

# OR/18/010 Surface and thickness grid checks

From Earthwise

[Jump to navigation](#) [Jump to search](#)

Terrington, R L, Thorpe, S. 2018. Post-calculation checks of GSI3D Models V2. *British Geological Survey Open Report*, OR/18/010.

An important post calculation check is to generate a grid inspection of the top and base surfaces and the thickness (isopach) maps generated from exports produced from modelling software such as GSI3D and GOCAD®. Areas of extreme high or low values in the thickness of the unit or where there are isolated areas of extreme thickness or thinness of a unit (bulls-eyes) could indicate errors in the correlation or poorly calculated areas ([see Checking grid exports for bulls-eyes](#)). In some cases these could be true representations of the changing thickness of a unit. In all of these cases, it would be necessary to go back to the original model to check if the data corroborates the top and base anomalies and thickness grids produced.

Likewise, by assessing the top and base unit grids it is possible to identify unit areas which may or may not have calculated to their full extents so they appear as holes in the surface grids ([see Checking top and base surfaces for holes](#)).

Surface crossovers can occur for example if the model is poorly constrained, where there are many thin geological units, or the surfaces undulate steeply across the area. By assessing the thickness grids produced, negative values can indicate where these crossovers occur ([see Checking for surface crossovers — negative thicknesses](#)).

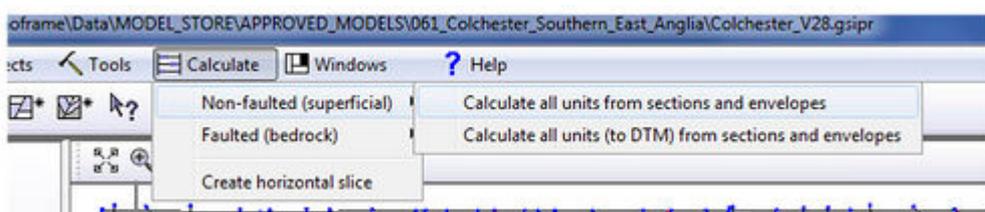
Some other unnatural features may appear from assessing grids, such as the influence of bounding sections between model areas, sometimes known as docking sections. These can unnaturally influence the depths recorded which appear as a linear feature ([see Artefacts from cross-section based modelling](#)).

In the following sections, there are examples of how to produce these outputs, and identify these potential errors in the model.

## Methodology — grid export and import for analysis

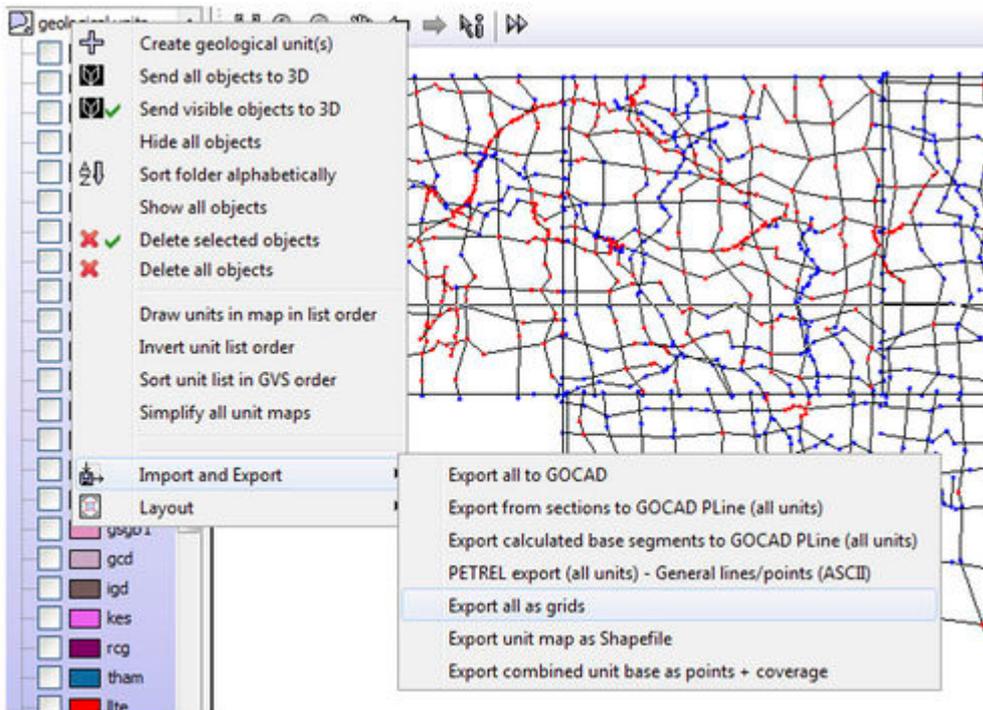
The following steps show how to export grids from a GSI3D project, convert them to ESRI grids and then change their symbology classification to help identify any potential anomalies in the surfaces or thicknesses of the unit. Please note — this will only work for superficial calculated projects in GSI3D but please check if the grids have already been exported before proceeding.

1. Open the GSI3D and calculate the model. Use the **Calculate all units from sections and envelopes (Figure 11)**. The other option actually creates holes in the model where a surface is poorly constrained and results in a calculation above the DTM.



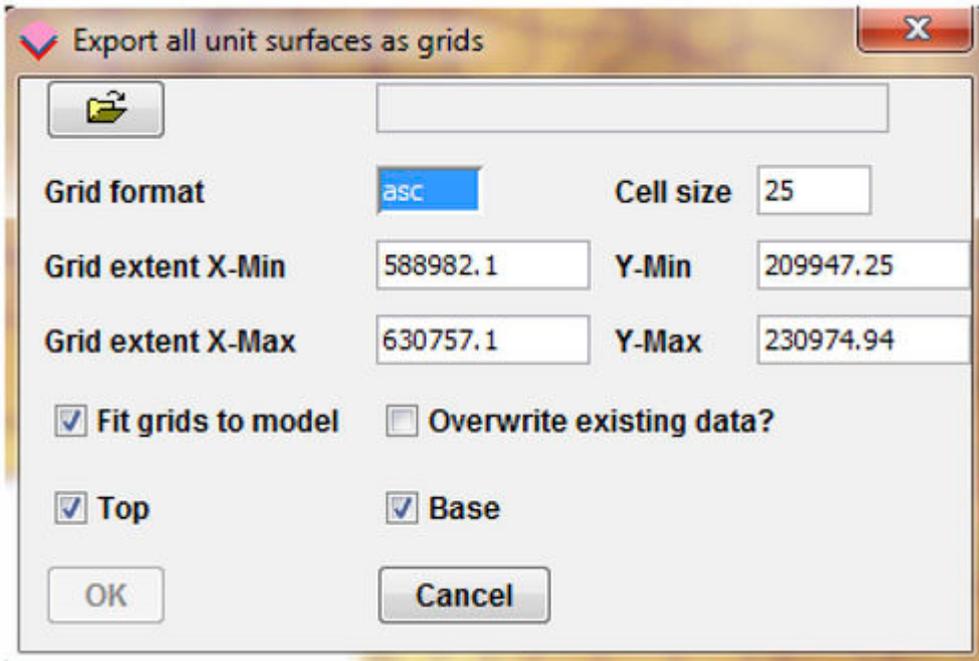
**Figure 11** calculating a GSI3D Model.

2. Once the model has finished calculating, export the grids by right clicking on Geological Units in the Map Window TOC — Import and Export — Export all as grids (Figure 12).



**Figure 12** Exporting grid unit tops, bases and thicknesses from a GSI3D model.

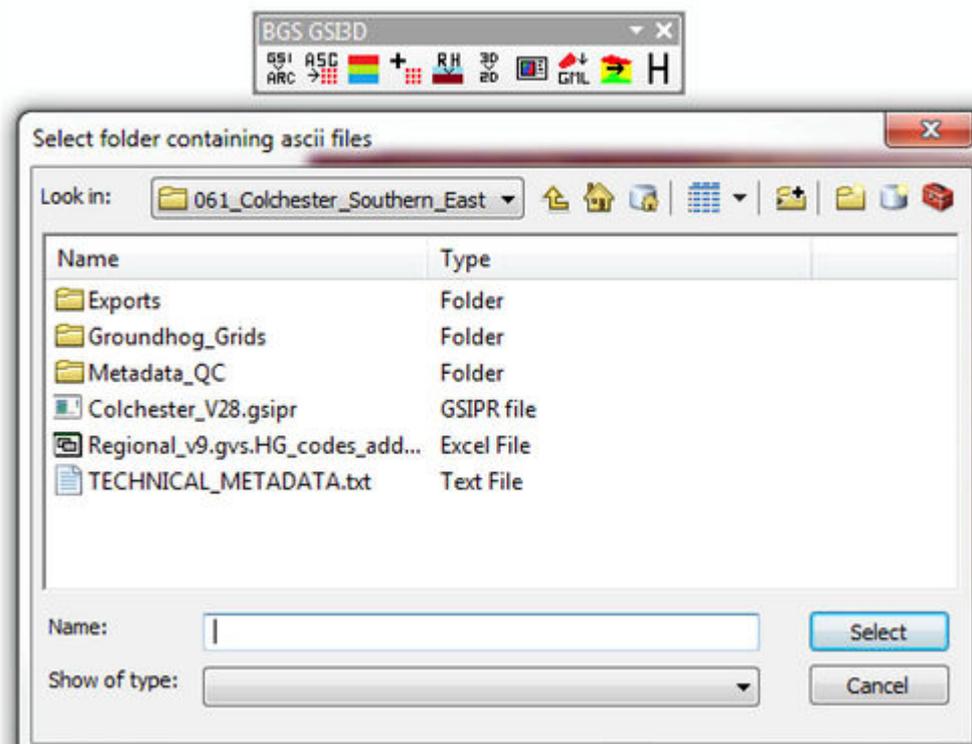
3. The following dialogue will appear. The default grid extent can be kept the same as this gives the full model area. The cell size must be changed to something more suitable depending on the resolution of the DTM and model, such as 25 m or 50 m for superficial models. Even at this cell size, some units may appear patchy such as the thin sinuous units like Alluvium or Head for example. See section 3.3 for more details on checking these units. Select a folder to save the grids to and press OK. (Figure 13).



**Figure 13** Grid export options.

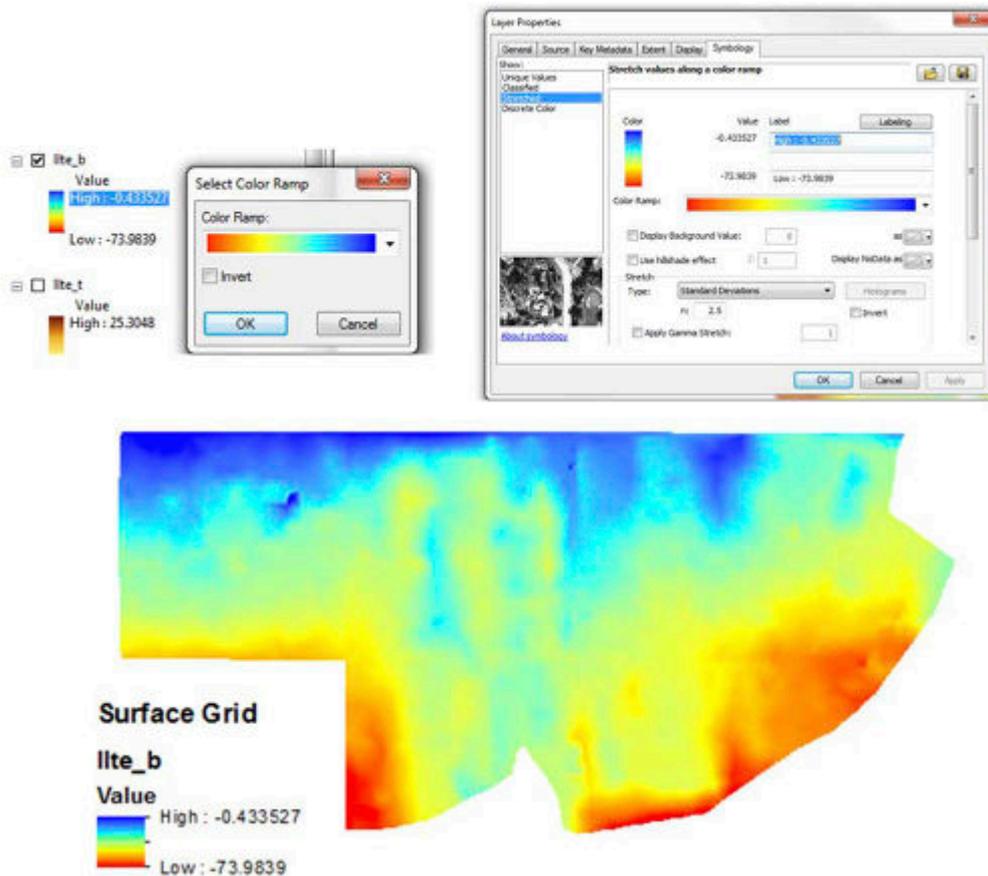
4. These grids will appear as ASCII grids (.asc) in the folder specified. There should be three files for each unit, a base surface (\_B), a top surface (\_T), and a thickness calculated from the top and base surfaces (\_TH). These can be loaded directly into ArcGIS, however it might be necessary to convert them to ESRI grids if to re-classify them using the classified symbology options (See step 5).

5. The ESRI ArcGIS GSI3D toolbar can be used to do a bulk conversion of the ASCII grids to ESRI grids  (Please note — When converting to ESRI grid, any files names of more than 13 characters will not be converted as there is a file name restriction size for ESRI grids — Figure 14)



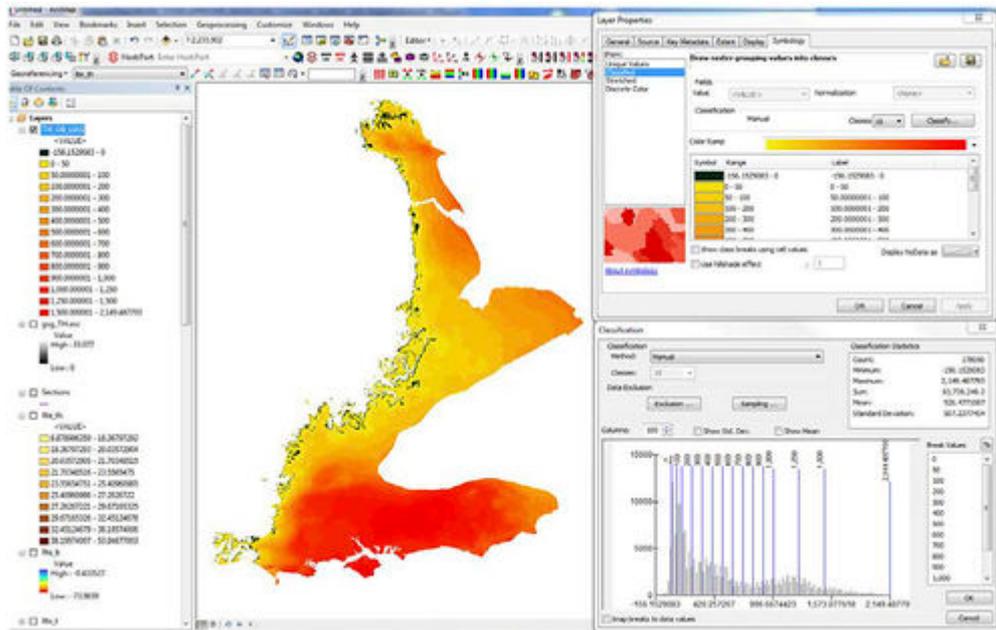
**Figure 14** Bulk conversion of ASCII grid to ESRI grids.

6. The ESRI grids can be imported directly into ArcGIS. To help identify any potential anomalies, the colour ramp for the ESRI grid can be altered as shown in the example below (Figure 15) or re-classified to identify extreme values (Figure 16). To edit the colour ramp, either double left click directly onto the colour ramp and choose a suitable colour ramp to visualise the gridded surface or right click on the grid object — Properties — Symbology and change the colour ramp to something suitable to identify features easily (Figure 15).



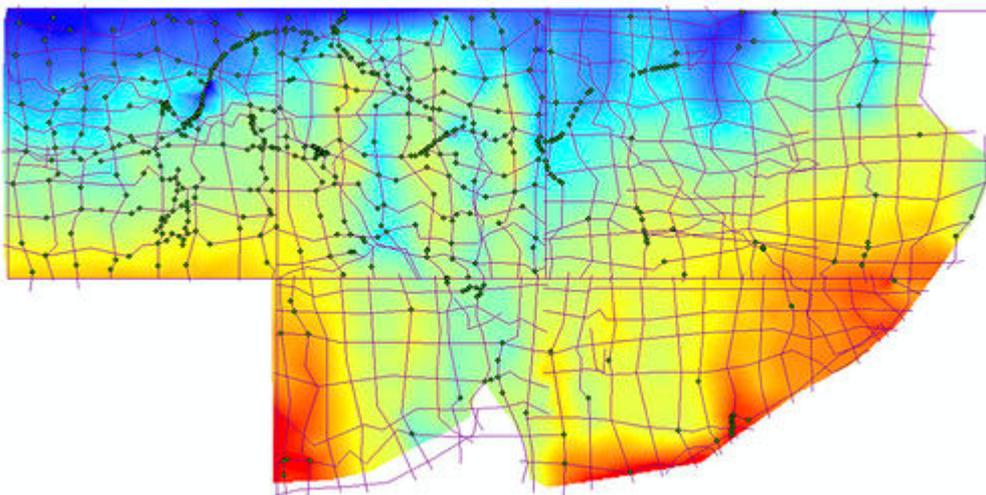
**Figure 15** Colour ramping grid data.

7. By re-classifying the data colour ramp into partitions, it is possible to identify extreme values, or values that should not occur such as negative thickness values. In the example below, the **Break Values** have been adjusted for the thickness grid data of the Top Lias to the ground surface. Therefore anything below zero is coloured up as black and can be identified easily within the map view (Figure 16).



**Figure 16** Re-classifying data using break values.

8. An additional export from the GSI3D project which can increase the speed in which to identify any anomalous data are the GSIPR exports using the ArcGIS toolbar. . This tool exports the sections, boreholes and envelopes as shapefiles. These can be added to the ArcGIS project and by using the boreholes and sections overlain onto the grid exports, potential anomalies within the GSI3D data can be identified quickly (Figure 17).

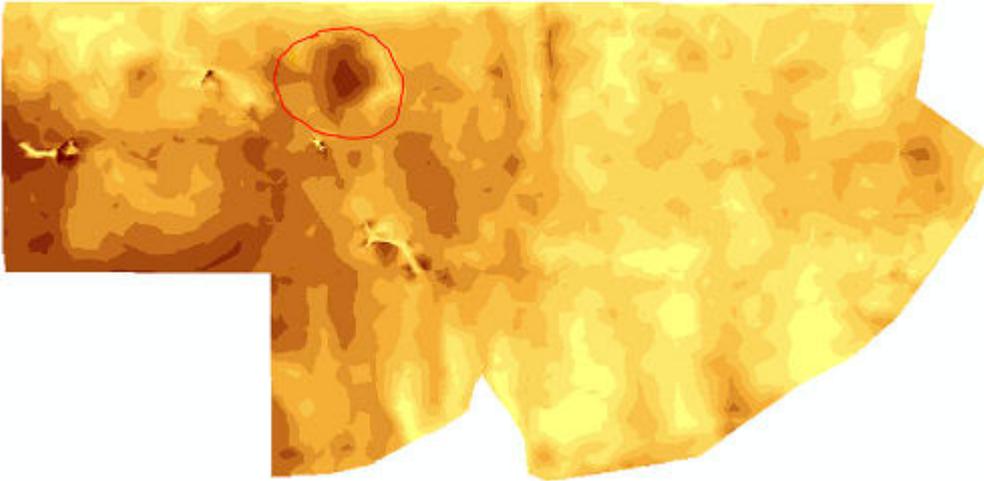


**Figure 17** Grid (with colour ramp), section and borehole locations.

## Checking grid exports for bulls-eyes

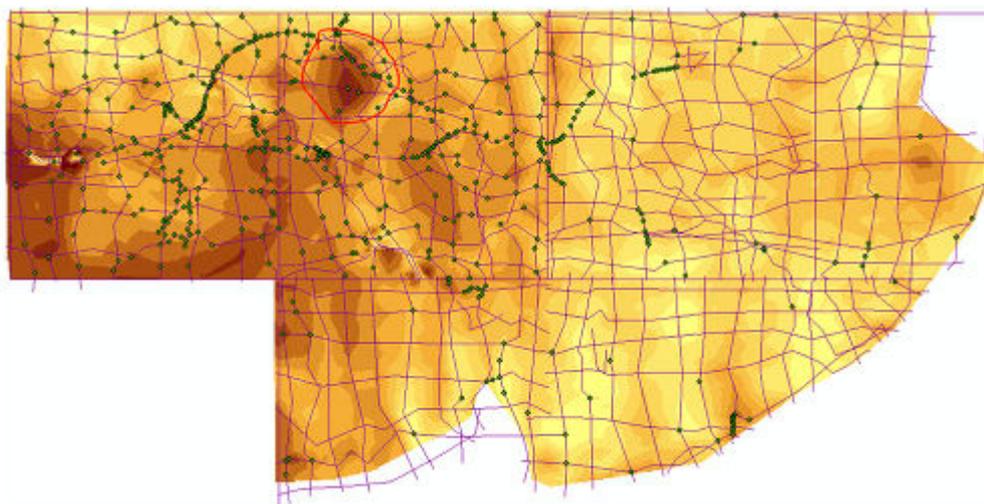
Bulls-eyes in surfaces or thickness grids indicate sharply changing gradients in isolated areas. These might be natural features such as scour hollows (Royse et al., 2008<sup>[1]</sup>) into which there are terrace gravel infills into the upper bedrock surface which commonly occur in London, or dissolution hollows where material may have collapsed and fallen into hollows into rocks that are susceptible to dissolution. Faulting in bedrock surfaces may show sharp undulations in the top and base surfaces, however, the thickness of that unit should remain quite consistent between these faults. These are just a few examples where these types of artefacts reflect natural variations in the geological structure.

However, in some instances these might be artefacts caused from a poor calculation of the surface, mistakes in the interpretation or a lack of data. Below is an example of a potential bulls-eye highlighted in red (Figure 18)



**Figure 18** Bulls-eye identification.

By overlaying the sections and boreholes, the potential problem areas can be identified and investigated in GSI3D (Figure 19)



**Figure 19** Bull-eye identification with sections and boreholes.

In this case, there are two sections that go straight through the middle of the bulls-eye and there is a borehole at the intersection of these sections. This can be recorded as a potential area of the model to check, in this case the borehole and intersecting cross-sections. Alternatively, the area may occur between cross-section and boreholes which may indicate a lack of data constraint in that area.

In all cases it will be necessary to go back and check the original model.

## Checking top and base surfaces for holes

By exporting the grids, it is sometimes possible to identify areas where the calculation of that unit does not truly represent the whole extent of that unit both laterally and at depth. This could occur in any unit but is most likely to happen in thin sinuous units such as Alluvium or Head. For example, in Figure 20, the Alluvial envelope shows the extent of the unit as taken from the geological map. The 2nd image in this figure shows the gridded output of the base surface for the alluvial unit.



**Figure 20** Missing parts or holes in model grid exports (Alluvium).

Reasons for this could include:

- Poorly constrained by cross-sections in the GSI3D model
- The resolution of the grid (cell size) is not fine enough to truly represent that unit
- Other units such as Artificial Ground that usually lies above the alluvium may have cut the unit out through human actions. This may account for some of the missing unit in the calculated grid. (Figure 21)



**Figure 21** Artificial Ground (brown) with gridded base Alluvium unit (black).

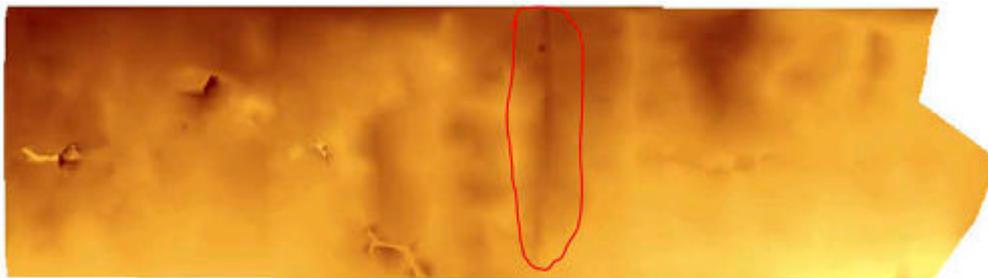
## Checking for surface crossovers – negative thicknesses

As shown in Figure 16 in [Methodology – grid export and import for analysis](#), negative thicknesses can occur where there are surface to surface crossovers or where a calculated surface occurs above the DTM (more commonly found in GOCAD regional models). They are unlikely to be found in the GSI3D derived grid exports because of the nature of the calculation. However, they are found in GOCAD derived grid exports, particularly close to subcrop and outcrops where the unit thins.

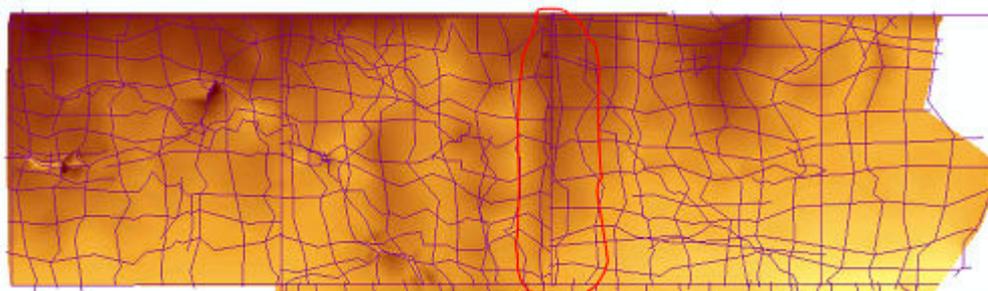
## Artefacts from cross-section based modelling

Occasionally, features can appear in surfaces generated from modelling software which are not natural features but are artefacts of where sections have been drawn or anomalous points in the dataset have been used, such as an incorrect borehole level. Point data will often appear as bulls-

eyes (please refer to [Checking grid exports for bulls-eyes](#)). The other common artefact from GSI3D (or other section drawn 3D geological models), are linear features that are corresponding to the line of section (Figure 22). This is partly due to the method used in GSI3D which is a direct interpolation of the correlation points which means that the surface is not smoothed as in other 3D modelling software. In Figure 23, the section location corresponds to the unnatural artefact in the surface generated (a docking section between two model areas that have been modelled at different times).



**Figure 22** Linear artefact in model surface.



**Figure 23** Linear feature with cross-sections.

## Suggested alternative checks

Contours are a useful method for identifying structures in bedrock, especially areas of faulting or folding for top or base surfaces. Contours could also be used to identify anomalous data where areas of the model steepen or thicken/thin unnaturally.

For GOCAD/SKUA generated models it is possible to check the thickness of a unit within the software by using the **Distance to Surface** function which enables the user to map the distance (thickness) as a property for the surface of interest. This also identifies any potential crossovers between surfaces.

## Reference

1. [↑](#) Royse, K, Reeves, H, and Gibson, A. 2008. The modelling and visualisation of digital geoscientific data as an aid to land-use planning in the urban environment, an example from the Thames Gateway. 89-106 in *Communicating environmental geoscience*. Liverman, D G E, Pereira, C, and Marker, B (editors). *Special publication*, 305. (London, UK: Geological Society London.)

Retrieved from

[http://earthwise.bgs.ac.uk/index.php?title=OR/18/010\\_Surface\\_and\\_thickness\\_grid\\_checks&oldid=35916](http://earthwise.bgs.ac.uk/index.php?title=OR/18/010_Surface_and_thickness_grid_checks&oldid=35916)

[Category:](#)

- [OR/18/010 Post-calculation checks on GSI3D Models V2](#)

# Navigation menu

## Personal tools

- Not logged in
- [Talk](#)
- [Contributions](#)
- [Log in](#)
- [Request account](#)

## Namespaces

- [Page](#)
- [Discussion](#)

## Variants

## Views

- [Read](#)
- [Edit](#)
- [View history](#)
- [PDF Export](#)

## More

## Search

## Navigation

- [Main page](#)
- [Recent changes](#)
- [Random page](#)
- [Help about MediaWiki](#)

## Tools

- [What links here](#)
- [Related changes](#)
- [Special pages](#)
- [Permanent link](#)
- [Page information](#)

- [Cite this page](#)
- [Browse properties](#)

• This page was last modified on 15 March 2018, at 11:18.

- [Privacy policy](#)
- [About Earthwise](#)
- [Disclaimers](#)

