Contents

Introduction

This guide contains instructions for viewing spatial data in ArcGIS. The source of the data is Marine Digimap, Digimap Ordnance Survey Collection and ShareGeoDigimap.

You will need access to ArcGIS software to complete this guide. No prior knowledge of ArcGIS is required. However, an understanding of the basic GIS terms such as raster and vector would be good. This information can be found in the following online learning object:

http://edina.ac.uk/digimap/support/digimapelearning/index.html

The instructions and images have been prepared using ArcGIS version 10.1.

Scenario

Paul is studying for an MRes in Environmental Analysis and Assessment at Heriot Watt University.

His dissertation topic is on the site of the new River Forth crossing, between Fife and the area north of Edinburgh. He needs to create a map of the area, using Ordnance Survey map data.

It's important for Paul to understand the water depth profile at the proposed site. He is also interested in finding out about the characteristics of the intertidal area.

What will I learn?

- The key applications used in ArcGIS desktop software
- How to:
    - add raster and vector map data to ArcMap
    - amend symbology of map layers
    - create a simple query to select map features
    - join two tiles of raster map data together (mosaic)
    - create a cross section to analyse water depth
    - save cross section as a Shapefile

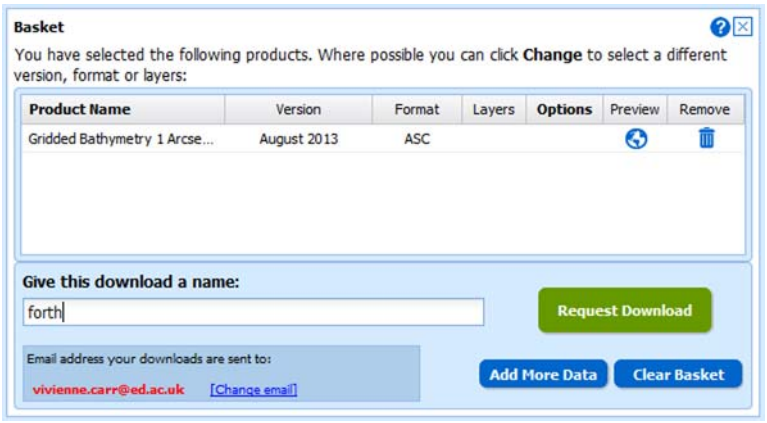
What data do I need?

For this exercise you will need some map data from Marine Digimap, Digimap Ordnance Survey Collection and ShareGeo. The licences do not permit us to supply you with the data. You will need to download it.

1 Marine data

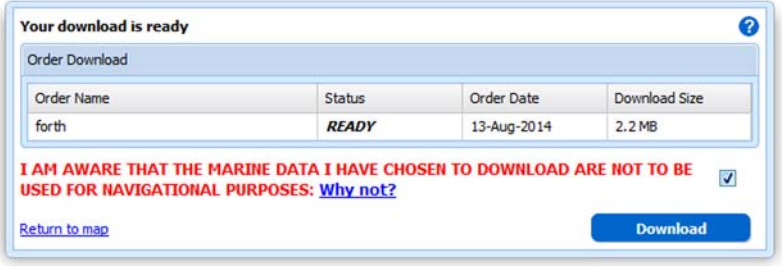
1. Login to Digimap
2. Select Marine > Download… > Marine Download
3. Search for Forth Bridge
4. Click Select Visible Area under Step 1
5. Select **Gridded Bathymetry 6** from the category Bathymetry

6. Click Add to Basket at the bottom left of the screen
7. Name the order
8. Click Request Download



You will now receive 2 emails from Digimap

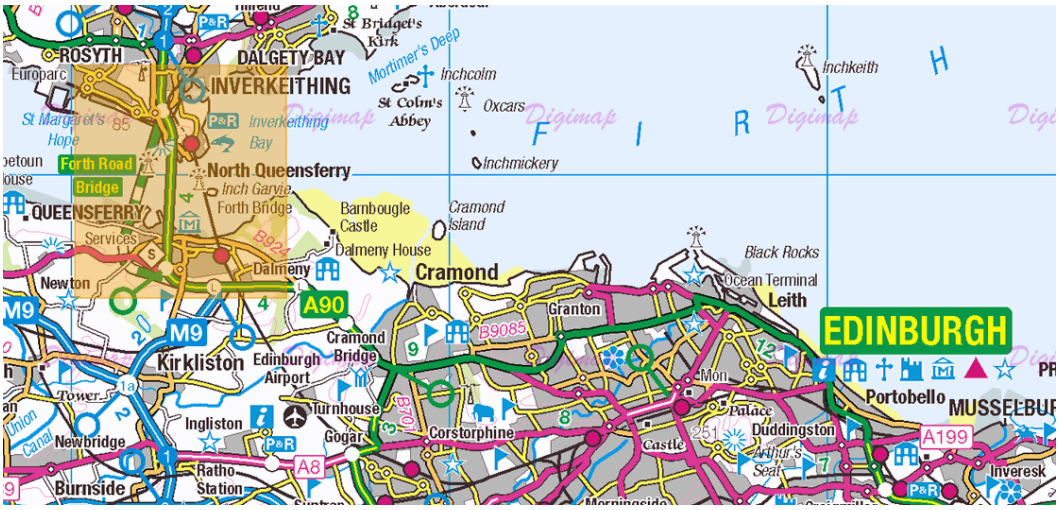
9. Click the link in the second email
10. Check the box to agree the data is not to be used for navigation
11. Click Download



12. Save the file **data.zip** to a suitable folder on your computer. **We recommend renaming the file to Gridded Bathymetry.**

2 Ordnance Survey data

1. Login to Digimap
2. Select Ordnance Survey > Download… > Data Download
3. Zoom in to Edinburgh
4. Click Draw Rectangle and draw a rectangle that covers both Forth bridges



5. Select **VectorMap District** from the Vector data category
6. Click Add to Basket
7. Name your order – we recommend naming it VectorMap
8. Click Request Download
9. Download the zip file when you receive the email from Digimap telling you the order is ready

3 VectorMapDistrict Style files

1. Go to this web page: http://www.ordnancesurvey.co.uk/business-and-government/help-and-support/products/vectormap-district.html
2. Download the file Layer Files.zip

4 Intertidal data

1. Login to Digimap
2. Select Discover > ShareGeo Digimap
3. Search for **tidal**
4. Click on the record **Scottish Mainland classified inter-tidal polygons**
5. Save the file **Scot_Coast_pol.zip** to a suitable folder.

5 Create a Forth Bridge folder

This exercise will be easier if all of your map data is in one place.

1. Open Windows Explorer
2. Create a new folder

3. Name it Forth Bridge
4. Now move all of the map data that you have downloaded into the Forth Bridge folder

You should now have a Forth Bridge folder, with 4 sub-folders: one with Marine data, one with Ordnance Survey data, one with Ordnance Survey layer files and one with inter-tidal data.

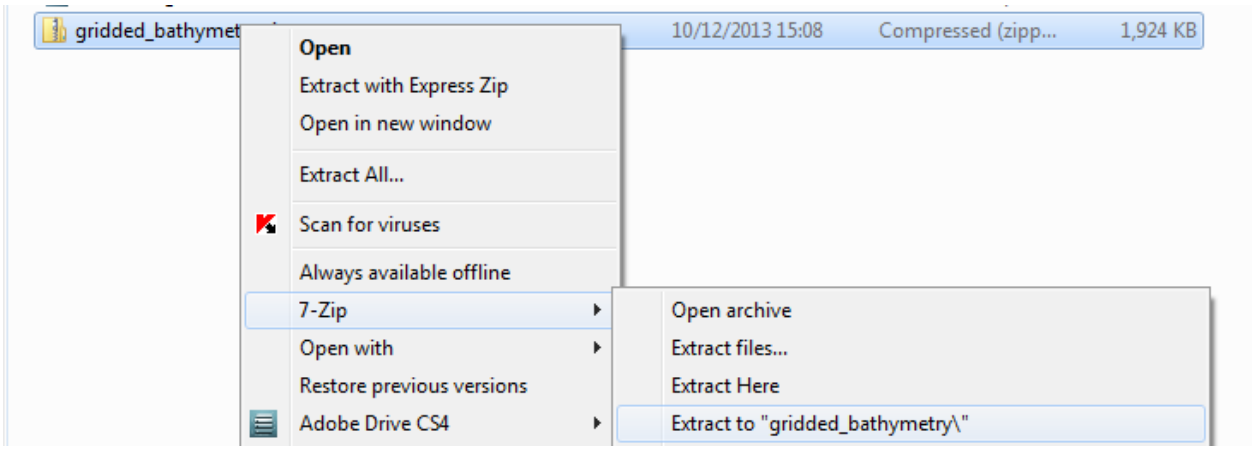
6 Unzip data files

To access the map data, you need to unzip the data files you have downloaded.

This step will vary depending on the software available on your computer. The following steps describe the process on a Windows desktop computer.

1. Open Windows Explorer or your file manager
2. View the contents of your Forth Bridge folder – there should be 3 zip files
3. Right click on one of the zip files
4. Look for Extract all or Unzip
5. Unzip the contents of the file to a new folder
6. Repeat this for all 3 zip files that you downloaded

This image shows the unzip process on a computer that uses software called 7-Zip to unzip compressed files.

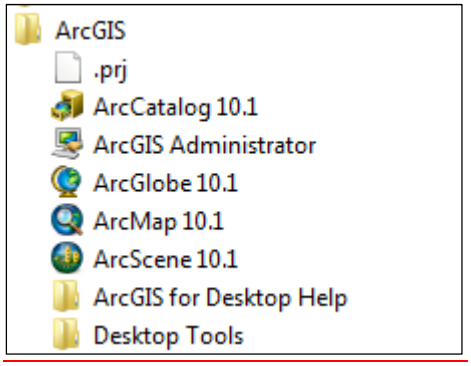


ArcGIS

ArcGIS is Geographic Information System software that is used to view and analyse geospatial data. There are different levels of license for ArcGIS, but all levels include two applications: ArcMap and ArcCatalog.

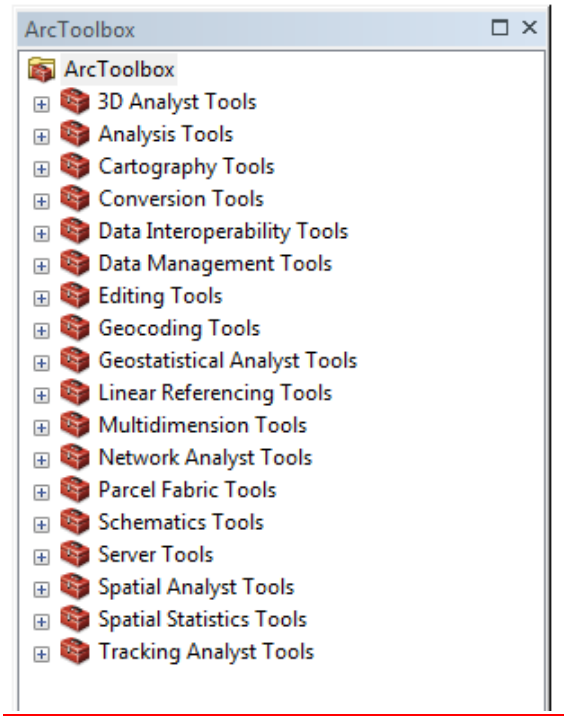
- ArcMap is the application you work with to view, explore and analyse map data and create maps for publication.

- ArcCatalog is the application you work with to manage data.



Some ArcGIS Desktop products include additional applications, such as:

- ArcToolbox™ - an application that contains many tools for GIS tasks, such as data management and analysis. You can access ArcToolbox from both ArcMap and ArcCatalog.



ArcMap

The ArcMap interface consists of the table of contents on the left and the map display area, as well as a number of toolbars and menus for working with the map and its data.

In this image you can see that 4 'layers' of map data have been added to the map and are visible in the map display area on the right:

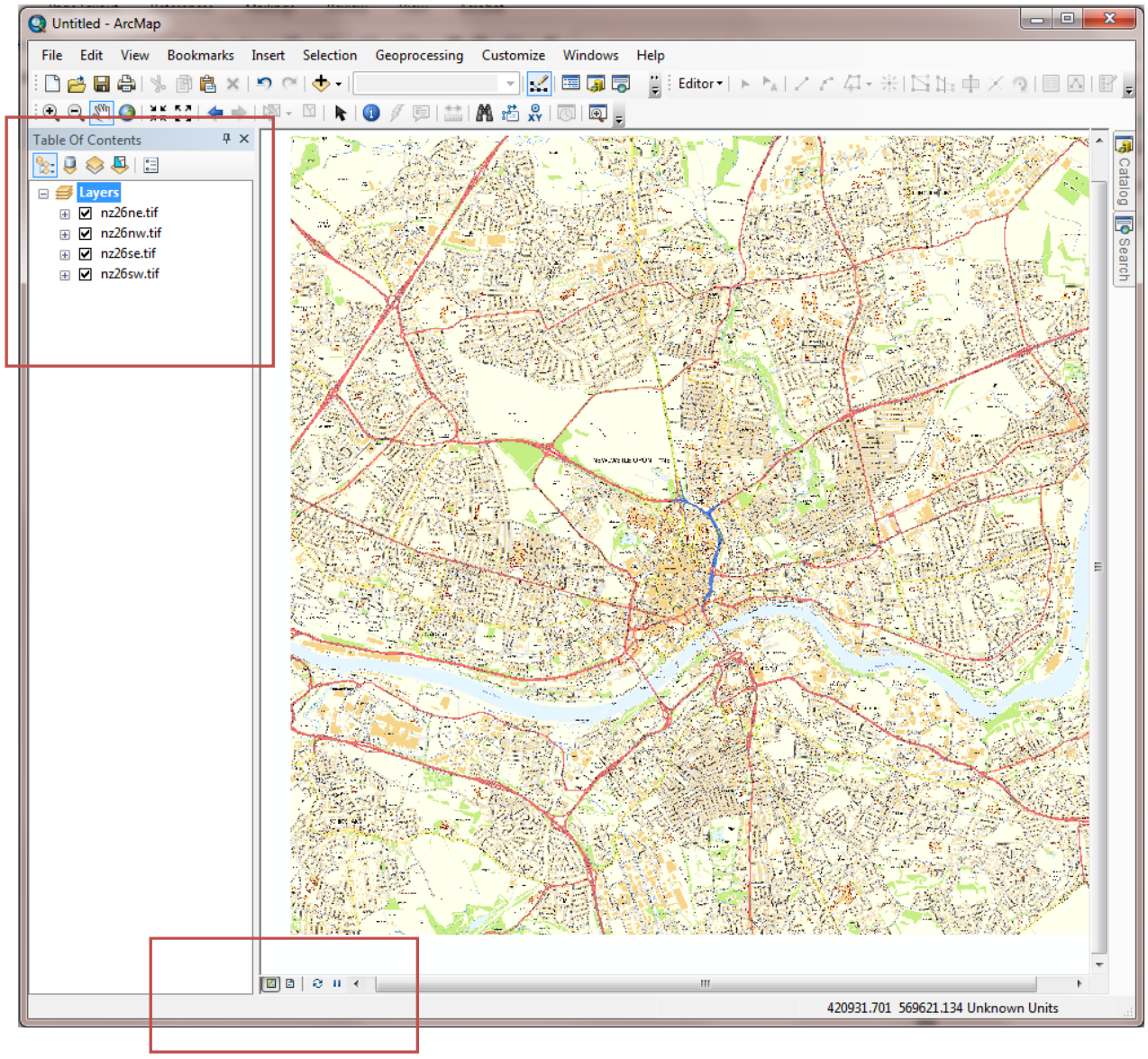


Table of Contents

The order of layers within the table of contents is important; the layers at the top of the table of contents draw on top of the layers below them. Therefore, you should put the layers that form the background of your map, such as the ocean, at the bottom of the table of contents.

Map Display Area

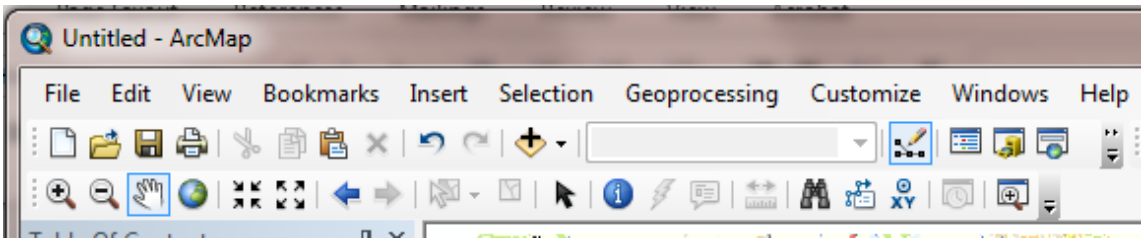
There are two views for working with data: data view and layout view – switch between views at bottom left of the map display area.

1. In Data view, you explore, edit, query, analyse, and symbolize data.

2. In Layout view, you arrange data frames and add other map elements, such as scale bars, titles, and legends, to create a map layout that can be published in print or digital form.

Toolbars

The Standard and Tools toolbars are visible in this screen. Toolbar options are available from View > Toolbars on the main menu. Toolbars can be floating or fixed.



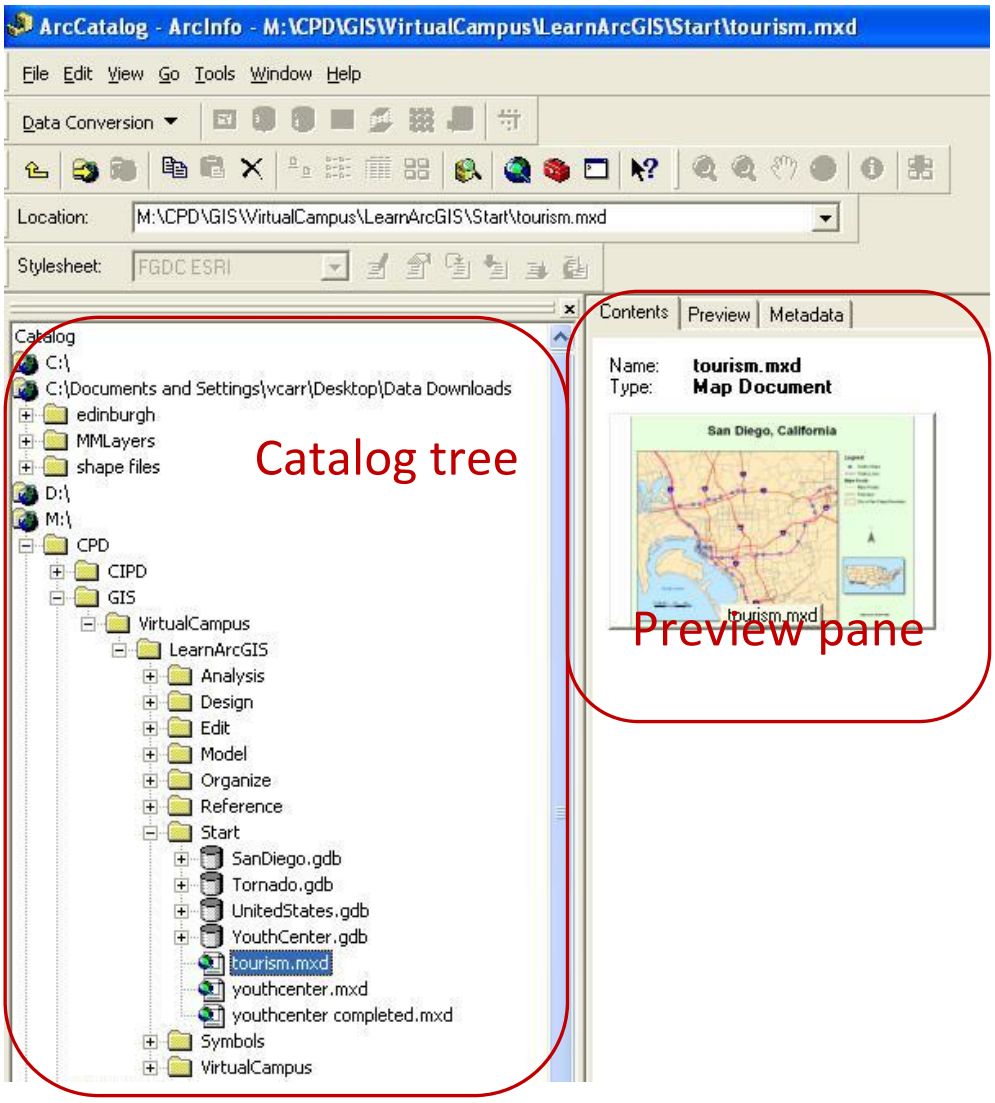
ArcCatalog

ArcCatalog is the ArcGIS application designed for browsing, managing, and documenting geographic data. Think of ArcCatalog as a window into your GIS database. From ArcCatalog you can access data stored on your computer's hard drives, local networks, and even the Internet.

To access data, you create a connection to its location (such as a folder on your C: drive). Collectively, the connections you create are called the catalog.

The catalog tree, on the left, can be used to browse and preview data.

The preview pane on the right provides three different tabs for previewing information about the data; contents, preview and metadata.

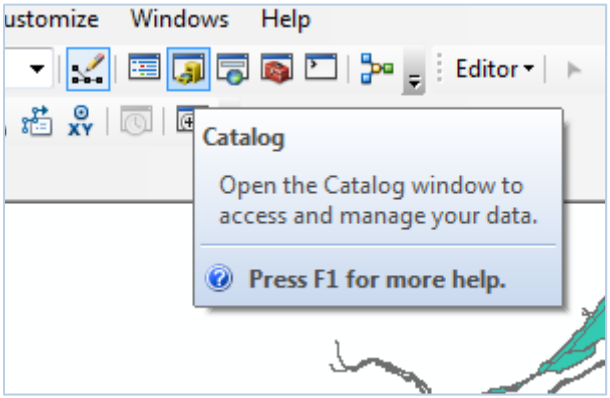

ArcCatalog - ArcInfo - M:\CPD\GIS\VirtualCampus\LearnArcGIS\Start\tourism.mxd
File Edit View Go Tools Window Help
Data Conversion
Location: M:\CPD\GIS\VirtualCampus\LearnArcGIS\Start\tourism.mxd
Stylesheet: FGDC ESRI
Catalog
C:\
C:\Documents and Settings\vcarr\Desktop\Data Downloads
edinburgh
MMLayers
shape files
D:\
M:\
CPD
CIPD
GIS
VirtualCampus
LearnArcGIS
Analysis
Design
Edit
Model
Organize
Reference
Start
SanDiego.gdb
Tornado.gdb
UnitedStates.gdb
YouthCenter.gdb
tourism.mxd
youthcenter.mxd
youthcenter completed.mxd
Symbols
VirtualCampus
Catalog tree
Contents
Preview
Metadata
Name: tourism.mxd
Type: Map Document
San Diego, California
tourism.mxd
Preview pane

#

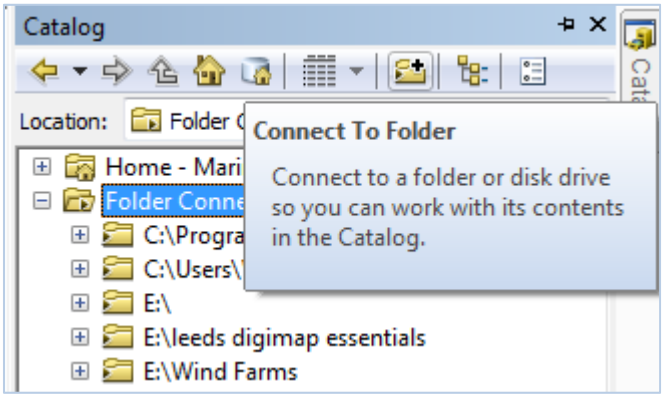
Create a folder connection

ArcGIS essentially treats files like databases. In order to access a dataset, you need to establish a connection to the folder that contains the data. In this case we will connect to the "Forth Bridge" folder.

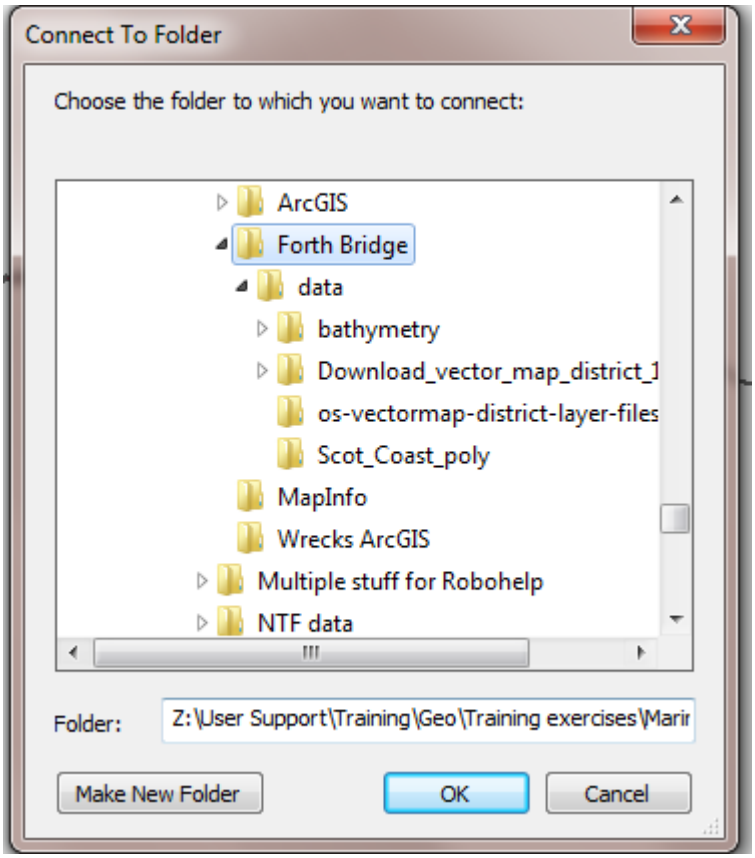
1. Open **ArcCatalog**. You will find the ArcCatalog icon on the toolbar:



2. ArcCatalog will now be visible on the right of ArcMap.
3. Click the Connect to Folder button, a yellow folder with a plus sign on it.



4. Navigate to the Forth Bridge folder.
5. Click **OK**.


Connect To Folder
Choose the folder to which you want to connect:
ArcGIS
Forth Bridge
data
bathymetry
Download_vector_map_district_1
os-vectormap-district-layer-files
Scot_Coast_poly
MapInfo
Wrecks ArcGIS
Multiple stuff for Robohelp
NTF data
Folder:
Z:\User Support\Training\Geo\Training exercises\Marir
Make New Folder
OK
Cancel

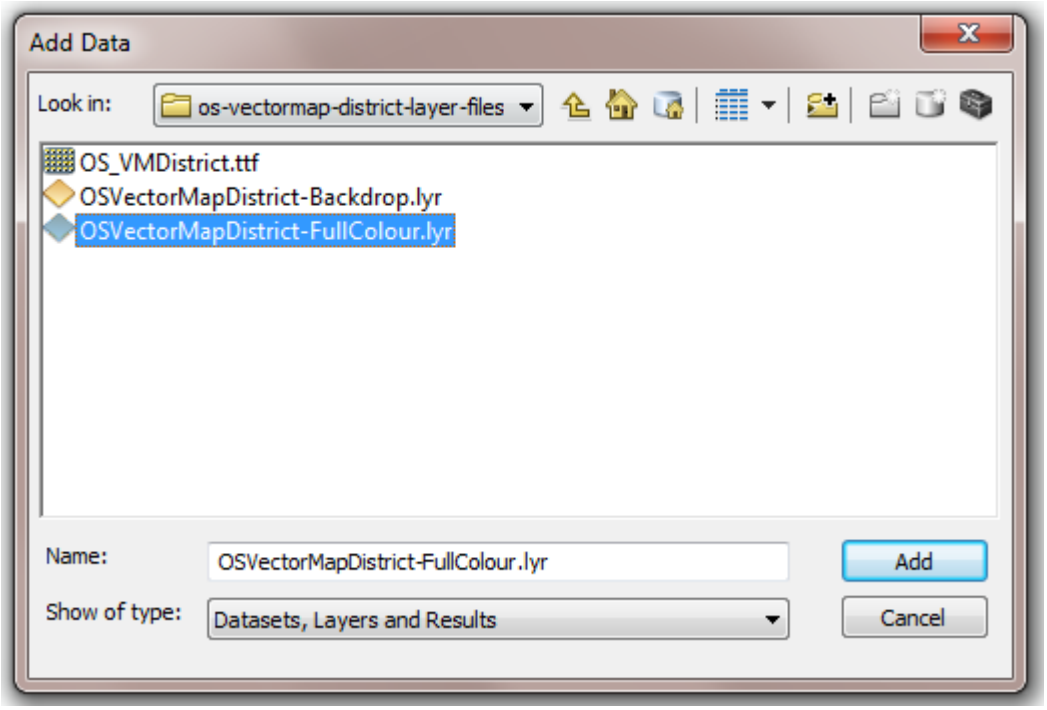
View and style geographic data

We mentioned that Paul needed a map of the area around the Forth Bridge. An appropriate dataset for our purposes is VectorMap District. We downloaded this from Digimap Ordnance Survey Collection.

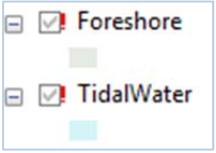
First we will add the style files for the data, i.e. the files that contain the cartographic styling information (the colour and line thickness of the roads, buildings etc).

Add Vector Map District data style files

1. Open ArcMap.
2. Select New Maps > Blank Map
3. Click Add data
4. Navigate to the folder **Forth Bridge > data > os-vectormap-district-layer-files:**
5. Add the full colour layer file.

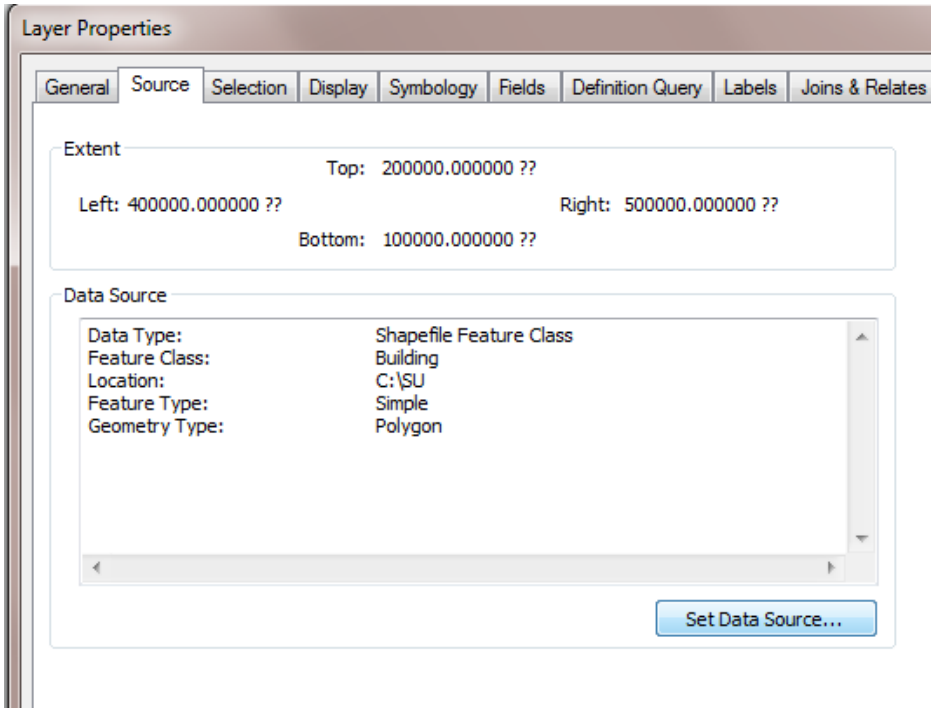


You will notice that lots of layers seem to have been added but nothing has appeared in the map. This is because we have added the style file and need to conect it to the actual data. ArcGIS identifies broken/missing data links with a small red exclamation mark.

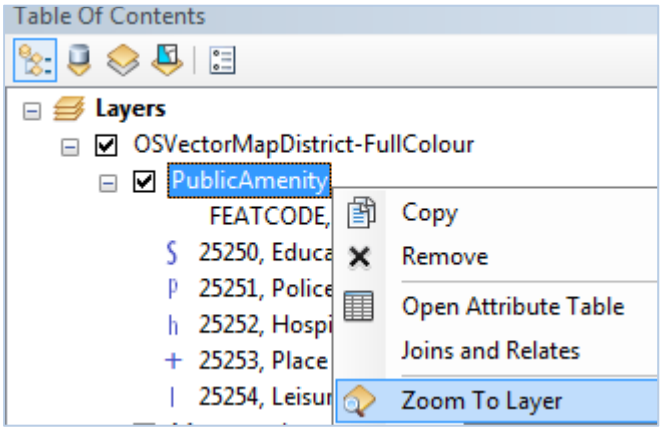


Connect style file to data file

1. Right click a layer, e.g. Roads – us the SECOND layer file in the list
2. Select Properties.
3. Click the Source tab.
4. Click on the Set Data Source button.
5. Navigate to, then add the corresponding data file, e.g. for the Road layer follow the path **Forth Bridge > VectorMapDistrict > vmd-vector-315031 > NTRoad.shp.**



You should see some points added to your map window. If not, check that the layer is checked in the Table of Contents. Still nothing? Right click and select Zoom to layer.



6. Repeat steps 1-5 to set the data source for the following layers:
    a. Buildings
    b. Surface water Area
    c. Surface water line
    d. Woodland

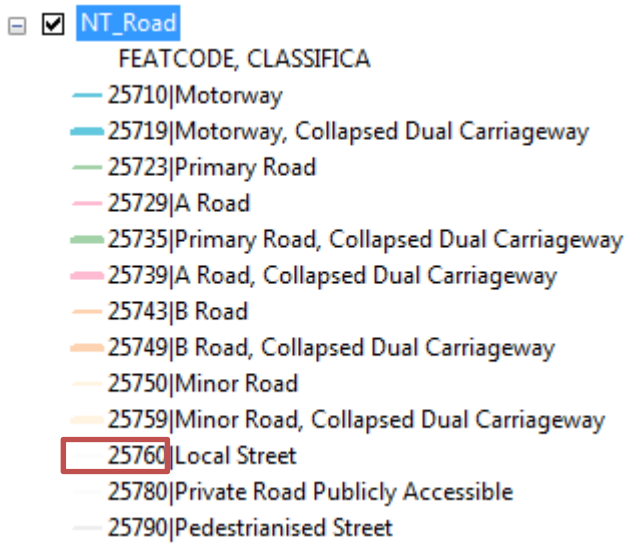
e. Land

This should be suficient to provide spatial context.

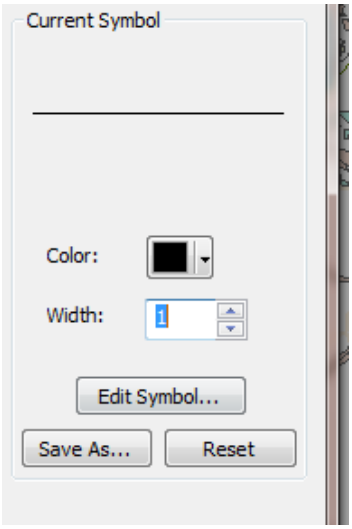
Note on map symbols

Note: you can change any symbol used on the map by clicking on it in the Table of Contents, e.g.

1. Click on the line next to Local Street, a Symbol Selector box will pop up:



2. You can then change the line colour and thickness, e.g. in this image we have chosen a black line of width point 1.
3. Click OK.



Save your project

1. Click File Save as
2. Save your ArcMap project to a suitable folder with a meaningful name.

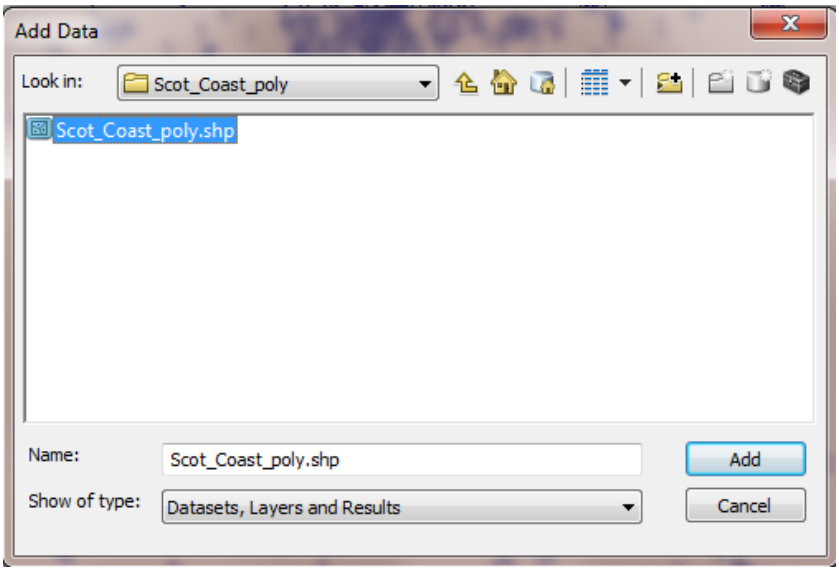
Add intertidal data

We are now going to add a dataset that shows the nature of the intertidal zone. It was derived from OS MasterMap data and is therefore subject to the same terms of use as MasterMap data downloaded directly from Digimap.

We downloaded this data[1] from one of the ShareGeo repositories, where you can find some really good datasets:

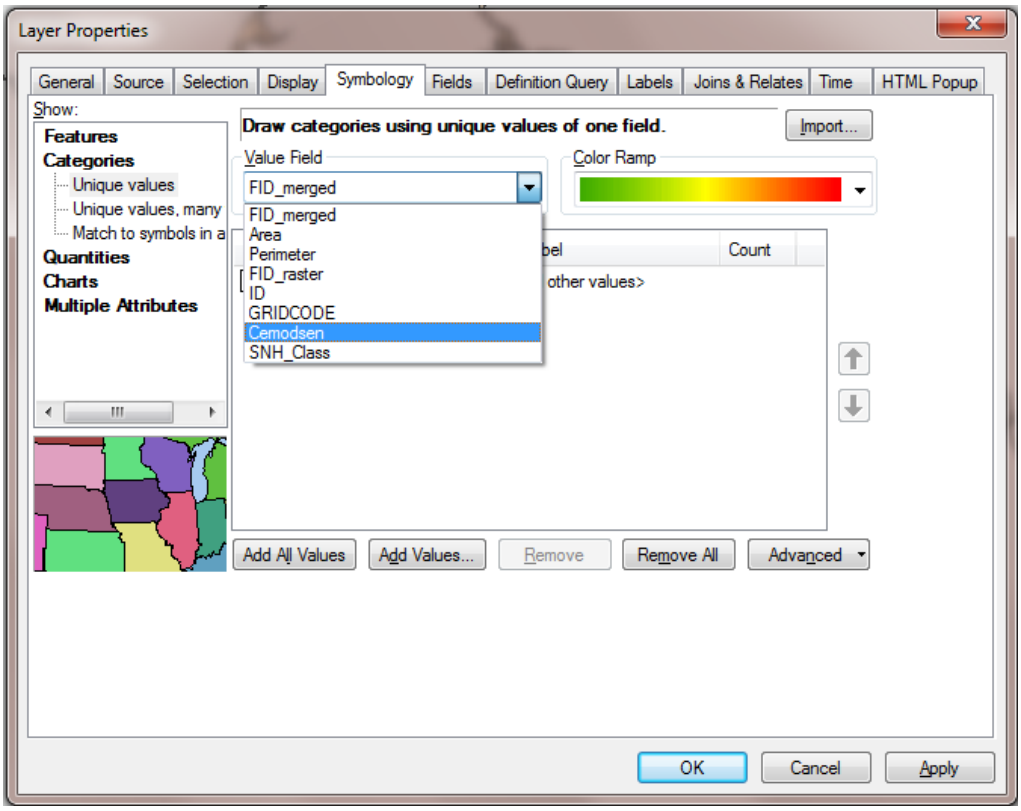
- ShareGeo Open – a repository for open geospatial data
- ShareGeo Digimap – a repository of useful and interesting datasets derived from data licenced through Digimap. The collections that your institution subscribe to will dictate the datasets that are visible in ShareGeo Digimap

3. Click Add Data button.
4. Navigate to the folder **Scot_Coast_Poly.**
5. Click the shape file.
6. Click Add.

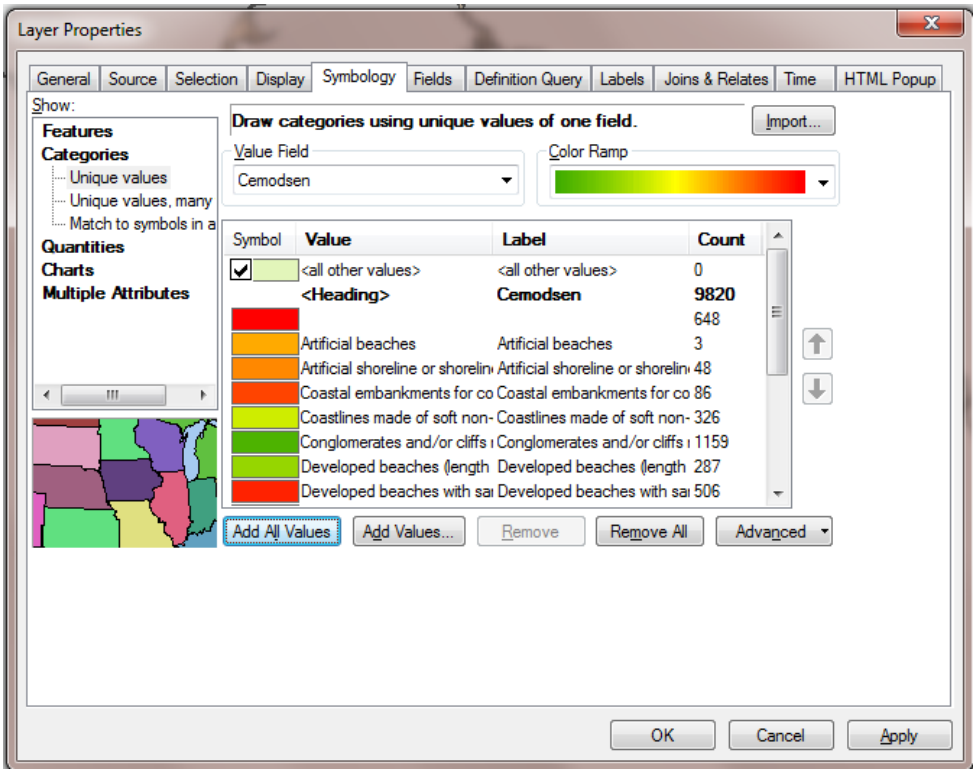


7. Apply a colour scheme to the data.
    a. Right click the layer in the Table of Contents.
    b. Select **Properties.**
    c. Select the Symbology tab.
    d. Click Categories > Unique Values .
    e. Set the Value Field to **Cemodsen.**

[1] http://digimap.edina.ac.uk/sharegeo/handle/10389/197 if the link doesn't work, search for Inter-Tidal in ShareGeo Digimap and select Scottish mainland classified inter-tidal polygons.



f. Select a colour scheme from the Colour Ramp on the right.

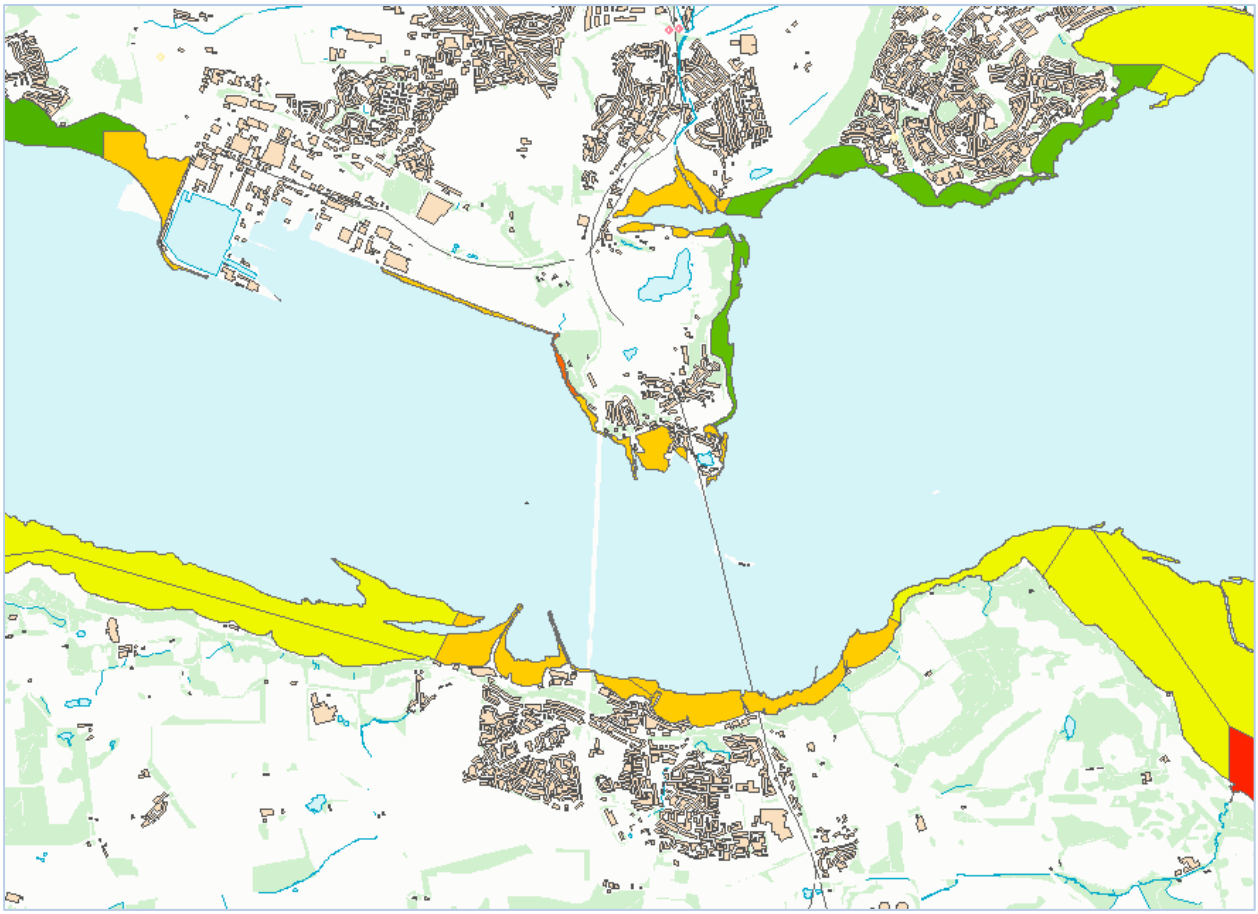


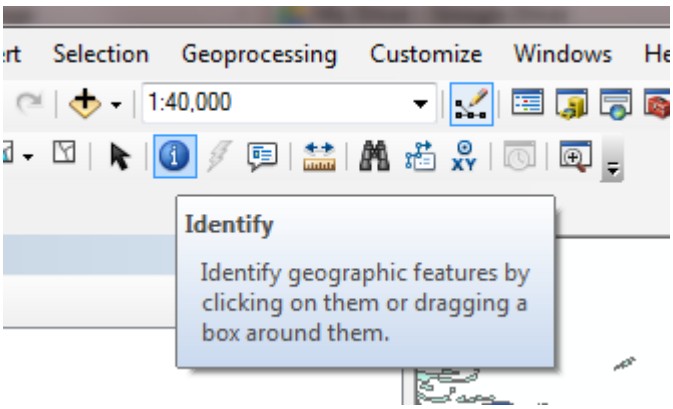
8. Click **OK** at the Properties box.

Identify Intertidal characteristics

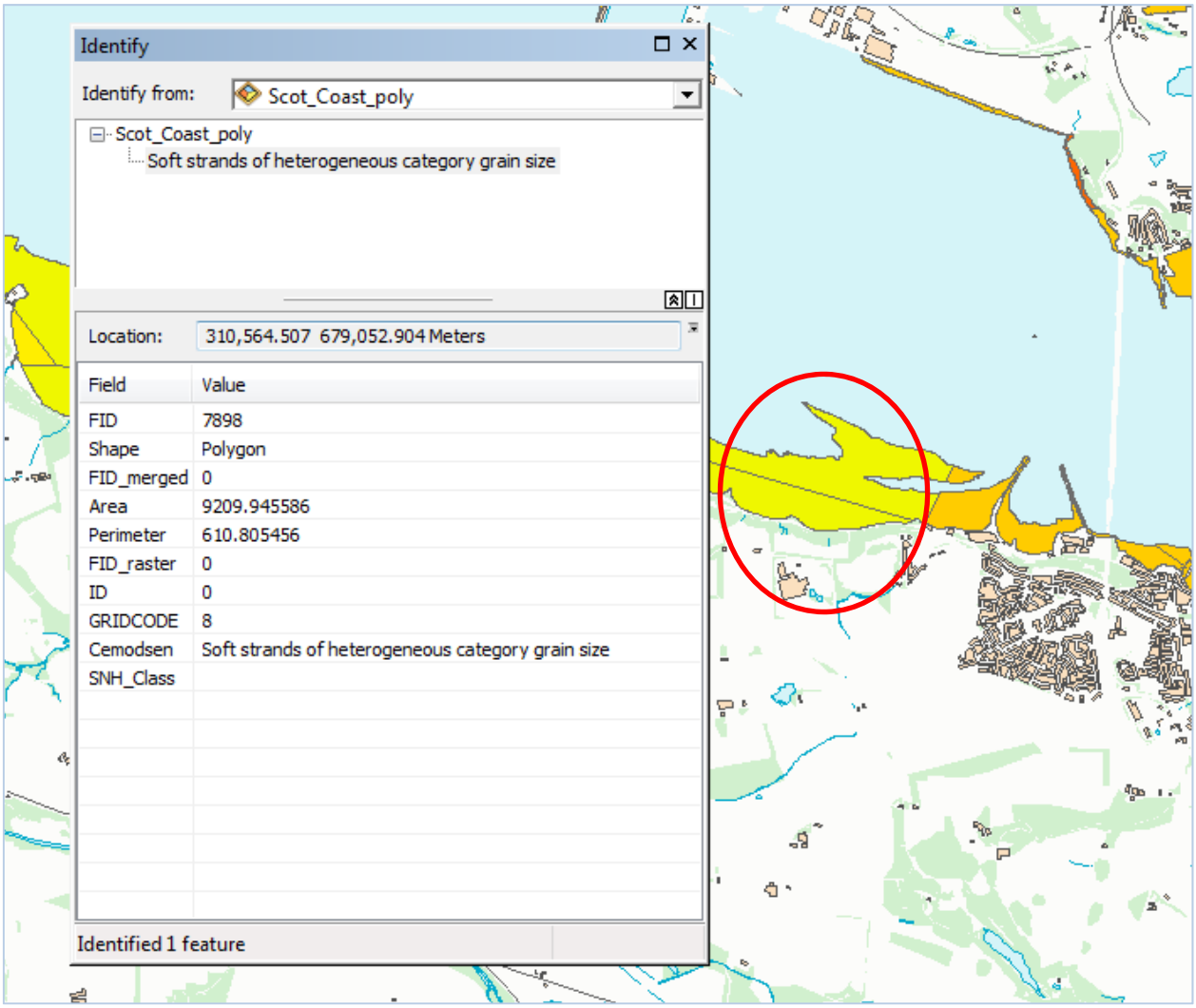
We may want to find out more about the intertidal area. We can use the Identify tool to do this.

First, let's make sure we are in the right area. Zoom until you are around the Forth Bridges. If you have all of your map layers checked (visible on the map), your map window should look similar to this image.

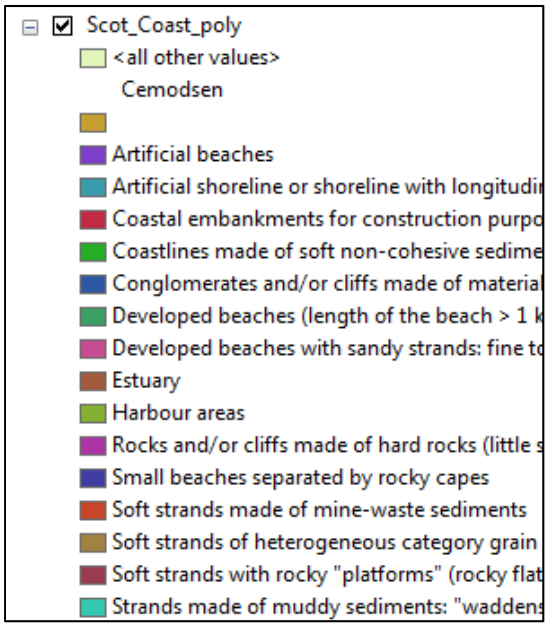




- What are the properties of the intertidal area where the bridge is to be built? For example, by clicking the Identify tool then clicking on a polygon near the bridge (circled in this image) we get an information box which gives us information from the layer's attribute table.



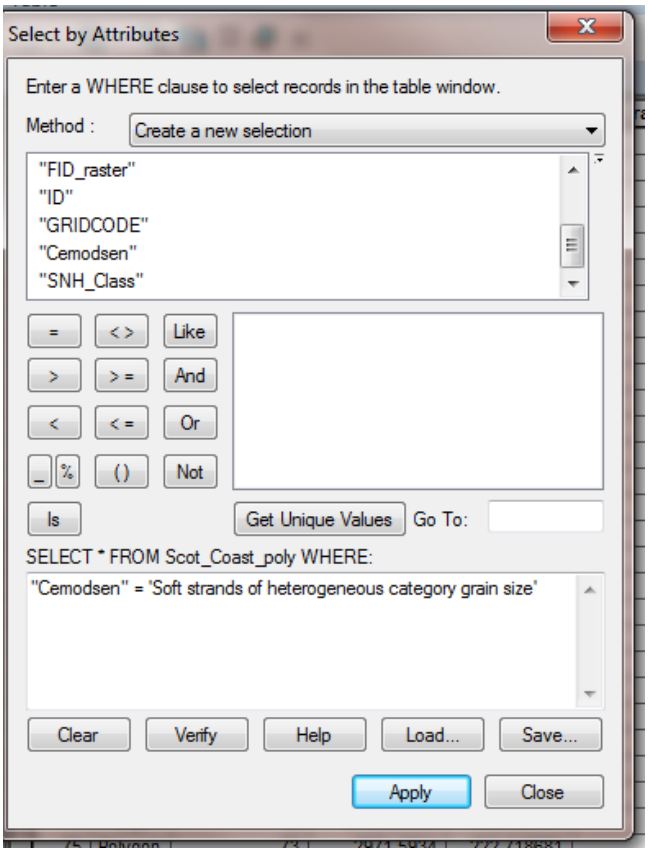
- We could try and select all regions in Scotland that have a particular intertidal characteristic, e.g. Soft strands of heterogeneous category…



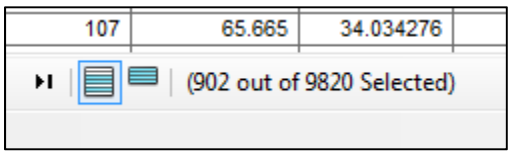
1. Open the attribute table of the Scot_Coast poly layer.
2. Choose **Select by Attributes** from the top left and compose a suitable query.

You have to select items one by one to place them in the query box at the bottom.

3. Double click **Cemodsen**.
4. Click the **equal** sign.
5. Click **Get Unique Values** to populate the box with all the possible values of the Cemodsen field.
6. Double click "**Soft strands…**" to add it to our query.
7. Click **Verify** to check that your query is valid.
8. Finally, click **Apply**.



At the bottom of our attribute table it states the number of records selected, in this case 902:

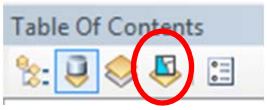


If you close the attribute table, the selected records should be outlined in blue on the map, e.g. in this image we can see some areas near the Forth Bridge have been selected:

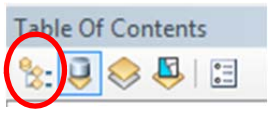
Save a selection as a Shapefile

We may want to save our selected records so that we can use them again, in this or in a different project.

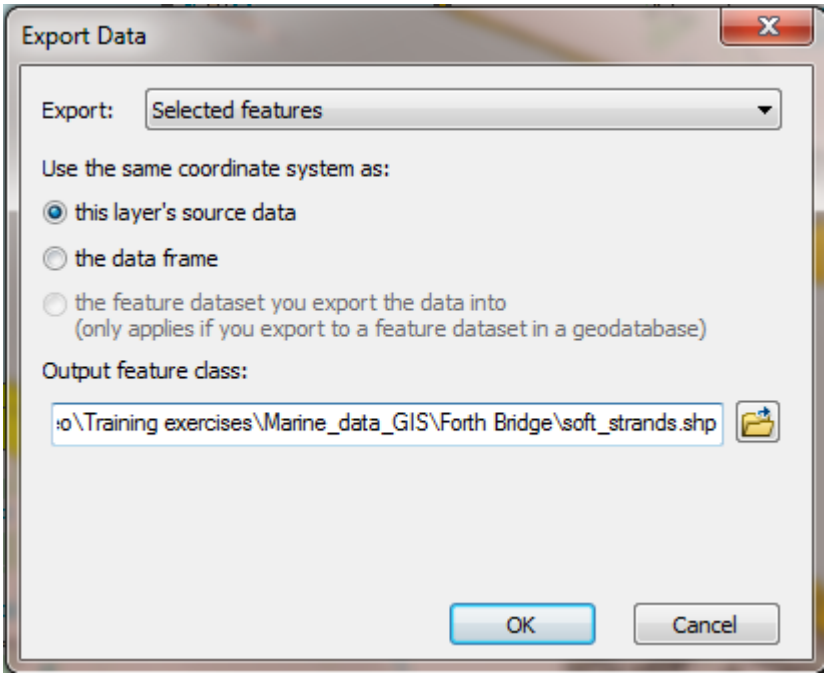
1. Switch the Table of Contents to **List by Selection**



2. Right click the Scot_Coast_Poly layer
3. Select **Create Layer from Selected Features**
4. Switch back to List by Drawing Order



5. Right click the Scot_Coast_poly selection > Data > Export Data
6. Select to export Selected Features
7. Use the same coordinate system as the source data
8. Click the yellow folder icon
9. Save the export in a suitable place with a meaningful name
10. Ensure you select Shape file from the Save as type drop down box
11. Click OK



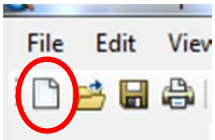
You now have the soft strands as a separate layer that you can reuse if you wish.

Add bathymetry data

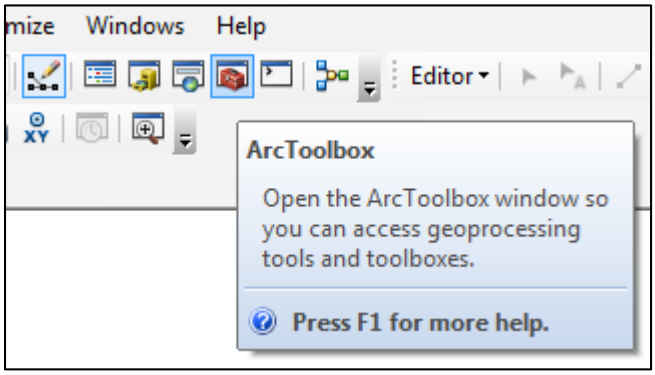
We would like to view the water depth for the Forth Estuary. We have provided you with some data from Marine Digimap – Gridded Bathymetry data from the Hydrospatial Download service. This data comes in ASCII format and in WGS 84 projection.

Gridded bathymetry is supplied as ASCII data and we will need to convert it to a raster.

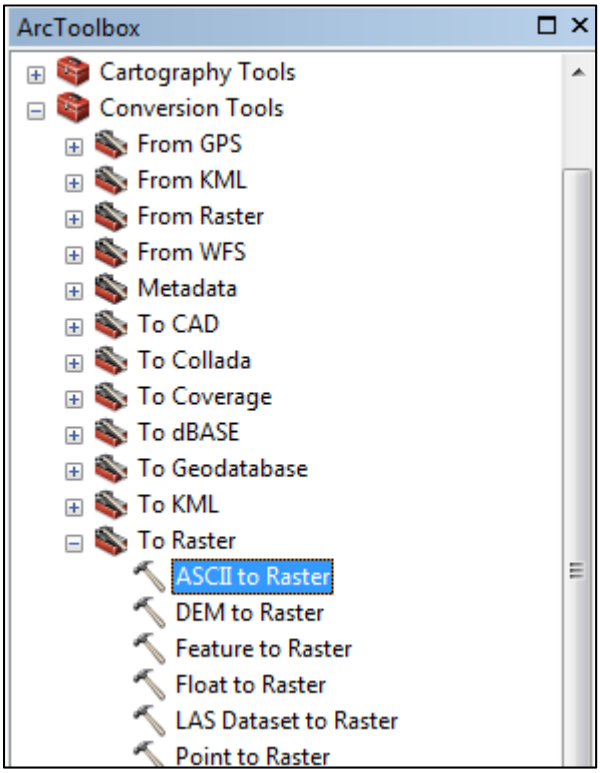
1. Save your current ArcMap project file.
2. Start a new project by clicking the New Map File icon.



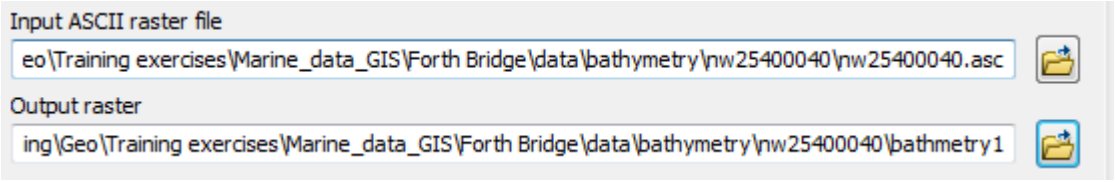
3. Open **ArcToolbox**. You will find the icon on the toolbar, it's a red icon:



4. Select **Conversion Tools > To Raster > ASCII to Raster**:

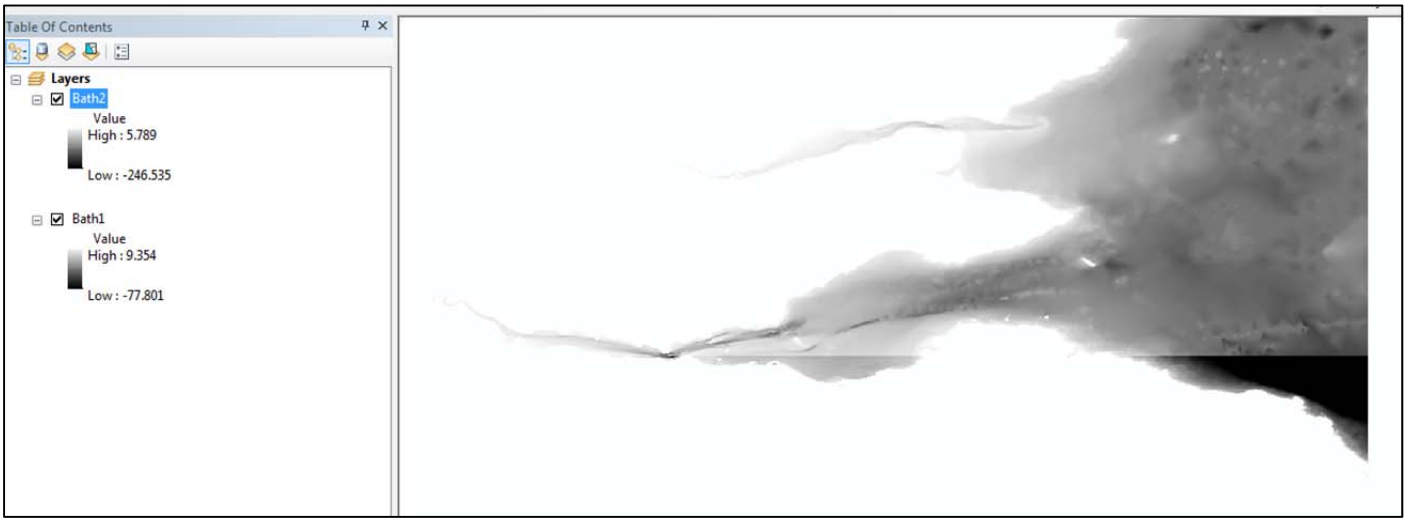


5. For the Input ASCII raster file, navigate to the location of your Gridded Bathymetry files, e.g. **Forth Bridge > Gridded Bathymetry**
    a. Select the folder NW25400040
    b. Select the file nw25400040.asc
6. Place the output file in a separate folder within the Forth Bridge folder, naming it something like **bathymetry 1**



7. Set the Output Data Type to **Float.**
8. Click OK to carry out the conversion.
9. Repeat steps 4-7 for the ASCII file in folder NW25600040, naming the output file **bathymetry 2.**

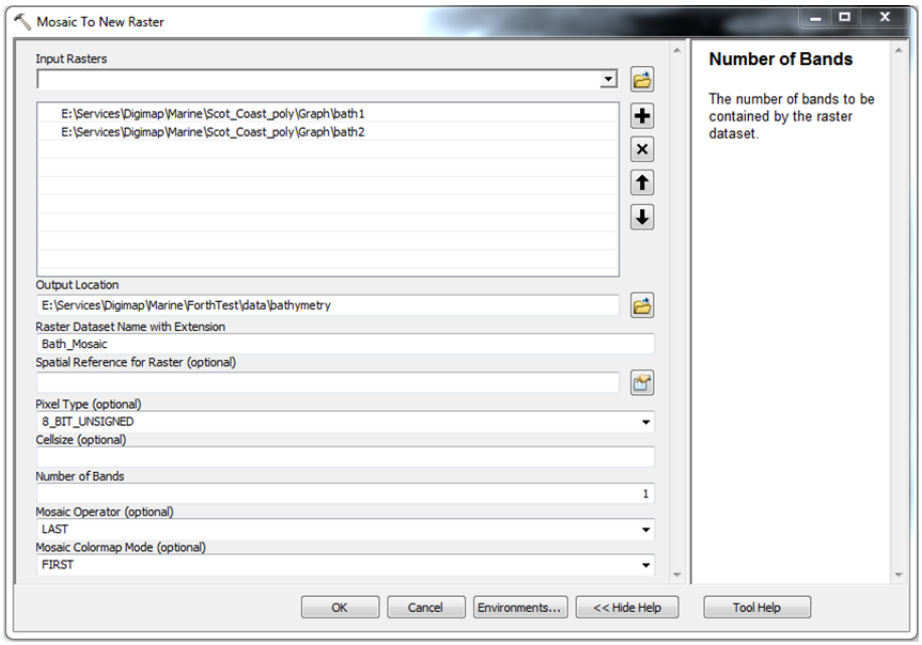
The two rasters you have created should have been automatically loaded.



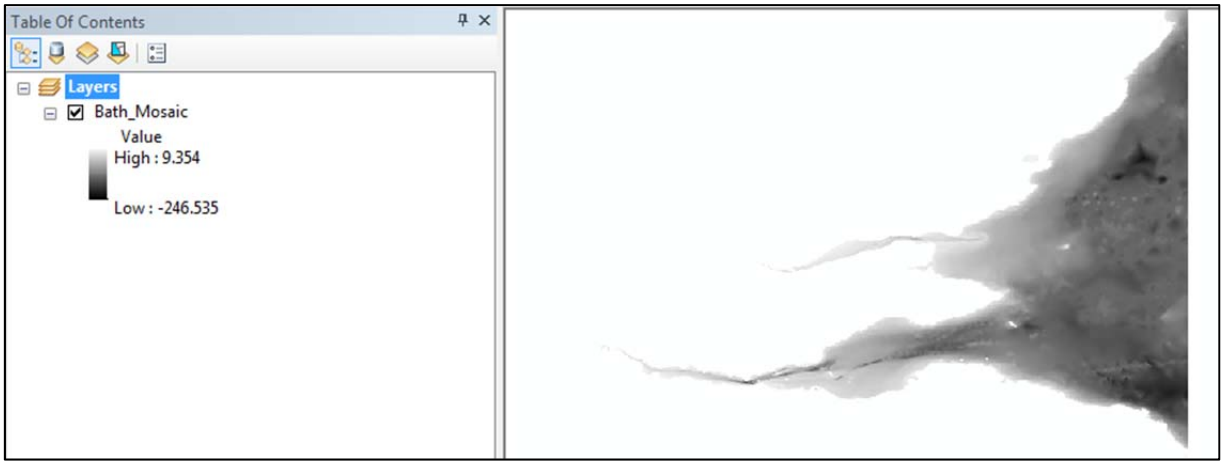
We now have our bathymetry data loaded but the tiles don't look right; there is a join between the two tiles. This is just the way that ArcMap displays the data, stretching each grid individually to the max-min values it contains.

We will create a mosaic of the two grids. This is particularly useful when working with multiple tiles as it makes it easier to load the multiple grids.

10. Open **ArcToolbox**
11. Select **Data Management Tools > Raster > Raster Dataset > Mosaic to New Raster**
12. Input rasters – add bathymetry1 and bathymetry2 here
13. Output Location – click on your Gridded Bathmetry folder to add this as the location for the new raster
14. Give the output a name (Bath_Mosaic), don't bother with a file extension
15. Set the **Number of Bands** to 1



16. Click **OK**.
17. Bath_Mosaic should be automatically added to the project when it has completed. The join is seamless and the high and low values are now 9 and -246.



Data Projection

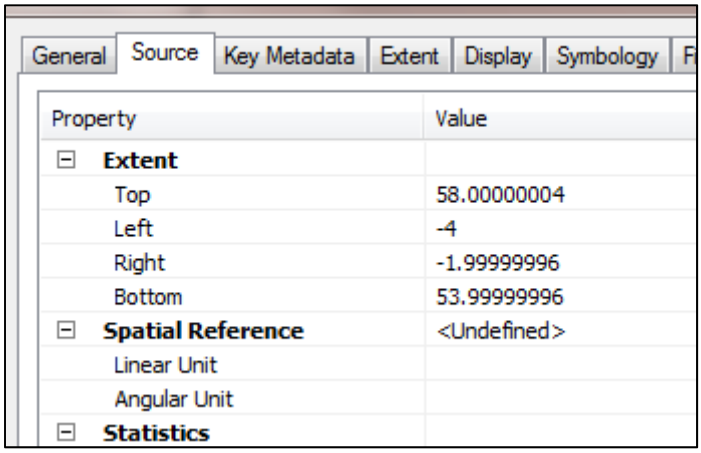
All data downloaded from Marine Digimap is in WGS84 projection. The Ordnance Survey data that we have added and styled (the Vector Map District data) is in OSGB 1936[2].

To make it easier to analyse the two datasets together we should convert one of the projections so they are the same. In this case it is going to be easier to convert the Bathymetric mosaic to be in OSGB 1936.

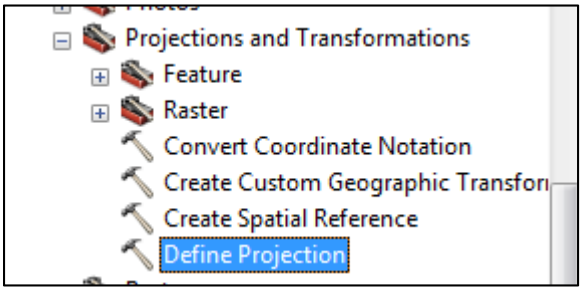
Note: ArcGIS will perform an "on the fly transformation" so why bother? Well, the on the fly transformation may not always pick the most appropriate transformation algorithm.

1. First we will check that the mosaic has a projection and if it is missing we will define it.

    a. Right click **Bath_Mosaic** in the Table of Contents.
    b. Select Properties > Source> Scroll down to see if Spatial Reference is defined or undefined:

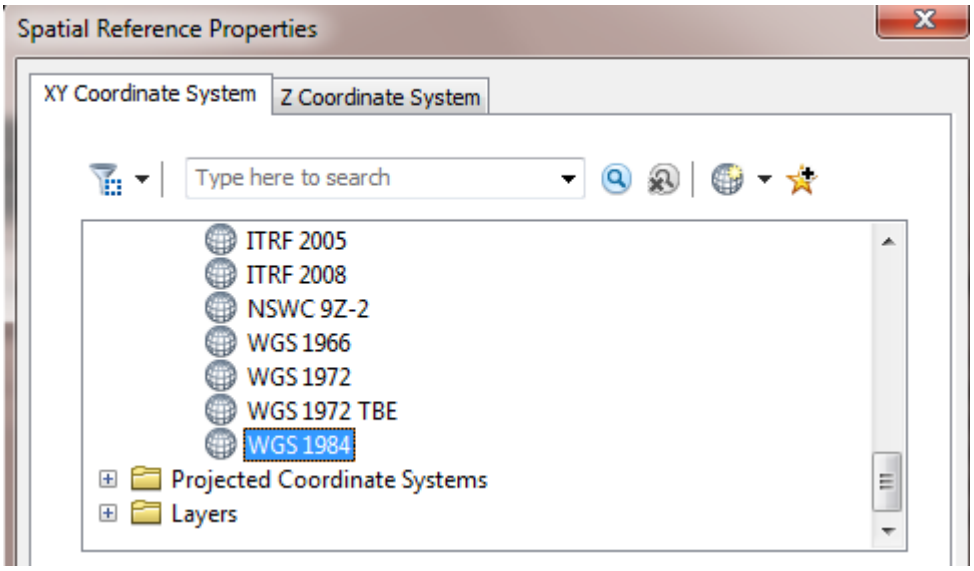


    c. If undefined, close the layer properties.
    d. Select **ArcToolbox** > Data Management > Projections and Transformations > Define Projection:



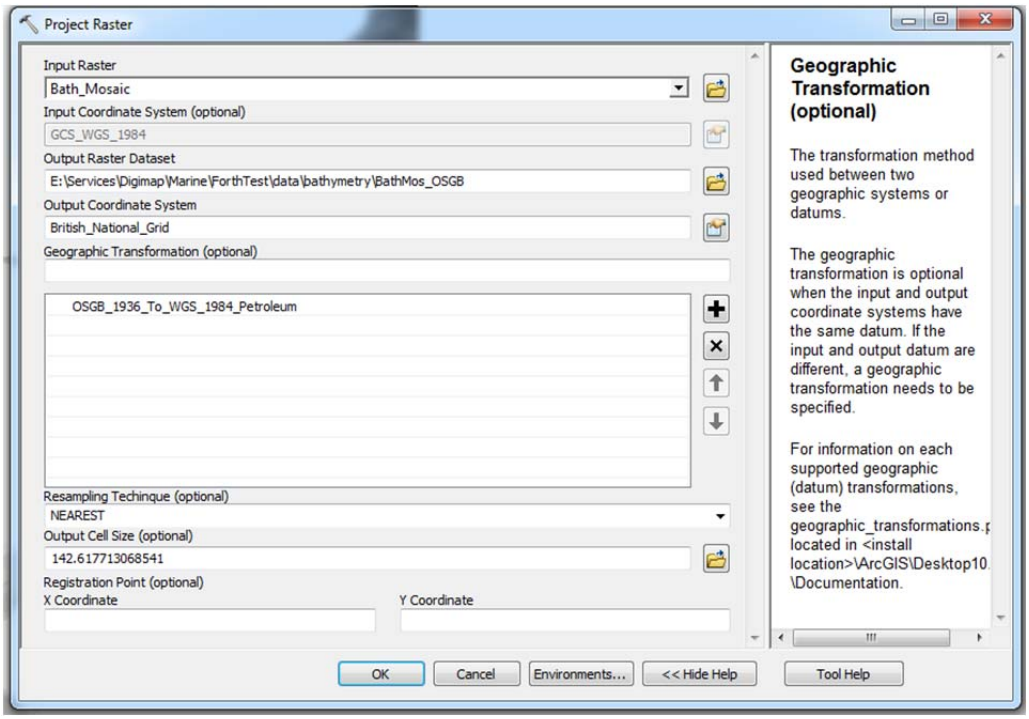
    e. Set the projection to WGS84.
    f. Select **Bath_Mosaic** as the Input Dataset.
    g. For the coordinate system, select **Geographic Coordinate System > World > WGS1984**

[2] To learn about map projections, have a look at the Digimap elearning modules: http://wyvis.edina.ac.uk/webhelp/training/training.htm#elearning/eLearning.htm



h. Click **OK**

2. Now that the projection of the mosaic is defined, we can convert it to OSGB 1936:
   a. ArcToolbox > Data management > Projections > Raster > Project Raster
   b. Select **Bath_Mosaic** as the input raster
   c. The Input Coordinate System should be automatically defined as WGS 1984.
   d. Select your bathymetry folder to save the output and call it something like **BathMos_OSGB**
   e. **Geographic Transformation – set this to OSGB_1936_to_WGS_1984_petroleum** (this is the most accurate transformation between WGS84 and OSGB).



We have now mosaiced two grids and transformed them from WGS1984 to OSGB 1936.

Analyse Forth water depth

We might want to analyse the water depth across the Forth at the position of the proposed Forth Bridge. We will plot a cross section cross our bathymetry raster data.

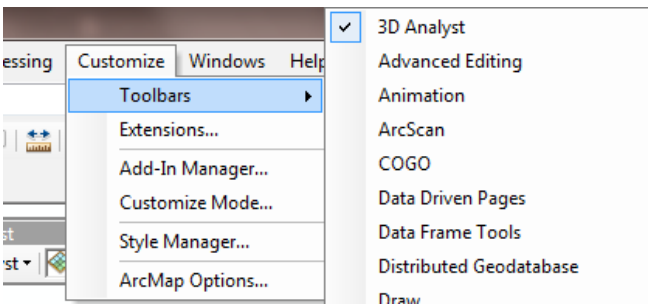
Add Bathymetry and theme

1. Click Add Data.
2. Add the mosaic bathymetry that is in OSGB, we named it BathMos_OSGB.
3. Change the color ramp – right click the bathymetry layer (BathMos_OSGB).
4. Select Properties.
5. Select the Symbology tab and select an appropriate color ramp.
6. **Note –** I selected a blue ramp but the colours needed inverted to represent deep areas with dark colours. To achieve:
    a. **Apply** the color ramp via Properties > Symbology
    b. **Right click** the colour ramp in the Table of Contents
    c. Check **Invert**
7. Centre the view on the Forth Road Bridge. We should now have something similar to the image below.

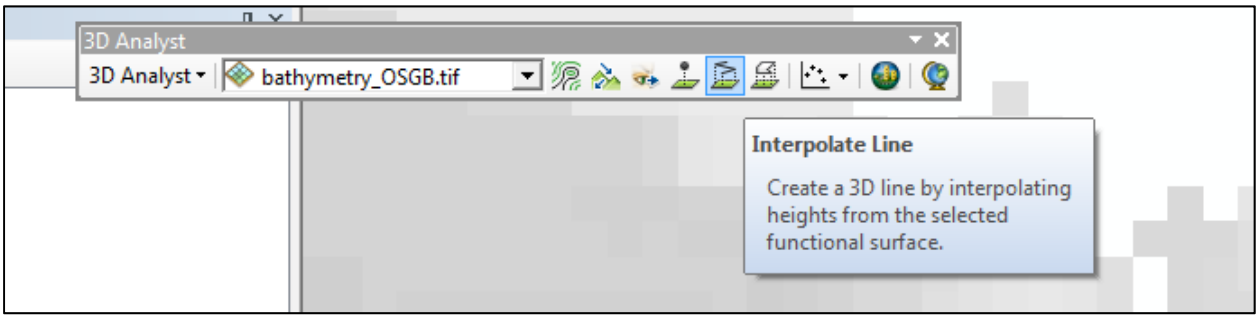
Plot a cross section across the Bathymetry data

To plot a cross section, we need to ensure that we have the 3D analyst extension activated.

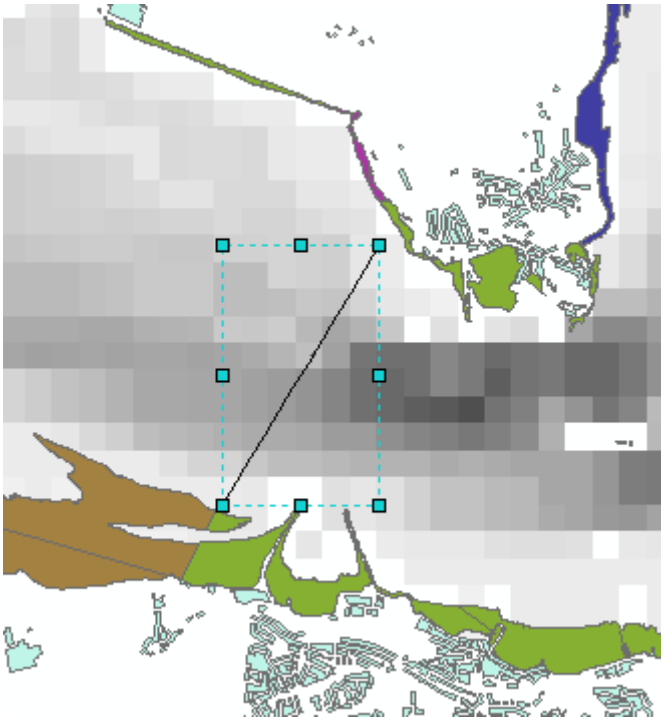
1. From the top menu options – **Customize** > **Toolbars** and check **3D analyst**.



2. Select **Interpolate Line** from the **3D analyst toolbar.**
3. Ensure that the bathymetry layer is selected.

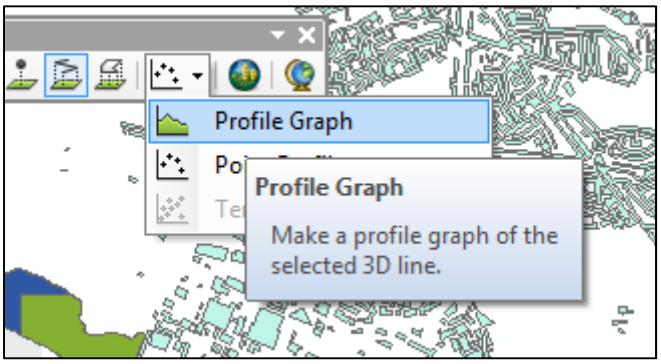


4. The cursor will turn to a cross. Now we need to draw our line of the approximate route of the new bridge.
5. Click at the first point on the map, then click once on any further points. Double click to finish. Example line shown in this image (approximate route):

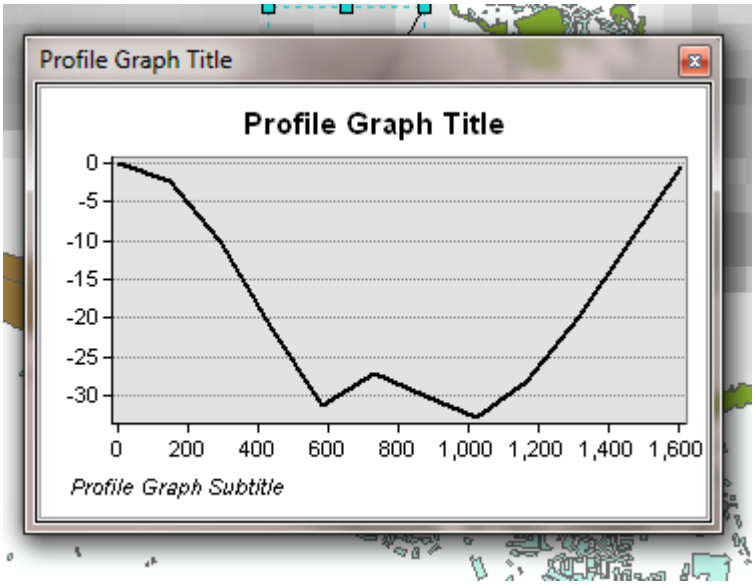


Now we want to display a profile of the water depth over the course of our line.

6. Click the **graph** drop down on the 3D analyst toolbar and select **Profile Graph:**



7. The profile will be drawn in the direction we drew our line, in this case from north to south. The deepest point is more than 30 metres.

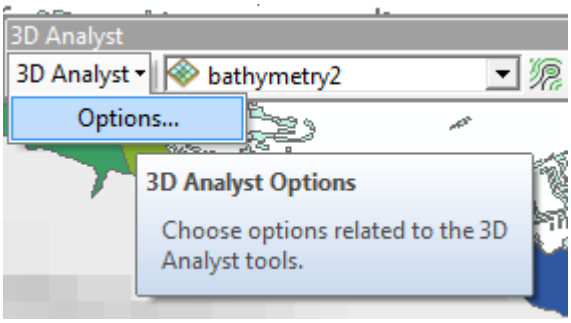


You now have options to export this graph profile as an image file or to alter the details (title, axis names) by double clicking on the image.

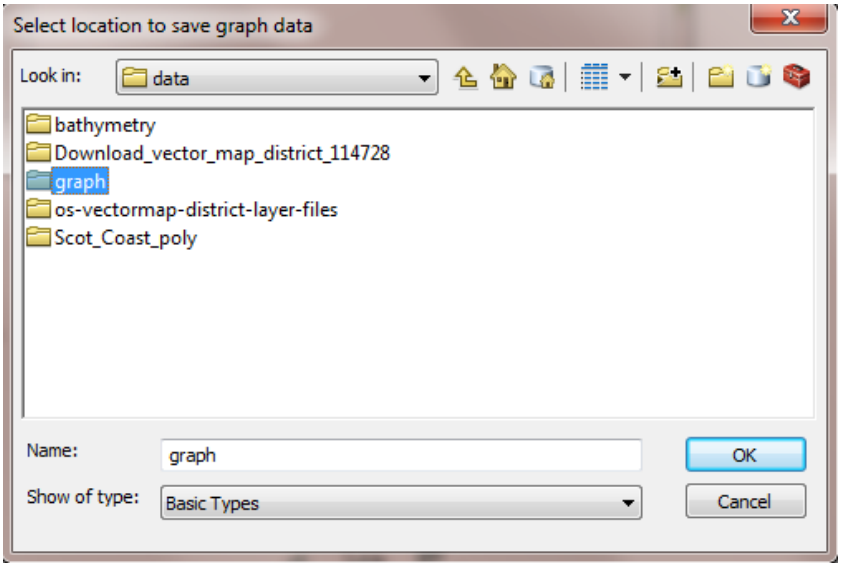
Save your cross section line as a shape file

First, we have to set up a few variables to control where the data will be saved.

1. Select **3D Analyst options > Graph Data**.



2. For the location, I usually set up a sub-folder called graph.

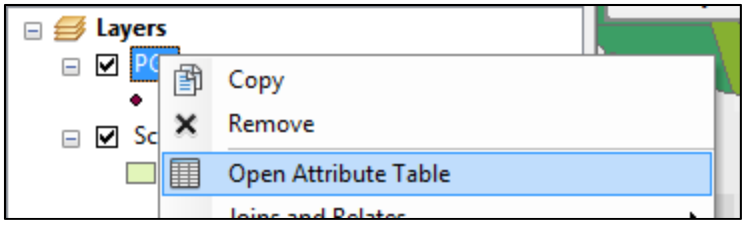


3. Don't worry about the graph template, we don't need to set it, but if you are interested it is usually located at*: C: Program Files > ArcGIS > Desktop101.1 > Graph Templates > Select Default.ScatterplotMatrix.tee.*
4. Click **Apply** and **OK**.
5. You will have to regenerate your graph.
6. A shape file will be created in the graph folder.
7. Click **Add Data.**
8. Navigate to the graph folder that you created.
9. Add the shape file to your ArcMap project.

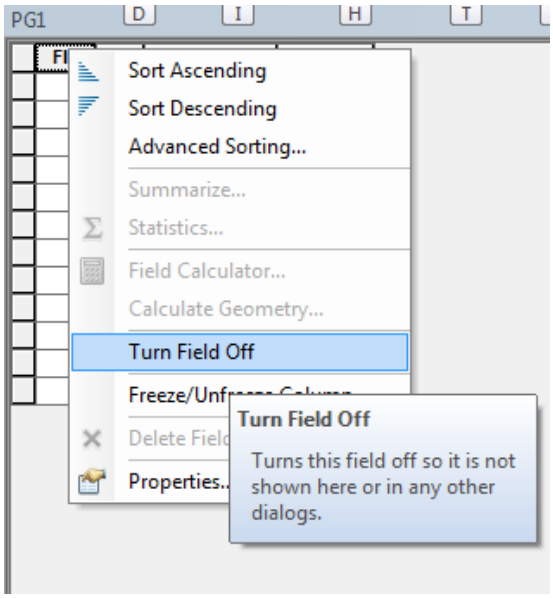
Export the data in the shape file

Not all analysis can be done in ArcGIS and it may be useful to export the cross section data so we can manipulate it in another software program.

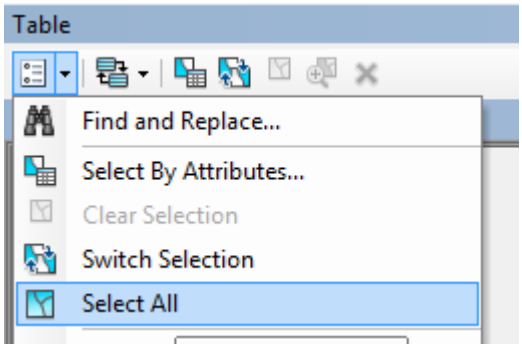
1. Right click the graph shape file and select Open Attribute Table:

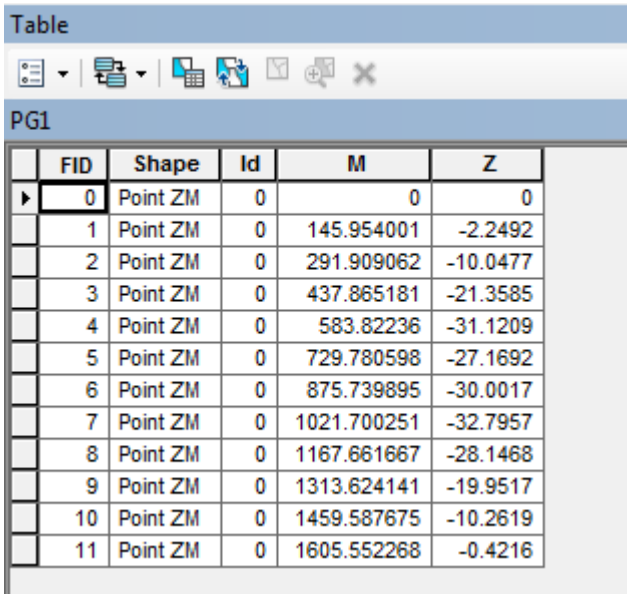


2. We can now export the data – in the attribute table, right click the **FID** field
3. Select **Turn Field Off.**
4. Repeat for the **Shape** field.



5. Click the drop down arrow and choose **Select All:**





Table

PG1

FID	Shape	Id	M	Z
0	Point ZM	0	0	0
1	Point ZM	0	145.954001	-2.2492
2	Point ZM	0	291.909062	-10.0477
3	Point ZM	0	437.865181	-21.3585
4	Point ZM	0	583.82236	-31.1209
5	Point ZM	0	729.780598	-27.1692
6	Point ZM	0	875.739895	-30.0017
7	Point ZM	0	1021.700251	-32.7957
8	Point ZM	0	1167.661667	-28.1468
9	Point ZM	0	1313.624141	-19.9517
10	Point ZM	0	1459.587675	-10.2619
11	Point ZM	0	1605.552268	-0.4216

6. Right click on any grey box at the left side of the data and **Copy Selected**
7. Paste into Notepad and save as <name>.txt (don't use Word as it will introduce spurious characters)
8. You can now manipulate this in excel or another package and can use the shape file we created in our cross section line (in the graph folder) to identify where the profile was taken.

Optional – display geology data

In the Geology Digimap Collection it is possible to download offshore geology data. There is solid geology and sediment data.

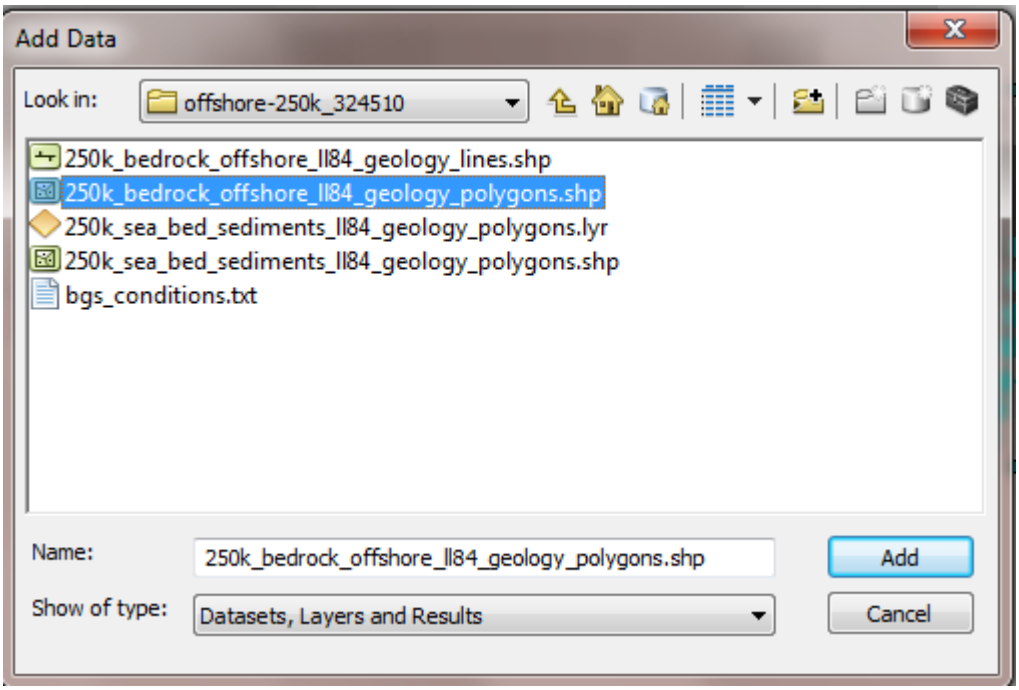
If you wish to complete this section, first download the data from Geology Digimap.

Geology data download

1. Login to Digimap.
2. Select Geology > Download > Geology Download.
3. Search for Forth, select Forth Bridge (City of Edinburgh).
4. Click Select Visible Area under Step 1.
5. Select 1:250000 Offshore Geology data.
6. Click Add to Basket.
7. Give the order a name.
8. Click Request Download.
9. When you receive the 'order is ready' email, save the download file to the Forth Bridge folder.
10. Unzip the zip file.

Add the Geology data in ArcMap

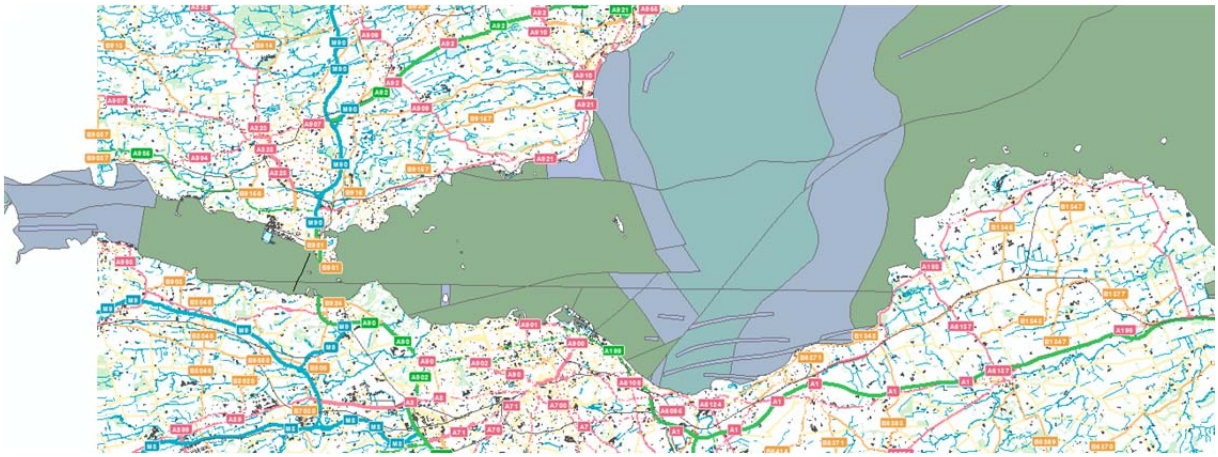
1. Click the **Add data** button.
2. Navigate to the location of your offshore geology data.
3. Select the offshore geology polygon data from the folder:



4. Right click the layer name in the table of contents and select P**roperties** > **Symbology.**
5. Select **Categories** > **Unique values** (we want a different colour for each rock type).
6. Set the **value** filed to LEX_D.
7. Pick a colour ramp.

8. Click OK.

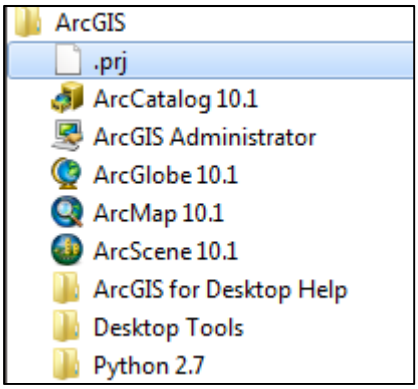
You have now loaded the offshore geology data. You might want to turn on off the bathymetry data and the intertidal data as they will both be obscured by the offshore geology layer.



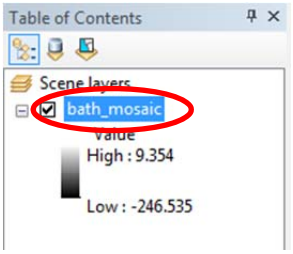
3D visualisation in ArcScene

If you have ArcScene then you can visualise this data in 3D. We won't go into too many details here but will cover the basics of importing some data and projecting it into 3D.

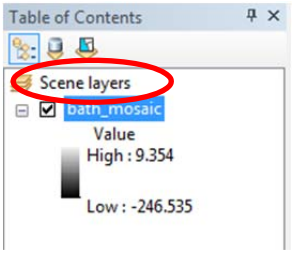
ArcScene is a 3D viewer and will be listed as a programme in your ArcGIS folder. Check your ArcGIS folder in All Programs to see if you have it.



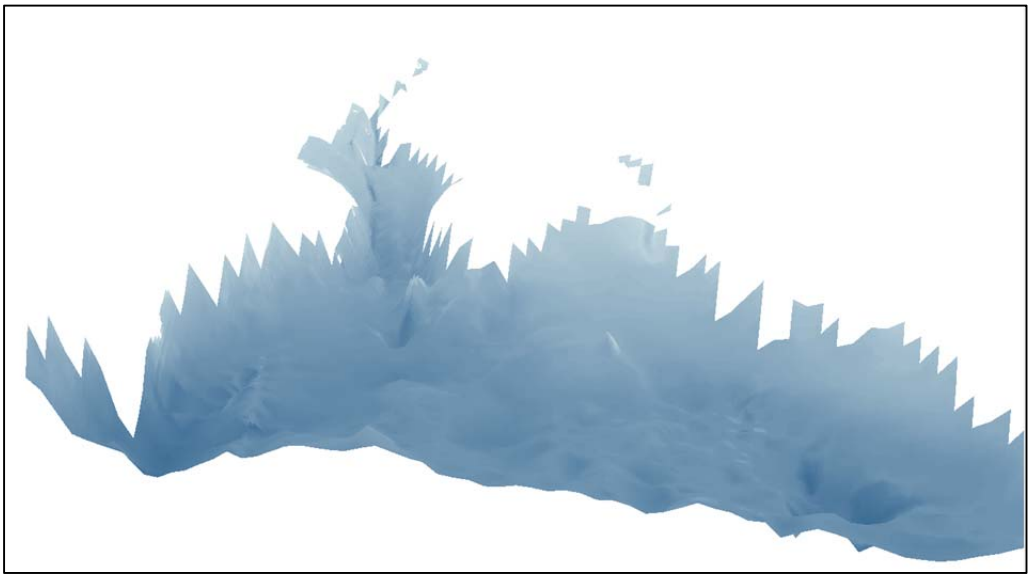
1. Open ArcScene.
2. Add the Bathymetry data.
3. To project this into 3D.
    a. Right click on Bathymetric layer (BathMos_OSGB).



b. Select Properties.
c. Select the Base Heights tab.
d. In the Elevation from Surface select "Floating on a custom surface" – it should display the path to the bathymetric data we have already loaded.
e. Click **OK.**
f. Right click the **Scene Layers.**



g. Select **Scene Properties.**
h. In the **General Tab**, set the Vertical Exaggeration, in this case we will set the value to 100.
i. Click **OK.**



Other possibilities

You could add another raster and display it on the 3D surface. The image below shows a raster of the offshore geology data surface.

You can do lot more in ArcScene to give your data perspective, just play.