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

PART 3

HD 41/15

**MAINTENANCE OF HIGHWAY
GEOTECHNICAL ASSETS**

SUMMARY

This document provides best practice guidance for the inspection and maintenance management of the highway Geotechnical Asset and sets out the Standard to be applied for motorway and all-purpose trunk roads.

INSTRUCTIONS FOR USE

1. Remove Contents pages from Volume 4 and insert new Contents dated July 2015.
2. Remove HD41/03 from Volume 4, Section 1 which is superseded by this new Standard and archive as appropriate.
3. Insert HD41/15 into Volume 4, Section 1.
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**THE DEPARTMENT FOR REGIONAL DEVELOPMENT
NORTHERN IRELAND**

Maintenance of Highway Geotechnical Assets

Summary: This document provides best practice guidance for the inspection and maintenance management of the highway Geotechnical Asset and sets out the Standard to be applied for motorway and all-purpose trunk roads.

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GEOTECHNICAL ASSETS**

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1 INTRODUCTION

Background

- 1.1 A geotechnical asset is defined as the man-made or natural earthworks below the road pavement layers and the adjacent land beside the road.
- 1.2 Geotechnical assets support more than just the carriageway; they typically also support structures and communications equipment, which may be owned by a third party.
- 1.3 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, or the asset is not disturbed, e.g. by removal of supporting material (excavation at the toe of a slope) or opening of potential zones of weakness (excavation at the crest of a slope).
- 1.4 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 degradation 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.
- 1.5 Although inspections will 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 will inevitably be cases where unforeseen changes occur and assets do not deteriorate as predicted, resulting in Geotechnical Events and subsequent remedial works.
- 1.6 Whilst 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.
- 1.7 The drivers for decision making in the management of the geotechnical asset are generally a balance of:
 - (i) The risk posed to the road network from ground related, or external hazards.
 - (ii) 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).
 - (iii) The cost of geotechnical asset management activities (and available budgets).

Scope

- 1.8 This document details the following components of the management of geotechnical assets:
 - (i) The role of organisations and people in the management of geotechnical assets.
 - (ii) Planning and risk management of activities undertaken on geotechnical assets throughout their lifecycle (inspection, monitoring and interventions).
 - (iii) The information requirements for the management of geotechnical assets.

1.9 This document does not cover:

- (i) Strategic investment planning including the use of decision support tools.
- (ii) Asset health, asset criticality or performance metrics.
- (iii) Design and construction of new geotechnical assets.
- (iv) Data management of geotechnical asset information.

Purpose

- 1.10 This document is intended to be used by geotechnical practitioners involved in geotechnical asset management, in both the Overseeing Organisation and service providers acting on behalf of the Overseeing Organisation.
- 1.11 This document forms part of an asset management system and describes the properties and maintenance of the geotechnical asset. The principles adopted in this document follow those outlined in ISO 55000 (Ref 1).
- 1.12 This document supersedes HD41/03: Maintenance of Highway Geotechnical Assets.

Implementation

- 1.13 This standard must be used forthwith on all projects for the management of geotechnical assets of motorway and all-purpose trunk roads except where the procurement of works and/or services has reached a stage at which, in the opinion of the Overseeing Organisation, its use would result in significant additional expense or delay progress (in which case the decision must be recorded in accordance with the procedure required by the Overseeing Organisation).
- 1.14 Whilst the general principles of the advice and guidance contained in this document are endorsed, this standard is not mandatory for use in Scotland, Wales or Northern Ireland, and reference to correct procedural aspects should be made to the respective Overseeing Organisation's maintenance instructions and manuals.
- 1.15 The annexes to this standard are specific to the Overseeing Organisation. They present the implementation requirements and advice of that Overseeing Organisation and should be amended accordingly. The Overseeing Organisation's service provider shall follow the requirements set out in the annexes.

Definitions

1.16 For the purpose of this Standard, the following definitions apply.

Abbreviation/Term	Meaning
characteristic	A property of a geotechnical asset.
defect	A feature observed within a geotechnical asset that is assigned Class 1 in accordance with this standard.
Detailed Inspection	Synonymous with Principal Inspection
Emergency Inspection	An inspection undertaken in response to a Geotechnical Event, or other short term requirement.
Feature	An observation that is assessed as requiring a feature grade.

Abbreviation/Term	Meaning
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 location index.
Feature Location Index	An index applied to a feature to reflect its proximity to the network and 3 rd party assets.
GeoAMP	Geotechnical Asset Management Plan.
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.
HD41 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. Includes monitoring inspections.
Monitoring Inspection	An inspection where quantitative information is recorded to model the changes in characteristics.
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.
Overseeing Organisation	This refers to the following organisations (or their successors): Highways England; Transport Scotland; Welsh Government (Llywodraeth Cymru) and The Department for Regional Development (Northern Ireland).
Principal Inspection	The main type of geotechnical asset inspection in which all inventory and condition information is recorded or confirmed.
Subsequent Feature Grade	A grade applied to a feature with a predicted condition. The time frame for prediction is typically 5 years.

WITTHDRAWN

2 ORGANISATION AND ROLES

Roles

- 2.1 This document defines and refers to two key organisational roles:
- (i) A Geotechnical Advisor (GA); responsible for overview of the asset performance and agreement of management strategy & plans.
 - (ii) A Geotechnical Maintenance Liaison Engineer (GMLE); responsible for operational management activities.
- 2.2 Typically the Geotechnical Advisor will represent the interests of the Overseeing Organisation, whilst the Geotechnical Maintenance Liaison Engineer will represent the organisation responsible for day-to-day management of the assets.
- 2.3 The organisation(s) responsible for the day-to-day management of the assets for the Overseeing Organisation will be defined by the particular contract requirements in place. Throughout this application document, the main organisation undertaking the activities is referred to as the service provider, irrespective of contractual arrangement.
- 2.4 The Geotechnical Maintenance Liaison Engineer should liaise directly with their respective Geotechnical Advisor.

Competencies and responsibilities

- 2.5 The GMLE shall be a chartered member of a relevant professional body and have a minimum of 5 years post chartered experience. The GMLE shall be able to demonstrate responsibility for the planning and execution of projects involving geotechnical design, construction and monitoring.
- 2.6 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 outlined in this application document.
- 2.7 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.

WITTHDRAWN

3 GEOTECHNICAL ASSET MANAGEMENT PLAN

- 3.1 A Geotechnical Asset Management Plan (GeoAMP) sets out how the geotechnical asset is to be managed for a specific area or route. The GeoAMP is prepared by the service provider and details the forward programme of inspections and planned interventions. Forward planning activities within a GeoAMP shall be for a rolling five year period.
- 3.2 The service provider shall review the GeoAMP on an annual basis at a time agreed with the Overseeing Organisation.
- 3.3 The service provider shall submit the GeoAMP to the Overseeing Organisation for agreement.

Outline Contents

- 3.4 The GeoAMP shall include, as a minimum, details of the following:
- (i) An outline of the geotechnical hazards that potentially affect the motorway and trunk road network.
 - (ii) An overview of the geotechnical asset, the number of assets, their length, and dates of last inspection.
 - (iii) An overview of the historic, current and predicted condition of the geotechnical asset.
 - (iv) A summary of the inspections, surveys (such as ground investigations) and monitoring carried out within the reporting period of the GeoAMP.
 - (v) A summary of Geotechnical Events that have occurred within the reporting period of the GeoAMP and their impact on the network.
 - (vi) A schedule of inspections and monitoring to be carried out.
 - (vii) Details of surveys (such as ground investigations).
 - (viii) A summary of the completed and proposed geotechnical works.
- 3.5 The GeoAMP shall record risk assessments for inspection and maintenance activities. The methods used shall be recorded. Risk assessment should include the following:
- (i) hazards,
 - (ii) geotechnical asset information,
 - (iii) network criticality and
 - (iv) Proximity to other asset groups

Hazard appraisal

- 3.6 Hazards shall be identified and documented when considering geotechnical risk.

3.7 The following types of hazard shall be considered:

- (i) Natural hazards, relating to the natural environment in which the road is located. These hazards may be due to the behaviour of geological materials (for example voids due to dissolution of limestone, or soft/compressible ground due to the presence of alluvium) or the behaviour of natural slopes within the landscape (for example large-scale post-glacial slope instability).
- (ii) Man-made hazards, which are not related to the imposition of the road network on the landscape. Examples include hazards relating to mining and quarrying, or construction of landfill.
- (iii) Man-made hazards, which are related to the imposition of the road network on the landscape, for example over-steep slopes in earthworks.

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

3.9 Known mitigation measures shall be recorded. Examples of mitigation measures are slope drainage, capping of shafts or monitoring etc. Maintenance may be required to ensure the long-term performance of mitigation measures.

3.10 Hazards become defects as a result of triggers. Examples of triggers are severe weather events or defects related to other assets. Triggers shall be recorded against identified hazards or defects.

3.11 A prediction of the deterioration of the geotechnical asset should be made using the process in section 6, using Table 6-3 to derive Initial Feature Grades applied over specific time frames.

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

3.13 Detailed requirements for the GeoAMP are presented in Annex B.

4 ASSET DEFINITION

Geotechnical asset types

- 4.1 The geotechnical asset of the Overseeing Organisation is divided into the following asset types:
- (i) **minor earthworks**
 - (ii) **major earthworks**
- 4.2 Minor earthworks are those assets whose maximum vertical height within the longitudinal extent of the asset is less than 2.5m. Minor earthworks may comprise cuttings, embankments and at-grade sections.
- 4.3 Major earthworks are assets having a maximum vertical height within the longitudinal extent of the asset greater than or equal to 2.5m. If 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. Major earthworks may comprise cuttings, embankments and bunds.

The geotechnical asset Model

- 4.4 The geotechnical asset is modelled by linear lengths of network that usually follow the centreline of the carriageway. The network is not limited to the Overseeing Organisation's pavement network because assets may start or finish beyond that network, due to assets extending onto sections of road managed by another highway authority.

Longitudinal definition of a geotechnical asset

- 4.5 The longitudinal extents (i.e. the start and end locations along the road length) of a geotechnical asset are defined by:
- (i) points of zero height between geotechnical assets of different types (as defined below) or,
 - (ii) bridges and underpasses or,
 - (iii) service provider area boundaries or
 - (iv) significant changes in geology (as shown on the 1:50,000 BGS map, or observed) or
 - (v) significant changes in earthwork fill materials (as shown on as-built drawings, or observed).

Lateral definition of a geotechnical asset

- 4.6 The lateral extents of a geotechnical asset are defined by:
- (i) the centre line of the carriageway immediately adjacent to the asset and/or
 - (ii) the ownership boundary of the Overseeing Organisation, typically marked by a fence line.
- 4.7 A section of the Overseeing Organisation network will typically have two geotechnical assets associated with it, one to each side of the carriageway centre line. In some cases, geotechnical assets may lie between carriageways (e.g. split carriageways and slip roads).

WITTHDRAWN

5 INSPECTIONS

5.1 Inspection of a geotechnical asset has the following aims:

- (i) To observe and record the presence, location and type of geotechnical assets that fall within the responsibility of the service provider.
- (ii) To determine and record the key characteristics that describe each complete geotechnical asset; for example the geological material of which the asset is comprised, the geometry of the asset etc.
- (iii) To observe and record the characteristics that relate to the condition of the geotechnical asset at the time of inspection.
- (iv) To evaluate the geotechnical setting of the highway corridor within the landscape and the activities of adjacent landowners that may impact on the performance of the highway assets.

5.2 The length and number of geotechnical assets to be inspected may change for a number of reasons:

- (i) Acquisition of assets into the responsibility of the Overseeing Organisation, for example through adoption of a local authority road.
- (ii) Through the physical creation of new assets by construction of new road sections.
- (iii) 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).
- (iv) Removal of assets from the responsibility of the Overseeing Organisation due to changes in administrative arrangements (such as de-trunking).
- (v) Physical removal of the asset, such as in a junction re-modelling or similar.

Inspection types

5.3 Inspections types comprise the following:

- (i) Detailed or Principal Inspections – these are the main type of inspection, providing inventory and condition data.
- (ii) Monitoring Inspections – these are inspections undertaken as an intervention option to address risks posed by geotechnical assets.
- (iii) Emergency inspections – inspections undertaken in response to a Geotechnical Event.
- (iv) Inspections by non-geotechnical staff e.g. watchman inspections to recognise obvious geotechnical characteristics that are indicators of change.

5.4 Monitoring Inspections may be carried out as part of a schedule of Principal Inspections.

Inspection methods

- 5.5 Inspections of assets shall be carried out such that the required information can be obtained.
- 5.6 Principal Inspections shall be carried out when the surface of the asset is visible, i.e. when the ground profile is not obscured by vegetation.
- 5.7 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 (Refs 3 & 4). Subsequent inspection requirements shall be determined using a risk-based approach.
- 5.8 Inspections of major earthworks should normally be close visual inspections. Methods of inspection such as remote inspection techniques e.g. from vehicle, or detailed aerial or terrestrial photography or scanning may be applicable.

Observations made during inspections

- 5.9 During inspections of geotechnical assets, characteristics of the assets shall be recorded over part or all of the asset length. These characteristics are recorded as Observations.
- 5.10 Characteristics shall be recorded in a formalised and repeatable manner.
- 5.11 Changes in the condition of the asset relative to the previous inspection shall be recorded.
- 5.12 Geotechnical hazards that could impact the road network, including those that are visible outside of the occupancy boundary shall be recorded, for example adjacent development, landfill operations, quarrying etc.
- 5.13 Non-geotechnical characteristics should not be recorded (for example presence of other assets), unless they indicate the presence of a hazard to the geotechnical asset (e.g. blocked drainage).
- 5.14 Quantitative information on particular observations within an asset shall be collected during Monitoring Inspections.
- 5.15 Photographs should be taken and/or sketches drawn, where their presence would assist in the understanding of the condition of the asset.
- 5.16 All Observations made during an inspection shall be assessed in accordance with the methods set out in Section 6.
- 5.17 Where a feature is assessed to be a defect (see Section 6) the following information relating to the feature shall be recorded:
 - (i) at least one photograph,
 - (ii) an annotated sketch and
 - (iii) quantitative measurements.

Inspection frequency

- 5.18 The frequency of inspections shall be determined by the service provider using an assessment of risk posed by the asset to the road network, or other criteria as agreed with the Overseeing Organisation.
- 5.19 If insufficient information is available to undertake a risk assessment, or the Overseeing Organisation sets a specific frequency requirement, the stipulated requirement shall be the longest return frequency.
- 5.20 Risk assessments shall be carried out by the service provider. The results of the risk assessments and proposed inspection frequencies shall be agreed with the Overseeing Organisation. Guidance on the risk assessment process is provided in Annex A.
- 5.21 Principal Inspections of new assets shall be carried out as soon as practical after construction or transfer to the service provider.
- 5.22 The scheduled frequency of inspection shall be recorded against each asset in the asset management information system by the service provider.
- 5.23 It is recommended that inspection frequencies are generally set for a series of contiguous earthworks rather than isolated individual assets. This will simplify planning of inspections and limit the time required to be spent travelling between isolated parts of the network, interrupting the continuous asset inspection.

Geotechnical Events

- 5.24 A Geotechnical Event is a geotechnical defect that poses a threat to the safety of users, workers or other parties or critical assets, such that immediate action is to be taken. Examples include, but are not limited to:
- (i) 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 or,
 - (ii) subsidence of the carriageway due to collapse of a solution feature or mine shaft or
 - (iii) imminent subsidence of the carriageway due to scour of an embankment.
- 5.25 Immediate action following a Geotechnical Event may include one or more of the following:
- (i) temporary signing or traffic management,
 - (ii) temporary barriers,
 - (iii) debris clearance,
 - (iv) temporary support,
 - (v) Monitoring Inspections
- 5.26 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 Overseeing Organisation. The process is shown in Figure 1.
- 5.27 Where the service provider determines that a Geotechnical Event has not occurred and the issue relates to another asset, the relevant asset manager should be informed.

5.28 The service provider shall notify the Overseeing Organisation of the occurrence and details of a Geotechnical Event.

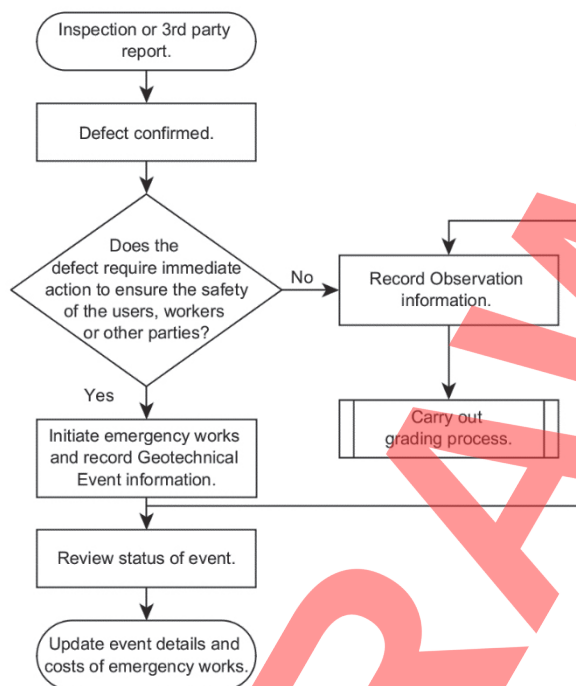


Figure 1 – Geotechnical Event Process

6 ASSESSMENT

Assessment and grading of features

- 6.1 Features are located observations within a geotechnical asset and recorded during an inspection that are assessed as requiring grading.
- 6.2 The grading of features provides an indicator of the relative condition of the asset at that point and is used for subsequent input into risk-based assessments, including inspections and interventions.
- 6.3 The service provider shall assess all observations and carry out grading when necessary.
- 6.4 The grading process requires two inputs: (i) Feature Class and (ii) Feature Location Index. The process for Feature Grade Assessment is shown in Figure 2 and is described below.
- 6.5 The service provider should seek the advice of the Overseeing Organisation for organisation-specific guidance on the inspection and grading of features.

Assessment of Feature Class

- 6.6 For each feature identified during an inspection of a geotechnical asset, the service provider shall assign a Feature Class, based on the definitions given in Table 6-1.
- 6.7 The examples provided in Table 6-1 are intended to provide a repeatable assessment, however there will be exceptions to the examples and engineering judgement should be applied when determining Classes. Reasons for allocating Feature Class should be recorded if justification's required.
- 6.8 The assessment of Feature Class must not consider the impact of the feature on the network or 3rd party property. It shall be confined to the size and type of feature only.

Class	Description of feature	Examples of features
Class 1 (visible defects)		
1A	Major defects.	<p>A slip greater than ½ height of a major earthwork.</p> <p>A rock fall involving large boulder-size* blocks of rock or greater than 1m³ volume of rock debris.</p>
1D	Minor defects.	Defects other than Major defects.
Class 2: (likely defects)		
2	<p>At Risk areas.</p> <p>Assessment may be based on available information (maps, historical reports, behaviour of similar assets, etc.) and or visual inspection.</p>	<p>An asset overlying an area of mining activity where no mitigation measures were carried out during construction or where mitigation measures have deteriorated.</p> <p>An area of sidelong natural or made ground subject to historical slope movement.</p> <p>Animal burrows.</p>

Class	Description of feature	Examples of features
Class 3: Areas of repair		
3	<p>At Risk Repaired areas.</p> <p>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.</p> <p>This class does not apply to areas that have been reinforced as part of a widening or improvement project.</p>	<p>Granular slope replacement of a failed cutting.</p> <p>Areas of remedial slope drains.</p> <p>Areas of remedial mine filling.</p> <p>Areas of remedial rock bolting.</p> <p>Areas of bio-engineering.</p>
<p>Notes:</p> <p>Class 1B and 1C as used in HD41/03 have been consolidated into Class 1A.</p> <p>Class 2A and 2B as used in HD41/03 have been consolidated into Class 2.</p> <p>Class 3A, 3B and 3C as used in HD41/03 have been consolidated into Classes 2 and 3.</p> <p>*Large boulder is particle of diameter greater than 600mm, approx.</p>		

Table 6-1 Classification of features

6.9 This classification system is to be applied to all features identified in all geotechnical asset types.

Assessment of Feature Location Index

6.10 The service provider must assign a Feature Location Index for each feature, based on the definitions given in Table 6-2 below:

Location Index	Assets affected
A	<p>Assets that ensure the safety of users, workers or other parties, or safeguard the environment.</p> <p>Overseeing Organisation assets: e.g. the running lanes or hard shoulder used as a running lane. Emergency refuge areas, vehicle restraint systems and motorway communications and structures etc.</p> <p>3rd party assets: e.g. adjacent safety-critical infrastructure or buildings, reservoirs or pylons etc.</p>
B	<p>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.</p> <p>Overseeing Organisation assets: e.g. hard shoulder or roadside, structures and communications etc.</p> <p>3rd party assets: e.g. adjacent non-safety-critical infrastructure or buildings etc.</p>
C	Land occupied by the Overseeing Organisation and adjacent to the carriageway but not A or B.
D	<p>Land occupied by the Overseeing Organisation and remote from the carriageway but not A or B.</p> <p>3rd party assets: e.g. adjacent soft estate.</p>

Table 6-2 Location Index of features

Assessment of Feature Grade

- 6.11 The service provider shall use the Feature Class and Feature Location Index to derive the HD41 Feature Grade as set out below and shown in the process map in Figure 2.
- 6.12 The service provider shall use the Feature Class and Feature Location Index of the feature observed or inferred at the time of inspection to derive the Initial Feature Grade Assessment using Table 6-3.

Initial Feature Grade Assessment				
Location Index	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

Table 6-3 Initial Feature Grade

- 6.13 The service provider shall then make an assessment of the potential deterioration of the feature (should no intervention be made) and shall estimate the Feature Class and Feature Location Index that the feature is likely to have in five years' time (or at a time interval agreed with the Overseeing Organisation).
- 6.14 The likely Feature Class and Feature Location Index shall be used in Table 6-4 below to derive the Subsequent Feature Grade.

Subsequent Feature Grade Assessment				
Location Index	Assessed 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

Table 6-4 Subsequent Feature Grade

- 6.15 The service provider shall record the higher value of the Initial and Subsequent Feature Grade as the HD41 Feature Grade. The HD41 Feature Grade shall be used to determine the immediate geotechnical intervention requirements.
- 6.16 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 6-3).

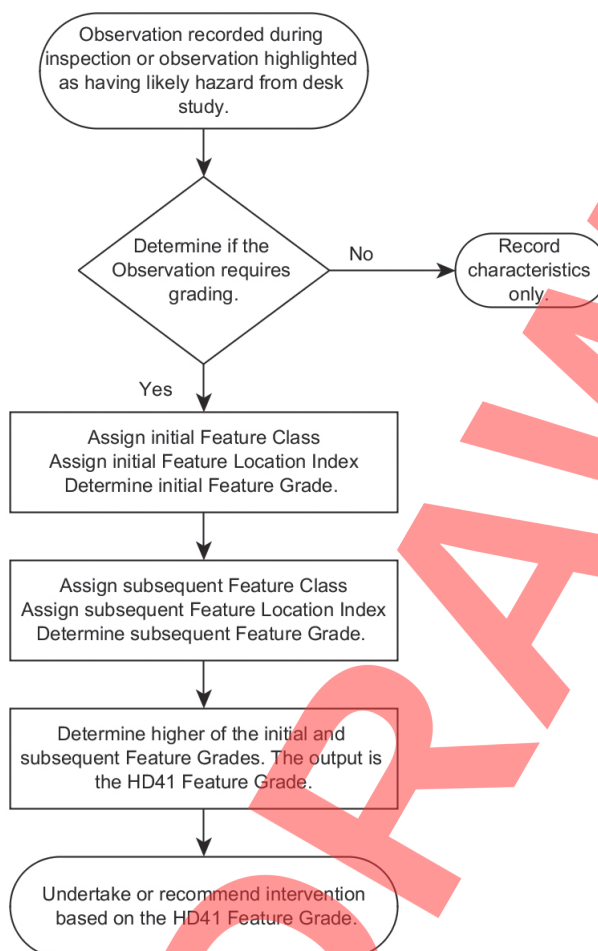


Figure 2 – Feature Grading Process to determine the requirement for immediate geotechnical interventions

7 GEOTECHNICAL INTERVENTION AND SCHEME PRIORITISATION

Geotechnical Intervention

- 7.1 The service provider shall determine and record the required geotechnical intervention using the HD41 Feature Grade determined from the process described above.
- 7.2 Table 7-1 provides suggested geotechnical interventions for each Feature Grade. The highest priority intervention will be on those observations having Feature Grade 5. The lowest priority (Feature Grade 1) may result in no further action, other than continued inspection. Engineering judgement should be used and integrated asset management considerations should be made to determine the actual intervention method.
- 7.3 The method of assessment has been designed to be as objective as possible, to enable the process to be repeated. The Feature Grade must not be amended to suit the intervention. The interventions given in Table 7-1 are for guidance only, variations from the recommended interventions can be made with supporting justification.

HD41 Feature Grade	Recommended Geotechnical intervention
5	Timely intervention to ensure safety should be undertaken. Remedial intervention should 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 should 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 may be programmed as part of other schemes.
2	Remedial intervention is not required, but preventative intervention may be required. Works do not need to be programmed and may be done as part of other schemes.
1	Remedial or preventative intervention is not required.

Notes:

- To be considered for all feature grades:
- Review Principal Inspection frequency and monitoring requirements.
 - Consider linkages to other programmed interventions to optimise traffic management and supervision.

Table 7-1 Recommended geotechnical interventions

- 7.4 Many interventions on the geotechnical asset will involve construction or maintenance of associated assets, particularly the drainage asset. The planning of geotechnical interventions should be undertaken with due consideration of such cross-asset issues, and efficiencies should be sought where works can be phased to be undertaken on various asset types at the same time (for example through reduction of traffic management costs).

Schemes

- 7.5 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.
- 7.6 Schemes shall be developed in accordance with the processes required by the Overseeing Organisation. The geotechnical management of schemes shall be in accordance with HD22 (Ref 2).

8 INFORMATION REQUIREMENTS

8.1 Information is required to be recorded to support the following elements of geotechnical asset management:

- (i) inspections,
- (ii) geotechnical asset (inventory),
- (iii) geotechnical asset (condition),
- (iv) Geotechnical Events,
- (v) schemes and
- (vi) documents and records.

8.2 Information details are defined in Annex C.

NOT FOR CONSTRUCTION

9 REFERENCES

Ref Number

Reference Details

Normative

- 1 ISO 55000:2014 Asset management — Overview, principles and terminology.
- 2 HD22/08: Managing Geotechnical Risk (DMRB 4.1.2)

Informative

- 3 Rock slope risk assessment (Report PPR554). Transport Research Laboratory, 2011.
- 4 Rock engineering guides to good proactive: rock slope remediation and maintenance works (Report PPR555). Transport Research Laboratory, 2011.

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ANNEX A – IMPLEMENTATION REQUIREMENTS AND GUIDANCE

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A-12. Implementation

A-12.1 This Annex shall be used by service providers to comply with geotechnical asset management processes specific to the relevant Overseeing Organisation. It also provides additional advice and background to the text in HD41.

A-12.2 The Overseeing Organisation is Highways England or its successor.

A-13. Layout of the annex

A-13.1 Where appropriate, the annex uses clause references (in parenthesis) to the main standard to make cross reference to the standard straightforward.

A-14. Organisation and Roles

A-14.1 (ref:cl. 2.4) Direct liaison between the Geotechnical Advisor and the Geotechnical Maintenance Liaison Engineer is encouraged. The Geotechnical Advisor should be able to impart considerable experience about past schemes and key hazards.

A-15. Geotechnical Asset Management Plan

A-15.1 (ref:cl. 3.0) Guidance for the preparation of the Geotechnical Asset Management Plan is provided in Annex B of the standard. The Overseeing Organisation provides a spreadsheet template for the tables. Searches and reports from the Overseeing Organisation's asset information system are also available to generate the data required for the tables. The service provider should liaise with the Geotechnical Advisor for the latest guidance.

A-15.2 (ref: cl. 3.6-3.10) Geotechnical Hazards

A-15.3 The sources of information used for the hazard assessment typically include the following:

- specific hazard maps,
- old maps,
- current maps (OS, BGS),
- spatial data sets,
- geotechnical asset information and
- geotechnical report records.

A-15.4 A list of some principal geotechnical hazards (or geohazards) which have the potential to affect highway geotechnical assets is presented below (Table A-1). The prevalence of some or all of these hazards may be appropriate for consideration in assessment of risk.

A-15.5 Some areas may have been subject to previous preventative or remedial measures. These areas should be assessed to determine the residual risk.

A-15.6 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.

A-15.7 Inspection frequencies and the factors influencing them should be reviewed on a regular basis such as annually prior to production of the GeoAMP.

Key Category	Sub-category	Geotechnical Event resulting from combination of hazard and trigger
Natural hazards	Dissolution features (inc cavities/voids) Note: The presence and hazard posed by natural cavities may not always be related to surface water 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 hazards (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)

Key Category	Sub-category	Geotechnical Event resulting from combination of hazard and trigger
Man-made hazards (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 may require suitable triggers to cause the events listed in Column 3. Triggers may include natural occurrences such as heavy rainfall, high winds or earthquakes

Table A-1 – Geotechnical hazard categories

A-16. Asset definition

A-16.1 (ref:cl. 4.1) The following terminology shall be used to describe the geotechnical asset for use by the Overseeing Organisation:

HD41 Term	Overseeing Organisation Term
Minor Earthwork	At-Grade
Major Earthwork	Cutting, Embankment or Bund

A-17. Inspections

A-17.1 (ref: cl. 5.18) The frequency of inspections should be based on assessment of the risk posed to the network, 3rd party assets, users, workers or others by deterioration of the asset. Typically the higher this 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 criticality of asset locations.

A-17.2 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.

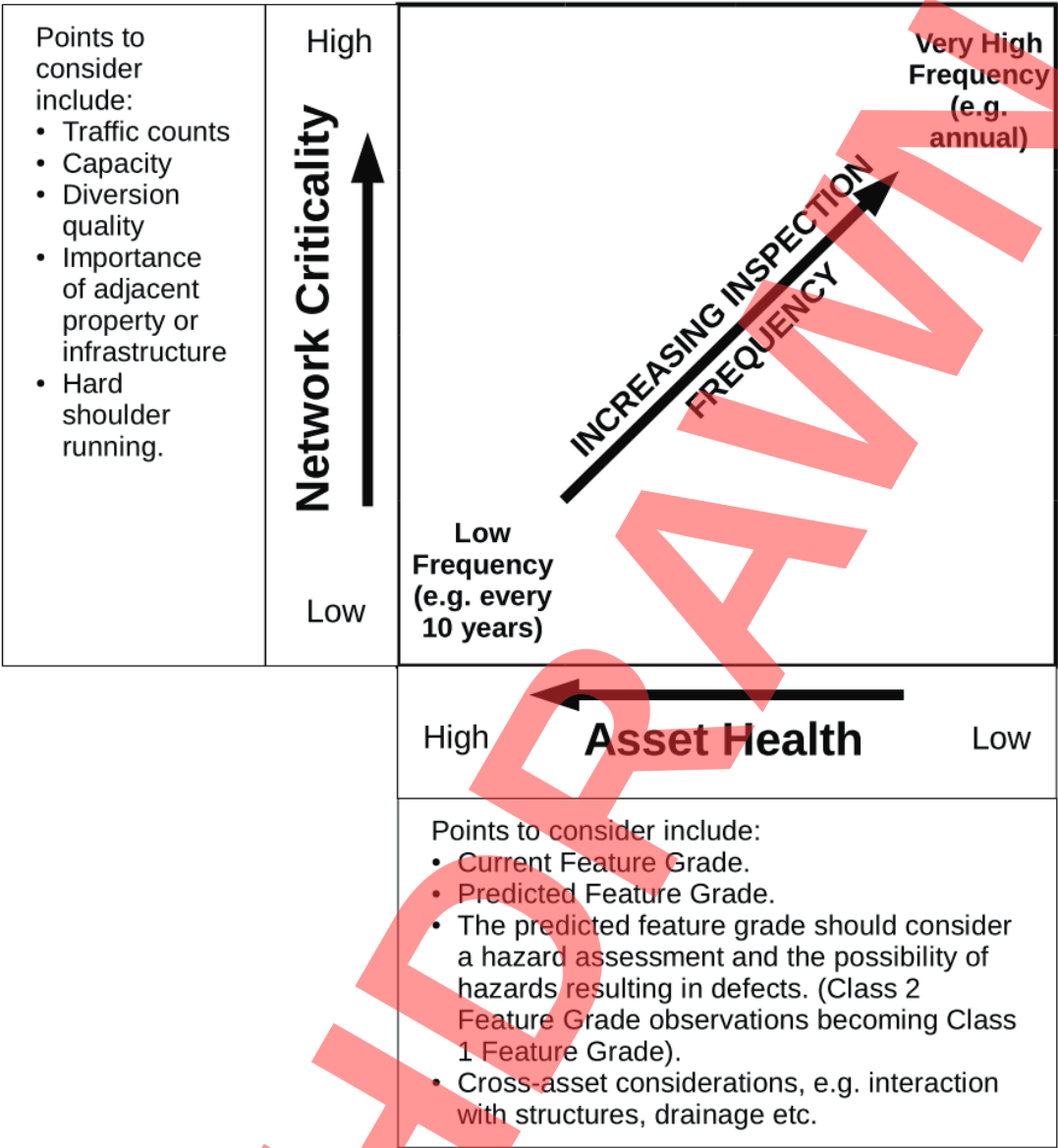


Figure A-1 – Example framework for the assessment of inspection frequency

- A-17.3** This framework considers the interaction of the health of the asset and the criticality of the network. The health of the asset can be determined from the current and predicted Feature Grade. The predicted Feature Grade considers the nature of the hazards and the likelihood of defects arising from the hazard. The criticality of the network should also be considered over time, e.g. the construction of Smart Motorway, major maintenance and renewals schemes.
- A-17.4** The process and framework for risk assessment is not mandated. The subject of risk assessment is a developing aspect of geotechnical asset management. Prior to carrying out a risk assessment the service provider should contact the Overseeing Organisation to determine the latest guidance.
- A-17.5** The following inspection frequencies should be used, dependent on the risk level:
- 6 to 10 year return frequency or,
 - 2 to 5 year return frequency or,

- 6 months to 1 year return frequency or
- Less than 6 months return frequency.

A-18. Example Principal Inspection Frequencies

A-18.1 The following paragraphs give examples of how suitable Principal Inspection frequencies might be assigned.

(i) 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 increased from a five year 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).

(ii) 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. Whilst 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).

(iii) 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. Whilst 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 decreased from a five year to an eight year interval. Maintenance of rock netting is recorded against specific assets and highlighted in the GeoAMP.

A-19. Monitoring Inspections

A-19.1 (ref cl.5.3ii) 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.

A-19.2 The collection and use of quantitative information is useful as evidence for scheme appraisal and as input into predictive modelling of asset deterioration.

A-20. Planning of Monitoring Inspections

A-20.1 It is important to be clear regarding what is being monitored and how and when that monitoring is being undertaken. Records should be kept of sites subject to monitoring, particularly including the details described below.

- What is being monitored, and how the monitoring is being carried out.
- How often monitoring is to be undertaken and at what times of year (for example, following winter storms).
- 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.
- Identified trigger levels and the actions to be undertaken if trigger levels are reached or exceeded (including emergency response procedures).
- What allowance there is for increased monitoring in times of increased risk (e.g. extreme weather events).
- What the communication routes are for reporting of monitoring results and which individuals are responsible for communication.

A-20.2 Initial recommendations of monitoring regimes for individual sites should be recorded through an entry in the asset information 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.

A-21. Monitoring Techniques

A-21.1 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 will depend 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:

- Visual inspection.

- Measurements between pegs installed at the surface.
- Direct measurements of features at fixed locations, e.g. tension crack width and length; backscarp height, or tilt of surfaces, safety furniture or structures.
- Photographic records taken of the same aspect on repeated occasions.
- Subsurface instrumentation including piezometers, inclinometers and extensometers. These may be automated or manually read.
- Remote sensing techniques such as LiDAR and high resolution aerial photography, including change detection analyses.
- Tell-tale instrumentation.

A-21.2 It is important that the techniques used allow data to be collected that will illustrate trends of deterioration where these are present. Readings should be repeatable and the accuracy and repeatability of instrumentation should be assessed. Careful consideration should be given to the installation of monitoring equipment; for example, inclinometers should be installed to sufficient depth to be anchored below likely failure surfaces and surface monitoring pegs should be sufficiently robust that they are not readily disturbed by wildlife.

A-22. Reporting of Monitoring

A-22.1 The GeoAMP will summarise all monitoring in place, or known to be commencing, at the time of preparation, however, as the GeoAMP is an annually submitted document, there may still be a need for additional monitoring reports to be submitted including the details described above. Reporting requirements for monitoring should also be agreed locally with the Overseeing Organisation.

A-23. Geotechnical Events

A-23.1 (ref: cl. 5.24) Geotechnical Events are defined as occurrences of geotechnical defects that pose a threat to the safety of users, workers or other parties such that immediate action is to be taken. Such immediate action is required to be taken to mitigate the defect's impact, through for example the installation of temporary safety barrier or implementation of traffic management. Geotechnical Events supersede and expand on the role of geotechnical maintenance forms in notifying the Overseeing Organisation of such occurrences.

A-23.2 A Geotechnical Event may need to be recorded as an incident to comply with contractual obligations.

A-23.3 A Geotechnical Event includes details of:

- Reporting of the event to and by the service provider
- Effects on the running of the carriageway, for example traffic management and closures
- Elements of highway infrastructure impacted by the event

A-23.4 Additionally, a status is allocated to a Geotechnical Event. This may be Imminent, Ongoing or Cleared. The majority of events will have an Ongoing or Cleared status. However it is recognised that in some cases emergency measures will be taken in the case of defects which have not yet impacted adversely on the network, but which are expected to in the imminent future. An example may be where a backscarp

is rapidly retreating towards the safety barrier during a period of wet weather and would be expected to undermine the barrier if the period of current weather conditions continues. The status would be required to be changed accordingly once the situation has either developed or stabilised.

A-23.5 The Geotechnical Event may also incur costs associated with activities such as:

- emergency works
- site investigation
- reporting, and
- construction of an eventual solution.

A-23.6 Assessment

A-23.7 (ref: Table 6-1) Class 2 Features are those assessed to be likely to deteriorate to a Feature Class 1 defect. This may be done as part of a desk study process when preparing the GeoAMP using a hazard assessment together with an understanding of triggers.

A-24. Deterioration Assessment

A-24.1 The following sources of information may be used to inform assessments:

- Infrastructure embankments, condition appraisal and remedial treatment (C592). CIRIA, 2003
- Infrastructure cuttings, condition appraisal and remedial treatment (C591). CIRIA, 2003
- Transport Research Laboratory publications,
- quantitative data obtained through regular monitoring inspections,
- slope stability modelling,
- national/international experience,
- locations prone to flood risk as determined from EA Flood Risk models and
- engineering judgement and local experience. Advice should be sought from the Overseeing Organisation.

A-24.2 Geotechnical Intervention and scheme prioritisation

A-24.3 (Ref: cl 7.5) Good quality (complete and accurate) geotechnical asset information obtained during Principal Inspections, and Monitoring Inspections is of key importance in the development of a forward programme of proposed geotechnical maintenance activities. Supporting evidence such as sketches and photographs are helpful to communicate the nature of the feature.

A-24.4 The objective data collected during Monitoring Inspections is especially useful to demonstrate deterioration and the requirement for intervention.

ANNEX B – GEOTECHNICAL ASSET MANAGEMENT PLAN – GUIDANCE

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B-1. Introduction

- B-1.1** The following document details the requirements for the Geotechnical Asset Management Plan (GeoAMP). Note that the GeoAMP was previously referred to as the ‘GAMP’. The change in acronym was introduced to remove possible confusion with the General Asbestos Management Plan (GAMP).

B-2. Implementation

- B-2.1** This Annex shall be used by service providers to comply with the GeoAMP requirements specific to the relevant Overseeing Organisation. It also provides additional advice and background to the text in HD41.
- B-2.2** The Overseeing Organisation is Highways England or its successor.

B-3. Document structure and confidentiality

- B-3.1** The GeoAMP has been divided into two parts in order to separate commercially sensitive information from the geotechnical asset reporting, assessment and planning of future management activities.
- B-3.2** 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.
- B-3.3** 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.
- B-3.4** Information included in Part Two of the GeoAMP, and in any associated spreadsheets will be treated as commercially sensitive and in confidence. It shall 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 shall have no access restrictions placed on it.
- B-3.5** Part 2 of the GeoAMP must be marked **OFFICIAL – SENSITIVE COMMERCIAL** in capital letters at the top and bottom of each page.

B-4. Document compilation

- B-4.1** Parts 1 and 2 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.
- B-4.2** 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.
- B-4.3** 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.
- B-4.4** Where tables are included in Part 2 of the GeoAMP they shall be consistent with the format of the tables and ordering of the information presented in Part 1.

- B-4.5** 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.
- B-5. Document submission**
- B-5.1** The metadata for GeoAMP Parts One and Two shall be recorded on the Overseeing Organisation's geotechnical records management system. Part One shall be issued to the Overseeing Organisation for upload onto the records management system. Part Two shall be issued to the Overseeing Organisation for storage on their internal records management system.

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GeoAMP Requirements: PART ONE

B-6. Suggested Contents

- **Summary**
- **Introduction**
- **Geotechnical setting**
- **Recent Activity and Developments**
- **Maintenance activity over the previous year**
 - Inspections and monitoring
 - Maintenance works
 - Other maintenance activity
- **Other geotechnical developments**
- **Asset data**
 - Asset data quality and currency
 - Asset data summary
- **Discussion of asset classification**
- **Risk based approach**
- **Hazards and triggers**
- **Potential impacts**
- **Risk Assessments**
- **Proposed programme**
- **Improving, replacing and building new assets**

B-7. Summary

- B-7.1** 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 i.e. landslides, flooding, subsidence.
- B-7.2** 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.
- B-7.3** Provide a summary table of Principal Inspections, Monitoring Inspections, studies, ground investigations, design input & construct works for the forthcoming 5 year period.

B-8. Introduction

- form of maintenance contract (with start and end dates),
- name of service provider,
- names of Managing Agent Geotechnical Liaison Engineer and Geotechnical Advisor,
- any changes to area boundaries and what affect the changes have on the number and type of assets.

B-9. Geotechnical setting

- topography,
 - hydrology,
 - geology,
 - geomorphological features,
 - key man-made ground related features and,
 - motorway and trunk road network.
- B-9.1** Highlight key features affecting or having the potential to affect the geotechnical asset. Whilst 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.
- B-9.2** Include suitable maps (min A3 size) presenting these features within an Appendix to the GeoAMP.
- ## **B-10. Recent activity and developments**
- B-10.1** Provide a brief summary description of geotechnical developments, maintenance activities and Geotechnical Events over the previous year.

B-11. Maintenance activity over the previous year

Inspections and monitoring

- B-11.1** Provide a list of inspections completed compared with those intended based on the previous GeoAMP. Route lengths inspected are to be quoted for comparison.
- B-11.2** Describe monitoring activities undertaken to assess the deterioration of identified defects or assets considered to be 'at risk'.

Maintenance works

- B-11.3** Provide details of works completed and the impact of the works to the network. The information required to be included is listed below.

Works completed – Part One:

- Year
 - Project or site title
 - Geotechnical defect IDs
 - Road, e.g. Motorway or All Purpose Trunk Road (APTR)
 - Type, e.g. Embankment or Cutting
 - Project Size, e.g. Small, Major, Hybrid etc.
 - Work type
 - Whether this was the principal work type.
 - Description of 'other' where selected as the work type
 - Approximate length of works (m)
 - Approximate vertical height of works / retained height (m)
 - Quantity of the standard unit for this work type
 - Comments including VM score if known.
- B-11.4** Renewals projects included in this table should be those which have geotechnical lead, or which are geotechnical elements of a 'hybrid' scheme. Major Projects must not be included. 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.
- B-11.5** Include a list of all geotechnical works completed in the current service provider's contract in an Appendix to the GeoAMP.

Other maintenance activity

B-11.6 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.

B-12. Other geotechnical developments

B-12.1 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:

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

B-13. Asset data

Asset data quality and currency

B-13.1 Tabulate by 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-13.2 below gives an example table layout. Fictional figures are used to illustrate the calculations used.

B-13.2 Comment on the tabulated data with respect to completeness of inspections, accuracy of data and ongoing utilisation of data.

Table B-13.2 – Summary of asset inspection approval currency

HD41 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%

B-13.3 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.

Asset data summary

B-13.4 Tabulate on a route by route basis total inspected geotechnical asset length as well as length of 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-13.4 below gives an example table layout and applicable notes. Fictional figures are used to illustrate the calculations used.

Table B-13.4 – Summary of asset by Feature Grade

Route ¹	Inspected length (km)	HD41 Feature Grade					Totals (km)
		1 (km)	2 (km)	3 (km)	4 (km)	5 (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	11.0
Route n	75	0	1.2	5.4	5.0	2.1	14.7
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 lists here, which may be a single road, or a combination of roads that form a route in the area.

B-13.5 Tabulate on a network basis the percentage change in Feature Grade 5, 4 and 3 features ideally over the last 5 years. This should aid the understanding of how preventative and remedial works are gradually improving the Feature Grade of the geotechnical asset. Also include a summary of the deterioration assessment feature grade, based on the five-year timeframe assessments of Initial Feature Grade. Table B-13.5 below gives an example table layout and applicable notes. Fictional figures are used to illustrate the calculations used.

Table B-13.5 – Summary of asset Feature Grade at Year ****

Feature Grade	Year 1 ¹		Year 2		Year 3		Change between last two years		Deterioration Assessment (Forecast Feature Grade) ³	
	Total length of Obs (km) ²	As % of inspected asset length (%)	Total length of Obs (km) ²	As % of inspected asset length (%)	Total length of Obs (km) ²	As % of inspected asset length (%)	Total length of Obs (km) ²	As % of inspected asset length (%)	Total length of Obs (km) ²	As % of inspected asset length (%)
5	4.4	0.88	4.3	0.86	3.8	0.76	-0.5	-0.1	4.1	0.82
4	6.5	1.3	6.2	1.24	5.8	1.16	-0.4	-0.08	6.1	1.22
3	58.6	11.72	59.6	11.92	62.1	12.42	2.5	0.5	64.3	12.86

Notes:

1. Enter financial years in here, e.g. 2013/2014 etc.
2. Previous years GeoAMPs can be used to obtain the historical figures
3. Use Initial Feature Grade matrix with the 5 year Feature Class and Feature Location Index to derive the Forecast Feature Grade

B-14. Discussion of asset classification

B-14.1 Include discussion of the asset data, including comments on:

- Any detrimental changes e.g. increase in the percentage of defects, and known or likely causes of these changes.
- Geographical areas of note, for example those with high concentrations of defects or notably low percentages of defects. Reasons for such concentrations where known.
- Interpretation of the At Risk and minor defect data, its accuracy and how this may possibly affect future inspection strategies. Basis for assignment of At Risk zones.

B-15. Risk based approach

B-15.1 Describe the risk based approach used in the development of the forward programmes of:

- inspections,
- monitoring and maintenance,
- scheme development.

B-15.2 Describe the methods used in the identification of hazards, triggers and potential impacts.

B-15.3 Set out the forward programme and describe how the risk-based approach has been used to derive the programme.

B-16. Hazards and triggers

B-16.1 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.

B-16.2 Compile a hazard map of the area if sufficient information is available. Make reference to any specific route studies previously completed.

B-16.3 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.

B-17. Potential impacts

B-17.1 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 route criticality, traffic flow, hard shoulder running etc. Include comments on:

- cross-asset impacts (for example impacts on pavement, cabling and drainage)
- lane closures

- diversions
- disruption to business
- requirements for traffic management, and
- safety implications.

B-18. Risk Assessments

B-18.1 Present the results of the risk assessments.

B-19. Proposed programme

B-19.1 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 from the Traffic Operations Programming Guide (TOPG).

- Programme of Principal Inspections and monitoring
- Programme of studies and ground investigations
- Programme of design activities
- Programme of construction activities.

B-19.2 Provide the programme of inspections for the forthcoming 5 years including details of route, year of inspection and earthwork length to be inspected. This information should be presented in a table.

B-19.3 Provide a summary table including the information listed below.

Principal Inspection and Monitoring Inspection programme – Part One:

- Financial Year
- Road name(s) or site name
- Type, e.g. Principal Inspection (Repeat), Monitoring Inspection
- Type Group, e.g. Inspection
- Number of man days required
- Approximate length (km)
- Comments.

B-19.4 Provide a plan of the area showing the locations of the inspections and monitoring for the forthcoming year.

B-20. Improving, replacing and building new assets

B-20.1 Provide a summary table of schemes to be undertaken in the next 5 years. The information required to be included is listed below.

- Year
- Scheme title
- Geotechnical defect ID's if known
- Road, e.g. Motorway or All Purpose Trunk Road (APTR)
- Type, e.g. Embankment or Cutting
- Project Size, e.g. Small, Major, Hybrid etc
- Proposed work type
- Whether this is the principal work type
- Approximate length of works (m)
- Approximate vertical height of works / retained height (m)
- Quantity of the standard unit for this work type
- Comments including prioritisation

GeoAMP Requirements: PART TWO

B-21. Suggested Contents

- Principal Inspections and Monitoring Inspections over the previous year
- Principal Inspections and Monitoring Inspections predicted for the next 5 years
- Maintenance and renewal activity over the previous year
- Maintenance and renewal activity predicted for the next 5 years
- Lessons learned / good practice

B-22. Principal Inspections and Monitoring Inspections over the previous year

B-22.1 Present a table of inspections completed in the last year. Include the information regarding outturn costs as listed below:

Principal Inspection and Monitoring Inspection programme – Part Two:

- Financial Year
- Road name(s) or site name
- Type, e.g. Principal Inspection (Repeat), Monitoring Inspection
- Type Group, e.g. Inspection
- Number of man days required
- Approximate length (km)
- Comments
- Costs excluding traffic management (£)
- Traffic management fixed cost (£)
- Traffic management unit cost (£/day)
- Traffic management duration (days)
- Calculated total traffic management cost (£)
- Total costs including traffic management (£)

B-23. Principal Inspections and Monitoring Inspections predicted for the next 5 years

B-23.1 Present a table of scheduled inspections for the next 5 years. Include the information regarding predicted costs as listed below:

Principal Inspection and Monitoring Inspection programme – Part Two:

- Financial Year
- Road name(s) or site name
- Type, e.g. Principal Inspection (Repeat), Monitoring Inspection
- Type Group, e.g. Inspection
- Number of man days required
- Approximate length (km)
- Comments
- Costs excluding traffic management (£)
- Traffic management fixed cost (£)
- Traffic management unit cost (£/day)
- Traffic management duration (days)
- Calculated total traffic management cost (£)
- Total costs including traffic management (£)

B-24. Maintenance and renewal activity over the previous year

B-24.1 Present a table of maintenance works completed in the last year. Include the information regarding outturn costs as listed below:

Works completed – Part Two:

- Year
- Project or site title
- Geotechnical defect IDs
- Road, e.g. Motorway or All Purpose Trunk Road (APTR)
- Type, e.g. Embankment or Cutting
- Project Size, e.g. Small, Major, Hybrid etc.
- Work type
- Whether this was the principal work type
- Approximate length of works (m)

- Approximate vertical height of works / retained height (m)
- Quantity of the standard unit for this work type
- Comments including VM score if known
- Non-construction cost if relevant (£)
- Mobilisation cost (£)
- Works cost (total meterage cost) (£)
- Calculated total construction cost (sum of mobilisation cost and works cost) (£)
- Calculated average unit cost (total construction cost divided by number of units) (£/m or £/m²)
- Traffic management fixed cost (£)
- Traffic management unit cost (£/day)
- Traffic management duration (days)
- Calculated total traffic management cost (£)
- Total cost of in year activity (£)
- Budgeted total cost of in year activity as presented in previous GAMP (£)
- Comments, including reasons for differences between budgeted and outturn costs.

B-25. Maintenance and renewal activity predicted for the next 5 years.

B-25.1 Present a table of maintenance activity predicted for the next 5 years. Include the information regarding predicted costs as listed below:

Works predicted – Part Two:

- Year
- Scheme title
- Geotechnical defect ID's if known
- Road, e.g. Motorway or All Purpose Trunk Road (APTR)
- Type, e.g. Embankment or Cutting
- Project Size, e.g. Small, Major, Hybrid etc.
- Proposed work type
- Whether this is the principal work type

- Approximate length of works (m)
- Approximate vertical height of works / retained height (m)
- Quantity of the standard unit for this work type
- Comments including prioritisation
- Estimated traffic management cost (£)
- Estimated construction cost (£)
- Estimated total cost
- Budgeted total cost as presented in previous GAMP (£)
- Comments

B-26. Lessons learned / good practice

- B-26.1** Include details of any aspects of data management, planning, inspection or maintenance 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.

ANNEX C – INFORMATION REQUIREMENTS

WITHDRAWN

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C-1. Implementation

This Annex shall be used by service providers to comply with the information requirements specific to the relevant Overseeing Organisation. It also provides additional advice and background to the text in HD41.

The following tables set out the information required to support the geotechnical asset management processes. These requirements form part of the asset management system.

The Overseeing Organisation is Highways England or its successor.

C-2. Inspection information

Information Group	Information Sub-Group	Information Description	Units	Valid Information	Example
Inspection	Inspection	Date	—	—	19/04/2015
Inspection	Inspection	Type	—	At Risk AutoGenerated Initial PI Monitoring Reactive Repeat PI	Initial PI
Inspection	Inspection	Proportion of asset visible for inspection.			
Inspection	Inspection	Remarks	—	—	Update of GAD Data to reflect repair of features.
Inspection	Inspection	Inspectors' initials	—	—	CMT/XB
Inspection	Inspection	Survey equipment	—	—	GARMIN GPS, 30 m Measuring Tape, Clinometer
Inspection	Inspection	Survey accuracy	Metre	—	15
Inspection	Inspection	Weather	—	Dry Wet	Dry
Inspection	Inspection	Action performed on observation or earthwork record at this inspection	—		1

C-3. Geotechnical asset information

Information Group	Information Sub-Group	Information Description	Units	Valid Information	Example
Earthwork	Workflow	Status	–	Approved Archived Preliminary	Approved
Earthwork	Workflow	Frequency of inspection			
Earthwork	Location	Area number	–		3
Earthwork	Location	Route name? Region name? May need to be added as separate fields?			
Earthwork	Location	Road number	–	Approved list of Roads	A1(M)
Earthwork	Document	Principal Inspection Form number (legacy field)	–	–	51
Earthwork	Location	Location description	–	–	J9 on slip
Earthwork	Location	Side of carriageway (facing direction of traffic)	–	Left Right	Right
Earthwork	Location	Link/section name	–	–	4/49 and 4/50
Earthwork	Location	Carriageway direction	–	A/W C/W E/B N/B S/B W/B	N/B
Earthwork	Inventory	Type	–	At Grade Bund back Bund front Cutting Embankment	Cutting
Earthwork	Inventory	Geology record based on observations?	–	Y/N	Y
Earthwork	Inventory	Geology record based on BGS map?	–	Y/N	N

Information Group	Information Sub-Group	Information Description	Units	Valid Information	Example
Earthwork	Inventory	Geology record based on new site investigation?	–	Y/N	N
Earthwork	Inventory	Geology record based on existing site investigation?	–	Y/N	Y
Earthwork	Inventory	Geology description	–	–	Light grey brown gravelly sand over brown sandy clay/very clayey sand
Earthwork	Inventory	In situ BGS geology code	–	Current BGS geology code list	LMBE
Earthwork	Inventory	Embankment/fill BGS geology code	–	Current BGS geology code list for fill	LMBE
Earthwork	Inventory	Calculated geology code	–	–	F_LMBE
Earthwork	Inventory	Year of construction	–	1900 – Present	2012
Earthwork	Inventory	Source of construction year	–	<p>Derived from Area 3 data set</p> <p>Derived from as-built drawing</p> <p>Derived from asset report</p> <p>Derived from CBRD Website</p> <p>Derived from historical report</p> <p>Derived from other sources</p> <p>Derived from roads information websites</p> <p>Derived from SEAMS/HAPMS data set</p> <p>Derived from SMIS data set</p>	Derived from SMIS data set

Information Group	Information Sub-Group	Information Description	Units	Valid Information	Example
Earthwork	Inventory	Quality of construction year record		No Age Data Available Proven Good quality Average Unconfirmed Unknown	Good quality
Earthwork	Inventory	Rock slope?	–	Y/N	N
Earthwork	Inventory	Anchors?	–	Y/N	Y
Earthwork	Inventory	Reinforced slope? This is intended for slopes reinforced by design, not in response to a failure			
Earthwork	Location	Start Location – chainage within earthwork	Metre	–	18.9995
Earthwork	Location	Start Location – recorded OS easting	–	–	542329.3866
Earthwork	Location	Start Location – recorded OS northing	–	–	305671.4784
Earthwork	Location	Start Location – reference point for non-GPS location	–	–	mp 3/8a
Earthwork	Location	Start Location – measured direction from reference point	–	A/W C/W E/B N/B S/B W/B	N/B
Earthwork	Location	Start Location – distance measured from reference point	Metre	–	109
Earthwork	Location	Start Location – measured chainage along road	Metre	–	235
Earthwork	Inventory	Start Location – slope angle (from horizontal)	Degree	–	23
Earthwork	Inventory	Start Location – slope length	Metre	–	18
Earthwork	Inventory	Start Location – slope height	Metre	–	10

Information Group	Information Sub-Group	Information Description	Units	Valid Information	Example
Earthwork	Inventory	Start Location – slope morphology factor	–	–	36
Earthwork	Inventory	Start Location – slope bearing	Degree North	–	110
Earthwork	Location	Start Location – carriageway type	–	L M R SOFF SON	SOFF
Earthwork	Location	End Location – chainage within earthwork	Metre	–	18.9995
Earthwork	Location	End Location – recorded OS easting	–	–	542329.3866
Earthwork	Location	End Location – recorded OS northing	–	–	305671.4784
Earthwork	Location	End Location – reference point for non-GPS location	–	–	mp 3/8a
Earthwork	Location	End Location – measured direction from reference point	–	A/W C/W E/B N/B S/B W/B	N/B
Earthwork	Location	End Location – distance measured from reference point	Metre	–	109
Earthwork	Location	End Location – measured chainage along road	Metre	–	235
Earthwork	Inventory	End Location – slope angle (from horizontal)	Degree	–	23
Earthwork	Inventory	End Location – slope length	Metre	–	86
Earthwork	Inventory	End Location – slope height	Metre	–	15
Earthwork	Inventory	End Location – slope morphology factor	–	–	36
Earthwork	Inventory	End Location – slope bearing	Degree North	–	110

Information Group	Information Sub-Group	Information Description	Units	Valid Information	Example
Earthwork	Location	End Location – carriageway type	–	L M R SOFF SON	SOFF

C-4. Observation information

Information Group	Information Sub-Group	Information Description	Units	Valid Information	Example
Observation	Workflow	Status	–	Approved Archived Preliminary Superseded	Preliminary
Observation	Inventory	Vegetation – bare ground	–	Extensive	Occasional
Observation	Inventory	Vegetation – grass	–	Moderate	Extensive
Observation	Inventory	Vegetation – brambles	–	None	Moderate
Observation	Inventory	Vegetation – shrubs	–	Occasional	Occasional
Observation	Inventory	Vegetation – trees	–	Large	Extensive
Observation	Inventory	Vegetation – shrub height	–	Medium	Large
Observation	Inventory	Vegetation – tree height	–	None	Small
Observation	Condition	Water feature – seepage?	–	Small	–
Observation	Condition	Water feature – marshy?	–	Y/–	–
Observation	Condition	Water feature – ponding?	–	Y/–	Y
Observation	Condition	Water feature – erosion?	–	Y/–	–
Observation	Condition	Water feature – hydrophilic vegetation?	–	Y/–	–
Observation	Condition	Water feature – high moisture content?	–	Y/–	–
Observation	Condition	Direct feature – slip?	–	Y/–	Y
Observation	Condition	Direct feature – slope bulge?	–	Y/–	Y
Observation	Condition	Direct feature – tension cracks?	–	Y/–	Y
Observation	Condition	Indirect feature – dislocated trees?	–	Y/–	–
Observation	Condition	Indirect feature – distorted structure?	–	Y/–	–
Observation	Condition	Direct feature – desiccation?	–	Y/–	–
Observation	Condition	Direct feature – terracing?	–	Y/–	Y
Observation	Condition	Direct feature – leachate?	–	Y/–	Y
Observation	Condition	Indirect feature – cracked pavement?	–	Y/–	Y

Information Group	Information Sub-Group	Information Description	Units	Valid Information	Example
Observation	Condition	Indirect feature – dislocated fence/barrier/kerb?	–	Y/–	–
Observation	Condition	Direct feature – toe debris?	–	Y/–	–
Observation	Condition	No risk feature – other?	–	Y/–	–
Observation	Condition	Direct feature – ravelling?	–	Y/–	–
Observation	Condition	Direct feature – wedge/block failure?	–	Y/–	Y
Observation	Condition	Direct feature – planar failure?	–	Y/–	–
Observation	Condition	Direct feature – subsidence?	–	Y/–	Y
Observation	Inventory	Temporary repair?			
Observation	Inventory	Drainage at top of slope	–	Culvert	Unlined Ditch
Observation	Inventory	Drainage on slope	–	French	Gravel
Observation	Inventory	Drainage at base of slope	–	Gravel Herringbone Kerb Lined Ditch None Pipe Reservation Transverse Unlined Ditch Watercourse	Kerb
Observation	Inventory	Reinforcement – geogrid?	–	Y/–	Y
Observation	Inventory	Reinforcement – steel mesh?	–	Y/–	–
Observation	Inventory	Reinforcement – interlocking blocks?	–	Y/–	–
Observation	Inventory	Reinforcement – geotextile?	–	Y/–	Y
Observation	Inventory	Reinforcement – gabions?	–	Y/–	Y
Observation	Condition	Reinforcement – defect?	–	Y/–	–
Observation	Inventory	Reinforcement – rock bolts?	–	Y/–	–
Observation	Inventory	Reinforcement – other?	–	Y/–	–
Observation	Inventory	Vertical extent of engineering support measures (as a proportion of asset height)			

Information Group	Information Sub-Group	Information Description	Units	Valid Information	Example
Observation	Condition	Evidence of distress or deterioration of engineered support measures			
Observation	Condition	Description	–	–	Vegetation – new trees / mossy
Observation	Condition	Class now	–	1A 1D 2 3	2
Observation	Condition	Location index now	–	A B C D	C
Observation	Condition	Drainage at top of slope defective?	–	Y/–	–
Observation	Condition	Drainage on slope defective?	–	Y/–	Y
Observation	Condition	Drainage at base of slope defective?	–	Y/–	Y
Observation	Condition	Feature grade now	–	1 2 3 4 5	3
Observation	Condition	Class 5 years	–	1A 1D 2 3	1D

Information Group	Information Sub-Group	Information Description	Units	Valid Information	Example
Observation	Condition	Location index 5 years	–	A B C D	C
Observation	Condition	Feature grade 5 years	–	1 2 3 4	2
Observation	Condition	Indirect feature – animal burrowing?	–	Y/–	Y
Observation	Inventory	Indirect feature – debris fence?	–	Y/–	–
Observation	Condition	Direct feature – poor backfilled excavation?	–	Y/–	–
Observation	Condition	Direct feature – unbackfilled excavation?	–	Y/–	Y
Observation	Inventory	Indirect feature – comms/cable trench?	–	Y/–	Y
Observation	Inventory	Indirect feature – landfill site in proximity?	–	Y/–	–
Observation	Inventory	Reinforcement – concrete retaining wall?	–	Y/–	–
Observation	Inventory	Reinforcement – block retaining wall?	–	Y/–	Y
Observation	Inventory	Reinforcement – crib wall?	–	Y/–	Y
Observation	Inventory	Reinforcement – granular replacement?	–	Y/–	–
Observation	Inventory	Reinforcement – rock fill?	–	Y/–	Y
Observation	Inventory	Reinforcement – sheet piles?	–	Y/–	–
Observation	Inventory	Reinforcement – soil nails?	–	Y/–	–
Observation	Inventory	Reinforcement – regrade?	–	Y/–	–
Observation	Location	Start Location – chainage within earthwork	Metre	–	18.9995
Observation	Location	Start Location – recorded OS easting	–	–	542329.3866
Observation	Location	Start Location – recorded OS northing	–	–	305671.4784

Information Group	Information Sub-Group	Information Description	Units	Valid Information	Example
Observation	Location	Start Location – reference point for non-GPS location	–	–	mp 3/8a
Observation	Location	Start Location – measured direction from reference point	–	A/W C/W E/B N/B S/B W/B	N/B
Observation	Location	Start Location – distance measured from reference point	Metre	–	109
Observation	Location	Start Location – measured chainage along road	Metre	–	235
Observation	Inventory	Start Location – slope angle (from horizontal)	Degree	–	23
Observation	Inventory	Start Location – slope length	Metre	–	18
Observation	Inventory	Start Location – slope height	Metre	–	10
Observation	Inventory	Start Location – slope morphology factor	–	–	36
Observation	Inventory	Start Location – slope bearing	Degree North	–	110
Observation	Location	Start Location – carriageway type	–	L M R SOFF SON	SON
Observation	Location	End Location – chainage within earthwork	Metre	–	18.9995
Observation	Location	End Location – recorded OS easting	–	–	542329.3866
Observation	Location	End Location – recorded OS northing	–	–	305671.4784
Observation	Location	End Location – reference point for non-GPS location	–	–	mp 3/8a

Information Group	Information Sub-Group	Information Description	Units	Valid Information	Example
Observation	Location	End Location – measured direction from reference point	–	A/W C/W E/B N/B S/B W/B	N/B
Observation	Location	End Location – distance measured from reference point	Metre	–	109
Observation	Location	End Location – measured chainage along road	Metre	–	235
Observation	Inventory	End Location – slope angle (from horizontal)	Degree	–	23
Observation	Inventory	End Location – slope length	Metre	–	86
Observation	Inventory	End Location – slope height	Metre	–	15
Observation	Inventory	End Location – slope morphology factor	–	–	36
Observation	Inventory	End Location – slope bearing	Degree North	–	110
Observation	Location	End Location – carriageway type	–	L M R SOFF SON	SOFF

Information Group	Information Sub-Group	Information Description	Units	Valid Information	Example
Observation feature	Condition	Type	–	Animal Burrows Comms/Cable Trench Cracked Pavement Desiccation Disloc Fence/Barrier/Kerb Dislocated Trees Distorted Structure Erosion High MC Hydro Vegetation Leachate Marshy Other Planar Failure Ponding Poor Backfilled Excavation Ravelling Seepage Slip Slope Bulge Subsidence Tension Cracks	Animal Burrows
Observation feature	Condition	Volume of failed material	Metre cubed	–	25
Observation feature	Condition	Size of block (length x breadth x depth)	Metre cubed	–	23

Information Group	Information Sub-Group	Information Description	Units	Valid Information	Example
Observation feature	Condition	Length	Metre	–	40
Observation feature	Condition	Breadth	Metre	–	34
Observation feature	Condition	Depth	Metre	–	6.874
Observation feature	Condition	Density	(no. per m2)	–	4
Observation feature	Condition	Horizontal misalignment	Metre	–	1.867
Observation feature	Condition	Vertical misalignment	Metre	–	0
Observation feature	Condition	Angular distortion	Degrees	–	30
Observation feature	Condition	Flow rate	Litres/min	–	0.05
Observation feature	Condition	Min distance to running lane	Metre	–	12.5
Observation feature	Condition	Min distance to comms cable	Metre	–	5
Observation feature	Condition	Min distance to hard shoulder	Metre	–	6
Observation feature	Condition	Min distance to inhabited builds	Metre	–	89
Observation feature	Condition	Min distance to safety barrier	Metre	–	5.3
Observation feature	Condition	Min distance to non-inhab builds	Metre	–	4
Observation feature	Condition	Min distance to comms cabinet	Metre	–	4
Observation feature	Condition	Min distance to structure	Metre	–	11
Observation feature	Condition	Min distance to drainage	Metre	–	76
Observation feature	Condition	Min distance to pylon	Metre	–	2.3
Observation feature	Condition	Min distance to other	Metre	–	1.5
Observation feature	Condition	Min distance to boundary	Metre	–	10
Observation feature	Condition	Description of 'other'	–	–	From crest of slope

Information Group	Information Sub-Group	Information Description	Units	Valid Information	Example
Observation feature	Condition	Comment	–	–	Comprises two failures. 1st failure 5m length, 2nd failure 9m length.

C-5. Geotechnical Event information

Information Group	Information Sub-Group	Information Description	Units	Valid Information	Example
Geotechnical Event	Workflow	Date of event reported			
Geotechnical Event	Workflow	Time of event reported			
Geotechnical Event	Workflow	Location of event			
Geotechnical Event	Workflow	Type of geotechnical incident			
Geotechnical Event	Workflow	Type of geotechnical defect	-	Shallow soil slope failure Deep soil slope failure Rock slope failure (toppling) Rock slope failure (planar) Rock slope failure (wedge) Rock slope failure (ravelling) Mixed (soil/rock) slope failure Reinforced slope failure Failure of debris retention (e.g. rock netting) Debris flow/washout failure Subsidence	
Geotechnical Event	Workflow	Date of event / defect made safe			
Geotechnical Event	Workflow	Time of event / defect made safe			
Geotechnical Event	Workflow	Who reported the event?			

Information Group	Information Sub-Group	Information Description	Units	Valid Information	Example
Geotechnical Event	Workflow	Who was the event first reported too?			
Geotechnical Event	Workflow	Brief description of the event			
Geotechnical Event	Workflow	Maximum effect of the event on the running of the OO road network		None Hard shoulder only Congestion only Partial closure Total closure	
Geotechnical Event	Workflow	Total AADT of the road affected by the event			
Geotechnical Event	Workflow	HGV % value of the road affected by the event			
Geotechnical Event	Workflow	Length of carriageway directly affected by the event			
Geotechnical Event	Workflow	Length of temporary traffic management put in place to address the event			
Geotechnical Event	Workflow	How does the event impact others		Affecting carriageway Affecting OO estate (within boundary) Affecting 3rd party land/property Affecting communications Affecting signage Affecting drainage Affecting structures Affecting safety barrier/equipment Other impact (i.e. not listed above)	

Information Group	Information Sub-Group	Information Description	Units	Valid Information	Example
Geotechnical Event	Workflow	Where 'Other impact' is chosen, describe the impact			
Geotechnical Event	Workflow	What is the likely cause of the event		<p>Oversteepened slope</p> <p>Blocked drainage</p> <p>Exceptional rainfall</p> <p>Inadequate maintenance</p> <p>Utility failure</p> <p>Lack of vegetation</p> <p>Poorly backfilled excavation</p> <p>Non-backfilled excavation</p> <p>Animal burrowing</p> <p>Inadequate drainage</p> <p>Poor construction</p> <p>Unknown</p> <p>Other cause (i.e. not listed above)</p>	
Geotechnical Event	Workflow	Where 'Other cause' is chosen, describe the impact			

Information Group	Information Sub-Group	Information Description	Units	Valid Information	Example
Geotechnical Event	Workflow	<p>Assess total cost due to the incident, which may include several components:</p> <p>Costs of emergency works</p> <p>Investigation and design costs for emergency remedial works</p> <p>Cost of emergency remedial works</p> <p>Costs of monitoring</p> <p>Traffic management costs (during the extent of the incident and any subsequent works)</p>			
Geotechnical Event	Workflow	Provide a linked reference to details of any project being undertaken to address the event			
Geotechnical Event	Workflow	RMMS inspection ID(s)			
Geotechnical Event	Workflow	RMMS defect ID(s)			
Geotechnical Event	Workflow	RMMS defect type category		<p>1</p> <p>2.1</p> <p>2.2</p>	

C-6. Scheme information					
Information Group	Information Sub-Group	Information Description	Units	Valid Information	Example
Project Information	Workflow	Project Reference			
Project Information	Workflow	Project Title			
Project Information	Workflow	Project Type		Dualling scheme Highway Improvement Scheme Local network management scheme New structure scheme Structure replacement scheme	
Project Information	Workflow	Area/DBFO/Region number	—	Use an approved OO Area from the available Pick List	
Project Information	Workflow	Client's representative			
Project Information	Workflow	Contractor			
Project Information	Workflow	Contractor's designer			
Project Information	Workflow	Start date			
Project Information	Workflow	Planned finish date			
Project Information	Workflow	Actual finish date			
Project Information	Workflow	Keywords			
Project Information	Workflow	General remarks			
Project Information	Workflow	Linked reports			
Project Information	Workflow	Linked boreholes			
Project Information	Workflow	Linked drawing sets			

Information Group	Information Sub-Group	Information Description	Units	Valid Information	Example
Project Information	Workflow	Linked located files			
Project Information	Workflow	Linked Geotechnical Events			
Project Information	Workflow	Linked observations			
Project Information	Workflow	Linked roads			
Project Information	Workflow	Contact details			

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