
**VOLUME 4 GEOTECHNICS AND
DRAINAGE
SECTION 1 EARTHWORKS**

PART 2

HD 22/08

MANAGING GEOTECHNICAL RISK

SUMMARY

This Standard sets out the procedures to be followed and certificates to be used during the process of planning and reporting of all Geotechnical Works carried out on highways under the jurisdiction of the relevant Overseeing Organisation to ensure that the Geotechnical Risk is correctly managed.

INSTRUCTIONS FOR USE

This revised Standard is to be incorporated in the Manual.

1. This document supersedes HD 22/02, which is now withdrawn.
2. Remove existing contents page for Volume 4 and insert new contents page for Volume 4 dated August 2008.
3. Remove HD 22/02, which is superseded by HD 22/08, and archive as appropriate.
4. Insert HD 22/08 in Volume 4, Section 1, Part 2.
5. Please 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.



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THE DEPARTMENT FOR REGIONAL DEVELOPMENT
NORTHERN IRELAND

Managing Geotechnical Risk

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REGISTRATION OF AMENDMENTS

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1. INTRODUCTION

Why Geotechnical Certification?

1.1 Geotechnical certification is used to ensure that geotechnical risk is managed throughout the lifetime of a scheme. It is applied to all schemes which involve geotechnical activities and which may pose a risk to the general public, the Overseeing Organisation and/or the Overseeing Organisations's asset.

1.2 The purpose of this standard is to provide a clear and consistent framework to record the management of the geotechnical risk involved in a scheme. Certification is applied as a series of steps at four Key Stages of projects. It is intended that these stages are related to the key stages of decision making within the lifetime of a scheme.

1.3 Third party development may be proposed adjacent to/under or over the highway and, as such proposals will be submitted to the Highways Agency as a statutory consultee in the planning process, it is required that this standard shall be followed by the third party in order that the process is as efficient as possible. As a minimum, Key Stages 1, 2 and 3 will need to be completed. **Where Overseeing Organisation's Highway Projects are referred to in the following sections, this should be taken to apply also to third party projects.**

1.4 This standard establishes the two key personnel who shall ensure that geotechnical risk is managed. These personnel are the Designer's Geotechnical Advisor (DGA) and the Overseeing Organisation's Geotechnical Advisor (GA). A key aspect of effectively managing geotechnical risk is the establishment of liaison between these parties at an early stage of the project.

Background

1.5 This Standard sets out the procedures to be followed and certificates to be used during the process of planning and reporting ground investigations and of the planning, design and construction of Geotechnical Works for the Overseeing Organisation's Highway Projects in England, Wales and Northern Ireland. The purpose of certification is to ensure that the geotechnical risks to such projects are correctly identified, reported and managed. **Whilst the principles behind these procedures are to be adopted for use in Scotland,**

separate certification procedures as set out in SH4 (Ref 17) are currently being retained.

1.6 The Standard was introduced to ensure that the geotechnical risk was properly managed by providing a consistency of approach for geotechnical design and certification for all highway projects. This revision to the Standard reflects changing procurement methods for both design and construction, together with an increase in maintenance work and the need to encourage innovation.

No construction project is risk free.
Risk can be managed, minimised,
shared, transferred or accepted.
It cannot be ignored.

Constructing the Team,
Latham 1994

1.7 An essential part of ensuring value for a project is the identification and management of project risks. All parties involved in a project have a role in ensuring that project risks are identified, overcome or managed. Ground conditions are often uncertain and a risk to any project. The risks from these ground conditions must be managed in a pro-active manner (Ref 1). The main risk that the 1992 standard set out to overcome was that of cost overrun, however, ground related risks affect and influence many facets of construction. The revised standard issued in 2002 introduced simplified and streamlined processes to ensure that ground related risks are correctly managed. The 2002 version of this standard introduced the concept of geotechnical categories based on the complexity and degree of geotechnical risk to the project and followed the guidance given in BS EN 1997-1 (Ref 2).

1.8 The current revision has been based on feedback received from users of the 2002 Standard and is intended to further simplify and improve the process. The reporting process has been also been aligned to reflect the requirements of BS EN 1997-1 and 1997-2 (Refs 2 and 3).

Mandatory Requirements

1.9 Paragraphs of this Standard that are mandatory requirements of the Overseeing Organisations, are highlighted by being contained in boxes. The remainder of the document contains advice and guidance.

Definitions and Abbreviations

1.10 The abbreviations and definitions below are used in the following sections of this standard:

Designer: The Organisation employed to carry out the actual design work required for a project.

Designers Geotechnical Advisor (DGA): The Geotechnical Engineer with the experience appropriate to the project being undertaken, and with the experience and qualifications of a GA as set out by the Site Investigation in Construction Series Documents produced by the Institution of Civil Engineers 1993 (Ref 8), employed by the Designer as Lead Professional, to oversee and act as focal point for the planning, procurement interpretation and implementation of the geotechnical aspects of a project.

Earthworks: Work of excavating or raising of ground.

Geotechnical Activities: Shall include without limitation, the design, construction and maintenance of:

- a) Earthworks.
- b) Strengthened Earthworks.
- c) Ground Investigations, both intrusive and non-intrusive.
- d) Excavation/assessment below sub-base level.
- e) Earth retaining structures.
- f) Structural foundations and excavations.
- g) Excavations for tunnels and service ducts.

Geotechnical Asset: A principal element of the highway network, comprising the foundations to the pavement and structures, together with the land within the highway boundary, through which the route is formed, (including cuttings embankments, pavement

subgrade and a diverse range of natural geological strata and man-made materials).

Geotechnical Design Report: The report setting out assumptions, data, methods of calculation and results of the verification of safety and serviceability as required by BS EN 1997-1.

Geotechnical Engineering: The application of sciences of soil and rock mechanics and engineering geology, in building, civil engineering construction, and the protection of the environment.

Geotechnical Risk: The risk to the project or the Overseeing Organisation's asset created by the site ground conditions, public, environmental, construction and operational activities.

Geotechnical Works: The carrying out of Geotechnical Activities including associated aspects such as the assessment of contamination risks.

Ground Investigation Report: The report presenting all available geotechnical information and an evaluation of that information as required by BS EN 1997-2.

Independent Checking Consultant (ICC): A Geotechnical Consultant employed by the Overseeing Organisation to carry out an independent check of aspects of the geotechnical design.

Managing Agent (MA): The organisation responsible for the day to day management and maintenance of the highway network.

Overseeing Organisation: The governmental or other body with statutory responsibility for the highway.

Overseeing Organisation Site Nominee (OOSN): The representative of the Overseeing Organisation based on site.

SEAF: Strengthened Earthwork Appraisal Form (included in **Appendix E**).

Strengthened Earthworks: Placed or in situ soil or other material, the stability of which has been improved by and including without limitation, inclusions in the form of tensile reinforcement acting through interface friction, bearing or other means, e.g. reinforced soil, soil nailing or by external support such as gabions.

Technical Approval Authority (TAA): The organization responsible for agreeing the Approval in Principle and subsequently accepting the relevant certificates for the design of structures covered by BD 2 (Ref 10).

Third Party: Any person, organisation or other legal entity that is not employed directly or indirectly by the Overseeing Organisation.

Associated Standards and Advice Notes

1.11 The following standards are associated with HD 22:

- HA 44 (DMRB 4.1.1 Ref 4) –Earthworks - Design and preparation of contract documents
- HD 41 (DMRB 4.1.3 Ref 5) – Maintenance of highway geotechnical assets
- HA 73 (DMRB 4.1.7 Ref 6) – Specific advice in relation to ground investigations on contaminated land
- HA 74 (DMRB 4.1.6 Ref 7) – Treatment of Fill and Capping Material Using Either Lime or Cement or Both

Scope and Application

1.12 This Standard sets out in four Key Stages the procedures and documentation to be used for all geotechnical works on Overseeing Organisation Highway Projects and projects that affect the Overseeing Organisation's asset. The purpose of the Standard is to ensure that the geotechnical risks are identified and managed. This process is backed up by the submission of one or more Geotechnical Certificates as appropriate.

1.13 The procedures are applicable to:

- a) Projects promoted by the Overseeing Organisation, where the Overseeing Organisation is responsible for procurement of both the design and construction.
- b) Projects promoted by the Overseeing Organisation, where the design and construction procurement is the responsibility of a Third Party.

- c) Those parts of projects promoted by a Third Party, where they adjoin or otherwise affect highways under the jurisdiction of the Overseeing Organisation.
- d) Planning applications/projects referred to the Overseeing Organisation for direction, where they adjoin or otherwise affect a highway under the jurisdiction of the Overseeing Organisation.
- e) **In Scotland, for road projects promoted by the Trunk Road Authority, the principles of this Standard are to be adopted, but differing organisational structures mean that separate certification and checking requirements as set out in SH 4 /89 (Ref 21) are currently being retained.**

1.14 All projects where Geotechnical Activities (as defined in 1.10) are involved shall be certified by the Design Organisation. As well as the projects indicated in paragraph 1.13, the procedures set out in this Standard are also required for the following processes, whether carried out as part of another project, or as projects in their own right:

- a) Where geotechnical information is required as part of assessment, design and or remedial works for structures covered by BD 2 (Ref 10).
- b) Installation by trenchless or other techniques of service crossings, where the internal diameter of that crossing is 2000mm or less.
- c) The design of remedial works to rectify defects affecting the geotechnical asset.
- d) Temporary works involving geotechnical activities that affect the Overseeing Organisation's asset.

1.15 This Standard also introduces the requirements for all Strengthened Earthworks to be individually appraised, using the SEAF, which mirrors the Approval in Principle process that is used for highway structures and described in BD 2 (Ref 10).

Implementation

1.16 This Standard shall be used forthwith on all projects currently in preparation except where the preparation of a contract has reached a stage at which, in the opinion of the Overseeing Organisation, its use would result in significant additional expense or delay progress.

Liaison between Overseeing Organisation and Design Organisation

1.17 Each Overseeing Organisation shall have on its staff, or shall appoint, a GA with responsibility for the geotechnical aspects of the work of the Overseeing Organisation. For each project, the Designer shall also appoint a lead professional of DGA as defined in Site Investigation in Construction Series Documents (Ref 8), as their focal point for all the geotechnical aspects of that project. The GA and the DGA shall liaise on the geotechnical aspects of the project.

Independent Checking – Application to Scotland only

1.18 The Overseeing Organisation may from time to time appoint a Geotechnical Consultant to carry out an Independent Check of the Geotechnical Design of a project. This Consultant shall be called the ICC. The ICC may where required by the Overseeing Organisation act as the Overseeing Organisation's GA. Procedures in regard to the requirements and adoption of the geotechnical certification and checking process in Scotland are set out in SH4 /89 (Ref 17).

Construction, Design And Management (CDM) Regulations

1.19 The reports produced as part of the Geotechnical Certification process can be used to fulfil the requirements of the CDM regulations (Ref 9) as they shall document the residual project Health and Safety risks and the methods employed to avoid, reduce and control these. The reports shall be included in any tender documentation and the pre-construction information and construction phase plan. They shall subsequently form part of the Health and Safety File.

Geotechnical Certificate

1.20 A Geotechnical Certificate signed by the DGA shall accompany ALL geotechnical submissions made by the Designer to the Overseeing Organisation. A model Geotechnical Certificate is presented in Appendix A. This Certificate may, if required, be incorporated within the contract documentation for a project; as part of the contract certification for that project. On receipt of a Geotechnical Certificate and its accompanying submission, the Overseeing Organisation or its representative will respond within a time limit laid down in the relevant contract documentation or within any such other time limit agreed (generally 28 days). The professional responsibility for the geotechnical work rests with the Designer, and any agreement given by the Overseeing Organisation in the course of the Geotechnical Certification process shall not relieve the Designer of that responsibility.

2. MANAGEMENT OF GEOTECHNICAL RISK

2.1 To be effective in terms of reducing risk and identifying opportunities, geotechnical risk management should be started as soon as possible following project identification. Appendix A of Standard HD 41 (Ref 5) provides advice on what constitutes geohazards that pose risks and will need to be considered when developing the risk registers for a project. The establishment of the Geotechnical Risk Register is an essential part of these procedures and is developed and refined as the project progresses.

2.2 Geotechnical risk management should not be carried out in isolation, but should be considered as an integral part of the whole of the project process from initial planning through to construction and completion. The processes set out in this Standard will require interaction between all members of the project team.

2.3 To ensure that the geotechnical risks are identified and then correctly managed this Standard requires the project team to follow a logical sequence of reporting and review of the geotechnical design process. The Standard sets out Key Stages to be followed during the process of planning and reporting Geotechnical Activities (**as defined in 1.10**) for all highways under the jurisdiction of the relevant Overseeing Organisation. These Key Stages link in with the major parts of the overall project procurement process.

2.4 There are four Key Stages in the Geotechnical certification procedure. These stages are arranged to be an integral part of the overall project progression to ensure the procurement of the geotechnical information necessary to undertake an accurate assessment of project risks. They are listed below:

Key Stage 1 Initial Review of Project and Geotechnical Risks to determine its **Geotechnical Classification** and thus the requirement for Geotechnical Certification: *This stage ensures that potential geotechnical risks are identified at project inception. The requirements for specialist geotechnical processes are also assessed at this stage. The document required from the Designer at this stage is the Statement of Intent (See Appendix B.)*

Key Stage 2 Preliminary Assessment including Preliminary Certification: *This stage contributes to the preparation of the outline design and where necessary the requirement for land acquisition and orders preparation. The documents required from the Designer at this stage are the Preliminary Sources Study Report (Desk Study) and the Ground Investigation Report. (See Appendices C and D.)*

Key Stage 3 Geotechnical Design and Construction Certification: *This stage provides the information for the detailed design and for the contractor to prepare and carry out construction. The output required from the Designer at this stage is a Geotechnical Design Report with all sections completed prior to construction of relevant areas. (See Appendix E.)*

Key Stage 4 Geotechnical Feedback: *This stage reports on all construction work and particularly any unexpected ground conditions requiring changes to design that occurred. This Key Stage is a requirement in contracts let by the Overseeing Organisation. The output required from the Designer at this stage is the Geotechnical Feedback report (See Appendix F.)*

2.5 The Statement of Intent, Preliminary Sources Study Report (Desk Study), the Ground Investigation Report, the Geotechnical Design Report and the Feedback Report comprise the main requirements for this Standard. These reports are supported by a single certificate system included in Appendix A.

3. GEOTECHNICAL CERTIFICATION PROCEDURES

3.1 The **Geotechnical Classification** shall be agreed by the Overseeing Organisation and the Designer, irrespective of procurement method or design/construction responsibility, as part of the Key Stage 1 as soon as the project brief has been agreed.

3.2 Depending on the complexity of the proposed geotechnical works and the geotechnical risk implications to health and safety, all projects shall have their **Geotechnical Classification** established by being placed in one of the geotechnical categories which follow the guidance given in BS EN 1997-1 (Ref 2).

Geotechnical Category 1: Projects which only include small and relatively simple structures, earthworks or geotechnical activities, for which it is possible to ensure that the fundamental requirements will be satisfied on the basis of experience and qualitative geotechnical investigations. The Geotechnical activities/structure must also carry a negligible risk in terms of overall stability, ground movements and known ground conditions. In these cases the procedures may consist of routine methods for foundation design and construction.

Category 1 procedures should only be used where there is no excavation below the water table or where comparable local experience indicates that a proposed excavation below the water table will be straightforward.

Geotechnical Category 2: Projects which include conventional types of geotechnical structures, earthworks and activities, with no exceptional geotechnical risks, unusual or difficult ground conditions or loading conditions. Designs for Category 2 should normally include quantitative geotechnical data and analysis to ensure that the fundamental requirements are satisfied. Routine procedures for field and laboratory testing and for design and execution may be used.

The majority of geotechnical activities associated with highways should fall into this category.

Geotechnical Category 3: Projects which involve geotechnical activities or structures which fall outside the limits of Categories 1 and 2. These projects include very large, unusual or complex geotechnical activities, earthworks and structures or those involving abnormal geotechnical risks or unusual or exceptionally difficult ground conditions.

3.3 These classifications are determined on the basis of the geotechnical works and risk implications. They do not necessarily correspond to the categories adopted for technical approval to BD 2 and a Category 3 structure may not correspond to Geotechnical Category 3. For example, a complex structure may have conventional foundations or a conventional structure may be located in an area where abnormal geotechnical risks are present. Determination of the geotechnical classification in such situations should include discussions with the structural designer and Technical Approval Authority (TAA).

3.4 Following the Initial Review in Key Stage 1, all projects that clearly involve geotechnical activities or where there is a possibility that they may be required, shall be placed in one of the Geotechnical Categories 1-3.

3.5 For projects where, at the outset, it is clear that geotechnical activities are absent, the project file shall be annotated to that effect and no further action need be taken unless the project brief is amended. The **Geotechnical Classification** shall be reviewed if there is a change to the project brief. Subsequent Certification procedures will depend on that revised **Geotechnical Classification**, type of project or the procurement method to be used.

3.6 Projects shall have their **Geotechnical Classification** reassessed at each Key Stage. This reassessment may indicate that for some projects, no further Geotechnical Certification is required. For these projects the Overseeing Organisation will

record this decision in the project file and notify the Designer of the reclassification. For projects retaining a **Geotechnical Category** of 1 to 3 the Geotechnical Certification process appropriate to that classification shall be followed.

3.7 The Geotechnical Certification Process is described in subsequent sections 4 to 7 of this Standard.

a) Key Stage 1: Initial Review of Project – Section 4

This section outlines the areas to be considered when making an assessment on the requirement for a project to be subject to Geotechnical Certification and for the Geotechnical Category to be assigned. The Initial Review is to be undertaken by the Designer and reported in the Statement of Intent, which should be produced for all projects where geotechnical activities are involved. However, in the event of any excessive delays in the project procurement or any change in the Design Organisation, a new Statement of Intent will be required, regardless of the current stage of the project.

b) Key Stage 2: Preliminary Certification – Section 5

All projects, where geotechnical activities are, or may be, envisaged shall be subject to the Preliminary Certification procedures. This section details the requirements for this Preliminary Certification. The method of procurement will determine the subsequent certification requirements, which will be agreed by the Overseeing Organisation.

For Category 1 projects, a separate Preliminary Sources Study Report is not required; reporting of the desk study can be incorporated in the Ground Investigation Report.

c) Key Stage 3: Geotechnical Design and Construction Certification – Section 6

The requirements for reporting at Key Stage 3 apply to all projects where geotechnical activities occur. Paragraphs 1.13 and 1.14 provide further information.

Geotechnical Specialist Process Certification: Requirements for Strengthened Earthworks

When a designer of any project, irrespective of the method of procurement, proposes the use of Strengthened Earthworks, they shall obtain acceptance to their design proposals by submitting a Strengthened Earthworks Appraisal Form (SEAF).

d) Key Stage 4: Geotechnical Feedback – Section 7

There is a contractual requirement to provide as built information for all projects undertaken on behalf of the Overseeing Organisation. For geotechnical activities, this is presented in the form of a Geotechnical Feedback Report and this report forms the final part of the Geotechnical Certification for a project.

Geotechnical Reports – General Requirements

3.8 A fundamental requirement of the Geotechnical Certification process is the production of reports to accompany the Geotechnical Certificates. The reports must demonstrate how the geotechnical risks on a project are to be managed during the design and construction of a project. An overview of the requirement of the reports is given in this section and the required formats are presented in the Appendices B to F.

The five reports are as follows:

- Statement of Intent (SoI).
- Preliminary Sources Study Report (PSSR).
- Ground Investigation Report (GIR).
- Geotechnical Design Report (GDR).
- Geotechnical Feedback Report (GFR).

3.9 The aim of these reports is to set out, in a logical manner, the Design Organisation's processes in identifying and overcoming or managing geotechnical risks on a project. The Geotechnical Design Report is a key document, which clarifies how the geotechnical design was undertaken and forms part of the records for the project.

3.10 The geotechnical reports produced as part of the Geotechnical Certification process are intended to be living documents, in that they shall be updated and amended as the design progresses, information becomes available and geotechnical risks are identified and resolved. Should the method of procurement or design organisation be changed during the life of the project, geotechnical information produced for the project shall be transferred. The outgoing Designer shall complete and certify the geotechnical reporting to the stage required at handover. Any reports so certified shall be passed to the new Designer, as part of information provided with the contract documentation for the procurement of the project. Responsibility for the information in any reports handed over shall pass to the new Designer. If the new Designer is not content with the information so provided this shall be made clear and the subsequent versions of the reports that are produced shall cover these issues.

3.11 The content of the various reports will depend on the geotechnical complexity of the project. However the report section numbering indicated in Appendices B, C, D and F shall be adhered to irrespective of project size, with sections not being used or not relevant being noted as such in the contents page of each report. The final content requirements will be agreed between the Overseeing Organisation's Geotechnical Advisor and the Designer's Geotechnical Advisor. For projects within Geotechnical Category 1 it is acceptable to produce a shortened form of report to the same format that addresses the areas where geotechnical risk needs to be managed.

3.12 All geotechnical reports produced under the auspices of Geotechnical Certification are intended to be open documents and available to all parties during the progress of a project throughout its design, tender and construction phases.

3.13 One hard and one electronic copy of the final version of all reports, produced for a project, shall be issued to the Overseeing Organisation. For projects undertaken on behalf of the Highways Agency, these records will be retained in their Archive which is contained within the Highways Agency's Geotechnical Data Management System (HAGDMS). Full details of the requirements for the formatting and presentation of electronic reports for HAGDMS are available from HAGDMS. In brief, this comprises a copy of all reports in Adobe Acrobat .pdf format on a master CD or DVD along with factual Site Investigation data in AGS (Association of Geotechnical and Geo-environmental Specialists) data transfer format, as detailed in MCHW.

3.14 One copy of any factual report produced for the project shall be forwarded to the British Geological Survey, Kingsley Dunham Centre, Keyworth, Nottingham NG12 5GG, for inclusion in the National Borehole Database. In Northern Ireland any factual report shall be forwarded to the Geological Survey of Northern Ireland, 20 College Gardens, Belfast, BT9 6BS.

3.15 **[Scotland only]** Whilst the precise form of the Geotechnical Reporting detailed in this Standard is not mandatory in Scotland, the principles and functions of the Geotechnical Report System are endorsed and recommended for consideration for usage on Scottish trunk road work. Accordingly the Overseeing Organisation may take the view on a project specific basis, that individual contracts are to include a requirement for the production, on a developing basis, of a designer prepared Geotechnical Report.

4. KEY STAGE 1: INITIAL REVIEW OF PROJECT

4.1 In order to establish the Geotechnical Certification requirements of a project it shall be reviewed to determine its Geotechnical Category.

4.2 To determine the Geotechnical Category, the complexity of the project shall be identified together with the geotechnical activities that may be involved. These shall be assessed together with the risks posed by and to the project. The Geotechnical Categories are defined in paragraph 3.2 based on the requirements of BS EN 1997-1.

4.3 Following the Initial Review, determination of geotechnical classification and appointment of the Design Organisation, the Designer's Geotechnical Advisor shall submit a "**Statement of Intent**" to the Overseeing Organisation. The Statement of Intent is intended to identify known or suspected geotechnical risks and to state the scope, purpose, estimated programme and cost of the initial geotechnical assessments to Preliminary Certification at **Key Stage 2**. This shall also include the preparation of the preliminary Geotechnical Risk Register. The format of the Statement of Intent is mandatory and is given in **Appendix B**. It is intended to be a brief document and for many projects will take the form of a letter.

4.4 The Statement of Intent shall be subject to the agreement of the Overseeing Organisation's Geotechnical Advisor, before the Designer's Geotechnical Advisor proceeds to Key Stage 2. This stage enables early dialogue to be established between these parties.

4.5 The Statement of Intent may form part of any Commissioning Report that the Designer is required to produce on appointment. However, the Statement of Intent must still be submitted to the Overseeing Organisation's Geotechnical Advisor as part of the certification process.

4.6 For projects with a geotechnical classification of 2 or 3, the Design Organisation a separate Preliminary Sources Study Report (Desk Study) and Ground Investigation Report, as appropriate, should be prepared and submitted for Key Stage 2.

4.7 For Geotechnical Category 1 projects, a separate Preliminary Sources Study Report is not required.

4.8 For projects, which clearly indicate that no geotechnical activities will be involved, there is no need for them to be assessed further and the Project file shall be annotated accordingly.

5. KEY STAGE 2: PRELIMINARY CERTIFICATION

5.1 There are two outputs from Key Stage 2: The Preliminary Sources Study Report (Desk Study) and the Ground Investigation Report. For Category 1 schemes, a separate Preliminary Sources Study Report (PSSR) is not required; reporting of the desk study can be incorporated in the Ground Investigation Report (GIR). The PSSR shall be completed as a matter of priority after project inception. It shall cover the geotechnical and other investigation implications for the feasibility of all project options. The PSSR is an important document for the Overseeing Organisation to use when assessing the Health and Safety hazards and environmental aspects presented by a project, especially as part of any initial route determination. The mandatory format for the report is given in Appendix C.

Preliminary Sources Study

5.2 The content of the PSSR shall cover the geotechnical risks, implications and feasibility of all scheme options. Reference shall be made to the AGS Guide to the Model Document (Ref 11), TRL Report 192 (Ref 12) and BS 5930 (Ref 13) when preparing the document.

5.3 The PSSR is required for all Category 2 and 3 projects and includes a site reconnaissance. The PSSR is an important document, not only from a geotechnical viewpoint but also because the **Geotechnical Risk Register** (Ref 1) assists the Overseeing Organisation in assessing the complexity and history of the site, especially with reference to the Health and Safety hazards presented. The register establishes the approach required to manage those risks identified and provides the geotechnical input into the assessment of project risks required by documents such as the Highways Agency's Value for Money Manual (Ref 16).

5.4 For Geotechnical Category 1 projects, the desk study should be reported as part of the GIR. Following acceptance of the Statement of Intent, the Designer shall carry out any agreed investigations in order to produce the GIR and following a review of the risks, confirm that the project category is correct.

5.5 The PSSR shall address the geological, geotechnical, geomorphological, hydrological and geo-environmental aspects of the project site as well as the historical development of the area. Contamination risks shall be investigated and reported on.

5.6 The PSSR shall give a preliminary engineering assessment of the project area and inform of any likely hazards to construction. It shall identify the risks and consequences to the project of the information gained and using the risk register establish the means to manage those risks.

5.7 The PSSR, within its Annex A, shall develop the objectives and methodology for phased investigation of ground conditions, which should cover both geotechnical and geo-environmental requirements.

5.8 On the basis of the information gathered for the PSSR, the significant geotechnical issues will be identified and it will be possible to assess the vulnerability of a project to these issues and to any associated hazards. The initial risk register produced as part of the Statement of Intent shall be updated to reflect the greater amount of site specific information that is now available. This updating of the risk register is part of the risk management system which shall be repeated through to project completion as more data becomes available.

5.9 The PSSR shall confirm or amend the project's **Geotechnical Classification** and the Overseeing Organisation's Geotechnical Advisor (GA) may decide, subsequent to receipt of the PSSR, that no further Geotechnical Certification is required. Should the brief for the project be revised, then the original Statement of Intent shall be revised as necessary, and a decision made by the Overseeing Organisation's GA on the requirements for further Geotechnical Certification.

5.10 Where the Overseeing Organisation is responsible for procuring the project, Annex A to the PSSR shall be prepared making recommendations for the ground investigation phase. Depending on the extent of information available and/or the method of procurement, the production of Annex A may be

combined with the PSSR or delayed until a later stage of the project. Where a ground investigation is procured in a staged manner at different times, revisions to Annex A shall be clearly annotated with a revision suffix to provide a unique descriptor. This shall be discussed and agreed between the Overseeing Organisation's GA and the Designer's Geotechnical Advisor (DGA).

5.11 On completion of the ground investigation the Designer shall submit a GIR (**Appendix D**) fully completed with all the factual records and test results produced by the specialist contractor (preferably produced as a separate volume). Confirmation or amplification of problems found in the PSSR shall be included in this report. Where the project is a new route or alignment, the Designer shall programme this work, so that the **Report and all relevant design information are available for consideration for the preparation and submission of the 1:2500 Compulsory Purchase Order plans.**

5.12 Where a supplementary ground investigation is required, a **revised Annex A to the PSSR** shall be produced, followed, after the completion of the additional investigation, by the updating of the GIR to include this information.

Ground Investigation Report

5.13 The contents of the GIR shall be as set out in BS EN 1997-2. This shall consist of:

- a presentation of all available geotechnical information including geological features and relevant data;
- a geotechnical evaluation of the information, stating the assumptions made in the interpretation of the test results. The GIR shall state known limitations of the results.

5.14 The format to be followed in presenting the report is given in Appendix D.

6. KEY STAGE 3: GEOTECHNICAL DESIGN AND CONSTRUCTION CERTIFICATION

6.1 At detailed design stage, the Designer shall complete the Geotechnical Design Report (GDR) (as set out in **Appendix E**). The GDR is the Designer's detailed report on their interpretation of all the investigations and the design of the geotechnical elements of the project and shall include all items covered in the Ground Investigation Report (GIR) updated as necessary. The report shall detail how the risks identified in the Geotechnical Risk Register have been managed.

6.2 A **Geotechnical Certificate (Appendix A)** shall accompany all submissions of the GDR. If significant amendments, which affect the geotechnical design, are made during design development and construction, then the GDR shall be updated by way of a revision to reflect those changes. This revision shall also be submitted under cover of a new Geotechnical Certificate.

6.3 The GDR may be submitted in whole, or parts, to suite the design and construction programme as agreed with the Overseeing Organisation's Geotechnical Advisor. However, the GIR shall be submitted and accepted before any section of the GDR is submitted i.e. Key Stage 2 must be complete before Key Stage 3 submissions commence. Relevant sections of the GDR shall be submitted 28 days prior to the programmed start date of the work covered by the submission. (This time limit may be amended by contract documentation or in agreement with the Overseeing Organisation.) **No works covered by the Geotechnical Design Report should be commenced by the Contractor before the relevant Certification for that part of the Works has been completed.**

Geotechnical Design Report

6.4 The full GDR shall be submitted as part of the certification at **Key Stage 3**. It shall comprise the information arising from the detailed design stage of the project. The format is given in **Appendix E**. For simple designs, a single sheet may be sufficient. In addition to the requirements set out in BS EN 1997-1 it will be necessary to include a separate Appendix providing the completed Specification Tables 1/5, 6/1, 6/2 and 6/3 and Series 500, 600 and 1600 Appendices.

6.5 If, as part of the Contract Documentation, the Contractor has been provided with a preliminary or draft GDR, produced for the project by a previous Designer, the Contractor may utilise the information contained within that report by expanding and updating it, to reflect the Contractor's design and any changes to time dependent information. Responsibility for any information utilised from such a report shall be the Contractor's and the Contractor's Designer.

6.6 Where Geotechnical Certification is being undertaken for highway structures covered by BD 2, the Designer responsible for this shall procure and report ground investigations as required to achieve geotechnical certification. The relevant sections of the GDR shall be attached to the Assessment Report or AIP for the structure. If strengthened earthworks are envisaged or required, then additionally Section 8.3 of the Geotechnical Design Report shall be completed together with a Strengthened Earthwork Appraisal Form (SEAF) (see **Appendix E**).

Brief for Overseeing Organisation Site Nominee (Overseeing Organisation responsible for procurement)

6.7 The Geotechnical Design Report shall be provided to the Overseeing Organisation Site Nominee (OOSN) on the construction site, for guidance. This is to ensure that the OOSN is fully aware of the development and philosophy of the geotechnical design and will thus be alerted to possible geotechnical risks and be put in a sound position to deal with those issues and matters which are within the OOSN's delegated powers.

6.8 During the course of the construction process, any significant differences, between the actual conditions found and those expected, are to be reported formally in writing by the Designer to the OOSN, who in turn shall report them to the Overseeing Organisation without delay. The consequences of these differences shall be reported in the Geotechnical Feedback Report (GFR) (**Appendix F**).

Additional Geotechnical Investigation during Main Works Contract

6.9 Should there be a need for additional ground investigations to be carried out during the course of a main works contract; or if the design is amended from that contained in the certified GDR, then this additional/amended work shall be subject to Geotechnical Certification.

6.10 Prior to any additional GI work being carried out, a revised **Annex A to the PSSR** covering the proposed work, together with a **Geotechnical Certificate (Appendix A)**, shall be submitted by the Designer to the Overseeing Organisation via the OOSN. Following the completion of the investigation and any design work necessary, the GDR shall be updated. This revised GDR shall be submitted under cover of a fresh Geotechnical Certificate and shall include the additional work and any amendment to the design.

Requirements For Strengthened Earthworks

6.11 Where the use of Strengthened Earthworks is proposed on any project, irrespective of procurement method, the Designer shall, prior to the submission of any design data to the Overseeing Organisation, complete and submit a SEAF based on the model form set out in **Appendix E**.

6.12 Where required by contract documentation, an outline SEAF may have to be submitted and approved prior to the return of any tender documentation. When this is the case a full SEAF will be required to be resubmitted once contracts have been awarded and design work undertaken.

6.13 Strengthened Earthwork designs shall be checked by a Checking Team, which may be from the Designer, but shall be independent of the Design Team.

6.14 The completed SEAFs shall be attached, as an Annex to the GDR.

7. KEY STAGE 4: GEOTECHNICAL FEEDBACK

7.1 The Designer shall, at the completion of the construction phase, produce a **Geotechnical Feedback Report (GFR)**. The requirements for the feedback report and format are illustrated in **Appendix F**. **Key Stage 4** is required as part of the contract requirements for projects undertaken on behalf of the Overseeing Organisation.

The Geotechnical Feedback Report

7.2 The GFR shall be completed by the Designer's Site Staff and shall be submitted to the Overseeing Organisation within 6 months of Project Completion.

7.3 The GFR is required for all projects, irrespective of the method of procurement. It should be prepared as an ongoing task during the contract construction period.

7.4 The report shall utilize construction data to provide a record of the location and nature of materials encountered and utilised. Particular geotechnical problems and their solutions shall be recorded. The report shall also highlight any area of the specification or standards used that should be reviewed in the light of problems encountered on site. It also should highlight any requirements for ongoing monitoring or abnormal maintenance requirements.

7.5 The format of the GFR is given in **Appendix F**. A reduced scope of reporting for Category 1 projects is appropriate. This should be agreed with the Overseeing Organisation prior to submission of the report.

7.6 The GFR should be produced as an independent document, but once accepted should be incorporated within the Health and Safety File produced for the scheme.

7.7 The GFR is the required submission at **Key Stage 4**.

7.8 As Built drawings suitable for loading onto Highways Agency's Geotechnical Data Management System (HAGDMS).

8. REFERENCES

1. **Managing Geotechnical Risk**
DETR Partners in Technology Programme
Institution of Civil Engineers Thomas Telford
2001
2. **BS EN 1997-1 Eurocode 7: Geotechnical Design – Part 1: General Rules**
3. **BS EN 1997-2 Eurocode 7: Geotechnical Design – Part 2: Ground Investigation and Testing**
4. **HA 44 – Earthworks: Design and Preparation of Contract Documents (DMRB 4.1.1)**
5. **HD 41 – Maintenance of Highway Geotechnical Assets (DMRB 4.1.3)**
6. **HA73 – Site Investigation for Highway Works on Contaminated Land (DMRB 4.1.7)**
7. **HA 74 – Treatment of Fill and Capping Materials Using Either Lime or Cement or Both (DMRB 4.1.6)**
8. **Site Investigation in Construction Series Documents 1 to 4**

Site Investigation Steering Group. Institution of Civil Engineers. Thomas Telford 1993
9. **Construction (Design & Management) Regulations**

Statutory Instrument 2007 No 320
10. **BD 2 – Technical Approval of Highway Structures (DMRB 1.1)**
11. **AGS Guide to the Model Document**

Association of Geotechnical Specialists
12. **Sources For Site Investigation in Britain TRL Report 192**

Transport Research Laboratory, Crowthorne 1996
13. **Code of Practice for Site Investigations BS 5930**

British Standards Institution 1999
14. **Electronic Transfer of Geotechnical Data from Ground Investigations**

Association of Geotechnical Specialists 3rd Edition 2000
15. **Manual of Contract Documents for Highway Works**

Volume 1: Specification for Highway Works (December 1998)

Volume 4: Bills of Quantities for Highway Works (December 1991): HMSO (MCHW 4)
16. **Value for Money Manual**

Highways Agency HMSO April 1999
17. **SH 4/89 – Geotechnical Certification Procedures (DMRB 4.1.7)**

9. ENQUIRIES

All technical enquiries or comments on this Standard should be sent in writing as appropriate to:

Chief Highway Engineer
The Highways Agency
123 Buckingham Palace Road
London
SW1W 9HA

G CLARKE
Chief Highway Engineer

Director, Major Transport Infrastructure Projects
Transport Scotland
8th Floor, Buchanan House
58 Port Dundas Road
Glasgow
G4 0HF

A C McLAUGHLIN
Director, Major Transport Infrastructure
Projects

Chief Highway Engineer
Transport Wales
Welsh Assembly Government
Cathays Parks
Cardiff
CF10 3NQ

M J A PARKER
Chief Highway Engineer
Transport Wales

Director of Engineering
The Department for Regional Development
Roads Service
Clarence Court
10-18 Adelaide Street
Belfast
BT2 8GB

R J M CAIRNS
Director of Engineering

APPENDIX A GEOTECHNICAL CERTIFICATE

Geotechnical Certificate

Scheme Title

Geotechnical Certificate

(* - Delete as appropriate)

Certificate Seq. No.....

HAGDMS No.....

GEOTECHNICAL CERTIFICATE

Form of Certificate to be used by the Designer for certifying the design of geotechnical works

1. We certify that the Reports*, Design Data*, Drawings* or Documents* for the Geotechnical Activities listed below have been prepared by us with reasonable professional skill, care and diligence, and that in our opinion:
 - i. constitute an adequate and economic design for the project
 - ii. solutions to all the reasonably foreseeable geotechnical risks have been incorporated
 - iii. the work intended is accurately represented and conforms to the Employer's*/Client's* requirements
 - iv. with the exception of any item listed below or appended overleaf, the documentation has been prepared in accordance with the relevant standards from the Design Manual for Roads and Bridges and the Manual of Contract Documents for Highway Works.

where the certificate is accompanying revision to design data already certified the following statement shall also be included

- v. **The design elements covered by this certificate are not detrimental to the design elements previously certified and not amended by this certificate**

2. LIST OF REPORTS, DESIGN DATA, DRAWINGS OR DOCUMENTS

3. DEPARTURES FROM STANDARDS

List of any departures from relevant standards if none write 'none'

***4. INCORPORATION OF GEOTECHNICAL DATA INTO CONSTRUCTION DETAILS**

where the certificate is accompanying final design data the following statement shall also be included

The Reports, Design Data Drawings or Documents listed in 2 above have been accurately translated onto the construction drawings or other design documents bearing the unique numbers listed below/appended overleaf.

Signed:
Designer (Designers Geotechnical Advisor)

*Signed:
*Contractor (Agent or Contracts Director)

Name:
Date:
On behalf of
.....

*Name:
*Date:
*on behalf of
.....

This Certificate is:

- (a) received* (see note)
- (b) received with comments as follows:* (see note)
- (c) returned marked “comments” as follows:* (see note)

Signed:
Overseeing Organisation Geotechnical Advisor
Name:
Date:

Note:

**‘RECEIVED’ = SUBMISSION ACCOMPANYING CERTIFICATE IS ACCEPTED.
‘RECEIVED WITH COMMENTS’ = SUBMISSION ACCOMPANYING CERTIFICATE GENERALLY ACCEPTABLE BUT REQUIRE MINOR AMENDMENT WHICH CAN BE ADDRESSED IN SUBSEQUENT REVISIONS.
‘RETURNED MARKED COMMENTS’ = SUBMISSION ACCOMPANYING CERTIFICATE UNACCEPTABLE AND SHOULD BE REVISED AND RESUBMITTED.**

APPENDIX B FORMAT OF STATEMENT OF INTENT

1. SCHEME

Name and details of Scheme, key plan.

2. OBJECTIVES

3. EXISTING INFORMATION

Summary of existing information that has been identified to date.

4. GEOTECHNICAL RISK

Preliminary summary of key geotechnical risks that are envisaged.

5. PROPOSED STUDIES AND INVESTIGATIONS

Outline of proposed studies and investigations that are to be undertaken to achieve geotechnical certification.

6. SPECIALIST CONSULTATION

Details of any consultations required with reasons.

7. PROGRAMME AND COST

Estimated programme and cost of work involved in preparation of the Preliminary Sources Study and Ground Investigation Report and any physical work required up to completion of Key Stage 2 to support that report. (*Not required in all cases*).

APPENDIX C FORMAT OF PRELIMINARY SOURCES STUDY REPORT

1. INTRODUCTION

Title Sheet, clearly indicating the name of the scheme, together with the title, details of the authorship and the version number of the report. The version number and date of the report shall be clearly placed as a footer to every page of the report.

Reference to Statement of Intent. Limits of study area and content and note of any previous geotechnical studies in the area.

2. SOURCES OF INFORMATION & DESK STUDY

Details of the results of all enquiries made and of all sources used for geotechnical, historical and other general information relevant to the area (Ref.12 and 13). Nil or negative responses should also be reported.

3. FIELD STUDIES

Description of any field activities undertaken for this report - walkovers, geomorphological/geological mapping, probing, pitting and testing work, drainage/hydrological studies, geophysical or photographic surveys etc.

4. SITE DESCRIPTION

The topography, geology, hydrology, hydrogeology, geomorphology, man-made features and historical development of the area should be investigated together with the geo-environmental and possible contamination issues. Most conveniently presented as a series of plans and overlays.

5. GROUND CONDITIONS

Description of soils anticipated, with engineering properties known and predicted; significance of geological formations, ground water conditions etc.

6. PRELIMINARY ENGINEERING ASSESSMENT

For each soil type and/or location preliminary consideration of the design implications including: General - location, classification, earthworks acceptability criteria, groundwater, likely difficulties and problems, areas/features to avoid.

Cuttings – side slopes (short and long term), potential acceptability of material, merits of special drainage or ground treatment, swelling problems.

Embankments – side slopes, characteristics and restrictions on use of particular soils, plant use options, drainage requirements, foundation treatment.

Subgrade – likely CBR values for cutting areas and for potential fill materials in embankments, capping layers and availability of material, drainage requirements.

Structure foundations – Alternative types of foundation likely to be applicable, estimates of bearing pressures and settlements, groundwater, problem areas/strata, potential construction difficulties etc.

Contaminated land/Soil Chemistry – possibility of harmful elements present in soil or groundwater and implications of these on health and safety. Scope for the reuse of marginal/recycled material within the works.

Any existing geotechnical problems i.e. Slope failures, solution features, mineworkings slopes with marginal factors of safety, very soft/highly compressible soils.

Effects of man made obstacles/site history.

7. COMPARISON OF PROJECT OPTIONS AND RISKS

List all geotechnical, geo-environmental, historical and other factors discovered which are likely to influence the project i.e. routes, alignment, health and safety or buildability.

An updated Geotechnical Risk Register; in which the risks of the primary hazards are assessed, the consequences of these risks to the project determined, and details of how the risks are to be managed given. CDM implications should be highlighted.

A statement of the preferred routes/options (on geotechnical grounds) should be given if appropriate.

8. DRAWINGS AND PHOTOGRAPHS

Site Plan (usually 1:10,000) with study limits and scheme options. Plans/overlays to show topography, historical development, existing trial holes, geology, geomorphology, hydrogeology, hazards including contaminated ground and man made features etc as appropriate. Geological longitudinal sections with cross-sections where appropriate.

Photographs both ground and air obtained for the study should be reproduced and referenced to the site plan.

ANNEX A TO PRELIMINARY SOURCES STUDY

1. OBJECTIVES and FORMAT OF ANY INVESTIGATION

(For example): To provide information to confirm and amplify the geotechnical and geomorphological findings of the Preliminary Sources Study, as reported separately and to obtain detailed knowledge of the soils encountered and their likely behaviour and acceptability. To ascertain ground water conditions and locations of underground workings, if any. Limits of work envisaged.

2. SPECIAL PROBLEMS TO BE INVESTIGATED

Location of structures. Sub-soil conditions below areas of high embankment. Aquifers and likely water-bearing strata affecting the works. Rock stability problems. Effects on adjacent properties etc. Any man-made features to be encountered. Contaminated ground.

3. PROPOSED INVESTIGATION

Fieldwork - details of exploratory work proposed for specific areas with reasons for choice of investigatory method. Laboratory work - details of proposals with reasons for choice of test and relevance to design. Summarised as tables. Requirement for Factual Data to be supplied in digital form to AGS Format.

4. SITE & WORKING RESTRICTIONS

Traffic management, difficult access, Statutory Undertaker's plant, Network Rail restrictions, flora and fauna, designated sites e.g. SSSI's.

5. SPECIALIST CONSULTATION

Details and reason if proposed.

6. PROGRAMME, COST AND CONTRACT ARRANGEMENTS

Anticipated start dates, contract periods, restrictions on programme, cost estimates (VAT excluded) for factual and interpretative work. Arrangements for contract work and supervision of contract.

7. REPORTING

Responsibility for reporting (with reasons), format and topics to be covered.

APPENDIX D **FORMAT OF GROUND INVESTIGATION REPORT**

Note: This report shall meet the requirements for the Ground Investigation Report as set out in BS EN 1997-2, following the format set out below.

TITLE SHEET AND CONTENTS

Clearly indicating the name of the scheme together with the title, details of the authorship and the version number of the report. The version number and date of the report shall be clearly placed on every page of the report.

Contents of all volumes listed in the front of each volume with the contents of the particular volume highlighted. No Company specific disclaimers are to be attached to the report.

1. EXECUTIVE SUMMARY

2. INTRODUCTION

- 2.1 Scope and objective of the report
- 2.2 Description of project (including site description)
- 2.3 Geotechnical Category of project
- 2.4 Other relevant information

3. EXISTING INFORMATION

This section should be a review carried out by the designer of all existing, geotechnically relevant information available on the project. The review should highlight the implications to the project of that information. The PSSR will be a basis for this section, but the information contained in it should be updated as necessary when such information is of a time-limited nature. Photographs obtained should be reproduced and clearly referenced.

- 3.1 Topographical maps (old and recent)
- 3.2 Geological maps and memoirs
- 3.3 Aerial photographs (old and recent)
- 3.4 Records of mines and mineral deposits (including an updated Mineral Valuer's Report)
- 3.5 Land use and soil survey information
- 3.6 Archaeological and historical investigations
- 3.7 Existing ground investigations (including the relevant investigations carried out for the Overseeing Organisation and the results of those investigations)
- 3.8 Consultation with Statutory Bodies and Agencies for example (but not necessarily limited to):
Natural England, English Heritage, Environment Agency.
- 3.9 Flood Records

- 3.10 Contaminated land
- 3.11 Other relevant information (may include hydrology and hydrogeology, natural cavities, landslides, erosion and deposition, seismic etc.)

4. FIELD AND LABORATORY STUDIES

This section is to describe the investigations carried out by the Designer as part of the design process.

- 4.1 Walkover survey
- 4.2 Geomorphological/geological mapping
- 4.3 Ground Investigations. (Description of the investigations carried out by the designer, including an outline of the aims and reasoning behind the requirement for the investigation)
 - 4.3.1 Description of fieldwork
 - 4.3.2 A copy of the ground investigation report should be provided; this can be bound separately if required.
 - 4.3.3 Results of in situ tests
- 4.4 Drainage studies
- 4.5 Geophysical surveys
- 4.6 Pile tests
- 4.7 Other field work
- 4.8 Laboratory investigation
 - 4.8.1 Description of tests
 - 4.8.2 Copies of test results (may be bound separately or with 4.3.2 above)

(For sections 4.3.2, 4.3.3 and 4.8.2 the information should also be provided in digital form as set out in the Association of Geotechnical Specialists publication 'Electronic Transfer of Geotechnical Data from Ground Investigations' (Ref 14).

5.0 GROUND SUMMARY

This section describes the Designer's summary interpretation of the results of the investigations carried out in sections 3 and 4 above. The Ground Summary shall provide the summary interpretation on the topography, geology, hydrology, hydrogeology, geomorphology, man-made features and historical development of the project and may be supplemented by a series of plans and overlays. If appropriate, a general ground model to be used for design shall be presented for the site.

6.0 GROUND CONDITIONS AND MATERIAL PROPERTIES

This section is the Designer's evaluation of the ground conditions at relevant sections along the project route and shall present the ground model to be used for design at each relevant section. Details and descriptions of the various materials to be encountered shall be included together with a full justification for the parameters adopted for the geotechnical design. Full references shall be given especially where generic parameters are to be adopted.

- 6.1 Topsoil
- 6.2 Made ground, including details of any contamination/contaminated areas
- 6.3 Separate heading for each material
- 6.4 Groundwater/chemistry

7.0 GEOTECHNICAL RISK REGISTER

This section contains an update of the Geotechnical Risk Register established for the project. The register will highlight the risks and consequence of those risks together with the measures taken to mitigate those risks. It is essential that there is cross referencing in the report to ensure that the mitigation measures are taken forward in the design outlined in the Geotechnical Design Report.

8.0 REFERENCES

APPENDIX E FORMAT OF GEOTECHNICAL DESIGN REPORT

Note: This report shall meet the requirements for the Geotechnical Design Report as set out in BS EN 1997-1 following the format set out below. The report shall include full details of the interpretation of design data and justification for the design and include a layout drawing of that part of the works. The report is subdivided into sections on cuttings, embankments, structures and strengthened earthworks and shall be further subdivided for each unique earthwork or structure. Drainage design relevant to subgrade design and capping shall be included. For larger schemes, the designer is encouraged to submit this section of the report in parts to suit the design and construction programme for the works (see paragraph 6.3). A discussion of potential contamination and proposed remediation requirements (if required) shall be included.

BS EN 1997-1 requires this report to include a plan of supervision and monitoring, as appropriate. Items, which require checking during construction or, which require maintenance after construction shall be clearly identified. This shall be reported in Section 9 of this report.

1.0 EARTHWORKS

1.1 Cutting stability

Full details of the methods of analysis, soil parameters, drainage, slope angles, CBR and other considerations. Summary of design including location, side slopes, maximum and typical depths, relevant site investigation, assumed soil strata and ground water conditions, earthworks, drainage requirements and pavement design. This may be either tabulated or submitted as a series of summary forms.

1.2 Embankment stability

Full details of the methods of analysis, soil parameters, drainage, slope angles, CBR and other considerations. Summary of design including location, side slopes, maximum and typical depths, relevant site investigation, assumed soil strata and ground water conditions, predicted settlements, earthworks, drainage requirements and pavement design. This may be either tabulated or submitted as a series of summary forms.

1.3 Re-use of Materials

Discussion of potential for re-use of excavated material and appropriate earthworks acceptability criteria.

2.0 HIGHWAY STRUCTURES

Details of Highway Structure type

Full details of the method of analysis and soil parameters assumed in design of foundations and retaining elements. Summary of design including allowable bearing pressures, pile capacity, earth pressures, differential settlement and protection against chemical attack to be provided for each structure. This information may be either tabulated or submitted as a series of summary forms.

3.0 STRENGTHENED EARTHWORK

Details of Strengthened Earthworks.

Full details of the method of analysis and material parameters assumed in the design with reference to the appropriate SEAF. Summary of design to be provided at each location. This information may be either tabulated or submitted as a series of summary forms

4.0 DRAINAGE

Details of how the drainage design will address the groundwater conditions and how groundwater risks are to be managed.

5.0 PAVEMENT DESIGN, SUBGRADE & CAPPING

Method of analysis, soil parameters, ground water assumptions.

6.0 ASSESSMENT OF POTENTIAL CONTAMINATION

6.1 Summary of the extent of the contamination testing that has been undertaken.

Description of the liaison that has been undertaken with the statutory authorities and the scope of risk assessments carried out to comply with regulatory authorities requirements. This section is to include a summary of the current status with regards to regulatory approval and shall record the acceptance of these risk assessments by the statutory body.

6.2 Summary of the findings and conclusions of the risk assessments including the site remediation requirements that have been agreed with regulatory authorities.

This section shall include any restrictions placed on the chemical content of materials to be used in the works i.e. what it is acceptable to leave on the site and what needs to be removed from site. This can be presented in terms of limits for UIA and UIB in accordance with Series 600 of the Specification.

6.3 Details of contaminated materials to be removed from site.

7.0 GROUND TREATMENT INCLUDING TREATMENT OF ANY UNDERGROUND VOIDS ETC.

8.0 SPECIFICATION APPENDICES

Details of parameters and amendments for the specification appendices completed in Annex 1 (Ref 15).

9.0 INSTRUMENTATION AND MONITORING

9.1 Full details of purpose, installation requirements, restrictions and frequency of readings

9.2 Use of Observational Methods/Controls. Predicted and critical readings and restrictions on work

9.3 Pile testing requirements

10 REFERENCES

ANNEX 1

Completed Specification Table 1/5 and series 500, 600 and 1600 appendices including tables 6/1, 6/2 and 6/3.
(Ref 15)

ANNEX 2

Completed SEAFs

ANNEX 2 TO GEOTECHNICAL DESIGN REPORT: STRENGTHENED EARTHWORK APPRAISAL FORM (“SEAF”)

Ref. No.....

(Notes appended to explain the anticipated content of sections)

1. SCHEME DETAILS

- 1.1 Name of Scheme
- 1.2 Type of Highway
- 1.3 Permitted Traffic Speed
- 1.4 Nature of scheme/scheme element
(eg new highway construction, highway widening, earthworks maintenance)

2. STRENGTHED EARTHWORK TYPE, PURPOSE AND LOCATION

- 2.1 Generic Type of Strengthened Earthwork
(eg strengthened soil slope, gabions, strengthened soil, soil nailing, crib wall)
- 2.2 Purpose of Strengthened Earthwork
(ie to allow highway widening, for earthworks failure reinstatement, for new construction in area of restricted land take etc).
- 2.3 Intended Location(s) for Use
(a schedule of proposed lengths of strengthened earthworks and locations.)

3. OUTLINE OF EXISTING GROUND AND GROUNDWATER CONDITIONS

(this section to refer to the relevant sections of the Geotechnical Design Report when available)

- 3.1 Ground Investigation Data
(list report references and comment on extent of data)
- 3.2 Existing Ground Conditions
(brief summary of natural soil sequence, presence of Made Ground etc)
- 3.3 Existing Groundwater Conditions
(note on groundwater levels)
- 3.4 Soil and Groundwater Chemistry
(note on sulfate/chloride/pH conditions and/or ground contamination and microbiological action)
- 3.5 Existing Geotechnical Problems and Risks
(any factors of geotechnical significance related to the existing ground conditions, e.g. slope failures, solution features, mineworkings, slopes with marginal factors of safety, very soft/highly compressible soils etc)

4. PROPOSED STRENGTHENED EARTHWORK

- 4.1 Description of Strengthened Earthwork
(range of and average height of proposed strengthened earthwork in its final form, ie slope face angle, facing/landscaping details including where appropriate topsoil and planting details)
- 4.2 Foundation Preparation, including any Measures to deal with Geotechnical Problems
(foundation proposals for the strengthened earthwork, including any special measures or associated works to take account of any problems outlined in 3.5 above)
- 4.3 Materials to be used in Construction
(outline description of geosynthetics, soil nails, gabion baskets, imported fill materials etc., including Design Certificates and evidence of CE marking under the Construction Products Directive where appropriate)
- 4.4 Drainage Measures
(particular drainage control measures to be incorporated)
- 4.5 Arrangements for Highway Furniture and Buried Services and Landscaping
(relevant details)
- 4.6 Inspection and Maintenance
(particular inspection and maintenance requirements [including where appropriate the maintenance of vegetated slope faces], over and above routine observations)
- 4.7 Interface with Structures
(brief details of interface construction measures with bridges, abutments, retaining walls, buried structures, other Strengthened Earthworks etc)

5. DESIGN METHODS

- 5.1 Internal Stability
(the referenced design method/approach for determining stability of the strengthened earthwork itself)
- 5.2 External/Global Stability
(the referenced design method/approach for determining stability of any associated overall slopes which include the strengthened earthwork)

6. DESIGN/ASSESSMENT CRITERIA

- 6.1 List of Relevant Documents
- 6.2 Limit State Design Criteria
(factors of safety on limit state stability conditions to be applied in the design, on both stability of the strengthened earthwork itself and on overall stability of associated slopes)
- 6.3 Serviceability Design Criteria
(any total/differential settlement or other movement criteria adopted by the designer, including any imposed by Employer's Requirements)
- 6.4 Design Parameters for Soils and Materials
(schedule of relevant main design parameters for the soils and other materials to be used in construction)

- 6.5 Design Groundwater Conditions
(statement of worst case, or range of piezometric conditions and/or ru values to be used in design)
- 6.6 Live Loadings
(confirmation of worst case live loadings to be assumed in design)
- 6.7 Description/Diagram of Idealised Soil Structure Model to be used in Analysis
(provide a section of the strengthened earthwork to illustrate the design method and associated main design assumptions)
- 6.8 Precautions against Chemical Attack to Materials
(measures to accommodate ground conditions set out in 3.4)
- 6.9 Proposed Departures from Design Standards
(departures from documents listed in 6.1)

7. CHECKING

(Designer to indicate the independent checking procedures to be employed)

8. DRAWINGS AND DOCUMENTS

- 8.1 List of drawings and documents accompanying submission

- Appendix A Soils Information
(A list of the relevant trial hole logs and test results from the soils reports listed in para 3.1 and from any additional site investigation, extract from Geotechnical Report including the relevant parts of section 8 of the Geotechnical Report)
- Appendix B Relevant Correspondence, Documents and Certificates from Consultation with Relevant Authorities.
- Appendix C Drawings and documents.

9. THE ABOVE DESIGN AND CONSTRUCTION PROPOSALS ARE SUBMITTED FOR REVIEW.

Signed:
Geotechnical Team Leader, Design Team
Name:
Engineering Qualifications:
Date:
On Behalf of
Geotechnical Certificate Ref No.

*Signed:
*Contractor (Agent or Contracts Director)

*Name:
*Date:
*on behalf of

10. THE ABOVE SEAF IS:

- i: received*
- ii: received with comments as follows*
- iii: return marked "comments" as follows*

* delete as appropriate.

Signed:
Overseeing Organisation's Geotechnical Advisor
Name:
Date:
(Overseeing Organisation's Geotechnical Advisor to confirm Geotechnical Certificate Reference no (where appropriate) and comments appended to that Certificate)

Note:

'RECEIVED' = SUBMISSION ACCOMPANYING CERTIFICATE IS ACCEPTED.
'RECEIVED WITH COMMENTS' = SUBMISSION ACCOMPANYING CERTIFICATE GENERALLY ACCEPTABLE BUT REQUIRE MINOR AMENDMENT WHICH CAN BE ADDRESSED IN SUBSEQUENT REVISIONS.
'RETURNED MARKED COMMENTS' = SUBMISSION ACCOMPANYING CERTIFICATE UNACCEPTABLE AND SHOULD BE REVISED AND RESUBMITTED.

APPENDIX F FORMAT FOR GEOTECHNICAL FEEDBACK REPORT

1.0 TITLE SHEET

Clearly indicating the name of the scheme together with the title (eg Geotechnical Feedback Report) and version and date of the report. The version number and date of the report shall be placed as a footer to every page of the report. For smaller schemes it may be appropriate to adopt a reduced scope for the Feedback Report. This should be discussed with the Overseeing Organisation prior to submission of the report.

2.0 CONTENTS

Contents of all volumes listed in the front of each volume with the contents of the particular volume highlighted.

3.0 INTRODUCTION

- 3.1 Scope and object of the report.
- 3.2 Limits of the area covered by the report.
- 3.3 Bibliography of scheme specific geotechnical reports
- 3.4 Other relevant information.

4.0 EARTHWORKS

- 4.1 General description of the earthworks.
- 4.2 Problems not envisaged in the Geotechnical Design Report and their solutions.
- 4.3 Weather conditions.
- 4.4 Application of acceptability criteria.
- 4.5 Haul conditions and types of plant used.
- 4.6 Comparison of predicted and actual quantities of acceptable and unacceptable material.
- 4.7 Topsoil and planting.
- 4.8 Details of any validation reports prepared to demonstrate compliance with the site remediation strategy and the requirements of the regulatory bodies.

5.0 CUTTINGS

- 5.1 For each cutting, location of materials excavated and their subsequent destination in the Works (with dates)* – see Note 1.
- 5.2 Plant used and details of problems encountered.
- 5.3 Instability problems and unusual ground conditions.
- 5.4 Ground water conditions and problems and drainage measures to overcome them.
- 5.5 Contaminated and hazardous material encountered on site and the location of disposal, both on and off site.

6.0 EMBANKMENTS

- 6.1 For each embankment, source and location of all material placed (with dates)*- See Note 1.
- 6.2 Plant used and details of problems encountered.
- 6.3 Instability problems and unusual ground conditions.
- 6.4 Foundation treatment, including drainage measures and treatment of soft areas.
- 6.5 Settlement of foundation and fill material.

7.0 SUBGRADE/CAPPING/PAVEMENT

- 7.1 Method of subgrade preparation, details of capping materials used and details of any problems encountered.
- 7.2 Method of placing each pavement layer and details of any problems.

8.0 DRAINAGE

- 8.1 Details of temporary drainage and its effectiveness.
- 8.2 Methods of installing permanent drainage and details of any problems encountered.

9.0 IMPORTED MATERIALS

- 9.1 Types of imported materials and their use.
- 9.2 Source of imported materials and their location in the Works (with dates)* - see Note 1.
- 9.3 Acceptability and performance.

10.0 STRENGTHENED EARTHWORKS

- 10.1. Description of Strengthened Earthworks types and locations.
- 10.2. Fill materials used.
- 10.3 Record of soils and groundwater conditions encountered and drainage measures required.
- 10.4 Inspection and maintenance requirements.
- 10.5 Details of any in situ testing.
- 10.6 Details of any problems encountered.

11.0 STRUCTURE FOUNDATIONS

- 11.1 Record of soil and ground water conditions encountered.
- 11.2 Temporary works required and their effectiveness.
- 11.3 Details of any problems encountered.
- 11.4 Pile logs summary, pile test results and other relevant information.
- 11.5 Settlement records with dates of each major stage including backfill of abutments and approach fills.
- 11.6 Details of as built foundations.

12.0 TESTING

- 12.1 Summary of site laboratory testing.
- 12.2 Separate section on each type of test giving a summary of all results together with comments on them and their effectiveness.
(If a material report is prepared by the testing organisation then this should be used as the basis for this section with the actual report attached as an appendix to the Feedback Report)

13.0 INSTRUMENTATION

- 13.1 Location and details of instruments.
- 13.2 Purpose, performance and usefulness.
- 13.3 Readings (with dates) and predicted values.
- 13.4 Details and effects of resulting action.
- 13.5 Comment on need to continue monitoring.

14.0 SUMMARY OF PROBLEMS EXPERIENCED AND DESIGN CHANGES

- 14.1 Summary of problems and details of design changes to overcome them.
- 14.2 Comments on how problems might be avoided in the future, including suggested revisions required to the SHW and DMRB.

15.0 RESIDUAL HEALTH AND SAFETY RISKS

Details of any residual Health and Safety risks on the project which would need to be considered if future work is carried out by the maintaining authority e.g. residual contamination, potential ground gas – Make reference to the Health and Safety File where appropriate.

*NOTE 1 Items marked * (and others where possible) may be conveniently presented on longitudinal profiles and accompanying plans compiled as construction proceeds. Alternatively, electronic presentation of data may be appropriate.*

NOTE 2 Photographs should be included in the report to illustrate particular points.