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INTRODUCTION

This guide contains instructions for viewing different types of spatial data from Digimap Ordnance Survey Collection in ArcGIS.

You will need access to ArcGIS software to complete the exercises in 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

Dave is studying for an MSc in Environmental Science at the University of Leeds.

His dissertation is investigating the potential impact of proposed wind farms in Cumbria on the surrounding ecology.

Dave has collected ecological data at the proposed sites to feed into his 3D GIS model of the sites and surrounding area. He also has the coordinates of each proposed site and existing wind farm sites.

What map creation and data analysis will Dave do?

- Map showing Cumbria in the context of the North of England.
- Map showing the location of the proposed wind farms.
- Create Digital Terrain Models, plus contour maps, to analyse the ecological factors for the regions around each proposed site.

WHAT WILL I LEARN?

- The key applications used in ArcGIS desktop software
- How to:
 - Add raster and vector data to ArcMap
 - Amend symbology of map layers
 - Create a buffer zone around a map feature
 - Export map as an image
 - Create a new shapefile of potential wind turbine locations
 - Add attribute information to new shapefile
 - Carry out viewshed analysis
 - Create a relief map using a Digital Terrain Model from Digimap

WHAT DATA DO I HAVE?

We have downloaded data from Digimap Ordnance Survey Collection and ShareGeo.

You have a folder called **Wind Farms Exercise data**, with two sub-folders.

Name	Date modified	Type
Digimap_Download_wind_farms_90380	20/08/2013 14:27	File folder
Wind Farms in Great Britain	20/08/2013 16:27	File folder

Here's a summary of the data in these folders:

1. Digimap_Download:

Name	Date modified	Type	Size
raster-250k_229687	20/08/2013 11:06	File folder	
terrain-50_229685	02/09/2013 17:33	File folder	
terrain-50-dtm_229684	23/08/2013 17:00	File folder	
citations_orders_90380.txt	20/08/2013 10:42	Text Document	3 KB
contents_order_90380.txt	20/08/2013 10:42	Text Document	17 KB

- **raster-250k.** 1:250000 raster – backdrop map in TIFF format.
 - **terrain-50.** OS Terrain 50, contours and spot heights.
 - **Terrain-50-dtm.** OS Terrain 50 DTM (Digital Terrain Model), used for 3D modelling of terrain.
2. **Wind Farms in Great Britain** - data on the location of wind farms in Great Britain has been collated and made available by one of our Digimap colleagues in ShareGeo¹. This is a service where academics can share their map data with others.

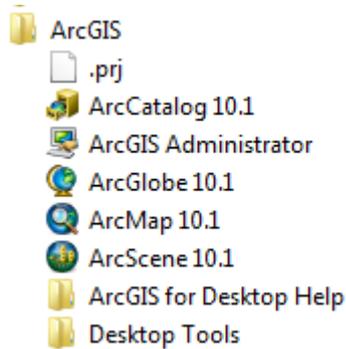
¹ <http://www.sharegeo.ac.uk/handle/10672/294>

There are Shape files (ArcGIS file format, compatible with many other software packages) in the folder on the location of operational wind farms, those consented, those proposed and wind farms under construction.

ARCGIS

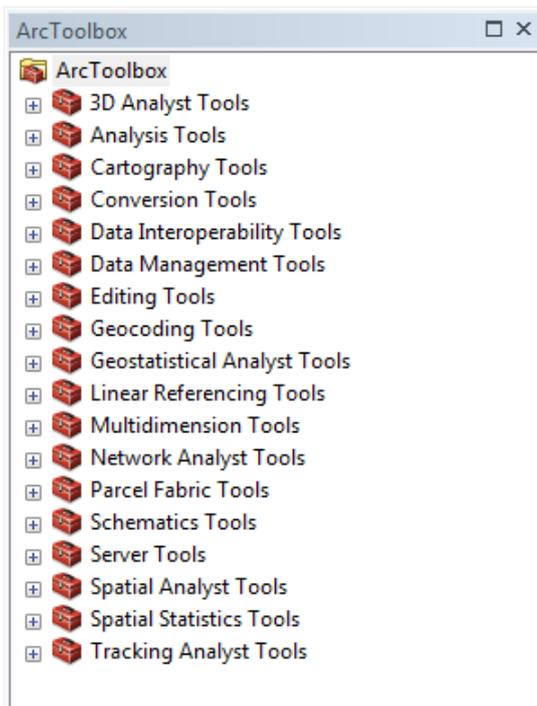
ArcGIS is **Geographic Information System** software that is used to view and analyse geospatial data. There are different levels of license for ArcGIS, but all levels include two applications: ArcMap and ArcCatalog.

- **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:

1. **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:

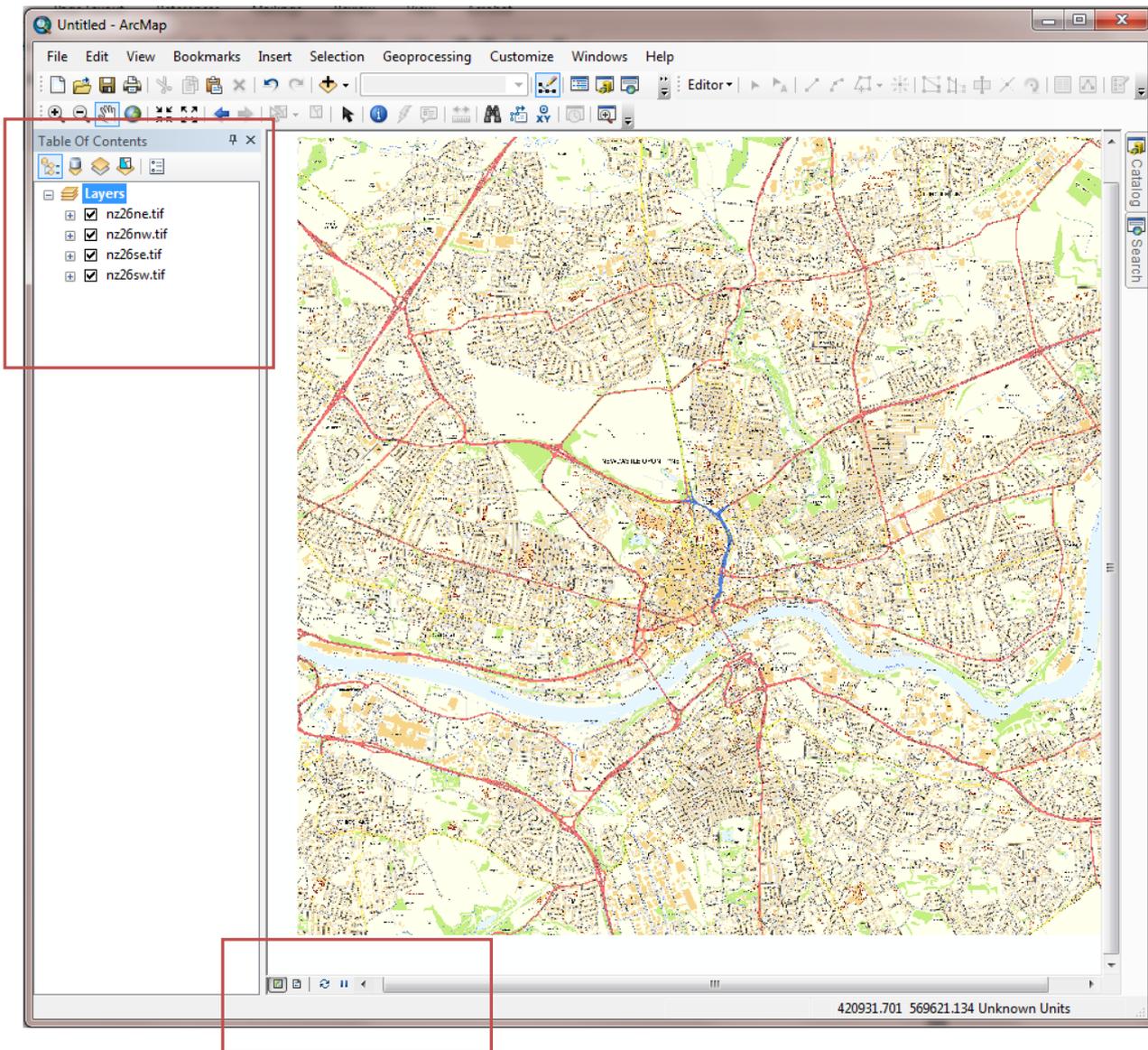


TABLE OF CONTENTS

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.

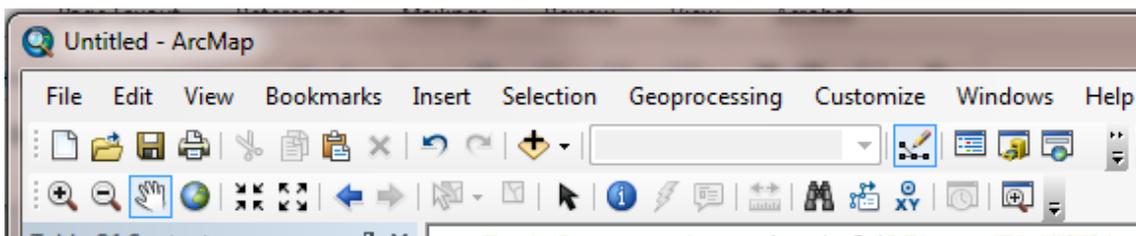
MAP DISPLAY AREA

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.



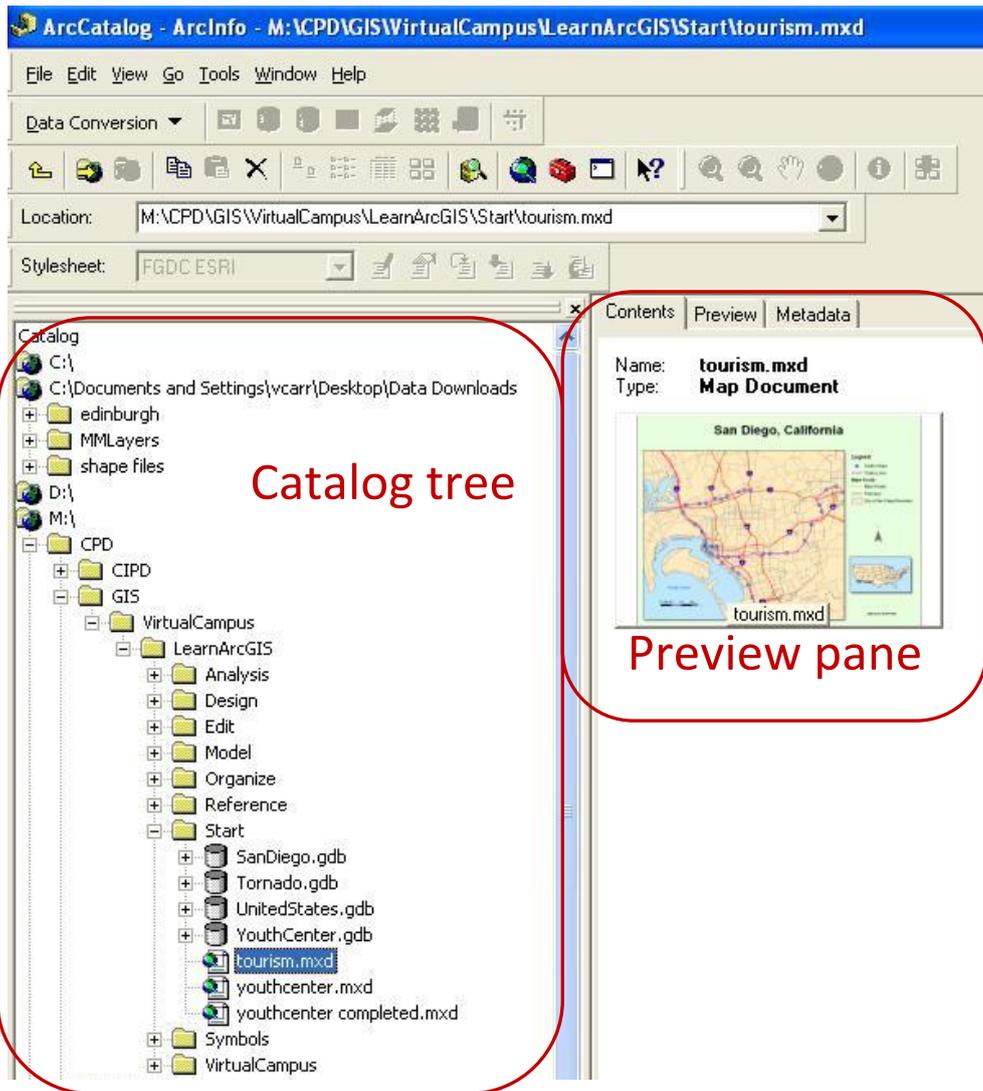
ARCCATALOG

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.

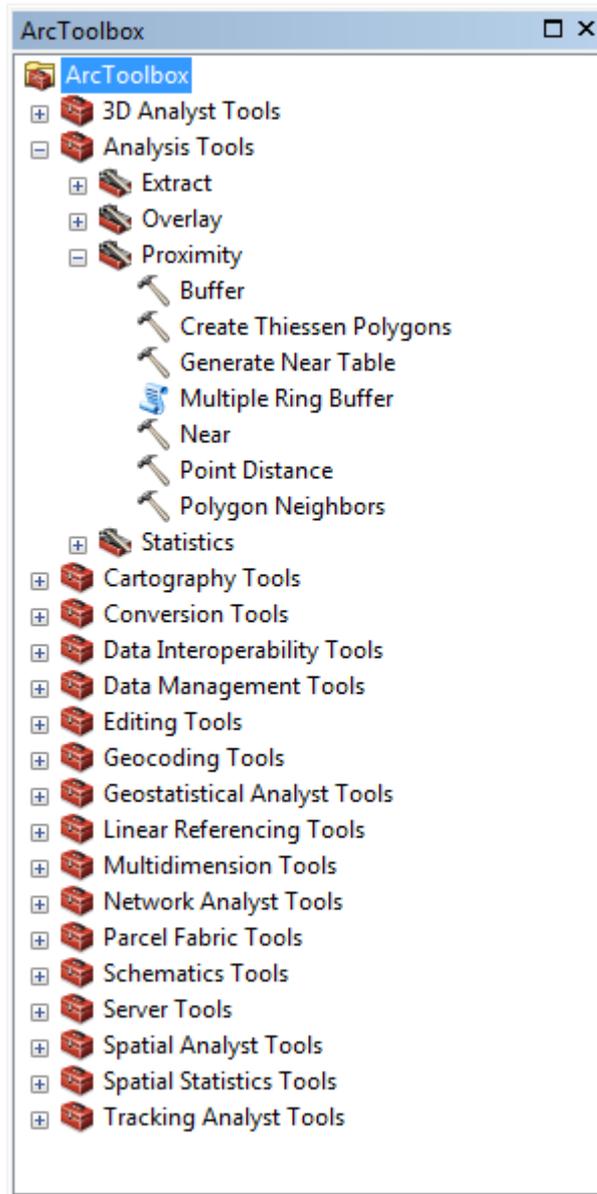
The preview pane on the right provides three different tabs for previewing information about the data; contents, preview and metadata.



ARCTOOLBOX

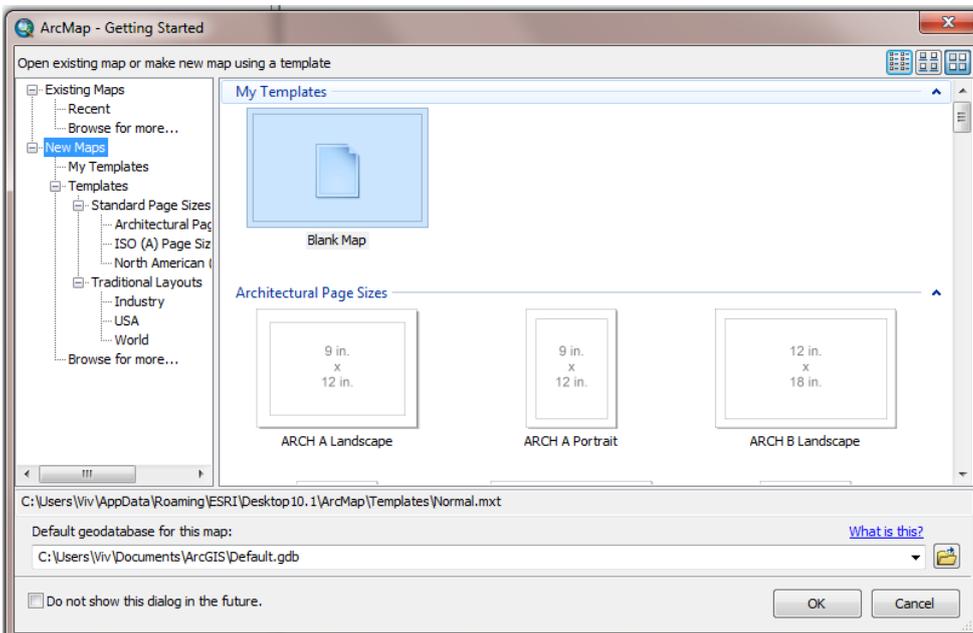
ArcToolbox provides an organised collection of tools used for GIS analysis, data management, and data conversion.

The number of tools you have depends on your ArcGIS license.



START ARCMAP

1. Start **ArcMap** from your list of programs.
2. Select **New Maps > Blank map**.
3. Click **OK**.



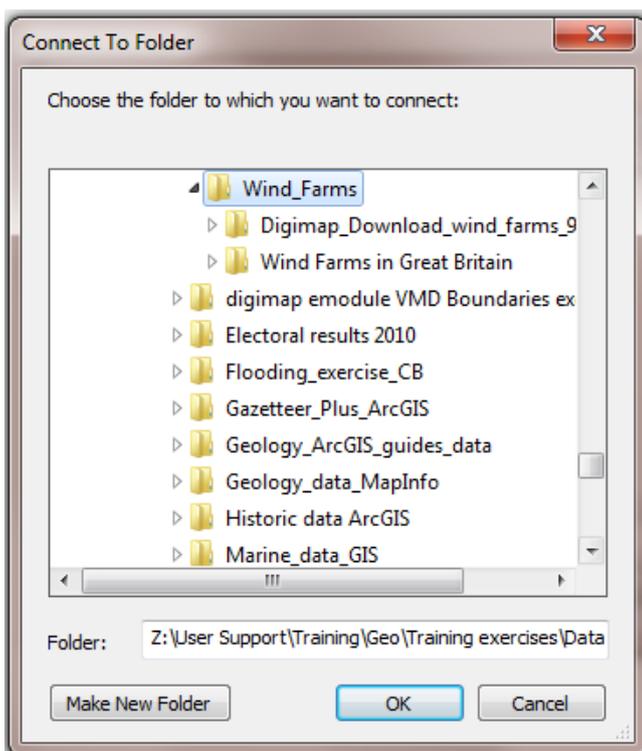
IMPORT 1:250000 MAP DATA

Let's add the 1:250000 raster map data as a background for our wind farm locations.

RASTER maps, in this instance a scanned map², are provided in TIFF image format from Digimap.

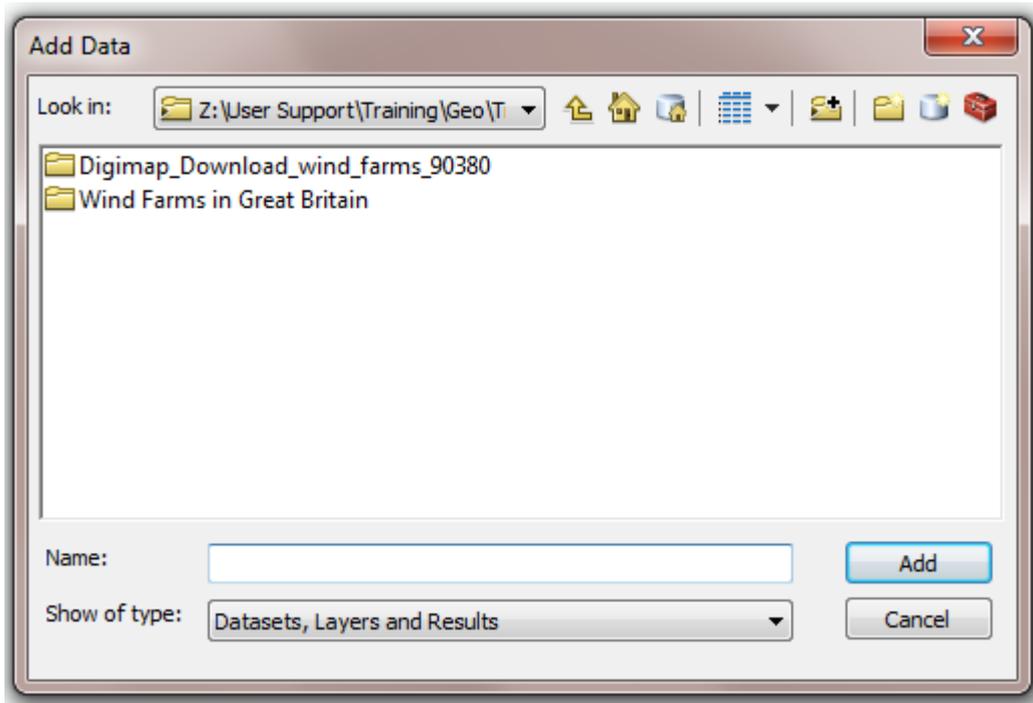
These files are straightforward to work with in GIS; they require no preparation or conversion.

1. Click **Add Data** 
2. You may need to connect to the folder that contains your Digimap data. ArcGIS does not automatically see your data folder. Click the **Connect to folder** button  and select the folder **Wind Farms Exercise data**.
3. Click **OK**.

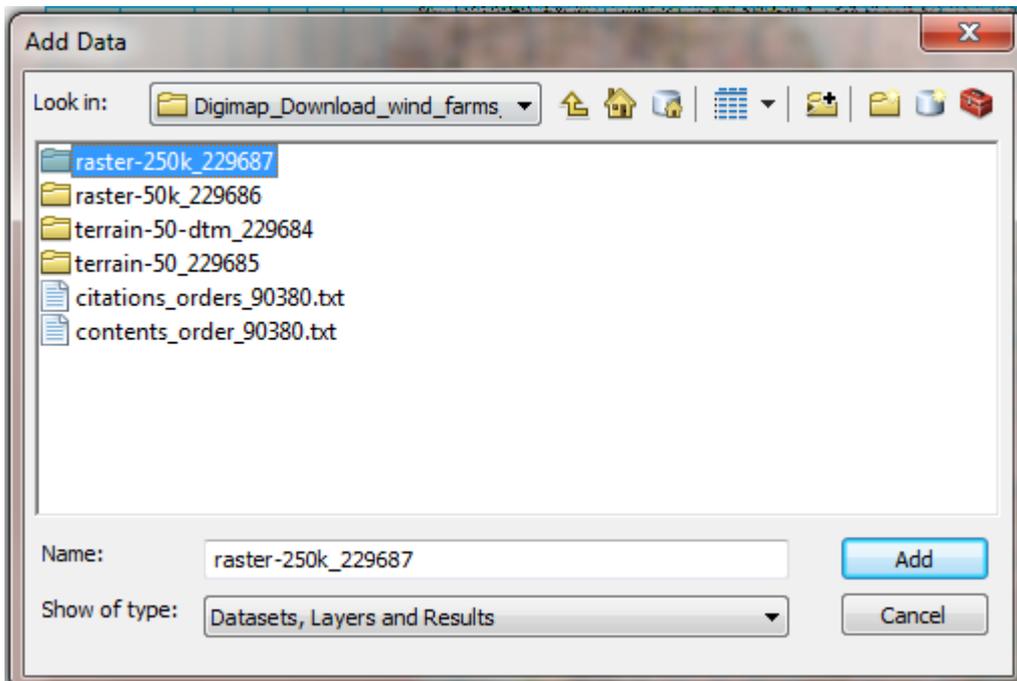


² <http://www.ordnancesurvey.co.uk/oswebsite/products/backdrop-mapping.html>

4. Double click on the folder **Digimap_Download_wind_farms_90380**:

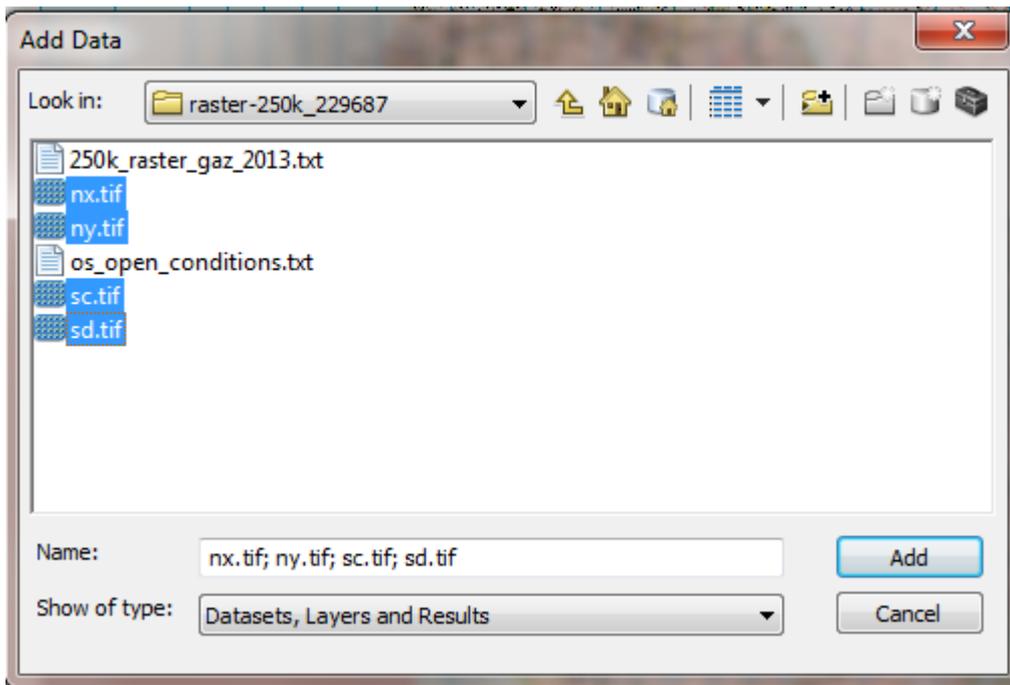


5. Double click the folder **raster-250k_229687**:

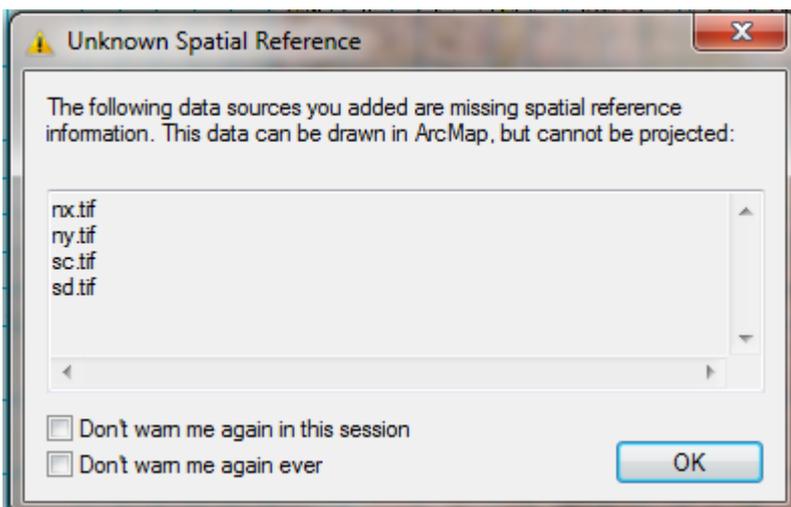


6. Use CTRL-click to select all 4 .tif files in the folder.

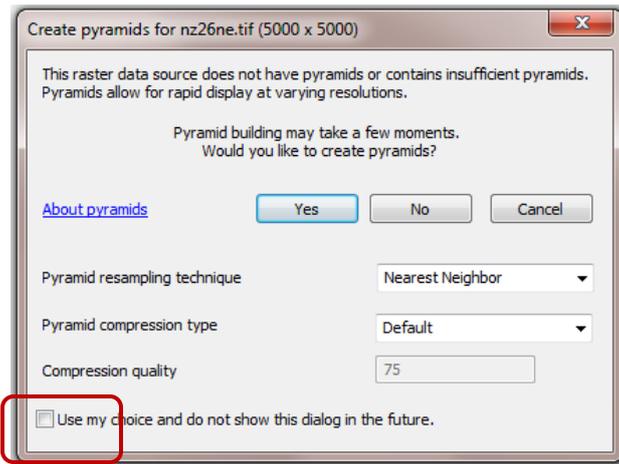
7. Click **Add**.



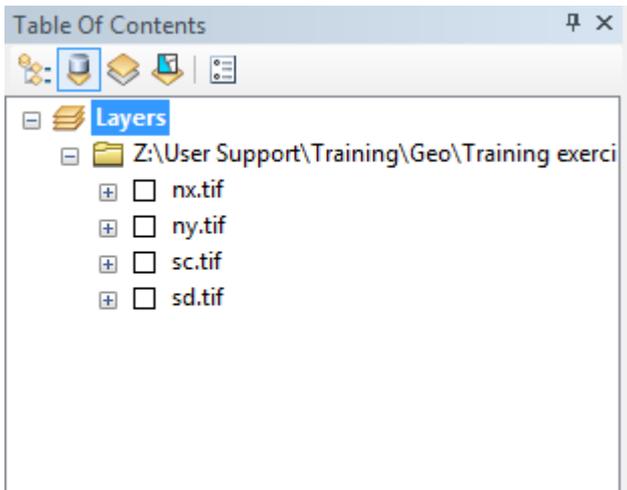
1. If you receive this error, message, click OK:



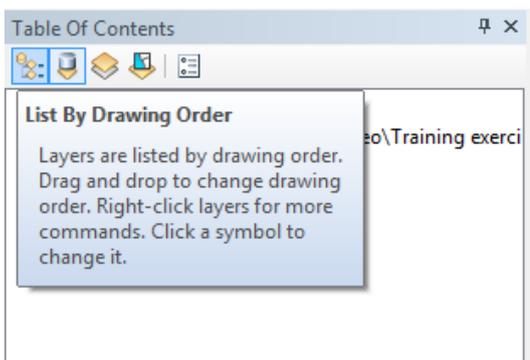
2. If asked to create pyramids, say Yes.
3. Tick the box 'use my choice and do not show this dialog...'



You will see the Table of Contents now has some layers:



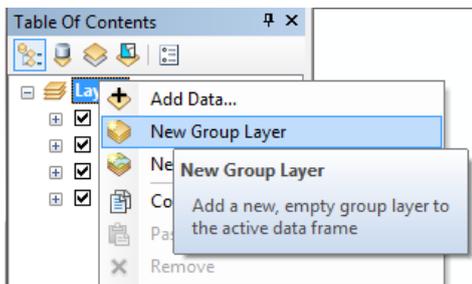
8. Click the button **List by Drawing Order** at the top of the Table of Contents – this makes it easier to see what is going on in the table of contents:



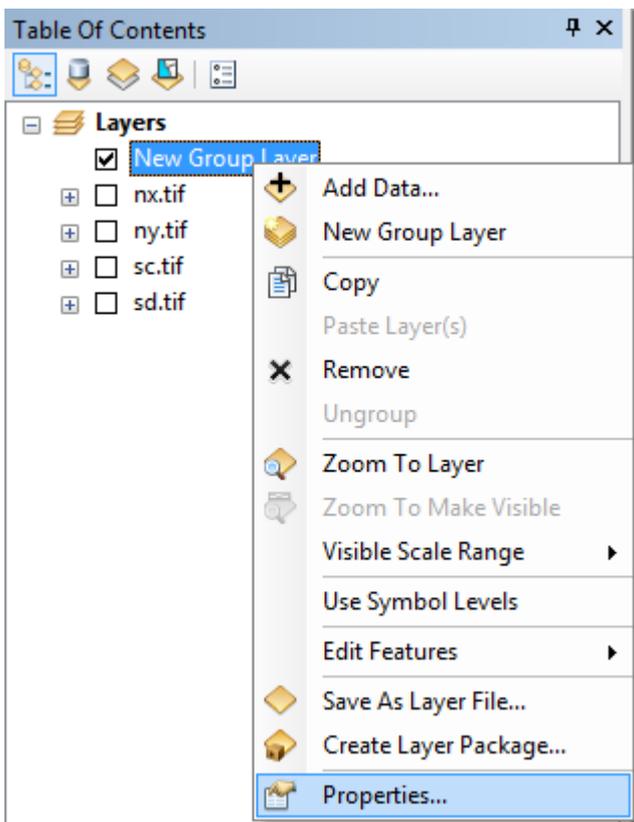
CREATE A GROUP LAYER

In this exercise we will add several different map data files to ArcMap. The table of contents can get quite busy. Let's create a group layer to put all of our 1:250000 raster data together.

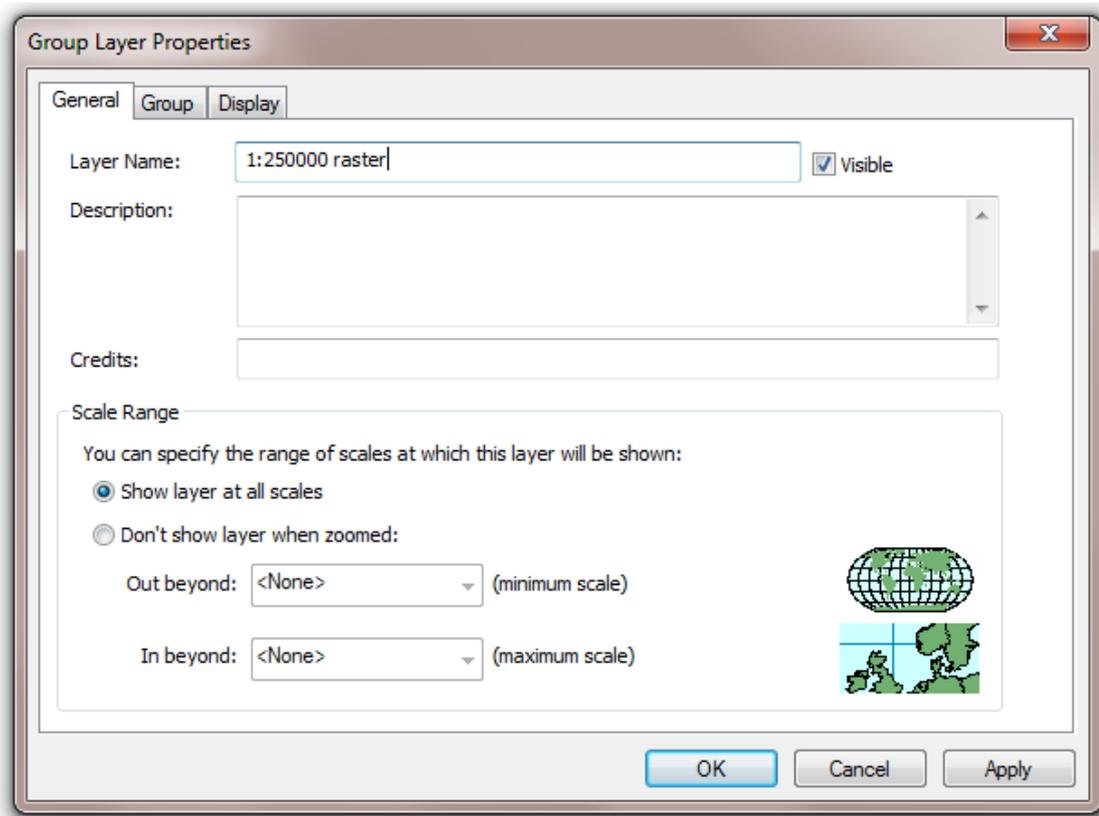
9. Right-click on **Layers**.
10. Select **New Group Layer**.



11. Now right click on the New Group Layer and select Properties.



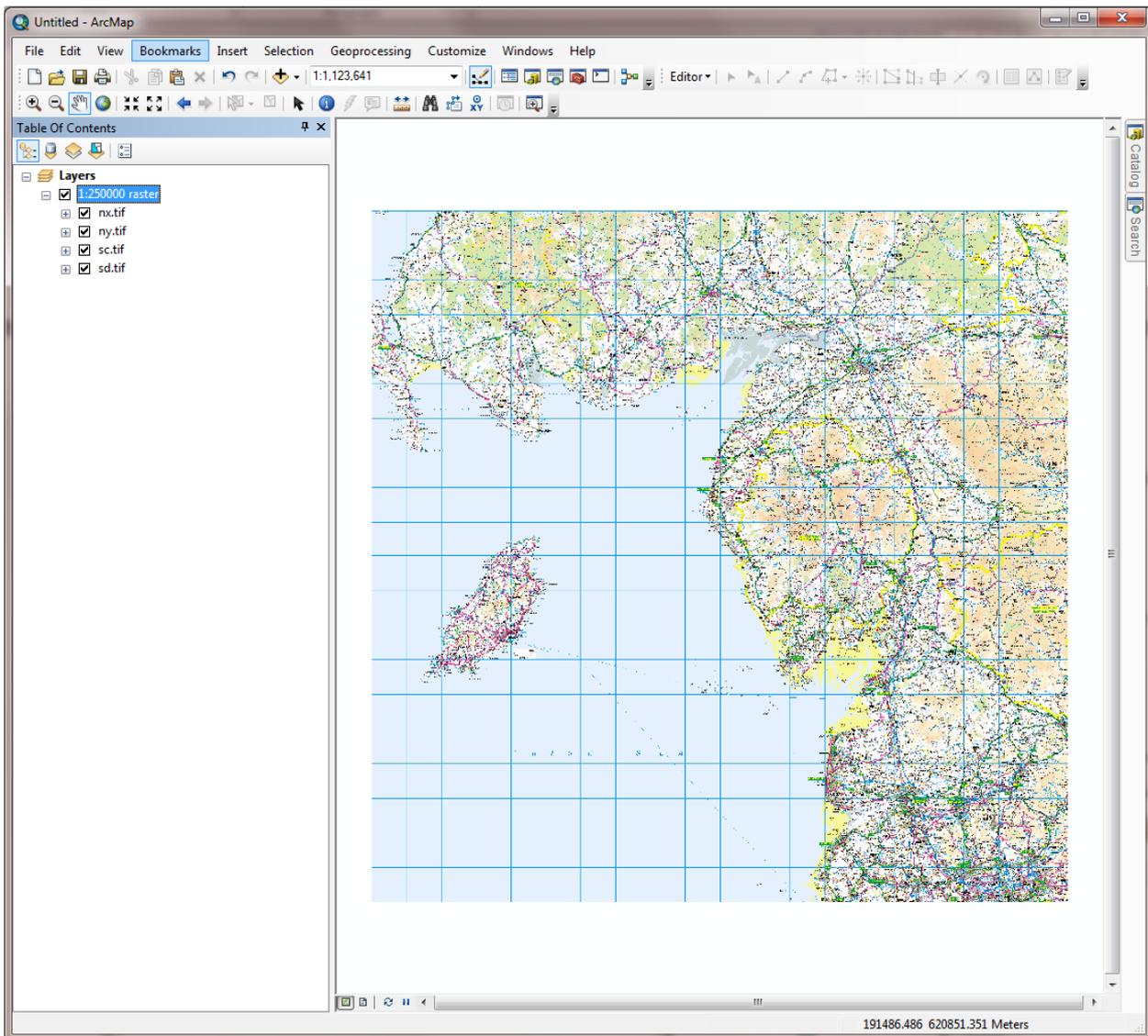
12. Select the General Tab.
13. Type **1:250000 raster** in the Layer Name box.



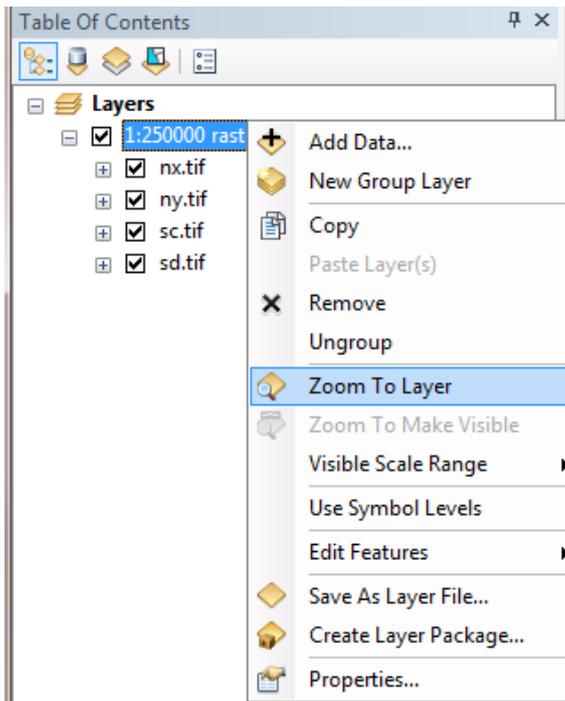
14. Click **OK**.

15. Click and drag all the 1:250000 raster layers to the new group layer.

Your ArcMap window should look similar to the image below.



If you cannot see any map data, try right clicking on the 1:250000 raster group layer and select **Zoom to layer**:



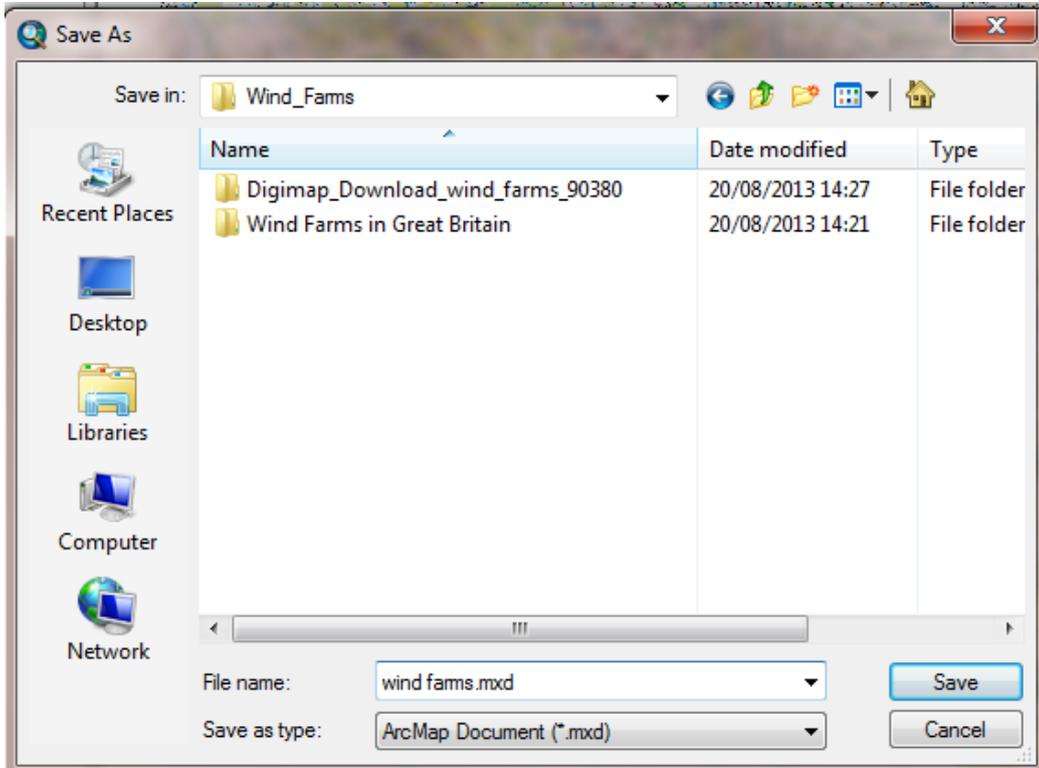
SET THE COORDINATE SYSTEM

We want to set the coordinate system of our project to British National Grid.

1. Right click the word Layers at the top of the Table of Contents.
2. Select Properties.
3. Select the Coordinate System tab.
4. Select **Projected Coordinate Systems > National Grids > Europe > British National Grid.**
5. Click Apply.
6. Click OK.

SAVE YOUR ARCMAP DOCUMENT

7. Save your ArcMap document. Click **File > Save as**.
8. Name the file and click save.



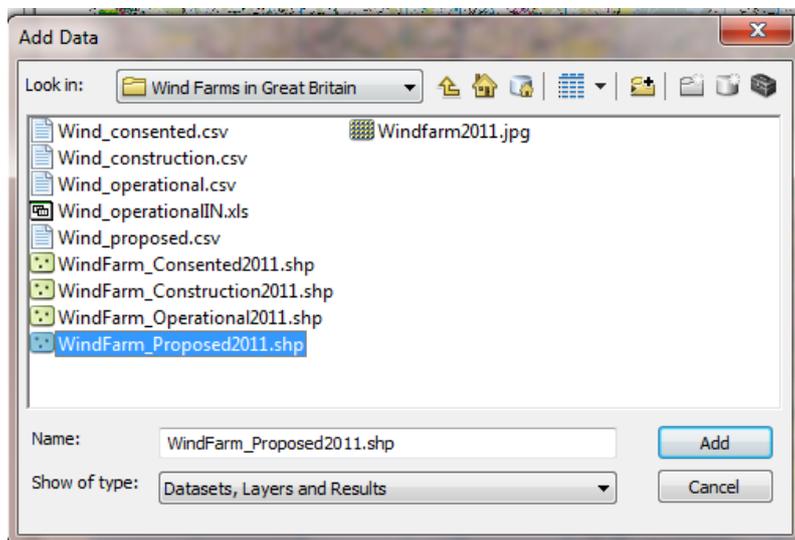
You are saving the file as an ArcMap document. If you move any of the map data from the current location, you will have to update the connections to the map data in your ArcMap document.

ADD WIND FARM DATA

Data on the location of wind farms in Great Britain has been collated and made available by one of our Digimap colleagues in ShareGeo³. This is a service where academics can share their map data with others.

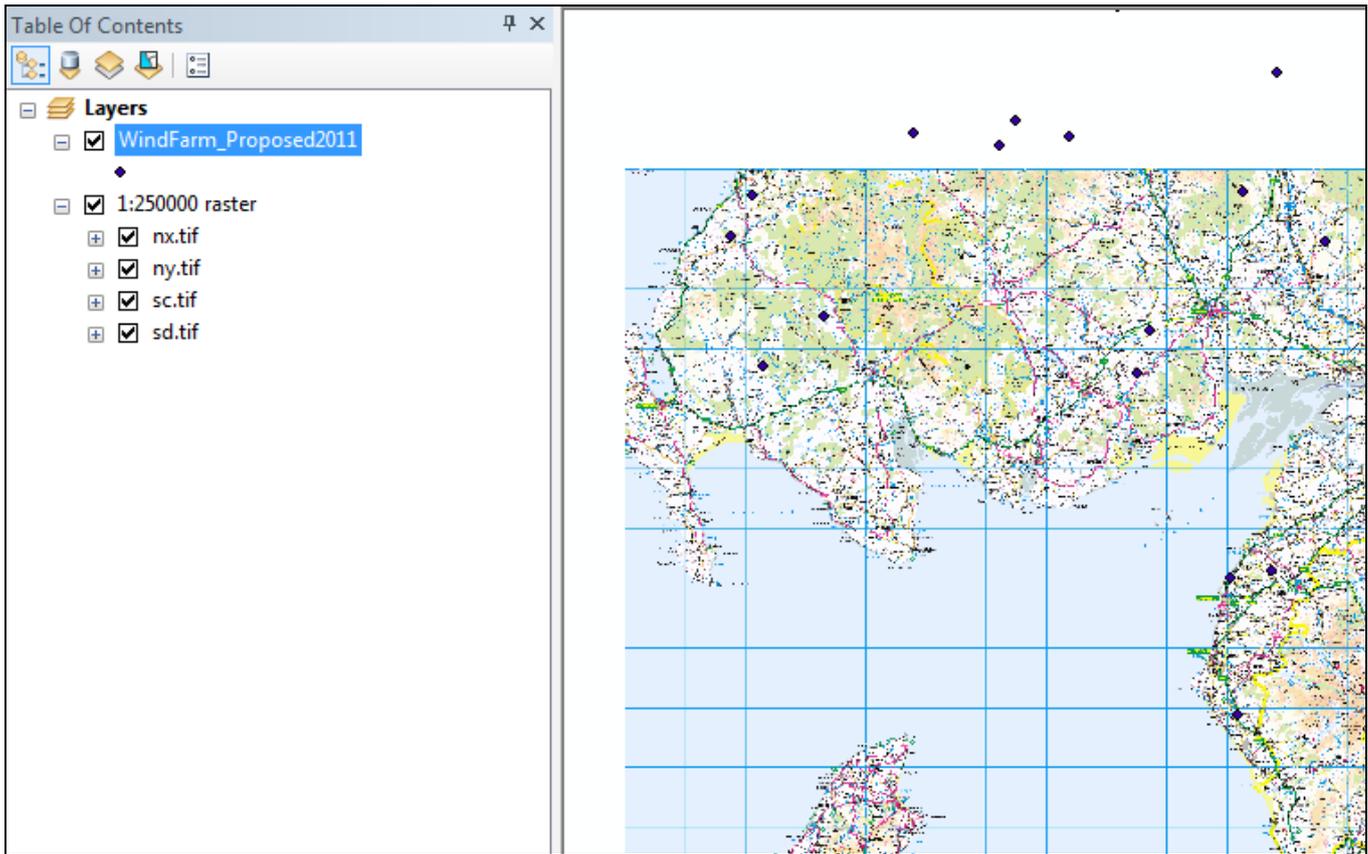
This map data is provided in Shape file format, which is compatible with ArcGIS and many other GIS software packages.

1. Click **Add Data**.
2. Navigate to the **Wind Farms exercise data > Wind Farms in Great Britain** folder. Double click on it.
3. Click the shape file **WindFarm_Proposed2011** and click **Add**.



You should see a new layer in the Table of Contents area. Some points should also be visible on your map, e.g.:

³ <http://www.sharegeo.ac.uk/handle/10672/294>



SELECT CUMBRIA WIND FARMS

Note that the wind farm data is for the whole of Great Britain. We are only really interested in the Cumbria area.

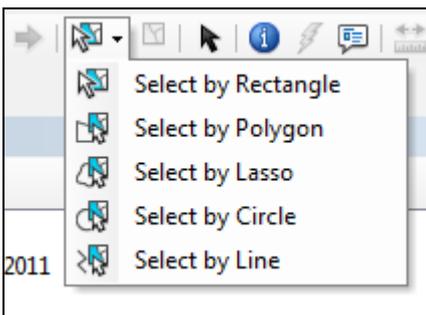
Let's select wind farms in our area of interest, and create a new layer based on our selection.

1. First, zoom in until you can clearly see the wind farms in Cumbria, similar to the image below – you don't need to cover exactly the same area.

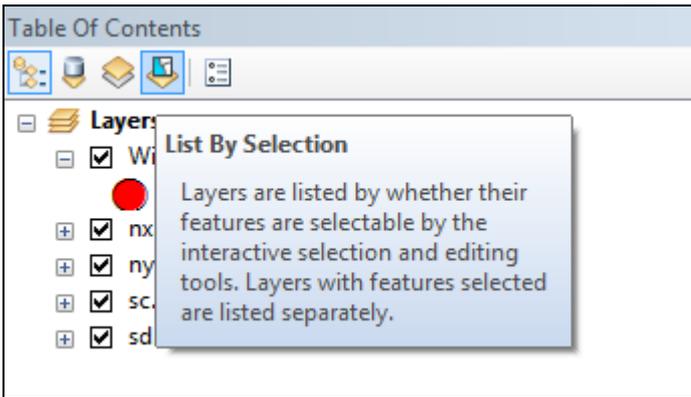


Now, we want to select the wind farms we can see.

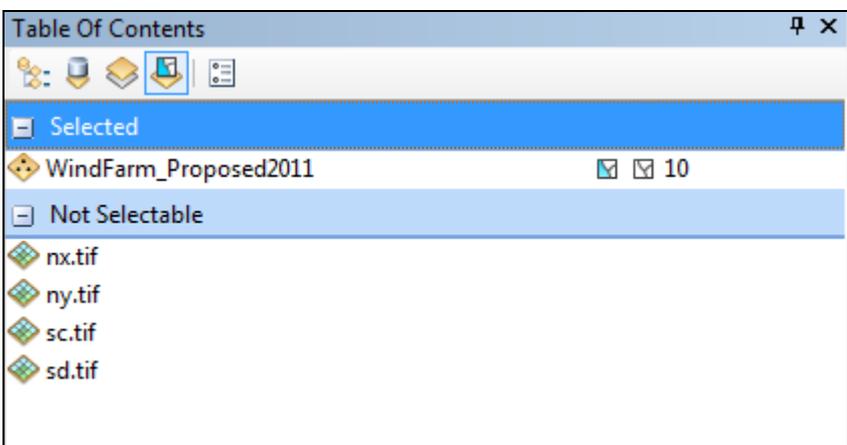
2. Click the Select by Feature button on your toolbar.
3. Click Select by Rectangle.



4. Click on your map and draw a rectangle that covers all the visible wind farm symbols.
5. The rectangle will disappear, but your wind farms should be highlighted on the map.
6. Now go to the Table of Contents.
7. Click the List by Selection button.

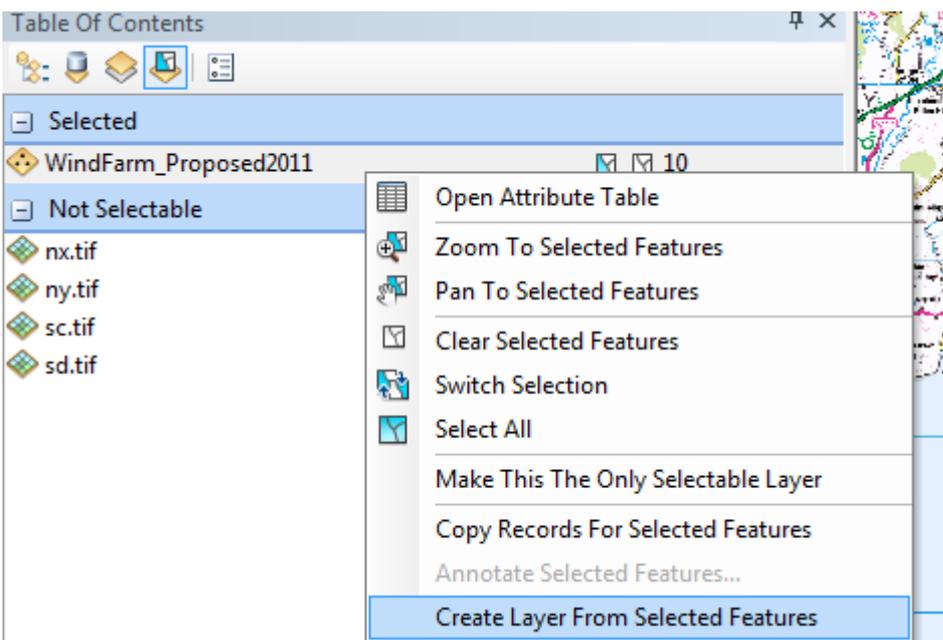


8. You should see that under **Selected**, it lists the WindFarm_Proposed2011 layer.

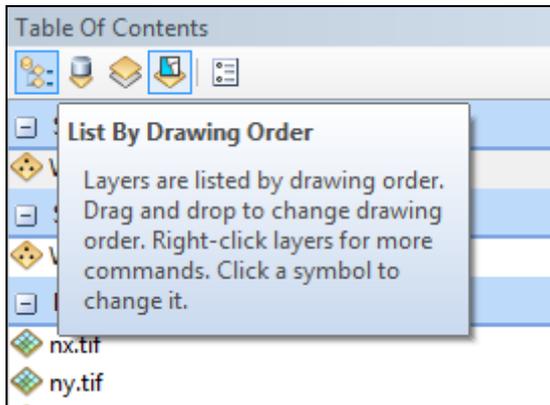


9. Right click on the wind farms layer.

10. Select Create Layer from Selected Features.



11. Click on List by Drawing Order.



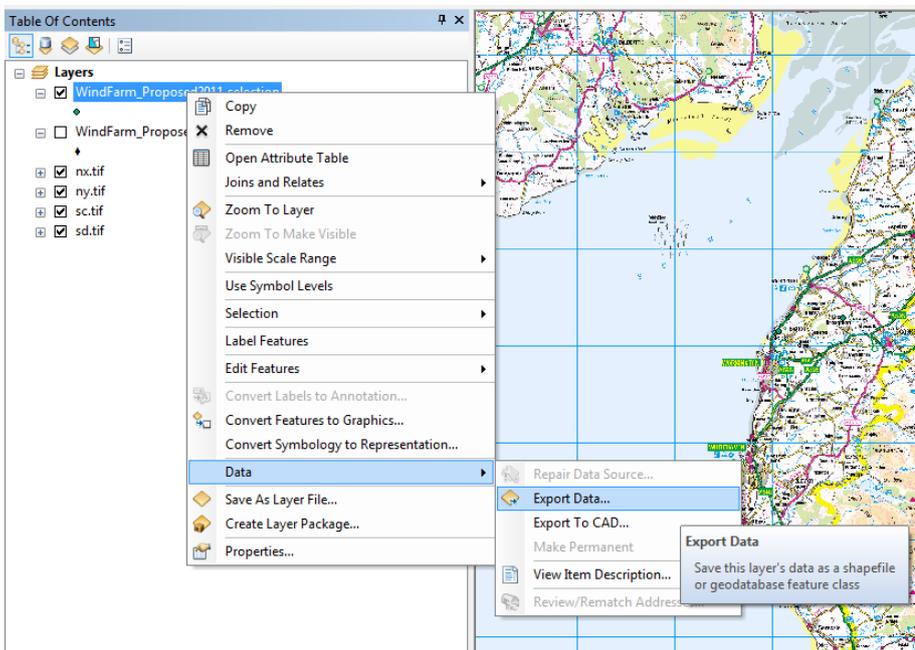
You should see a new layer added in the Table of Contents.

12. Uncheck the original Wind Farms layer, so that you are only displaying the wind farm selection layer.

13. Let's export our new layer (of the wind farms in Cumbria), so that we have it as a separate file, should we need to use it again.

14. Right click on the wind farms selection layer.

15. Select **Data > Export Data.**



16. Ensure you have selected **Export all Features.**

17. Check you have selected to use the same coordinate system as the original layer.

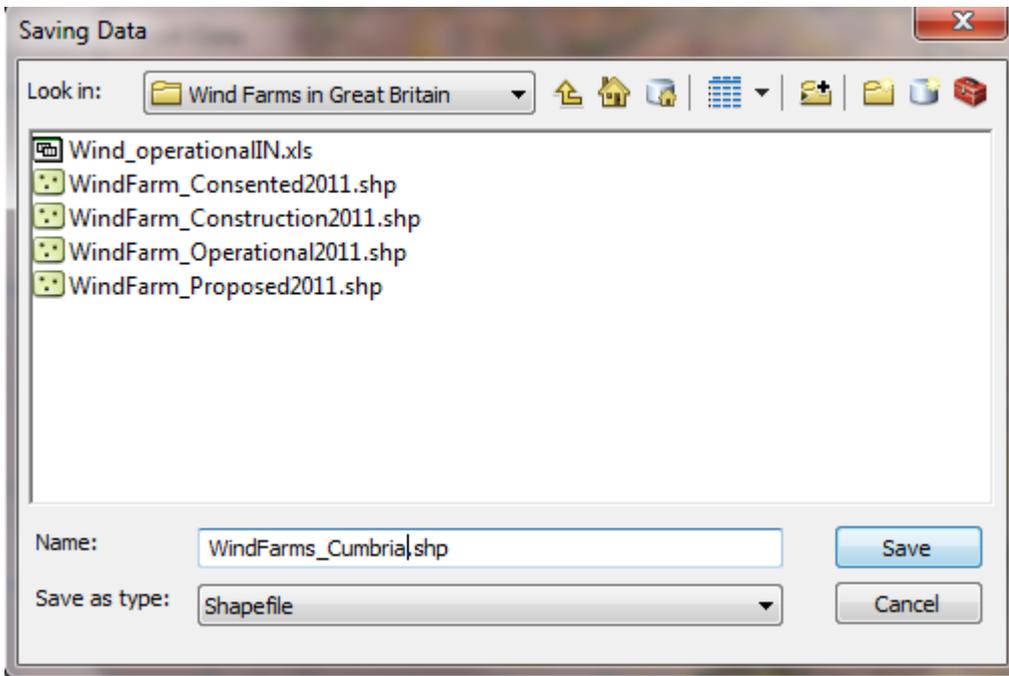
18. Click on the yellow folder icon, to select a location for the new file.

19. Select your Wind Farms Exercise data > Wind Farms in Great Britain folder.

20. Now give it a name, for example **WindFarms_Cumbria**.

21. Check that the type of file is a **Shapefile**.

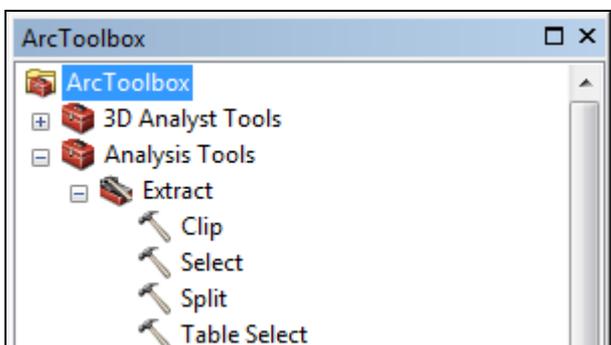
22. Click **Save**.



23. Click Yes to add the exported data as a layer.

24. Your Table of Contents should now have three Wind Farms layers. We only really need the Wind Farms Cumbria layer, so right click the other two in turn, and remove them.

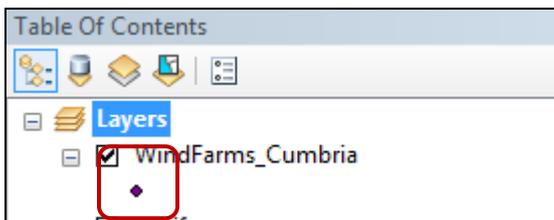
NOTE: if you want to do this for multiple layers of map data, we would recommend exploring the **Clip tool in Arc Toolbox** to clip the data to your area of interest.



CHANGE WIND FARM SYMBOLS

ArcMap assigns random colours and symbols to imported map data. Let's change the symbols for the wind farms so they stand out more against our raster map:

1. Click on the symbol under the **WindFarms_Cumbria** layer:

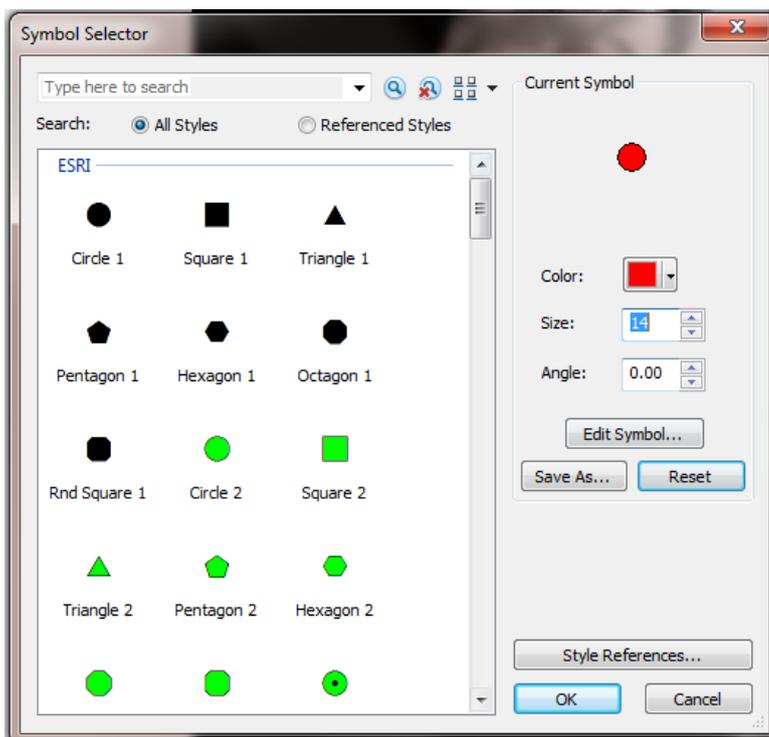


2. The Symbol Selector box is generated.

The current symbol is only 4.00 points in size and is a dark colour.

4. Select an alternative – we suggest a bright colour and a size of 10 points or more.

5. Click **OK**.

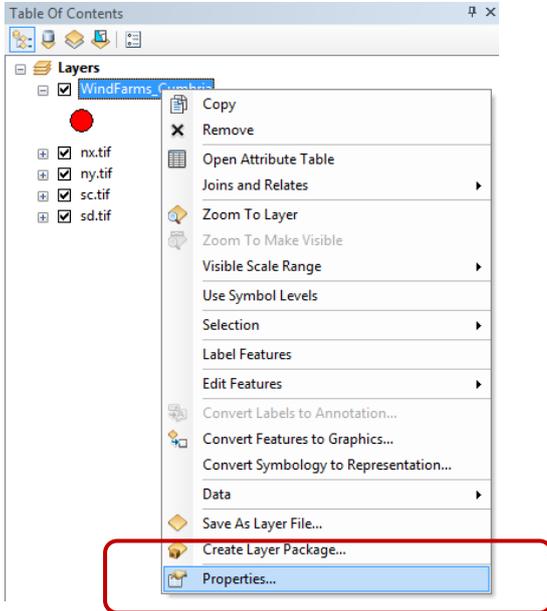


Your symbols should now be more visible.

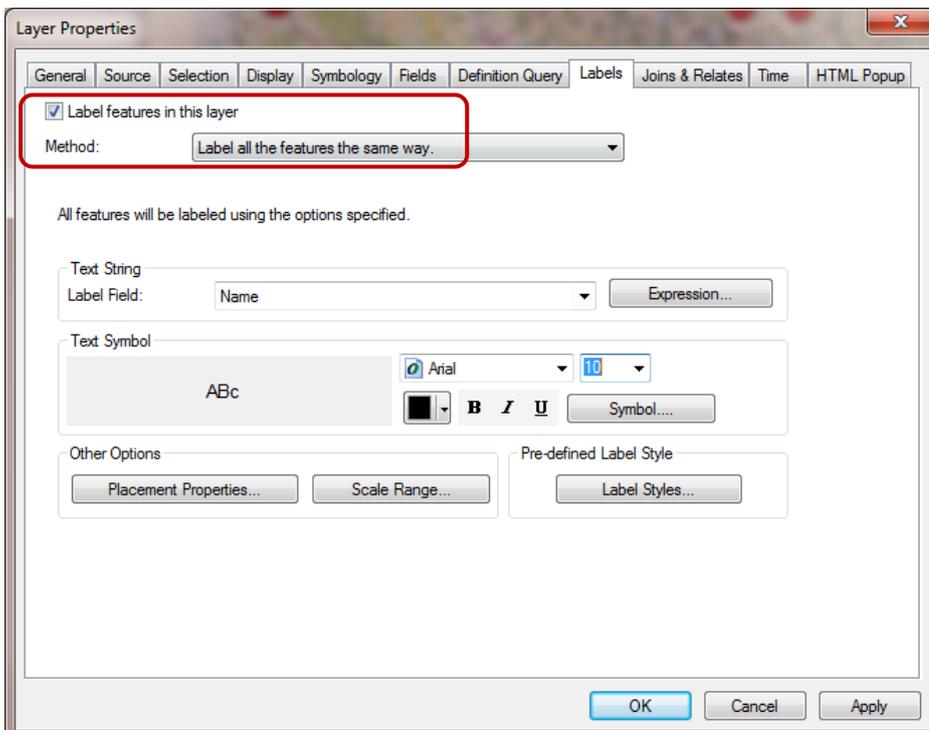
LABEL WIND FARMS

Now let's label the wind farms.

1. Right click on the wind farm layer and select properties:

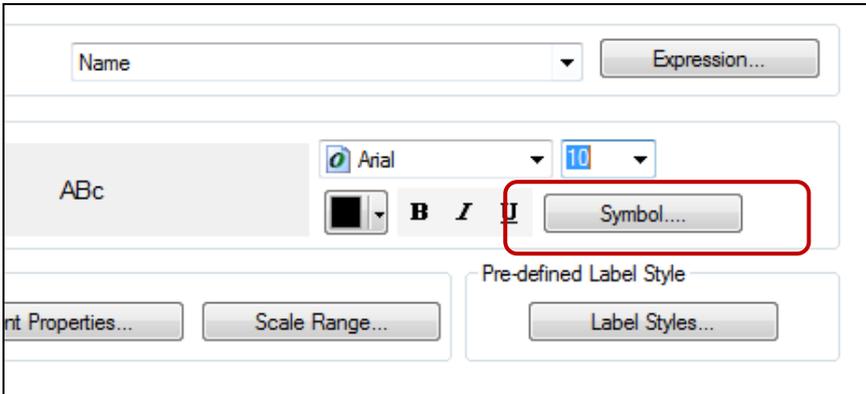


2. Complete the **Labels** tab as shown in this image:

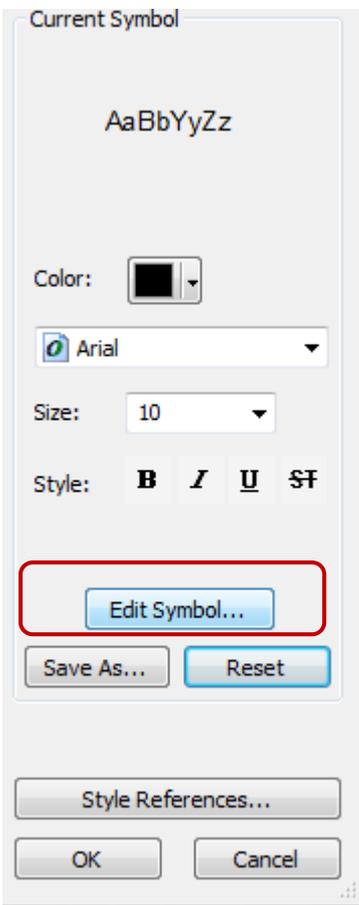


If you wish to make the label stand out more, you can add a halo.

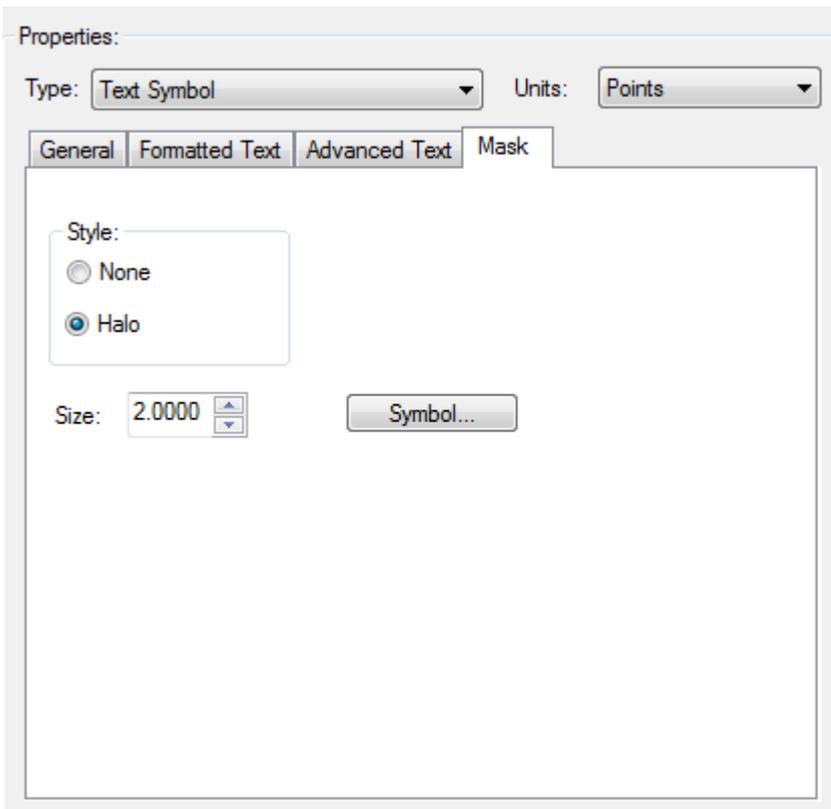
3. Click Symbol:



4. Click Edit Symbol:



5. Click Mask > Halo:



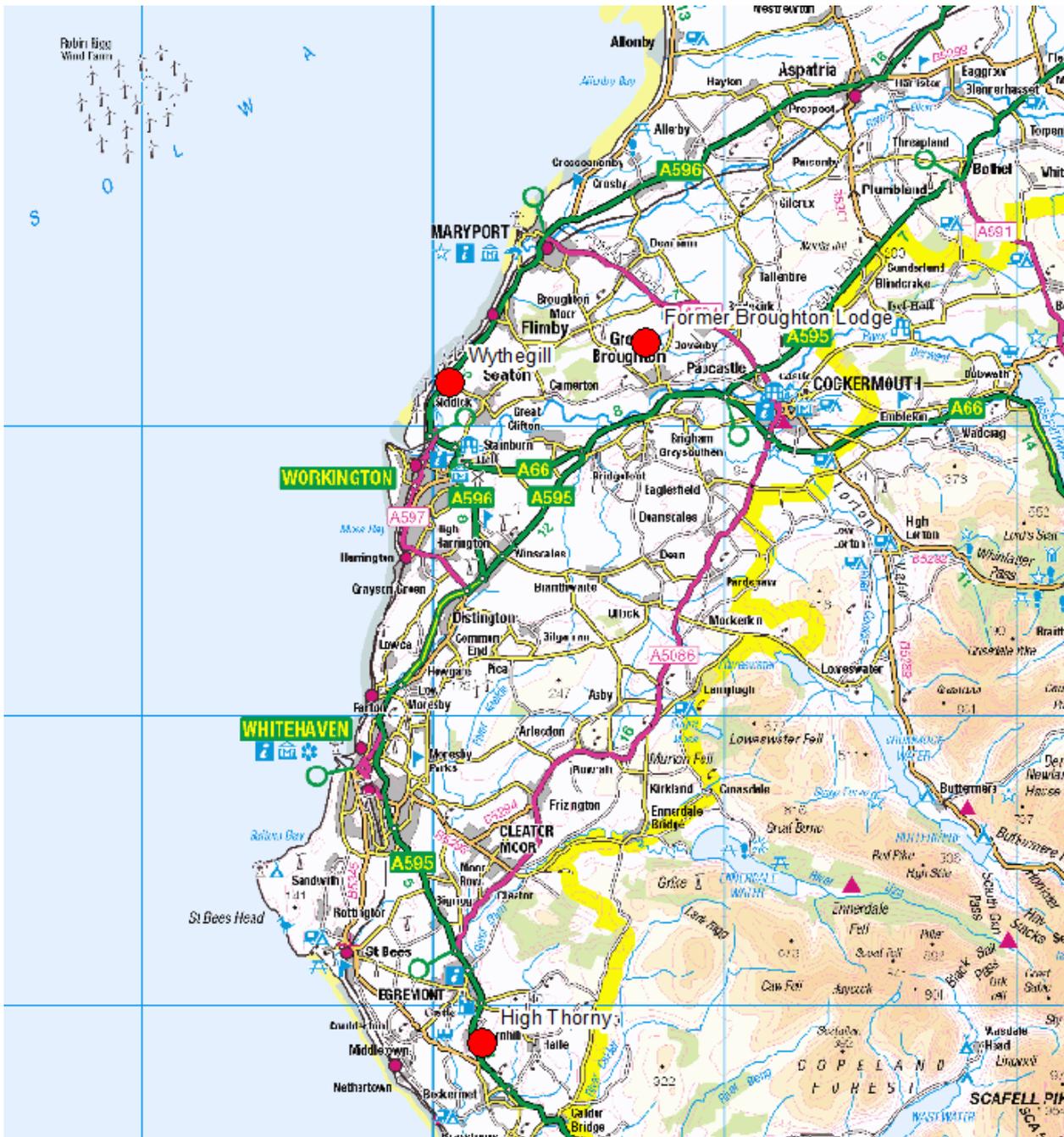
6. Click OK.
7. Click OK.
8. Click OK at the Layer Properties box.

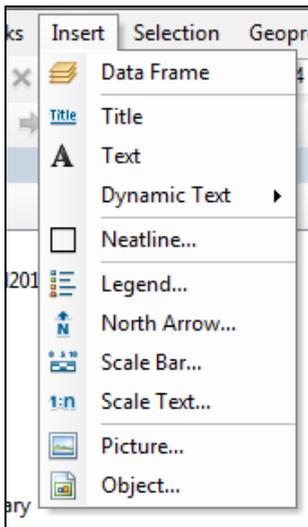
Zoom in a little to check the location of some of the proposed sites in Cumbria.

In ArcMap you can zoom in by:

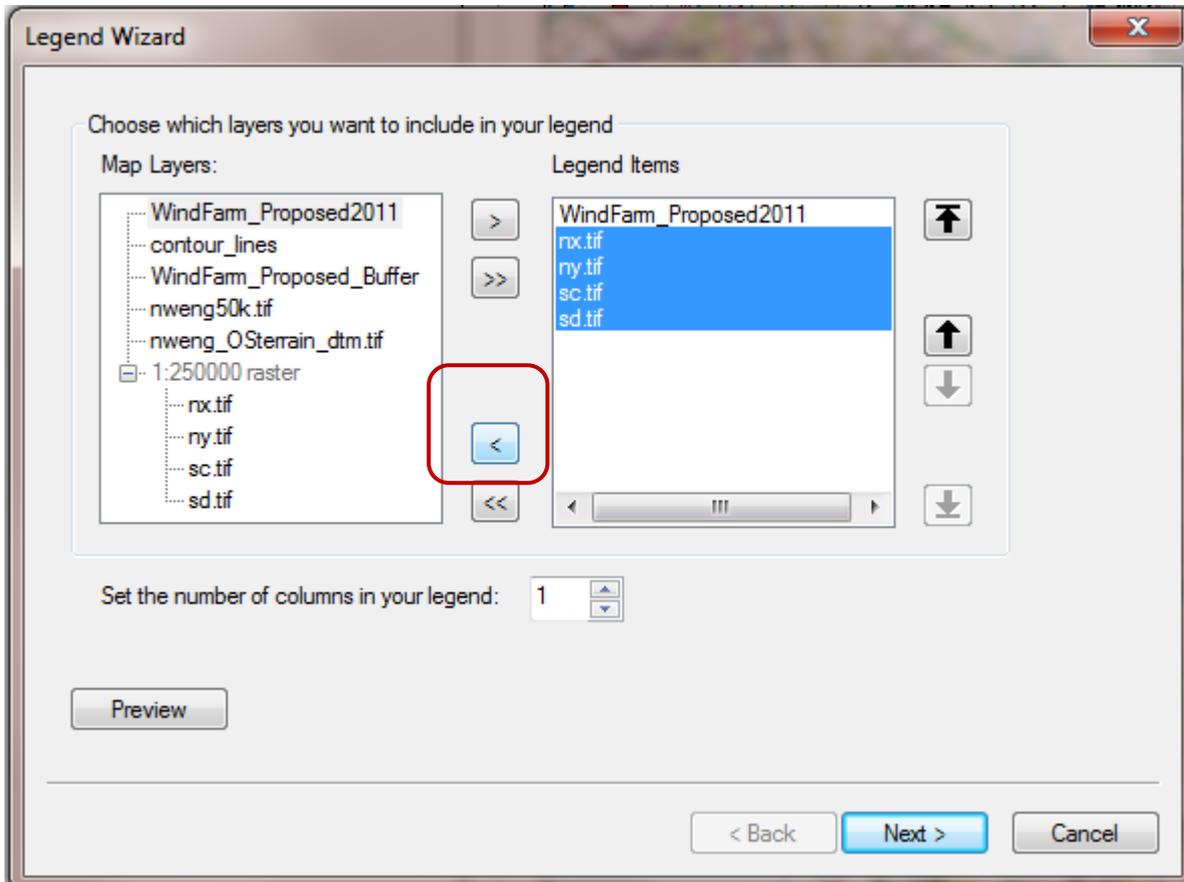
9. Moving the scroll wheel on your mouse AWAY from the screen.
10. Click the Zoom in button then click on the map:



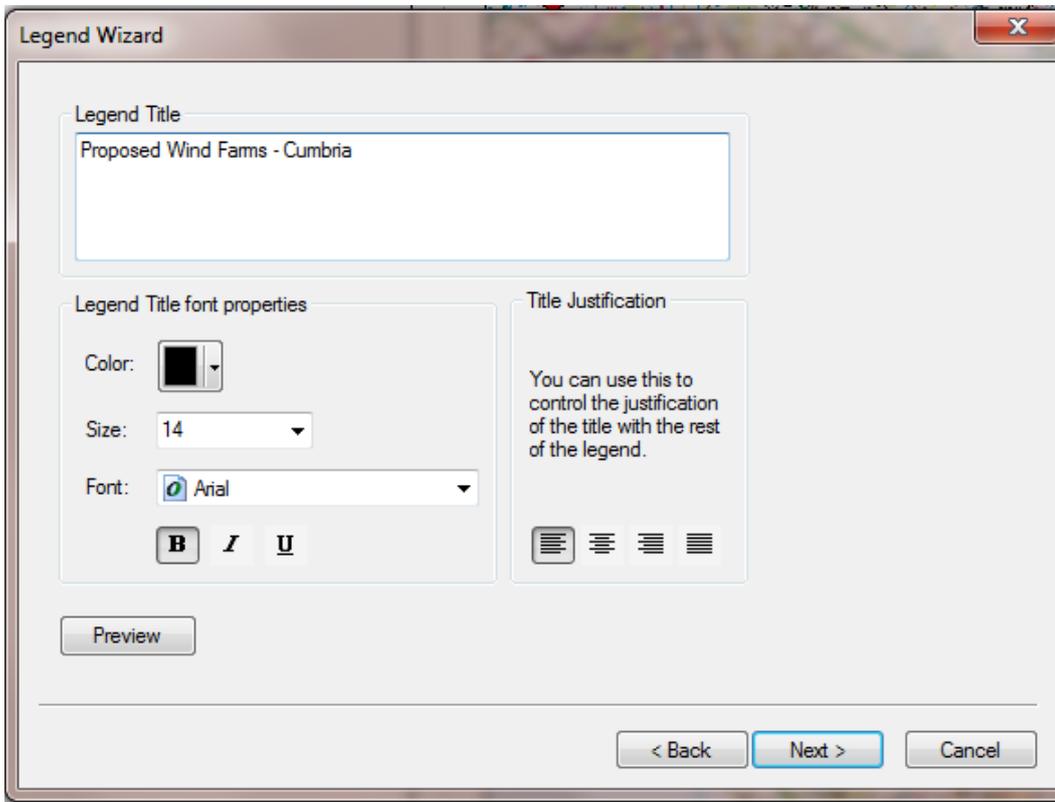




2. Click Insert > Legend.
3. You only want the Wind Farms on the legend. Select all 4 tif files and click the left arrow to remove them from your legend.
4. Click Next.



5. Change the Title to Proposed Wind Farms – Cumbria.
6. Click Next.

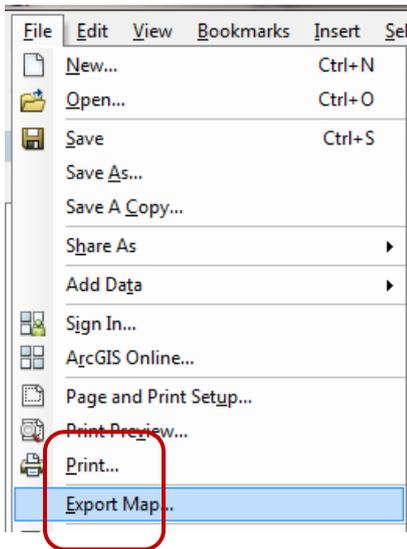


7. Select settings for the frame; we suggest a light grey background with a 1.5pt border and gap. Use the preview if you are unsure.
8. The next screen lets you change the size of the legend symbols. Just click Next.
9. The next screen is about spacing the legend items.
10. Click Finish.
11. You can now click and drag the legend box around until you are happy with its position.
12. Now Insert > North Arrow and select a style and position for the arrow on the map.
13. Insert > Scale bar and select a style and position for it on the map.

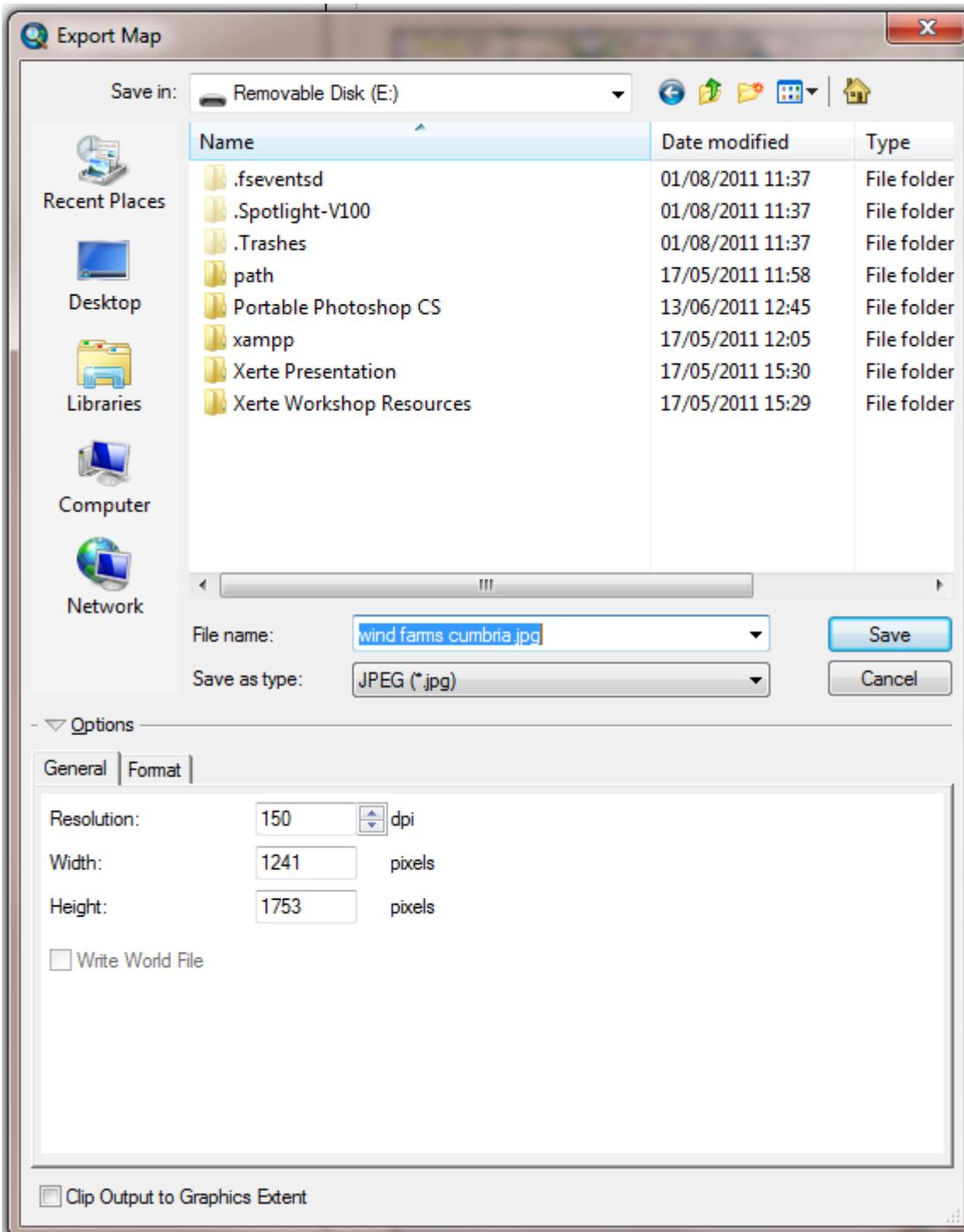
EXPORT IN LAYOUT VIEW

Now lets export the map as an image.

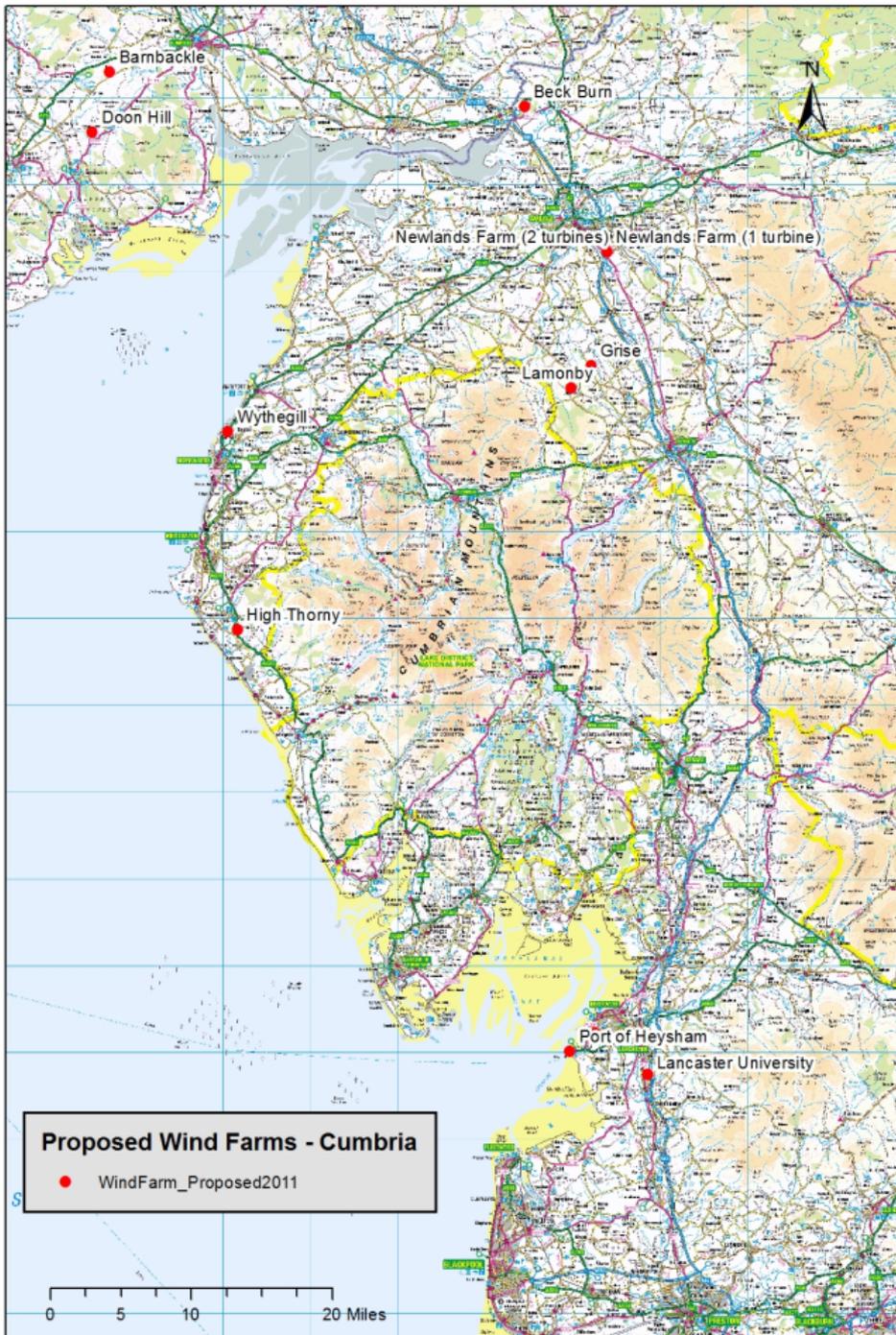
1. Click File > Export Map:



2. Select a folder to save the map.
3. Select a format from the dropdown box e.g. JPG.
4. Select a size appropriate for your print requirements, we have gone for 150dpi.
5. Click Save.



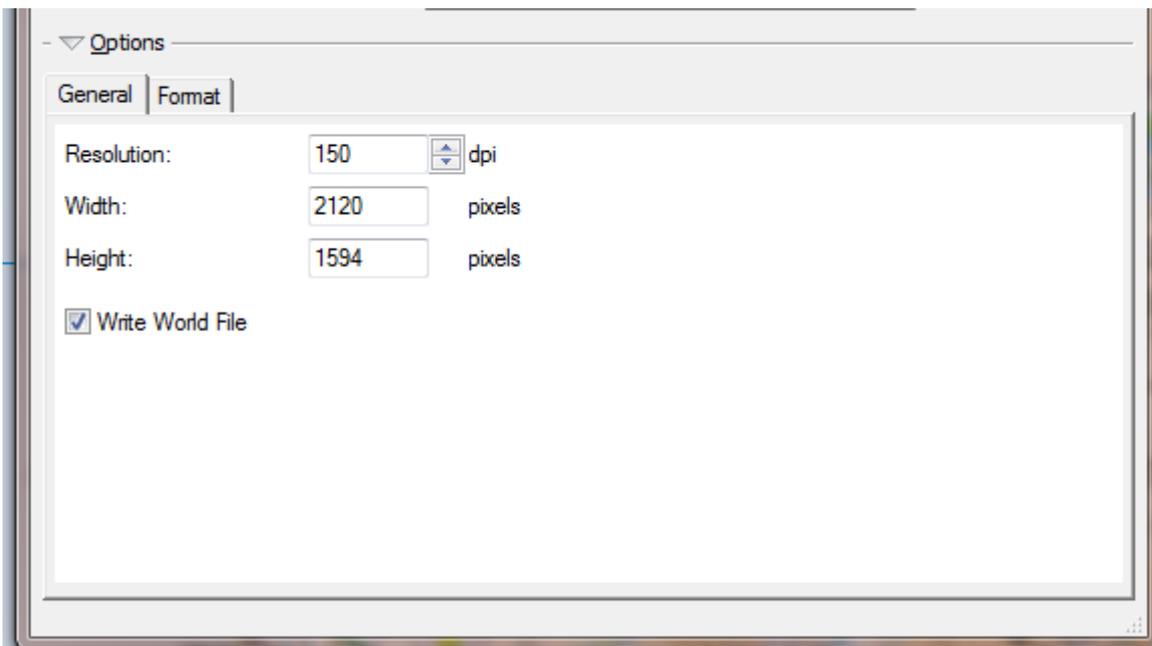
You should be able to double click on the JPG file to view the image of your map.



NOTE: we have exported our map while in Layout view. This has given us an image that we can use in documents. If we want to export our map and re-use it in GIS, we will need to export it in Data view – that way we can get a World file, i.e. a file with the geographic coordinates of our map.

EXPORT IN DATA VIEW

1. Switch back to Data View – we have to switch to data view if we want to create a World file with our map.
2. Click File > Export Map.
3. Make the required settings.
4. Tick the Write World File box. If you think you will want to use your exported map in GIS, you will need a World File (a file containing the geographic coordinates for your map).
5. Finally click Save.



You should now have a JPG (or other chosen format) plus an additional file with a different file suffix, e.g. JGW (for a JPG) or TFW (for a TIF). The additional file contains the geographic coordinates of your map image.

Don't discard the other file, you will need it to use your exported map image in GIS.

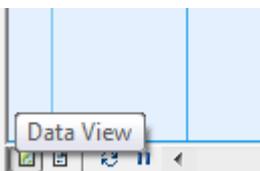
ADD CONTOUR LINES

It will be useful to view the wind farms with contour lines, to get an idea of the height of the proposed locations.

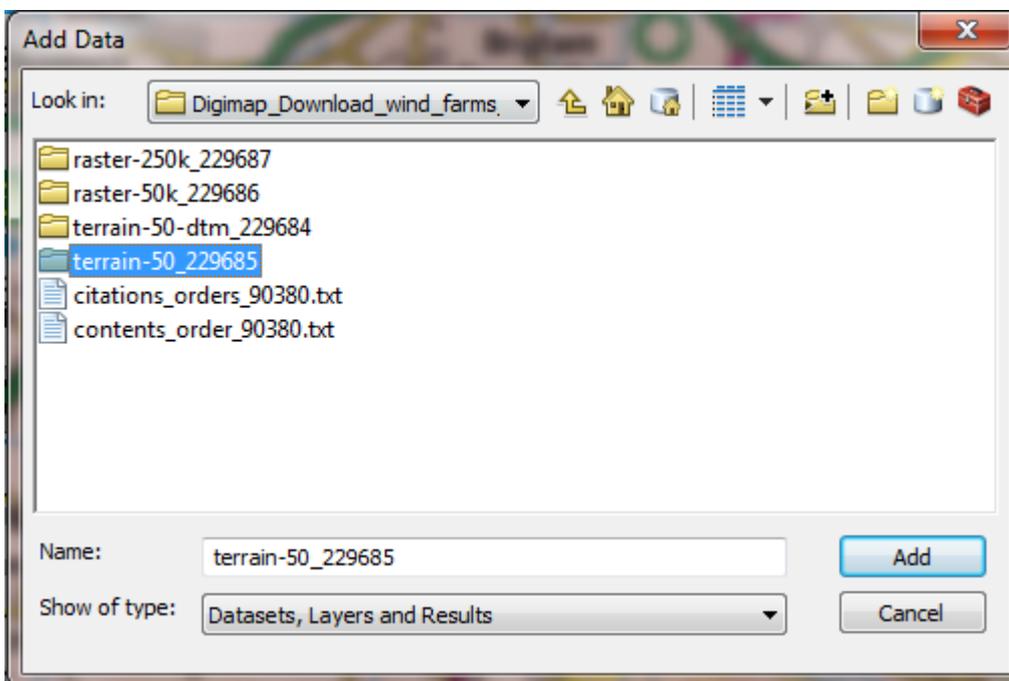
We downloaded a map product called **OS Terrain 50** from Digimap's Ordnance Survey Collection. The data is supplied as **Shape files**.

NOTE: Our download from Digimap contained 52 Shape files. We merged these to create 2 new shape files (1 for contour lines and 1 for spot heights). We used a function in ArcToolbox to do this (Data Management > General > Merge).

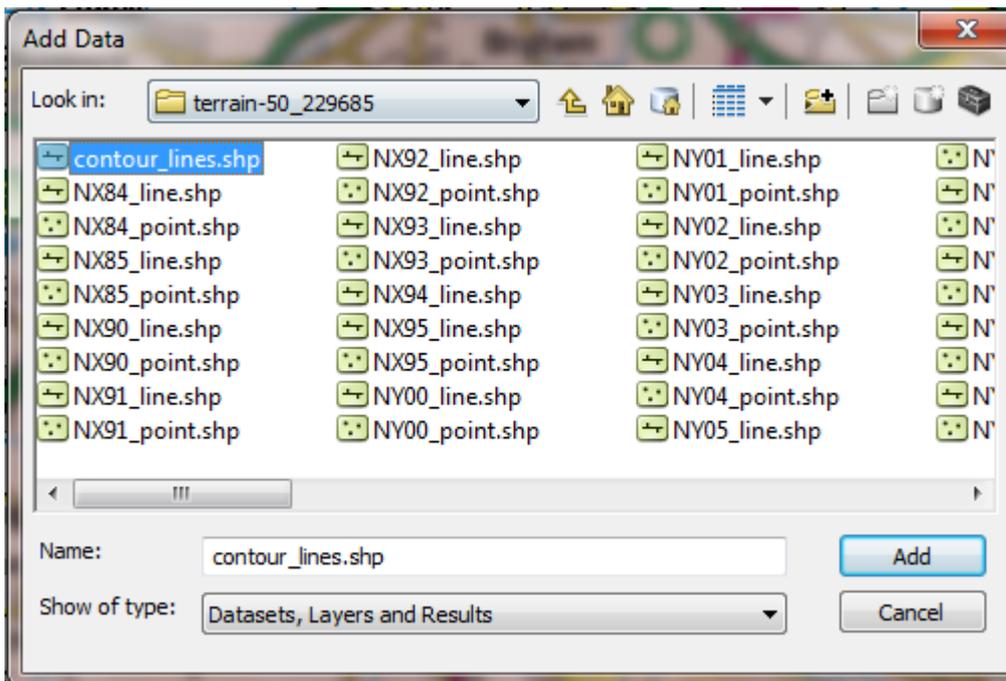
1. Switch back to Data View, if you are still in Layout View:



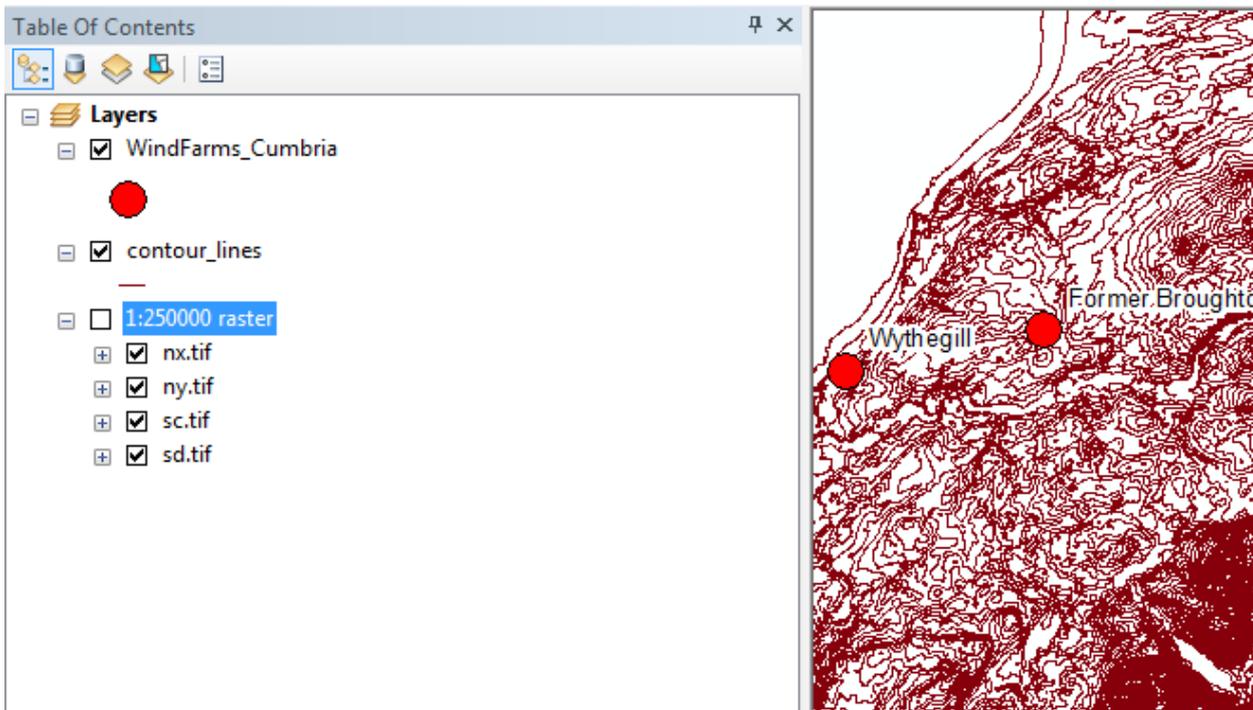
2. Click Add Data.
3. Navigate to the Digimap_Download folder.
4. Double click on the folder **terrain-50_229685**:



5. Click the shape file **contour_lines**.
6. Click Add:



Your map probably now looks quite busy! Switch off the 1:250000 raster maps to make it clearer:



ATTRIBUTE TABLES

Our contour lines are vector map data, i.e. we have the geography of each individual contour line. Our wind farm data is also vector map data.

One feature of vector map data is that information can be stored on its attributes. Let's have a look at the attribute table:

1. Right click the **contour_lines** layer.
2. Click **Open Attribute Table**.

There are several fields in the contour line attribute table. The field **Prop_value** contains the height in metres of the contour.

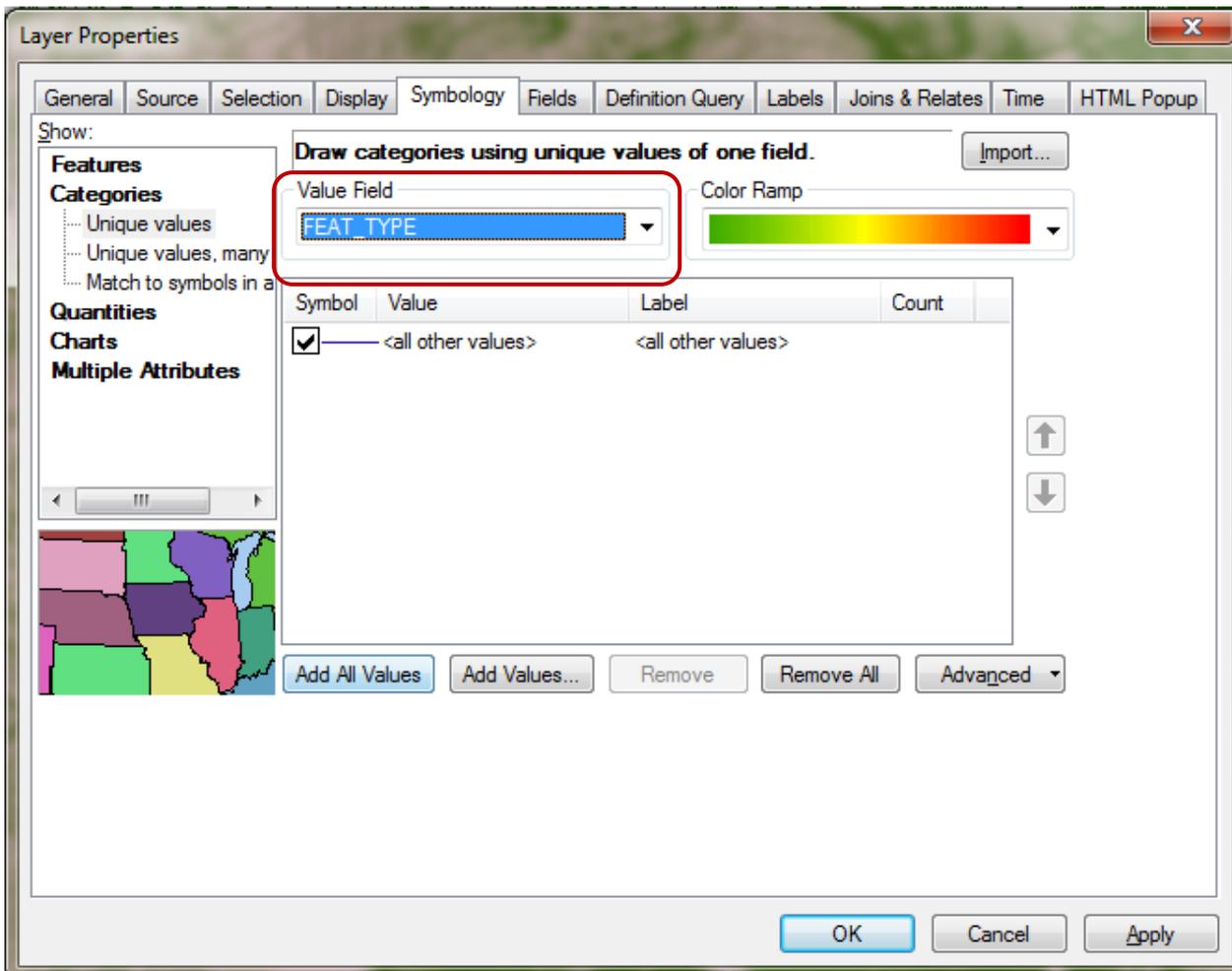
Note that there are two different types of feature in the field **Feat_Type** – ContourLine and LandWaterBoundary:

31	Polyline	os.t50.nx84.38	ContourLine	ordinary	40
32	Polyline	os.t50.nx84.39	ContourLine	ordinary	40
33	Polyline	os.t50.nx84.40	LandWaterBoundary	meanLowWater	-3
34	Polyline	os.t50.nx84.41	LandWaterBoundary	meanHighWater	2.11
35	Polyline	os.t50.nx84.42	LandWaterBoundary	meanLowWater	-3
36	Polyline	os.t50.nx84.43	LandWaterBoundary	meanLowWater	-3
37	Polyline	os.t50.nx84.44	LandWaterBoundary	meanLowWater	-3
38	Polyline	os.t50.nx84.45	LandWaterBoundary	meanLowWater	-3
39	Polyline	os.t50.nx84.46	LandWaterBoundary	meanLowWater	-3
40	Polyline	os.t50.nx84.47	LandWaterBoundary	meanLowWater	-3

Whilst not necessary for this exercise, you could use the different feature types to create a different style of line for each. The steps below could be applied to other vector data and would be useful in creating different symbols for different types of road if you were using road data, for example.

If you would like to try this, follow steps 3 to 10. If not, skip on to the next section.

3. Right click on the contour lines layer and select properties.
4. Click the **Symbology** tab.
5. Click **Categories > Unique Values** on the left.
6. Click the drop down box **Value Field**.
7. Select **FEAT_TYPE**.
8. Click **Add All Values**.



You should now see the Symbology tab populated with different symbols for each type of feature.

Symbol	Value	Label	Count
<input checked="" type="checkbox"/>	<all other values>	<all other values>	0
	<Heading>	FEAT_TYPE	24259
	ContourLine	ContourLine	23272
	LandWaterBoundary	LandWaterBoundary	987

9. Accept the symbols by clicking **Apply and OK**.

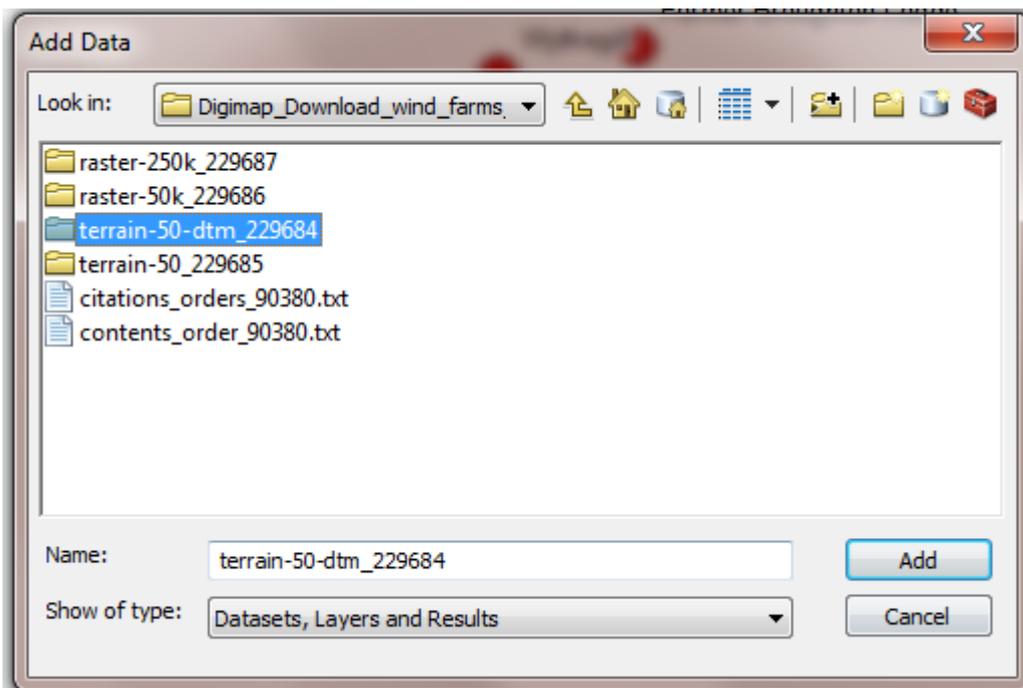
10. Remember you can edit the line styles by clicking on them one-by-one and selecting new symbols.

VIEW DIGITAL TERRAIN MODEL

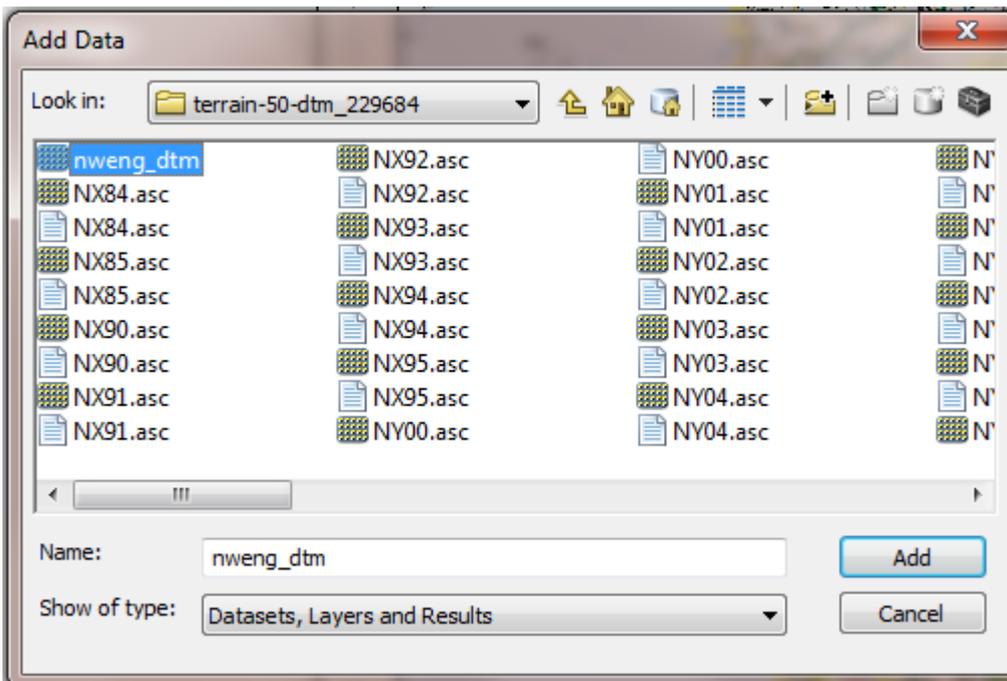
Now let's have a look at Digital Terrain Model map data. This type of map data is used for 3D modelling and is very useful in visualising landscapes.

We downloaded **OS Terrain 50 DTM** from Digimap Ordnance Survey Collection. The map data was provided in ASC format, a raster format. For our area, we needed 52 tiles. We have merged the 52 tiles into 1 TIFF file. We did this using Arc Toolbox (Raster > Raster Dataset > Mosaic to new raster).

1. First, switch off the contour lines by unchecking the box next to them in the Table of Contents.
2. Click Add Data.
3. Navigate to the Digimap_Download folder.
4. Double click on the folder **terrain-50-dtm_229684**:

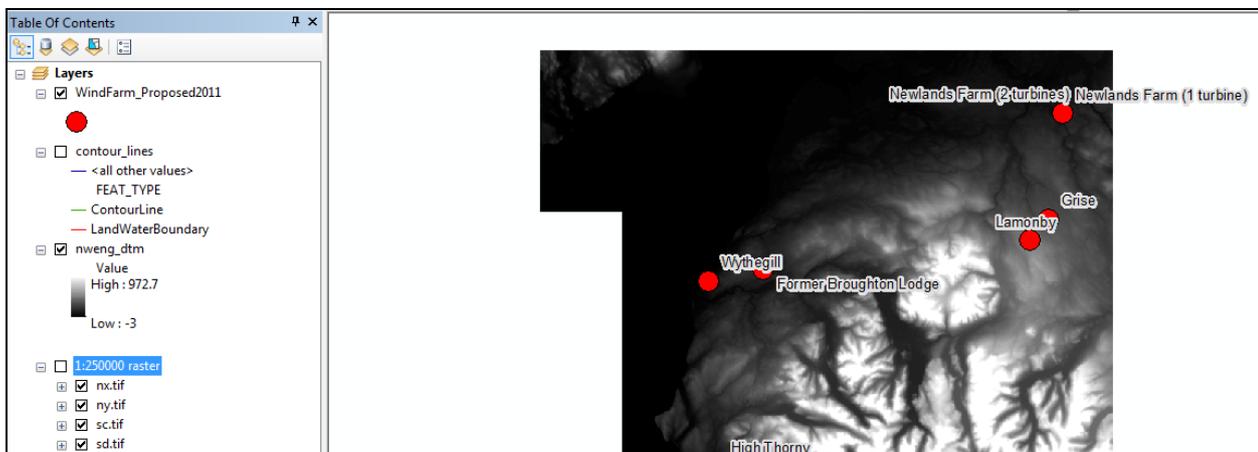


5. Click on the file **nweng_dtm.tif**.



A new layer has been added. Things to note:

- Lighter areas are higher. You should be able to see valleys quite clearly as they are darker.



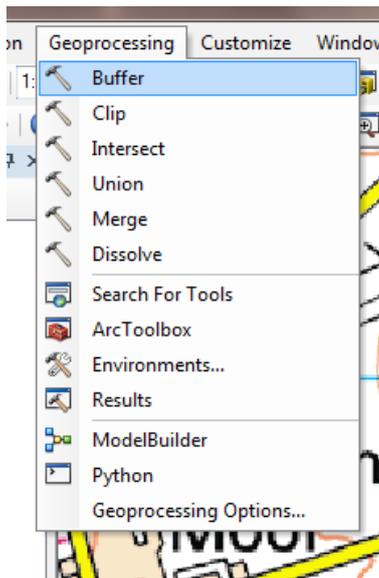
OPTIONAL: play around with the symbology for your DTM layer. You can find symbology options by right clicking the layer, select Properties then Symbology.

MAP DATA ANALYSIS

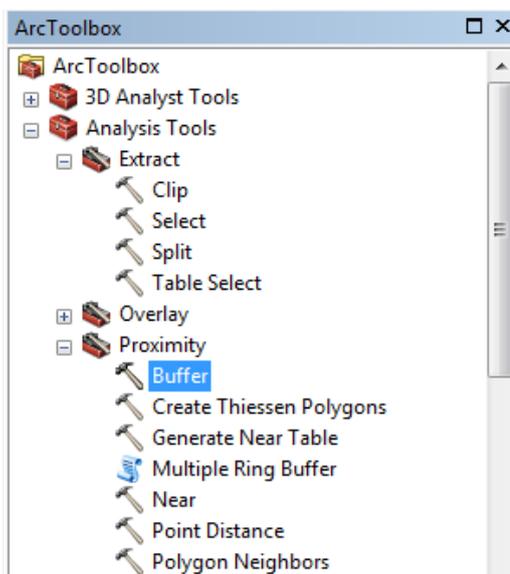
Let's imagine we want to find out about the potential impact on areas surrounding the proposed wind farms. One way to start the analysis is to create a buffer zone around each wind farm.

ArcToolbox contains a Buffer tool.

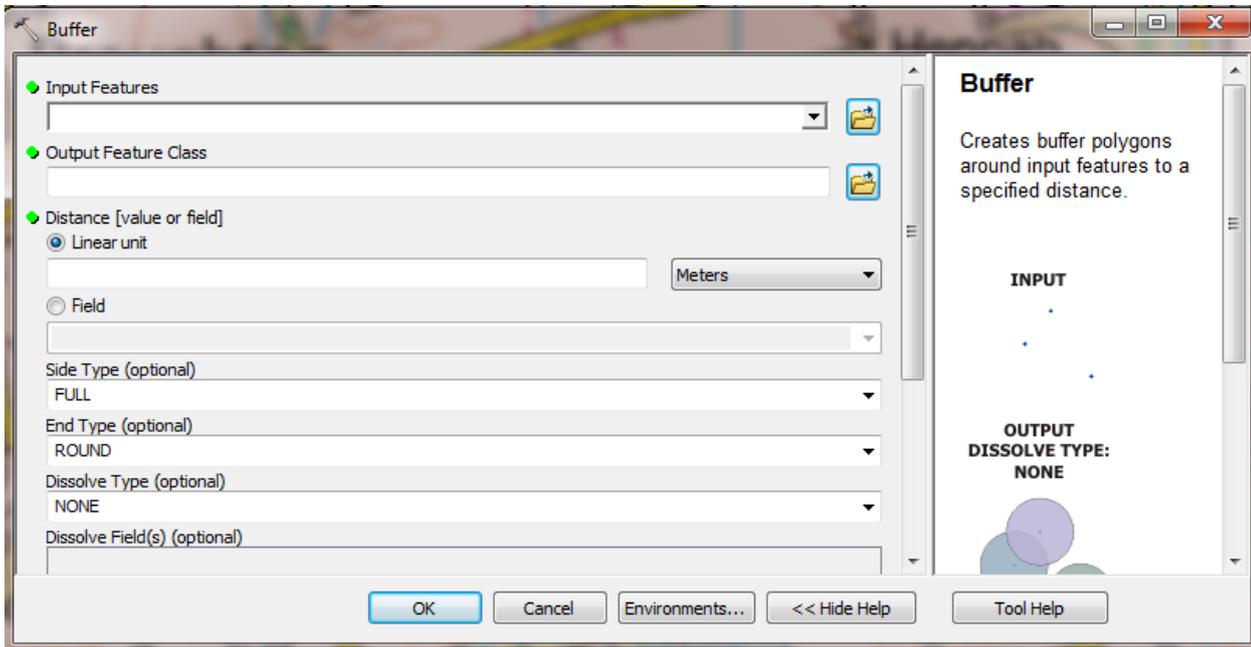
1. Click **GeoProcessing > Buffer:**



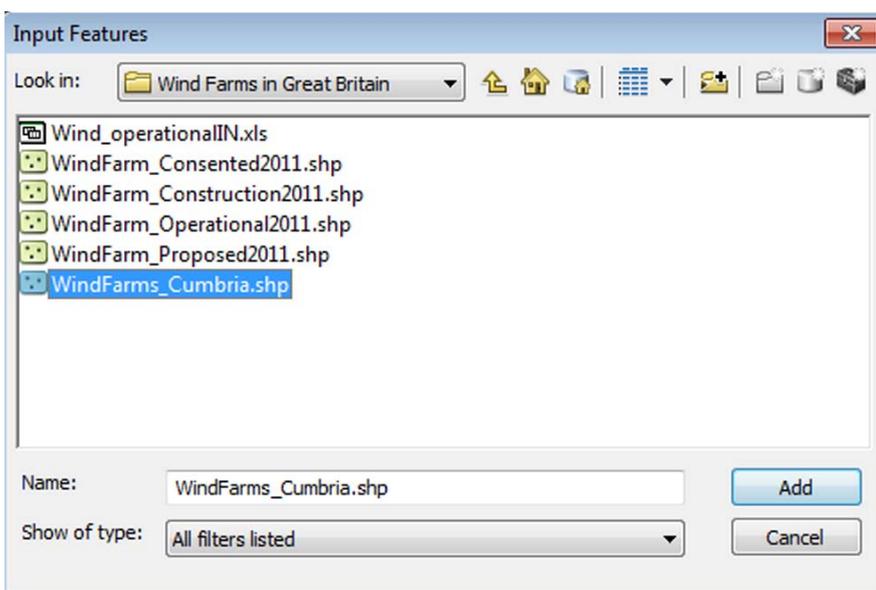
Alternatively click Arc Toolbox and select **Analysis > Proximity > Buffer:**



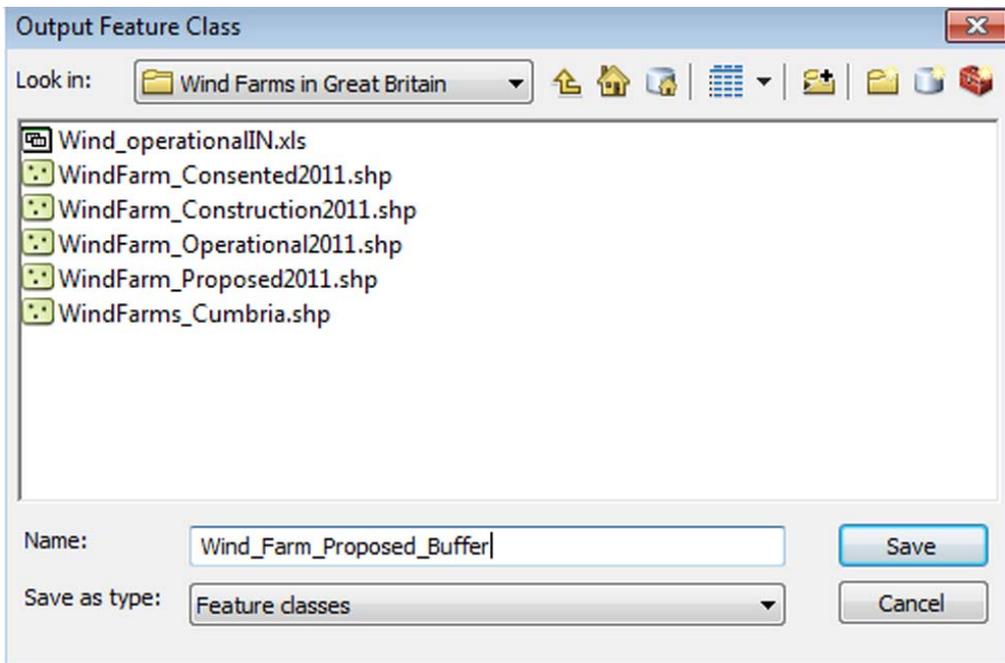
You need to complete the Input Features, Output Feature Class and Distance fields.



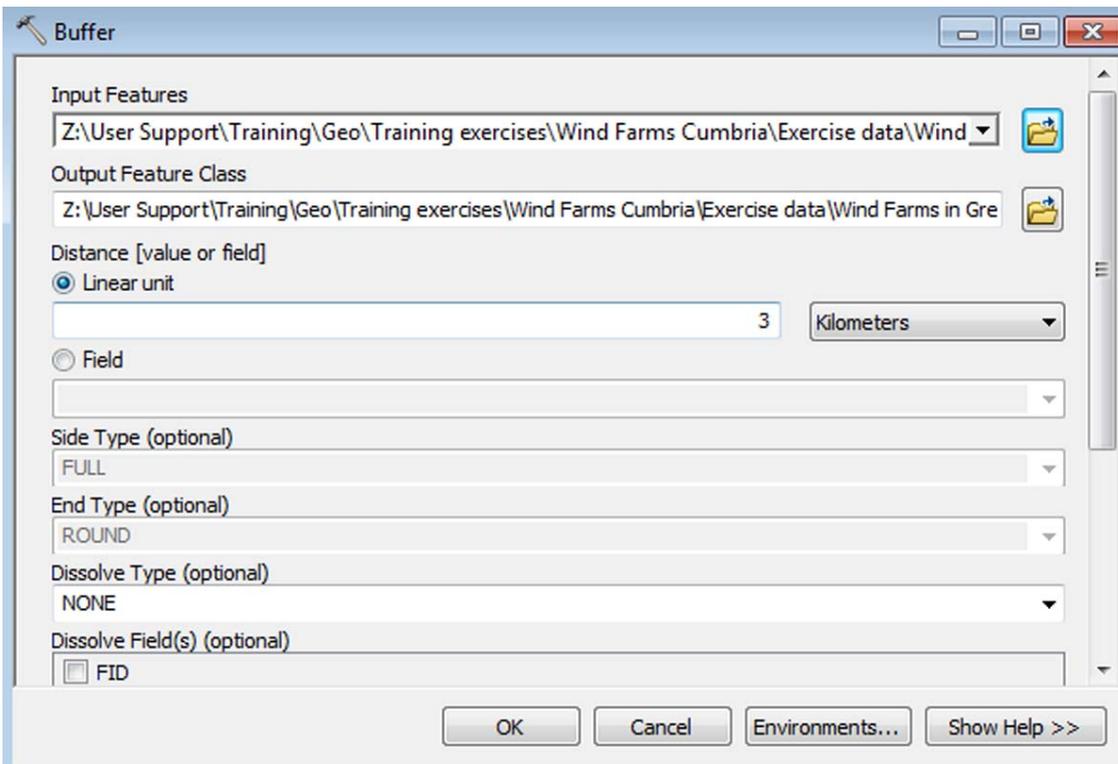
2. Input Features – click the yellow folder next to Input Features.
3. Navigate to your **Wind Farms in Great Britain** folder.
4. Click the **WindFarm Cumbria shapefile** that you exported earlier (when we selected the Cumbria wind farms).
5. Click **Add**.



- Click on the yellow folder next to Output Feature Class.
- Type the name of a new feature class in the **Name** box - we have used **WindFarms_Proposed_Buffer**. This will create a new shape file containing the buffer information.
- Click **Save**.



- Type **3** and select **Kilometers** in the Distance field.
- Click OK.



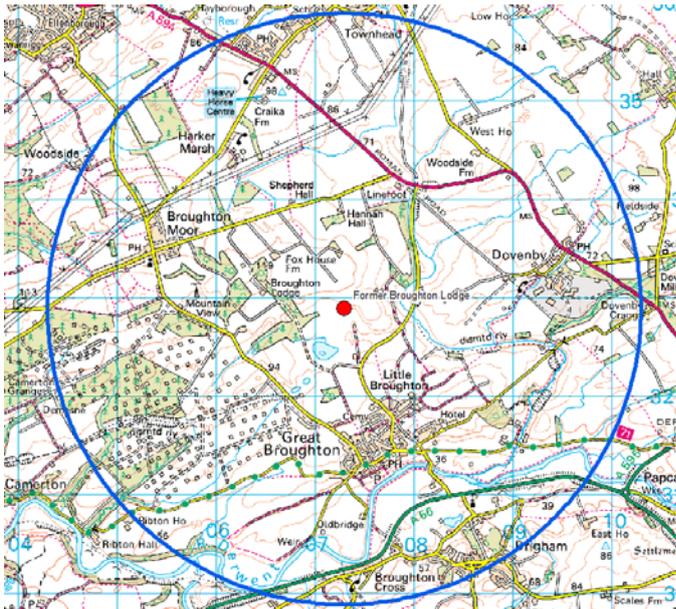
Your buffer zones will automatically be added to the table of contents and your map, for example as shown in the image below:



NEXT STEPS

What could Dave do next?

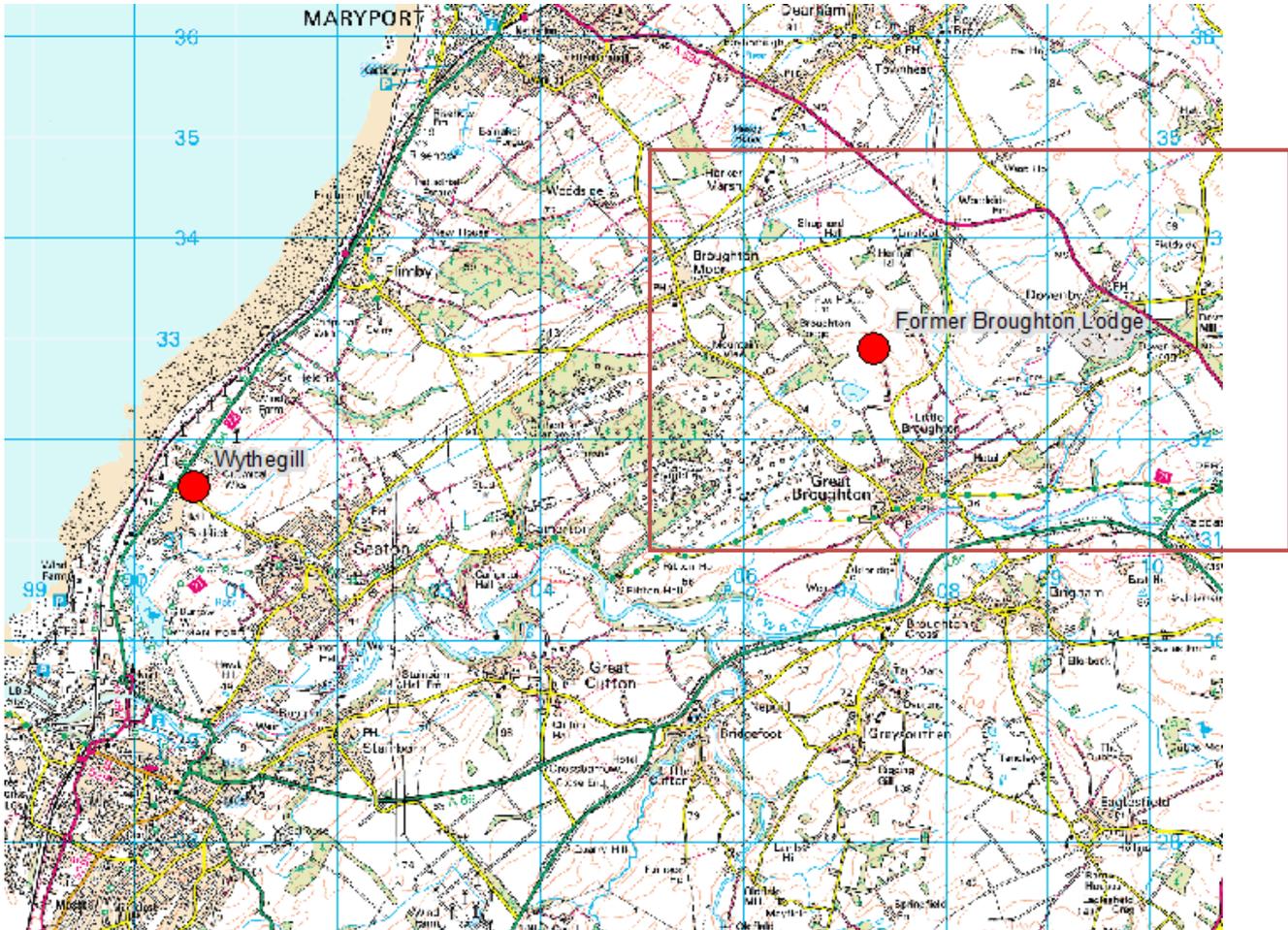
- He needs to better understand the areas around the proposed sites. His first step could be to view the sites in ArcGIS with more detailed backdrop mapping, e.g. 1:50000 raster data from Digimap.



- He may want to create viewsheds, i.e. establish what can be seen from a particular vantage point, so he can understand if the wind farms block the view of any landmarks. Viewsheds allow you to specify the height above the ground of a target (in this case the turbine) and then analyse the surrounding topography to calculate where the target is visible and not visible.
- Combine the raster data with the DTM. This would help people interpret the output from his models as they will be able to see both the topography (DTM) and the built environment (raster map).
- He will want to integrate his ecological data into his model and assess the impact the development might have on groups such as raptors.

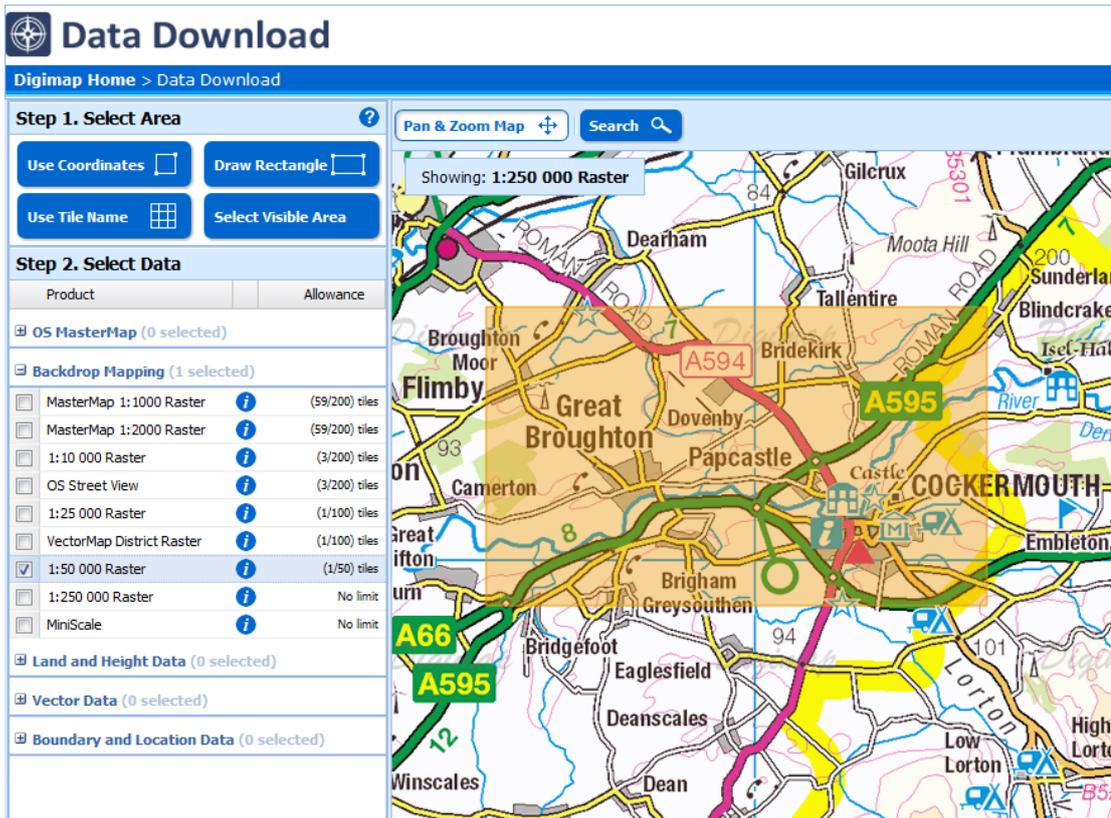
CREATE VIEWSHED

Let's try and create a viewshed. There are several proposed sites in Cumbria on our map, let's do this analysis for one of them, Former Broughton Lodge:



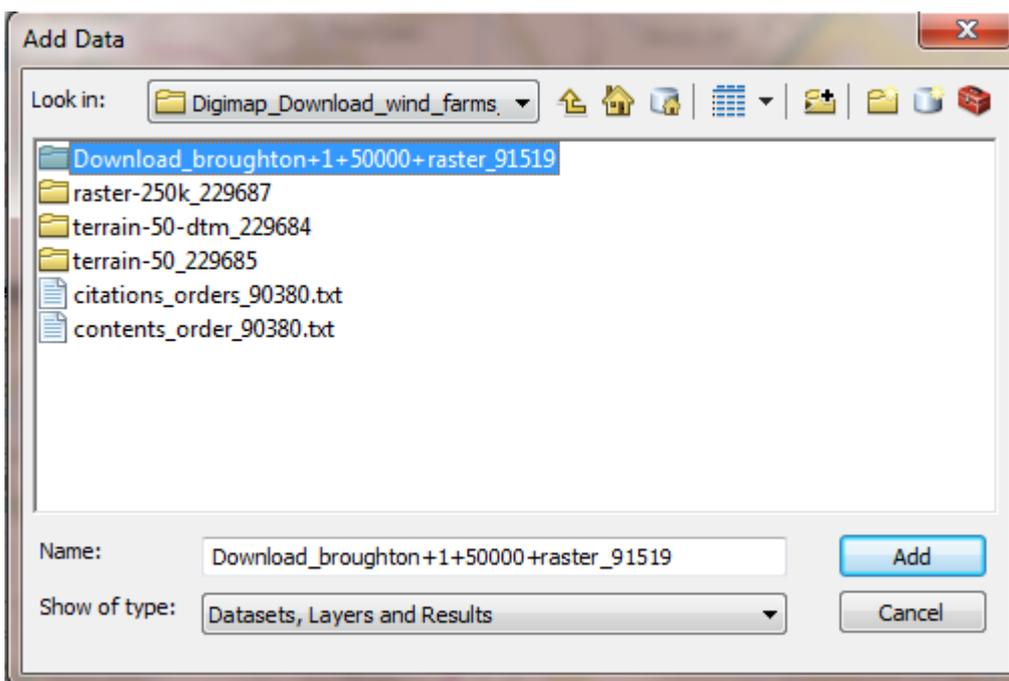
First, we need to create a new shapefile representing the position of the proposed windfarm. Ideally we need some more detailed backdrop data to allow us to do this.

1. We recommend you go to the Data Download service and download the **1:50000 raster** data from the Backdrop Mapping category, for the approximate area shown in the image below of the Data Download service.
2. Note that we cannot supply you with this data directly as this map data is covered by the Digimap licence and you must be a registered user of Digimap to access it.

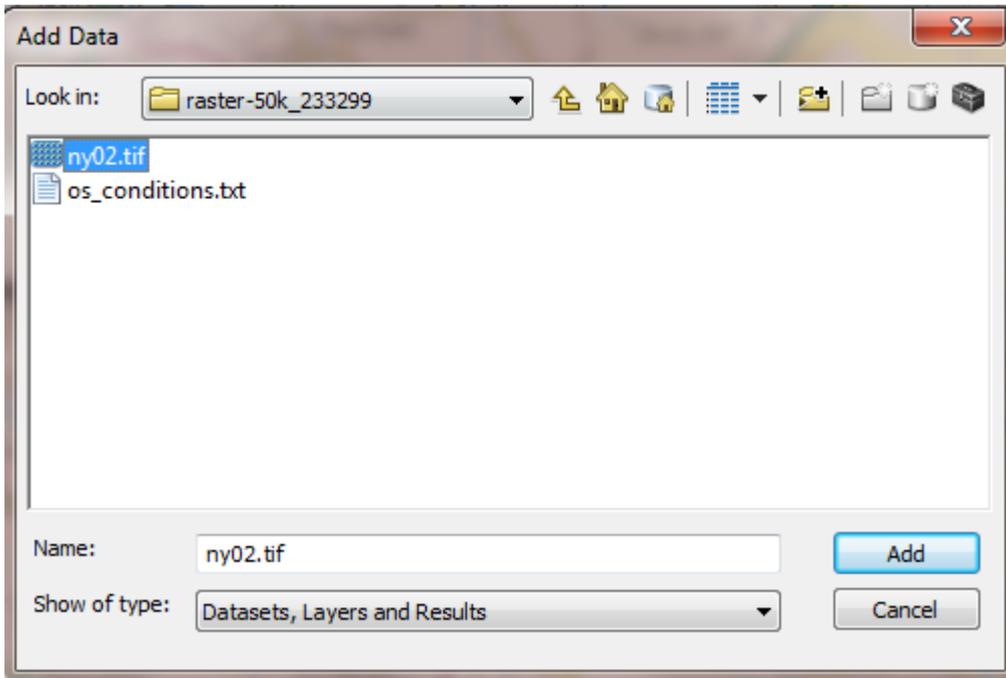


Once you have downloaded your data and extracted it from its zip file:

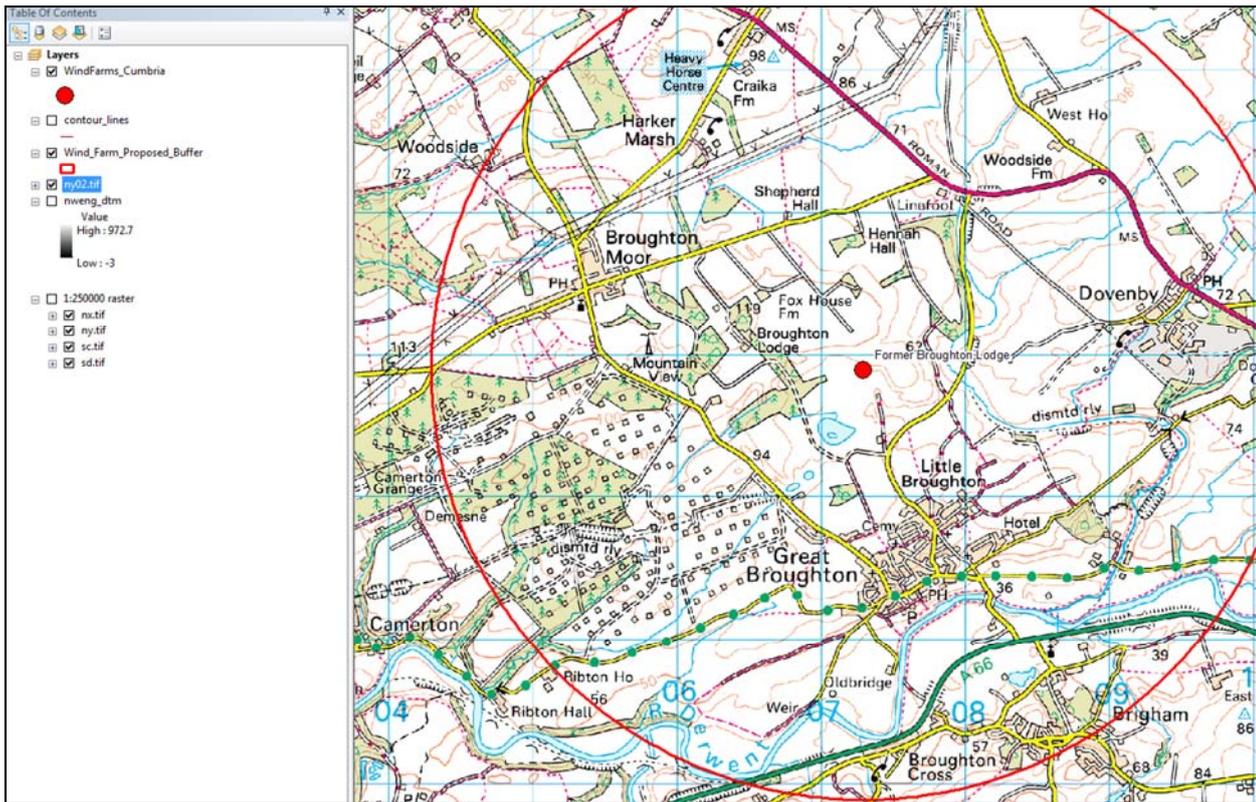
3. In ArcMap, click Add data.
4. Navigate to the folder containing your newly downloaded 1:50000 raster map data:



5. Double click on the folder and sub-folder.
6. Select the TIF file(s) within the sub- folder. Note that your folder may contain additional TIF files, depending on the area you downloaded.
7. Click **Add**.



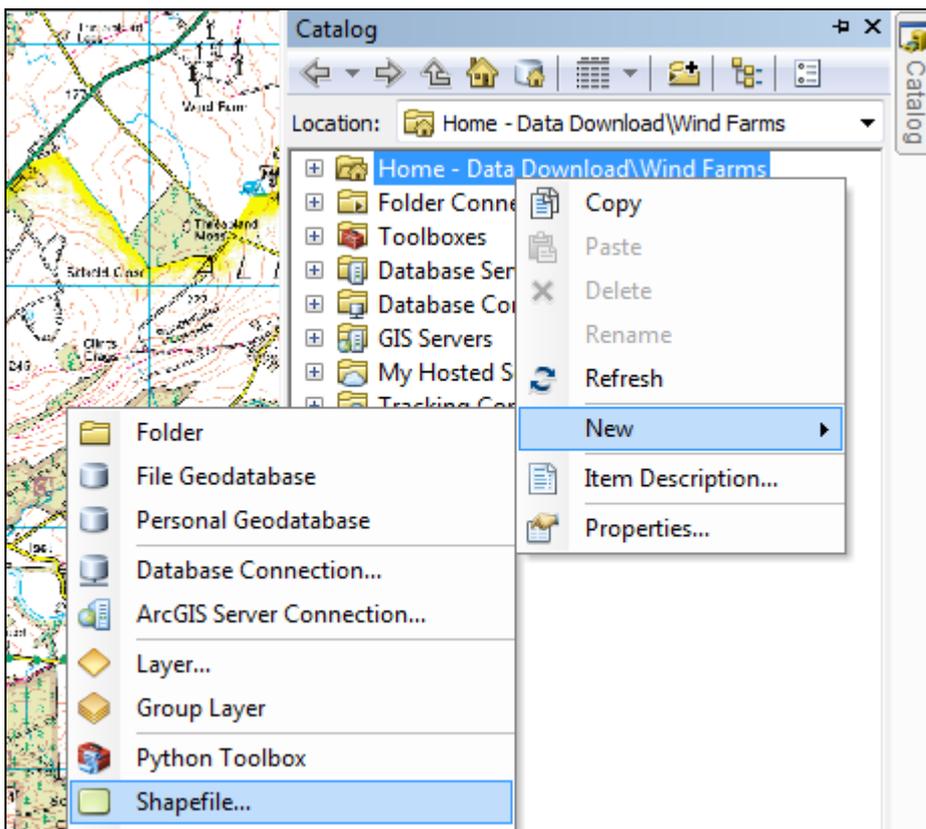
8. Ensure your 1:50000 raster data is in your Table of Contents.
9. Uncheck all layers EXCEPT 1:50000 raster data and the Wind Farms Cumbria layer.
10. Zoom in to the site of the Former Broughton Lodge proposed wind farm:



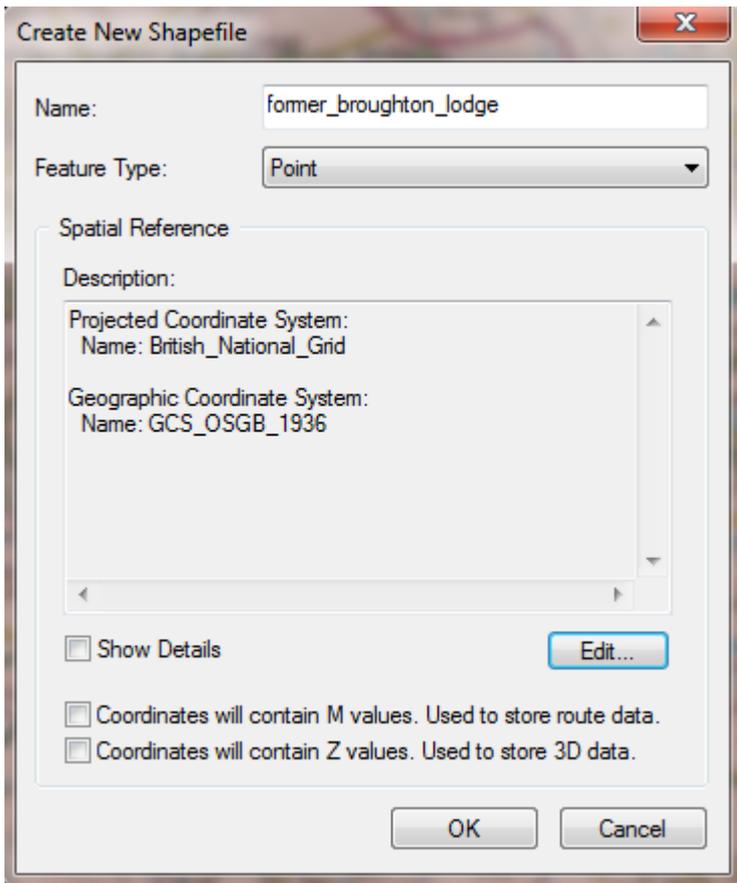
CREATE SHAPE FILE AND ADD POINTS

Now let's create a new, empty shape file.

1. Start **ArcCatalog** on the right of ArcMap.
2. Navigate to the folder **Wind Farms exercise data > Wind Farms in Great Britain**.
3. Right click on **Wind Farms in Great Britain**, select **New > Shapefile**.

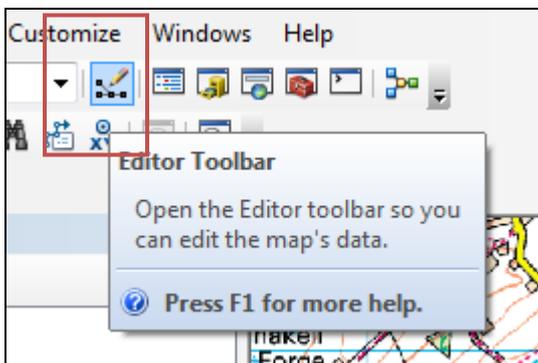


4. Give your file a name e.g. **former broughton lodge**.
5. Select **point** as feature type (we are going to add the points where wind turbines will be located).
6. Select British National Grid – **Edit > Projected Coordinate Systems > National Grids > Europe > British National Grid**.
7. Click **OK**.

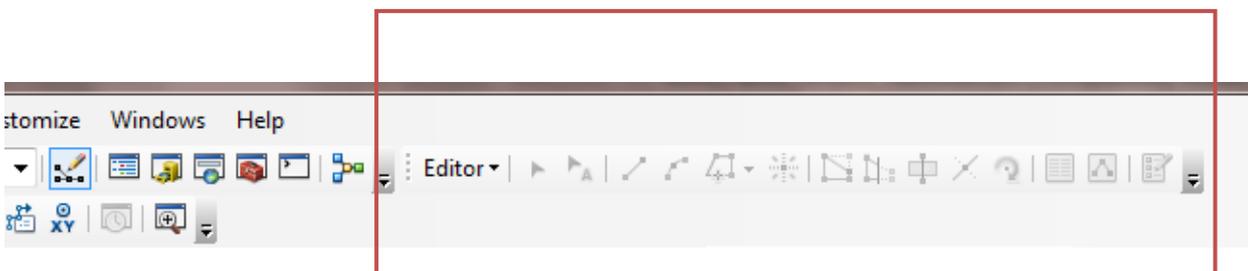


8. Now we want to add some data to our Shapefile – the points where wind turbines will be located.

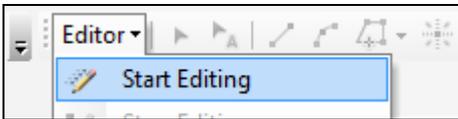
9. Click on the **Editor Toolbar** button:



The Editor toolbar should appear, to the right or below your existing toolbar display – some of the buttons may be greyed out:

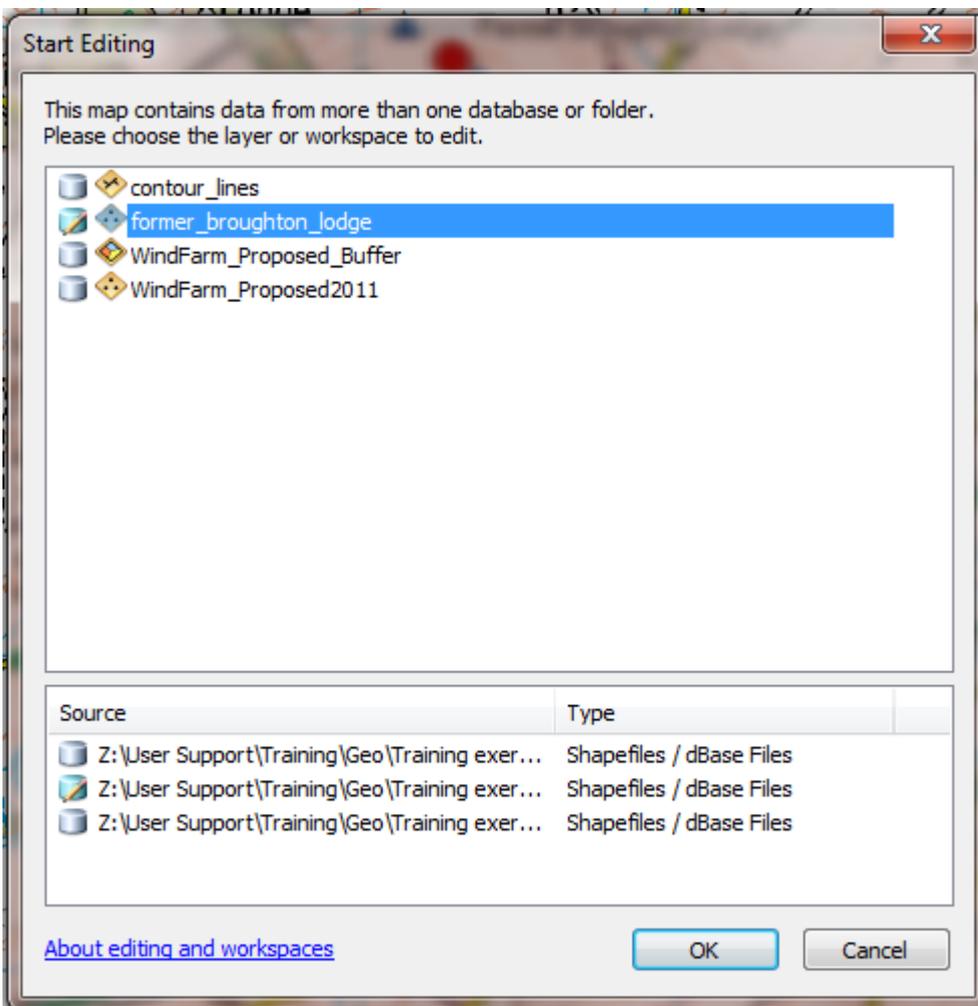


10. Click **Editor > Start Editing**:



11. Select the **former broughton lodge** shape file.

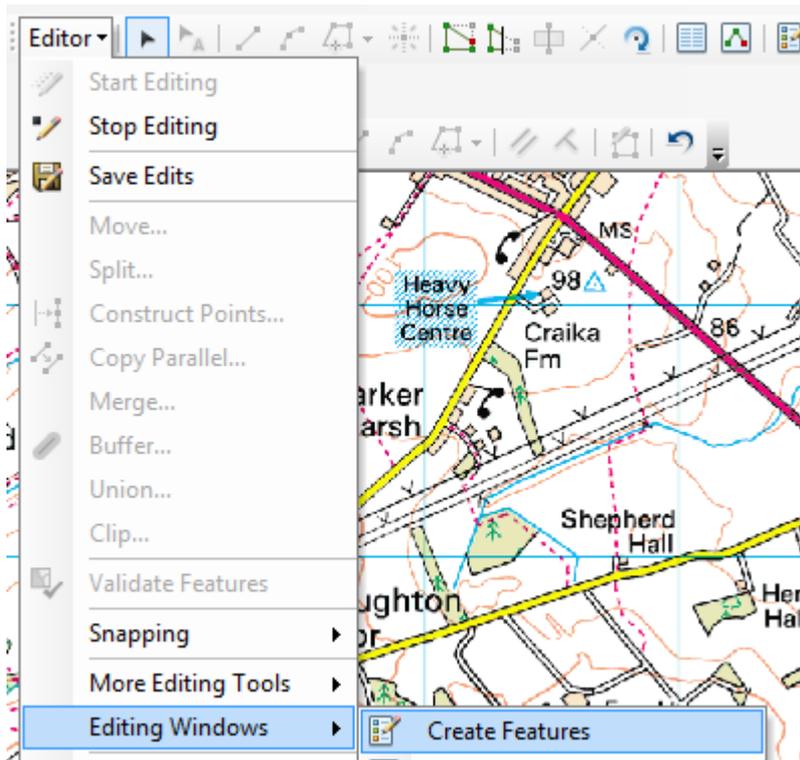
12. Click **OK**.



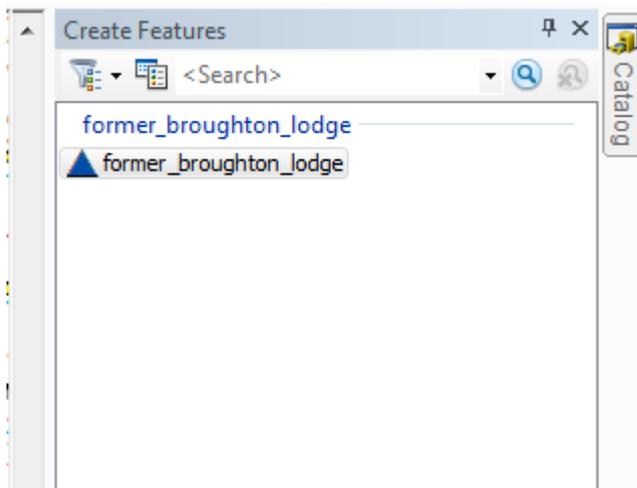
We can now start editing.

13. Let's open the Create Features window.

14. Click **Editor > Editing Windows > Create Features**.

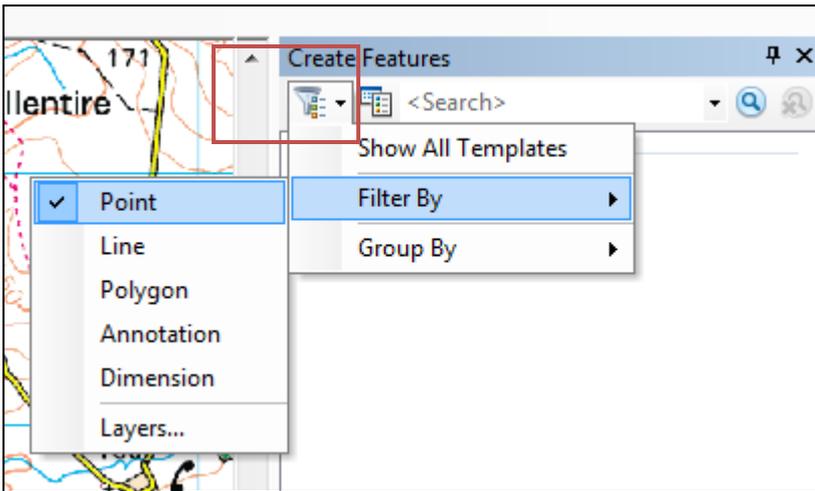


A **Create Features** window will open on the right of ArcMap. You should see an area Construction Tools at the bottom.



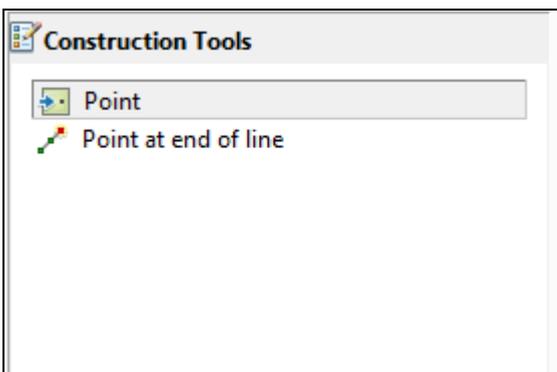
We need to select what type of feature we want to add. This is done in the Constructions Tools area, but it may be empty.

15. Click on the arrange templates button under Create Features (looks like a funnel).
16. Click Filter by > Point.



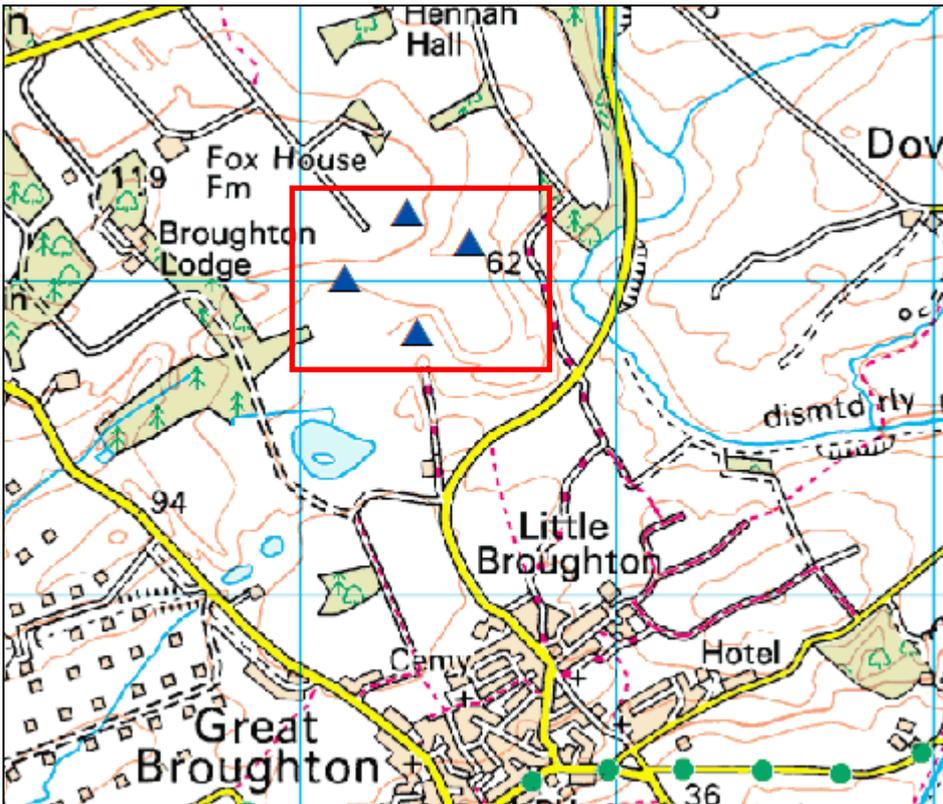
17. You should see a symbol for point appear in the Construction tools area.

18. Click on **Point**.

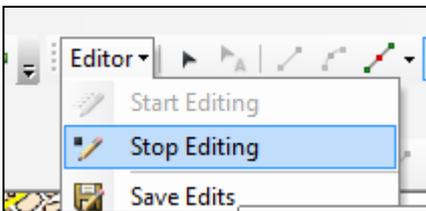


Your cursor will change – you should see a dot on the end of it.

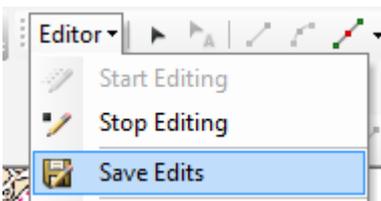
19. Click on the map at each point where you want the wind turbines to be located, e.g. see our 4 blue points on the image below.



20. Once you are finished adding points, click **Editor > Stop Editing**.



21. Click **Editor > Save Edits**.

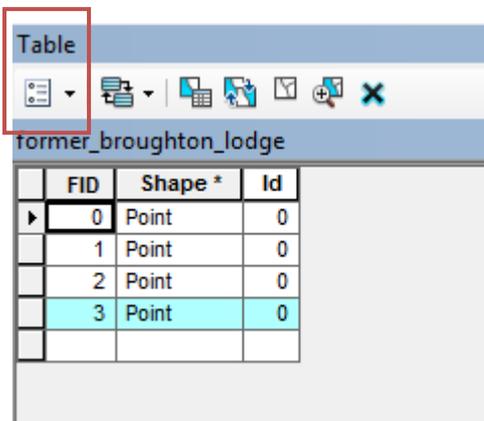


We have now added new points to our shapefile.

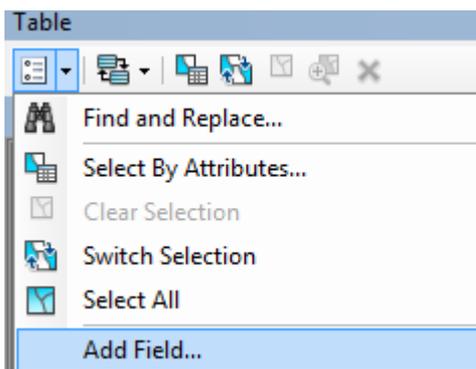
ADD ATTRIBUTE INFORMATION TO SHAPEFILE

The next thing we want to do is add some attribute information to our shapefile – the height of the wind turbines (OFFSETA) and the height of the observer (OFFSETB).

1. Right click **former broughton lodge** in the Table of Contents.
2. Select **Open Attribute Table**.
3. Click the icon in the top left.



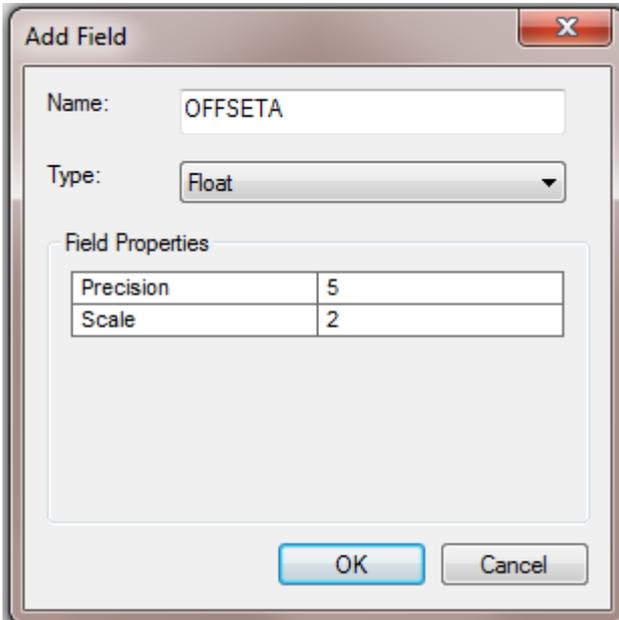
4. Select **Add Field**.



Complete the box as follows:

5. Name – OFFSETA.
6. Type – Float.
7. Precision – 5. This specifies the number of digits that can be stored in a number field. For example, the number 56.78 has a precision of 4.

- Scale – 2. This is the number of digits to the right of the decimal point in a number in a field of type float or double. For example, the number 56.78 has a scale of 2. Scale is only used for Float and Double field types.
- Click **OK**.



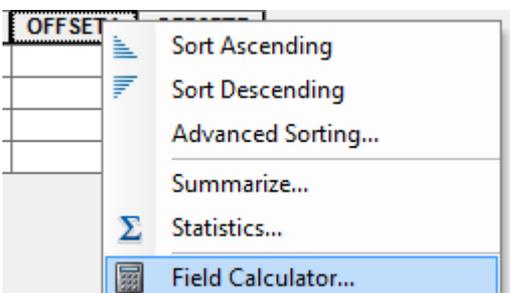
- Add a new field with the same settings, naming it **OFFSETB**.

Now we need to **set the values of OFFSETA and OFFSETB**.

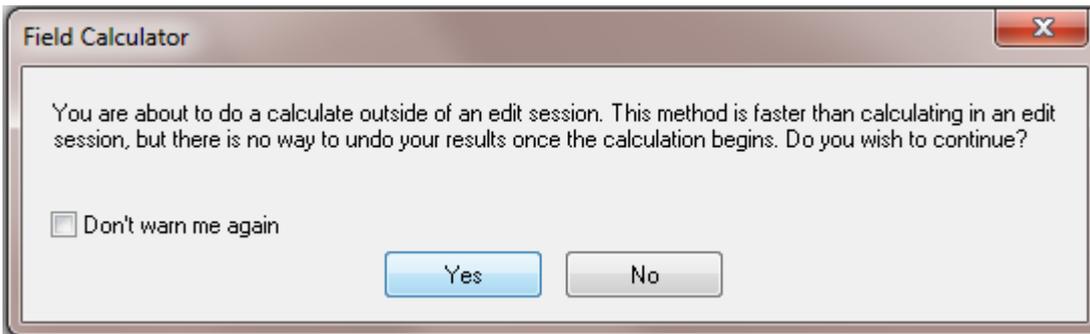
OFFSETA is the height of the turbines (to the top of the blades) and commercial towers seem to be about 120m high.

OFFSETB is the observer. An average person's eyes are about 1.6m off the ground. To set these values:

- Right click OFFSETA and select Field Calculator:



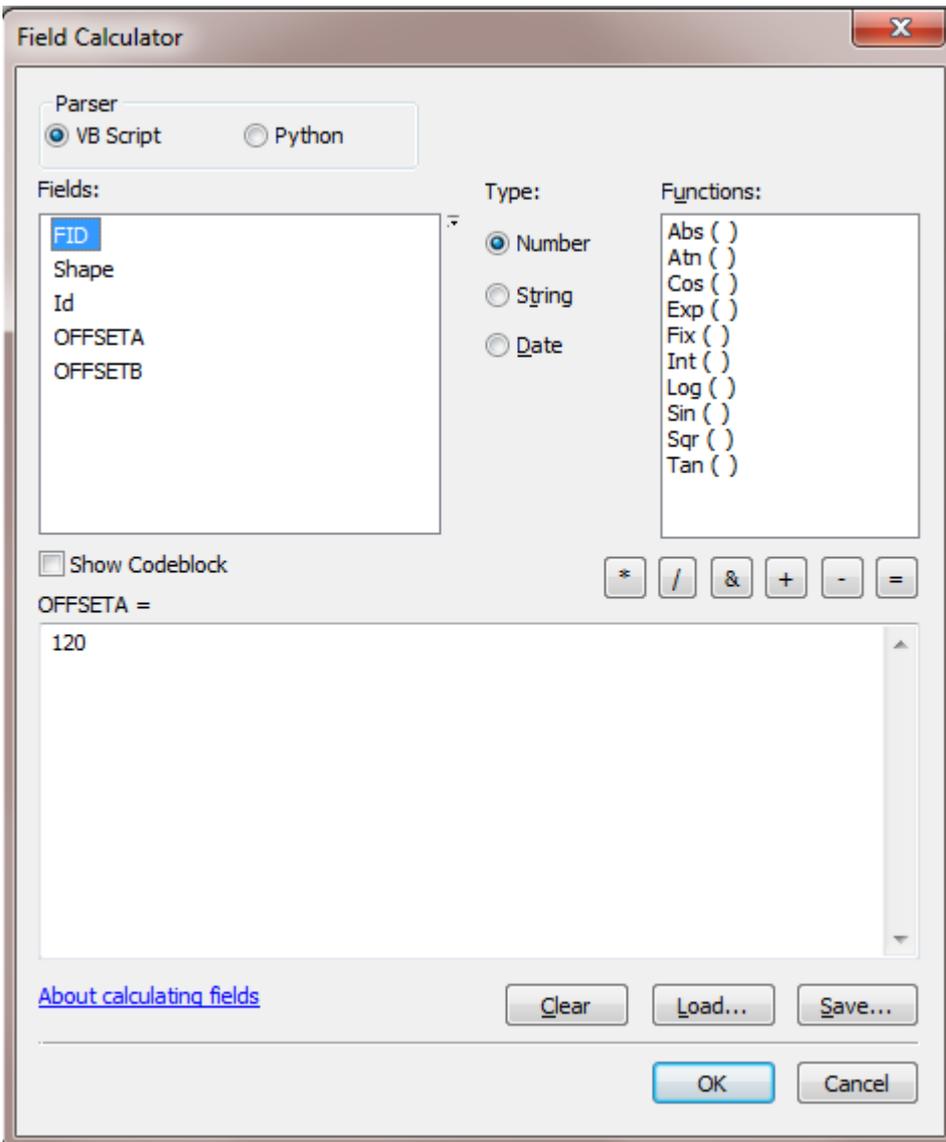
12. Say Yes.



13. The lower box should have OFFSETA = above it.

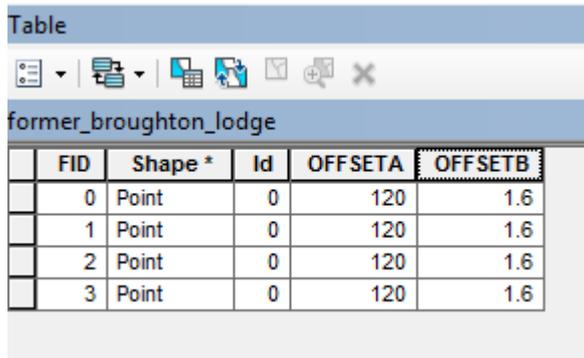
14. Type 120 in the box.

15. Click OK.



16. Right click OFFSETB and click Field Calculator.
17. Enter 1.6 in the bottom box.
18. Click OK.

Your table should now look like this:

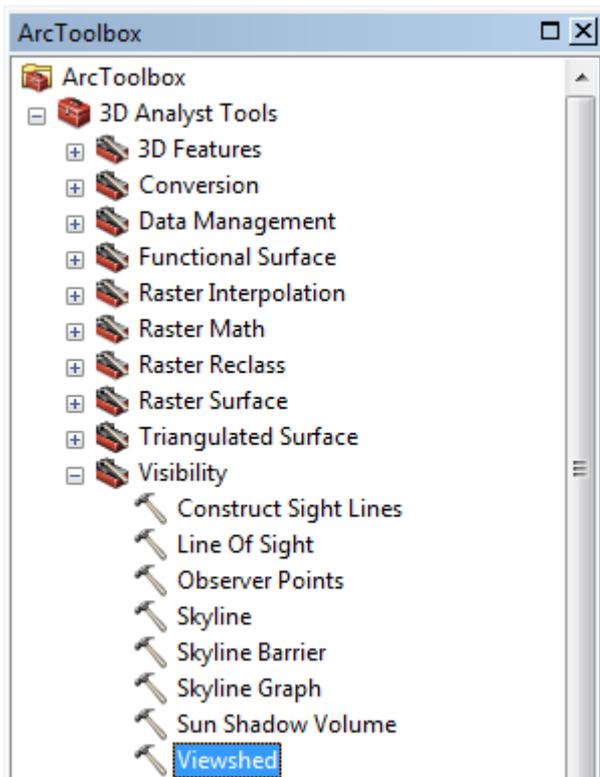


FID	Shape *	Id	OFFSETA	OFFSETB
0	Point	0	120	1.6
1	Point	0	120	1.6
2	Point	0	120	1.6
3	Point	0	120	1.6

19. Close the Attribute table.

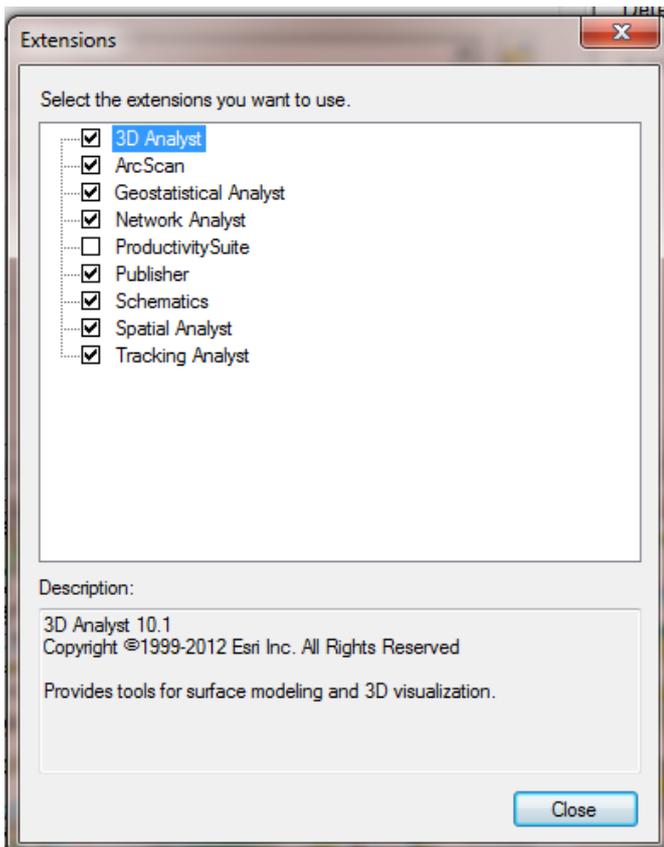
CONDUCT VIEWSHED ANALYSIS

1. Open ArcToolbox.
2. Select **3D Analyst Tools > Visibility > Viewshed**.



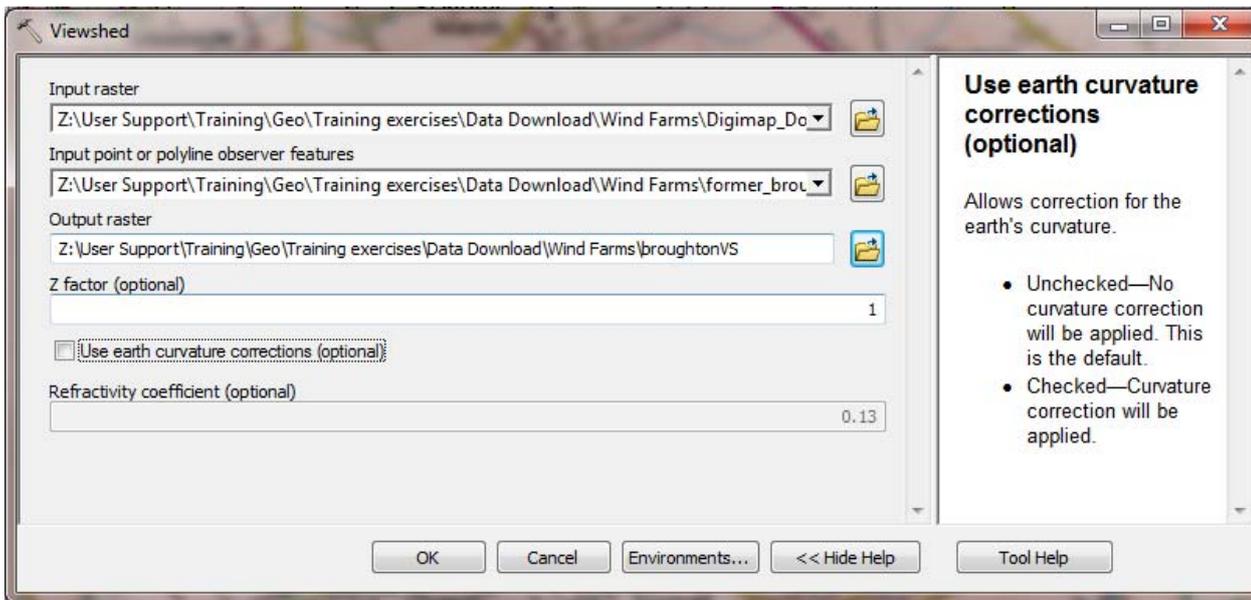
NOTE if you get a message telling you that you need Spatial Analyst ,follow these steps:

3. Customise > Toolbars > Spatial Analyst.
4. Customise > Extensions > Spatial Analyst.

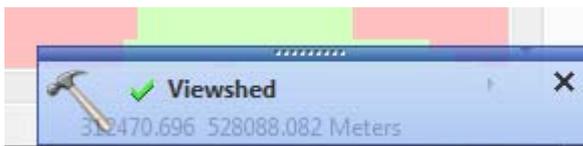


After clicking Viewshed, complete the box:

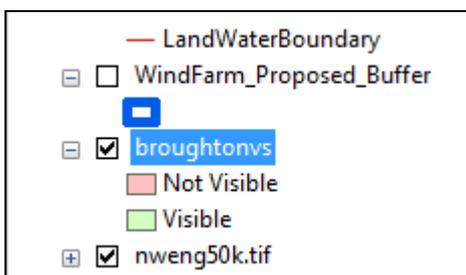
5. Input raster – connect to the DTM data file **nweng_dtm** (look in Digimap Download > terrain-50-dtm folder).
6. Input point features – connect to your new shapefile.
7. Output raster – name it something meaningful e.g .broughton_viewshed.
8. Curvature of Earth will be a factor for large areas – leave it for this example.
9. Click OK.



If it works, your map will change and you will see a green tick in the bottom right of the screen:



What you are seeing on your map is a binary image showing areas where the wind turbines are visible and where they are not visible.



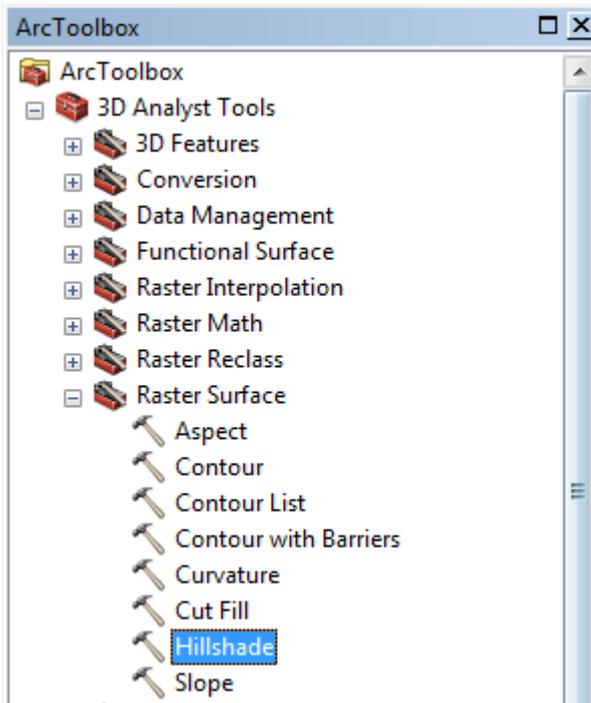
The next task is to take this output file and present it in a meaningful way.

DISPLAY VIEWSHED ANALYSIS VISUALLY

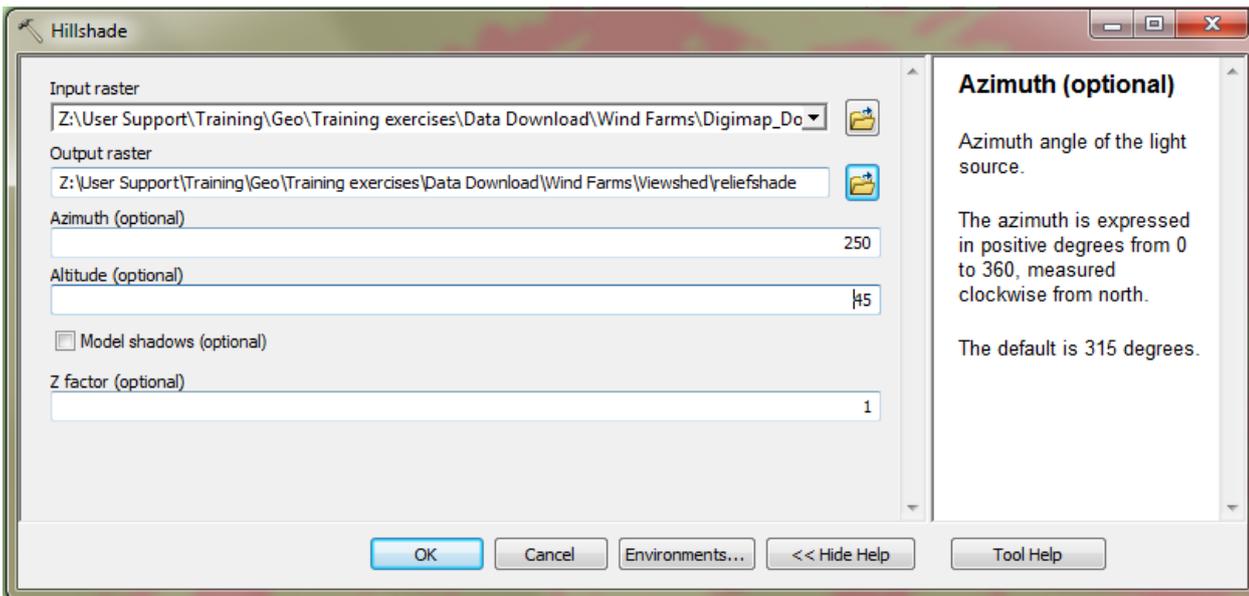
Ideally we want to be able to see the viewshed data with one of the raster maps, to understand from what points the turbines are visible. It would be really useful to combine this with a relief map which shows us hills more clearly.

Let's create a relief map, using our DTM data.

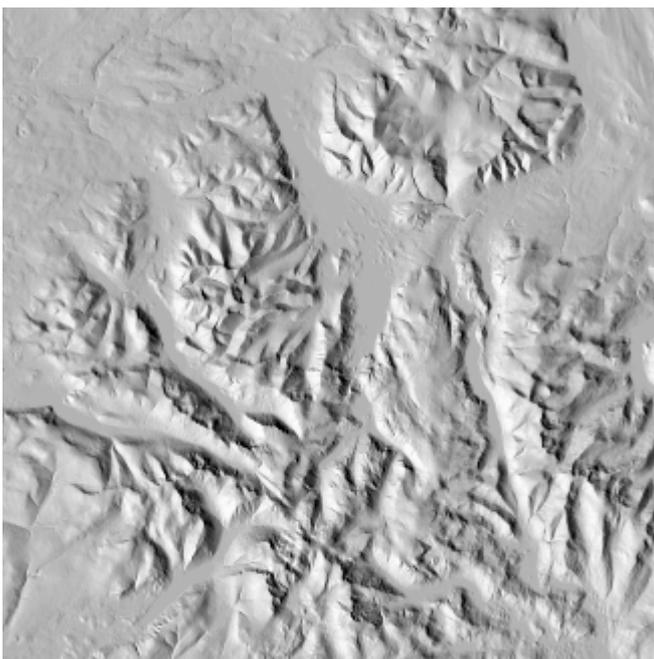
1. Open ArcToolbox.
2. Select 3D Analyst > Raster Surface > Hillshade.



3. The input raster is the DTM file **nweng_dtm**.
4. Select a folder and a name for the output relief map e.g. reliefshade.
5. Set the Azimuth at 250 – this will give us shading at late afternoon.
6. Keep the default value of 45 for the altitude.
7. Click Save.



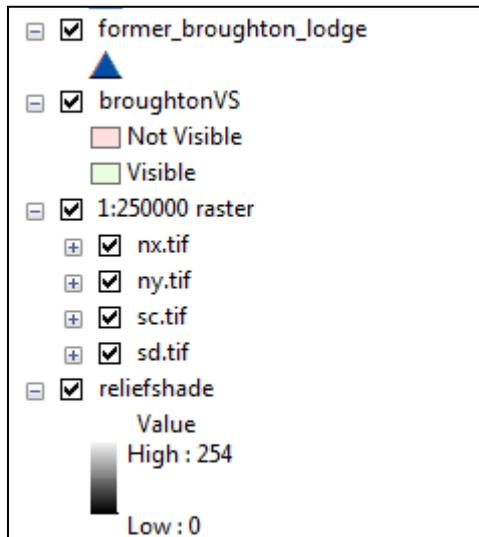
Your map should change to show a relief map.



Now we can display different map data to try and convey the viewshed information more meaningfully.

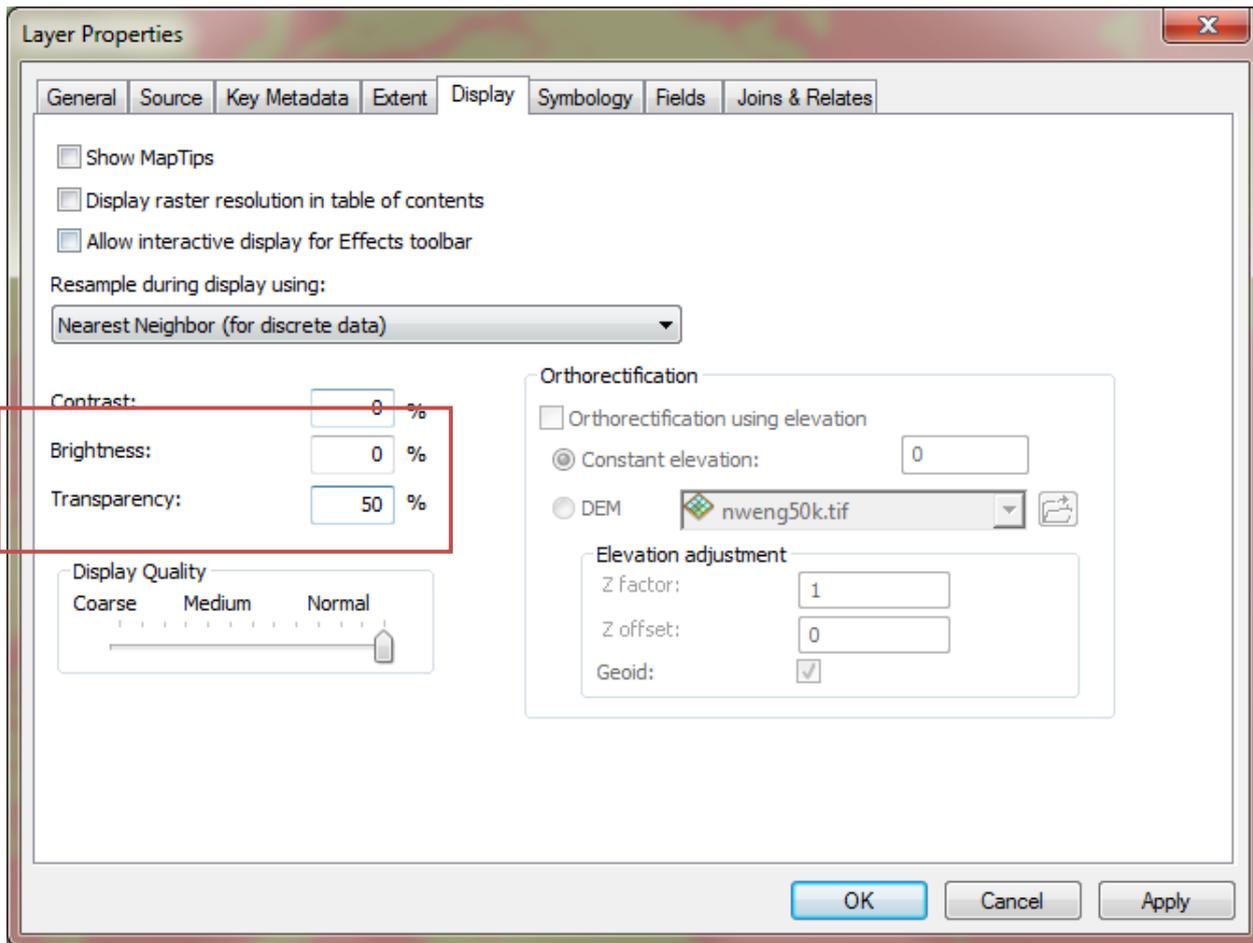
1. First, tick the following map layers to ensure they are switched on:
 1. 1:250000 raster.
 2. broughtonVS (or whatever you called your viewshed layer).

3. former broughton lodge (or whatever you called your new shape file with the wind turbine locations).
 4. Reliefshade, your new relief map
2. Change their order in the table of contents by clicking and dragging on them. We recommend this order from top to bottom – shapefile of wind farm locations, viewshed layer, 1:250000 raster map, relief map:

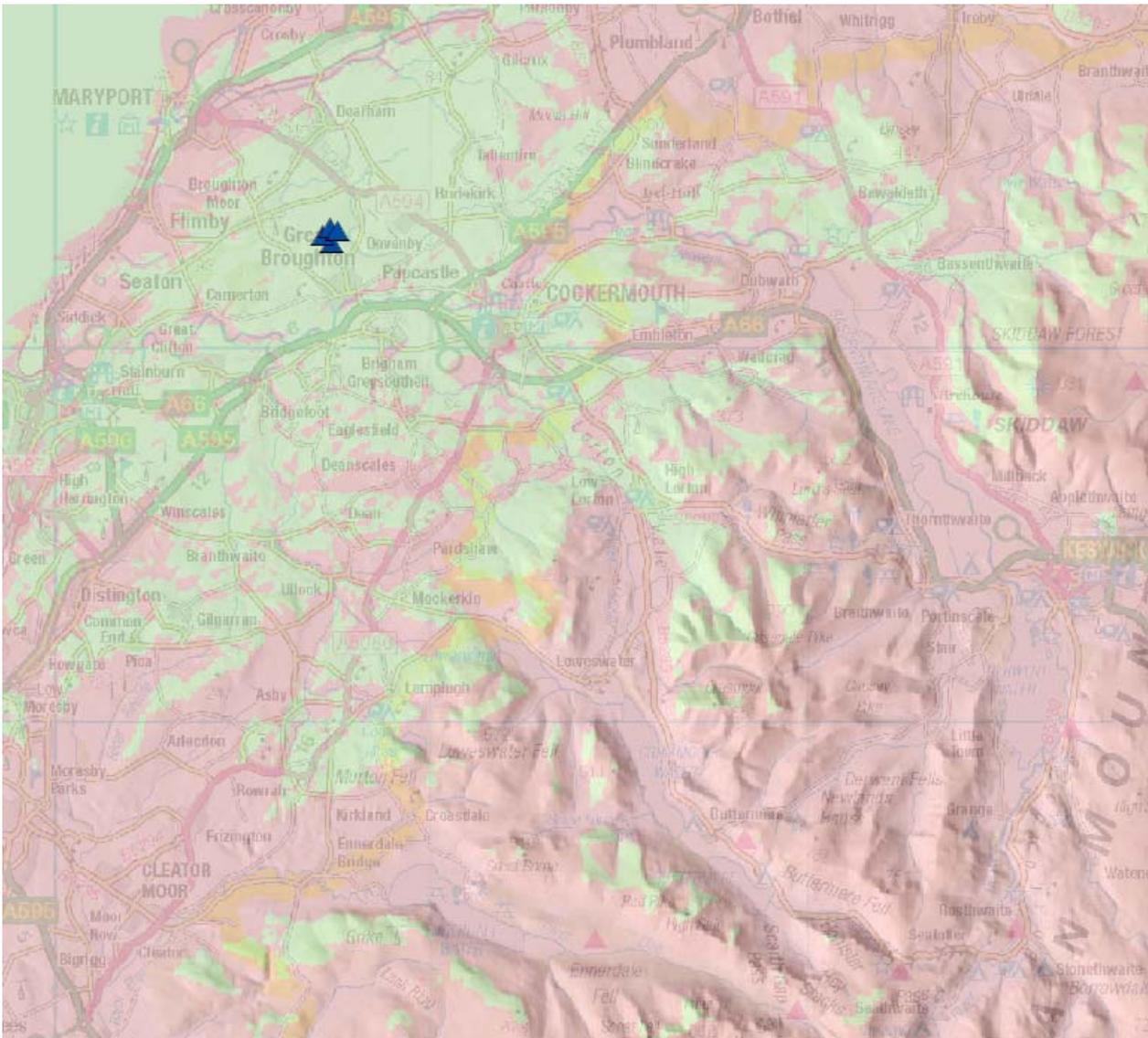


Play around with the transparencies of different layers.

3. Right click broughtonVS > Properties > Display and change the transparency to 50%.
4. Click OK.
5. Try a similar, or higher, transparency number for your raster map.



Hopefully your map will now display your viewshed data with the raster map and your relief map underneath, to help those reading your research understand where the turbines are visible.



NOTE: the viewshed analysis does not take account of buildings. So whilst your map makes it look as if the turbines are visible from the centre of Cockermouth, this may not be the case from every angle.