



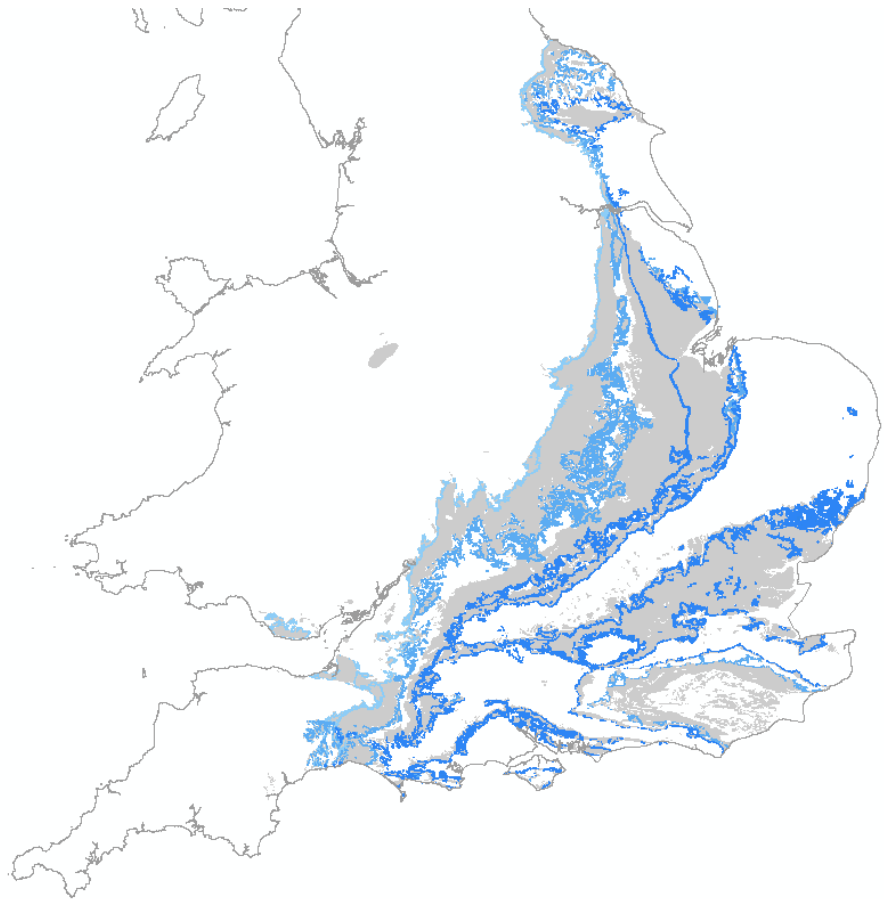
**British
Geological Survey**

NATURAL ENVIRONMENT RESEARCH COUNCIL

User Guide for the Shrink-Swell Subsurface (GeoSure Extra) dataset

GeoAnalytics & Modelling Programme

Open Report OR/16/041



BRITISH GEOLOGICAL SURVEY

GEOANALYTICS & MODELLING PROGRAMME

OPEN REPORT OR/16/041

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National Grid Reference

SW corner 0,0
Centre point 350000,550000
NE corner 700000,1300000

Map

Sheet 0, 1:50 000 scale, GeoSure

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Summary

This report describes the national scale Shrink–Swell subsurface (GeoSure Extra) 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 the layer. 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 Geology Programmes have contributed to the project. 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.

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 straightforward A to E potential hazard classification.

This document provides information for users on an additional dataset for the assessment of the Shrink–Swell properties of the sub-crop of the 8 main clay formations in Great Britain.

Further information on all the digital data provided by the BGS can be found on our website at <http://www.bgs.ac.uk/data/home.html?src=topNav> or by contacting:

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1 About the Shrink–Swell Subsurface Dataset

1.1 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 Models

- 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
- Radon potential
- Soil Parent Material Model
- Non-coal mining hazards data

1.2 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.

These hazards may also impact on anyone involved in the construction of large structures (deep foundations), infrastructure networks (road or rail) or utility companies. The 3D properties of these materials can be used to identify potential problems at surface, in the shallow sub-surface or deeper underground (e.g. tunnels).

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, construction companies, consulting engineers, builders, homeowners, solicitors, loss adjusters, the insurance industry, architects and surveyors.

1.3 WHAT THE DATASET SHOWS?

This addition to the GeoSure Shrink-Swell data consists of a single data layer in Geographical Information System (GIS) format that identifies areas of potential shrink-swell hazard at sub-crop level (up to 10 metres depth) in Great Britain. It is essentially a national hazard susceptibility map. This data has been produced by geologists, geotechnical specialists and information developers at the British Geological Survey and is presented as a GIS data layer. The dataset provides an indication of the presence of shrink-swell prone clays beneath other deposits (superficial or bedrock), up to a depth of c. 10 metres.

Swelling clays can change volume due to variation in moisture, this can cause ground movement, particularly in the upper two metres of the ground (or deeper if excavated and exposed) 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. During deeper excavation and construction works (i.e. basement excavations, tunnels or utility corridors), these volume changes might also affect clay shrink-swell prone lithologies.

2 Technical Information

2.1 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 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.

2.2 SCALE

The Shrink–Swell Subsurface for the GeoSure Extra dataset is produced for use at 1:625,000 scale providing a generic indication of the shrink–swell susceptibility at depths to 10 metres, as a planning tool prior to detailed site investigation.

2.3 FIELD DESCRIPTIONS

Table 1 – Attribute Table Field Descriptions

Field Name	Field Description
CLASS	Classification of hazard on a scale of B – D Class ‘-’ is already covered by the GeoSure Shrink-swell surface dataset which should be referred to
DEPTH	Depth of the Subsurface layer (5-10m)
LEGEND	Description of the hazard
VERSION	Dataset name and version number

Table 2 – GeoSure Legends

CLASS	SHRINK–SWELL
A*	Ground conditions predominantly non-plastic
B	Ground conditions predominantly low plasticity
C	Ground conditions predominantly medium plasticity
D	Ground conditions predominantly high plasticity
E*	Ground conditions predominantly very-high plasticity

*only classes B – D are currently present within the subsurface clay formations within this dataset. The full range of A- E equates to the GeoSure shrink swell layer that includes all geological deposits at surface.

2.4 CREATION OF THE DATASET

The part of the bedrock formation that is visible at surface (or under superficial deposits) is known as the outcrop. The part of the formation that is underneath another bedrock formation (therefore hidden from the surface) is known as the Subsurface. This has been used to generate the Shrink–Swell Subsurface methodology.

2.5 BGS SUPPORTING DATASETS

The datasets used to create and validate the Shrink–Swell GeoSure Extra layer are:

- GeoSure Shrink-Swell V7
- DiGMap 625k
- UK 3D v2015 (GB 3D) dataset - 625k scale
- Superficial Deposits Thickness Model (ASTM) version 5.
- BGS National Geotechnical Information Database

2.6 METHODOLOGY

To produce the Shrink–Swell Subsurface for GeoSure natural ground stability data layer an 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.

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.

Scattered data points derived from 3D cross section geological interpretations were extracted from the 625k scale UK 3D v2015 (GB 3D) dataset. The points were coincidental with the following lithostratigraphic units:

- Gault Formation and Upper Greensand Formation (GUGS)
- Kellaways Formation and Oxford Clay (KLOX)
- Lias Group (LI)
- Lambeth Group (LMBE)
- Mercia Mudstone Group (MMG)
- Thames Group (THAM)
- Wealdon Group (W)
- West Walton Formation, Ampthill Clay Formation and Kimmeridge Clay Formation (WWAK)

The cross section data points were then imported into GOCAD where individual clay unit surfaces were created by interpolation modelling; these were then imported into ArcGIS.

The hazard GIS layer is rated on an A – E classification (representing increasing hazard).

2.7 COVERAGE

3D information was created by modelling geologists at 1:625K scale using borehole analysis to create fence diagrams at regular intervals across the UK resulting in the UK National Geological Model (UK 3D v2015 (GB 3D)). From this 3D model, the top surfaces of the following lithostratigraphic units were extracted:

- Gault Formation and Upper Greensand Formation (GUGS)
- Kellaways Formation and Oxford Clay (KLOX)
- Lias Group (LI)
- Lambeth Group (LMBE)
- Mercia Mudstone Group (MMG)
- Thames Group (THAM)
- Wealden Group (W)
- West Walton Formation, Ampthill Clay Formation and Kimmeridge Clay Formation (WWAK)

The extent of these eight data layers is shown in Figure 1.

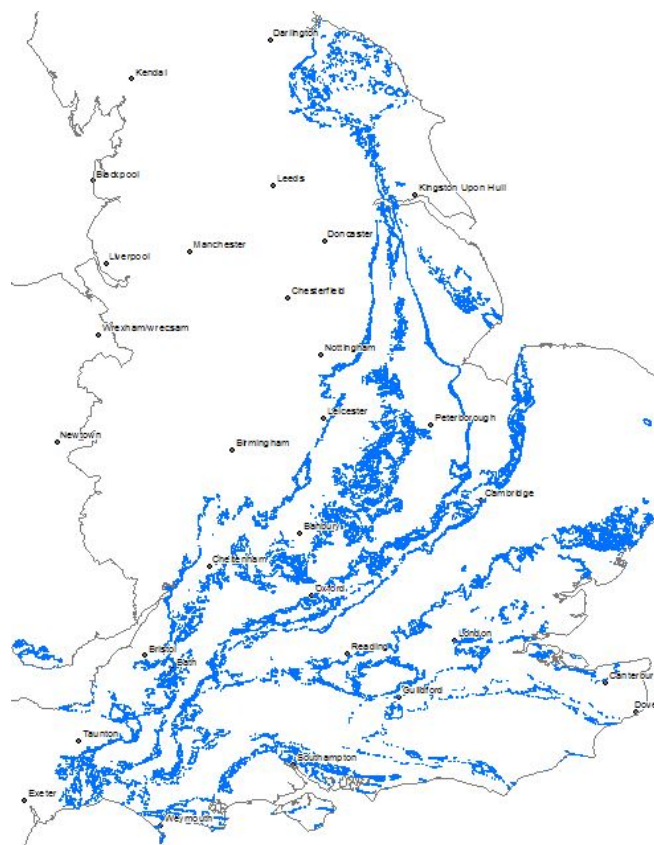


Figure 1 – Coverage of the Shrink–Swell Sub-crop dataset

N.B. Some formations may extend outside the area of Figure 1, but only in localised areas.

2.8 DATA FORMAT

The 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.

2.9 LIMITATIONS

- GeoSure Shrink-Swell Extra has been developed at 1:625 000 scale and is intended for use as a desk study screening tool prior to detailed site investigations.
- GeoSure Extra is concerned with potential ground stability related to NATURAL geological conditions only. It does NOT cover any man-made hazards, such as contaminated land or mining.
- GeoSure Extra 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.

- Site specific assessments should be carried out by suitably qualified and experienced professionals and using appropriate methods. The information provided in these data are designed for DESK STUDY phases.

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3.1 CONTACT INFORMATION

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