Design Manual for Roads and Bridges

Geotechnics
Inspection & Assessment

CS 641
Managing the maintenance of highway geotechnical assets

(formerly HD 41/15)

Revision 0

Summary
This document defines the roles of organisations and people in the management of geotechnical assets, the planning and risk management of activities undertaken on geotechnical assets and defines the associated information requirements.

Application by Overseeing Organisations
Any specific requirements for Overseeing Organisations alternative or supplementary to those given in this document are given in National Application Annexes to this document.

Feedback and Enquiries
Users of this document are encouraged to raise any enquiries and/or provide feedback on the content and usage of this document to the dedicated Highways England team. The email address for all enquiries and feedback is: Standards_Enquiries@highwaysengland.co.uk

This is a controlled document.

Contents

Release notes

Version	Date	Details of amendments
0	Mar 2020	CS 641 replaces HD 41/15. The full document has been re-written to make it compliant with the new Highways England drafting rules.

Foreword

Publishing information

This document is published by Highways England.

This document forms part of an asset management system and describes the management of maintenance of the geotechnical asset. The principles adopted in this document follow those defined in BS ISO 55000 [Ref 1.N]

This document supersedes HD 41/15: Maintenance of Highway Geotechnical Assets, which is withdrawn.

Contractual and legal considerations

This document forms part of the works specification. It does not purport to include all the necessary provisions of a contract. Users are responsible for applying all appropriate documents applicable to their contract.

Introduction

Background

Geotechnical assets typically have a long service life. They generally deteriorate slowly over time and require little routine maintenance, as long as associated assets such as drainage and structures are well maintained, and the asset is not disturbed by removal of supporting material (for example excavation at the toe of a slope) or opening of potential zones of weakness (for example excavation at the crest of a slope).

As the assets age they may develop characteristics that indicate loss of function. These characteristics may be subtle changes, which observed at a single point in time may not be indicative of deterioration, however when observed over a period of time allow an assessment of the rate of deterioration and a prediction of the loss of function to be made. This assessment provides the opportunity to manage the asset in an active way such that preventative works can be planned and carried out in a timely and cost-effective manner.

Although inspections can assist with assessing active intervention to prevent defects affecting the network, the majority of geotechnical assets comprise natural materials, which are inherently variable. This variability of materials can make the prediction of rate of deterioration difficult. Typically assets deteriorate progressively over time, however there can inevitably be cases where unforeseen changes occur and assets do not deteriorate as predicted, resulting in geotechnical events and subsequent remedial works.

While activities required for management of geotechnical assets are ultimately undertaken on individual assets, decisions on where to act, when, in which order of priority and for what overall cost can only be undertaken with an understanding of the entire geotechnical asset and the inter-relationship between all physical assets and the wider environment.

The drivers for decision making in the management of the geotechnical asset are generally a balance of:

1) the risk posed to the road network from ground related, or external hazards;
2) the performance required from the geotechnical assets contributing to overall service levels for the highway network (e.g. to minimise disruption caused by roadworks, or provide soft estate habitats); and,
3) the cost of geotechnical asset management activities (and available budgets).

Assumptions made in the preparation of the document

The assumptions made in GG 101 [Ref 2.N] apply to this document.

Abbreviations

Abbreviation	Definition
EqIA	Equality impact assessment
GA	Geotechnical advisor
GeoAMP	Geotechnical asset management plan
GMLE	Geotechnical maintenance liaison engineer
RSHI	Rock slope hazard index

Terms and definitions

Term	Definition
Characteristic	An inventory or condition property of a geotechnical asset, such as the presence of tension cracks or vegetation of a certain type or the geometry of a slope at a given location
Condition	A characteristic, or set of characteristics, that can be used to understand the state of deterioration of the asset
Defect	A feature observed within a geotechnical asset that is assigned class 1 in accordance with this document
Emergency inspection	An inspection undertaken in response to a geotechnical event, or other short-term requirement
Feature	A located observation that is assessed as requiring a feature grade
Feature class	A classification applied to a feature to reflect its type and size
Feature grade	Grading applied to a feature based on its feature classification and feature location index
Feature location index	An index applied to a feature to reflect its proximity to the network and 3rd party assets
Geohazard	An object, feature or activity related to the natural or engineered ground (including geotechnical assets) that has the potential to have adverse effects or undesirable consequences
Geotechnical advisor	A chartered engineering geologist or geotechnical engineer, with experience as defined in section 2, who represents the interests of the Overseeing Organisation
Geotechnical asset	The man-made or natural earthworks below the highway pavement layers, structures and the adjacent land within the Overseeing Organisation boundary
Geotechnical asset management plan	Document that sets out how the geotechnical asset is to be managed for a specific area or route, for a rolling five year time period
Geotechnical asset information management system	Information technology system used to record and manage data relating to geotechnical assets
Geotechnical event	A geotechnical defect that poses a threat to the safety of users, workers or other parties such that immediate action is to be taken
Geotechnical maintenance liaison engineer	A chartered engineering geologist or geotechnical engineer, with experience as defined in section 2, with responsibility for geotechnical asset management issues and activities within the organisation responsible for the day-to-day management of the geotechnical assets

(continued)

Hazard	An object, feature or activity that has the potential to have adverse effects or undesirable consequences
CS 641 feature grade	The higher value of the initial and subsequent feature grades
Initial feature grade	A grading applied to a feature reflecting the condition at the time of inspection
Inspection	Examination of a geotechnical asset to record the characteristics of the asset, both in terms of inventory and condition
Intervention	Works undertaken on a geotechnical asset to meet a maintenance requirement, address the impact of a geotechnical event, or prevent a geotechnical asset deteriorating; NOTE: Includes monitoring inspections.
Inventory	A typically unchanging characteristic of a geotechnical asset that relates to details of its construction, such as its height, drainage provision or geological composition
Limiting height	The bounding height that delimits major and minor earthworks
Monitoring inspection	An inspection where quantitative information is recorded to document the changes in characteristics
Network criticality	The attributes of the road network at a given location and time that relate to its importance to the Overseeing Organisation
Non-routine maintenance	Infrequent intervention undertaken on a geotechnical asset (e.g. scaling of rock slopes, removal of large trees)
Observation	Characteristic (or group of characteristics) located on a geotechnical asset
Principal inspection	The main type of geotechnical asset inspection in which all inventory and condition information is recorded or confirmed
Service provider	The organisation(s) responsible for the day-to-day management of the assets
Subsequent feature grade	A grading applied to a feature with a predicted condition; NOTE: The time frame for prediction is typically 5 years.
Triggers	A factor that causes a hazard to be realised

1. Scope

Aspects covered

1.1 This document shall be used for the following components of the management of geotechnical assets:

1) defining the role of organisations and people in the management of geotechnical assets;
2) planning and risk management of activities undertaken on geotechnical assets throughout their life cycle (inspection, monitoring and interventions); and,
3) defining the information requirements for the management of geotechnical assets.

1.2 This document shall not be used for requirements or advice relating to:

1) strategic investment planning including the use of decision support tools;
2) asset condition, network criticality or performance metrics (other than in the assessment of inspection frequencies);
3) design and construction of new geotechnical assets; or,
4) data management of geotechnical asset information.

Implementation

1.3 This document shall be implemented forthwith on all schemes involving the management of geotechnical assets on the Overseeing Organisations' motorway and all-purpose trunk roads according to the implementation requirements of GG 101 [Ref 2.N].

NOTE *Whilst the general principles of the advice and guidance contained in this document are endorsed, this document is not mandatory for use in Scotland or Northern Ireland, and the correct procedural aspects are presented in the respective National Application Annexes.*

Use of GG 101

1.4 The requirements contained in GG 101 [Ref 2.N] shall be followed in respect of activities covered by this document.

2. Organisation and roles

Roles

2.1 The organisation responsible for the day-to-day management of the assets is referred to as the service provider and they shall appoint a geotechnical maintenance liaison engineer (GMLE) who is then responsible for related operational management activities.

NOTE *Specific Highways England requirements on organisation and roles are provided in the England National Application Annex.*

2.1.1 The GMLE should liaise directly with their respective geotechnical advisor (GA).

NOTE 1 *The organisation(s) responsible for the day-to-day management of the assets is defined by the particular contract requirements in place.*

NOTE 2 *Throughout this document, the main organisation undertaking the activities is referred to as the service provider, irrespective of contractual arrangement.*

Competencies and responsibilities

2.2 The GMLE shall demonstrate the level of experience and competence necessary to carry out the role, and have this confirmed in writing as acceptable to the Overseeing Organisation.

2.2.1 This level of experience should normally be chartership from a relevant professional body and a minimum of five years post chartered experience.

NOTE *Examples of relevant professional bodies include:*

1) the Geological Society of London;

2) the Institution of Civil Engineers; and,

3) the Institute of Materials, Minerals and Mining.

2.3 The GMLE shall be able to demonstrate responsibility for the planning and execution of projects involving geotechnical design, construction and monitoring.

2.4 The GA shall be a chartered member of a relevant professional body and have at least ten years (or a relevant masters degree and eight years) relevant post-chartership experience in ground engineering and infrastructure works.

NOTE 1 *Examples of relevant professional bodies include:*

1) the Geological Society of London;

2) the Institution of Civil Engineers; and,

3) the Institute of Materials, Minerals and Mining.

NOTE 2 *This requirement exceeds that of general eligibility for entry onto the Register of Ground Engineering Professionals at Adviser level.*

2.5 All personnel undertaking inspections shall have received training in the methods of inspection, recognition of geotechnical characteristics, assessment of observations and grading of geotechnical features defined in this application document.

2.6 At least one member of any inspection team shall have specialist experience of geotechnical inspection activities, and have proven and demonstrable experience of geotechnical engineering and site inspection.

3. Geotechnical asset management plan

3.1 A geotechnical asset management plan (GeoAMP) shall set out how the geotechnical asset is to be managed for a specific area or route, for a rolling five year period.

NOTE *Specific Highways England requirements for the geotechnical asset management plan are provided in the England National Application Annex.*

3.2 The GeoAMP shall be prepared by the service provider to give details of the forward programme of inspections and planned interventions.

3.3 The service provider shall review and update the GeoAMP on an annual basis at a time agreed with the Overseeing Organisation.

3.4 The service provider shall submit the GeoAMP to the Overseeing Organisation for agreement.

NOTE *A suggested GeoAMP template is presented in appendix B.*

Outline contents

3.5 The GeoAMP shall include details of the following:

1) an outline of the geotechnical hazards that potentially affect the motorway and all-purpose trunk road network;
2) an overview of the geotechnical asset, the number of assets, their length, and dates of last inspection;
3) an overview of the historic, current and predicted condition of the geotechnical asset;
4) a summary of the inspections, surveys (such as ground investigations) and monitoring carried out within the reporting period of the GeoAMP;
5) a summary of geotechnical events that have occurred within the reporting period of the GeoAMP and their impact on the network;
6) a schedule of inspections and monitoring to be carried out;
7) details of surveys (such as ground investigations) to be carried out; and,
8) a summary of the completed and proposed geotechnical interventions.

3.5.1 The GeoAMP may be split into two parts, to allow separation of any commercially sensitive information into a document that has restricted circulation.

3.5.2 Where a GeoAMP has been split into two parts, the part of the document containing commercially sensitive information should be marked official - sensitive commercial in capital letters at the top and bottom of each page.

3.6 The GeoAMP shall record the assessments undertaken for the planning of inspection and management activities and the methods used to produce them.

3.6.1 The assessments undertaken for the planning of inspection and management activities should include the following:

1) hazards;
2) geotechnical asset information;
3) network criticality;
4) proximity to other asset groups; and
5) other relevant factors (such as temporary works or access arrangements).

Geohazard appraisal

3.7 Geohazards shall be identified and documented when assessing geotechnical risk.

3.7.1 The following types of geohazard should be assessed as part of the appraisal (see also table 3.7.1):

1) natural geohazards, relating to the natural environment in which the road is located. These geohazards can be due to the behaviour of geological materials;
2) man-made geohazards, which are not related to the imposition of the road network on the landscape; and,
3) man-made geohazards, which are related to the imposition of the road network on the landscape.

Table 3.7.1 Geohazard categories

Key category	Sub-category	Geotechnical event resulting from combination of hazard and trigger
Natural geohazards	Solution features (inc. cavities/voids) Note: the presence and hazard posed by natural cavities is not always related to surface or groundwater	Subsidence, Collapse
	Soft or compressible ground	Subsidence
	Natural landslides (soil)	Material on road
	Natural landslides (rock)	Material on road
	Shrink/swell	Subsidence/heave
	Groundwater rise	Slope instability (as landslides), Surface flooding
	Soil or groundwater chemistry	Chemical damage (e.g. thaumasite), Health and safety impacts (e.g. methane or radon)
Man-made geohazards (non-road)	Abandoned mine workings and mine entries (coal and non-coal) Note: includes deneholes	Subsidence, Collapse, Surface instability
	Backfilled opencast mines	Subsidence
	Current or future mining	Subsidence
	Quarries	Rock face instability (old quarries), Blast and vibration (active quarries), Stability
	Landfill sites	Subsidence, Pollution (leachate & methane)
Man-made geohazards (road)	Engineered slopes of marginal stability (rock or soil)	Material on road or cracks/damage to assets
	Defective or inappropriate drainage	Slope instability, Surface flooding, Erosion, Dissolution of soluble rocks
	Animal burrows Note: these are classified as 'man-made' as they tend to affect man-made earthworks	Slope instability
	Loss of vegetation	Slope instability, Erosion
Note: the hazards categorised in columns 1 and 2 require suitable triggers to cause the events listed in column 3. Triggers include natural occurrences such as heavy rainfall, high winds or earthquakes.		

NOTE *It can be appropriate to assess other man-made hazards, for example reservoirs, pylons or other third party infrastructure, where these affect the geotechnical asset.*

3.8 The sources of information used for the geohazard assessment shall be recorded.

NOTE 1 *The sources of information used for the geohazard assessment typically include the following:*

1) specific geohazard maps;
2) old maps;
3) current maps (Ordnance Survey, British Geological Survey);
4) spatial data sets;
5) geotechnical asset information; and,
6) geotechnical report records.

NOTE 2 *A significant amount of geohazard information can now be readily and rapidly obtained from various online sources and information providers, including the Overseeing Organisation's asset information systems.*

3.9 Known intervention and mitigation measures undertaken since the last GeoAMP update shall be recorded.

3.9.1 Sections of the road network that have been subject to previous preventative or remedial measures should be assessed to determine the residual risk.

3.9.2 Maintenance of mitigation measures may be required to ensure their long-term performance.

NOTE *Examples of mitigation measures are slope drainage, capping of shafts or monitoring.*

3.10 Geotechnical event triggers shall be recorded against identified hazards or defects.

NOTE *Examples of triggers are severe weather events or defects related to other assets.*

3.11 A prediction of the deterioration of the geotechnical asset shall be made using the process in section 6.

3.11.1 A deterioration assessment should be supported by quantitative data and/or precedence information from elsewhere on the network, or from desk study review of other sources of information.

4. Asset definition

Geotechnical asset types

4.1 The geotechnical asset shall be divided into the following asset types:

1) minor earthworks; being cuttings, embankments and at-grade sections whose maximum vertical height within the longitudinal extent of the asset is less than 2.5m; and,
2) major earthworks; being cuttings, embankments and bunds whose maximum vertical height within the longitudinal extent of the asset is greater than or equal to 2.5m.

NOTE 1 *Where a major earthwork begins at-grade and extends to a vertical height equal to or greater than 2.5m within its longitudinal extent, then it is considered to be a major earthwork from its start point (at-grade) to its end point.*

NOTE 2 *Specific Highways England requirements for asset definition are provided in the National Application Annex.*

Longitudinal definition of a geotechnical asset

4.2 The longitudinal extents (i.e. the start and end locations along the road length) of a geotechnical asset shall be defined by:

1) points of zero height between geotechnical assets of different types;
2) bridges and underpasses;
3) service provider area boundaries;
4) significant changes in geology (as shown on the 1:50,000 British Geological Survey map, or observed); and,
5) significant changes in earthwork fill materials (as shown on as-built drawings, or observed).

NOTE *The network is not limited to the pavement network because assets can start or finish beyond that network, due to assets extending onto sections of road managed by another highway authority.*

Lateral definition of a geotechnical asset

4.3 The lateral extents of a geotechnical asset shall be defined by:

1) the centre line of the road; and,
2) the ownership boundary of the Overseeing Organisation, typically marked by a fence line.

NOTE 1 *A section of the network can have two geotechnical assets associated with it, one to each side of the road centre line.*

NOTE 2 *In some cases, geotechnical assets can lie between carriageways (e.g. split carriageways and slip roads).*

5. Inspections

5.1 Inspections of geotechnical assets shall be carried out to enable their management.

NOTE *Specific Highways England requirements for inspections are provided in the England National Application Annex.*

5.2 The results of all inspections shall be recorded in the Overseeing Organisation's geotechnical asset information management system.

NOTE *The information to be obtained from inspections is provided in the National Application Annex.*

5.2.1 Inspection of a geotechnical asset should include the following aims:

1) to observe and record the presence, location and type of geotechnical assets that fall within the responsibility of the service provider;
2) to determine and record the key characteristics that describe each complete geotechnical asset;
3) to observe and record the characteristics that relate to the condition of the geotechnical asset at the time of inspection; and,
4) to evaluate the geotechnical setting of the highway corridor within the landscape and the activities of adjacent landowners that can impact on the performance of the highway assets.

NOTE 1 *Key characteristics that describe each complete geotechnical asset include, for examples, the geological material of which the asset is comprised, and the geometry of the asset.*

NOTE 2 *The length and number of geotechnical assets to be inspected can change for a number of reasons:*

1) acquisition of assets into the responsibility of the Overseeing Organisation, for example through adoption of a local authority road;
2) through the physical creation of new assets by construction of new road sections;
3) through the physical creation of assets that are markedly different to an asset that they are enhancing, such that they can be considered new assets (for example junction re-modelling or significant widening of embankments);
4) removal of assets from the responsibility of the Overseeing Organisation due to changes in administrative arrangements (such as de-trunking); or,
5) physical removal of the asset, such as in a junction re-modelling or similar.

Inspection types

5.3 Inspection types shall comprise the following:

1) principal inspections – these are the main type of inspection, providing inventory and condition data;
2) monitoring inspections – these are inspections undertaken as an intervention option to address risks posed by geotechnical assets;
3) emergency inspections – inspections undertaken in response to a geotechnical event; and,
4) other inspections by non-geotechnical staff to recognise geotechnical characteristics that are indicators of change.

NOTE *It can be appropriate for the GMLE to provide guidance or training to non-geotechnical staff on the recognition of geotechnical characteristics.*

5.3.1 Monitoring inspections may be carried out as part of a schedule of principal inspections.

Inspection methods

5.4 Principal inspections shall be carried out when the surface of the asset is visible, i.e. when the ground profile is not obscured.

5.4.1 Inspections of major earthworks should normally be visual inspections by walkover.

5.4.2 Methods of inspection such as remote inspection techniques e.g. from a vehicle, or detailed aerial or terrestrial photography or LiDAR may be applicable.

5.5 Where a visual inspection by walkover cannot be undertaken, the reason shall be recorded in the geotechnical asset information management system.

5.6 Where a geotechnical asset with exposed rock slopes is added to the inspection programme for the first time, an assessment of the slope shall be carried out using the rock slope hazard index (RSHI) system.

NOTE *Details of RSHI can be found in TRL PPR 554 [Ref 6.I] and TRL PPR 555 [Ref 5.I].*

5.7 Subsequent inspection requirements for geotechnical assets including exposed rock slopes shall be determined using a risk-based approach.

Observations made during inspections

5.8 During inspections of geotechnical assets, characteristics of the assets shall be recorded over part or all of the asset length.

NOTE *Characteristics of assets are recorded as observations.*

5.9 Characteristics shall be recorded in a standardised and repeatable manner.

NOTE *The means for recording characteristics are provided in the National Application Annex.*

5.10 Changes in the condition of the asset relative to the previous inspection shall be recorded.

5.11 Geotechnical hazards that have the potential to impact the road network, including those that are visible outside of the occupancy boundary shall be recorded.

NOTE *Examples of geotechnical hazards that have the potential to impact the road network are adjacent development, landfill operations, quarrying etc.*

5.11.1 Non-geotechnical characteristics should not be recorded, unless they indicate the presence of a hazard to the geotechnical asset.

5.11.2 Where a defective non-geotechnical characteristic is observed or recorded, the relevant authority should be alerted.

NOTE *An example of a non-geotechnical characteristic is highway drainage, which is not to be recorded unless it is defective and impacting on the geotechnical asset.*

5.12 Monitoring inspections shall record quantitative information.

5.13 Photographs shall be taken during the inspection and/or sketches drawn, to assist in the understanding of the condition of the asset.

5.14 All observations made during an inspection shall be assessed in accordance with the methods set out in section 6.

5.15 Where a feature is assessed to be a defect (in accordance with section 6) the following information relating to the feature shall be recorded:

1) at least one photograph;
2) an annotated sketch; and,
3) quantitative measurements.

Inspection frequency

5.16 The frequency of inspections shall be determined by the service provider using an assessment of risk posed by the asset to the road network.

5.16.1 Other criteria for frequency of inspections may be set by the Overseeing Organisation.

NOTE *Examples of other criteria that can change the frequency of inspections include access constraints, other renewal activities etc.*

5.17 Inspection frequencies, the factors influencing them and the means of assessment shall be reviewed and recorded annually as part of the development of the GeoAMP in accordance with the guidance in Appendix A.

5.18 Where insufficient information is available to undertake a risk assessment, the inspection frequency shall not be longer than any specific criteria of the Overseeing Organisation, which is provided in the National Application Annex.

5.19 The results of the risk assessments and proposed inspection frequencies shall be agreed with the Overseeing Organisation.

NOTE *Guidance on the risk assessment process is provided in Appendix A.*

5.20 Principal inspections of new assets shall be carried out within six months of completion of construction, or transfer to the service provider.

5.21 The scheduled frequency of inspection shall be recorded by the service provider in the Overseeing Organisations geotechnical asset information management system.

5.21.1 Inspection frequencies should be set for a series of contiguous earthworks rather than isolated individual assets.

NOTE *Setting inspection frequencies for contiguous earthworks can simplify planning of inspections and limit the time required for travelling between isolated parts of the network, interrupting the continuous asset inspection.*

Geotechnical events

5.22 The service provider shall notify the Overseeing Organisation of the occurrence and details of a geotechnical event.

NOTE *Examples of geotechnical events can include, but are not limited to:*

1) blockage of the carriageway by material that has moved as the result of slope failure of a cutting or debris flow as a result of erosion;
2) subsidence of the carriageway due to collapse of a solution feature or mine shaft; or,
3) imminent subsidence of the carriageway due to scour of an embankment.

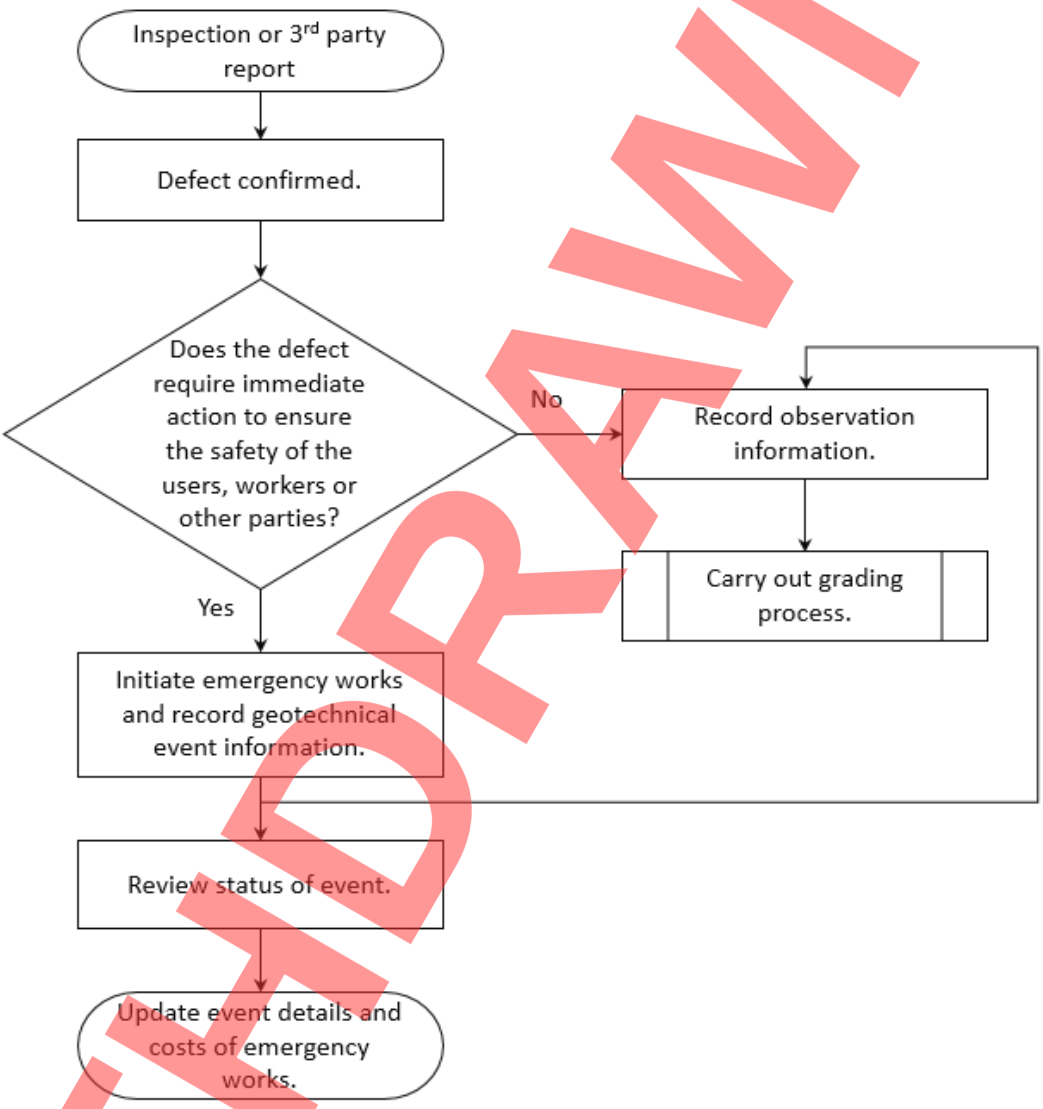
5.23 Immediate action shall be taken to mitigate the safety impacts of a geotechnical event.

NOTE *Examples of immediate action that can be taken to mitigate the impacts of a geotechnical event are:*

1) temporary signage or traffic management;
2) temporary barriers;
3) debris clearance;
4) temporary support; and,
5) monitoring inspections.

5.24 Following the report or discovery of a potential geotechnical event, the service provider shall carry out an emergency inspection and record the information required by the geotechnical event process, as shown in figure 5.24, in the geotechnical asset information management system.

Figure 5.24 Geotechnical event process



5.24.1 Where the service provider determines that a geotechnical event has not occurred and the issue relates to another asset type, the relevant authority should be informed.

6. Assessment

Assessment and grading of features

6.1 The service provider shall assess all observations and carry out grading when an observation is determined to be a defect, at risk area or area of repair.

NOTE 1 The grading of features provides an indicator of the relative condition of the asset at that point in time and is used for subsequent input into risk-based assessments, including inspection frequency and intervention selection.

NOTE 2 Specific Highways England guidance on the assessment and grading of features is provided in the England National Application Annex.

Assessment of feature class

6.2 For each feature identified during an inspection of a geotechnical asset, for all geotechnical asset types, the service provider shall assign a feature class, based on the definitions given in table 6.2.

Table 6.2 Classification of features.

Class	Description of feature	Examples of features
Class 1 (visible defects)		
1A	Major defects.	A slip greater than half the height of a major earthwork. A rock fall involving large boulder-size[1] blocks of rock or greater than 1m^3 volume of rock debris.
1D	Minor defects.	Defects other than major defects.
Class 2 (likely defects)[2]		
2	At risk areas. Assessment can be based on available information (maps, historical reports, behaviour of similar assets, etc.) and/or visual inspection.	An asset overlying an area of mining activity where no mitigation measures were carried out during construction or where mitigation measures have deteriorated. An area of sidelong natural or made ground subject to historical slope movement. Animal burrows.
Class 3 (areas of repair)		
3	At risk repaired areas. Sections of geotechnical assets where defects have been repaired or where preventative works have been undertaken to prevent deterioration of areas considered to be at risk. This class does not apply to areas that have been reinforced as part of the original design of a widening or improvement project.	Granular slope replacement of a failed cutting. Areas of remedial slope drains. Areas of remedial mine infilling. Areas of remedial rock bolting. Areas of bio-engineering.
Notes: [1]Large boulder is a particle of diameter greater than 630 mm approx. [2]Class 2 features are those assessed as likely to deteriorate to a feature class 1 defect.		

NOTE 1 The examples provided in table 6-2 are intended to guide a repeatable assessment.

NOTE 2 There can be exceptions to the examples and engineering judgement can be applied when determining classes.

6.2.1 Reasons for allocating feature class during an inspection of a geotechnical asset should be recorded, if justification is required, in the geotechnical asset information management system.

6.3 The assessment of feature class shall not include the impact of the feature on the network or 3rd party property.

6.4 The assessment of feature class shall be confined to the size and type of feature only.

Assessment of feature location index

6.5 The service provider shall assign a feature location index for each feature, based on the definitions given in table 6.5 below:

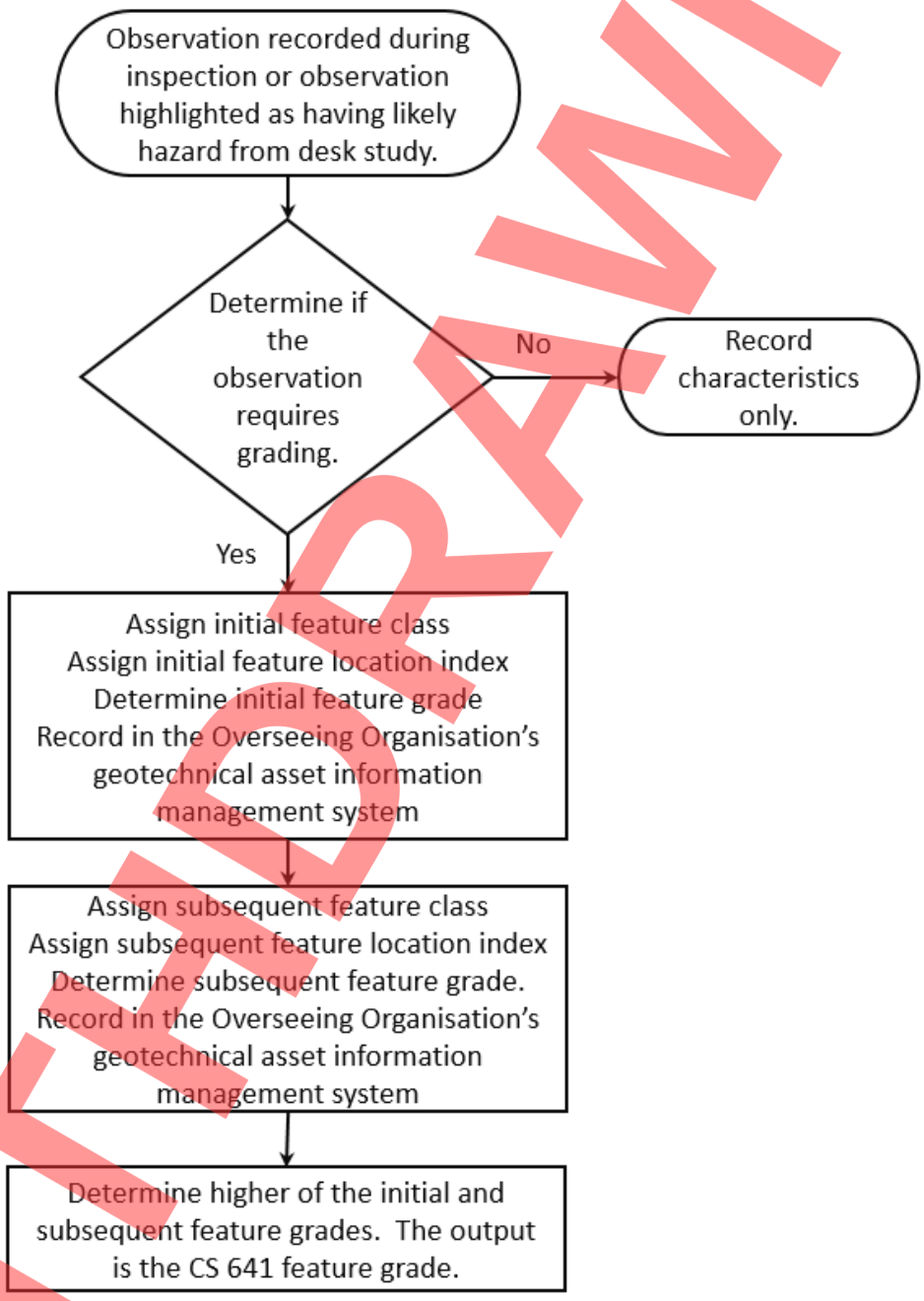
Table 6.5 Location index of features

Location index	Assets affected	Overseeing Organisation examples	3rd party examples
A	Assets that ensure the safety of users, workers or other parties, or safeguard the environment.	The running lanes or hard shoulder used as a running lane. Emergency refuge areas. Vehicle restraint systems and motorway communications and structures.	Adjacent safety-critical infrastructure or buildings. Reservoirs. Pylons.
B	Assets which are less critical to the safety of users, workers or other parties, or safeguard the environment but are required to ensure the reliable performance of the network.	Hard shoulder or roadside structures. Communications.	Adjacent non-safety-critical infrastructure or buildings.
C	Adjacent land not A or B.	Land occupied by the Overseeing Organisation and adjacent to the carriageway but not A or B.	Not applicable.
D	Remote land not A or B.	Land occupied by the Overseeing Organisation and remote from the carriageway but not A or B.	Adjacent soft estate.

Assessment of feature grade

6.6 The service provider shall use the feature class and feature location index to derive the CS 641 feature grade as set out in figure 6.6.

Figure 6.6 Feature grading process



6.7 The service provider shall use the feature class and feature location index of the feature observed or inferred at the time of inspection, or highlighted in a desk study to derive the initial feature grade assessment using table 6.7.

Table 6.7 Initial feature grade

Initial feature grade assessment				
Feature location index	**Feature class**			
	1A	**1D**	**2**	**3**
A	5	4	3	1
B	5	3	3	1
C	4	3	2	1
D	3	2	1	1

6.8 The service provider shall make an assessment of the potential deterioration of the feature (assuming no intervention) and assess the feature class and feature location index that the feature is likely to have in five years' time.

NOTE *The following sources of information can be used to inform assessments of deterioration:*

1) infrastructure embankments, condition appraisal and remedial treatment CIRIA CIRIA C592 [Ref 4.I];

2) infrastructure cuttings, condition appraisal and remedial treatment CIRIA CIRIA C591 [Ref 3.I];

3) Transport Research Laboratory publications;

4) quantitative data obtained through regular monitoring inspections;

5) slope stability modelling;

6) national/international experience;

7) locations prone to flood risk as determined from flood risk models; and,

8) engineering judgement and local experience.

6.9 The assessed feature class and assessed feature location index shall be used to derive the assessed subsequent feature grade using table 6.9.

Table 6.9 Subsequent feature grade

Subsequent feature grade assessment				
Assessed feature location index	**Assessed feature class**			
	1A	**1D**	**2**	**3**
A	4	3	1	1
B	4	2	1	1
C	3	2	1	1
D	2	1	1	1

6.10 The service provider shall record in the Overseeing Organisations geotechnical asset information management system the higher value of the initial and subsequent feature grade as the CS 641 feature grade.

6.10.1 A predicted view of the asset and hence deterioration, may be determined using a likely feature class and feature location index applied to the initial feature grade table (table 6.7).

NOTE *The predicted view is used to gain an understanding of the likely future condition of the geotechnical assets, if the recommended interventions described in section 7 are not undertaken.*

7. Geotechnical intervention and scheme prioritisation

Geotechnical intervention

7.1 The service provider shall determine the appropriate geotechnical intervention.

NOTE *Specific Highways England requirements on geotechnical intervention and scheme prioritisation are provided in the England National Application Annex.*

7.1.1 The appropriate geotechnical interventions should be determined from the recommendations in table 7.1.1.

Table 7.1.1 Recommended geotechnical interventions

CS 641 feature grade	Recommended geotechnical intervention
5	Timely intervention to ensure safety is to be undertaken. Remedial intervention is be programmed typically within one year. Assess inspection and monitoring requirements. Contingency planning required in preparation for any accelerated deterioration.
4	Remedial or preventative intervention is to be programmed typically within 5 years. Assess inspection and monitoring requirements. Contingency planning required in preparation for any accelerated deterioration.
3	Remedial intervention not generally required within 5 years however remedial or preventative intervention can be programmed as part of other schemes.
2	Remedial intervention is not required, but preventative intervention can be required. Works do not need to be programmed and can be done as part of other schemes.
1	Remedial or preventative intervention is not required.
NOTE: The frequency of principal inspections and any monitoring requirements is assessed for all feature grades.	

7.1.2 Geotechnical interventions should be recorded within the GeoAMP, as described in section 3.

7.1.3 The interventions given in table 7.1 should be used for guidance only, variations from the recommended interventions can be made with supporting justification and in agreement with the Overseeing Organisation's GA.

NOTE 1 *Complete and accurate geotechnical asset information obtained during inspections of all types is of key importance in the development of a forward programme of proposed geotechnical management activities.*

NOTE 2 *The objective data collected during monitoring inspections is especially useful to demonstrate deterioration and the requirement for intervention.*

NOTE 3 *The method of assessment has been designed to be as objective as possible, to enable the process to be repeated.*

7.1.4 Site specific details of the intervention method should be determined through an assessment of the engineering requirements needed to address the risks.

NOTE 1 *Many interventions on the geotechnical asset can involve construction or maintenance of associated assets, particularly the drainage asset.*

NOTE 2 *For further guidance on the importance of the drainage asset to the performance of the geotechnical asset, see CD 535 [Ref 2.I] and CIRIA C714 [Ref 7.I].*

7.1.5 Cross-asset issues should be taken into account in the planning of geotechnical interventions to maximise implementation efficiencies and reduce network disruption through the parallel phasing of works on various asset types.

7.2 The feature grade shall not be amended to suit the intervention.

Schemes

7.3 Where interventions require the development of a scheme, the information gathered during inspections, monitoring and surveys shall be used to provide supporting evidence of the scheme requirement and prioritisation.

7.4 The geotechnical management of schemes developed as a requirement of an intervention shall be in accordance with CD 622 [Ref 3.N].

8. Data and information requirements

8.1 Geotechnical data and information shall be recorded in the Overseeing Organisation's geotechnical asset information management system to support the following elements of geotechnical asset management:

1) inspections;
2) geotechnical asset (inventory);
3) geotechnical asset (condition);
4) geotechnical events;
5) schemes; and,
6) documents and records.

8.1.1 Geotechnical data should be managed in accordance with BS 8574 [Ref 1.l].

NOTE *Details of the information required by Highways England to support geotechnical asset maintenance management are provided in the England National Application Annex.*

9. Normative references

The following documents, in whole or in part, are normative references for this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Ref 1.N	BSI. BS ISO 55000, 'Asset management: Overview, principles and terminology'
Ref 2.N	Highways England. GG 101, 'Introduction to the Design Manual for Roads and Bridges'
Ref 3.N	Highways England. CD 622, 'Managing geotechnical risk'

10. Informative references

The following documents are informative references for this document and provide supporting information.

Ref 1.I	BSI. BS 8574, 'Code of practice for the management of geotechnical data from ground engineering projects'
Ref 2.I	Highways England. CD 535, 'Drainage asset data and risk management'
Ref 3.I	CIRIA. Perry J, Pedley, M and Brady, K.. CIRIA C591, 'Infrastructure cuttings, condition appraisal and remedial treatment'
Ref 4.I	CIRIA. Perry J, Pedley M and Reid M. CIRIA C592, 'Infrastructure embankments, conditional appraisal and remedial treatment'
Ref 5.I	Transport Research Laboratory. McMillan, P, Harber, AJ & Nettleton, IM. TRL PPR 555, 'Rock engineering guides to good practice: rock slope remediation and maintenance works'
Ref 6.I	Transport Research Laboratory. McMillan, P & Nettleton, IM. TRL PPR 554, 'Rock slope risk assessment'
Ref 7.I	CIRIA. Spink T, Duncan I, Lawrance A, Todd A.. CIRIA C714, 'Transport infrastructure drainage: condition appraisal and remedial treatment'

Appendix A. Guidance on inspection frequency

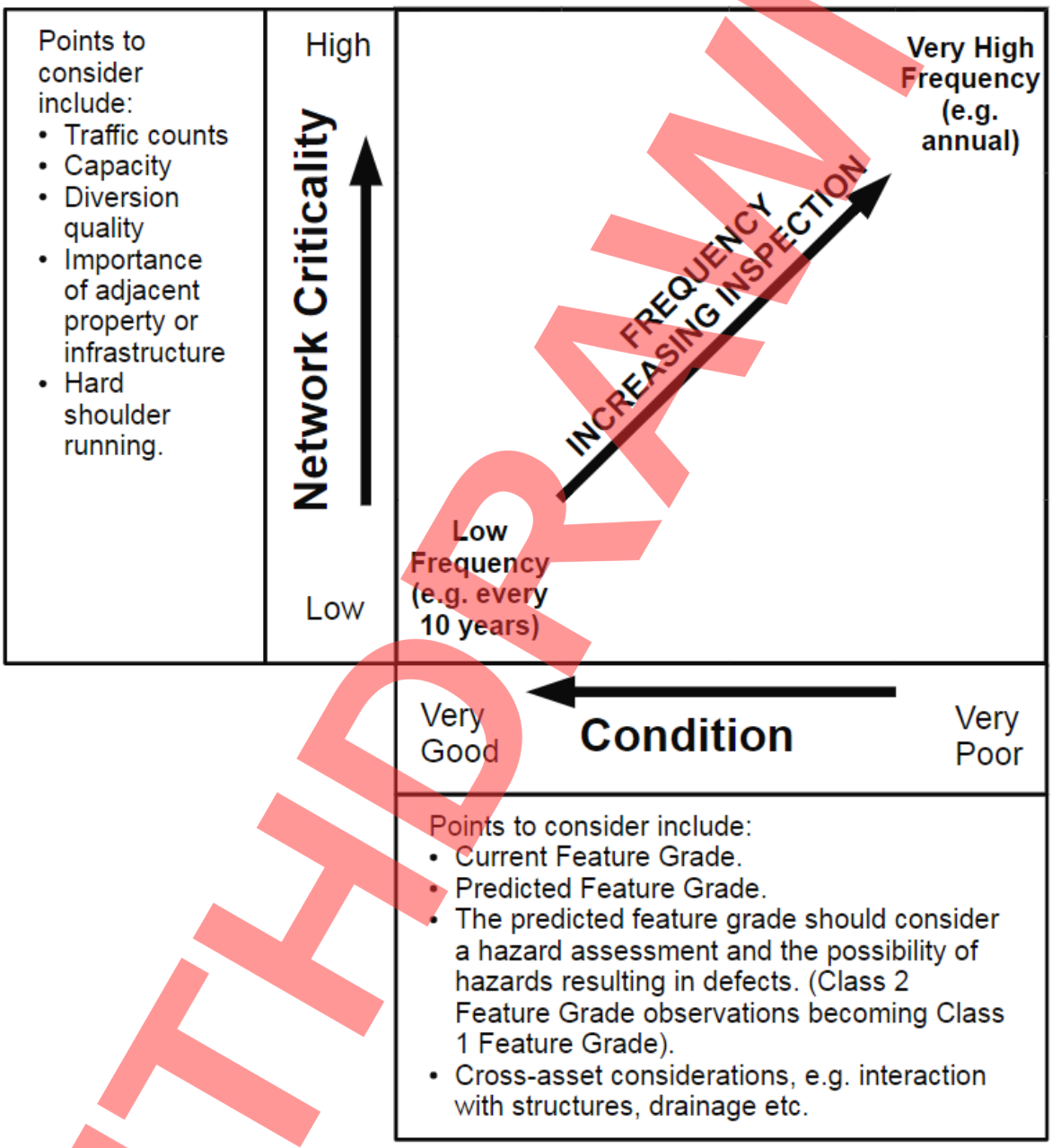
A1 Inspections

A1.1 Inspection frequency

The frequency of inspections should be based on assessment of the risk posed to the network, third-party assets, users, workers or others by deterioration of the asset. Typically the higher the risk, the greater the appropriate frequency of inspection. The risk assessment should be based on considerations of asset feature grades, amount and types of hazards, likelihood of triggers and network criticality of asset locations.

Inspection frequencies may vary from low frequencies, possibly with a return frequency between 6 and 10 years to high frequencies, possibly with more than one inspection a year. In the case of high frequency inspections these may be more suited to inspection of individual sites under a monitoring programme than to high frequency principal inspections. A framework for the assessment of appropriate inspection frequencies is presented in figure A.1 below.

Figure A.1 Example framework for the assessment of inspection frequency



This framework considers the interaction of the condition of the asset and the network criticality. The condition of the asset can be determined from the current (initial) and predicted (subsequent) feature grade. The subsequent feature grade considers the nature of the hazards and the likelihood of defects arising from the hazard. The network criticality should also be considered over time, e.g. the construction of smart motorway, major maintenance and renewals schemes.

A1.2 Example principal inspection frequencies

The following gives examples of how principal inspection frequencies can be assigned.

A1.2.1 Principal inspection frequency example one

A 6.5km long stretch of single carriageway trunk road forms the principal link between the motorway network and a major city. The road follows a historical route along a valley side. Periglacial conditions

caused the development of a mantle of foundered strata through which the road has been formed, generally on sidelong ground. Several major defects have previously occurred both upslope and downslope of the road and have necessitated the construction of deep bored pile walls as remedial measures. Ongoing deterioration of existing minor and major defects has also been recorded.

The route experiences high volumes of commuter traffic and associated congestion. The alignment features several tight bends with limited line of sight.

On this basis the principal inspection frequency for this route has been set to a one year interval. The major defects are subject to monitoring inspections at 6 monthly intervals and trigger levels have been set to provide early warning of imminent geotechnical events. Associated remedial actions are included in the renewals programme (via the GeoAMP).

A1.2.2 Principal inspection frequency example two

A 14km long stretch of motorway forms a key route to a major airport. The majority of the route is supported by and formed through earthworks within overconsolidated clay deposits. Several major defects have previously occurred within these earthworks, generally considered to be associated with oversteep slope construction and the presence of over-the-edge drainage. Embankment slopes in the area have been subject to regular repairs. A large number of minor defects are currently recorded indicating that major defects are likely unless preventative action is taken.

The available diversion routes pass through the centre of three large towns. While the motorway itself is generally of three-lane construction in both directions, it is close to capacity and is subject to heavy congestion at peak times.

On this basis the principal inspection return frequency for this route has been set at a five year interval. Monitoring inspections are scheduled at annual intervals for those minor defects that are likely to become major defects. Associated preventative actions are included in the renewals programme (via the GeoAMP).

A1.2.3 Principal inspection frequency example three

An 80km stretch of predominantly dual carriageway trunk road passes through and over earthworks formed in chalk deposits. The road was constructed to recent standards.

No significant slope repairs or existing major or minor defects have been identified along the route. However ravelling of some of the steeper exposed chalk cuttings is ongoing and mitigated using rock capture netting. While some dissolution features are expected to be present within the chalk, overlying drift deposits are generally limited in extent and the risk of geotechnical events associated with these features is considered to be negligible.

On this basis the principal inspection return frequency for the route has been set to an eight year interval. Maintenance of rock netting is recorded against specific assets and highlighted in the GeoAMP.

A1.3 Monitoring inspections

Monitoring is integral to the overall inspection programme and should form a key part of the long term risk management of the geotechnical asset. Monitoring inspections can take a variety of forms, but independent of the methods employed it is important to ensure that the purpose of monitoring is clear and that trigger levels and actions required following the exceedance of such trigger levels are defined.

The collection and use of quantitative information is useful as evidence for scheme appraisal and as input into predictive modelling of asset deterioration.

A1.3.1 Planning of monitoring inspections

It is important to be clear regarding what is being monitored, and how and when that monitoring is being undertaken. Records should be kept, in the Overseeing Organisation's geotechnical asset information management system, of sites subject to monitoring, particularly including the details described below.

1) what is being monitored, and how the monitoring is being carried out;

2) how often monitoring is to be undertaken and at what times of year (for example, following winter storms);
3) detailed descriptions of the defects being proposed for monitoring, any historical monitoring results that are available, and a summary of the defect/repair history of the asset;
4) identified trigger levels and the actions to be undertaken if trigger levels are reached or exceeded (including emergency response procedures);
5) what allowance there is for increased monitoring in times of increased risk (e.g. extreme weather events); and,
6) what the communication routes are for reporting of monitoring results and which individuals are responsible for communication.

Initial recommendations of monitoring regimes for individual sites should be recorded in the Overseeing Organisation's geotechnical asset information management system at the appropriate stage of consideration of a defect. For example, where a defect of feature grade 4 has been identified during a principal inspection, but the site investigation is pending or deferred, then monitoring of the defect may be carried out to understand the rate of deterioration. The need for monitoring should be reviewed regularly with the Overseeing Organisation to ensure that it is still relevant and that intervals of monitoring are still appropriate.

A1.3.2 Monitoring techniques

A variety of techniques are available for the monitoring of geotechnical features and monitoring at a given site is likely to include one or a combination of such techniques. The appropriate combination of techniques depends on a number of factors including the nature and extent of the defect, available budget, access constraints and expected rate of deterioration. Techniques used may include one or more of the following:

1) visual inspection;
2) measurements between pegs installed at the surface;
3) direct measurements of features at fixed locations, e.g. tension crack width and length; backscarp height, or tilt of surfaces, safety furniture or structures;
4) photographic records taken of the same aspect on repeated occasions;
5) subsurface instrumentation including piezometers, inclinometers and extensometers. These may be automatically or manually read;
6) remote sensing techniques such as LiDAR and high resolution aerial photography, including change detection analyses; and,
7) tell-tale instrumentation.

It is important that the techniques used allow data to be collected that can illustrate trends of deterioration where these are present. Readings should be repeatable and the accuracy and repeatability of instrumentation should be assessed. Monitoring installations should be designed to ensure that they provide reliable results; for example, inclinometers should be installed to sufficient depth to be anchored below likely failure surfaces and surface monitoring pegs should be robust so that they are not readily disturbed by wildlife.

A1.3.3 Reporting of monitoring

The GeoAMP should summarise all installed and currently planned monitoring at the time of preparation. Additional monitoring summary reports should be submitted between the annual GeoAMPs if appropriate. These monitoring summary reports should be recorded in the Overseeing Organisation's geotechnical information management system.

Appendix B. Advised content of geotechnical asset management plan

B1 Introduction

This appendix provides an example geotechnical asset management plan (GeoAMP), that may be used by service providers to comply with the requirements in Section 3.

B2 Document structure and confidentiality

The GeoAMP is divided into two parts in order to separate commercially sensitive information from the geotechnical asset reporting, assessment and planning of future management activities.

Part one of the GeoAMP presents background information, details of works, inspections and surveys completed over the previous year, a summary of significant hazards affecting the geotechnical asset and discussion of potential impacts. It presents the risk-based approach used in the planning and prioritisation of inspection, monitoring and renewals schemes.

Information included in part two of the GeoAMP includes details of outturn costs of key geotechnical activities over the previous year and predicted costs of future geotechnical activities. It also describes lessons learned over the previous year and recommendations of good practice.

Information included in part two of the GeoAMP, and in any associated spreadsheets is to be treated as commercially sensitive and in confidence. It is to have limited access, restricted to the respective service provider and Overseeing Organisation staff until the termination of the contract with the service provider or as defined otherwise in that contract. Information in part one of the GeoAMP has no access restrictions placed on it.

B3 Document compilation

Parts one and two of the GeoAMP should be compiled as separate documents, such that they have their own document revision and contents pages. The titles of the documents should be the same other than the part numbers and they should reference each other.

Where previous GeoAMPs have been submitted within the current service provider contract, reference should be made to previous GeoAMP submissions for generic information. This does not need to be repeated in each GeoAMP unless the information has changed.

The service provider should liaise with the Overseeing Organisation prior to compiling the GeoAMP to obtain the latest version of electronic file templates such as spreadsheet tables.

Where tables are included in part two of the GeoAMP they should be consistent with the format of the tables and ordering of the information presented in part one.

The information included in the GeoAMP should be based on the current network area. The potential impact of known planned area boundary changes should be recorded and any impact stated.

B4 Document submission

The metadata for GeoAMP parts one and two should be recorded on the Overseeing Organisation's geotechnical asset information management system. Part one should be issued to the Overseeing Organisation for upload onto the geotechnical asset information management system. Part two should be issued to the Overseeing Organisation for storage on their internal records management system.

B5 GeoAMP example: part one

B5.1 Suggested contents

The suggested contents of the GeoAMP are as follows:

1) summary;
2) introduction;

3) geotechnical setting;
4) recent activity and developments;
5) maintenance activity over the previous year;
    a) inspections and monitoring;
    b) maintenance works;
    c) works completed; and,
    d) other maintenance activity;
6) other geotechnical developments;
7) asset data;
    a) asset data quality and currency; and,
    b) asset data summary;
8) discussion of asset classification;
9) risk-based approach;
10) hazards and triggers;
11) potential impacts;
12) risk assessments;
13) proposed programme; and,
14) improving, replacing and building new assets.

B5.2 Summary

Succinctly summarise the content of the report; describe any fundamental changes in contract; note any significant geotechnical works completed since production of the last GeoAMP and those scheduled within the next 12 months; highlight significant events that directly affected the feature grade of the geotechnical asset since the previous report e.g. landslides, flooding, subsidence.

Include current observation lengths to which each feature grade has been assigned, both in length in kilometres and as a percentage of the total earthwork length in the maintenance area.

Provide a summary table of principal inspections, monitoring inspections, studies, ground investigations, design input and construct works for the forthcoming five-year period.

B5.3 Introduction

The suggested contents for this section of the GeoAMP are as follows:

1) form of maintenance contract (with start and end dates);
2) name of service provider;
3) names of GMLE and GA; and,
4) any changes to area boundaries and what affect the changes have on the number and type of assets.

B5.4 Geotechnical setting

The suggested contents for this section of the GeoAMP are as follows:

1) topography;
2) hydrology;
3) geology;
4) geomorphological features;
5) key man-made ground related features; and,
6) motorway and trunk road network.

Highlight key features affecting or having the potential to affect the geotechnical asset. While this section may not require repetition in each version of the GeoAMP, any significant changes since production of the previous GeoAMP should be described. These may have occurred, for example, as a result of changing of network boundaries or improved/revised knowledge.

Include maps (minimum A3 size) presenting these features within an appendix to the GeoAMP.

B5.5 Recent activity and developments

Provide a brief summary description of geotechnical developments, maintenance activities and geotechnical events over the previous year.

B5.6 Maintenance activity over the previous year

B5.6.1 Inspections and monitoring

Provide a list of inspections completed compared with those intended based on the previous GeoAMP. Route lengths inspected are to be quoted for comparison.

Describe monitoring activities undertaken to assess the deterioration of identified defects or assets considered to be 'at risk'.

B5.6.2 Maintenance works

Provide details of maintenance works completed and the impact of the works to the network.

B5.6.3 Works completed

The suggested contents for this section of the GeoAMP are as follows, to be presented in tabular form:

1) year;
2) project or site title;
3) geotechnical defect unique reference numbers as recorded in the Overseeing Organisation's geotechnical asset information management system;
4) road type, e.g. motorway or all purpose trunk road;
5) earthwork type, e.g. embankment or cutting;
6) project size, e.g. small, major, hybrid etc.;
7) work type;
8) whether this was the principal work type;
9) description of 'other' where selected as the work type;
10) approximate length of works (metres);
11) approximate vertical height of works / retained height (metres);
12) quantity of the standard unit for this work type; and,
13) comments including value management score if known.

Renewals projects included in this table should be those which have a geotechnical lead, or which are geotechnical elements of a 'hybrid' scheme. Major projects should not be included.

Include a list of all geotechnical works completed in the current service provider's contract in an appendix to the GeoAMP.

B5.6.4 Other maintenance activity

Describe any other geotechnical maintenance activities undertaken including production of route or network wide studies and maintenance strategy reviews. Key conclusions of such studies and reviews should be summarised.

B5.7 Other geotechnical developments

Provide a summary of any significant events, occurrences or developments affecting the network over the previous year not directly related to geotechnical maintenance activity. This may include:

1) changes to the network extents;
2) significant natural events e.g. severe weather, flooding;
3) construction of other assets that have affected the geotechnical asset; and,
4) identification of any other specific hazards with the potential to affect the geotechnical asset, for example works outside the occupancy boundary.

B5.8 Asset data

B5.8.1 Asset data quality and currency

Tabulate by CS 641 feature grade the inspected geotechnical asset length for the 12 months preceding the GeoAMP. Also include the percentage of this inspected asset length for which the data has been approved by the service provider. Table B.1 gives an example table layout. Fictional figures are used for illustration.

Comment on the tabulated data with respect to completeness of inspections, accuracy of data and ongoing utilisation of data.

Table B.1 Summary of asset inspections

CS 641 feature grade	Inspected length (km)	Inspected No.	Percentage with approved inspection data
1	30	35	100%
2	50	23	92%
3	75	45	95%
4	10	40	99%
5	1	8	100%

Provide an explanation for any percentage approved asset lengths below 100%. Comment on the accuracy and consistency of the data and any tasks aimed at its improvement.

B5.8.2 Asset data summary

Tabulate, on a route by route basis, total inspected geotechnical asset length as well as length of CS 641 feature grade 5, 4, 3, 2 and 1 defects and express the total length of defects as a percentage of the route length. Also express the total of each type of defect as a percentage of the total geotechnical asset length on the network. Table B.2 below gives an example table layout and applicable notes. Fictional figures are used for illustration.

Table B.2 Summary of asset by feature grade

		Defect length by CS 641 feature grade					
Route[1]	**Total inspected length (km)**	**1 (km)**	**2 (km)**	**3 (km)**	**4 (km)**	**5 (km)**	**Totals (km)**
Route 1	100	1.2	0.5	11.2	2.3	1.5	**16.7**
Route 2	50	0.6	0.1	5.6	1.5	3.2	**11.00**
Route n	75	0	1.2	5.4	5.0	2.1	**13.7**
Totals	225	1.8	1.8	22.2	8.8	6.8	**41.4**
% of inspected length		**0.8**	**0.8**	**9.9**	**3.9**	**3.0**	**18.4**
Notes: [1] Routes can be listed here, which may be a single road, or a combination of roads that form a route in the area.							

Tabulate on a network basis the percentage change in feature grade 5, 4 and 3 features over the last 5 years. This should aid the understanding of how preventative and remedial works are changing the condition of the geotechnical asset. Also include a summary of the assessed subsequent feature grade, based on a five-year time frame from the observation of the initial feature grade. Table B.3 below gives an example table layout and applicable notes. Fictional figures are used for illustration.

B5.9 Discussion of asset classification

Table B.3 Summary of asset feature grade at Year ****

Financial Year	Measure	CS 641 feature grade		
		5	4	3
Year 1[1]	**Total length of observations[2] (km)**	4.4	6.5	58.6
	As % of inspected asset length (%)	0.88	1.3	11.72
Year 2[1]	**Total length of observations[2] (km)**	4.3	6.2	59.6
	As % of inspected asset length (%)	0.86	1.24	11.92
Year 3[1]	**Total length of observations[2] (km)**	3.8	5.8	62.1
	As % of inspected asset length (%)	0.76	1.16	12.42
Change between last two years	**Total length of observations[2] (km)**	-0.5	-0.4	2.5
	As % of inspected asset length (%)	-0.1	-0.08	0.5
Deterioration assessment[3] (Forecast feature grade)	**Total length of observations[2] (km)**	4.1	6.1	64.3
	As % of inspected asset length (%)	0.82	1.22	12.86
Notes: **** Enter the year of the GeoAMP here. [1] Enter financial years in here. e.g. 2018/2019 etc. [2] Previous years GeoAMPs can be used to obtain the historical figures [3] Use initial feature grade matrix with the subsequent feature class and feature location index to derive the forecast feature grade				

Include discussion of the asset data, including comments on:

1) any detrimental changes e.g. increase in the percentage of defects, and known or likely causes of these changes;

2) geographical areas of note, for example those with high concentrations of defects or notably low percentages of defects and reasons for such concentrations where known; and,
3) interpretation of the 'at risk' and minor defect data, its accuracy and how this may possibly affect future inspection strategies and the basis for assignment of at risk zones.

B5.10 Risk-based approach

Describe the risk-based approach used in the development of the forward programmes of:

1) inspections;
2) monitoring and maintenance; and,
3) scheme development.

Describe the methods used in the identification of hazards, triggers and potential impacts.

Set out the forward programme and describe how the risk-based approach has been used to derive the programme.

B5.11 Hazards and triggers

Describe hazards with the potential to affect the geotechnical asset which have been considered in the risk- based approach adopted. Describe data and studies that have been used to identify the prevalence of these hazards. Hazards should not be restricted to those directly related to slopes; consideration should be given to other hazards such as natural and man-made cavities and weaker deposits beneath embankments. Consideration should also be given to hazards lying outside of the occupancy boundary.

Compile a hazard map of the area if sufficient information is available. Make reference to any specific route studies previously completed.

Discuss the triggers associated with these hazards which could result in the development of a defect. For example heavy rainfall may trigger defects in desiccated high plasticity clay earthworks.

B5.12 Potential impacts

Describe how the potential impacts have been assessed for defects associated with these hazards and triggers, especially where there are concentrations of feature grade 4 or 5 defects along a route that may lead to geotechnical events. These may include network criticality, traffic flow, hard shoulder running etc. Include comments on:

1) cross-asset impacts (for example impacts on pavement, cabling and drainage);
2) lane closures;
3) diversions;
4) disruption to business;
5) requirements for traffic management;
6) safety implications; and,
7) risk assessments.

B5.13 Risk assessments

Present the results of the risk assessments.

B5.14 Proposed programme

Present the programme for the whole cycle of geotechnical maintenance from principal inspection to planned construction of any renewals schemes. Include any key financial dates and any key dates of relevance to network operations:

1) programme of principal inspections and monitoring;
2) programme of studies and ground investigations;
3) programme of design activities; and,
4) programme of construction activities.

Provide the programme of inspections for the forthcoming five years including details of route, year of inspection and earthwork length to be inspected.

B5.14.1 Principal inspection and monitoring inspection programme

The suggested contents for this summary table are as follows:

1) financial year;
2) road name(s) or site name;
3) inspection type, e.g. principal inspection (repeat), monitoring inspection;
4) type group, e.g. inspection;
5) resources required (staff and time);
6) approximate length (km); and,
7) comments.

Provide a plan of the area showing the locations of the inspections and monitoring for the forthcoming year.

B5.15 Improving, replacing and building new assets

Provide a summary table of schemes to be undertaken in the next five years. The information required to be included is listed below:

1) year;
2) scheme title;
3) geotechnical defect unique reference numbers as recorded in the Overseeing Organisation's geotechnical asset information management system;
4) road type, e.g. motorway or all-purpose trunk road;
5) earthwork type, e.g. embankment or cutting;
6) project size, e.g. small, major, hybrid etc.;
7) proposed work type;
8) whether this is the principal work type;
9) approximate length of works (m);
10) approximate vertical height of works/retained height (m);
11) quantity of the standard unit for this work type; and,
12) comments including prioritisation.

B6 GeoAMP example: part two

B6.1 Suggested contents

The suggested contents for this section of the GeoAMP are as follows:

1) principal inspections and monitoring inspections over the previous year;
2) principal inspections and monitoring inspections predicted for the next five years;
3) maintenance and renewal activity over the previous year;
4) maintenance and renewal activity predicted for the next five years; and,
5) lessons learned and good practice.

B6.2 Principal inspections and monitoring inspections over the previous year

Present a table of inspections completed in the last year. Include the information regarding outturn costs.

B6.2.1 Principal inspection and monitoring inspection programme over the previous year

The suggested contents for this section of the GeoAMP are as follows:

1) financial year;
2) road name(s) or site name;
3) inspection type, e.g. principal inspection (repeat), monitoring inspection;
4) type group, e.g. inspection;
5) resources required (staff and time);
6) approximate length (km);
7) comments;
8) costs excluding traffic management (£);
9) traffic management fixed cost (£);
10) traffic management duration (days);
11) traffic management unit cost (£/day);
12) calculated total traffic management cost (£); and,
13) total costs including traffic management (£).

B6.3 Principal inspections and monitoring inspections predicted for the next five years

Present a table of scheduled inspections for the next five years. Include information regarding predicted costs.

B6.3.1 Principal inspection and monitoring inspection programme for the next five years

The suggested contents for this section of the GeoAMP are as follows:

1) financial year;
2) road name(s) or site name;
3) inspection type, e.g. principal inspection (repeat), monitoring inspection;
4) type group, e.g. inspection;
5) resource required (staff and time);
6) approximate length (km);
7) comments;
8) costs excluding traffic management (£);
9) traffic management fixed cost (£);
10) traffic management duration (days);
11) traffic management unit cost (£/day);
12) calculated total traffic management cost (£); and,
13) total costs including traffic management (£).

B6.4 Maintenance and renewal activity over the previous year

Present a table of maintenance and renewal works completed in the last year. Include information regarding outturn costs.

B6.4.1 Work completed

The suggested contents for this section of the GeoAMP are as follows:

1) year;
2) project or site title;
3) geotechnical defect unique reference numbers as recorded in the Overseeing Organisation's geotechnical asset information management system;
4) road type, e.g. motorway or all-purpose trunk road;
5) earthwork type, e.g. embankment or cutting;
6) project size, e.g. small, major, hybrid etc.;
7) work type;
8) whether this was the principal work type;
9) approximate length of works (m);
10) approximate vertical height of works / retained height (m);
11) quantity of the standard unit for this work type;
12) comments including value management score if known;
13) non-construction cost if relevant (£);
14) mobilisation cost (£);
15) works cost (total meterage cost) (£);
16) calculated total construction cost (sum of mobilisation cost and works cost) (£);
17) calculated average unit cost (total construction cost divided by number of units) (£/m or £/m^2);
18) traffic management fixed cost (£);
19) traffic management duration (days);
20) traffic management unit cost (£/day);
21) calculated total traffic management cost (£);
22) total cost of in year activity (£);
23) budgeted total cost of in year activity as presented in previous GeoAMP (£); and,
24) comments, including reasons for differences between budgeted and outturn costs.

Costs listed should include all elements that contribute to a geotechnically led scheme, not just the input of the geotechnical team. For example, if a slope repair includes elements or drainage, safety fence reinstatement etc., these should be included in the costs provided.

B6.5 Maintenance and renewal activity predicted for the next five years

Present a table of maintenance and renewal activity predicted for the next five years. Include information regarding predicted costs.

B6.5.1 Works predicted

The suggested contents for this section of the GeoAMP are as follows:

1) year;
2) scheme title;
3) geotechnical defect IDs if known;
4) road, e.g. motorway or all-purpose trunk road;
5) type, e.g. embankment or cutting;
6) project size, e.g. small, major, hybrid etc.;
7) proposed work type;
8) whether this is the principal work type;
9) approximate length of works (m);
10) approximate vertical height of works / retained height (m);

11) quantity of the standard unit for this work type;
12) comments including prioritisation;
13) estimated traffic management cost (£);
14) estimated construction cost (£);
15) estimated total cost;
16) budgeted total cost as presented in previous GeoAMP (£); and,
17) comments.

B6.6 Lessons learned and good practice

Include details of any aspects of data management, planning, inspection, maintenance or renewal that could be adopted as good practice, together with any recommendations for changes in processes or methods. Consider whether this information can also be included in part one, to enable the Overseeing Organisation to inform others of good practice.

Geotechnics
Inspection & Assessment

CS 641
England National Application Annex to CS 641 Managing the maintenance of highway geotechnical assets

(formerly HD 41/15)

Revision 0

Summary
This National Application Annex sets out the Highways England-specific requirements on managing the maintenance of highway geotechnical assets.

Feedback and Enquiries
Users of this document are encouraged to raise any enquiries and/or provide feedback on the content and usage of this document to the dedicated Highways England team. The email address for all enquiries and feedback is: Standards_Enquiries@highwaysengland.co.uk

This is a controlled document.

Contents

Release notes

Version	Date	Details of amendments
0	Mar 2020	Highways England National Application Annex to CS 641.

Foreword

Publishing information

This document is published by Highways England.

This document supersedes HD 41/15: Maintenance of Highway Geotechnical Assets, which is withdrawn.

Contractual and legal considerations

This document forms part of the works specification. It does not purport to include all the necessary provisions of a contract. Users are responsible for applying all appropriate documents applicable to their contract.

Introduction

Background

This National Application Annex gives the Highways England specific requirements for CS 641 Managing the maintenance of highway geotechnical assets.

Assumptions made in the preparation of this document

The assumptions made in GG 101 [Ref 5.N] apply to this document.

Abbreviations

Abbreviation

Abbreviation	Meaning
ADMM	Asset Data Management Manual ADMM [Ref 1.N]

Terms and definitions

Terms

Term	Definition
Geotechnical asset information management system	Information technology system used to record and manage data relating to geotechnical assets, as defined in the asset data management manual (ADMM).
Special geotechnical measure	Techniques that: 1) enable a soil or rock to permanently stand at an angle greater than achievable by simple earthworks (for example the inclusion of tensile reinforcement, soil nailing, chemical additives or external support such as gabions); 2) mitigate a pre-existing geotechnical hazard; 3) remediate a post-construction defect. The term allows the identification of such areas in asset data systems.

E/1. Organisation and roles

E/1.1 The name and contact details of the geotechnical maintenance liaison engineer (GMLE) shall be kept up-to-date within the geotechnical asset management plan (GeoAMP).

E/1.2 All personnel undertaking inspections shall have received training in the Highways England methods of inspection, recognition of geotechnical characteristics, assessment of observations and grading of geotechnical features.

NOTE *A guidance note on the field identification and classification of geotechnical observations Geotechnical Observations [Ref 2.N] is available for download from the geotechnical asset information management system.*

E/2. Geotechnical asset management plan

E/2.1 The service provider shall use the GeoAMP spreadsheet for the recording of the tabular elements of the GeoAMP.

NOTE *The GeoAMP spreadsheets are available for download from the geotechnical asset information management system.*

E/2.2 Descriptive details of all parts of the GeoAMP shall be recorded on the geotechnical asset information management system.

E/2.3 All parts of the GeoAMP shall be submitted to Highways England for review and acceptance before upload in the agreed format.

NOTE 1 *Details of the agreed upload format are provided in the report submission protocols document HAGDMS Geotechnical [Ref 3.N] available for download from the geotechnical asset information management system.*

NOTE 2 *Part one of the GeoAMP is to be be uploaded to the geotechnical asset information management system once accepted.*

NOTE 3 *Part two of the GeoAMP is to be be uploaded to the internal records management system once accepted.*

Geohazard appraisal

E/2.4 When appraising the hazards as part of the consideration of geotechnical risk, the service provider shall review the available information on the geotechnical asset information management system, as well as other available sources of information.

NOTE *The available information on the geotechnical asset information management system includes:*

1) *hazard maps for a corridor around the strategic road network;*
2) *hazard map definition documents;*
3) *Ordnance Survey and British Geological Survey maps at various scales;*
4) *various other mapping layers from third party suppliers;*
5) *aerial photography and other remotely sensed imagery;*
6) *technical reports;*
7) *technical drawings;*
8) *an archive of borehole information;*
9) *geotechnical asset inventory and condition information; and,*
10) *information on the drainage asset.*

E/3. Asset definition

E/3.1 The following terminology shall be used to describe the geotechnical asset:

Table E/3.1 Asset definition

CS 641 term for asset types	Specific geotechnical asset types	Highways England term
Minor earthwork	Cuttings, embankments and at-grade sections	At-grade
Major earthwork	Cuttings, embankment and bunds	Cutting, embankment or bund

E/4. Inspections

E/4.1 The required information to allow geotechnical assets to be managed successfully, including the characteristics of geotechnical assets, shall be recorded in a formalised and repeatable manner in accordance with the requirements of the ADMM [Ref 1.N].

E/4.1.1 Further guidance on the recording of characteristics as observations should be obtained from the guidance note on the field identification and classification of geotechnical observations Geotechnical Observations [Ref 2.N] available for download from the geotechnical asset information management system.

E/4.1.2 Guidance on the completion and reporting of principal inspections carried out following construction of a new asset, or modification of an existing asset, should be obtained from the handover of geotechnical as-built data guidance document Geotechnical handover [Ref 4.N], available for download from the geotechnical asset information management system.

NOTE *The handover of geotechnical as-built data guidance document Geotechnical handover [Ref 4.N] includes details of the means of recording special geotechnical measures.*

Inspection frequency

E/4.2 Where insufficient information is available to undertake a risk assessment to determine the frequency of inspection of a geotechnical asset, the frequency shall be set to 5 years.

E/4.3 The scheduled frequency of inspection for geotechnical assets shall be recorded against each asset in the geotechnical asset information management system.

Geotechnical events

E/4.4 Geotechnical events shall be recorded in the geotechnical asset information management system in accordance with the geotechnical event process.

E/4.4.1 A geotechnical event can incur costs, which should be recorded, associated with activities such as:

1) emergency works;
2) site investigation;
3) reporting; and,
4) construction of a remedial solution.

NOTE *Recording of a geotechnical event includes providing details of:*

1) the reporting of the event to and by the service provider (for example the date and time the event was recorded, and the initials of the reporters) ;
2) effects on the running of the carriageway (for example extent of traffic management and lane closures); and,
3) elements of highway infrastructure impacted by the event.

E/4.5 A status shall be allocated to a geotechnical event.

E/4.5.1 This allocated status may be: 'imminent', 'ongoing' or 'cleared' as below.

1) imminent, see note below;
2) ongoing, meaning that the event and its impacts are yet to be fully assessed or cleared; or,
3) cleared, meaning the the event and its impacts have been fully assessed, and cleared.

NOTE *The majority of events have an 'ongoing' or 'cleared' status. It is recognised that in some cases emergency measures needs to be taken in the case of defects that have not yet impacted adversely on the network, but which are expected to occur in the imminent future. An example could be where a backscarp is rapidly retreating towards the safety barrier during a period of wet weather and could be expected to undermine the barrier if the period of current weather conditions continues. The status needs to be changed accordingly once the situation has either developed or stabilised.*

E/5. Assessment

E/5.1 All observations shall be assessed and grading carried out when an observation is determined to be a feature.

E/5.1.1 Further guidance on the assessment and grading of features should be obtained from the guidance note on the field identification and classification of geotechnical observations Geotechnical Observations [Ref 2.N], available for download from the geotechnical asset information management system.

E/6. Geotechnical intervention and scheme prioritisation

E/6.1 Where non-routine maintenance requirements have been determined that are not based on the recommended geotechnical interventions in section 7 of CS 641 [Ref 6.N], they shall be recorded in the geotechnical asset information management system in accordance with the requirements of the ADMM [Ref 1.N].

E/7. Information requirements

E/7.1 Information required to support geotechnical asset maintenance management shall be recorded in accordance with the requirements of the ADMM [Ref 1.N].

E/8. Normative references

The following documents, in whole or in part, are normative references for this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Ref 1.N	Highways England. ADMM, 'Asset Data Management Manual'
Ref 2.N	Highways England. Geotechnical Observations, 'Guidance note on the field identification and classification of geotechnical observations'
Ref 3.N	Highways England. HAGDMS Geotechnical, 'HA Geotechnical Report Submission Protocols Advisory Information for HAGDMS Users'
Ref 4.N	Highways England. Geotechnical handover, 'Handover of geotechnical as-built data guidance document'
Ref 5.N	Highways England. GG 101, 'Introduction to the Design Manual for Roads and Bridges'
Ref 6.N	Highways England. CS 641, 'Managing the maintenance of highway geotechnical assets'

Department for Infrastructure
An Roinn Bonneagair

Geotechnics
Inspection & Assessment

CS 641
Northern Ireland National Application Annex to CS 641 Managing the maintenance of highways geotechnical assets

(formerly HD 41/15)

Revision 0

Summary
Please contact the Department for Infrastructure, Northern Ireland, for the application of CS 641 Managing the maintenance of highways geotechnical assets. The email address is dcu@infrastructure-ni.gov.uk

Feedback and Enquiries
Users of this document are encouraged to raise any enquiries and/or provide feedback on the content and usage of this document to the dedicated team in the Department for Infrastructure, Northern Ireland. The email address for all enquiries and feedback is: dcu@infrastructure-ni.gov.uk

This is a controlled document.

Contents

Release notes

Version	Date	Details of amendments
0	Mar 2020	Department for Infrastructure Northern Ireland National Application Annex to CS 641.

Foreword

Publishing information

This document is published by Highways England on behalf of the Department for Infrastructure, Northern Ireland.

This document supersedes HD 41/15, which is withdrawn.

Contractual and legal considerations

This document forms part of the works specification. It does not purport to include all the necessary provisions of a contract. Users are responsible for applying all appropriate documents applicable to their contract.

Introduction

Background

This National Application Annex gives the Department for Infrastructure Northern Ireland-specific requirements for managing the maintenance of highway geotechnical assets.

Assumptions made in the preparation of this document

The assumptions made in GG 101 [Ref 1.N] apply to this document.

NI/1. Scope

NI/1.1 In Northern Ireland the application of 'Managing the maintenance of highways geotechnical assets' CS 641 [Ref 2.N] shall be in accordance with Department for Infrastructure Policy.

NI/2. Normative references

The following documents, in whole or in part, are normative references for this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Ref 1.N	Highways England. GG 101, 'Introduction to the Design Manual for Roads and Bridges'
Ref 2.N	Highways England. CS 641, 'Managing the maintenance of highway geotechnical assets'

Geotechnics
Inspection & Assessment

CS 641
Scotland National Application Annex to CS 641 Managing the maintenance of highway geotechnical assets

(formerly HD 41/15)

Revision 0

Summary
This National Application Annex gives the Transport Scotland specific requirements for managing the maintenance of highway geotechnical assets.

Feedback and Enquiries
Users of this document are encouraged to raise any enquiries and/or provide feedback on the content and usage of this document to the dedicated Transport Scotland team. The email address for all enquiries and feedback is: TSStandardsBranch@transport.gov.scot

This is a controlled document.

Contents

Release notes

Version	Date	Details of amendments
0	Mar 2020	Transport Scotland National Application Annex to CS 461.

Foreword

Publishing information

This document is published by Highways England on behalf of Transport Scotland.

This document supersedes HD 41/15, which is withdrawn.

Contractual and legal considerations

This document forms part of the works specification. It does not purport to include all the necessary provisions of a contract. Users are responsible for applying all appropriate documents applicable to their contract.

Introduction

Background

Whilst the general principles of the advice and guidance contained in CS 641 are endorsed, that document is not mandatory for use in Scotland, and the correct procedural aspects are presented in this National Application Annex.

Assumptions made in the preparation of this document

The assumptions made in GG 101 [Ref 1.N] apply to this document.

S/1. Scope

S/1.1 Whilst the general principles of the advice and guidance contained in CS 641 are endorsed, that document is not mandatory for use in Scotland, and reference shall be made to the Scotland Overseeing Organisation's asset management documents for the correct procedures.

NOTE *The email address for enquiries is TSStandardsBranch@transport.gov.scot*

S/2. Normative references

The following documents, in whole or in part, are normative references for this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Ref 1.N	Highways England. GG 101, 'Introduction to the Design Manual for Roads and Bridges'

Llywodraeth Cymru
Welsh Government

Geotechnics
Inspection & Assessment

CS 641
Wales National Application Annex to CS 641 Managing the maintenance of highway geotechnical assets

(formerly HD 41/15)

Revision 0

Summary
This National Application Annex contains the Welsh Government specific requirements related to managing the maintenance of highway geotechnical assets.

Feedback and Enquiries
Users of this document are encouraged to raise any enquiries and/or provide feedback on the content and usage of this document to the dedicated Welsh Government team. The email address for all enquiries and feedback is: Standards_Feedback_and_Enquiries@gov.wales

This is a controlled document.

Contents

Release notes

Version	Date	Details of amendments
0	Mar 2020	Welsh Government National Application Annex to CS 641.

Foreword

Publishing information

This document is published by Highways England on behalf of the Welsh Government.

This document supersedes HD 41/15 which is withdrawn.

Contractual and legal considerations

This document forms part of the works specification. It does not purport to include all the necessary provisions of a contract. Users are responsible for applying all appropriate documents applicable to their contract.

Introduction

Background

This National Application Annex gives the Welsh Government-specific requirements for managing the maintenance of highway geotechnical assets.

Assumptions made in the preparation of this document

The assumptions made in GG 101 [Ref 2.N] apply to this document.

Abbreviations

Abbreviations

Abbreviation	Meaning
GeoAMP	Geotechnical asset management plan
GMLE	Geotechnical maintenance liaison engineer

Terms and definitions

Terms

Term	Definition
Geotechnical asset information management system	Information technology system used to record and manage data relating to geotechnical assets.
Major earthwork	Cutting, embankment or bund
Minor earthwork	At-grade section. These can include cuttings and embankments.
Special geotechnical measure	Techniques that: 1) enable a soil or rock to permanently stand at an angle greater than achievable by simple earthworks (for example the inclusion of tensile reinforcement, soil nailing, chemical additives or external support such as gabions); 2) mitigate a pre-existing geotechnical hazard; 3) remediate a post-construction effect. This term allows the identification of such areas in asset data systems.
Special geotechnical monitoring site	A site that requires long-term geotechnical monitoring to ensure the safety and functionality of the highway, where a remedial solution is uneconomical or impractical. Examples include: 1) large-scale active and relic landscapes; 2) legacy subsidence issues caused by mining activities or soft ground; 3) sites on third-party land adjacent to the highway with a history of movement or failure. Site specific monitoring regimes can involve visual inspections, reading of instrumentation, surveying of movement markers, crack monitoring or other methods.

W/1. Organisation and roles

W/1.1 The name and contact details of the Geotechnical Maintenance Liaison Engineer (GMLE) shall be kept up-to-date within the Geotechnical Asset Management Plan (GeoAMP).

W/1.1.1 The role of Geotechnical Maintenance Liaison Engineer may be held by an individual or an organisation, with the agreement of the Welsh Government.

W/1.2 All personnel undertaking inspections shall have received training in the Welsh Government's methods of inspection, recognition of geotechnical characteristics, assessment of observations and grading of geotechnical features.

W/1.3 All personnel undertaking inspections or acting as GMLE shall submit a curriculum vitae (cv) to the Welsh Government to demonstrate the qualifications and experience to meet the requirements in Section 2 of CS 641.

W/1.4 At least one member of any inspection team shall have a degree in geology or engineering, or equivalent, or have extensive proven and demonstrable experience of geotechnical engineering and site inspection.

W/2. Geotechnical asset management plan

W/2.1 The geotechnical asset management plan (GeoAMP) shall be submitted to Welsh Government for review and acceptance.

Geohazard appraisal

W/2.2 When appraising the hazards as part of the consideration of geotechnical risk, the service provider shall review all available information on the geotechnical asset information management system and other publicly available sources of information.

W/3. Asset definition

W/3.1 The terminology listed in Table W/3.1 shall be used to describe the geotechnical asset.

Table W/3.1 Asset definition

CS 641 term for asset type	Specific geotechnical asset types	Welsh Government term
Minor earthwork	Cuttings, embankments and at-grade sections	At-grade
Major earthwork	Cuttings, embankment and bunds	Cutting, embankment or bund

W/4. Inspections

W/4.1 The necessary information to allow geotechnical assets to be managed successfully, including the characteristics of geotechnical assets, shall be recorded in a formalised and repeatable manner.

W/4.1.1 Further guidance on the assessment and grading of features should be obtained from the guidance note on the field identification and classification of geotechnical observations Geotechnical Observations [Ref 1.N] available from the geotechnical asset information management system.

W/4.1.2 Guidance on the completion and reporting of principal inspections carried out following construction of a new asset, or modification of an existing asset, should be obtained from the Welsh Government's Geotechnical Advisor.

Inspection frequency

W/4.2 Where insufficient information is available to undertake a risk assessment to determine the frequency of inspection of a geotechnical asset, the frequency shall be set to five years.

W/4.3 The scheduled frequency of inspection for geotechnical assets shall be recorded against each asset in the geotechnical asset information management system.

Geotechnical events

W/4.4 Geotechnical events shall be recorded in the geotechnical asset information management system in accordance with the geotechnical event process.

W/4.5 If there is a geotechnical event, the GMLE shall be alerted.

W/4.6 Depending on the severity of a geotechnical event a suitably qualified person shall attend the site to assess the event's criticality.

W/4.6.1 The initial site visit should take place as soon after the event as possible and advice be provided to the Welsh Government.

NOTE *Recording of a geotechnical event includes providing details of:*

1) *the initial reporting of the event to and by the service provider (for examples the location, nature and extent of event, the date and time the event was recorded, and the names of the reporters);*
2) *assessment of current risk to road users and others, and additional measures to reduce risk;*
3) *effects on the running of the carriageway (for example extent of traffic management and lane closures);*
4) *elements of highway infrastructure impacted by the event; and,*
5) *photographs.*

W/4.7 A Welsh Government 'Geotechnical event form' [WG Geotechnical Event Form [Ref 3.N]] shall be completed by the GMLE and submitted to the Welsh Government's Geotechnical Advisor as soon after the event as possible.

W/4.7.1 Mitigations/activities that might be agreed may include:

1) emergency works;
2) monitoring;
3) site investigation;
4) reporting;
5) construction of a remedial solution.

W/5. Assessment

W/5.1 All observations shall be assessed and grading carried out when an observation is determined to be a feature.

W/5.1.1 Further guidance on the assessment and grading of features should be obtained from the guidance note on the field identification and classification of geotechnical observations Geotechnical Observations [Ref 1.N] available from the geotechnical asset information management system.

W/6. Geotechnical intervention and scheme prioritisation

W/6.1 Any site-specific monitoring regimes and non-routine maintenance requirements not based on the recommended geotechnical interventions in Section 7 of CS 641, shall be recorded in the geotechnical asset information management system.

W/7. Normative references

The following documents, in whole or in part, are normative references for this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Ref 1.N	Highways England. Geotechnical Observations, 'Guidance note on the field identification and classification of geotechnical observations'
Ref 2.N	Highways England. GG 101, 'Introduction to the Design Manual for Roads and Bridges'
Ref 3.N	Welsh Government. WG Geotechnical Event Form, 'Welsh Government Geotechnical Event Form'

Appendix W/A. Welsh Government geotechnical advice form

Figure W/A.1 Geotechnical event form - Part 1

CS641: Welsh Government Geotechnical Event Form

PART 1 of 2:

Llywodraeth Cymru
Welsh Government

To be completed by Geotechnical Maintenance Liaison Engineer (GMLE) or Service Provider

CS641 Definition: Geotechnical Event - A geotechnical defect that poses a threat to the safety of users, workers or other parties such that immediate action is to be taken.

Location Name:	
Trunk Road Area:	☐ North and Mid Wales ☐ South Wales
Road:	
Start Location / Grid Ref:	
End Location / Grid Ref:	
Date / Time of Event:	
Weather at time of Event:	
Brief description of Geotechnical Event:	
Emergency Inspection carried out?	☐ Yes ☐ No ☐ Photos attached
Form submitted by:	
Job Title:	
Contact Email:	
Contact Phone:	
Date submitted:	

Tick the box adjacent to the item if the element is relevant to the Geotechnical Event

Earthwork(s) affected
- ☐ Cutting
- ☐ Embankment
- ☐ At Grade
- ☐ Rock Slope
- ☐ Bund

Location affected
- ☐ Carriageway
- ☐ Hardshoulder
- ☐ Adjacent to carriageway
- ☐ Remote from carriageway

Geotechnical Event
- ☐ Blockage of carriageway
- ☐ Subsidence of carriageway
- ☐ Imminent subsidence of carriageway
- ☐ Other (please provide details below)

Continues Over

Figure W/A.2 Geotechnical event form - Part 2

Immediate actions following Geotechnical Event

- ☐ Temporary signing or traffic management
- ☐ Temporary barriers
- ☐ Debris clearance
- ☐ Temporary support
- ☐ Monitoring inspections
- ☐ Other

Elements of highway infrastructure affected by the Geotechnical Event

- ☐ Drainage
- ☐ Safety barriers
- ☐ Structures
- ☐ Signs
- ☐ Lighting columns
- ☐ Trees
- ☐ CCTV or speed cameras
- ☐ Cabling / Comms / Electrical Cabinet
- ☐ Highway boundary fence
- ☐ Road pavement
- ☐ Footway / Shared use path
- ☐ Other (please provide details below)

Third Party Assets affected by Geotechnical Event

- ☐ Utility company asset
- ☐ Private property (commercial)
- ☐ Private property (residential)
- ☐ Other (please provide details below)

Other:

CS641: Welsh Government Geotechnical Event Form

PART 2 of 2:

Llywodraeth Cymru
Welsh Government

To be completed by the Geotechnical Advisor (GA) or Welsh Government representative

Geotechnical Advisor:			
Database(s) Checked:	☐ IRIS	☐ HAGDMS	☐ Other
Date reviewed:			
Database Findings:			
Geotechnical Advisor's Comments and Recommendations:			
Geotechnical Event Distribution:			
Geotechnical Event Status:	☐ None ☐ Imminent	☐ Ongoing	☐ Cleared
RETURN FORM TO:	**lain.McKenzie@gov.wales**	**Form Rev: 02**	