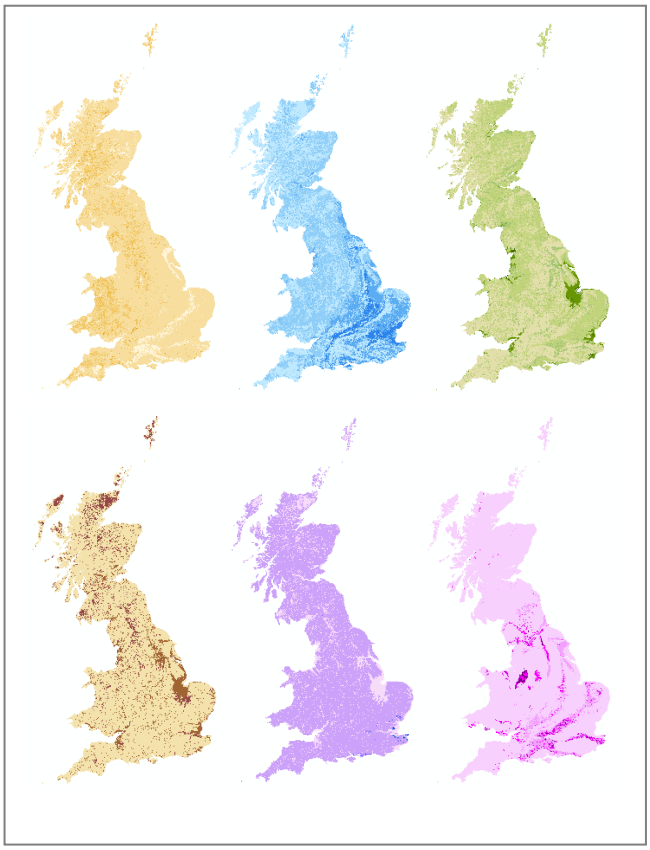
British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

User Guide for the British Geological Survey GeoSure dataset: Version 8

Report OR/17/050



BRITISH GEOLOGICAL SURVEY

OPEN REPORT OR/17/050

User Guide for the British Geological Survey GeoSure dataset: Version 8

Contributor/editor

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GeoSure 6 layers.

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BRITISH GEOLOGICAL SURVEY

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The British Geological Survey is a component body of the Natural Environment Research Council.

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Summary

This report describes the national scale Natural Ground Stability (GeoSure) dataset. The methods used to create the dataset have been critically assessed and its fitness for purpose determined by specialists in BGS.

This document outlines the background to why the dataset was created, its potential uses and gives a brief description of each of the 6 component layers. Technical information regarding the GIS and how the data was created is described and advice is provided on using the dataset.

Acknowledgements

A number of individuals in the GeoAnalytics & Modelling and Engineering Directorates have contributed to the project and helped compile this report. This assistance has been received at all stages of the study. In addition to the collection and processing of data, many individuals have freely given their advice, and provided the local knowledge. The authors would like to specifically acknowledge the following for their input and development of the GeoSure methodologies for this version 8 release: Claire Dashwood, Dave Entwisle, Lee Jones, and Andy Farrant.

1 Introduction

Founded in 1835, the British Geological Survey (BGS) is the world's oldest national geological survey and the United Kingdom's premier centre for earth science information and expertise. The BGS provides expert services and impartial advice in all areas of geoscience. Our client base is drawn from the public and private sectors both in the UK and internationally.

Our innovative digital data products aim to help describe the ground surface and what's beneath across the whole of Great Britain. These digital products are based on the outputs of the BGS survey and research programmes and our substantial national data holdings. This data coupled with our in-house Geoscientific knowledge are combined to provide products relevant to a wide range of users in central and local government, insurance and housing industry, engineering and environmental business, and the British public.

The GeoSure dataset comprises six different Geographical Information System (GIS) layers, with each layer representing a different natural ground stability hazard that occurs in Great Britain. The GeoSure datasets are polygon (area) layers, which are described using a simple A to E potential hazard classification (A = Low, E = High).

This document provides information for users on the six ground stability hazard layers, together forming the GeoSure Natural Ground Stability dataset.

Further information on all the digital data provided by the BGS can be found on our website at http://www.bgs.ac.uk/data/digitaldata/digitaldata.cfm or by contacting:

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2 About the GeoSure Dataset

2.1 BACKGROUND

Public understanding of the effect of ground conditions on the safety of their property and the implication for the value of their property is growing. Local councils are under increasing pressure from central government to provide environmental information. Information about geological hazards is needed, in particular, the identification of areas with a potential for ground movement.

In response to this, The British Geological Survey initiated a development programme to produce datasets that identified and assessed potential geohazards threatening the human environment in Great Britain. Along with the GeoSure ground stability datasets, the programme also generated:

- Superficial Deposit Thickness Model
- Scans of onshore borehole logs for Great Britain
- Scans of geology and historic topography maps
- Ground permeability data

- Susceptibility to groundwater flooding data
- Geological indicators of past flooding data
- Environmental sensitivity data
- GIS data identifying potential radon hazard
- Soil Parent Material Model
- Non-coal mining hazards data

2.2 WHO MIGHT REQUIRE THIS DATA?

Natural ground stability hazards may lead to financial loss for anyone involved in the ownership or management of property, including developers, householders or local government. These costs could include increased insurance premiums, depressed house prices and, in some cases, engineering works to stabilise land or property. Armed with knowledge about potential hazards, preventative steps can be put in place to alleviate the impact of the hazard to people and property. The cost of such prevention may be very low, and is often many times lower than the repair bill following ground movement.

The identification of ground instability and other geological hazards can assist regional planners; rapidly identifying areas with potential problems and aid local government offices in making development plans by helping to define land suited to different uses. Other users of these data may include developers, homeowners, solicitors, loss adjusters, the insurance industry, architects and surveyors.

2.3 WHAT THE DATASET SHOWS?

GeoSure ground stability data consists of six data layers in Geographical Information System (GIS) format that identify areas of potential hazard in Great Britain. It is essentially a national hazard susceptibility map. These data have been produced by geologists, geotechnical specialists and information developers at the British Geological Survey and are presented as separate GIS data layers relating to the cause of the geohazard. These are explained in brief below:

Shrink-Swell

Swelling clays can change volume due to variation in water content, this can cause ground movement, particularly in the upper two metres of the ground that may affect many foundations. Ground moisture variations may be related to a number of factors, including weather variations, vegetation effects (particularly growth or removal of trees) and the activities of people. Such changes can affect building foundations, pipes or services.

Landslides (Slope Instability)

Slope instability occurs when particular slope characteristics (such as geology, gradient, sources of water, drainage, or the actions of people) combine to make the slope unstable. Downslope movement of materials, such as a landslide or rockfall may cause damage, such as a loss of support to foundations or services or, in rare cases, impact damage to buildings.

Soluble Rocks (dissolution)

Ground dissolution occurs when certain types of rocks, containing layers of soluble material, get wet and the soluble material dissolves. This can cause underground cavities to develop. These cavities reduce support to the ground above and can lead to a collapse of overlying rocks.

Compressible Ground

Some types of ground may contain layers of very weak materials like peat or some clays. These may compress if loaded by overlying structures, or if the groundwater level changes. This compression may result in depression of the ground surface, potentially disturbing foundations and services.

Collapsible Deposits

Some soils may collapse when a load (such as a building or road traffic) is placed on them, especially if they become saturated. Such collapse may cause damage to overlying property or services.

Running Sand

Some rocks and soils can contain loosely packed sandy layers that can become fluidised by water flowing through them. Such sands can 'run' (flow), potentially removing support from overlying buildings and causing damage.

3 Technical Information

3.1 DEFINITIONS

Hazard: A potentially damaging event or phenomenon.

Risk: The impact of the hazard on people, property or capital.

For example, a shrinkable clay could be perceived as a hazard, but the likelihood of it causing structural damage would be the risk. A high hazard rating (e.g. "E") does not necessarily translate to a high risk. For example, if a particular location has a relatively high ground stability hazard, but the properties that are built there have taken this into account, and are designed to withstand the hazard, they will not have a comparable level of risk. This is because the likelihood of the hazard causing any loss has been reduced due to the design of the property.

GeoSure does not identify the cost of a hazard being realised, and therefore does not consider risk. GeoSure only examines the conditions that leave an area exposed to a hazard.

3.2 SCALE

The GeoSure natural ground stability dataset is produced for use at 1:50 000 scale providing 50 m ground resolution.

3.3 FIELD DESCRIPTIONS

Table 1 Attribute table field descriptions

Field name	Field description
CLASS	Classification of hazard on a scale of A - E
LEGEND	Description of the hazard
VERSION	Dataset name and version number

Full class descriptions as they appear in the dataset are shown in Appendix 1.

3.4 CREATION OF THE DATASET

Each natural ground stability hazard GIS layer is rated on an A – E classification (representing increasing hazard). For each layer, a brief description of the hazard is provided for each hazard level. These descriptions are shown in Appendix 1.

To produce the GeoSure natural ground stability data layers, the assessment of hazard is made by:

- identifying the factors that are involved in creating the hazard
- assessing which are thought to be present at each location
- assessing how significant they are thought to be at each location

The factors are then combined to estimate the level of hazard. The level of potential hazard does not mean that a damaging event is going to happen but is an indication of how many causative factors may be present and how severe they are thought to be. For example, in the case of the potential for slope instability, the factors are: -

- The type of rock forming the slope
- The gradient of the slope
- The water level in the slope

As an illustration, consider a rock type, clay, which is known to be associated with landslides in some parts of Britain. Figure 1 illustrates the hazard rating given if this rock type was present on a slope with a very gentle gradient. The resultant hazard rating remains very low (B).

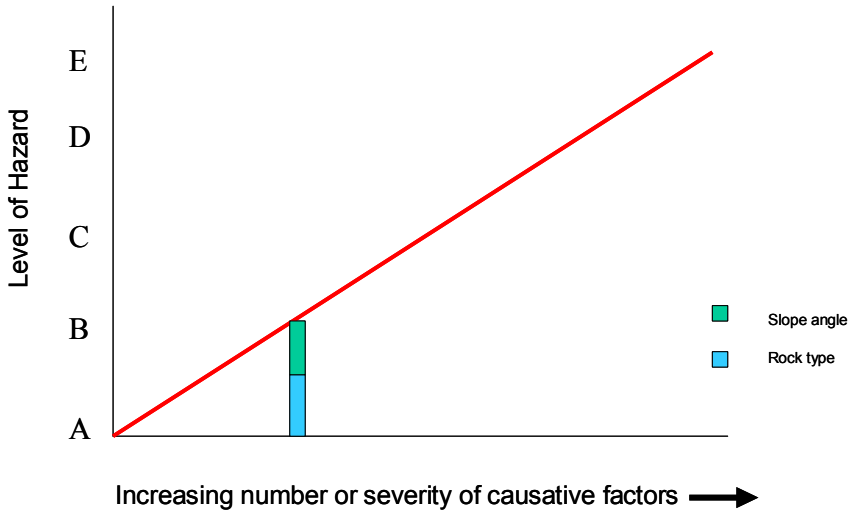

Figure 1: Rock type and slope angle are not significantly increasing landslide hazard.

Figure 2 illustrates the scenario if the gradient of the slope was steeper and the potential for slope instability is greater. The contribution to the hazard rating by slope gradient is increased, leading to a higher hazard rating.

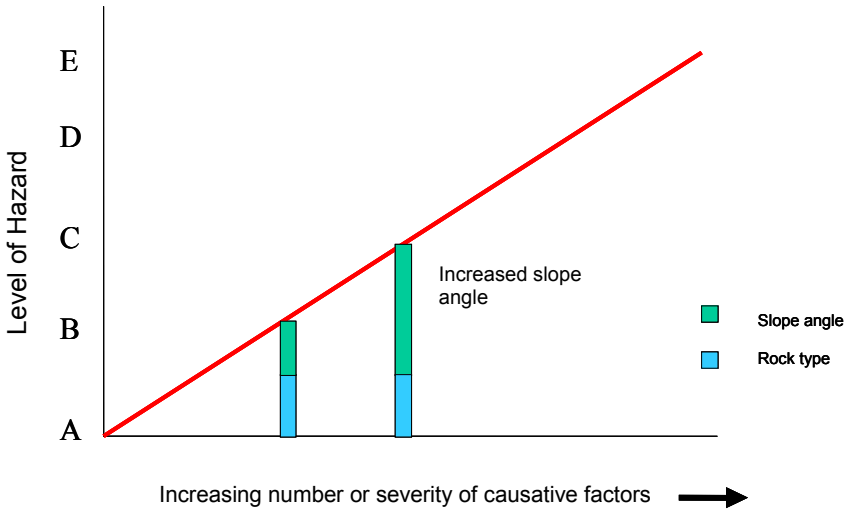

Figure 2: Slope angle is greater resulting in hazard level C.

Figure 3 illustrates a further scenario, where, in another area, the same clay rocks and the same gradient as shown in Figure 2 are present, but, the presence of water makes the hazard potential greater, raising the hazard potential to a level D. This may occur, for example, in locations where the rocks present are also known to be susceptible to soaking up water during a wet winter or severe rainfall event (something which is known to weaken rocks).

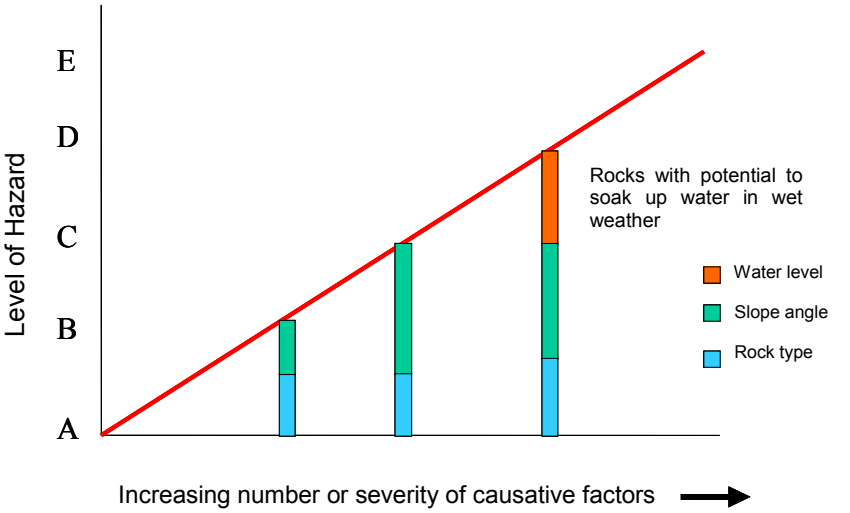

Figure 3: Rise in potential hazard level to D due to the presence of rocks which may be susceptible to soaking up water.

If an area is classed as level D for slope instability hazard, this means it is a state such that a relatively small change in conditions might cause a ground movement to take place. Any of the factors could become more significant. The material of the slope may weaken due to weathering, the slope may be steepened by undercutting or more water may soak into the rocks. It is also possible that another factor might add to the three that are present. In some countries an earthquake might add the final factor leading to failure. In Britain, it is more likely that one of the existing factors will increase such as an increase in the amount of water present due to continued wet weather, or even a leaking drain (Figure 4).

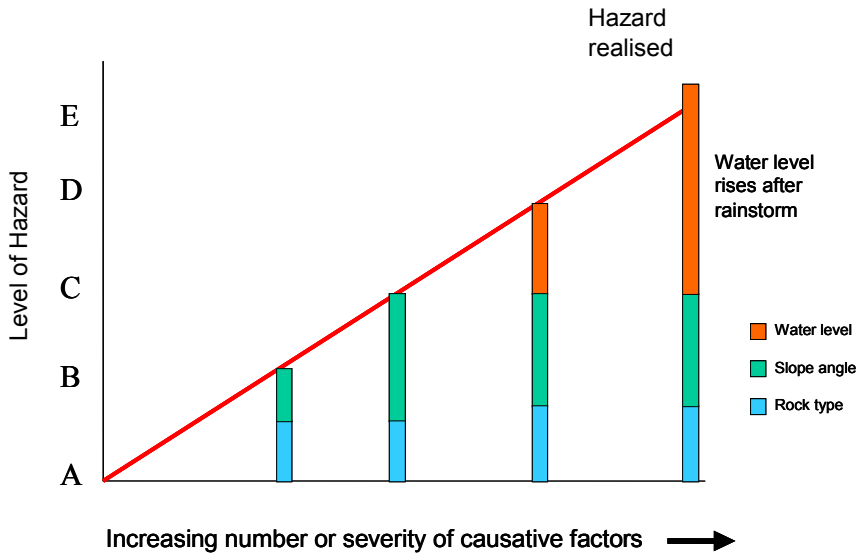

Figure 4: Causative factor are of sufficient number and severity to cause hazard to occur.

Thus the hazard assessment method can be used to indicate how vulnerable areas are to experiencing hazard events and of how frequently these hazard events might be expected to occur.

Use of this data can help manage land to best advantage, safely and with the lower likelihood of financial loss.

3.5 DATASET HISTORY

BGS is continually surveying and resurveying areas of Britain, improving and updating the geological maps. These updates are made to the BGS Geology 50k dataset regularly. As GeoSure is based upon the most up to date information available, each new version of BGS Geology 50k prompts a new version of GeoSure. Appendix 3 shows the updates between version 7 and 8 which have been incorporated into GeoSure V8. BGS is committed to improving GeoSure as more information becomes available. Additional enhancements are made to the datasets for each new version. Below is an outline of the data history of GeoSure.

Version 1 (released 2004): Derived from DiGMapGB-50 version 1.

Version 2 (released 2005): Derived from DiGMapGB-50 version 2, incorporating superficial thickness data and enhancements to understanding the behaviour of some glacial deposits.

Version 3 (released 2006): Derived from DiGMapGB-50 version 3, incorporating enhancements in quaternary mapping of localised areas in England and Wales, and large areas of Scotland. Each data layer is also rectified to align with British National Grid origin. Date of release changed to January.

Version 4 (released 2008): New 1:50 000 and higher geological mapping in 21 areas. Improvement of the NEXTMap™ DTM in areas of tree cover throughout GB. Higher resolution Superficial thickness model used throughout GB.

Version 5 (released 2009): New 1:50 000 geological mapping in 14 areas. Fully revised Dissolution methodology. Geologist interpreted superficial thickness model included.

Version 6 (released 2011): New 1:50 000 geological mapping in 18 areas. Fully revised and geologist interpreted collapsible ground methodology. Updated Superficial Thickness Model

version 5 included. Methodologies for all layers now scripted and vector data is utilised all the way through the creation process.

Version 7 (released 2014): New 1:50 000 geological mapping in 20 areas plus minor changes across England, Scotland and Wales. New information incorporated into the shrink-swell layer as a result of research and modelling of lithological variations in the London Clay. Partially revised methodology for the Slope Stability (Landslides) layer incorporating additional information from the DiGMapGB-50 mass movement layer.

Version 8 (released 2018): New 1:50 000 geological mapping in 18 areas as well as data refinement associated with coastal areas and miscellaneous corrections to features across the country. Partially revised methodology for the Slope Stability (Landslides) layer incorporating new information on Quaternary Till deposits.

3.6 COVERAGE

Data is provided to identify each of the six natural geohazards in Great Britain. Each data layer is shown in figure 5 and the scale of coverage is provided in appendix 2.

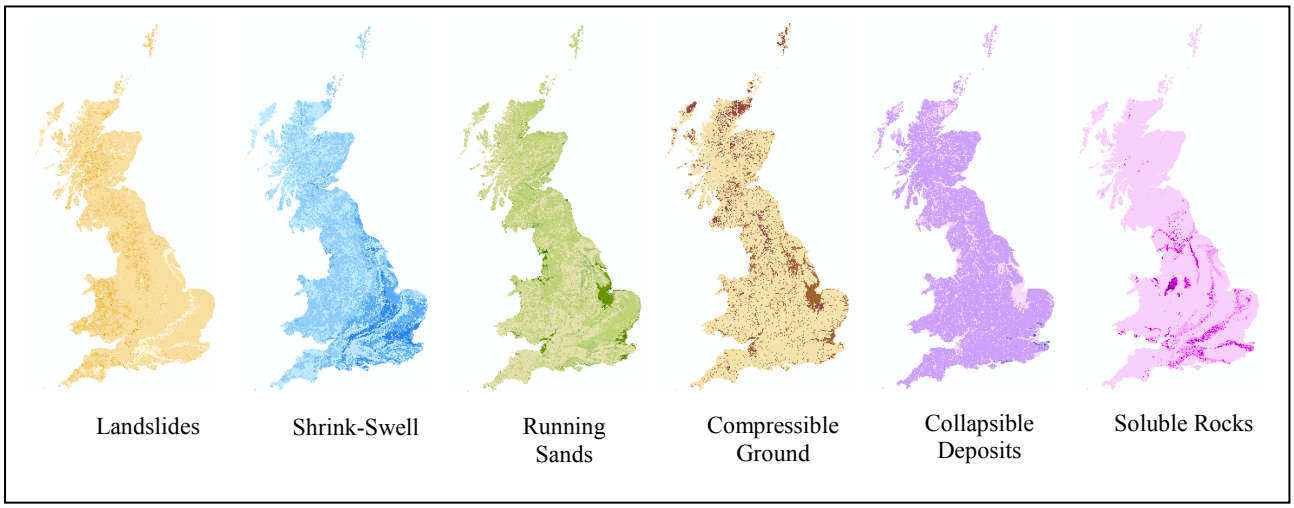

Figure 5: The coverage of the GeoSure dataset.

3.7 DATA FORMAT

The GeoSure natural ground stability dataset has been created as vector polygons and are available in a range of GIS formats, including ArcGIS (.shp), ArcInfo Coverages and MapInfo (.tab). More specialised formats may be available but may incur additional processing costs.

3.8 LIMITATIONS

- GeoSure has been developed at 1:50 000 scale and must not be used at larger scales, and all spatial searches against the data should be done with a minimum 50 m buffer.

- GeoSure data are created as vector polygons and are available in a range of GIS formats, including ArcGIS (.shp), ArcInfo Coverages and MapInfo (.tab). More specialised formats may be available but may incur additional processing costs.

- GeoSure is concerned with potential ground stability related to NATURAL geological conditions only. GeoSure does NOT cover any man-made hazards, such as contaminated land

or mining. The only exception to this is the Compressible Ground hazard layer, which does consider man-made ground e.g., landfill.

- GeoSure is based on, and limited to, an interpretation of the records in the possession of The British Geological Survey at the time the data set was created.

- An indication of natural ground instability does not necessarily mean that a location will be affected by ground movement or subsidence. Such an assessment can only be made by inspection of the area by a qualified professional.

- The words provided in the Appendix 1 are designed to provide a general indication of the meaning of the various GeoSure hazards levels. If the data is to be used for advising specific sectors of end users in detail, e.g. home-buying, property insurance, site development and construction, then the BGS can provide additional end user guides and additional attribution details for the data. To find more about this, please contact our Business Solutions department through the BGS Central Enquiries Desk using the contact details at the start of this document.

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But **will not** be permitted to:

- provide a bureau service for others or incorporate the data in the generation of products or services for commercial purposes
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- place (any part of) the dataset(s) on the Internet

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When the BGS digital datasets are revised any upgrades will be automatically supplied to the licensee, at no additional cost. Geological map datasets are revised on a periodic rather than on an annual basis, licensees will therefore not automatically receive a new dataset each year unless changes have been made to the data.

These are general comments for guidance only. A licensee of BGS's digital data is provided with full details of the basis on which individual BGS datasets licensed to them are supplied.

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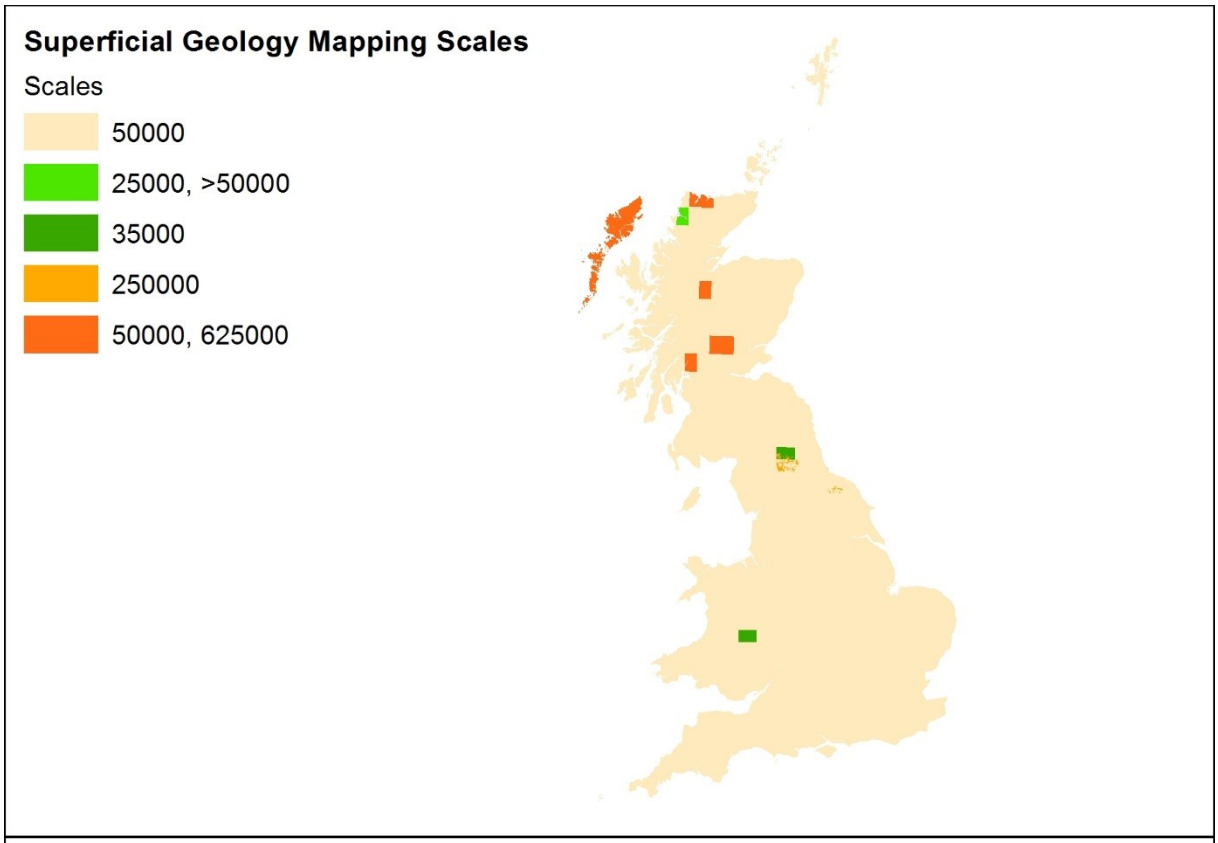
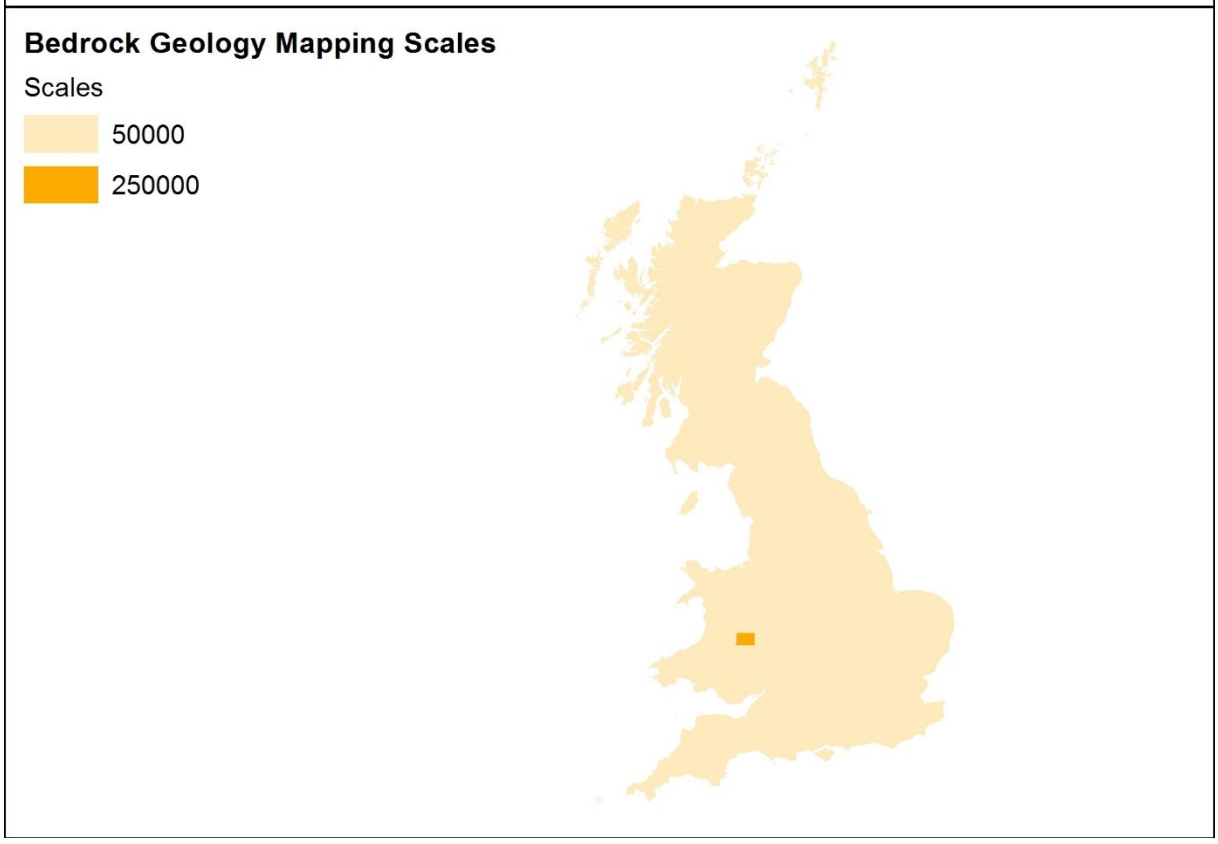
Appendix 1 GeoSure Legends

CLASS	COLLAPSIBLE DEPOSITS	RUNNING SAND	COMPRESSIBLE DEPOSITS	SLOPE INSTABILITY (LANDSLIDES)	SOLUBLE ROCKS (DISSOLUTION)	SHRINK SWELL
A	Deposits with potential to collapse when loaded and saturated are believed not to be present.	Running sand conditions are not thought to occur whatever the position of the water table. No identified constraints on land use due to running conditions.	Compressible strata are not thought to occur.	Slope instability problems are not thought to occur but consideration to potential problems of adjacent areas impacting on the site should always be considered.	Soluble rocks are either not thought to be present within the ground, or not prone to dissolution. Dissolution features are unlikely to be present.	Ground conditions predominantly non-plastic.
B	Deposits with potential to collapse when loaded and saturated are unlikely to be present.	Running sand conditions are unlikely. No identified constraints on land use due to running conditions unless water table rises rapidly.	Compressibility and uneven settlement problems are not likely to be significant on the site for most land uses.	Slope instability problems are not likely to occur but consideration to potential problems of adjacent areas impacting on the site should always be considered.	Soluble rocks are present within the ground. Few dissolution features are likely to be present. Potential for difficult ground conditions or localised subsidence are at a level where they need not be considered.	Ground conditions predominantly low plasticity.
C	Deposits with potential to collapse when loaded and saturated are possibly present in places.	Running sand conditions may be present. Constraints may apply to land uses involving excavation or the addition or removal of water.	Compressibility and uneven settlement potential may be present. Land use should consider specifically the compressibility and variability of the site.	Slope instability problems may be present or anticipated. Site investigation should consider specifically the slope stability of the site.	Soluble rocks are present within the ground. Some dissolution features may be present. Potential for difficult ground conditions are at a level where they may be considered, localised subsidence need not be considered except in exceptional circumstances.	Ground conditions predominantly medium plasticity.
D	Deposits with potential to collapse when loaded and saturated are probably present in places.	Running sand conditions are probably present. Constraints may apply to land uses involving excavation or the addition or removal of water.	Compressibility and uneven settlement hazards are probably present. Land use should consider specifically the compressibility and variability of the site.	Slope instability problems are probably present or have occurred in the past. Land use should consider specifically the stability of the site.	Soluble rocks are present within the ground. Many dissolution features may be present. Potential for difficult ground conditions are at a level where they should be considered. Potential for subsidence is at a level where it may need to be considered.	Ground conditions predominantly high plasticity.
E	Deposits with potential to collapse when loaded and saturated are present.	Running sand conditions are almost certainly present. Constraints will apply to land uses involving excavation or the addition or removal of water.	Highly compressible strata present. Significant constraint on land use depending on thickness.	Slope instability problems almost certainly present and may be active. Significant constraint on land use.	Soluble rocks are present within the ground. Numerous dissolution features may be present. Potential for difficult ground conditions should be investigated. Potential for localised subsidence is at a level where it should be considered.	Ground conditions predominantly very high plasticity.

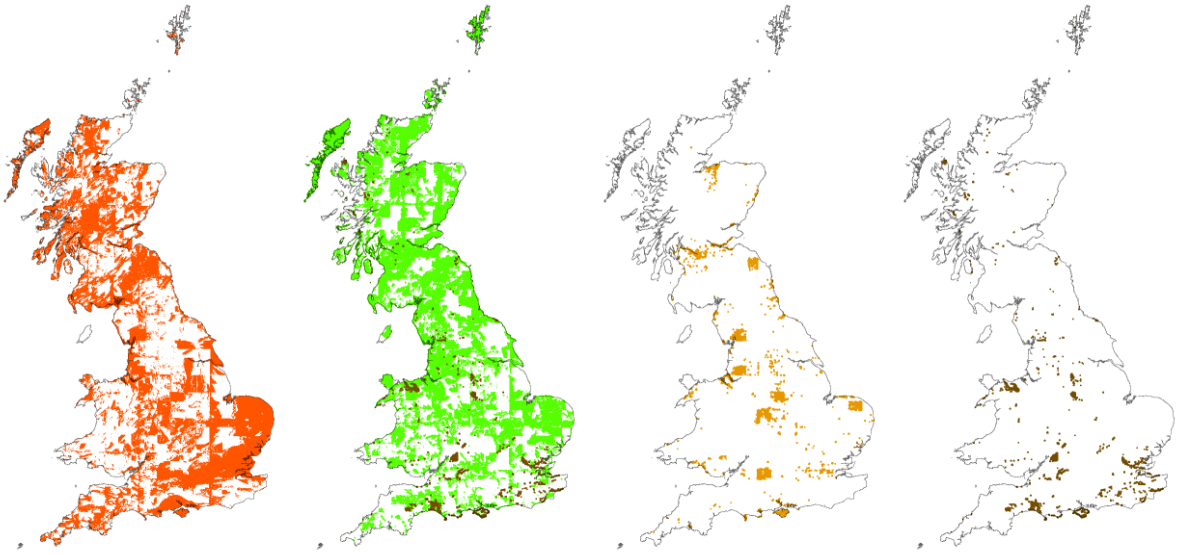
Appendix 2 Mapping Scales





Appendix 3 Changes in Spatial Data in BGS Geology 50k Version 8

Locations of new or modified content in BGS Geology 50k (previously DiGMapGB-50) Version8 (by comparison with V7)



Bedrock Superficial Artificial Mass Movement