OR/14/029 Model datasets used

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H Burke, S J Mathers, J P Williamson, S Thorpe, J Ford and R L Terrington. 2014. *The London Basin superficial and bedrock LithoFrame 50 Model*. Nottingham, UK, British geological Survey.

The model covers eight 1:50 000 scale England & Wales series geological map sheets: 254 (Henley-on-Thames), 255 (Beaconsfield), 256 (North London), 257 (Romford), 268 (Reading), 269 (Windsor), 270 (South London) and 271 (Dartford); together with thin small portions of a further 14 1:50 000 scale map sheets: 238 (Aylesbury), 239 (Hertford), 240 (Epping), 241 (Chelmsford), 253 (Abingdon), 258–259 (Southend and Foulness), 267 (Hungerford and Newbury), 272 (Chatham), 283 (Andover), 284 (Basingstoke), 285 (Guildford), 286 (Reigate), 287 (Sevenoaks) and 288 (Maidstone). These 1:50 000 scale map sheet areas are named and their extents are shown in blue in Figure 3, with the Area 1–12 tiles outlined in red.

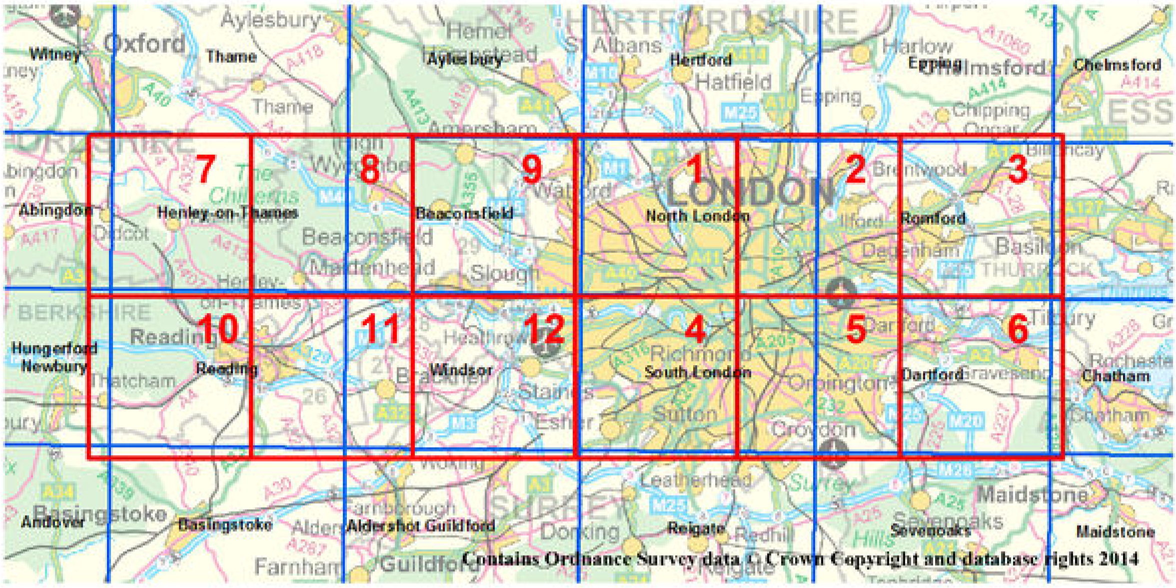

Figure 3 1:50 000 scale geological map sheets corresponding to the model.

DiGMapGB-50 geology polygons were selected from the national DiGMapGB-50 dataset with a buffer of 1-2 km for each tile using a GIS. Polygons that are split at 1:50 000 map sheet boundaries were dissolved into single polygons in the combined GSI3D project. The DiGMapGB-50 extract was checked for inconsistencies, such as polygon attributes changing at the map sheet boundaries, and these were rationalised where possible with precedence given to the more recent survey and nomenclature. The London Basin model therefore updates the geology of the DiGMapGB-50 version 6.

Because the model was constructed over a number of years, several versions of DiGMapGB-50 were used. Table 2 lists the DiGMapGB-50 version initially used for each model tile.

Table 4 List of DiGMapGB-50 versions used in the model tiles

Area	DiGMap version and date	Area	DiGMap version and date	Area	DiGMap version and date	Area	DiGMap version and date
1	V3, 2006	4	V 3, 2006	7	V5, 2008	10	V5, 2008

2	V3, 2006	5	V3, 2006	8	V5, 2008	11	V5, 2008
3	V3, 2006	6	V3, 2006	9	V4, 2007	12	V5, 2008

Boreholes

Borehole information was downloaded from the BGS Intranet Data Portal, which automatically generates GSI3D-ready model files. The *bid* file contains the location information of each borehole (easting, northing and start height) and the *blg* file holds the downhole information recorded in the BGS Borehole Geology (BoGe) database. On completion of any borehole coding needed the bid and blg files were downloaded on a tile by tile basis.

As the Intranet Data Portal retrieves every entry in the Borehole Geology database for a given borehole, the blg file contained duplicates where a borehole had been coded for different purposes by different interpreters. For example, a borehole coded for the production of a national Rockhead (base of Quaternary) model may have been re-coded for use in the London Basin 3D model, but both interpretations appear in the BGS borehole geology database. To address this, the blg file was processed to remove multiple coding entries on a priority basis, using the Content Code (which indicates the purpose of coding) and the identity of the coder. The order of priority was revised for each model tile because different projects had carried out borehole coding in the different areas.

In addition, master bid and blg files were produced for the whole of the London Basin, incorporating the best available interpretation of the geology of each borehole. These files also include some the reinterpreted borehole records coded during in the recent (2013) detailed HS2 route model, which crosses tiles 1 and 9.

In total, 7174 borehole logs were considered in cross-section construction (Figure 4), comprising both confidential and open access borehole data, plus geotechnical boreholes that were absent from the BGS Single Onshore Borehole Index (SOBI). During the project assembly a GIS was used to ensure an even distribution of coded boreholes wherever possible, and additional boreholes were selected for coding from the BGS Borehole Geology database to infill the data poor areas. Selection criteria were drilled depth, borehole location and level of detail in the borehole log. Deeper boreholes were selected preferentially to constrain the deepest geological units, such as the top Chalk surface. The quality of the logs themselves was also important. For example, a recently drilled borehole with a detailed log was selected preferentially over an old log conveying scant information. Old water wells were particularly difficult to use as they often prove the depth of the top Chalk surface, but provide no information on the thickness or composition of overlying units.

Boreholes were coded in the BGS Borehole Geology database using the content code ‘LS’ (London Strategic Model), which identifies coding specific to this project. To standardise the borehole coding, the superficial deposits coding scheme (Cooper et al. 2006[1]) was used, where single letter codes represent the main lithologies (boulders are represented by the letter B, L is for cobbles, V for gravel, S for sand, C for clay, Z for silt and P for peat). For mixed compositions, the main lithology is coded first, with additional lithologies added to the right in order of decreasing proportion. An example of how the codes can be applied to increasingly mixed lithologies is shown in Table 5. In this scheme, almost any combination of the letter codes is permissible.

Table 5 An example of the superficial deposits coding scheme

Clay	Silty clay	Sandy, silty clay	Gravelly, sandy, silty clay	Gravelly, sandy, silty clay with cobbles	Gravelly, sandy, silty clay with cobbles and boulders
C	CZ	CZS	CZSV	CZSVL	CZSVLB

Where a Borehole Geology database entry already existed for a borehole, it was not re-coded if the level of detail was sufficient for modelling. However, where a borehole only conveyed the depth of Rockhead, it was re-coded to maximise the data available for the 3D model. A selection of borehole logs were coded in areas with a high borehole density because of the sheer number of them, and only the deepest or most detailed logs were selected for coding where clusters occurred.

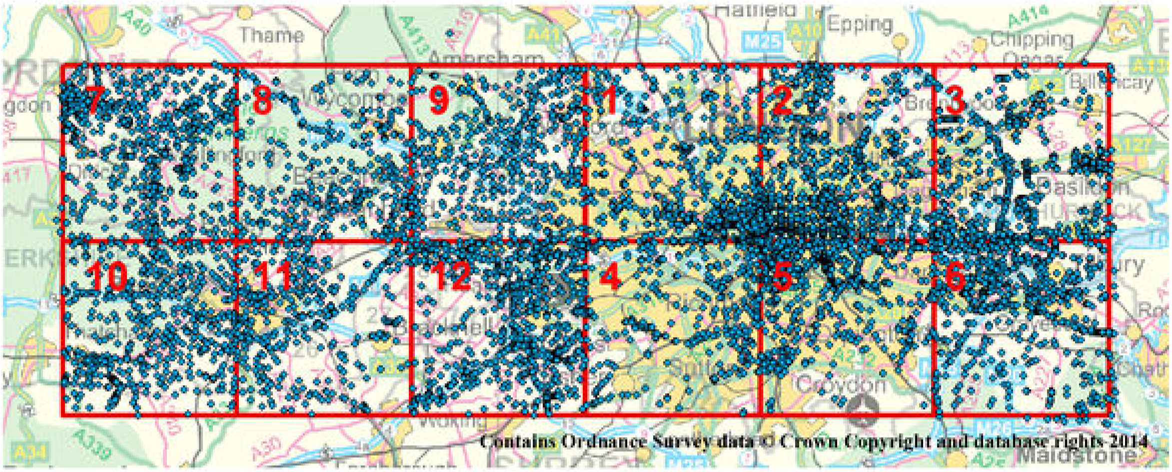

Figure 4 Location of borehole logs consulted in model construction.

Digital terrain model (DTM)

All individual model tiles used a DTM in ASCII grid format, sub-sampled from the superseded 5 m resolution CEH DTM or the later, also superseded, 5 m NextMap DTM. These DTM extracts were downloaded via the BGS Intranet Data Portal and were converted to TINs within the GSI3D project to cap each model. Tiles 1–6 initially used a DTM with a cell size of 25 m, and tiles 7–12 were constructed using a 50 m DTM.

The combined model is now capped by a BGS produced Bald Earth DTM with a 100 m cell size. This DTM is based on the same NextMap DTM as before but with Ordnance Survey Landform Profile data inserted for extensive wooded areas as the NextMap DTM was found to be unreliable in these locations, it often depicted the top of the tree canopy rather than the actual ground surface.

Legacy and other 3D model data

Thames Gateway models

Tiles 2, 3, 5 and 6 overlap pre-existing unapproved LithoFrame 10 Thames Gateway 3D models (shown as the blue hatched area in Figure 5). In tiles 2, 3, and 5, the Thames Gateway model data was not incorporated but was replaced by the London Basin model.

In Tile 6, the Thames Gateway cross-sections and envelopes (unit coverages) were retained and extended to the edge of this tile, with the correlation lines reassessed, matched to the 1:50 000 scale map linework and the previously completed model tiles. The stratigraphy of these Thames Gateway cross-sections were simplified to fit the schema of the London Basin model, in particular including the removal of subdivisions within the alluvium. The earlier Thames Gateway project borehole coding was retained and decisions on whether to accept these earlier interpretations were decided on a case by case basis in the context of the revised cross-sections.

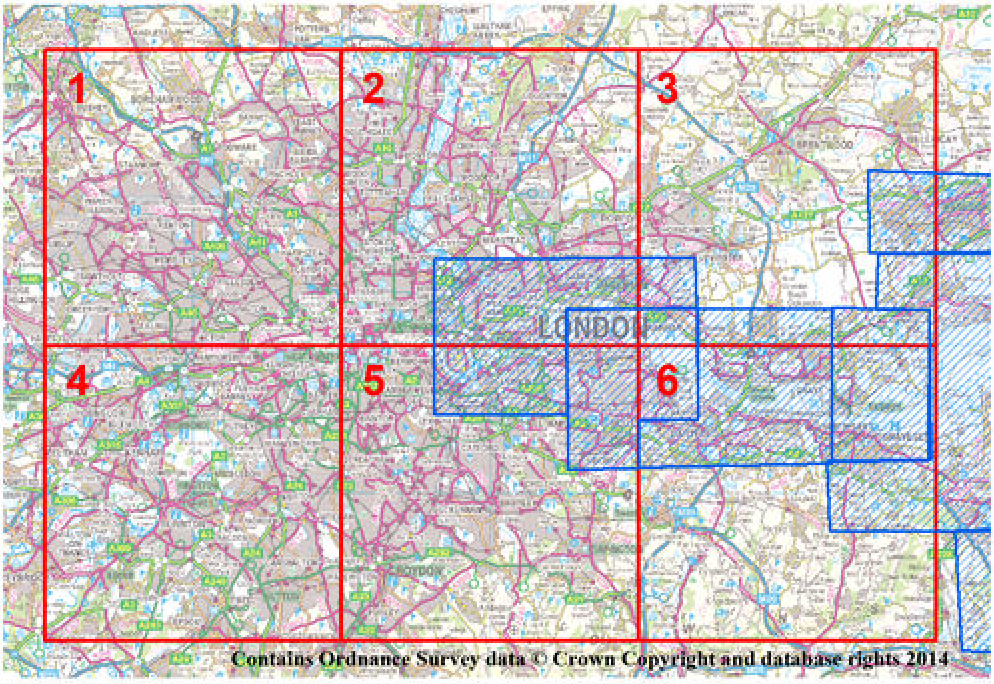

Figure 5 The Thames Gateway models, shown in blue hatching.

HS2 route model

The 1:10 000 scale HS2 route model, commissioned by HS2 Ltd in 2013, adds more detail to the London Basin LithoFrame 50 regional model in tiles 1 and 9. This involved a reinterpretation of borehole data within the HS2 project area (shown in blue shading in Figure 6), which was then incorporated into the London Basin combined borehole files. Extra cross-sections were added into the HS2 area, and these were then incorporated into the London Basin regional model. The superficial deposits correlated in the London Basin model cross-sections were matched to the HS2 cross-sections. The HS2 model conveys greater detail in the anthropogenic deposits than DigMapGB-50, and this was not carried over into the revision of the London Basin model.

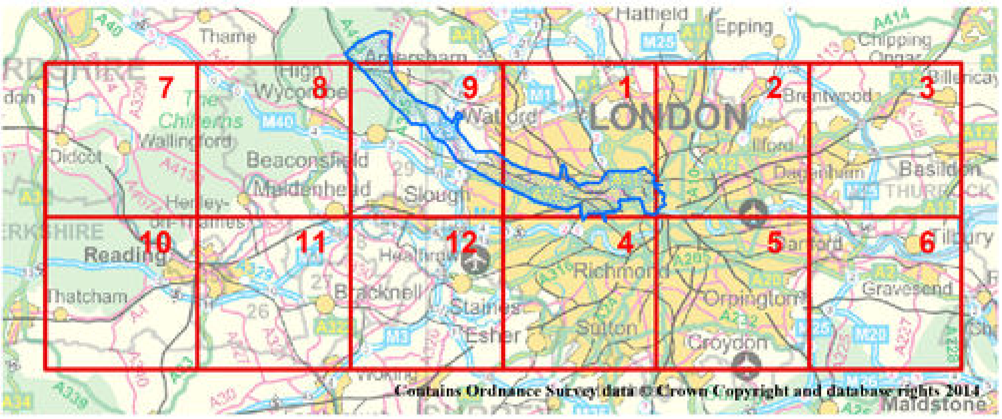

Figure 6 The LithoFrame 10 HS2 route model area, shown in blue stipple.

Other models

In the west, the London Basin Model overlaps with bedrock models for the Berkshire Downs, the Goring Gap, and the Itchen. These do not include significant components of superficial deposits but were considered in the bedrock geology interpretation.

In the east, the London Basin Model overlaps with higher resolution models including, Farringdon, Lower Lea Valley, Thames Flood Prevention, Thames Flood Defence, Tilbury Docks, and ALF Archaeology. It also adjoins a model for Cliffe at Hoo, Kent. These models were not taken into account in the London Basin model, and in some cases (e.g. Farringdon) they post-date the basin wide model and were built using its existing cross-sections as a framework.

There are also two bedrock models referred to as the Inner London Chalk Project (Royse et al. 2010[2]) and Cray-Swanscombe Project that do not include superficial deposits. The former includes a subdivision of the Chalk Group, which was beyond the scope of the current basin model.

The eastern half of the London Basin model coincides with the LOCUS model developed by BGS in the mid 1990s, the new model supersedes it but makes use of some of the borehole coding undertaken for this earlier study.

Artificial ground representation

Artificial ground was already recorded on some 1:50 000 scale map sheets in the model area, but not on others. To address these inconsistencies a GIS-based desk study was carried out to identify instances of artificial ground that were not present in the DiGMapGB-50 or -10 datasets. This involved examining modern 1:10 000 scale topographic maps for areas where the ground surface has been artificially modified, such as in embankments and cuttings along transport routes, reservoirs, etc. At the same time, the existing DiGMap artificial ground data was validated, including the resolution of mismatches across original map sheet boundaries, these were corrected in the model. However, the Artificial Ground categories are excluded from the model calculation because, although they are mapped as coverages in x and y dimensions, there is insufficient data in the model to constrain the base of these deposits (z) and so produce a calculated volume. To date this updated artificial ground information has not been incorporated into the currently released version of DiGMapGB-50.

Data collation

A GSI3D project workspace was set up for each of the model tiles, each contained data relevant to that particular area. This included clipped national DiGMapGB-50 polygon data, a DTM with a cell size of 25 m (in tiles 1–6) or 50 m (tiles 7–12) to cap the model, and the relevant borehole data files. The boreholes, DTM and DiGMapGB-50 polygons were also buffered to include data from slightly outside the tile area in order to provide contextual information. This buffered area also provided data to help constrain the base of geological units in the absence of corresponding data near the edge of a tile.

References

1. ↑ COOPER, A H, KESSLER, H and FORD, J R. 2006. A revised scheme for coding unlithified deposits (also applicable to engineering soils). *British Geological Survey Internal Report* IR/05/123
2. ↑ ROYSE, K , KESSLER, H., ROBINS, N., HUGHES, A..& MATHERS, S. 2010 The use of 3D geological models in the development of the conceptual groundwater model. *Zeitschrift der Deutschen Gesellschaft für Geowissenschaften*, 161 (2). 237–249 doi|10.1127/1860-1804/2010/0161-0237

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