VOLUME 4 GEOTECHNICS AND DRAINAGE

SECTION 1 EARTHWORKS

PART 2

HD 22/02

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 roads and motorways 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 This document supersedes HD 22/92, which is now withdrawn.
2. Remove existing contents page for Volume 4 and insert new contents page for Volume 4 dated May 2002.
3. Remove HD 22/92, which is superseded by HD 22/02, and archive as appropriate.
4. Insert HD 22/02 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.

THE HIGHWAYS AGENCY

SCOTTISH EXECUTIVE DEVELOPMENT DEPARTMENT

THE NATIONAL ASSEMBLY FOR WALES
CYNULLIAD CENEDLAETHOL CYMRU

THE DEPARTMENT FOR REGIONAL DEVELOPMENT
NORTHERN IRELAND

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 roads and motorways under the jurisdiction of the relevant Overseeing Organisation to ensure that the Geotechnical Risk is correctly managed.

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REGISTRATION OF AMENDMENTS

Amend No	Page No	Signature & Date of incorporation of amendments	Amend No	Page No	Signature & Date of incorporation of amendments

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MANAGING GEOTECHNICAL RISK

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Part 1

Procedures for Geotechnical Certification

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1. GEOTECHNICAL CERTIFICATION

Introduction

1.1 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, to ensure that the geotechnical risks to such projects are correctly identified and managed. Whilst the principles behind these procedures are to be adopted for use in Scotland, separate certification procedures as set out in SH4/89 [Ref 21] are currently being retained.

1.2 Geotechnical Standard HD 22 was introduced in 1992, to address criticism from the National Audit Office (NAO) that cost overruns on highway projects were due in the main, to claims of unforeseen ground conditions. Examination of the geotechnical processes then being undertaken (Ref 1) showed a marked variation in the application of geotechnical investigation and design, leading to a greatly increased risk to Overseeing Organisations of cost increases, with the consequences of uncertainty to budget prediction and control.

1.3 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. The original Standard was biased towards the larger projects and supported the then current design and procurement method. In that guise it served well, but with changing methods of procurement of both design and construction, together with an increase in maintenance work and the need to encourage innovation, its revision has become necessary.

> *No construction project is risk free. Risk can be managed, minimised, shared, transferred or accepted. It cannot be ignored.*
>
> Constructing the Team, 1994
> Latham 1994

1.4 The Office of Government Commerce (OGC) requires that steps are taken to ensure that projects represent value by considering a combination of whole life costs and quality to meet customer's requirements. These requirements are set out in documents such as the Highways Agency Value for Money Manual (Ref 20). An essential part of that process 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. All too often the design approach has been mechanistic, which has resulted in critical conditions going undiscovered, or parameters determined during investigation not being relevant. Ground conditions are always uncertain and a risk to any project. The risks from these ground conditions must be managed in a positive manner (Ref 2). Part 4 of the above Value for Money Manual (Ref 20) provides guidance on the identification, assessment and management of risks during planning and maintenance phases of a project.

1.5 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 (Fig 1). These risks need to be correctly identified and their effect on the project managed systematically, if significant problems are to be avoided.

1.6 This revised Standard draws on the strengths of the old Standard, but to ensure that the ground related risks are correctly managed it introduces simplified and streamlined processes. The Standard introduces the concept of geotechnical categories based on the complexity and degree of geotechnical risk to the project and follows the guidance given in Eurocode 7 (Ref 3).

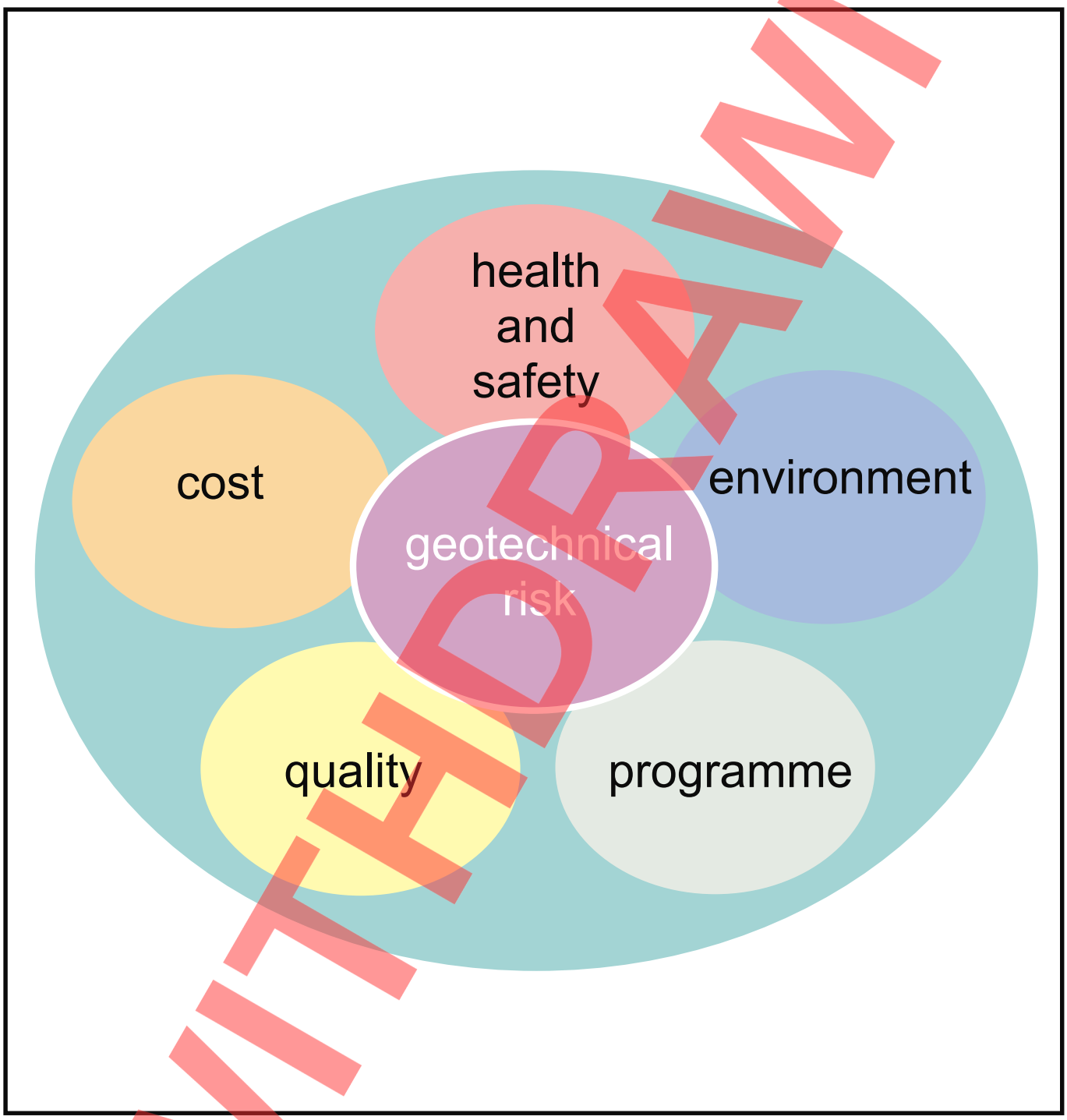

Fig 1 Geotechnical related risks can affect many other facets of construction (Ref 2)

MANAGEMENT OF GEOTECHNICAL RISK

1.7 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 7) provides advice on what constitutes geo-hazards 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.

1.8 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 and specialisms of the project team.

1.9 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 **(Part 1 Appendix A)** 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.

1.10 Three reports comprise the main requirements for this Standard; these are a Preliminary Sources Survey (Desk Study), a Geotechnical Report and a Feedback Report. These reporting requirements and report formats are applicable to any project be it large or small, the only difference being the extent of work required. These reports are supported by a single certificate system.

1.11 The procedures set out in this document are relevant to all projects of the Overseeing Organisation, where geotechnical activities will be undertaken, ie scheme/project assessments, new construction, improvements, remedial, maintenance, and reconstruction works. They have been developed to complement the different methods of project procurement and are contract neutral. The essential criteria in selecting the appropriate procedure is the ownership of the project's development and thus responsibility for the risks and not the form of contract being used.

Layout of Document

1.12 The Standard is in two parts. Part 1 covers the requirements for and procedures to be followed, to achieve Geotechnical Certification. Part 2 details the geotechnical reporting required to underpin that certification.

Mandatory Requirements

1.13 Paragraphs of this Standard, which are mandatory, are highlighted by being contained in a box. These are sections with which the Overseeing Organisation must comply. The remainder of the document contains advice, which is commended to the Overseeing Organisation for their consideration.

Definitions and Abbreviations

1.14 Terms used in this Standard are defined in **Part 1 Appendix A**.

Scope and Application

1.15 This Standard sets out in key stages, the procedures and documentation to be used, for all geotechnical works, on Overseeing Organisation Highway Projects, to ensure that the risks to a project, posed by the geotechnical element, are correctly identified and managed. This process is backed up by the submission of a Geotechnical Certificate.

1.16 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 a road or motorway 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 road or motorway 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.

1.17 All projects where Geotechnical Activities **(Part 1 Appendix A)** are involved shall be certified in respect of geotechnical elements by the Design Organisation. As well as the projects indicated in para 1.16, 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) Geotechnical investigations carried out as part of structural assessment, design and remedial/maintenance work for structures covered by BD 2 (Ref 11).

b) Installation by trenchless or other techniques of service crossings, where the internal diameter of that crossing is 900mm or less.

c) The design of remedial works to rectify defects affecting the geotechnical asset.

1.18 This Standard also introduces the requirements for all Strengthened Earthworks to be individually appraised, with the introduction of the SEAF (Strengthened Earthworks Appraisal Form).

Associated Standards

1.19 The procedures to be adopted and documentation to be used for Ground Investigation contracts are set out in SD 13 (MCHW 5.3.1 Ref 4) and advice on ground investigation procedures is given in SA 9 (MCHW 5.3.2 Ref 5). HA 44 (DMRB 4.1.1 Ref 6) provides advice on the design and preparation of contract documents relating to Geotechnical Works. HD 41 (DMRB 4.1.3 Ref 7) sets out the procedures on the maintenance and inspection of geotechnical works and HA 73 (DMRB 4.7.1 Ref 8) provides specific advice in relation to ground investigations on contaminated land.

Implementation

1.20 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. Notwithstanding the above, this Standard shall be used on all projects for which tenders are to be invited after 1 January 2003, unless specific approval has been obtained from the Overseeing Organisation to use other documents.

Liaison between Overseeing Organisation and Design Organisation

1.21 Each Overseeing Organisation has on its staff, or will appoint, a Geotechnical Advisor (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 Geotechnical Advisor status (DGA) as defined in Site Investigation in Construction Series Documents (Ref 9), as his focal point for all the geotechnical aspects of that project. The GA and the DGA shall liase on the geotechnical aspects of the project.

Independant Checking - Application to Scotland

1.22 The Overseeing Organisation may from time to time appoint an Independent Checking Consultant (ICC) who may act as the GA but will also have additional responsibilities as set out in **Part 1 Appendix K**.

Construction, Design & Maintenance Regulations (CDM)

1.23 The reports produced as part of the Geotechnical Certification process are an integral part of the requirements of the CDM regulations (Ref 10). They shall be included in any tender documentation, subsequent to the production of that report and ultimately included as part of any Health and Safety File for the project.

Geotechnical Certificate

1.24 A Geotechnical Certificate signed by the DGA shall accompany **ALL** geotechnical submissions made by the Designer to the Overseeing Organisation. An example of a Geotechnical Certificate is given at **Part 1 Appendix B**. 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.

Geotechnical Certification Procedures

1.25 There are four key stages in the Geotechnical certification procedure. These stages are arranged to be an integeral part of the overall project progression to ensure the procurement of the geotechnical information necessary to ensure the correct assessment of project risks. They are listed below and are set out on **Chart 1**:

Key Stage 1 Initial Review of Project and Project Risks to determine its **Geotechnical Classification** and thus the requirement for Geotechnical Certification: *This stage ensures that potential risks are addressed at project inception. The geotechnical risks and requirements for specialist processes are assessed at this stage.*

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.*

Key Stage 3 Geotechnical Design & Construction Certification: *This stage provides the information for the detailed design and for the contractor to prepare and carry out construction.*

Key Stage 4 Geotechnical Feedback: *This stage reports on all changes that occurred during construction and includes recommendations for inspection, maintenance and improvements in the future.*

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

1.27 Depending on the complexity of the proposed geotechnical works and the geotechnical risk implications to health & safety, all projects shall have their **Geotechnical Classification** established by being placed in one of the geotechnical categories which follow the guidance given in Eurocode 7 (Ref 3).

Geotechnical Category 1: Projects which involve relatively simple geotechnical activities and/or small geotechnical risk.

Geotechnical Category 2: Projects concerning conventional types of geotechnical activities, with no unusual or difficult ground conditions and involving no abnormal geotechnical risks.

Geotechnical Category 3: Projects concerning very large, unusual or complex geotechnical activities or geotechnical activities involving abnormal geotechnical risks or unusual or exceptionally difficult ground conditions.

1.28 Where the production of geotechnical information is required only for input into further Specialist Process Certification (eg Structural Approval in Principle via Standard BD 2 Ref 11) then this shall be treated separately outside these Categories as outlined on **Chart 2**.

Key Stages for Geotechnical Certification

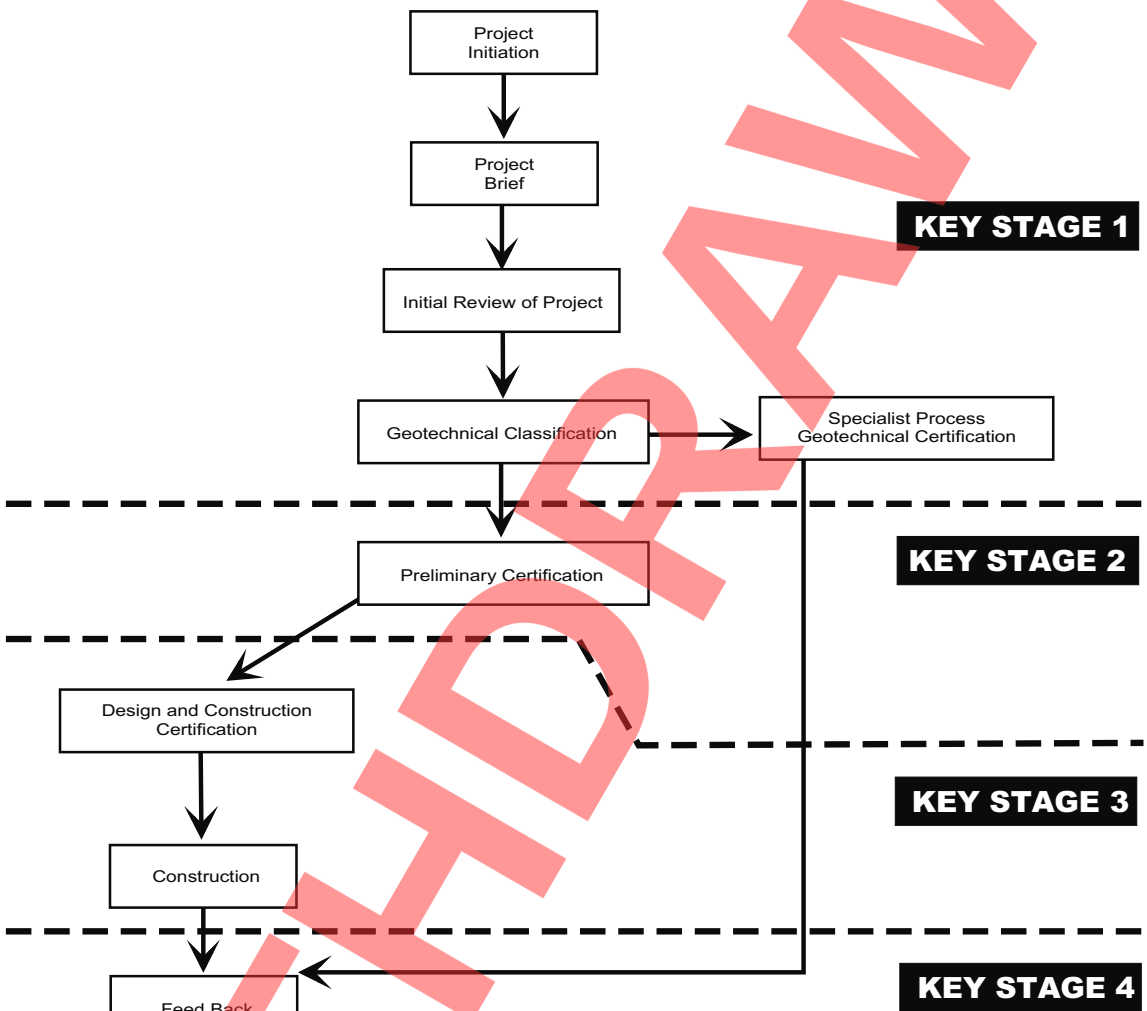

Chart 1

1.29 Projects, which at Key Stage 1 clearly involve geotechnical activities or there is the possibility that they may be required, shall be classified in Geotechnical Categories 1-3 and shall proceed to Preliminary Certification.

1.30 For projects where 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.

1.31 Projects shall have their **Geotechnical Classification** reassessed as part of the Preliminary Certification. 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/Overseeing Organisation of the reclassification. For projects retaining a **Geotechnical Classification** of 1 to 3 the Geotechnical Certification process appropriate to that classification shall be followed.

1.32 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.

1.33 The Geotechnical Certification Process is set out in Chart 1 and as a series of appendices to this part of the Standard.

a) Part 1 Appendix C: Key Stage 1. Initial Review of Project (Chart 2)

This appendix 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.

b) Part 1 Appendix D: Key Stage 2. Preliminary Certification (Chart 3)

All projects, where geotechnical activities with a Geotechnical Category of 2 or 3 are, or may be, envisaged shall be subject to the Preliminary Certification procedures. This appendix 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.

c) Part 1 Appendix E: Key Stage 3. Geotechnical Design & Construction Certification: Geotechnical Certification for Geotechnical Category 1 projects (Chart 4)

This appendix outlines the simplified Geotechnical Certification procedures that are appropriate Geotechnical Category 1 projects. These are applicable irrespective of the method of procurement of the project.

d) Part 1 Appendix F: Key Stage 3. Geotechnical Design & Construction Certification: Geotechnical Certification for Geotechnical Category 2 or 3 Projects, where the Overseeing Organisation is responsible for Project Procurement (Chart 5)

This appendix outlines the procedures required for Geotechnical Certification for Geotechnical Category 2 or 3 projects, when the Overseeing Organisation is responsible for the procurement of a project, eg:

i) The Overseeing Organisation appoints a Designer who is responsible for the preparation of the design and supervision of its construction.

ii) The Overseeing Organisation is responsible for obtaining any necessary Statutory Orders for the project.

iii) Developer promoted schemes where the Overseeing Organisation undertakes project through agreement.

e) Part 1 Appendix G: Key Stage 3. Geotechnical Design & Construction Certification: Geotechnical Certification for Geotechnical Category 2 or 3 Projects, where the Third Party responsible for Project Procurement (Chart 6)

This appendix outlines the procedures required for Geotechnical Certification for projects with a Geotechnical Category of 2 or 3, when the Overseeing Organisation passes, by contract, the responsibility for design and construction procurement to a third party or a third party promotes the scheme from the outset.

f) Part 1 Appendix H: Geotechnical Specialist Process Certification: Production of Geotechnical Information for Assessment, Maintenance or Technical Approval of Highway Structures covered by BD 2 (Chart 7)

The production of geotechnical information required for highway structures covered by BD 2 (Ref 11) shall be subject to Geotechnical Certification, as set out in this appendix.

g) Part 1 Appendix I: Geotechnical Specialist Process Certification: Application to Defects affecting the Geotechnical Asset

Where defects affecting the geotechnical asset occur, then the reporting, investigation and remedial works proposals required by HD 41 (Ref 7), shall be covered by Geotechnical Certification as set out in this appendix.

h) Part 1 Appendix J: Geotechnical Specialist Process Certification: Requirements for Strengthened Earthworks (Chart 8)

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

j) Part 1 Appendix K: Requirements for Independent checking (Appendix applicable to Scotland only)

This appendix refers to the requirement relating to the Independent Checking Consultant (ICC).

Geotechnical Reports

1.34 Appendices C to H require the production of reports to accompany the Geotechnical Certificates, the requirement for these reports are set out in **Part 2** of this Standard.

1.35 The geotechnical reports produced as part of the Geotechnical Certification process are intended to be living documents, in that it is expected that they will 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 will 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 they shall make this clear and substantiate it in the subsequent versions of the reports that they are required to produce.

1.36 The content of the various geotechnical reports will depend on the geotechnical complexity of the project; however the layout of the reports shall be adhered to irrespective of project size, with sections not being used or not relevant, being noted in the contents page of each report. The final content requirements will be agreed between the Overseeing Organisation and the Designer's Geotechnical Advisor.

1.37 The aim of these reports is to set out, in a logical manner, the Design Organisation's processes for managing geotechnical risks on a project. They are important documents, which clarify how the geotechnical design was undertaken and form part of the records for the project.

1.38 **[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 useage 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.

APPENDIX A DEFINITIONS

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

Design Organisation (DO): The organisation responsible for undertaking the design of a project.

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 Geotechnical Advisor as set out by the Site Investigation in Construction Series Documents produced by the Institution of Civil Engineers 1993 (Ref 9), 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.

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

Maintaining Agent (MA): The organisation responsible for the day to day maintenance of a specific area of highway.

Overseeing Organisation Site Nominee (OOSN): The representative of the Overseeing Organisation based on site, (ie Engineer's Representative (ER) on ICE 5th edition contracts (Ref 12), Department's Agent on D & B/DBFO Contracts or Project Manager New EC suite of contracts (Ref 13)).

Strengthened Earthworks: Placed or insitu 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, eg reinforced soil, soil nailing or by external support such as gabions.

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

a) Earthworks

b) Strengthened Earthworks

c) Ground Investigations including trial pits

d) Excavation/assessment below sub-base level

e) Earth retaining structures

f) Structural foundations and excavations

g) Excavations for tunnels and service ducts

Geotechnical Works: The carrying out of Geotechnical Activities.

Earthwork: Work of excavating or raising of ground.

SEAF: Strengthened Earthwork Appraisal Form (**Part 1 Appendix J** refers).

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APPENDIX B GEOTECHNICAL CERTIFICATE

Scheme Title

Geotechnical Certificate

(- Delete as appropriate)* **Certificate Seq. 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 a fit for purpose 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)

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

*Signed: .....
*Contractor (Agent or Contracts Director)

*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.

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APPENDIX C INITIAL REVIEW OF PROJECT (CHART 2)

C1.1 In order to establish the Geotechnical Certification requirements of a project the project shall be reviewed to determine its Geotechnical Classification.

C1.2 The review shall be carried out by the Overseeing Organisation as soon as the project brief is confirmed or a third party notifies the project to the Overseeing Organisation.

C1.3 In order to establish these requirements, 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. An Initial Geotechnical Risk Register shall be prepared. Fig C1 illustrates an example of a simple Risk Register.

C1.4 **Chart 2** outlines the procedures to be followed when assessing the Geotechnical Classification.

C1.5 **Geotechnical Category 1 Projects** are those that involve minor geotechnical activities and/or risk and where the ground conditions are known from comparable experience to be sufficiently straightforward, that simple or basic methods may be used for design and construction.

C1.6 **Geotechnical Category 2 Projects** will be conventional types of earthworks structures and foundations with no abnormal risks or unusual or exceptionally difficult ground conditions. The majority of geotechnical activities associated with highways should fall into this category. Category 2 Projects require quantitative geotechnical data and analysis to ensure that the fundamental requirements are satisfied, but routine procedures for field and laboratory testing and for design and construction may be used.

C1.7 **Geotechnical Category 3 Projects** comprise those projects which do not fall within the limits of Geotechnical Categories 1 & 2. They include very large or unusual structures, activities involving abnormal risks or unusual or exceptionally difficult ground or loading conditions. Projects affected by contaminated land would generally be included within this category.

C1.8 For projects with a geotechnical classification of 1, the Design Organisation will proceed with certification as outlined in **Part 1 Appendix E**.

C1.9 For projects with a geotechnical classification of 2 or 3, the Design Organisation will arrange for Preliminary Certification **Part 1 Appendix D** to be carried out.

C1.10 For projects, which clearly indicate that no geotechnical activities will be involved there will be no need for them to be assessed further and the Project file annotated accordingly.

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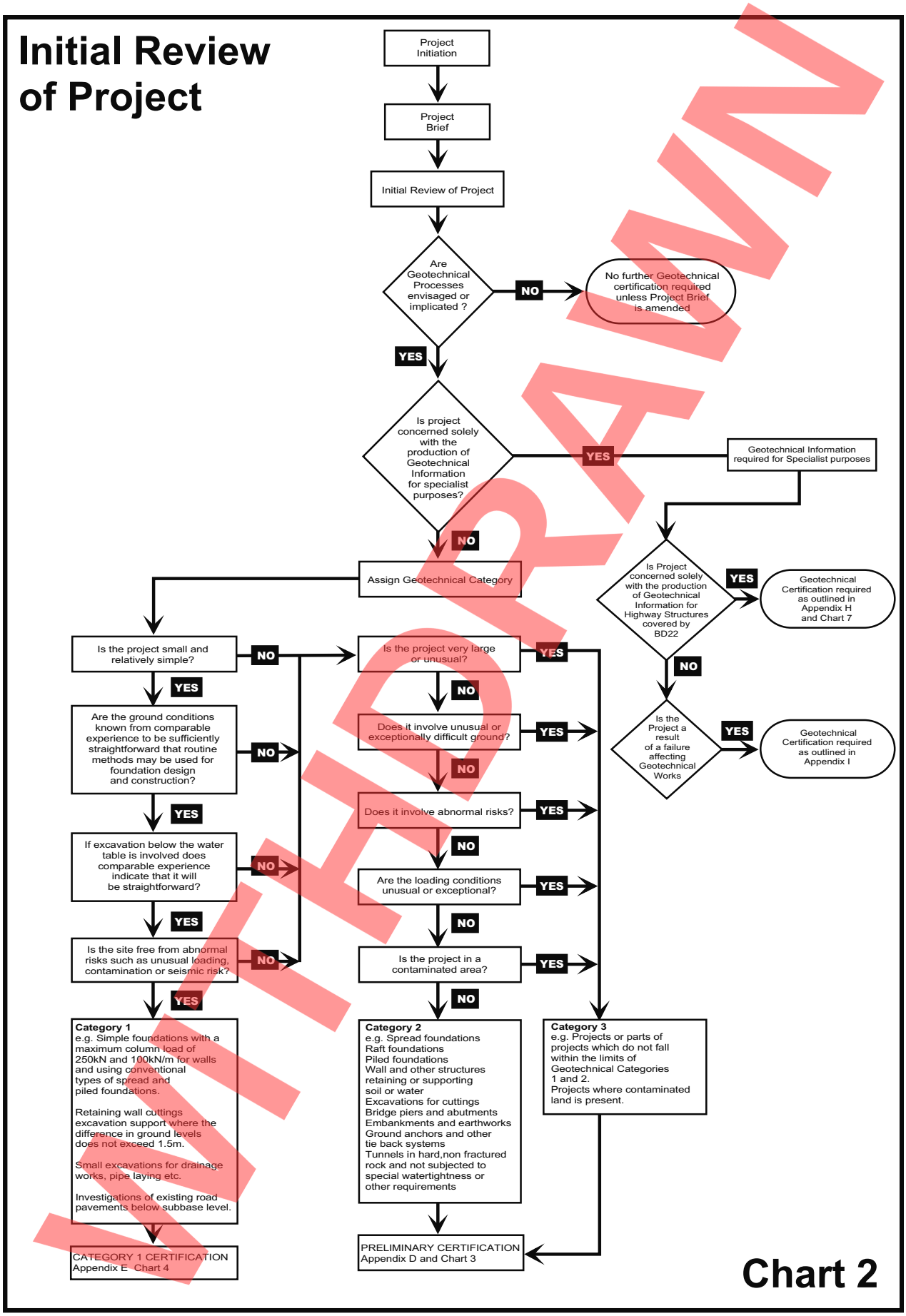

HAZARD/RISK	CAUSE	BEFORE CONTROL P	I	R	CONSEQUENCE
Failure	variable soils	5	5	25	collapse
	groundwater	3	4	12	collapse
	erosion of slope face	5	5	25	collapse
Damage to adjacent services	variable soil in cutting	4	4	16	excessive settlement
Disintegration	corrosion/chemical attack of nails	3	5	15	gradual structural failure

Risk rating (R) = Probability (P) x Impact (I)

PROBABILITY (P)	
Very Likely	5
Likely	4
Probable	3
Unlikely	2
Negligible	1

IMPACT (I)		TIME	COST
Very High	5	> 10 weeks on completion	> £1M
High	4	> 1 week on completion	100k to 1M
Medium	3	> 4 weeks: < 1 wk on completion	10k to 100k
Low	2	1 to 4 weeks: none on completion	1k to 10k
Very Low	1	< 1 week to activity: none on completion	< 1000

Simplified example of part of a risk register for a shallow footing

Fig C.1 Simplified example of a Risk Register

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APPENDIX D PRELIMINARY CERTIFICATION (CHART 3)

D1.1 The procedures to be followed to carry out Preliminary Certification are illustrated on **Chart 3**.

D1.2 Soon after appointment, the Designer responsible for the design or assessment of the project shall be required to submit a **"Statement of Intent"**, which is a brief statement of what is proposed to satisfy the basic geotechnical aspects of the project. This statement provides the Overseeing Organisation with an outline of the tasks involved, together with programme and cost implications of the initial geotechnical assessments. An example is given at **Part 2 Appendix A**.

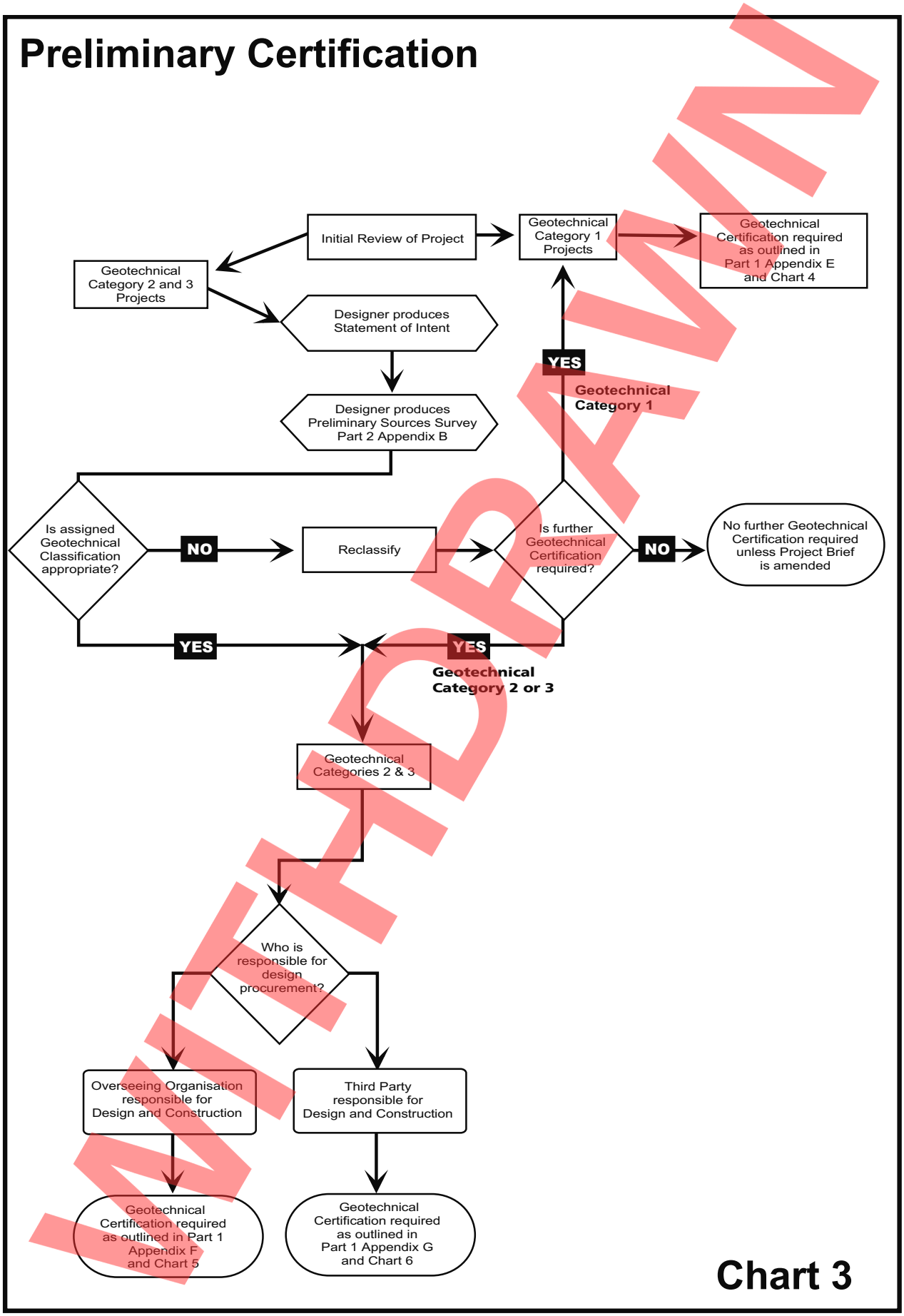
D1.3 The Statement of Intent will be subject to the agreement of the Overseeing Organisation, before the Designer proceeds with the Preliminary Sources Study.

D1.4 The Statement of Intent may form part of any Commissioning Report that the Designer is required to produce on appointment.

D1.5 The Preliminary Sources Study (PSS) report 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 PSS is an important document for the Overseeing Organisation to use when assessing the Health & Safety hazards and environmental aspects presented by a project, especially as part of any initial route determination. An example of the contents of this report is given in **Part 2 Appendix B**.

D1.6 On the basis of the information gathered for the PSS, the geotechnical issues will begin to be identified and it will be possible to assess the vulnerability of a project to these issues and to any associated hazards. At this stage a formalised geotechnical risk management system should be set up, which will be continued through to project completion.

D1.7 The PSS will confirm or amend the project's **Geotechnical Classification** and the Overseeing Organisation may decide, subsequent to receipt of the Preliminary Certification, that no further Geotechnical Certification is required. If this is the case then both the Overseeing Organisation and the GA shall endorse the Statement of Intent with that fact and the Designer shall be informed. 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 on the requirements for further Geotechnical Certification.



APPENDIX E GEOTECHNICAL DESIGN & CONSTRUCTION CERTIFICATION: GEOTECHNICAL CERTIFICATION FOR GEOTECHNICAL CATEGORY 1 PROJECTS (CHART 4)

E1.1 For Geotechnical Category 1 projects, shortened procedures are appropriate and these are outlined in **Chart 4**.

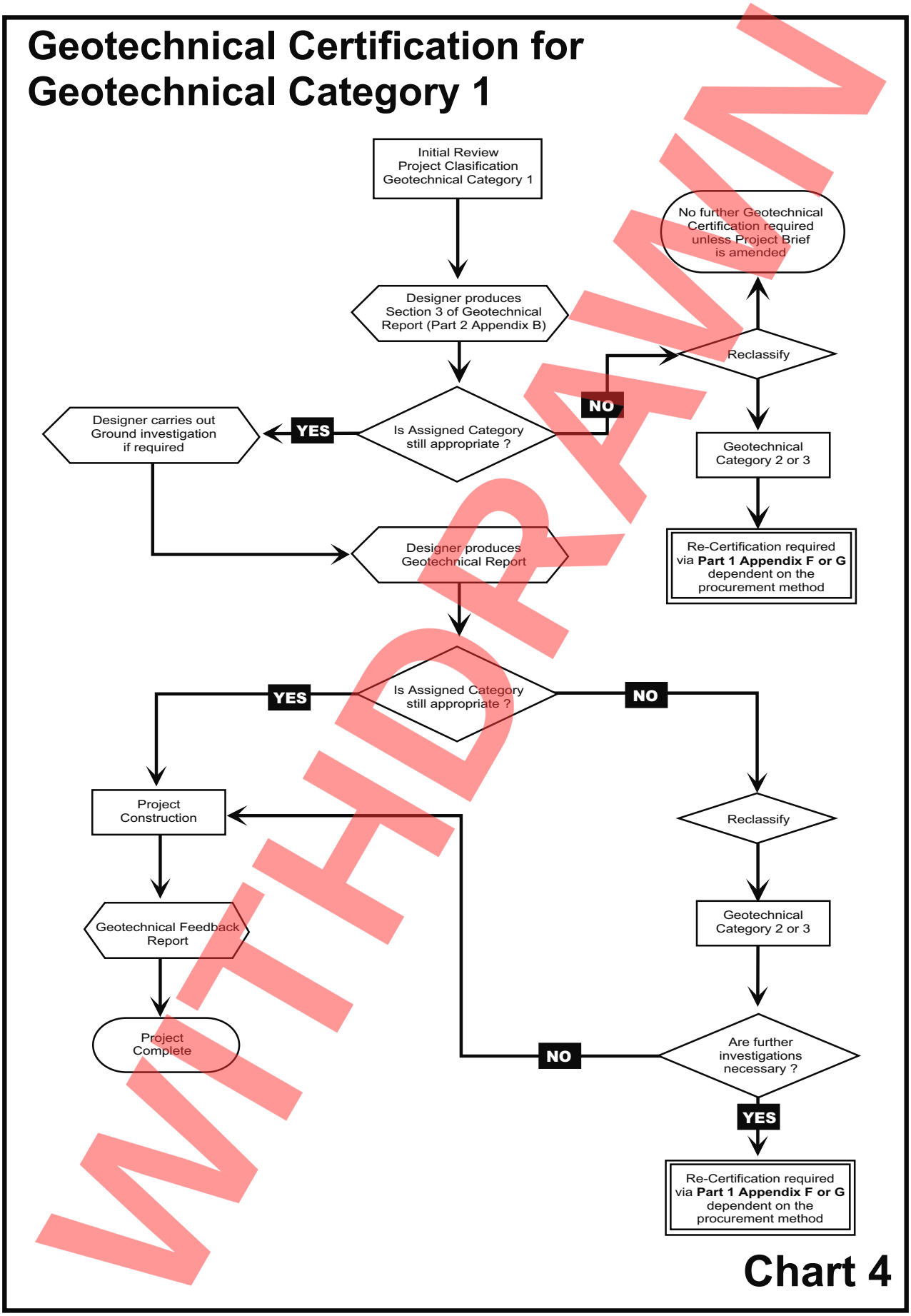
E1.2 On completion of the initial review, the Designer shall carry out any investigations required to produce section 3 of the Geotechnical Report (**Part 2 Appendix C**) and following a review of the geotechnical risks, confirm that the project category is correct.

E1.3 The procurement method to be used for any ground investigations required will depend on the form of procurement being used for the project as a whole.

E1.4 The Geotechnical Report shall consist of those sections that are relevant to that project. The report may, subject to the agreement of the Overseeing Organisation, be submitted as a whole, or in parts as the work progresses. (Unused sections shall be identified within the content page).

E1.5 If during design or construction of the project, activities are identified that would extend or alter the project, then the Overseeing Organisation should be informed and the Designer must review the **Geotechnical Classification** to ensure that the risks associated with this increased complexity are fully assessed. Following any reclassification, a revised Geotechnical Report shall be issued covering any amendment required to the design. If further investigations are required then the project shall be certified, as outlined in **Part 1 Appendix F** or **G**, dependent on the procurement method for the project.

E1.6 Following completion of construction, a Geotechnical Feedback report consisting of those sections relevant to the project shall be produced. (Unused sections shall be identified within the content page).



APPENDIX F GEOTECHNICAL DESIGN & CONSTRUCTION CERTIFICATION: OVERSEEING ORGANISATION RESPONSIBLE FOR PROJECT PROCUREMENT (CHART 5)

F1.1 For Geotechnical Category 2 or 3 projects, when the Overseeing Organisation is responsible for the procurement of the project design and construction, or Statutory Orders are required, the following certification process illustrated on **Chart 5** shall be followed.

F1.2 Before preparing Contract Documents for any ground investigation, or other survey that may be required, the Designer shall review and update as necessary the **Annex A** to **Preliminary Sources Study**, which detailed the requirements for any investigations necessary. This revision will place special emphasis on current costings and extent of any surveys. Production of ground investigation contract documents will follow directly from the revised annex.

F1.3 Where supplementary ground investigations are required after the main investigation, the procedure above shall be repeated and a further **Annex A** to the **Preliminary Sources Study** produced. This shall be annotated with a revision suffix to provide a unique descriptor.

The Geotechnical Report (Preliminary)

F1.4 On completion of the ground investigation the Designer shall submit a report consisting of Sections 1 to 7 of the Geotechnical Report **(Part 2 Appendix C)** 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 Preliminary Sources Study shall be included in this report. It shall also include a brief on the geotechnical design parameters and where appropriate, as section 8 of the report, an outline design with commentary on the underlying philosophy and any special measures which need to be incorporated. These shall be included in a form suitable for use in the preparation of the final design. Advice on items to be included in the factual and interpretative parts of the Geotechnical reports is given in SA 9 (Ref 5), Ground Investigation Procedure. Where the project is a new route or alignment, the Designer shall programme this work, so that the preliminary Geotechnical Report and all relevant design information are available for consideration for the preparation and submission of the 1:2500 Compulsory Purchase Order plans.

F1.5 Where a supplementary ground investigation is required; the **revised Annex A to the PSS** shall be produced (cf para F1.3), followed, after the completion of the additional investigation, by the updating of the Geotechnical Report (Preliminary) to include this information.

Geotechnical Report

F1.6 Once approval for final design to be carried out has been given by the Overseeing Organisation, the Designer shall prepare the Geotechnical Report (as set out in **Part 2 Appendix C**). This report shall be submitted to the GA not later than the completion of the design work and normally at least 2 months prior to the submitting to the Overseeing Organisation of any draft tender documentation. The Geotechnical Report is the Designer's detailed report on his interpretation of all his investigations and the design of the geotechnical elements of the project and shall include all items covered in the Preliminary Geotechnical Report updated as necessary. The report will detail how the risks identified in the Geotechnical Risk Register have been managed.

F1.7 When submitting the draft tender documentation for the project construction works (the Main Works Contract), the Designer shall also complete and sign a **Geotechnical Certificate (Part 1 Appendix B)** as confirmation that the design contained in the tender documents incorporates, and is compatible with, the information contained in the Geotechnical Report. Tenders shall not be invited prior to submission of this certificate to the Overseeing Organisation and its acceptance marked as received. If significant amendments, which affect the geotechnical design, are made to the draft tender documents, then the Geotechnical Report must be updated by way of an addendum to reflect those changes. This addendum must also be submitted under cover of a fresh

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Geotechnical Certificate. Advice on the design of earthworks and the preparation of contract documents is given in HA 44 (Ref 6).

Brief for Overseeing Organisation Site Nominee

F1.8 The Geotechnical 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 is put in a sound position to deal with those issues and matters which are within his delegated powers.

F1.9 On projects which involve major or complex geotechnical activities, then a Geotechnical Site Engineer (GSE) shall be appointed to the site staff, who shall be responsible for the supervision of the geotechnical aspects of the project. The qualifications of this GSE shall be commensurate with the complexities of the work and the qualification requirements shall be agreed between the DGA and GA in consultation with the Overseeing Organisation.

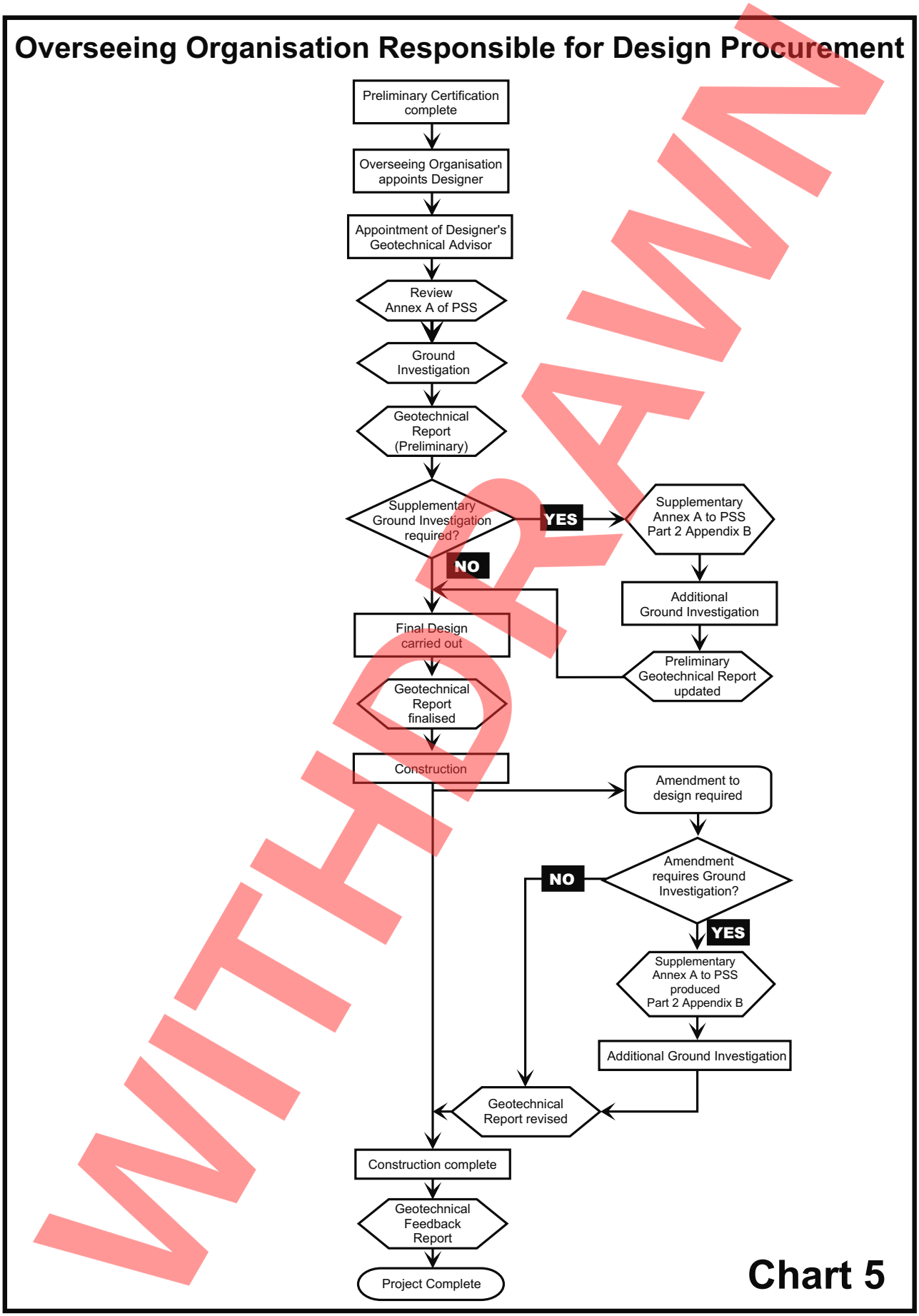
F.1.10 During the course of the construction process, any significant differences, between the actual conditions found and those expected, are to be reported formally in writing by the Designer to the OOSN, who in turn shall report them to the Overseeing Organisation and GA without delay. The consequences of these differences shall be reported in the **Geotechnical Feedback Report (Part 2 Appendix D)**.

Additional Geotechnical Investigation during Main Works Contract

F1.11 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 Geotechnical Report, then this additional/amended work shall be subject to Geotechnical Certification.

F1.12 Prior to any additional GI work being carried out, a revised **Annex A to the PSS** covering the proposed work, together with a **Geotechnical Certificate (Part 1 Appendix B)**, 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 Geotechnical Report shall be updated. This revised Geotechnical Report shall be submitted under cover of a fresh Geotechnical Certificate and shall include the additional work and any amendment to the design.

F1.13 The Designer shall, at the completion of the construction phase, produce a **Geotechnical Feedback Report (Part 2 Appendix D)**.



APPENDIX G GEOTECHNICAL DESIGN & CONSTRUCTION CERTIFICATION: THIRD PARTY RESPONSIBLE FOR PROJECT PROCUREMENT (CHART 6)

G1.1 Where a project is to be procured by appointing a contractor, who is responsible both for the design and the construction of that project, ie D&B/DBFO/Third Party procurement; then the Contractor, through his Designer, has responsibility for the procurement of the necessary geotechnical information, reports and certification. This certification process is indicated on **Chart 6**.

G1.2 The Contractor's Designer shall appoint a Designer's Geotechnical Advisor (DGA) as defined in para 1.21.

G1.3 The Designer shall be responsible for the production and submission of a Geotechnical Report, as set out in **Part 2 Appendix C**. This report and any subsequent amendments to it, shall be submitted by the Designer to the Overseeing Organisation. A **Geotechnical Certificate (Part 1 Appendix B)** shall accompany all submissions of the Geotechnical Report.

G1.4 The Geotechnical Report may be submitted in whole, or parts, as agreed with the Overseeing Organisation, subject to the following; Geotechnical Report Sections 1 to 7 must be submitted and received, before subsequent sections can be submitted. Sections 8, 9, 10 and annexes 1, 2 & 3 must 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 Report can be commenced by the Contractor before the relevant Certification for that part of the Works has been completed.**

G1.5 If, as part of the Contract Documentation, the Contractor has been provided with a preliminary or draft Geotechnical Report, produced for the project by a previous Designer (eg produced to enable orders to be obtained); 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.

G1.6 If amendments to the design, (as detailed within a submitted and certified Geotechnical Report) is required, or a further ground investigation (which will lead to amendment to that report) is needed, then the Geotechnical Report shall be revised and resubmitted under cover of a further Geotechnical Certificate. The revision shall cover the additional work and any amendment to the design.

G1.7 The Designer shall, at the completion of the construction phase, produce a Geotechnical Feedback Report **(Part 2 Appendix D)**.

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Third Party Responsible for Design Procurement

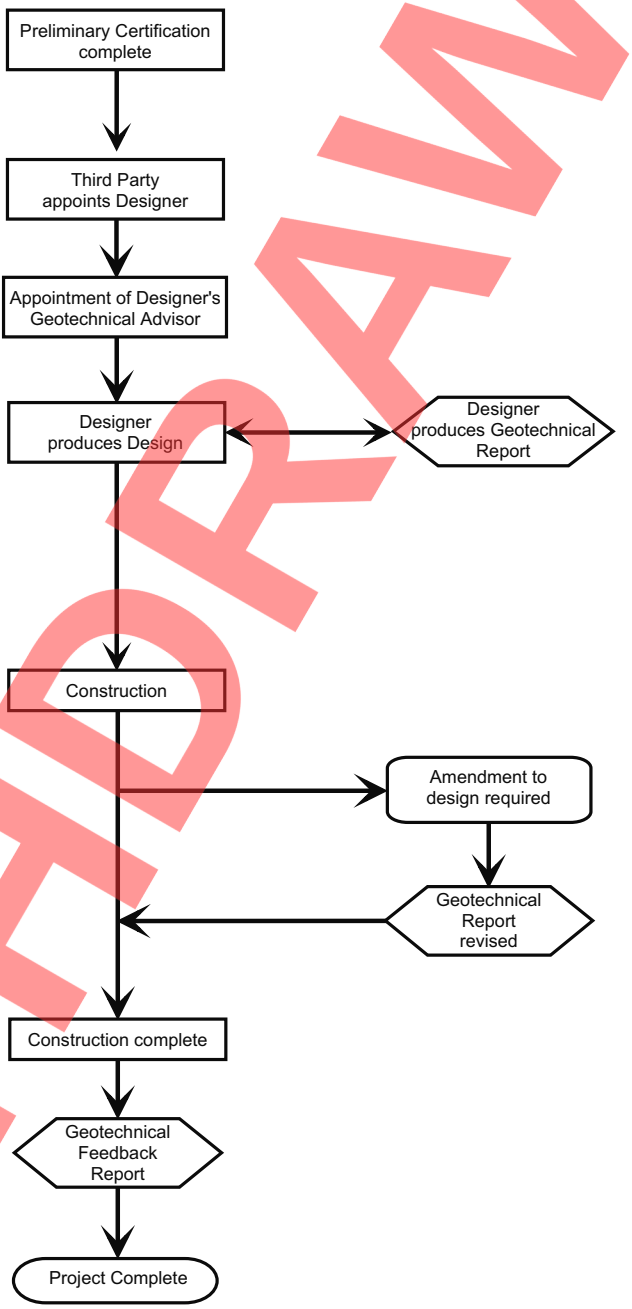

Chart 6

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APPENDIX H GEOTECHNICAL SPECIALIST PROCESS CERTIFICATION: PRODUCTION INFORMATION FOR ASSESSMENT, MAINTENANCE AND/OR TECHNICAL APPROVAL FOR HIGHWAY STRUCTURES COVERED BY BD 2 (CHART 7)

H1.1 Where geotechnical information, including ground investigations, is required for structural assessment, maintenance and Technical Approval purposes (being carried out for structures covered by and described in BD 2 (Ref 11), the acquisition and reporting of that information shall be subject to Geotechnical Certification.

H1.2 The Designer, appointed to carry out the assessment or to prepare the Technical Approval documents, shall procure and report Ground investigations as follows and shown on **Chart 7**.

a) All geotechnical submissions to be accompanied by a Geotechnical Certificate as required by para 1.24 and **Part 1 Appendix B**.

b) A Preliminary Sources Study Report shall be produced, **(Part 2 Appendix B)**.

c) The Geotechnical Advisor and the Technical Approval Authority (TAA) shall agree the method of procurement to be used for any ground investigations required.

d) The Designer shall supervise the Ground Investigation contract and shall produce the Geotechnical Report to cover the investigation and its interpretation. This report shall be in the format set out in **Part 2 Appendix C** and consist of not less than sections 1 to 8 and Annex 2. Other sections shall be included if required by the GA/TAA (see also f below).

e) The completed Geotechnical Report is then attached to the Assessment Report or AIP for the structure.

f) If strengthened earthworks are envisaged or required, then additionally section 8.3 of the Geotechnical Report shall be completed together with a **SEAF (Part 1 Appendix J)**, which shall be attached to the Geotechnical Report for inclusion in the AIP.

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Production of Geotechnical Information for Highway Structures covered by BD2

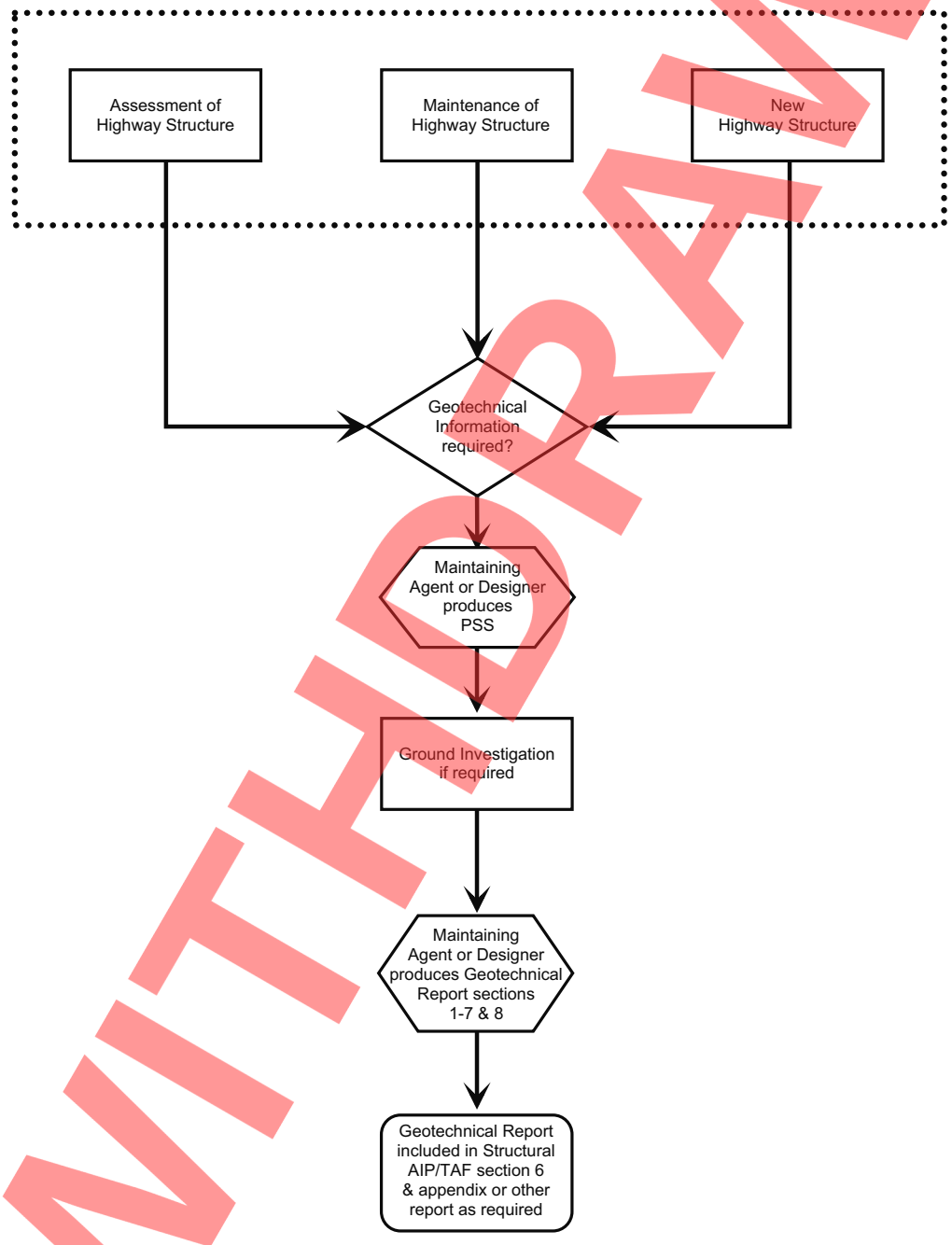

Chart 7

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APPENDIX I GEOTECHNICAL SPECIALIST PROCESS CERTIFICATION: APPLICATION TO DEFECTS AFFECTING THE GEOTECHNICAL ASSET

I1.1 HD 41 (Ref 7) and the Trunk Road Maintenance Manual (TRMM) (Ref 14) sets out the obligations of Maintaining Agents (MA) for recording and inspecting Geotechnical Works.

I1.2 When, during the course of inspection (or at any other time), a failure, or risk of failure affecting the geotechnical infrastructure of the highway is noted, then the Maintaining Agent for that area of the network shall take action to record and repair that failure. The procedure to be followed, to report and to investigate the failure is set out in HD 41 (Ref 7).

I1.3 Any investigation and remediation of the failure shall be subject to Geotechnical Certification. The format and layout of reports required by HD 41 (Ref 7) shall follow the requirements set out in Part 2 of this Standard.

I1.4 The **Geotechnical Report (Part 2 Appendix C)** shall consist of those sections that are relevant to that project. (Unused sections shall be identified within the content page), which may, subject to agreement of the Overseeing Organisation, be submitted as a whole or in parts as agreed with the Overseeing Organisation.

I1.5 A **Geotechnical Certificate (Part 1 Appendix B)** shall accompany all report submissions.

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APPENDIX J GEOTECHNICAL SPECIALIST PROCESS CERTIFICATION: REQUIREMENTS FOR STRENGTHENED EARTHWORKS

J1.1 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 Strengthened Earthwork Appraisal Form (SEAF) based on the model form set out below.

J1.2 Where required by contract documentation, an outline SEAF may have to be submitted and approved in outline prior to the return of any tender documentation. When this is the case a full SEAF will be required to be resubmitted as an addendum once contracts have been awarded and design work undertaken.

J1.3 Strengthened Earthwork designs shall be checked by a Checking Team, which may be from the Designer, but shall be independent of the Design Team.

J1.4 The completed SEAF forms shall be attached, as an appendix to the Geotechnical Report.

J1.5 The requirements of a SEAF and its layout are illustrated on the accompanying model SEAF.

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Model 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. This must include an OS grid reference for both the start and finish of the individual elements to an accuracy of less than 5 metres)

3. OUTLINE OF EXISTING GROUND AND GROUNDWATER CONDITIONS

(this section to refer to the relevant sections of the Designers Geotechnical 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 sulphate/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, eg 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 geotextiles, 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 Earthwork 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 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
(draw 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 trialhole 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: .....
Team Leader, Design Team
Name: .....
Engineering Qualifications: .....
Date: .....
On Behalf of .....
Geotechnical Certificate Ref No.

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)

APPENDIX K REQUIREMENTS FOR INDEPENDENT CHECKING (THIS APPENDIX IS APPLICABLE TO SCOTLAND ONLY)

K1.1 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 Independent Checking Consultant (ICC). The ICC may where required by the Overseeing Organisation act as the Overseeing Organisation's GA.

K1.2 Procedures in regard to the requirements and adoption of the geotechnical certification and checking process in Scotland are set out in SH4/89 [Ref 21].

Managing Geotechnical Risk

Part 2

Reporting Requirements for Geotechnical Certification

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2. REPORTING REQUIREMENTS FOR GEOTECHNICAL CERTIFICATION

1. Introduction

1.1 Part 1 of this Standard sets out the procedures to be followed to achieve Geotechnical Certification. A requirement of that process is the production of reports to accompany the Geotechnical Certificates. Details of these reports are set out in this part of the Standard.

1.2 One copy of the final version of all reports, produced for a project, shall be placed in the Overseeing Organisation Geotechnical Archive.

1.3 One copy of any factual report 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.

1.4 The object of these reports is not just as a backup to the process of Certification, but to set out in a logical manner, the Designer's thought process in identifying and overcoming or managing the Geotechnical Risk to a project.

1.5 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.

2. Statement of Intent

2.1 The Statement of Intent is prepared by the Designer to indicate the scope, purpose programme and cost of the initial geotechnical investigations to **key stage 2 (Part 1 para 1.25)**. This includes the updating of the preliminary Geotechnical Risk Register produced for the Initial Review of the Project. An example of the Statement of Intent is given at **Part 2 Appendix A**.

3. Preliminary Sources Study

3.1 The Preliminary Sources Study (PSS) is carried out for all projects and includes a site reconnaissance. The PSS is an important document, not only from a geotechnical viewpoint. The establishment of the **Geotechnical Risk Register (Ref 2)** will assist the Overseeing Organisation in assessing the complexity and history of the site, especially with reference to the Health and Safety hazards presented. The register will establish the approach required to manage those risks identified and provide the geotechnical input into the assessment of project risks required by documents such as the Highways Agency's Value for Money Manual (Ref 20).

3.2 The PSS will address the geology, geomorphological, hydrological and geo-environmental aspects of the project site as well as the historical development of the area. Contamination and man made obstructions should be investigated and reported on.

3.3 The PSS will give a preliminary engineering assessment of the project area and inform of any likely hazards to construction. It identifies the risks and consequences to the project of the information gained and using the risk register establishes the means to manage those risks.

3.4 The PSS, within its Annex A, should develop the objectives and methodology for phased investigations of ground conditions, which should cover both geotechnical and geo-environment requirements.

3.5 An example of the content of a PSS is given in **Part 2 Appendix B**.

4. Geotechnical Report

4.1 The Geotechnical Report is the Designer's detailed report on the interpretation of all of the investigations and the design of the geotechnical aspects of the project. An example of the layout, headings and content is given in **Part 2 Appendix C**.

4.2 The Geotechnical Report Layout has been designed as a living report, which can be produced in parts and updated as necessary as the project develops. By updating the report, the project will be supported by a unique and valuable geotechnical reference document.

4.3 The Geotechnical Report consists of the following major sections:

a) **Section 3.** A review of all the existing information, which will update as necessary, the information contained in the PSS. It will include details of any previous investigations.

b) **Section 4** sets out the investigations, which the Designer has undertaken for the project. Any factual Report on the investigations may be incorporated within the report for small projects, or attached as an appendix for more major investigations.

c) **Section 5** details the Designer's summary interpretation of the investigations reported in sections 3 & 4.

d) **Section 6** summarizes the interpretation of the ground conditions of the project and details and describes the various materials and conditions to be encountered together with the justification for the parameters adopted for the design.

e) **Section 7** contains the Geotechnical Risk Register for the project. Risks are defined, their consequence established and evaluated and methods to manage those risks developed.

f) **Section 8** details the design criteria to be adopted for each element of the geotechnical design. It is split into sections covering cuttings, embankments, structures etc.

g) **Section 9** gives details of instrumentation and monitoring requirements, including the use of the Observational Method for control.

h) **Annex 1** sets out the completed Specification Table 1/5 6/1 6/2 & 6/3 and series 500 & 600 appendices.

i) **Annex 2** gives the layout for the completed cutting, embankment, structure and strengthened earthwork summary information forms. The boxed layout of these forms should be expanded as necessary to ensure completeness of the information.

j) **Annex 3** comprises completed SEAF forms.

5. The Geotechnical Feedback Report

5.1 The Geotechnical Feedback Report is required for all projects, irrespective of the method of procurement and is produced by the Designer's Site Staff. It should be prepared as an ongoing task during the contract construction period.

5.2 The report shall utilize construction data to provide a record of the location and nature of materials encountered and utilized. 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.

5.3 The format of the Geotechnical Feedback Report is given at **Part 2 Appendix D**.

5.4 The Geotechnical Feedback Report should be produced as an independent document, but once accepted should be incorporated within the Health and Safety File produced for the scheme.

APPENDIX A STATEMENT OF INTENT

The Statement of Intent is intended to identify known or suspected geotechnical risks and to state how these are to be investigated. It should be submitted to the Overseeing Organisation after appointment of a Design Organisation, together with an estimated programme and cost of work involved in carrying out the Preliminary Certification to complete key stage 2

1. SCHEME

Name and details of Scheme, key plan.

2. OBJECTIVES

3. EXISTING INFORMATION

List of all relevant reports and sources of information.

4. GEOTECHNICAL RISK

Update of preliminary Geotechnical Risk Register (Ref 2) produced for the Initial Review of the Project. Review Geotechnical Categories (Ref 3 and **Chart 2**).

5. PROPOSED STUDIES AND INVESTIGATIONS

Programme for further and more detailed studies and investigations proposed (in the light of 3 & 4) to complete the Preliminary Sources Study.

6. SPECIALIST CONSULTATION

Details if required with reasons.

7. PROGRAMME AND COST

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

APPENDIX B PRELIMINARY SOURCES STUDY REPORT

The content of the Preliminary Sources Study report should cover the geotechnical risks, implications and feasibility of all scheme options. Reference should be made to the AGS Guide to the Model Document (Ref 15), TRL Report 192 (Ref 16) and BS5930 (Ref 17) when preparing the document.

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, of all sources used for geotechnical, historical and other general information relevant to the area. (Ref. 16 & 17). 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 geography, 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 (with reasoning) 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.

Atmospheric pollution

Any existing geotechnical problems ie. 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, geoenvironmental, historical, contamination and other factors discovered, which are likely to influence the project i.e. routes, alignment, health & safety or buildability.

Details of the establishment of the 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 & 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, SU information, high health status animal herds, Railtrack etc.

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. (To comply with the requirements of **Part 2 Appendix C**.)

APPENDIX C FORMAT OF GEOTECHNICAL REPORT

*(NOTE: The section layout numbering indicated is **mandatory** for every report. Sections not used shall be left blank and the contents page annoted 'not used' for that section.)*

1. TITLE SHEET & 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 as a footer to 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.

2. INTRODUCTION

2.1 Scope and objective of the report

2.2 Description of project (including site description)

2.3 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 PSS 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

3.9 Flood Records

3.10 Contaminated land

3.11 Other relevant information

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 Copy of Ground Investigation Factual report or copies of exploratory hole records (may be bound as a separate volume if bulky)

4.3.3 Results of insitu 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 18).

5.0 GROUND SUMMARY

This section describes the Designer's summary interpretation of the results of the investigations carried out in sections 2-4 above. The Ground Summary should provide the summary interpretation on the geography, 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.

6.0 GROUND CONDITIONS AND MATERIAL PROPERTIES

This section is the Designer's interpretation of the ground conditions along the project route and should contain details and description of the various materials to be encountered together with a full justification for the parameters adopted for the geotechnical design. Full references should 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 details 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 section 8 of the report.

8.0 GEOTECHNICAL DESIGN CRITERIA

The text portions (8.1.1, 8.1.3, 8.2.1 and 8.3.1) of this section should include full details of the interpretation and justification for the design and include a layout drawing of that part of the works. The summary sheets (8.1.2, 8.1.4, 8.2.2 and 8.3.2) should be a summary of that information. Sections 8.1, 8.2 and 8.3 should be subdivided for each unique earthwork or structure.

8.1 Earthworks

8.1.1 Cutting stability- Full details of the methods of analysis, soil parameters, factors of safety, drainage, slope angles, CBR and other considerations

8.1.2 Cutting summary information sheet (form A)

8.1.3 Embankment stability - Full details of the methods of analysis, soil parameters, factors of safety, drainage, slope angles, CBR and other considerations

8.1.4 Embankment summary information sheets (form B)

8.2 Highway Structures

8.2.1 Details of Highway Structure type. Full details of the method of analysis, soil parameters including earth pressures and factors of safety, used for bearing capacity, pile design, settlement, soil reinforcement, protection of concrete and reinforcing elements against chemical attack and other considerations including, without limitation, soil/structure interaction, Chemicals in the ground, ground water, air pollution and water transported through structures

8.2.2 Highway Structure Summary information sheet (form C)

8.3 Strengthened Earthworks

8.3.1 Details of Strengthened Earthwork. SEAF Reference no full details of the method of analysis, soil parameters including earth pressures and factors of safety, used for bearing capacity, settlement, soil reinforcement, protection of concrete and reinforcing elements against chemical attack and other considerations including, without limitation, soil/ structure interaction. SEAF Reference no

8.3.2 Strengthened Earthwork summary information sheet (form D)

8.4 Drainage

8.5 Pavement Design Subgrade & Capping - Method of analysis, soil parameters, ground water assumptions

8.6 Contaminated Land, including details of risk assessment carried to confirm compliance with statutory requirements on the ultimate destination of all contaminated material

8.7 Ground Treatment including treatment of old mine workings etc

8.8 Specification Appendices - Details of parameters and amendments for the specification appendices completed in Annex 1. (Ref 19)

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 and 600 appendices including tables 6/1, 6/2 & 6/3. (Ref 19)

ANNEX 2
Forms A, B, C & D

ANNEX 3
Completed SEAF Forms

scheme

(Form A)

GEOTECHNICAL REPORT
CUTTING SUMMARY INFORMATION

CHAINAGE and OS GRID Reference of the start and finish of the cutting			MAX DEPTH		Reference/ Comments
SIDE SLOPE 1 in.....N/W 1 in.....S/E			TYPICAL DEPTH		
SLOPE TOPSOIL DEPTH			RELEVANT TRIAL HOLES		
SOILS/GEOLOGY					
Strata	Typical depths		Water Bearing		
PREVIOUS GROUND HISTORY					
CONTAMINATED GROUND RISK ASSESSMENT REQUIRED?					
GROUNDWATER					
SOIL CHEMISTRY					
SLOPE STABILITY					
Side slope	Short term FOS	Long term FOS	Construction constraints/ recommendations		
EARTHWORKS					
	Soil type	Quantity	Acceptability Criteria	% acceptable	
TEMPORARY DRAINAGE					
anticipated requirements					

Form A (cont) Cutting summary information

PERMANENT DRAINAGE						Reference/ comments
Location	Type	Depth	Spacing	Backfill/ filter	Special measures	
PAVEMENT DESIGN						
Chainage/OS Grid Reference	Subgrade	Design CBR	Capping thickness		Special measures	
Design *"Traffic"* *"msa"*					Pavement types rigid/flexible/ composite	
PAVEMENT DRAINAGE						
Location	Type	Depth		Backfill/ filter	Special measures	
OTHER DESIGN FEATURES *(eg foundation treatment)*						
ASSOCIATED HIGHWAY STRUCTURES						
Chainage/OS Grid Reference		Type		Special Measures		
An A4/A3 size Plan of the cutting (approx scale 1:1250) is attached which shows the location of the exploratory holes and other design features						

scheme

(Form B)

GEOTECHNICAL REPORT
EMBANKMENT SUMMARY INFORMATION

CHAINAGE and OS GRID Reference of the start and finish of the embankment			MAX DEPTH	Reference/ Comments
SIDE SLOPE 1 in.....N/W 1 in.....S/E			TYPICAL DEPTH	
SLOPE TOPSOIL DEPTH			RELEVANT TRIAL HOLES	
SOILS/GEOLOGY				
Strata	Typical depths		Water Bearing	
PREVIOUS GROUND HISTORY				
CONTAMINATED GROUND RISK ASSESSMENT REQUIRED				
GROUNDWATER				
SOIL CHEMISTRY				
FOUNDATION TREATMENT				
Chainage/OS Grid Ref	treatment details			
Fill Material Proposed				
SLOPE STABILITY				
Side slope	Short Term FOS	Long Term FOS	Construction Constraints/ Recommendations	
SETTLEMENT				
Description	Total Settlement		Time for 90%	
Foundation				
Embankment fill				

Form B (cont) Embankment summary information

EARTHWORKS					
	General Fill	Selected Fill	Drainage Layer	Capping Layer	
Material					
Quantity					
Onsite/import					
DRAINAGE					
Location	Type	Spacing	Depth	Backfill/ Filter	Special Measures
PAVEMENT DESIGN					
Chainage/OS Grid Reference	Subgrade	Design CBR	Capping thickness	Special measures	
Design *"Traffic"* *"msa"*		Pavement types rigid/flexible/ composite			
OTHER DESIGN FEATURES					
ASSOCIATED STRUCTURES					
Chainage/OS Grid Reference	Type	Special Measures			
An A4/A3 size Plan of the embankment (approx scale 1:1250) is attached which shows the location of the exploratory holes and other design features					

scheme **(Form C)**

GEOTECHNICAL REPORT
HIGHWAY STRUCTURE SUMMARY INFORMATION

* delete as appropriate

STRUCTURE NAME			CHAINAGE and OS Grid Reference			Reference/ Comments
STRUCTURE TYPE			AIP Ref No			
			DESIGN LIFE 120/other*			
SOILS/GEOLOGY			RELEVANT TRIAL HOLES			
Strata			Typical depths			
PREVIOUS GROUND HISTORY						
CONTAMINATED GROUND RISK ASSESSMENT REQUIRED						
GROUNDWATER						
EARTH PRESSURE VALUE k0* ka* kp*						
BEARING CAPACITY	Spread Footings					
Structure Element	Founding Stratum	Founding Level (m AOD)	Footing Size	Allowable Bearing pressure (Kn/m2)		
PILE DESIGN						
Structure Element	Founding Stratum	Toe Level (m AOD)	Pile dia (m)	Pile length (m)	Pile working load (kN)	
Pile type..... Criteria for selecting pile toe level..... Allowance for negative skin friction within design.....						

Form C Structure summary information

SETTLEMENT						
Structural Element	Founding Level (mAOD)	Immediate Settlement (mm)	Total Settlement (mm)	Time for 90%	Settlement Remaining at Completion	
Differential settlement to be allowed for between adjacent supports.....mm						
Differential settlement allowed between structure and approach embankment.						
GROUND MOVEMENTS						
Associated Earthworks	Settlement due to Embankment loading	Heave due to Cutting Excavation	Subsidence Due to Mineral Extraction	Flowing Water	Other	
Cause of Movement						
Maximum Movement (mm)						
Measures to Deal with Movement						

Form C Structure summary information

CHEMICAL ANALYSIS						
type of test/sample	soil	soil:water	water	other	air from ADAS map	
Sulphate/ Sulphide						
chloride						
ph						
redox						
other						
Buried Concrete classification.....Class ..... (BRE Special Digest No 1) Corrugated Steel Culvert ground/water classification						
OTHER DESIGN FEATURES						
NOTES						
An A3/A4 size drawing is attached which includes an elevation of the structure (approx scale 1:500) showing the foundations and ground conditions together with a location plan (approx scale 1:1250) showing the structure and exploratory holes.						

scheme **(Form D)**

GEOTECHNICAL REPORT
STRENGTHENED EARTHWORK SUMMARY INFORMATION

* delete as appropriate

STRENGTHENED EARTHWORK NAME	CHAINAGE and OS Grid Reference		Reference/ Comments
STRENGTHED EARTHWORK TYPE	SEAF Ref No		
	DESIGN LIFE 60/120/other*		
SOILS/GEOLOGY	RELEVANT TRIAL HOLES		
Strata	Typical depths		
PREVIOUS GROUND HISTORY			
CONTAMINATED GROUND RISK ASSESSMENT REQUIRED			
GROUNDWATER	Bearing capacity of founding strata		
Ru value for design			
Reinforcing Material	Slope Angle	Face Height (m)	
Facing Type	Fixing Details	Layer Spacing	
Topsoil depths and retention method	Vegetation Requirements		
Interaction with other structural elements/features	Foundation Preparation	Element Spacing	
Nail Type	Nail Length	Nail Spacing	
Drainage Control Measures			

Form D Strengthened Earthwork summary information

SETTLEMENT					
Structural Element	Founding Level (mAOD)	Immediate Settlement (mm)	Total Settlement (mm)	Time for 90%	Settlement Remaining at Completion
Differential settlement to be allowed for .....mm					

GROUND MOVEMENTS					
Associated Earthworks	Settlement due to Embankment loading	Heave due to Cutting Excavation	Subsidence Due to Mineral Extraction	Flowing Water	Other
Cause of Movement					
Maximum Movement (mm)					
Measures to Deal with Movement					

CHEMICAL ANALYSIS					
Type of test/sample	Soil	Soil:water	Water	Other	Air from ADAS map
Sulphate/ Sulphide					
chloride					
ph					
redox					
other					
Buried Concrete classification.....Class ..... (BRE Special Digest No 1)					

OTHER DESIGN FEATURES	
NOTES	

An A3/A4 size drawing is attached which includes an elevation of the structure (approx scale 1:500) showing the foundations and ground conditions together with a location plan (approx scale 1:1250) showing the structure and exploratory holes.

APPENDIX D FORMAT FOR GEOTECHNICAL FEEDBACK REPORT

(Prepared by the Designer's Site Staff during the Period of Maintenance and submitted to the Overseeing Organisation within 6 months of Project Completion)

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.

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 (Engineering/Technical/Economic) not envisaged in the Geotechnical 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.

5.0 CUTTINGS

5.1 For each cutting, location of materials excavated and their subsequent destination in the Works (with dates)*.

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)*.

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 their 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)*.

9.3 Acceptability and performance.

10.0 STRENGTHENED EARTHWORKS

10.1. Description of Strengthened Earthworks types and locations.

10.2. Strengthening & 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 pullout or other insitu 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 Settlement control stations.

11.7 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 or removal from site.

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.

*NOTE 1 Items marked * (and others where possible) may be conveniently presented on longitudinal profiles and accompanying plans compiled as construction proceeds.*

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

3. REFERENCES

1. **Mott MacDonald & Soil Mechanics Ltd. TRL Project Report 60**

   Study of the efficiency of site investigation practices
   TRL 1994

2. **Managing Geotechnical Risk**

   DETR Partners in Technology Programme
   Institution of Civil Engineers
   Thomas Telford 2001

3. **British Standards Institution Eurocode 7 Geotechnical Design**

   BSI DD ENV 1997-1:1995

4. **SD 13** - Documentation Requirement for Ground Investigation Contracts (MCHW5.3.1)

5. **SA 9** - Ground Investigation Procedure (MCHW 5.3.2)

6. **HA 44** - Earthworks: Design and Preparation of Contract Documents (DMRB 4.1.1)

7. **HD 41** - Maintenance of Highway Geotechnical Works (in preparation current document HA 48 DMRB 4.1.3)

8. **HA73** - Site Investigation for Highway Works on Contaminated Land (DMRB 4.7.1)

9. **Site Investigation in Construction Series Documents 1 to 4**

   Site Investigation Steering Group. Institution of Civil Engineers.
   Thomas Telford 1993

10. **Construction (Design & Management) Regulations**

    Statutory Instrument no 3140 1994 amended by Statutory Instrument no.1592 1996
    HMSO 1996

11. **BD 2** - Technical Approval of Highway Structures (DMRB 1.1)

12. **Conditions of Contract and Forms of Tender, Agreement & Bond for use in connection with Works of Civil Engineering Construction**

    5th Edition (June 1973) (Revised January 1986)
    Institution of Civil Engineers 1986

13. **The New Engineering Contract (2nd Ed)**

    Institution of Civil Engineers
    Thomas Telford 1995

14. **Trunk Roads Maintenance Manual [TRMM]**

    Highways Agency
    HMSO

15. **AGS Guide to the Model Document.**

    Association of Geotechnical Specialists

16. **Sources For Site Investigation in Britain TRL Report 192**

    Transport Research Laboratory, Crowthorne 1996

17. **Code of Practice for Site Investigations BS5930**

    British Standards Institution 1999

18. **Electronic Transfer of Geotechnical Data from Ground Investigations**

    Association of Geotechnical Specialists
    3rd Edition 2000

19. **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)

20. **Value for Money Manual**

    Highways Agency
    HMSO April 1999

21. **SH4/89** - Geotechnical Certification Procedures (DMRB 4.1.7)

4. ENQUIRIES

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

Chief Highway Engineer
The Highways Agency
St Christopher House
Southwark Street
London SE1 0TE

G CLARKE
Chief Highway Engineer

Chief Road Engineer
Scottish Executive Development Department
Victoria Quay
Edinburgh
EH6 6QQ

J HOWISON
Chief Road Engineer

Chief Highway Engineer
The National Assembly for Wales
Cynulliad Cenedlaethol Cymru
Crown Buildings
Cathays Park
Cardiff CF10 3NQ

J R REES
Chief Highway Engineer

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

G W ALLISTER
Director of Engineering