

# **ArcGIS Online activity on Landforms and Landscapes**

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Geographic information systems can help educate students and teachers in a more practical orientated setting. GIS help improve and develop information technology (IT) skills within the classroom such as learning how to display and store data digitally, mapping information online and being able to analyse the data on a map. We will be using ArcGIS Online, produced by Environmental Systems Research Institute (ESRI), to make our own map as it is free and is available to everyone. GIS is an excellent developmental tool which can enhance geography education because it's visually appealing, fun and offers new technologies to schools.

So far in school, you have been learning about landforms and landscapes in Geography. The following practical is designed for your curriculum and we will use GIS to identify and map Volcanoes, Earthquakes and Tectonic plates worldwide. GIS allows us to map information and to look for patterns between the data. We will use GIS to identify a high risk area associated with a volcanic eruption, focusing particularly on Mount St. Helens. A geographic insight into this type of hazard will help determine where people need to evacuate to in order to avoid a volcanic eruption. This will help you revise for your upcoming exams.

## **How does GIS Benefit the Geography Curriculum?**

GIS benefits the geography curriculum by teaching students new techniques, and helps improve students' geographical knowledge by:

- Developing IT skills.
- Enabling them to prepare a detailed and well-designed digital map.
- Providing access to up-to-date data and maps via the internet.
- Allowing students to experiment with features, their appearance and their layout on the map.

- Helping make sense of data and identifying spatial patterns between layers of information.

Integrating digital maps and GIS techniques into a project about Mount St. Helens should help students understand and revise the topic of volcanoes.

### Syllabus Structure

The practical is designed for students studying either ordinary or higher level Geography in National Council Curriculum Assessment (NCCA) syllabus.

CHRISTMAS HOLIDAYS			
16-18	Earth's internal structure Plate tectonics Volcanoes and earthquakes	CU1.1	Atlas maps Satellite photos Aerial photographs, diagrams Newspaper and textual sources
			13

The aim of this practical relates to the content description of Core Unit 1.1 Patterns and Processes in the Physical Environment Leaving Certificate Geography Curriculum.

### CORE UNIT 1: PATTERNS AND PROCESSES IN THE PHYSICAL ENVIRONMENT

	Content description	National settings	International settings
<b>I.1</b>	<b>The tectonic cycle</b>  <b>Statement:</b> <b>The mobility of the earth's crust produces endogenic forces, which give rise to geological structures within it. Crustal structures are created, modified and destroyed as part of the tectonic cycle.</b>  Students should study: <ul style="list-style-type: none"> <li>• the internal structure of the earth</li> <li>• the plate tectonics model</li> <li>• plate boundaries as zones of crustal construction and destruction</li> <li>• the geography of volcanoes and earthquakes and how they and their effects may be predicted.</li> </ul>	The position of Ireland in relation to plate boundaries now and in past geological periods.  Antrim basalt extrusion in relation to the opening of the Atlantic.	Global geography of lithospheric plates.  Global geography of volcanic and seismic activity.

**Aim of Practical:** The purpose of this practical is to familiarise students with GIS tools and data display using ArcGIS Online, using it to spatially reference, analyse and present geographic data to enhance understanding. On completion of this practical students will have gained technical knowledge of GIS and have acquired a variety of GIS skills which can be applied within further education and future careers.

	<b>Aim of Practical</b>	<b>Learning Outcomes</b>
<b>Exercise 1</b>	To achieve basic understanding in using and opening a new map in ArcGIS Online.	<ul style="list-style-type: none"> <li>To know how to sign in to ArcGIS Online.</li> <li>To be able to open a new map and search for and work with Basemaps.</li> </ul>
<b>Exercise 2</b>	To achieve basic understanding of using ArcGIS Online maps and tools.	<ul style="list-style-type: none"> <li>Search for and open maps and navigate around within a map.</li> <li>Be able to locate places, addresses, and other landforms within a map.</li> </ul>
<b>Exercise 3</b>	To achieve basic understanding with ArcGIS Online and data layers.	<ul style="list-style-type: none"> <li>Know where to find and add layers to your map.</li> </ul>
<b>Exercise 4</b>	Be able to produce an effective and well-designed map	<ul style="list-style-type: none"> <li>To turn layers on and off.</li> <li>Know how to display layers in the Contents page and Map.</li> <li>Change layer properties e.g. changing symbols, colour, patterns, size, transparency, shapes etc.</li> <li>Be able to rename layers.</li> </ul>
<b>Exercise 5</b>	To achieve further understanding of ArcGIS tools.	<ul style="list-style-type: none"> <li>Be able to save a Map Document onto ArcGIS Online.</li> </ul>
<b>Exercise 6</b>	To recap on Mount St. Helens in order to gather data for GIS analysis.	<ul style="list-style-type: none"> <li>Use information about Mount St. Helens in a GIS Buffering exercise.</li> </ul>
<b>Exercises 7-9</b>	<ul style="list-style-type: none"> <li>To assess the risk areas most affected by Mount St. Helens volcano and to spatially interpret the data.</li> <li>Analyse the information presented on a map.</li> </ul>	<ul style="list-style-type: none"> <li>Be able to add a Buffer Layer</li> <li>Open an Attribute Table</li> <li>Count features within a Buffer Layer</li> <li>Be able to analyse and identify spatial patterns between features on a map and of the relationships that exist between them.</li> </ul>
<b>Exercise 10</b>	<ul style="list-style-type: none"> <li>To determine a high risk area by using a measuring tool.</li> <li>To spatially interpret</li> </ul>	<ul style="list-style-type: none"> <li>To be able to measure area and distances between features.</li> <li>Draw a conclusion between features on a map.</li> </ul>

	relationships by location between features.	
<b>Exercise 11</b>	<ul style="list-style-type: none"> <li>To achieve further understanding of using ArcGIS Online and data layers.</li> </ul>	<ul style="list-style-type: none"> <li>Know where to find and add layers from different sources.</li> </ul>
<b>Exercise 11.1</b>	<ul style="list-style-type: none"> <li>To gain an understanding of Network Analysis tools and techniques in order to spatially interpret data.</li> </ul>	<ul style="list-style-type: none"> <li>Be able to add a Network Analysis layer to a map.</li> <li>Analysing the data on a map in order to find the closest and best route to the Hospital from the town Cougar.</li> </ul>

**What is ArcGIS and ArcGIS Online:**

- <https://www.youtube.com/watch?v=3m0I5SmnVc0&list=PLiC1i3ejK5vtyUTMRDSZYcSZwJ12E2VCN>
- <http://resources.arcgis.com/en/help/getting-started/articles/026n00000014000000.htm>

Sources of Data Used	
<ul style="list-style-type: none"> <li>Esri</li> </ul>	<ul style="list-style-type: none"> <li>Earth Science Atlas</li> </ul>
<ul style="list-style-type: none"> <li>USGS Education</li> </ul>	<ul style="list-style-type: none"> <li>ArcGIS web server</li> </ul>

**Video Link Tutorials**

1. How to Add Layers:  
<https://www.youtube.com/watch?v=DG0fUDZH3I8>
2. How to Change Layer Properties:  
[https://www.youtube.com/watch?v=roH\\_kkZkiUE](https://www.youtube.com/watch?v=roH_kkZkiUE)
3. How to Add a Buffer Layer:  
<https://www.youtube.com/watch?v=cGrH3AxzrK8>
4. How to Measure Distances:  
[https://www.youtube.com/watch?v=jsEd\\_3xuEtQ](https://www.youtube.com/watch?v=jsEd_3xuEtQ)

## Estimated Practical time - 50mins

### EXERCISES

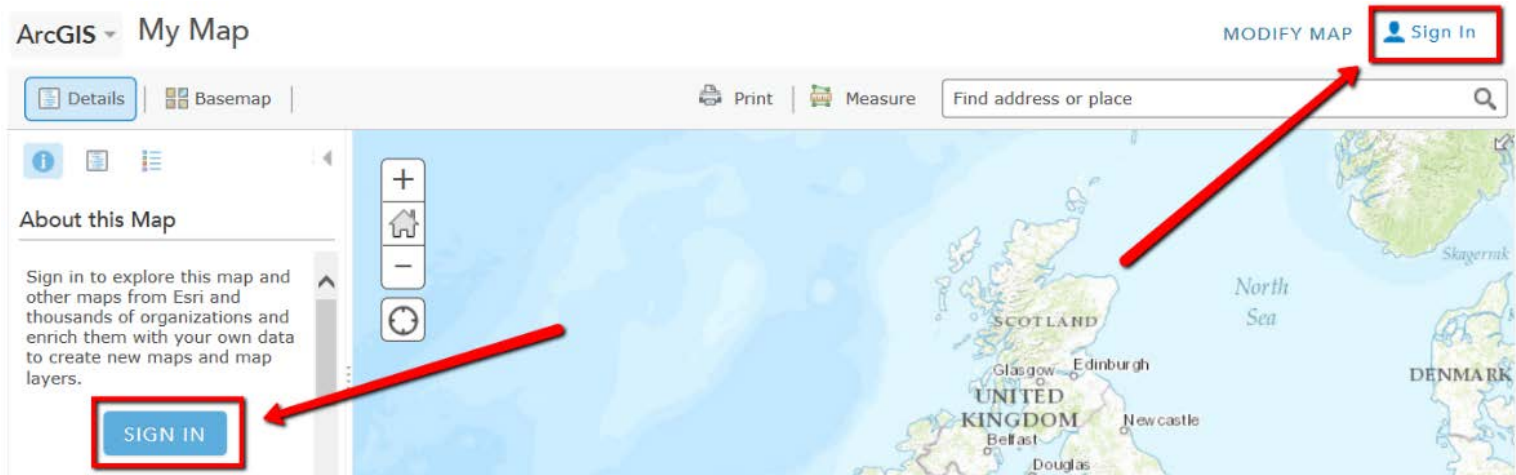
We will now begin by taking a look at ArcGIS Online and displaying data on the map. Throughout the exercise, make sure you follow each step closely and understand the instructions given. If you have any questions or are unsure how to complete a task, Please Ask for Help!! You are now ready to start your practical.

### Exercise 1: Open a Map on ArcGIS Online

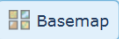
1. To begin, open a web browser and go to:

<https://www.arcgis.com/home/webmap/viewer.html> (type in the address or click on the link).

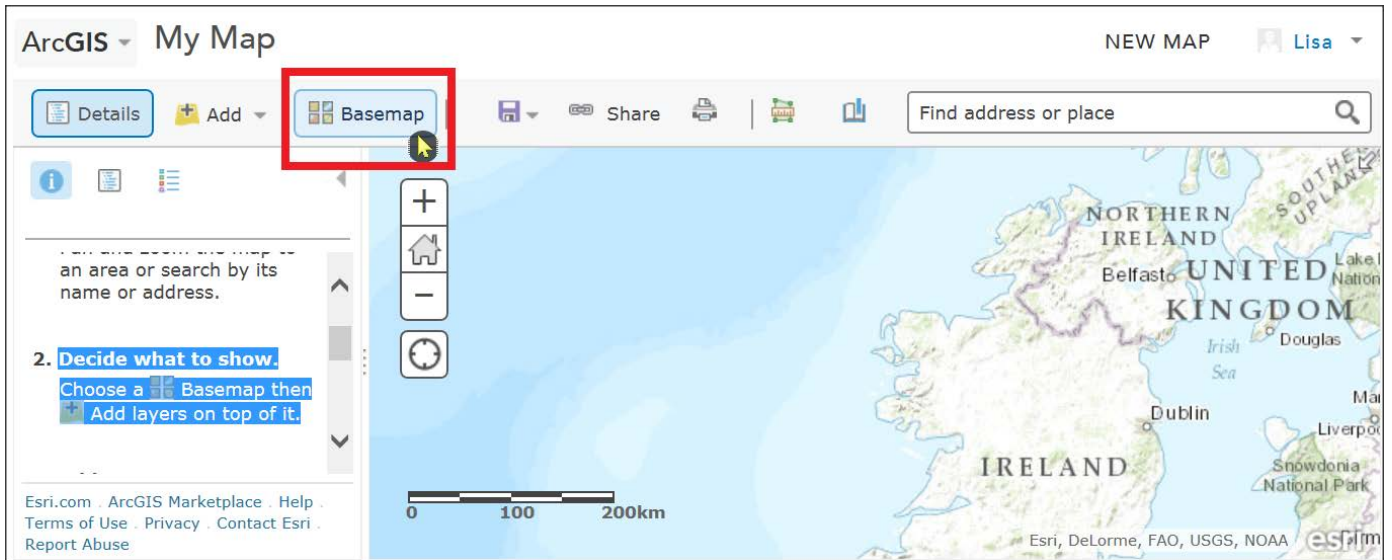
2. Click the sign in Button  Sign In at the top right hand side of the screen or left hand side of the screen . A sign in box will appear.



3. Enter your username and password to log on. (If you don't already have an ArcGIS Online account, you can sign up for a free 'public account' at <http://www.esri.com/software/arcgis/arcgisonline/features/public-account>).

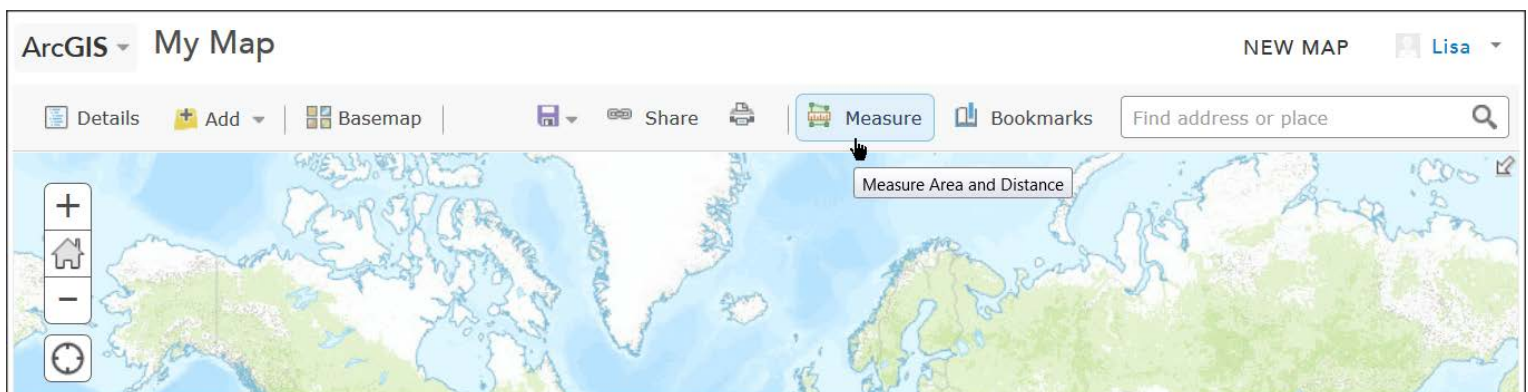
4. Click the **Basemap Gallery** button  on the Mapping toolbar tab and select **Topographic** (a detailed map of the World surface) – this one may already be displayed.

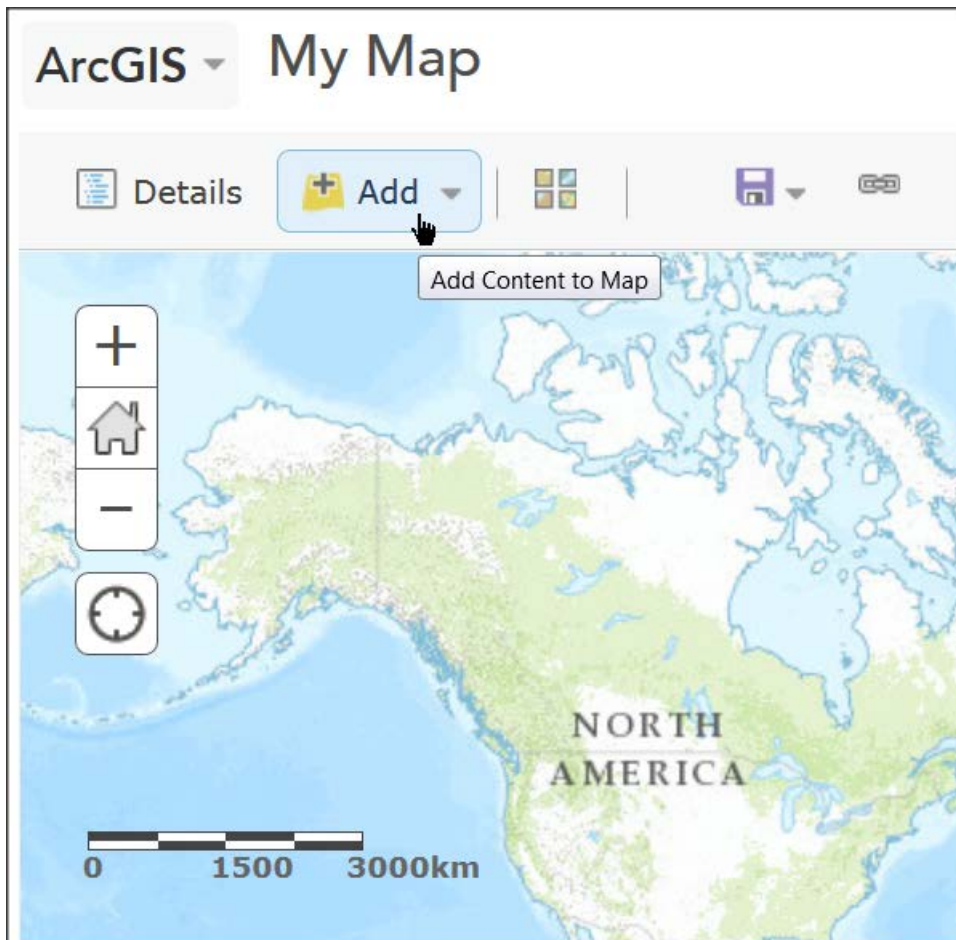
You can change the base map at any time by using the Basemap Gallery button, which shows a range of basemaps provided by Esri via ArcGIS Online



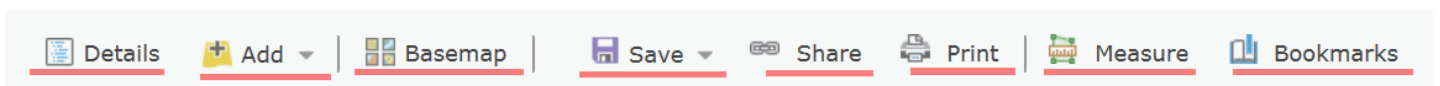
## Exercise 2: Moving Around the Map

As you can see, there are various tools on ArcGIS Online. To identify each tool, hold your cursor over the button, and it will display a brief description of that tool, as shown below





ArcGIS ▾ My Map



### Tool Functions:

- The **Details** button shows details of the Map.
- The **Save** button provides options to save a Map.
- The **Share** button lets you choose who can view a map. You have to save a map before you can share it.
- The **Print** button copies your map to another web page for printing.



- The **Basemap** gallery gives you the option to add different types of maps, such as Imagery, Oceans, Open Street Map etc. It is not possible to modify a basemap and the basemap must be the lowest layer (i.e. all other content is drawn on top of the basemap).
- The **Add** button lets you add by searching ArcGIS online, by inputting a web address pointing to a specific layer or file, or adding a file from your computer.
- The **Measure** tool measure distances and area or finds coordinates of a point on the map.
- **Bookmarks** allows you to save and return to particular locations on a map.

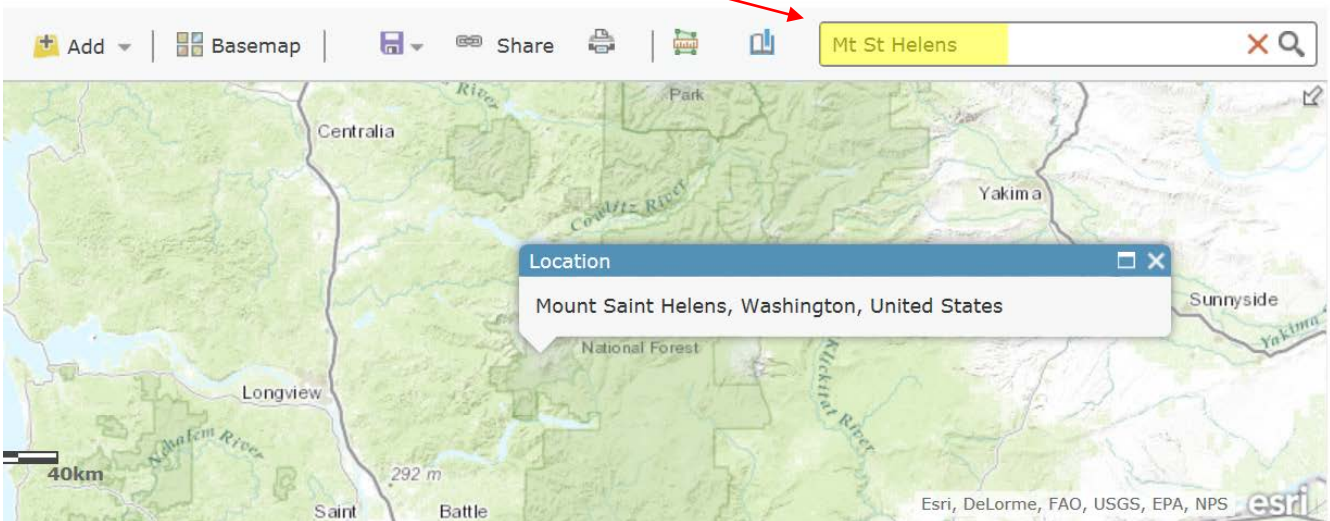
To zoom in and out, use your mouse wheel or the **Navigation** tool at the top left of the display window.



Hold down the left mouse button to move around the map in any direction (i.e. to 'pan').

You can use the search tool located on the right hand side of the screen, and type in a location, address, etc. We will be focusing on Mount St. Helens in this practical, so type this into the search box, and the map will navigate to that area.

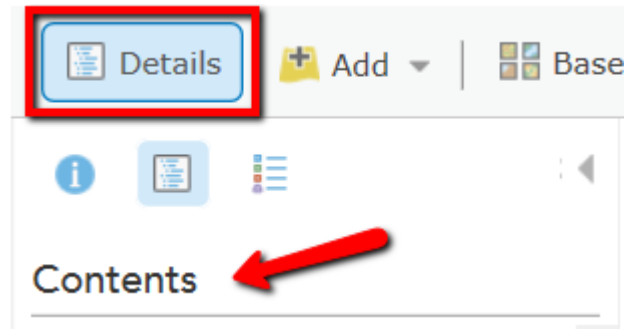




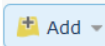
Spend a few minutes experimenting with the tools available. When you have finished hold down the **zoom out (-)** button so you can see a map of the world.

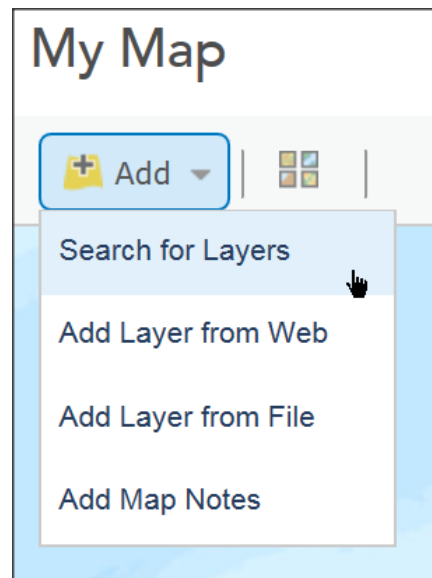
### Exercise 3 : Adding Data Layers to your Map Document

The map you work with in ArcGIS Online includes a basemap that provides background information, to which you can add other layers that will be displayed on top. Layers consist of common information about places. The basemap is like the base of a pizza, and the layers are like toppings laid on each other. You can add layers from various online sources to provide a more detailed and informative map. In the first task we will add a layer of volcanoes to the map. Data layers are also displayed in the Contents tab which is used to organise layers of data. Display the contents by clicking the middle button below the **Details** button ('Show Contents of Map'). At the moment only the Basemap will be listed.

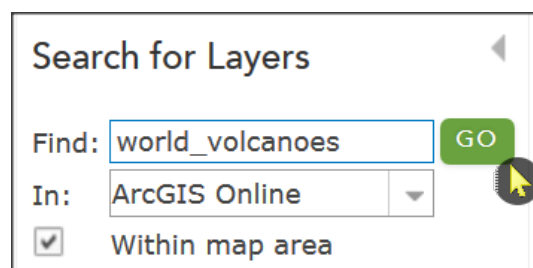


You will now add a layer of spatial data about volcanoes to your map.

1. Click the **Add** button  on the toolbar to open the Add Content dropdown menu.
2. Select **Search for Layers**.

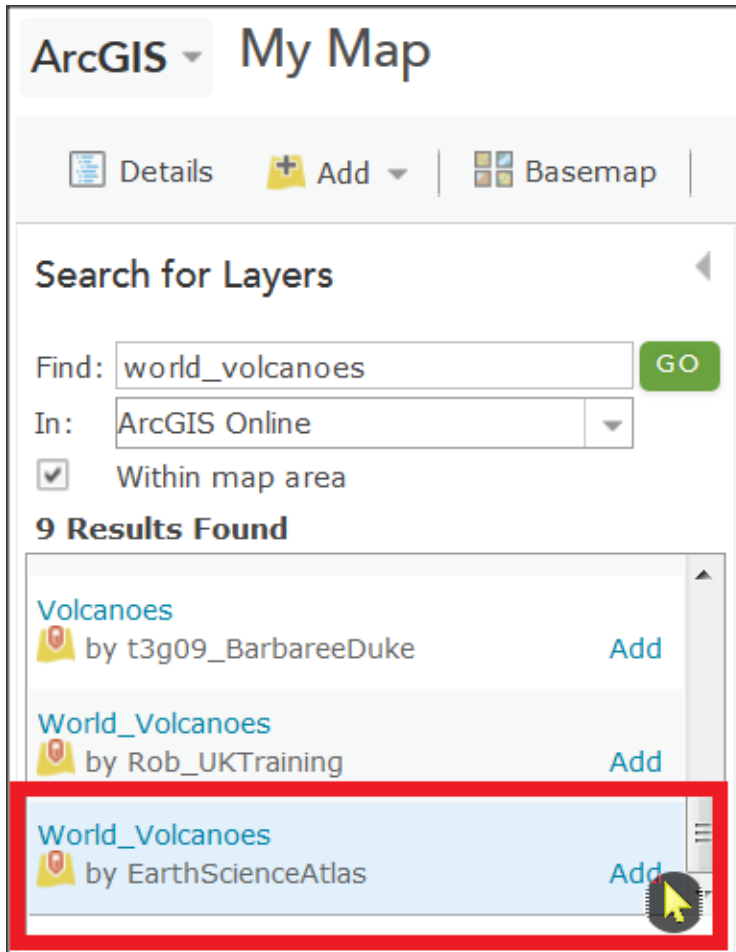


3. Type **world\_volcanoes** into the **Find** field and press ENTER or click the **Go** button .



4. Select **World\_Volcanoes by EarthScienceAtlas** (as shown below) and click the **Add** link to add the layer to your map.

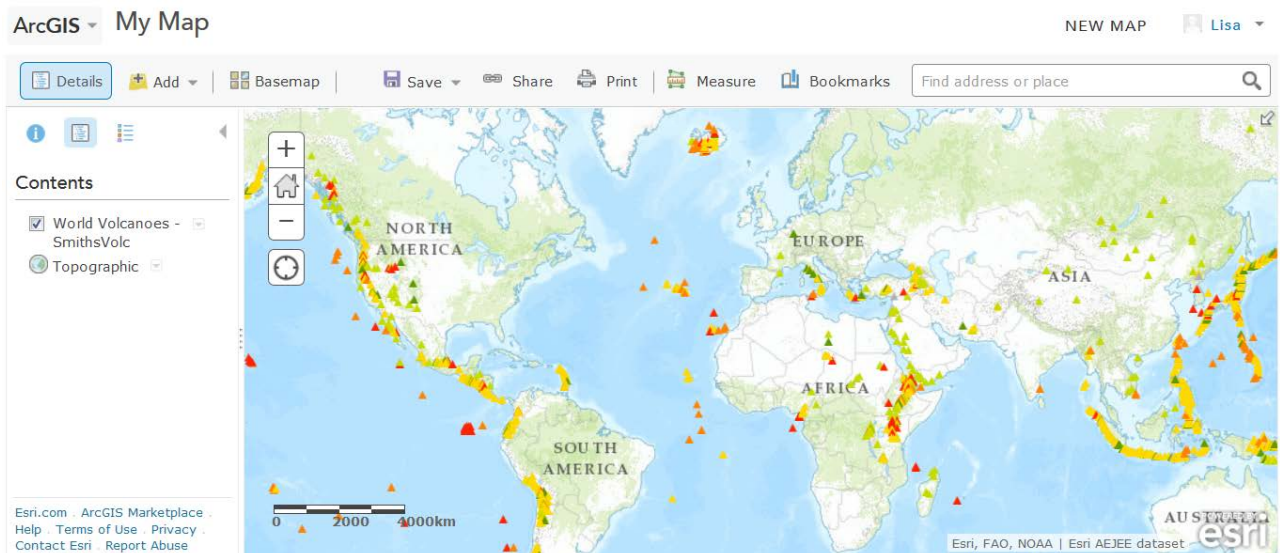
\*Note: if you click on the layer titles in the list provided, a pop-up will appear, displaying a brief summary about the data.



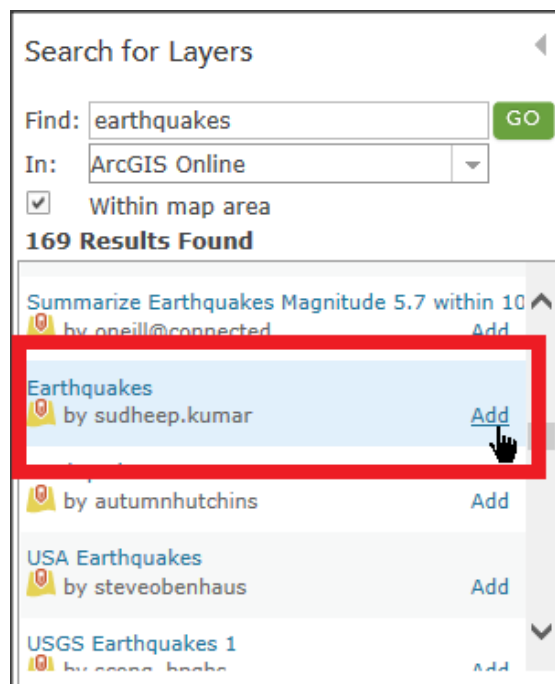
5. Next, click **Done Adding Layers**



Your screen should like the image below. Volcano data should be added as a layer in the Table of Contents and displayed in the ArcGIS display area. As you can see, ArcGIS automatically gives a colour to any features you add to your map.



6. Now add more layers. Type **Earthquakes** into the **Find** field and select the **sudheep.kumar** option – see below (the layer is almost half-way down the list). Click the **Add** button. (*IMPORTANT: if you find it difficult to locate the layer due to the number of layers listed, you can take a shortcut by using the exact web address where the layer is stored, as explained in point 6(b) below.*)



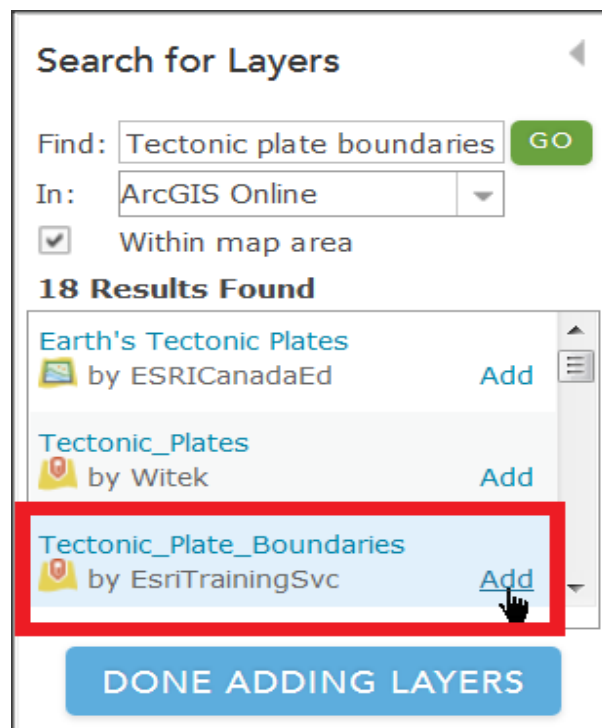
- 6(b). An alternative way of adding the layer is as follows: Click the **Add** button, then **Add Layer from Web**. In the next window, keep the choice of

**An ArcGIS Server Web Service** and copy and paste the following web address into the URL box:

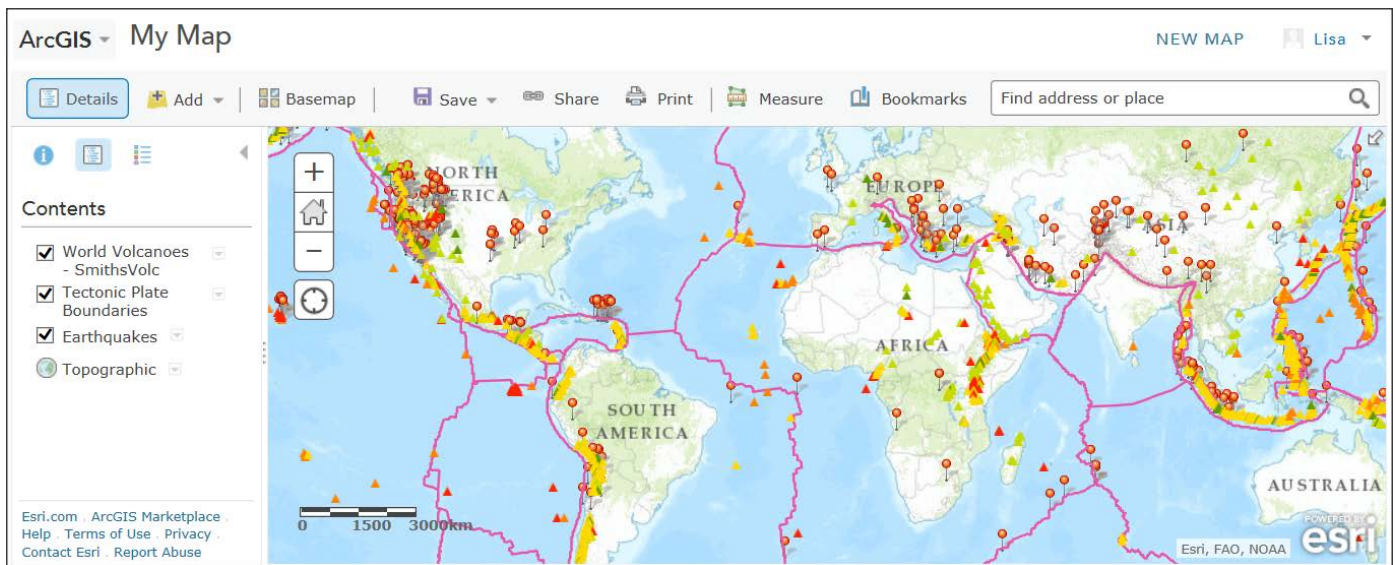
http://services1.arcgis.com/Kq4xB498o2K1KK7t/arcgis/rest/services/Earthquakes/FeatureServer

The click **Add Layer** and the earthquakes layer should display on the map.

7. Now use **Add, Search for Layers** again to find a layer called **Tectonic\_Plate\_Boundaries** – select the one by EsriTrainingSvc.

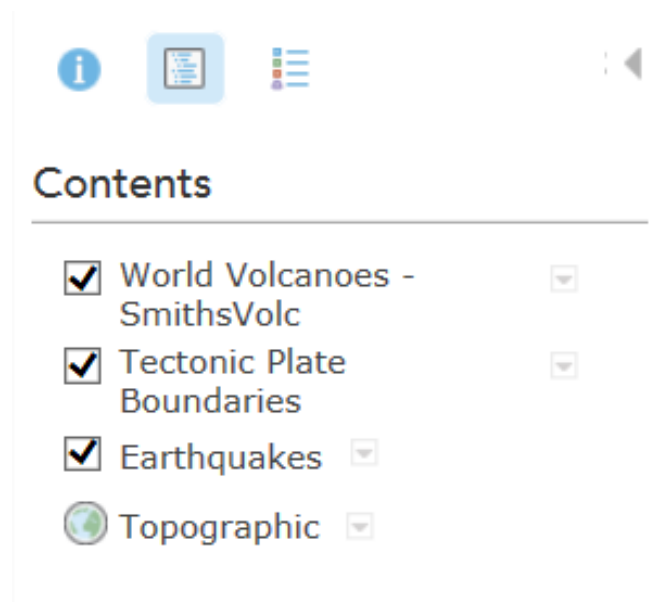


8. When you have finished (and clicked **Done Adding Layers**) your screen should resemble the image below.

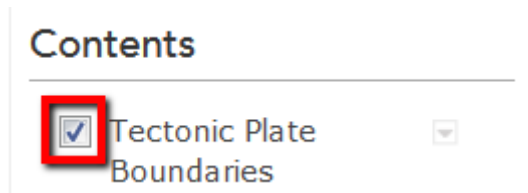


### Exercise 4.1: Working with Layer Properties in the Table of Contents

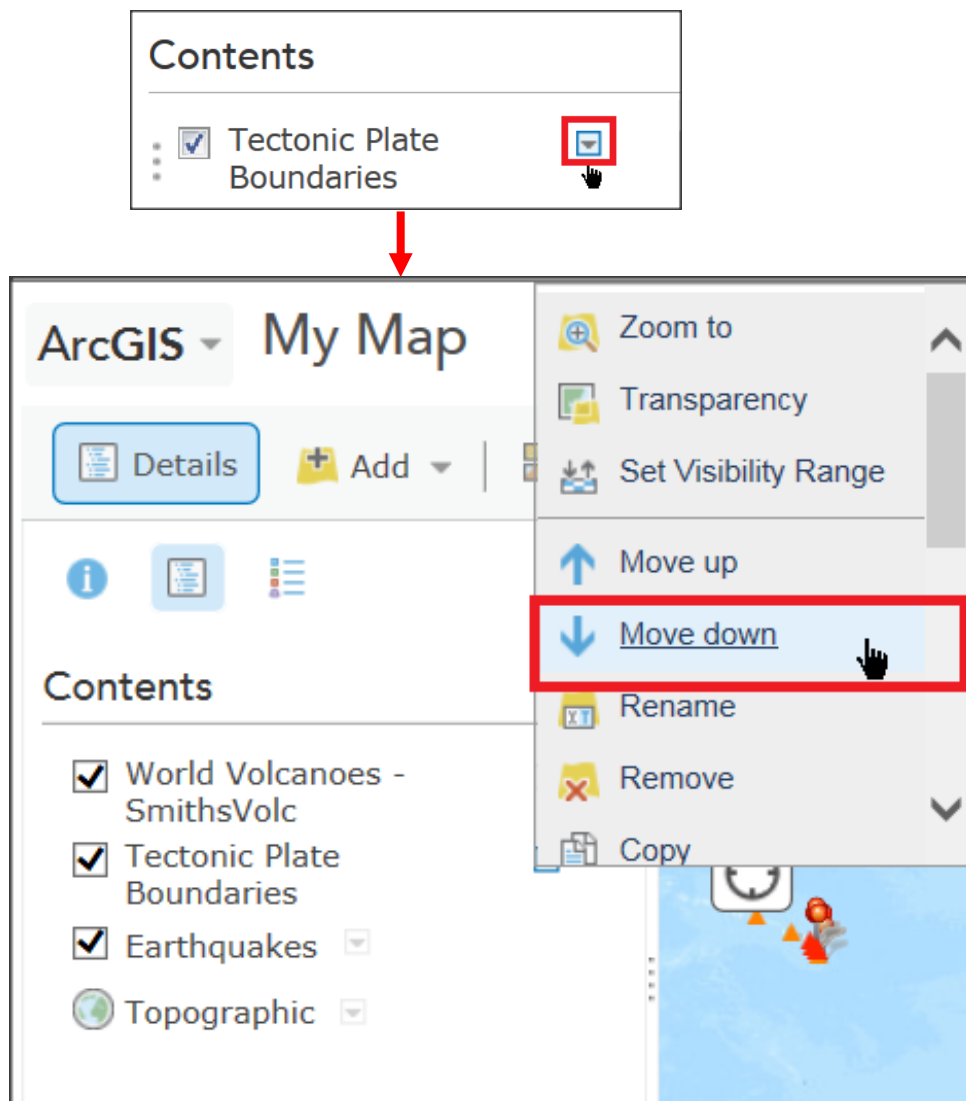
We will now use the Table of Contents to change how the layers are displayed on the map.



The check box next to the data layer's name controls whether or not the layer is displayed – click on the box to display it (a tick will appear in the box). Unticking the box turns off the display for that layer, until you tick the box again.

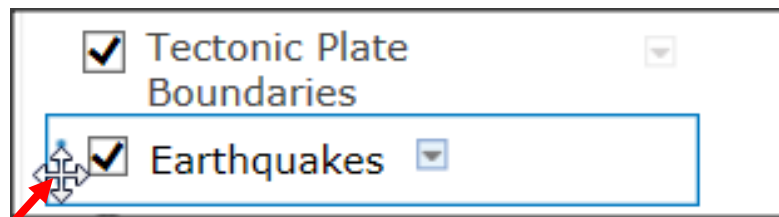


The order in which layers are drawn is from the bottom to the top. Therefore any background layers (such as the Topographic base map) should be placed at the bottom of the Table of Contents. If you want to change the order in which they are drawn, just click the down arrow beside the Layer's name, and select either **Move up** or **Move down**.



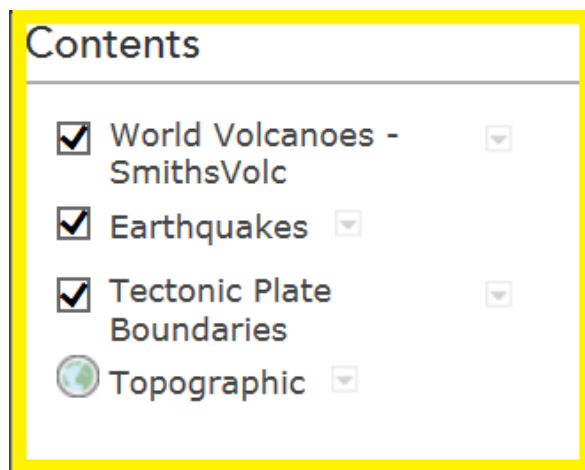


Alternatively you can move your cursor to the left of the layer, and click the layer and drag it either up or down the Table of Contents to a new position (as shown below)



Click and Drag to re-order Layers

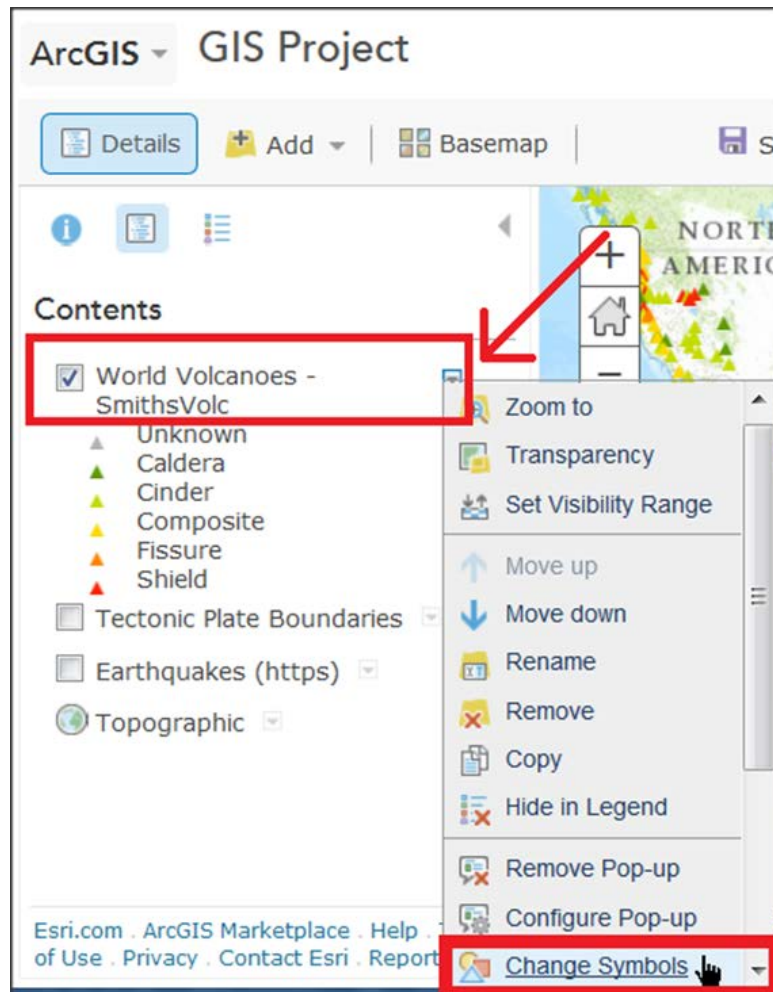
Place volcanoes at the top of the List and place Earthquakes underneath, followed by Tectonic plate boundaries.



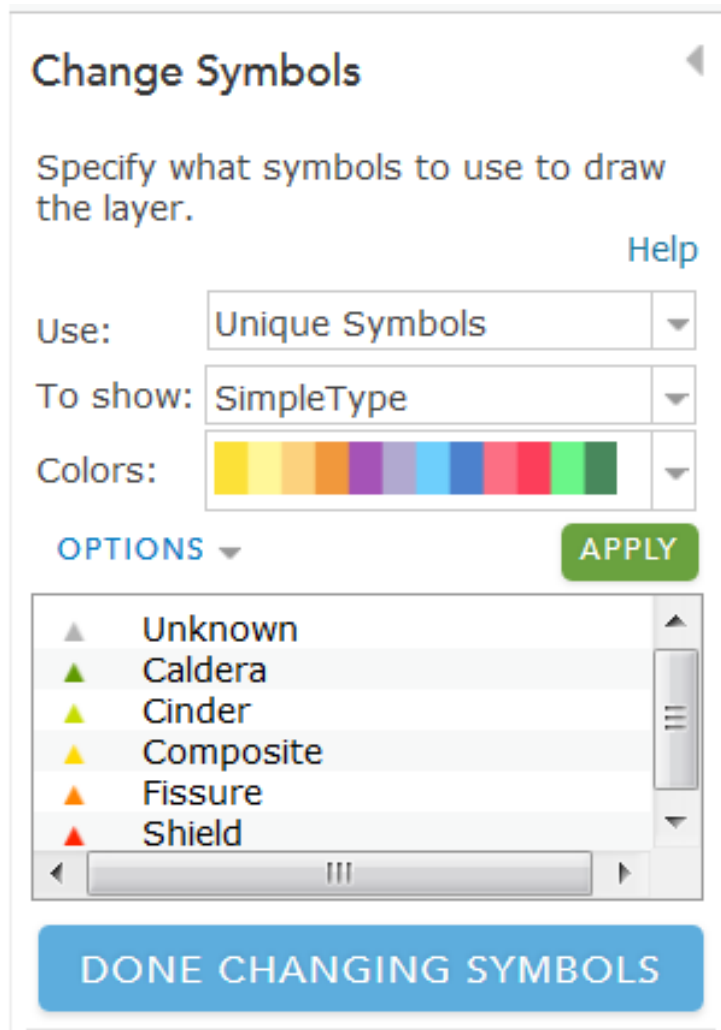
## Exercise 4.2: Working with Layer Properties

The way that data is displayed (e.g. colour, fill type, symbols etc.) can be changed to create an effective and well-designed map. In order to view or change the symbology:

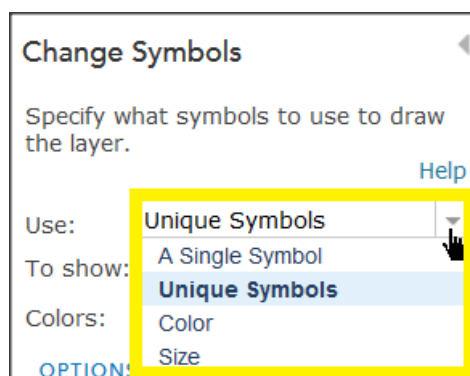
1. Click the arrow to the right of the layer name – Volcanoes
2. Click **Change Symbols**



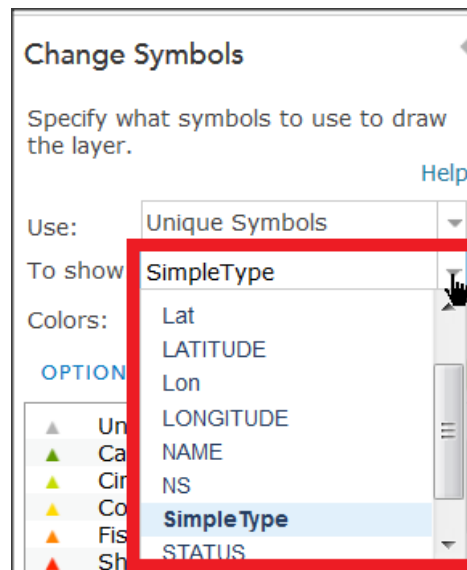
At the moment the data is displayed using unique values, which assign a different colour to each of the different categories in your data.



3. Click the drop down arrow to the right of the **Use** category to see the other options.



4. Click on **Unique Symbols** to keep this choice.
5. To select the attribute field you want to display, click the drop down arrow to the right of **To show** and select **Simple Type**.

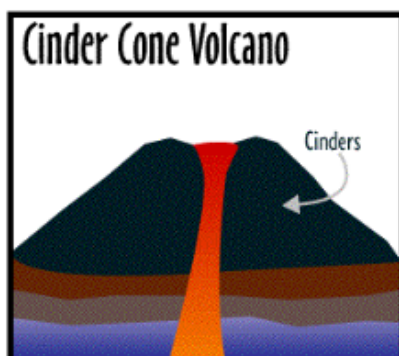


Simple Type is an attribute that is part of the volcanoes layer, which classifies the volcanoes by type (as shown below)

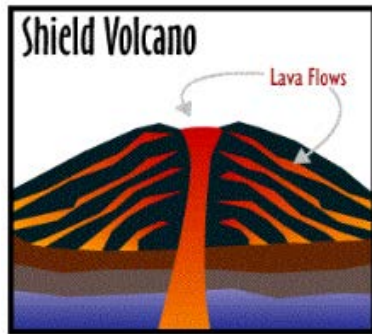


### Types of Volcanoes:

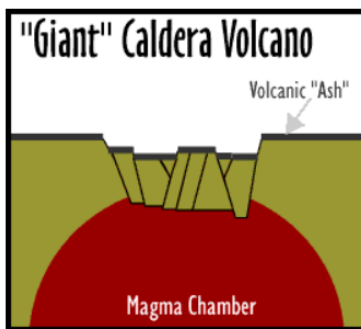
- A **Cinder Volcano** is a cone-like, hill shaped volcano. Examples include the Crater Lake in Oregon.



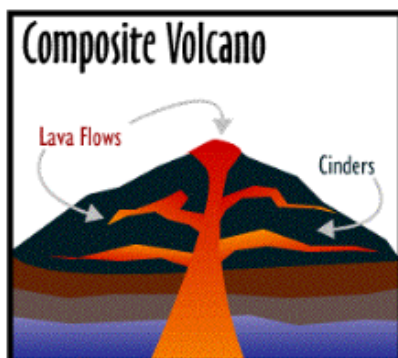
- **Shield Volcanoes** consist of a thin layer of lava, which forms a gently sloping volcano. These volcanoes have a large base and are usually quite big in size. Examples include Mauna Loa in Hawaii.



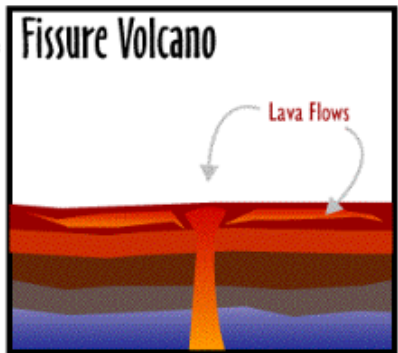
- A **Caldera Volcano** is shaped like a bowl, which forms when the volcano erupts causing the top of the volcano to collapse, creating a hollow.



- **Composite Volcanoes** are quite steep, composed of various layers of material which have exploded from a volcano e.g. Lava, ash, rock etc. Examples include Mount St. Helens.



- **Fissure Volcanoes** are quite flat and spread a massive amount of lava when they erupt.

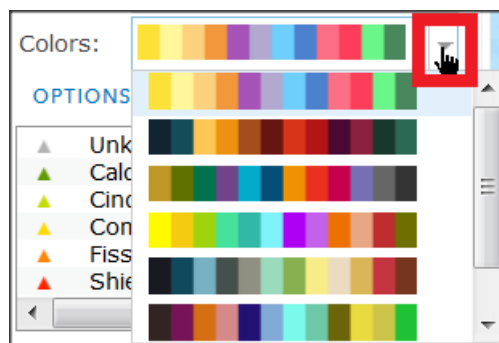


**Sources:**

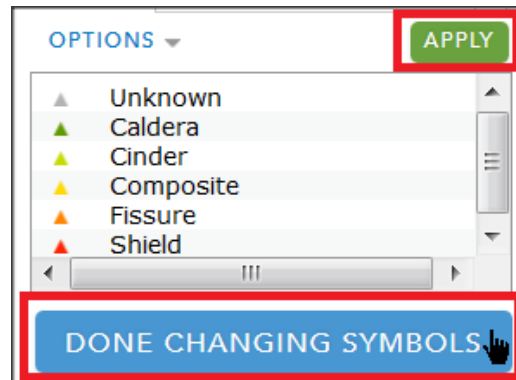
- Principal Types of Volcanoes - <http://pubs.usgs.gov/gip/volc/types.html>
- Types of Volcanoes - <https://www.dnr.sc.gov/geology/images/Volcanoes-pg.pdf>
- Exploring the Environment - <http://www.cof.edu/ete/modules/volcanoes/vtypesvolcan2.html>

6. Click the drop down menu beside the **Colour** set for the symbols to see the colour ramps available, but don't make any changes.

Colour Ramp displays a group of symbols according to a range of colours

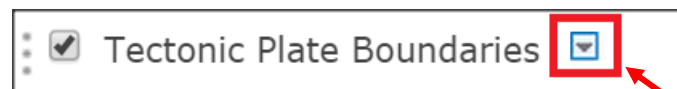


7. Click **Apply**, then **Done Changing Symbols** (note that if you have not made any changes, you can just click on the small arrow to the right of 'Change Symbols' to close the panel).



### Exercise 4.3: Change the layer properties for Tectonic plate Boundaries and Earthquakes.

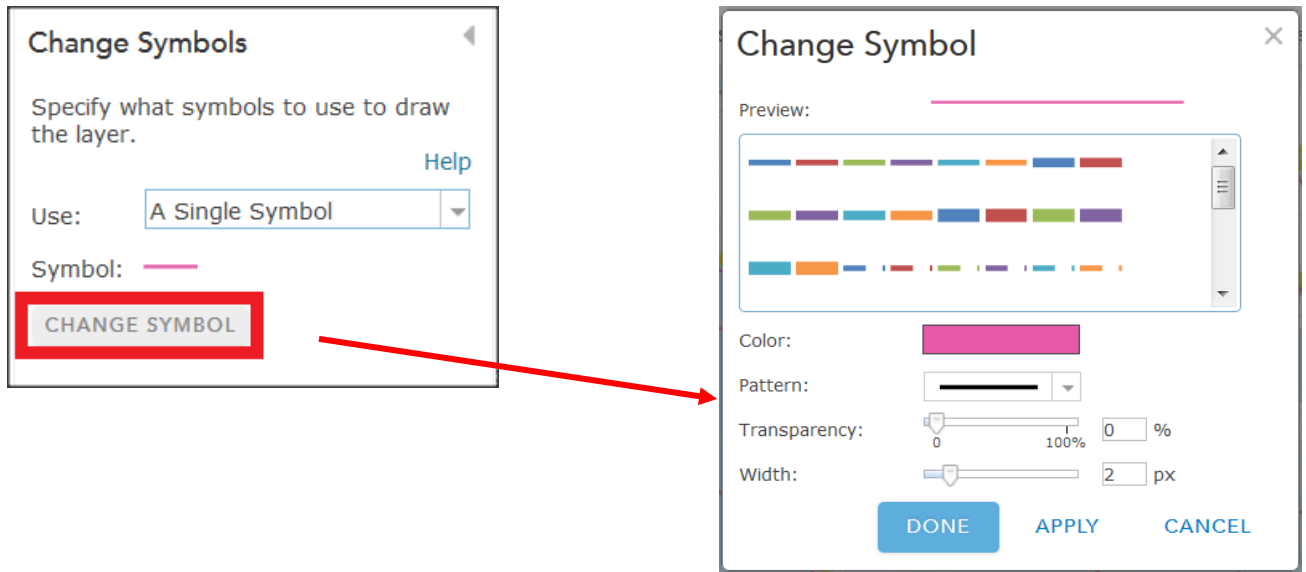
8. Open the drop down arrow beside Tectonic Plates.



Drop down Arrow

9. Then open the **Change Symbol** Button, and another box will open as shown below.





To change the colour, click inside the coloured box to open the colour palette.

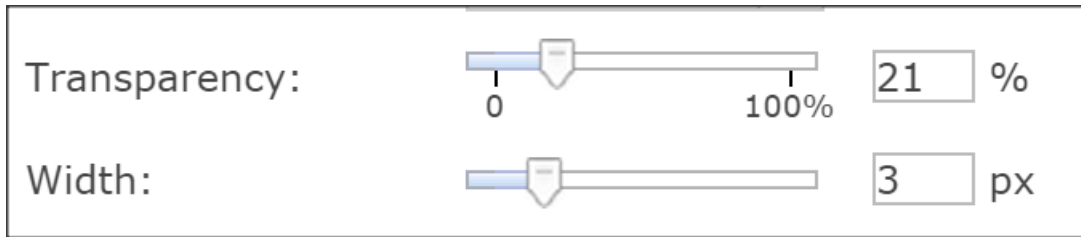
10. In the box, Select **Royal Blue** in the Colour Box for the Fill colour (the name of the colour will be displayed when you hover the mouse over any of the coloured boxes).



11. To change the Pattern of the plate boundary, click the drop down arrow and click the third option.



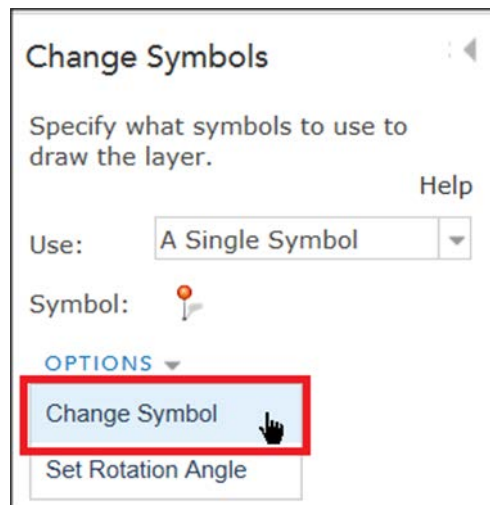
12. Change the **Transparency** to **21**, and the **Width** to **3**



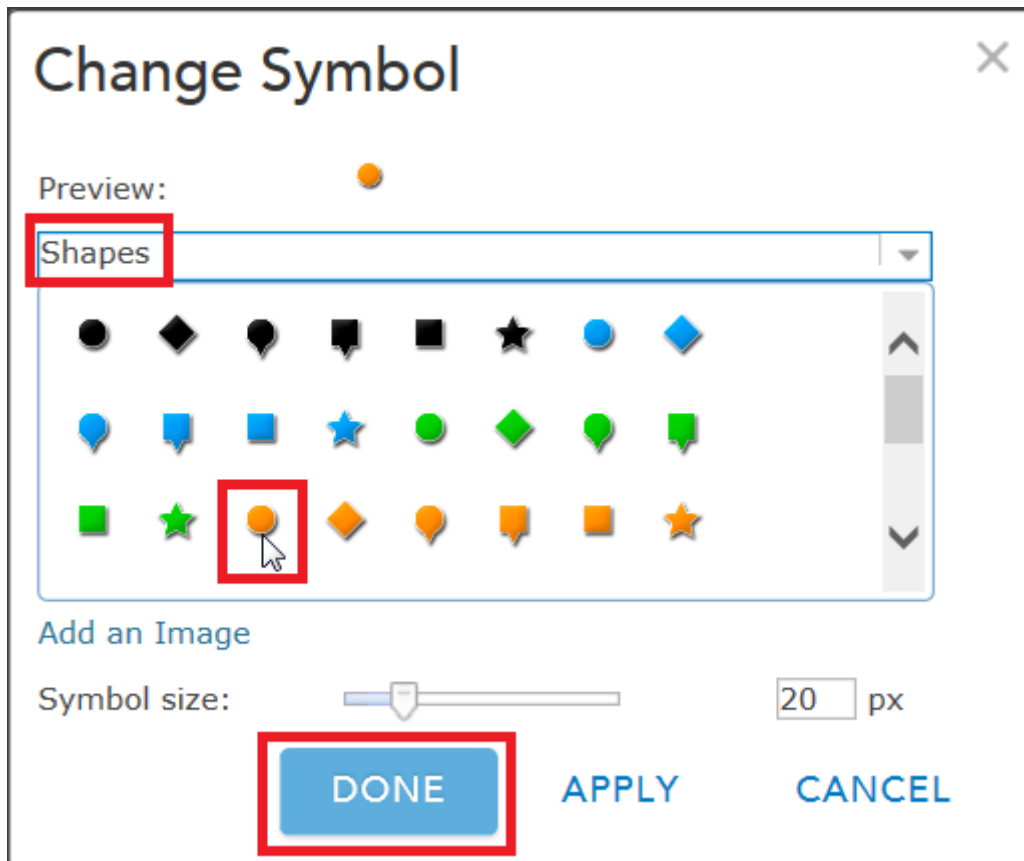
13. Click **APPLY** then **DONE**, then **DONE CHANGING SYMBOLS**.

To change the symbols for the Earthquake layer, click the arrow to the right of the Earthquakes layer and select **Change Symbols** as before.

14. Next, select the down arrow next to **OPTIONS**, then select **Change Symbol**

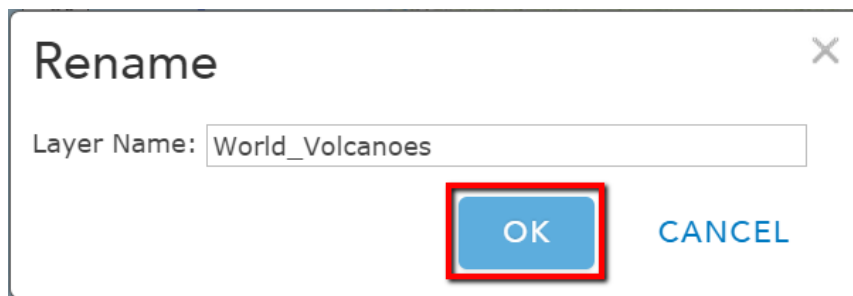
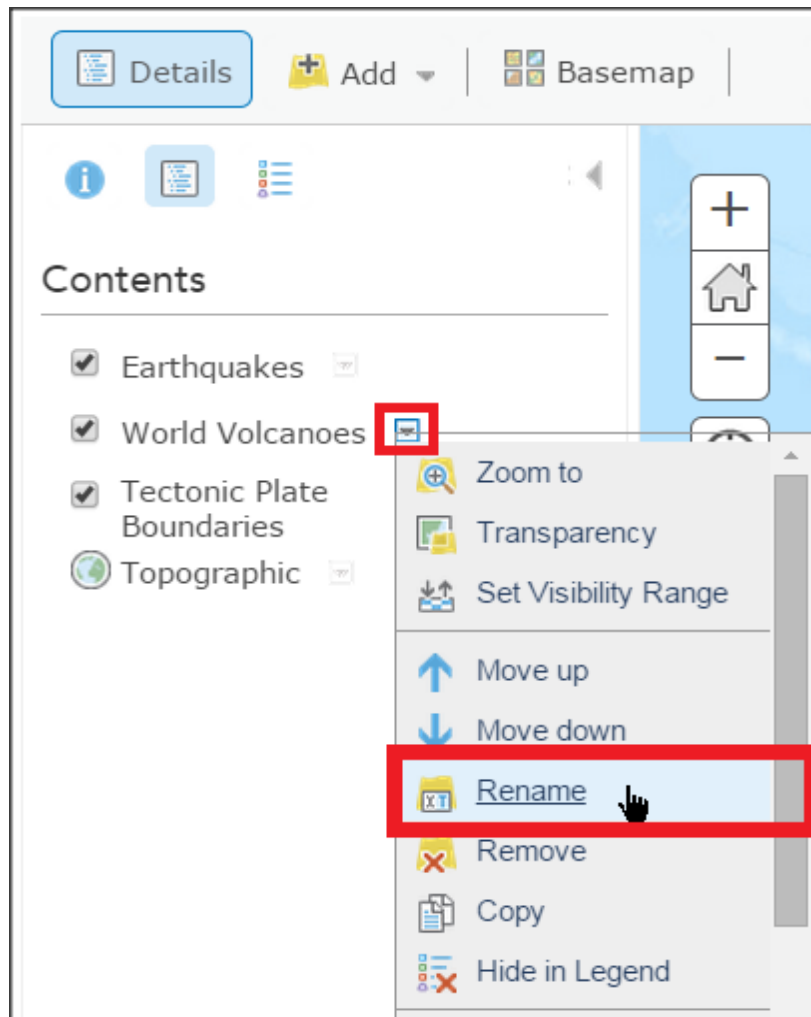


15. Select **Shapes** > then select the Orange Circle as shown below, then **DONE**, then **DONE CHANGING SYMBOLS**

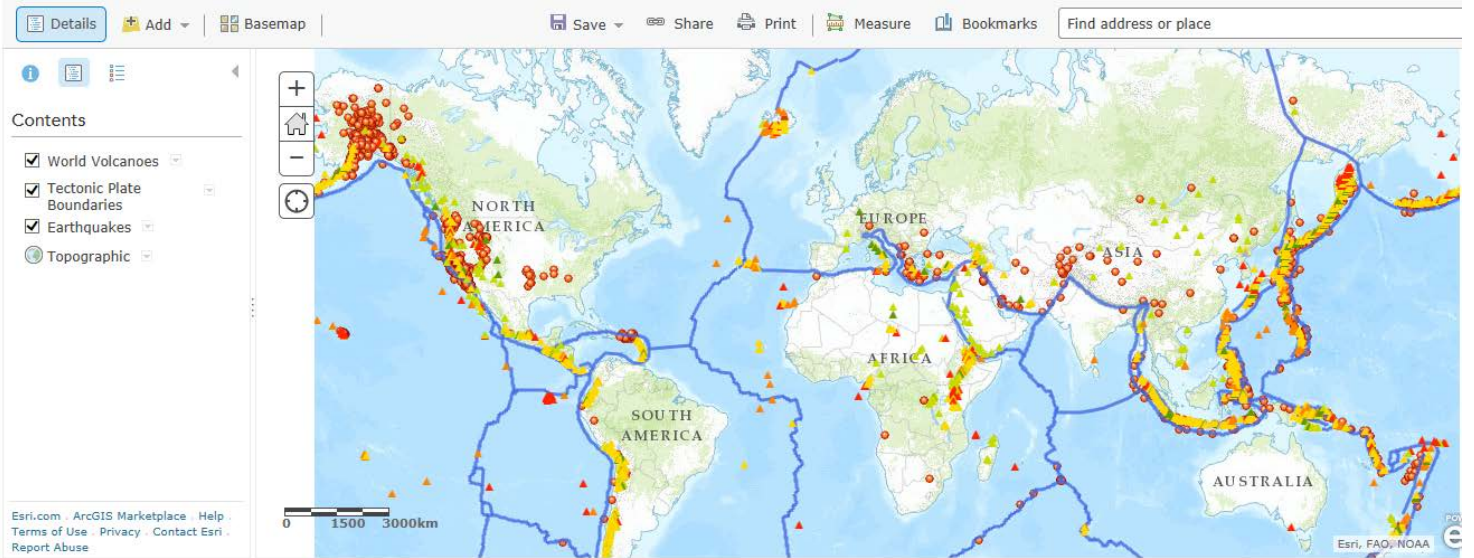


#### Exercise 4.4: Renaming Layers

16. To rename a layer to what you want to call it, select the drop down, then select **Rename**.
17. Rename the Volcanoes layer if you wish to call it something different and click **OK**



Depending on changes you have made to the symbols and layer names, your map should look something like the image below.



ArcGIS Online also contains a legend, which displays the map details and the symbols used to represent each layer. The legend opens in the side window.

The screenshot shows the 'Legend' window in ArcGIS Online. The window has three tabs: 'About', 'Content', and 'Legend', with 'Legend' selected and highlighted by a red box. Below the tabs, the legend is titled 'Legend' and lists three layers: 'World\_Volcanoes', 'Tectonic\_Plate\_Boundaries', and 'Earthquakes'. The 'World\_Volcanoes' layer is expanded to show six categories: 'Unknown' (grey triangle), 'Caldera' (green triangle), 'Cinder' (yellow triangle), 'Composite' (orange triangle), 'Fissure' (red triangle), and 'Shield' (red triangle). The 'Tectonic\_Plate\_Boundaries' layer is represented by a blue line. The 'Earthquakes' layer is represented by a red circle.

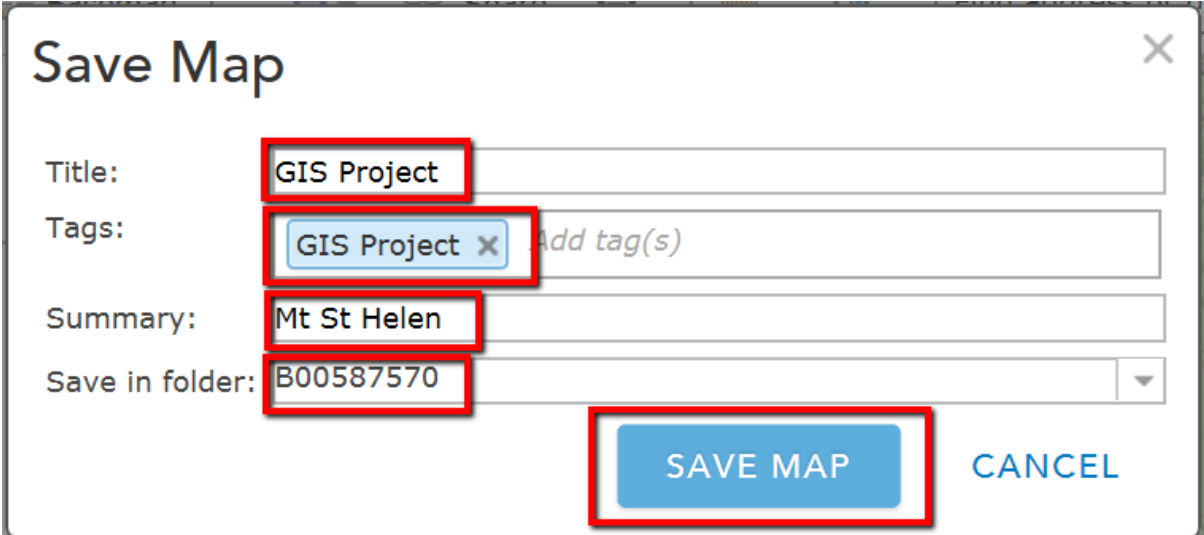
## Exercise 5: Saving the Map

You can save your maps in ArcGIS Online. When saving your map, you must add a title and type one or more Tags to describe your map. A Tag is a keyword or phrase that describes your map. Then enter a summary of your map. Choose a folder in My Content where you want to save the map and click Save. Once you've saved your map, it appears in My Content.

To save a map in ArcGIS Online

1. Click **Save**  from the top of the map viewer.

Fill in the Boxes like the image below > Click **SAVE MAP**



The screenshot shows the 'Save Map' dialog box with the following fields and values:

- Title: GIS Project
- Tags: GIS Project (with a close icon) and Add tag(s)
- Summary: Mt St Helen
- Save in folder: B00587570

At the bottom of the dialog are two buttons: **SAVE MAP** and **CANCEL**.

You should save your map regularly in case the website crashes, as there is no automatic save feature.

Before carrying out the following exercises, we will firstly recap on Mount St. Helens Volcano.

## Exercise 6: Mount St. Helens Revision Questionnaire

1. What day of the week was the eruption?

- Sunday
- Monday
- Wednesday
- Saturday

2. What time during the day was the eruption?

- 6.17
- 7.36
- 8.32
- 13.43

3. What date did Mount St. Helens erupt?

- May 18<sup>th</sup>
- Sept 18<sup>th</sup>
- July 18<sup>th</sup>
- Feb 18<sup>th</sup>

4. How far did the eruption spread over the land?

- 20km
- 30km
- 40km
- 65km

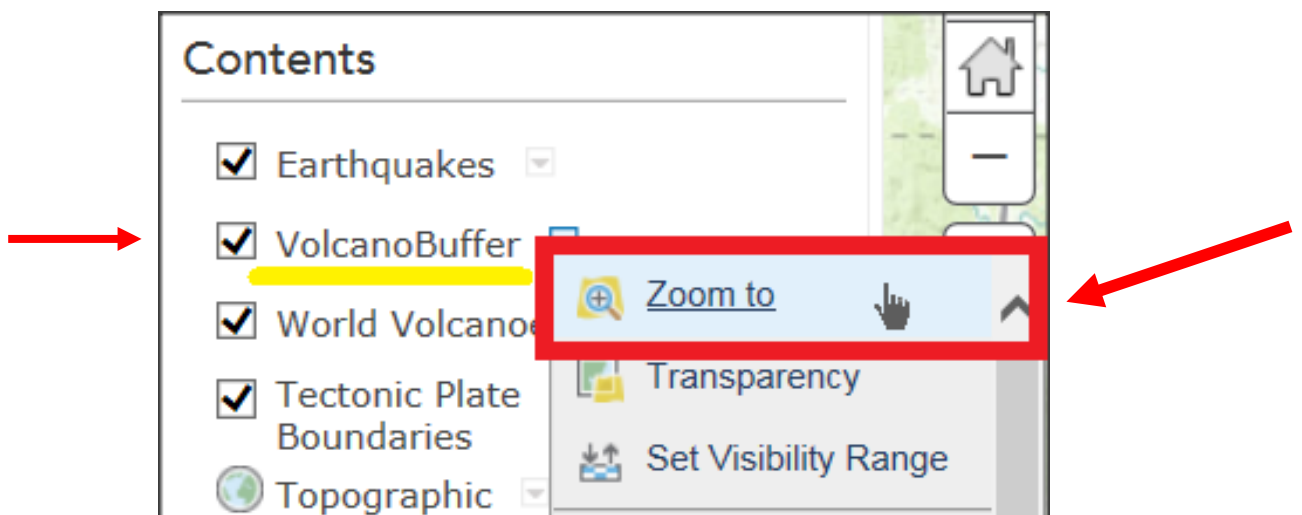
## Exercise 7: Adding a Buffer Layer

A buffer is a specified distance around a map point. Buffering a point (e.g. the centre of Mount St. Helens) creates a circular polygon around that point. Buffering allows us to identify features that are within a certain straight-line distance of a feature. The free version of ArcGIS Online does not include tools for creating buffers; however, it is possible to create a buffer using other GIS software (including the free package QGIS as well as paid-for versions of ArcGIS Online and ArcGIS Desktop) and add it

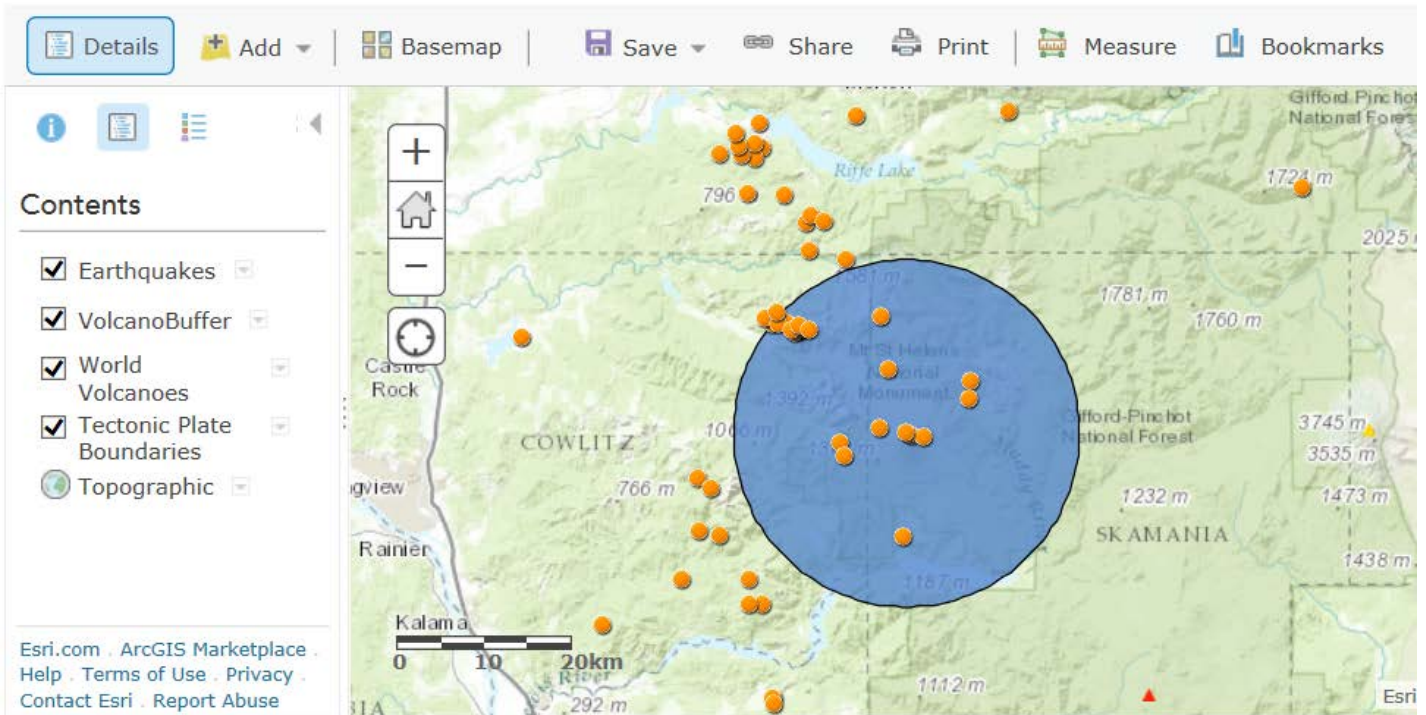


to ArcGIS Online. This has already been done for you, so we will now use a buffer of 20km in distance around Mount St. Helens volcano to indicate the area most affected by the eruption.

1. Click **Add** then **Search for Layers**.
2. Type **VolcanoBuffer** into the Find box, locate the correct layer in the (listed as **by B00587570**) and **Add** this layer to the map. Click **DONE ADDING LAYERS**.
3. If the display does not zoom in to the buffer zone automatically, click the drop down arrow beside the VolcanoBuffer layer and select **Zoom to**.

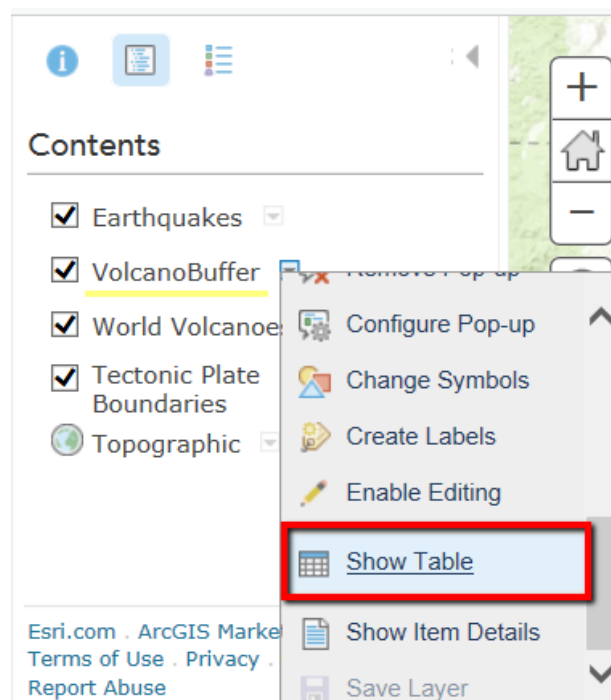


4. You can also use the Transparency function (shown in the image above) to make the buffer semi-transparent (around 50% transparency) so you can still see the layers underneath.
5. Move the earthquakes layer to the top of the list of Contents – remember you can move layers with **Move Up** / **Move Down** (using the same menu as above) or by clicking to the left of a layer and dragging it up or down the list.



To find information about features in a layer, click the Show Table option as shown below. The information in the table helps us to answer questions and to carry out analysis.

6. Open the menu using the arrow next to the VolcanoBuffer Layer, then click **Show Table**



VolcanoBuffer (1 feature, 0 selected)						Table Options ▾	✕
FID	NAME	ELEV	FIPS_CNTRY	COUNTRY	BUFF_DIST		+
0	Mt. St. Helens	2,975	US	United States	20.00		^

20km buffer

Hide Table

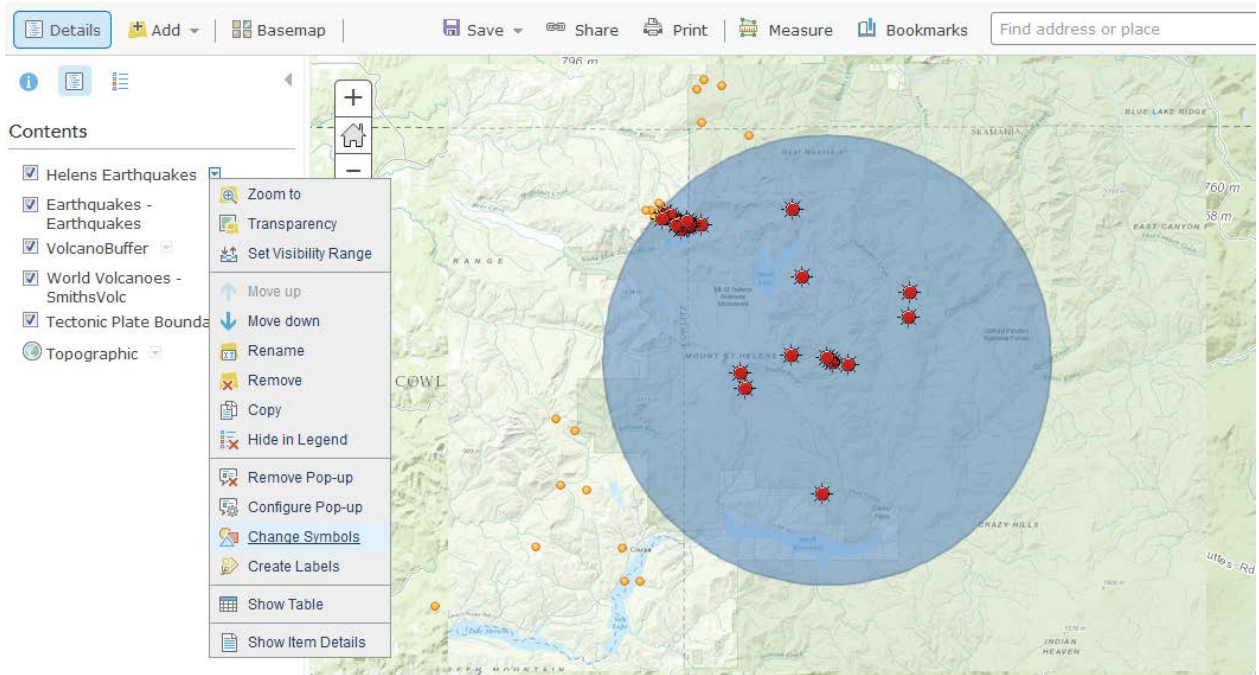
To hide the table, click the close tab at the top right hand corner of the Table

### Exercise 8: Counting features inside a buffer

You can also find out how many features are within a buffer. Perhaps it may be useful to find out how many earthquakes are near Mount St. Helens. GIS makes it very easy to count these features. This method involves 'Select by Location'. Select by Location allows us to select earthquakes based on their relation to Mount St. Helens. We want to select all the earthquakes that are completely within the Volcano Buffer. Since this function is not available in the free (public account) version of ArcGIS Online, this step has been done for you, and the layer 'shared' so you can add it to your map.

1. Click the **Add** button and use **Search for Layers** to find the layer called '**Helens earthquakes**' Add the layer and click **Done Adding Layers**.

You should see that all points (earthquakes) in the buffer have been highlighted. To see the highlighted earthquakes more clearly, you can use **Change Symbols** to change the colour, the size and/or the type of marker symbol used for the Helens earthquakes layer.



We will now count the records in the buffer.

2. Click the arrow beside Helens Earthquakes, then click **Show Table**. The table provides information about these earthquakes. See the feature count at the top of the table.

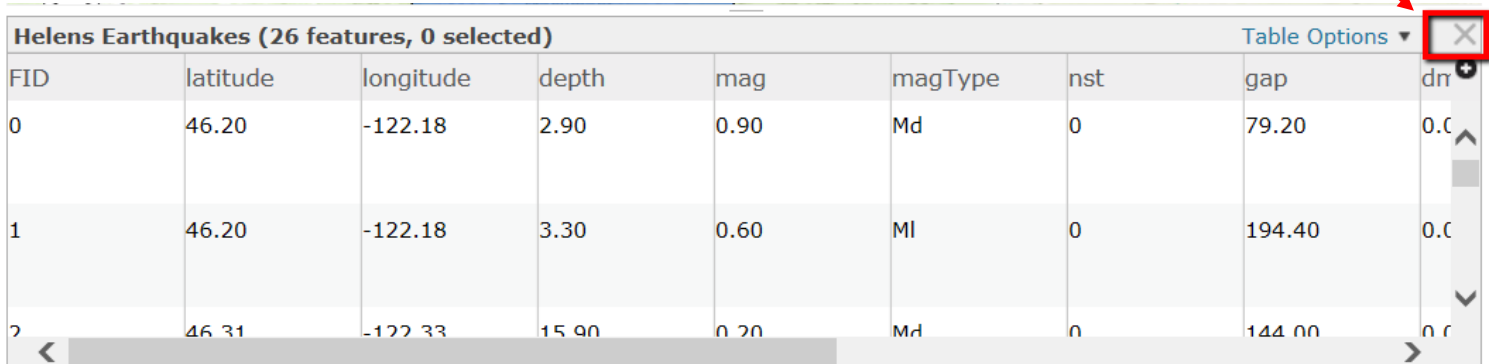
Helens Earthquakes (26 features, 0 selected) Table Options

FID	latitude	longitude	depth	mag	magType	nst	gap
0	46.20	-122.18	2.90	0.90	Md	0	79.20
1	46.20	-122.18	3.30	0.60	MI	0	194.40

This is a very useful and quick way to count features within a certain area. A buffer can provide information about data inside or outside of the specified distance.

To hide table, click the close tab at top right hand corner of the Table

Hide Table



FID	latitude	longitude	depth	mag	magType	nst	gap	dr
0	46.20	-122.18	2.90	0.90	Md	0	79.20	0.0
1	46.20	-122.18	3.30	0.60	Ml	0	194.40	0.0
2	46.31	-122.33	15.90	0.20	Md	0	144.00	0.0

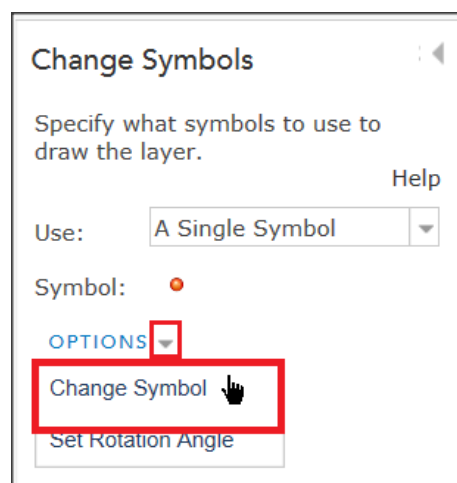
### Exercise 9: Adding a Town/Cities Buffer Layer

We now want to add a layer of the North America towns and cities located within the 20km Mount St. Helens buffer to our map viewer. To do this:

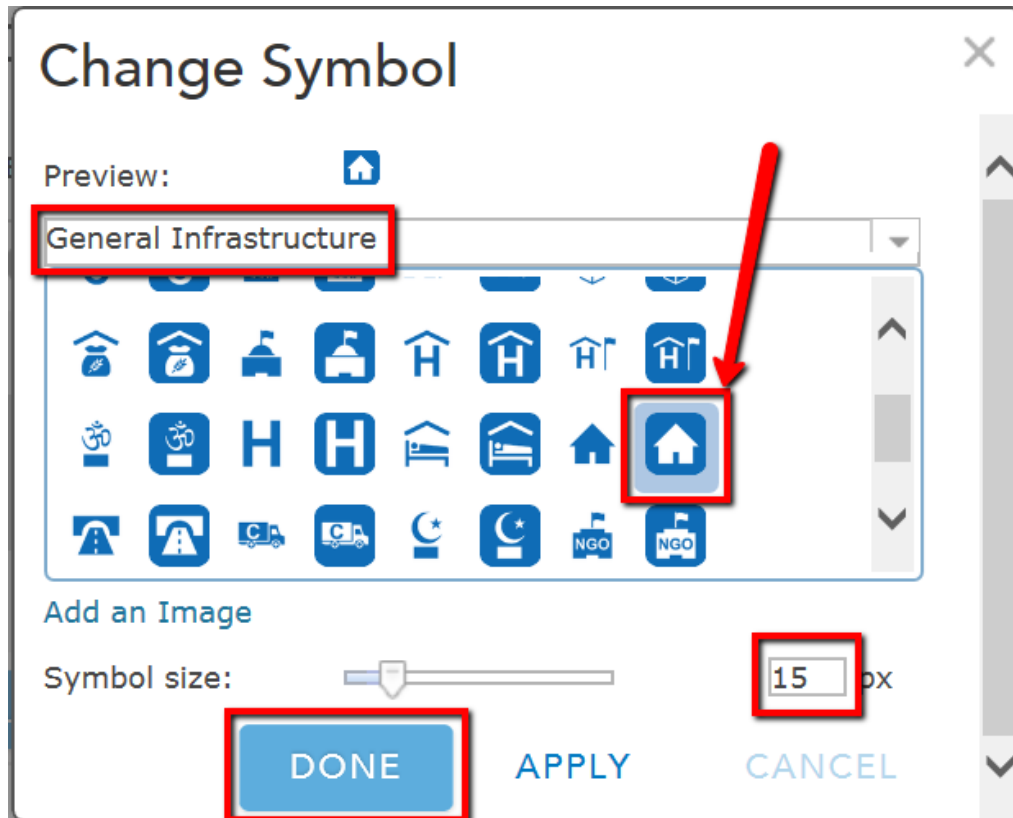
1. Add > Search for Layers > Find **Towns\_buffer** > Add > Done Adding Layers.

To distinguish the towns layer from the earthquakes, change the symbol as follows:

2. Click the drop down arrow beside towns\_buffer, and select **Change Symbols**

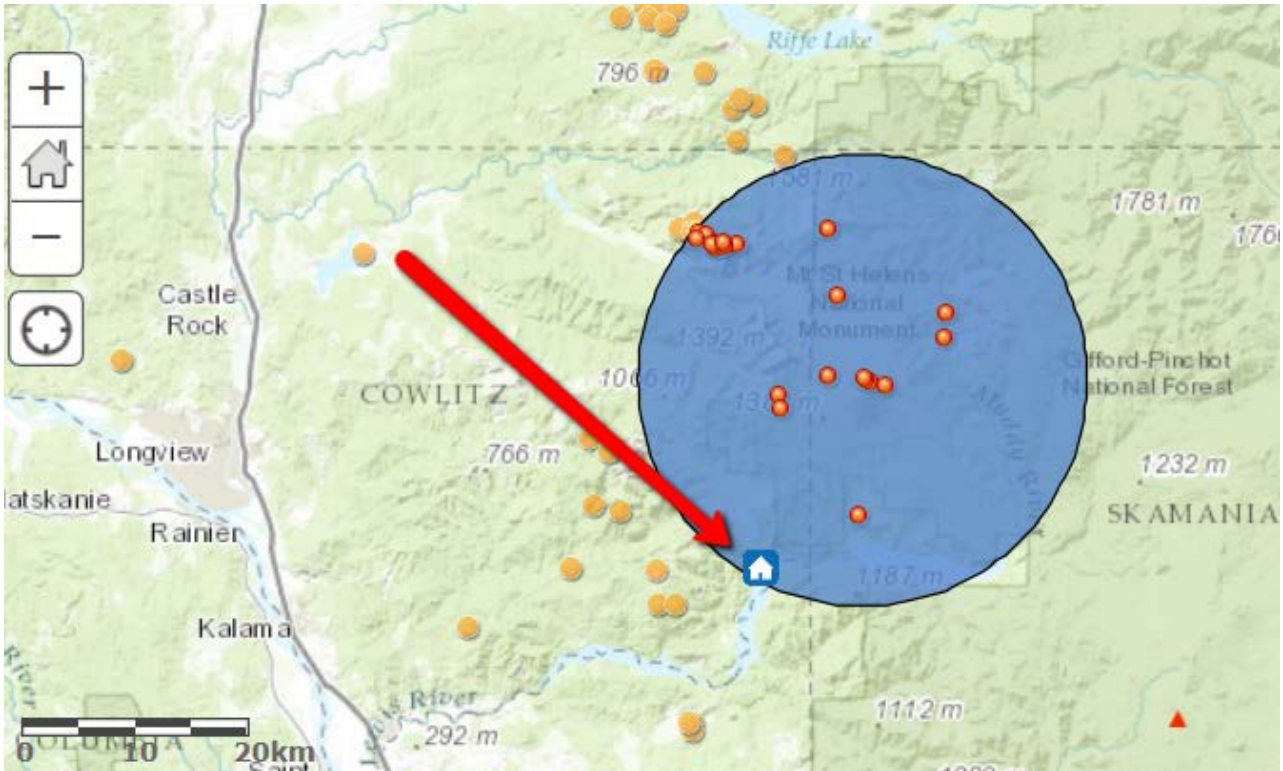


3. Select **General infrastructure**, choose the symbol as shown below, and set the symbol size to 15



4. Click Done Changing Symbols.
5. Remember you can use **Change Symbols** if you want to change the colour of the volcano buffer (e.g. to make sure the town symbol stands out more clearly).







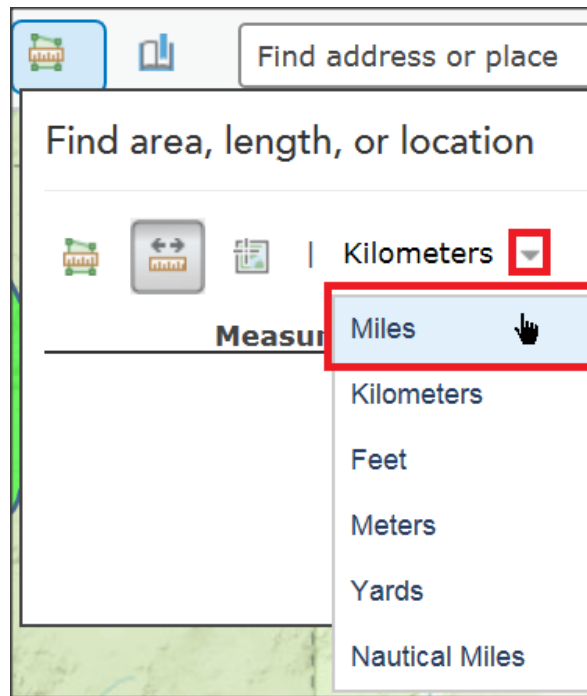
6. If you click on the symbol showing the location of the town, a pop-up box will be displayed showing attribute information about the town – you will see that the name of the town is Cougar.

### Exercise 10: How to measure distances

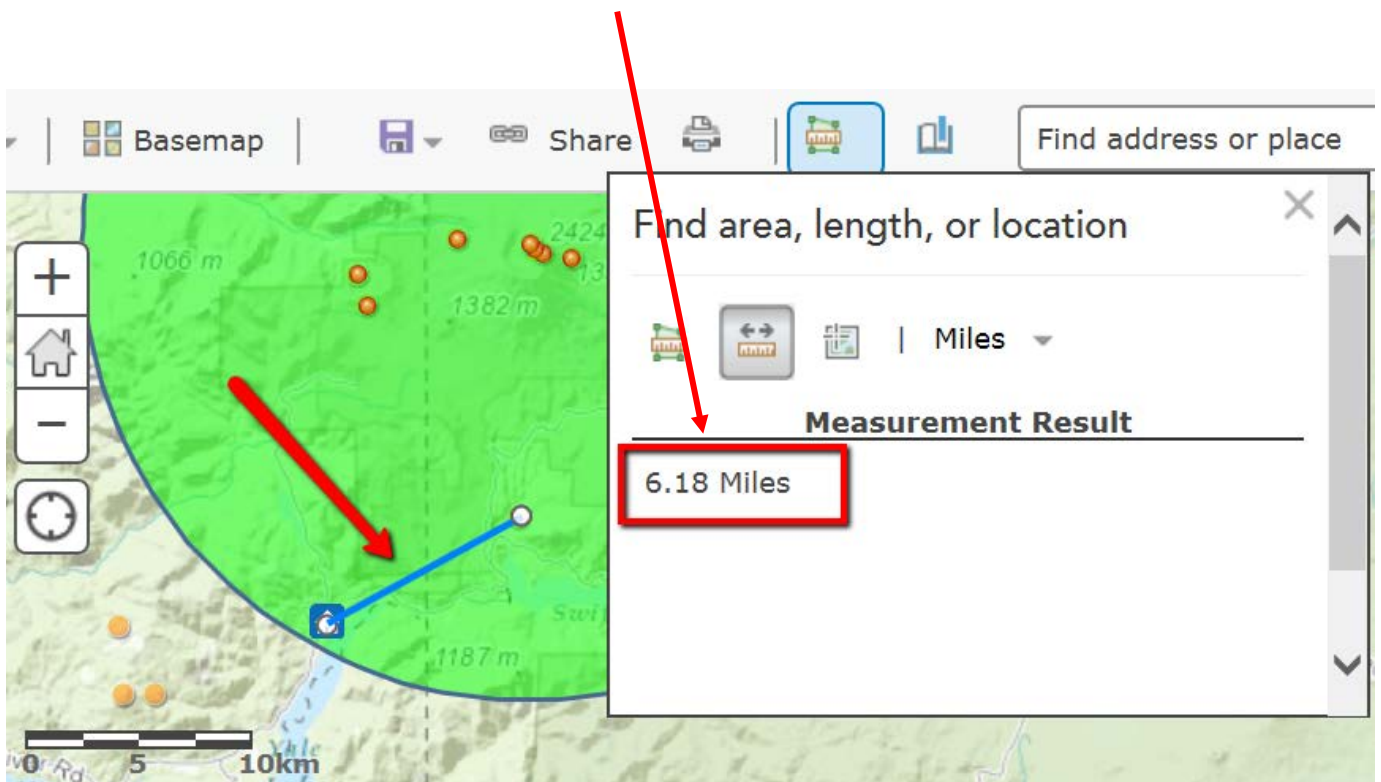
You can measure a distance or area by drawing a line or polygon on a map using the measuring tool. When you click the **Measure** tool, the measure window opens. This box provides different options for measuring a distance or area. The Measure tool also allows you to identify a point's longitude and latitude (degrees).

1. To measure distances, select the measuring tool  **Measure** which is provided in the tools toolbar. When a new window opens, click **Distance**  and then click the drop down arrow beside the distance units, and select **Miles**.





2. Click on the symbol showing the location of the town **Cougar** once, and then **double-click** on the closest earthquake nearest that town (NE of Amboy, Washington). You should see the distance displayed in the measurement results box.

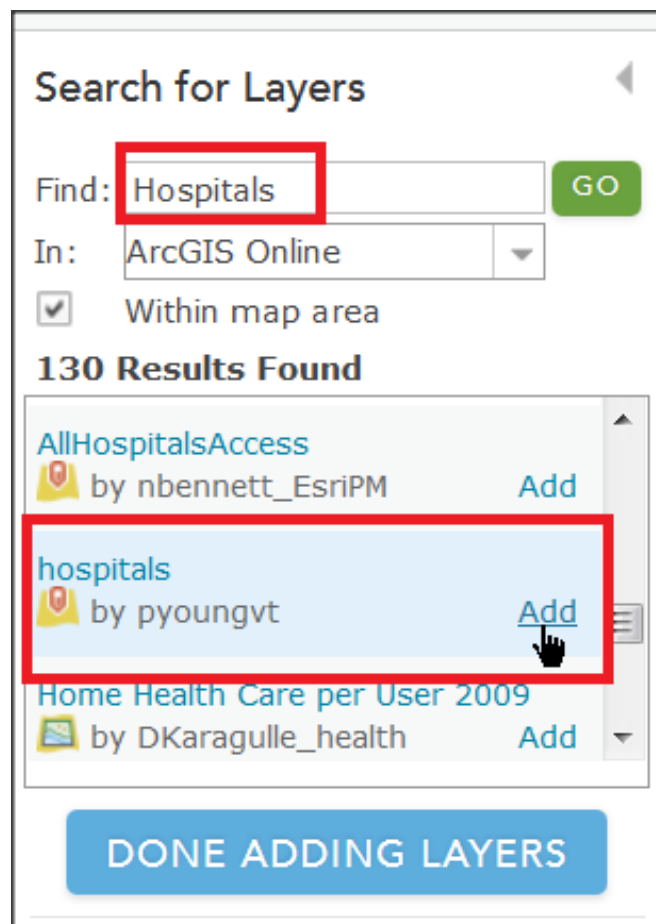


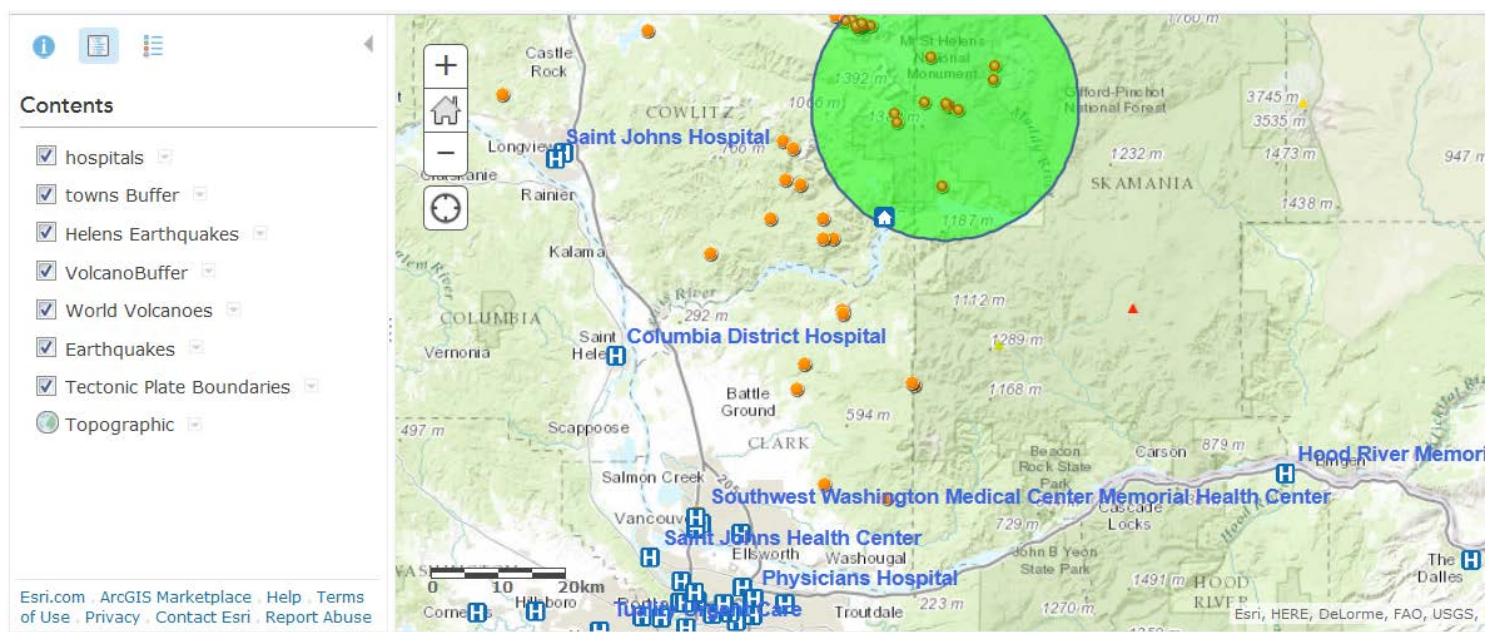
The town of Cougar is approximately 6 miles from this earthquake; the town is also located within the 'high risk' buffer area of the Mount St. Helens Volcano. Cougar has a population of 157 people who would be at risk if the volcano erupted again.

## Exercise 11: Adding Layers

We may now want to know where the hospitals are located in case of a disaster. To do this, add the hospital layer from ArcGIS Online as follows:

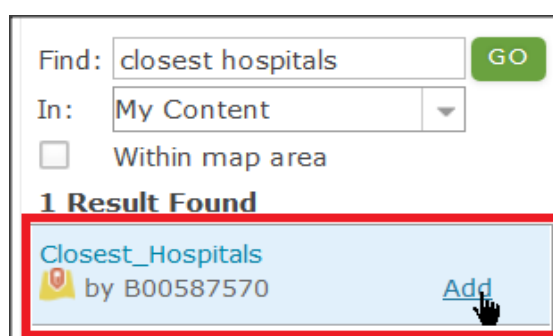
1. Type **Hospitals** into the Find box. Select **Hospitals by pyoungvt** (the layer is about two-thirds the way down the list).
2. **Add** the Hospitals layer to your map. If you can't see the hospitals displayed, zoom out a bit.

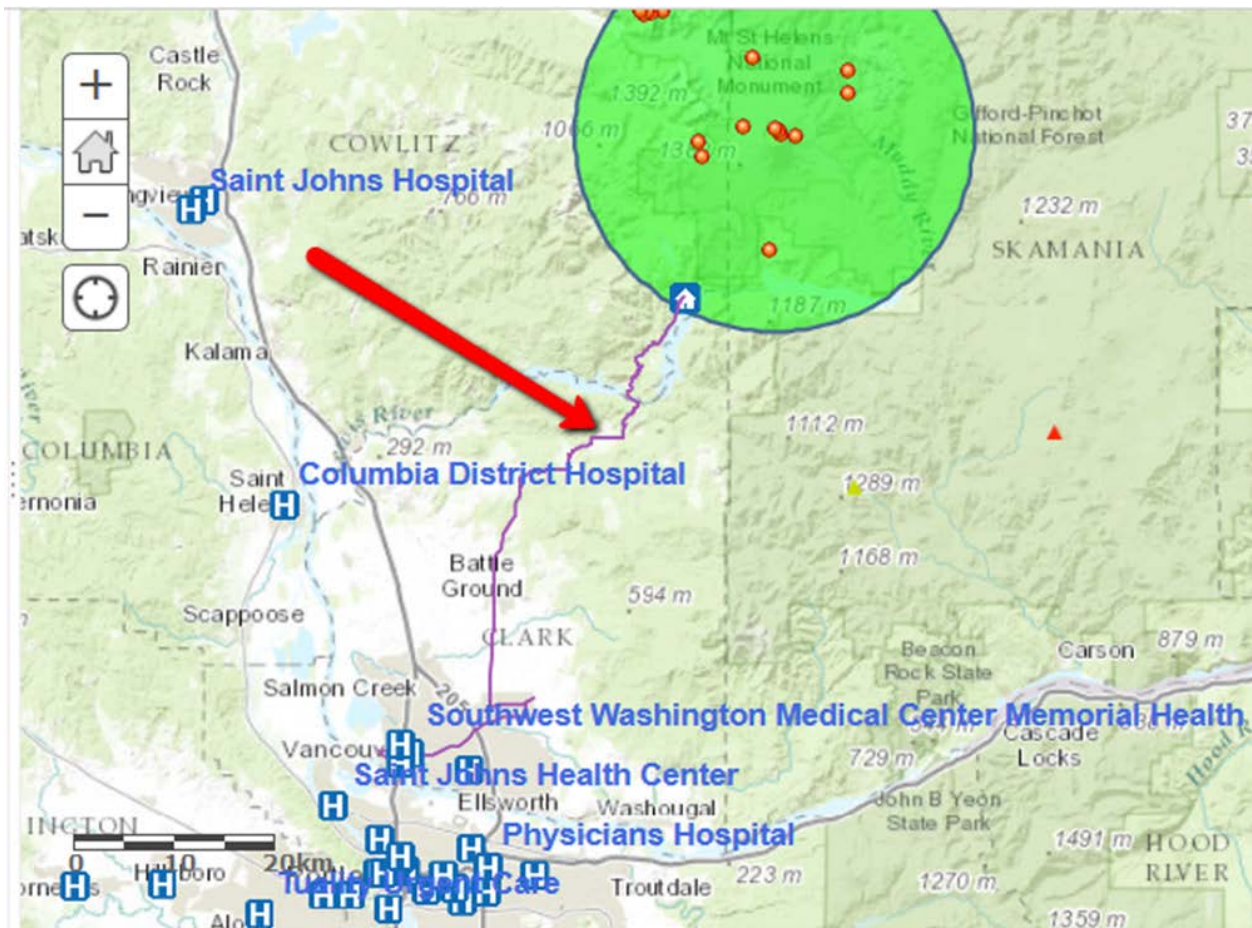




## Exercise 11.1: Finding the Closest Hospital

A GIS has been used to identify the closest hospitals to the town of Cougar and create a layer showing the route (this could be done with software like the paid-for version of ArcGIS Online, or ArcGIS Desktop, or QGIS). Use **Add** to search for a layer called **Closest\_Hospitals** and add it to your map. Note that the layer shows the quickest route by road, rather than the shortest straight-line distance.





If you click on any part of the route, a pop-up will appear displaying the names of the closest hospitals.

(1 of 2)

Cougar - Saint Joseph Hospital	
FID	1
FacilityID	4,078
FacilityRa	2
Name	Cougar - Saint Joseph Hospital
IncidentCu	2
FacilityCu	1
IncidentID	3
Total_Leng	82,198.45
Zoom to	

(2 of 2)

Cougar - Barnes General Hospital	
FID	0
FacilityID	4,061
FacilityRa	1
Name	Cougar - Barnes General Hospital
IncidentCu	2
FacilityCu	2
IncidentID	3
Total_Leng	75,397.14
Zoom to	

This demonstrates how we can use GIS to show the quickest route to a hospital, which could save time and lives in an emergency.

Make sure you save your map if you haven't done already!

You can print your map or take screen shots and paste them into a Word document or Powerpoint presentation.

### **Summary**

You have now finished your practical. This practical has outlined a number of important steps such as adding and displaying data in a GIS map and how to measure distances.

Completing this practical has helped you gain some valuable skills and has introduced you to some basic introductory steps in using ArcGIS Online. You are now able to create a well-designed and professional map, in which you can link patterns and relationships between data that can be used in assignments, presentations, and job and college interviews etc. GIS is very beneficial and a great tool for students and teachers in the classroom.

Overall, I hope that this exercise has been interesting and enjoyable and has increased your awareness of what GIS is and its benefits!