisation a valuable insight into the prospective ground conditions likely to be encountered. For highway widening schemes, the original ground investigation reports and construction records are of prime importance.

2.8 For all highway schemes, the old Ordnance Survey maps and any other available maps should be consulted. These will often yield valuable information about past uses of the site, including old mineral workings and possible contaminative uses of land (see HA 73 (DMRB 4.1.7) and Perry and West (1996) for more details).

Use of Aerial Photography

2.9 If stereoscopic pairs of aerial photographs of the route are available they may be of assistance in locating places where special attention is necessary. It is recognised, however, that the use of these photographs only augments the investigation procedures outlined elsewhere in this Advice Note. Further information on aerial photography and photographic interpretation of geological features can be obtained from Dumbleton and West (1970), Dumbleton (1983), and Geological Society (1982).

2.10 Aerial photographs of Great Britain are held either by the Ordnance Survey at Southampton or by the commercial companies who flew the surveys. Enquiries should be made to Air Photo Sales, Ordnance Survey, Southampton, who hold the Central Register of Aerial Photographs to ascertain where the photographs relevant to the route is held. Applications should then be made to the appropriate organisation to purchase the photographs. Aerial photographs prior to 1972 are available from the National Monuments Record Centre. The Royal Commission on the Ancient and Historical Monuments of Scotland, Edinburgh, hold aerial photographs for Scotland. Most aerial photography is in black and white but colour film and special emulsions can also be employed.

2.11 Most county planning authorities take aerial photographs of various parts of their county at regular intervals and it is usually possible to obtain copies on request.

Special Aerial Photographic Techniques

2.12 Infra-Red, False Colour Infra-Red and Multi-spectral photography are techniques that have been attempted in Great Britain to ascertain the position of mine shafts, adits, underground cavities, unstable ground and other geological features. To date, generally speaking, these techniques have not revealed anything more than could have been obtained from conventional black and white air photography. However, infra-red and false colour infra-red techniques have been found to be helpful in locating water sources. Air photography incorporating these techniques is not generally available, but will have to be specially flown.

Consultation with the British Geological Survey

2.13 The feasibility, in terms of geological conditions and the engineering problems they pose, of any highway scheme should be ascertained at the very outset of any investigation. It is advisable to consult the British Geological Survey (BGS) for all schemes likely to involve large earthworks, major structures and tunnels or where geological problems are believed to exist. Such consultation is particularly useful where more than one route is under consideration. Except for telephone enquiries of a minor nature, which take up very little time, the BGS will require repayment for all consultations and enquiries. At a later stage in a scheme the BGS may, if requested, also be able to carry out detailed geological investigations on a repayment basis. This may be appropriate where work contains a large element of geological investigation or if the BGS has specialist local knowledge of the area.

Geotechnical Certification

2.14 Investigations carried out for the Highways Agency, Welsh Office and the Department of the Environment (Northern Ireland) will require geotechnical certification in accordance with HD 22 (DMRB 4.1.2). Separate certification procedures currently operating in Scotland are being retained for a further period and will apply to investigations carried out for the Scottish Office Development Department. The references to the Preliminary Sources Study Report in this Advice Note do not apply in Scotland.

Visual Examination of the Site

2.15 At an early stage a thorough visual examination should be made of the site and surrounding area. The extent of ground adjacent to the site which should be examined is a matter of judgement and will depend upon topography and the nature of earthworks envisaged. The surface will frequently reveal signs of sub-surface conditions that need special investigation. Such signs include springs, sinkholes, the growth of water loving grasses on higher ground, scarps, broken or undulating ground on hillsides and unexpected depressions. Very localised and distinctive changes in the appearance of crops and vegetation may indicate filled pits and quarries or other changes in subsoil conditions. Enquiries of farmers and other local inhabitants will frequently yield useful information.

Volume 5 home page

2.16 The visual examination can often be supported by examination of any aerial photography which has covered the area (See paragraphs 2.6 to 2.8).

2.17 At this stage of the project a Geomorphological Interpretation may be useful in planning the fieldwork required.

Existing Excavations, Earthworks, etc

2.18 Excavations on or near the site may have been made in the recent past by Statutory Undertakers laying gas, water and electricity mains or by other authorities constructing sewers. Enquiries to these organisations may produce useful information about subsoil conditions. Nearby railway or road cuttings can also reveal soil types and their stability characteristics as can old pits in rock, chalk, gravel, sand, clay, etc. Some care should be taken in interpreting this information since many old excavations were excavated slowly by hand or machine and their long term performance may well be different to that of excavations carried out quickly by modern plant. Also the careless use of high explosives may have caused damage to otherwise fairly coherent and intact rock structures. Similarly, in the vicinity there may be embankments or buildings and other structures having a settlement history because of the presence of compressible or unstable soils. For highway widening schemes, a detailed examination of the condition of the existing earthworks and structures should be carried out. It is therefore possible by inspection, search of records and enquiry, to gain considerable knowledge about the subsoil conditions of a site before any formal ground investigation is initiated. Where such information cannot be obtained, or may need verifying, it may be necessary to carry out a preliminary ground investigation.

Desk Study

2.19 It is good practice at this stage to collect all the desk study and site reconnaissance information together. This will allow a review of the available geotechnical information and an assessment of what further work is required. An assessment as to whether the site is potentially contaminated should be made at this stage, and more details are given in HA 73 (DMRB 4.1.7). Similarly for road schemes where lime stabilisation may be feasible, Design Organisations should refer to HA 74 (DMRB 4.1.6). When all the available information has been analysed, the main ground investigation, and preliminary ground investigation if required, may then be planned.

Preliminary Ground Investigation

2.20 A preliminary ground investigation for a proposed road scheme may be necessary in order to provide an overview of ground conditions, highlight potential problems, facilitate route selection and determine the extent of the main ground investigation (Matheson, 1979). In the latter case the preliminary survey facilitates the preparation of a more accurate, and hence satisfactory, Bill of Quantities for the main investigation because there will be a greater knowledge of the frequency and types of exploratory holes, sampling and testing likely to be necessary. The preliminary investigation may also be necessary to check the reliability of old borehole records obtained during the desk study. The preliminary ground investigation should, in conjunction with information gained from other sources, identify any areas of the site which require particular attention in the main ground investigation.

Main Ground Investigation

2.21 The main ground investigation should be planned in the light of knowledge of site conditions already gained and of the probable disposition of cuttings, embankments, structures, likely temporary works and effects on adjacent properties. Where problems are known to exist the appropriate measures to determine their character and magnitude should be allowed for in the Contract. The investigation should be flexible enough to enable unexpected conditions to be adequately assessed.

2.22 It is important that close liaison is maintained between all parties during the ground investigation, and that the objectives are clearly understood. To this end, it is beneficial to have a formal meeting between the Design Organisation and the Ground Investigation Contractor prior to the start of the works to exchange information, clarify details in the programme and agree how potential problems are to be dealt with. The importance of using suitably qualified and experienced staff has been discussed in paragraph 2.1.

2.23 By extending and increasing the frequency of the boring, drilling or probing as the investigation proceeds, the location, extent and depth of the following should be ascertained:

(a) material to be excavated from cuttings, likely to be acceptable as fill;

(b) material to be excavated from cuttings whose acceptability as fill is doubtful, or which may be moisture susceptible;

(c) rock excavation in cuttings;

(d) soft compressible soils beneath highway formation level;

(e) any other adverse ground conditions.

2.24 The main ground investigation should be planned to provide sufficient information to enable tenderers for the main Contract to assess and price the works.

2.25 Either observation or inspection pits or both, hand or machine dug, should be opened up as a matter of course on a ground investigation unless conditions make it impracticable. These pits will yield information about the uniformity or otherwise of soil in the mass that cannot be ascertained from boreholes. They will also afford the opportunity to determine the frequency and size of boulders, to take representative samples from gravels and to obtain bulk samples of soils for acceptability testing.

2.26 At the sites of bridges and other structures, sufficient exploratory holes should be put down to enable the geological structure of the ground to be plotted in some detail and the engineering properties established. The extent of the boring or excavation will depend on how much is already known of ground conditions and whether spread or piled foundations are envisaged. It is important that exploratory holes for structures are accurately located at the required positions. Errors in positioning are likely to result in the need for further work at a later stage. If the location of the structure is subsequently altered, further exploratory holes should be put down at the new position.

2.27 The extent of the proposed investigation affecting structures should be agreed with those responsible for the technical approval of those structures.

2.28 In soft alluvial soils, it may be difficult to ascertain what sizes of samples should be taken and from what levels to represent fairly the ground as a whole in order to provide reasonably accurate information about bearing capacity and consolidation characteristics. Advance boring by a continuous sampling machine with visual inspection can be of immense assistance in making decisions about the sampling and testing appropriate to the soils encountered.

2.29 Part of the investigation may be to establish the geological structure. The depth and spacing of boreholes will need to be carefully considered to ensure that this aim can be established, with variations if necessary. The British Geological Survey may be requested to log cores if necessary when correlation of strata is doubtful.

Depth and Spacing of Boreholes and Trial Pits

2.30 No hard and fast rules can be given for the depth and spacing of exploratory holes. This will depend on the specific circumstances of each site and the amount and quality of existing information. Some guidance is given in BS 5930. The selection criteria for the depth and spacing of exploratory holes should always be to ensure that sufficient information is obtained to enable the proposed works to be adequately designed.

2.31 For highway schemes it is important that the position of exploratory holes is staggered about the centreline to ensure sufficient transverse coverage of the site. Boreholes must be deep enough to penetrate well below the bottom of cuttings. If there is any likelihood of the road profile being altered then a view must be taken on whether the investigation should allow for this.

2.32 It should be appreciated that all methods of ground investigation have inherent limitations, eg boulder content cannot be estimated with any accuracy by means of light cable percussive boreholes. The methods of investigation should be chosen in the light of the anticipated ground conditions and the proposed works. The aim is to reduce the uncertainties to a minimum. Nevertheless there will always be some residual uncertainty due to the inherent variability of the ground and the limitations of the methods of investigation.

Sampling and Testing

2.33 The amount of sampling and testing necessary for any survey should be carefully assessed. Large numbers of samples of a particular soil should not be taken and subjected to a full range of tests, many of them expensive to perform, when the characteristics and classification of that soil are already well known. When large volumes of such soils exist on a site, this investigation should be largely confined to proving, by visual examination and limited testing of samples, their extent and depth relevant to the construction proposed. This practice also applies to investigations in geological formations where strata changes are rapid and knowledge is chiefly required of the relative positions of the various materials to be encountered in cutting or

foundations of structures. Sufficient testing should be carried out to assess the variability of soil properties, particularly for moisture susceptible materials. The tests carried out should relate to the intended use of the soil (ie as a fill material or as foundation for pavements, structures and embankments or in temporary works) and to the methods of working or a combination of these.

2.34 The Overseeing Organisation may, on projects for which it is responsible, provide further advice on the extent of sampling and testing required and on the selection of acceptability criteria. Advice may also be given on the number of tests required and selection of appropriate tests to assist with stability analysis of earthworks during design, to assess the bearing capacity for foundations and to assess the earth pressures on abutments and retaining walls using the appropriate soil parameters.

Limitations of the Value of Test Results

2.35 The results of tests on small samples of soil can often be misleading and not represent the behaviour of the soil in the mass. For example, deposits of alluvial clays may contain fine bands or partings of silt and sand and the material as a whole would have a much higher permeability than indicated by consolidation tests on small samples. Similarly, shear tests on a fissured clay will give much higher strengths than occur in practice if the samples tested contain no fissures. These two examples illustrate the problems of scale and it is clear that only a very large volume of soil could represent the mass but the taking of such large samples and the testing of them are usually impracticable. However, it may be possible to partially overcome the problems of scale by carrying out appropriate in-situ tests. For the two examples given above, this could involve permeability tests in piezometers or the application of pressuremeter or plate bearing tests. Wherever possible, in-situ CBR tests should be carried out on potential subgrade materials.

2.36 Apart from the size of the sample there exists the problem in many geological formations of producing samples, and in some cases adequate borehole logs, which will be of value in judging the behaviour and mass characteristics of the soil in advance of excavation or piling. These formations are of heterogeneous soils and rocks deposited or weathered in a non-uniform manner and they often defy any attempt at correlation between boreholes. Examples are, parts of the Mercia Mudstone, Claygate Beds and Bracklesham Beds. To a lesser degree this problem may be encountered in other formations.

Groundwater

2.37 The collection of information on the groundwater regimes to be found on a site is essential not only for the design of earthworks but for drainage design, temporary works, assessing working methods and use of plant.

2.38 Groundwater levels found during exploration should always be recorded together with the times at which they are measured. Inflows of water into exploratory holes should be distinguished from general water tables. In some soils inflows may create unstable conditions in the sides of the borehole or trial pit.

2.39 If more detailed and long term information is required then standpipes or piezometers should be installed. For strata consisting of sands and gravels, water tables and their seasonal changes can be ascertained without great difficulty from open tubes in the ground. For soils of low permeability the true phreatic surface may be difficult to identify and the use of piezometers monitored over a long period is necessary. This is particularly important for situations such as cuttings, existing slopes, (particularly those with a history of instability) and where embankments on soft alluvial deposits are being considered. Seasonal variations in groundwater levels can only be monitored by the use of standpipes or piezometers.

Aggressive Soils and Groundwater

2.40 If aggressive soils and groundwater are suspected in places which may lead to chemical attack on bridge foundations or drainage installations the appropriate sampling and testing should be carried out. If the use of buried metal structures such as steel piling or corrugated steel sections is contemplated the ground and/or fill should be tested to assess whether the ground environment is suitable for such structures. Requirements vary depending on the application, but guidance can generally be found in those parts of the MCHW or DMRB covering particular structures.

Fill, Waste and Contaminated Land

2.41 Detailed guidance is contained in HA 73 (DMRB 4.1.7) ‘Site Investigation for Highway Works on Contaminated Land’.

Soil for stabilisation with lime

2.42 Detailed guidance is contained in HA 74 (DMRB 4.1.6) 'Design and Construction of Lime Stabilised Capping'.

Condition Survey

2.43 Where, in the opinion of the Design or Overseeing Organisation, there is a possibility of property or land being affected by the construction of cuttings, tunnels, other forms of construction ,blasting, fracture grouting, pretreatments, ground water lowering and other geotechnical processes, it is important, in order to assess the validity of any claims that may be submitted for damages, that the condition of adjacent structures, groundwater levels and ground levels be established before, during and after the execution of the main Works. Where an existing highway (eg a tunnel) may be affected by subsequent construction, a condition survey should also be carried out.

2.44 Usually as a condition of any wayleave obtained for tunnels or ground anchors to go under buildings an agreed condition survey schedule is drawn up between the property owners and the Overseeing Organisation. This form of agreement is also advocated for other situations in which property or land is potentially at risk and will help to resolve any disputes which may arise later. Similar considerations will apply to proposed construction projects which may affect existing highways.

2.45 The condition survey will highlight the likelihood of damage and where practicable permit timely adjustments to the design.

Direction and Supervision on Site

2.46 For Contracts set up under the ICE Conditions of Contract for Ground Investigation, the Design Organisation will be responsible for the direction, control, interpretation and overall adequacy of the investigation and will therefore have to provide the appropriate level of site supervision to fulfil that responsibility.

2.47 The Design Organisation should provide direction and supervision in the form of an experienced engineer, engineering geologist or geologist of its own staff who may be on site the whole time or on a visiting basis depending on the magnitude and complexities of the work. The site engineer should have the authority to vary or extend the exploration plan during the investigation within limits laid down by the Overseeing Organisation. The importance of using suitably qualified and experienced staff has been discussed in paragraph 2.1.

2.48 If contractual arrangements other than those described above are made, such as the appointment of a Specialist Consultant, the responsibility for the adequacy of the investigation should be clearly defined.

Ground Investigation and Scheme Programming

2.49 The general sequence of investigations has been discussed in paragraph 2.2. It may be advantageous to carry out a single complete soil survey where this will be effective and economical, and minimise inconveniences to land or property owners. In practice, it is more usual for the survey to be carried out in two stages for the reasons outlined in paragraph 2.20. If contamination is present or suspected at a site, the main ground investigation may have to be phased to allow adequate investigation of the contamination aspects (see HA 73 (DMRB 4.1.7)). The carrying out of in-depth ground investigation activities on site before announcement or protection of a preferred route (or corridor), or whilst public inquiry procedures are in progress is generally a course of action which should be avoided wherever possible. Whilst a preliminary ground investigation may, if required, be carried out at a stage prior to order publication, the main investigation should normally be undertaken later in the programme but before any public inquiry commences. Subsequently, the need for supplementary or additional ground investigations may be considered, at which time any change in the extent of the investigation brought about by changes in the orders can be taken into account.

2.50 It should be noted that changes, albeit minor changes, in the Orders can generate the need for additional or supplementary ground investigation.

Ground Investigation Reports

2.51 A factual report of a ground investigation should include boring and rotary drilling records, test results, plans and sections showing the position of all exploratory holes, the strata encountered in them and any other data specified or requested by the Overseeing Organisation (eg groundwater levels, etc). The sections may be used to indicate the depths at which samples have been taken and the test results may be shown alongside. A symbolic or colour code should be used to distinguish the different types of soils for which full

descriptions with the geology should be given. The scales of plans and sections should not be smaller than 1 to 2,500 horizontal and 1 to 250 vertical.

2.52 The requirements for the factual report are set out in Clause 12 of the Specification for Ground Investigation. The actual format and requirements of the report should be stated in Schedule 1.16 of the Specification. Suggested contents are provided in Annex A of this document.

Interpretation of Ground Investigation Data

2.53 For ground investigation projects carried out for the Overseeing Organisations, the Contractors are normally appointed following competitive tendering. The Contractors are usually required to submit a report on factual data. A report which interprets the factual data, gives advice on earthworks, contamination, foundations and proposes solutions to identified problems is usually prepared by suitably qualified and experienced staff within the Design Organisation who have been appointed by the Overseeing Organisation. An alternative procedure is to employ an independent specialist consultant to plan the investigation and provide the interpretation and advice from the factual report of a Contractor employed for exploration and testing only. When a particularly difficult problem is encountered the engagement of an eminent expert on the subject concerned should be considered.

2.54 The interpretative report should seek to explain any anomalies in the factual information and draw an overall picture of site conditions exploring the ranges within which soil properties have been found to vary, seasonal changes and changes to soil conditions which may be brought about by the construction process.

2.55 The brief for the interpretative report will need to be carefully considered to ensure that all the geotechnical design requirements are fully met. The difficulties of preparing an adequate brief should not be underestimated.

2.56 Where the interpretative report is to be prepared by the GI Contractor the brief will need to be set out in Schedule 1.16 of the Specification for Ground Investigation. Suggested contents are given in Annex B of this Advice Note, but this may require amendment to suit a particular Contract. The mechanism for amendments and alterations is given in Chapter 4 ‘Contract documentation’.

2.57 An essential part of the interpretative work is, for most sites, the plotting of the inferred geological structure on sections. This is required for design purposes (eg the designing of bridge foundations), for assessing the volumes of various soils to be excavated and also, in many instances, for investigating stability problems. An important part of the interpretation will be the assessment of acceptability of the materials encountered for re-use as fill. Reference should be made to HA 44 (DMRB 4.1.1). The bearing capacity of finished earthworks for pavement design and the effects of any contamination on the proposed works should also be addressed.

Information to be made available to the Highway Construction Contractor

2.58 The Overseeing Organisation should not withhold any information that could assist the tenderer in pricing the work required by the Contract. Under the CDM Regulations, disclosure at tender stage is required of any information which could affect the health and safety of persons carrying out the construction work. This includes any surveys of the site and its neighbourhood with health and safety implications. It should not normally be necessary to withhold information that might relate to other work, eg for an alternative but unadopted method of constructing foundations or embankments. The information obtained from the site investigation should be made available as follows.

(a) SI information bound in Tender Documents.

The location of all boreholes, the factual geology and those test results which have been used in the earthworks design together with the limits for classification of the soils to be encountered (see paragraph 2.14). This information is critical to the earthworks design and as such should be appreciated by the tenderer and will be subject to scrutiny by both Contractor and Design Organisation once the Contract is signed.

(b) SI Information made available to Tenderers.

Copies of all factual ground investigation reports which provide information used in the design of earthworks and structural foundations

Following up Ground Investigations

2.59 It is essential that engineers and geologists who have been involved in a site investigation and the preparation of a report should have every facility for

following up their work during construction but there are practical and administrative difficulties. Clearly there should be few of these in the case of staff employed by the Overseeing Organisation, Agent Authorities and Consulting Engineers preparing and supervising the construction of schemes. When the ground investigation, including the interpretative report has been prepared by a specialist firm whose Contract or agreement terminates on the submission of the report there will be no financial incentive for follow up visits. Employees of the firm should be encouraged to visit the site during construction with the permission of the Contractor obtained through the Overseeing Organisation but the cost must ordinarily be borne by the specialist firm.

2.60 Where soils and rocks are to be exposed in deep cuttings during construction, the British Geological Survey should be given the opportunity to examine the exposed strata at their own cost.

2.61 Some major construction Contracts will need to include supplementary or additional ground investigation where further proving work is required. See also paragraphs 3.11 and 3.12.

2.62 The main construction Contract for a road scheme should include a Geotechnical Feedback Report to be prepared as part of the 'as-built' information. The usefulness of this Report is twofold.

(a) To provide 'as-built' information for maintenance purposes.

(b) To provide feedback of a geotechnical nature on the use of materials, performance of acceptability parameters, etc.

2.63 Where unusual or innovative techniques are employed or the conditions warrant monitoring beyond the end of the Construction Contract, the Overseeing Organisation should identify these and agree the testing, instrumentation and inspections required during the Contract.

Geophysical Investigations

2.64 Geophysical methods can be used either as a reconnaissance tool at the beginning of a ground investigation or as a planned part of the main investigation. They may also be used in maintenance surveys. Geophysical methods allow the non-destructive investigation of a site. Any anomalies can then be investigated by intrusive methods, thus reducing the amount of ground disturbance and nuisance associated with conventional methods of investigation. Each geophysical survey is site specific and should be carefully planned, carried out and interpreted by experienced engineering geophysicists. It is often useful to carry out trials with several methods at the start of a geophysical investigation to determine which method(s) are most appropriate to the site conditions. Details of applications of geophysics to engineering are given by the Geological Society Engineering Group Working Party (1988).

The Employment of Ground Investigation Contractors and Consultants

2.65 The Highways Agency, Welsh Office, Department of the Environment (Northern Ireland) and the Scottish Office Development Department maintain records of ground investigation Contractors, consultants and geotechnical specialists and will advise on their employment.

Distribution of Copies of Reports

2.66 One copy of every complete ground investigation report should be sent to the Overseeing Organisation and one copy of the Factual Report only to British Geological Survey, Keyworth, Nottingham, NG12 5GG for the information of the borehole officer. In Scotland, the report should be sent to the British Geological Survey, Murchison House, West Mains Road, Edinburgh EH9 3LA, for the information of the Records Officer, and in addition one copy of the Factual Report should be sent to TRL Scotland, Craigshill West, Livingston, West Lothian EH54 5DU.

Site Investigation for Underground Structures

2.67 The location, identification and determination of the properties of the strata within the sphere of influence of the proposed tunnel are required in addition to the usual ground investigation. The behaviour of the ground under the likely method or methods of tunnelling and tunnel lining and any ground treatment should be examined. In addition groundwater plays a very important role in underground construction and the ground investigation report should give appropriate attention to its influence and control during construction.

2.68 The influence of the construction of the works on adjacent structures above and below ground in the short and the long term should be included. Thus a tunnel may require additional or alternative means of investigation to those normally used.

2.69 The interpretation of the investigation should deal with the problems of applying data obtained from desk studies and essentially one-dimensional boreholes, to forecast the behaviour of a three-dimensional highway tunnel where the size will be several orders of magnitude greater and usually in an orthogonal direction. Additional information may be available from adits, air shafts and probe borings. The geological model and the engineering design should be continuously reviewed during construction as information from the excavation becomes available.

2.70 Guidance on site investigation procedures for tunnels may be found in Dumbleton and West (1976) and CIRIA Report 79. Quality Services of the Highways Agency should be consulted at the earliest possible stage. In Scotland the National Roads Directorate, Scottish Office Development Department should be consulted.

Data from Previous Ground Investigations

2.71 Where the CDM Regulations apply to a ground investigation, all information relevant to health and safety should be included in the tender documents. This will normally include any desk study reports and existing ground investigation reports. Reference should be made to the CDM Regulations and Approved Code of Practice for further details of these and other requirements. It is recommended that this data be given without prejudice and for the Contractor's information only. It is not recommended that any interpretative data be made available. It must be made clear to the Contractor that this factual data is not part of the Contract to avoid any subsequent contractual problems.

3. SITE INVESTIGATION PROCEDURE ON LAND IN WHICH THE EXISTENCE OF ABANDONED MINES AND SHAFTS IS KNOWN OR SUSPECTED

Legal Position of the Coal Authority

3.1 The freehold interest in all coal is vested in the Coal Authority, and the Authority must be consulted about any proposed boring programme which may penetrate a coal seam, intact or worked out. For property and coal related liabilities, subsidence claims, administrative, financial and legal matters, the Coal Authority should be consulted at 200 Lichfield Lane, Mansfield, Nottinghamshire NG18 4RG.

The records of abandoned mines kept by Mining Records section of the Coal Authority indicate the position and extent of known workings and their depths as measured down shafts. These records are not complete and many workings are unknown and uncharted. Mining Reports section of the Coal Authority can give information on working mines and coal deposits, and estimates of the extent of subsidence and its likely effect on structures. Both Mining Records and Mining Reports sections are located at Bretby Business Park, Ashby Road, Burton-on-Trent, Staffordshire DE15 0QD.

Information on areas where opencast extraction of coal has been carried out may also be obtained from the Mining Records section.

Coal and Other Minerals

3.2 Both coal and other minerals have also been worked close to the surface in the past but the responsibility for abandoned workings in them cannot often be fixed. Annex C contains a list of custodians of plans of abandoned mines who should be consulted when mineral workings are suspected beneath the sites of highway schemes. At the start of a project, reference may be made to a useful map to a scale of approximately 1 to 625,000 published by the Ordnance Survey which shows general areas of coal and iron working in England, Scotland and Wales.

Study of Available Records

3.3 Geological Survey Maps and Memoirs will show where coal and certain other minerals may occur and, in addition, there may be signs of working in the form of spoil heaps or depressions in the ground caused by subsidence. Hummocked ground should be treated with suspicion. Shafts may be visible on the surface where mining has been carried out. Early Ordnance Survey maps may reveal the positions of some shafts but many others were sunk, abandoned and filled in or covered up long before such maps were made or between revisions. All available maps should be consulted, including the mine abandonment plans. This work should be carried out by an experienced mining geologist, as the format of mine plans may be confusing to the non-specialist. The Coal Authority and the custodians listed in Annex C have records of shafts which supplement the information in the Ordnance Survey but they may not be exhaustive, since there was no statutory requirement for mine owners to deposit plans of abandoned mines before 1872. Local enquiries can frequently produce a great deal of information which is otherwise unobtainable.

The 'Review of Mining Instability in Great Britain' (Arup Geotechnics, 1992) is also a useful source of information.

Consultation with the Coal Authority

3.4 Consultations with the Coal Authority should be established at the addresses in paragraph 3.1. They are the first point of contact for mining and opencast enquiries. They will then assist with enquiries and also identify the Contractor and Licencee extracting the coal for further consultation.

3.5 The records of abandoned mines indicate the position and extent of known workings and their depths. These records are not complete and many old workings dating from before 1872, are unknown and uncharted.

3.6 It is not always possible to ascertain the depths, thicknesses, dips and strikes of coal seams from the information available but a limited amount of boring, as part of the ground investigation, should fill the gaps in available knowledge about the geological structure. The Coal Authority and Licensee must be consulted about the proposed boring programme since any penetration of a coal seam, worked out or intact, will amount to entry upon the Coal Authority's property as defined in paragraph 3.1 of this Advice Note and affects the

Licensee's working. The Coal Authority and the Licensee will be entitled to object if they consider there is danger or detriment to their interests and to impose certain conditions on how boring is carried out and the boreholes finally sealed. For most other mineral workings there is no national statutory authority to consult.

Ground Investigation Before Construction Works

3.7 A close network of borings or rotary drilling undertaken at the Ground Investigation stage to locate and chart in detail the pattern and condition of old workings is not justifiable except on the sites of embankments and of structures outside cuttings and at prospective service area sites. See also paragraphs 2.21 to 2.29. In such cases some detailed investigation work may be necessary before the main contract commences in order that design decisions can be made, that cannot reasonably be made later.

3.8 A high standard of workmanship and supervision is required if mining investigations are to yield satisfactory results. Suitably qualified and experienced personnel should be employed and an experienced mining geologist should be available at all times during site operations. Communication is essential; all parties should clearly understand the purpose of each borehole.

3.9 The geological structure should be plotted on plans and longitudinal sections to a scale of 1 to 1,250 or 1 to 1,000 which also show the proposed formation level of the highway. Plans should show structure contours plotted for marker horizons such as coal seams and also show rockhead contours.

3.10 The presence of coal or other mineral seams within 15 metres, or ten times the thickness of extraction whichever is the greater, of the rock head (or the foundation level in cuttings, if in rock) will indicate the areas of danger which will require further investigation and so exploration should not normally proceed beyond this depth. For these areas, and especially if bridges or other structures occur within them, sections and cross sections to a larger scale should be plotted to show clearly the positions of cuttings, bridge foundations, drainage etc in relation to the seams and hence to possible or known mine workings. Holes deeper than 15 metres (or 10 times the thickness) may be required on the sites of structures, particularly where two or more seams exist, in which case the effect of the deeper seam on the shallow one will need to be assessed.

3.11 The requirements of Overseeing Organisations for the design of highway structures in areas of mining subsidence are given in BD 10 'Design of Highway Structures in Areas of Mining Subsidence' (DMRB 1.3.6). Further advice is also given in CIRIA Special Publication 32 'Construction over Abandoned Mine Workings' (Construction Industry Research and Information Association, 1984).

Ground Investigation During Highway Construction

3.12 Experience has shown that decisions on how to deal with such workings can only be made effectively after they have been opened up for inspection. Therefore detailed exploration to confirm the presence of old workings should form part of the main construction contract and exploration should be carried out as soon as possible after letting the contract. The usefulness of boring or drilling operations during ground investigation in this connection is therefore limited to proving that there are workings in a coal seam or other mineral deposits and, by ascertaining the depth, enabling the Engineer to decide whether they should be exposed and backfilled, left alone or whether some grouting techniques are justified. The search for, and the proving of ,the existence of shafts and outlets should also be carried out when the main construction contract commences and excavation to expose can be substituted for the uncertainties of drilling or geophysical investigation.

3.13 If solid coal is encountered in all boreholes this is not necessarily proof that the coal has not been worked. Further to paragraph 3.9 above, boreholes may need to go deeper than scheduled to establish marker horizons. If workings are encountered these can be examined by orientated closed circuit television in dry situations or sonar cavity surveying equipment in flooded situations.

Treatment of Disused Mine Shafts and Adits in Coal Workings

3.14 The design and material specification for reinforced concrete to render openings into coal workings safe is to be in accordance with BS 5400, Part 4, amended in BD 24 (DMRB 1.3.1) and the Specification for Highway Works (MCHW 1). In all cases the Coal Authority must be consulted about the methods of investigation and treatment.

3.15 The treatment of openings in other mineral mines may be dealt with in a similar manner to that for coal. In all cases the advice of a Chartered Engineer with appropriate experience should be obtained.

3.16 Further advice is given in CIRIA Special Publication 32 ‘Construction over Abandoned Mine Workings’ (Construction Industry Research and Information Association, 1984).

4. CONTRACT DOCUMENTATION

4.1 The requirements for Contract documentation for ground investigations carried out for the Overseeing Organisations are set out in SD 13 (MCHW 5.3). *Where the Design Organisation considers amendments or additions are required to suit the circumstances on a particular Contract these should be cleared with the relevant Overseeing Organisation.*

4.2 The Contract document for a typical remeasurement GI Contract is made up of the following, where appropriate, in the order given.

(a) Cover sheet

(b) Contents sheet

(c) Form of Tender

(d) Appendix to the Form of Tender

(e) Form of Agreement (not required if let by a Regional Office in England and Wales or the Scottish Office Development Department)

(f) Conditions of Contract

(g) Special Requirements

(h) Preamble to the Specification

(i) Schedules 1 to 3 inclusive - Information, exploratory holes and Engineer's facilities

(j) Schedule 4 - Specification amendments

(k) Schedule 5 - Specification additions

(l) Further Schedules required by reference in Amended or Additional Specification Clauses

(m) Preamble to the Bill of Quantities

(n) Amendments to the Method of Measurement

(o) Bill of Quantities

(p) Dayworks schedule

(q) Bill of Quantities Summary and Tender Total

(r) Rates for Professional and Technical Staff.

Items (a) to (h) inclusive, (m) to (r) are covered by SD 13 (MCHW 5.3). Advice on items (i) to (l) inclusive are given in the Notes for Guidance on the Specification for Ground Investigation (MCHW 5.3).

4.3 Instructions for tendering are not to be bound into the tender document.

4.4 The Conditions of Contract (CoC) used are the ICE Conditions of Contract for Ground Investigations dated 1983 as amended by the Model Contract Document (MCD) for Ground Investigation Contracts issued by the Overseeing Organisation. The ICE CoC are not reproduced but are included in the document by reference. Only the amendments and additions including the Special Requirements as set out in the MCD are reproduced.

4.5 The Specification is to be included in the Contract documentation by reference in the Preamble. The document itself should not be included as part of Contract documents. The Specification has been structured in such a format that changes can be made by means of Schedules. Schedules are also used to describe the information on the Project in general and the work to be carried out by the Contractor.

4.6 The Method of Measurement (MoM) is to be included in the Contract documentation by reference in the Preamble to the Bill of Quantities. The MoM itself should not be included as part of the Contract documents. However any amendments to the MoM will immediately follow the Preamble. The reference in Clause 57 of the CoC and in the Appendix to the Form of Tender should be amended to refer to the MoM for Ground Investigation published by the Stationery Office Ltd (MCHW 5.3).

4.7 Preambles to the Specification and to the Bill of Quantities are set out in SD 13 (MCHW 5.3) along with the Schedules referred to in paragraph 4.2 above. Further advice on the Schedules is given in the Notes for Guidance on the specification for ground investigation. (MCHW 5.3).

4.8 An example Bill of Quantities is given in Annex D.

5. REFERENCES

ARUP GEOTECHNICS (1992). Review of mining instability in Great Britain. Her Majesty's Stationery Office, London.

BRITISH STANDARDS INSTITUTION (1981). Code of Practice for site investigation *British Standard 5930*. British Standards Institution, London (under revision).

BRITISH STANDARDS INSTITUTION (1990). Steel, concrete and composite bridges. Part 4 Code of Practice for design of concrete bridges. *British Standard 5400*. British Standards Institution, London.

CONSTRUCTION INDUSTRY RESEARCH AND INFORMATION ASSOCIATION (1979). Tunnelling - Improved Contract Practices. *CIRIA Report 79*. Construction Industry Research and Information Association, London.

CONSTRUCTION INDUSTRY RESEARCH AND INFORMATION ASSOCIATION (1983). Site investigation manual. *Special Publication 25*. Construction Industry Research and Information Association, London.

CONSTRUCTION INDUSTRY RESEARCH AND INFORMATION ASSOCIATION (1984). Construction over abandoned mine workings. *Special Publication 32*. Construction Industry Research and Information Association, London.

DESIGN MANUAL FOR ROAD AND BRIDGE WORKS. Her Majesty's Stationery Office, London.

HD22 Ground investigation and earthworks: procedures for Geotechnical Certification (DMRB 4.1.2)

HA43 Geotechnical considerations and techniques for widening highway earthworks

HA44 Earthworks: design and preparation of contract documents (DMRB 4.1.1)

HA73 Site investigation for highway works on contaminated land (DMRB 4.1.7).

HA74 Design and construction of lime stabilised capping (DMRB 4.1.6).

BD10 Design of highway structures in areas of mining subsidence (DMRB 1.3.6)

BD24 Design of concrete bridges. Use of BS 5400: Part 4:1990 (DMRB 1.3.1)

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DUMBLETON, MJ and G WEST (1970). Air photograph interpretation for road engineers in Britain. *TRRL Laboratory Report 369*. Transport Research Laboratory, Crowthorne.

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Volume 1: Specification for highway works (MCHW 1).

Volume 2: Notes for guidance on the specification for highway works (MCHW 2).

Volume 5: Contract documents for specialist activities.

Specification for ground investigation for highway works (MCHW 5.3);

Method of measurement for ground investigation for highway works (MCHW 5.3);

Notes for guidance for the specification of ground investigation for highway works (MCHW 5.3);

SD 13 Documentation requirements for ground investigation contracts (MCHW 5.3);

Model contract document (MCD) for ground investigation contracts (MCHW 5.3).

MATHESON, G D (1979). Preliminary site investigations for highways: Suggested contents. *TRRL Leaflet LF891*. Transport Research Laboratory, Crowthorne.

MOTT MACDONALD AND SOIL MECHANICS LTD (1993). Study of the efficiency of site investigation practices. *TRL Project Report 60. Transport* Research Laboratory, Crowthorne.

PERRY, J and G WEST (1996). Preliminary sources of information for site investigation in Britain. (Revision of TRL Laboratory Report 403). *TRL Report 192*. Transport Research Laboratory, Crowthorne.

6. ENQUIRIES

Approval of this document for publication is given by the undersigned:

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All technical enquiries or comments on this document should be sent in writing as appropriate to the above.

ANNEX A

SUGGESTED CONTENTS OF FACTUAL REPORT

A.1 The factual report shall contain the following information, where applicable, in the format required in Schedule 1.16.

(a) Title sheet - to be agreed with the Design Organisation.

(b) Contents of all volumes (not details) - to be listed in the front of each volume with the contents of the particular volume highlighted.

(c) Brief factual description of the extent of the work carried out, eg number of boreholes and trial pits, date and duration of work, weather conditions, special testing carried out, definition of all symbols used which are not defined on the standard record sheets or elsewhere.

(d) Data presentation - record sheets in exploratory hole order with test results for each exploratory hole presented immediately after the EXPLORATORY HOLE LOG in the following order:

EXPLORATORY HOLE LOG
SHEAR STRENGTH
CONSOLIDATION
TRIAXIAL TEST (Consolidated Undrained/Consolidated Drained)
COMPACTION/CBR/MCV
PARTICLE SIZE DISTRIBUTION
LABORATORY TEST SUMMARY SHEET

on A4 size sheets photoreduced from A3 size originals. Blank master copies of the A3 size originals will be made available by the Design Organisation where required by the Contractor.

(e) Blocks of data requiring special record sheets shall be presented with all the results of one particular method in one batch. The form of record under this heading should comprise:

(i) dynamic probing - Blow count for each 75mm penetration;
(ii) static probing - Cone resistance against depth. Sleeve friction resistance. Friction ratio;
(iii) permeability testing - Plot of test results as described in the Contract. Coefficient of Permeability;
(iv) piezometer records - Table and/or plot of piezometric levels against time.

(f) Summary sheets of test results should be grouped on an agreed basis (materials/areas) and shall be presented in a sequential order as agrees with the Design Organisation.

(g) Key plan showing alignment(s) and/or area covered by the investigation.

(h) Location plans showing the positions of exploratory holes.

(i) A general longitudinal section along the route to a scale of not smaller than 1:2500 horizontal to 1:250 vertical shall be submitted giving the following information:

(i) the existing ground level along the centre line;
(ii) the road profile provided by the Design Organisation;

(iii) vertical and horizontal scales, the vertical scale having a suitable datum line appropriate for use in reading the data;

(iv) the exploratory holes identified and projected normally on to the road profile.

(j) Other sections shall be submitted where these are required to illustrate and enlarge upon such problems as: variation of strata normal to the centre line; sidelong ground; dipping of strata in cut; and banks on soft ground. Such sections shall be made sufficiently large to permit the more intensive exploration to be clearly illustrated.

A.2 Copies of the Digital Data Report will be required according to Clause 12.4 of the Specification for Ground Investigation. Identical numbers of Digital Data Reports and Factual Reports are not normally required. It is advantageous to provide more Digital Data Reports than Factual Reports as this reduces the amount of paper involved and allows easier access to data for design purposes.

ANNEX B

SUGGESTED CONTENTS OF INTERPRETATIVE REPORT

B.1 The interpretative report shall contain the following information, where applicable, in the format required in Schedule 1.16.

(a) Title sheet - to be agreed with the Design Organisation.

(b) Each volume to have a contents page showing the content of all the volumes with that of the individual volume highlighted.

(c) The report should comprise an appraisal of all the geotechnical aspects of the route to enable the road and bridgeworks to be effectively and economically designed.

(d) The substance of the report should comprise the analyses of data collected and recommendations of criteria for both engineering and investigatory purposes. These criteria of engineering significance should be related to the nature of the materials encountered, their engineering properties and their relation to their design function in the geological environment in which they exist. It should not be a simple chainage by chainage gazetteer. The design recommendations for the alignment(s) should be presented in precis form and should be placed at the end of the written report under G (Engineering Recommendation). Relevant engineering properties relationship charts, sections and other data should be presented as technical appendices to the report and should be suitably cross referenced in the text.

(e) The factual content of the interpretative report should be presented separately from any discussion or recommendations and confined to the early chapters.

(f) The form of the report is as follows.

A. INTRODUCTION

This should be a reference to the Scope and Object of the Contract and a summary of the report contents.

B. EXISTING INFORMATION

This should summarise the sources of existing information including desk study or Preliminary Sources Study Report (where appropriate) used in the work and the range of data thus obtained.

C. FIELDWORK

This should comprise a brief description of the fieldwork undertaken and should outline its purpose. It should also highlight any constraints which have affected the design of the investigation.

D. LABORATORY WORK

This should comprise a summary, and where of value, a description of the laboratory testing undertaken and should outline its purpose.

E. SITE DESCRIPTION

This should include a geographic, geomorphological, geological, hydrogeological and historical description of the area investigated and include the findings of the investigation.

F. ENGINEERING DISCUSSION OF GROUND CONDITIONS - TECHNICAL NOTES

(i) Background and Reliability

This should include an explanation (in the form of technical notes) of how the interpreter has translated the raw data from A to E into design recommendations. An explanation of the bases and an assessment of the reliability of these predictions should be given. Some calibration of this reliability should be included if possible.

Design criteria can be presented in one of two ways.

Material A, Areas A, B, C, etc.
Or
Area A, Materials A, B, C, etc.

For each material or area the following matters should be included in the discussion as relevant.

(ii) Earthworks - General

This should include the location, juxtaposition, nature and classification of all materials relevant to the engineering works. A discussion of their properties related to forming the finished earthworks and other critical factors. In addition an indication of the cost implications of altering cutting or embankment slope geometry for required agricultural or landscaping purposes should be presented.

(iii) Earthworks - Acceptability

This should include a discussion on the selection of acceptability criteria, presence of moisture susceptible material, uncertainties in the classification of material, drainage requirements to ensure acceptability, the feasibility of rendering material acceptable by modification or stabilisation, the effects of excavation, placement or compaction methods on acceptability and any other critical factors.

(iv) Earthworks - Cuttings

This should cover the constraints that apply, the selection of cutting slope criteria, the methods of excavation where these are critical, the behaviour of cuttings in short and long term, and recommendations for measures to improve stability where appropriate. All earthworks drainage measures deemed necessary or desirable should be outlined. The nature, purpose and expected behaviour of such drainage works should be presented together with any time dependent criteria. Any other critical factor should be reported.

(v) Earthworks - Embankments

This should outline any constraints that apply, the selection of embankment slope criteria, any particular filling operation criteria that are critical, any embankment foundation problems which exist, and their behaviour in the short and long term. Where new embankments are to be tied into existing ones, an assessment of the condition of the existing embankment, anticipated settlements of both embankments and measures necessary to ensure the integrity of the combined embankment should be discussed. All groundwater drainage measures deemed necessary or desirable should be outlined. The nature, purpose and expected behaviour of such drainage works should be presented together with any time dependent criteria. Any other critical factors should be reported.

Volume 5 home page

(vi) Structure Foundations

Alternative types of foundation should be considered and their relevance to the ground conditions given. The predicted performance and behaviour of these foundations should be based on data provided by the Design Organisation and related to the relevant material types. The method of analysis and the recommendations for design parameters should be outlined and any problems, constraints or critical factors discussed and remedial techniques suggested. All drainage measures deemed necessary or desirable should be outlined. The nature, purpose and expected behaviour of such drainage works should be presented together with any time dependent criteria. Any other critical factors should be reported.

(vii) Tunnels

The anticipated ground conditions should be described, with an indication of the uncertainty of the prediction. Major changes in strata should be highlighted, eg rockhead or granular bands in clay. Groundwater levels, strata permeability and likely inflows to the tunnel should be assessed. The effect of the ground conditions on possible construction methods, lining designs and drainage measures should be discussed. Likely ground movements and their effect on adjacent structures should be assessed, together with any mitigating measures. The possibility of encountering gas, old mine workings or other hazards, and any precautions or remedial works should be evaluated. Any other critical factors should be reported.

(viii) Pavement - Subgrade Conditions

The philosophy behind the selection of subgrade strength values should be explained. Critical formation conditions related to pavement design, construction and behaviour should be presented together with information on which these are based. All drainage measures deemed necessary or desirable should be outlined. The nature, purpose and expected behaviour of such drainage works should be presented together with any time dependent criteria.

(ix) Groundwater

The soil and water chemistry relating to the occurrence of harmful elements and the necessary precautions required in design should be detailed.

(x) Geotechnical Processes

Any suggested techniques for dewatering, grouting, stabilisation, soil nailing, reinforced earth etc should be outlined with an explanation of the location, type of process, purpose and expected performance.

(xi) Instrumentation and Monitoring

The nature, location, and purpose of any instrumentation and monitoring deemed necessary should be outlined. A suggested programme should be provided in each case.

(xii) Contamination

All areas where contamination is present should be identified, with the nature of the contamination and potential risk to the scheme assessed. The selection criteria for unacceptable (Class U2) materials and possible methods of treatment to render the material acceptable should be discussed (Detailed advice is given in HA 73).

(xiii) Ground Movements

This should include a discussion of anticipated ground movements likely to be caused by the works and their effect on surrounding property or the environment. The effect of construction methods on the magnitude and rate of ground movement should be discussed, together with any means of mitigating the effects.

(xiv) Problem Areas

A list should be made of all areas which are considered likely to present problems during construction and which require further investigation and analysis. The proposed methods of investigation and analysis should be outlined.

(xv) Other Significant Characteristics

Any unusual and/or relevant characteristics of particular materials should be emphasised and in-situ and laboratory test results processed to illustrate the particular characteristic. These should be presented in 'H. APPENDICES' and cross referenced in the text.

(xvi) Outstanding Factors

All the outstanding factors not covered by the report should be presented together with the reasons for them not being covered and the suggested investigation procedure required to provide solutions should be outlined. This should also cover fieldwork and laboratory work needed as a result of changes in the geometry or location of the route during the currency of the report production but after the fieldwork on which it is based is completed.

G. ENGINEERING RECOMMENDATIONS

Each earthwork and each structure (including tunnels) should be listed in chainage order and accompanied by an agreed name for the structure or earthwork. In each case the recommended geometry, soils properties selected for design purposes and all procedural notes and associated problems noted and cross referenced to the relevant sections of F above. The precise format of this section is to be agreed with the Design Organisation.

H. APPENDICES

Longitudinal and cross sections should be included for each earthwork or structure, and elsewhere where relevant, at a scale of 1:1000 horizontal to 1:100 vertical or as agreed with the Design Organisation and giving the following information where applicable.

(i) The existing ground level along the centre line.

(ii) The road profile provided by the Design Organisation.

(iii) Vertical and horizontal scales, the vertical scale having a suitable datum line appropriate for use in reading the data.

(iv) The exploratory holes, identified and projected normally on to the road profile and drawn with each stratum represented by a symbolic legend to be agreed with the Design Organisation.

(v) All instances where groundwater was encountered and minimum and maximum standing and piezometric water levels.

(vi) The shear strength test results, standard penetration test results and CBR test results plotted against locations from which samples were taken.

(vii) The location of consolidation, particle size distribution, and other tests as appropriate.

(viii) For soils in cuttings the percentage moisture content and index property tests plotted against locations from which samples were taken.

In addition sections should be used to indicate:

(i) the location of acceptable and unacceptable materials assessed for each cutting and the optimal use of these materials;

(ii) the predicted design CBR values at foundation level together with any details of suggested capping layer construction.

All data in 'H. APPENDICES' should be cross referenced to the text.

ANNEX C

LIST OF CUSTODIANS OF PLANS OF ABANDONED MINES

C.1 The present requirements governing abandoned mine plans are set out in section 20 of the Mines and Quarries Act 1954 supplemented by regulations 12-14 of the Coal and Other Mines (Surveyors and Plans) Regulations 1956 and the Coal and Other Mines (Abandonment Plans) Rules 1956. The owner of an abandoned mine is required, within fifteen months of its abandonment, to send plans thereof to the inspector for the district.

It is highly likely that records of mines abandoned before 1872 will be incomplete for the following historical reasons. Although accurate plans of mine workings were required to be kept as early as 1855 under the 'General Rules to be observed in all Coal Mines', it was not until the Coal Mines Regulation Act 1872 came into force that mine owners were required to send plans of any abandoned mine, within fifteen months of its abandonment, to the Secretary of State; similar provisions were made for miscellaneous mines in the Metalliferous Mines Regulation Act 1872. The requirements relating to plans of abandoned mines were continued in subsequent regulations in the Coal Mines Regulation Act 1887 and the Coal Mines Act 1911. Following the Report of the Departmental Committee on the Prevention of Dangers in Mines from Accumulations of Water or Other Liquid Matter in 1927, the Secretary of Mines issued an appeal to royalty owners and others voluntarily to deposit in the Mines Department, or to furnish for registration particulars of, old plans in their possession, particularly those made before 1872. The appeal had a generous response enabling the Mines Department to issue a new and greatly enlarged Catalogue of Plans of Abandoned Mines. A similar appeal was made in 1974 following the disaster at Lofthouse Colliery.

Section 20(4) of the Act states that plans shall be preserved by the Minister or some other person under arrangements made or approved by the Minister. The plans may now be viewed in the following places.

(a) All UK coal mines and Scottish oil shale mines:

The Coal Authority
Mining Records Department
Bretby Business Park
Ashby Road
Burton-on-Trent
Staffordshire DE15 0QD

(b) Non-coal mines:

(i) England and Wales - list of contacts in local authorities

AVON
Mr J E Orton
P.O. Box 11
Avon House
The Haymarket
Bristol
BS99 7DE
Tel: 0117 929 0777

BIRMINGHAM
Mr N Kingsley
Central Library
Chamberlain Square
Birmingham
B3 3HQ
Tel: 0121 235 4219

CHESHIRE
Mrs H Haynes
Cheshire County Council
County Hall
Chester
CH1 1SF
Tel: 01244 602246

CLEVELAND
Mr D H Tyrell
County Archivist
Exchange House
6 Marton Road
Middlesborough
Cleveland
TS1 1DB
Tel: 01642 248321

CLWYD
Mr A G Vesey
Clwyd County Archivist
The Old Rectory
Harwarden
Deeside
Clwyd
CH5 3NR
Tel: 01244 532364

CORNWALL
Christine North
County Archivist
Cornwall Record Office
County Hall
Truro
TR1 3AY
Tel: 01872 73698/74282

CUMBRIA
Mr R J Gillanders
British Geological Survey
Murchison House
West Mains Road
Edinburgh
EH9 3LA
Tel: 0131 667 1000

DERBYSHIRE
Margaret Sullivan
Director of Education
Derbyshire Records Office
County Offices
Ernest Bailey Buildings
New Street
Matlock
DE4 3AG
Tel: 01629 580000 ext 35202

DEVON
Mr P Trott
Devon County Council
County Hall
Grace Road
Exeter
EX2 4QD
Tel: 01392 382295

DUDLEY
Mrs K Atkins
Dudley Metropolitan Borough
5 Ednam Road
Dudley
West Midlands
DY1 1HL
Tel: 01902 880011

DURHAM
Miss J Gill
The County Archivist
County Record Office
Durham
DH1 5UL
Tel: 0191 386 4411 ext 2533

DYFED
Mr J Owen
County Archivist
County Record Office
Carmarthen
Dyfed
SA31 1LQ
Tel: 01267 233 333 ext 4182

GLOUCESTERSHIRE
Mr D H Smith
County & Diocesan Archivist
County Record Office
Clarence Row
Alvin Street
Gloucester
GL1 3DW
Tel: 01452 425294

GWENT
Mr D Tibbott
County Archivist
County Record Office
Gwent County Council
County Hall
Cwmbran
Gwent
NP44 2XH
Tel: 01633 838838

GWYNEDD
Mr B R Parry
Archivist & Museum Officer
Gwynedd County Council
County Offices
Caernarfon
Gwynedd
LL55 1SH
Tel: 01286 672255

ISLE OF MAN
Mrs J Connor
Manx Museum
Kingwood Grove
Douglas
Isle of Man
Tel: 01264 675522

LANCASHIRE
Mr K Hall
Lancashire County Council
Lancashire Record Office
Bow Land
Preston
PR1 2RE
Tel: 01772 54868

LEICESTERSHIRE
Mrs G Jones
Leicester Record Office
57 New Walk
Leicester
LE1 7JB
Tel: 0116 254 4100 ext 238

LINCOLNSHIRE
C P C Johnson
Lincoln Archives Office
The Castle
Lincoln
LN1 3AB
Tel: 01522 525158

MANCHESTER
Miss M Patch
County Records Office
56 Marshall Street
New Cross
Manchester
M4 5FU
Tel: 0161 832 5284

MERSEYSIDE
Miss A M Boyle
St Helens M B C
Legal Department
Town Hall
Corporation Street
St Helens
WA10 1HP
Tel: 01744 24061

MID GLAMORGAN
Mrs P Moore
Archivist
Glamorgan Record Office
County Hall
Cathays Park
Cardiff
CF1 3NR
Tel: 01222 780282

NORTHAMPTONSHIRE
Miss R Watson
County Archivist
Northamptonshire Record Office
Wooton Hall Park
Northampton
NN4 8BQ.
Tel: 01604 762129

NORTHUMBERLAND
Mrs F Bird
County Record Office
Melton Park
North Gosforth
Newcastle Upon Tyne
NE3 5QX
Tel: 0191 236 2680

NOTTINGHAMSHIRE
Mr A Henstock
Nottingham Archives Service
County Hall
High Pavement
NG1 1HR
Tel: 0115 9504524

NORTH YORKSHIRE
Mr M Y Ashcroft
County Archivist
Malpas Road
Northallerton
N. Yorkshire
DL7 8AF
Tel: 01609 777585

POWYS
Mr N Holt
County Solicitor
Powys County Council
Powys County Hall
Llandrindod Wells
Powys
LD1 5LG
Tel: 01597 826368

SHEFFIELD
Mr R Childs
Principal Archivist
Central Library
Surrey Street
Sheffield
S1 1XZ
Tel: 01742 734711

SHROPSHIRE
Miss Bagley
Head of Records
County Record Office
The Shirehall
Abbey Foregate
Shrewsbury
Shropshire
SY2 6ND
Tel: 01743 252851

SOMERSET
Mr A Green
County Record Office
County of Somerset
Orbridge Road
Taunton
TA2 7PU
Tel: 01823 337 600 or
01823 278 805 or
01823 276 813

SOUTH YORKSHIRE
Mr G A Ball
Barnsley MBC
S/YKS Mining Advisory Service
Central Office
Kendray Street
Barnsley
S70 4JA
Tel: 01226 770770

STAFFORDSHIRE
Mr D Fowkes
Staffordshire County Archivist
Staffordshire Records Office
County Buildings
Eastgate Street
Stafford
ST16 2LZ
Tel: 01785 223121 ext 8380

SURREY
Miss W Bowhill
Surrey County Council
The Chief Executive's Office
County Hall
Kingston Upon Thames
KT1 2DN
Tel: 0181 541 9156

TYNE & WEAR
Mr B Jackson
Tyne & Wear Archives Service
Blanford House
Blanford Square
Newcastle Upon Tyne
NE1 4JA
Tel: 0191 232 6789

WALSALL
Mr C Latimer
Walsall Local History Centre
Essex Street
Walsall
WS2 7AS
Tel: 01922 721305

WARWICKSHIRE
Mrs C Woodland
Assistant Archivist
County Record Office
Priory Park
Cape Road
Warwick
CV34 4JS
Tel: 01926 422735

WEST MIDLANDS
Joy Higgs
Archives Section
Smethwick District Library
High Street
Smethwick
West Midlands
B66 1AB
Tel: 0121 558 0497

WEST YORKSHIRE
Mr Frost
West Yorks Archives Services
Registry of Deeds
Newstead Road
Wakefield
WF1 2DE
Tel: 01924 295982

WILTSHIRE
Mr E W Jones
Wiltshire County Council
County Hall
Trowbridge
Wiltshire
BA14 8JN
Tel: 01225 753641

WOLVERHAMPTON
Ms E A Rees
Wolverhampton Library
& Services Division
Snow Hill
Wolverhampton
WV1 3AX
Tel: 01902 714579

WORCESTER
Mr A W Wherry
County Archivist
Hereford & Worcester County Council
Spetchley Road
Worcester
WR5 2NP
Tel: 01905 763763 ext 6350

(ii) Scotland

Mr R J Gillanders
Records Officer
British Geological Survey
Murchison House
West Mains Road
Edinburgh
EH9 3LA
Tel: 0131 667 1000

(iii) Northern Ireland

Mr H Sinclair
Department of Environment (NI)
Planning Service Headquarters
Clarence Court
10 - 18 Adelaide Street
Belfast
BT2 8GB
Tel: 01232 540636

and

Mrs G McCulloch
Department of Economic Development
Minerals and Petroleum Unit
Netherleigh
Massey Avenue
Belfast
BT4 2JP
Tel: 01232 529900

ANNEX D

EXAMPLE BILL OF QUANTITIES

Item	Description	Quantity	Unit	Rate	£ p
	GENERAL ITEMS AND PROVISIONAL SUMS				
1	Erection, servicing and dismantling offices for the Engineer		Item		
2	Erection, servicing and dismantling offices and stores for the Contractor		Item		
3	Vehicle Type 1 for the Engineer		V/Wk		
4	Establishment on site of all equipment		Item		
5	Photographs		No.		
6	Bound photograph volumes		No.		
7	Traffic Safety and Management		Item		
8	Allow for Engineer's telephone calls	Provis'	Sum		
9	Allow for any special testing instructed by the Engineer	Provis'	Sum		
10	Allow for returning to site to carry out additional work ordered by the Engineer within the Contract period	Provis'	Sum		

Total for General Items and Provisional Sums Carried to Summary _____

_____

Item	Description	Quantity	Unit	Rate	£ p
	SITE OPERATIONS				
	Moving of Equipment				
1	Move boring equipment to the site of each exploratory hole		No.		
2	Move drilling equipment to the site of each exploratory hole		No.		
3	Move pitting and trenching equipment to the site of each exploratory hole		No.		
	Boring				
4	Cable percussion boring in a vertical exploratory hole 150 mm dia. between existing ground to not exceeding 10 metres depth		m		
5	Cable percussion boring in a vertical exploratory hole 150 mm dia. between 10 metres to not exceeding 20 metres depth		m		
6	Backfilling in a vertical exploratory hole 150 mm dia. between ground level to not exceeding 10 metres depth with excavated material		m		
7	Backfilling in a vertical exploratory hole 150mm dia between 10 metres to not exceeding 20 metres depth with excavated material		m		
	Hard Strata and Obstructions				
8	Break out hard strata and obstructions with cable percussion boring equipment		m		
	Rotary Drilling				
9	Rotary drilling to produce continuous cores in a vertical exploratory hole 76 mm dia. between existing ground to not exceeding 10 metres depth		m		
		To Collection			

SITE OPERATIONS (continued)

Item	Description	Quantity	Unit	Rate	£ p
10	Rotary drilling to produce continuous cores in a vertical exploratory hole 76 mm dia. between 10 metres to not exceeding 20 metres depth		m		
11	Backfilling in a vertical exploratory hole 76 mm dia. between ground level to not exceeding 10 metres depth with sand		m		
12	Backfilling in a vertical exploratory hole 76 mm dia. between 10 metres to not exceeding 20 metres depth with sand		m		
	Inspection Pits, Trial Pits and Trenches				
13	Excavate topsoil in trial pit		m^3		
14	Excavate soil in trial pit between existing ground to not exceeding 1.2 metres depth		m^3		
15	Backfill trial pit with excavated material between existing ground to not exceeding 1.2 metres depth		m^3		
16	Leave open trial pit		m^2/day		
	Standing Time of Equipment				
17	Standing time of boring equipment		h		
18	Standing time of drilling equipment		h		
19	Standing time of pitting and trenching equipment		h		
	Sampling				
20	Small disturbed samples weighing not less than 1.0 kg		No.		
21	Bulk disturbed samples weighing not less than 25 kg		No.		
	To Collection				

SITE OPERATIONS (continued)

Item	Description	Quantity	Unit	Rate	£ p
22	Undisturbed samples 100 mm dia. length not less than 450 mm from piston sampling		No.		
23	Groundwater samples not less than 500 ml		No.		
	Standpipes, Standpipe Piezometers and Pneumatic Piezometers				
24	Install standpipe piezometer in exploratory hole 150 mm dia.		m		
25	Piezometer porous elements		No.		
26	Cement/bentonite grout filling to exploratory hole 150 mm dia. below piezometer		m		
27	Cement/bentonite grout filling to exploratory hole 150mm dia. above piezometer		m		
28	Sand filling to exploratory hole 150 mm dia. around piezometer		m		
29	Flush protective covers		No.		
30	Groundwater readings		No.		
31	Remove standpipe piezometer		m		
	Insitu Testing				
32	Penetration resistance test required tests		No.		
33 etc	Other required tests		No.		

To Collection _____

Collection

Page
Page
Page
Page
Page

Total for Site Operations Carried to Summary _____

Item	Description	Quantity	Unit	Rate	£ p
	LABORATORY AND REPORTS				
	Laboratory Tests				
1	Carry out soil laboratory moisture content test		No.		
2	Carry out soil laboratory particle size distribution test		No.		
3 etc	List tests as required		No.		
	Carry out rock laboratory tests as listed		No.		
	Examination and description of samples as listed		No.		
	Report				
	5 copies of Factual Report		Item		
	5 copies of Interpretative Report		Item		
	10 copies Digital Data Report		Item		
	Total for Laboratory and Reports Carried to Summary				

SCHEDULES OF SITE OPERATIONS DAYWORKS

These Schedules are the Schedules referred to in Clause 52(3) of the ICE Conditions of Contract for Ground Investigation and have been prepared for use in connection with Dayworks carried out incidental to contract work where no other rates have been agreed.

1. LABOUR

1.1 Preamble

The rates given in the Labour Schedule shall be all inclusive and not subject to any percentage additions. They shall include all statutory and all other charges and costs including:

1.1.1 Wages, bonus, daily travelling allowances (fare and/or time), tool allowance and all prescribed payments including those in respect of time lost to inclement weather paid to workmen at plain time rates and/or at overtime rates.

1.1.2 Subsistence or lodging allowances and periodic travel allowances (fare and/or time) paid to or incurred on behalf of workmen.

1.1.3 Standard Rate National Insurances
Normal Contract Works, Third Party and Employers' Liability Insurances
Annual and Public Holidays with pay
Non-Contributory Sick Pay Scheme
Industrial Training Levy
Redundancy Payments Contribution
Contracts of Employment Act
Site Supervision and Staff

1.1.4 Small Tools - such as picks, shovels, barrows, trowels, hand saws, trestles, hammers, chisels, spanners and all items of a like nature. Protective clothing.

1.1.5 Head office charges and profit.

1.2 Labour Schedule

Item	Description	Quantity*	Unit	Rate*	£ p
1	Supervisor		Hour		
2	Rotary Drilling Foreman		"		
	Operator		"		
3	Rotary Drilling Assistant		"		
4	Rotary Drilling Hand		"		
5	Boring Rig Foreman		"		
	Operator		"		
6	Boring Rig Assistant		"		
7	Boring Rig Hand		"		
8	Senior Technician		"		
9	Technician		"		
10	Assistant Technician		"		
11	Fitter		"		
12	Welder		"		
13	Electrician		"		
14	Scaffolder		"		
15	Driver		"		
16	Watchman		"		
17	Labourer		"		
18	Timberman Foreman		"		
19	Timberman		"		
20	Crane Driver		"		
21	Banksman		"		
22	Digger Driver		"		
23	Boatman		"		
etc					
		To Collection			

* See Explanatory Notes

2. MATERIALS

2.1 Preamble

The Contractor shall state the percentage to be added to the cost of materials delivered to site. This percentage shall allow for the following:

2.1.1 Head office charges and profits.

2.1.2 Handling of materials including loading and unloading.

The cost of materials means the invoiced price of materials including delivery to site with deduction of any cash discounts exceeding 2½ per cent.

2.2 Add to the cost of materials delivered to site.....%.

3. PLANT

3.1 Preamble

The rates given in the Plant Schedule shall apply to plant already on site only, and shall include consumable stores, repairs, maintenance, insurance, fuel including distribution and general servicing and are to be paid for in whole units of time for each item, and for each period of hire.

3.2 Plant Schedule

Item	Description	Quantity*	Unit	Rate*	£ p
1	Rotary drilling rig including pumps and all necessary drilling and coring equipment		Hour		
2	Extra over Item 1 for flushing system other than water (State type)		"		
3	Extra over Item 1 for special equipment (State type)		"		
4	Light cable percussion boring rig with all necessary boring equipment casing SPT equipment and U100 sampling gear		"		
5	Extra over Item 4 for drilling attachment including pumps and all necessary drilling and casing equipment (State type)		"		
6	Extra over Item 4 for special equipment (State type)		"		

Item	Description	Quantity*	Unit	Rate* £ p
7	Pumps (State type)		"	
8	Static cone penetration test equipment		Day	
9	Site vane test equipment		Day	
10	Specialist sampling equipment (State type)		Day	
11 etc	Specialist testing equipment		Day	

To Collection
From Page
From Labour Schedule
Total for Dayworks
Carried to Summary

* See Explanatory Notes

4. SUPPLEMENTARY CHARGES

4.1 Preamble

4.1.1 The cost of transporting to site and removal on completion of additional labour, plant and equipment required for agreed Dayworks additional to that already on site shall be charged at cost plus the percentage stated below.

4.1.2 The cost of additional insurance premiums for abnormal contract work or special site conditions to be charged at cost plus the percentage stated below.

4.2 Add to the cost of providing the transportation referred to in 4.1.1 above .....%.

4.3 Add to the cost of additional insurance premiums referred to in 4.1.2 above.....%.

5. VALUE ADDED TAX

5.1 Value Added Tax has not been included in any of the rates in this Schedule but will be chargeable if payable to HM Customs and Excise by the Contractor.

6. EXPLANATORY NOTES

6.1 The Item Descriptions quoted in the Labour Schedule (paragraph 1.2 above) and the Plant Schedule (paragraph 3.2 above) are suggested examples only and the Engineer shall add to these Schedules the additional labour and plant for which the Engineer requires Daywork rates to be entered and delete any which is deemed to be inappropriate.

6.2 In order to include for a Dayworks element within the total Tender Sum, the Engineer should enter in both the Labour and Plant Schedules against each item an estimated quantity which the Engineer considers reasonable for that particular contract. These quantities will provide a guide to the tenderers when arriving at their rates for each item and also allow the calculation of a Dayworks element within the final Tender Sum which can be considered when the tenders are assessed.

6.3 The tenderer shall state the type of plant and equipment intended to be used beside each item as appropriate and shall enter the rates required for that plant. The tenderer shall aggregate the sums for the Labour and Plant Schedules and carry the total sum for Dayworks to the Summary.

SCHEDULE OF RATES FOR PROFESSIONAL AND TECHNICAL STAFF

The rates entered below will be used by the Engineer to make an initial estimate of the cost of employing the Contractor's staff for the preparation of the interpretative and advisory section of the report and for advisory work for the Engineer on site on the conduct of the investigation where ordered. They will also be used for the costing of the final account showing the hours spent by the various grades of staff and their expenses, which will be submitted for the Engineer's agreement.

The Contractor will be required to maintain adequate records of the time spent by each grade of staff and their expenses.

The original time sheets and vouchers for expenses should be made available to the Engineer.

SCHEDULE OF RATES FOR PROFESSIONAL AND TECHNICAL STAFF

Description	Unit	Rate
Technician	Hour	
Incorporated Engineer	Hour	
Graduate Engineer/Geologist/Environmental Scientist	Hour	
Graduate Engineer/Geologist/Environmental Scientist with at least 3 years of relevant experience since graduation	Hour	
Chartered Engineer/Geologist/Environmental Scientist with at least 5 years of relevant experience	Hour	
Principal Chartered Engineer/Geologist/Environmental Scientist with at least 10 years of relevant experience	Hour	
Expenses incurred by staff on site visits or who are resident by agreement with the Engineer		
Fares per mile from permanent station and return for:		
a) Technician and Incorporated Engineer	per mile	
b) Graduate Engineer/Geologist/Environmental Scientist, Graduate E/G/ES with at least 3 years of relevant experience & Chartered E/G/ES with at least 5 years of relevant experience	per mile	
c) Principal Chartered Engineer/Geologist/Environmental Scientist with at least 10 years of relevant experience	per mile	
All other expenses incurred in connection with a site visit where a return journey is made on the same day for:		
a) Technician and Incorporated Engineer	per visit	
b) Graduate Engineer/Geologist/Environmental Scientist, Graduate E/G/ES with at least 3 years of relevant experience & Chartered E/G/ES with at least 5 years of relevant experience	per visit	
c) Principal Chartered Engineer/Geologist/Environmental Scientist with at least 10 years of relevant experience	per visit	
All other expenses incurred in connection with visits where an overnight stay is necessary up to a period of 21 consecutive days for:		
a) Technician and Incorporated Engineer	per day	
b) Graduate Engineer/Geologist/Environmental Scientist, Graduate E/G/ES with at least 3 years of relevant experience & Chartered E/G/ES with at least 5 years of relevant experience	per day	
c) Principal Chartered Engineer/Geologist/Environmental Scientist with at least 10 years of relevant experience	per day	
All other expenses incurred in connection with a stay on site of more than 21 days for:		
a) Technician and Incorporated Engineer	per day	
b) Graduate Engineer/Geologist/Environmental Scientist, Graduate E/G/ES with at least 3 years of relevant experience & Chartered E/G/ES with at least 5 years of relevant experience	per day	