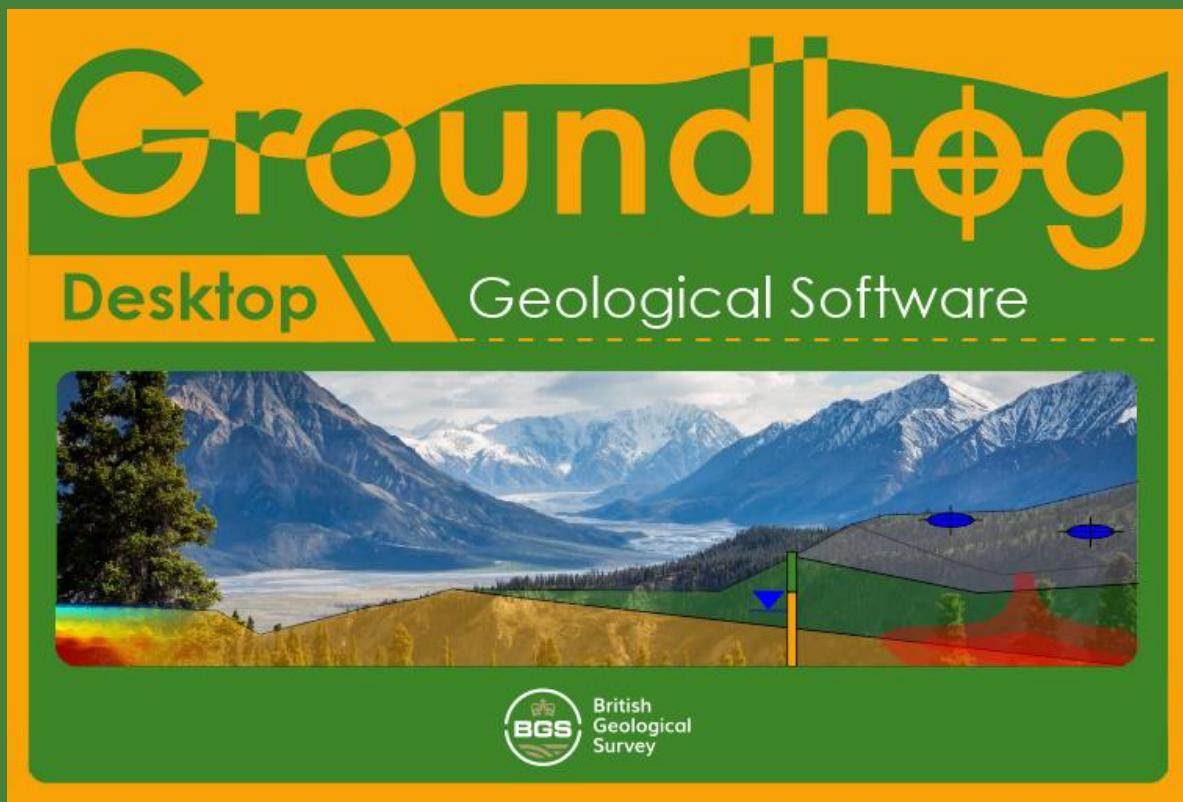


# BGS Groundhog Desktop

User Guide v2.1.0 (BETA)

July 2020



British  
Geological  
Survey

LQM  
LQM Sound science:  
Defensible decisions

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This document is intended as a general guide to the operation of the BGS Groundhog Desktop software (Groundhog) and no warranty is given as to the completeness or accuracy of the information contained within. The contents of this document are subject to change without notice.

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<http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/>

Topographic basemap images used within this user guide use OS open data layers.  
Contains OS Data © Crown Copyright and Database Right.

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## Versions

BGS Groundhog Desktop (Groundhog) is available in two versions badged (1) **Community** and (2) **Professional**. Community is free-to-use under the UK Open Government Licence. Professional has extended features for building conceptual and 3D site and geological models and is available under a commercial license via our UK commercial reseller, Land Quality Management Ltd. (LQM).

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## Contact Information

BGS Groundhog Desktop (Groundhog) is software created and maintained by the British Geological Survey. Further information about the development project, and the software download, can be found on our website.

[www.bgs.ac.uk/groundhog](http://www.bgs.ac.uk/groundhog)

For general enquiries about the Groundhog project, please email us.

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

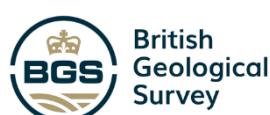
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## Distribution

Licenses for Groundhog Professional are distributed by Land Quality Management Ltd. (LQM). Further information can be obtained via their website.

<https://www.lqm.co.uk/csm/>

[judith@lqm.co.uk](mailto:judith@lqm.co.uk)



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# Introduction

This section provides an overview of Groundhog and information about how to install the software and activate a license.



*Photo by Hosea Georgeson on Unsplash*

## About Groundhog

BGS Groundhog Desktop (Groundhog) is geological software created and maintained by a team at the British Geological Survey. It is available in two versions, (1) **Community** and (2) **Professional**.

**Community** is free-to-use, including for commercial applications, under the UK Open Government Licence. You can use it to import and explore your site geological data such as maps and boreholes. It allows you to create custom borehole log templates, develop map line-work and draw geological cross-sections.

**Professional** includes all of the features of Community and adds a range of modelling capability. Use it to create annotated, conceptual site models. You can also use it to develop full 3D geological framework models. Professional requires a digital activation key which is available from our commercial reseller, Land Quality Management [www.lqm.co.uk](http://www.lqm.co.uk)

This user guide covers both versions. Please note that not all features described here are available in all versions of the software. Where a particular feature relates only to the Groundhog Professional version it will be highlighted like this:

### *Professional*

Groundhog is currently BETA software and not all of the available features of Groundhog are necessarily documented in this guide. Whilst considerable effort has gone into its design and testing, please be aware that the software is still in very active development and may not be completely stable in all situations. We are very happy to receive feedback from users by email [groundhog@bgs.ac.uk](mailto:groundhog@bgs.ac.uk)

A basic set of tutorial videos is available at;

<https://www.youtube.com/channel/UCQc4rWxP2sMPNFhHq6xOthQ/videos>

## Installation

**Please read all steps carefully to ensure correct installation of Groundhog!**

You can obtain the installer for Groundhog from the BGS website. There is only one installer, you do not need a separate installer for Community and Professional because the two versions are controlled by the digital license which is available from Land Quality Management.

[www.bgs.ac.uk/groundhog](http://www.bgs.ac.uk/groundhog)

[www.lqm.co.uk](http://www.lqm.co.uk)

Groundhog can only be installed on Windows computers. There are no specific minimum system requirements to run Groundhog, but you may find the 3D graphics capability performs better on a computer with a dedicated graphics card.

The download is in ZIP archive format which contains an installer executable (setup.exe). Extract the contents of the ZIP file to a temporary location.

<Right-click> on the <setup.exe> file and choose <Run as administrator>

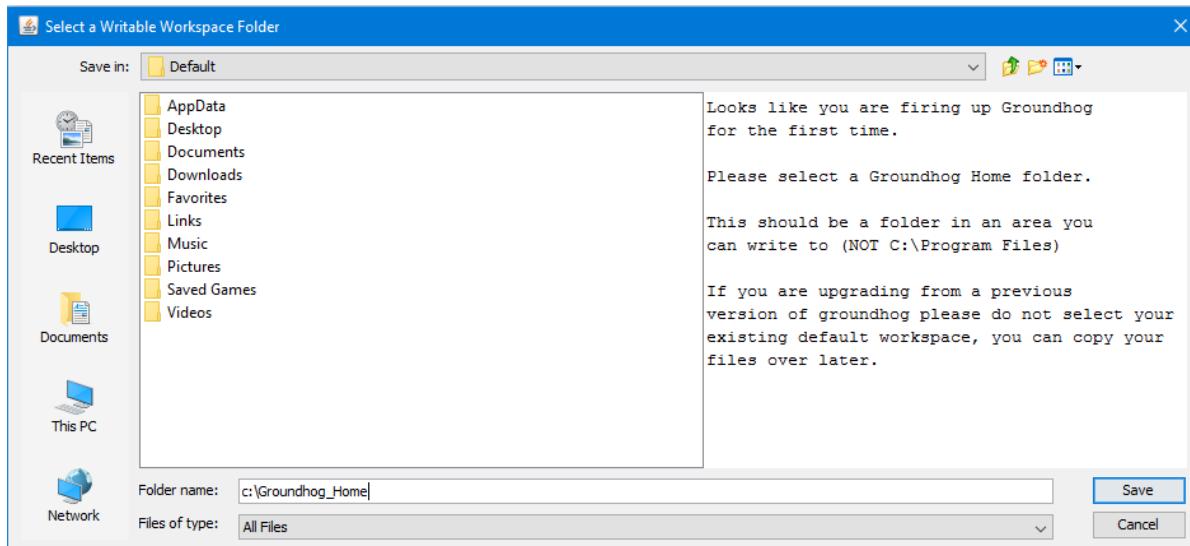
**IMPORTANT:** Depending on your organisation's security policies you may need assistance from your IT support department to carry out the software install.

The installation wizard guides you through a series of screens.

You will be prompted to choose an **installation folder**, which is usually C:\Program Files\BGS Groundhog Desktop, but you can install Groundhog wherever you prefer.

## First Use

The first time you start Groundhog you will see a screen like this.



If you have previously used Groundhog, you may already have a Groundhog Home area set up on your computer. However, there have been many changes in this release, so it is advisable to create a new area, which will enable Groundhog to copy into this area all the files that are required for successful running of Groundhog. You may have files which you wish to keep in your previous Groundhog home area. These can be copied across to your new Groundhog home area after the install process has completed.

Once you have provided a valid, writable area for the Groundhog home folder, Groundhog will copy the required folders and files from the install area to here and Groundhog will be ready to use. If you had previously upgraded Groundhog to Professional and this is not automatically enabled in your new Groundhog version, please contact the Groundhog team.

## Digital License Activation

Groundhog will automatically run in Community mode right away. There is no need to activate this version in any way. You can get started using it immediately and use it for as long as you like. We do humbly request that you consider acknowledging your use of Groundhog in your projects because this helps our project gain exposure, but you do not have to!

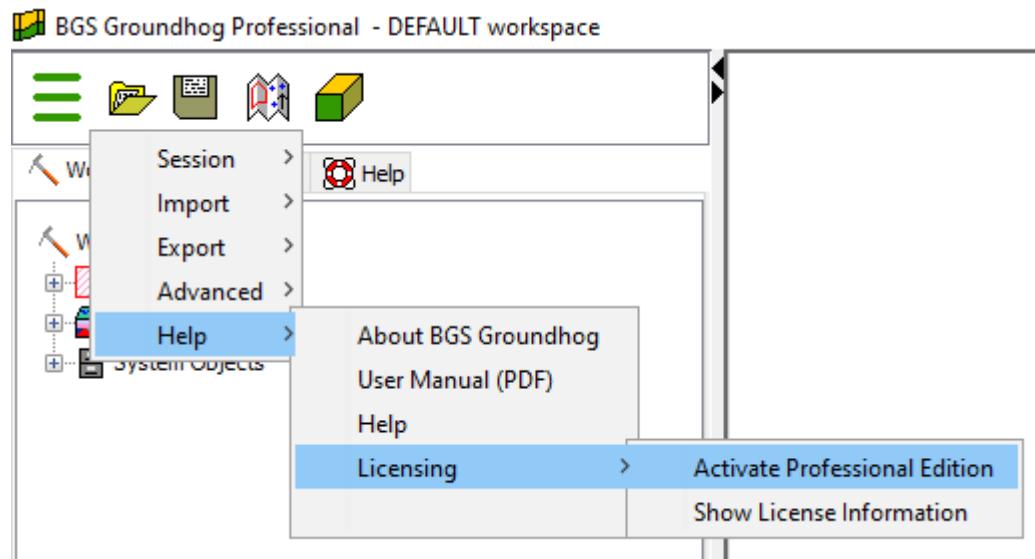
If you are upgrading to the Professional version of Groundhog you will need a digital activation key. Keys can be obtained from our commercial reseller, Land Quality Management Ltd.

[www.lqm.co.uk](http://www.lqm.co.uk)

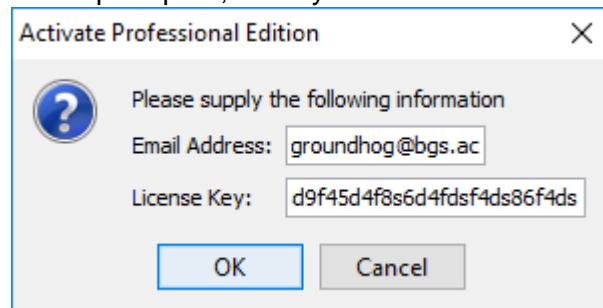
When you purchase your digital license for Groundhog Professional you will be asked for your email address. This information is only used for the purposes of generating a unique

digital key and is not stored anywhere except on your own computer as part of the procedure.

By return you will receive an email containing a digital license activation key. Start Groundhog and select <Help> <Licensing> <Activate Professional Edition> from the main menu button.



When prompted, enter your email address and the digital key you received.

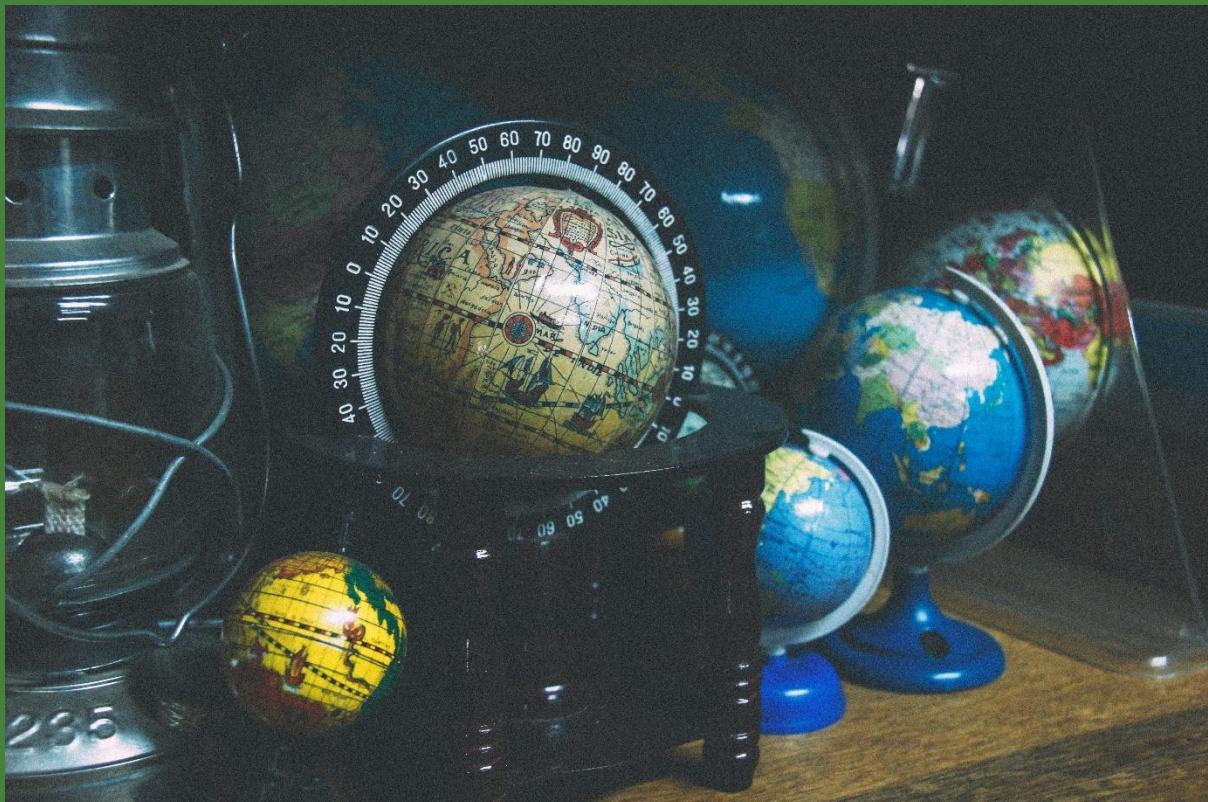


Once activated you will need to re-start Groundhog to switch to Professional mode. From now on, Groundhog will run in Professional mode for the duration of your license.

If you experience any difficulties with your activation, please contact the person who issued your digital key by email.

# Data Objects

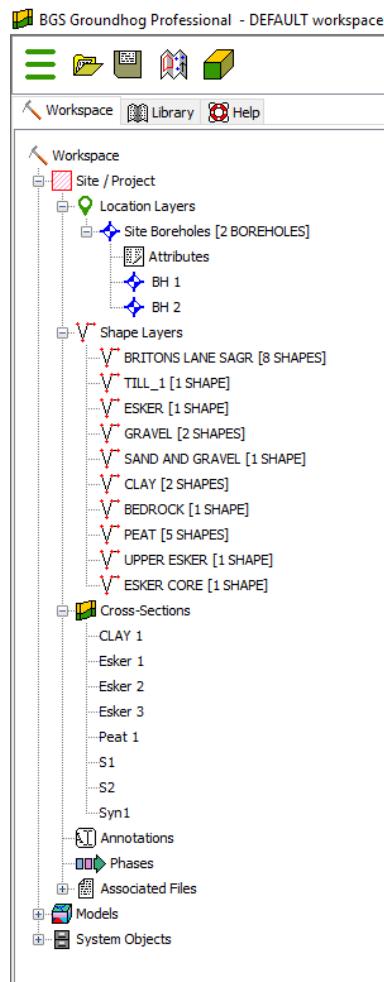
This section provides an overview of the key data object types supported by Groundhog, where they are held in the project structure and how to both create and import your own data structures into a Groundhog project.



*Photo by João Silas on Unsplash*

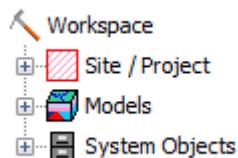
## Object Tree

Project data is held as various objects within the object tree. The object tree is found along the left side of the main user interface under the <Workspace> tab. For more details on the other components of the user interface please refer to the next main section of the user guide.



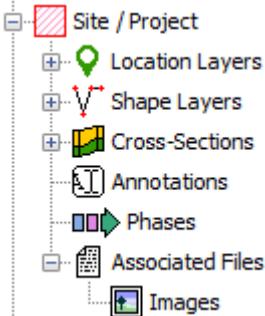
This tree panel is a typical multi-level object structure, like a Windows file explorer navigation panel. Expand the various folder nodes to explore your data at different levels. Note that not all folder nodes are available in all versions of Groundhog.

The object tree is arranged into three top-level folders.



### Site / Project Folder

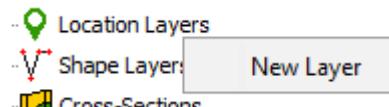
Contains the key site investigation data types such as GIS-style point and shape layers, borehole data, cross-sections, project phase and CSM information, annotations and linked files such as images.



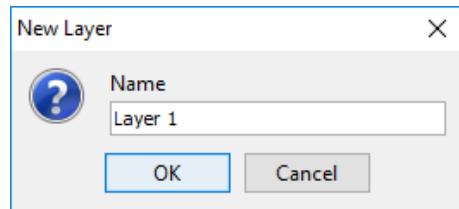
### *Location Layers Folder*

This folder holds both GIS-style point layers and also borehole dataset layers. Borehole layers are effectively treated as a special flavour of point layer, which is why they are grouped together as Location Layers.

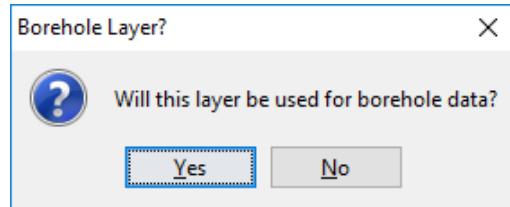
Make new, empty layers using <right-click> <New Layer>.



Enter a name.



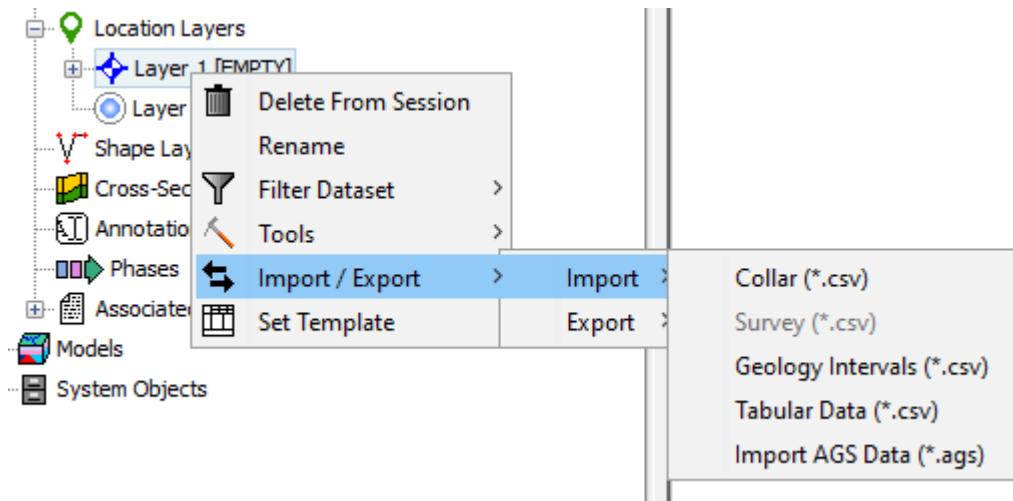
Click <Yes> if you want to make a layer for boreholes, click <No> to make a layer for point data.



This is the effect of doing both a borehole layer and a point layer. Note the different icons.



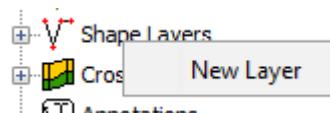
In the case of boreholes, a <Right-Click> option allows for data import. For more details on data import see the main user guide chapter **Importing & Exporting Data**.



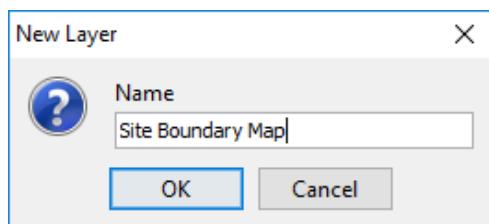
### *Shape Layers Folder*

This folder holds GIS-style shape layers (lines and polygons). Groundhog makes no distinction between lines and polygons, so they are grouped together into generic shape layers.

Make new, empty layers using <right-click> <New Layer>



Enter a name.

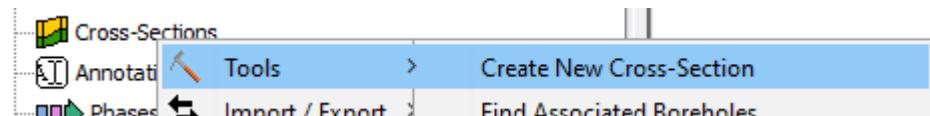


Empty layer is added to the folder.

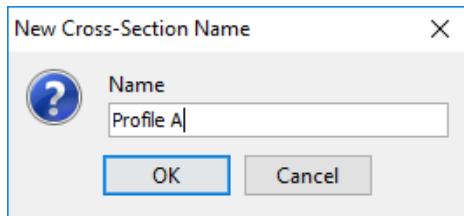


### *Cross-Sections Folder*

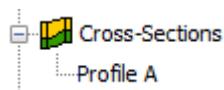
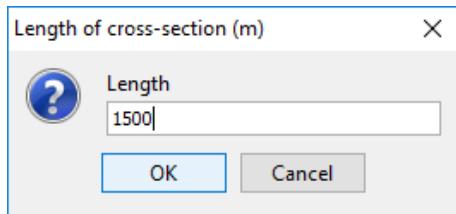
This is where drawn cross-sections will appear. At the moment, Groundhog stores all of these in a single folder. Typically you will create new cross-sections by drawing them in the map – please refer to the **Drawing Cross-Sections** chapter of the user guide for more information. However, it is possible to create non-spatially referenced cross-section objects directly from the tree if you just want to draw a cross-section without placing it in the map context via <right-click> <Tools> <Create New Cross-Section>.



Enter a name.



Specify a length in metres.

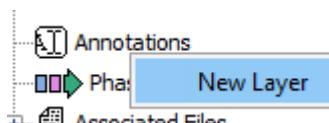


Cross-sections created in this way are all registered starting at [0, 0] grid coordinates.

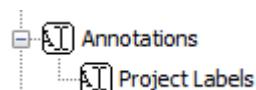
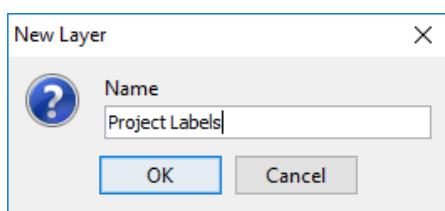
#### *Annotations Folder*

Annotations layers hold labels, callouts and graphics icons to label and represent objects within the project or the conceptual site model. Create a new layer for holding annotation objects via <Right-Click> <New Layer>.

*Professional*



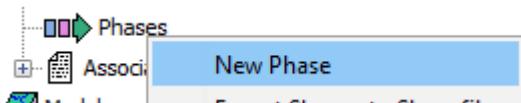
Enter a name.



Annotation layers can be created and edited in Professional mode and viewed in Community mode.

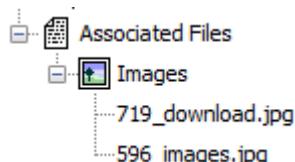
#### *Phases Folder*

The phases folder is specific to developing conceptual site models (CSMs) in Groundhog. For more details please refer to the **Developing Conceptual Site Models** chapter of the user guide. Phases hold the structure for the CSM, allowing multiple CSMs to be developed and related back to different phases of a project or site development. Create a new layer for holding phase objects via <Right-Click> <New Phase>.



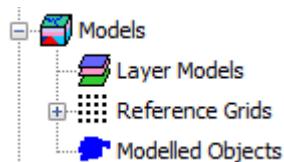
### Associated Files Folder

Certain types of imported file will appear in this folder when they are imported. A good example is imported image files which have their own specific sub-folder.



### Models Folder

Contains the key data types related to 2.5D and 3D models and related information.



### Layer Models Folder

This folder holds layer-based 3D geological models as well as other types of more 2.5D models such as surface or gridded property models such as water levels or chemical concentration maps. In Community mode this folder will display the available models in an existing project. In Professional mode you are able to create new models and edit existing models. Creating models is an in-depth topic. Please refer to the chapter on **Building Geological Models** in this user guide for more information.

### Reference Grids Folder

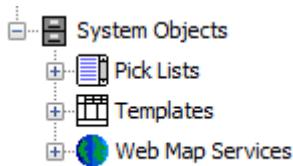
This folder holds any loaded grid layers. Typically, these are imported from ESRI ASCII grid format. Examples include DEM or DTM layers that you wish to use as topographic profiles for cross-section drawing and for acting as the topographic cap of 3D geological models. You can also bring in other layers such as water levels and engineering layers and display these in various ways within the software. For more information on how to get grid data into Groundhog workspaces and projects please refer to the Importing and Exporting Data section of this user guide.

### Modelled Objects Folder

This folder can be used to hold reference 3D objects such as models of infrastructure and buildings and other site objects. These objects can then be visualized using the 3D graphics window. Typically, such objects are imported from an OBJ file. Note that OBJ files can only be viewed using the 3D graphics window in Groundhog.

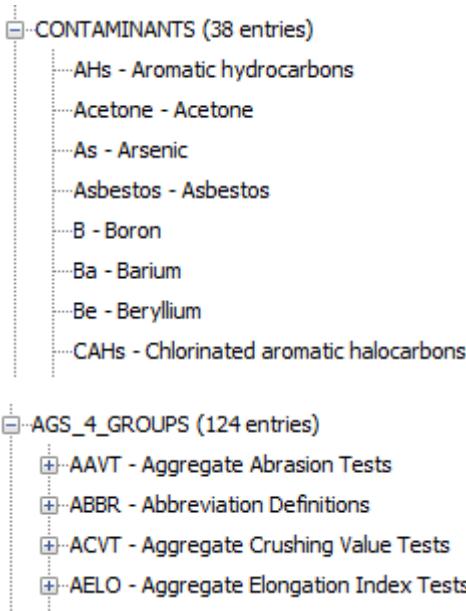
### System Objects Folder

This folder stores system-level objects which are typically available across all of your Groundhog projects.



### Pick Lists Folder

This folder holds pick list or dictionary objects. These are pre-set lists of values and descriptions that are used in various places within Groundhog to perform lookups. Although you can define your own pick lists, typically you do not need to interact with this folder in the current version of Groundhog. Examples include a pick list of possible contaminants for conceptual site models, or dictionary lookups for geotechnical data in AGS format.



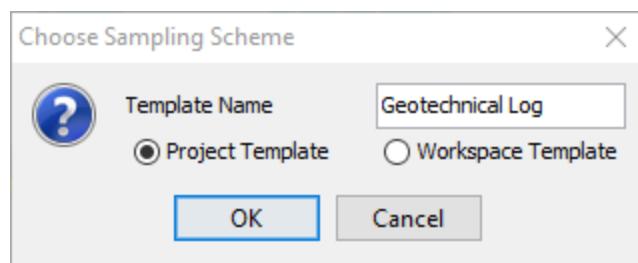
### Templates Folder

This folder holds borehole log templates. When Groundhog is first installed it will only contain a couple of default templates. You can add your own blank Template objects and then design them using the log window. For more information on how to design your own log templates please refer to the **Working With Borehole Logs** chapter of this user guide.

To make a new template use <right-click> <New Template>.



Enter a name.



If Project is selected, this template will be saved when you save the project and will be available to this project only. Otherwise, when you choose to save this template, it will be saved in the Ground Home WORKSPACE folder and will be available to all projects in the future.

The new template is added to the folder and is ready to be worked on.

└...Geotechnical Log [PROJECT] \*

#### *Web Map Services Folder*

This folder lists the available Web Map Services (WMS) in the workspace. Groundhog comes pre-loaded with BGS WMS layers and these will always be listed here, so long as Groundhog was able to load them at start up (requires an internet connection). Typically you will not interact with the object in this folder directly, but you will be able to add them as layers to map window.

# User Interface

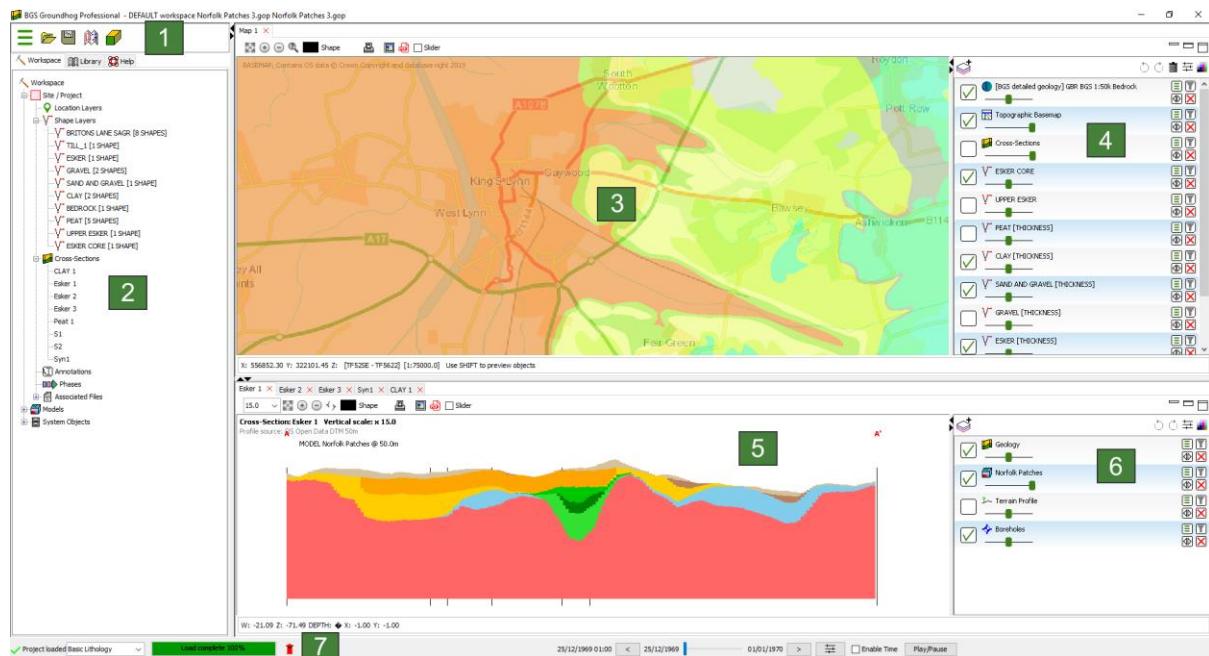
This section provides an overview of the graphical user interface and key panels and buttons within Groundhog.



*Original photo by Kobu Agency on Unsplash*

## Main Panels

The Groundhog user interface is arranged into a number of panels containing data objects and graphics. Because Groundhog is a highly interactive graphical tool you will benefit significantly from using a good-quality mouse equipped with a mouse wheel – a laptop trackpad is not a good match with Groundhog.



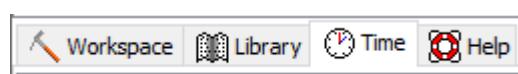
### Main Toolbar [1]

Contains high-level buttons for key operations.

	Main Menu	This is the main menu button providing access to a series of high-level functions such as import/export.
	Open Project	Opens a file chooser for opening Groundhog projects in the *.gop file format.
	Save Project	Opens a file chooser for saving the current session to a Groundhog *.gop file format.
	Open Map Window	Allows the creation of a new map (plan-view) window. When you create a new map window you will be prompted to select the data layers you want to see in the window. The available layers will depend on the data contained within your workspace or project. Press <Skip> to open a blank window.
	Open 3D Window	Opens the 3D graphics window.

### Session Panel [2]

A tabbed panel containing a range of session-level objects.



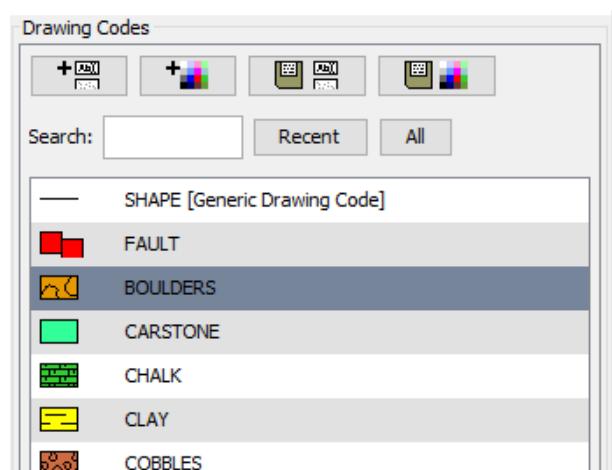
## *Workspace*

This contains the main Object Tree panel with a hierarchical list of all data objects in the session. For more details please refer to the Object Tree section of this user guide.

## *Library*



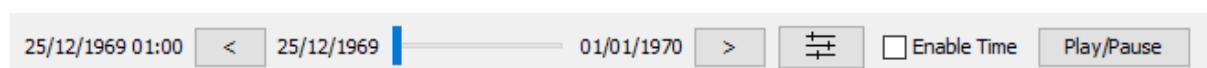
A panel containing a configurable library of available drawing codes (geology codes and other special codes). Single-click on an entry to select it as the active drawing code – this sets the code as active in all windows. The below example shows “BOULDERS” as the selected drawing code. Note that the special codes “SHAPE” and “FAULT” are always at the top, and the rest of the list is sorted alphabetically. Type into the search box to find codes. Click <All> to reset the list back to all values after searching.



	Add Code	Add a drawing code, and optionally a matching colour, to the library.
	Add Colour	Add a colour value to the library.
	Save Codes	Saves all current drawing codes to the global workspace.
	Save Colours	Saves all current colour values to the global workspace.

## *Time Controls*

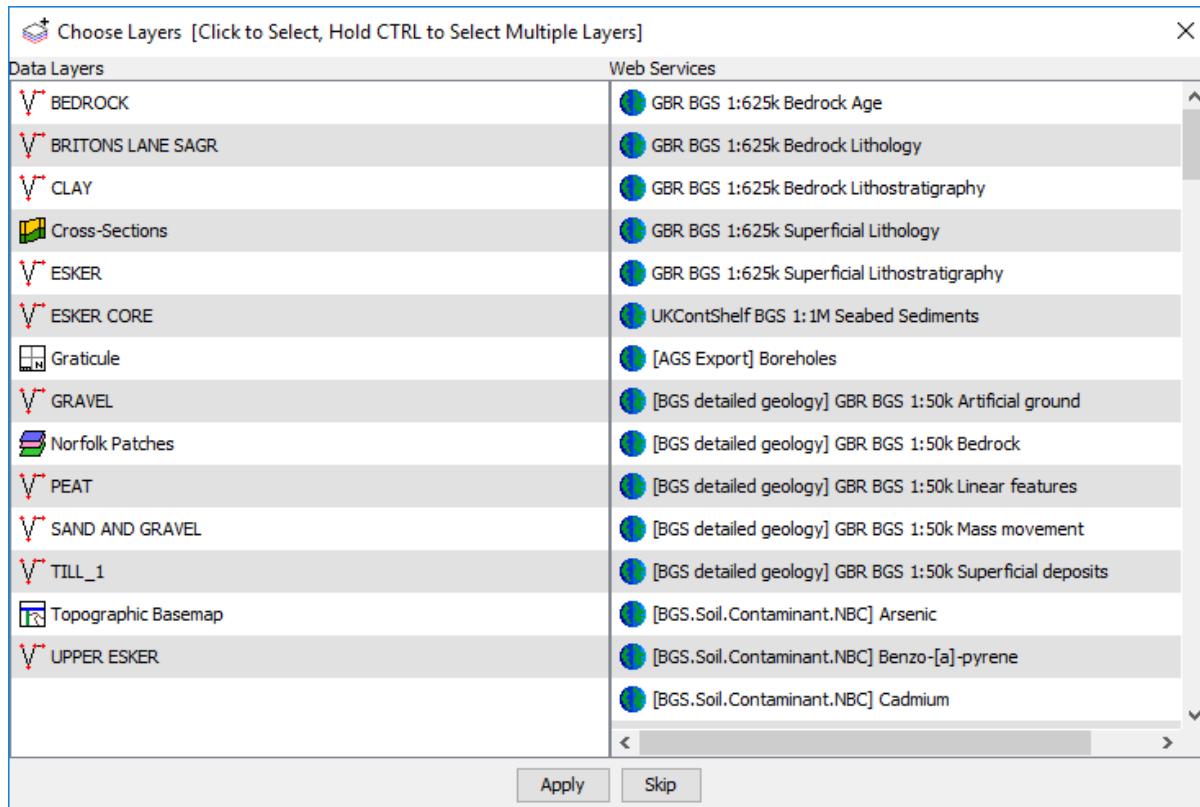
Where data and models have time-stamp information it is possible to use this as a filter for selective display of a particular time interval within the project. For example, you may have water level readings with time-stamps in your borehole data which can be displayed and animated with time. These features are currently undocumented. Please contact [groundhog@bgs.ac.uk](mailto:groundhog@bgs.ac.uk) for information.



## *Map Window [3]*

A tabbed component capable of displaying multiple map panels. Each map panel can display map data layers and can be used for digitizing points and shapes, constructing cross-section alignments and for placing borehole locations.

When you create a new map window you will be prompted to select the data layers you want to see in the map. The icons for each layer indicate the layer's data type. The available layers will depend on what data you have in your workspace and project.



The panel on the left shows data layers in the session and the panel on the right typically displays any web map services that are available. Single-click on individual entries to select them. If you want to select multiple layers hold the CTRL key, or to select a range of layer hold the SHIFT key, as-per typical list controls in Windows programs.

Some layers are **ALWAYS** available, including **Cross-Sections** (the default cross-sections folder) and **Graticule** (a grid overlay with scale bar and north arrow).

You will also have the option here to **Create New Layer**.

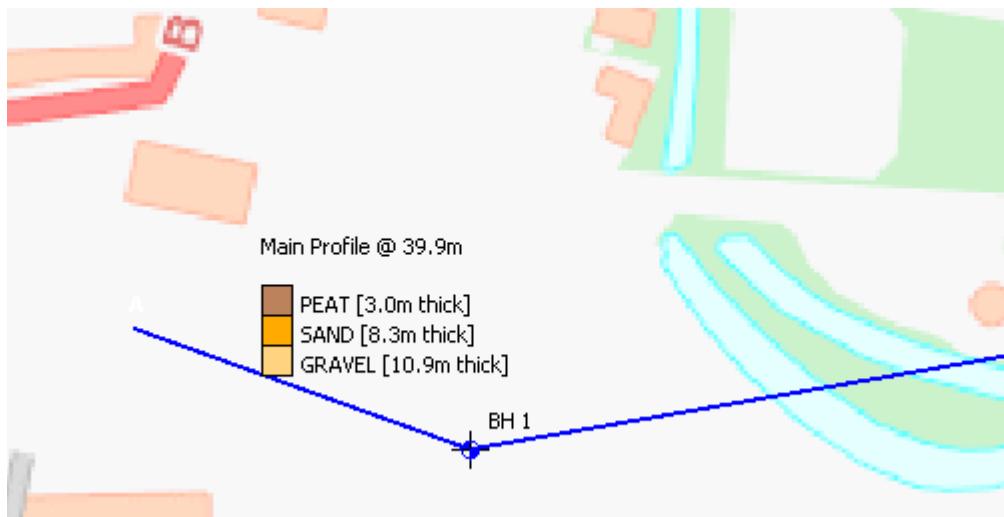
When you save your project it will store the configuration and scale of all opened map windows ready for your next session.

When you are working in the map view, if you are working in the UK it is a good idea to always add the default **Topographic Basemap** layer that is included with Groundhog for orientation purposes. Otherwise, you may wish to import a geo-registered image of your site/project area for the same purpose.

### *General Navigation*

Each graphics panel works like most interactive online map applications. The mouse is inherently multi-mode, reducing the need to constantly select different tools to pan and zoom. Click and hold mouse button 1 (typically the left button) and drag the mouse to pan the map around. Use the mouse wheel to zoom in and out (a good mouse wheel is very important for effective Groundhog operation). The mouse zoom is dynamically targeted to the mouse cursor position, allowing for very rapid and precise zoom in from small scale to large scale maps.

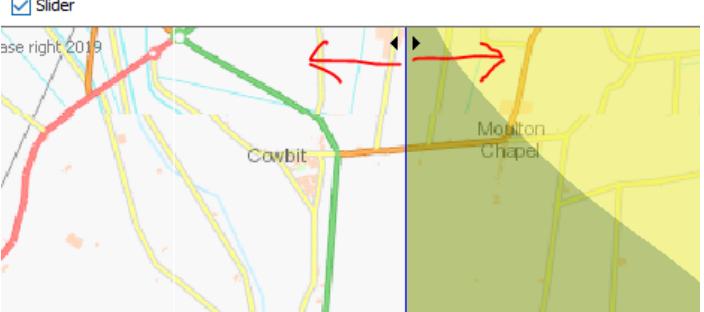
Certain types of object such as cross-sections and boreholes can be previewed or queried by holding down the SHIFT key whilst hovering over the object. Here is an example of hovering over a cross-section alignment whilst holding the SHIFT key.



*Toolbar*

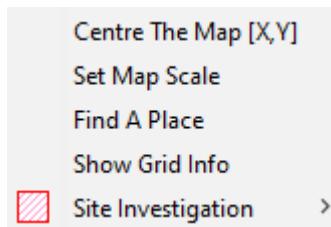


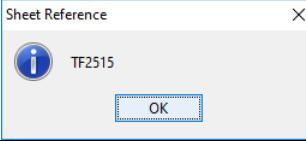
	Zoom To Extent	Zooms to the full extent of all layers in the map panel, or to the currently active layer, if one is selected.
	Zoom In	Incrementally zooms the map to a larger scale with each successive click.
	Zoom Out	Incrementally zooms the map to a smaller scale with each successive click.
	Gazetteer	Search for places (UK only) by place name, street+placement or county. Examples: “Nottingham” “Main Street, Keyworth” “Rutland”
	Select Drawing Code	Click to open the drawing code library panel in order to change the active drawing code. Also displays the currently active drawing code, including its colour and ornament if they are available.
	Print	Send the current map view to a printer.
	Save Image	Save the current map view to an image (JPEG or PNG).
	Save PDF	Save the current map view to a PDF document.
<input type="checkbox"/> Slider	Toggle Slider	The layer slider allows partial view of a user-defined collection of map data layers for rapid comparison. With the slider toggled on, use the mouse to drag the slider position in the map panel. The below example shows the BGS geology map WMS active as the

		active slider layer on top of a topographic basemap. For information about how to make a particular layer active in the slider refer to the section on the Map Window Layer Control below.
		

### Right-Click Operations

The map panel supports a number of context-sensitive right-click operations. These will depend on whether you are right-clicking on a specific data object such as a cross-section alignment or a point object, or whether you are in a “whitespace” area (a non-specific portion of the panel). In general, a “whitespace” click will present the following options.



Centre The Map	Enter a [X, Y] coordinate to centre the map at a specific location.
Set Map Scale	Enter a value to zoom the map to an approximate scale. For example, enter “10000” to scale to 1:10k. Note that the exact scaling is dependent on screen resolution.
Find A Place	(Gazetteer) Search for places (UK only) by place name, street+place name or county. Examples:  “Nottingham” “Main Street, Keyworth” “Rutland”
Show Grid Info	Show UK grid reference for the mouse cursor position, e.g.  
Site Investigation	Currently contains one option to hyperlink out to the historic map(s) available from the NLS for the clicked-on location. For more information please refer to the main section on developing conceptual site models.

## Map Window Layer Control [4]

When you create a new map window you will be prompted to select which data layers you want to add to the window. You can add layers layer on too. The layers you choose will be added to this layer control panel. The panel also has its own toolbar.

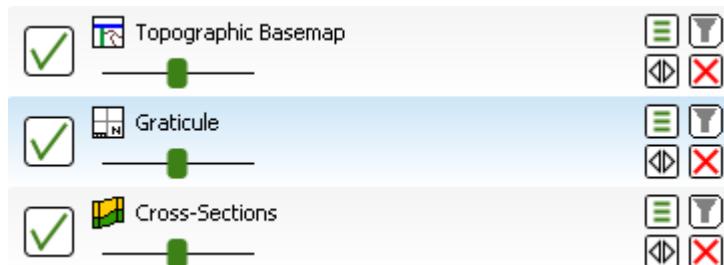
### Toolbar



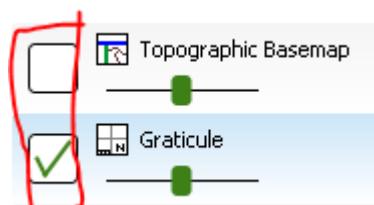
	Add Layers	Opens a list of available layers that can be added to the map. Note that the list does not present layers which are already in the map.
	Undo	Undo on the last operation. <b>IMPORTANT:</b> please note that the undo only becomes active when a data layer is made active – i.e., the undo is layer-specific.
	Redo	Redo on the last operation. <b>IMPORTANT:</b> please note that the redo only becomes active when a data layer is made active – i.e., the redo is layer-specific.
	Remove All Layers	Clears the map of all data layers.
	Window Settings	Access high-level settings for the map window.
	Background Colour	Change the background colour of the map panel. This can be useful for improving clarity of certain types of data.

### Layers

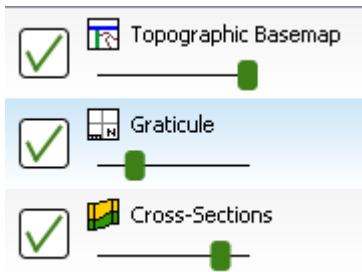
The layers panel lists all currently loaded layers within the map window. Different map windows can have different layers loaded.



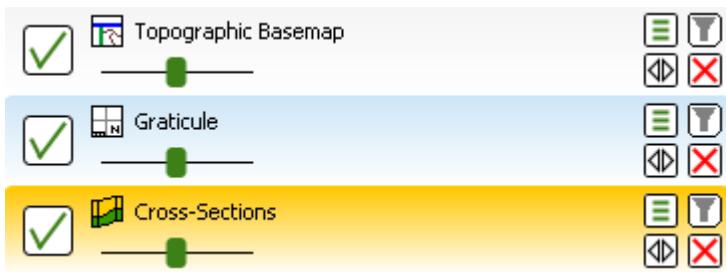
Checking the main tick-box on and off controls the visibility of each layer. In the example below, **Topographic Basemap** is not visible in the map panel, and **Graticule** is.



The slider controls under the name of each layer control the transparency of the layers. Slide the bar all the way to the left to make the layer completely transparent. Slide the bar all the way to the right to make the layer completely opaque.

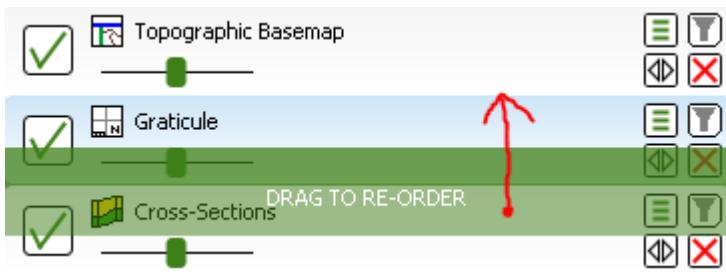


Single-click on a layer to make it the active layer. Depending on the layer type this may activate drawing/editing tools, query tools, or it may do nothing. When a layer is active it displays in orange. Only one layer can be active at a time. Single-click on the active layer to de-activate it. The example below shows the Cross-Sections layer as active.



The order of the layers in the panel dictates the drawing order in the map panel. The layer at the top of the list will be drawn as the top layer in the map graphics panel. The exception to this is that the active layer is always drawn on top of everything else.

To change the drawing order of a layer, single-click and hold on the layer, and drag it to re-position it in the list. In the example below, the Cross-Sections layer is being dragged upwards.

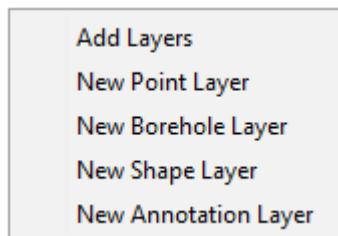


Each layer has four buttons on the right-hand side of its row.



	Settings	Access layer-specific settings.
	Toggle Slider Layer	Toggles the layer in and out of the active slider layer (see above for information about the slider controls). When the toggle button is orange it means the layer is active in the slider.
	Filter	At the moment this button is disabled for all layers pending future filtering capability.
	Remove	Removes the layer from the current window (does <b>not</b> delete the layer from the project!).

There are a number of operations available by right-clicking in any blank or “whitespace” portion of the layer control.



**Add Layers** is the same as the Add Layers button at the top of the layer control panel. The other options allow for the creation of new data layers directly in the map, but (depending on version) are currently restricted to Point, Borehole, Shape and Annotation\*.

\* Professional

#### Active Layer: Draw, Edit & Identify

Depending on the type of the layer certain editing, drawing and querying operations may be available on the active map layer. When a layer can be edited or drawn into it typically presents a tool palette in the map graphics panel when the layer becomes active. The example below shows the palette which has appeared in the top-left of the map panel by making a shape layer active in the layer control.



You can move the palette around in the map panel by dragging the green bar along the top of the box. Note that the palette becomes less transparent when the mouse cursor is over it.



For more detailed information on the various tools available in the palette, depending on the layer type, please refer to the section **Drawing Points & Shapes** within this user guide.

When a layer is active you may see variations on the right-click option available in the map window and also depending on whether you have right-clicked on an object or whitespace.

Some layers have identify capability when they are active. The identify operation is not a separate tool within groundhog – instead, with a layer active, just single-click on an object or location. A good example is the BGS WMS layers where the identify is active everywhere on the geology map. If the identify query yields results they will be displayed in the lower half of the map window layer control.



Notice the two options circled in red. These are **Copy the identify data to the clipboard** and **Add the lexicon code to the library panel**.

### Cross-Section Window [5]

A tabbed component capable of displaying multiple cross-section panels. Each cross-section panel can display profile data layers and can be used for drawing geological interpretations, viewing borehole transects and digitizing points and shapes. Unlike the map window, you can't just create a new, empty window. To open a section window you must open a specific cross-section object. You can do this either by double-clicking on its entry in the object tree, or by right-click on the section alignment in a map window.

When you open a cross-section in the cross-section window, some data layers are ALWAYS available, including **Terrain Profile** (the topographic profile for the cross-section), **Geology** (for drawing a geological interpretation), **Graticule** (a grid overlay with scale bars) and **Boreholes** (even if there are no boreholes in the alignment).

When you save your project it will store the configuration and scale of all opened cross-section windows ready for your next session.

### General Navigation

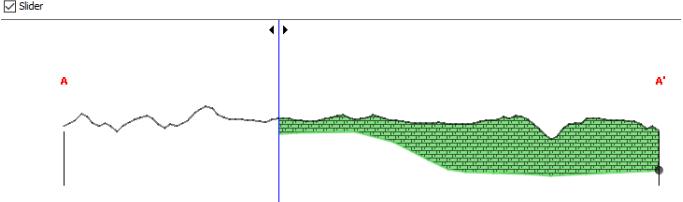
Each graphics panel works like most interactive online map applications. The mouse is inherently multi-mode, reducing the need to constantly select different tools to pan and zoom. Click and hold mouse button 1 (typically the left button) and drag the mouse to pan the cross-section around. Use the mouse wheel to zoom in and out (a good mouse wheel is very important for effective Groundhog operation). The mouse zoom is dynamically targeted to the mouse cursor position, allowing for very rapid and precise zoom in from small scale to large scale views.

### Toolbar

Section A X

10.0 ▼ Slider
    
 CHALK

<span>10.0</span> <span>▼</span>	Vertical Exaggeration	Sets the vertical exaggeration for the panel. Contains a list of pre-set values and can also be typed into for custom values.
----------------------------------	-----------------------	---

	Zoom To Extent	Zooms to the full extent of all the cross-section.
	Marquee Zoom	Draw a box to zoom to that area of the panel.
	Incrementally zooms the panel to a smaller scale with each successive click.	Incrementally zooms the cross-section to a smaller scale with each successive click.
	Refresh	Refreshes the graphics panel.
	Select Drawing Code	Click to open the drawing code library panel in order to change the active drawing code. Also displays the currently active drawing code, including its colour and ornament if they are available.
	Print	Send the current cross-section view to a printer.
	Save Image	Save the current cross-section view to an image (JPEG or PNG).
	Save PDF	Save the current cross-section view to a PDF document.
<input type="checkbox"/> Slider	Toggle Slider	The layer slider allows partial view of a user-defined collection of cross-section data layers for rapid comparison. With the slider toggled on, use the mouse to drag the slider position in the graphics panel. The below example shows the Geology layer as the active slider layer on top of a Terrain Profile layer. For information about how to make a particular layer active in the slider refer to the section on the Cross-Section Window Layer Control below.  

### Right-Click Operations

The map panel supports a number of context-sensitive right-click operations. These will depend on whether you are right-clicking on a specific data object such as a geology line or a shape object, or whether you are in a “whitespace” area (a non-specific portion of the panel). In general, a “whitespace” click will present the following options.

- Create Line [CHALK]
- New Shape Layer
- New Annotation Layer

Create Line [CODE]	Allows creation of a fixed-elevation geology line using the currently active drawing code.
New Shape Layer	Creates a new cross-section shape layer which you can draw into.

New Annotation Layer	Creates a new annotation layer which can be used to add labels, arrows and graphics to the cross-section.
	<b>Professional</b>

## Cross-Section Window Layer Control [6]

This panel lists the data layers which are currently added to the cross-section window. The panel also has its own toolbar.

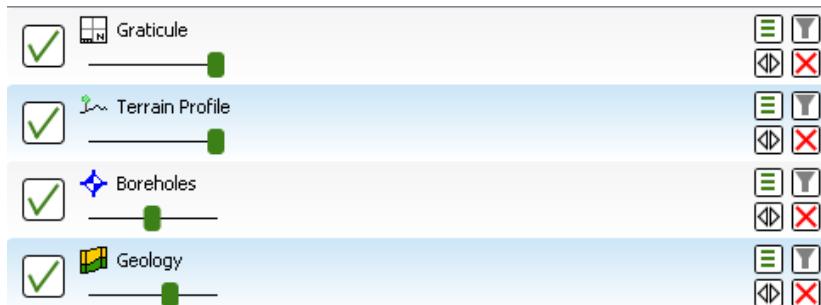
### Toolbar



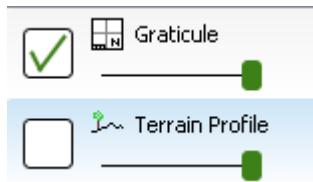
	Add Layers	Opens a list of available layers that can be added to the window. Note that the list does not present layers which are already in the list.
	Undo	Undo on the last operation. <b>IMPORTANT:</b> please note that the undo is global across all layers.
	Redo	Redo on the last operation. <b>IMPORTANT:</b> please note that the redo is global across all layers.
	Window Settings	Access high-level settings for the cross-section window.
	Background Colour	Change the background colour of the graphics panel. This can be useful for improving clarity of certain types of data.

### Layers

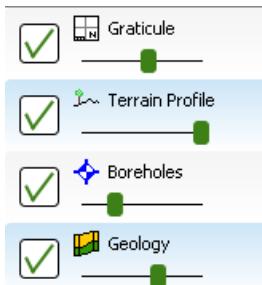
The layers panel lists all currently loaded layers within the cross-section window. Different windows can have different layers loaded.



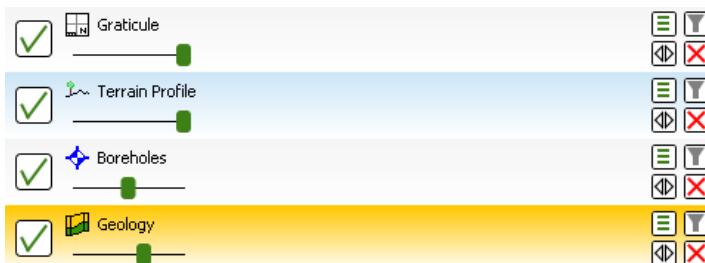
Checking the main tick-box on and off controls the visibility of each layer. In the example below, **Terrain Profile** is not visible in the section panel, and **Graticule** is.



The slider controls under the name of each layer control the transparency of the layers. Slide the bar all the way to the left to make the layer completely transparent. Slide the bar all the way to the right to make the layer completely opaque.

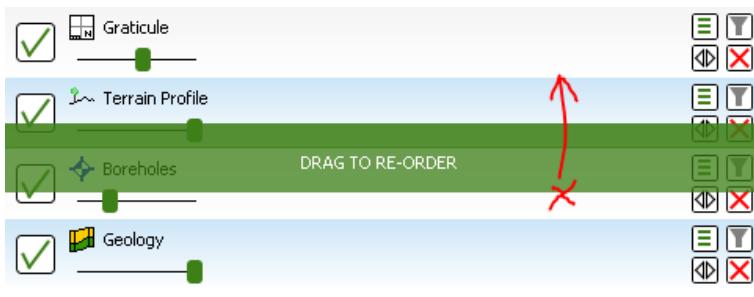


Single-click on a layer to make it the active layer. Depending on the layer type this may activate drawing/editing tools, query tools, or it may do nothing. When a layer is active it displays in orange. Only one layer can be active at a time. Single-click on the active layer to de-activate it. The example below shows the **Geology** layer as active.



The order of the layers in the panel dictates the drawing order in the cross-section panel. The layer at the top of the list will be drawn as the top layer in the graphics panel. The exception to this is that the active layer is always drawn on top of everything else.

To change the drawing order of a layer, single-click and hold on the layer, and drag it to re-position it in the list. In the example below, the Cross-Sections layer is being dragged upwards.



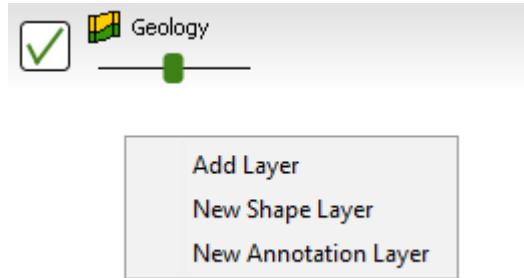
Each layer has four buttons on the right-hand side of its row.



	Settings	Access layer-specific settings.
	Toggle Slider Layer	Toggles the layer in and out of the active slider layer (see above for information about the slider controls). When the toggle button is orange it means the layer is active in the slider.
	Filter	At the moment this button is disabled for all layers pending future filtering capability.

<input checked="" type="checkbox"/>	Remove	Removes the layer from the current window (does <b>not</b> delete the layer from the project!)
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There are a number of operations available by right-clicking in any blank or “whitespace” portion of the layer control.

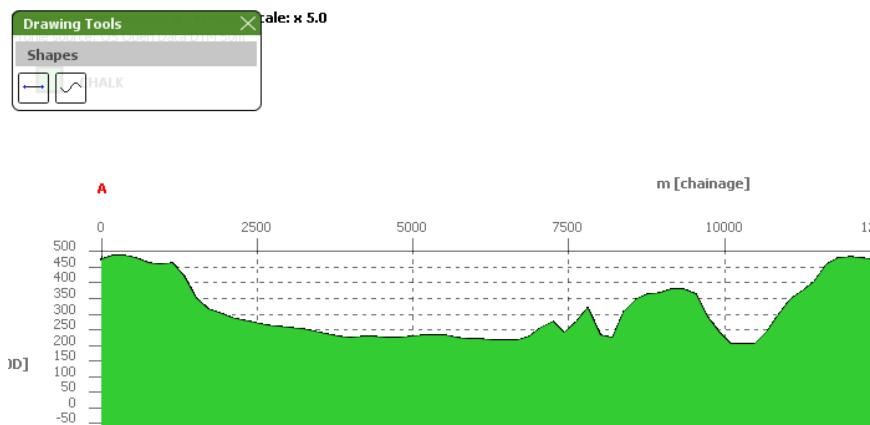


The **Add Layer** option presents the same dialogue as choosing this option from the top of this panel. The other options allow for the creation of new data layers directly in the section, but (depending on version) are currently restricted to Shape and Annotation\*.

\* *Professional*

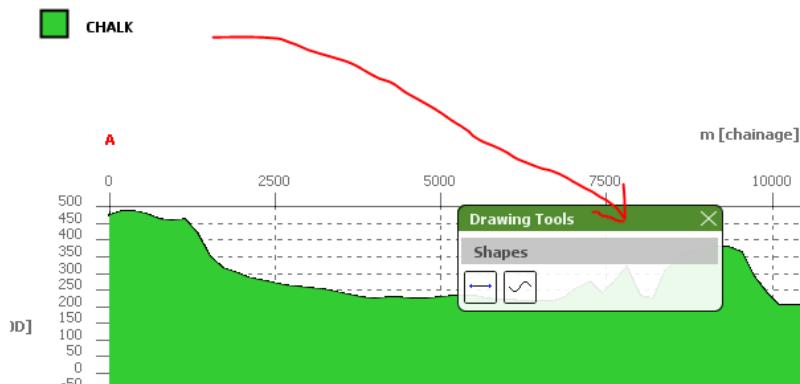
#### Active Layer: Draw, Edit & Identify

Depending on the type of the layer certain editing, drawing and querying operations may be available on the active cross-section window layer. When a layer can be edited or drawn into it typically presents a tool palette in the graphics panel when the layer becomes active. The example below shows the palette which has appeared in the top-left of the map panel by making the Geology layer active in the layer control.



You can move the palette around in the panel by dragging the green bar along the top of the box. Note that the palette becomes less transparent when the mouse cursor is over it.

Cross-Section: Section A Vertical scale: x 5.0  
Profile source: OS Open Data DTM 50m



For more detailed information on the various tools available in the palette, depending on the layer type, please refer to the **Drawing Points, Shapes & Annotations** and the **Drawing Cross-Sections** chapters within this user guide.

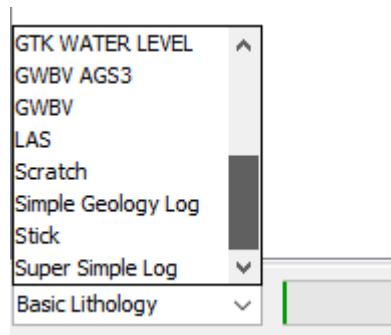
When a layer is active you may see variations on the right-click option available in the cross-section window and also depending on whether you have right-clicked on an object or whitespace.

## Status Bar [7]

The status bar displays certain information and controls related to the current session.

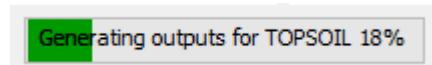
### *Global Borehole Log Template*

User this to set the default (global) borehole log template to use for the session.



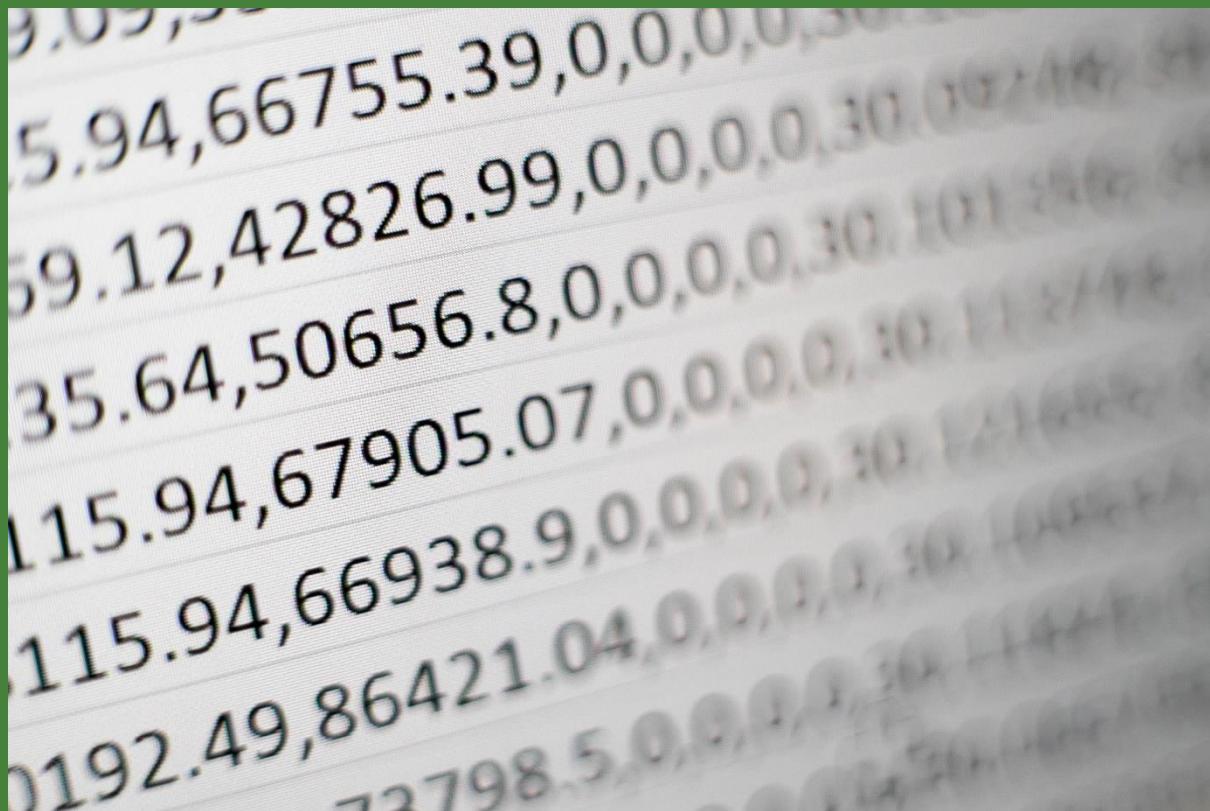
### *Progress Bar*

This displays the progress of certain processing operations, such as project loading and model building operations.



# Importing & Exporting Data

This section provides details of the various import and export capabilities of Groundhog.

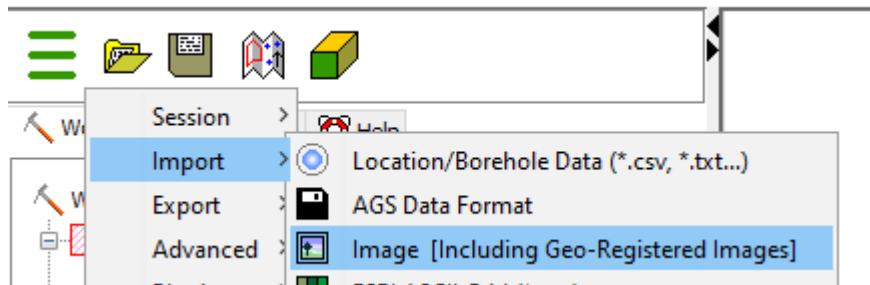


*Photo by Mika Baumeister on Unsplash*

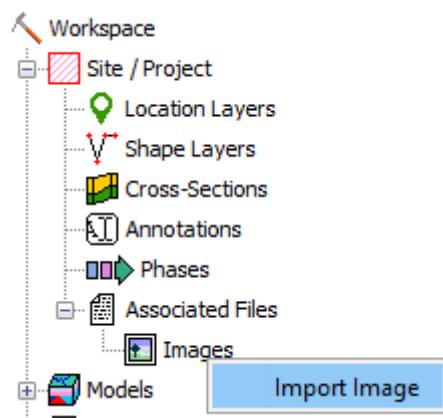
## Images

You can import images into your project in JPG/JPEG and PNG file formats. There are several ways to import them.

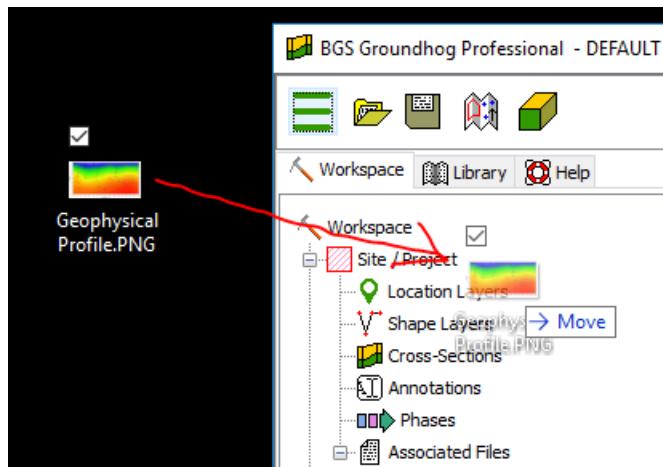
<Main Menu> <Import> <Image>.



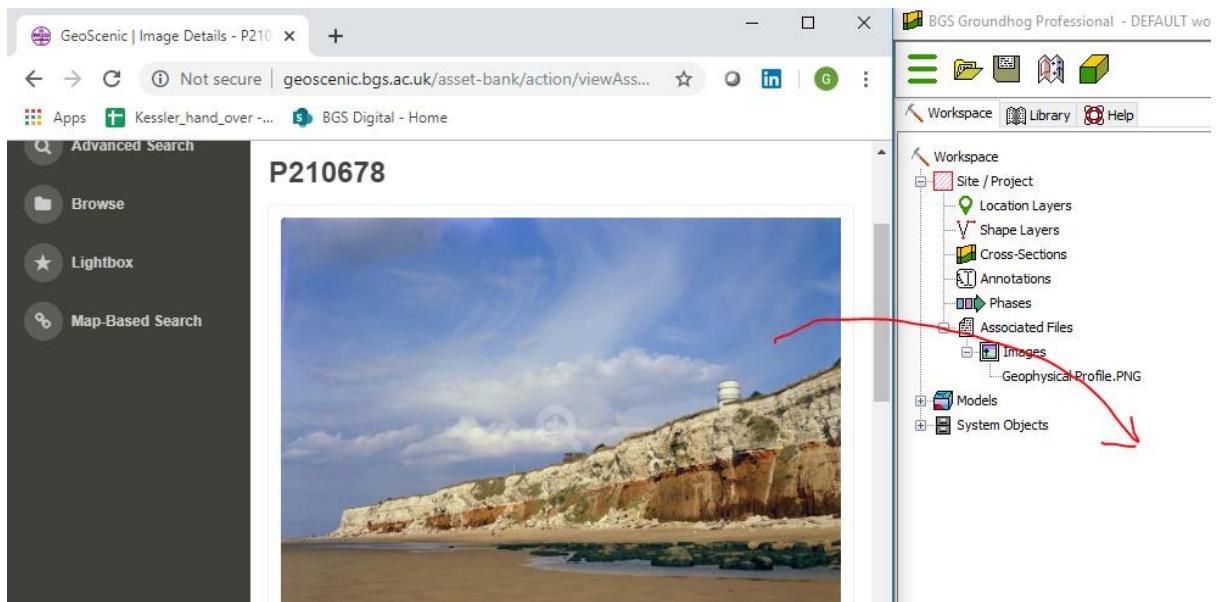
<Right-Click> on Images sub-folder.



Drag image file from folder or desktop.

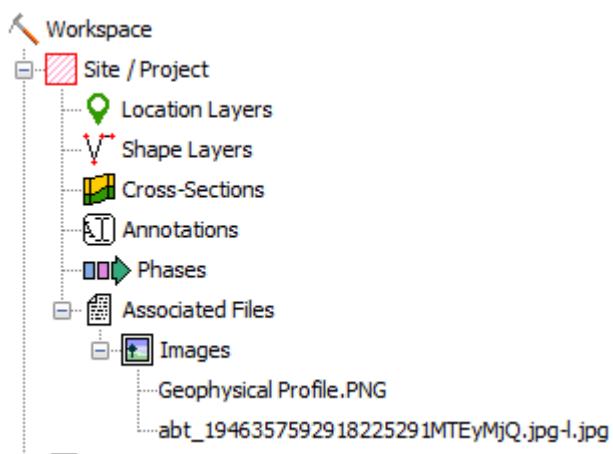


Drag image from web browser (browser dependent, test using Google Chrome).

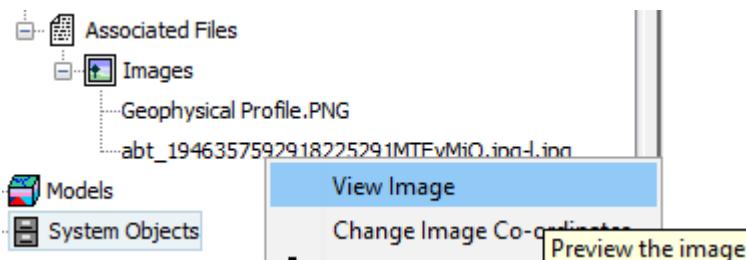


If you have difficulty dragging an image from the web browser, right-click on the image and open it in a new browser tab and try again.

When images are loaded they appear in the object tree under <Site / Project> <Associated Files> <Images>.



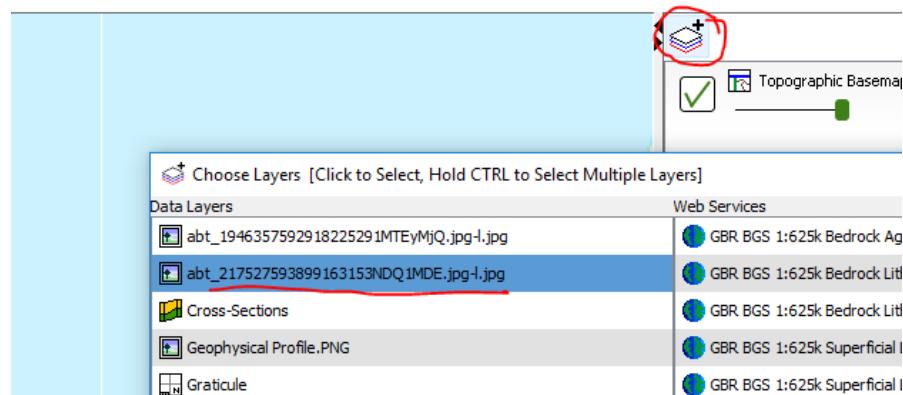
Double-click the entry in the tree, or use <Right-Click> <View Image> to view the image.

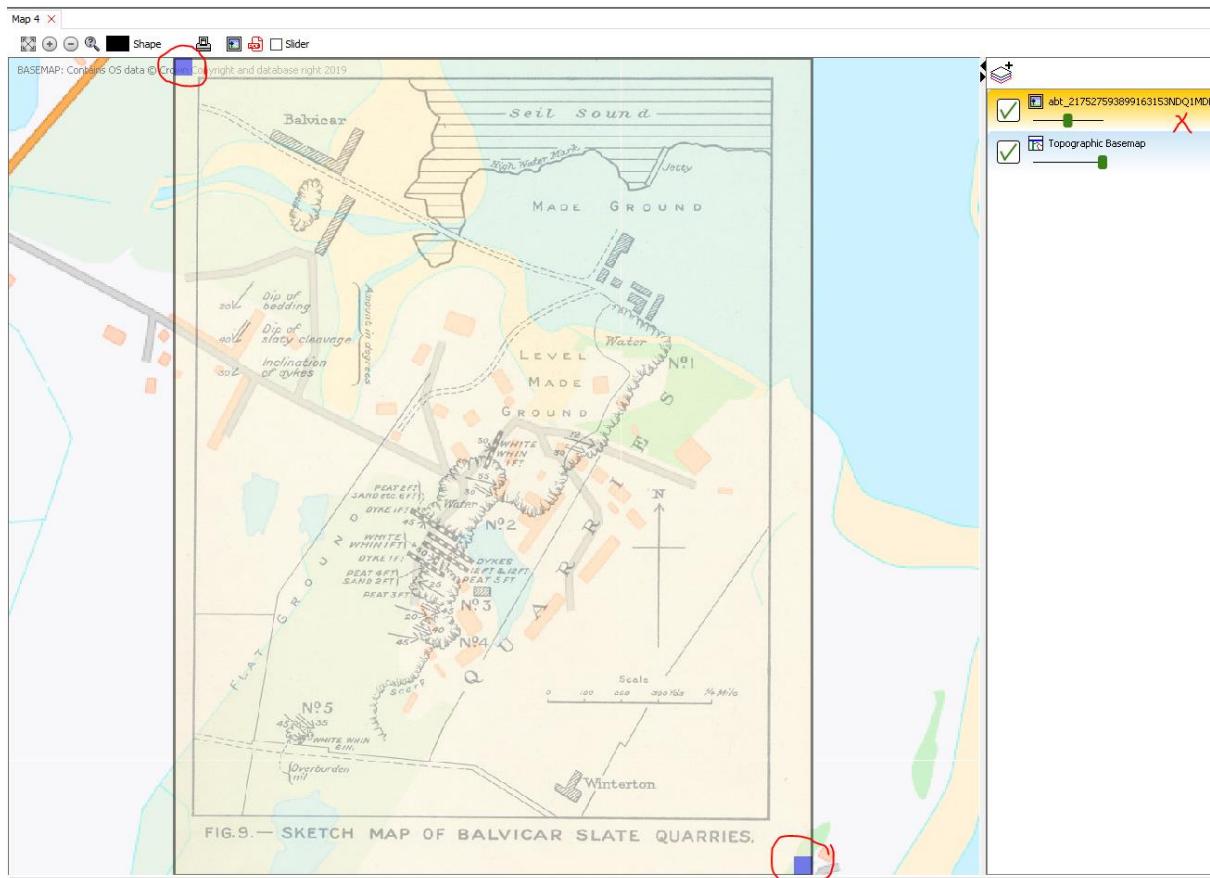




If the image is geo-registered and the world file is present, Groundhog will load the image together with its geo-registration information. When you add the image to a map window as a new layer it will display in the correct spatial location.

If you have an image that is not geo-registered, you can still add it to a map window as a layer. By default it will fill the available panel. Make the image layer editable and use the blue drag handles to register the image to the correct location.



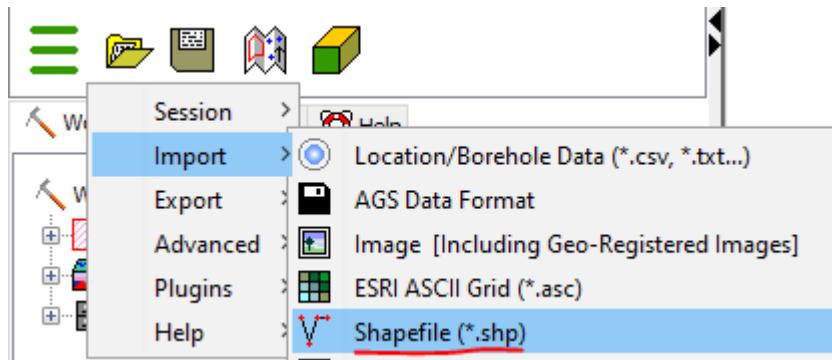


When the project is saved, Groundhog will generate a world file for the registration information.

## Shapefiles

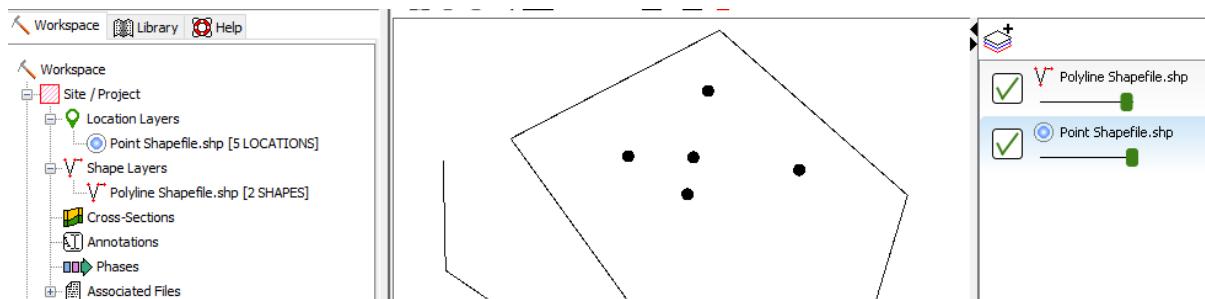
Groundhog has basic support for ESRI shapefiles (\*.shp). However, the shapefile format is proprietary and Groundhog relies on 3<sup>rd</sup> party libraries to support the import filter. Therefore, not all features of the file format are necessarily available, but most Point and Line type files should load. Complex multi-polygon files may be less reliable.

Import the file using <Main Menu> <Import> <Shapefile (\*.shp)>.

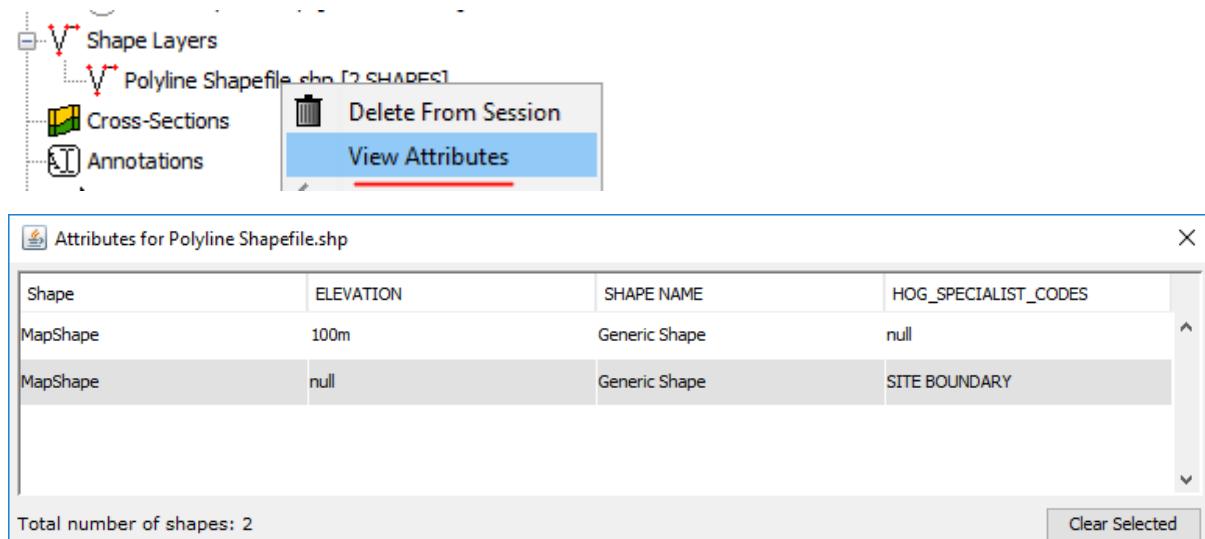


Alternatively, drag the \*.shp file into Groundhog from a folder or the desktop.

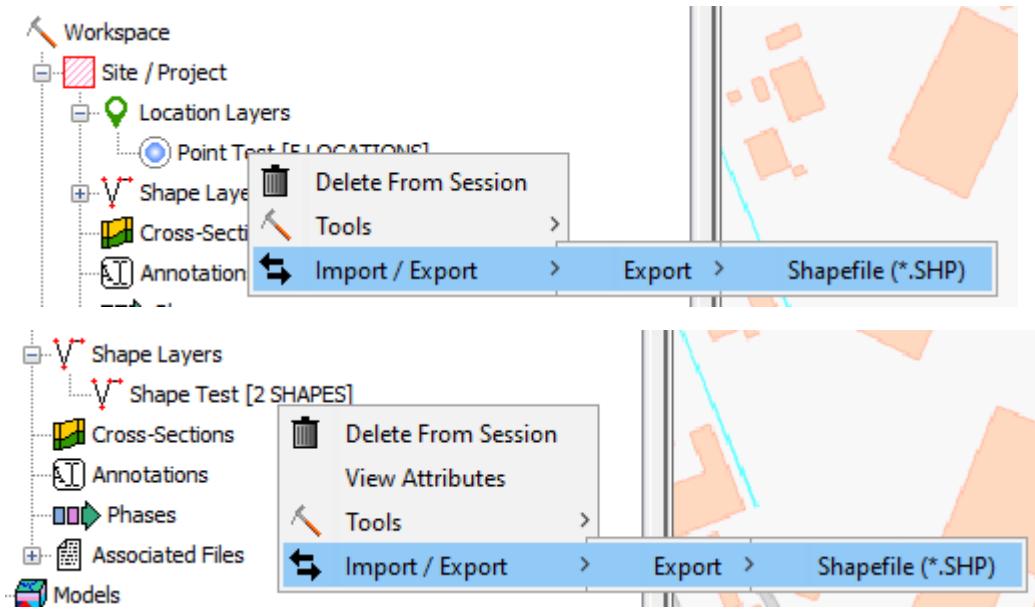
The data is imported as a new folder under the Location Layers (points) or Shape Layers (polyline), respectively. These folders can be added to any map window as a layer for display.



A right-click option provides access to a simple view (non-editable) of the attribute table.



You can export Point and Shape type layers to shapefile format using <Right-Click> <Import / Export> <Export> <Shapefile (\*.SHP)>

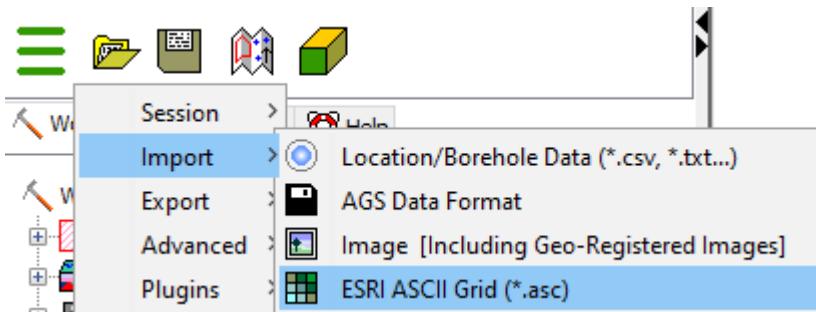


## ASCII Grids

ASCII grids can be imported and used either to display profiles or set as the surface layer (topography, i.e. DEM/DTM). Groundhog supports grids in ESRI's ASCII format.

[https://en.wikipedia.org/wiki/Esri\\_grid](https://en.wikipedia.org/wiki/Esri_grid)

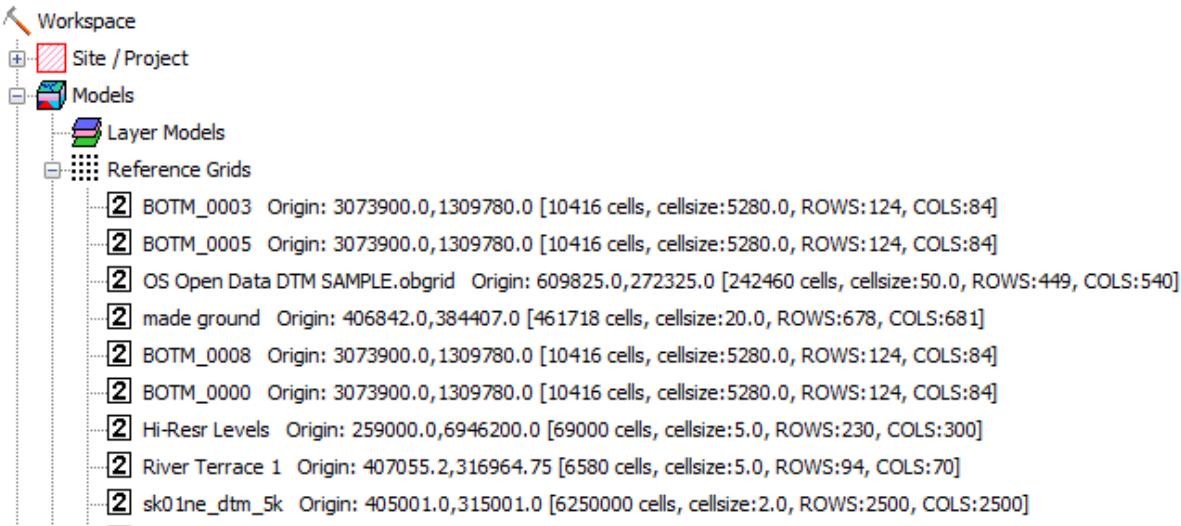
The grid data can be imported manually via <Main Menu> <Import> <ESRI ASCII Grid (\*.asc)>



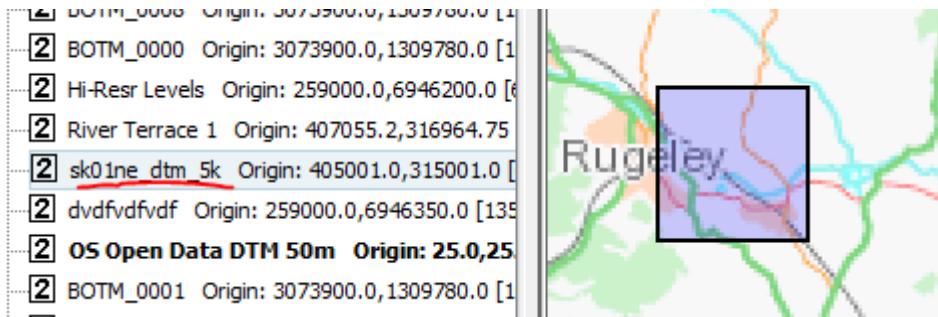
Alternatively, and especially for a series of files, paste them into either the WORKSPACE or the PROJECT directory and restart Groundhog.

When ASCII grids are loaded into Groundhog they are converted to a binary equivalent called a BGRID. This is so that the data can be queried more efficiently without loading the whole grid to memory.

Loaded grids appear in the object tree under <Models> <Reference Grids> and each label displays the extent of the grid object.

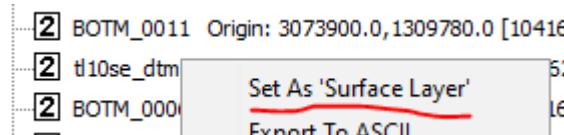


At present there is only a simple way to display the grid in the map, and that is as a simple extent rectangle. To do so, highlight the desired grid object in the tree and a blue rectangle will appear in the map window showing the extent of that grid.

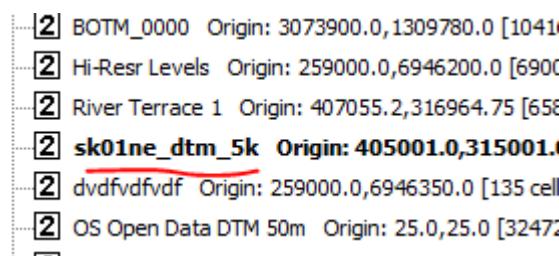


You can set a grid to be the default topographic surface layer within the project. This means the grid will be used as the basis of terrain profile (topography) generation in cross-sections by default.

<Right-Click> <Set As 'Surface Layer'>

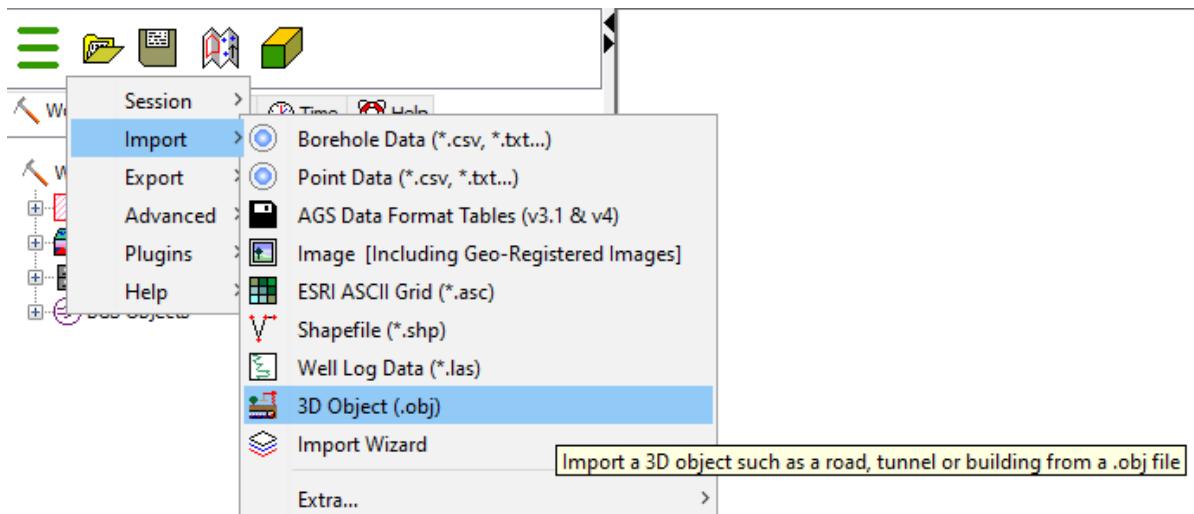


The currently set 'surface layer' grid will be displayed as bold in the object tree list.



## OBJ Files

3D objects can be imported from the industry-standard OBJ data format.



Loaded objects will appear in the data tree.



OBJ objects can be added to the 3D view.

# Working With Borehole Logs

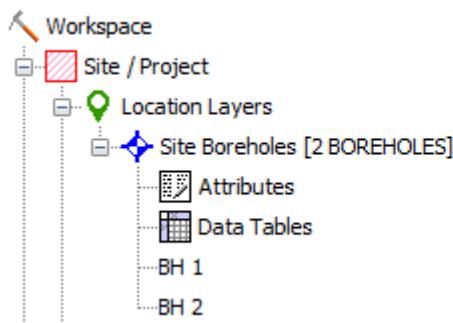
This section provides details on how to import and display your borehole data, make edits to the data and design your own custom log templates. It includes discussion of how to handle geotechnical and geophysical borehole data in AGS and LAS formats.



*Photo by Sven Mieke on Unsplash*

## Borehole Data Import

Groundhog supports a range of borehole data models and import options. When borehole data is loaded it will appear in the object tree under **Site / Project > Location Layers**.



Borehole datasets are arranged into folders. Each data import will create a separate folder. Within each folder there are three types of sub-folder;

1. Attributes,
2. Data Tables,
3. 0, 1, or more borehole objects.

The **Attributes** sub-folder contains the attribution at the dataset or project level. The **Data Tables** sub-folder contains associated tabular data (see later section on tabular data). Each **Borehole** object acts as a sub-folder and contains the geology/interval log and any additional metadata attributes for each individual location.

### CSV/TXT Format

You can import borehole data from delimited text files. The data can either be contained in a single file, or in two files (one containing the collar information and one containing the log data). If the data is split between two files make sure each file contains an ID field that can be used to match the logs to the correct collar.

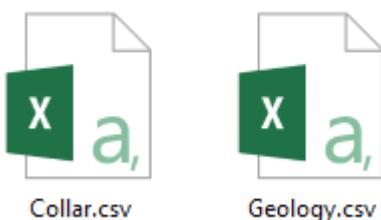
Here is a very simple example of a suitable format as text and as loaded into MS Excel. **This is a single file** containing the collar information and the geology log for **two boreholes**, BH 1 and BH 2. Note that because this is a single file, **the collar information is repeated for each geology interval**. It is also possible to store the collar information and the geology log **in separate files**.

In this example the NAME field can be used as the borehole ID. Groundhog can import as many fields as you like for each log interval, so you can include fields for lithology, litho-stratigraphy, descriptions, etc. The field names are not prescribed as they will be mapped during the import.

```
NAME,EASTING,NORTHING,LEVEL,FROM,TO,GEOL,DESCRIPTION
BH 1,461980,331765,59,0,1.5,MADE GROUND,Rubble and concrete
BH 1,461980,331765,59,1.5,4.6,CLAY,Loose silty clay
BH 1,461980,331765,59,4.6,5,PEAT,Dark brown peat
BH 1,461980,331765,59,5,15,SANDSTONE,Bedrock
BH 2,462155,331710,61,0,5.4,CLAY,Loose silty clay
BH 2,462155,331710,61,5.4,6.3,SILT,Loose silt
BH 2,462155,331710,61,6.3,14,SANDSTONE,Bedrock
```

	A	B	C	D	E	F	G	H
1	NAME	EASTING	NORTHING	LEVEL	FROM	TO	GEOL	DESCRIPTION
2	BH 1	461980	331765	59	0	1.5	MADE GROUND	Rubble and concrete
3	BH 1	461980	331765	59	1.5	4.6	CLAY	Loose silty clay
4	BH 1	461980	331765	59	4.6	5	PEAT	Dark brown peat
5	BH 1	461980	331765	59	5	15	SANDSTONE	Bedrock
6	BH 2	462155	331710	61	0	5.4	CLAY	Loose silty clay
7	BH 2	462155	331710	61	5.4	6.3	SILT	Loose silt
8	BH 2	462155	331710	61	6.3	14	SANDSTONE	Bedrock

In the following example the collar and geology data are split between two separate CSV files. Note that both files have a field that contains the name of the borehole, which will be mapped as the ID field for matching up the geology records to the correct location. This field does not have to be called NAME, it can be called anything as it will be mapped on import. It can also have different names in the collar and geology files. The file names are also not important.



Collar.csv

	A	B	C	D
1	NAME	EASTING	NORTHING	LEVEL
2	BH 1	461980	331765	59
3	BH 2	462155	331710	61

Geology.csv

	A	B	C	D	E
1	NAME	FROM	TO	GEOL	DESCRIPTION
2	BH 1	0	1.5	MADE GROUND	Rubble and concrete
3	BH 1	1.5	4.6	CLAY	Loose silty clay
4	BH 1	4.6	5	PEAT	Dark brown peat
5	BH 1	5	15	SANDSTONE	Bedrock
6	BH 2	0	5.4	CLAY	Loose silty clay
7	BH 2	5.4	6.3	SILT	Loose silt
8	BH 2	6.3	14	SANDSTONE	Bedrock

## Importing CSV

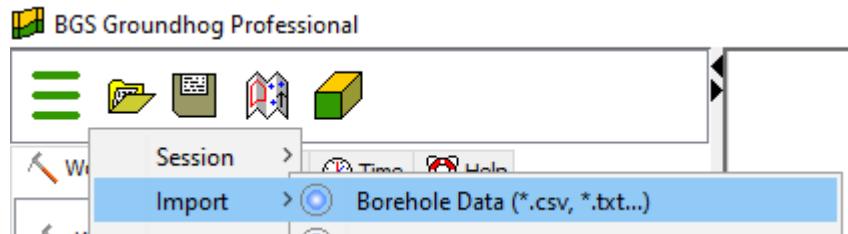
There are two routes to import boreholes from CSV.

1. Combined collar and geology import,
2. Individual import.

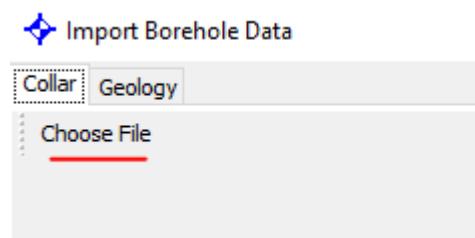
### *Combined Import*

This option allows provides a short-cut to import both the collar and geology data in a single step. It will work whether your data is split into separate collar and geology data files, or merged into a single file.

#### **Main Menu > Import > Borehole Data**



The dialog contains a tab for the collar and a tab for the geology. Click on the **Choose File** button on each tab to load up the data.



The names of the fields in the data file are listed to the left of the panel. Ignore the UNIT and TYPE columns.

Use the drop-down options in the **ALIAS** column to tell Groundhog the meaning of each field in the imported data file. Choose **<< Exclude From Import >>** for any redundant fields. The required fields for the import type are **marked in red** in the drop-down list of possible **ALIAS** values.

NAME	ALIAS	UNIT	TYPE
EASTING	<< Import As Is >>		
NORTHING	<< Import As Is >> << Exclude From Import >> LOCATION ID		
LEVEL	X		
FROM	Y		
TO	SAMPLE ID		
GEOL	Z		
DESCRIPTION	DEPTH FROM TO		

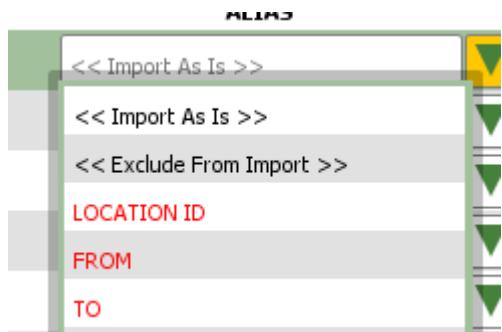
In this example we are working with the combined data file that contains both the collar and geology data. Note the mappings, including the fields that have been excluded.

ALIAS	
NAME	LOCATION ID
EASTING	X
NORTHING	Y
LEVEL	Z
FROM	<< Exclude From Import >>
TO	<< Exclude From Import >>
GEOL	<< Exclude From Import >>
DESCRIPTION	<< Exclude From Import >>

Note that the **LEVEL** field from the data file (which is the start height or elevation of the borehole) has been mapped to **Z**. This field is not mandatory for the import, but if there is a value available for this you should always map it.

Next, switch to the Geology tab and bring in the CSV file containing the geology data. Again, in this example, the data is in the same single file as the collar data.

The fields required for the geology import are different than for the collar data. Again, they are highlighted in red in the drop-down list.



Collar Geology

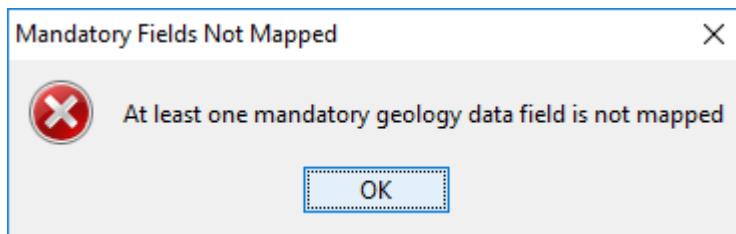
Mappings Data [7 rows]

ALIAS	
NAME	LOCATION ID <input type="button" value="▼"/>
EASTING	<< Exclude From Import >> <input type="button" value="▼"/>
NORTHING	<< Exclude From Import >> <input type="button" value="▼"/>
LEVEL	<< Exclude From Import >> <input type="button" value="▼"/>
FROM	FROM <input type="button" value="▼"/>
TO	TO <input type="button" value="▼"/>
GEOL	<< Import As Is >> <input type="button" value="▼"/>
DESCRIPTION	<< Import As Is >> <input type="button" value="▼"/>

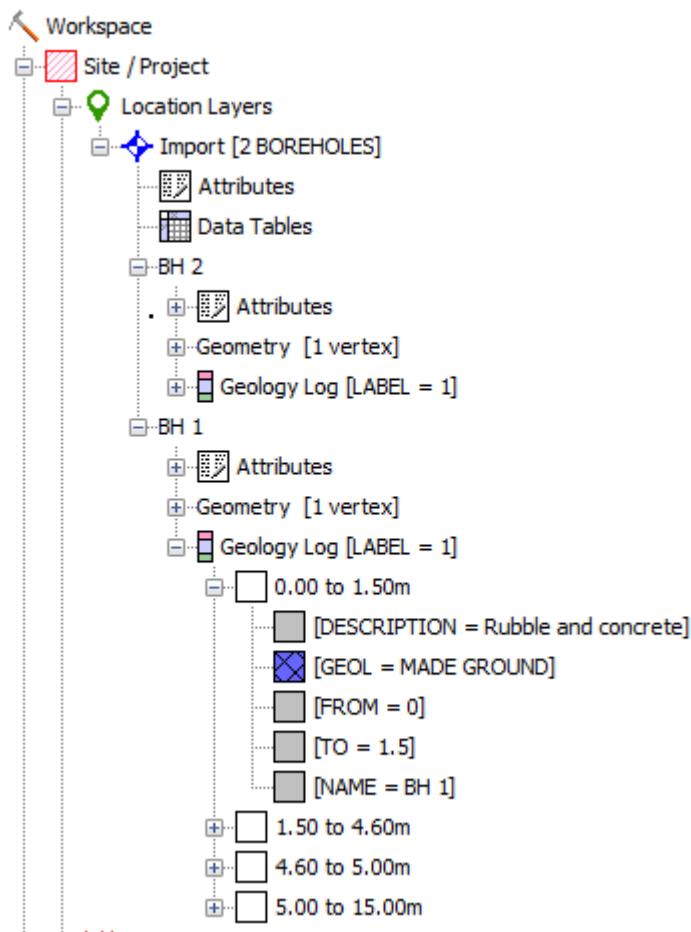
**IMPORTANT:** Make sure to use the correct field to map the **LOCATION ID** alias, as this will be used to match the records between the collar and geology data. GEOL and DESCRIPTION are both important fields that we want to see in the geology log, but they do not need to be mapped to any specific expected Groundhog field. So, they will just be imported using the name used in the data file.

Click **OK**.

If you have missed out any required fields in the **ALIAS** mappings, you will see this message. Go back into the mappings panels and correct these.



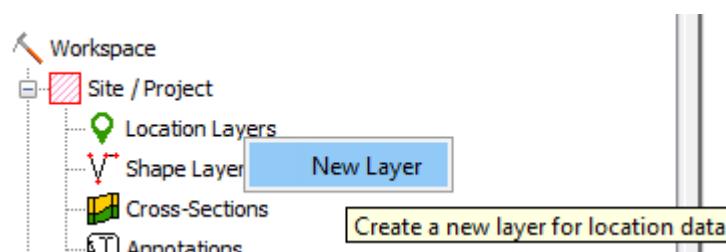
Otherwise, the import will proceed and a new borehole dataset folder will be created in the data tree.



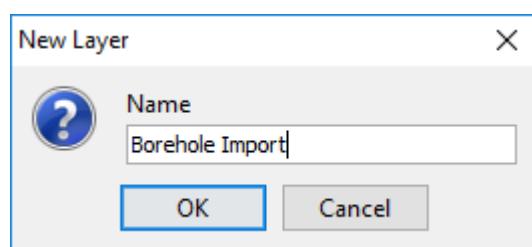
### *Individual Import*

This option allows the borehole dataset to be assembled one data file at a time. It also leads into the import of generic tabular data which is described in the following section.

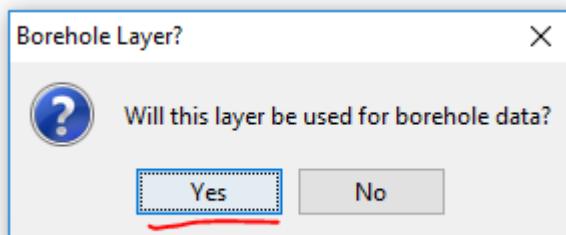
First, create an empty borehole dataset folder in the tree.



Enter a name for the folder.

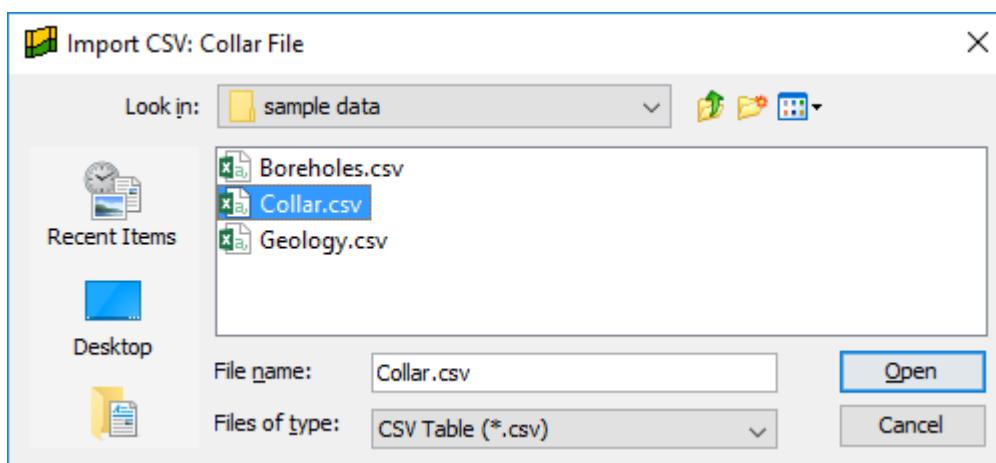
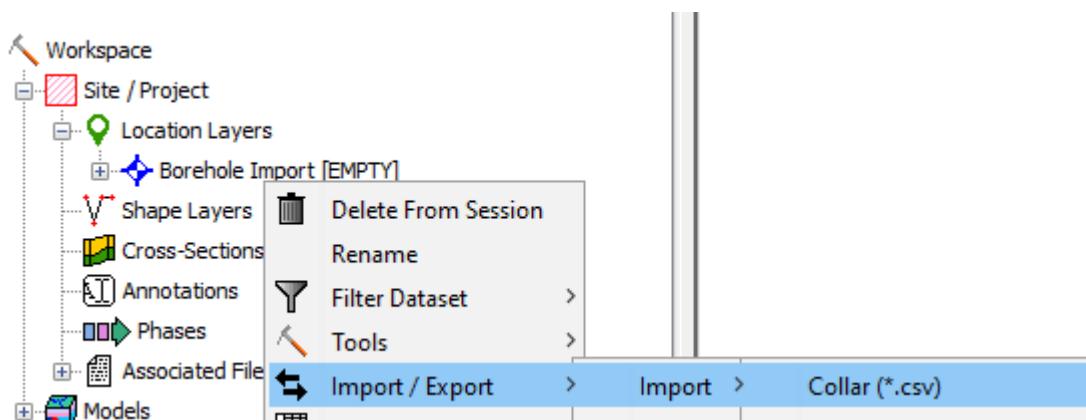


When prompted, click **Yes** to specify a borehole layer.



The new, empty borehole dataset folder will be created in the data tree.

Use **Right-Click > Import / Export > Import > Collar** on the borehole folder and select the file containing the collar data.



Use the pull-down ALIAS options to map the imported fields to the fields expected by Groundhog and click Apply. In the case of collar data this could be;

- LOCATION ID
- X
- Y
- Z (collar height or ground level)

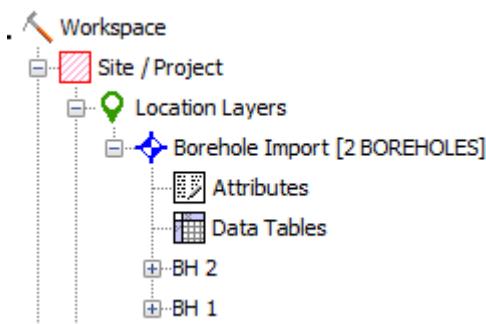
IMPORT TABLE: Collar

Mappings Data [2 rows]

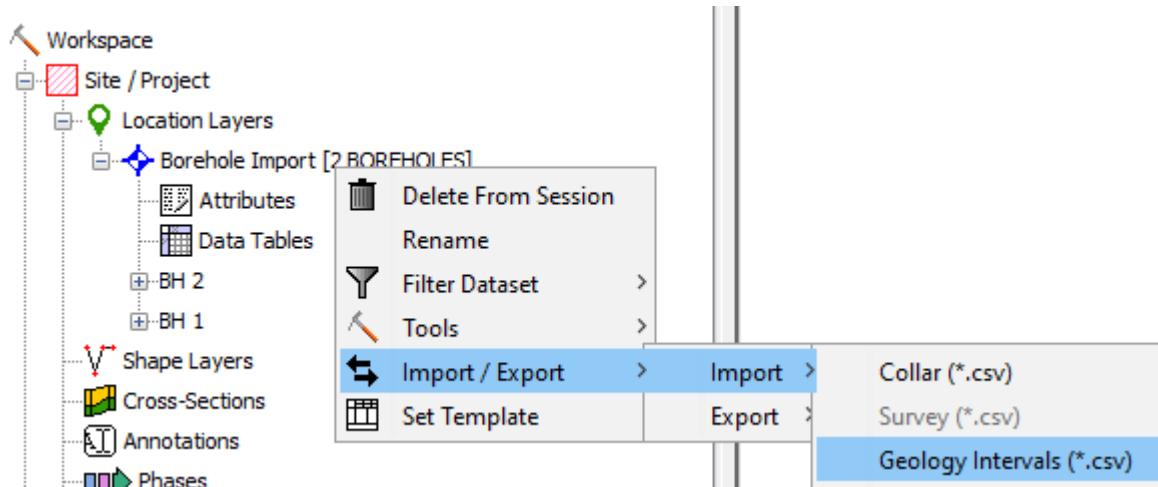
	ALIAS	UNIT	TYPE
NAME	LOCATION ID		
EASTING	X		
NORTHING	Y		
LEVEL	Z		

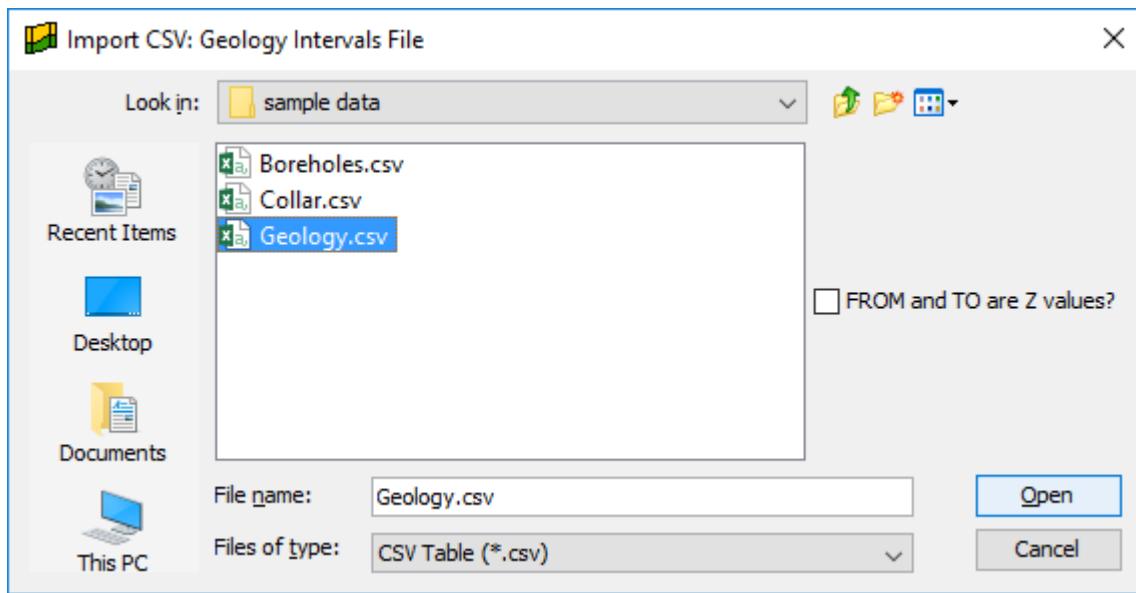
Apply Cancel

The imported collar entries are added to the data tree.



Next, import the geology data using **Right-Click > Import /Export > Import > Geology Intervals** on the borehole folder and select the file containing the geology interval/log data.



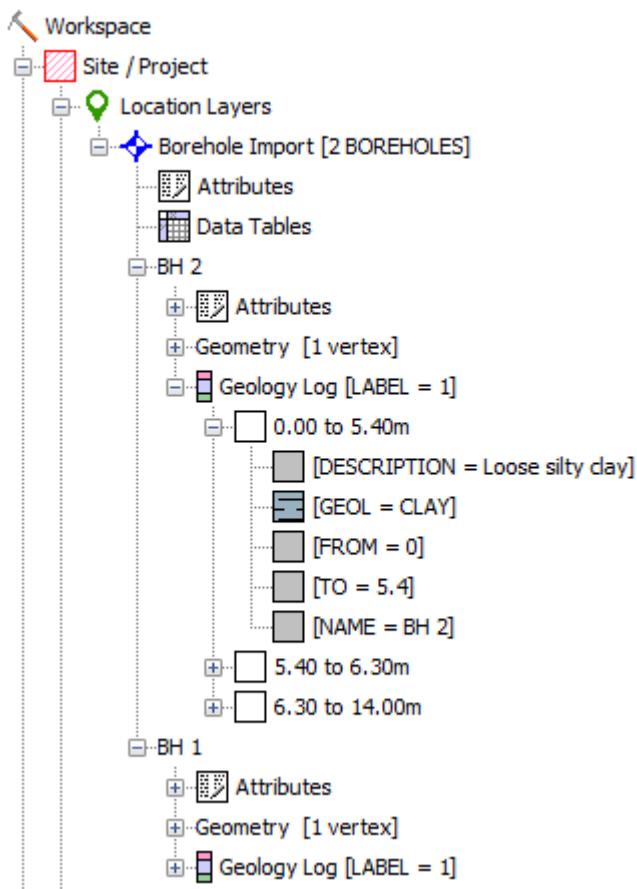


If the depth values in the log file are elevation, as opposed to depth-down-hole, check the special option box on the right of the file chooser dialog (**NOTE:** this function will only work if the collar has a Z, or ground level, value).

Map the fields using the drop-down options in the **ALIAS** column of the import screen. Required fields are highlighted in red. Click Apply.

ALIAS	
NAME	LOCATION ID <span style="float: right;">▼</span>
FROM	FROM <span style="float: right;">▼</span>
TO	TO <span style="float: right;">▼</span>
GEOL	<< Import As Is >> <span style="float: right;">▼</span>
DESCRIPTION	<< Import As Is >> <span style="float: right;">▼</span>

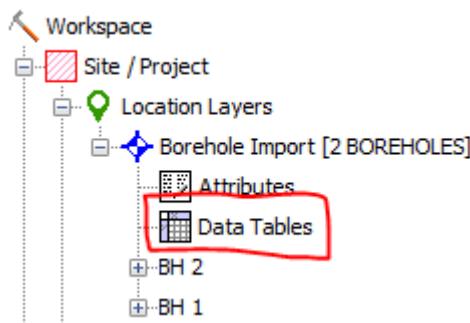
Inspect the data tree to see the imported geology logs.



## Importing Tabular Data

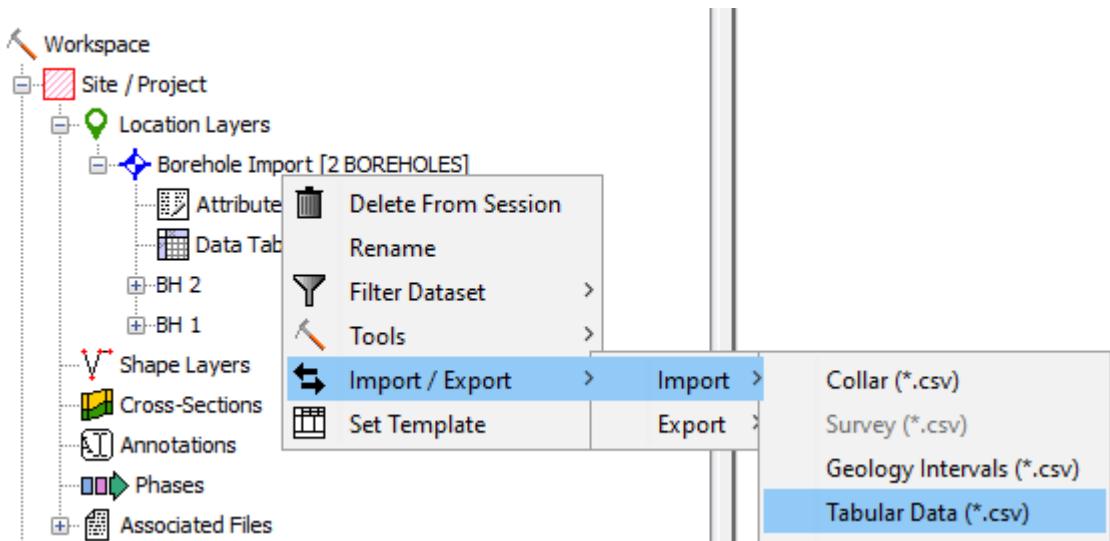
Besides the collar data and geology interval logs, Groundhog can also import any arbitrary down-hole data in tabular format. For example, sample and test data (in-situ and laboratory), geophysical measurements, installation and monitoring data, etc.

It is important to note that tabular data is held at the borehole dataset folder level and not against individual boreholes.

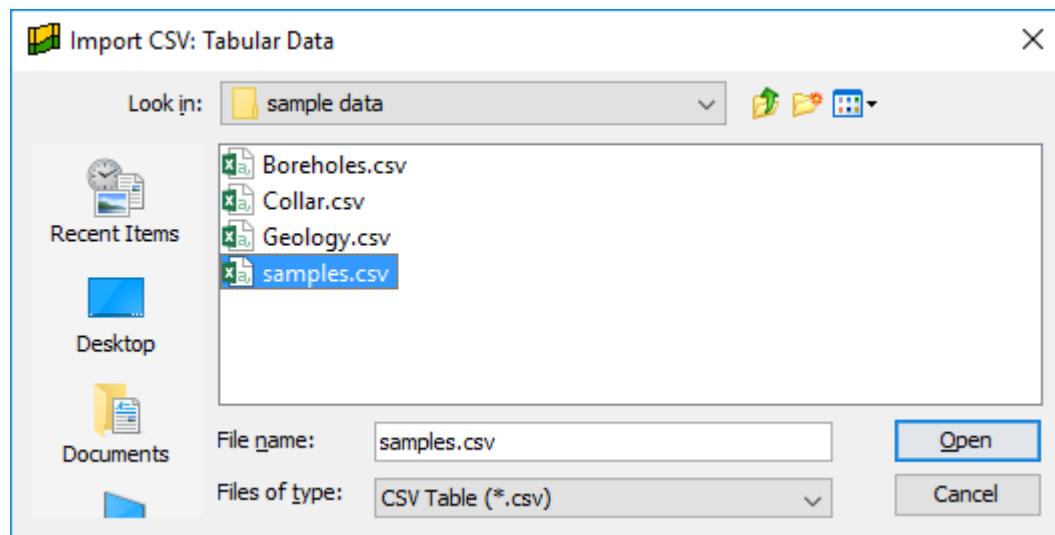


The rows within each table are mapped to the appropriate borehole object using an ID field.

To import a table of data use ***Right-Click > Import / Export > Import > Tabular Data***



Use the file chooser dialog to select the CSV file containing the data.



Next, use the field mapping dialog to specify the meaning of the key fields in the import file and to choose whether to exclude any. When importing tabular data you will need to map the fields within the data file to those expected, or treated specially, within Groundhog. This is done by selecting ALIAS values for each field in the data file in the mapping dialog. All fields are imported with their original name from the data file, but the ALIAS field tells Groundhog to treat particular fields as special values, such as depth, id, etc. Use the pull-down options against each field in the mapping dialog. You can also choose to exclude specific fields from the import. The image below shows a set of mappings for a typical import.

Mappings Data [15 rows]

	ALIAS	UNIT	1
LOCA_ID	LOCATION ID		ID
SAMP_TOP	FROM	m	2DP
SAMP_REF	<< Import As Is >>		X
SAMP_TYPE	<< Import As Is >>		PA
SAMP_ID	SAMPLE ID		ID
SAMP_BASE	TO	m	2DP
SAMP_DTIM	<< Exclude From Import >>	yyyy-mm-ddThh:mm	DT
SAMP_UBLO	<< Exclude From Import >>		ODP
SAMP_CONT	<< Import As Is >>		X
SAMP_PREP	<< Import As Is >>		X
SAMP_SDIA	<< Exclude From Import >>	mm	ODP
SAMP_WDEP	X		
SAMP_RECV	Y	m	2DP
	Z	%	ODP

You can also preview the data in the file using the Data tab, **but currently you can't edit the data.**

EDIT TABLE: SAMP

Mappings Data [15 rows]

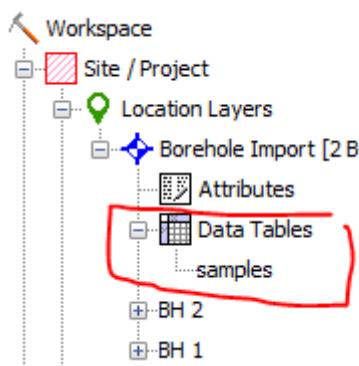
LOCA_ID	SAMP_TOP	SAMP_REF	SAMP_TYPE	SAMP_ID	SAMP_BASE
TP501	1.00	1	D		1.00
TP501	1.00	2	B		1.30
TP501	2.50	3	B		2.75
BH502	1.00	1	U		1.45
BH502	1.50	2	D		1.50
BH502	3.00	3	U		3.45
BH502	3.50	4	D		3.50
BH502	6.00	5	D		6.45

Here is an example of a CSV file viewed in Excel, containing sample information for two boreholes with FROM and TO depth fields.

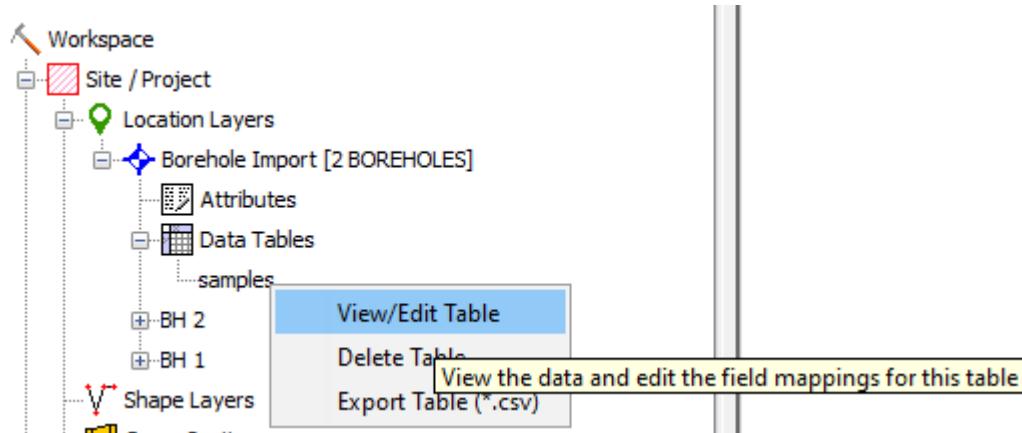
	A	B	C	D
1	ID	FROM	TO	SAMPLE TYPE
2	BH 1	0.5	0.6	Disturbed
3	BH 1	1.5	1.7	Bulk
4	BH 1	3.2	3.3	Undisturbed
5	BH 2	0.2	0.4	Disturbed
6				

ALIAS			
ID	LOCATION ID		▼
FROM	FROM		▼
TO	TO		▼
SAMPLE TYPE	<< Import As Is >>		▼

Once imported, the table will appear in the data tree.



Double-click on the table entry, or use right-click, to view the table and edit the field mappings once loaded.

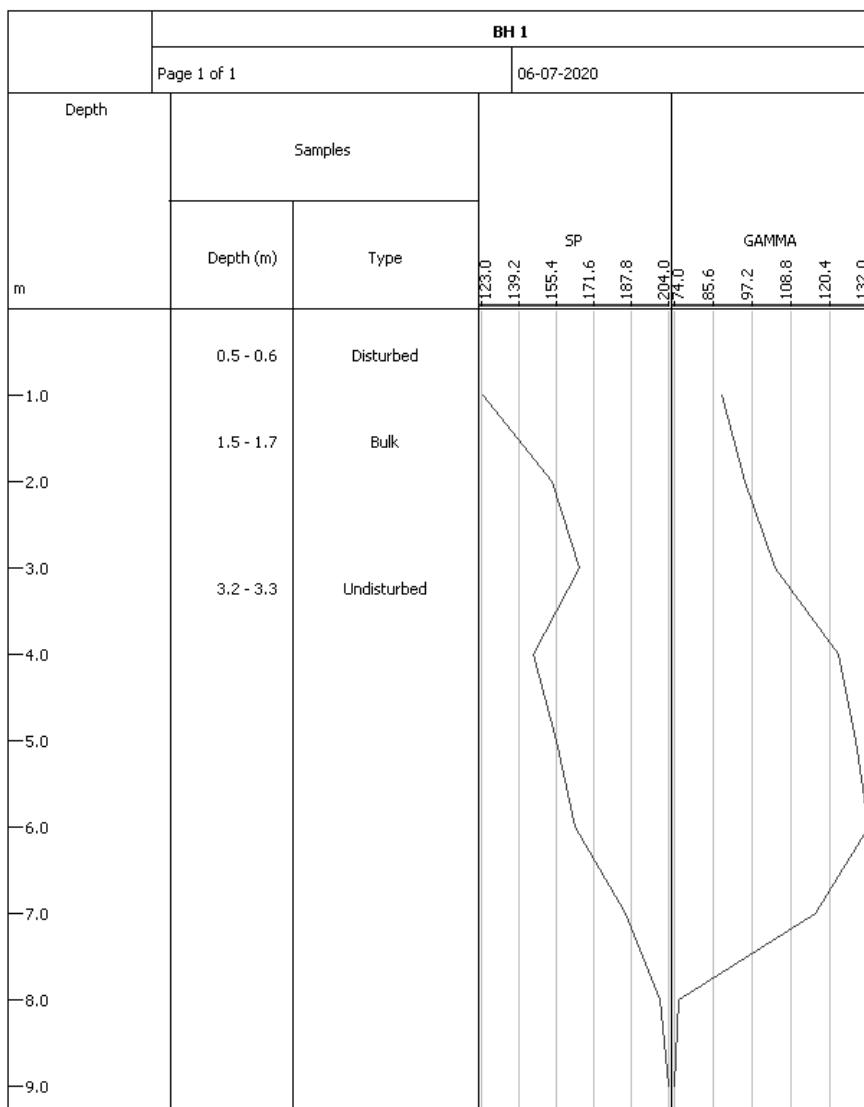


The following example shows how to import a depth-related value, such as geophysical test data, with a single test DEPTH field.

	A	B	C	D
1	BORE NAME	DEPTH	SP	GAMMA
2	BH 1	1	123	88
3	BH 1	2	153	95
4	BH 1	3	165	104
5	BH 1	4	145	123
6	BH 1	5	155	128
7	BH 1	6	163	132
8	BH 1	7	185	116
9	BH 1	8	200	75
10	BH 1	9	204	74
11				

ALIAS			
BORE NAME	LOCATION ID		▼
DEPTH	DEPTH		▼
SP	<< Import As Is >>		▼
GAMMA	<< Import As Is >>		▼

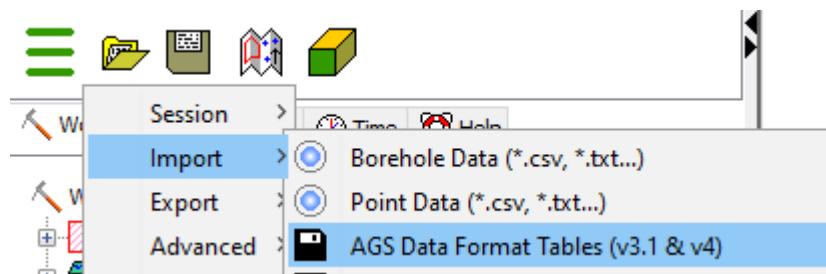
The following image below shows how the data from the tables can be used in log templates, for example.



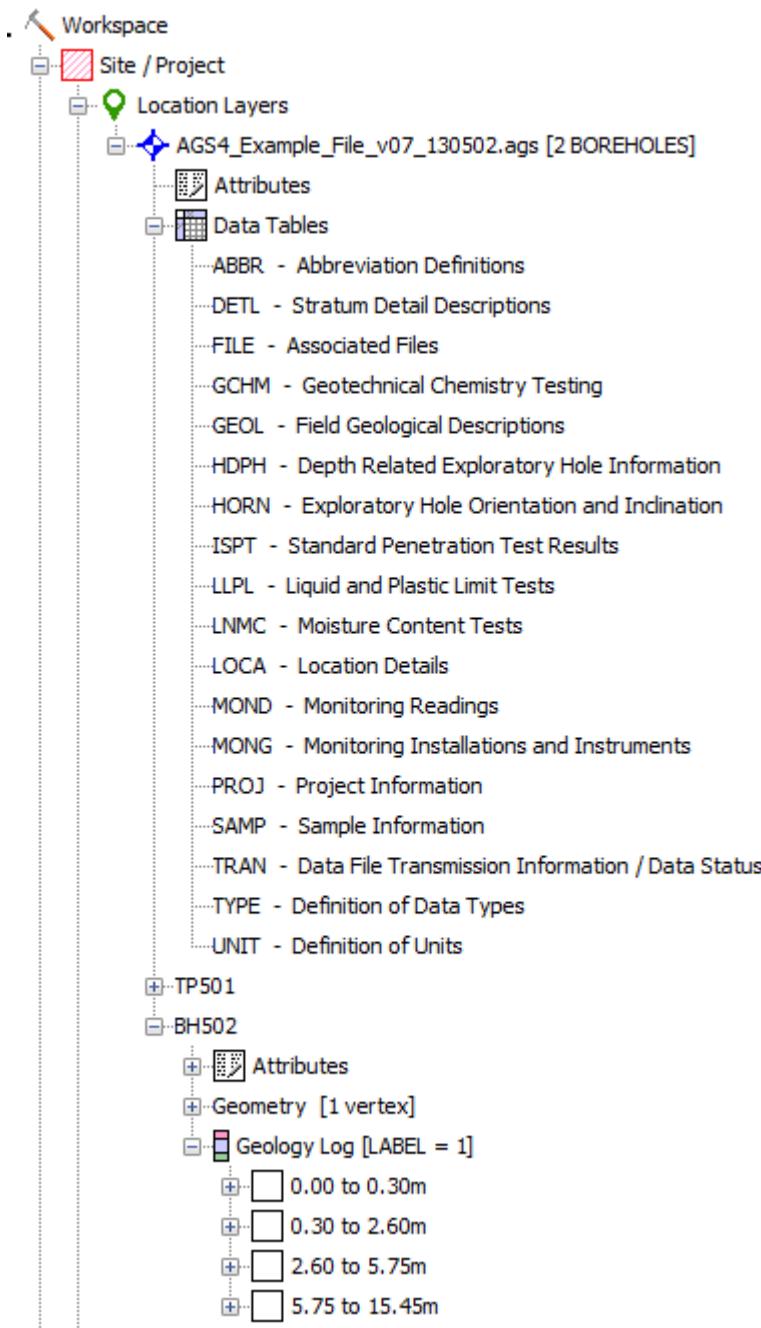
## Importing AGS Format Data

The AGS standard is a file format for the transfer of factual site investigation data in the UK and elsewhere. It is supported as an import option within Groundhog and, once imported, is treated as a set of data tables, much the same as a standard CSV import would be.

From the main menu, choose **Import > AGS Data Format Tables**



Select the AGS file (v3.1 and v4 are both supported). The imported data will take the form of a borehole dataset folder. Expand the folder to explore the imported geology logs (if present in the data file) and the various test and descriptive tables.

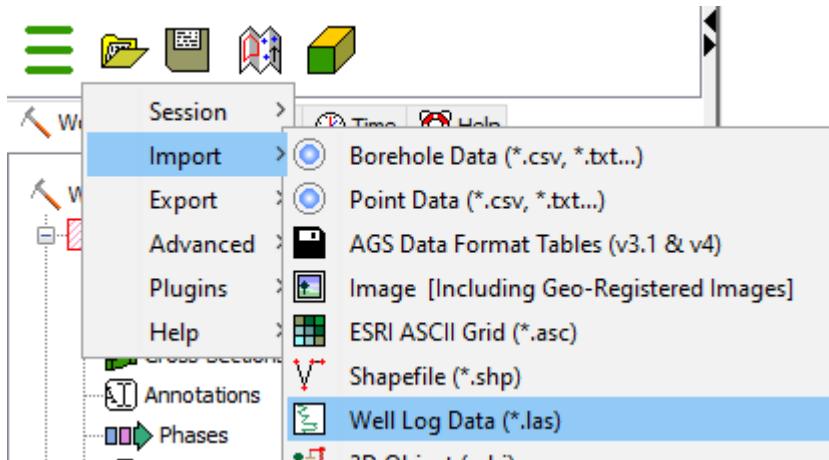


Sample AGS data taken from the AGS data format v4 example data file.

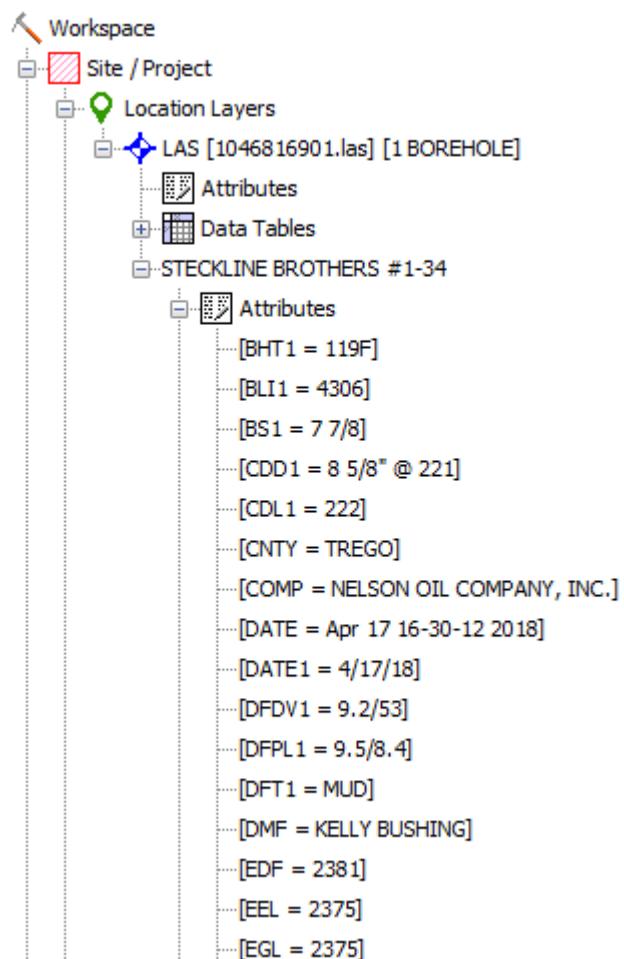
### Importing LAS Format Data

Groundhog supports the industry-standard Canadian Well Logging LAS data format for geophysical wireline log data. The imported data is stored in Groundhog data tables, similar to data imported from a tabular format such as CSV.

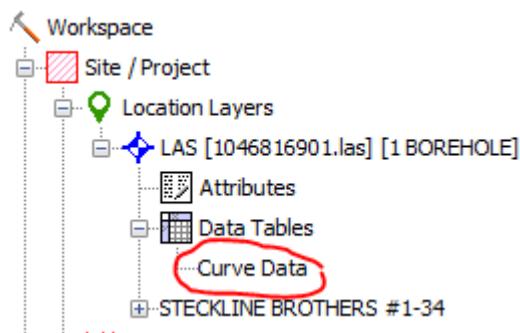
From the main menu, choose ***Import > Well Log Data (\*.las)***



The collar data is attached to the borehole entry in the data tree as a series of attributes.



The test data appears as a table called Curve Data under the Data Tables sub-folder of the borehole dataset folder (example file shown courtesy of Kansas Geological Survey download portal - <http://www.kgs.ku.edu/Magellan/Logs/>).



Double-click the table, or use right-click to view and edit the table mappings and to preview the data values (not editable).

**EDIT TABLE: Curve Data**

Mappings | Data [8679 rows]

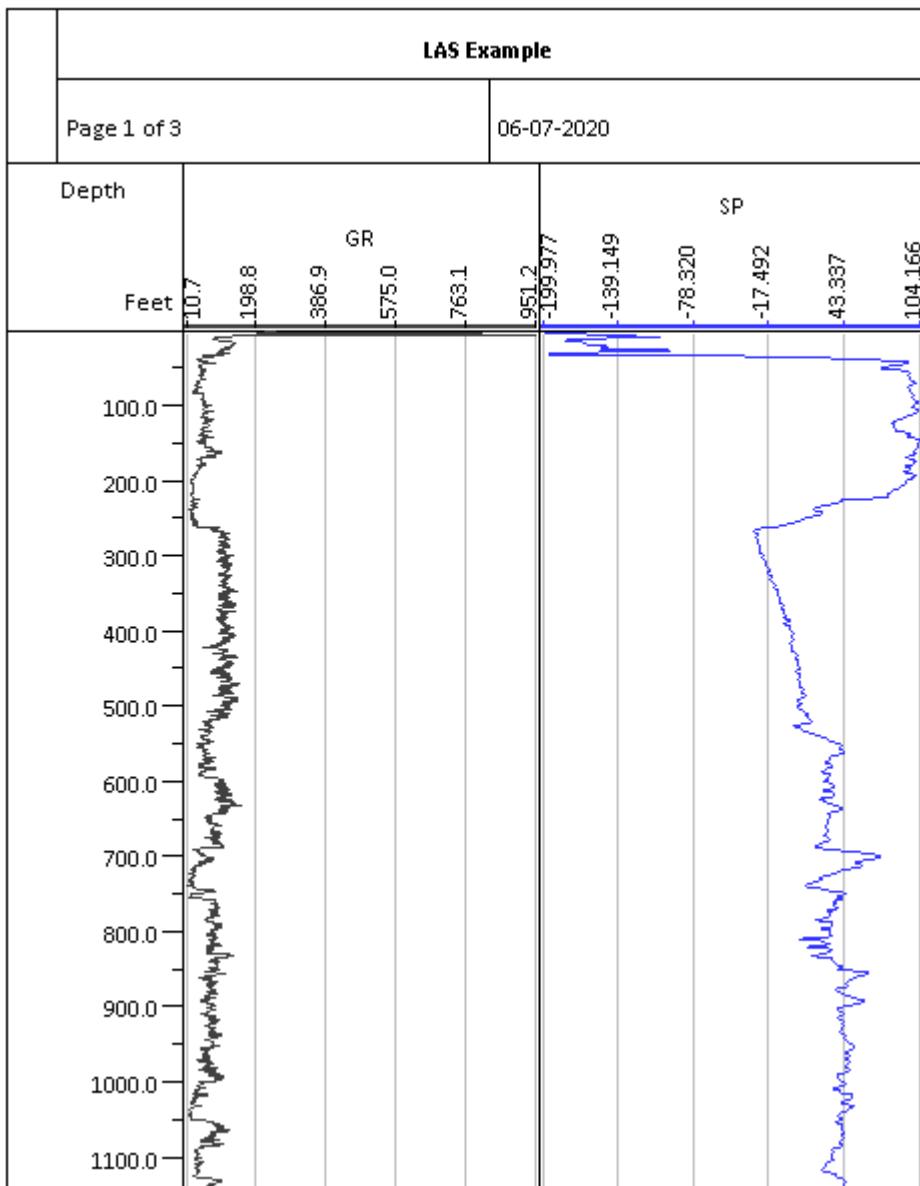
	ALIAS	UNIT
LOCATION ID	LOCATION ID	
DEPTH	DEPTH	FEET
ABHV	ABHV	FT3
CNPOR	CNPOR	PU
DCAL	DCAL	IN
DPOR	DPOR	PU
GR	GR	GAPI
RHOB	RHOB	G/CC
RHOC	RHOC	G/CC
RILD	RILD	OHM-M
RILM	RILM	OHM-M
RLL3	RLL3	OHM-M

EDIT TABLE: Curve Data

Mappings Data [8679 rows]

LOCATION ID	DEPTH	ABHV	CNPOR	DCAL	DPOR	GR
STECKLINE BRO...	0.0	-1.79769313486...	-1.79769313486...	-1.79769313486...	-1.79769313486...	252.5742
STECKLINE BRO...	0.1524	-1.79769313486...	-1.79769313486...	-1.79769313486...	-1.79769313486...	251.3724
STECKLINE BRO...	0.3048	-1.79769313486...	-1.79769313486...	-1.79769313486...	-1.79769313486...	230.4771
STECKLINE BRO...	0.457200000000...	-1.79769313486...	-1.79769313486...	-1.79769313486...	-1.79769313486...	207.6913
STECKLINE BRO...	0.6096	-1.79769313486...	-1.79769313486...	-1.79769313486...	-1.79769313486...	197.3913
STECKLINE BRO...	0.762	-1.79769313486...	-1.79769313486...	-1.79769313486...	-1.79769313486...	218.2829
STECKLINE BRO...	0.914400000000...	-1.79769313486...	-1.79769313486...	-1.79769313486...	-1.79769313486...	346.468
STECKLINE BRO...	1.0668	-1.79769313486...	-1.79769313486...	-1.79769313486...	-1.79769313486...	659.6419
STECKLINE BRO...	1.2192	-1.79769313486...	-1.79769313486...	-1.79769313486...	-1.79769313486...	951.1758
STECKLINE BRO...	1.371600000000...	-1.79769313486...	-1.79769313486...	-1.79769313486...	-1.79769313486...	707.4532
STECKLINE BRO...	1.524	-1.79769313486...	-1.79769313486...	-1.79769313486...	-1.79769313486...	597.9813
STECKLINE BRO...	1.676400000000...	-1.79769313486...	-1.79769313486...	-1.79769313486...	-1.79769313486...	487.7093
STECKLINE BRO...	1.828800000000...	-1.79769313486...	-1.79769313486...	-1.79769313486...	-1.79769313486...	276.9357
STECKLINE BRO...	1.9812	-1.79769313486...	-1.79769313486...	-1.79769313486...	-1.79769313486...	157.0069
STECKLINE BRO...	2.1336	-1.79769313486...	-1.79769313486...	-1.79769313486...	-1.79769313486...	105.5515
STECKLINE BRO...	2.286	-1.79769313486...	-1.79769313486...	-1.79769313486...	-1.79769313486...	87.6165
STECKLINE BRO...	2.4384	-1.79769313486...	-1.79769313486...	-1.79769313486...	-1.79769313486...	87.9074
STECKLINE BRO...	2.5908	-1.79769313486...	-1.79769313486...	-1.79769313486...	-1.79769313486...	86.3093
STECKLINE BRO...	2.743200000000...	-1.79769313486...	-1.79769313486...	-1.79769313486...	-1.79769313486...	84.2577
STECKLINE BRO...	2.8956	-1.79769313486...	-1.79769313486...	-1.79769313486...	-1.79769313486...	80.3556
STECKLINE BRO...	3.048	-1.79769313486...	-1.79769313486...	-1.79769313486...	-1.79769313486...	86.5411

The data in the table can be used in log templates, as-per any tabular data.



### BGS Borehole Records

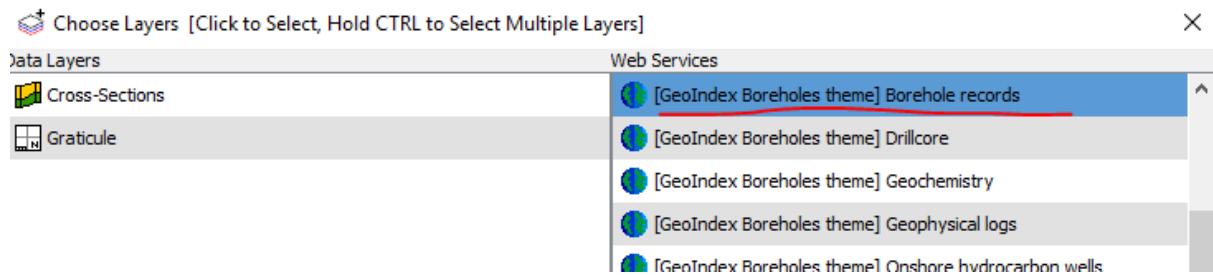
There are two ways to view borehole records held by the BGS, (1) view original driller's logs and (2) download AGS data.

#### *Viewing Driller's Logs From BGS*

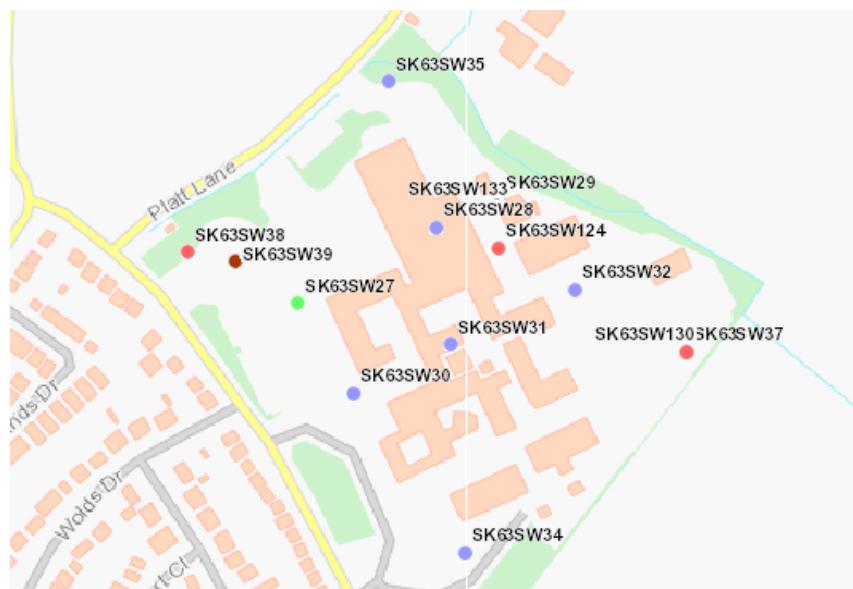
BGS holds driller's logs as scanned images for many of the borehole records. The locations of the records are available as a WMS (Web Map Service) which can be displayed in the Groundhog map window as a layer.



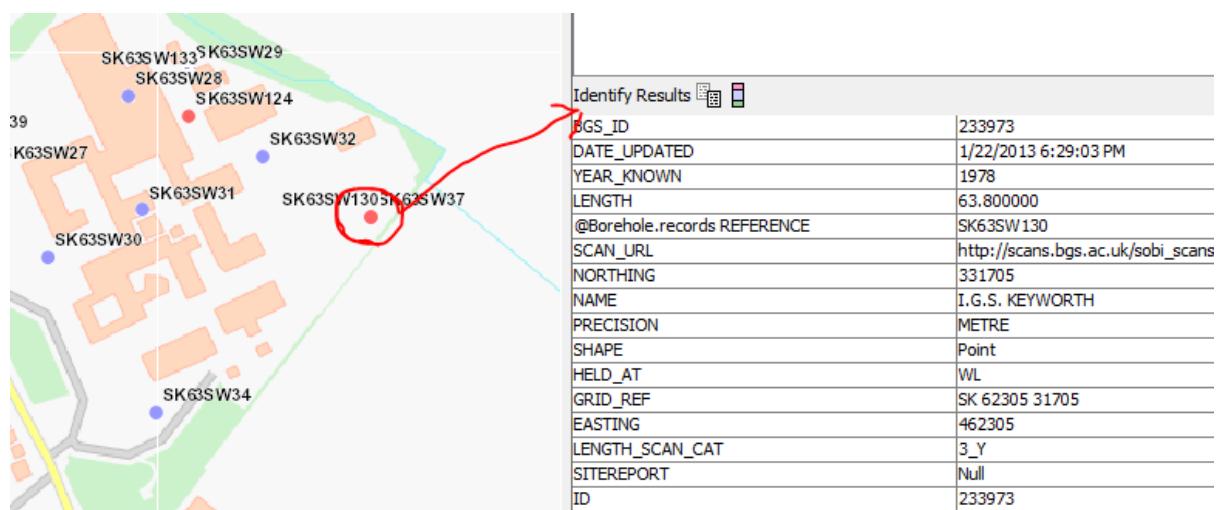
From the panel on the right of the layer selection dialog, select the layer called **[GeoIndex Boreholes theme] Borehole records**.



Zoom into an area to see the available records as a point layer.



Make the WMS points layer active by clicking on it in the layer control. When it is active it will turn orange. Now that the layer is active, click on any dot in the map to perform an identify query. The results will display in a panel on the right.



In the identify results panel, click on the borehole stick icon to hyperlink to the BGS record (opens in default web browser).

Identify Results   
 BGS\_ID  
 DATE\_UPDATED  
 READ UNKNOWN

**British Geological Survey**  
 NATURAL ENVIRONMENT RESEARCH COUNCIL

Version 2.0.6  
 BGS ID: 233973 : BGS Reference: SK63SW130  
 British National Grid (27700) : 462305,331705  
[Report an issue with this borehole](#)

<< < Prev Page 3 of 3 > Next > >>

(For Institute use only) GEOLOGICAL CLASSIFICATION	NATURE OF STRATA <small>British Geological Survey</small>	THICKNESS			DEPTH		
		Feet	Inches	Metres	Feet	Inches	Metre
Trent Formation (gypsiferous)	Trent A. Red-brown mudstones [upper part may be Parva Fm.] some green beds.	14.73		4.44	14.73		
	Trent B. Red-brown mudstones with macrogyrus	23.70		7.22	38.07		
	Windmill Skerries (2)	2.97		0.90	41.04		
KEMPER MARL	Trent C. Chocolate-brown mudstones with macrogyrus	10.75		3.27	51.79		
Edwinton Formation	Hollygate Skerries (7)	5.45		1.66	57.24		
	Edwinton - Mudstones with subordinate gypsiferous	6.56		2.00	63.8		

### Downloading AGS Data From BGS

The BGS' NGDC Digital Data Deposit Application can be used by industry and the public to deposit data into the BGS archives.

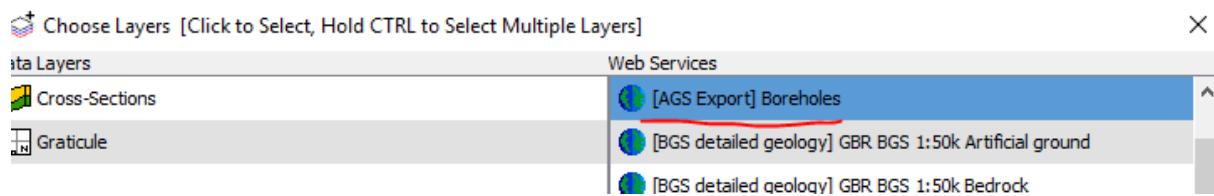
<http://transfer.bgs.ac.uk/ingestion>

Any AGS format data locations that are ingested are served back at as a WMS (Web Map Service) layer that can be displayed and queried within Groundhog.

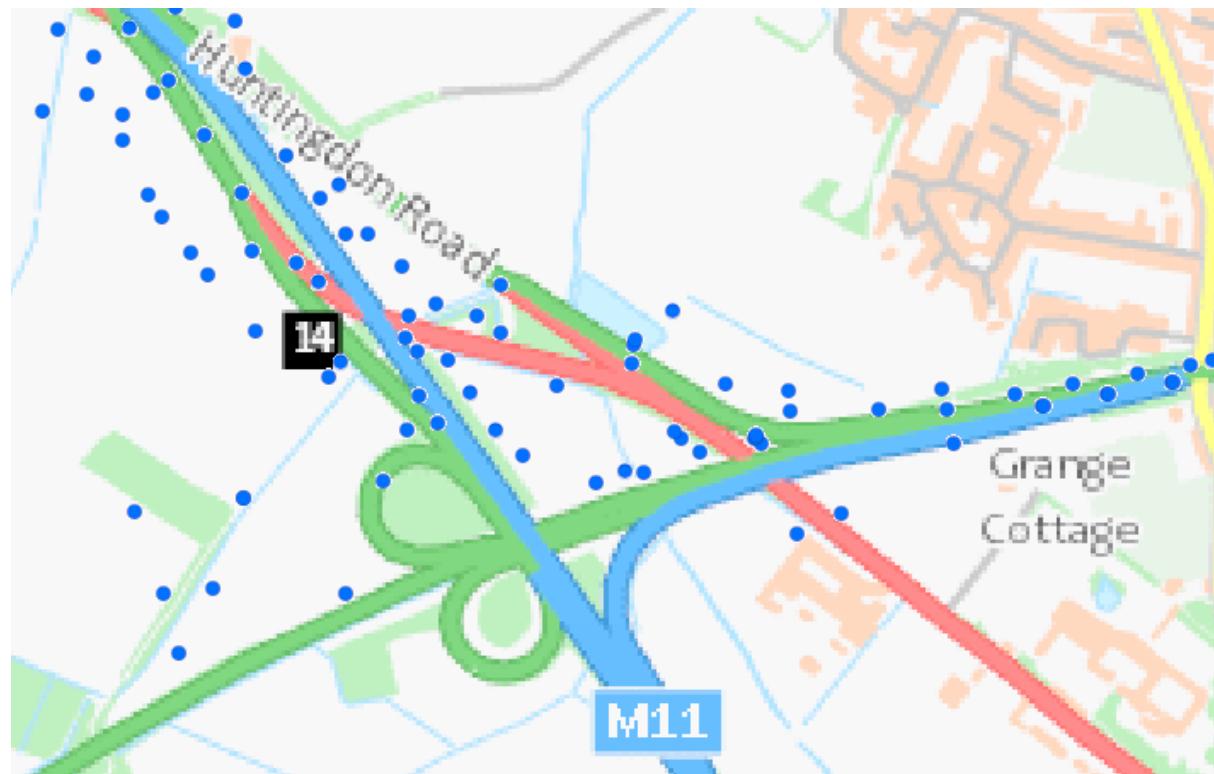
In a map window, open the add layers dialog.



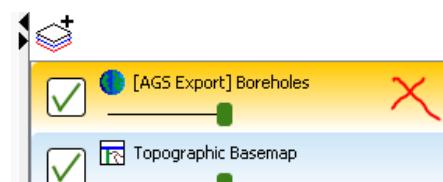
From the panel on the right of the layer selection dialog, select the layer called **[AGS Export] Boreholes**.

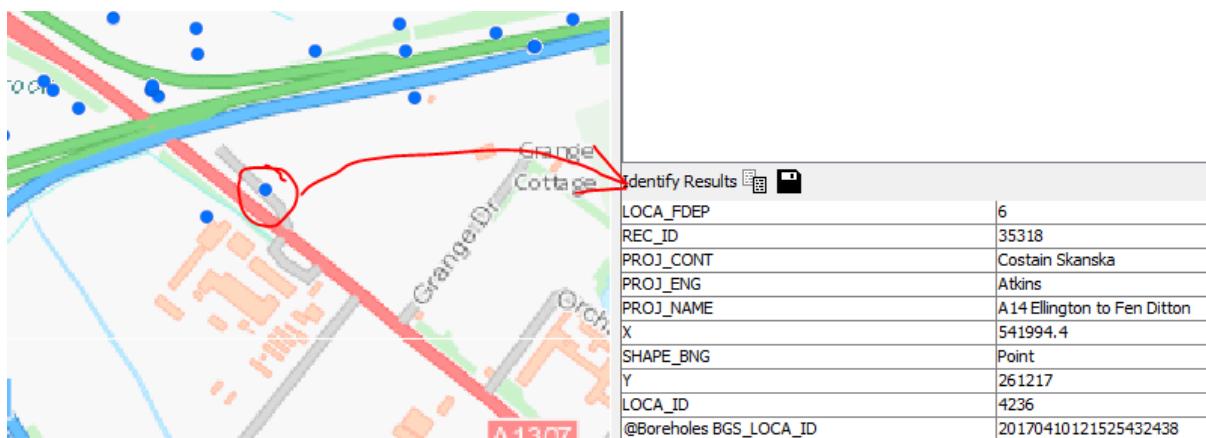


Zoom into an area to see the available records as a point layer.

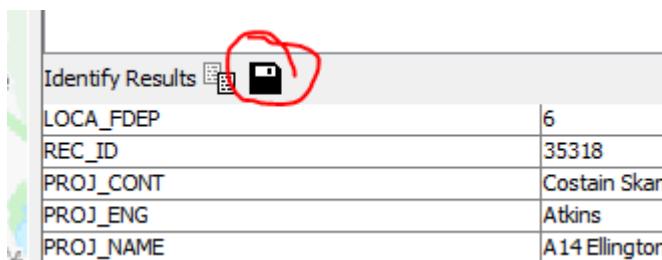


Make the WMS points layer active by clicking on it in the layer control. When it is active it will turn orange. Now that the layer is active, click on any dot in the map to perform an identify query. The results will display in a panel on the right.

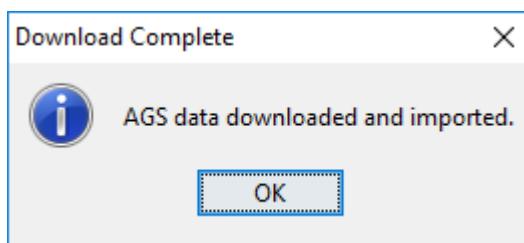
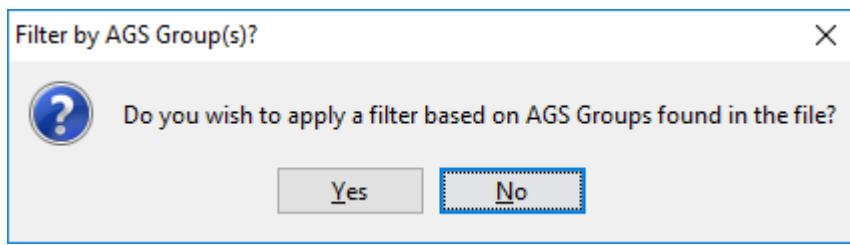




Click on the AGS save button in the identify results panel to attempt a download of the corresponding AGS data from the BGS database. Not all records have AGS data attached, but most should work.



Click <No>



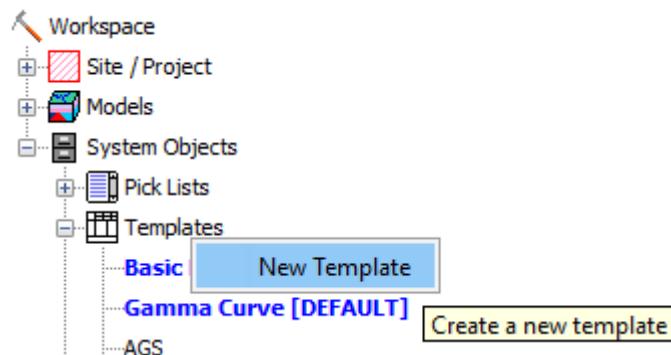
The data will appear in the object tree as a new borehole dataset folder ad can be worked with like any imported borehole dataset.

## Displaying Boreholes

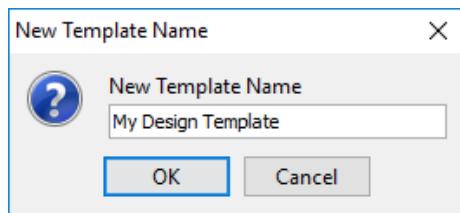
Borehole data is displayed using custom templates. These are column-based design templates and you can create your own within Groundhog. Once you have designed your template you can re-use it in each session and you can also share it with other Groundhog users.

## Creating Borehole Log Templates

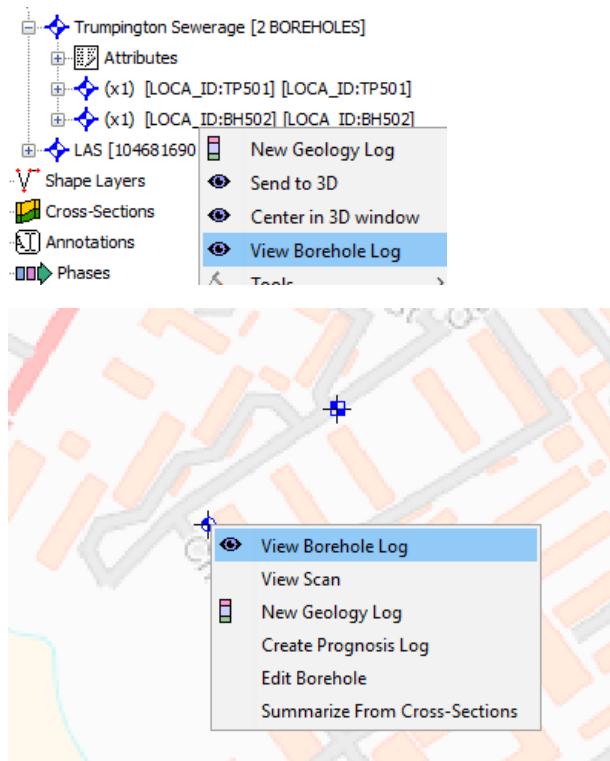
The first step is to create a new, blank template in the object tree via <System Objects> <Templates> <right-click> <New Template>



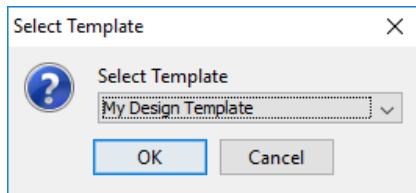
Enter a name.



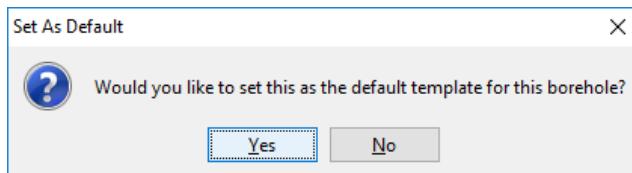
Next, send a borehole to the blank template using <right-click> <View Borehole Log> either in the object tree or from a borehole position in a map window.



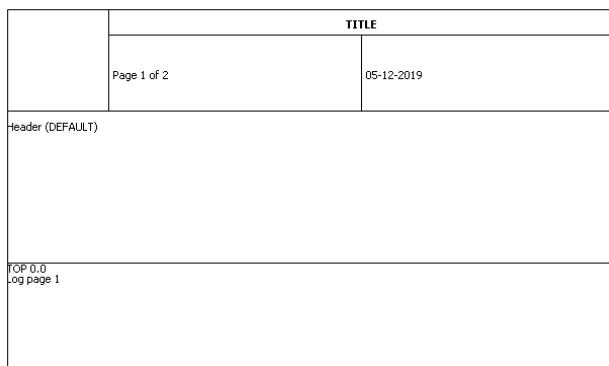
When prompted, choose the new template that you just created.



Decide whether to always use this template for this borehole.



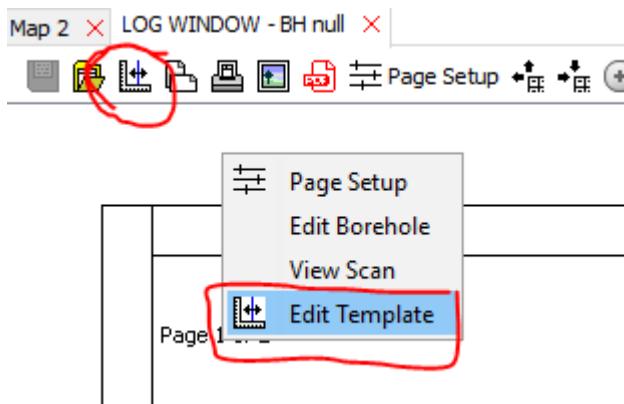
The borehole will attempt to display in the blank template, but will most likely look incorrect/blank because at this stage the template has no way of knowing which data fields to display. To make the template look how you want it you will need to make some edits to the design.



### Editing Borehole Log Templates

This section assumes a new, blank template (see previous section) is the starting point for creating a template design, but the same principles also apply to existing templates.

Switch the template to edit mode. You can use either the edit mode button, or you can right-click in the template itself and choose <Edit Template>.

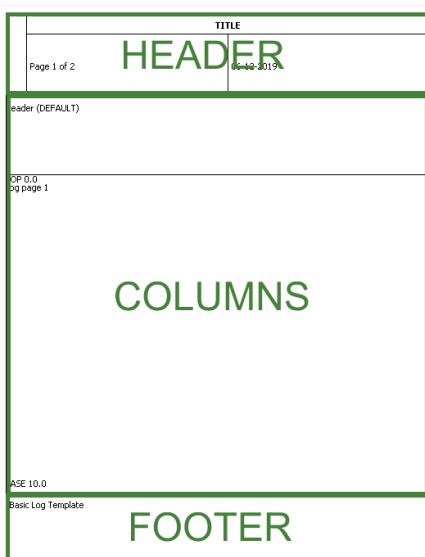


When the log template is in edit mode, the border lines will turn blue and an editing label will appear in red at the top of the page. To exit edit mode, press the <Stop Editing Template> button again.

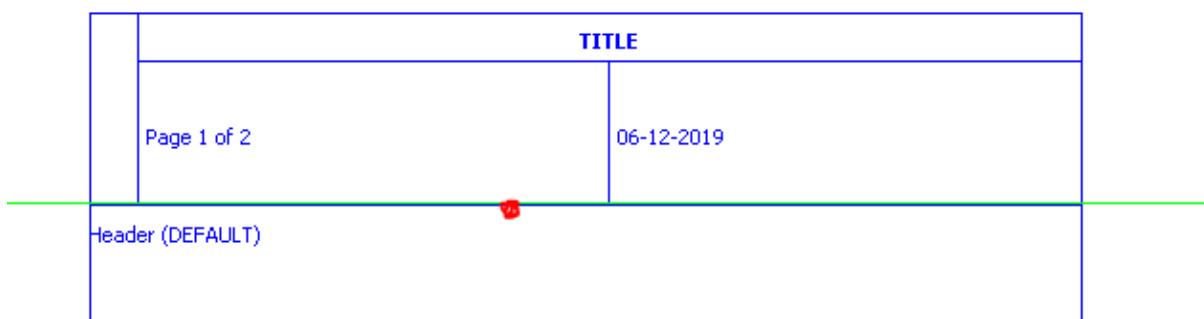
EDITING TEMPLATE "My Design Template"

TITLE		
Page 1 of 2		06-12-2019
Header (DEFAULT)		

Groundhog arranges the log design into three areas, the header, columns and footer.

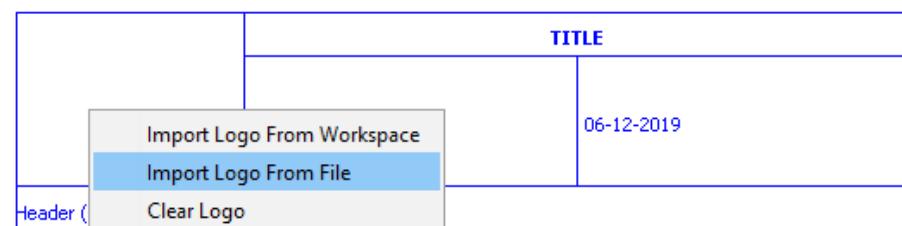
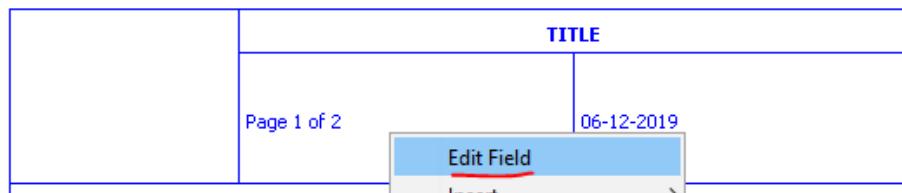
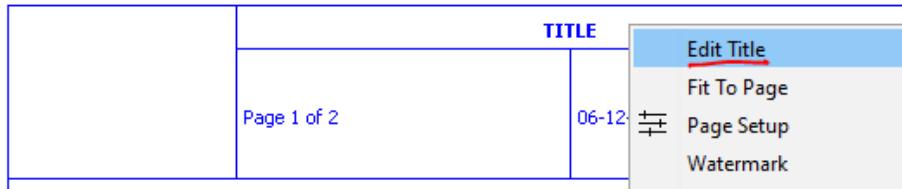


The size and width of the top-level areas can be modified by hovering over a template line and dragging it. When a line is drag-able, as the mouse hovers over it, it will highlight as an extended green line.

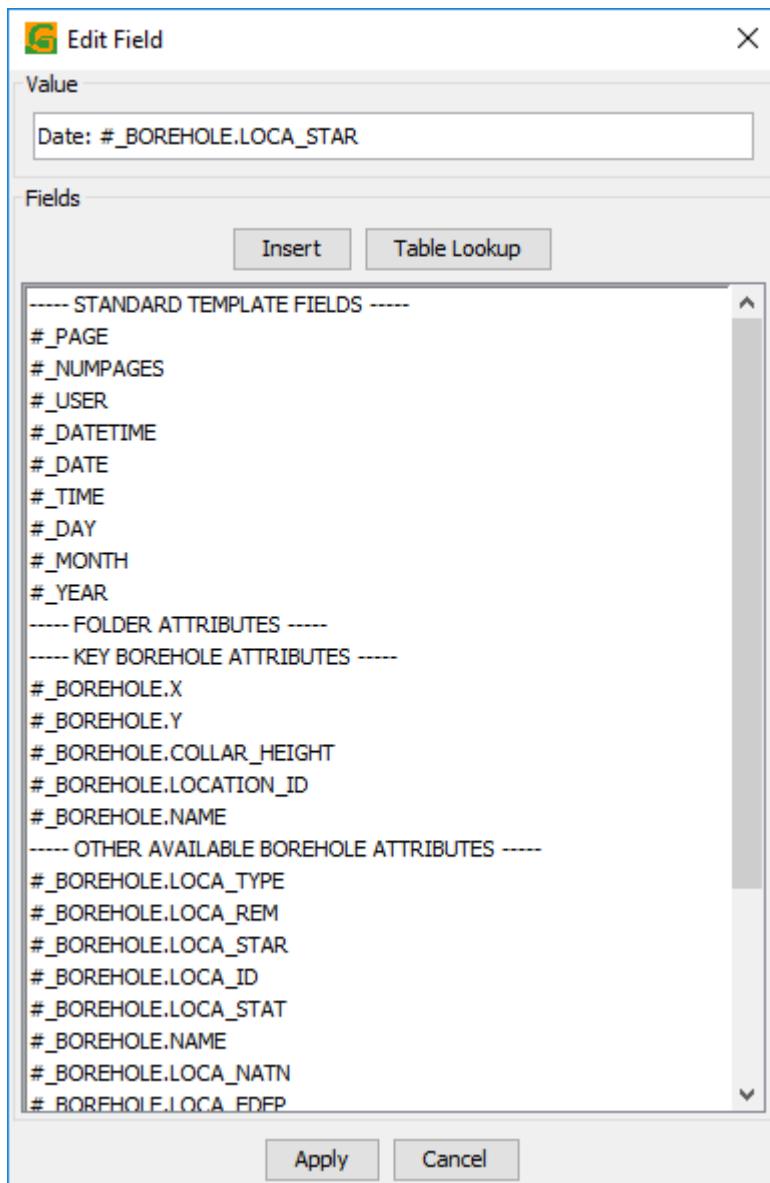


### Header

The header is a tabular component which can be used to display a document title, data fields, free-text labels and a corporate logo. To edit the contents of a cell, use right-click.

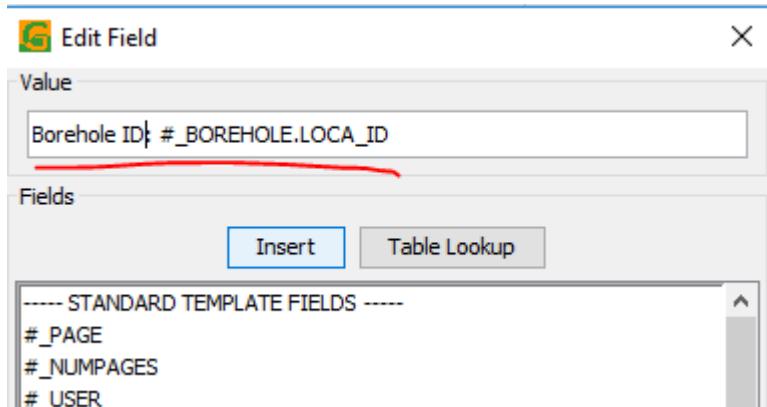


The field and title values can be free text or taken from data fields in the borehole data itself. When you edit such a cell, you will be presented with the field editing dialog. This dialog presents a list of available dynamic fields, both pre-set (e.g. date/time, page number) and data-driven (e.g. borehole attributes).

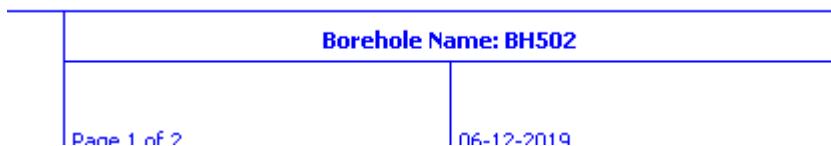


The text field at the top contains the value that will be displayed. The list below presents a range of data fields that can be inserted into the value to create dynamic values. The available data fields are a mixture of fields found in the borehole data and default fields such as date/time and page numbers. The output value can be formed of any combination of free-text and dynamic fields. To add a dynamic field to the value, place the cursor at the desired position in the Value field, highlight the desired data field in the list below, and click the <Insert> button. Note that dynamic fields must have a space each side of them.

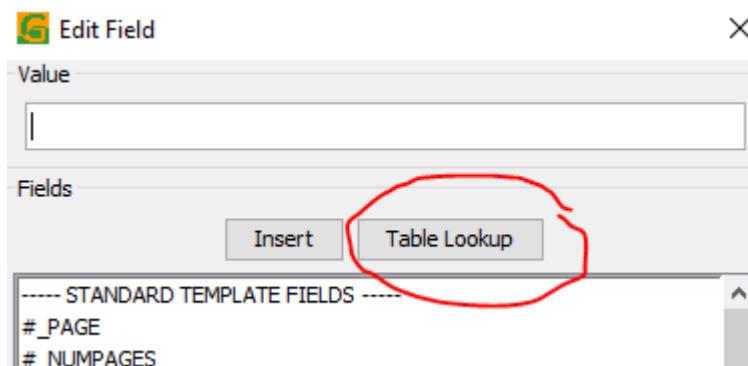
Here is an example of a field value using a field called LOCA\_ID and some free-text. LOCA\_ID is a field typically found in UK AGS format geotechnical log files and is just used here as an example of a field. The fields available will depend on the format and nature of your own borehole data.



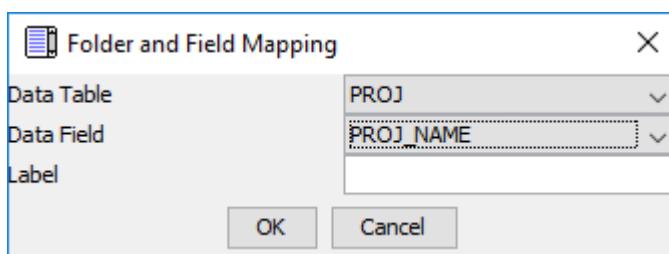
And this is how the value appears in the template once applied.



You can also add values from any of the data tables attached to the borehole dataset using the Table Lookup button.



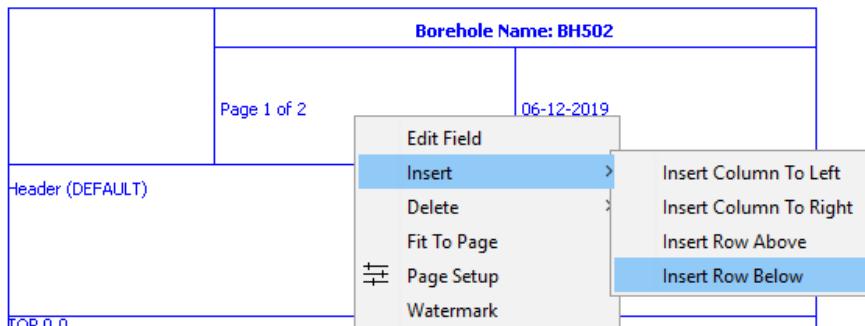
Drill down to extract the desired field. In the example below, the project name field is being added from an AGS 4 dataset. In the case of AGS this is the PROJ\_NAME field within the attached PROJ table. The Label field is not used in this feature.



If you select a field from a table that has multiple rows, the value will be assigned according to the following policy;

1. If the data table contains a borehole ID field, the first row with a matching ID will be used as the basis of the query,
2. If the data table has no ID field, the first row in the table will be used as the basis of the query.

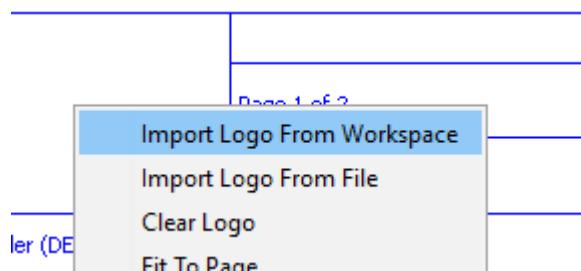
You can add/remove columns and rows to the header table using right-click.



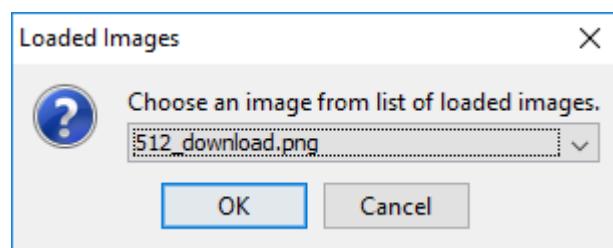
Here is an example of a header table with a number of rows and columns added and some field defined.

Borehole Name: BH502		
Page 1 of 2	06-12-2019	12:37
GL: 58.72	Easting: 523142.00	Northing: 178183.00

You can add a logo to the template using <right-click> <Import Logo From [Workspace or File]>.



Select the image to use. Here we are choosing one that is already loaded as an image in the session or workspace.





# British Geological Survey

Co-ords: 523142.0 - 171

Date: 2004-09-13

Trumpington District Council

Depth	m	Legend	Stratum Description
			Friable brown sandy CLAY with

### Columns

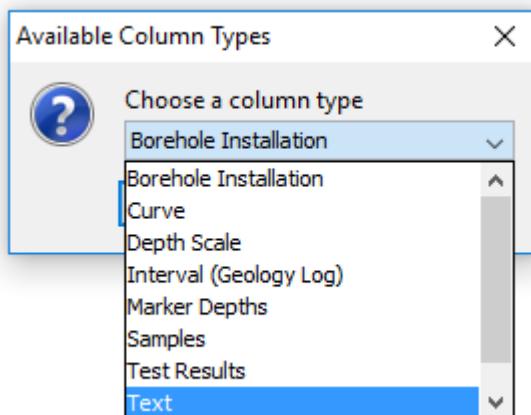
The columns area is where the borehole log data is placed. It is arranged as one or more data columns. Each column can have a different graphical type and pull on different data fields within the borehole. Each column is divided into a header and a log column.

Start by adding a new column to the blank template. Hover over the header portion of a pre-existing log column and <Insert Column on [Left or Right]>.

The screenshot shows the Borehole Log software interface. A context menu is open over the header of the 'Stratum Description' column. The menu options are:

- Fit To Page
- Page Setup
- Watermark
- Reset All Column Widths
- Set Column To a Specified Width
- Insert Column on Left** (highlighted in blue)
- Insert Column on Right
- Delete Column

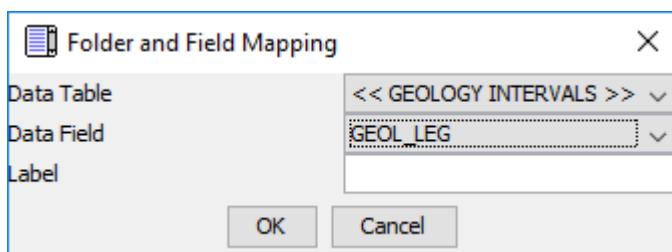
A prompt asks you to choose a graphical column type. Note that not all column types will work with all types of borehole or data field. Here we are adding a text column.



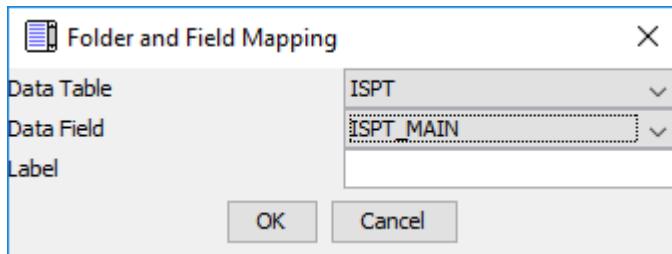
The available column types are;

- **Borehole Installation** – can be used to show backfill and pipe installation details.
- **Curve** – plots values at a depth in the form of a curve or a series of dots, for example a Gamma Log or CPT log.
- **Depth Scale** – a vertical depth scale in metres or feet.
- **Interval (Geology Log)** – used to plot geology intervals in an interpreted log.
- **Marker Depths** – plots depth boxes for intervals within the log.
- **Samples** – displays depths and types of samples.
- **Test Results** – displays any test result data as a label, including in-situ and laboratory test values. Can also be used to display water levels.
- **Text** – shows any text-based data down the log, for example a detailed stratum description.
- **Water Strikes** – shows strike and rest levels as symbols.

When a new column is inserted into the template typically you will be prompted to choose the field containing the data to use for that column. The exception is the depth scale, which is not based on a data field. The prompt usually takes the form of a drill-down. Select the folder or table, and then the field containing the data. Below are some examples based on an imported AGS 4 file;

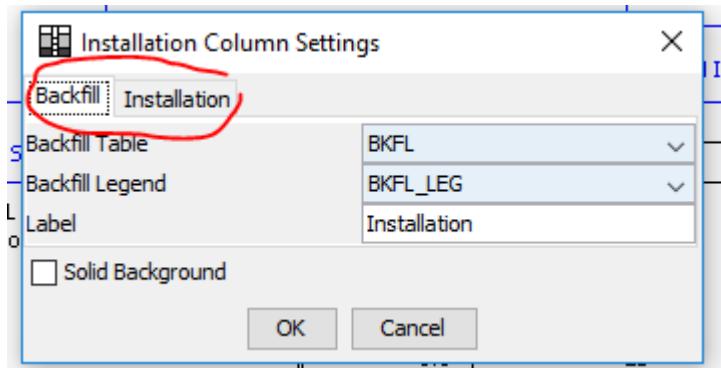


GEOL\_LEG field from the geology log (geology intervals folder)

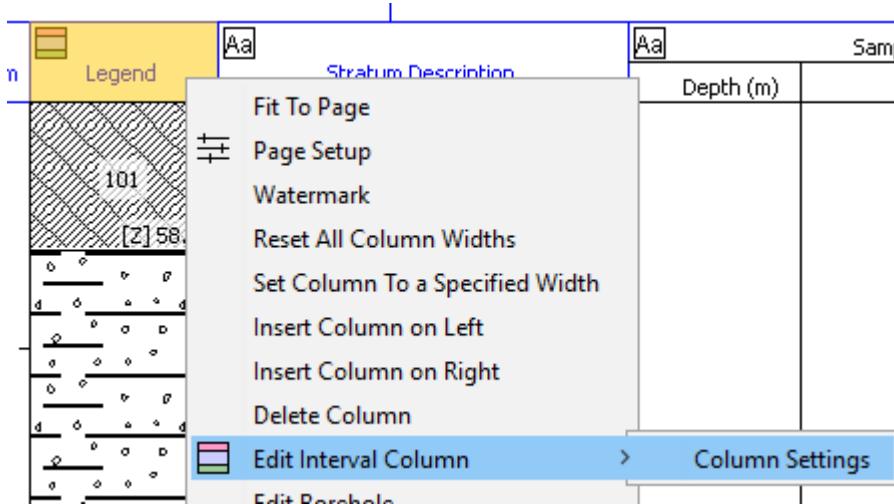


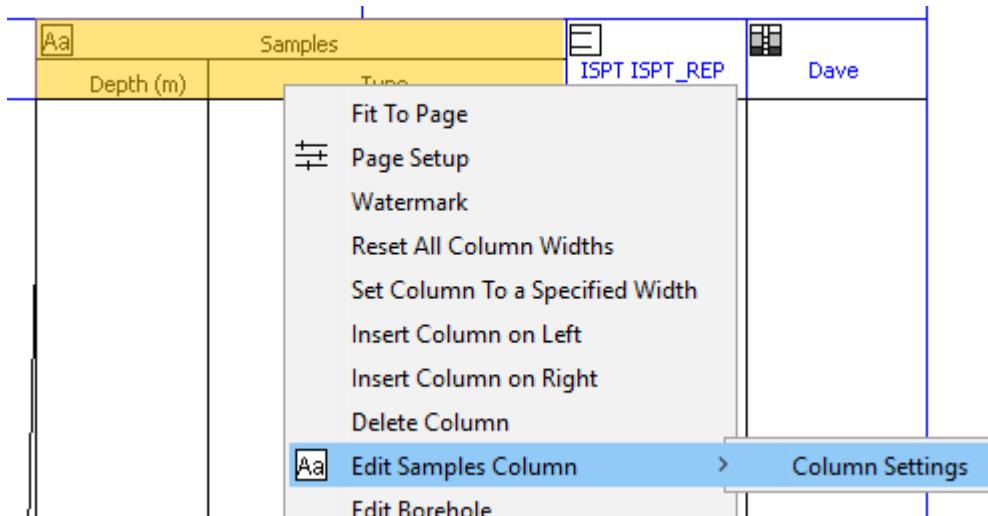
ISPT\_MAIN data field in the ISPT test result table.

Come column types show more than one data field simultaneously. For example the borehole installation column, which can show backfill and pipe data together. In such cases the mapping dialog will contain multiple tabs allowing the necessary field to be mapped.



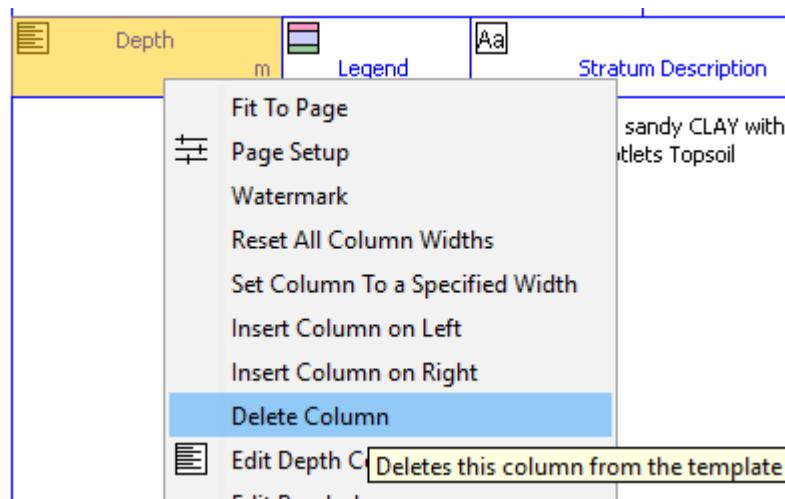
Once the data field mapping is completed, the column will be added to the template. You can access and edit the settings after the column is added using <Right-Click> <Edit TYPE Column> <Column Settings> in the header of each column, for example;





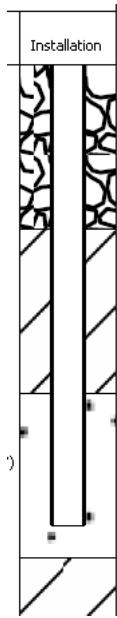
The settings dialog will look slightly different, depending on the type of the column. Often, the settings dialogs have additional settings that are not accessible when you first add the column, so they are worth exploring.

To remove a column from the template <Right-Click> on the column header and select <Delete Column>



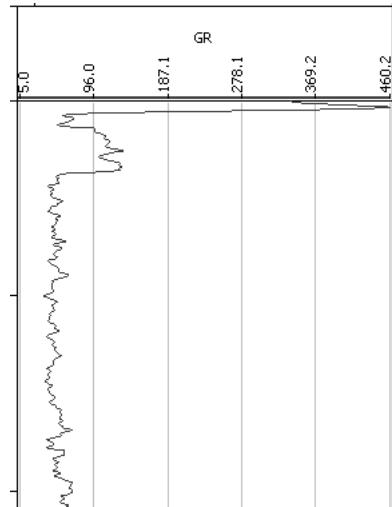
Here are typical examples of each of the available column types, shown here using an example AGS 4 format borehole data file and a LAS format geophysical file.

### Borehole Installation Column



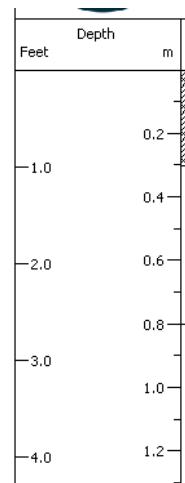
Example using BKFL.BKFL\_LEG for the backfill mapping and PIPE.PIPE\_TYPE for the pipe installation mapping.

### Curve Column



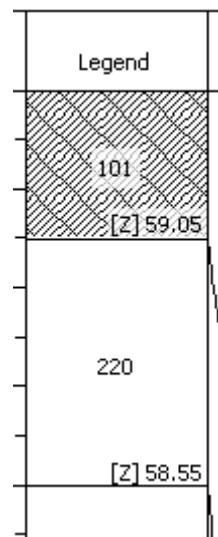
Example using GR field from an imported LAS Curve Data table.

### Depth Scale Log



Showing feet and metres scales.

### Interval (Geology Log) Column



Example using GEOL.GEOL\_LEG field.

### Marker Depths Column

Legend	DEPTH
101 [Z] 59.05	0.30
220	
[Z] 58.55	0.80

Example using GEOL.GEOL\_LEG field, shown against a corresponding interval column.

### Samples Column

Samples	
Depth (m)	Type
0.0	D
0.0	ES
0.0 - 0.3	B
0.3	D
0.3	ES
0.3 - 0.8	B
0.5	ES

Example using SAMP.SAMP\_TYPE field.

### Test Results Column

ISPT ISPT_REP
N=14 (1,0,1,1,5,7)
N=36 (5,7,11,8,9,8)

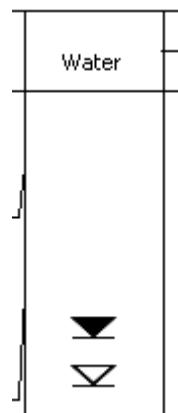
Example using ISPT.ISPT REP field.

### Text Column

Stratum Description
TOPSOIL: Dark brown slightly gravelly fine to coarse sand with occasional rootlets.
Soft brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is angular to subangular fine to medium of sandstone and mudstone.
Soft brown mottled grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse of sandstone and mudstone.
Firm greyish brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse of sandstone and mudstone.

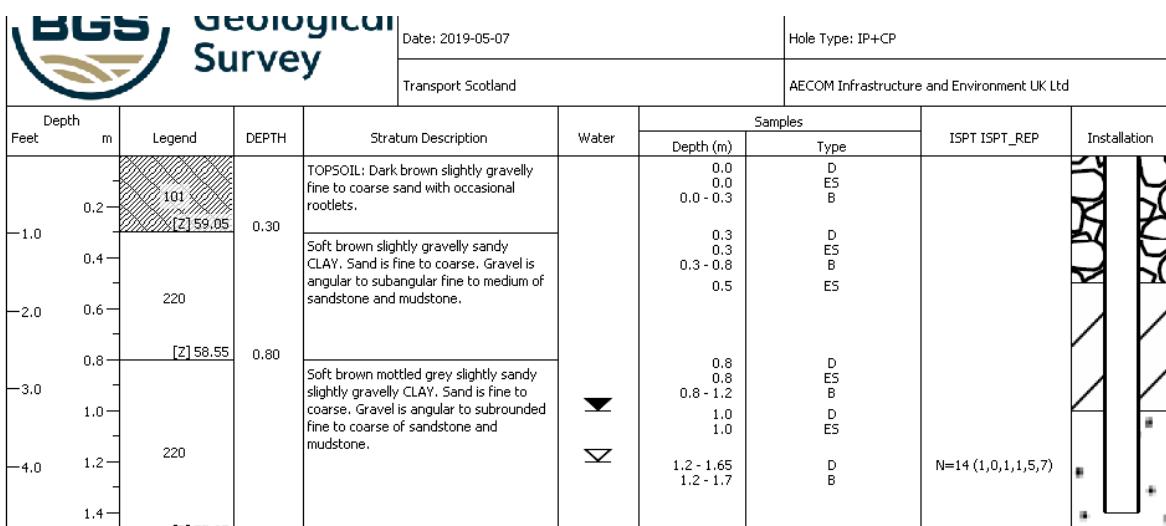
Example using GEOL.GEOL\_DESC field.

### Water Strikes Column



Example using dual mapping of WSTD.WSTD\_DPTH and WSTD.WSTD\_POST for strike and rest level.

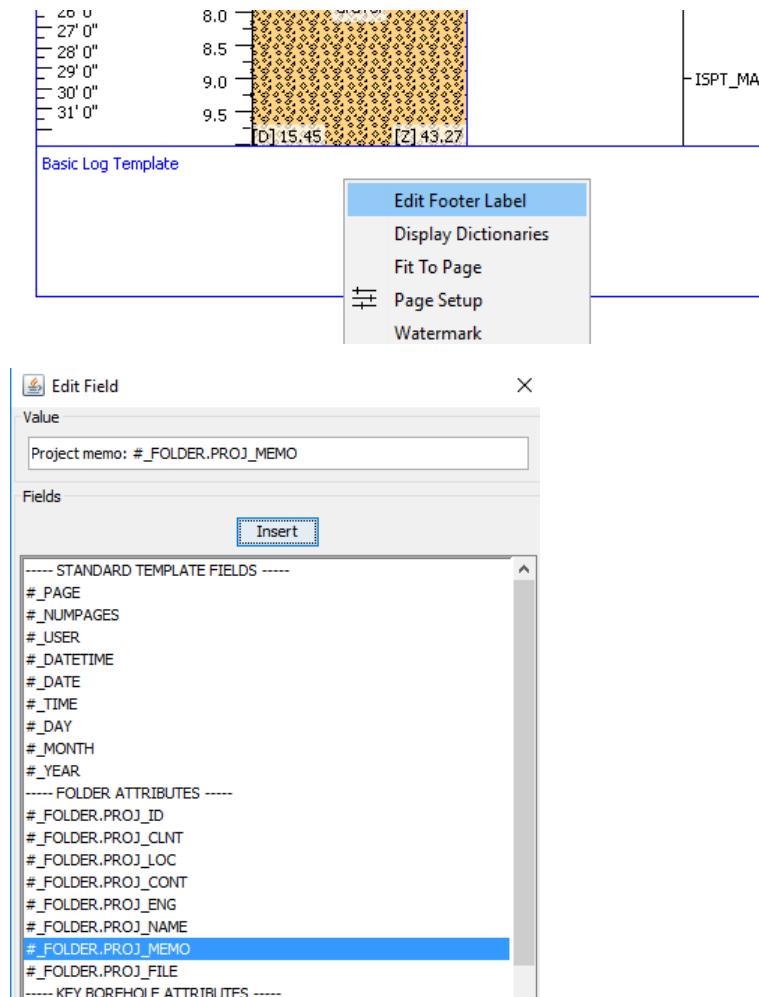
Here is an example with several different column types added to a template based on AGS data.



**IMPORTANT:** As you build up your template it is a good idea to save it regularly. Templates are held in the global workspace of Groundhog so that they can be used across all of your projects, so they need to be saved separately.

### Footer

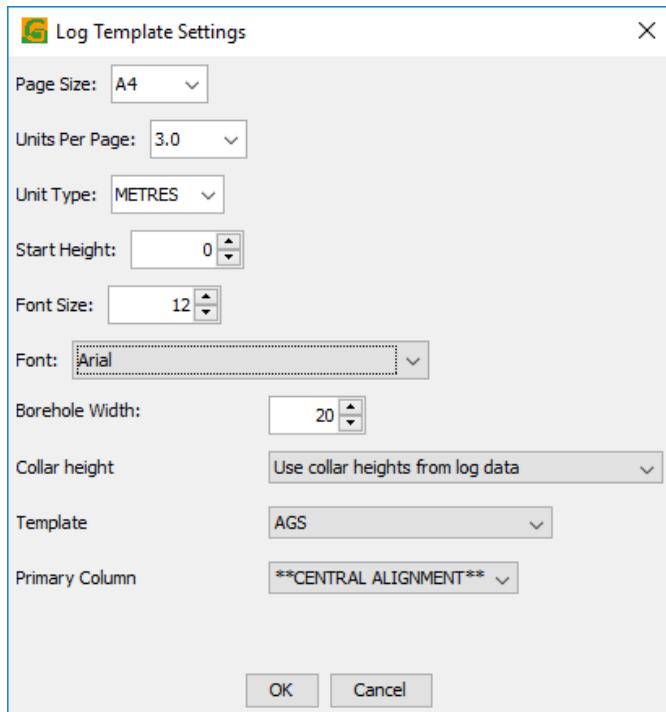
Having added some columns, let's set up the template footer.



### Page Setup

And finally, let's set the page size to A4, set the number of metres to display per-page, and fit the template to the page.

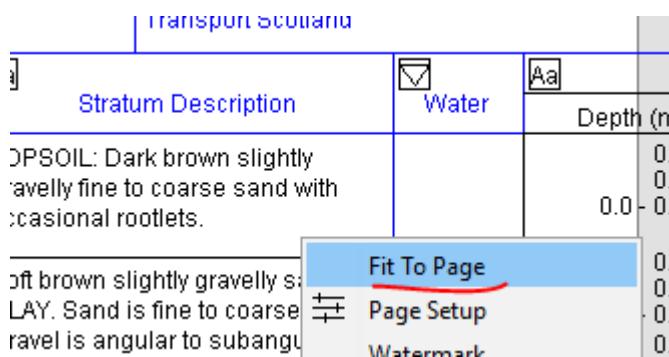




Flip to landscape orientation.



<Right-Click> anywhere <Fit To Page>



A stratigraphic column table with the following data:

Stratum Description	Water	Depth (m)
OPSOIL: Dark brown slightly gravelly fine to coarse sand with occasional rootlets.		0.0 - 0.
soft brown slightly gravelly s...		0.0
LAY. Sand is fine to coarse...		0.0
ravel is angular to subangular		0.0

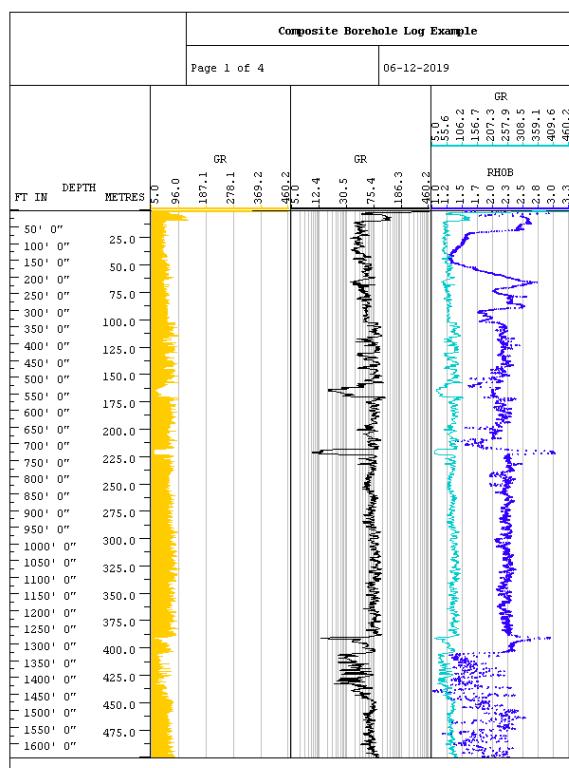
A context menu is open over the third row, with the 'Fit To Page' option highlighted and circled in red.

 <p><b>British Geological Survey</b></p>		BH100						
		Co-ords: 331711.91 - 667784.38					Level: 59.35	
		Date: 2019-05-07					Hole Type: IP+CP	
		Transport Scotland					AECOM Infrastructure and Environment UK Ltd	
Depth Feet	m	Legend	DEPTH	Stratum Description	Water	Samples		
						Depth (m)	Type	ISPT ISPT_REP Installation
-1.0	0.2	[ 59.05 ]	0.30	TOPSOIL: Dark brown slightly gravelly fine to coarse sand with occasional rootlets.		0.0	D	
-2.0	0.6	220	0.80	Soft brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is angular to subangular fine to medium of sandstone and mudstone.		0.0 - 0.3	ES	
-3.0	1.0	[ 58.55 ]				0.3 - 0.6	B	
-4.0	1.2	220				0.8	D	
-5.0	1.4	[ 57.85 ]	1.50	Soft brown mottled grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse of sandstone and mudstone.		0.8 - 1.6	ES	
-6.0	1.6					1.2 - 1.65	D	N=14 (1,0,1,1,5,7)
-7.0	1.8					1.2 - 1.7	B	
-8.0	2.0					1.5	D	
-9.0	2.2					1.5	ES	
-10.0	2.4					2.0	D	
-11.0	2.6					2.2 - 2.65	U	
-12.0	2.8							
		[ 54.70 ]						
A720 Sheriffhall Roundabout Improvement								

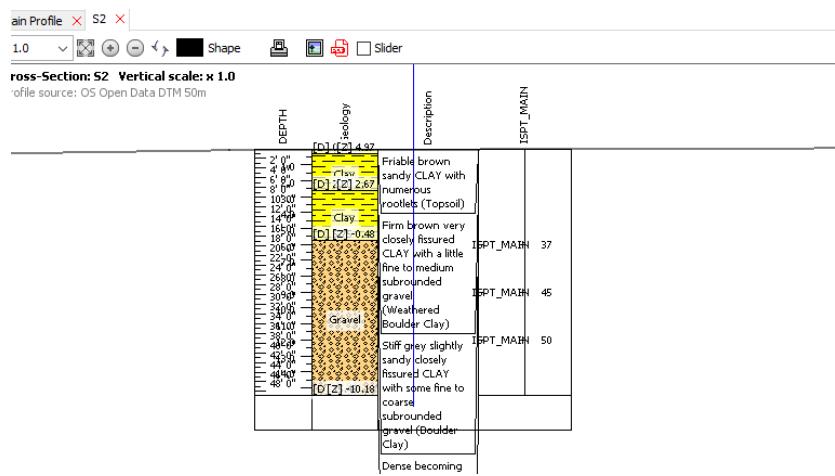
1

 <p><b>British Geological Survey</b></p>		BH100						
		Co-ords: 331711.91 - 667784.38					Level: 59.35	
		Date: 2019-05-07					Hole Type: IP+CP	

Here is an example of a wireline log style template.



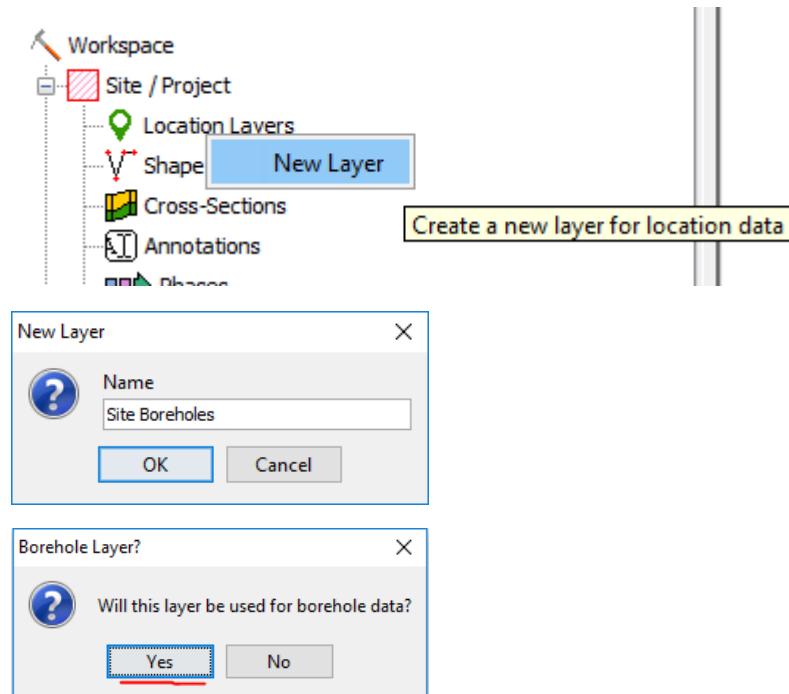
Note that the design template can also be used in the cross-section view.



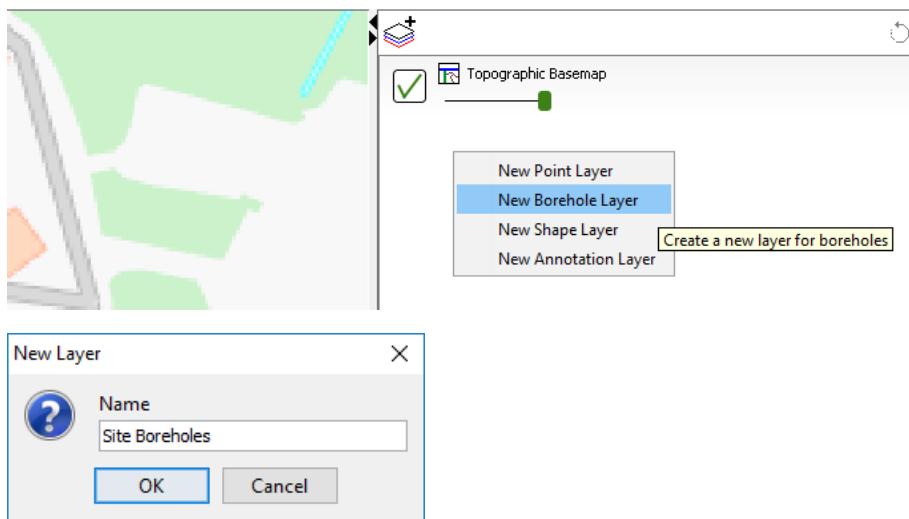
## Editing Borehole Data

You can enter and edit borehole data directly within Groundhog. To demonstrate this, we will create a blank borehole dataset to work into.

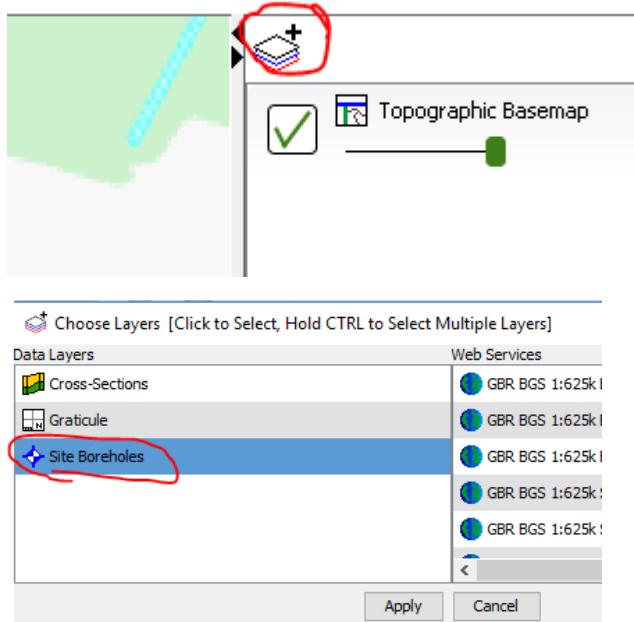
From the object tree Location Layers folder <right-click> <New Layer>.



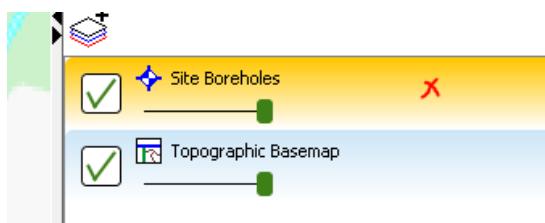
Or from the layers panel of a map window.



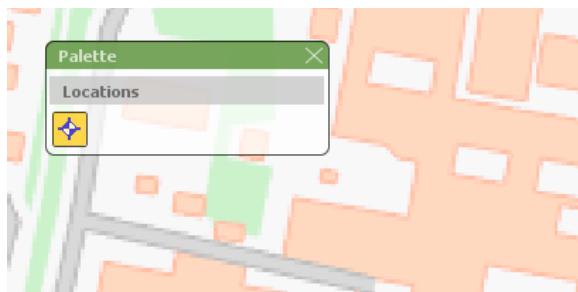
If the new layer is not already visible in a map window, add it.



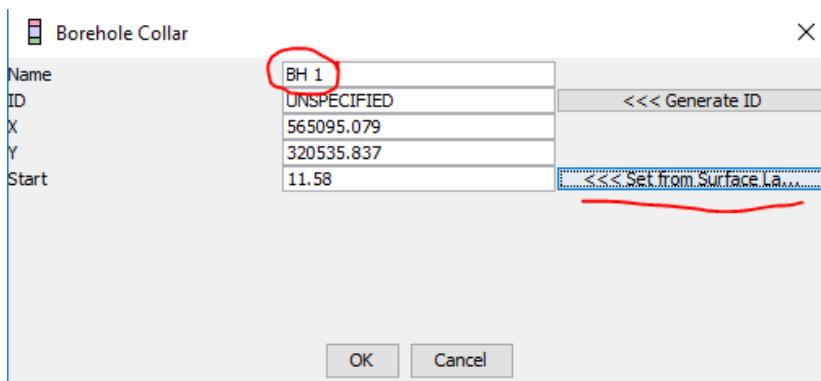
Make the layer active in the map by clicking on it in the layers panel (turns orange when active).



In the drawing palette, pick up the borehole placement tool (turns orange when selected).



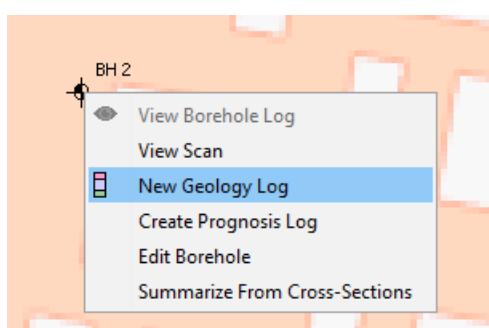
Single-click in the map to place new borehole object. Borehole collar dialog appears. Enter a name for the new borehole, adjust X,Y as desired to set a specific location. Also, if you have a suitable DEM/DTM loaded and set as the surface layer in the session, click the <Set from Surface Layer> button for the start height (ground level) field to set an elevation value for the top of the borehole, or type one manually if you have a more accurate one.



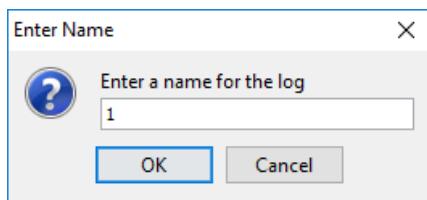
Borehole appears in the map. Add as many boreholes as you like and then de-activate the borehole layer in the map.



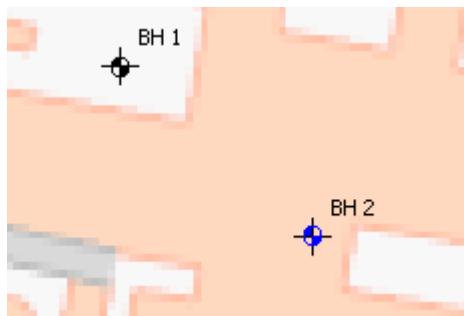
Hover the mouse over a borehole location and select <right-click> <New Geology Log>



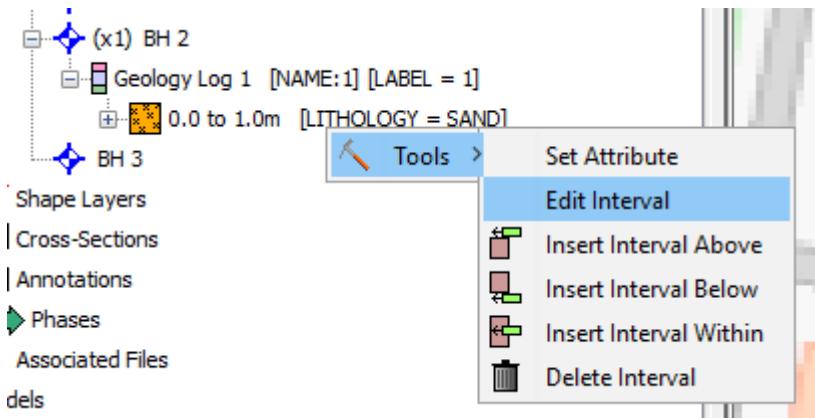
When prompted for a name for the log, just enter “1”.



This creates a geology interval log with 1m interval of SAND added to initialize the data structure. The log turns blue in the map to indicate the presence of a geology log.



In the object tree, note the options available on the interval of SAND.



Edit the interval using the dialog. Here we change the depth to the base of the first interval to be 7.4m (all values are depths, not elevations) and change its geology code to PEAT by typing it in.

Interval Properties

Top/base depths [7.4m thick]

Top (m):	0.000	ft/in
Base (m):	7.400	ft/in
Thickness (m):	7.400	ft/in

Interval Attributes

LITHOLOGY	PEAT	Lookup	Large Textbox
Add/Delete Attribute			

OK Cancel

Use the <Add/Delete Attribute> button to set new attribution on the interval. Here we add a field for a description.

Attributes

GY	PEAT	Lookup	L
Add/Delete Attribute			

List of Available Fields

Select which fields are required

Available fields

LABEL	<input type="checkbox"/>
LITHOLOGY	<input checked="" type="checkbox"/>

Note - un-selecting a field removes it from the Interval Properties

New Field OK Cancel

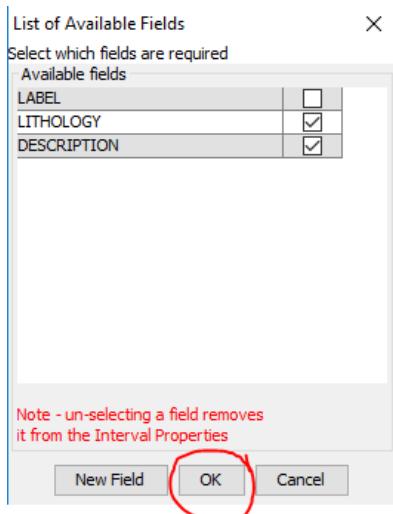
Name of New Field

?

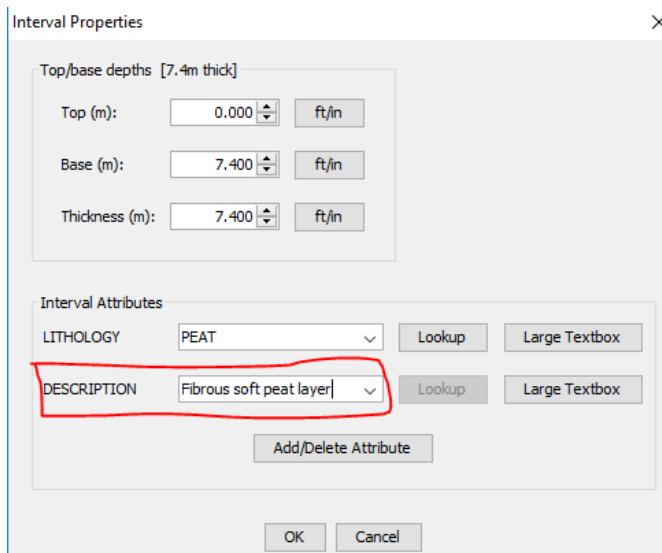
Name

DESCRIPTION

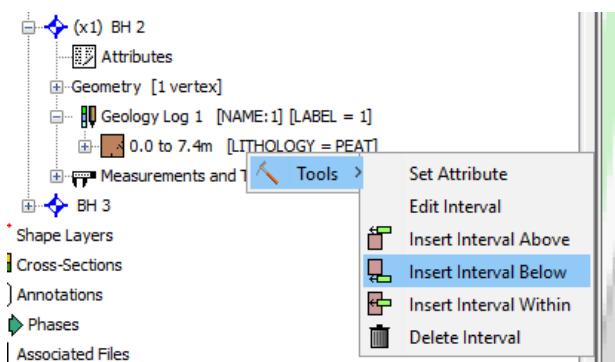
OK Cancel

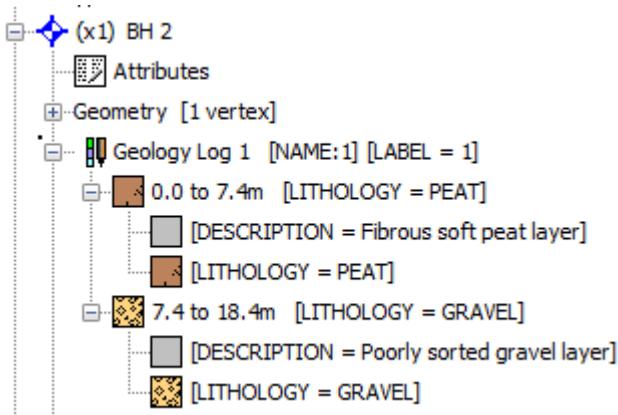
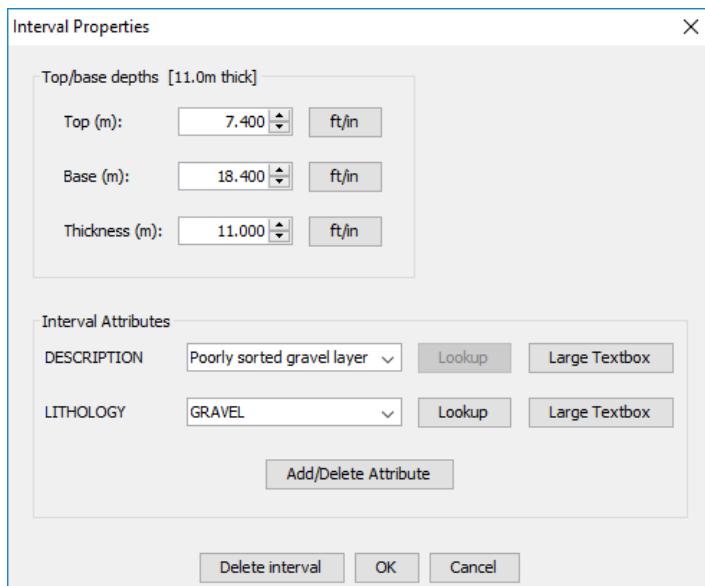


Type a value for the new field into the new entry row that has appeared.



Add new geology intervals in the same way using the interval editing dialog.





# Drawing Points, Shapes & Annotations

This section provides details on how to digitize into point and shape layers, including borehole-type point layers. It also covers how to add annotations such as labels, callouts, arrows and graphical icons. It does not include how to draw into the Geology layer of a cross-section – for that please refer to [Drawing Cross-Sections](#).



*Photo by Plush Design Studio on Unsplash*

## Creating New Layers

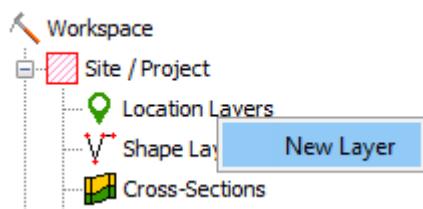
You can use Groundhog to create and draw point and shape layers and to create annotation layers containing labels, callouts, arrows and icon graphics. You can also import GIS shapefiles as these types of layers – for more details please refer to the chapter on **Importing & Exporting Data**.

Points and shapes can carry attribution and be styled in certain simple ways. Their attribution can form the basis of geological interpretation, for example by carrying a geology code they can be used to develop geological contact maps and structure contour maps, which can then be used as inputs to 3D models.

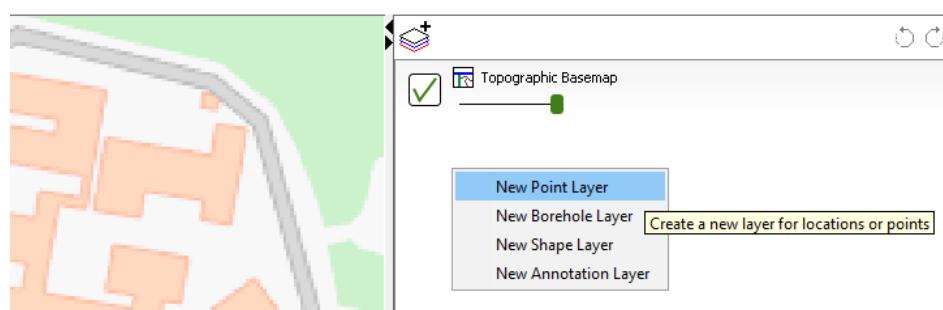
Shapes drawn into the map plane can be projected into the alignments of cross-sections so that you can match your subsurface correlation to the map line-work in order to create spatially and geologically consistent conceptual models.

### Creating and Editing Point Layers

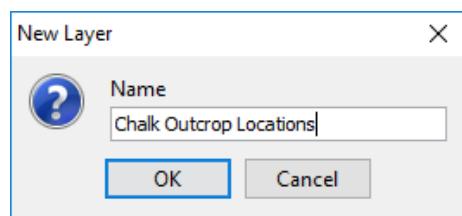
Point layers are map layers only (they can't be drawn into cross-sections). Create a new point layer from the object tree by right-clicking on the Location Layers folder, or from the map layer control panel by right-clicking in a blank whitespace area of the panel.



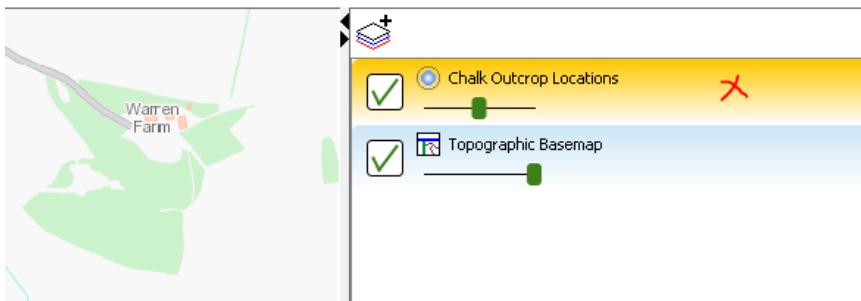
Or...



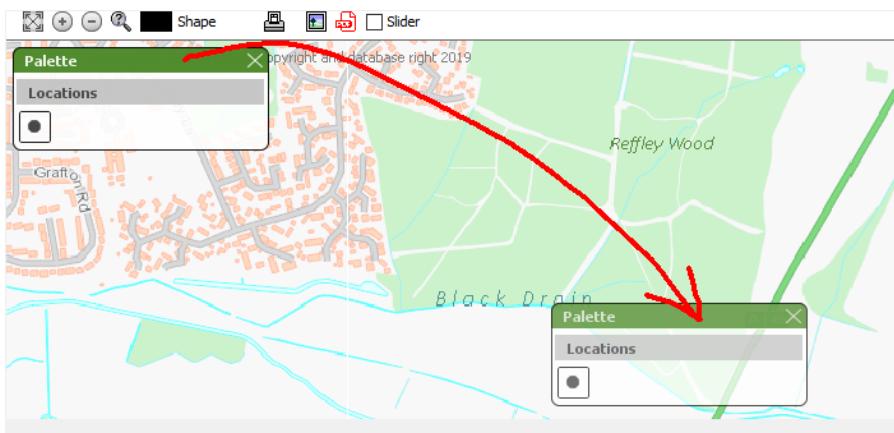
Enter a name for the layer.



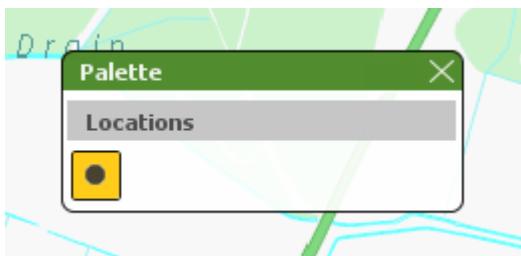
Make the layer active in the map by clicking on it in the layer control panel. It will turn orange when active.



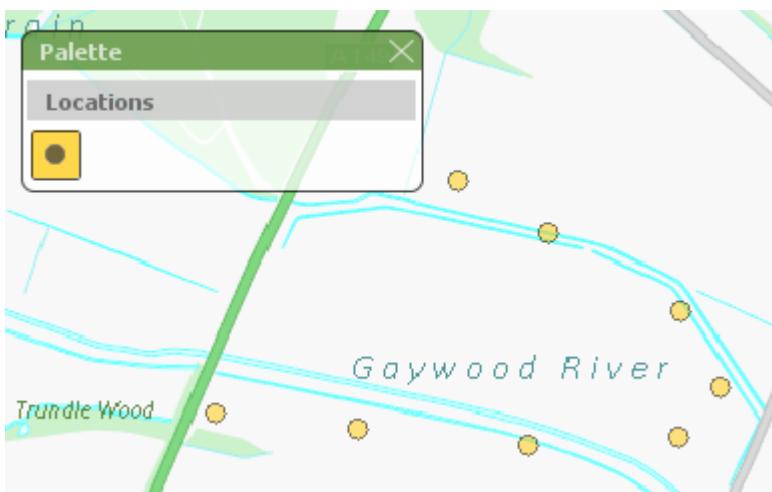
The drawing tool for points appears as a floating drawing tools palette. You can drag the palette around using the green bar at the top.

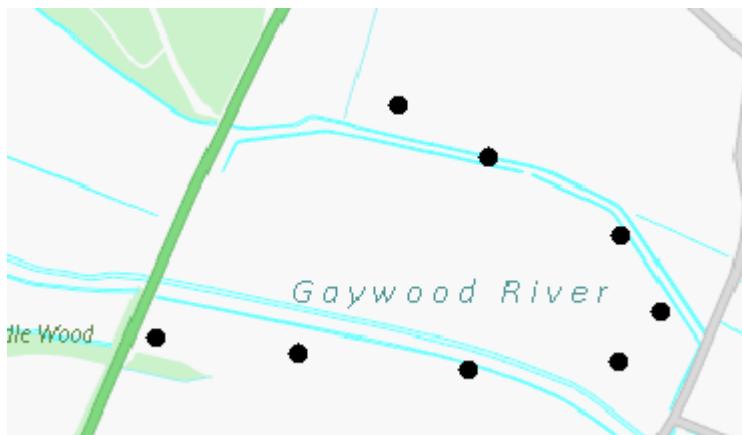


To draw points, pick up the point drawing tool from the palette by clicking on it. When it is active it will turn orange.

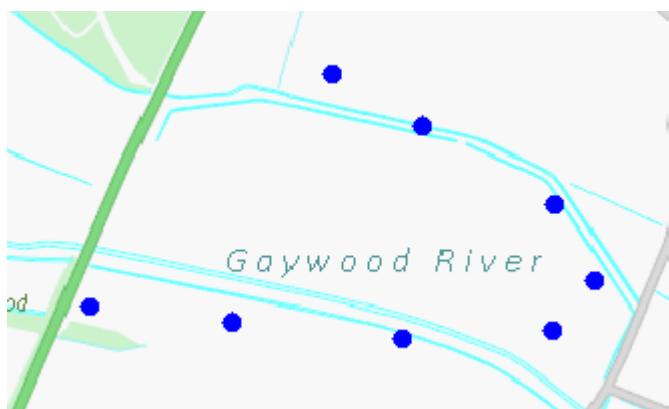
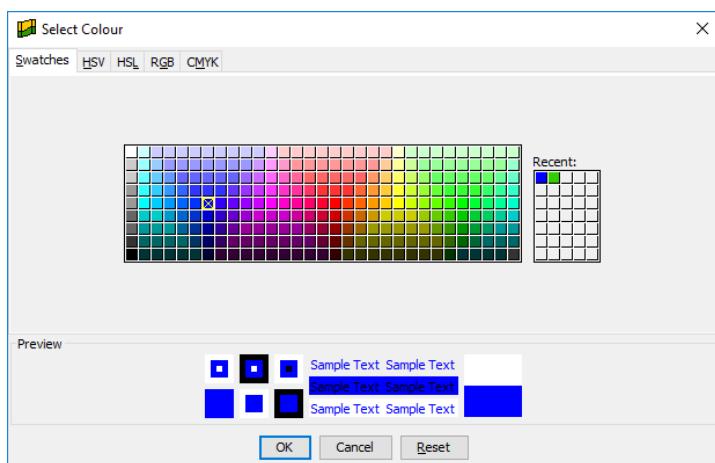
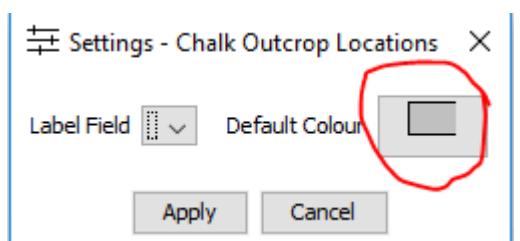
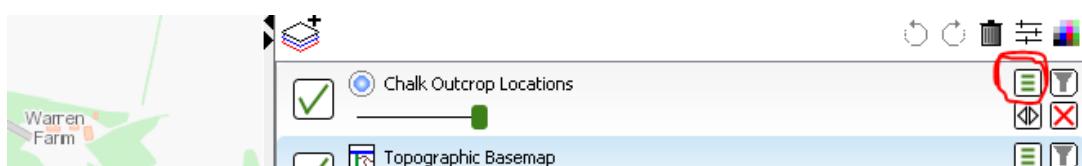


Single-click in the map to place points at the desired locations. When you are finished, deactivate the point layer in the map.



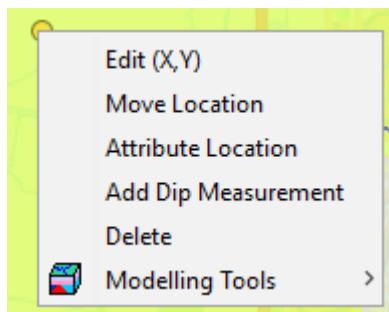


Set the colour of the points using the point layer settings in the layer control panel.

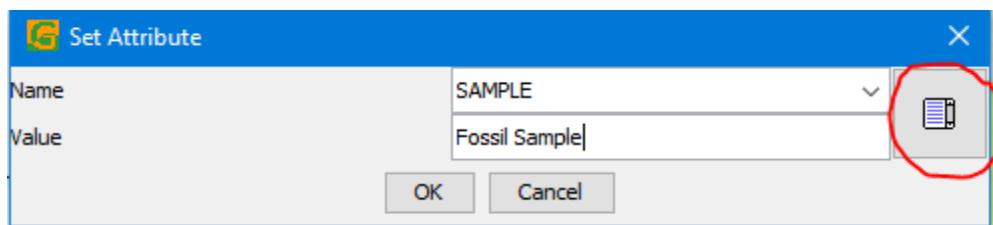


### Attributing Points

You can set name-value pair attributes on any point objects. With the layer active in the map, hover the mouse over a point and use <right-click> <Attribute Location>.



Specify an attribute name and value.



The dictionary on button on the right allows you to select from a list of commonly used attribute names.

You can then set the field as the label for the points using the layer settings.

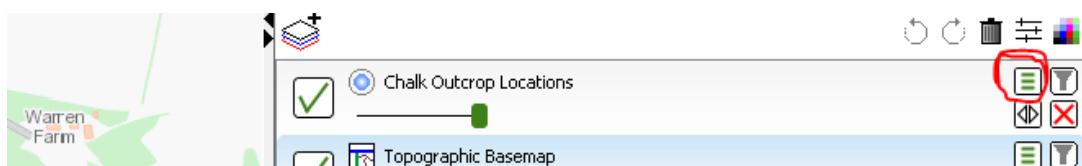
### Add Dip Measurement

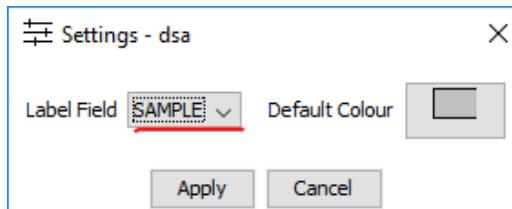
Presents a dialogue box requesting Dip, Azimuth, Radius and Geology.

Radius is the distance in metres that the point affects and setting this measurement varies the size of the dip measurement



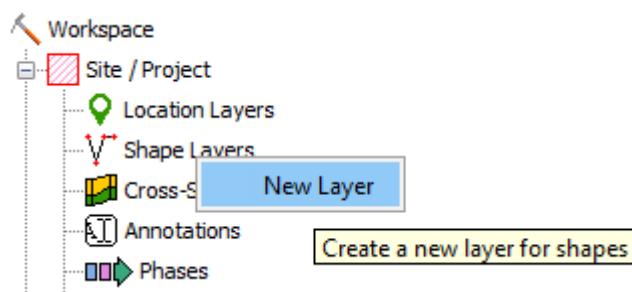
Geology is optional and is available as a shortcut way of entering this attribute.



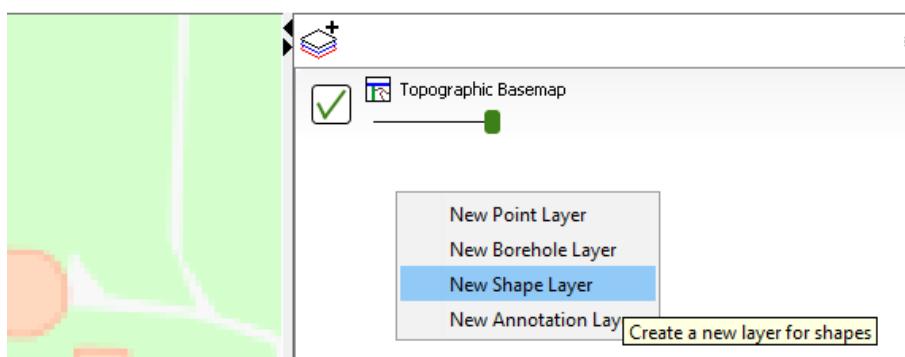


## Creating & Editing Shape Layers

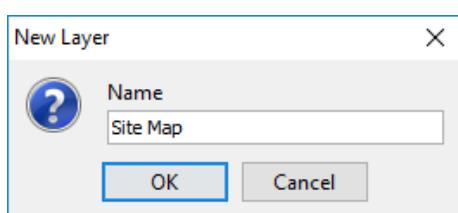
Shape layers are map or cross-section layers (they can also be drawn into cross-sections). Create a new shape layer from the object tree by right-clicking on the Shape Layers folder, or from the map layer control panel by right-clicking in a blank whitespace area of the panel.



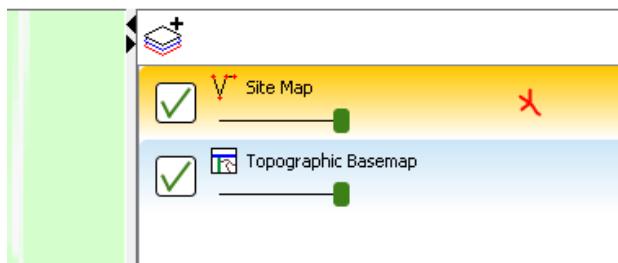
Or...



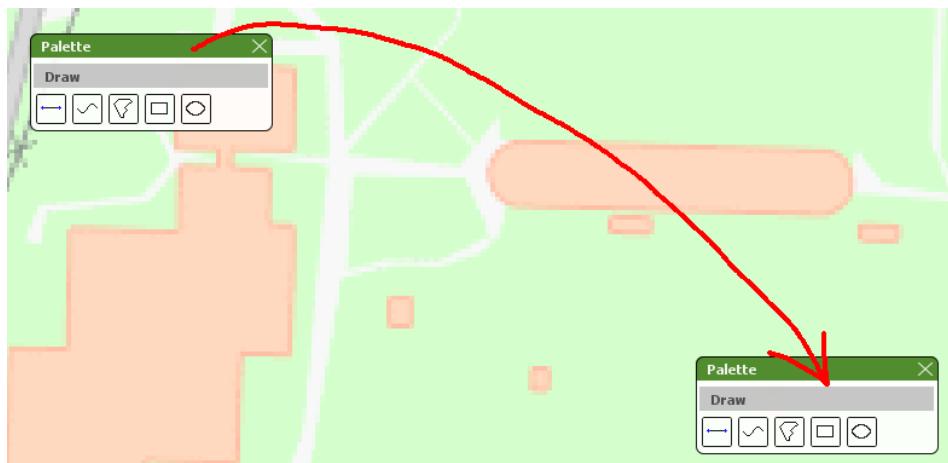
Enter a name for the layer.



Make the layer active in the map by clicking on it in the layer control panel. It will turn orange when active.



The drawing tool for points appears as a floating drawing tools palette. You can drag the palette around using the green bar at the top.



The drawing palette contains a number of drawing tools. Hover over each tool to see a short description.

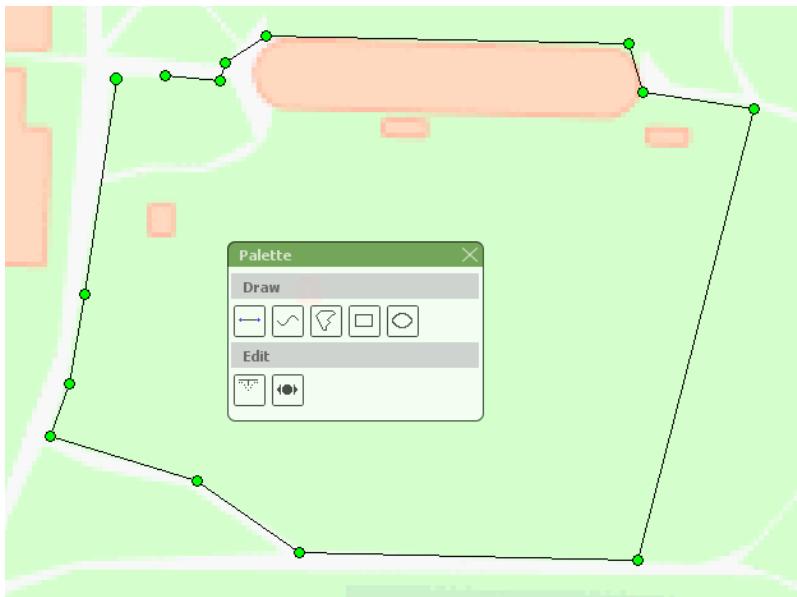


The following tools are available,

- **Polyline** – a digitizing tool, single-click to place vertices, double-click to finish,
- **Pen** – hold the mouse down and drag to create a free-form line
- **Polygon** – same as the polyline tool but snaps the two ends of the line to form a polygon
- **Rectangle** – click and drag to create a rectangle
- **Ellipse** – click and drag to create an ellipse

Single-click on a tool to select it. When a tool is active it will turn orange. In the following example we are using the polyline tool to digitize lines.

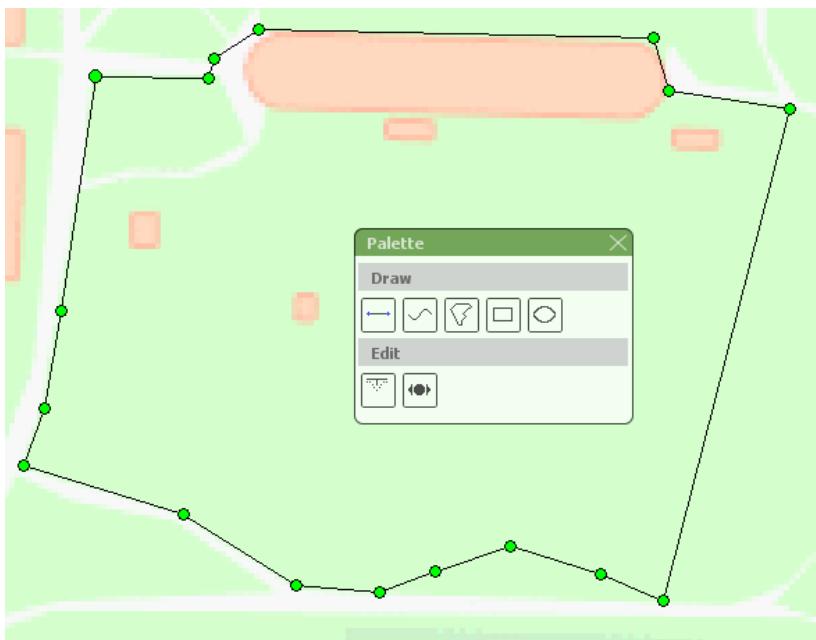




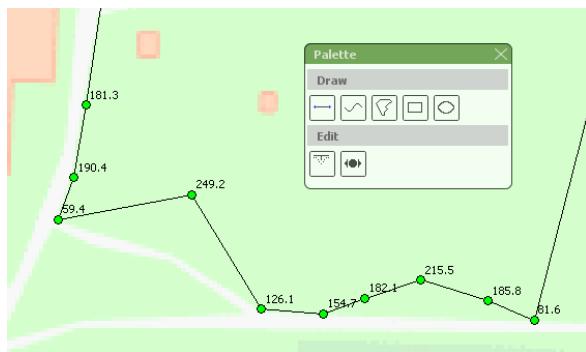
If you want to convert a polyline to a polygon, drag the last vertex towards the first vertex until it “snaps”. Alternatively, on the line itself, <right-click> <Male Polygon>.

When a line is active its vertices show as green dots and the line can be edited;

- Move vertices by dragging them,
- Delete vertices by double-clicking on top of them,
- Add new vertices by double clicking on a line segment.

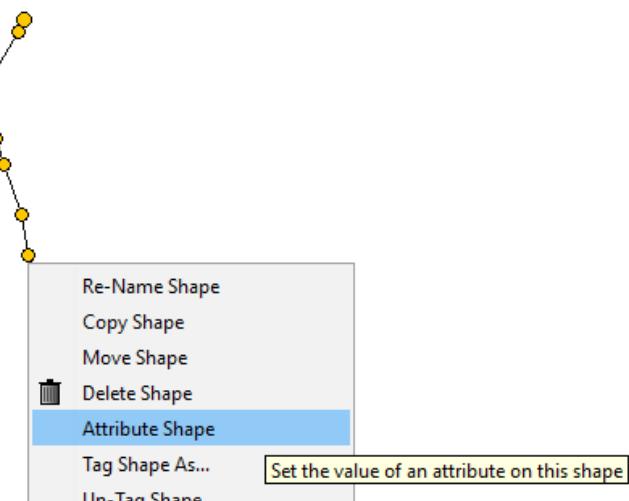


When editing a line, labels appear showing the angles (in degrees) between adjacent segments.

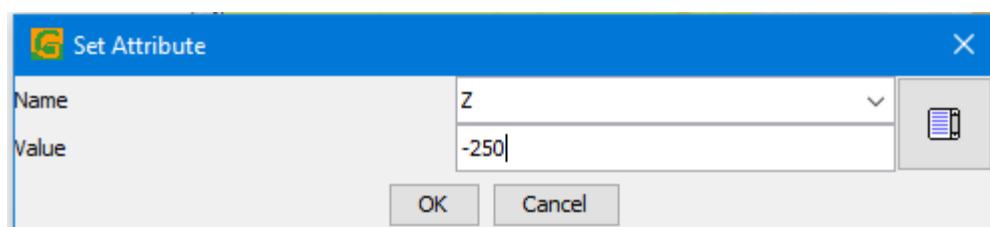


### Attributing & Tagging Shapes

You can set name-value pair attributes on any shape objects. With the layer active in the map, hover the mouse over a line and use <right-click> <Attribute Shape>.

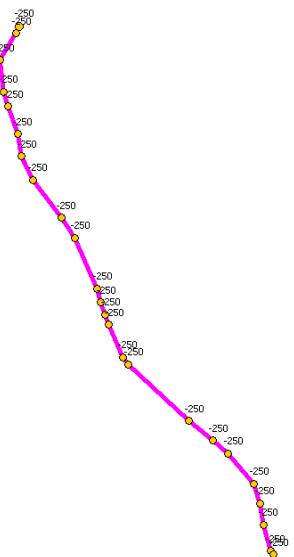
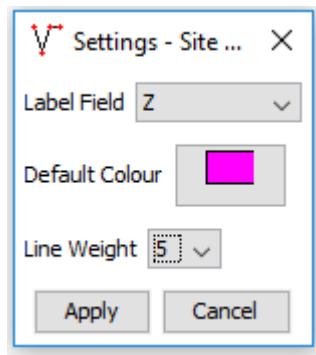


Specify an attribute name and value. In this example we are setting a Z value so that the line could represent a structure contour, for example.

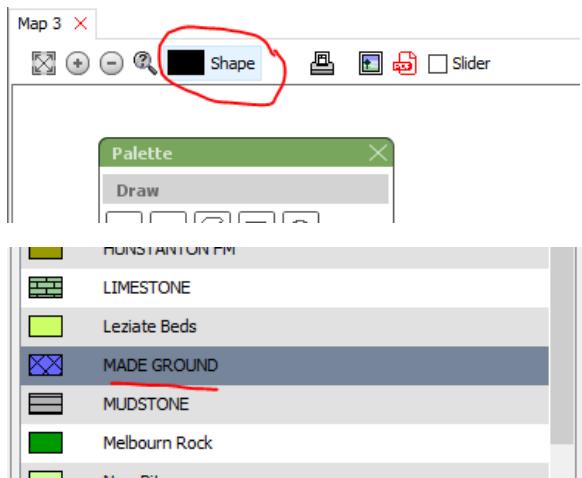


You can then set the field as the label for the shapes using the layer settings and also set colour and line thickness.

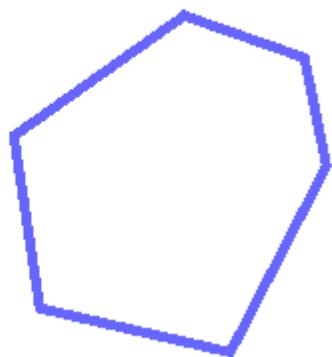
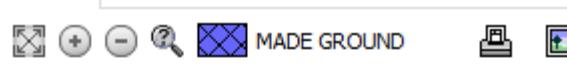




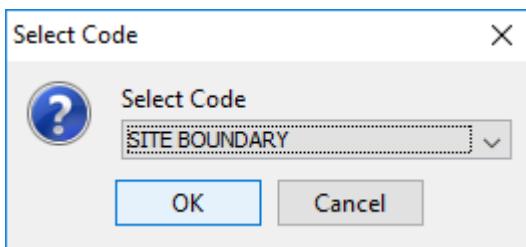
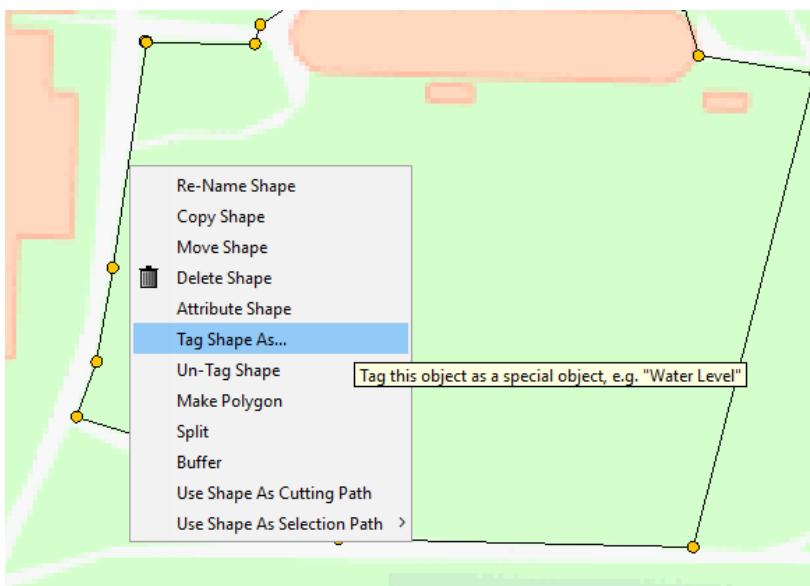
You can tag shapes with a geology code automatically as you draw just by setting an active drawing code other than "Shape".



With a geology drawing code set, draw the shape and it will be attribute with a field called "GEOLOGY" containing the drawing code that was active at the time.



You can also tag a shape with certain pre-set special attribute value. These are accessible by hover on the line and using <right-click>

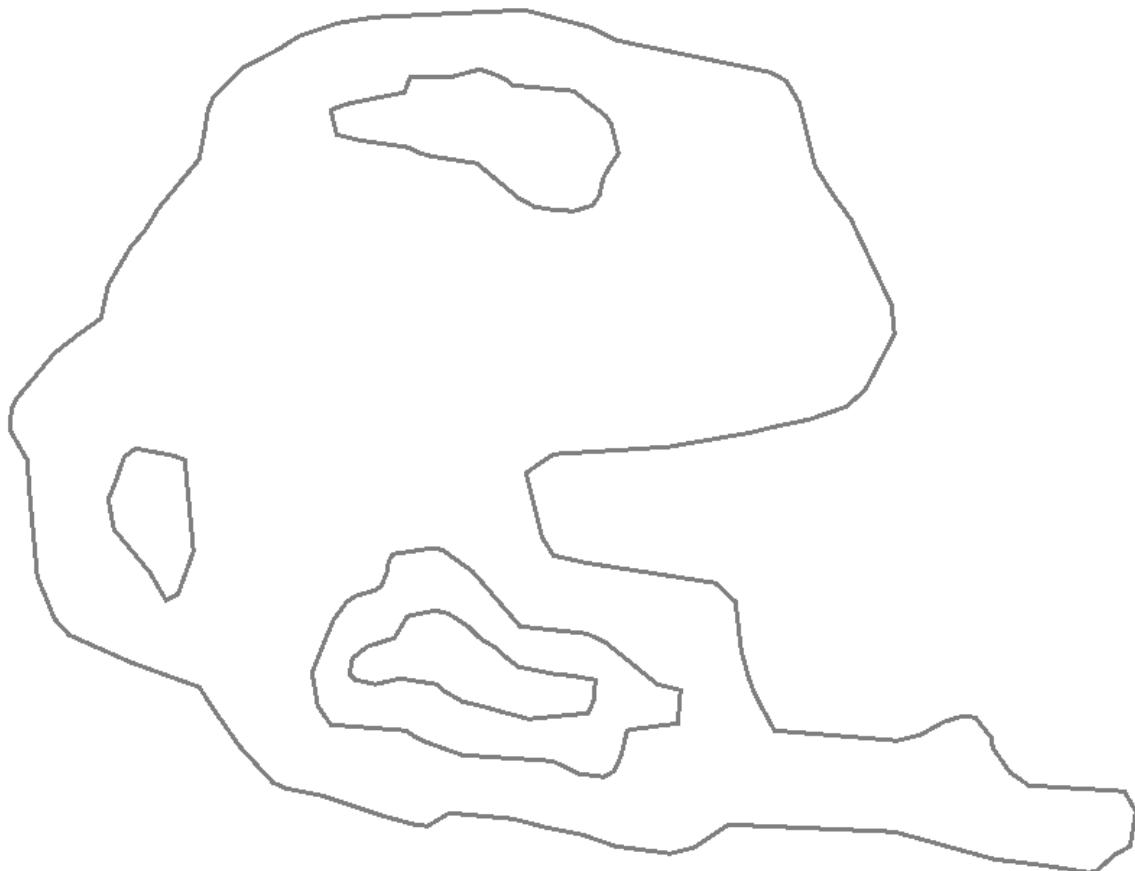


These tags cause the objects to act in certain special ways. For example, tagging a site boundary will style the shape as a bold, red line.

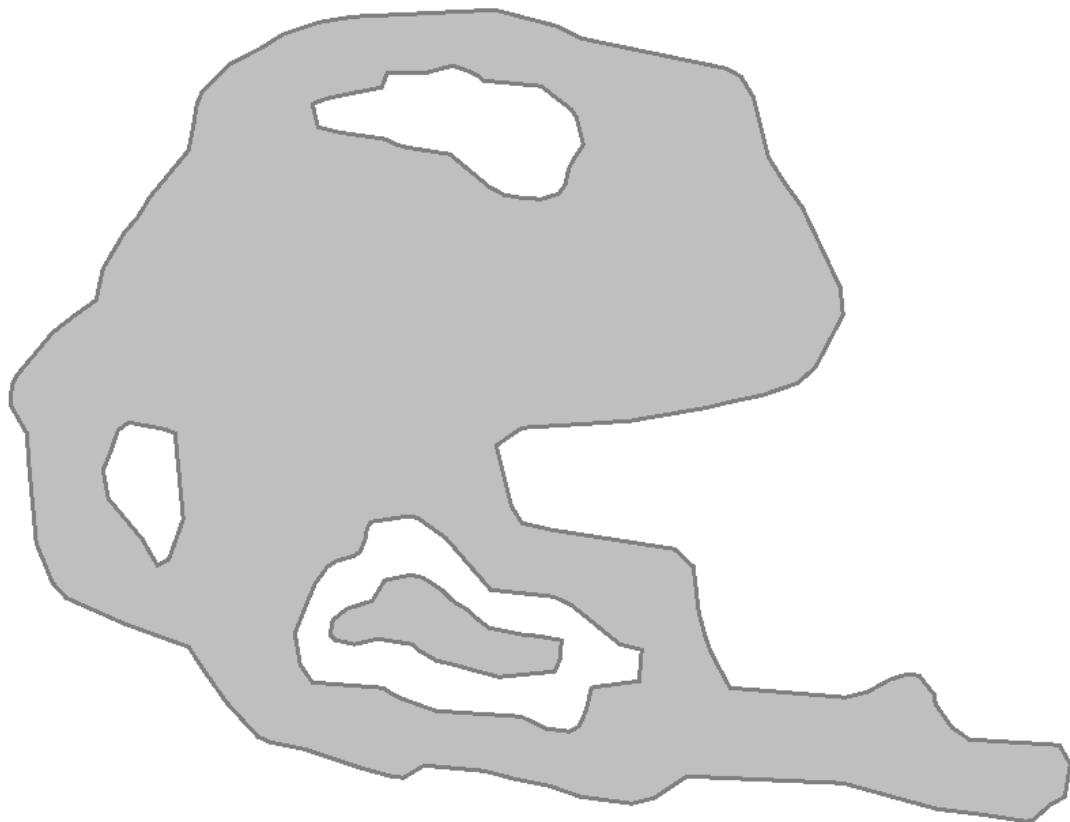
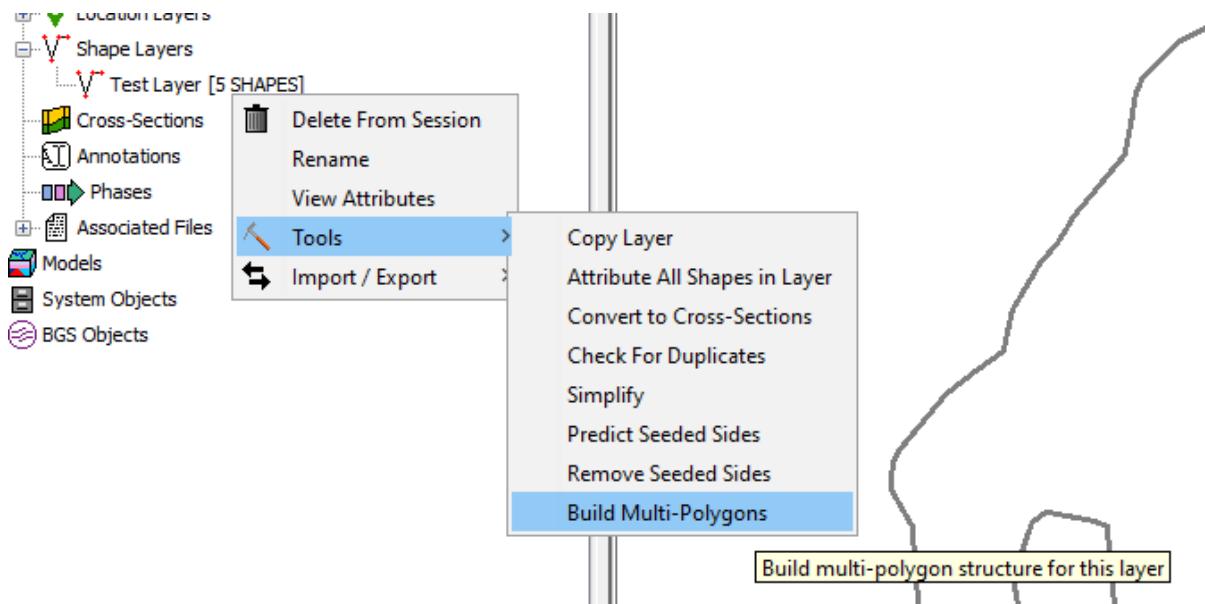


#### *Polygons With Holes*

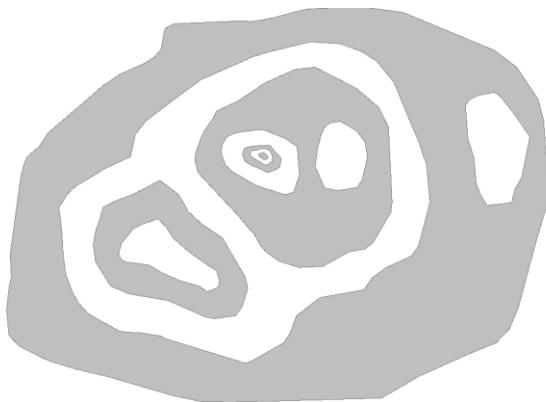
You can draw polygons with holes and Groundhog can automatically convert them into coverage envelopes. First, draw a series of polygons into a shape layer. Make sure each shape is a polygon either by dragging the last vertex towards the first to snap together, or via <Right-Click> <Make Polygon> on each line.



Next, in the data tree, use <Right-Click> <Tools> <Build Multi-Polygons> on the shape layer.



Groundhog will auto-detect the holes. This function operates to any level of nested detail. For very complex shape layers the auto-detection may take several moments to complete.



## Creating & Editing Annotation Layers

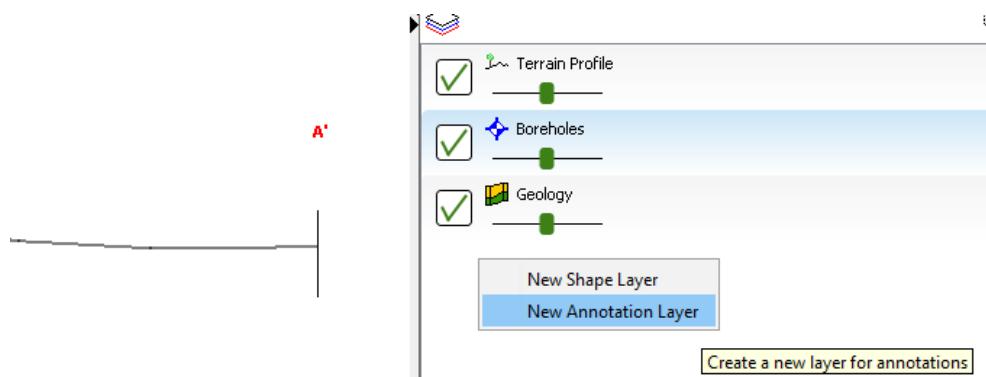
*Professional*

Annotation layers let you add a descriptive and symbolic layer to your projects, both in map and cross-section views. You can only create or edit annotation layers using Groundhog Professional, but you can view annotations in existing projects using Community.

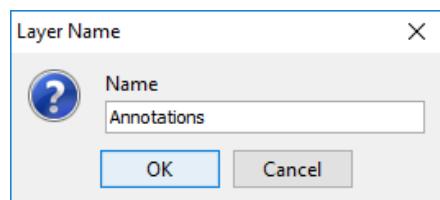
Annotations can take the form of;

- Labels – styled labels with boxes,
- Callouts – like labels, but with a pointer,
- Arrows – styled arrow shapes,
- Graphics – icon pictures that can be placed to represent key components of a conceptual model or interpretation.

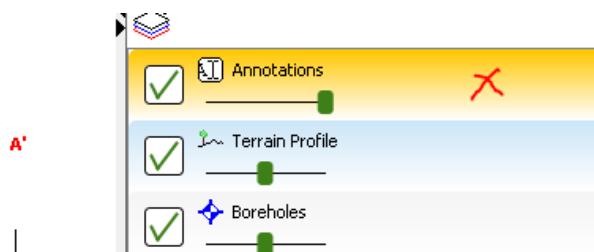
Use <right-click> <New Annotation Layer> in the layer control panel of either a map window or a cross-section window. In the following example we are working into a cross-section.



Enter a name. Note that you can have as many annotation layers as you like.



Make the layer active so that we can draw into it. When active it will display in orange.



When the layer is active the floating drawing tool palette will appear with a series of annotation-specific tools available.



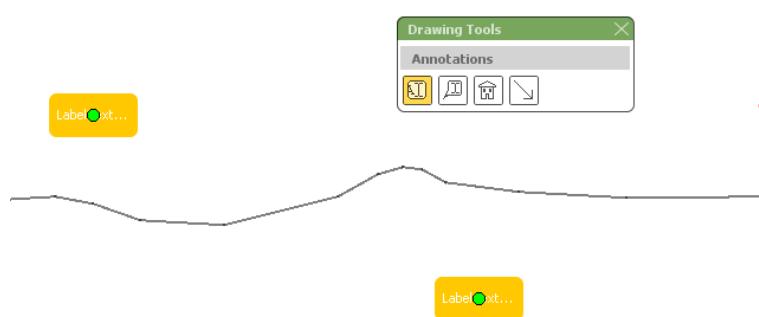
	Label	Place a label into the layer
	Callout	Place a callout into the layer
	Graphic	Place a graphic into the layer
	Arrow	Place an arrow shape into the layer

### Labels

Select a tool to start drawing. In this case, the labels tool. When the tool is active is will highlight in orange and it will stay active for as long as you want to keep placing annotations of that type. Click the button again to switch the tool off.

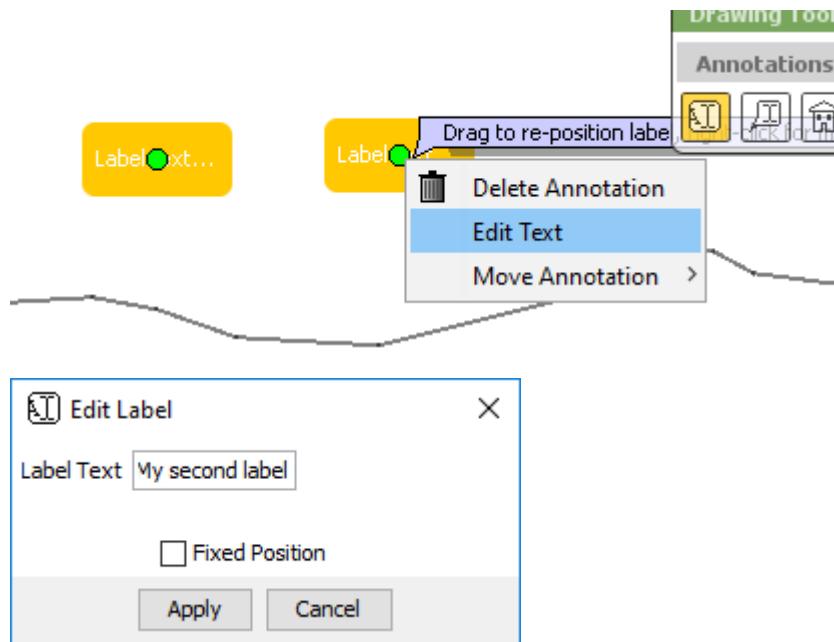


Single-click in the graphics panel (map or cross-section) to place the annotation object. Continue clicking to add more.



With the annotations layer active, each annotation will have green control nodes visible. Drag these to move the annotations around.

<Right-Click> on the green control nodes shows a context menu. In the case of labels we can use this to edit the label text.



When the annotations layer is active the labels appear orange to show they are in the active layer. De-activate the annotations layer to see them in their standard colour.

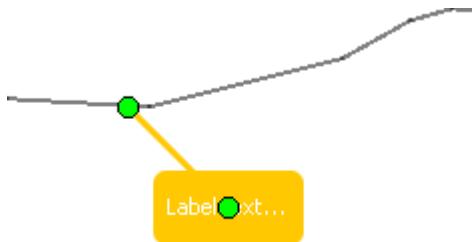


### Callouts

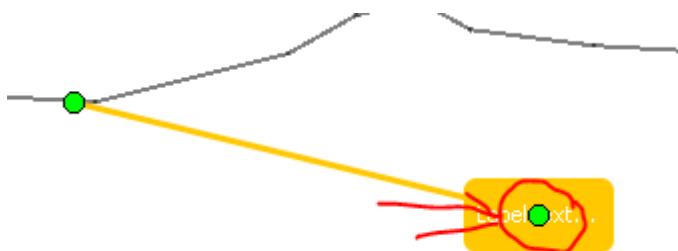
Activate the callout tool and place some callouts.



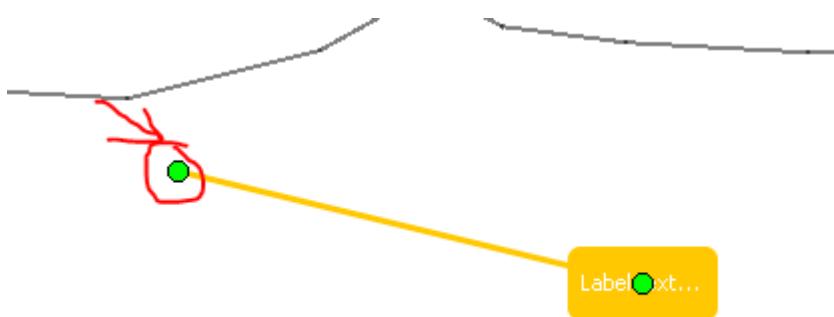
Note that callouts are like labels, but with a tail.



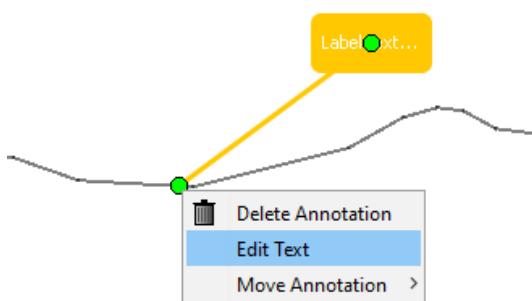
Move the label portion of the callout using the green control node inside the label.

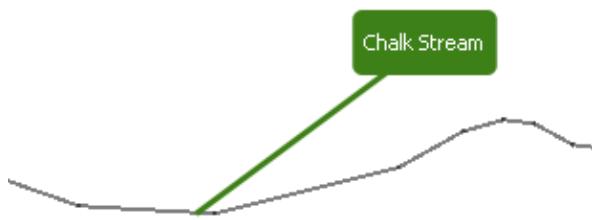


Move the tail by dragging the green control node at the end of the tail.



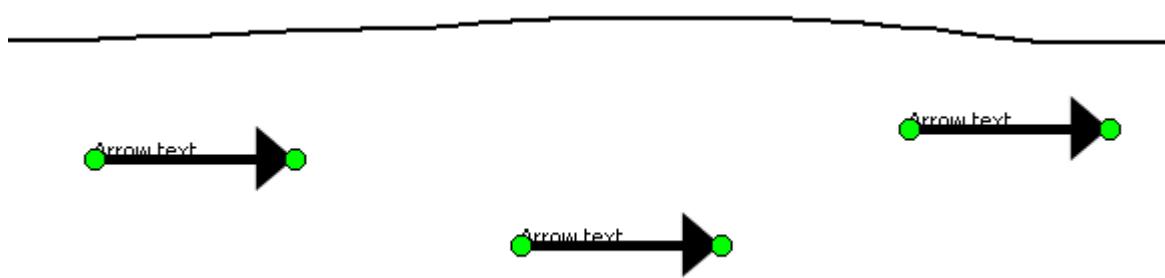
Right-click on the control node at the end of the tail to access the label editing dialog.



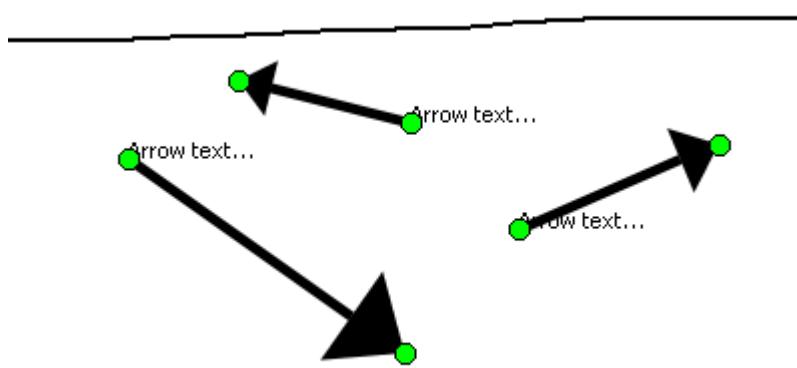


### Arrows

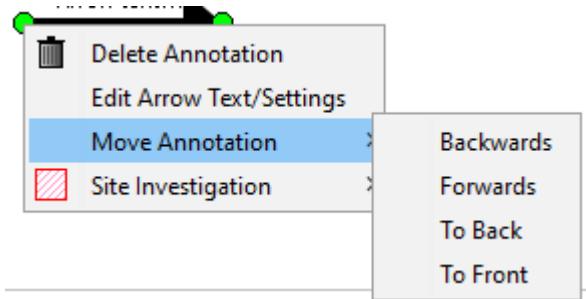
Activate the arrow tool in the drawing palette and single-click in the panel to place arrows.



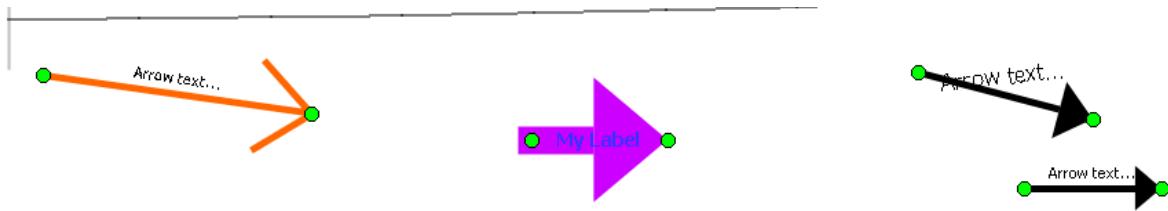
Drag the green nodes at either end of the arrows to size and position them.



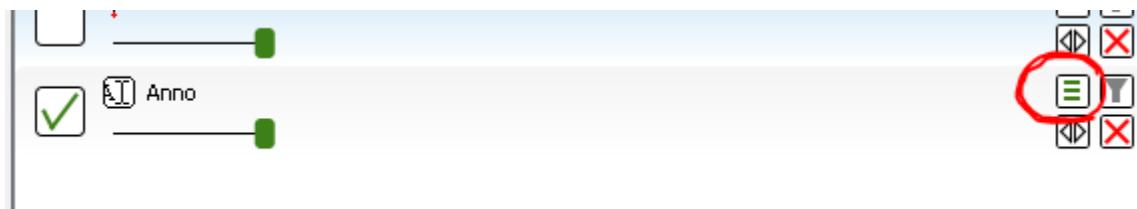
<Right-Click> on the first node of the arrow to access editing and ordering option.

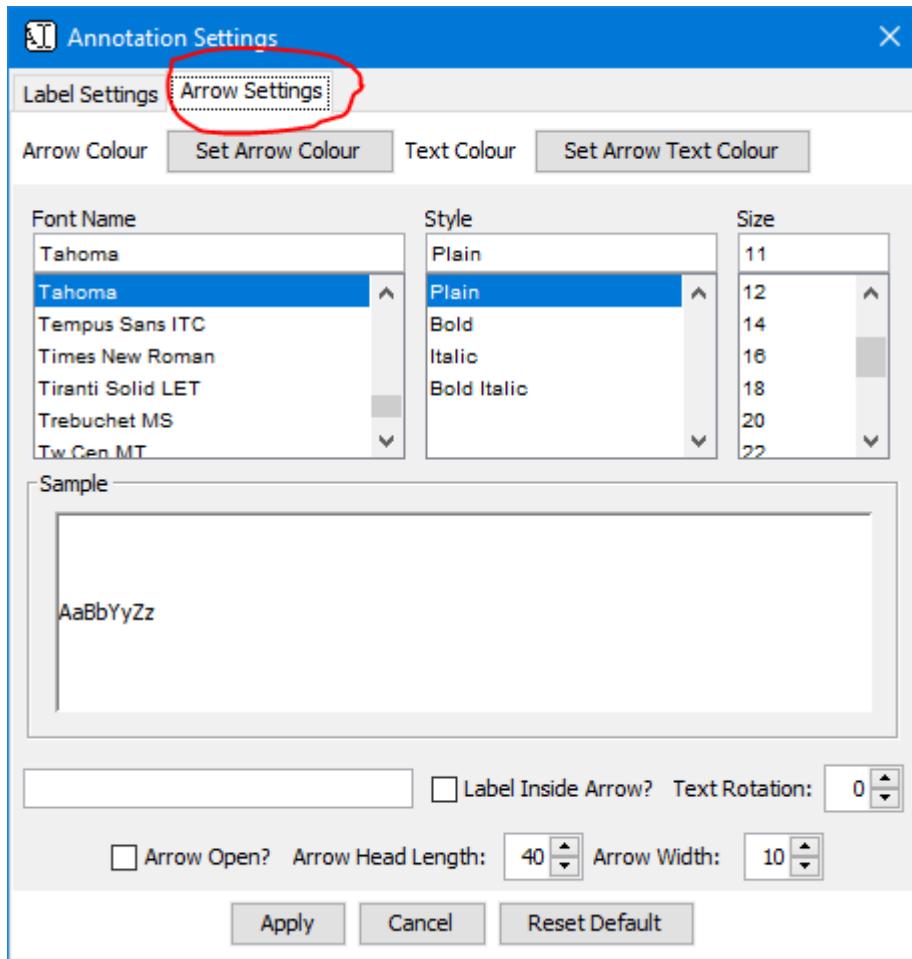


Use the dialog accessible under <Edit Arrow Text/Settings> option to set the appearance and label (if one is needed) of each arrow.



You can also set global setting for the entire layer via the settings button of the annotations layer.





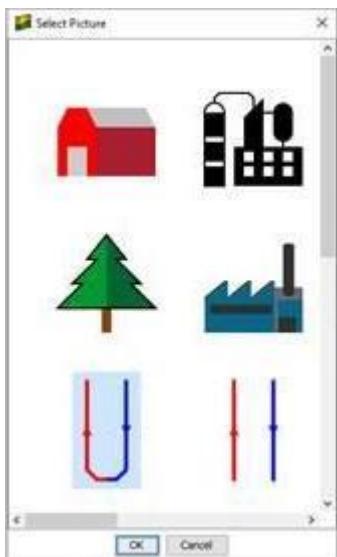
### *Graphics (Pictures)*

You can add graphical pictures into an annotation layer in both map and cross-section. Groundhog comes pre-loaded with a suite of pictures that you can use.

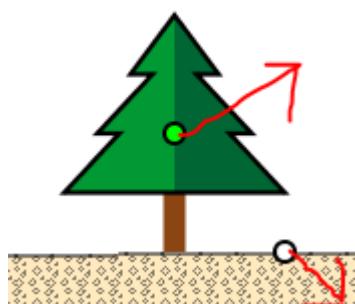
Select the graphic tool from the drawing palette.



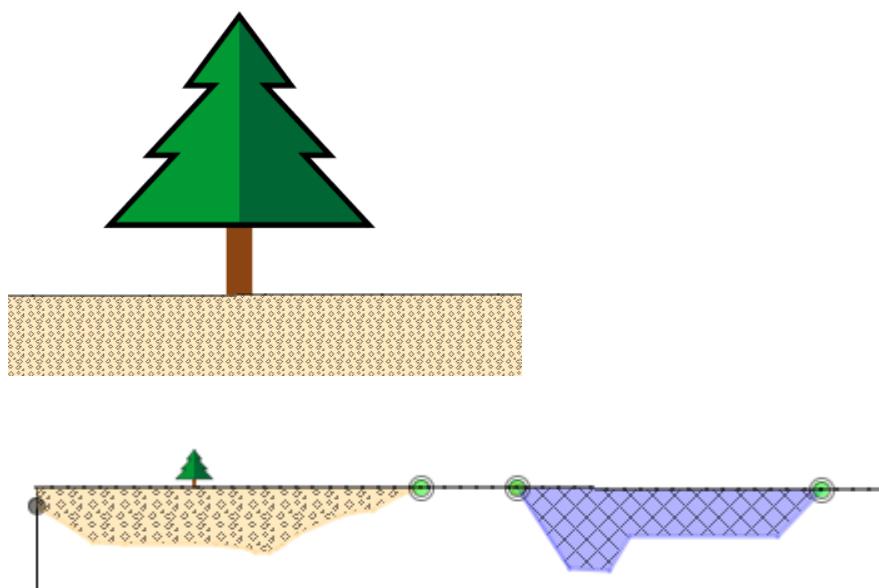
Single-click in the graphics panel to place pictures. You will be prompted to select the graphic picture to use. Click on the picture you want and click <OK>.



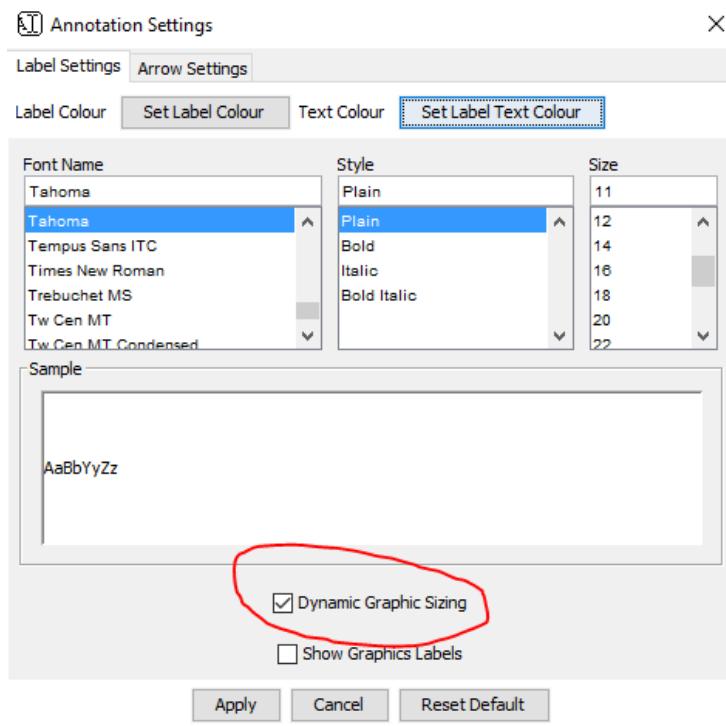
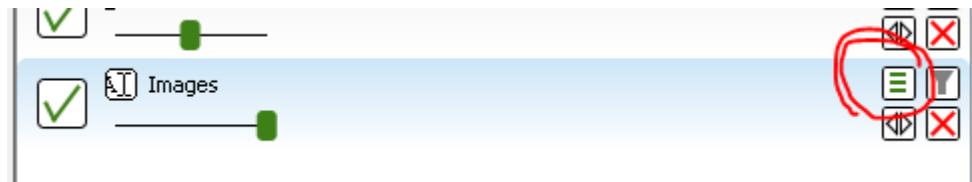
Use the green and white control nodes to move and re-size the picture, respectively.



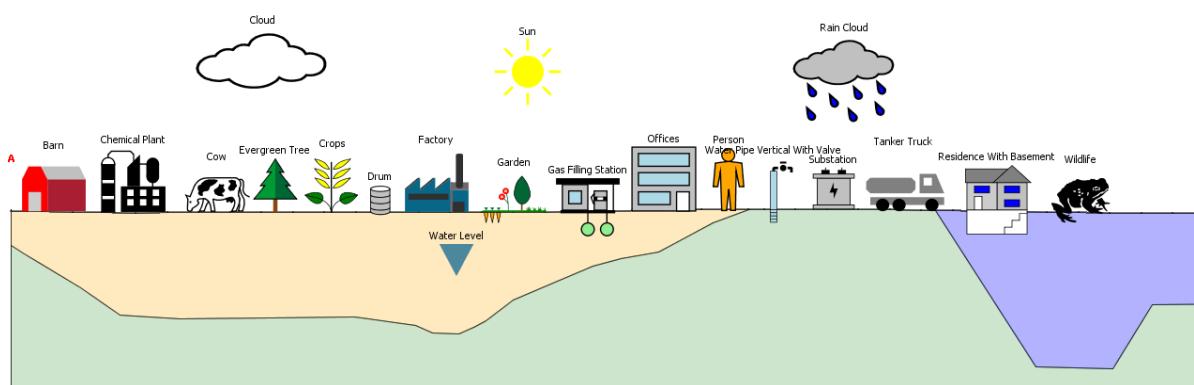
Annotation layers have two zoom modes. By default, the pictures will re-scale as you zoom in and out (dynamic re-sizing).



Alternatively, you can switch to non dynamic re-sizing via the layer settings dialog.



Add as many annotations as you wish. Here are some examples of the graphics supported within Groundhog. You are free to use these in outputs/reports, including for commercial projects.



# Drawing Cross-Sections

This section provides details on how to construct and digitise spatially-referenced geological cross-sections using Groundhog.



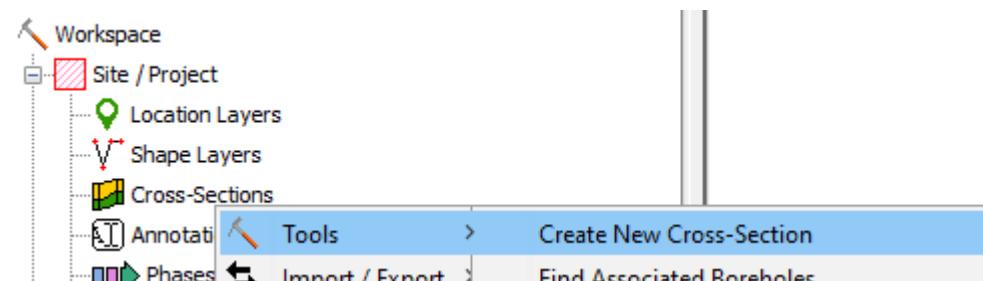
*Photo by Ivars Krutainis on Unsplash*

## Creating the Cross-Section Alignment

The first step in creating a cross-section is to construct its alignment on the map.

### Creating Cross-Sections Without an Alignment

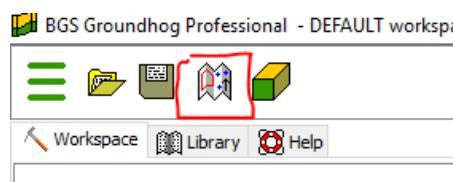
If you do not care about the map alignment and you just want to draw a cross-section of a specific length in isolation then you can use <right-click> <Tools> <Create New Cross-Section> in the object tree.



This will prompt you for a name and a length and will then open up the cross-section in a new window ready for drawing, etc. Note that the cross-section does still have a spatial alignment beginning at [0, 0] in the map.

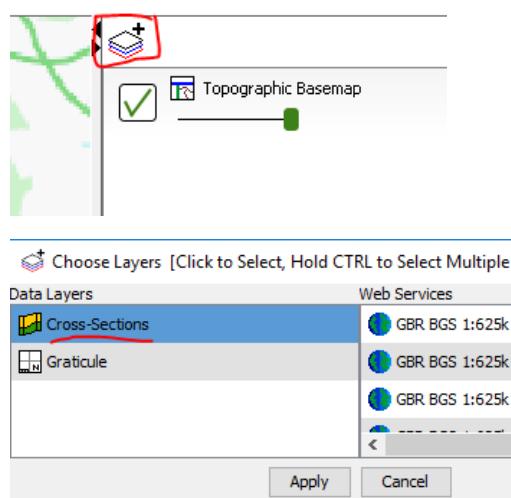
### Drawing a Polyline for the Alignment

However, you typically want to draw the cross-section alignment in the map interactively. First, make sure you have a map window open. Create a new map window for this purpose if necessary. If you are working in the UK it is a good idea to add the default **Topographic Basemap** layer that is included with Groundhog for orientation purposes or alternatively import a geo-registered image of your site/project.

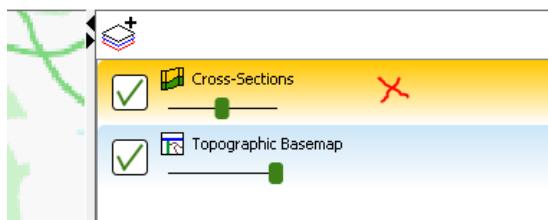


In the map window, zoom in to the approximate desired location of the cross-section, making sure that the extent of the map covers the entire cross-section alignment.

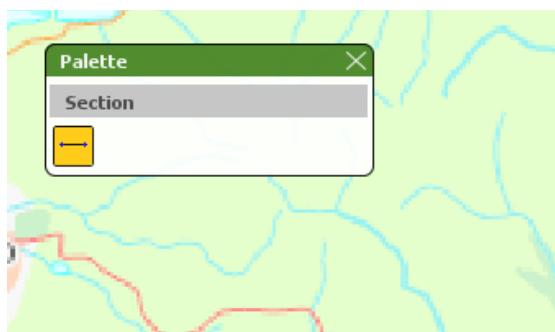
If it isn't already there, add the default **Cross-Sections** layer to the window.



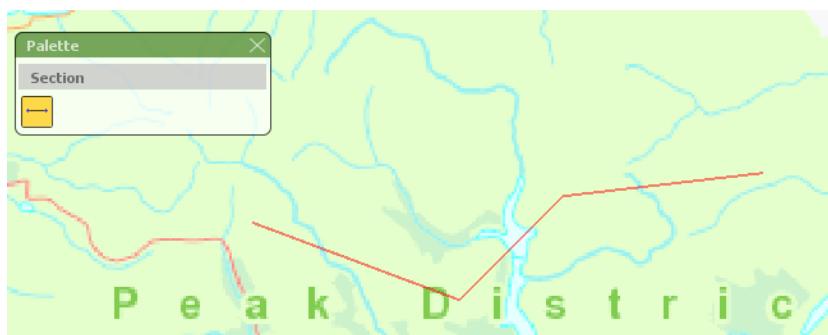
You are going to be drawing into the Cross-Sections layer, so make it active by single-clicking on it in the layer control panel. When it's active it will highlight in orange colour.



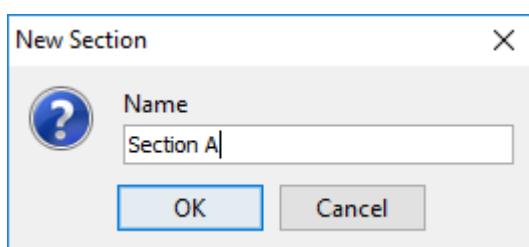
When the layer becomes active a drawing tool palette will appear in the map panel. There is only one tool available in cross-section layer mode, which is polyline. Pick this tool up by single-clicking on its icon in the palette. When it is active the tool will highlight in orange.



Start drawing the alignment. **Single-click to add positions** to the alignment. **Double-click at the last vertex** of the alignment to complete the operation. Cross-sections can have as many inflections as you like, or they can be just straight by only placing two vertices into the polyline.



Enter a name for the cross-section. If you wish to abandon the line you have drawn, simply cancel the name input dialog.



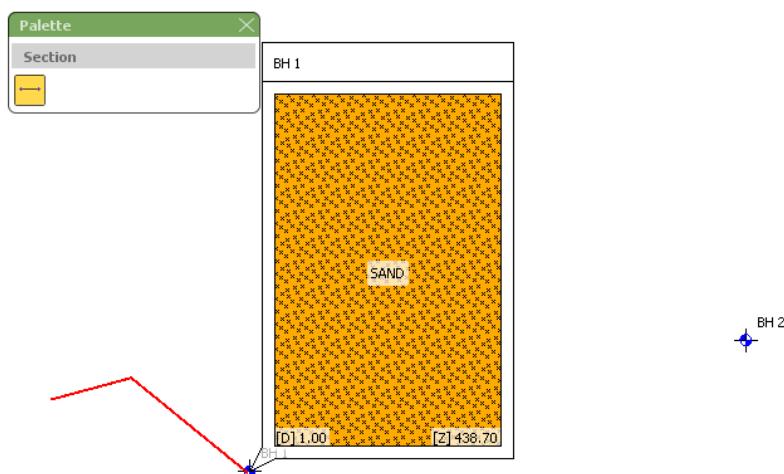
Continue drawing polylines to create cross-section alignments. When you are done drawing, make sure to de-activate the polyline tool by clicking on it so that it is no longer highlighted in orange.



With the cross-section drawing complete it will be added to the object tree and is now available for display and digitizing operations (see later sub-section of this chapter).

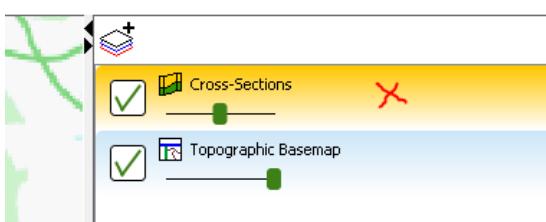
### Including Boreholes in the Cross-Section Alignment

You can force cross-section alignments through borehole locations so that you can use them for correlation. First, make sure to add the desired borehole folder to the map as a layer so that the borehole locations are visible. Now, as you draw the polyline for the cross-section alignment in the map, if you move the mouse cursor close to the location of a borehole object it will show a log preview of the borehole. This confirms that Groundhog has detected the borehole location, so single-clicking at that location will add the borehole itself to the cross-section alignment.



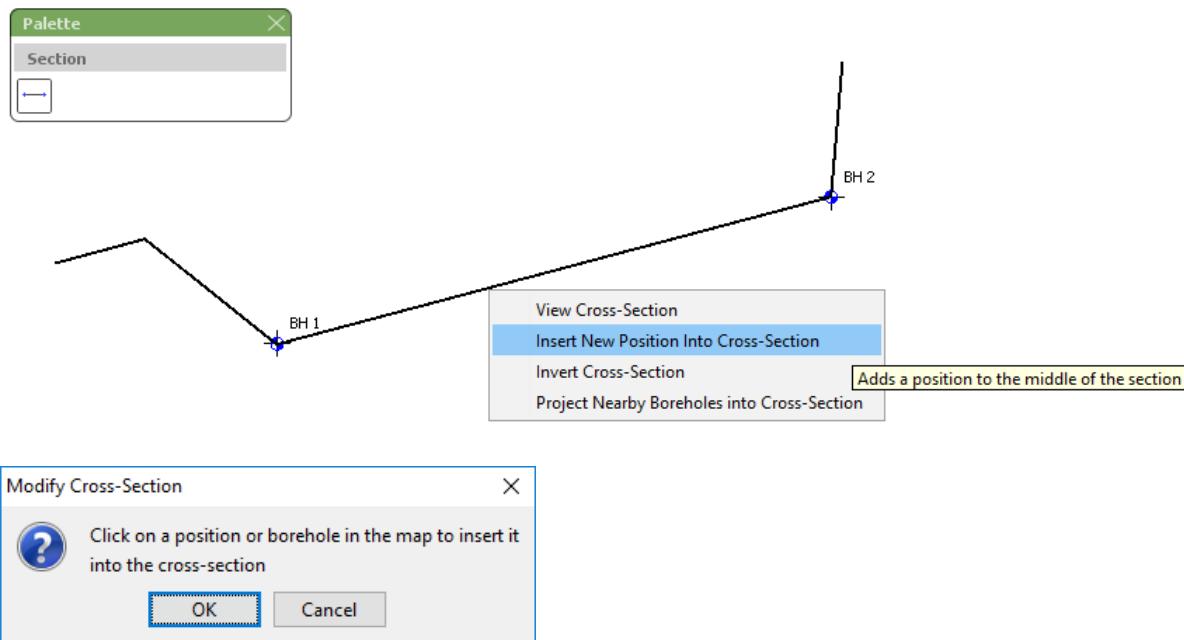
### Modifying the Alignment

Once a cross-section alignment has been drawn in the map you can still modify it. First, make sure the **Cross-Sections** layer is visible and active in the map.

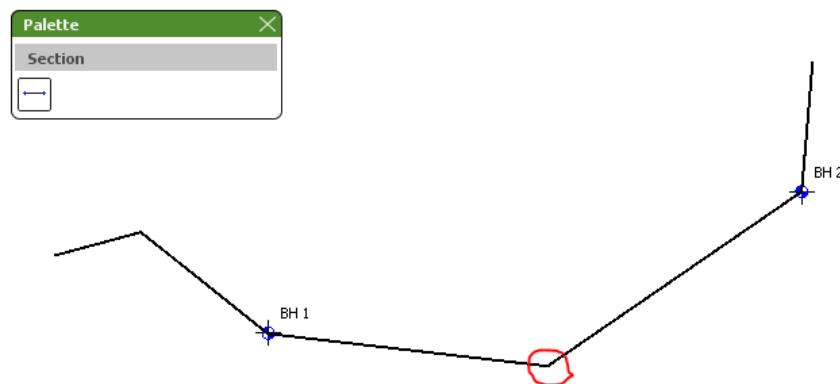


#### *Insert New Position*

Right-click on the segment of the polyline where you wish to insert a new map position and choose <Insert New Position Into Cross-Section>.

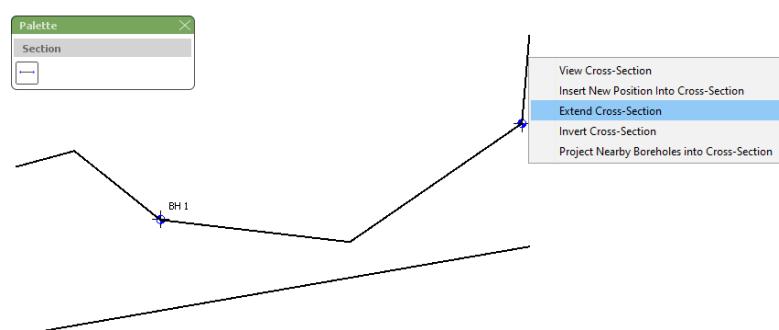


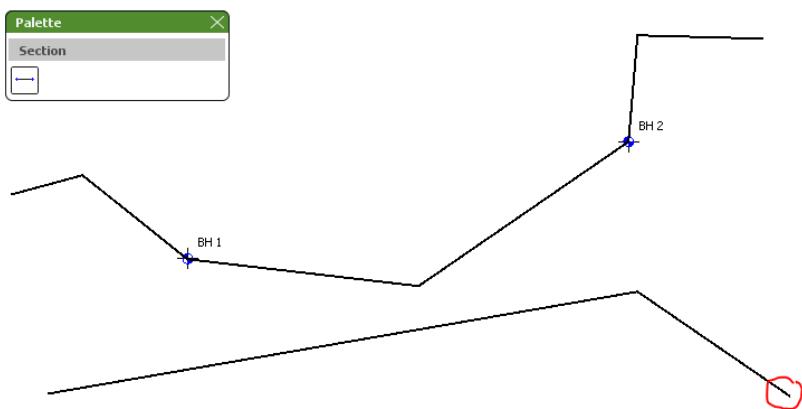
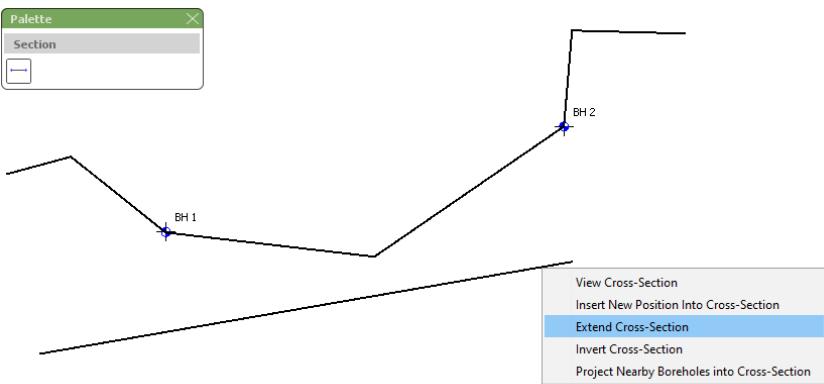
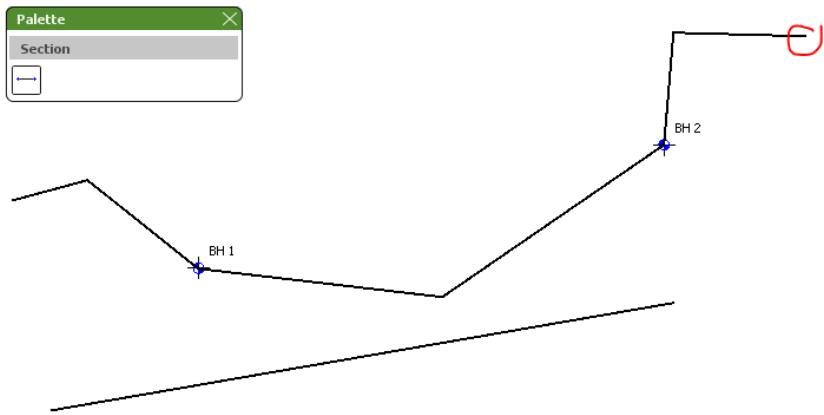
Click on the desired location in the map to insert it into that segment of the line.



### *Extending a Cross-Section*

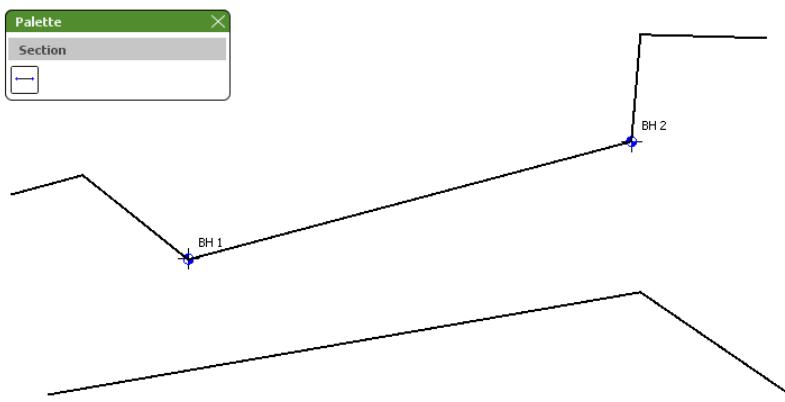
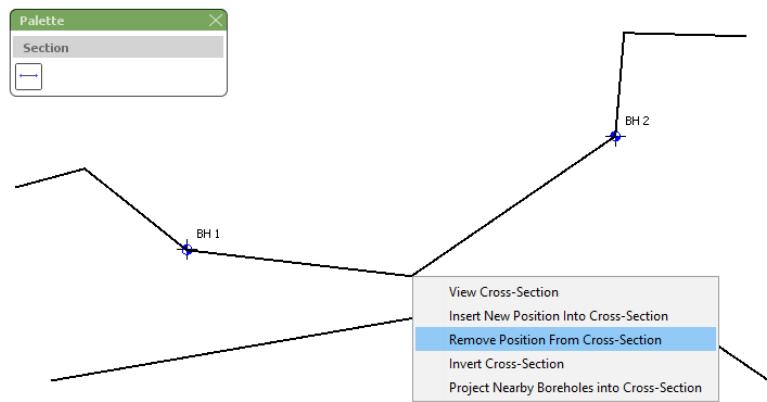
You can extend a cross-section at either end. Right-click on the segment at the desired end of the cross-section. If the cross-section only has one segment (i.e. it is a straight section), make sure to right click closer to the end of the line that you wish to extent. Choose <Extend Cross-Section>. The examples below show extending the cross-sections to the East (right).





### Removing a Position From the Alignment

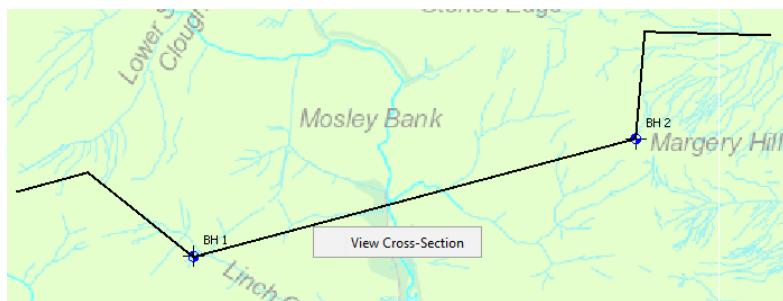
To remove a specific position from the alignment polyline, right click on the desired position (one of the section ends or an inflection point) and choose <Remove Position From Cross-Section>.

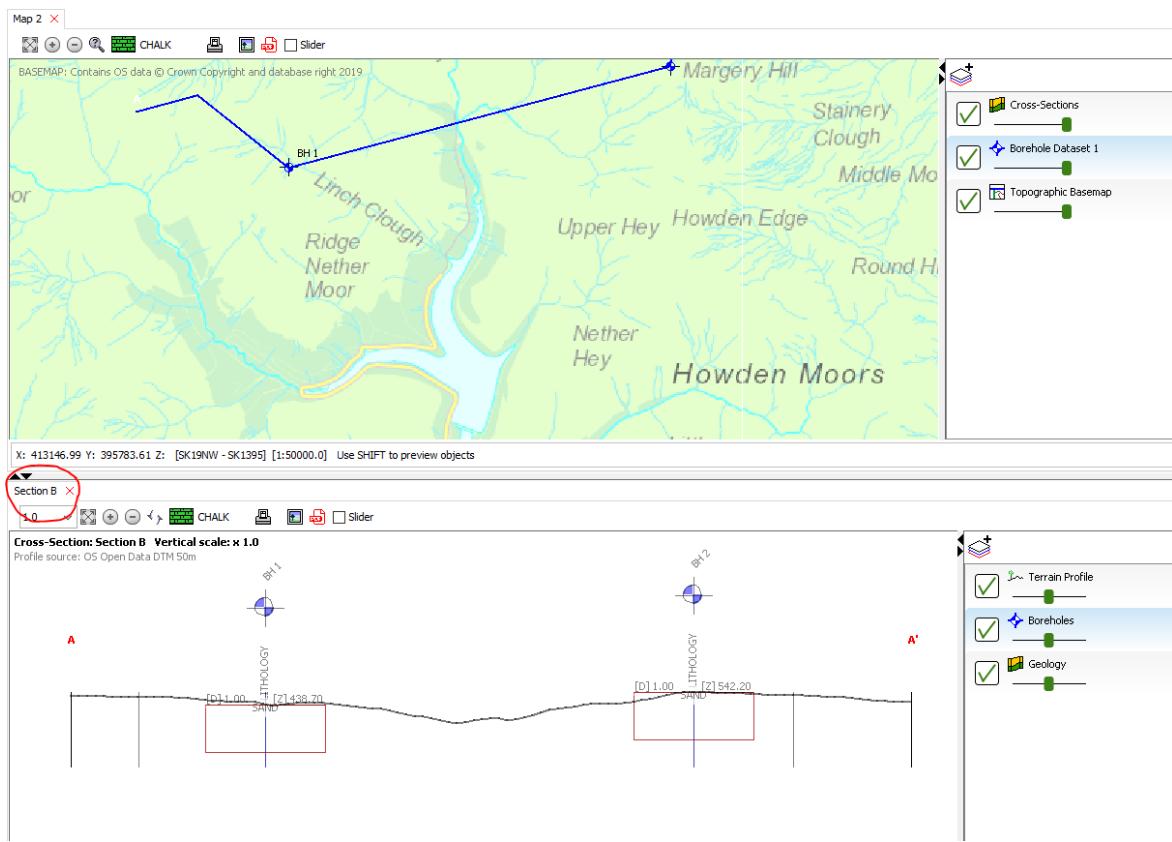


**IMPORTANT:** Please note that modifying cross-section alignments may have adverse effects on any correlated geology linework or other geometry objects that have already been drawn into the cross-section.

### Viewing and Editing the Cross-Section

To open a cross-section in a cross-section window, (1) double-click on it in the object tree or (2) use <right-click> <View Cross-Section> in the tree or (3) <right-click> on the alignment in the map and choose <View Cross-Section>. The cross-section window opens in a new tab.





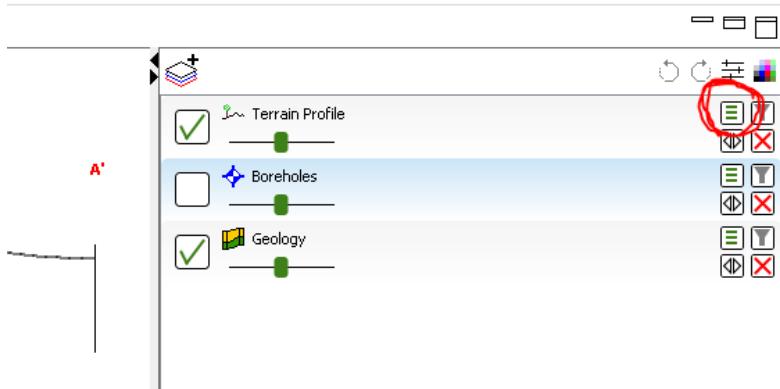
Zoom to full extent to centre the data in the panel.

### Topographic Profile

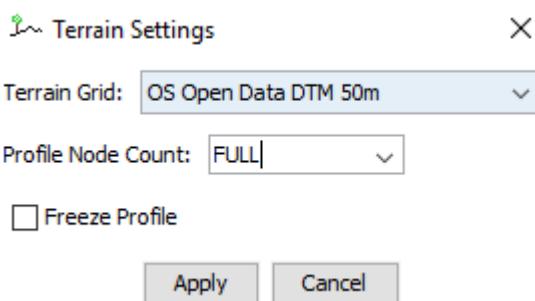
If a default surface layer (topography grid such as a DEM/DTM) is loaded and configured in the session then a topographic profile will be automatically generated and added as a **Terrain Profile** layer.



If there is no grid available for this a flat profile will be generated. To change or update the topographic profile, open the settings for the **Terrain Profile** layer.



Choose which grid layer to use for the profile generation and set a level of detail. If you want to sample the grid at full resolution, select “FULL” in this list.

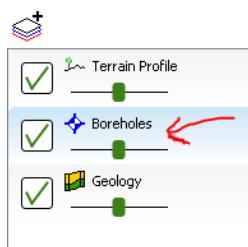


Click <Apply> to make the changes. The profile will be updated. When using “FULL” resolution on fine grids the update may take a few moments as the grid query is performed. Also, with the profile at very high-resolution you may find the graphics a little slower.

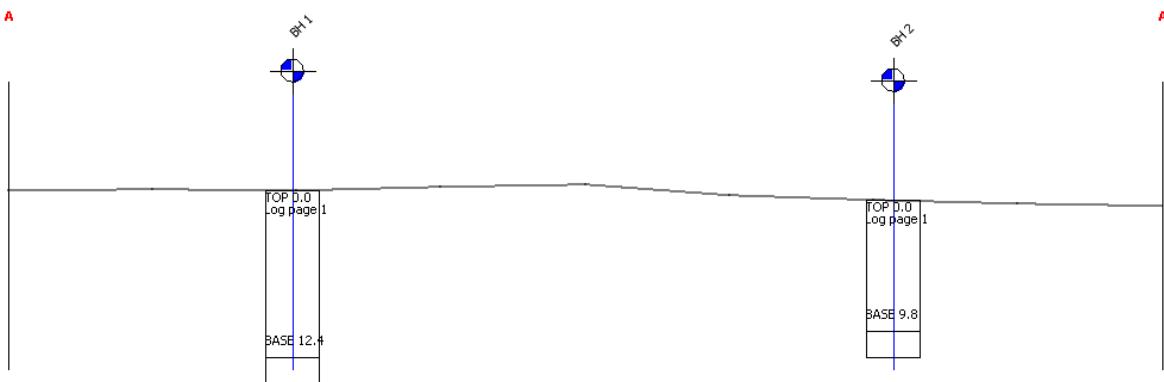
If you do not have a suitable grid to use for the topographic profile, simply drop an ASCII grid (\*.asc) file into the folder where your Groundhog project is saved and restart Groundhog. The grid will be picked up and added to the session as an option. For more detail on working with grid data please refer to the **Importing & Exporting Data** chapter.

### Viewing Boreholes

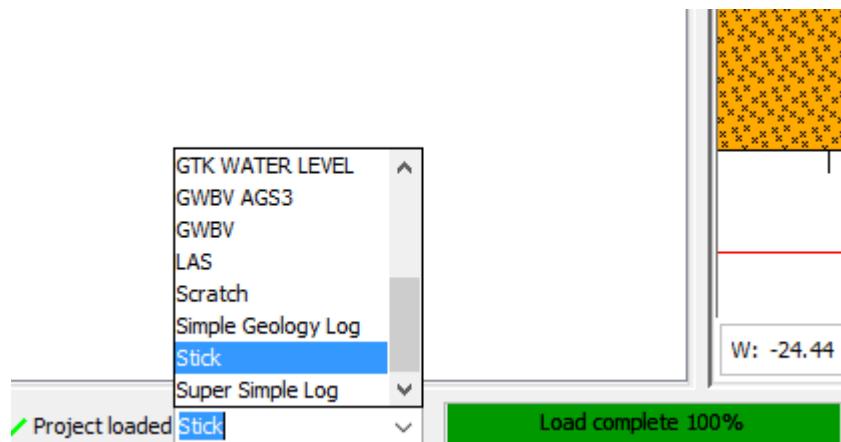
If you have drawn your cross-section alignment through any borehole locations they will be displayed as a **Boreholes** layer.



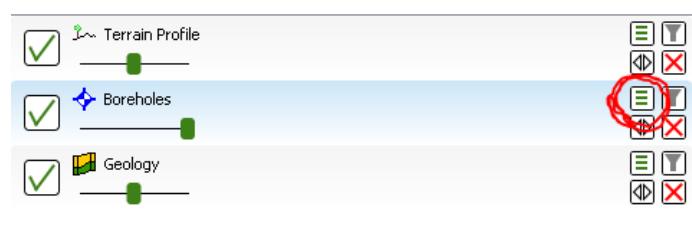
To begin with you may find that your boreholes appear as empty boxes with odd labels.



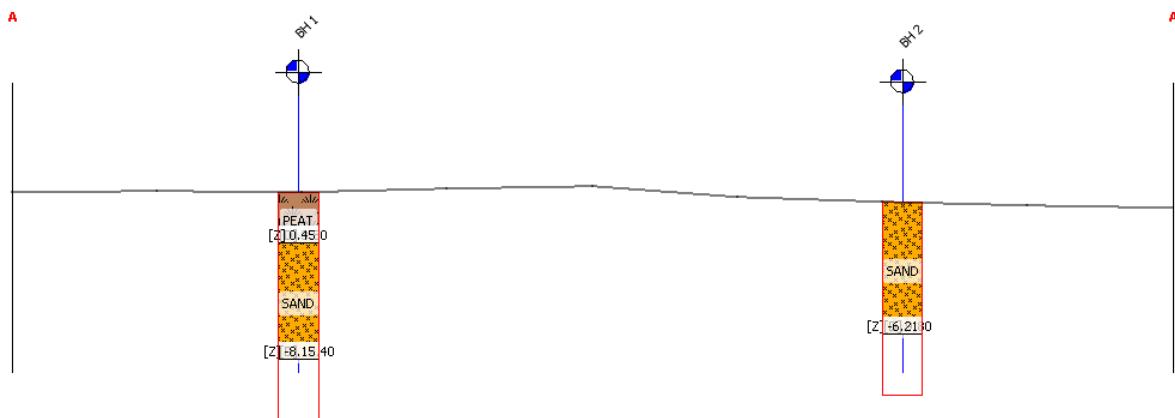
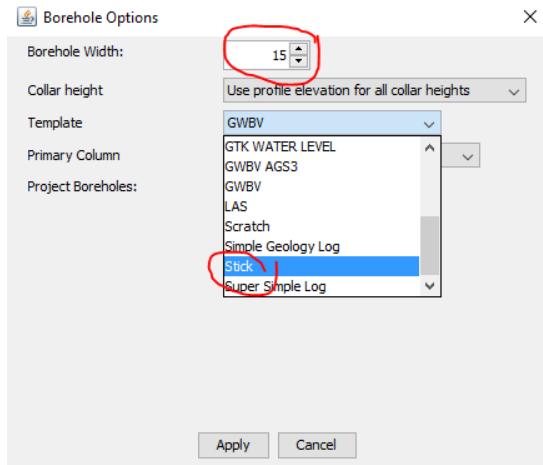
This usually happens when the active log template is unsuitable for the data contained within the boreholes themselves. Change to a more suitable template using either the global template settings in the main status bar of Groundhog.



Or, access the settings for the Borehole layer in the section window and choose a more appropriate template.



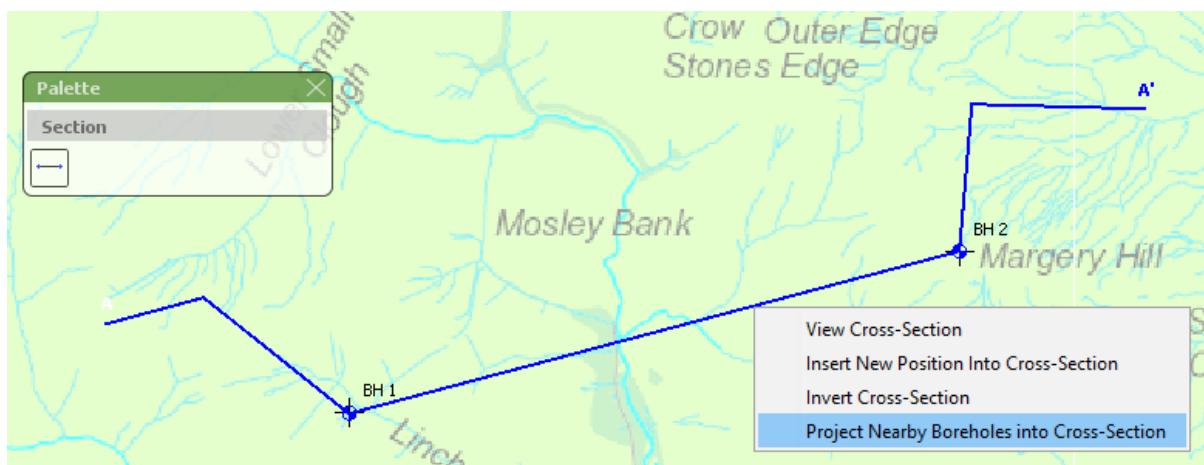
In the settings dialog choose a suitable template and also specify the width (in metres) of the log sticks until the logs appear as you want them.



If you don't have a suitable log template then you can design one. For more details please refer to the **Working With Borehole Logs** chapter. You can design templates to show different types of borehole data such as geotechnical test data and geophysical logs.

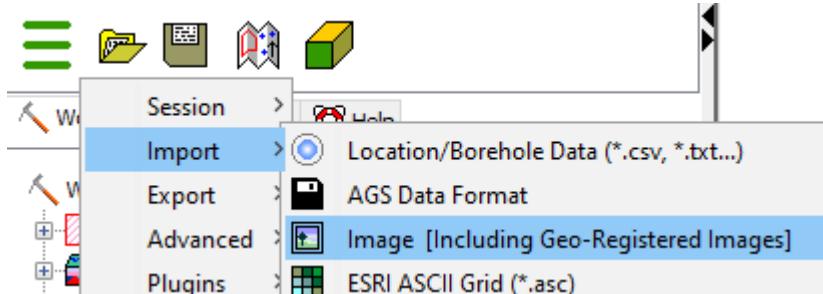
### Buffering Boreholes Into a Cross-Section

If you have not drawn your alignment directly through the boreholes, with the **Cross-Sections** layer active in the map, you can use a buffering operation to project them into the alignment using <right-click> <Project Nearby Boreholes Into Cross-Section>. Enter a buffer distance. The projection is performed orthogonal to the alignment. To remove the buffered boreholes, perform the same operation and enter a buffer distance of 0 (zero).

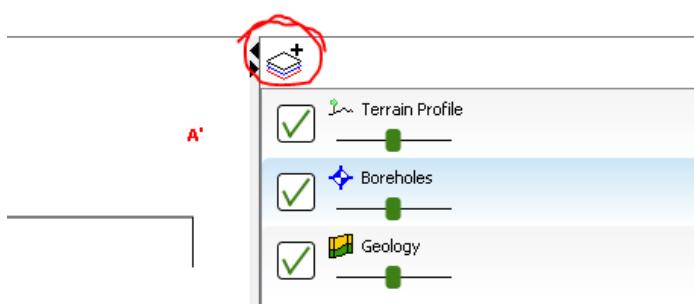


## Registering Images in Cross-Section

You can add images to a cross-sections as layers. This can be useful for showing geophysical data, for example. First, load the desired image into the project via <Main Menu> <Import> <Image>.



Position the cross-section panel to the approximate extent where you want the image to display. Add the image as a layer to the cross-section window.



Select the image you wish to add.

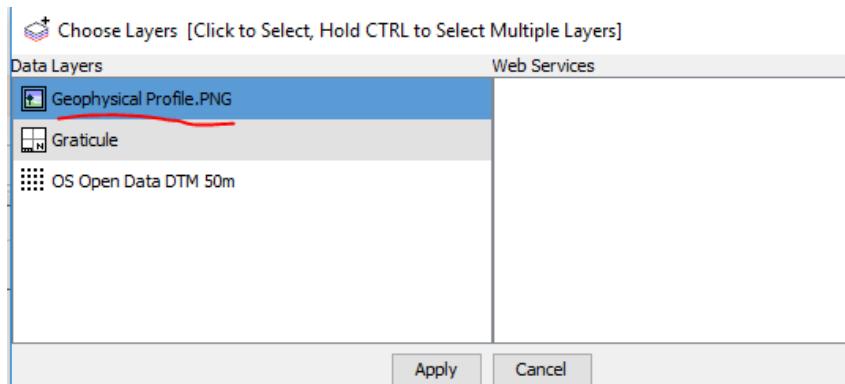
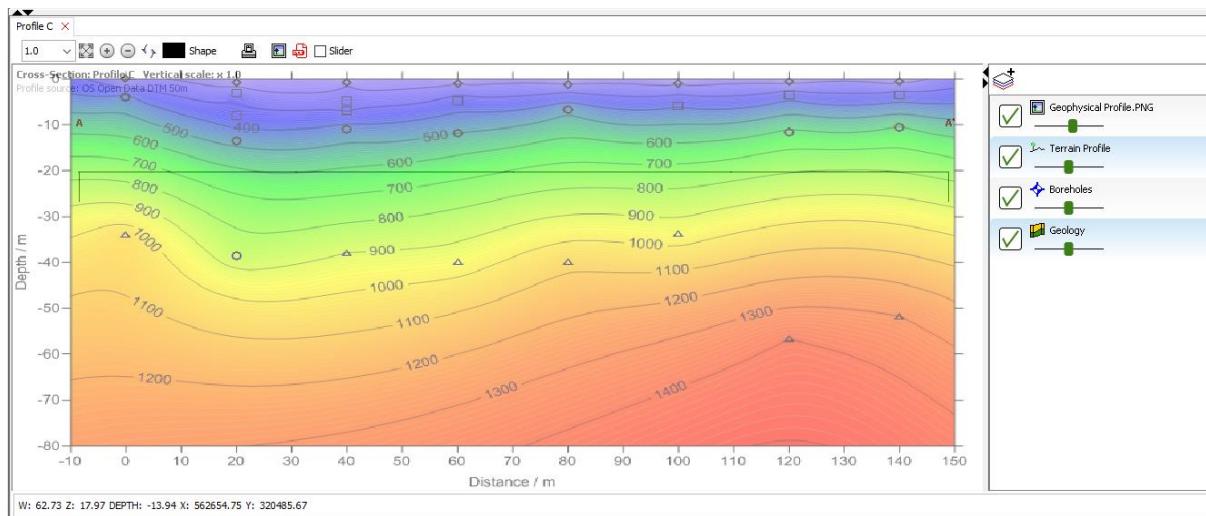
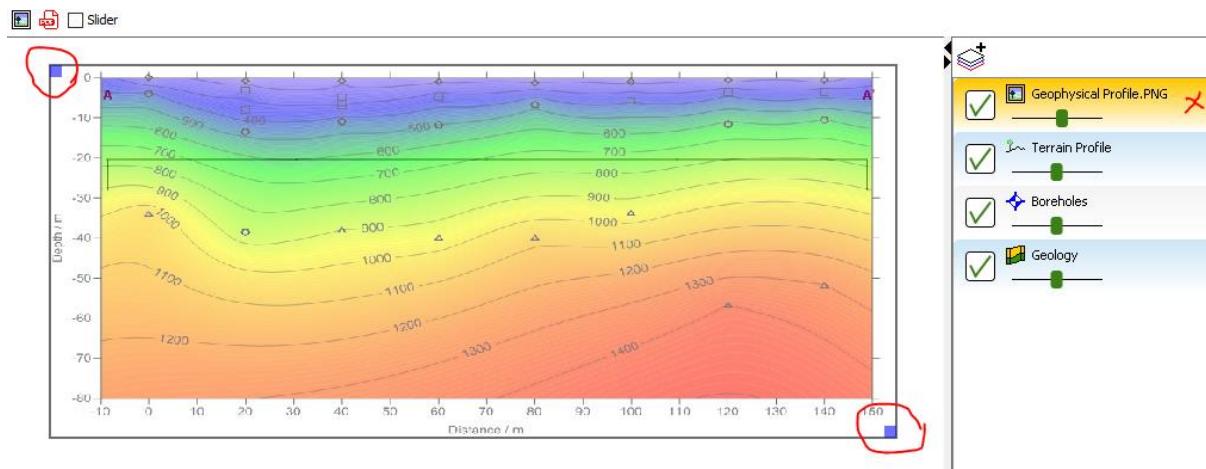


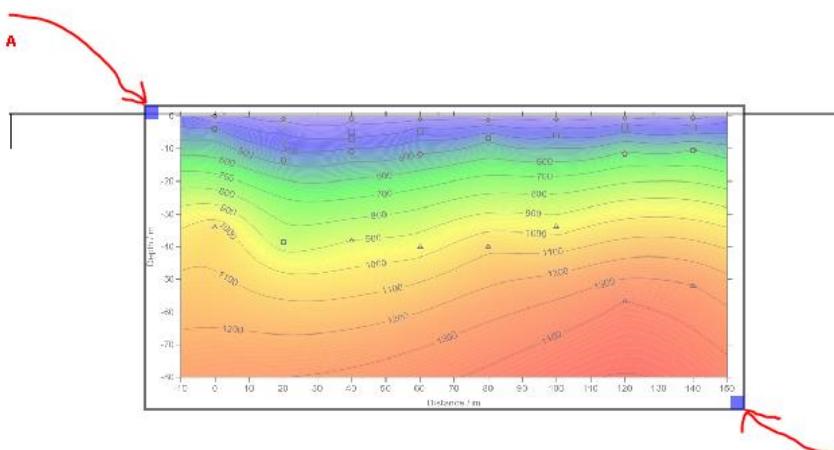
Image will appear, filling the visible extent of the graphics panel.



Click on the image layer to make it active. Note that square, blue control handles appear in the top-left and bottom-right of the image.

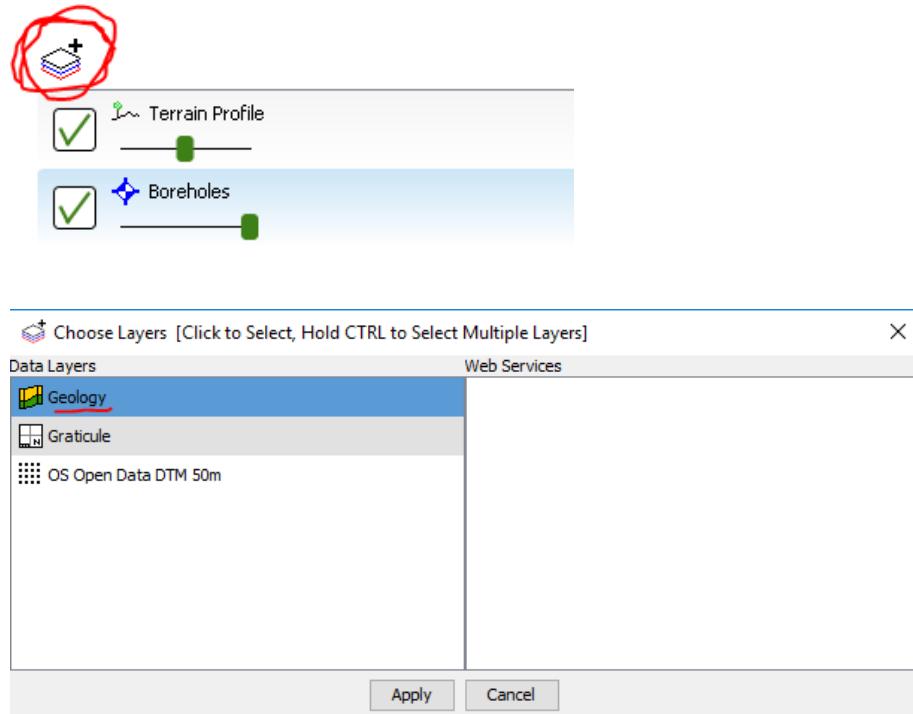


Use the top-left handle to move the image around and use the bottom-right handle to re-size the image. Whenever possible, try to use an image that has scale-bars included so that you can compare the values to the mouse cursor position in order to fine-tune the image registration.

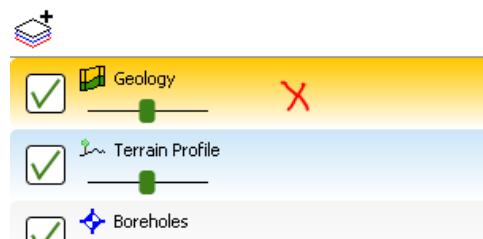


## Drawing Geology

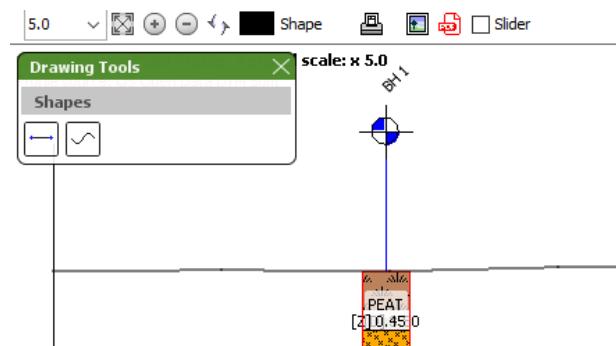
Geological interpretation is drawn into the **Geology** layer. The **Geology** layer is added to cross-section windows by default, but if you can't see it then you can re-add it.



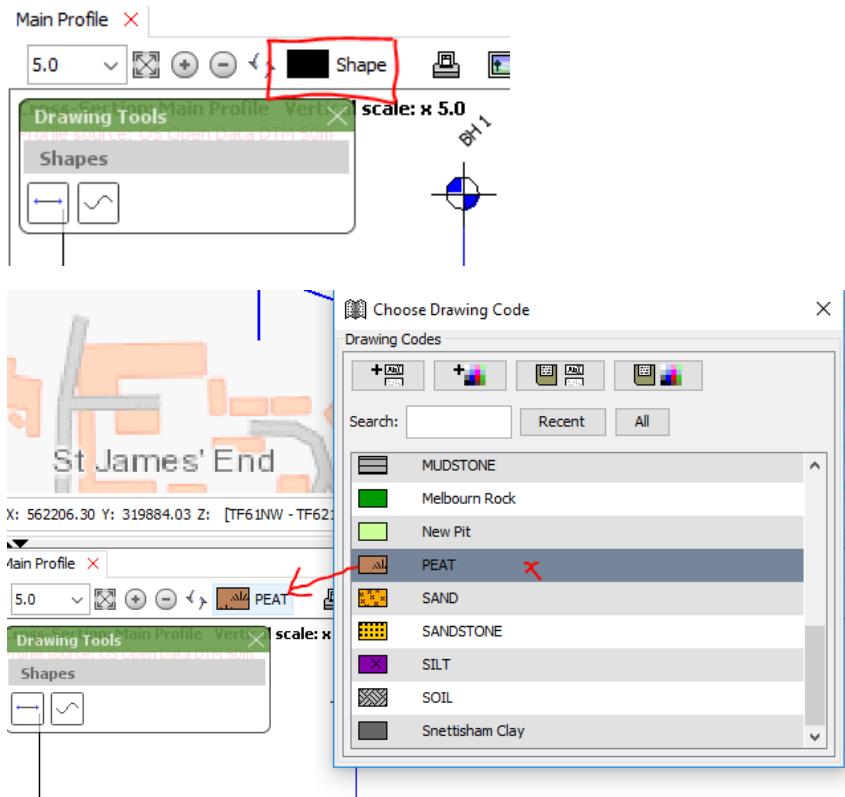
Make the Geology layer the active layer by clicking on it. It will turn orange when it is active (to de-activate it, click on it again).



When the Geology layer is active the drawing tool palette will appear in the graphics panel, with the polyline and pen tools available.



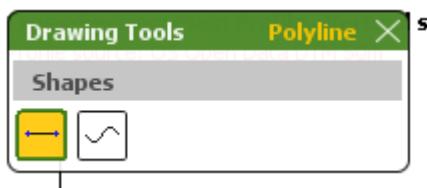
Before you start to draw geology you need to select a drawing code. The default drawing code is a generic code labelled "Shape". Instead, you need to select a geology code. Click on the drawing code selector button and pick a geology code from the list.



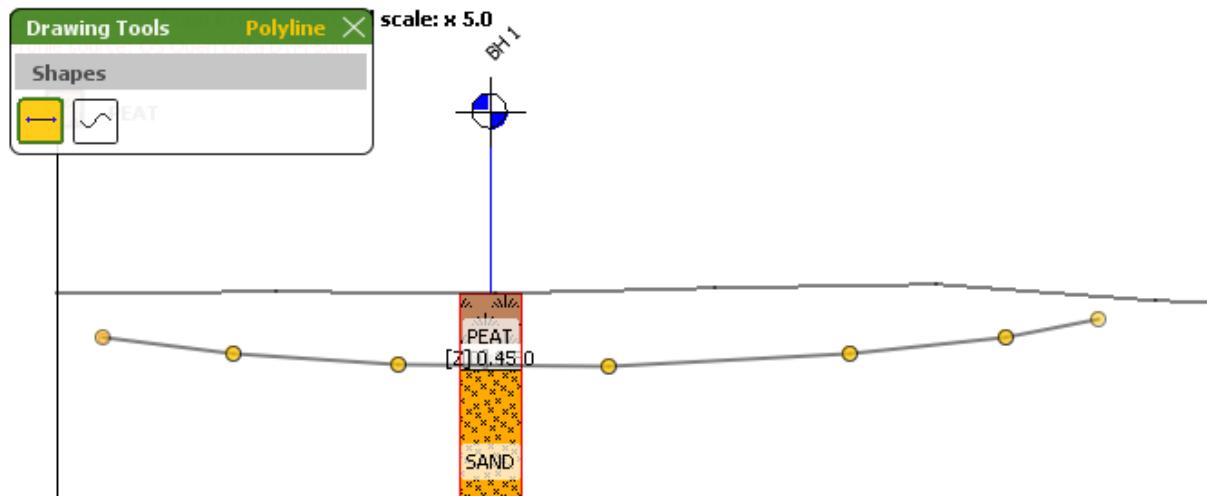
Note that the drawing code you select is then set as the active code and the button changes to display that code. In the above example, PEAT has been selected.

#### Polyline Tool

The polyline tool allows for accurate digitizing by placing each vertex individually. Click the button in the drawing tools palette to activate the polyline tool. When it is active it will turn orange.

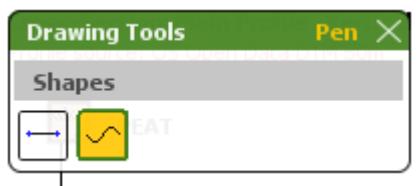


Single-click in the section to place vertices. Double-click to finish the line. Switch the polyline tool off when you are done drawing by clicking on it again in the palette.

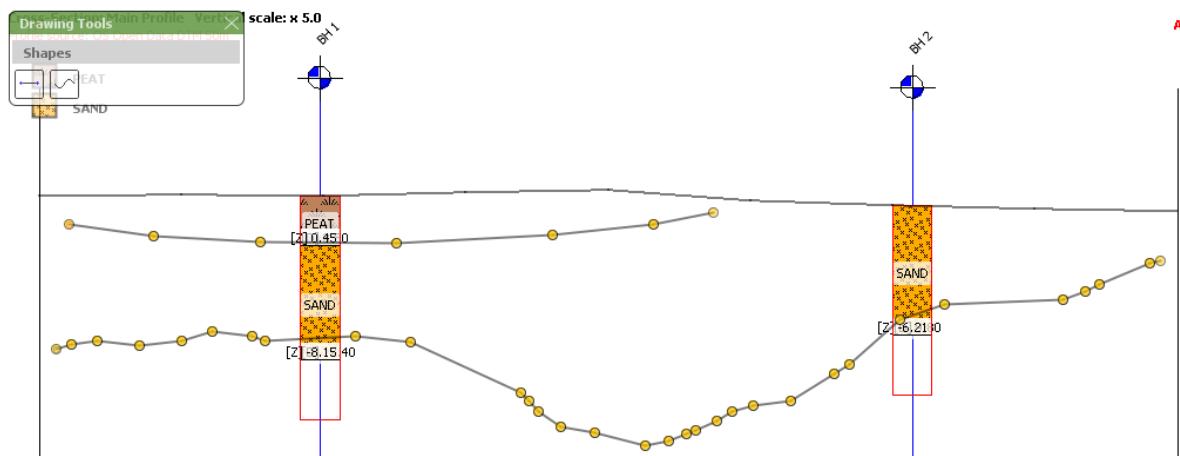


### *Pen Tool*

The pen tool allows for rapid, fluid drawing. Click the button in the drawing tools palette to activate the pen tool. When it is active it will turn orange.



Click and hold at the start of the line and drag the mouse to draw. Release the mouse button to stop drawing the line. When you are done drawing, switch off the pen tool by clicking on it again in the palette.



To re-shape a line, click on it to make it active (vertices turn green) and then drag any of the vertices to re-shape. Double-click on a vertex to delete it. Double click on a line segment to insert a new vertex.

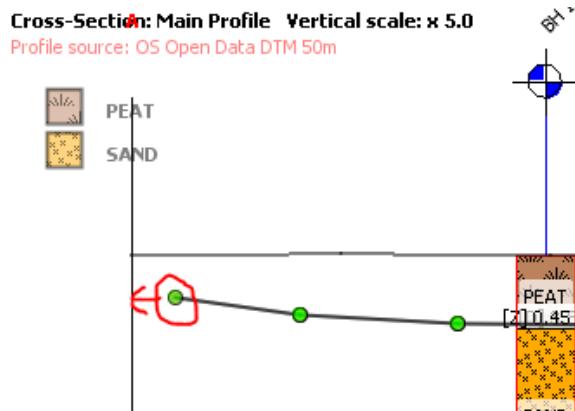
### *Snapping Geology Lines*

To begin with, just draw approximate lines when correlating the geology. Once you have drawn a line you then need to snap it to other lines in the section in order to get it to colour up as polygons. There are a few rules to follow and you need to remember that Groundhog treats geology lines as deposit BASES, not tops. When snapping, you can -

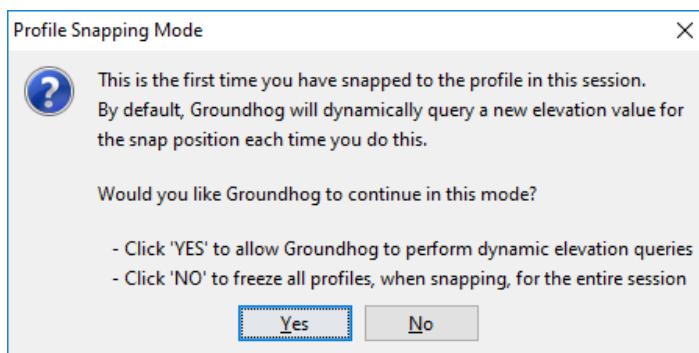
1. Snap the end of lines to the edges of the cross-section,

2. Snap the end of lines to the topographic (terrain) profile,
3. Snap the end of lines **upwards** onto other correlation lines (because the lines are deposit bases).

To snap the end of a line to something else, first make the line active by clicking on it. When the line is active its vertices will turn green. Once active, drag the vertex at each end of the line towards another line, based on the three rules listed above.



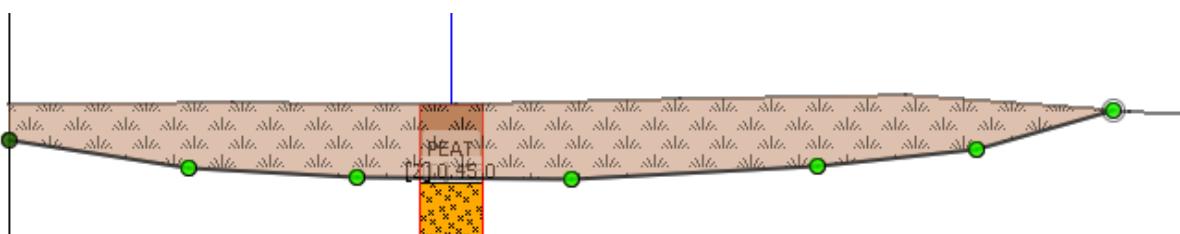
If you snap the end of a line to the terrain profile, you will be prompted like this. Click <No> if you just want to keep a static profile, or <Yes> to sample more accurate Z values from the terrain grid at the snap location.



A special icon will appear at any snap positions.

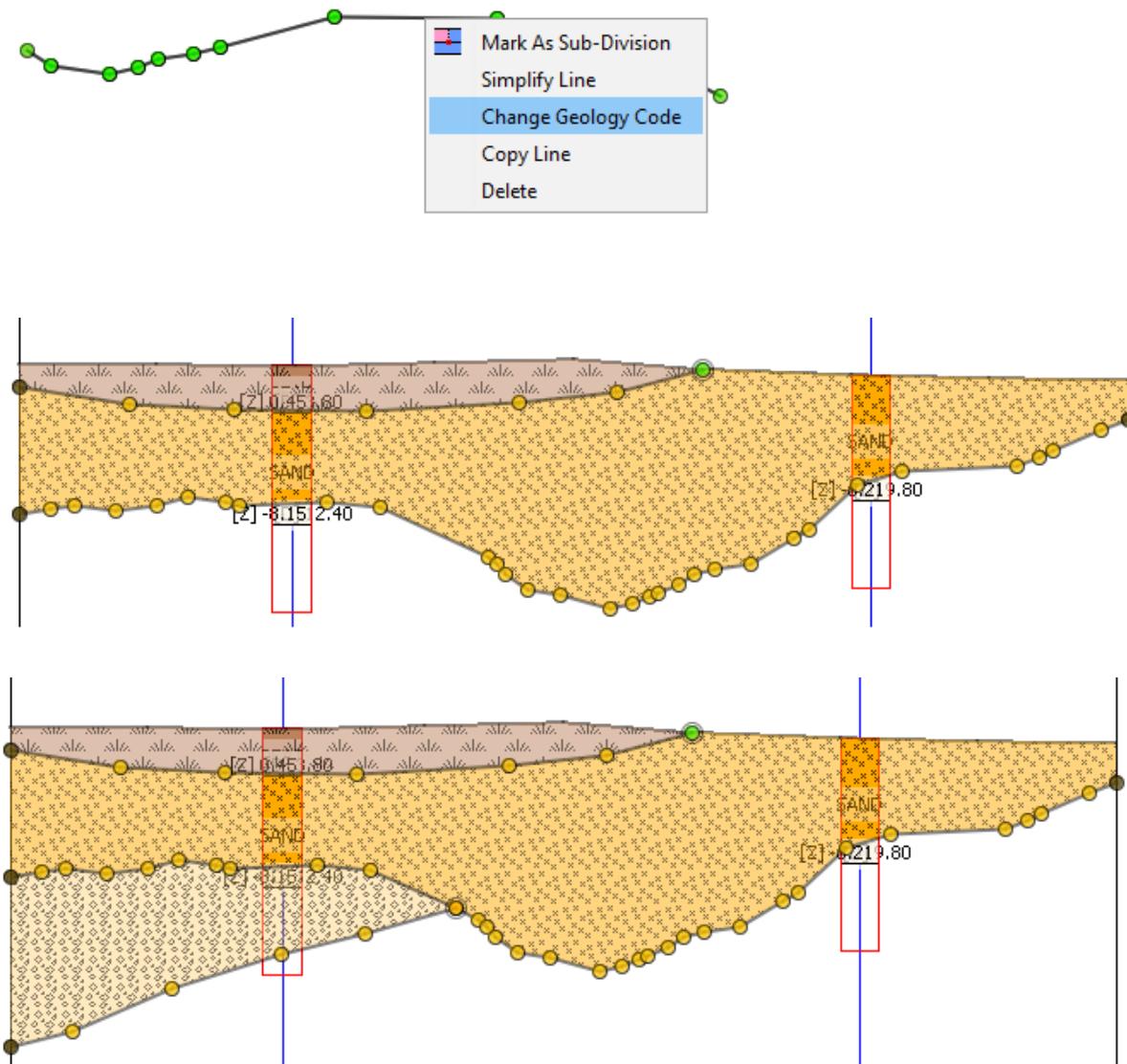


When both ends of a geology correlation line are snapped to something, the polygon builder will create a filled polygon for the deposit.

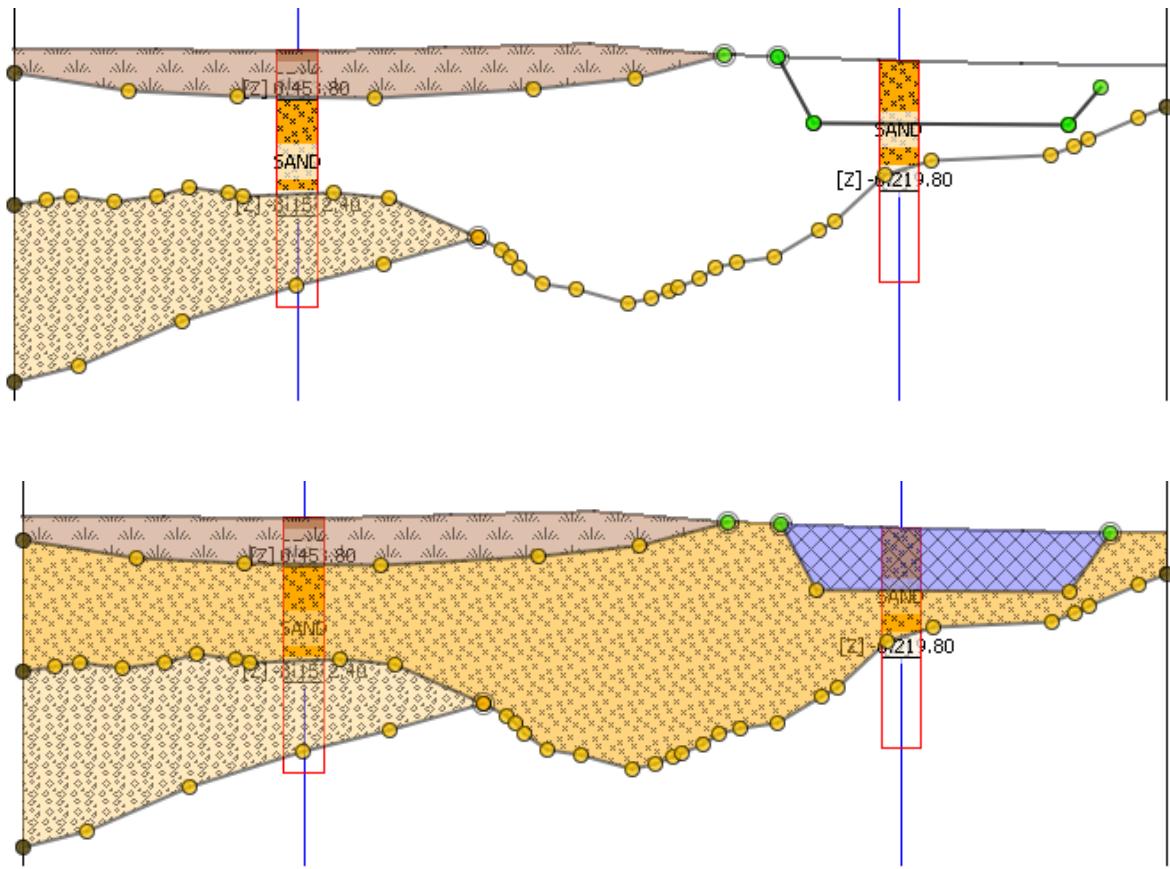


Click away from the active line to de-activate it. Continue drawing and snapping to build up the cross-section. Remember to select the appropriate drawing code before drawing each

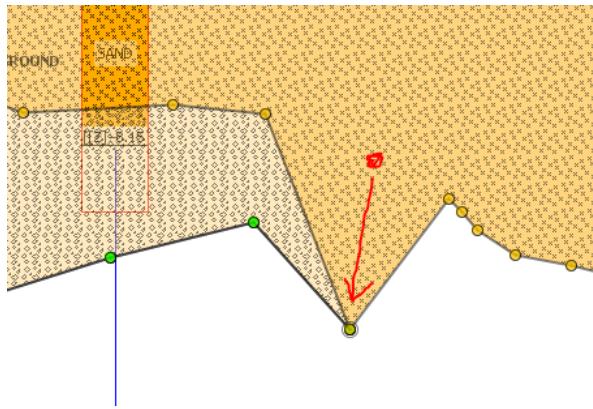
line. If you forget, make the line active by clicking on it then use <right-click> <Change Geology Code> and type in the new geology code.



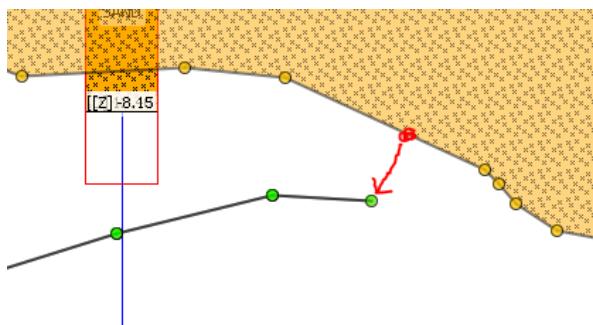
Don't worry if some existing polygons fail to render as you continue drawing. They should resolve themselves as soon as you snap the line you are working on. For example –



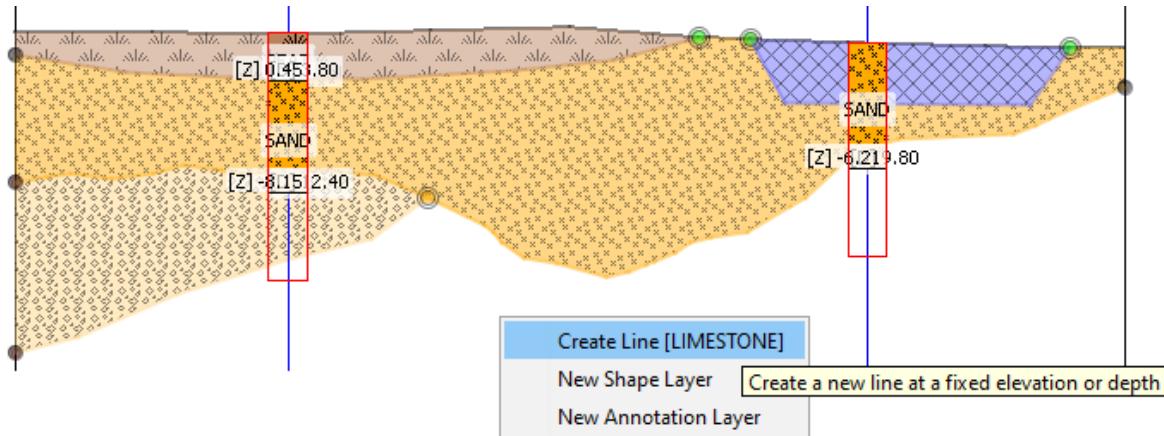
Moving any snapped positions will cause an edit to both correlation lines (except at the topographic profile).



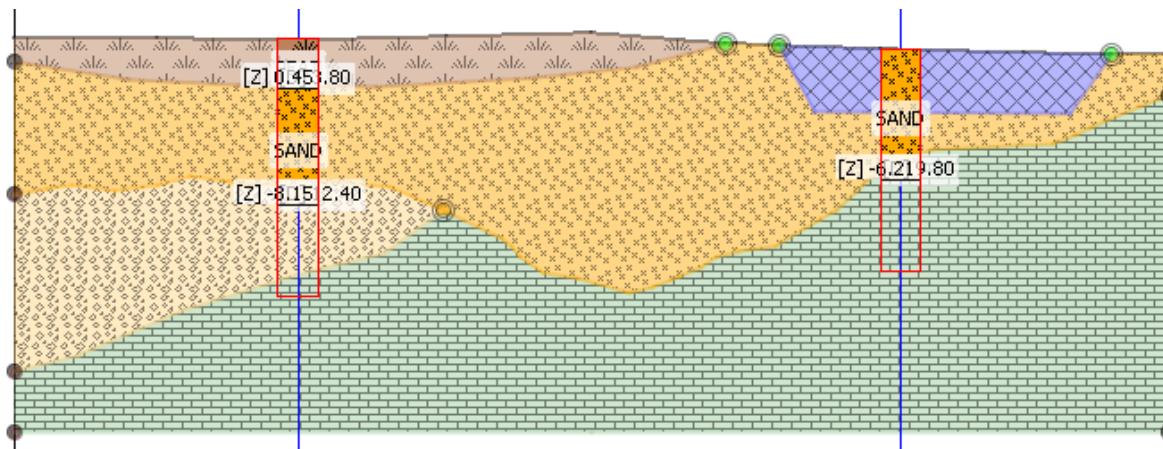
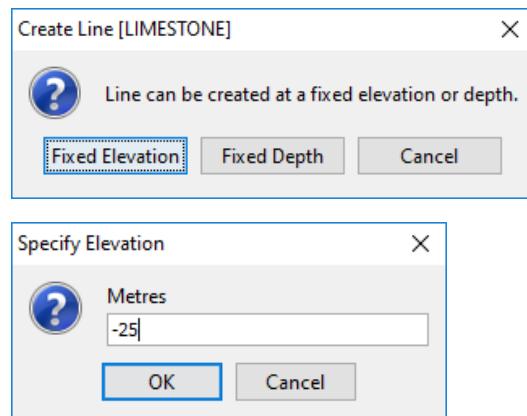
If you need to un-snap a snap location, hold the CTRL key as you drag the node away from the snap location.



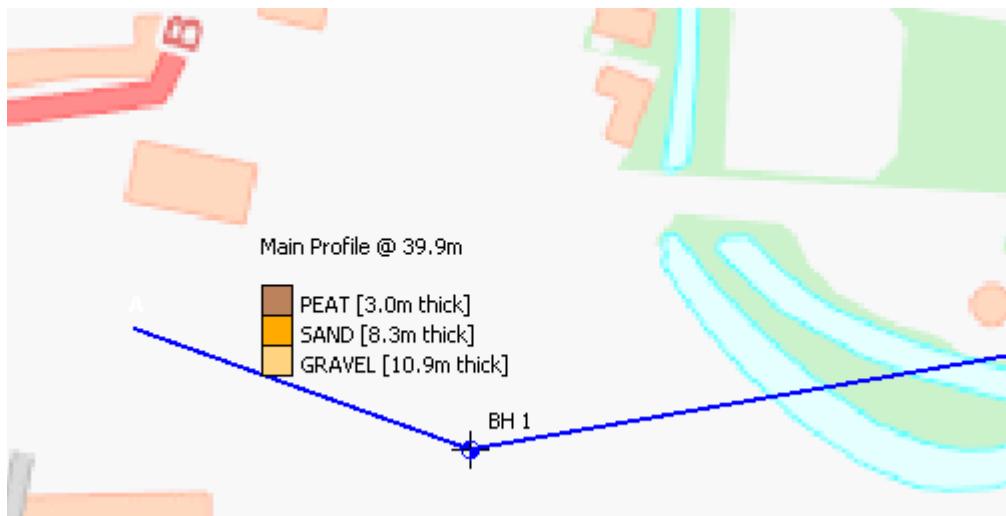
Create a correlation line at a fixed elevation using <right-click> <Create Line [DRAWING CODE]> anywhere in the panel.



Choose the datum (O.D. or DEPTH).

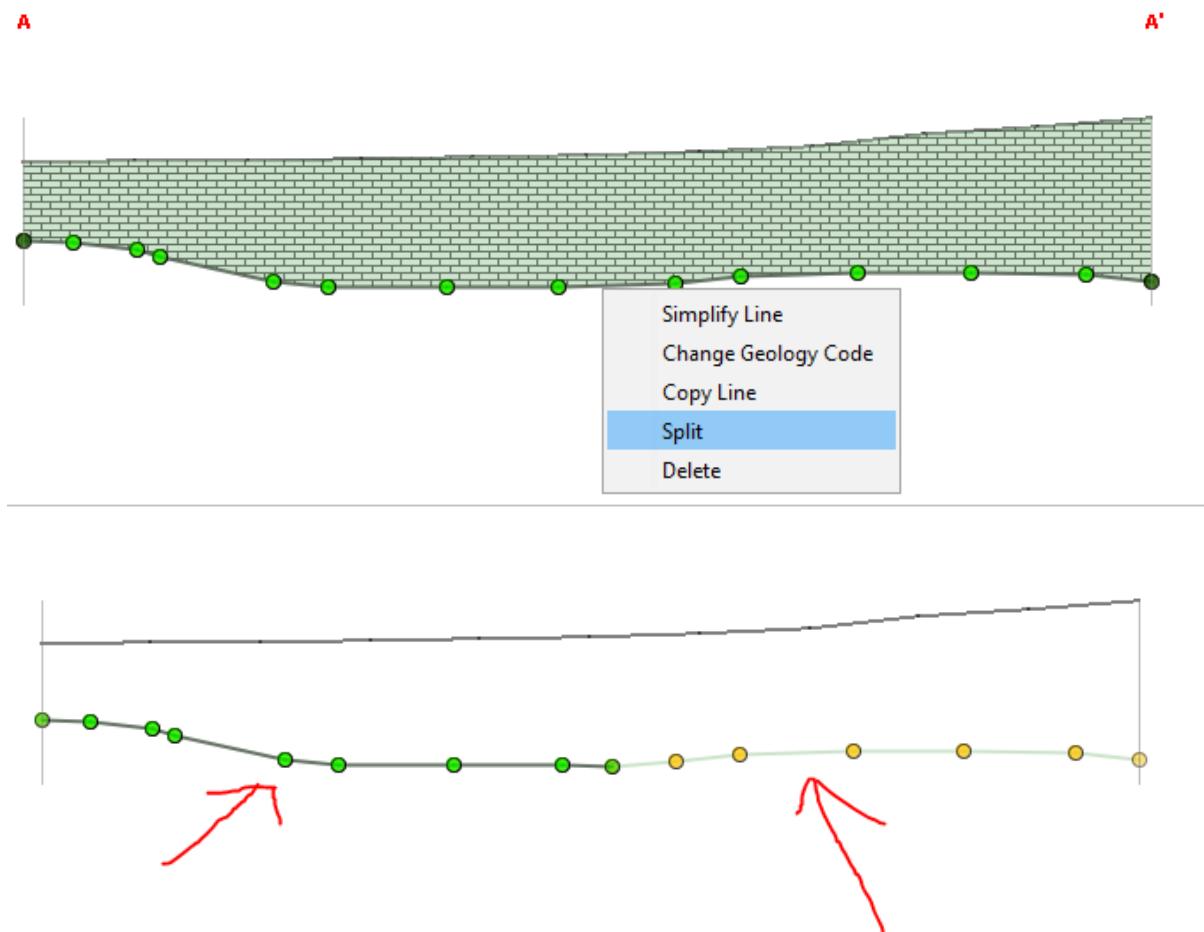


The geology that has been drawn into a cross-section can be previewed rapidly in the map by holding the SHIFT key and hovering over the alignment. If there is geological line-work at that location the sequence and thicknesses will be shown in a schematic image.



## *Split Geology Line*

A geology line can now be split into two lines by right clicking on the line at the position where it should be split and selecting **<split>**



In order to move the new node that has been placed in the split position, you will need to hold down the CTRL key, to prevent the two lines from re-joining together.

# Developing Conceptual Site Models

This section provides details on how to develop a conceptual model based around your site data within Groundhog.

*Professional*



*Photo by Shane McLendon on Unsplash*

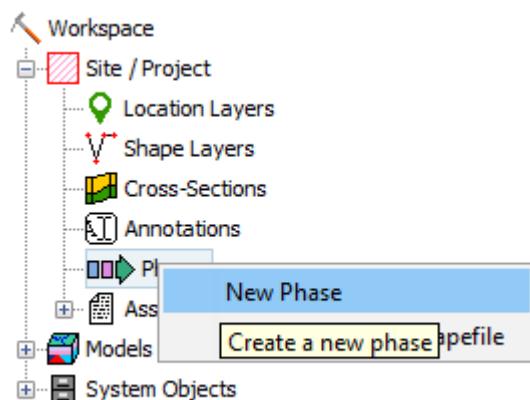
## Introduction

With a **Professional** license, you can use Groundhog to develop site conceptual models (CSM). A CSM in Groundhog is a digital representation of the pathways, or linkages, between contaminants, sources of contaminants, the potential receptors and the migration pathways that connect them. The CSM exists as a separate data structure or layer on top of the Groundhog project and allows you to integrate your conceptual understanding of pollutant linkages, for example within a catchment or a site, with the available site data and geological interpretation.

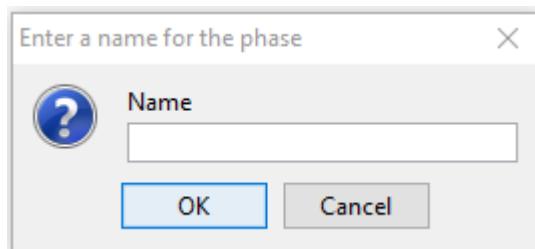
**Professional**

## Constructing the Data Model

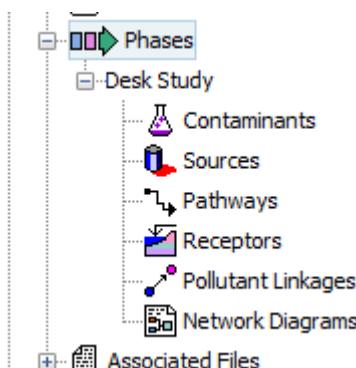
A CSM is attached to a notional project “Phase”. This allows you to develop separate models for different phases of a project, for example desk study, remediation, monitoring. Create a Phase object to contain the CSM using on Phases Folder.



Enter a name.



This initializes a CSM structure in the object tree as a series of folders, one per component type within the CSM.



The available CSM component types are;

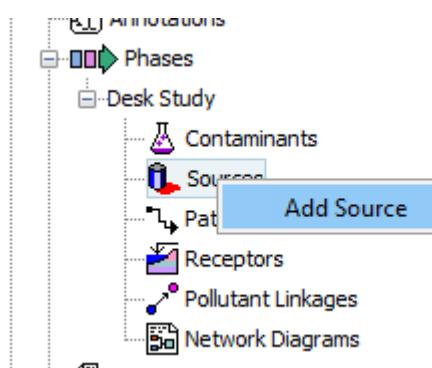
1. Contaminants

2. Sources

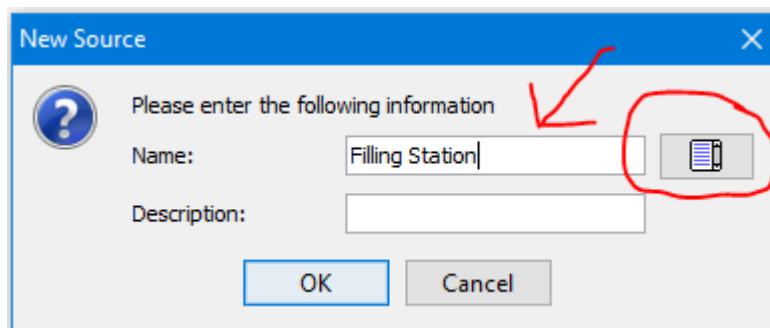
3. Pathways

4. Receptors

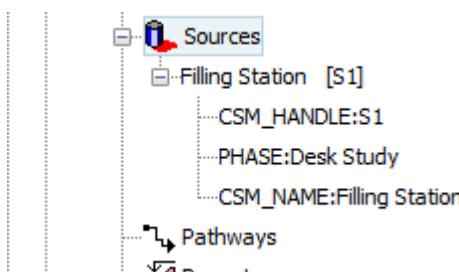
Create any one of these using <Right-click> on the appropriate folder <Add [Component Type]> for example <Add Source>.



Enter a name for the component and an optional description. You can also use the picklist key to browse a list of pre-set options.

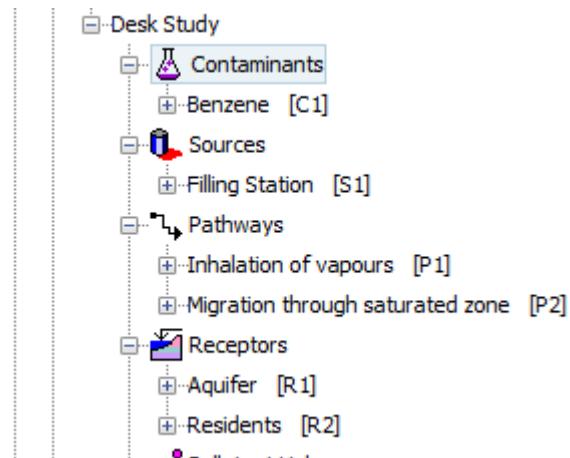


The component is added to the folder. In this case, expanding the new source object reveals a series of attributes.



The CSM\_HANDLE is the unique ID attributed to the component in the system.

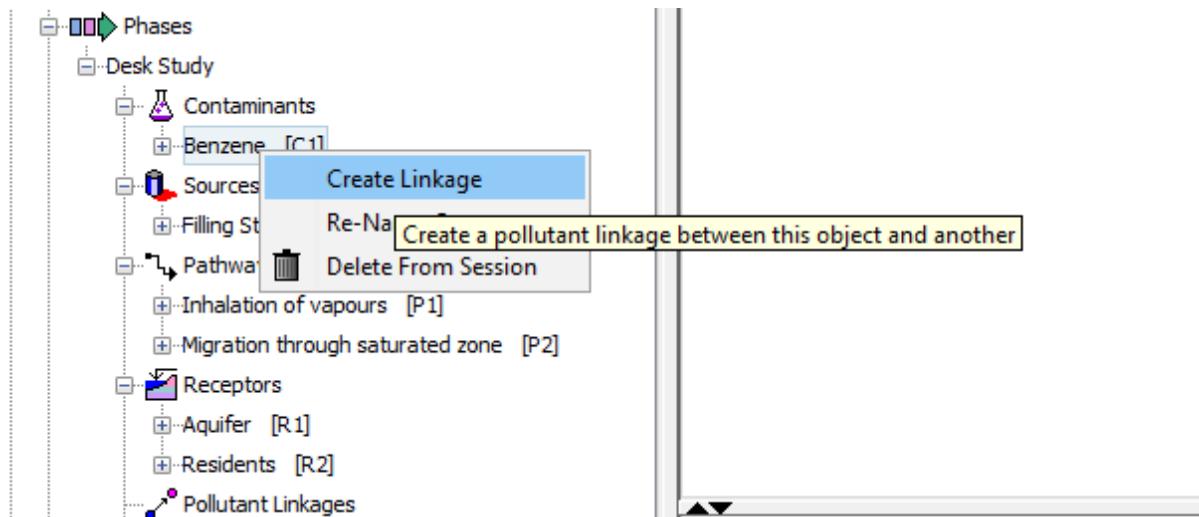
Continue adding as many components as you wish to the model.



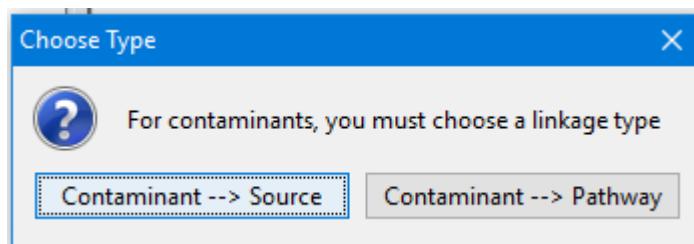
## Creating Pollutant Linkages

With the desired model components in place you can now define the pollutant linkages within the system. On any model component to create a linkage to or from that linkage.

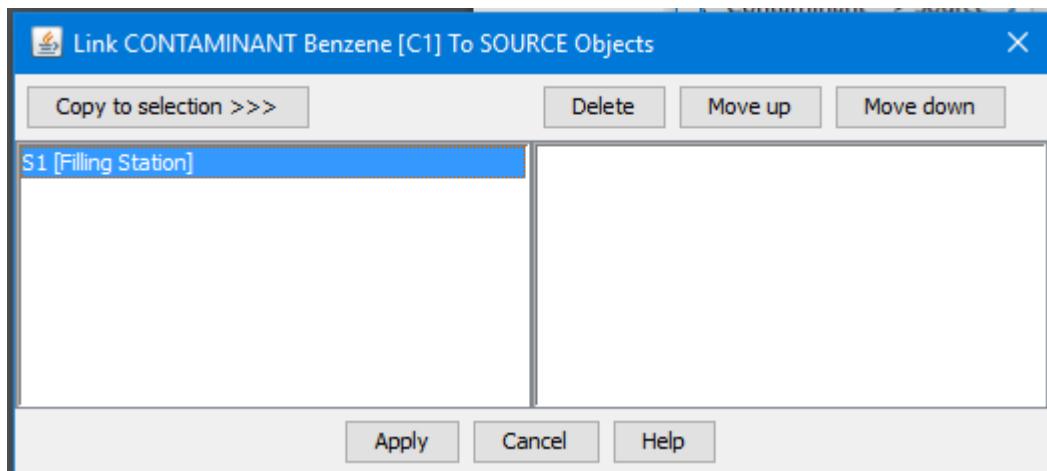
Here we link the contaminant "Benzene" to the Source "Filling Station".



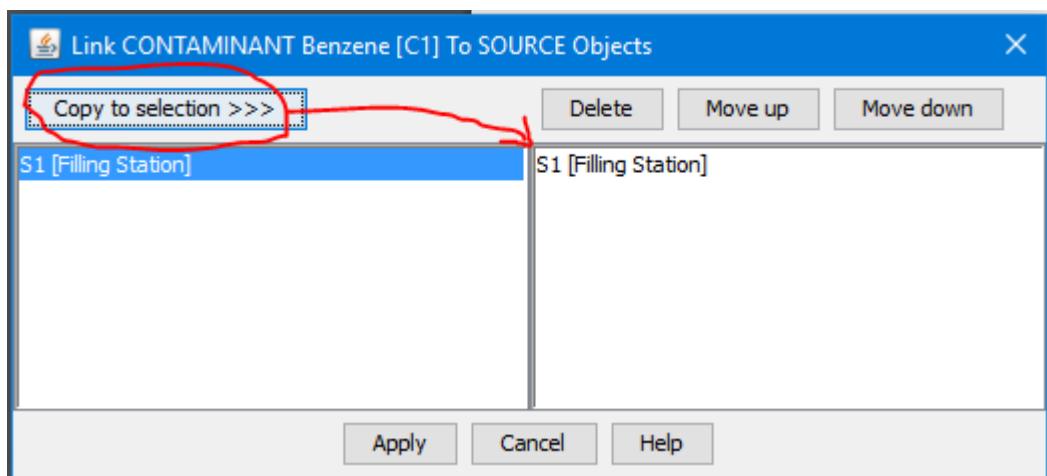
Click <Contaminant -> Source> button.



Highlight the Source component you wish to link to the Benzene contaminant (in this case, there is only one, "Filling Station").



Click <Copy to selection >>> to add “Filling Station” to the panel on the right and click <Apply> to create the linkage in the data model.

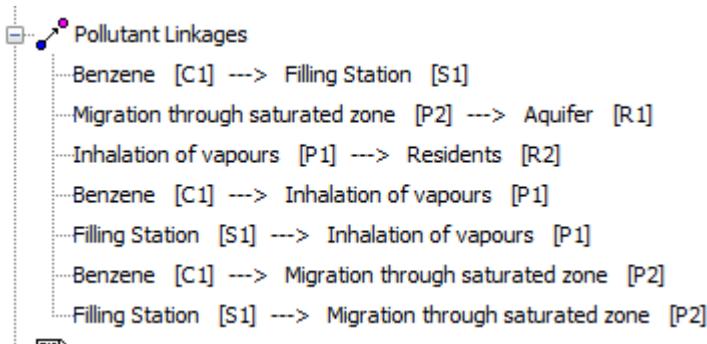


Continue in this way, creating all of the conceptual linkages within the model. You can create the following types of linkage;

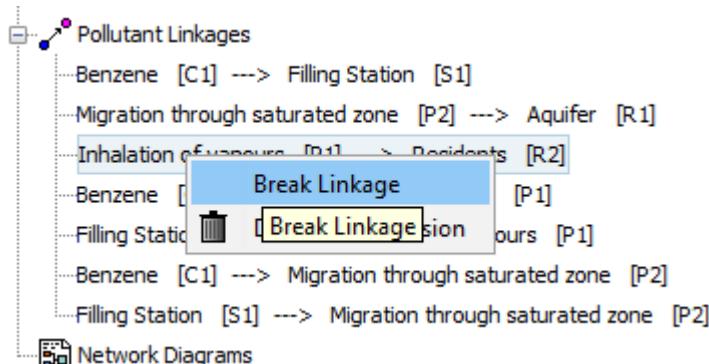
- Contaminant ◊ Source – a linkage between a particular source component and its potential contaminants.
  - **Contaminant -> Pathway** – linkages which describe how particular contaminants are able physically to migrate.
  - **Source -> Pathway** – linkages which show how particular sources are connected to particular migration pathways.
  - **Pathway -> Receptor** – linkages which show how particular pathways are connected to particular receptors.

Note that the linkage dialog will only present the currently available options for creating new links. If no further linking is possible a warning message will be displayed.

The linkages are displayed in the Pollutant Linkages folder.

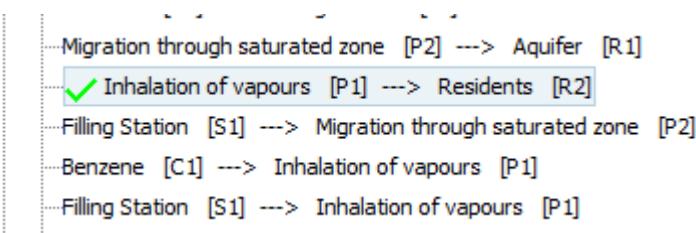
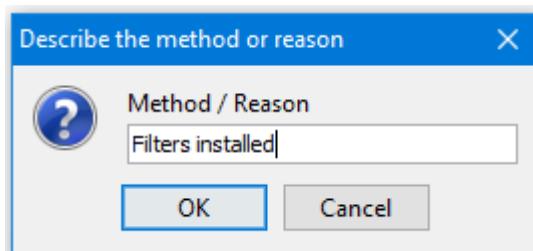


<Right-Click> on a linkage to delete it. You can also “break” the linkage, which allows you to record information about how the linkage has been broken within the conceptual model.



When a linkage is broken it shows that it has been addressed and will display with a green tick mark. Hovering over the linkage will display the description of the break. The break can be removed using

<Right-Click><Un-break Linkage>.



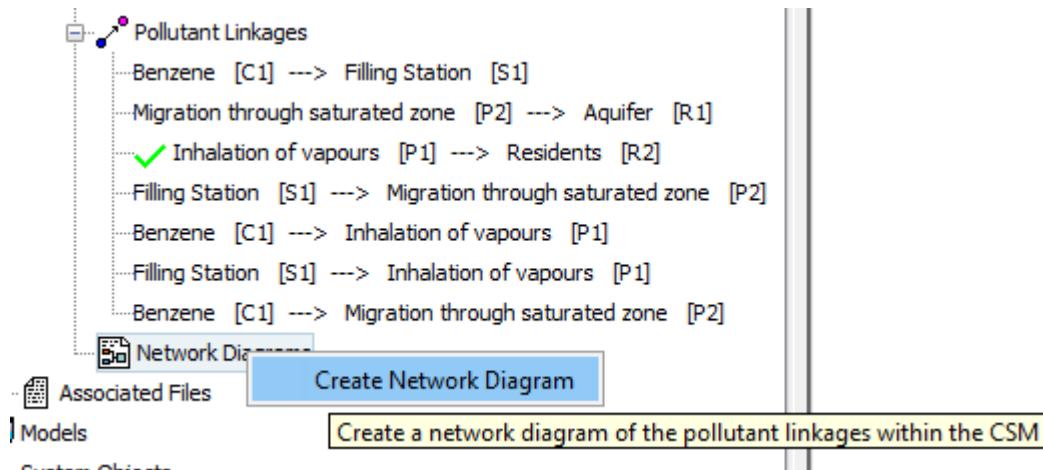
**IMPORTANT:** note that if you decide to delete a CSM component that is used by any of the linkages, all of those linkages will also be automatically deleted from the model.

## Displaying a Network Diagram

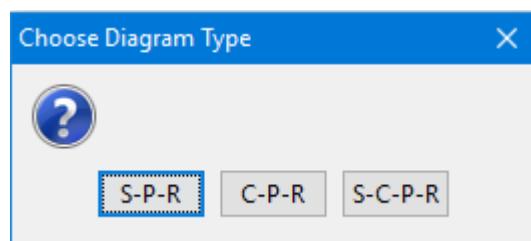
With the conceptual model data structure in place, and the pollutant linkages configured, you can create network diagrams automatically. Network diagrams show schematically and

conceptually how all of the components of the model are connected in terms of pollutant linkages.

<Right-Click> on the Network Diagrams sub-folder of the CSM structure in the object tree and click <Create Network Diagram>.

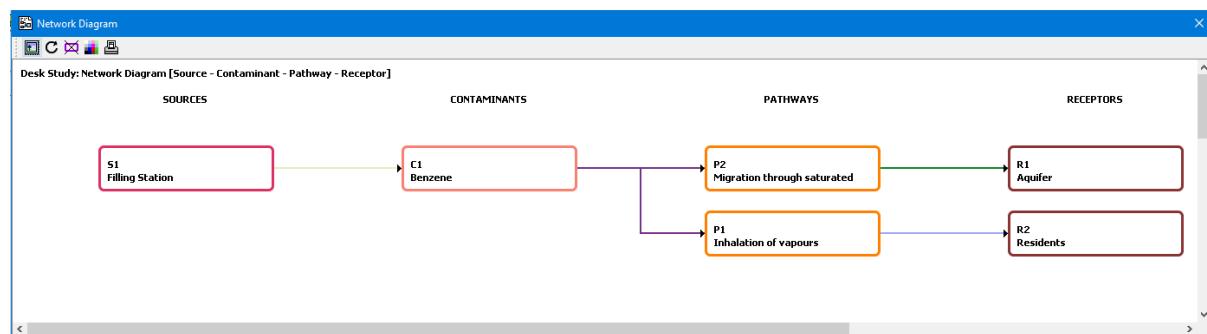


There are three types of diagram to choose from.

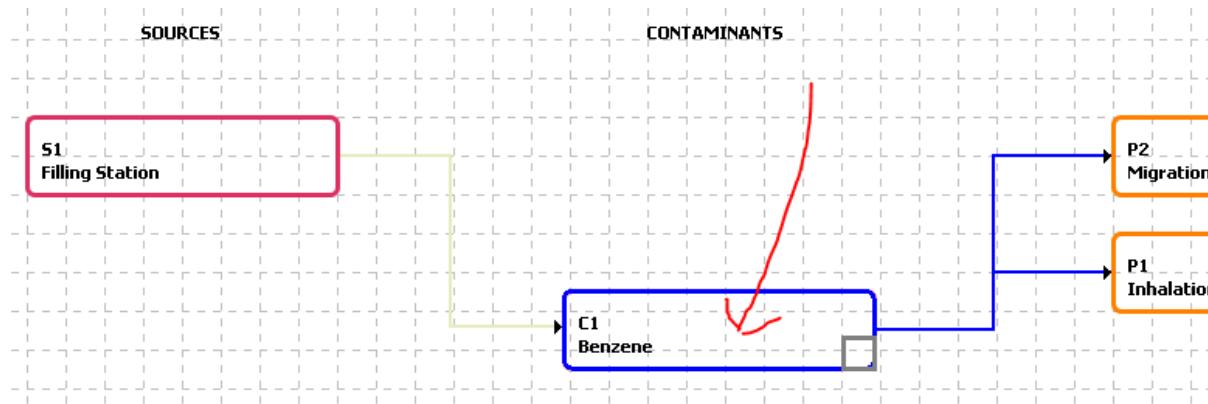


1. S-P-R – Source-Pathway-Receptor
2. C-P-R – Contaminant-Pathway-Receptor
3. S-C-P-R – Source-Contaminant-Pathway-Receptor

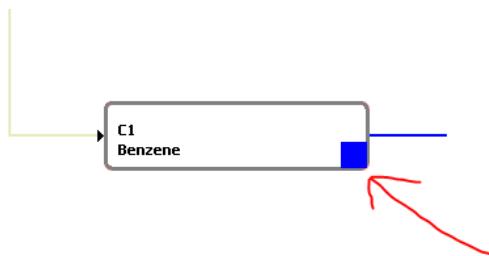
Here we show an S-C-P-R diagram.



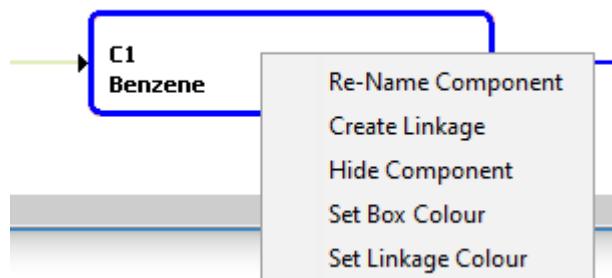
Drag the component boxes and the labels around as desired.



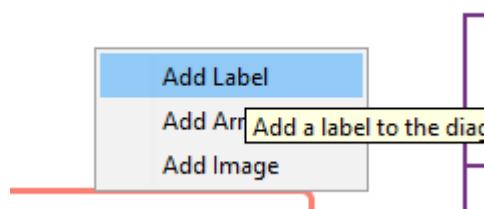
Use the handles in the bottom-right of each box to re-size.



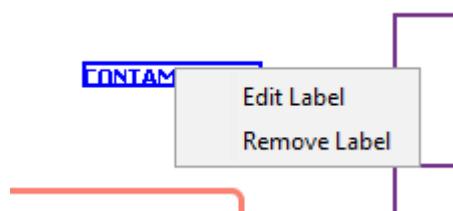
<Right-Click> in a CSM model component box to edit settings like colour and to create new linkages.



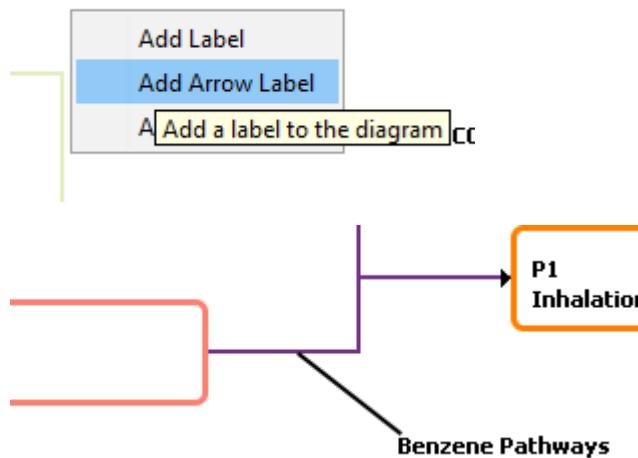
<Right-Click> <Add Label> in any whitespace region of the panel to create new text labels.



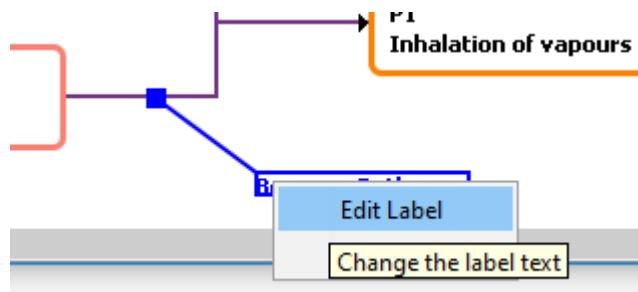
<Right-Click> on individual labels to edit the text or delete the label.



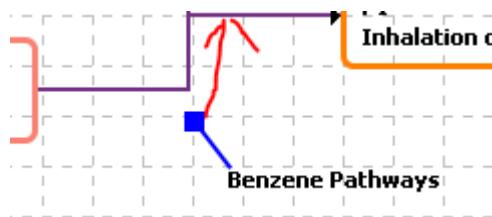
<Right-Click> <Add Arrow Label> in any whitespace region of the panel to create new labels which will be attached to a line, which can be used to point to the required linkage arrow.



<Right-Click> on the label to edit it

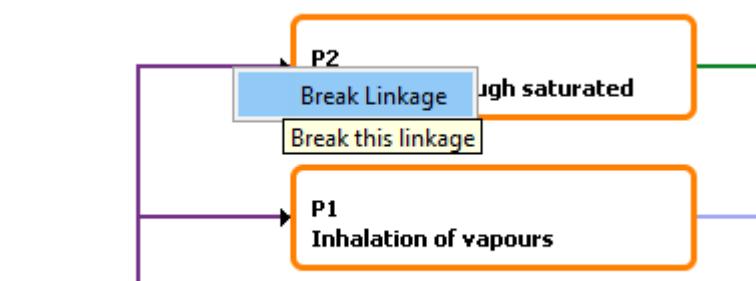


Click and drag the blue box at the end of the line to move it

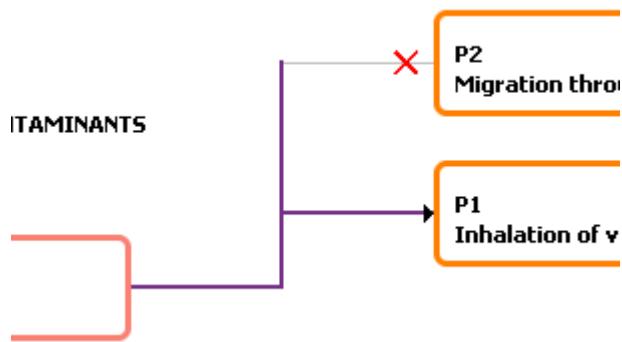


Note the **Add Image** option does not currently work.

<Right-Click> near to the end of a linkage, close to where it enters the next component box and select <Break Linkage> to break the linkage in the system.



Broken linkages display as partial grey lines with a red cross on them.



You can un-break a linkage using <Right-Click> <Un-break Linkage>.

**IMPORTANT:** at the moment, network diagrams are not saved as part of the project. Once you have the diagram looking how you want it, make sure to export it as an image for use in reports.

The following buttons are available in the network diagram toolbar.

	Export Image	Save a copy of the diagram to JPEG or PNG format image.
	Refresh	Re-builds the diagram, picking up any new CSM model components that have been added and removing those that have been deleted.
	Hide components	Hides any non-linked CSM model components from the diagram.
	New colours	Allocates new, random, colours to the linkages. Useful if the default colour scheme is undesirable.
	Print	Send the diagram to a printer.

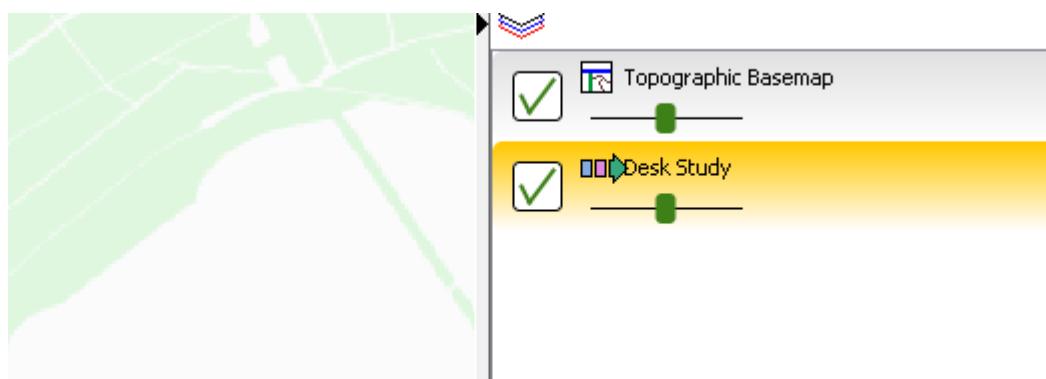
## Drawing CSM Objects in Map and Cross-Section

Certain objects that you draw or place into both map and cross-section can be tagged as being related to CSM model components. For example, you could draw the boundary of a landfill and attach it to the landfill object in your CSM.

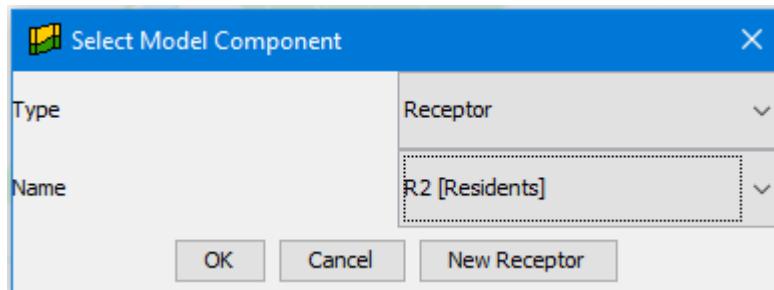
More details on how to use the drawing tools please refer to the chapter on **Drawing Points, Shapes & Annotations**.

### Shapes

First, add the Phase object to the window (map or cross-section) as a layer and click on it to make it active. The layer will turn orange when it is active.

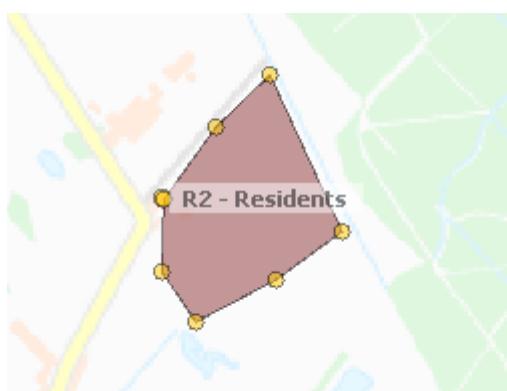


Once active, the drawing tools will appear allowing you to draw into the Phase layer. Draw a shape into the layer. When you double-click to finish the shape you will be prompted to tag it as a CSM model component. All shapes drawn into Phase layers MUST be tagged with a CSM model component.



If you have drawn a polyline, you can make the line active and then snap the two ends together to form a polygon.

The shape will adopt the default colour for the component type (in this case receptor colour) and a label with the name of the component will appear. The example below show a polygon drawn to indicate the extent of a proposed residential development.

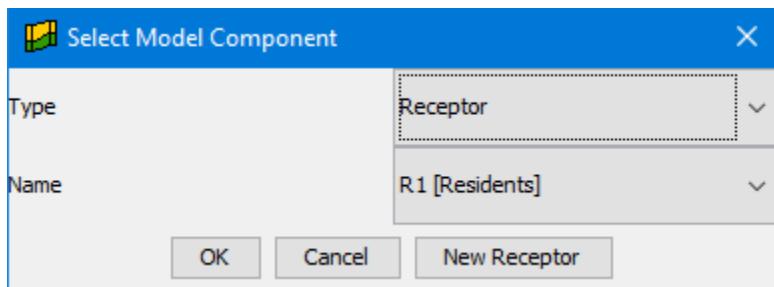


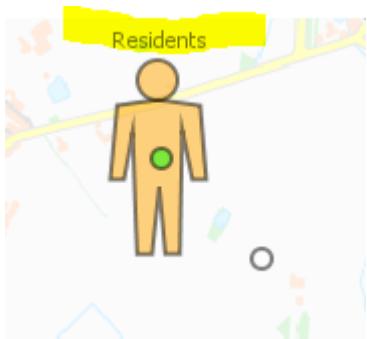
### Annotations

You can also tag picture objects and arrows in annotation layers as CSM model component objects.

### Pictures

When a picture is added, if a Phase exists within the session, you will be prompted to tag the picture with a CSM component. Pressing <Cancel> on this prompt results in the picture being added with no tag.

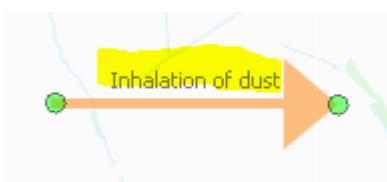




A picture can also be tagged with a CSM component after it has been added to the Map or Section window. To do this, with an annotation layer active, <Right-Click> on the centre node of a picture object and select a component type from the <Site Investigation> menu.

### Arrows

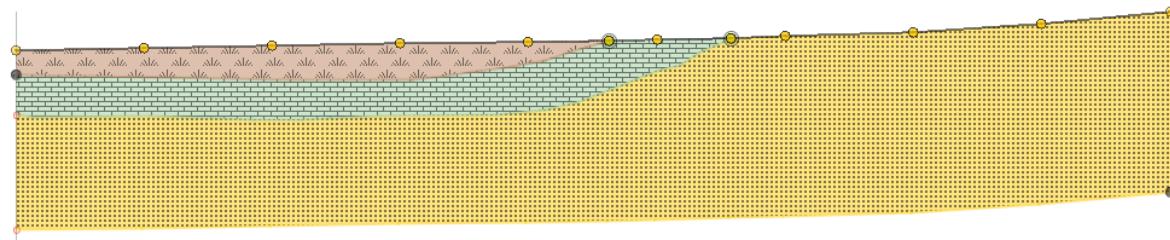
Arrows work in the same manner as pictures, in that they can be tagged with a CSM component when they are added, or after they have been added. To do this, with an annotation layer active, <Right-Click> on the first node of an arrow object and select a component type from the <Site Investigation> menu.



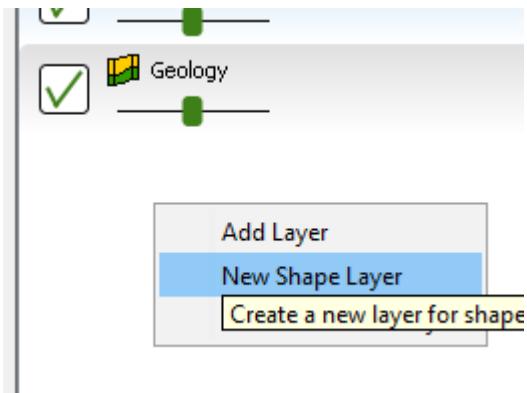
### Drawing Water Levels and Defining Aquifers

Special tools have been added to allow the definition of aquifer layers in drawn cross-sections and a water level can also be superimposed to define the saturated zone.

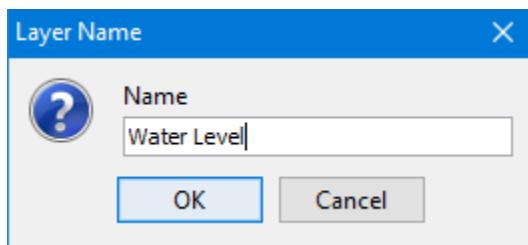
First, draw the geology into the cross-section.



To draw the water level, create a new shape layer in the cross-section using <Right-Click> <New Shape Layer> in the layer control panel.

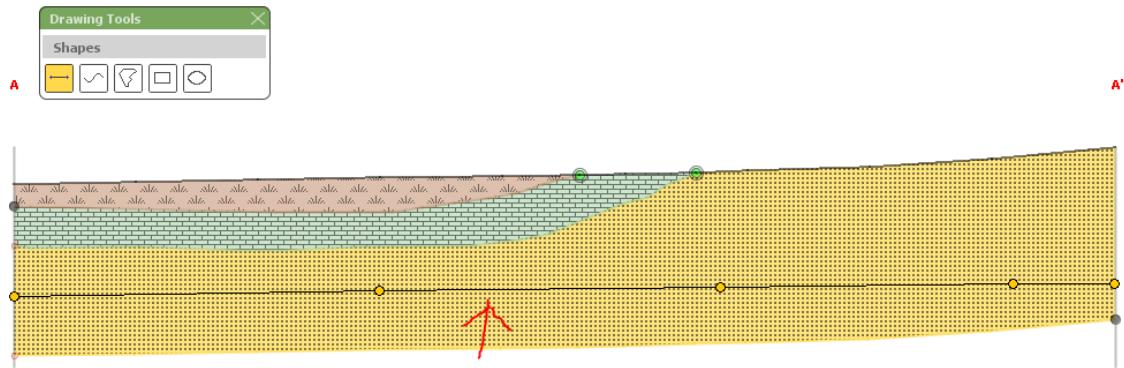


Enter a name (the name is not important).

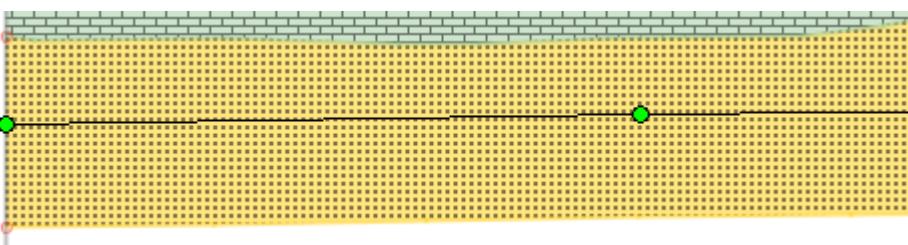


The layer will be added and will become active automatically so that you can draw into it. Pick up a drawing tool and draw the water level.

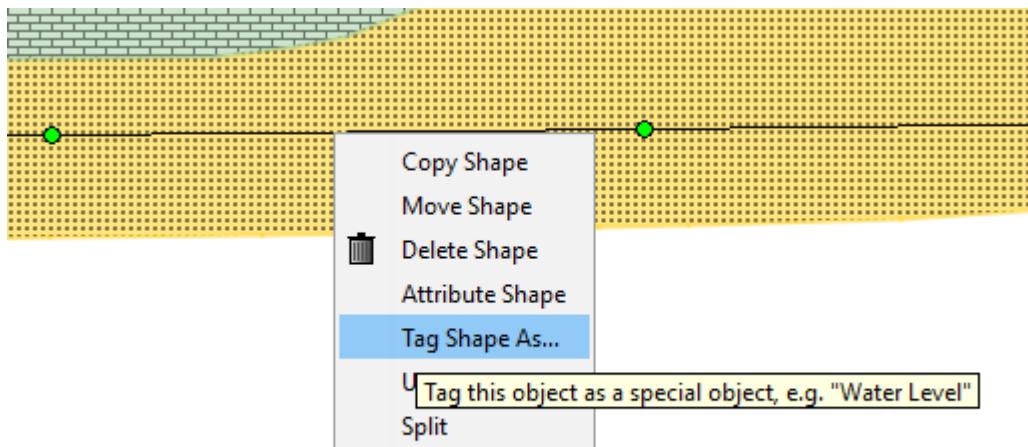
Cross-Section: s1 Vertical scale: x 1.0 (DEFAULT)  
Profile source: OS Open Data DTM 250m



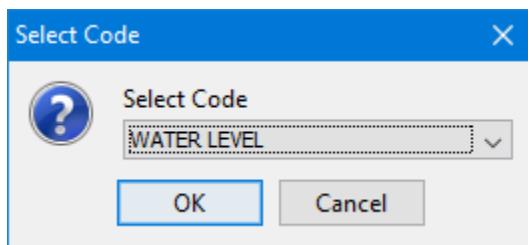
Switch off the drawing tool and click on the line to make it active. When it is active the line vertices will turn green.



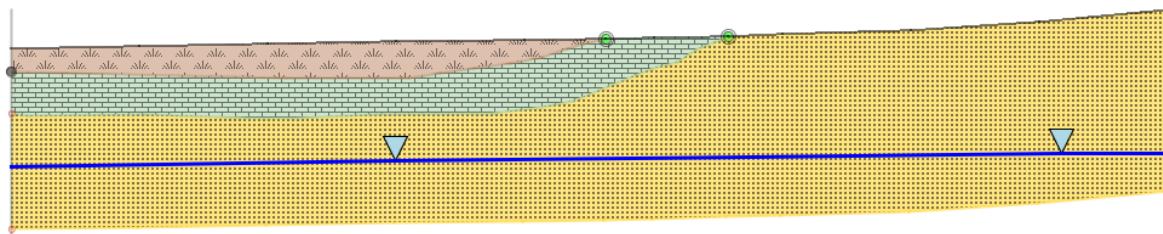
<Right-Click> on the line and select <Tag Shape As...>



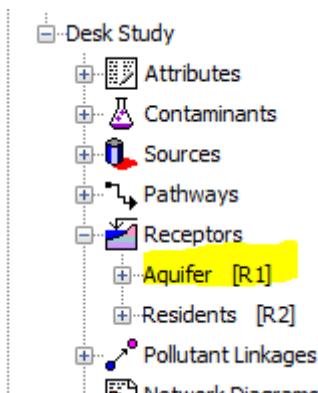
In the options that appear, select “WATER LEVEL”.



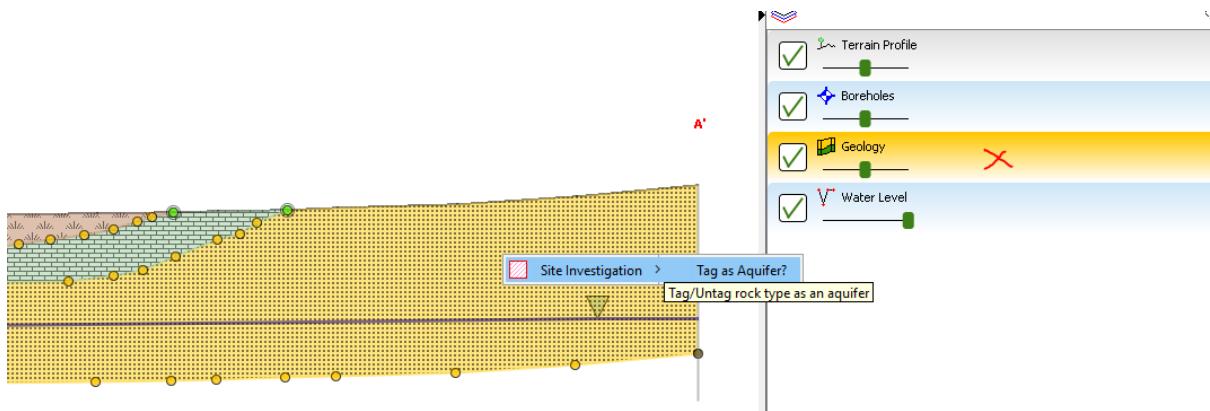
De-activate the shape layer in the layer control. The water level line will appear styled in a particular way to denote water level.



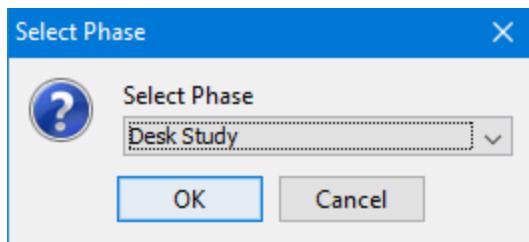
Next, you need to tell Groundhog which geological unit is the aquifer unit. This is linked to the CSM, so you will need to make sure you have an aquifer model component defined (i.e. as a receptor component) within the model.



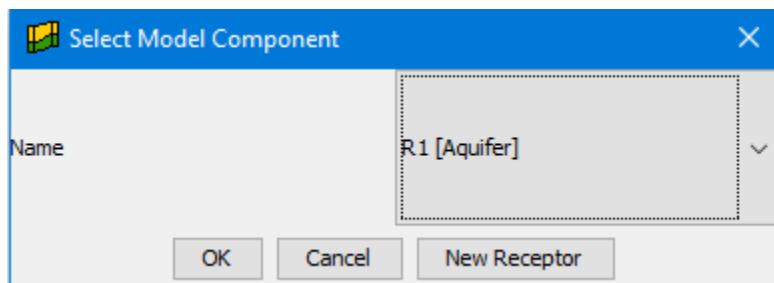
Make the Geology layer active in the layer control. <Right-Click> in the cross-section on the geological unit that corresponds to the aquifer and select <Site Investigation> <Tag as Aquifer?>.



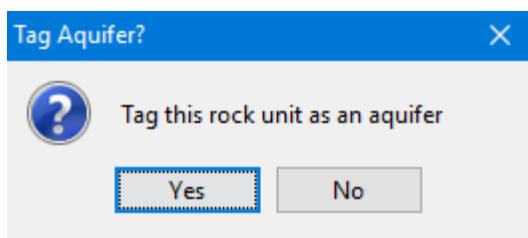
Select the Phase.



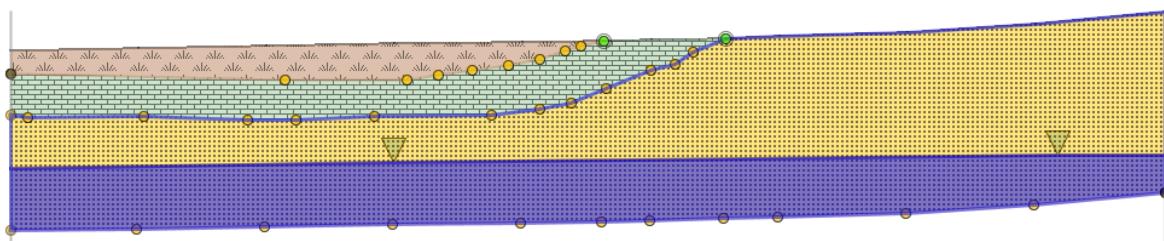
Select the aquifer from the list of receptors.



Click <Yes>



The aquifer unit will be outlined in blue and the saturated zone shaded in blue. Use the transparency of the Geology layer to get the best image.



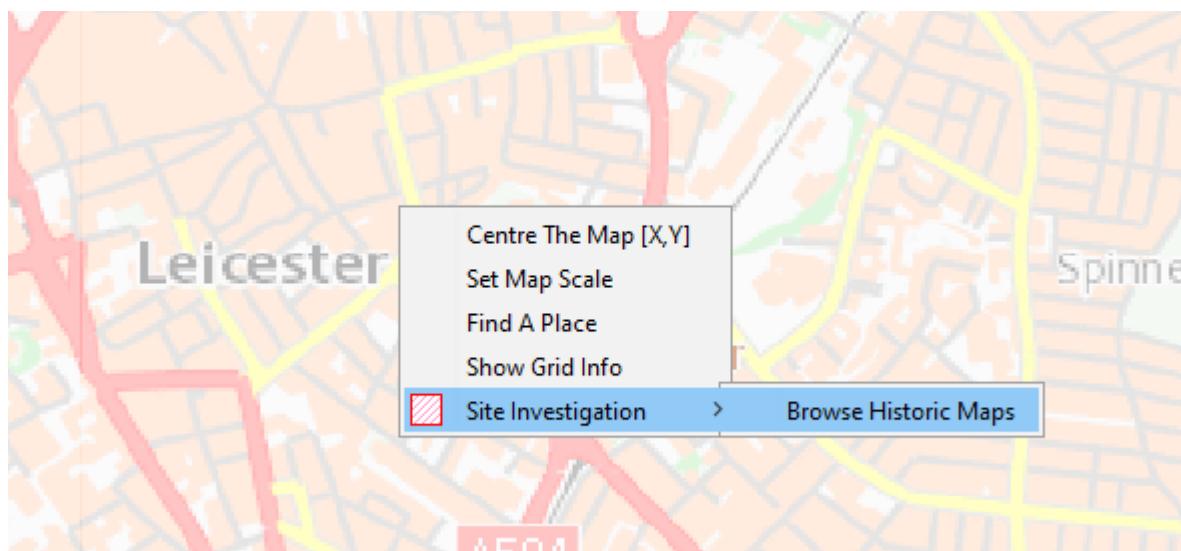
## Accessing Historic Maps

Historic maps are important in contaminated land and brownfield site studies because they provide insight into the historic land use. To help with this, Groundhog has a hyperlink functionality that will take you to the website of the National Library of Scotland, which has an archive of high-resolution scanned historic maps for the UK.

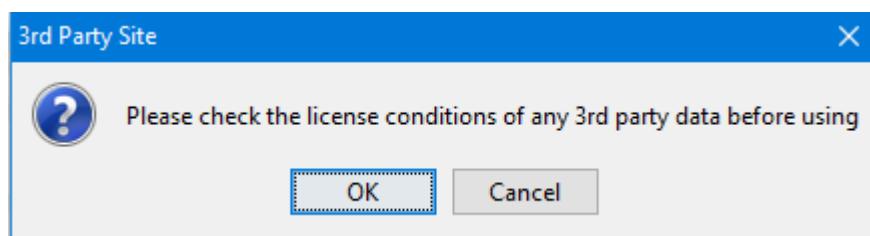
<https://maps.nls.uk/>

This feature is provided as a convenient 3<sup>rd</sup> party web link and in no way implies that the NLS has any connection to, or endorsement of, the Groundhog software.

<Right-Click> at the desired location in the map and select <Site Investigation> <Browse Historic Maps>.



You will be shown this message:



The NLS website should open in your default web browser. Typically, when the website first opens, an info box obscures the map view. Click the cross in the top right corner to close this.

**Find by Place - Help**

This application allows you to search for all of our online maps by their place/location.

1. Choose a map series that you would like to search by, selecting it from the drop-down lists in the left-hand panel:  
Use both 1. Select a category; and 2. Select a map / map series:

2. The map extents are shown as bounding boxes. Zoom in on your area of interest and click on it to view the map that covers this area. The extents of the map that you have selected is highlighted in blue, and a brief record and image of it appears in the right-hand panel:

3. Select this record or image in the right-hand panel to view a zoomable image or further information about the map sheet.

**Tips**

- Use the Search Gazetteer to position the map location on a particular place name. National Grid References (4, 6 or 8 figure) can also be input and the map will move to this location. You can also position the map by choosing particular counties and parishes from drop-down lists.
- Under Choose a map series, select Multiple categories / group search to search for all the map series, or for groups of series, covering a place.

Click the cross (top right) to close this window.

Don't show this message again

You should now see the historic map view zoomed to approximately the same scale and location as your Groundhog map view.

Find a place:  UK  World  
Type a placename...  
Search by National Grid Reference:  
Type Grid Ref:

Search County: Choose  
Choose a map series:  
1. Select a category: Great Britain, Ordnance Survey  
2. Select a map / map series: OS Six-inch, 1840s-1960s  
Zoom to this map / map series

Change transparency of bounding boxes:   
These series lists automatically update to those covering the map

Filter date range of map sheets:  
 1840 1960  
Zoom to selected map extents:   
Show my location:

Background map - ESRI World Topo

No map selected, please click on a coloured box on the map to the left that covers the area you are interested in

Privacy Copyright Site map Contact About

Single-click anywhere in the map. A panel should appear on the right showing a list view of the vintages of historic map available for that location.

[clear](#)

**Results - 6 maps:  
(1887 - 1952)**

[Leicestershire  
XXXI.SW](#)  
Series: Ordnance Survey. Six-inch to the mile  
Surveyed: 1886  
Published: 1887

[Leicestershire  
XXXI.SW](#)  
Series: Ordnance

Click on the hyperlinks in this list panel to open the map you want to view. The interactive map view will load. Zoom and pan in the historic map to see the area you are interested in.

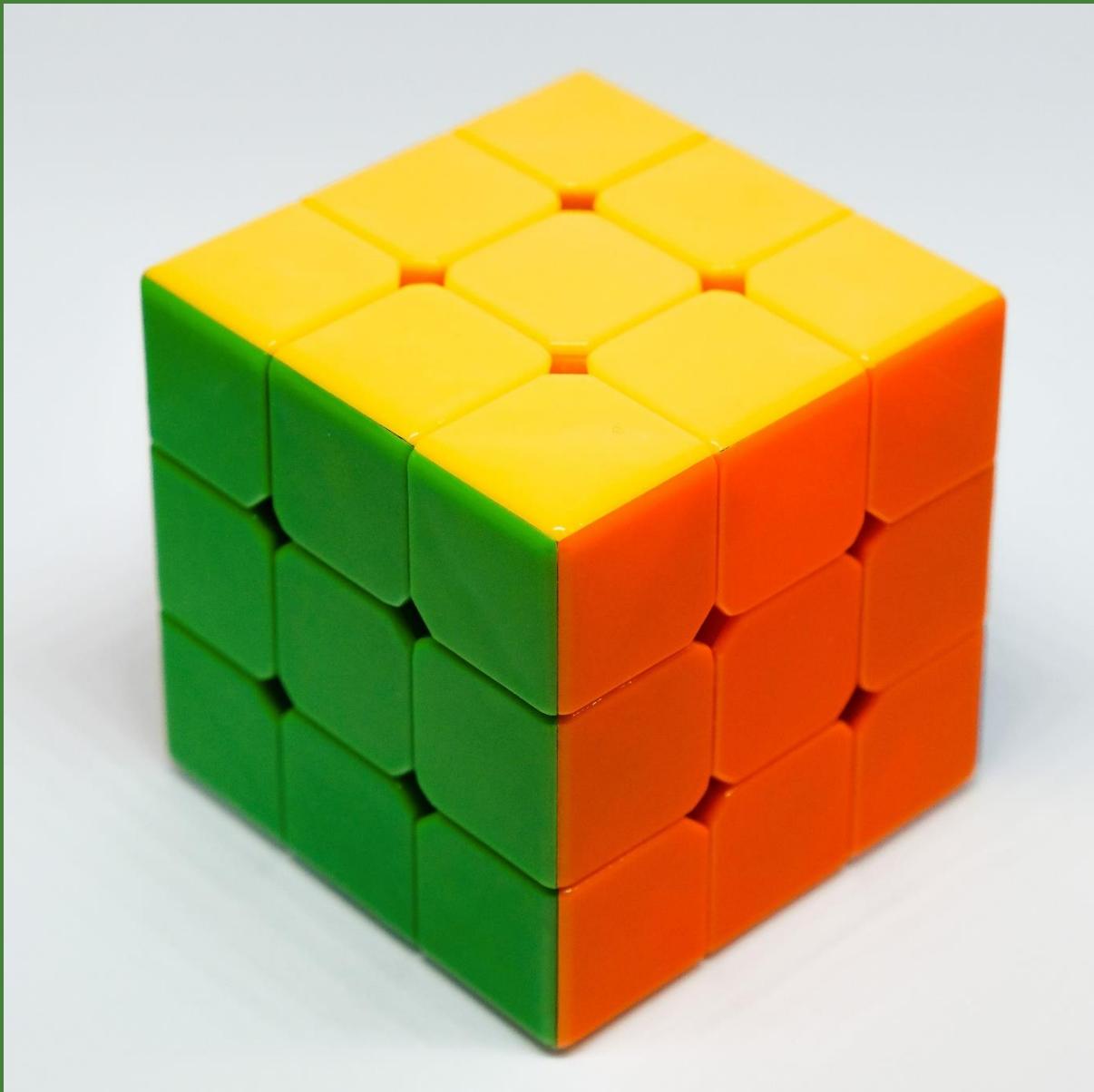


NLS Website Image

# Building Geological Models

This section provides details on how to construct 2.5D and 3D property and structural framework models of measurements and geology within Groundhog.

*Professional*



*Photo by Ruslan Keba on Unsplash*

## Intro

You can use the **Professional** edition of Groundhog to build simple 3D geological models.

Model building in Groundhog is based on a multi-input, dynamic workflow and uses a gridding method to build each deposit or layer within the model sequence. The workflow allows you to use a range of different inputs in various combination, together with simple algorithm selection, in order to rapidly build models. You can work directly from your data, or layer on your own interpretation using additional points and lines to shape the model. The workflow is rapid and allows for testing of different hypotheses and application of different datasets to see the effect. Each layer is constrained by inputs in the form of;

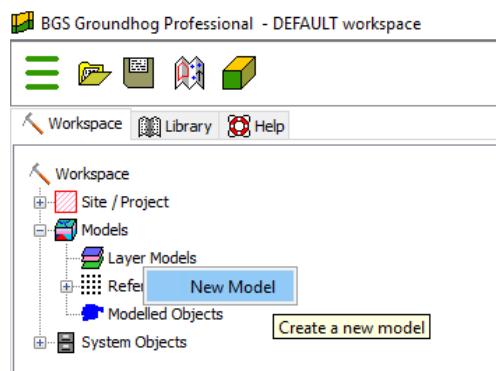
- Fixed thickness, depth or elevation,
- Borehole picks,
- Control points,
- Drawn-cross-sections,
- Structure contours,
- Map linework,
- Dip and azimuth values,
- Variable thickness rules.

Models are based on a simple grid data structure, but can be clipped out to project boundaries or other irregular polygonal shapes.

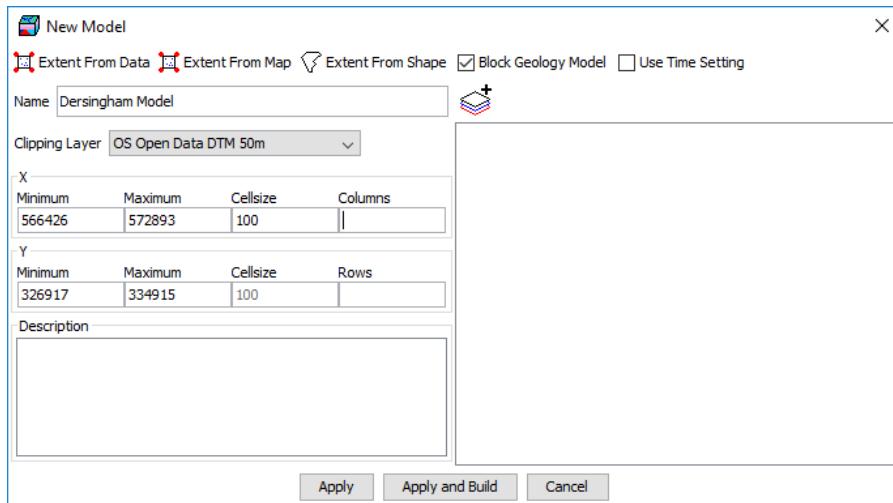
## Professional

### Defining the Model Grid

In the object tree, navigate to *Models > Layer Models* and select *Right-Click > New Model*.



The model editing dialog appears. Enter the necessary information to set the name of the model (free-text), choose which elevation model from the workspace to use as the topographic top of the model, and then enter the bounding box of the model area and an initial cellsize to use. Set a coarse resolution for the moment, you can refine it later. If you have a map window open and zoomed to the model area, you can use the *Extent From Map* button to populate the bounding box fields automatically.



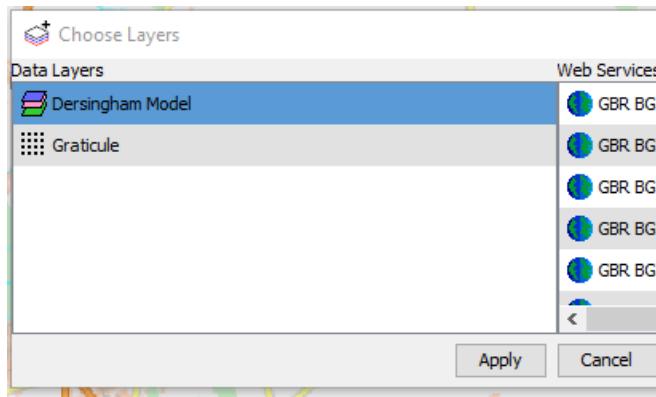
Review the input dialog and make sure you have set the following:

1. Min/max X and Y,
2. Cellsize (set this to a large value, i.e. low resolution, to begin with – you can change it later)
3. Name
4. Clipping Layer – select a grid, e.g. a DEM, from the workspace.

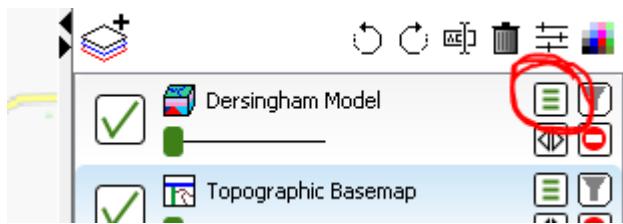
Click *Apply*. The model definition will be added to the object tree.



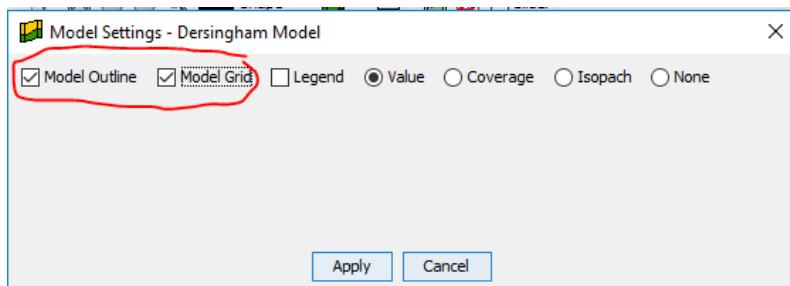
Add the model to a map window.



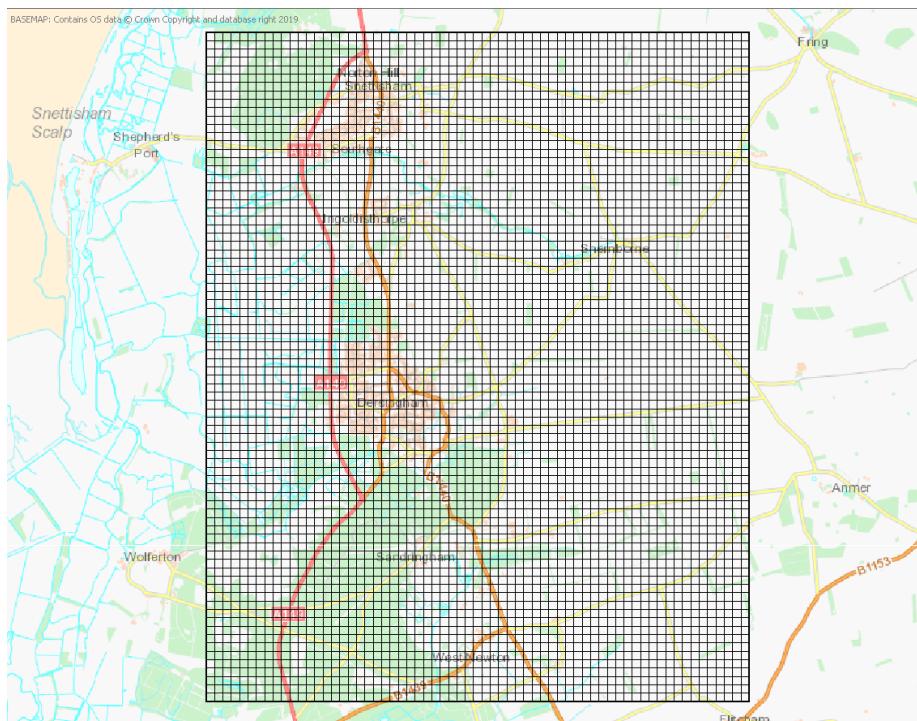
Open the settings for the model in the map window.



Check-on Model Outline and Model Grid.



Model outline and grid are now visible in the map.



**IMPORTANT: Now save the project.** For model building, Groundhog needs an output folder.

## Creating Model Layers

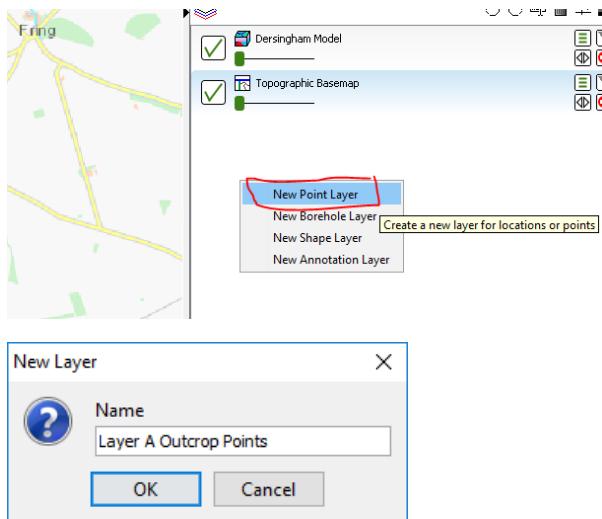
Each layer in the model can be based on a range of different inputs, including (depending on the layer type);

1. Borehole picks
2. Outcrop/subcrop points
3. Control points
4. Outcrop/subcrop linework
5. Structure contours

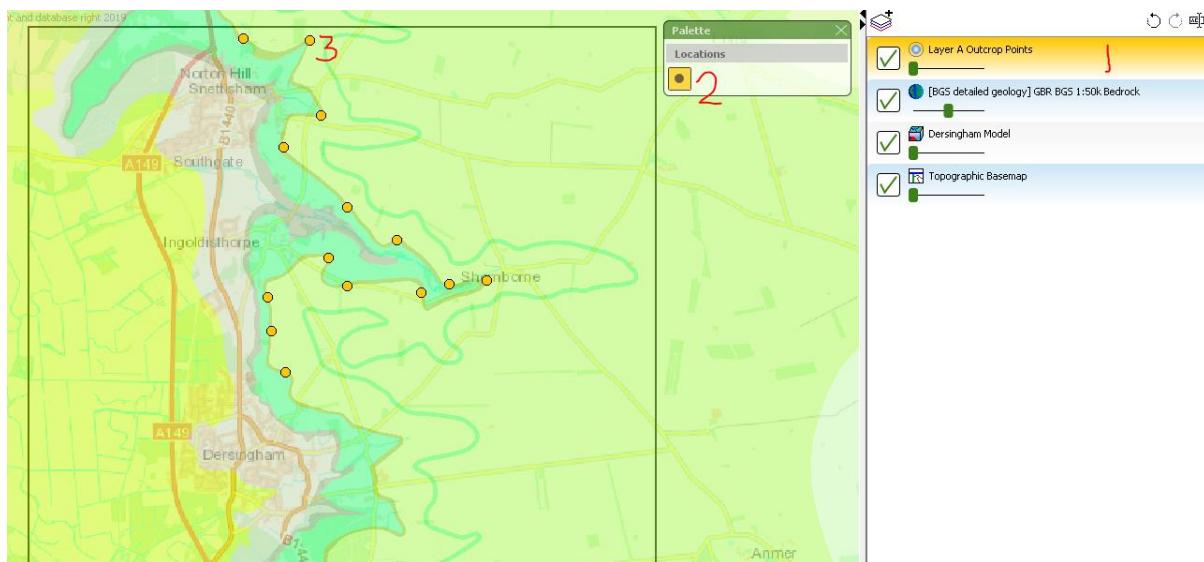
6. Cross-sections
7. Fixed depth or elevation
8. Dip and azimuth values
9. Fixed or graduated thickness values

The following example shows how to build up a layer from a set of different inputs. To begin with we will create some bedrock-style layers which are based on an implicit function controlled by a set of user-added inputs.

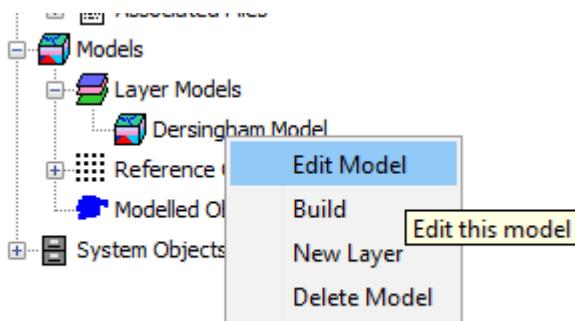
To get started, let's define some outcrop positions. Right-click to create a new point layer in the map.



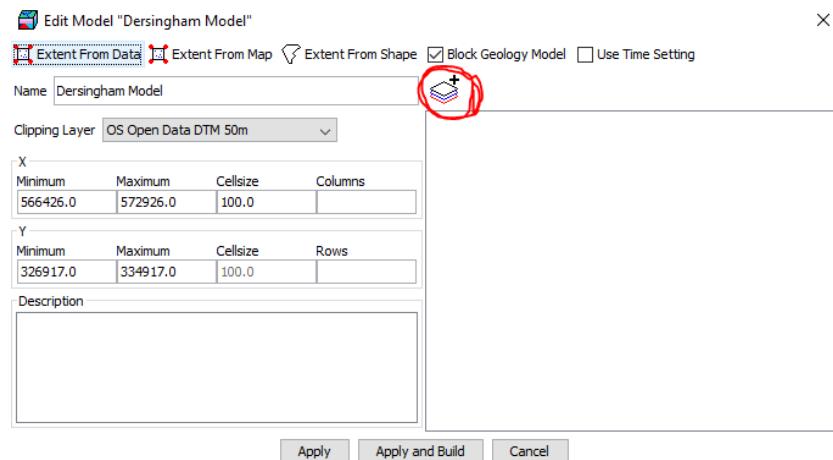
Make the new layer editable and place some points. Here we are using the BGS 50k Bedrock Web Map Service as a guide to positioning these points at the BASE of a mapped unit. When the points have been placed, de-activate the point layer.



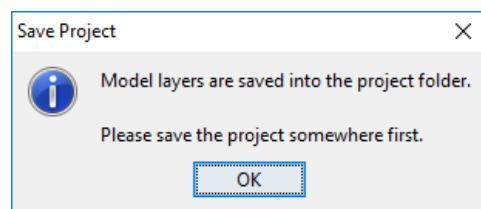
In the object tree, *right-click on the model object > Edit Model*



Click the Create Layer button in the model editing dialog.

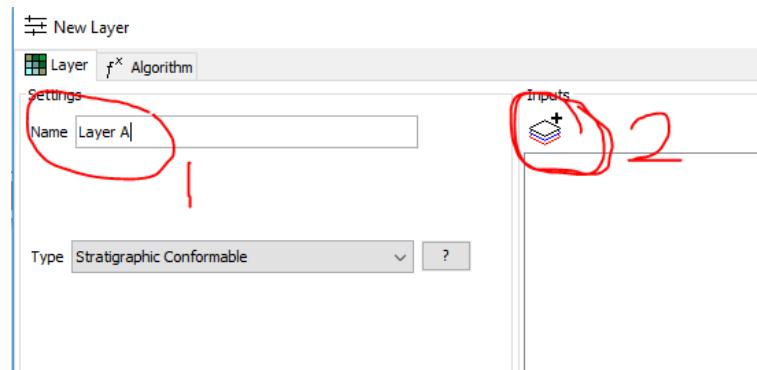


If the model is new and the project has not been saved, you will see this.

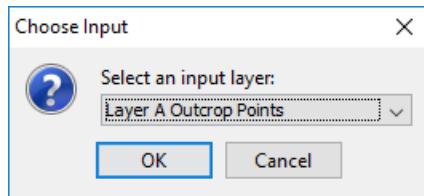


As models are calculated, their outputs are saved to the project folder. For this, Groundhog needs to know where the folder lives, so save the project somewhere and then repeat the Create Layer action again.

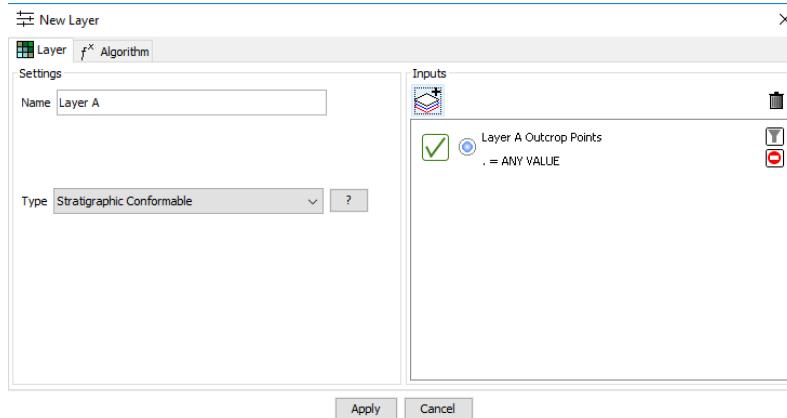
In the create layer dialog, enter a name for the layer and click the Add Inputs button.



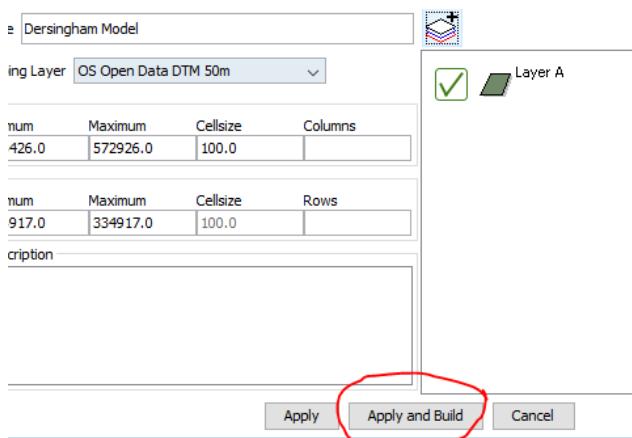
This is where we can select which data or parameters to use as input to the layer. Select the point layer we created as the input and click OK.



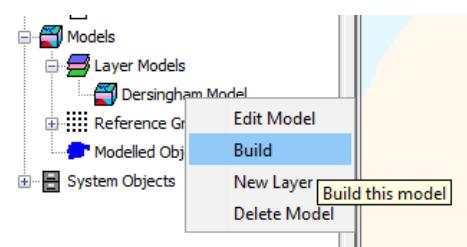
The points are now added as an input to the layer. Click *Apply*.



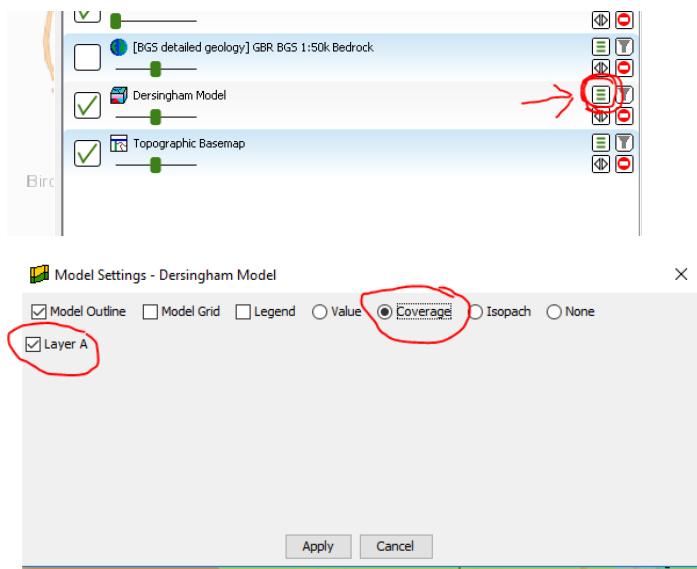
In the model editing dialog, click *Apply and Build*. If the model editing dialog is not open, right-click on the model in the object tree and select *Build*. The model will calculate, and the progress will be shown in the main progress bar.



Or...



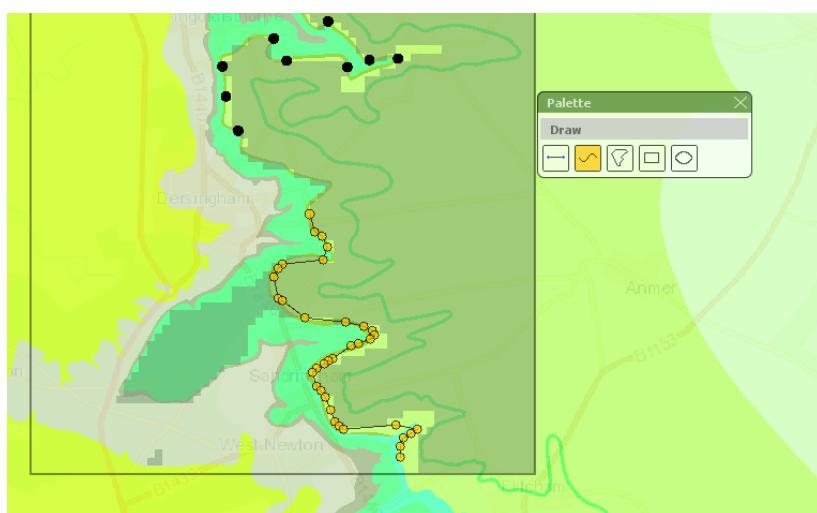
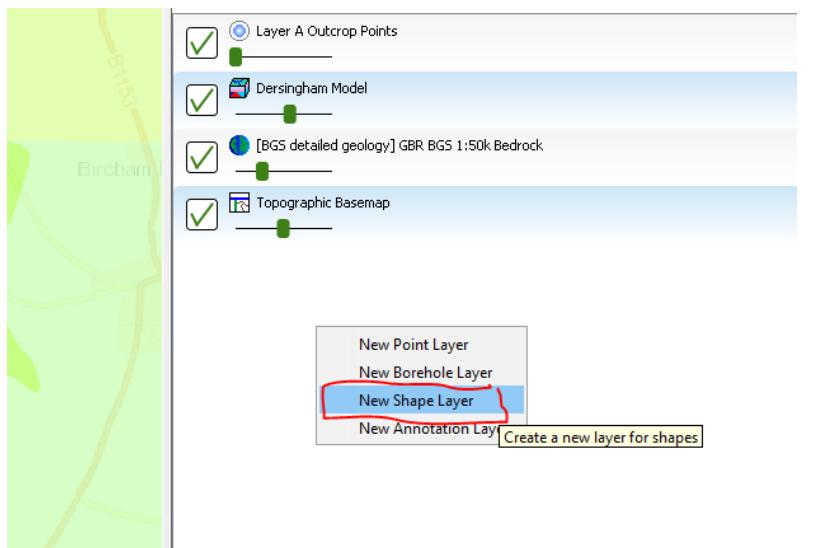
Go back to the settings dialog for the model layer in the map window and tick-on the new layer. Also, switch to map coverage view.



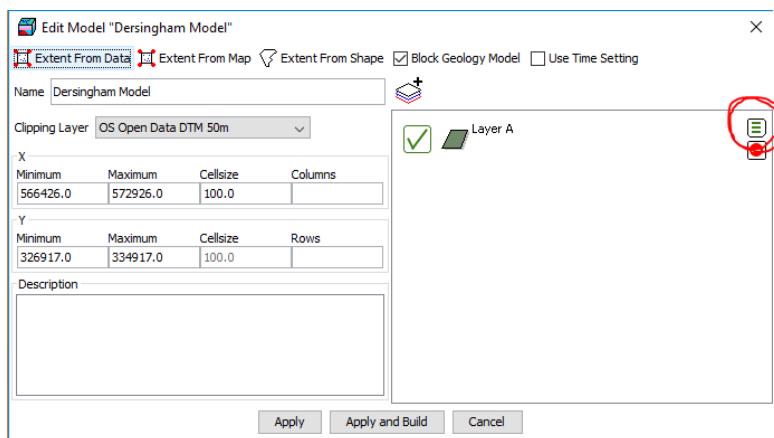
The calculated extent of the layer will be shown in the map. If it is unclear on top of the other layers, decrease the layer transparency using the slider bar in the layer control.



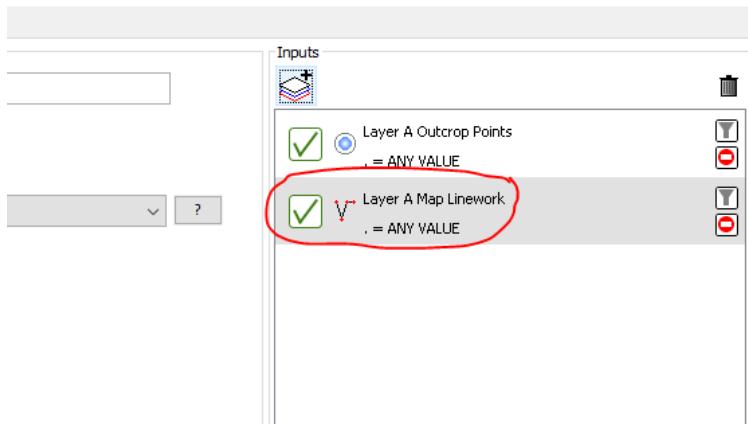
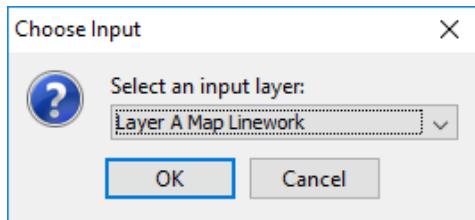
Next we will add some geological map linework. This could be imported from a shapefile, but for this example we will draw it by hand. Create a new shape layer in the map window and make it editable.



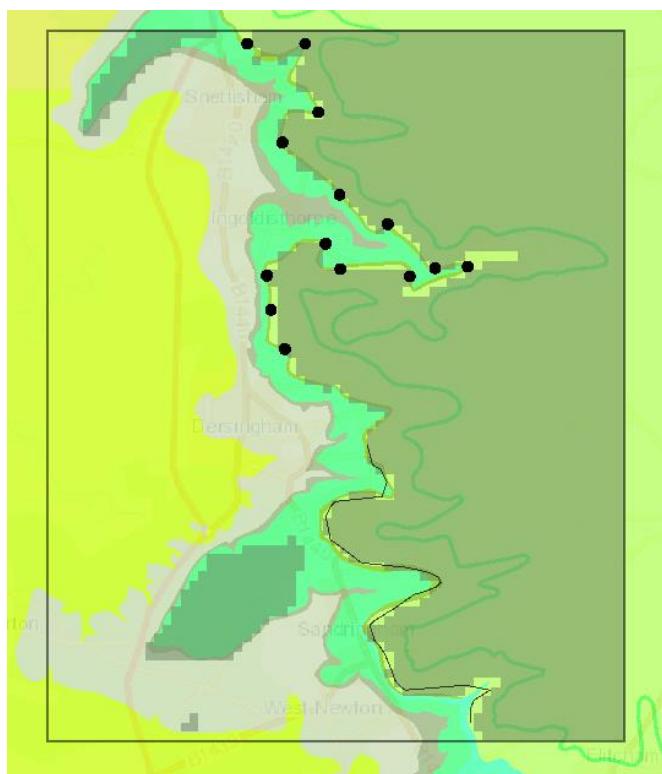
In the model editing dialog, open the settings for Layer A.



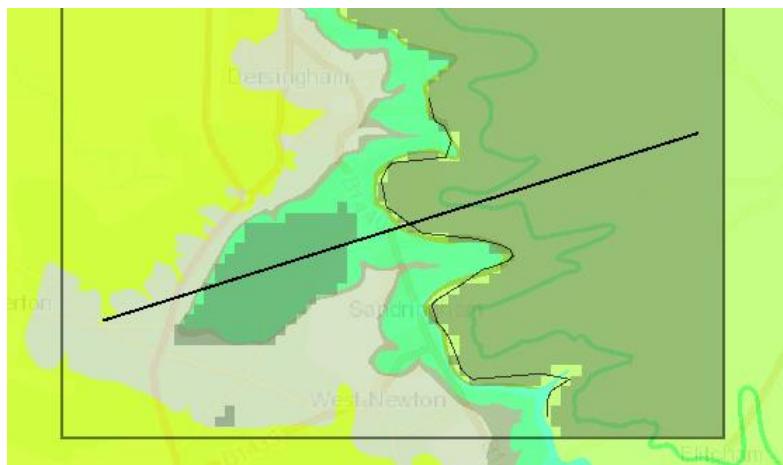
Add the new linework to the layer input list.



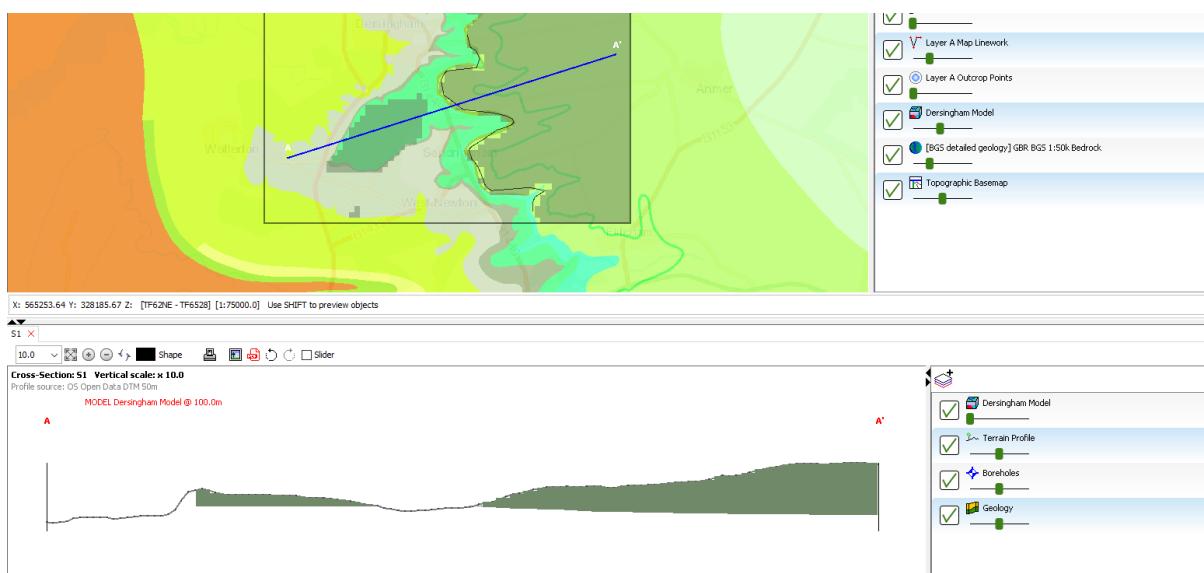
Apply and then re-build the model.



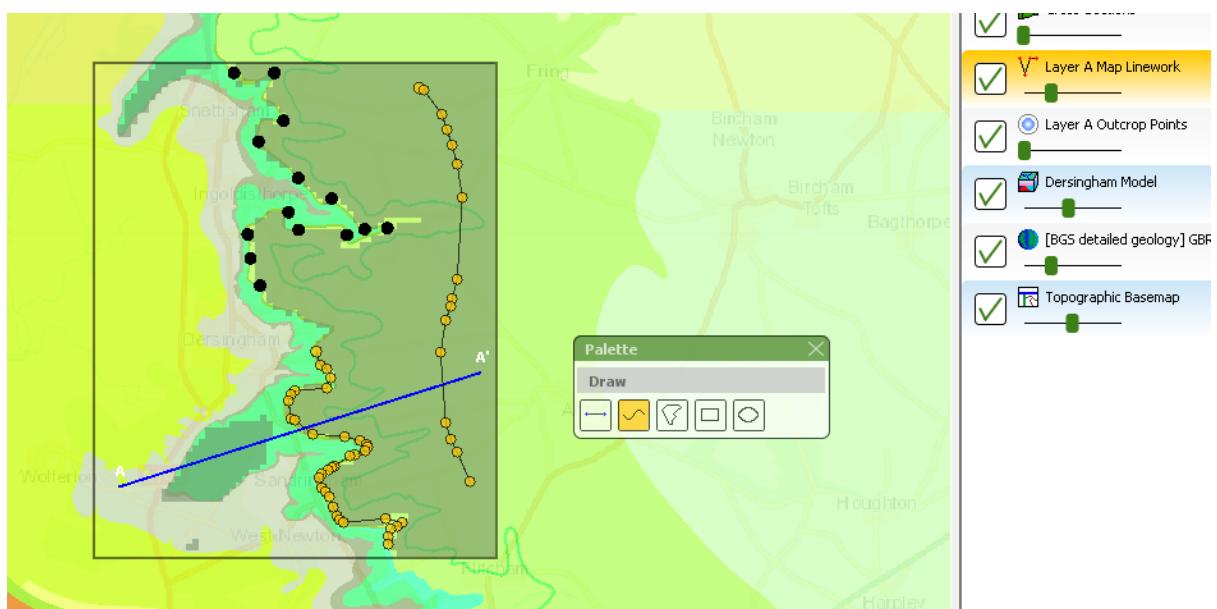
Note that there is a portion of Layer A in the south-west that does not match the geological map. Draw a cross-section through the model to inspect it at this location.



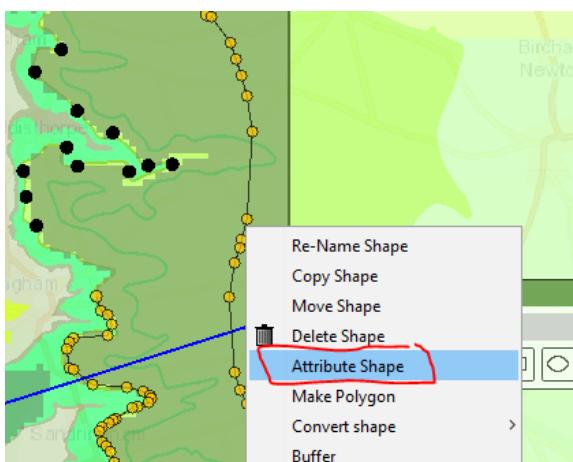
View the cross-section and add the model to the view as a layer.



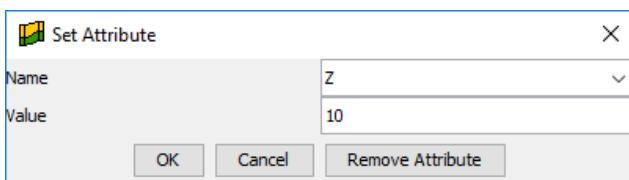
Let's add a component of dip to the layer using a structure contour. Draw a new line into the Layer A map.



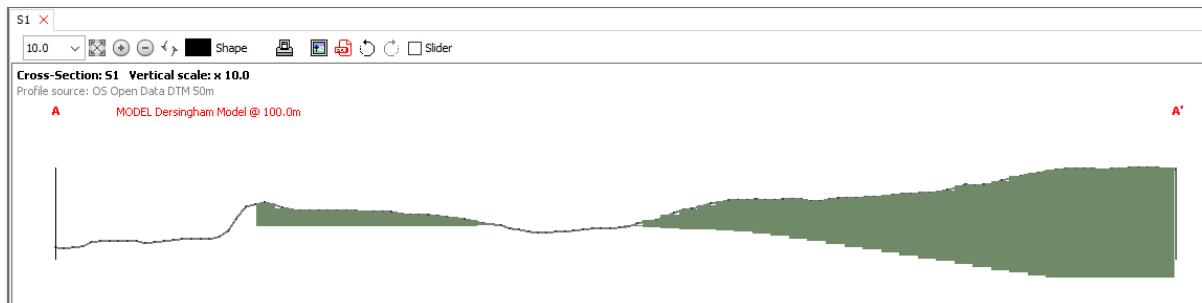
Switch the drawing tool off and right-click on the new line > *Attribute Shape*.



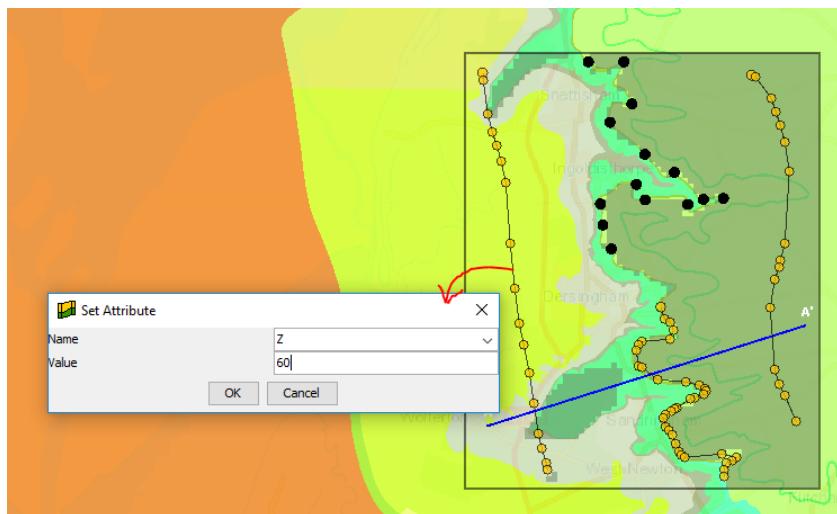
Set an attribute called "Z" with a value of "10". This attributes an elevation value of ten metres to the line, thereby making it a structure contour.



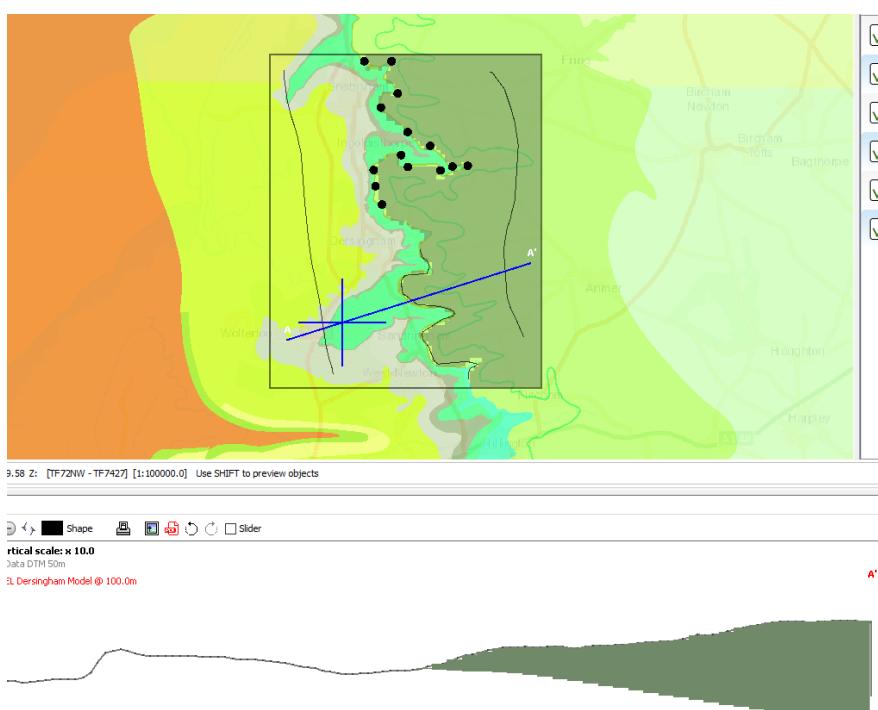
This adds some additional dip to the layer, but still has not resolved the unwanted outlier in the south west.



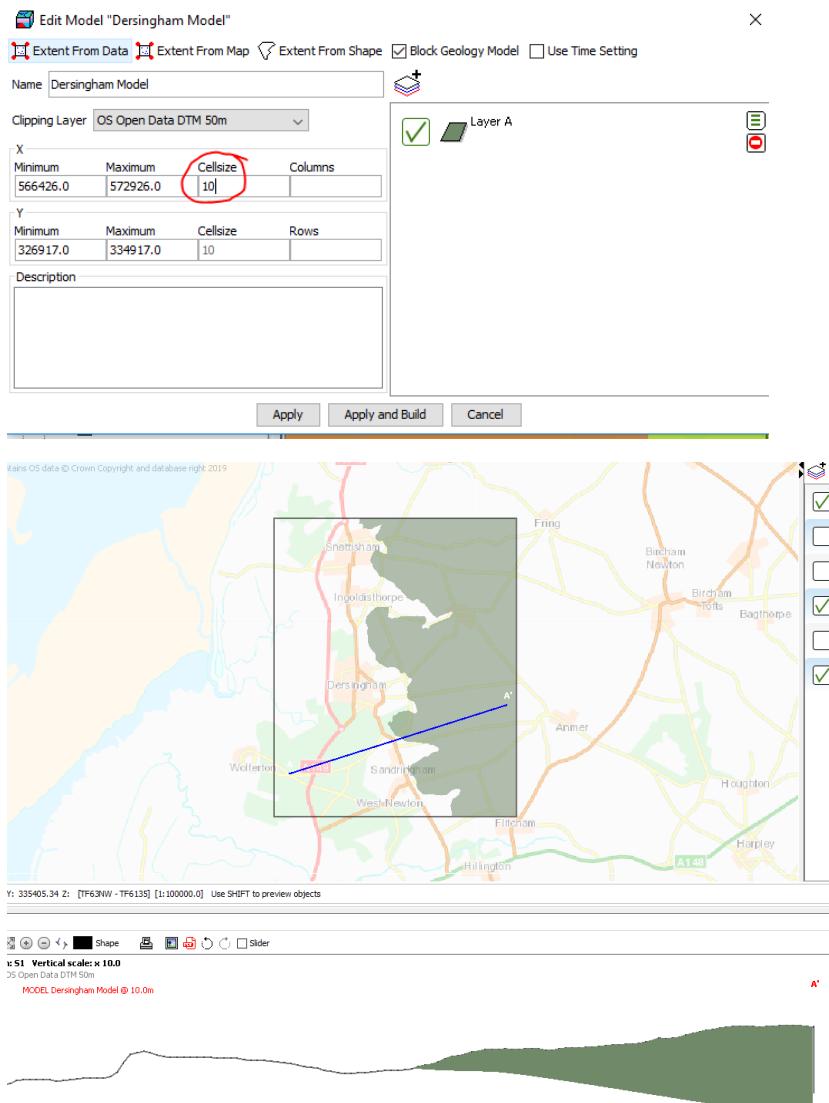
Draw another structure contour in the West, setting a Z value of 60m. This is effectively a structure contour in the air which can be used to pull the calculated surface up out of the ground.



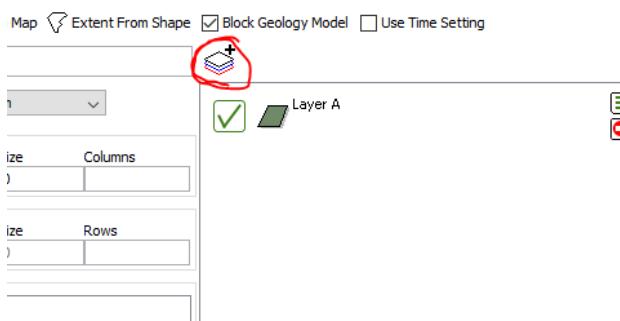
Re-build the model. The layer is now correctly resolved relative to the outcrop pattern.



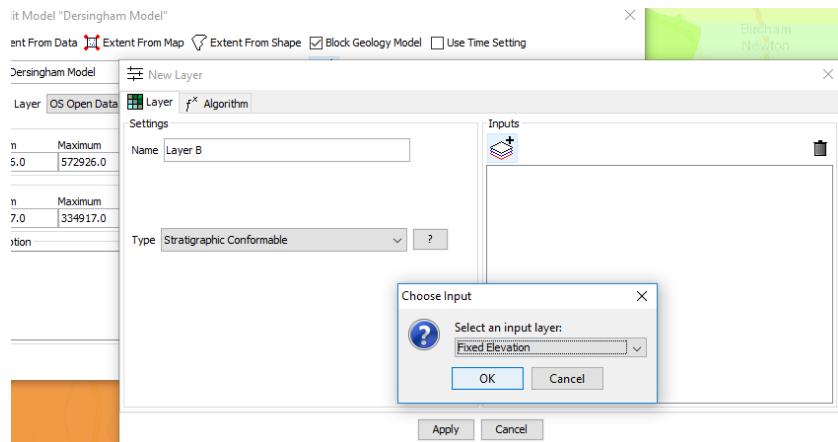
In the model editing dialog, increase the resolution of the model (e.g. to 10m cellsize from 100m) and re-build it.



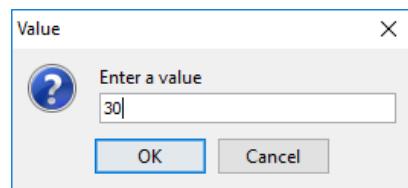
Next we will add another bedrock layer with a fixed elevation. Add a new layer to the model using the model editing dialog.



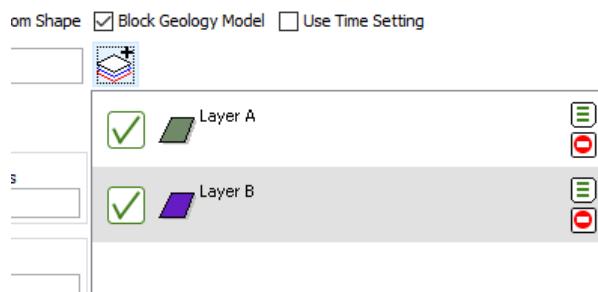
Make the input to this layer a Fixed Elevation parameter.



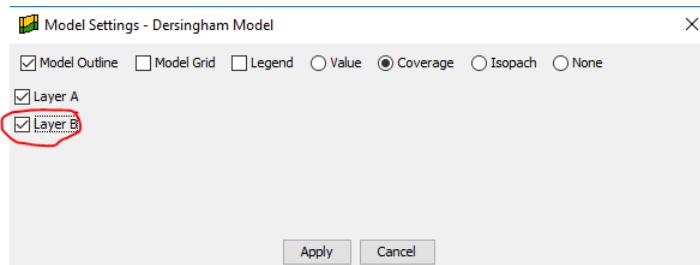
Here we set the elevation at 30m, for example.

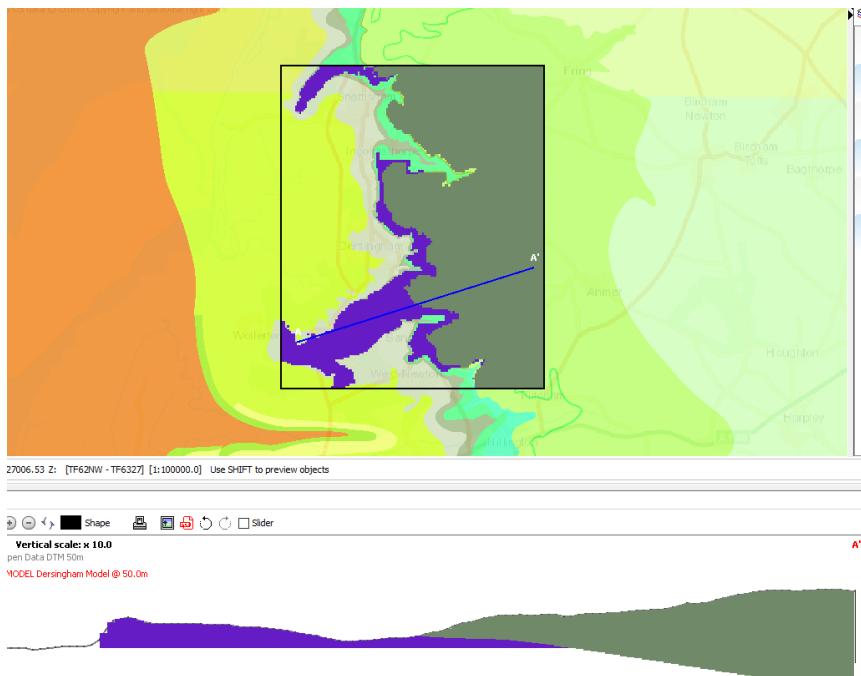


There are now two layers in the model. Re-build the model.

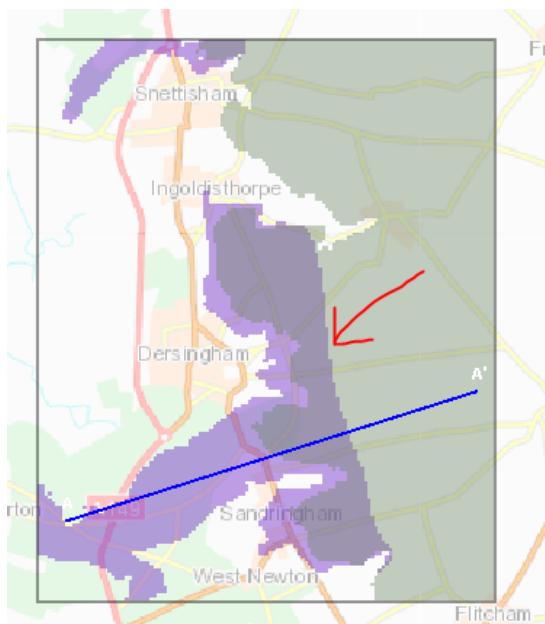


Go to the settings for the model layer in the map window and check-on the visibility of the new layer.

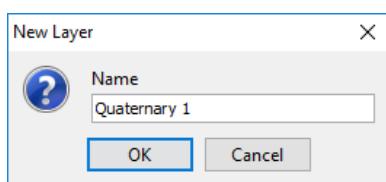


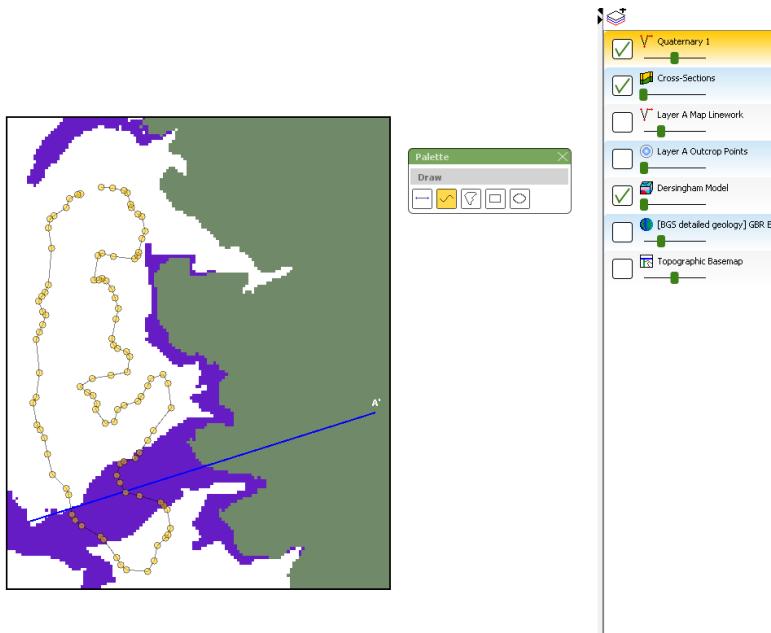


Note that the outcrop pattern of the new layer has been generated automatically, based on the intersection with the topography, and also that the sub-crop position caused by the erosional contact against the base of the layer above has also been detected automatically. Setting the model as semi-transparent in the map window shows the sub-crop map of Layer B beneath Layer A.

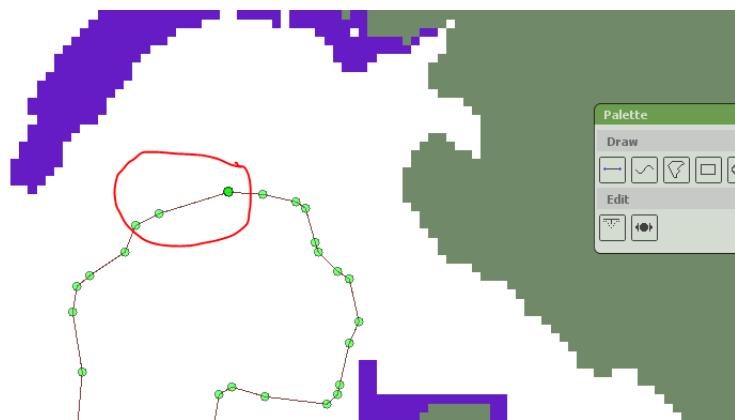


Next we will create a Quaternary-style layer based on map linework and a thickness value. Create a new shape layer in the map to draw into.

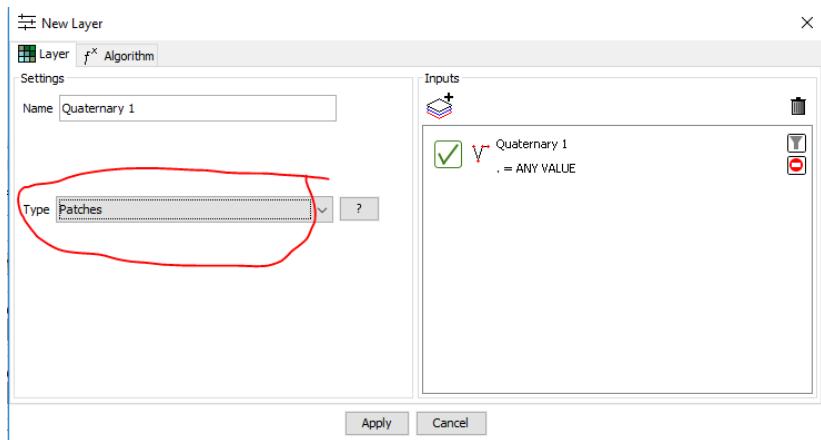




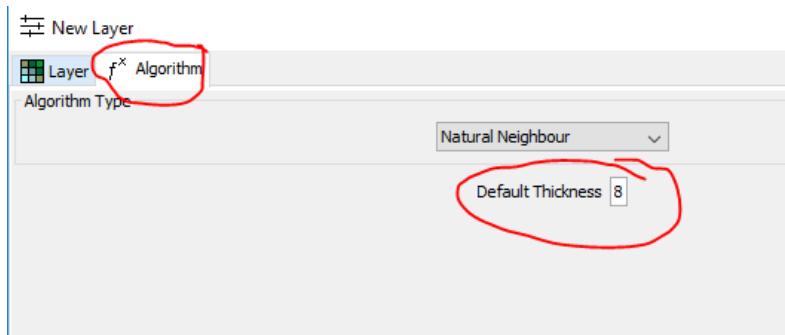
Make the new line active and snap the two ends together to form a polygon or right-click on the line and select *Make Polygon*.



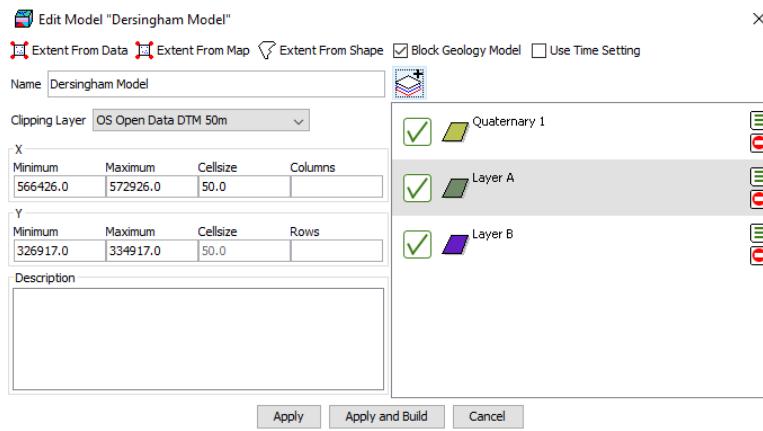
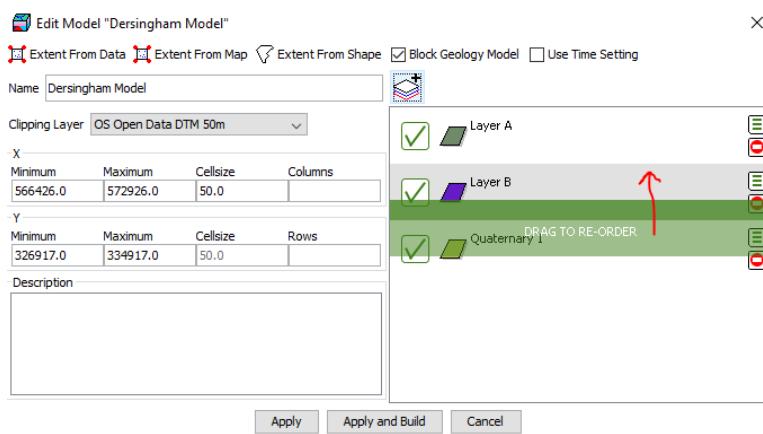
Create a new layer using the model editing dialog. Add the Quaternary map layer as the input and make sure to select a layer type of “Patches”.



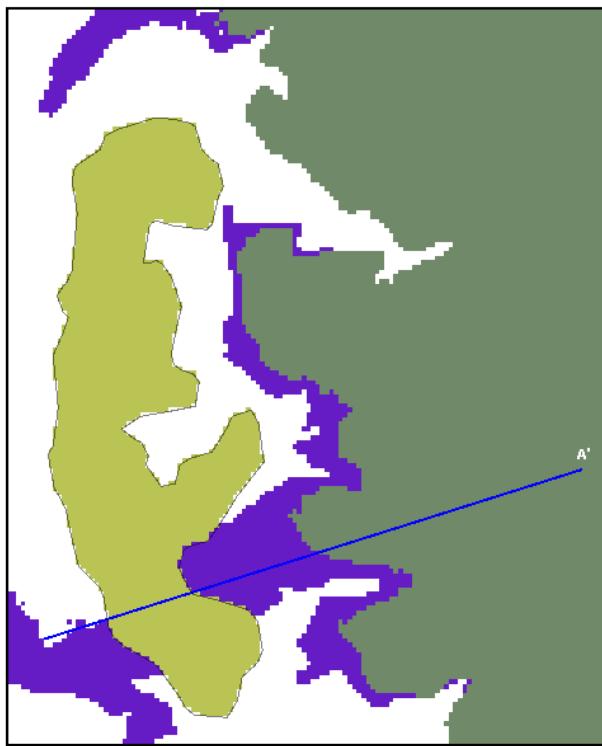
Switch to the Algorithm tab of the dialog and set the thickness value to 8 (m).



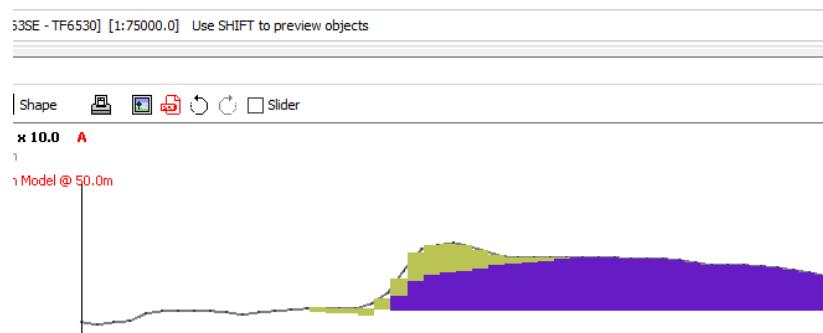
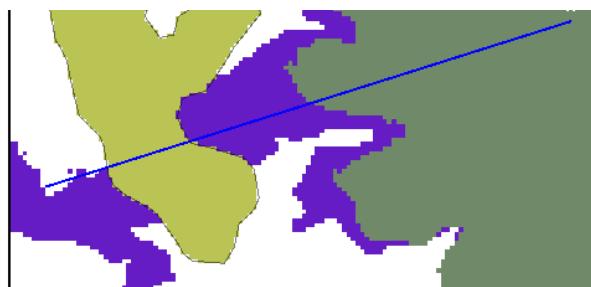
In the model editing dialog, note that the layer is at the bottom of the list. This list is used as the stratigraphic scheme and we need the Quaternary layer on top of the stack, so drag it to reposition at the top of the list.



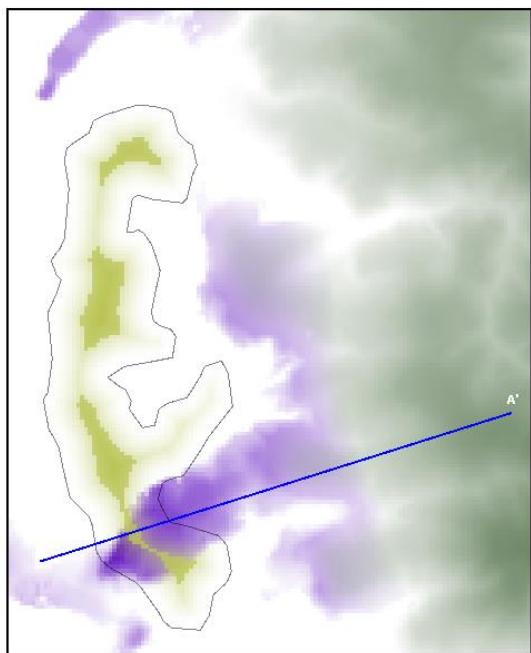
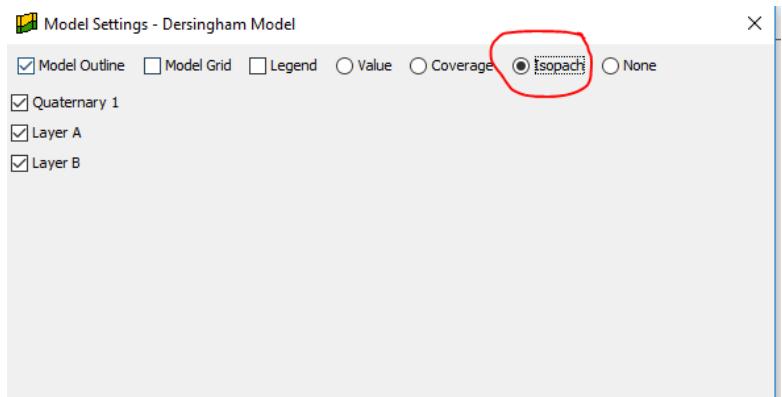
Re-build the model and make the new layer visible in the map. Note that the “patches” type layer honours the drawn map exactly, unlike the bedrock model layers which predict the outcrop pattern automatically.



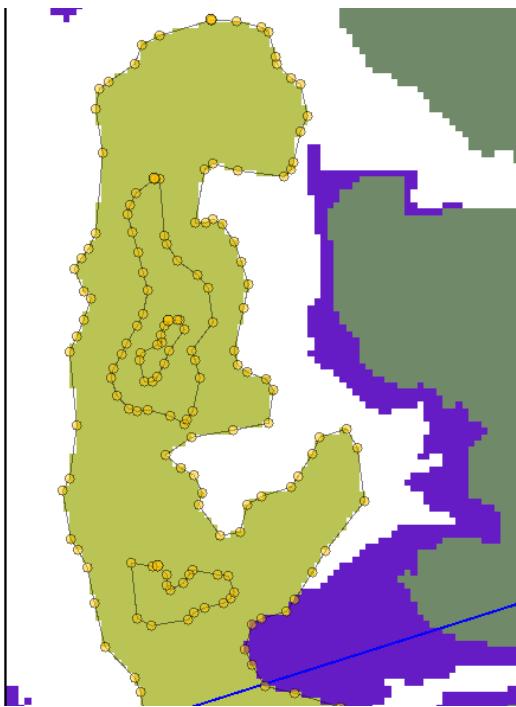
In profile, see how the layer thins out towards the edges of the mapped polygon.



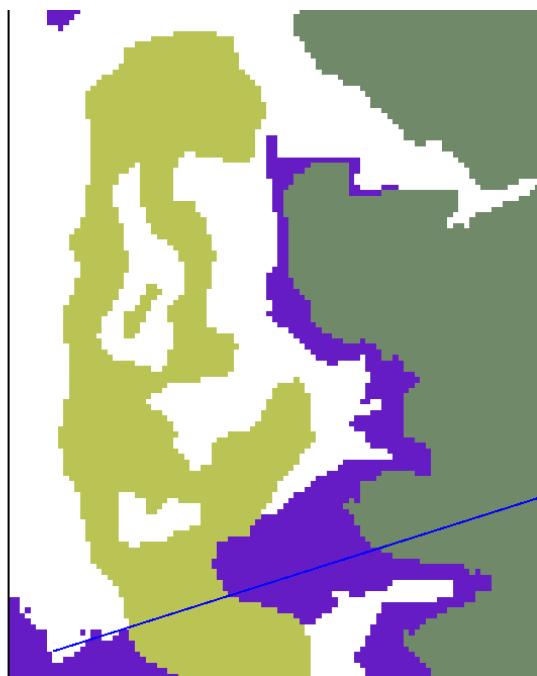
Toggle the map view to isopach (thickness) view to get an impression of how the thickness setting has been graduated within the mapped polygon.



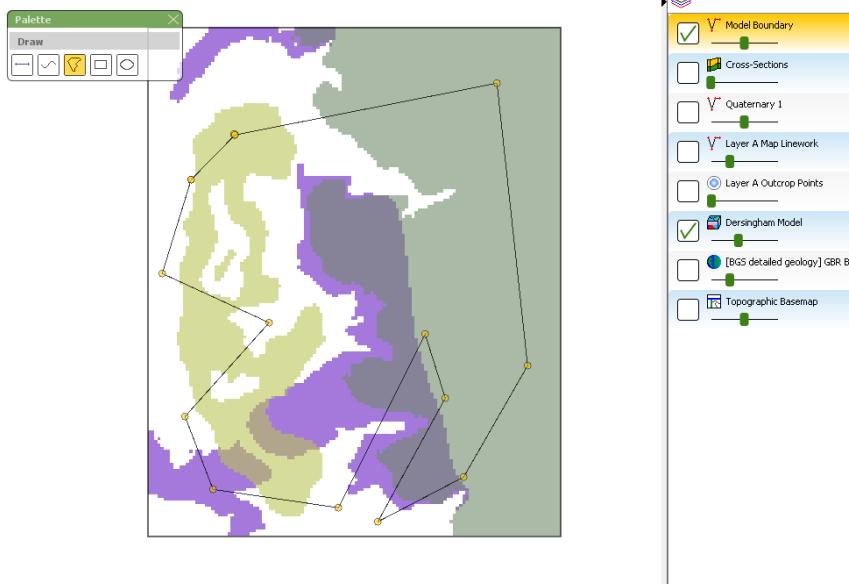
Edit the map layer and add some windows into the layer.



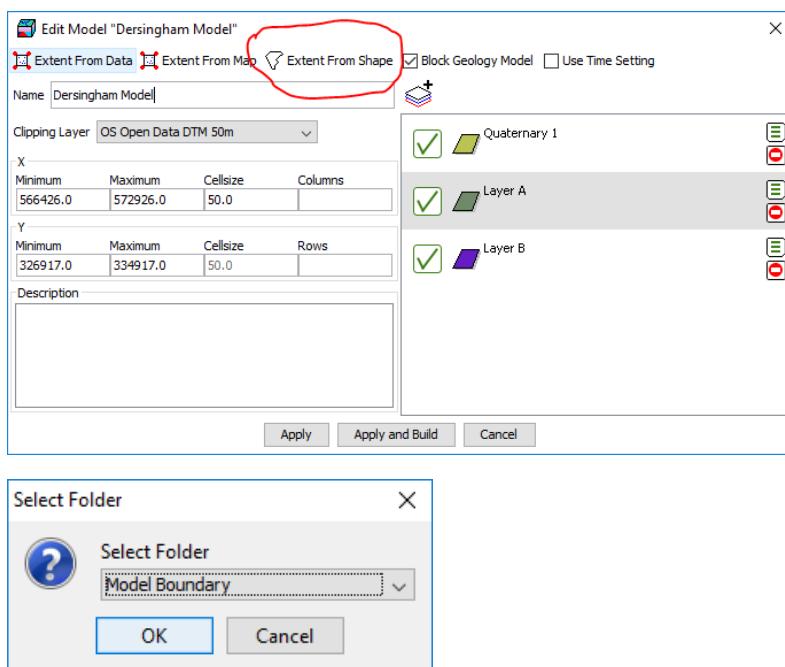
Re-build the model. Note how the hierarchy of windows and islands within the deposit is resolved automatically. This can be taken to any level or nesting required.



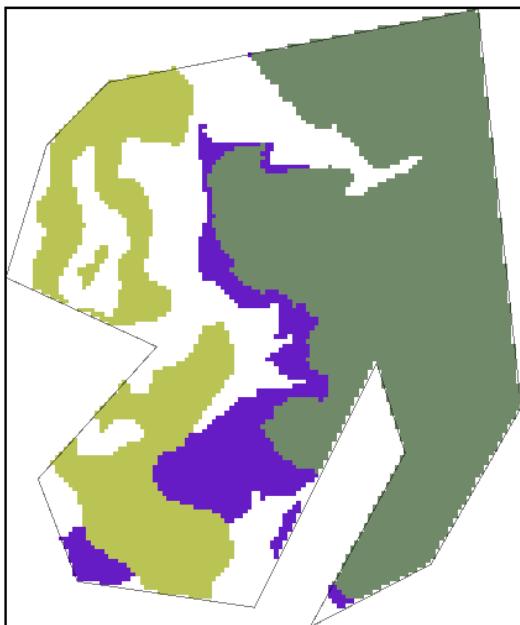
By default, model extents are rectangular. To define a polygonal boundary, create a shape layer and draw the boundary. Make sure to convert the shape to a polygon.



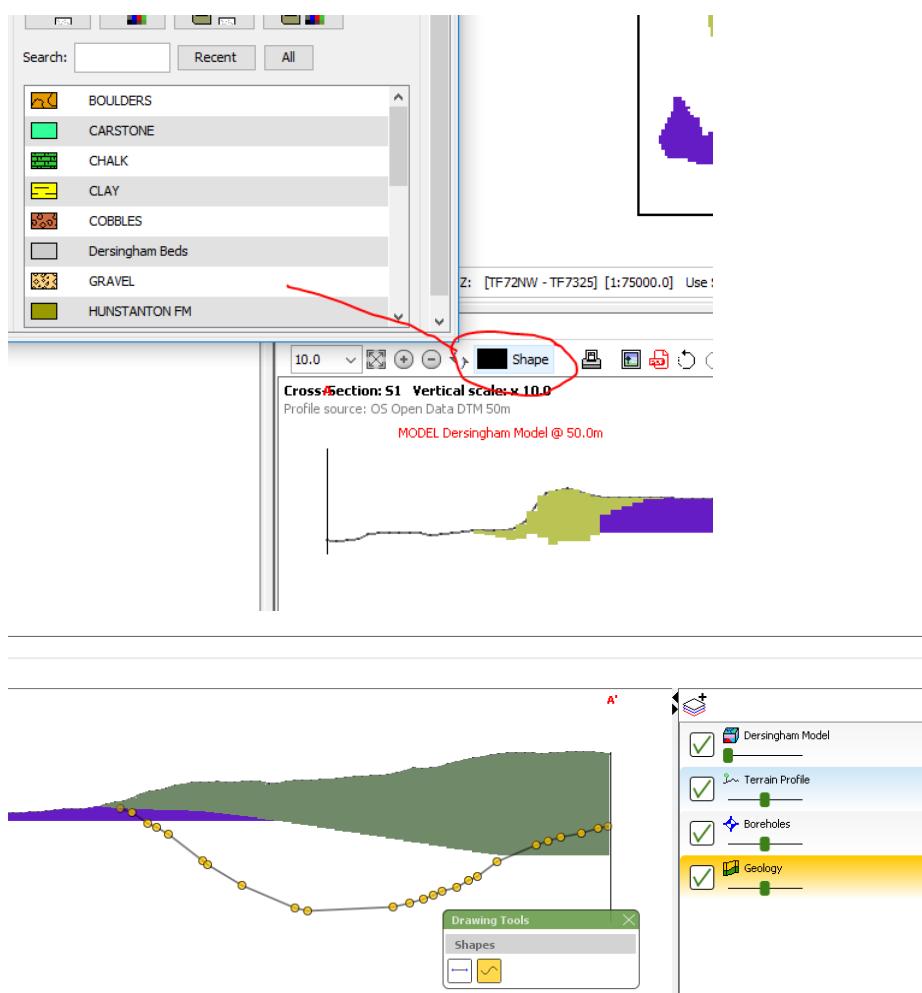
In the model editing dialog, click the *Extent From Shape* button and select the model boundary shape layer as the input.



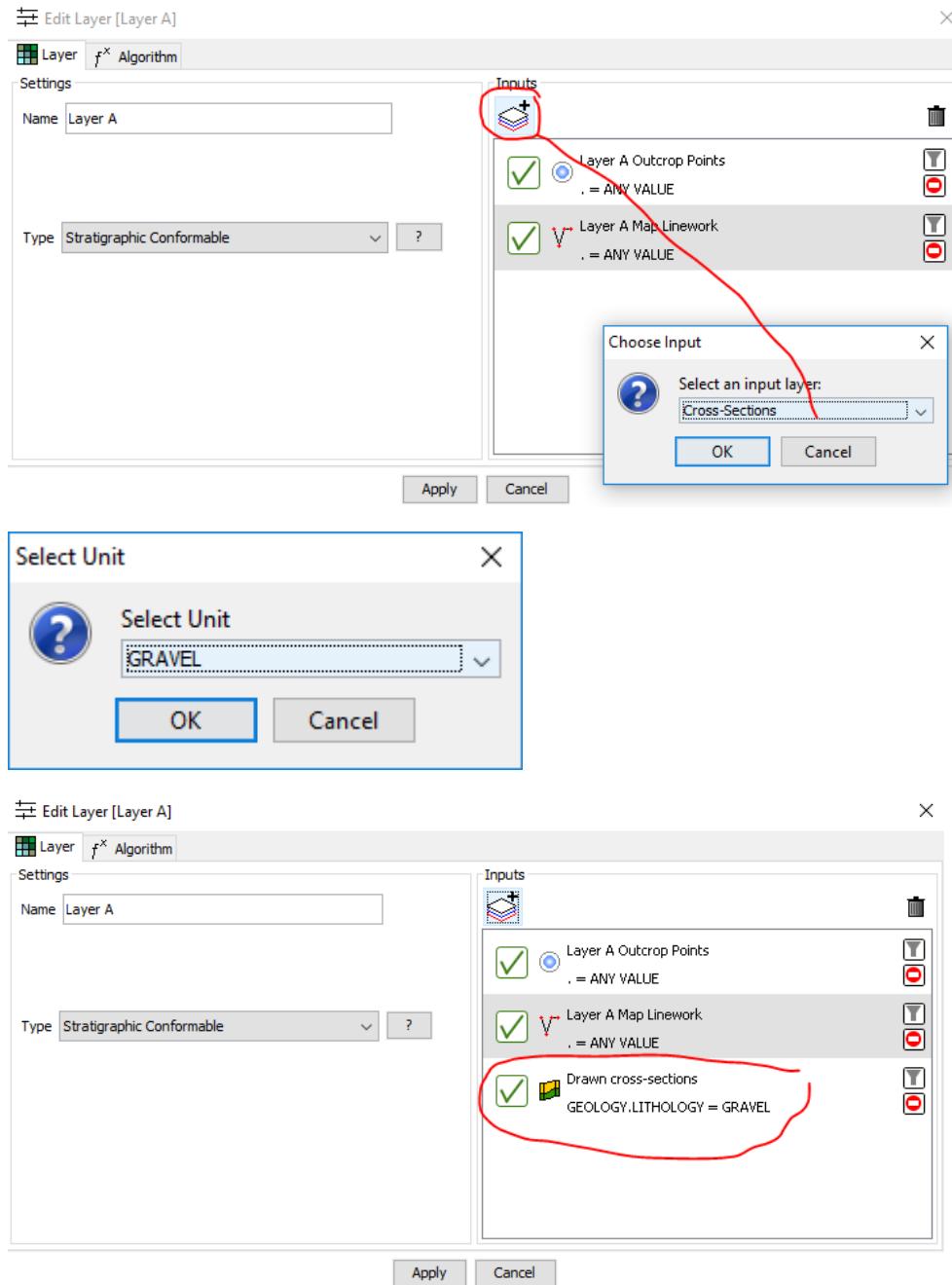
Re-build the model.



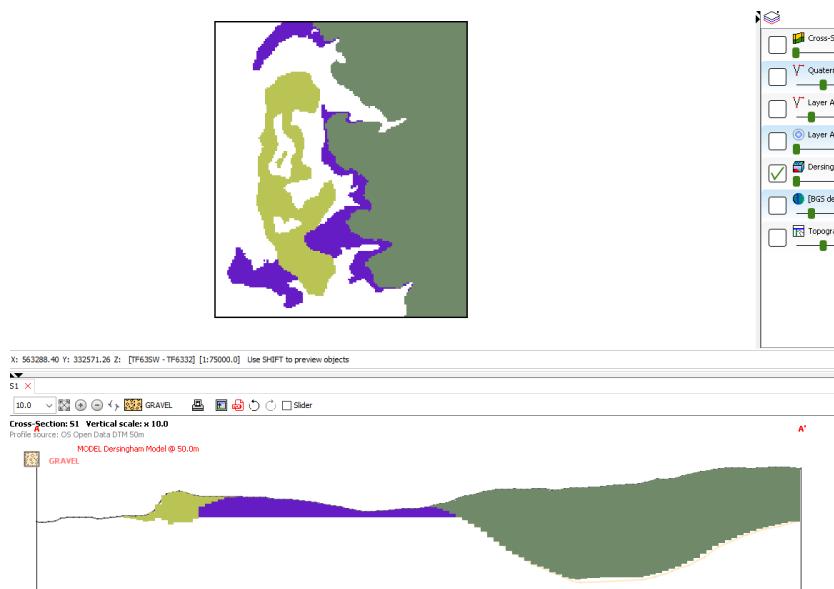
Draw into the cross-section to use as an input to bedrock layers. Choose a drawing code for the layer. Here we use GRAVEL, but the code can be whatever you like. To draw geology, make the Geology layer active in the section window.



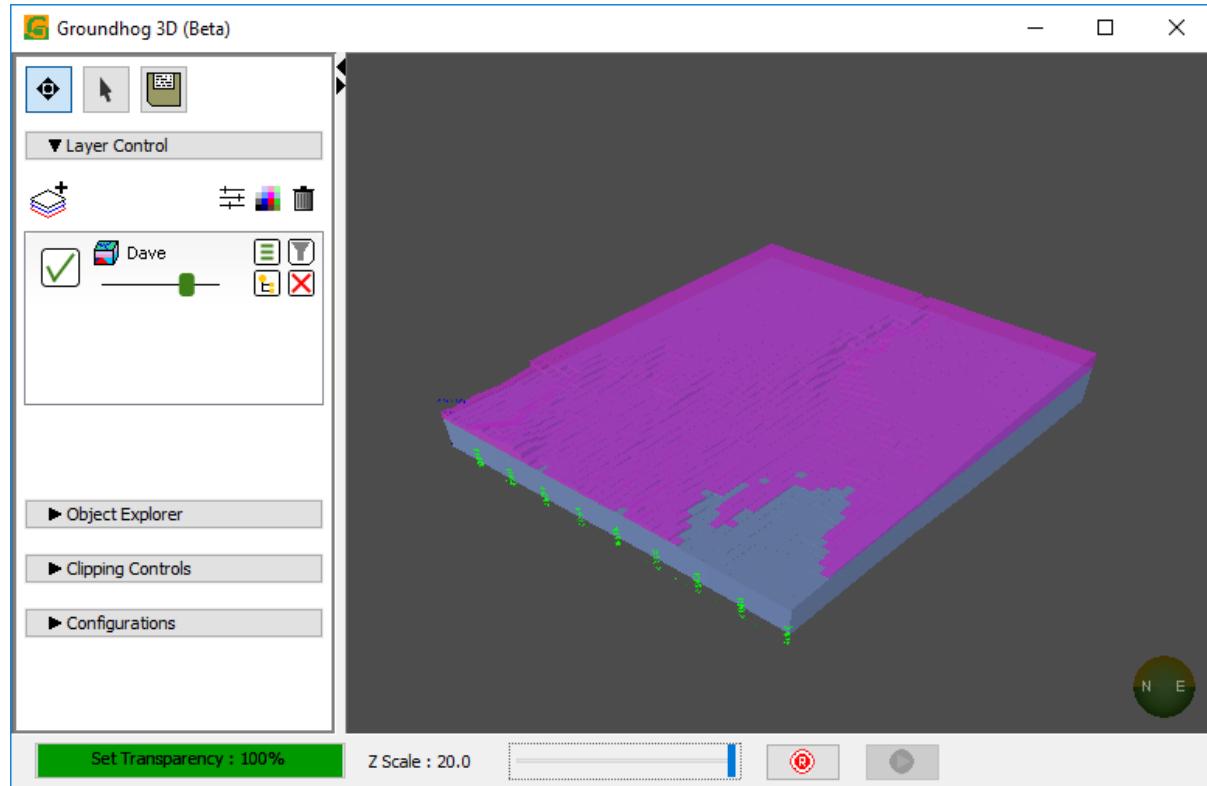
Add the cross-section information as an input to Layer A. Go to the settings for Layer A and choose Cross-Sections as a new input to the layer. When prompted, choose the drawing code “GRAVEL” as the filter for the input. This will use all instances of “Gravel” from all cross-sections as input to the layer calculation.



Re-build the model. Note that the correlation linework in the cross-section has been used to control the Layer A surface.



You can add models as a layer to the 3D view to visualise them. For more details, refer to the next chapter on using the 3D graphics window.

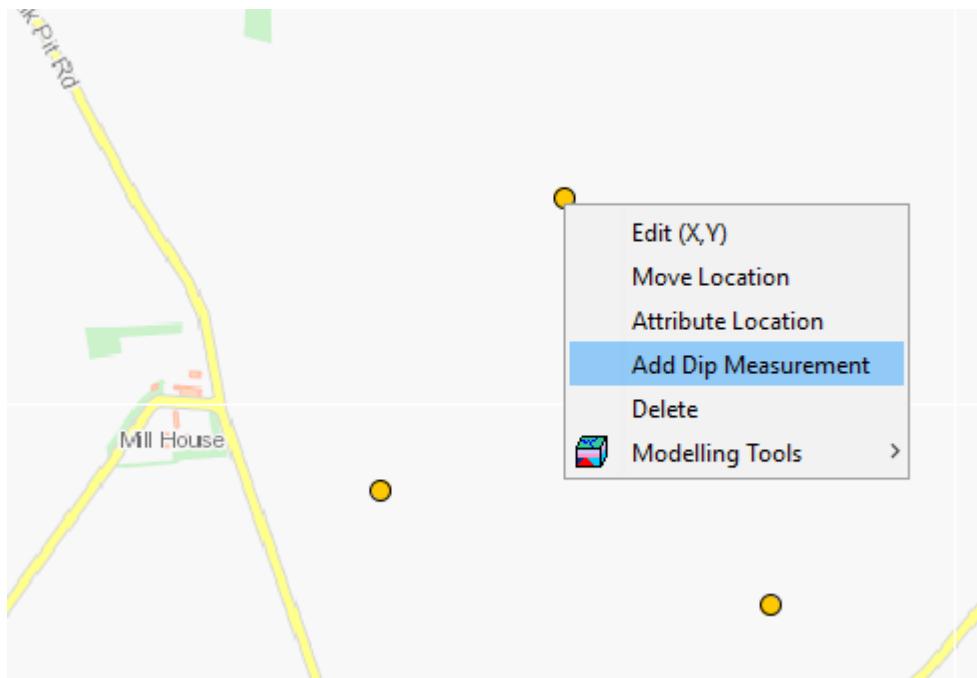


## Additional Tools

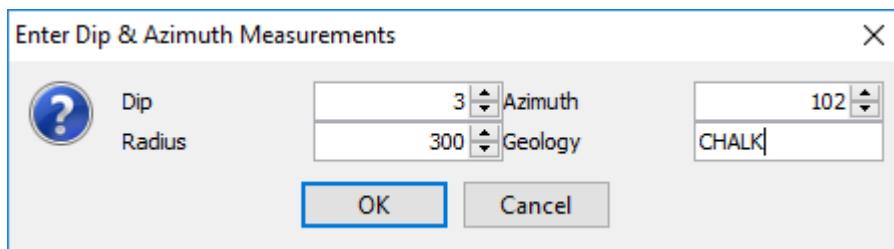
The above section provides a general introduction to building layer models using Groundhog. Here we detail a few extra, specific tools that are of use during the modelling process.

### Dip and Azimuth Inputs

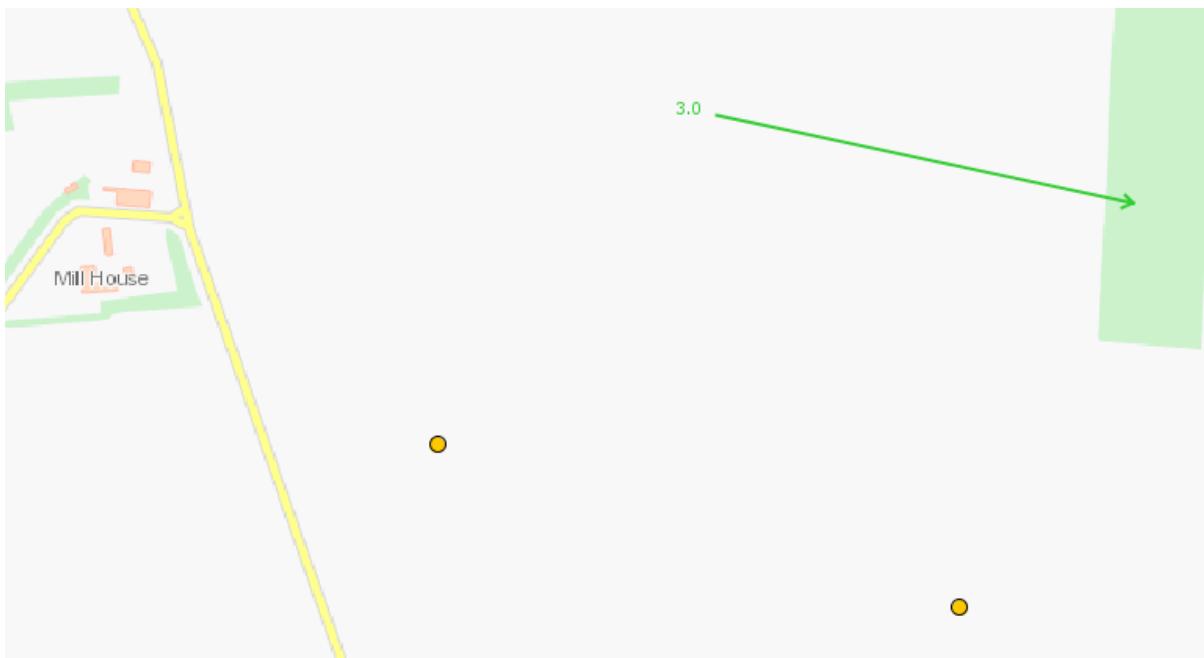
Dip and azimuth (structural) inputs are treated as points. To convert a point object to a structural point that can be used in the modelling, first make the point layer active. <Right-click> on the desired point and choose <**Add Dip Measurement**>



Use the input dialog to set the DIP, AZIMUTH and RADIUS values. RADIUS controls the zone of influence of the data point. You can also set a GEOLOGY code if you wish to have a single point layer containing structural points from different model layers.



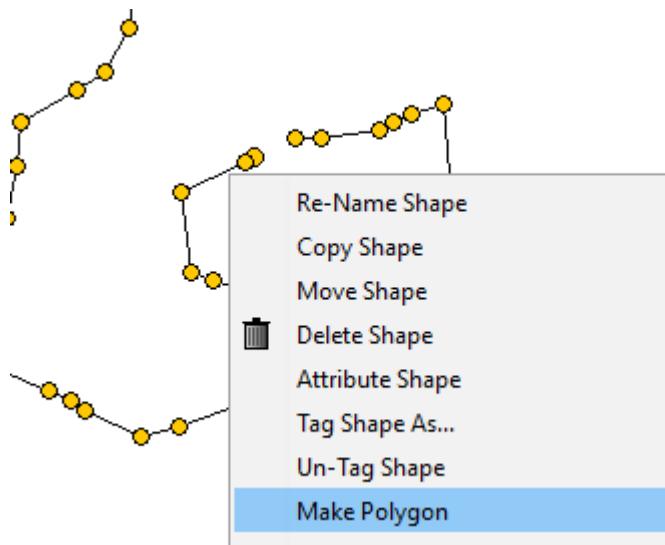
The point becomes an arrow showing the AZIMUTH. The length of the arrow shows the RADIUS of influence the point will have if used in a calculation.



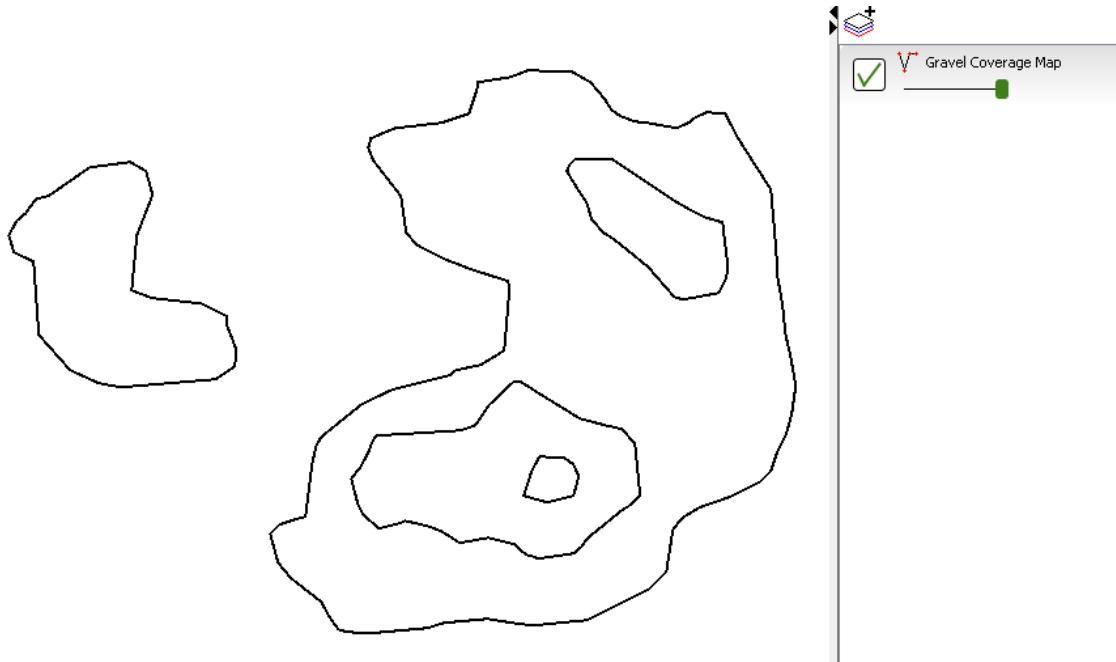
### Coverage Mode

When working with stratigraphic layers, by default Groundhog will auto-predict the outcrop/subcrop of each layer in the model. However, if you wish to have hard control over the calculation boundaries then you can draw (or import) a polygonal map to act as the boundary of the model calculation for the layer. This is known as COVERAGE mode. When you are working in this mode, Groundhog will not compute the presence of the layer anywhere outside the coverage polygon.

Draw the polygons for the coverage map into a shape layer (or import from a Shapefile, but make sure they are polygons). After drawing each shape, ensure it is a polygon either by dragging the last node towards the first node to snap it, or using **<Right-Click> <Make Polygon>**

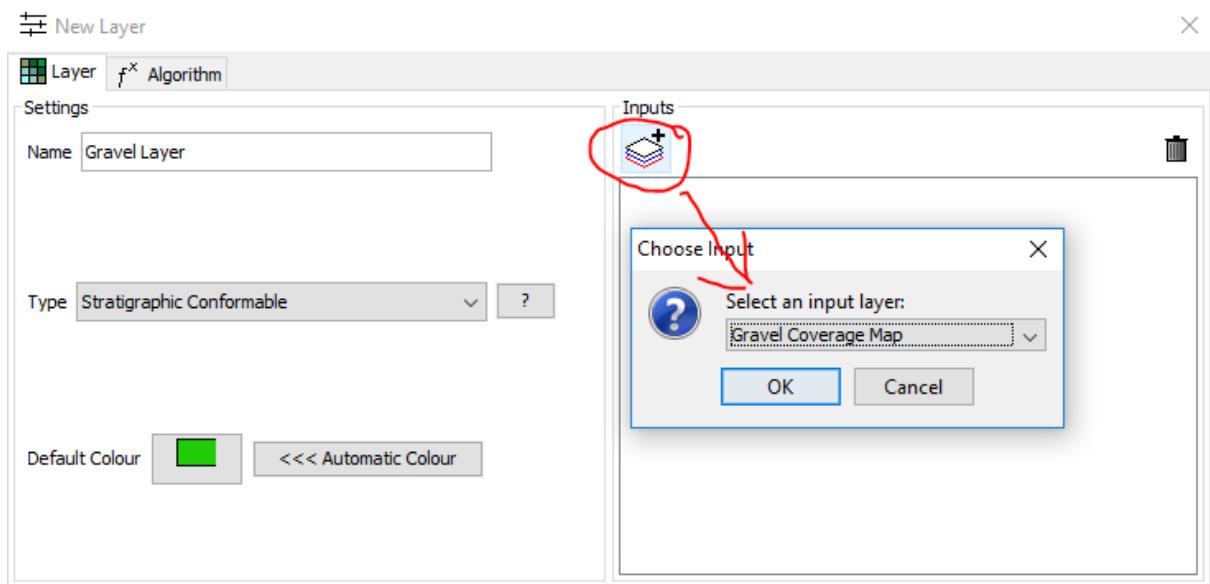


Here is an example of a coverage polygon drawn for a layer.

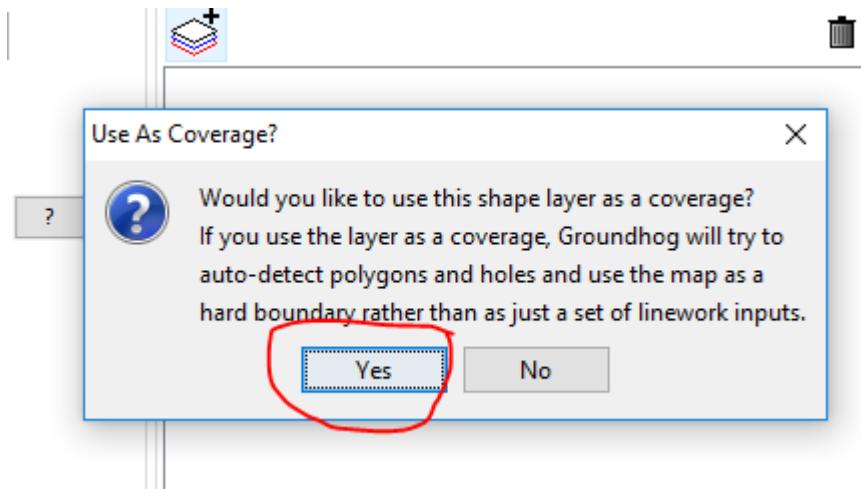


Note that a coverage can be composed of multiple polygons, including polygons-with-holes (nested) to any level of detail.

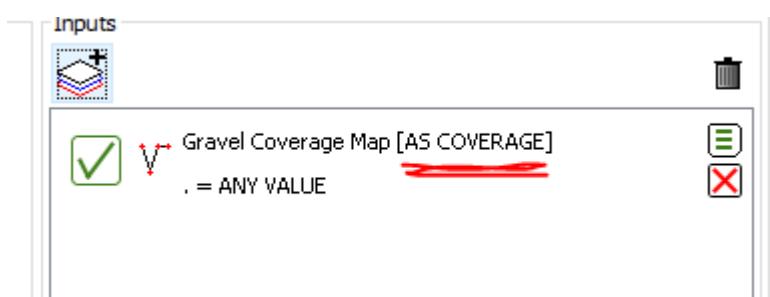
Next, add the shape layer to the desired model layer as an input.



When prompted to set the shape input as a COVERAGE layer, click <Yes>

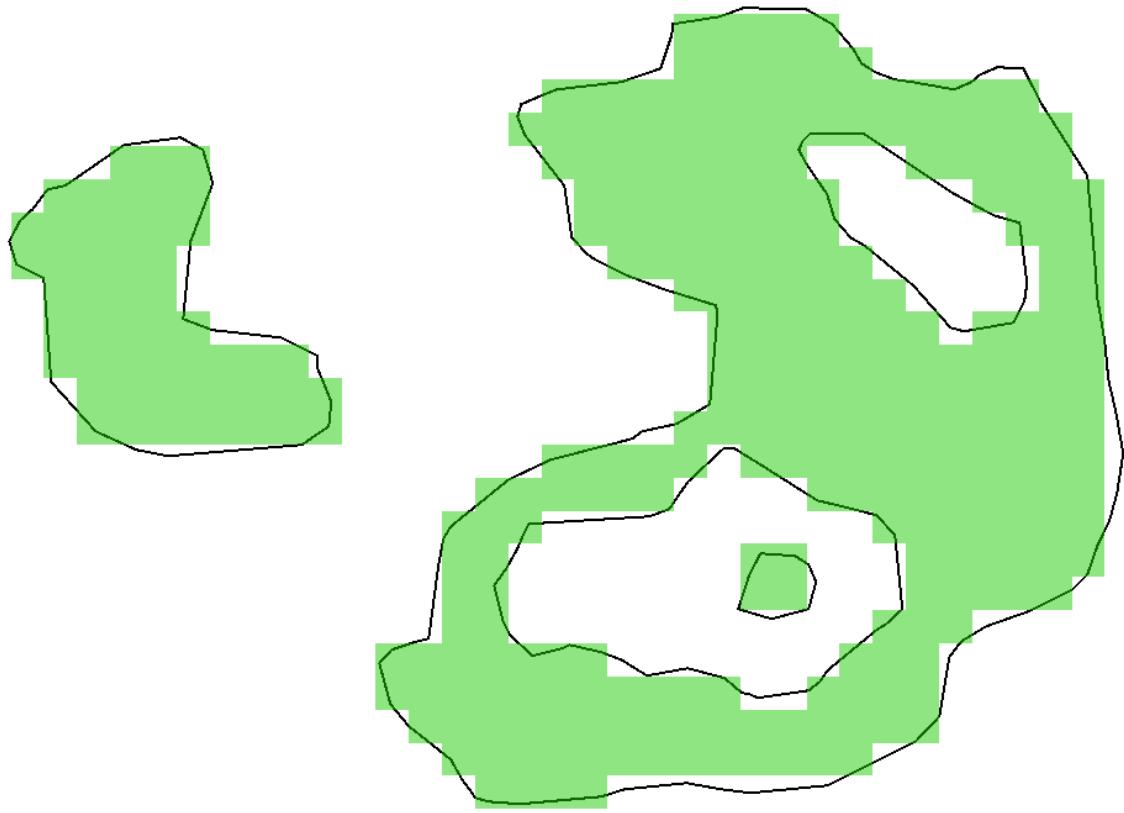


Note that shape layers which are acting as coverage layers are labelled thus in the input list.

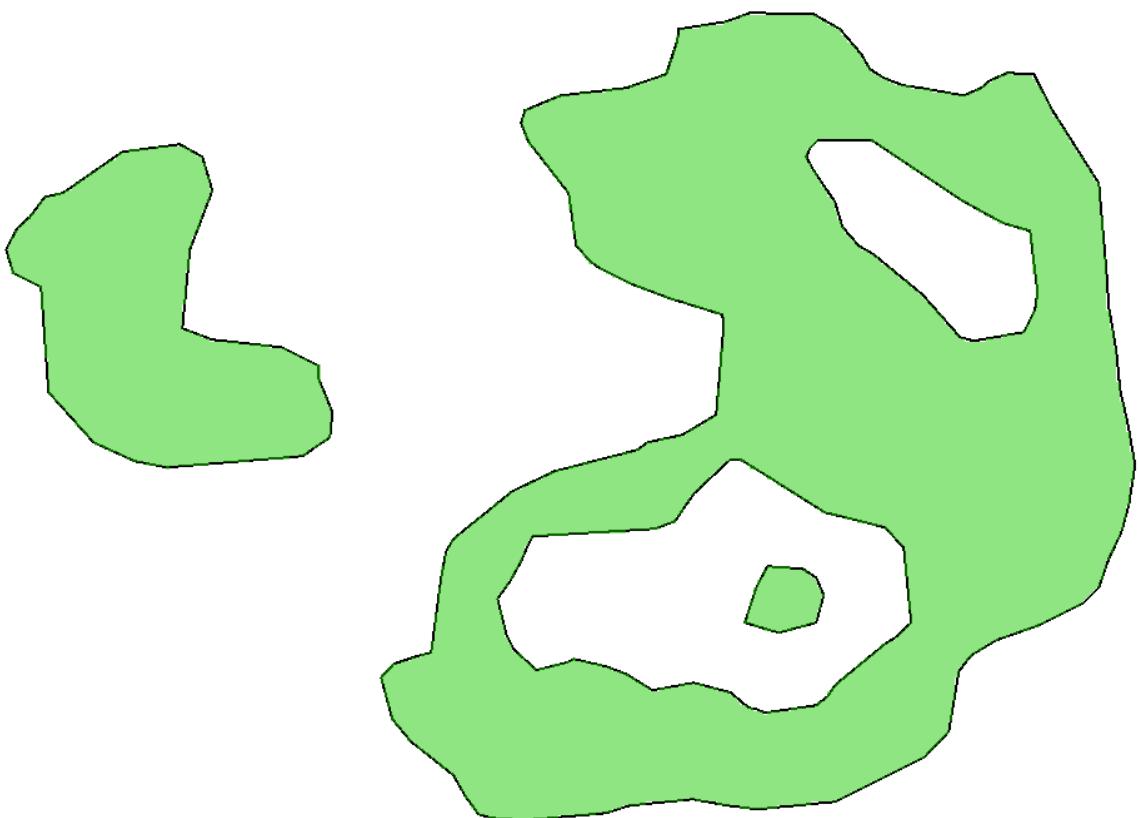


If you need to change the status of the layer you should delete it from the inputs list and then re-add it.

Calculate the model. Note that the calculation of the layer stays within the shapes of the coverage layer.

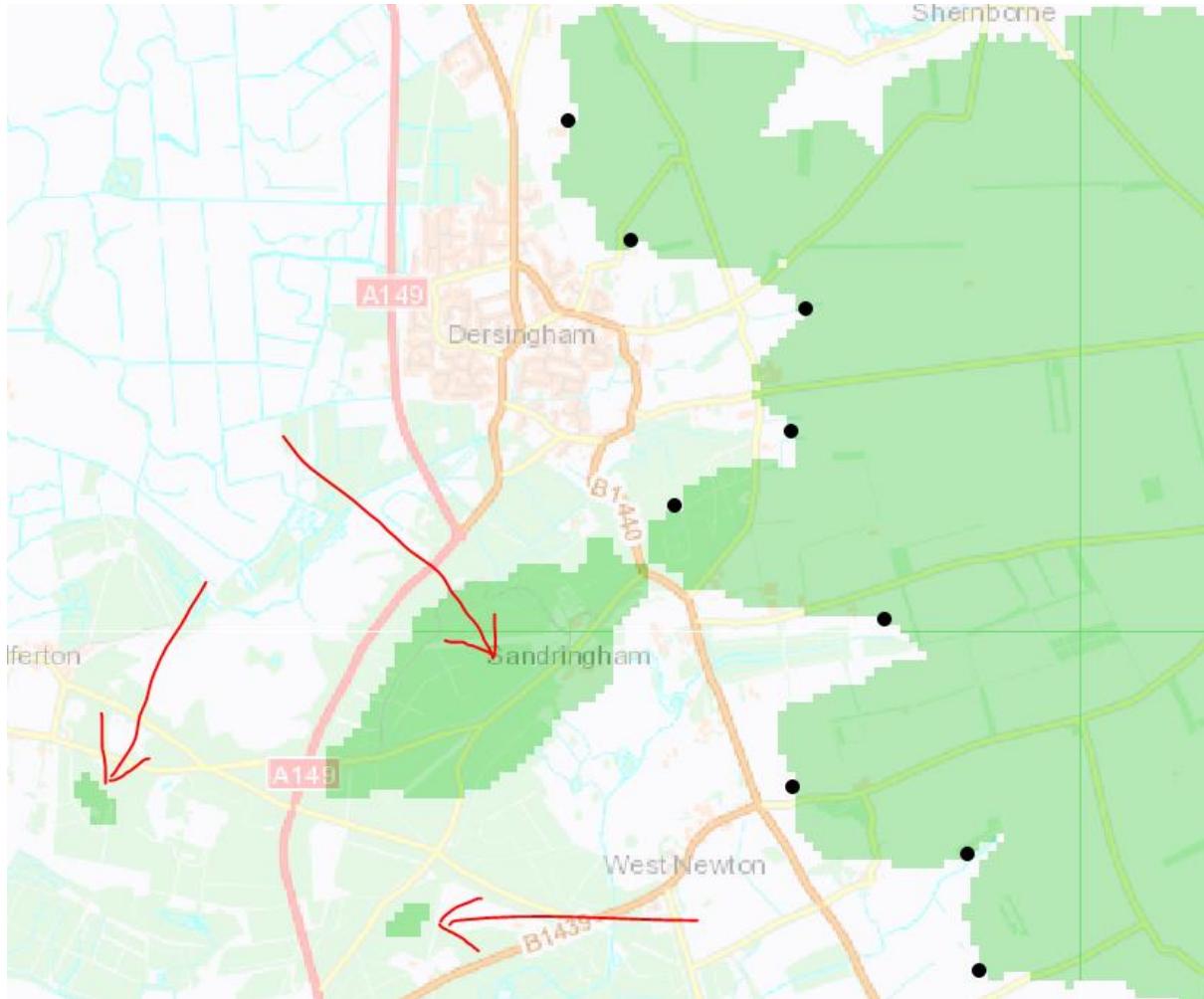


Working at a higher resolution shows the effect of this more clearly, especially if the coverage map is very detailed with lots of small holes and islands.

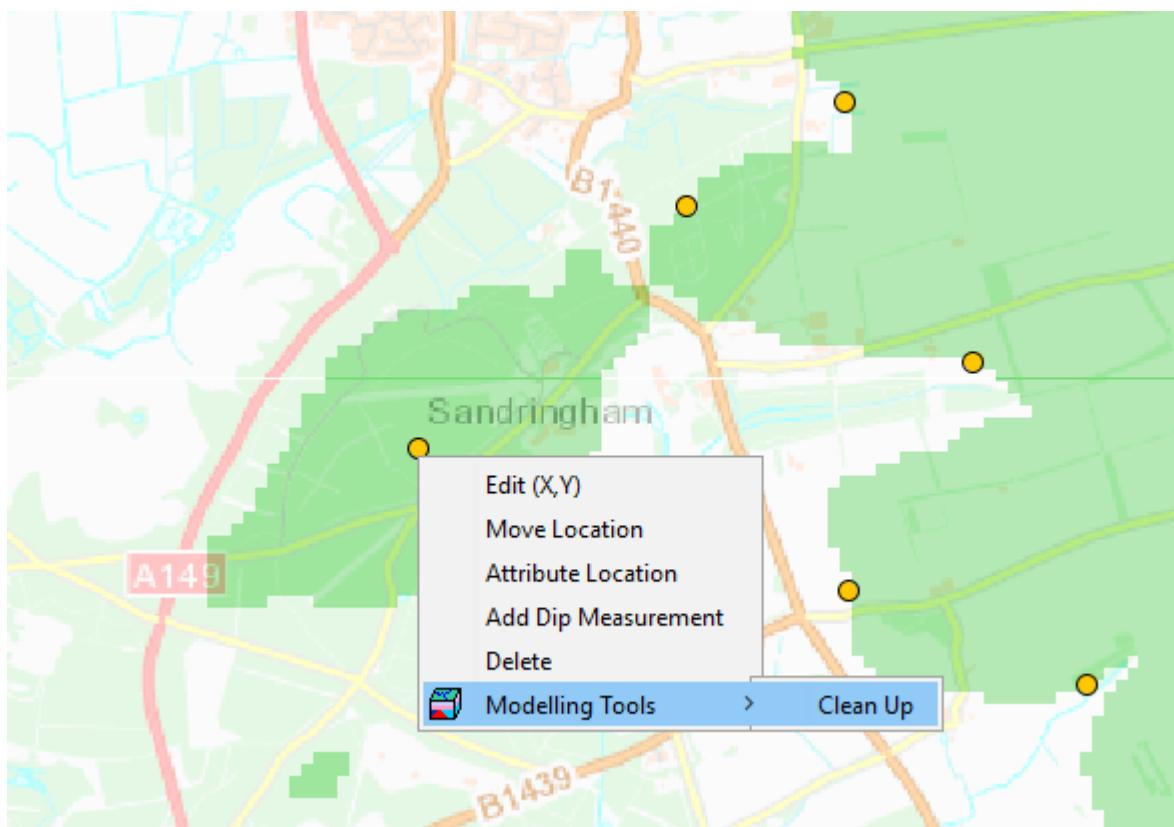


### *Control Points*

Points from point layers can be used as control points. Control points act to remove an area of modelling and are a quick way to clean up models. Below is an example of a model layer with an area that needs to be cleaned up (highlighted by the arrows).



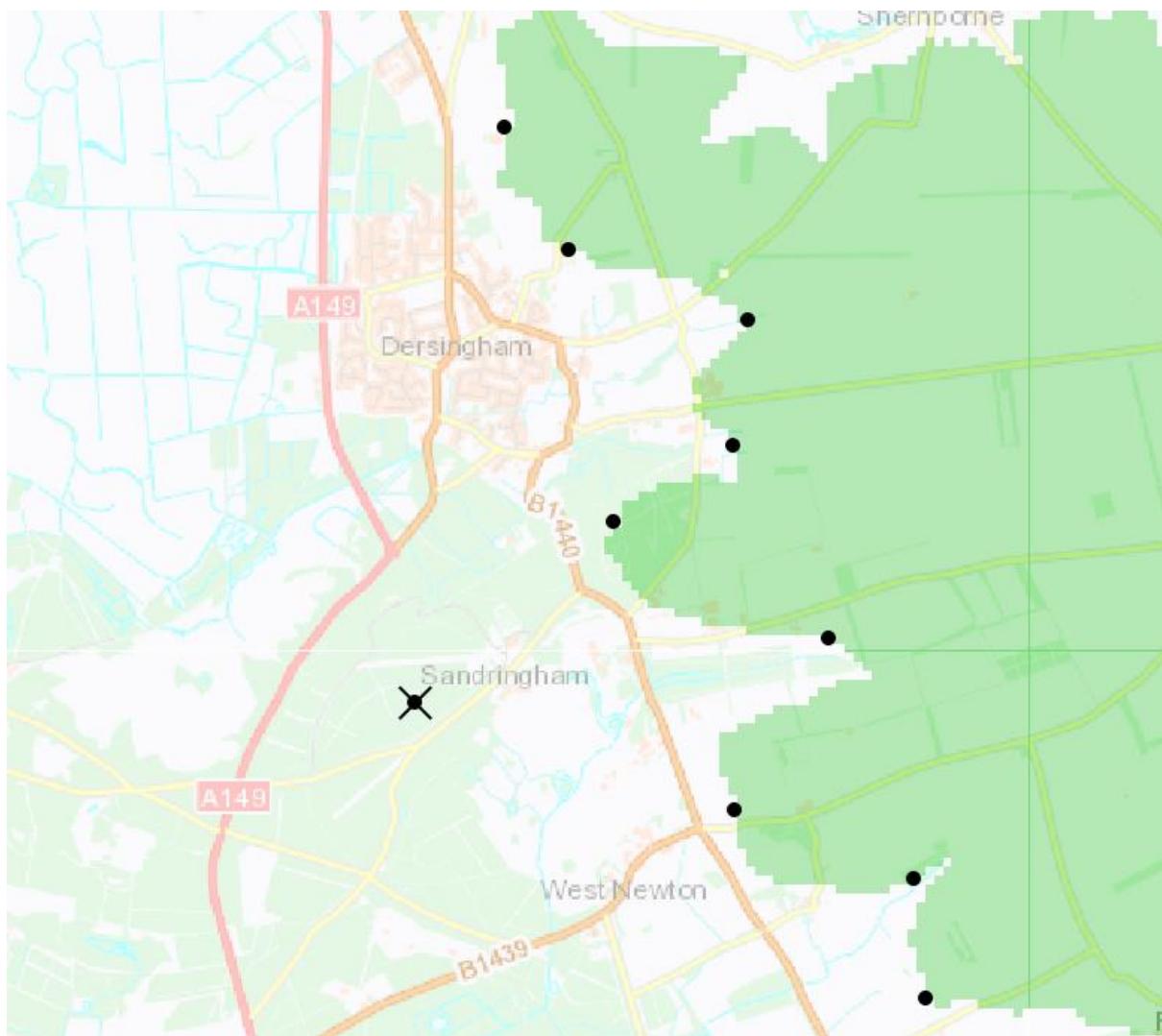
To set a point as a control point, place the point in the desired location and then use **<Right-Click> <Modelling Tools> <Clean Up>**



The point is displayed as a cross icon.



Re-build the model.



# 3D Graphics

This section provides details on how to operate the 3D graphics component within Groundhog.



*Photo by Nathan Duck on Unsplash*

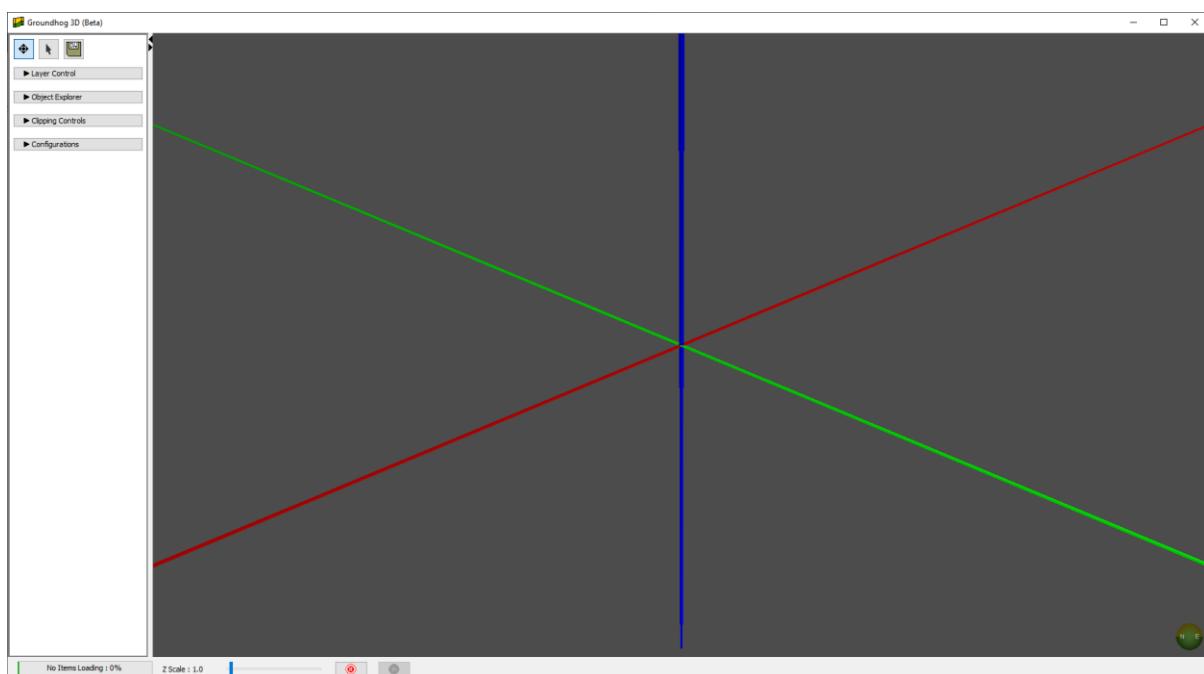
## About

The 3D window in groundhog has been developed in order to visualize the data that you import and create in 2D. All of the features of the 3D window are available in community edition. From viewing boreholes and cross sections, as you can in the map and section views, as solid, spatially referenced objects to elevation grids as surfaces and block geology models.

## First Use

To open the 3D window, click the  3D window button and you will be presented with the user interface.

## User Interface



The window has three main areas of control:

## The control panel



The control panel is where you will manipulate what data you are viewing and how you will view it in 3D. The controls are split into tabs for easy navigation and there are three controlling buttons at the top:



1. Move: This will allow you to rotate, pan and zoom in the 3D scene.

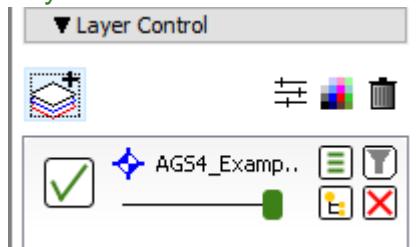


2. Pick: This button is currently in beta but when the window is in this mode, you can no longer move around but instead select objects by clicking them. When an object is selected (clicked on) it will open in the object explorer tab which we will visit later. (As this is in beta only some data types are supported)



3. Save: Self-explanatory but with many functions, the save button will allow you to save a variety of items from the configuration of the window (camera position and layers) to mp4 videos you record to .OBJ exports of supported layers in the window.

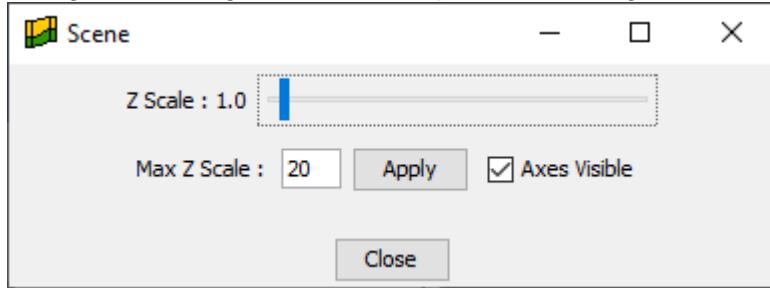
## Layer Control



The first of the tabs in the control panel is the **layer control** with which you will be familiar from the map and section window. Along the top, left to right, there is:

1. The add layer button, opening the usual dialogue

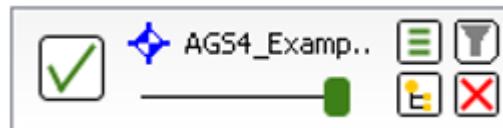
2. The global setting button which opens this dialogue:



Here you can set the vertical scale of the window, the maximum vertical scale for the slider and turn on and off the axes in the window.

3. The background colour button, which changes the background colour of the 3D window
4. The clear layers button which will remove all of the layers from the window.

The next item is the representation of a layer.

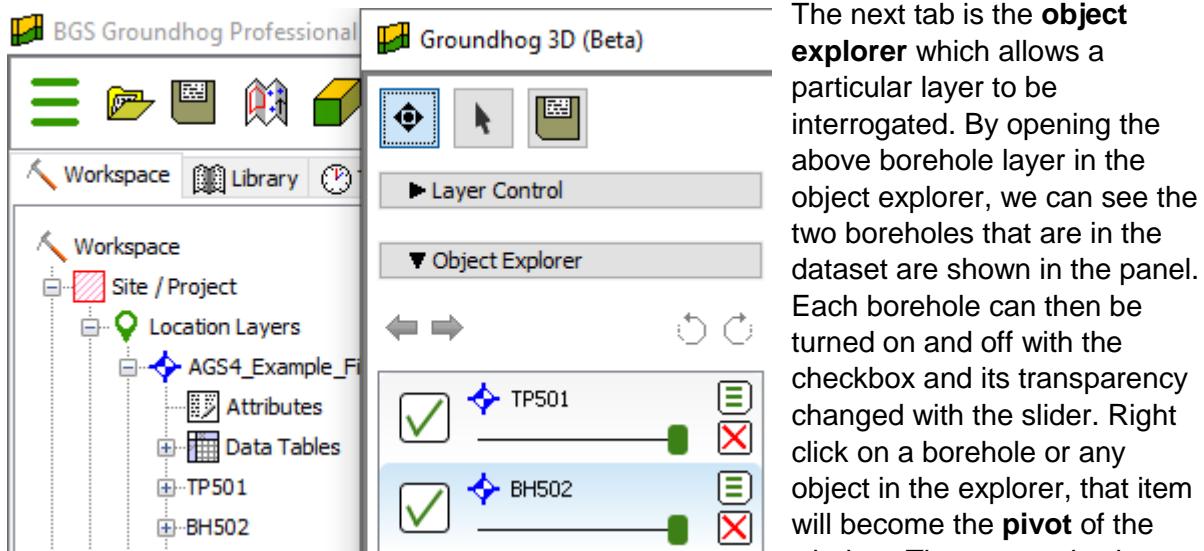


Here you can see the name of the layer, the icon of the layers type, in this case borehole, a checkbox for the visibility of the layer, a slider for the transparency and 4 buttons. From left to right, top to bottom:

1. Settings: this will open up any settings for the layer (some of which will be described below)
2. Filter: this will open any filters for the layer
3. Object Explore: Will open the layer in the object explorer (the next tab we will look at)
4. Remove: which will remove the layer from the window.

When multiple layers are in the layer control, they can be dragged around, just as in the map and section layer controls, to change the drawing order and allow certain objects to be seen through others.

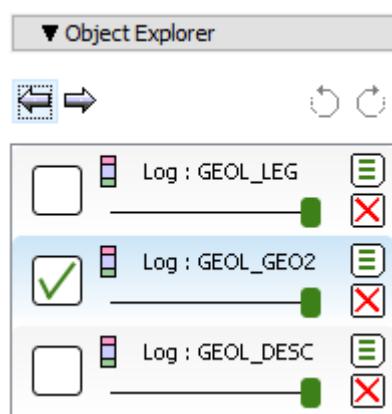
## Object Explorer



The next tab is the **object explorer** which allows a particular layer to be interrogated. By opening the above borehole layer in the object explorer, we can see the two boreholes that are in the dataset are shown in the panel. Each borehole can then be turned on and off with the checkbox and its transparency changed with the slider. Right click on a borehole or any object in the explorer, that item will become the **pivot** of the window. There may also be

settings for an object which can be accessed through the settings button.

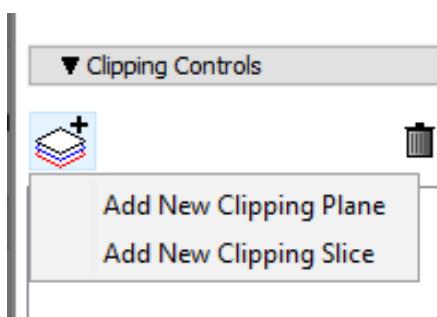
If you double click an object in the explorer, that object will be "opened".



Here, the object BH502 has been opened and you can now see all of the logs and manipulate them as with any other object.

The arrow buttons can be used to move backwards and forwards in and out of objects.

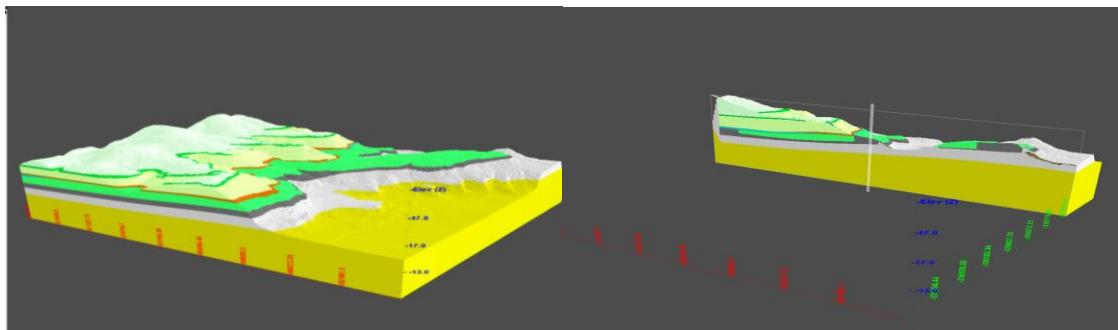
## Clipping Controls



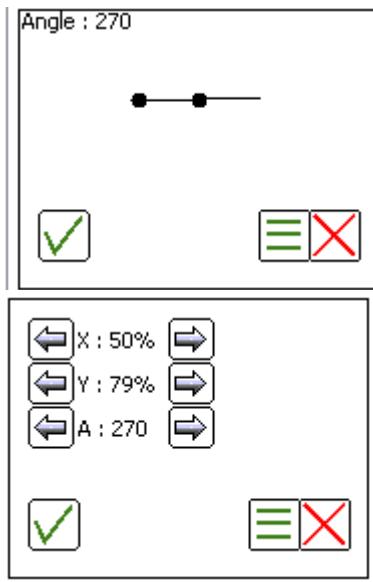
After the object explorer, you will find the **clipping controls** tab. The add button will give you two options:

1. Add new clipping Plane: this will add a new clipping plane to the scene, allowing you to slice and interrogate your data at whatever angle you wish wherever.

This is particularly useful for viewing 3D geological models produced in Groundhog Professional.



When you create a clipping plane, you will be greeted with a control that looks like this:

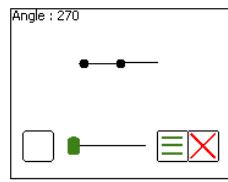


To rotate the plane, drag the circle at the end of the line, and to move the center point of the plane, drag the center circle in that direction.

If you are struggling with this control, by clicking the settings button, you can also incrementally change the positions.

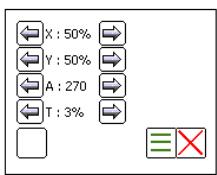
A is for azimuth as an angle in degrees.

If you choose a **clipping slice** the controls are much the same, with the addition of a

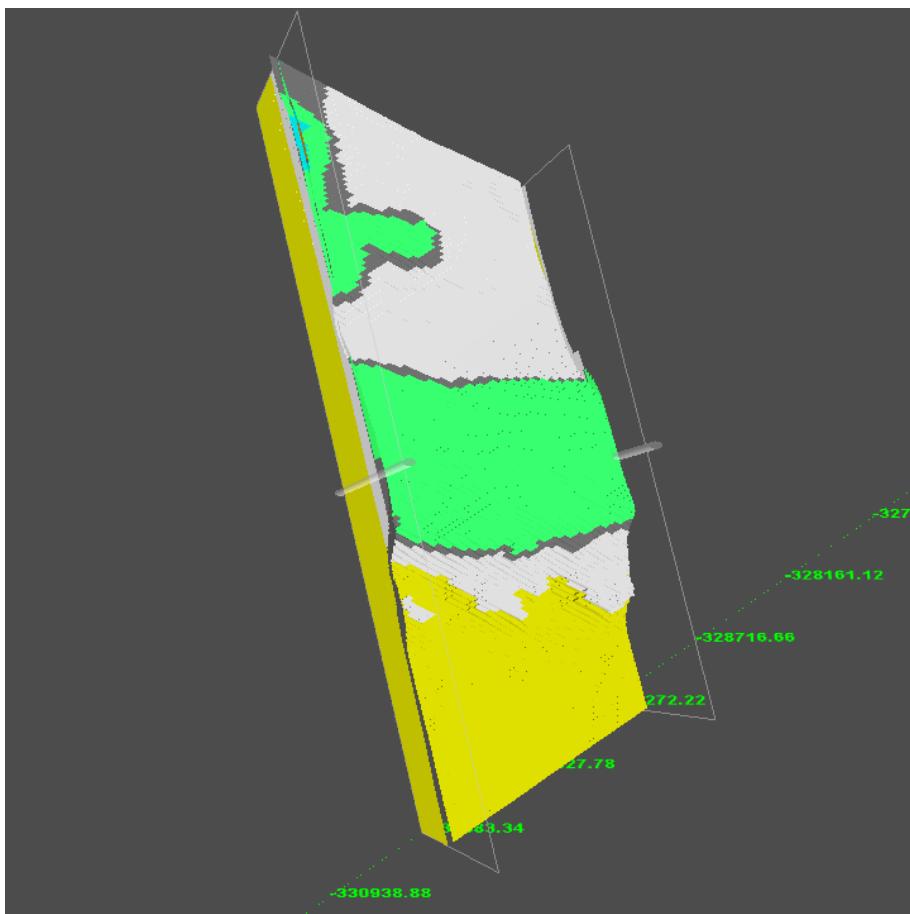


thickness. On the graphical control:

and by buttons is represented by T:



The difference with a clipping slice over a clipping plane is that there is somewhat a slice of cake taken out of a model :



## Configurations

**Configurations** is the final tab in the control panel and its purpose is to provide shortcuts to nice “views” of your data.

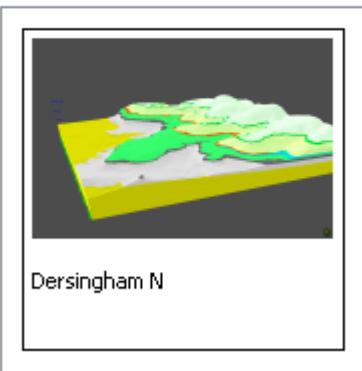
If you like an angle of looking at your data or particular clip, you can press the save button



and all the information will be saved, a link to it being shown then in the configurations tab.



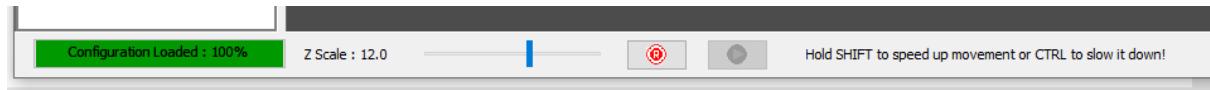
Select the saved configuration you would like to see and you will be taken there.



While a configuration is selected, selecting this button will allow you to rename the configuration

The bin will remove all configurations.

## The Hot Bar

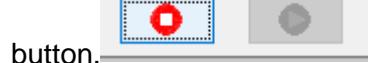


The hot bar is the area at the bottom of the groundhog 3D window which looks like the screenshot above. Here you can find useful information and some quick access tools.

The first item is the loading bar. This will give you information on the progress of any actions such as loading and saving.

Next is the vertical exaggeration slider. By moving this slider, you will increase or decrease the vertical exaggeration on the window.

The following tools you will find are the recording and playback tools. In order to create a playback, click the record button, maneuver around the scene in the order you wish to re-watch and, finally, click the stop button that will have replaced the record



In order to watch your playback, simply click the play button.

When the play button becomes available, you will be able to save a playback as an MP4 by

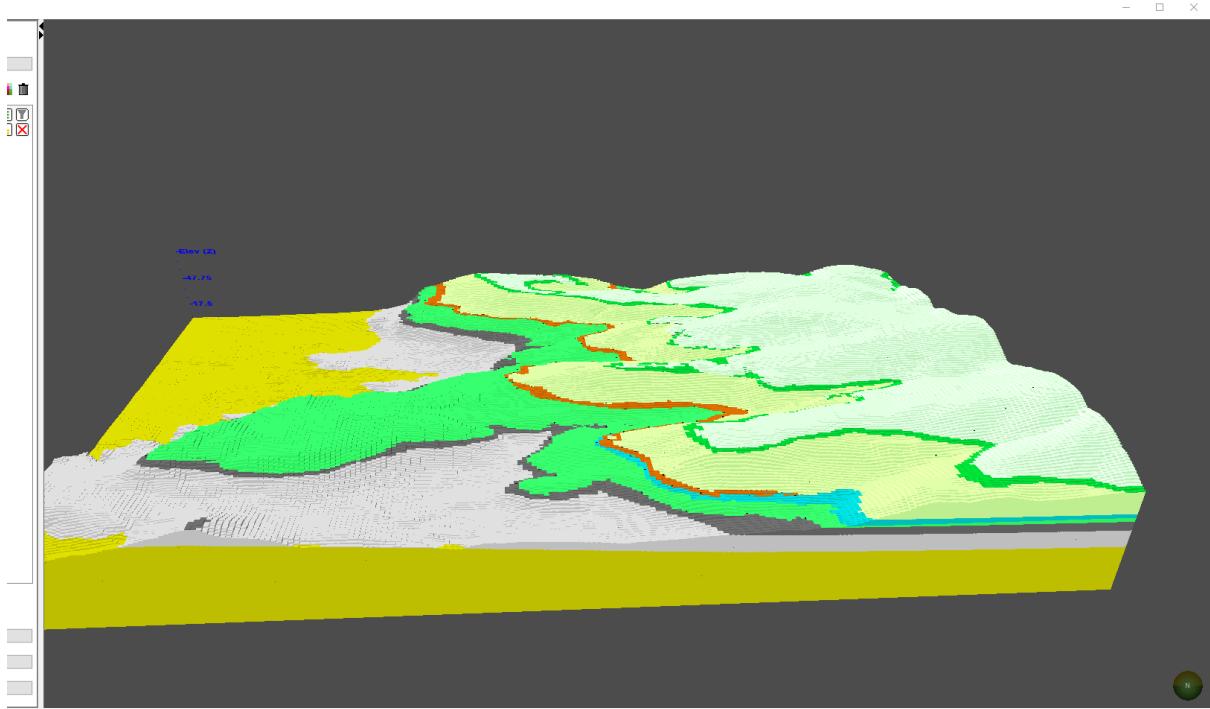
clicking the save button  and selecting the playback option from the dropdown.

Finally, on the hot bar, there is the message area.

**Hold SHIFT to speed up movement or CTRL to slow it down!** Useful tips will be displayed here.

## The Scene

This is the final area of the 3D window and is where all of the data appears.



This area is very minimal, here we have:

1. The data: Whatever you have added to the scene from the add layers button.
2. The compass: Showing the direction you are looking
3. The axes: giving the scale of the data you are viewing

Navigation of the scene is broken into three types:

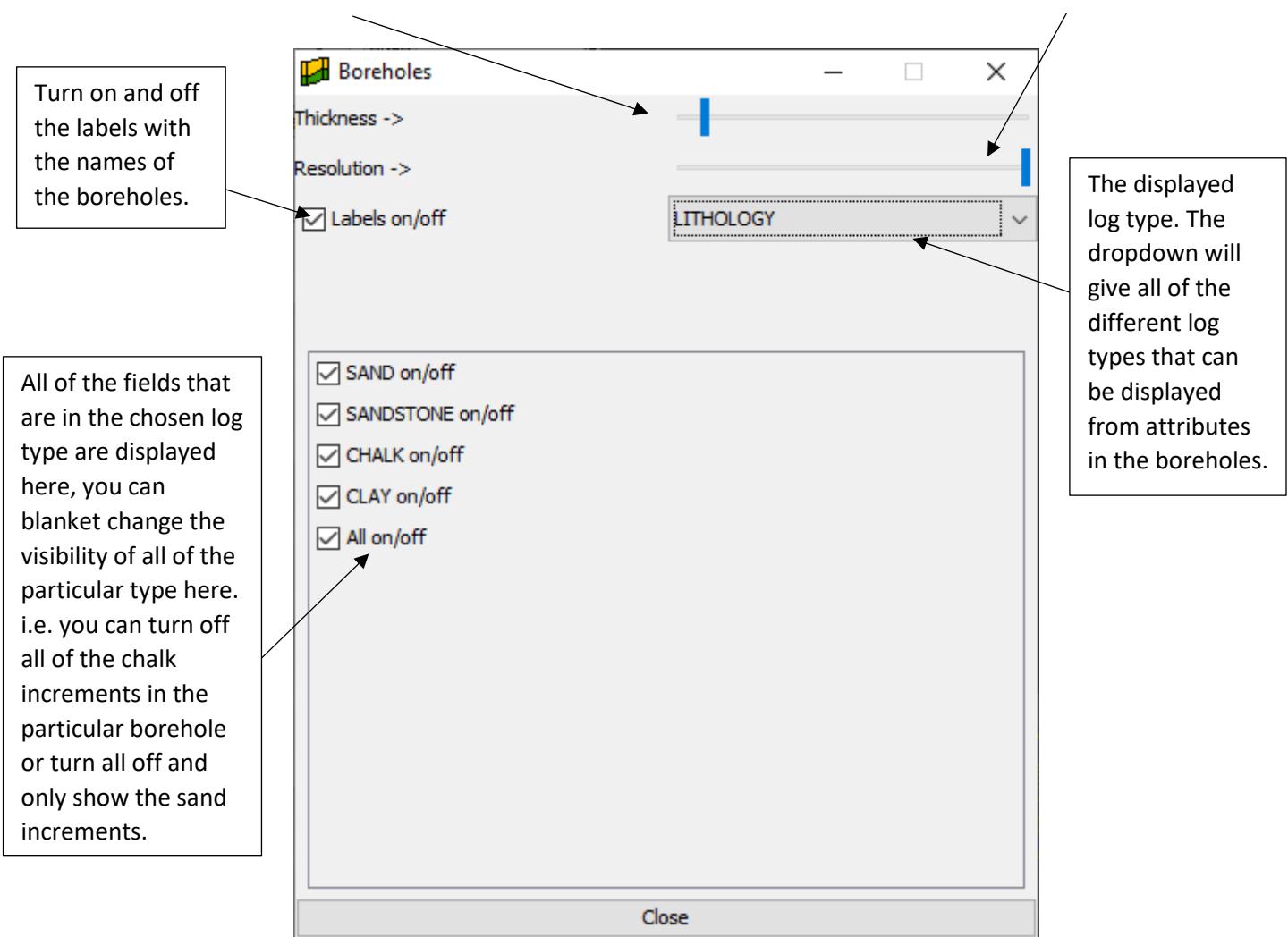
1. Rotation: press and hold left click and drag the mouse to rotate the scene.
2. Zoom: use scroll to zoom in and out from the data.
3. Pan: press down on the scroll wheel and hold then drag the mouse to pan around the scene.

## Settings

### Borehole Settings

The thickness setting. This will alter the diameter of the visualized boreholes.

The resolution slider. This setting will speed up the window when turned down, especially when viewing thousands of boreholes.

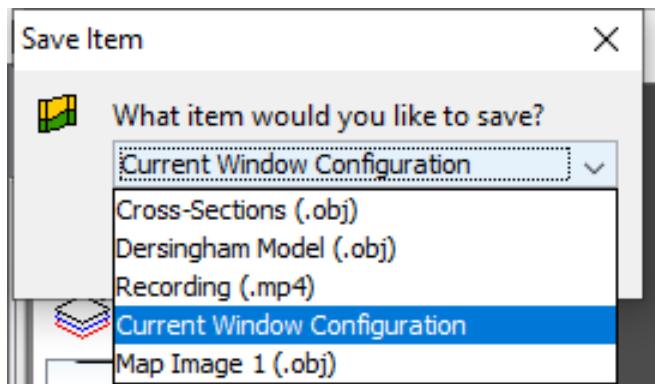


## Saving



The save button is a multi-functional save tool which will allow the saving of any savable layers or items that are currently existent within your current session. These could include 3D objects, videos and the configuration of your window.

When the save button is pressed, the following dropdown box will appear.



All of the options in the dropdown can be saved to their stated format and the possible options are as follows.

## Cross Sections

Cross sections can be saved from the 3D window to the .OBJ format which can then be imported into GeoVisionary and many other CAD platforms. There will be a selection of files exported which will be one for each unit and one which will represent all of the sections. All will be placed in a single folder in your chosen location called “Cross Sections”.

## Models

Geological models can also be saved to the .OBJ format and there will be a file created for each stratigraphic layer of your model. These will all be saved to the folder of your choosing.

## Surfaces

Keeping consistent with the other layers, surfaces too will be export as .OBJ files. There will be three files output.

Map Image 1.mtl	04/06/2020 10:08	MTL File	1 KB
Map Image 1.obj	04/06/2020 10:08	OBJ File	7,901 KB
Map Image 11591260071042.png	04/06/2020 10:08	PNG File	39 KB

These three should be kept together; there is one for the shapes, one for the colours and optionally one which will be the image used for the surface.

## Videos

If the playback function has been used then there will be the option to save this to an mp4 video. During the saving of the video, the window will be temporarily out of action and appear to move by itself, this is so that the information can be collected. Please do not interrupt this.

## Configurations

The final option is the current map window configuration and as previously mentioned will save the view on the screen as a waypoint which you will be able to click and return to at a later date. Once you have provided a memorable name, it will appear in the configurations tab like this:

