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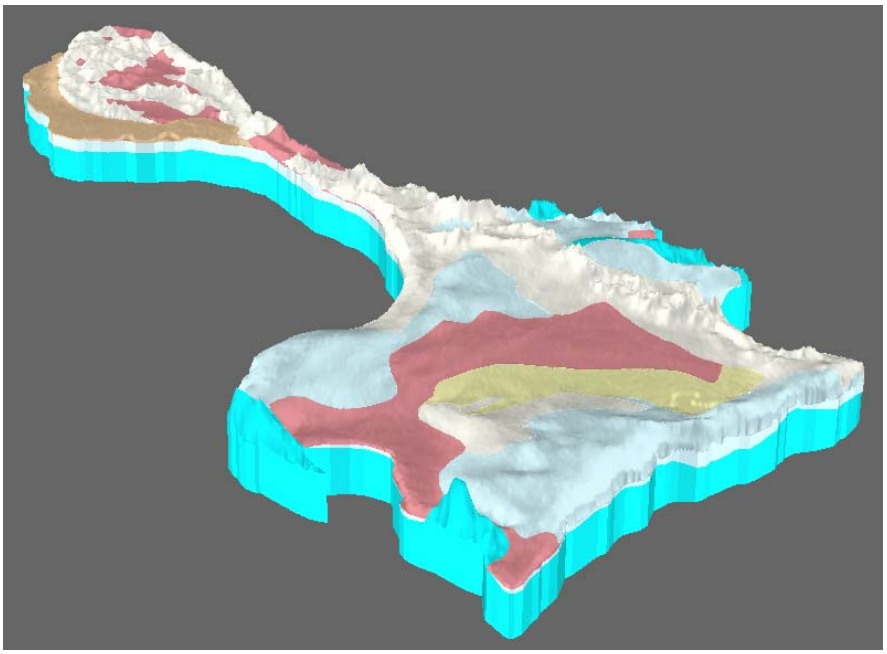
# Model Metadata Report for a 3d Model of Holy Island

Geological Modelling Systems Programme

Internal Report IR/13/005



BRITISH GEOLOGICAL SURVEY

GEOLOGICAL Modelling Systems PROGRAMME

INTERNAL REPORT IR/13/005

# Model Metadata Report for a 3d Model of Holy Island

S Thorpe and H Gow



*Keywords*

Report; Holy Island; GSI3D; 3d Model; Metadata.

*National Grid Reference*

SW corner 408130,641043
Centre point 411559,642706
NE corner 414593,644514

*Map*

Sheet 4, 1:50 000 scale, Holy Island

*Front cover*

View of the 3d model looking from SE corner across the causeway.

*Bibliographical reference*

THORPE, S, GOW, H. 2013. Model Metadata Report for a 3d Model of Holy Island. *British Geological Survey Internal Report*, IR/13/005. 14pp.



Keyworth, Nottingham British Geological Survey 2013

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# Foreword

This report is the published metadata details of a 3d modelling study by the British Geological Survey (BGS), and is based on Holy Island. The model was developed under the 3d Models for Teaching team, part of the Geological Modelling Systems program at BGS. 3D geological models have great potential as a resource for universities when teaching foundation geological concepts as it allows the student to visualise and interrogate UK geology. They are especially useful when dealing with the conversion of 2D field, map and GIS outputs into three dimensional geological units, which is a common problem for all students of geology. Today's earth science students use a variety of skills and processes during their learning experience including the application of schema's, spatial thinking, image construction, detecting patterns, memorising figures, mental manipulation and interpretation, making predictions and deducing the orientation of themselves and the rocks. 3D geological models can reinforce spatial thinking strategies and encourage students to think about processes and properties, in turn helping the student to recognise pre-learnt geological principles in the field and to convert what they see at the surface into a picture of what is going on at depth.

# Acknowledgements

A number of individuals have contributed to the project. This assistance has been received at all stages of the study. In addition to the collection of data, many individuals have given their advice, and provided local knowledge. We would particularly like to thank the following:

Emma Ward

Ricky Terrington

Steve Mathers

Dave Milward

# Contents



**FIGURES**



**TABLES**

# Summary

This report summarises the data and information used in the construction of the model of Holy Island, and the procedures and standards used to ensure its integrity.

# 1 Modelled volume, purpose and scale

This model concentrates on the superficial deposits found on Holy Island and sets this against a generic bedrock block (no specific bedrock units are depicted). The model is shown to a depth of -20m OD and is suitable for use at 1:50,000 scale. The model depicts five superficial units and one bedrock (generic) unit. The model was created as a simplified conceptual model of the area, and it is intended that this be used as a teaching aid to help understand the concepts of tidal deposition, potential impacts of sea level rise, evidence for past sea levels as well as dune development from prevailing wind and sediment erosion from prevailing current.

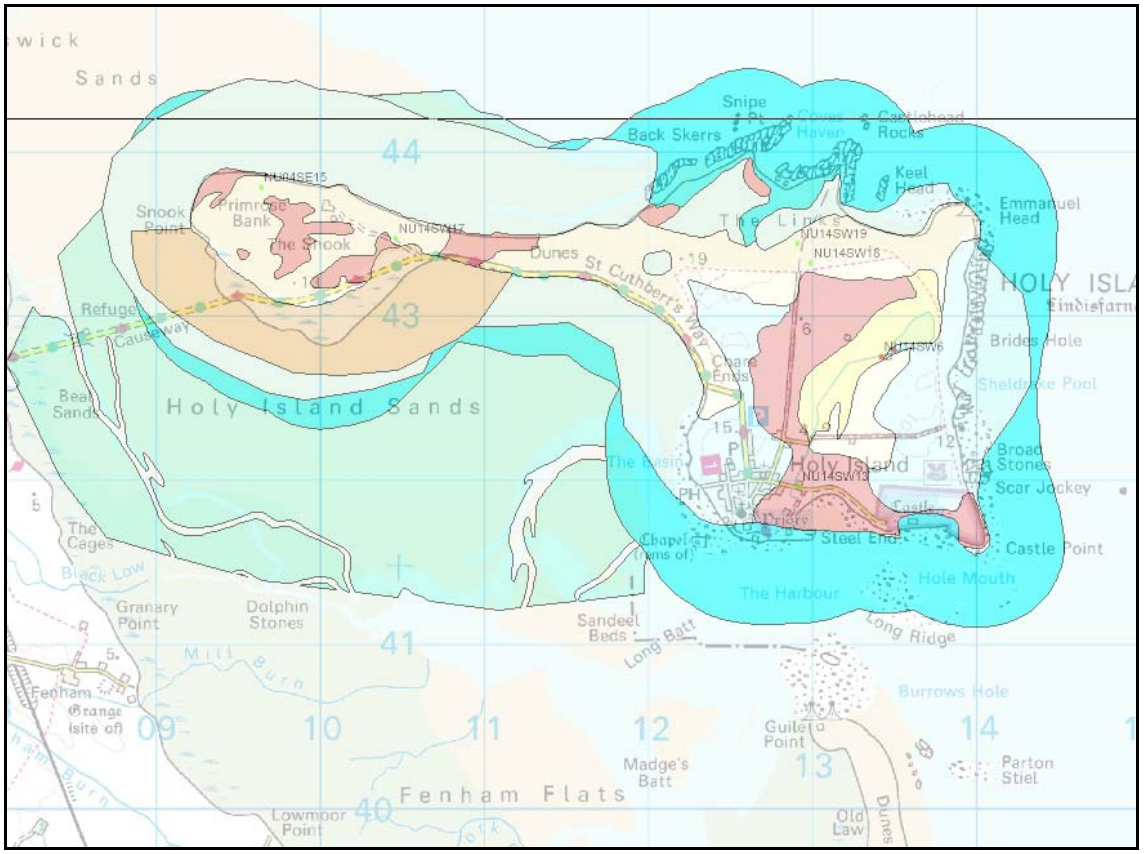


**Figure 1 - Model area showing geology**

# 2 Modelled surfaces/volumes

The Holy Island model began life as a much more complicated model, with the intention to model more units than were finally generated. Thus the model development log (section 4) shows two distinct phases of development. The Phase Two model concentrates on the superficial deposits in this tidal and dune ridge area and the final units modelled are:

- Blown Sand

- Beach Deposits, undifferentiated
- Alluvium
- Raised Beach Deposits
- Glacial Till
- Bedrock, undifferentiated

The surfaces were chosen to best represent the current superficial mapping, but the final distributions of some of the units (beach deposits, for example) was largely driven by the topography as the mapping was done many years previous and the DTM reflects the more recent dune development.

The initial start of the project was intended to include the bedrock units as mapped, but this was soon revised as the bedrock in this area included intrusions and deeply dipping strata which the software found difficult to handle.

# 3 Model datasets

Derivation and processing of (including date and by whom):

- DTM – S Thorpe produced the 10m DTM via the GSI3D Terrain Creation tool, and subsampling the BaldEarth Model.
- Borehole data – H Gow coded boreholes and created the borehole files necessary for GSI3D from scratch.
- Map data – 50k DiGMapGB was used
- GVS/GLEG used – the table below shows these two files

**Table 1 - GVS used in Holy Island 3d model**

| name | id | Unit-Name | Stratigraphy | Lithology | Description |
|---|---|---|---|---|---|
| Blown Sand | 5 | Blown Sand | BSA | S | Blown Sand |
| Beach Deposits | 10 | Beach Deposits | BCHD | S | Beach Deposits |
| Alluvium | 15 | Alluvium | ALV | XCZSV | Alluvium |
| Raised beach gravel | 20 | Raised beach gravel | RGB | XSV | Raised beach gravel |
| Till | 22 | Till | TILL | DMTN | Diamicton Boulder clay |
| Bedrock | 25 | Bedrock | BEDROCK | ROCK | Bedrock undifferentiated |

**Table 2 - GLEG used in Holy Island 3d model**

| | | | | | |
|---|---|---|---|---|---|
| BCHD | Description | 236 | 200 | 146 | 255 |
| BSA | Description | 254 | 254 | 236 | 255 |
| ALV | Description | 254 | 254 | 174 | 255 |
| RGB | Description | 236 | 146 | 146 | 255 |
| FFL | Description | 116 | 254 | 236 | 255 |
| TYL | Description | 116 | 254 | 236 | 255 |

| | | | | | |
|---|---|---|---|---|---|
| AG | Description | 174 | 254 | 236 | 255 |
| NETD | Description | 254 | 0 | 254 | 255 |
| Beach Deposits | Description | 236 | 200 | 146 | 255 |
| Blown Sand | Description | 254 | 254 | 236 | 255 |
| Alluvium | Description | 254 | 254 | 174 | 255 |
| Raised beach gravel | Description | 236 | 146 | 146 | 255 |
| Till | Description | 218 | 254 | 254 | 255 |
| Bedrock | Description | 0 | 255 | 255 | 255 |
| S | Description | 255 | 255 | 102 | 255 |
| XCZSV | Description | 153 | 204 | 204 | 255 |
| XSV | Description | 255 | 204 | 102 | 255 |
| DMTN | Description | 150 | 228 | 228 | 255 |
| ROCK | Description | 184 | 184 | 184 | 255 |
| Diamicton Boulder clay | Description | 218 | 254 | 254 | 255 |
| Bedrock undifferentiated | Description | 0 | 255 | 255 | 255 |

# 4 Model development log

This development log shows the evolution of the project from the initial idea of which units 'could' be modelled, to the final phase two development of the model.

**Metadata Log**

50K bedrock and Superficial DiGMapGB data to be used
DTM is 125 (Thorpe questions this entry as further down this log it states 5m?)
**Holy_Island_v0.6.gsipr**
Nearly all cross sections finished
**14/9/11 Holy_Island_v0.7.gsipr**
Starting to draw envelopes
BCHD – done
ALV - done
**Holy_Island_v0.8.gsipr**
BSA – done
RGB – done
TILL – done
AG 1 – done
FFL – done
AG 2 – done
TYL – done
AG 3 – done
**Holy_Island_v0.9.gsipr**
Model calculated but needs some work
**15/9/11 Holy_Island_v0.11.gsipr**
Gone through all sections snapping crop lines and tidying up

**Holy_Island_v0.28.gsipr – Offshore 500m**
**Holy_Island_v0.29.gsipr – Clipped to Island coastline**

## Phase 2

Adjustments based on Dave Millward's comments
Deleted all bedrock units, now just one unit called BEDROCK
**9/4/2012**
Holy_Island_V2_11_8.gsipr – changed to 10m DTM calculates much quicker (was 5m)
Edited Holy Island shapefile to match exact high water mark on OS 1:10k basemap
Email sent to Steve Mathers and Emma Ward 18/04/2012

1. The bedrock is now one unit
2. The model boundary has been redrawn and trimmed based on the high water mark shown on the 1:10,000 OS topo map.
3. Blown sand is now the youngest deposit in the GVS and sections have been adjusted to reflect this
4. Correlation lines in the cross sections have been adjusted to match topographical features on the DTM as opposed to following the old superficial mapping (DiGMapGB 50) in accordance with Dave's comment - *This may have arisen in part because of some inevitable discrepancies between the superficial mapping which was done many decades ago (on a map that topographically is not as good as the dtm), and the more recently acquired dtm. Hence we see beach deposits on the side of 'steep' hills where they clearly cannot be. In some of the sections there is an obvious feature defining the back of the beach and to which the geological line should be adjusted.*
5. Raised beach deposits have been changed to be 'cut-out' by the current beach deposits. Dave's comment - *In a number of sections the Raised beach deposits are shown to continue beneath the current beach deposits. This is counter intuitive – do you have evidence for this? Raised beach deposits were formed when sea level was higher than today and this should be "cut-out" by the current deposits. This will necessitate the construction of subcrop lines on the map as relationships such as these are a form of unconformity.*
6. All envelopes have been re-drawn to reflect changes made to the cross sections and also to follow the topographical features on the DTM.

The model still needs some work in terms of tidying up sections, snapping etc but I wanted to just get someone to give it the once over. If all is ok then it can be packaged up into the viewer. If I have got the wrong end of the stick with superficial geology and Dave's comments, it may be a good idea for me to sit with Steve and he can go through my sections and point these out.

Link to latest gsipr –
W:\Teams\GMS\3DGeoModTeaching\Data\Holy_Island\Holy_Island_Phase_2\
Holy_Island_V2_11_17.gsipr

Based on Leanne's comments on quaternary geology: The model shows great examples of the potential **impacts of sea level rise, evidence for past sea levels** as well as **dune development** from prevailing wind and **sediment erosion** from prevailing current. Questions can be phrased so as to get the students to think about the above concepts. The focus on quaternary would provide a balance from the straight bedrock models.
I think that this model will have some educational value and Emma will be able to write some relevant education material to go along side it.

**10/05/2012**
Went through whole model snapping all crossing arrows and crop line flags. Checked calculation and slightly altered some cross-sections to aid better calculation.
Latest version:
W:\Teams\GMS\3DGeoModTeaching\Data\Holy_Island\Holy_Island_Phase_2\Holy_Island_V2_20.gsipr
Model has been handed over to 3D modelling team due to Hannah's maternity leave. Model may need minor adjustments to show educational features, such as ages of deposits in GVS etc and then packaging up into viewer.

**10/01/2013**
S Thorpe checked over the model before sending it for formal approval. A number of the sections were lengthened to improve the calculation and provide more constraint.
Holy_Island_helper_4
Holy_Island_helper_9
Holy_Island_helper_10
Holy_Island_helper_11
Holy_Island_helper_12
Holy_Island_helper_14
Holy_Island_helper_17
Holy_Island_helper_18

New sections added:
Holy_Island_helper_101_ST
Holy_Island_helper_102_ST
**File saved as Holy_Island_V2_25.GSIPR – ready for approval.**

# 5 Model workflow

The standard GSI3D workflow for superficial geological models was followed. The DTM was allowed to shape the surface distribution of the Beach Deposit/Raised Beach relationships.

# 6 Model limitations

Improvements to this model could be considered by:

- Improving the ground knowledge of this area (although no further boreholes exist in the BGS collections there may be more data available)
- Where improvements in the software are made to make bedrock modelling more intelligent, then the complicated bedrock underlying this model could be modelled.
- The only caveat that should be observed when using this model is that the aim of the model is to provide a simplified conceptual visualisation of the Holy Island area. No detailed study has taken place in order to fully understand the complexities of the geology.

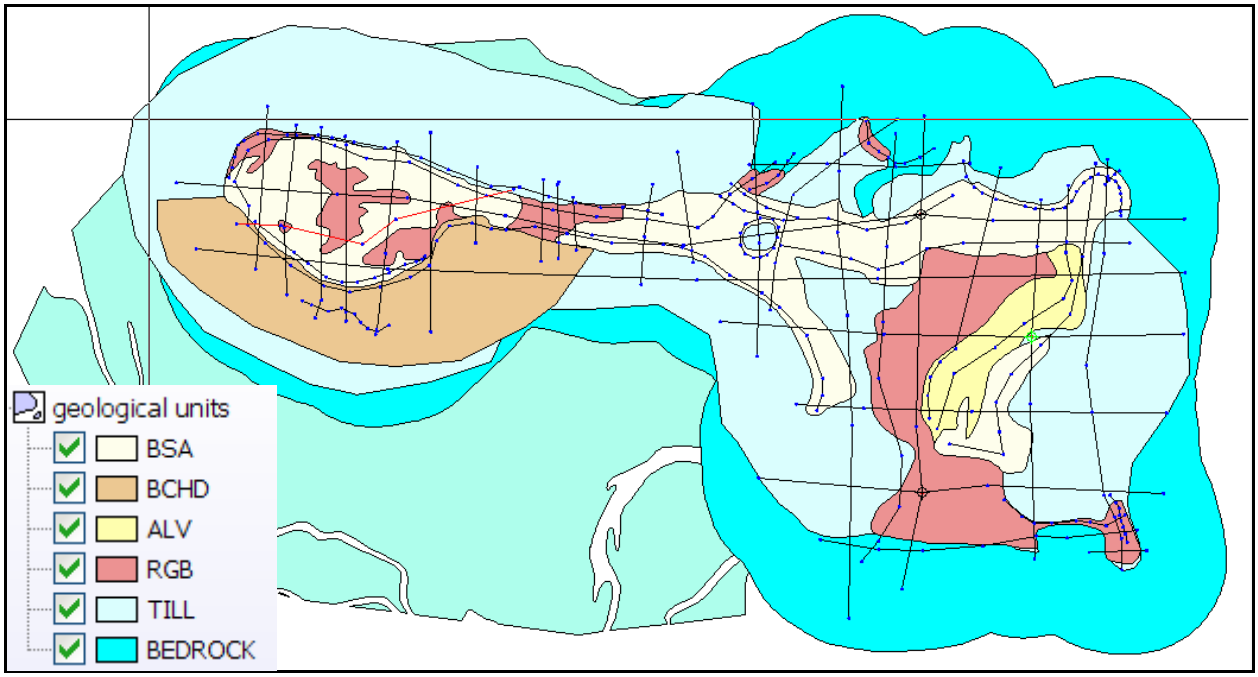


**Figure 2 - 2d map showing distribution of cross-sections used in model. Borehole are indicated by a circle with a cross inside (black = <10m depth; green = >10m depth)**

# 7 Model images

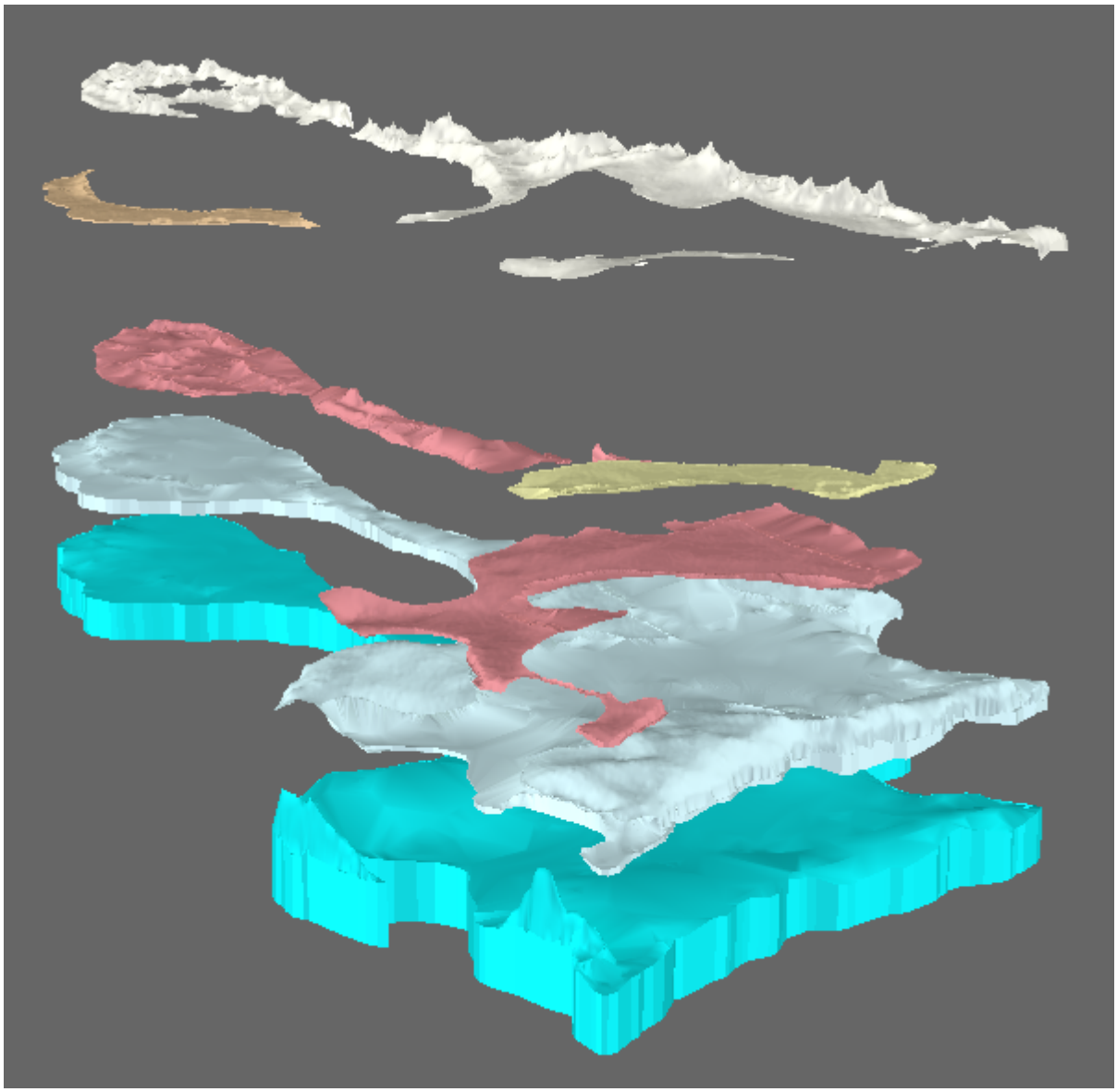

**Figure 3 - Exploded view of calculated Holy Island 3d Model**

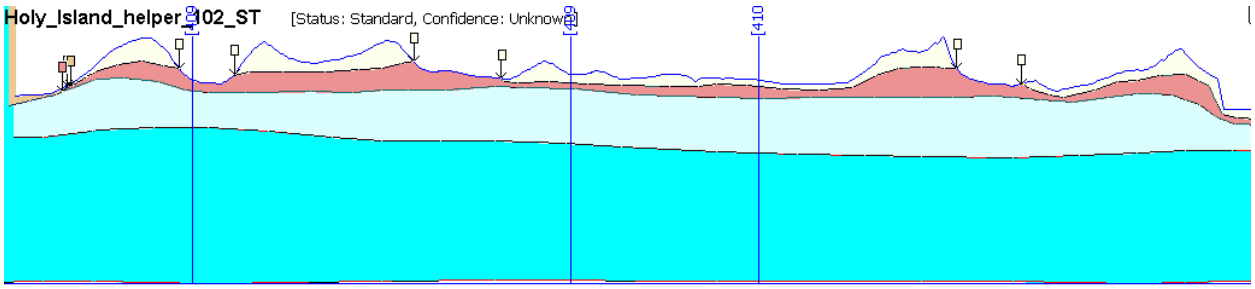


**Figure 4 - Example of a section through the dune, raised beach and Till, with the bedrock forming the base of the model.**

# References

British Geological Survey holds most of the references listed below, and copies may be obtained via the library service subject to copyright legislation (contact libuser@bgs.ac.uk for details). The library catalogue is available at: http://geolib.bgs.ac.uk.

GUNN, W. 1927. *Geology of Belford, Holy Island and the Farne Islands.* (London)

MATHERS, S. J, WOOD, B, KESSLER, H. 2011. *GSI3D 2011 software manual and methodology.* British Geological Survey Open Report OR/11/020