

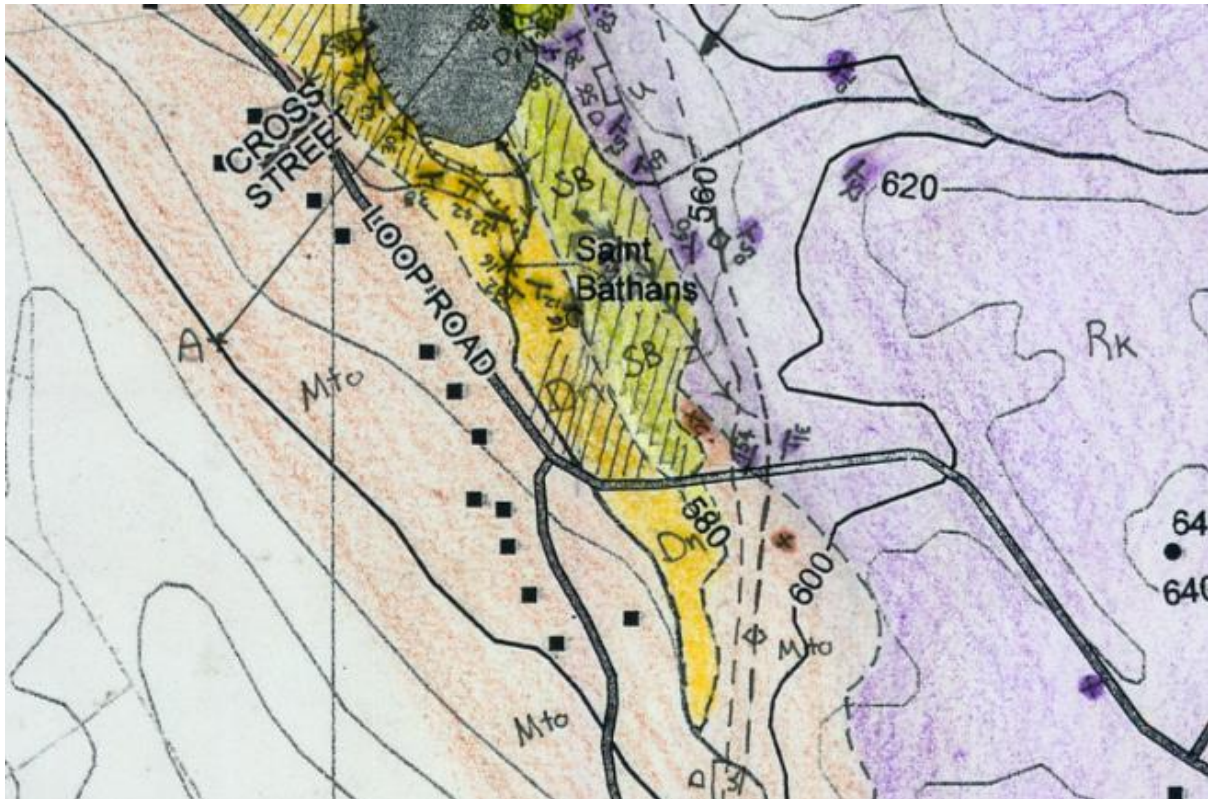
Digitising a map in arcgis desktop 10.3

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2 EVALUATING YOUR MAP

Below is a map I borrowed from a student, the area is Blue Lake at St Bathans.



What elements are on this map and how can they be abstracted as GIS data?

Type of data	GIS data type (and rules)	Attributes
Topo data	Objects: Points, lines and polygons	
Geological units	Objects: non-overlapping polygons. No gaps	Unit code
Geological contacts	Objects: lines should not have gaps. No overhangs	Accuracy
Fault	Line with a direction	Dip
Anticline	Line	

Q: What is the difference between a fault and an anticline in terms of abstraction in GIS?

A:

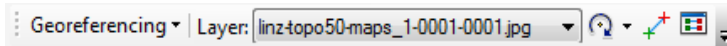
NOTE: Some of the following tasks are example tasks and are not specific to your map.

3 SETTING UP THE BASE MAP

You will need to start with some map open in Arcmap of your area, so that you have something to georeference your field map/s on. The tutorial folder has a map ready to go “**geology-digitsising-editing.mxd**” which connects to some vector data in “**GIS data.gdb**”. If it’s for your own map usually some kind of topo map will work (e.g. topo50 in NZ). Or just use the one you made as a basemap.

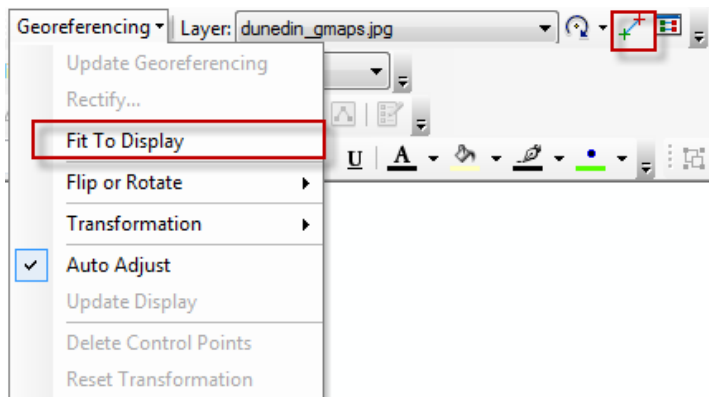
4 GEOFERENCING YOUR MAP/MAPS




1. Put the scanned file of your map in the folder with your map. The tutorial folder has “**example_map_portion**” that you can use.
2. Open your scanned map file in a photo viewer (we are going to georeference this with respect to your base map)
3. Open your map and adjust the field of view in ArcGIS to your printed map. Add your **Example_map_portion** to your map (using ArcCatalog sidebar)
4. Bring up the georeferencing toolbar (customize>toolbars>georeferencing)



What we want to do is to add fix points in the image to points on the map. We want an even spread of control points across the image if possible.



5. Select your **Example_map_portion** as the layer we want to georeference
6. Under georeferencing choose fit to display



7. In order to georeference this we need to make it translucent. Go to>layer properties>source and set transparency to 30%. Or bring up the **effects toolbar** to set transparency.
8. The next stage is to **snap** control points on the image to the map. The tool for doing this  is in the georeferencing toolbar.
9. The general method is to click a point on the image with this tool  and then click the corresponding point on the map. (see tips below). Because the scanned map has coordinates on it we can use these to aid in georeferencing.
 - a. Identity the coordinates of a single point on the map. Click on that point using this tool:  then right click
10. When you are happy you **MUST** update the georeferencing (Georeferencing toolbar menu>Update georeferencing) If you don’t do this before closing the document the georeferencing will be lost!

This creates an auxiliary files called a world file (e.g. .tfw) which describe how to move and stretch the image to fit it on the screen. Move items using arccatalog to ensure all files are moved properly.

4.1 GEOREFERENCING TIPS.

- Start with easily recognisable points.
- Rough placing: Pick a couple of points that are reasonably far apart on the image and georeference these roughly first.
- Once the image is roughly placed you can find a couple of better control points near the original ones (if needed). You may then decide to delete the original points.
- You can delete points that cause distortion using the link table 
- If you georeference points with known coordinates you can enter these directly into the links table. 

5 DIGITISING YOUR MAPS

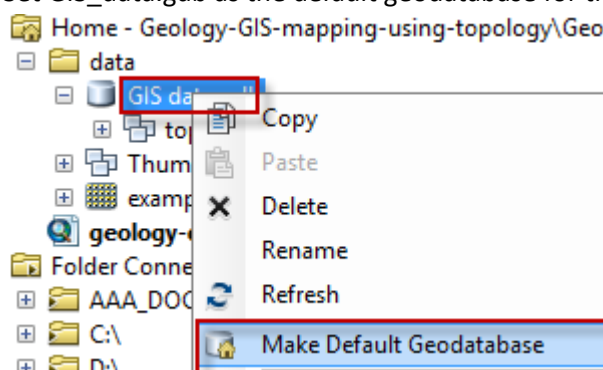
5.1 APPROACH TO DIGITISING

There are a lot of different ways to approach digitising a map in ArcGIS. The approach we will be using here is to draw all our geological contacts and a map boundary line and then generate the unit polygons based on the areas defined by the contacts. This approach produces the cleanest result and reduces duplication of effort.

5.2 SETTING UP YOUR DATA AND WORKSPACE FOR DIGITISING

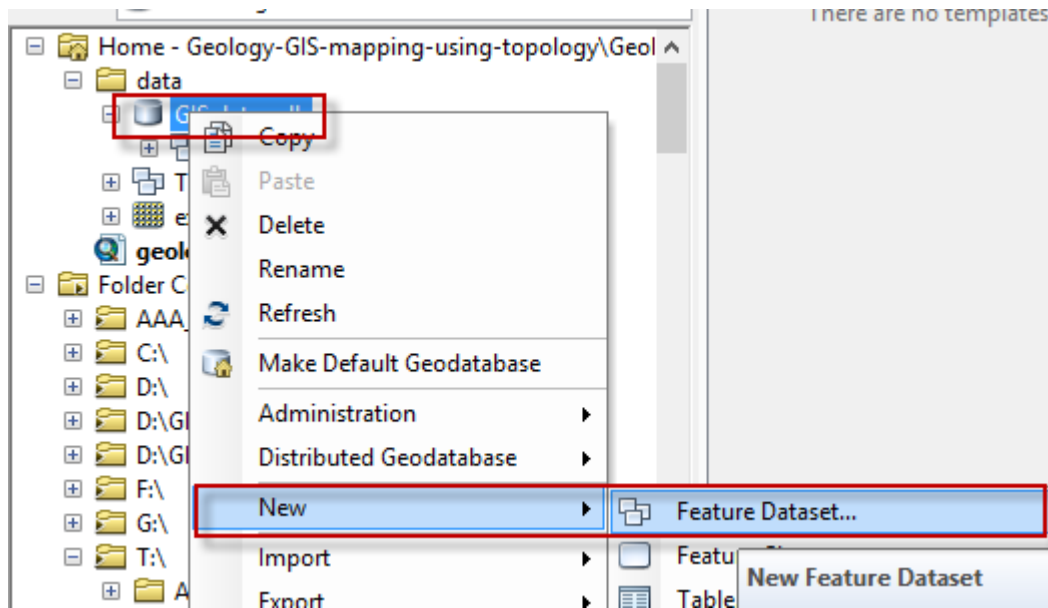
At this stage you should have a georeferenced map in Arcmap. Now we need to create some empty feature classes (vector GIS data).

1. Set GIS_data.gdb as the default geodatabase for this map.



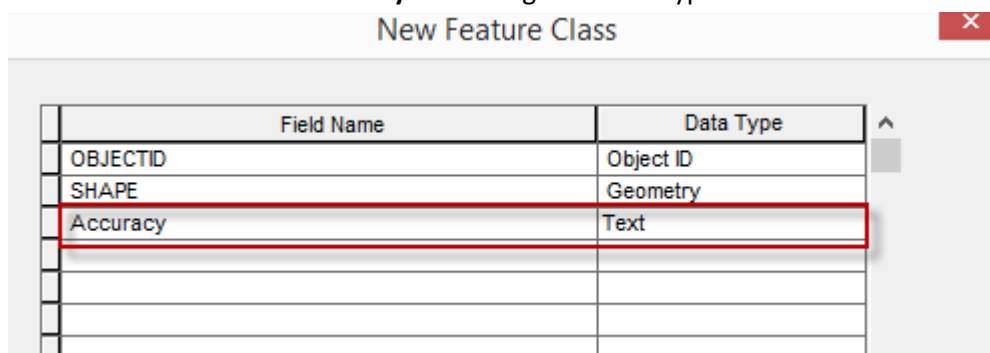
this puts it as the default location for saving etc.

2. Create a new feature dataset in the "GIS_data.gdb" called geology (right click on "GIS Data.gdb". You can make new file geodatabases by right clicking on a folder.

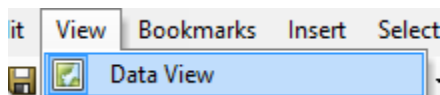


A feature dataset allows for relationships between features to be stored, which is useful for topological editing.

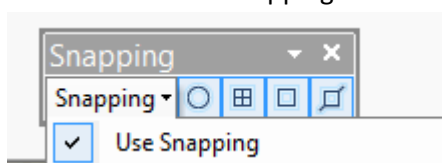
3. Create a new feature class within the feature dataset called Geology contacts.
4. Choose **line Features** as the type
5. Leave **Default** as the **Configuration keyword**
6. Add a Field name called **Accuracy** and change the data type to **Text**.



7. Finish.
8. We will create more feature classes in here as we go about digitising
9. Switch to data view in ArcGIS. **View>Data view**

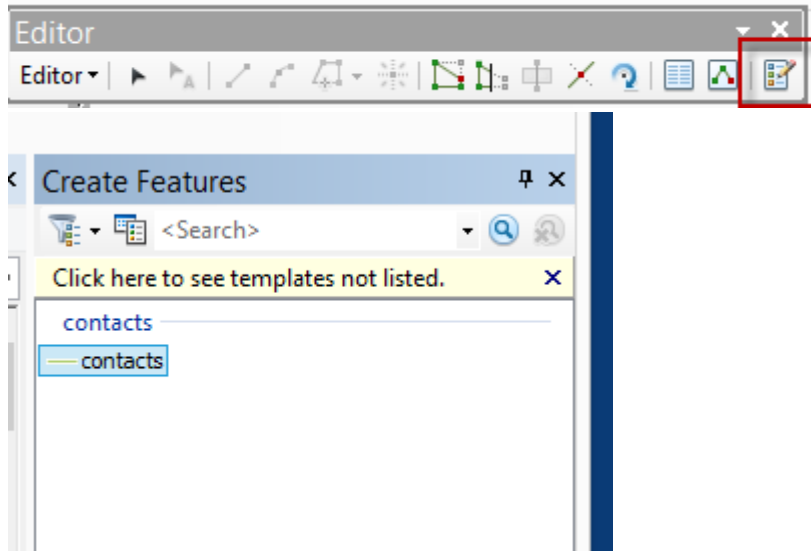


10. Make "**example_map_portion.tif**" the only visible layer
11. Bring up the editing toolbar **Customize Toolbars>editor**.
12. We also need snapping turned on and active so that all the lines connect together (in order for us to generate polygons later there must be no gaps).
 - 12.1. Open the snapping toolbar Via **Customize Toolbars>snapping**
 - 12.2. Make sure snapping is turned on and that all types are active.

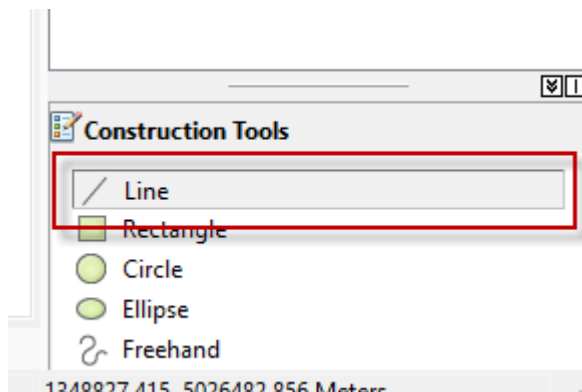


5.3 DIGITISING CONTACTS

1. Add your contacts layer to the map if you haven't already.
2. Start editing by going to **Editor>Start editing** or by right clicking on the feature you want to edit and choose **Edit Features>Start editing**. ArcGIS may prompt you to choose a file to edit. This means you can edit any files in the same folder or geodatabase (not just the file you selected)
3. You should see a create features dialog box on the right hand side. If you don't then click on the create features icon on the **Editor Toolbar**



4. Click on Contacts in order to edit contacts.
5. Down the bottom of the **create Features** box you will see **Construction Tools**. Make sure Line is selected.

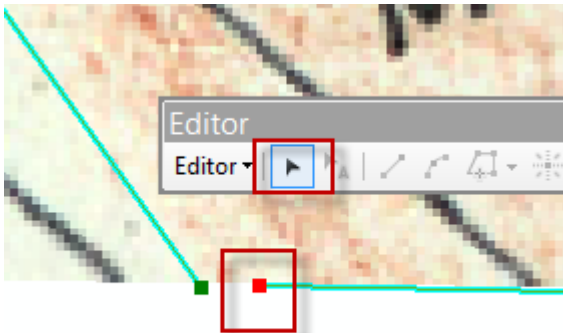


6. Start by drawing the bounds of the map area.
 - 6.1. Click on the map to draw points for the line. Ideally the line will snap to itself at the end. But this doesn't seem to work. Double click to finish the line with a small gap. Or **Right**

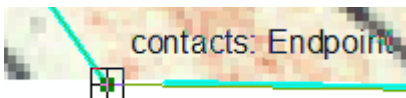
Click>Finish sketch.



- 6.2. Activate the Edit tool (in the Editor Toolbar) and then Double click on a node that you want to snap into place.



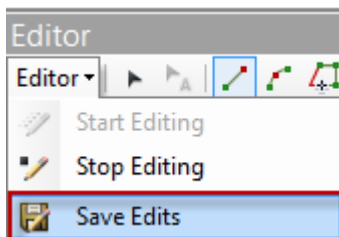
- 6.3. Drag it onto the other node until it snaps



- 6.4. Click off the object.

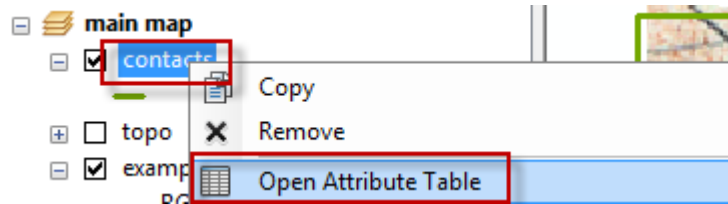
7. Next we need to digitise our contacts.

- 7.1. Click on **Contacts** in the **Create Features** box and digitise your contacts being careful to snap all lines together and drawing different lines for the different contact types (e.g. accurate or approximate)
- 7.2. It's a good idea to save edits as you go By going to **Editor toolbar>Save Edits**. Saving your map doesn't save data edits!



8. Finally we need to do is to fill in accuracy info in the attribute table.

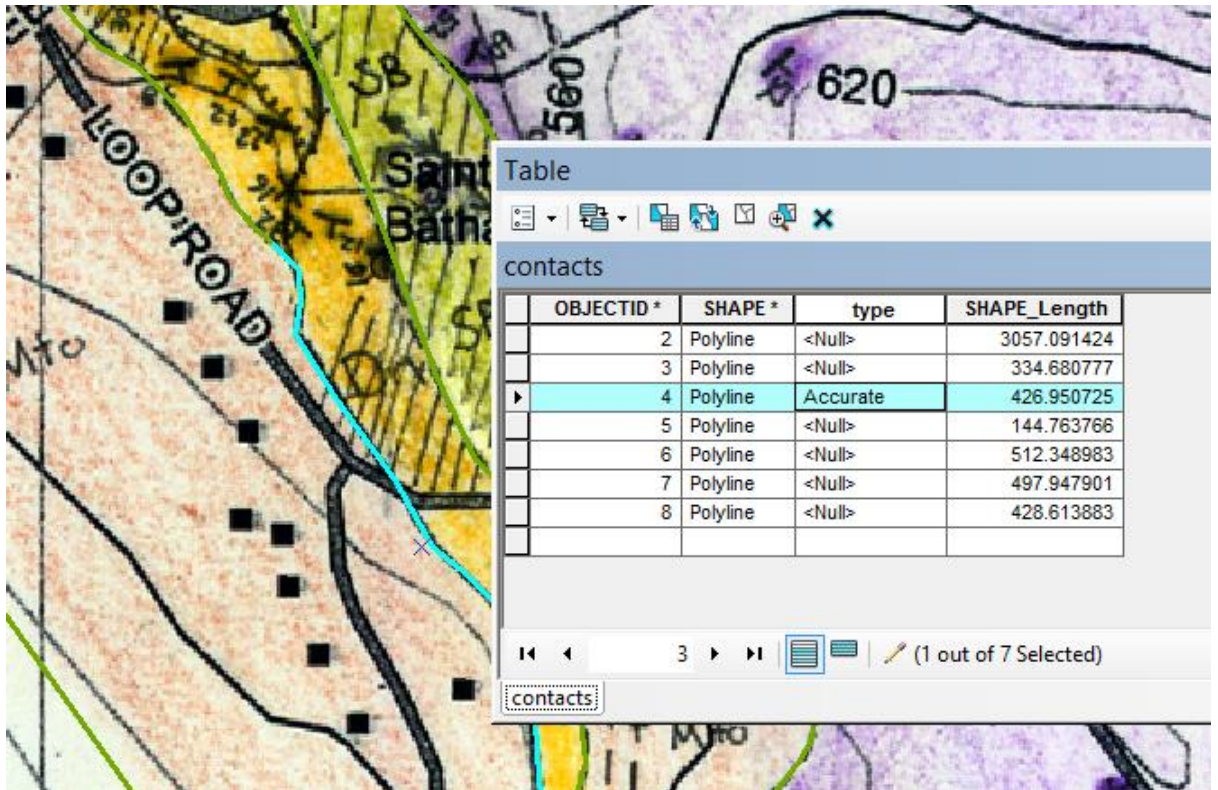
8.1. Right click on **contacts**>**Open Attribute table**



8.2. Start editing the contacts layer (required to edit attribute table).

8.3. Use the select tool and select a contact line.

8.4. The line you selected will show up blue in the attribute table. Set the accuracy field. **Solid = accurate, dashed = approximate.**



8.5. Go through the rest of the contact lines and set their accuracy attribute. Make sure you make the text exactly the same (case sensitive, spelt correctly).

8.6. Leave the bounds line with no attribute (we don't really need to show this).

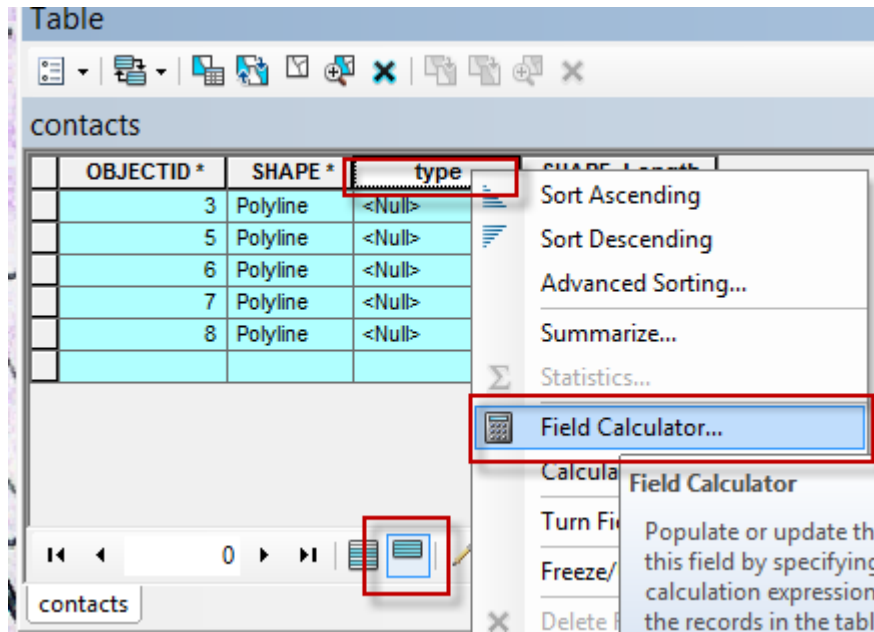
8.7. *TIP 1: You might find it easier to set these attributes at the same time you are drawing in the future.*

8.8. *TIP 2: Apply attributes in bulk using the field calculator.*

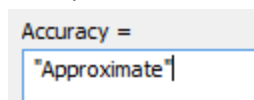
8.8.1. *Shift click to select contact lines with the same accuracy.*

8.8.2. *Filter for selected records in the attribute table.*

8.8.3. Then right click on the **Accuracy** column and select **Field Calculator**



8.8.4. Then put in the text that should appear in quotations: e.g. "Approximate".



8.8.5. Then click **OK**.

8.8.6. Then turn off the filter in the attribute table.

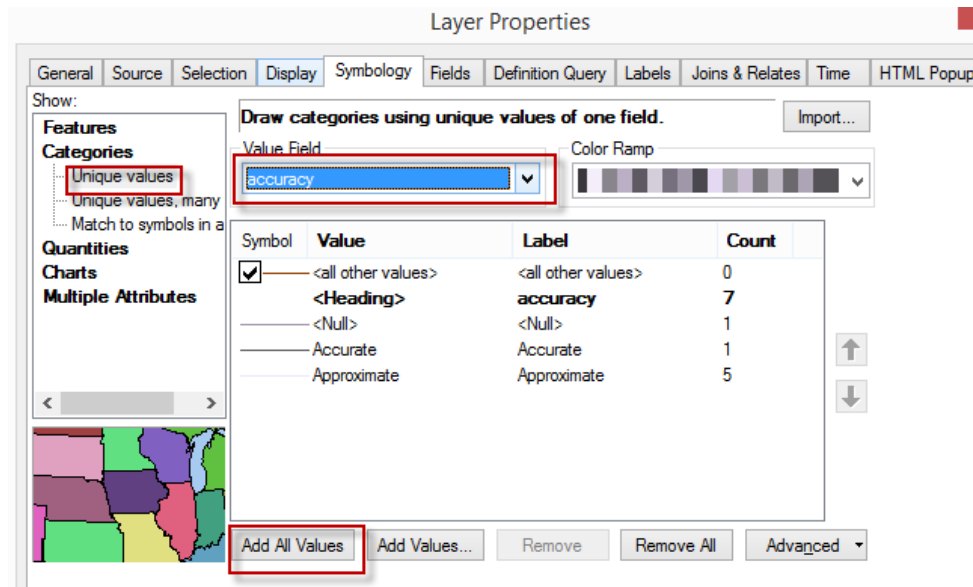
9. Save your edits

5.4 SYMBOLISING THE CONTACTS

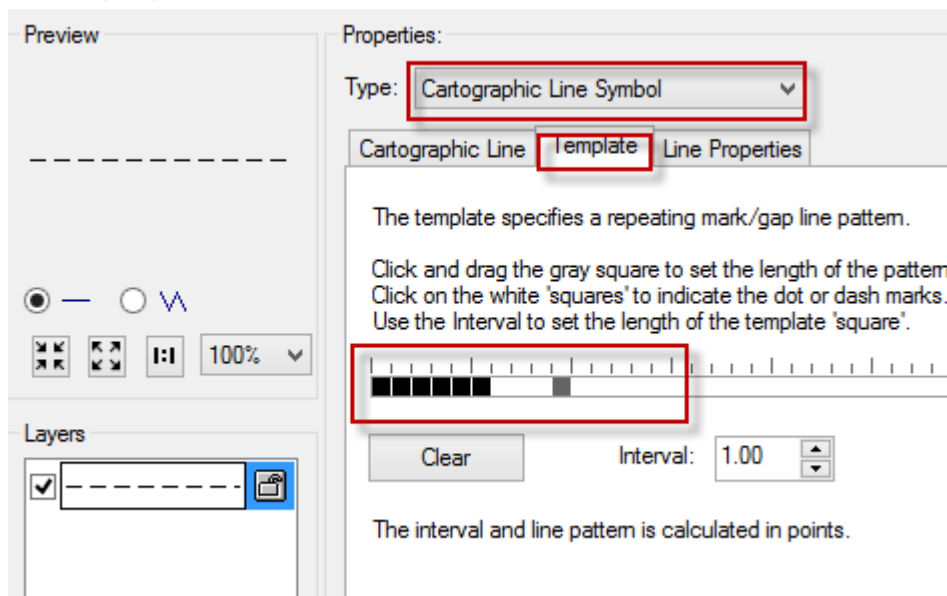
At this point we now have some nice GIS data with attributes. The next step is to change the symbology for our contact lines.

1. Right Click on **Contacts Layer>Properties**
2. Go to **Symbology** tab
3. Change type to **Categories>Unique values**
4. Set the **Value Field** to **accuracy**

5. Click on **Add All Values**



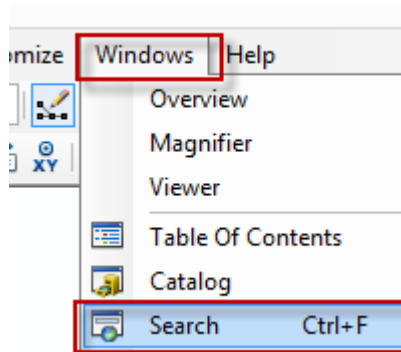
6. Remove **Null** and uncheck **<all other values>**
7. Double click on **Accurate** and set to solid 1 pt.
8. Double click on **Approximate** and set to black line 1pt.
9. Then click on **Edit symbol**
10. Switch to **Cartographic Line Symbol** type
11. Go to template tab
12. Move the grey box over and fill in some black squares to create a dashed line as shown below. Click OK, OK,OK.



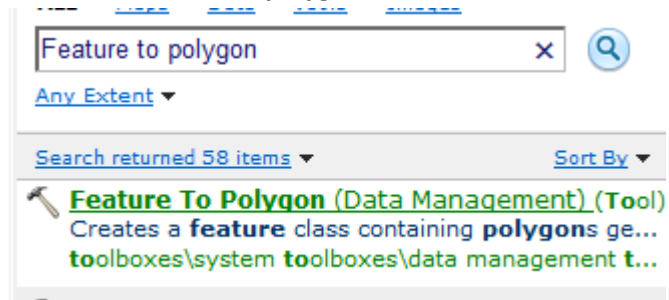
5.5 GENERATING POLYGONS

1. Now that we have our contact lines in, we can generate polygons within the spaces.

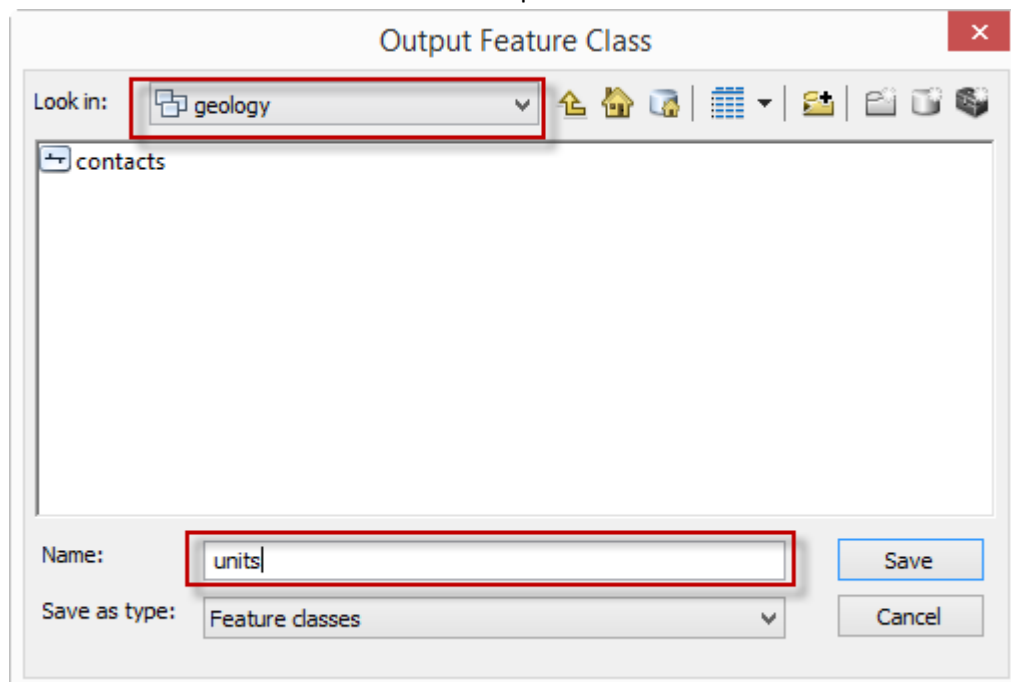
- 1.1. Open the Search box via **Menu bar>Windows>Search**



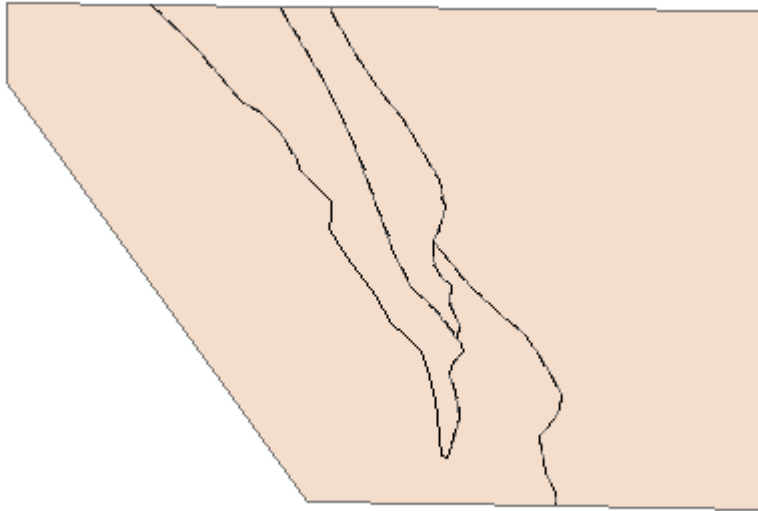
- 1.2. Search for **Feature to polygon** and click on the tool



- 1.3. Choose **contacts** as the input feature via the dropdown box (dropdown box is for layers in the map)
- 1.4. Save the feature class as **units** in the same place as the contacts



1.5. It will take a little bit of time, then the layer will be added to the map.



If there are any issues with not all the polygons being drawn it will be due to some of the lines not being connected properly. If so go back and edit the lines and re-run the script.

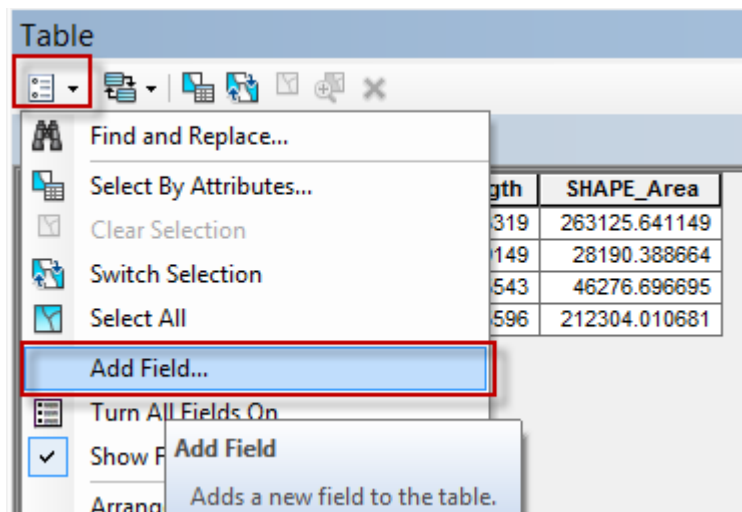
2. Next we need to generate an attribute field for unit code.

2.1. You need to exit edit mode to do this.

2.2. Open the polygon attribute table.

2.3. Click on the top left drop down menu.

2.4. Go to **Add Field**.



2.5. Set name as **unit_code** and type **text**

Add Field

Name:

Type:

Field Properties

Alias	
Allow NULL Values	Yes
Default Value	
Length	50

OK Cancel

3. Now we need to populate the unit code by looking at our scanned map. The approach is similar to how we set the attributes for contacts.

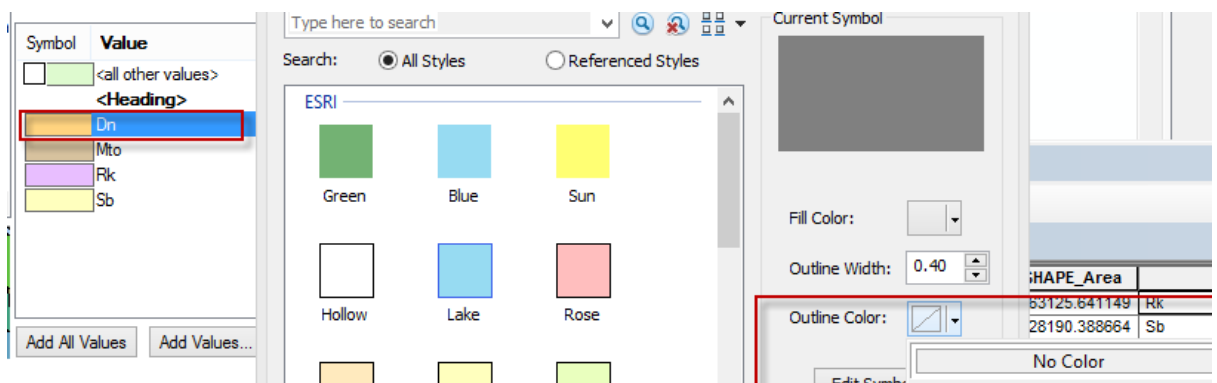
- 3.1. Start editing.
- 3.2. Click polygons.
- 3.3. Set code in attributes table.

Tip: set the fill colour for the polygons to blank or adjust the transparency so you can see the scanned map.

tip 2: Select rows in the attribute table then read the unit code off the map

5.6 SYMBOLIZING AND LABELLING POLYGONS

1. We can set the symbology for the unit codes using the same approach we used for the contacts.
2. Set the outline colour to none
 - 2.1. Right click on any symbol > **Properties for all symbols**
 - 2.2. Go to **outline colour** and select **none**



- 2.3.
3. Put on labels for the polygons
 - 3.1. Go to **Units> Properties> Labels tab**

3.2. Turn on **labels** and set field to **Unit code**

Layer Properties

General Source Selection Display Symbology Fields Definition Query **Labels** Joins & Relates Time

☒ Label features in this layer

Method: Label all the features the same way.

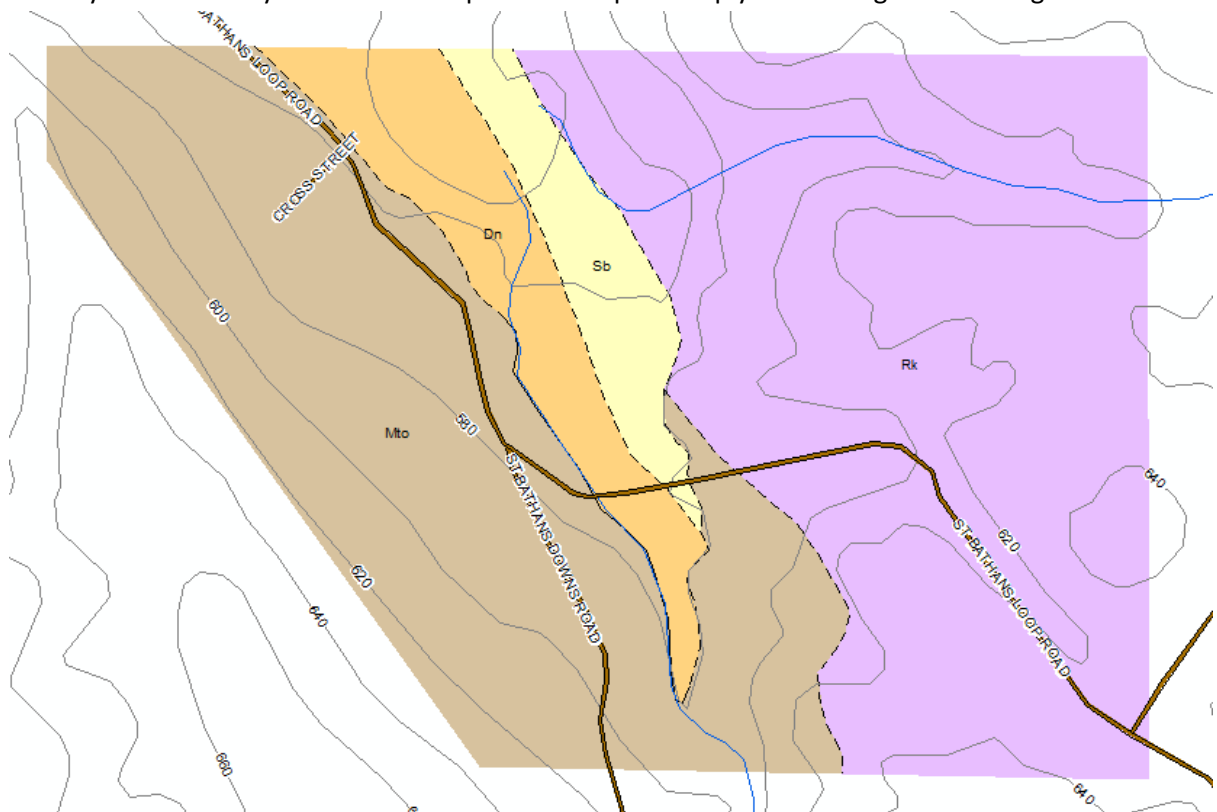
All features will be labeled using the options specified.

Text String

Label Field: **Unit_code** Expression...

☐ Text Symbol

4. When you switch off your scanned map. Put the topo on top you should get something like this:



5. Good Job!

5.7 DIGITISING OTHER MAP ELEMENTS – FAULTS, ANTICLINES ETC.

At this stage most of the complicated digitising is done. It should be relatively straightforward to digitise faults, anticlines and other linear features. Earlier in this document I asked you what the difference was between faults and anticlines in terms of abstraction. The answer is that non vertical faults have a dip direction associated with them (ticks). Whilst anticlines are generally symmetrical (although they can plunge or dip).

1. Go ahead and digitise other linear features on the map
2. In order to get the ticks on a fault pointing the right way you may need to flip the line following the steps below.

- 2.1. Click the Edit tool Edit Tool on the Editor toolbar and double-click the feature you want to edit.
- 2.2. Right-click any part of the sketch and click Flip.
- 2.3. Right-click anywhere on the map and click Finish Sketch.

6 PLOTTING STRUCTURAL GEOLOGY DATA IN ARCGIS

Instructions for plotting structural geology data can be found on this page:

<https://blogs.otago.ac.nz/si-geology/2015/04/24/plotting-structural-geology-data-in-arcgis/>

- An alternative approach if you haven't got your data in a spreadsheet is to create a blank point feature class with **dip az** and **dip** field and then click on points and enter data into the attribute table by reading (or measuring) off a paper copy of the map (or find an angle measure tool for arcGIS).

7 OTHER USEFUL TOOLS AND WORKFLOWS

7.1 EDITING USING TOPOLOGY

Topology is all about storing the relationships between features in a feature class (i.e. different polygons) and between different feature classes. Rules such as polygons must not overlap or have gaps. Once you have topological rules set up you can edit features while preserving topology. So for example if you try to move a geological contact it will move the contact, and both polygons on either side of the contact at the same time.

7.2 APPROACH FOR ITERATIVE MAPPING

Another workflow idea if you are updating over map over time is to create point features within a polygon with all the attributes for the polygon. Then you can run a spatial join to transfer the attributes to the unit polygons.

- You could overwrite the units polygon feature class or delete it first and then your layer in the map (or layer file) will just reconnect to the new units feature class.
- You could also use these points for labelling the units.
- Finally you could use model builder to string generating the polygons and spatially joining them.

8 SETTING UP A TOPO OVERLAY

Instructions are provided here:

TIP: You can clip the frame to the unit layer you have created.

<https://blogs.otago.ac.nz/si-geology/training-for-staff-and-students/preparing-a-topo-overlay-in-arcgis/> (you will skip the export step and follow instructions below)

9 PREPARING AND EXPORTING YOUR MAP AND/OR DATA

At this point you have a set of GIS data layers you can send to someone and they will be able to open it up and view the data. It's also nice to supply a layer file so that they can get the same symbology you use. A convenient way to do this is as a group layer (rather than individually)

1. Right click on the data frame and create a group layer.
2. Add all of your layers into it.
3. Right click on the Group layer and choose export layer file.

Another common method is to save your map and send that alongside your data.

It's also nice to generate a PDF or printable version of your map. Go ahead and set up the page size and add other map elements such as title, Author, datum info, legend, north arrow etc. You should be able to find instructions for this online.

9.1 EXPORTING YOUR MAP

1. Go to file>Export.
2. Choose PDF file type.
3. In the format tab
 - 3.1. Vectorize layers with bitmap marker fills
 - 3.2. Convert Marker Symbols to Polygons
 - 3.3. Embed all document fonts

