



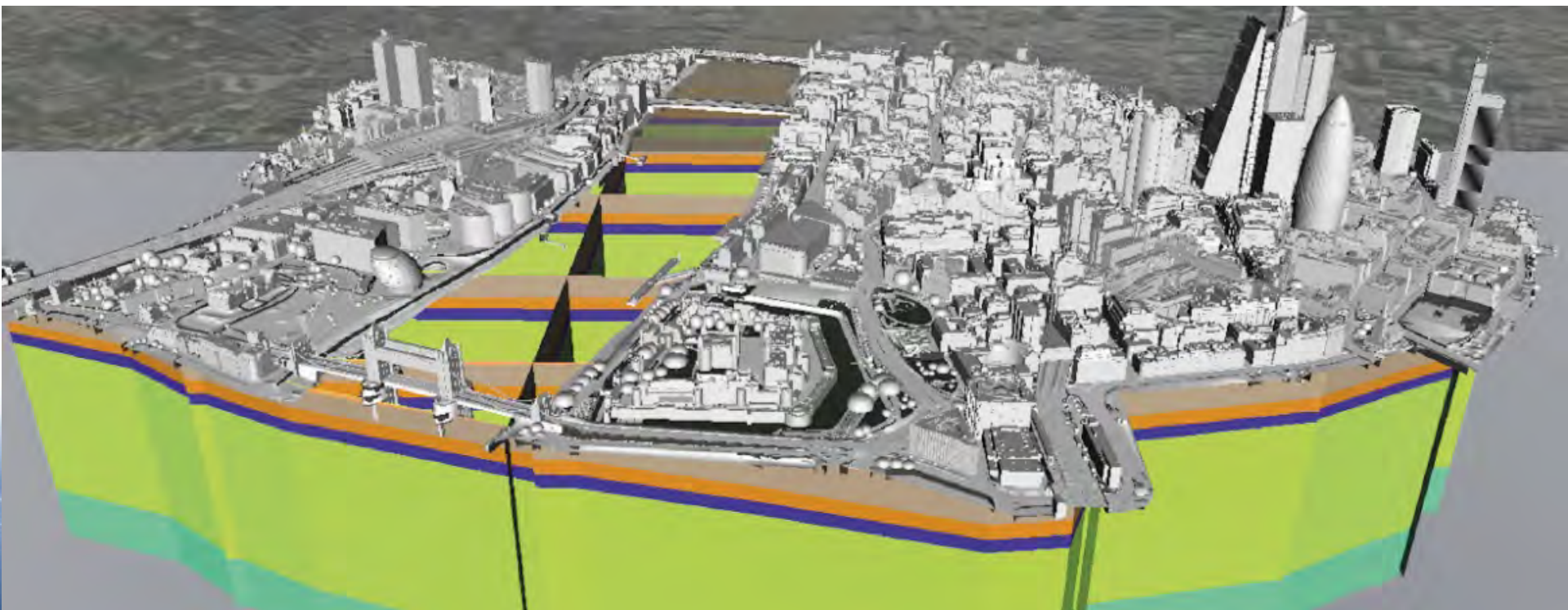
British  
Geological Survey

NATURAL ENVIRONMENT RESEARCH COUNCIL

Gateway to the Earth

# Construction and application of the London and Thames Valley 3D model

Helen Burke [hbu@bgs.ac.uk](mailto:hbu@bgs.ac.uk) and Holger Kessler [hke@bgs.ac.uk](mailto:hke@bgs.ac.uk)



# Introduction

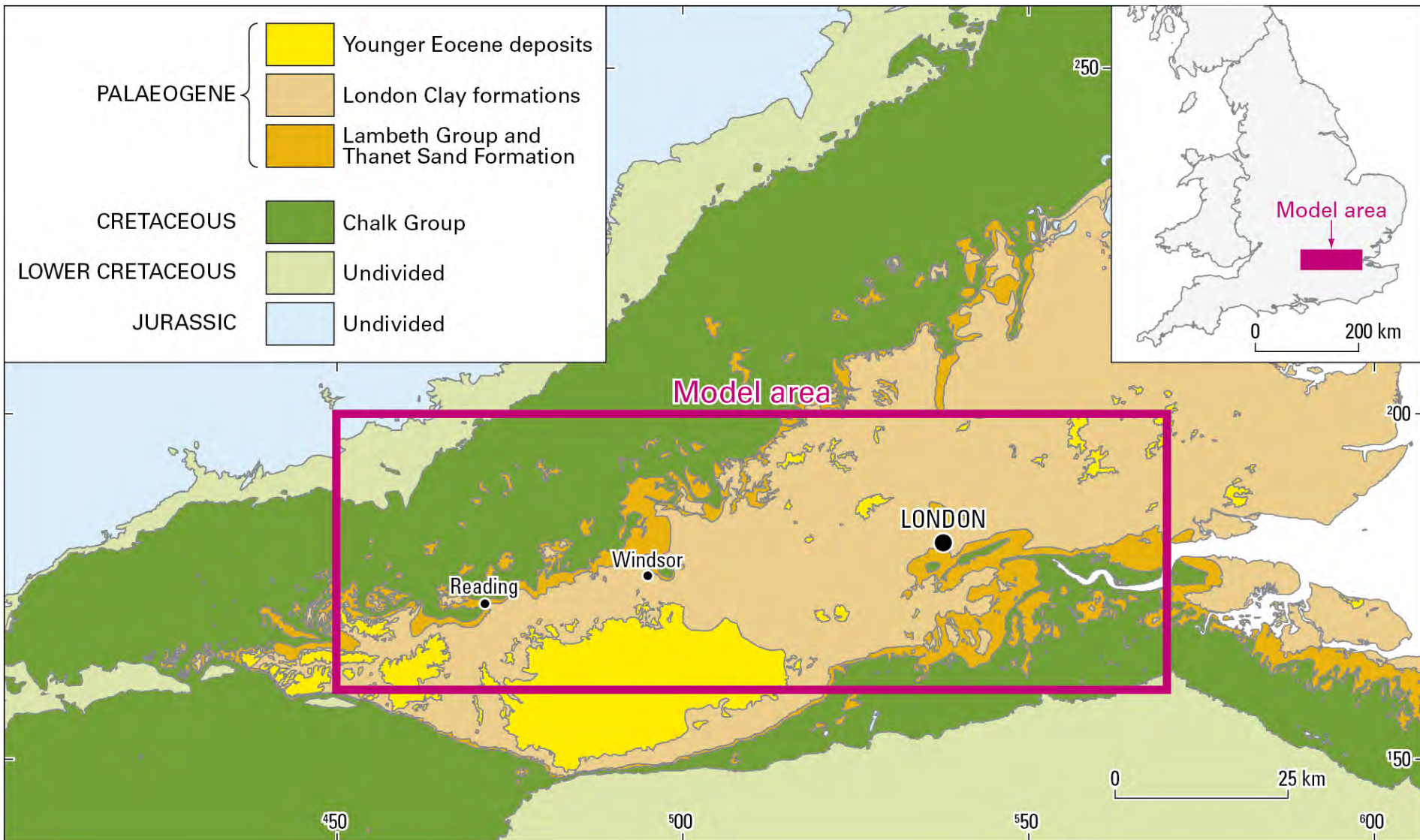
- Modelled area: 120x40km (8 50K map sheets)
- Model extends the geological maps into 3D
- 70 bedrock and superficial geological units modelled, plus artificial ground and mass movement deposits
- Modelled to c.500m depth
- 3D geological modellers: Helen Burke, Jon Ford, Steve Mathers, Ricky Terrington, Steve Thorpe, Paul Williamson
- Delivered as standard file types (vector, raster etc.) and also through the new [BGS Groundhog web viewer](#)
- [London geological model website](#)

## Published article:

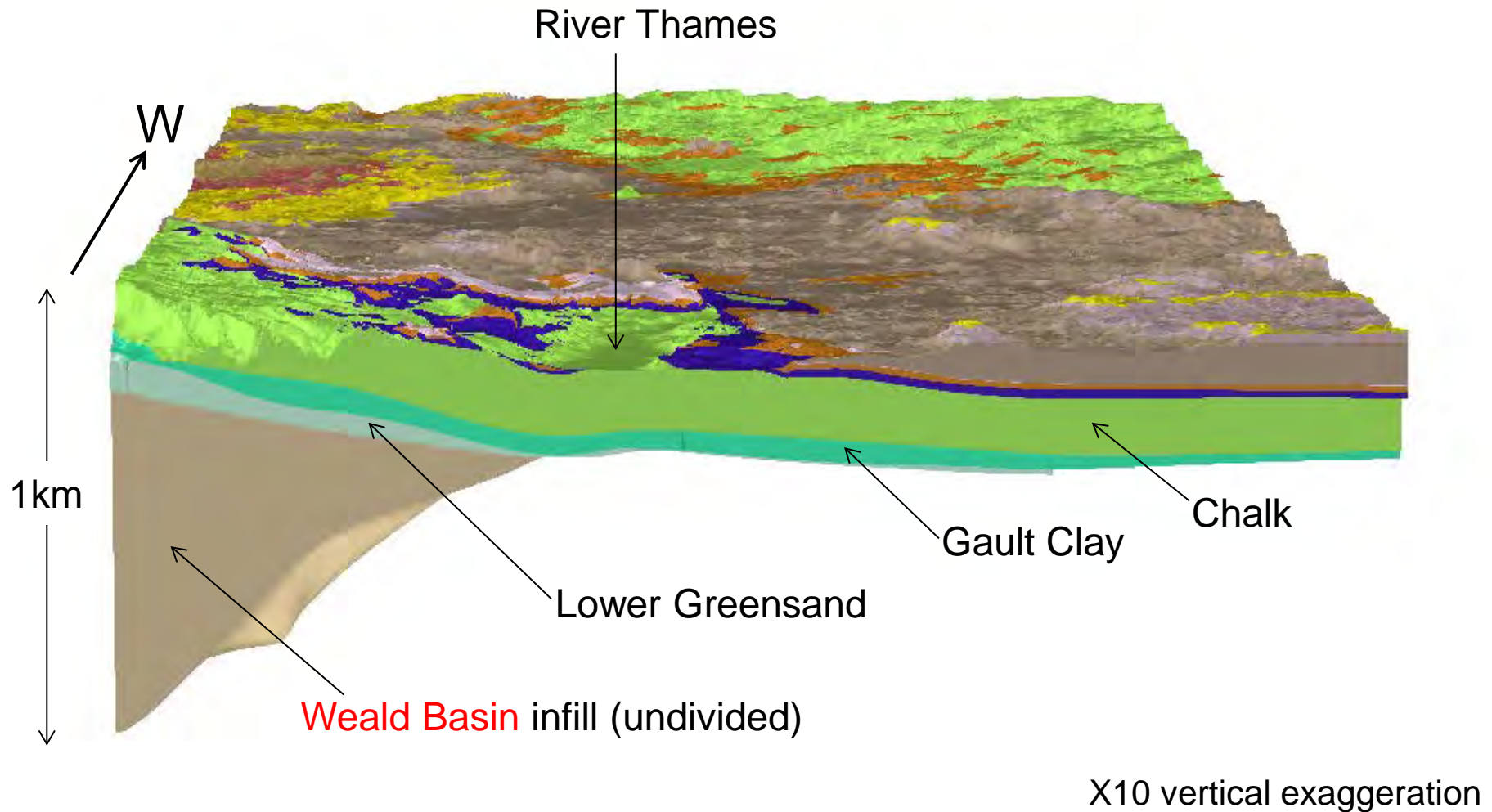




# Regional Bedrock Geology



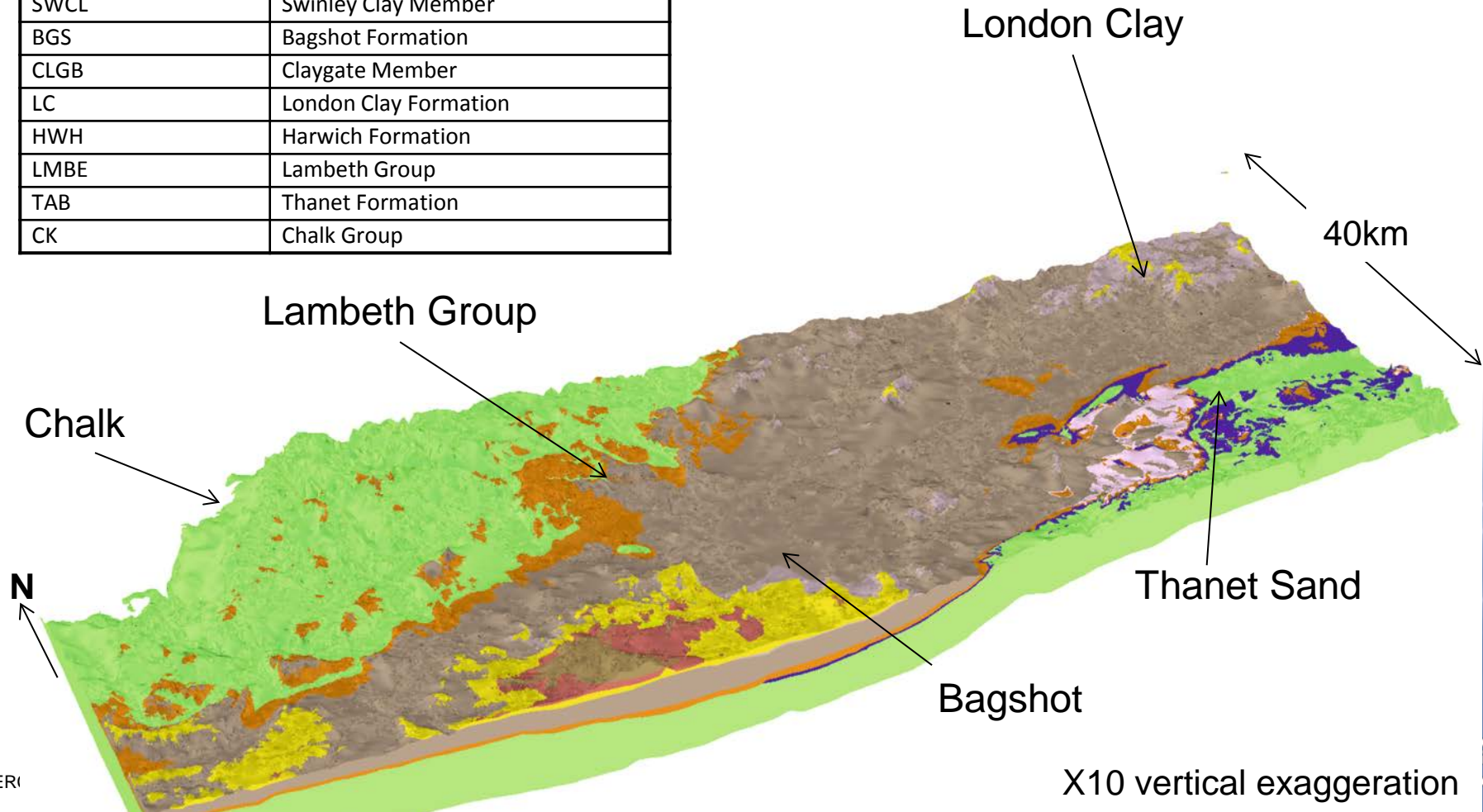
# 3D view of all modelled bedrock units



**Bedrock geology** looking west

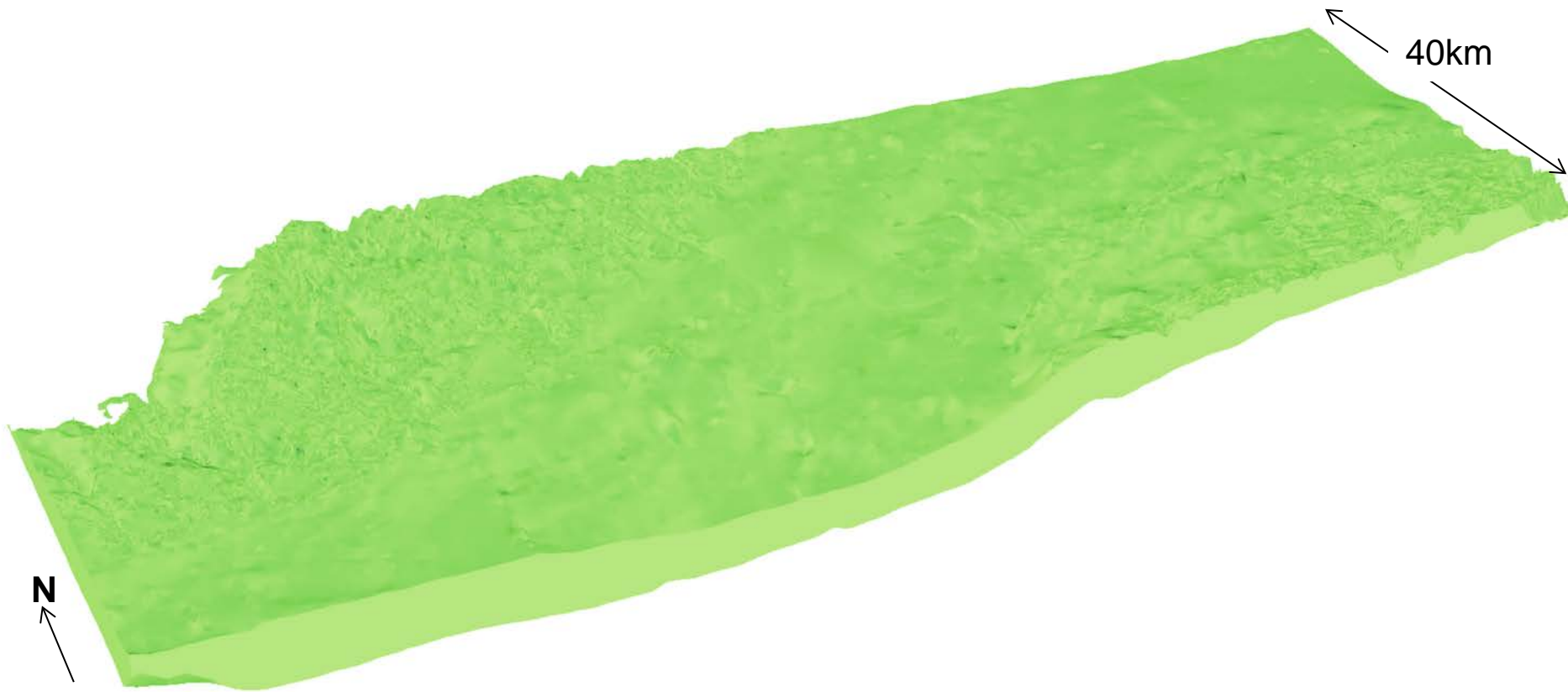
# Bedrock geology

BGS Lexicon code	Name
LNM	Lenham Formation
CMBS	Camberley Sand Formation
STHP	Stanners Hill Pebble Bed
WIDS	Windlesham Formation
SAHP	St Ann's Hill Pebble Bed
SWCL	Swinley Clay Member
BGS	Bagshot Formation
CLGB	Claygate Member
LC	London Clay Formation
HWH	Harwich Formation
LMBE	Lambeth Group
TAB	Thanet Formation
CK	Chalk Group



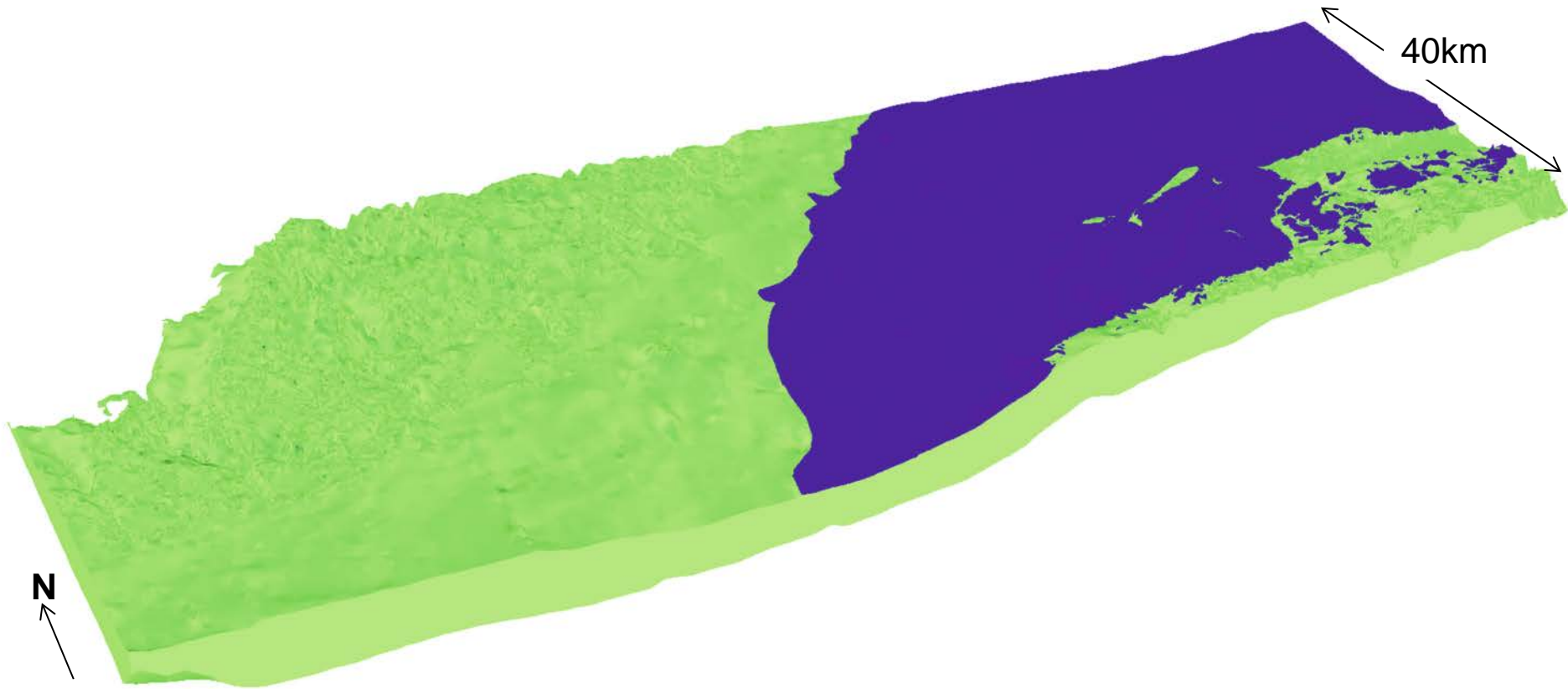


# 1 Chalk



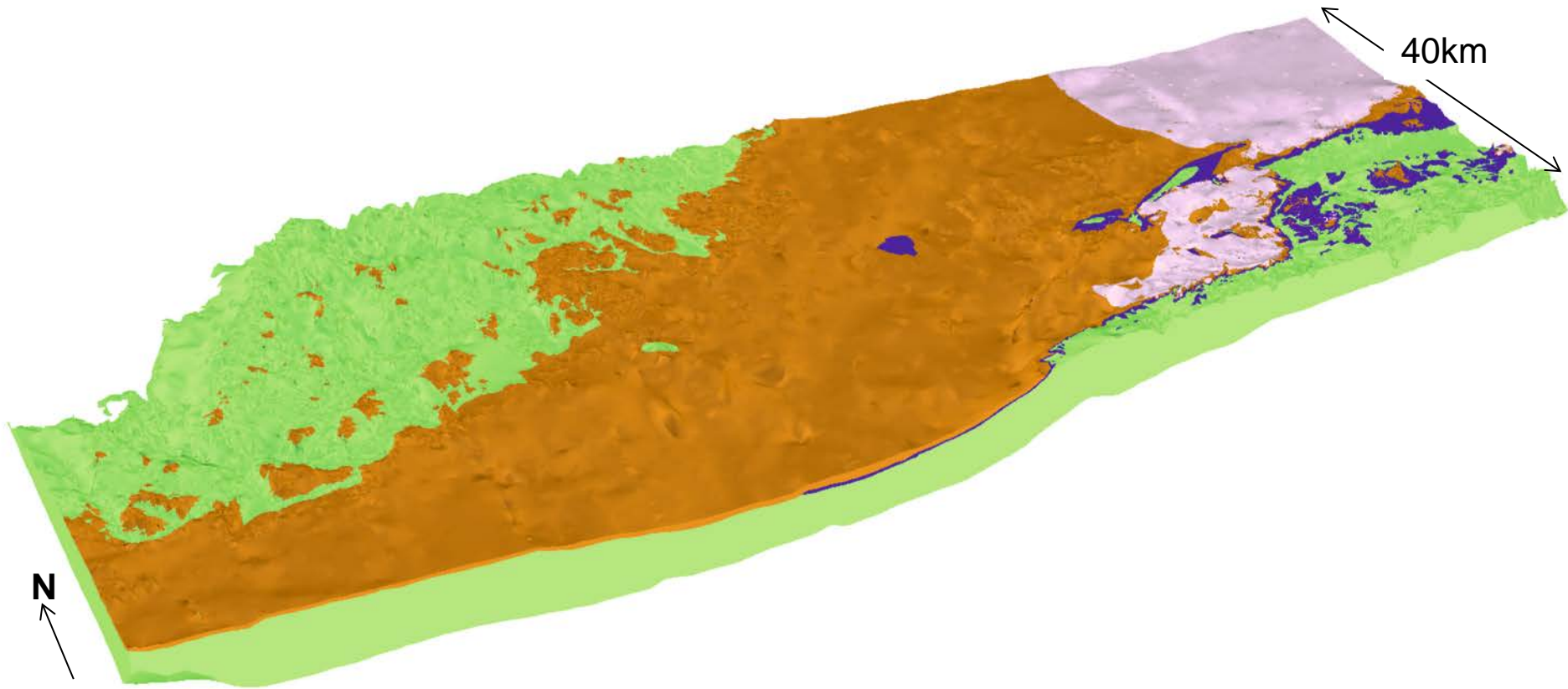
X10 vertical exaggeration

## 2 Thanet Formation subcrop (royal blue)



X10 vertical exaggeration

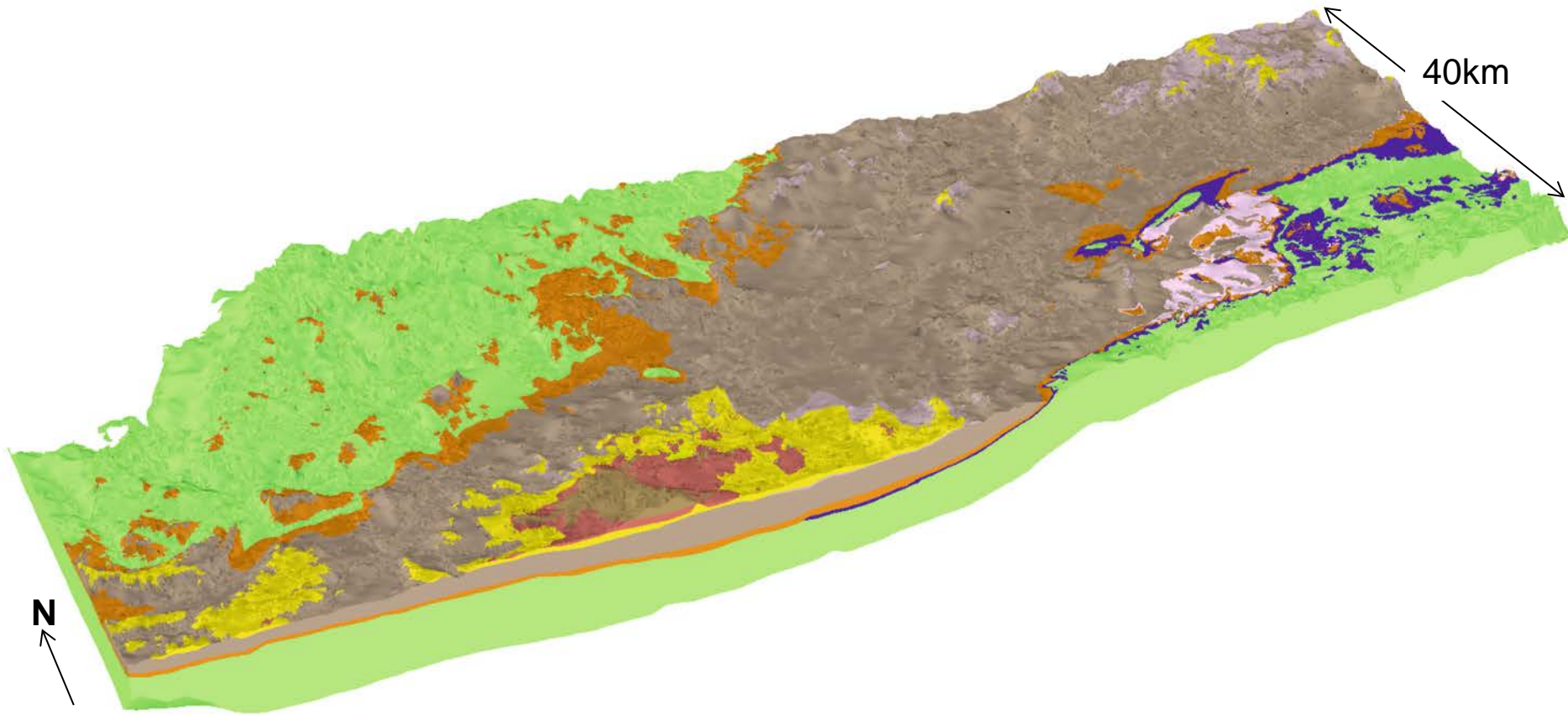
### 3 Harwich Formation (pink) and Lambeth Group (ochre)



X10 vertical exaggeration

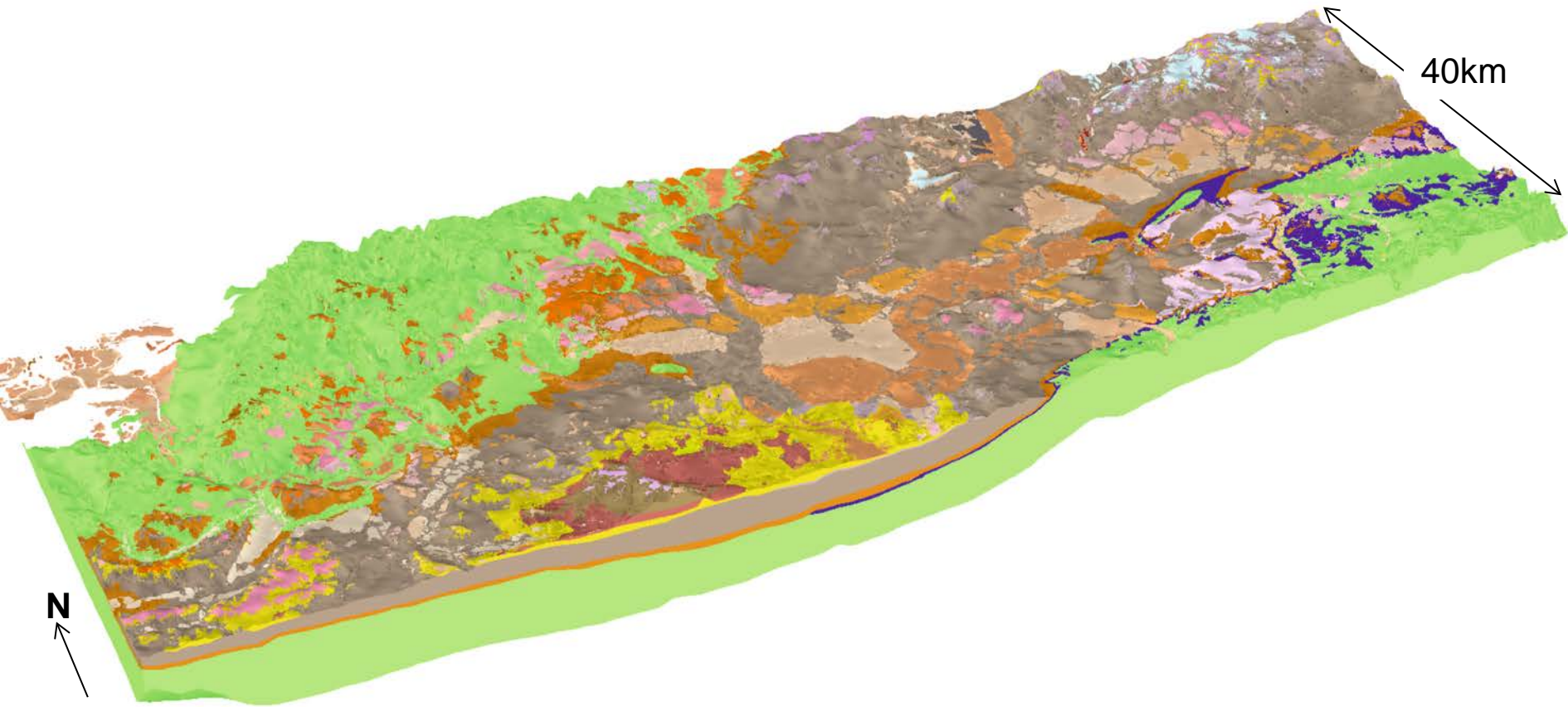


# 5 Bedrock geology at rockhead (all Quaternary removed)



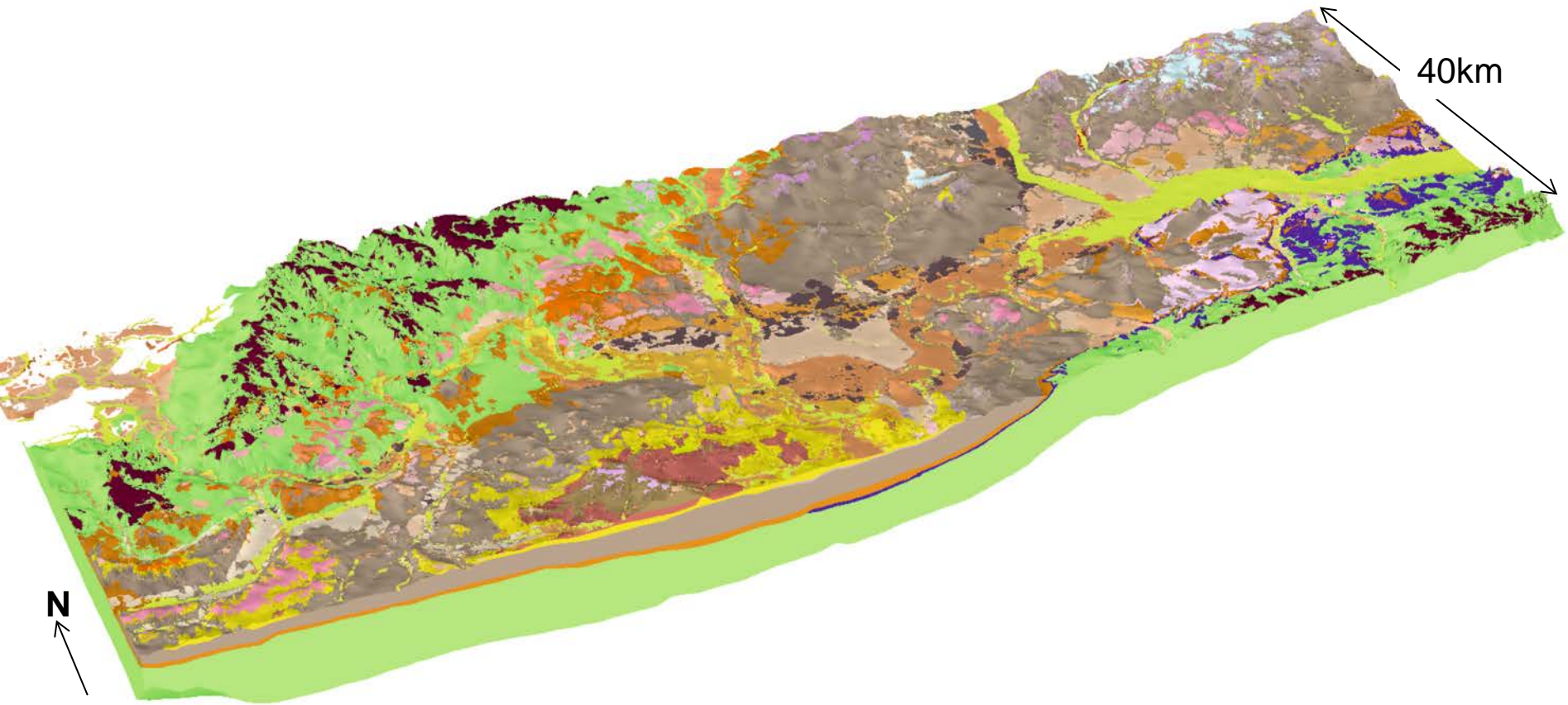
X10 vertical exaggeration

## 6 Quaternary deposits – most terrace gravel units and glacial deposits



X10 vertical exaggeration

# 7 All geological units

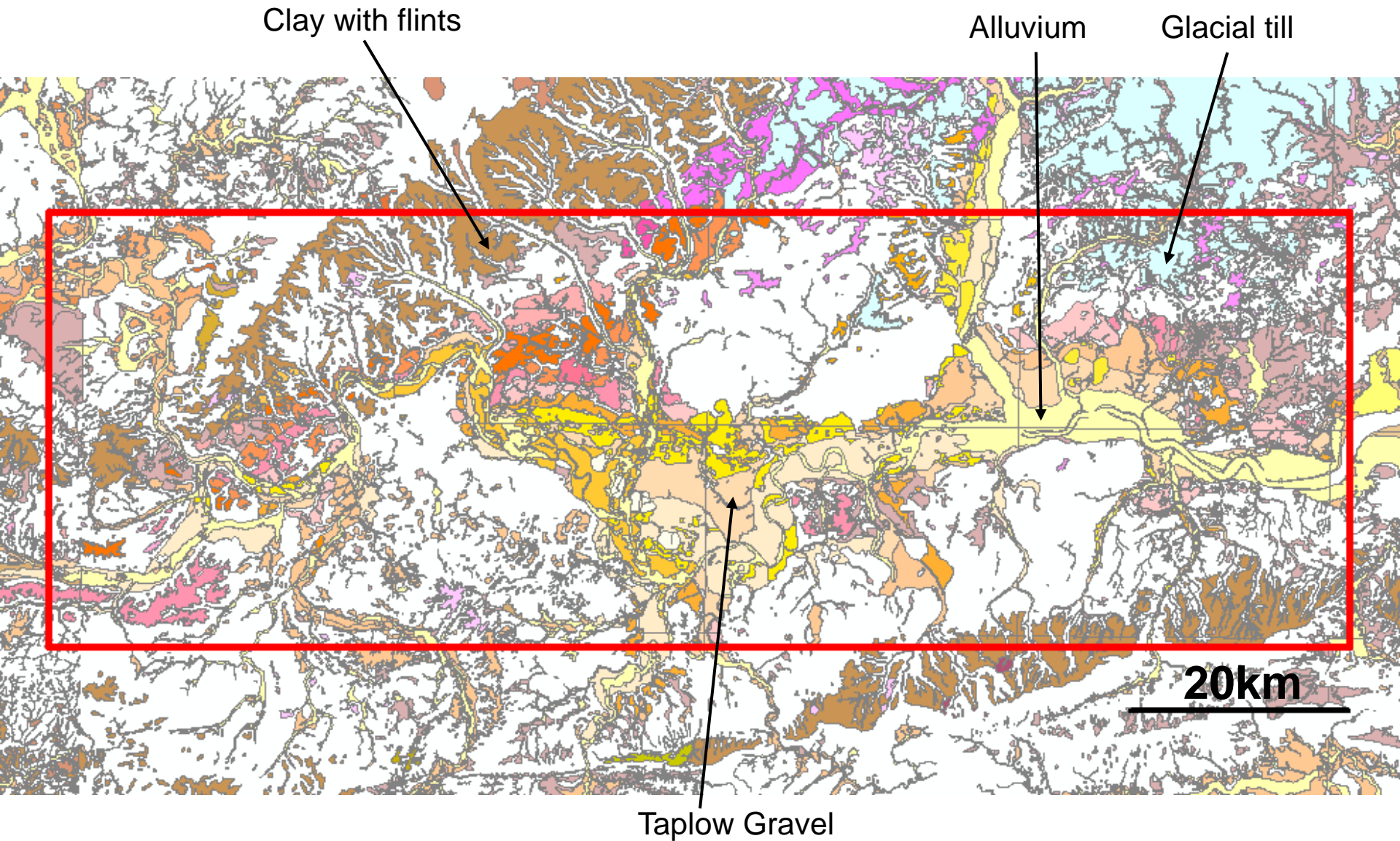


X10 vertical exaggeration

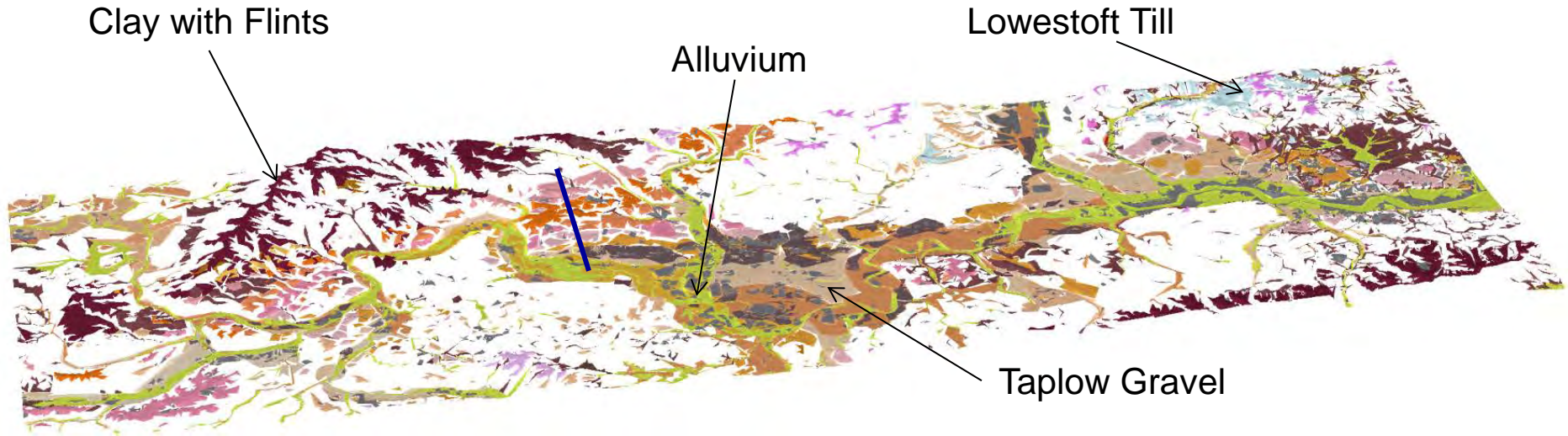
**Lower units** (to base Jurassic) added from existing regional model



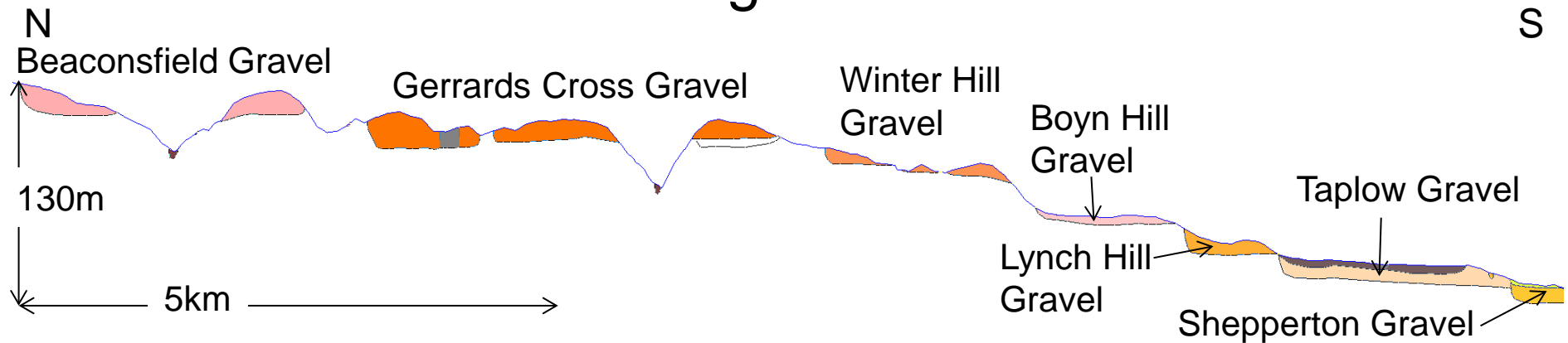
# Regional Quaternary Geology



# Quaternary and man made deposits (63 units)



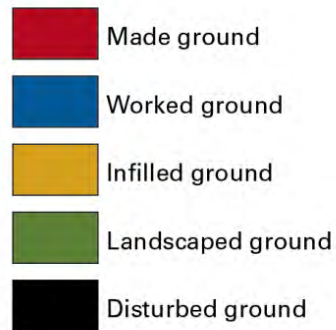
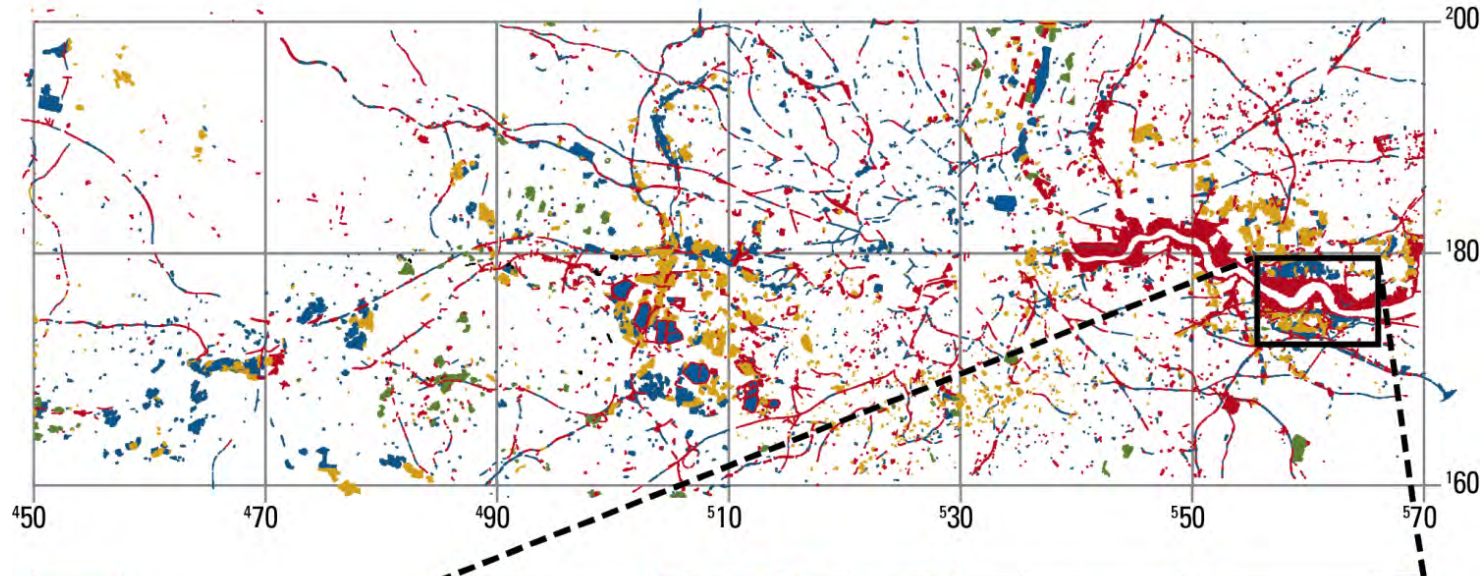
## Cross-section of terrace gravels



Vertical exaggeration x20



# Revised man made deposits



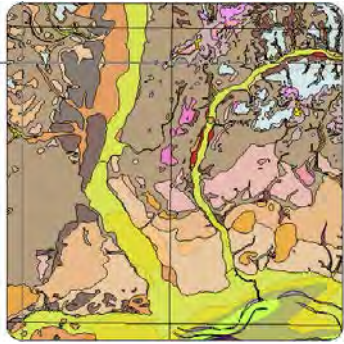
Significant upgrade of surface extent

Modelled only as polygons

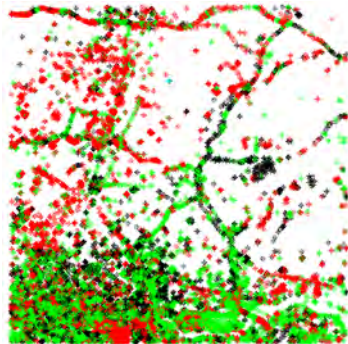
Bluewater  
39m of artificial ground



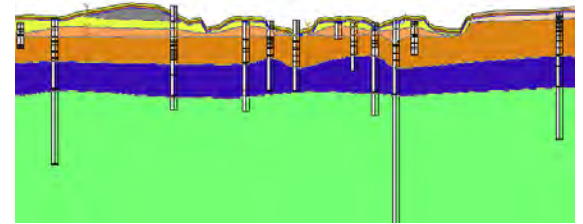
# 3D Modelling workflow



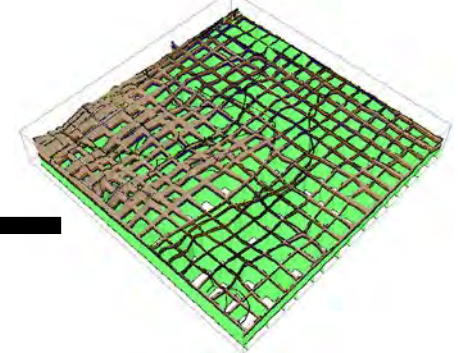
Map and DTM



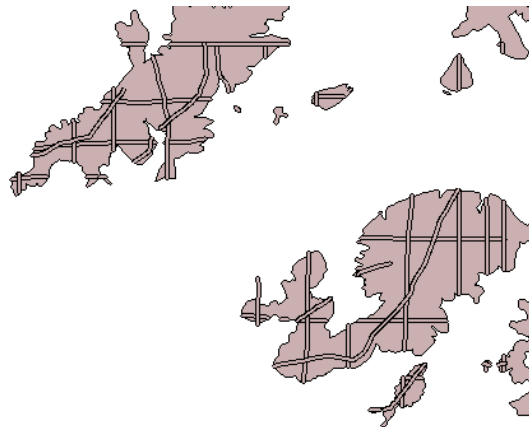
Boreholes



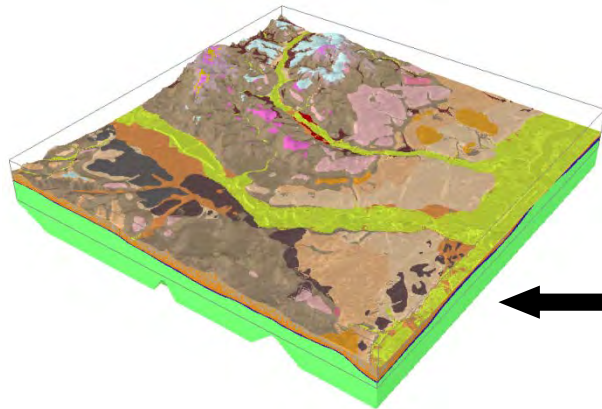
Cross-sections



Fence diagram

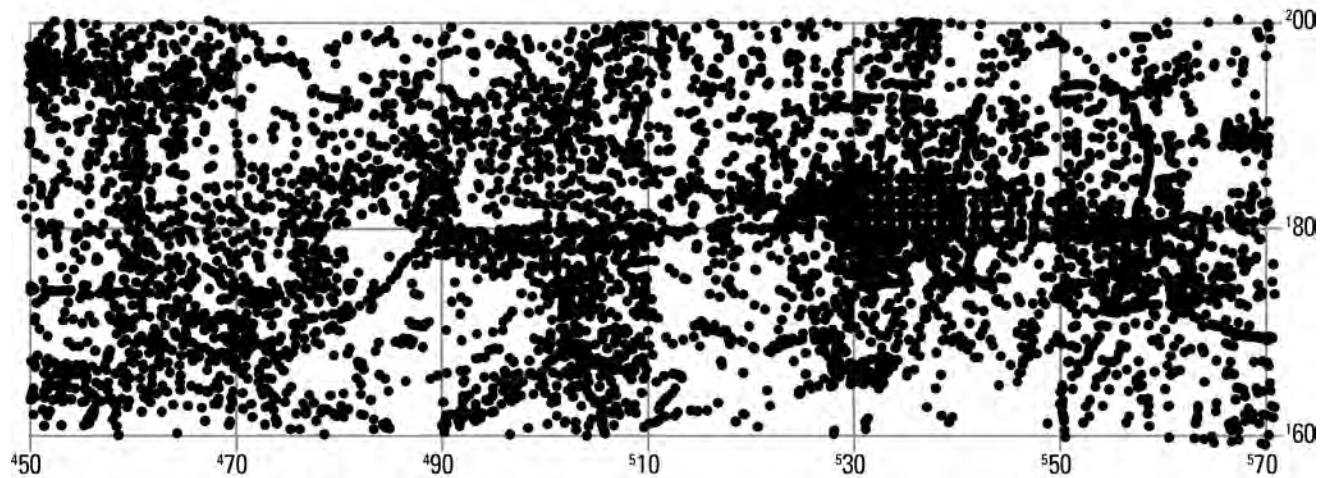


Unit distribution

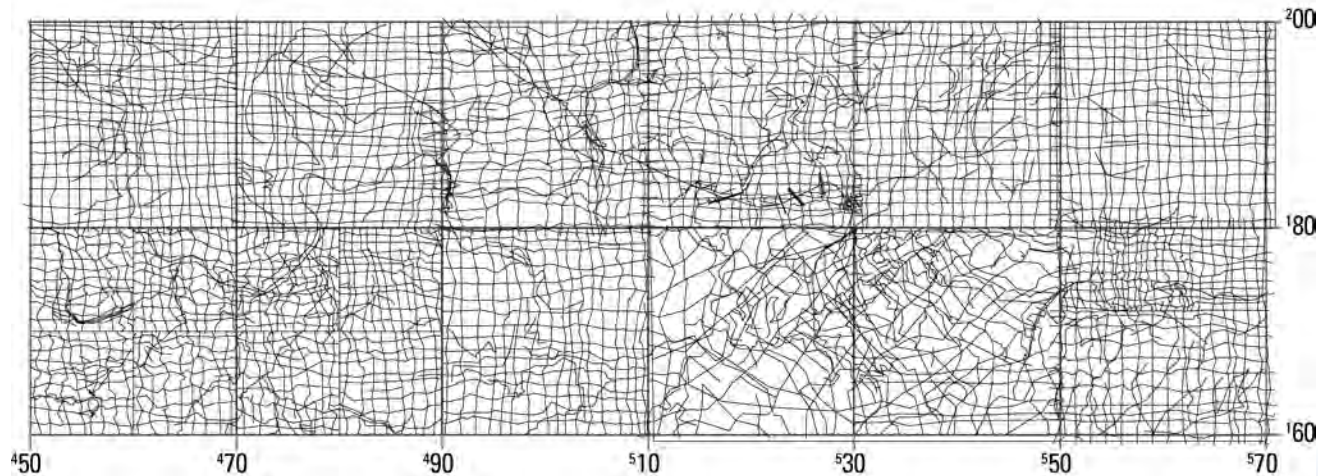


Geological Block model

# Cross-section and borehole locations

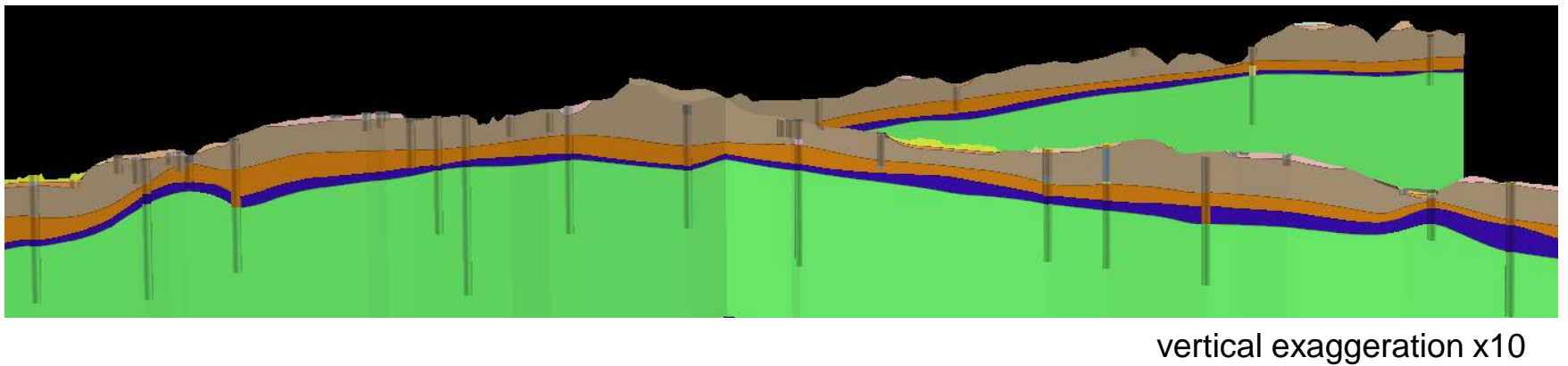
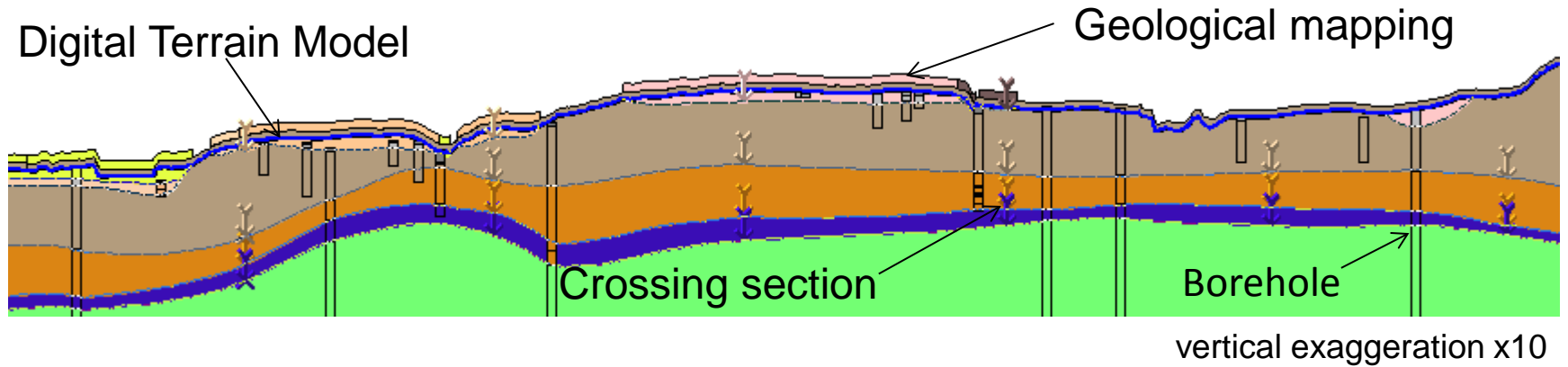


Boreholes considered in the modelling (c 7,000, 7%, the best records)



Cross-sections correlated to constrain the model

# Building cross-sections

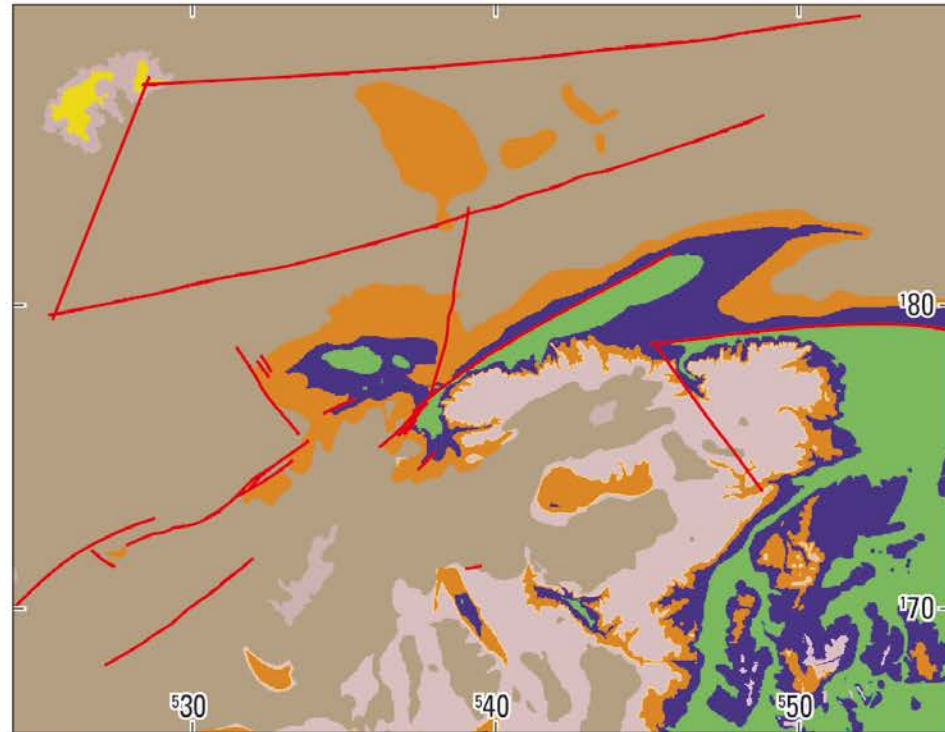
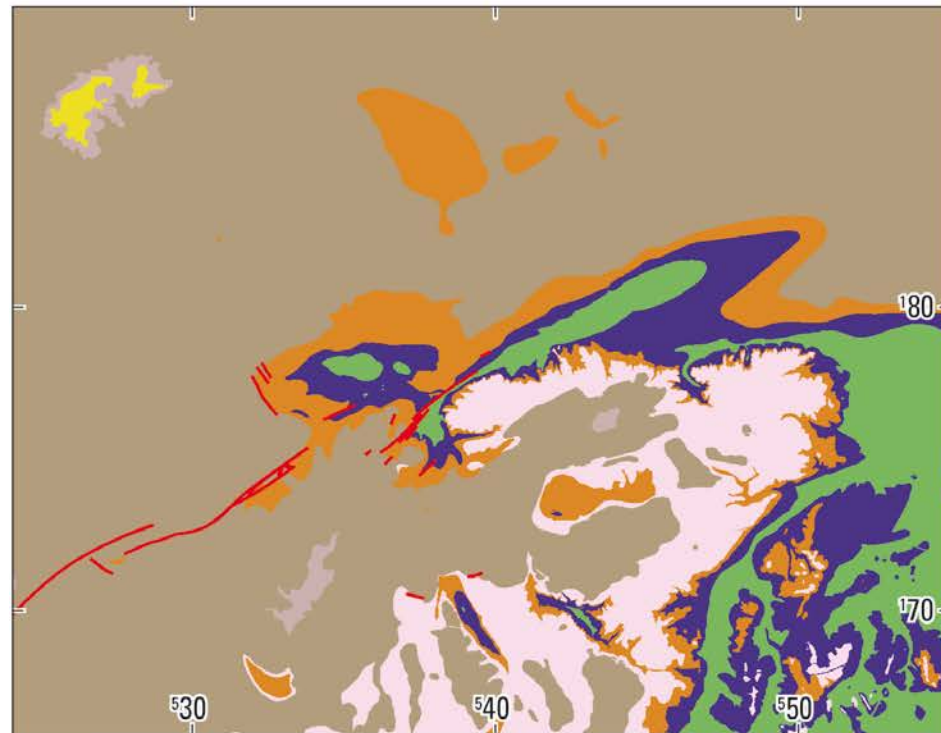




# New bedrock interpretation

Existing DiGMapGB-50

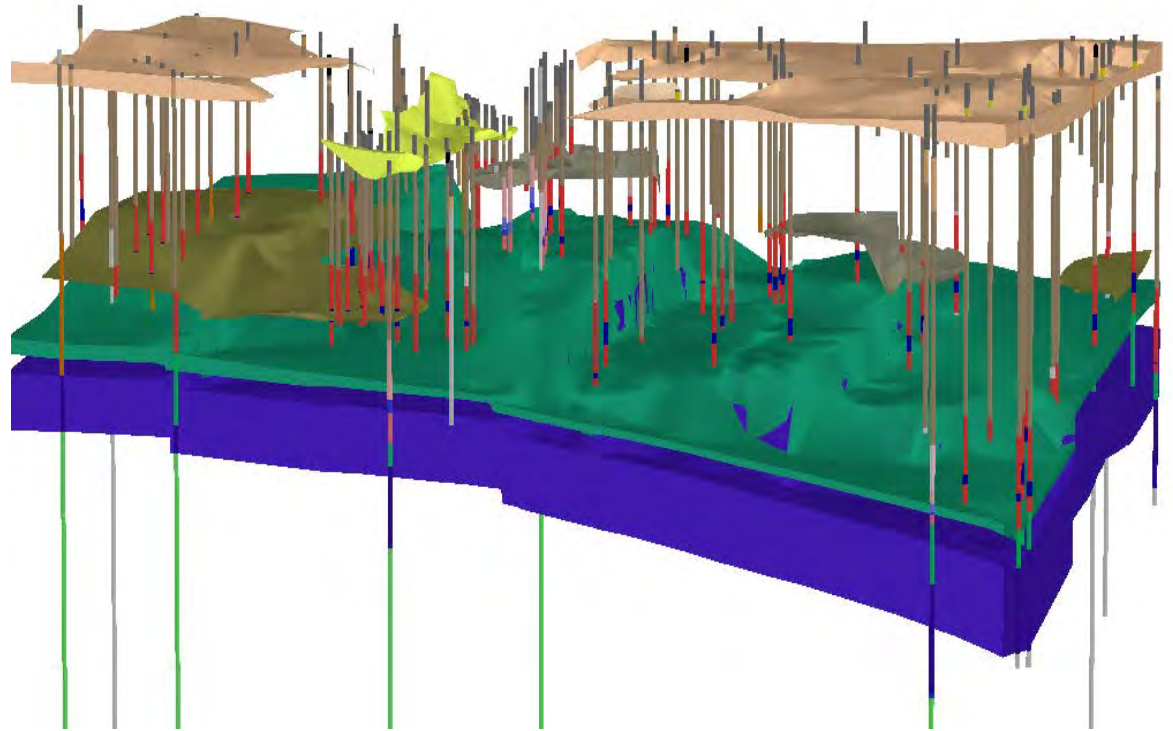
New interpretation from 3D visualisation



# Example of a detailed model within the London Area: Farringdon Station

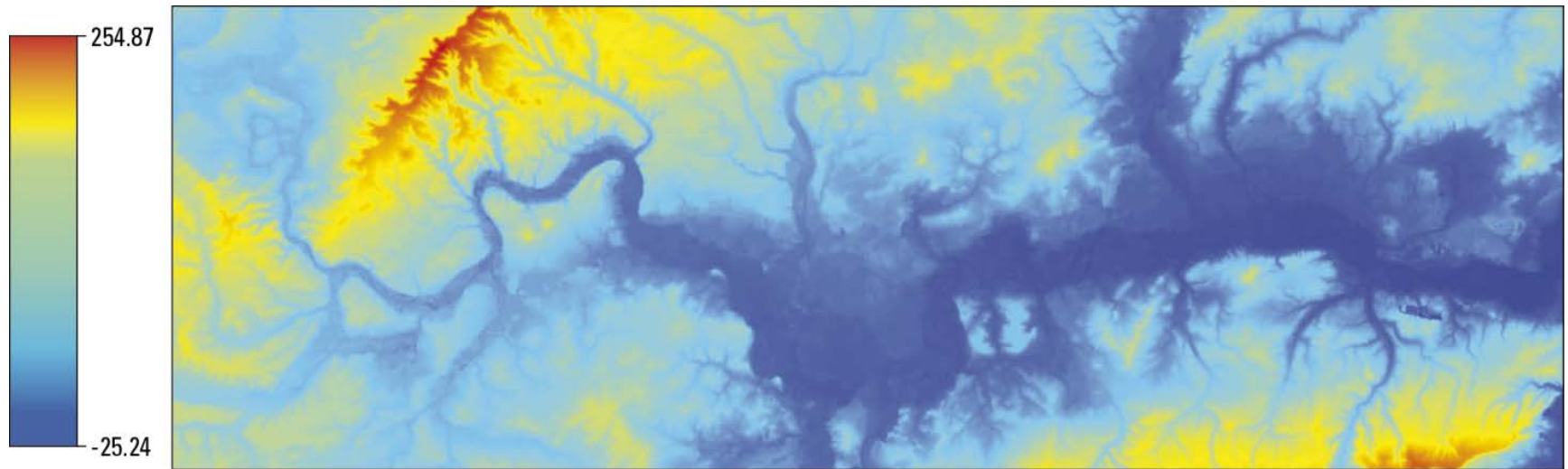
The regional model provides **a framework** for detailed site specific modelling

Sand units in alluvium,  
river gravels, Lambeth  
Group and Thanet  
Formation

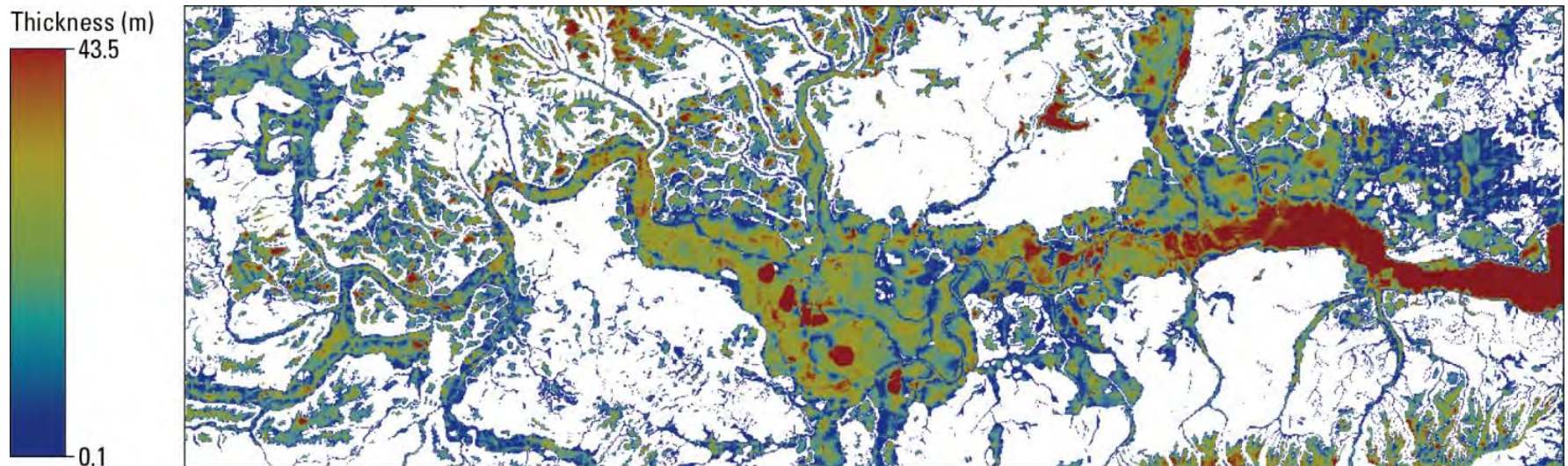




# New rockhead (base Quaternary) surface



# New Quaternary Thickness Model





# Further development of the model

As new **data is acquired**, we want to improve the model through the **participation of users and stakeholders**:

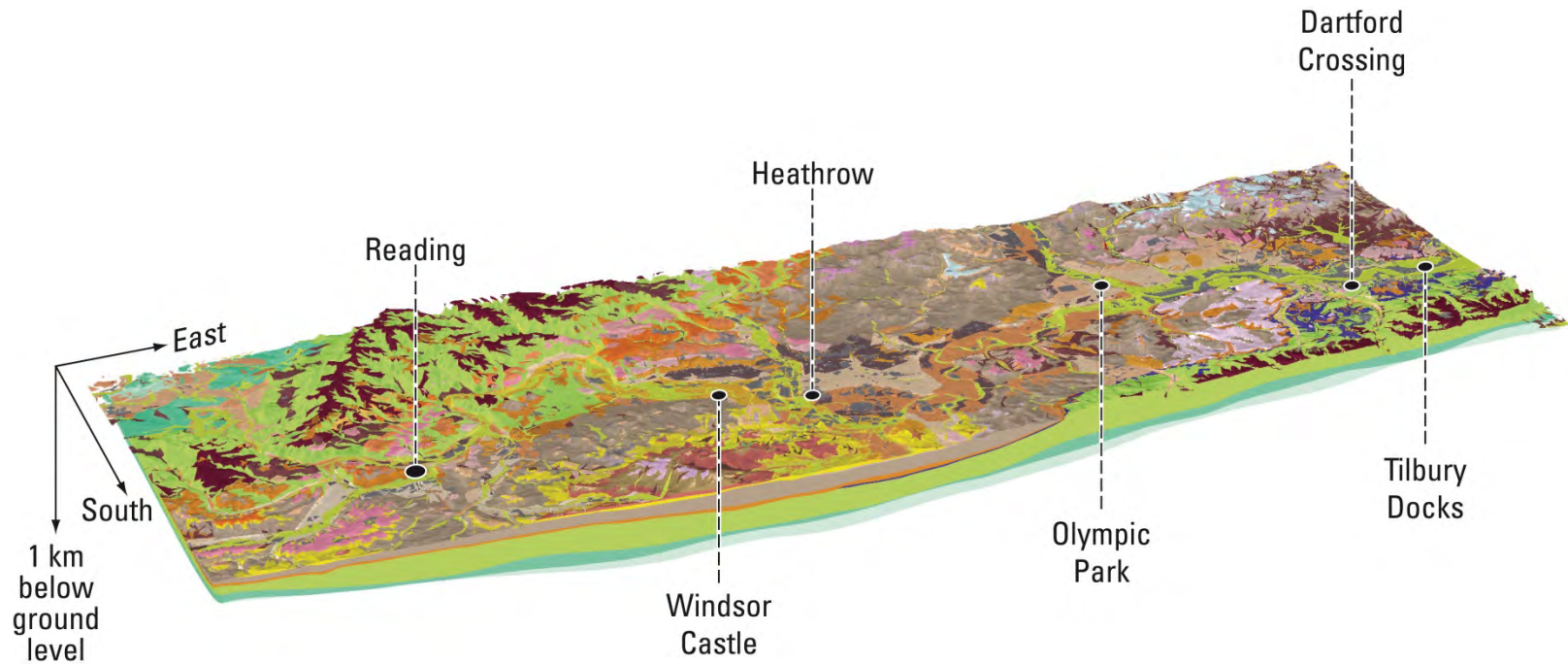
- Improve the 3D representation of **man made** deposits and **thin** deposits
- Improve fault modelling for an **integrated** structural interpretation
- **More stratigraphic detail**; Chalk and Lambeth Group
- Expand the coverage of the model
- Continuous revision of the model, and most importantly its use

# Geological model delivery



<http://www.bgs.ac.uk/igeology>

# Launch of commercial groundhog for the London and Thames model



<https://shop.bgs.ac.uk/Groundhog>



# BGS Groundhog

The screenshot shows the BGS Groundhog website interface. At the top, the BGS logo and 'British Geological Survey' text are visible. The main heading 'Groundhog' is in large, colorful letters. Below this, a navigation bar includes links for Home, Browser, Basket, Info, Help, T&Cs, Privacy, and Contacts. The main content area is titled '3D Geological Models from the British Geological Survey' and describes the National Geological Model. It includes a 3D map of the London area with labels for various locations like Heathrow, Windsor Castle, and the River Thames. Below the map, there are two types of models available: Deep, regional-scale models and Shallow, local-scale models. A section titled '3D Geological Model Outputs' lists four products for sale: Synthetic Borehole Reports (£10.00), Cross Section Reports (£30.00), Horizontal Section Reports (£30.00), and 3D Geological Model Data. Each product has a brief description and a download link for an example report. At the bottom, there is a 'Secure Online Payment' section with logos for Visa, Mastercard, and others.

The British Geological Survey (GBS) | <https://shop.bgs.ac.uk/Groundhog/>

**Groundhog**

Home Browser Basket Info Help T&Cs Privacy Contacts

### 3D Geological Models from the British Geological Survey

The British Geological Survey's National Geological Model is a 3D representation of the UK subsurface. This model shows not only the geological units at the surface (akin to a map), but also their variation with depth.

Models can be used to identify the thickness and order of geological units as well as provide information about how the elevations of geological surfaces vary spatially.

Currently, there are two types of model available:





- **Deep, regional-scale models**  
typically used for natural resource estimates and groundwater studies
- **Shallow, local-scale models**  
typically used for ground investigations, groundwater studies and tunnelling projects

Model coverage will increase over time as we load more models, so please visit us regularly.

Use the Model Browser to view our 3D geological model coverage and explore what outputs are available.

**Explore models and shop**

### 3D Geological Model Outputs

	<b>Synthetic Borehole Reports</b> Place a point on a map and obtain a prediction of the depths of the modelled units at that location. Download an <a href="#">Example Synthetic Borehole Report</a> (PDF 903KB)	<b>£10.00 (+VAT)</b>
	<b>Cross Section Reports</b> Place two points on a map to define a line and obtain a predicted cross section of the modelled geological units. Download an <a href="#">Example Cross Section Report</a> (PDF 963KB)	<b>£30.00 (+VAT)</b>
	<b>Horizontal Section Reports</b> Select a rectangular area on a map and obtain a geological map at an elevation below the ground surface. Download an <a href="#">Example Horizontal Section Report</a> (PDF 896KB)	<b>£30.00 (+VAT)</b>
	<b>3D Geological Model Data</b> Geological unit surfaces, thicknesses and 3D grids can be exported from the models and licensed in GIS/text formats. Some models can be delivered in interactive 3D viewers. Please contact us to discuss your requirements.	

Secure Online Payment

Visa Mastercard Maestro JCB

# BGS Groundhog (example output)

## Geological models

A geological model is a virtual representation of the geology in three dimensions. Geological models can provide information on geological unit surface elevations or thicknesses and can be queried to generate synthetic boreholes and vertical and horizontal cross-sections.

Geological models are created by geologists using geological data and expert knowledge. Data such as borehole records, geophysics, field observations and digital terrain models are interpreted and the conceptual geological understanding is captured via geological cross sections, geological maps and/or point interpretations that describe a surface. The 3D geological model is created by interpolation between all interpreted points.

The accuracy of the geological model is dependent on, for example, the data density, the prevailing understanding of the geology at the time of modelling and the geological complexity. The geological map herein indicates the sites of borehole records considered by the geologist and also the locations of interpreted cross sections; the density of these around the area of interest provides an indication of uncertainty.

## Limitations

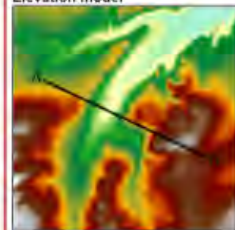
The quality of observations and interpretations may be affected by the availability of new data, by subsequent advances in knowledge, improved methods of interpretation, improved databases and modelling software, and better access to sampling locations. The top surface of the geological model is constrained by the digital terrain model; this may contain artefacts and may have been sub-sampled at a lower resolution and thus minor mismatches between geomorphological features and modelled units may occur.

The information herein should not be used as a replacement for site investigation. For further information on the limitations of modelling in this area, see the relevant metadata report available from [enquiries@bgs.ac.uk](mailto:enquiries@bgs.ac.uk) and view the terms and conditions at <http://shop.bgs.ac.uk/Groundhog>. For comprehensive information of the geology at this point, please use our BGS GeoReports Service at <http://shop.bgs.ac.uk/GeoReports>.

## Feedback

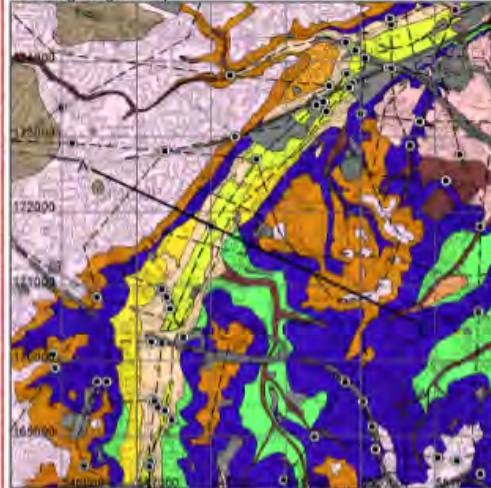
To improve geological models your feedback is essential. Please contact [enquiries@bgs.ac.uk](mailto:enquiries@bgs.ac.uk) if your site investigations yield data that could improve our interpretations.

## Elevation model



© NEXTMap Britain elevation data from Intermap Technologies

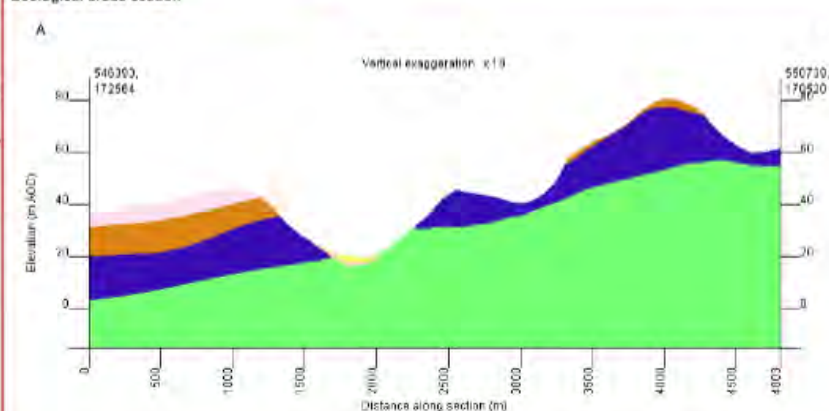
## Surface geological map



## Legend

- Worked Ground (Void)
- Made Ground (Variable composition)
- Infilled Ground (Variable composition)
- Landscaped Ground (Variable composition)
- Alluvium (Clay, Silt, Sandy, Gravelly)
- River Terrace Deposits (Gravel, Sandy)
- Head (Clay, Silt, Sandy, Gravelly)
- Crayford Silt Formation (Silt, Sandy)
- Taplow Gravel Formation (Gravel, Sandy)
- Lynch Hill Gravel Formation (Gravel, Sandy)
- Boyn Hill Gravel Formation (Gravel, Sandy)
- London Clay (Clay, Silt, Sandy)
- Harwich Formation (Sand, Gravelly)
- Lambeth Group (Clay, Silt, Sandy, Gravelly)
- Tranent Sand Formation (Sand)
- Chalk Formation, undifferentiated (Chalk)
- Gault and Upper Greensand Formations (Mudstone, Sandstone and Limestone)
- Lower Greensand Formation (Sandstone and Mudstone)
- Variscan and Jurassic strata, undifferentiated (Mudstone, sandstone and limestone)
- Borehole record
- Interpreted cross section
- Synthetic cross section

## Geological cross section



## Sidcup to Hextable

Report ID: GH\_100074/134

Model: London and Thames Valley geological model

Regional geological model originally created by H Burke, B Manners, J Ford, R Tarrington, S Thorpe, P Villasmán Model released: 2014.

The information on this map sheet, including the surface geological map and the synthetic cross section, is derived from the National Geological Model. Geological models provide an indication of reality; alternative interpretations of the same data are possible. The surface geological map is based on the published geological map, with revisions based on new interpretations and may therefore differ from published geological maps and products. Truncation of the lowest unit in the cross section does not necessarily denote its basal depth. Heights are in metres.

Deposits of artificial ground, head and clay with flints typically form thin veneers and whilst they are present on the surface map, they may be absent in the synthetic borehole or section.

Boreholes shown on the map were considered during the construction of the geological model. The original borehole records can be viewed at <http://shop.bgs.ac.uk/Groundhog>.

This product is based upon, and contains, Ordnance Survey materials with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office © Crown copyright, British Geological Survey, Ordnance Survey (license number 100021290 EUL).

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# Licensing options:

## **Free data**

Open Geoscience (Open Government License)

## **Commercial license**

3D data - cost ~60 p per seat, per year  
(plus data preparation and licensing charges)

## **Academic license**

Completely free for academic use  
(with acknowledgement of BGS)

## **Innovation agreement**

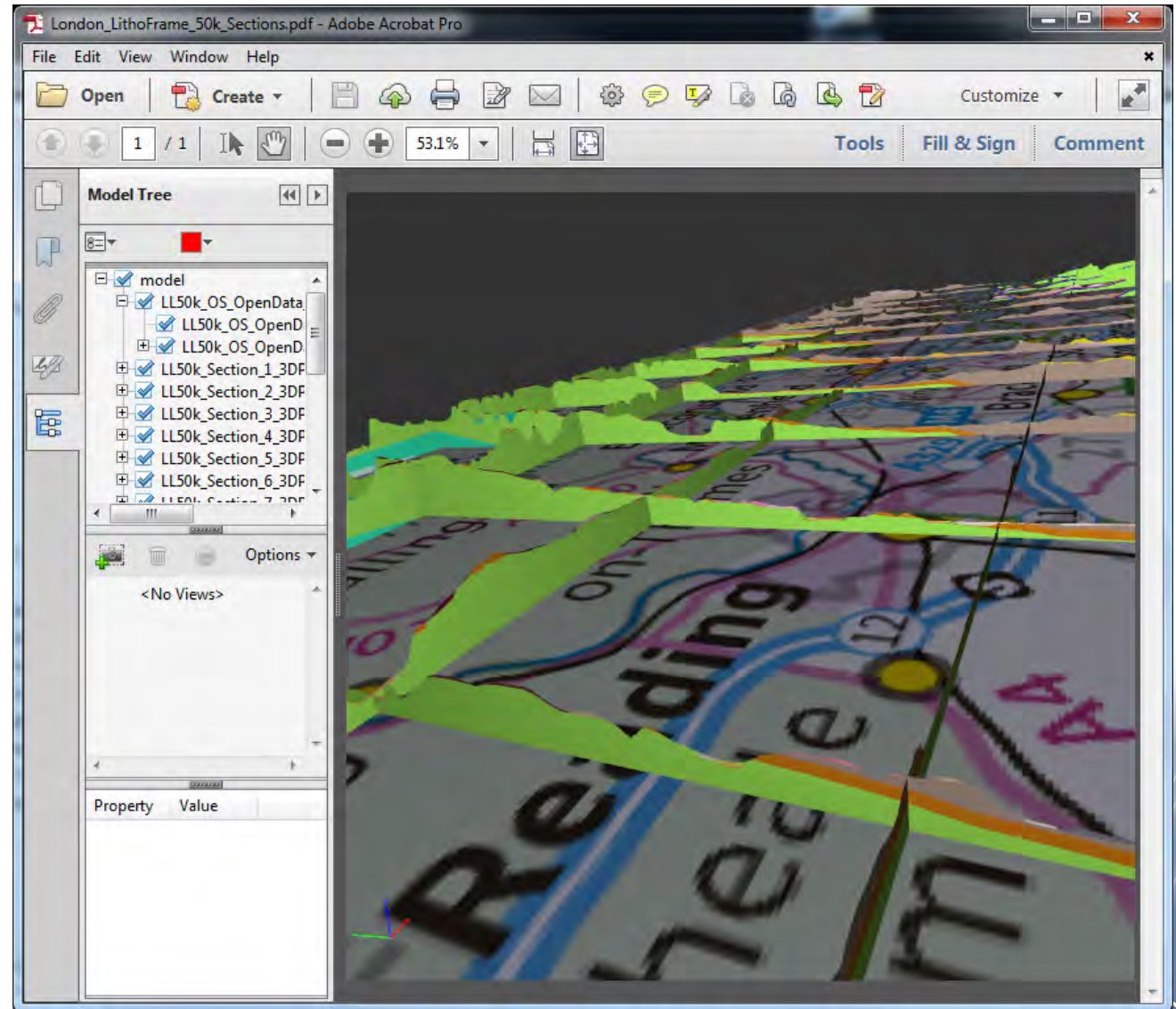
Free for evaluation purposes (limited time and area)

See <https://shop.bgs.ac.uk/Groundhog> or email [digitaldata@bgs.ac.uk](mailto:digitaldata@bgs.ac.uk)  
for further information



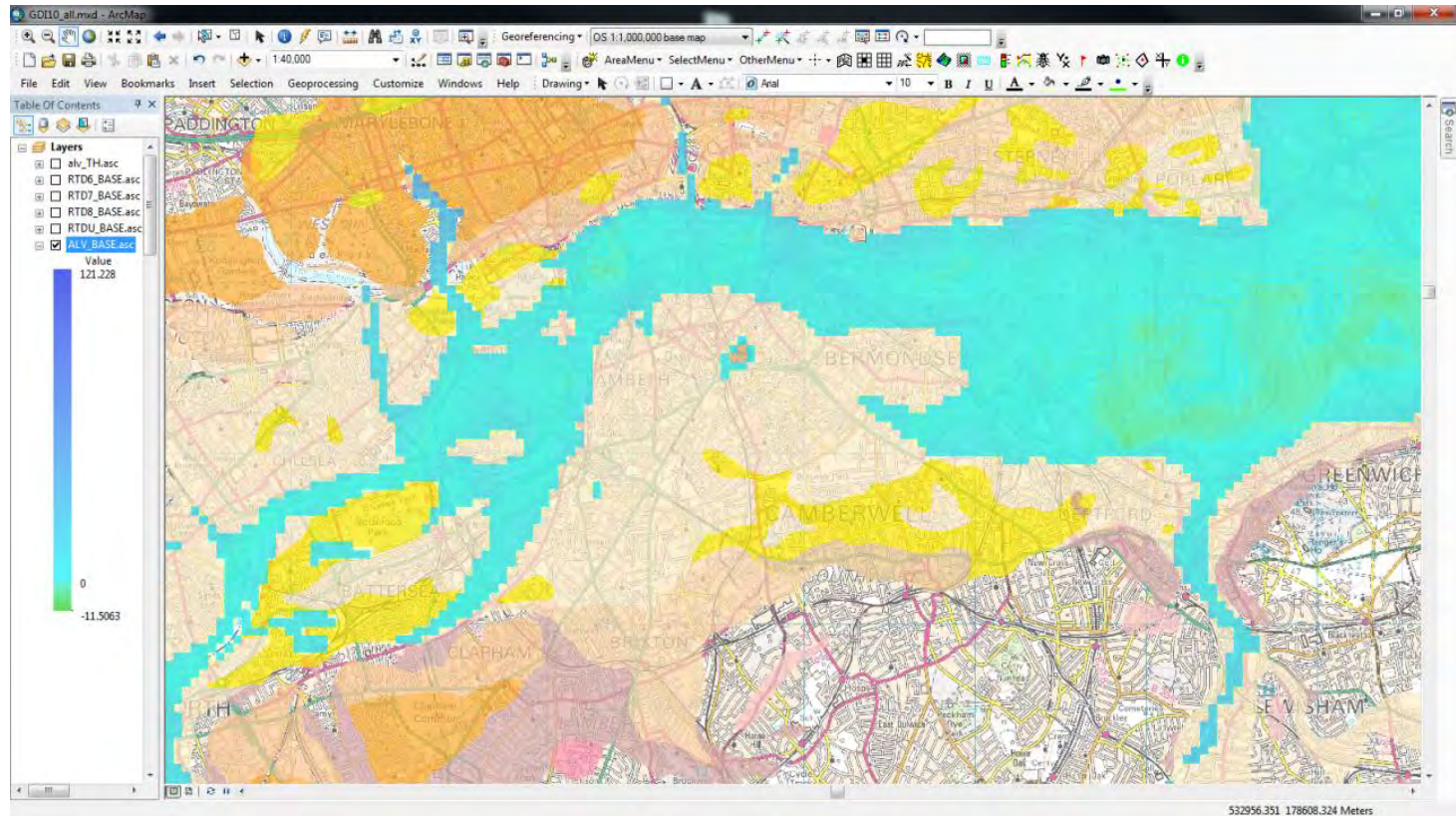
# Getting 3D models to you:

- 3D PDFs



# Getting 3D models to you:

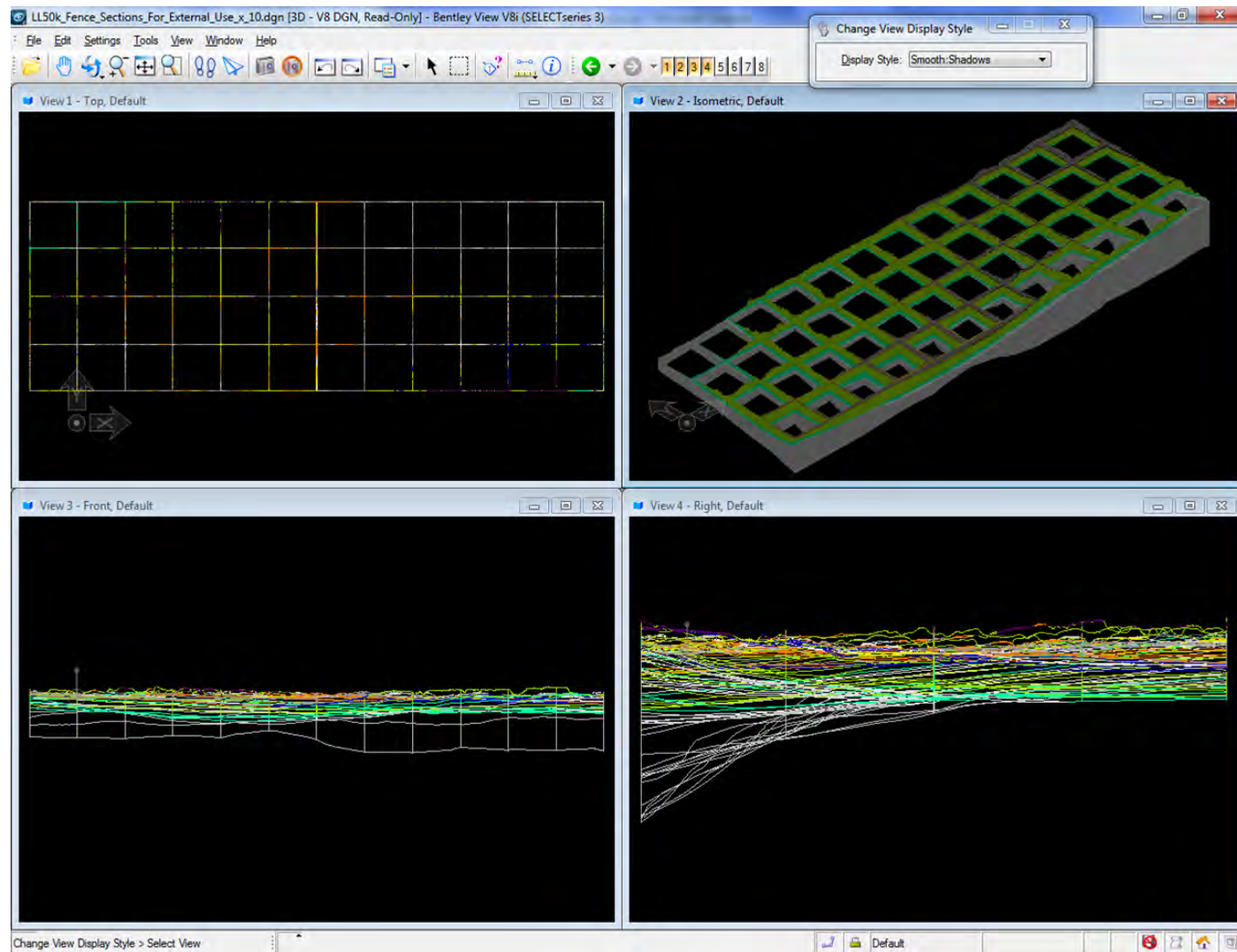
- 3D PDFs
- GIS





# Getting 3D models to you:

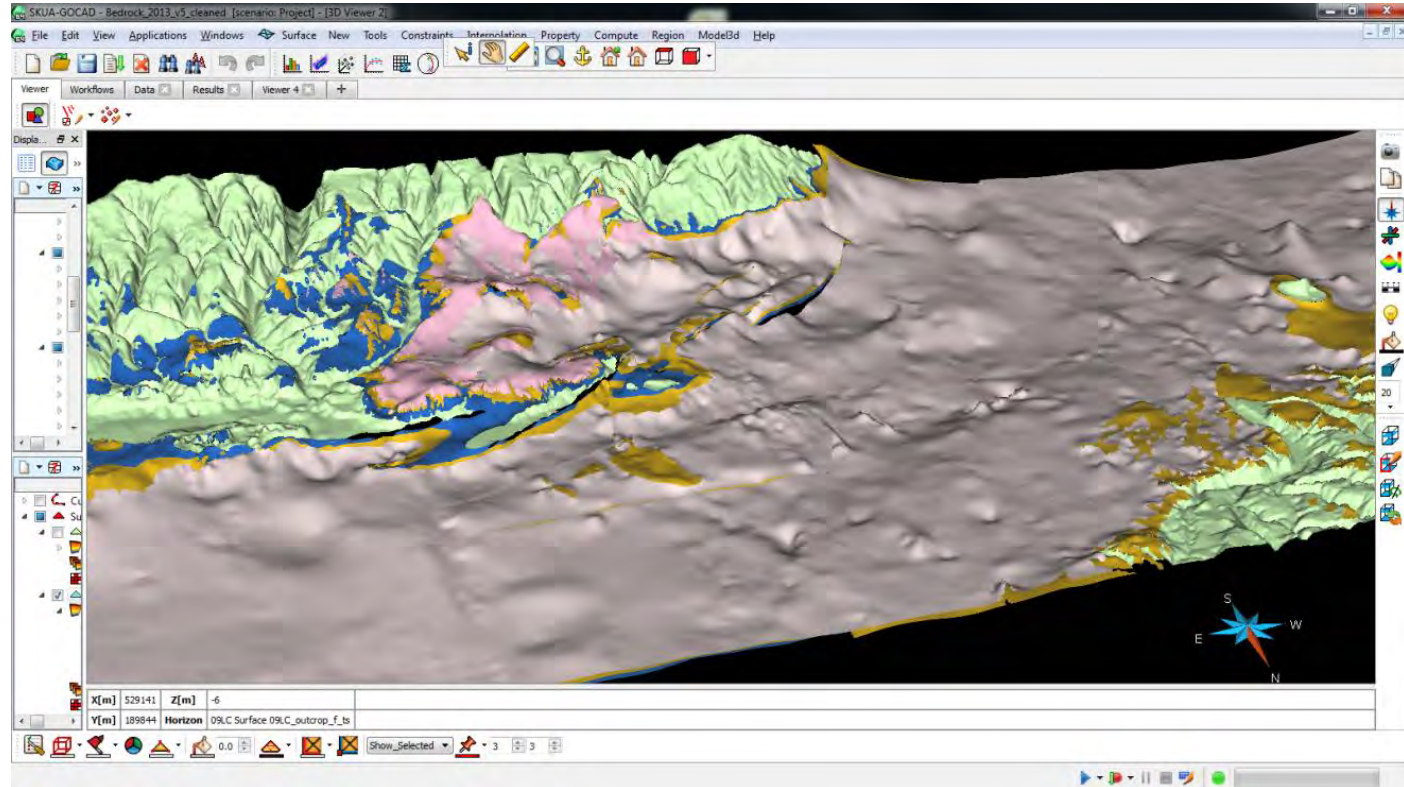
- 3D PDFs
- GIS
- CAD (BIM)





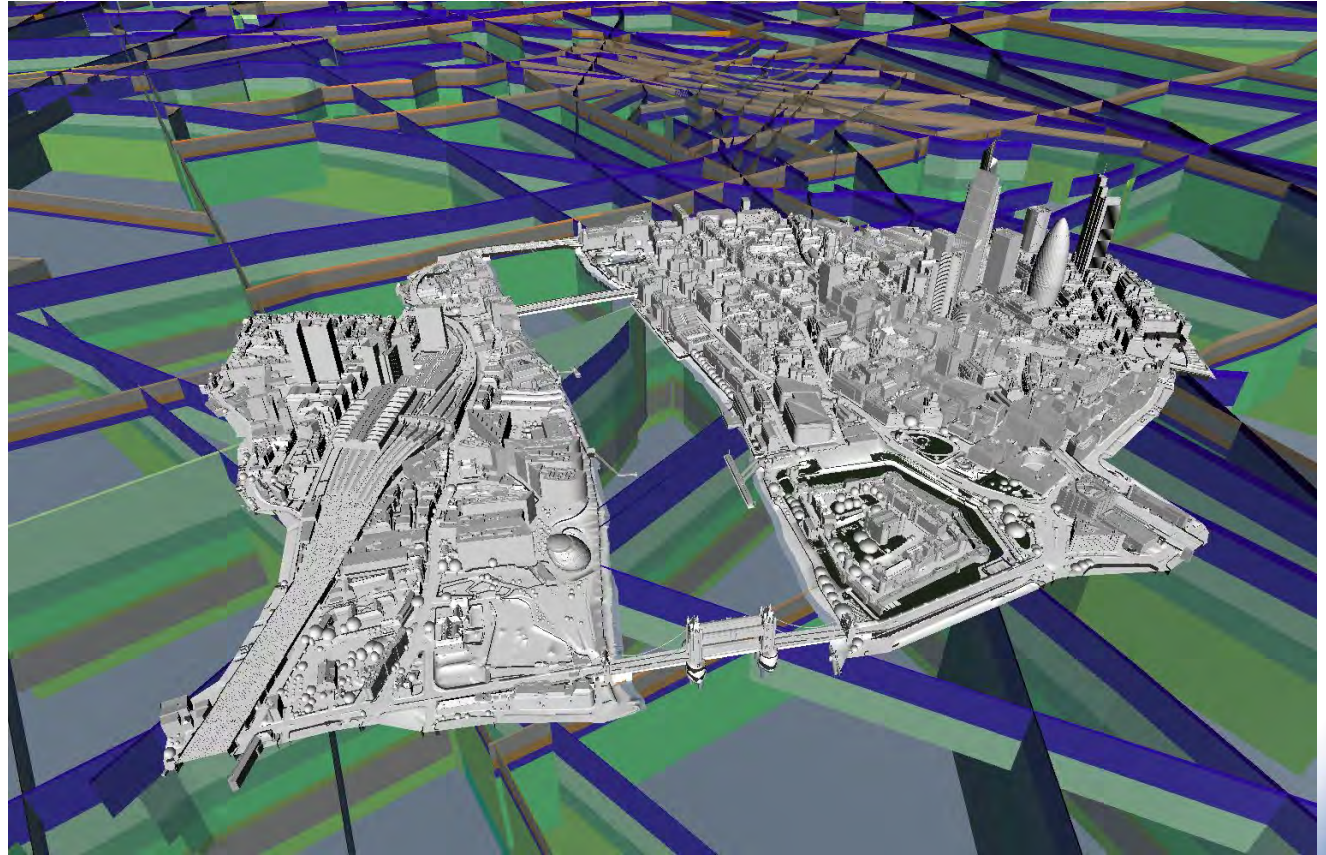
# Getting 3D models to you:

- 3D PDFs
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- CAD (BIM)
- Modelling software



# Getting 3D models to you:

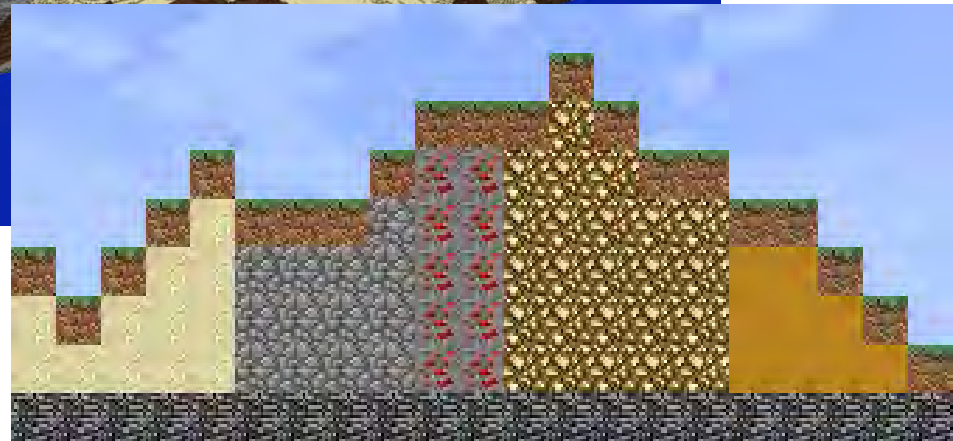
- 3D PDFs
- GIS
- CAD (BIM)
- Modelling software
- Visualisation packages





# Getting 3D models to you:

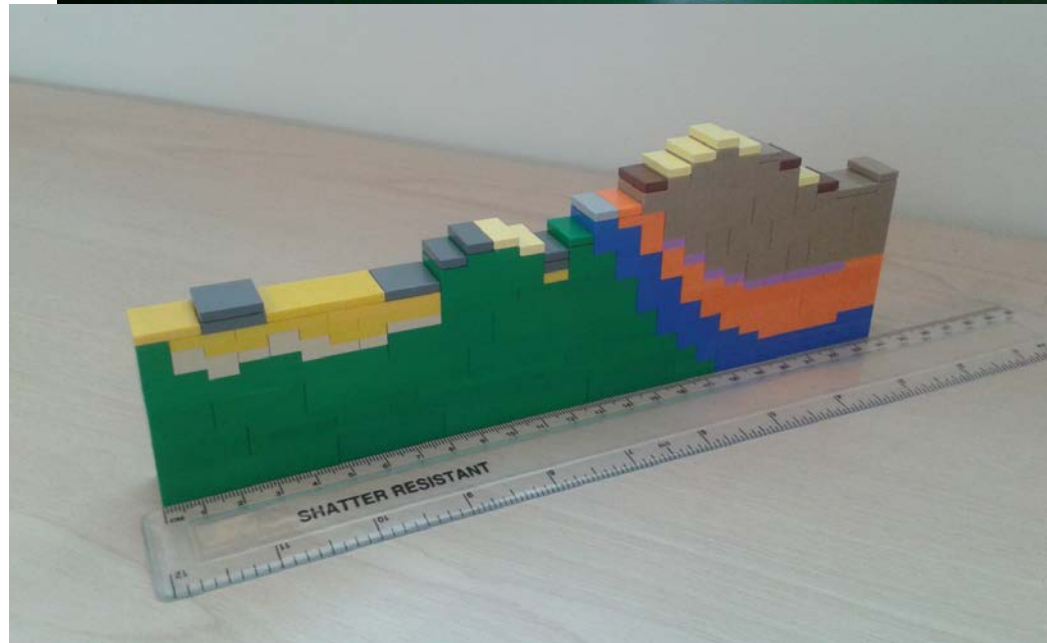
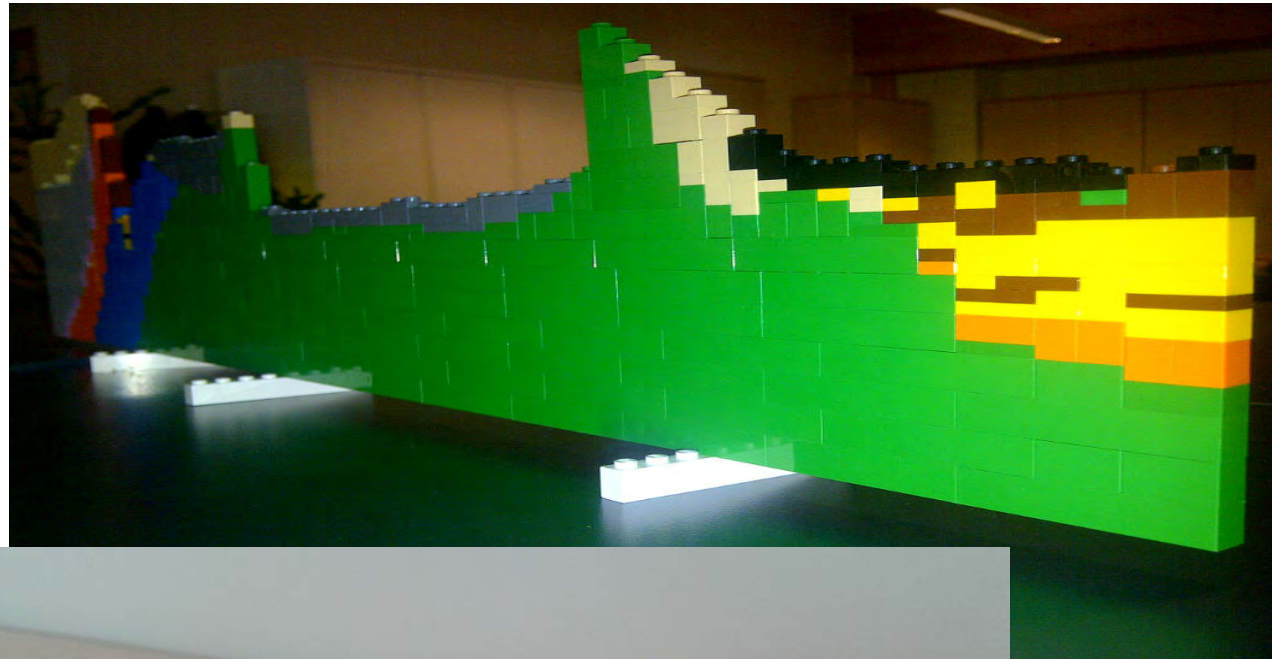
- 3D PDFs
- GIS
- CAD (BIM)
- Modelling software
- Visualisation packages
- Minecraft





# Getting 3D models to you:

- 3D PDFs
- GIS
- CAD (BIM)
- Modelling software
- Visualisation packages
- [Minecraft](#)
- Lego!



# Summary:

We are on a journey of improving the delivery of complex science that is fit for purpose

**All models are wrong some are useful**

George E. P. Box (Statistician)

We hope the London model will be useful to you, so, use it, tell us about it and ultimately help us to improve it....

[enquiries@bgs.ac.uk](mailto:enquiries@bgs.ac.uk)