GEOM1033 SIS Fundamentals
GEOM1159 GIS Fundamentals

Practical Exercise 1 – (6%)
Introduction to Geographic Data and Analysis

Aim
This aim of this practical exercise is to introduce you to the various types of geographic data that are commonly used in GIS projects. In addition, you will be introduced to a number of basic GIS selection and analysis functions. At the completion of this exercise, you should have an appreciation for the way in which graphical and attribute data is linked together within a GIS, and have an understanding of the different techniques for searching, querying, and displaying geographic information.

Data
The data you will be using for this practical exercise is available from Canvas (Assignments > Prac 1). Create a new folder in your H drive first, with the name 'Prac_1' (**Important:** Each practical exercise must have a separate folder directly in your "H" drive – the drive with your student number). Extract all files from the .zip file and save everything to your newly create folder in "H" drive. Use "7-Zip" and "extract files" to unzip the file. In the "7-Zip" frame Extract to - browse to the Prac_1 folder in your H drive.

The data consists of a number of geographic layers for the South-Eastern corner of Yellowstone National Park in the USA.

What to submit
The submission for this practical exercise consists of written answers to **Questions 1** to **6**. Each answer is worth **1 point** (total of **6 points**). Download the word file labelled 'Practical 1 – Submission document' and type in your answers to the space provided. Fill in your information (student number, name, and lab number from the list below), convert it to PDF, and then **submit online** through the link on Canvas.

GEOM1033
- Fri 12:30 – **Lab C**

GEOM1159
- Wed 16:30 – **Lab A**
- Fri 11:30 – **Lab B**

When to submit
Please submit within **2 weeks** from the time you received the Practical. See below for the specific dates:

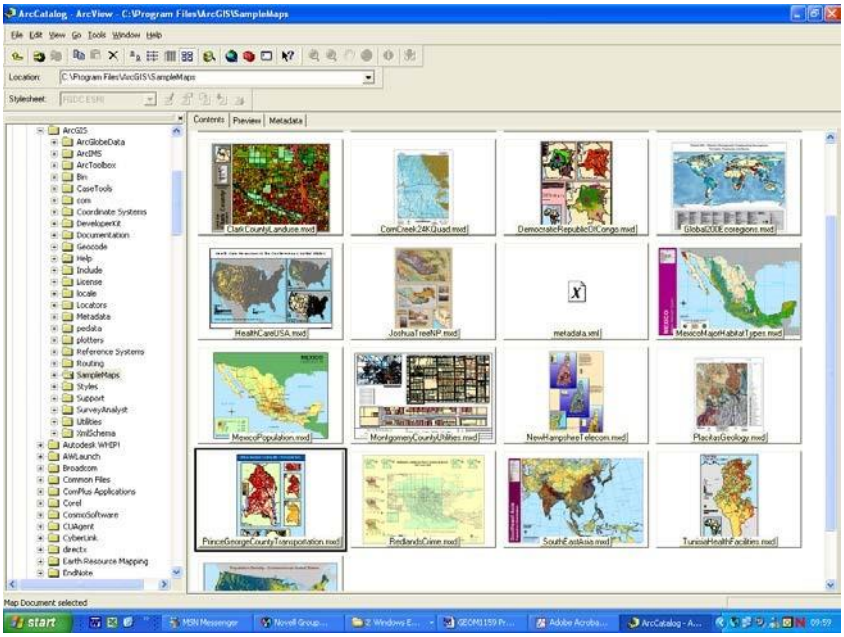
GEOM1033
- **Lab C** must submit by **Week 4** – Thursday, 26 March, 23:59.

GEOM1159
- **Lab A** must submit by **Week 3** – Tuesday, 17 March, 23:59.
- **Lab B** must submit by **Week 3** – Thursday, 19 March, 23:59.

Part A – Getting to know ArcGIS®

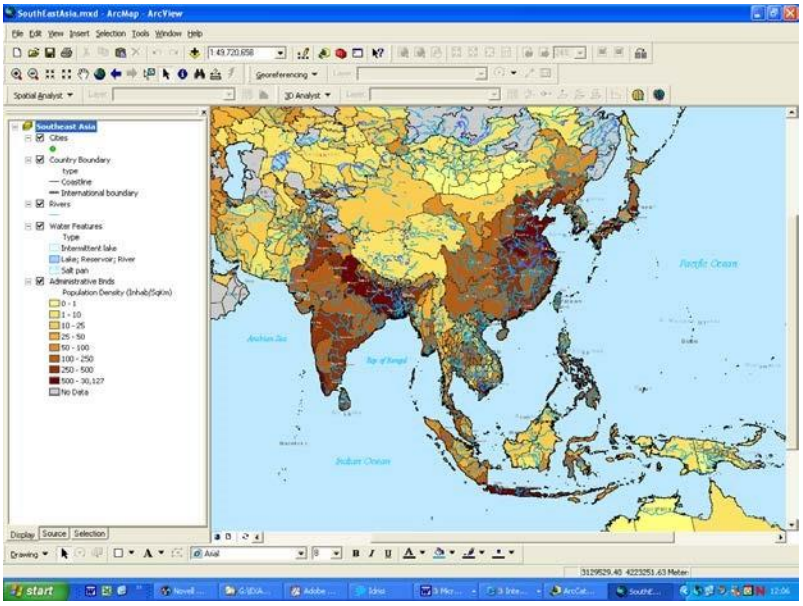
The GIS software we will use to complete this practical exercise is the ArcGIS® product from ESRI®. ArcGIS® is a common desktop GIS product and at a basic level, contains functionality similar to other desktop GIS applications such as MapInfo® and GeoMedia®.

ArcGIS® is in fact a suite of scalable products that have a common user interface. Two applications will be used in this practical session: ArcCatalog™ and ArcMap™.



ArcCatalog™ Interface

ArcCatalog™ is the application for managing spatial data as well as for recording, viewing, and managing metadata.

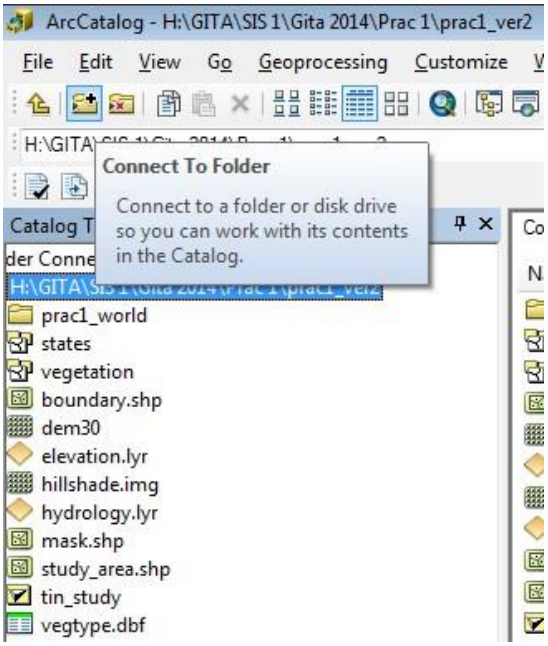


ArcMap™ Interface

ArcMap™ is used for all mapping and editing tasks as well as map-based analysis.

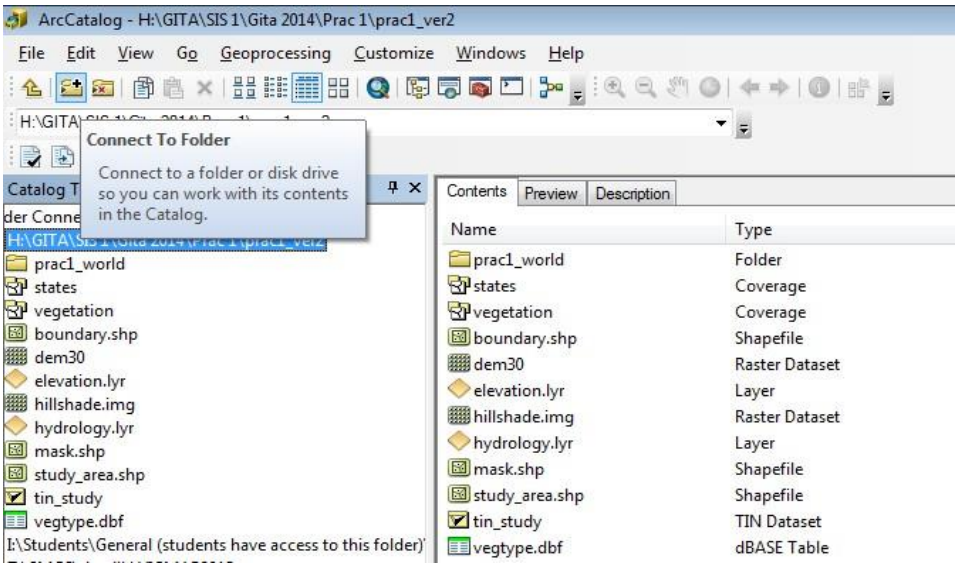
1) If you have not done so already, download the data for this practical exercise from Canvas (Assignments > Prac_1). Extract all files from the .zip file and save everything in a folder called "Prac_1" in your "H" drive.
   ****You must use 7-Zip to extract files, otherwise you may not see all the data.****

2) Start ArcCatalog™ (Start>Programs>ArcGIS). In order to access out data we first need to connect to the folder where all the data is saved. Click on the "Connect To Folder" button in the main toolbar and navigate to your Prac1 folder.



To connect to a specific folder (directory)

3) Referring to the figure below, select each of the "geographic layers" of data and investigate the context of each. You can do this by clicking on the Contents, Preview and Description Tabs. Each type of geographic data has its own set of icons in ArcCatalog™ (e.g. geodatabase, coverages, shapefiles, raster datasets, a TIN, dBASE® tables etc).



ArcCatalog™ Interface

Using the Preview and Description tabs, note the data format (raster or vector) and feature type (point, line or polygon) (if applicable) for each of the following geographic layers:

- *TIN_Study*
- *DEM30*
- *States*
- *Vegetation*
- *Hillshade*
- *Roads (hint – look inside the Yellowstone.mdb database)*

Question 1
Why are some geographic data sets made up of small squares (picture elements or "pixels"), whilst others are formed from points, lines and polygons?

In addition to geographic datasets, this directory also contains a number of ArcGIS layer files (lyr). Layer files are simply a way of storing specific symbology (and other settings), that is the way the data are displayed, independent of an underlying geographic dataset.

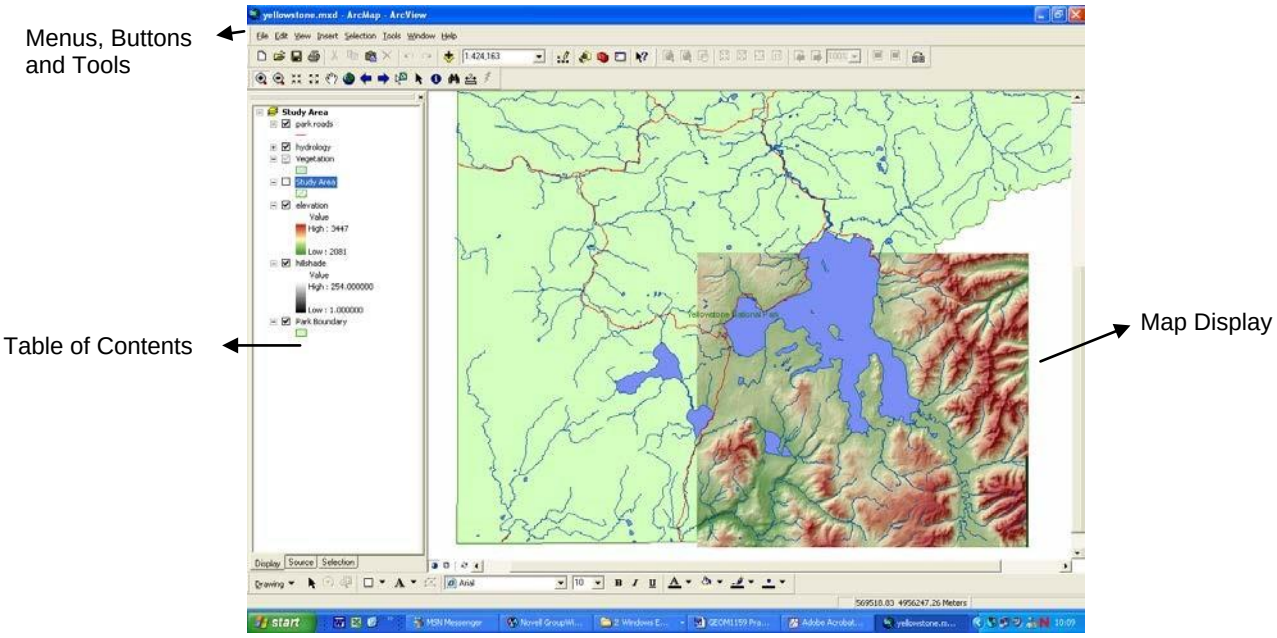
4) Select the ***Vegetation*** layer and select the preview tab in ArcCatalog. Use the spatial navigation tools (zoom, pan etc) to navigate around this data set. Use the Identify tool to investigate the attributes of the features in this layer. Change the layer to DEM30 and use the identify tool to check the "attributes" of this layer – what do the pixel values represent?

5) As part of a GIS project, we are often interested in both the "spatial" (graphical) data and the related "attribute" data. Select the ***States*** layer and change the "preview" option (located at the bottom of the screen from Geography to Table.

Question 2
List the attributes for the States layer and describe what sort of information you think is stored in each field.

6) Close ArcCatalog and Start ArcMap (Start>Programs>ArcGIS). Open the map document **Yellowstone.mxd** by clicking on the "Browse for more…" link under Existing Maps and navigate to your directory.

7) Within ArcGIS, map documents (mxd files) are the way we can store all of the information such as which layers we are using and how each layer is symbolised – in a similar way to a spreadsheet or a word processing document. Most desktop GIS products include some methods for storing or saving your "work" so that you can don't have to repeat all of the layer symbology and settings every time you start the GIS.



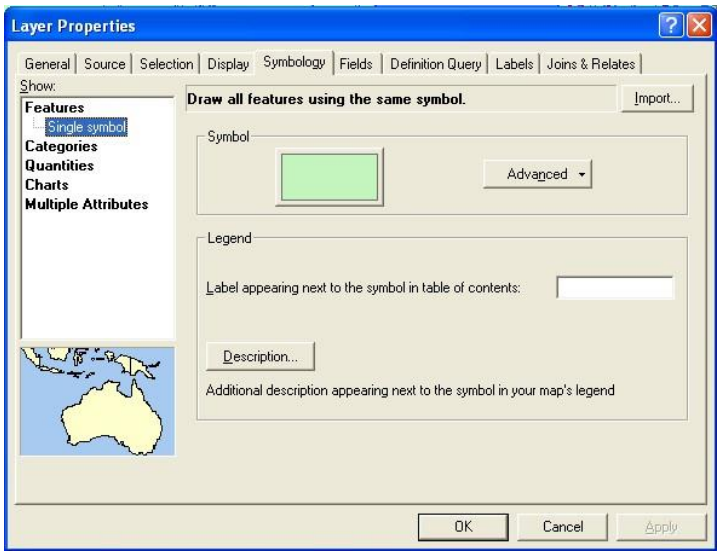
ArcMap Interface

8) Use the zoom and pan tools to navigate around the map. Notice that some of layers "turn on" and"turn off" as you zoom in and out. This is called scale dependent display.

Question 3

Can you think of 2 reasons why we might want the list of layers to be drawn to be dependent on the scale of the display? Explain.

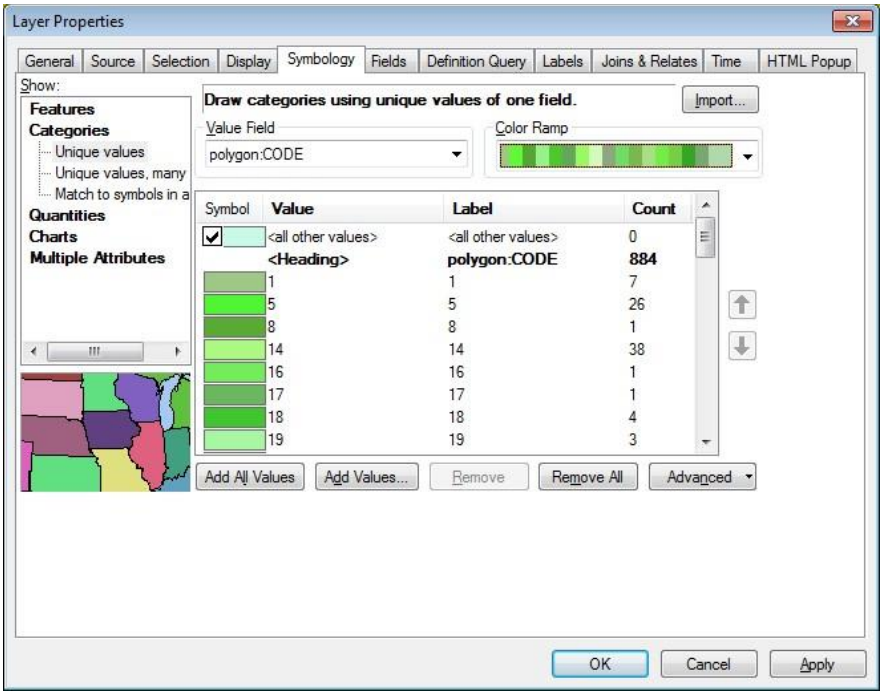
9) ArcGIS, like most desktop GIS products provides a range of options for displaying layers of geographic information. After zooming into the study area (i.e. so the Vegetation layer is displayed), right click on the Vegetation layer in the Table of Contents, click "Zoom To Layer" and then right click again and display the **Layer Properties** dialog. This is where all of your settings for your layers can be specified.



Vegetation Layer Properties - Single Symbol Display

10) Select the Symbology Tab and change the symbology used for this layer. Select **"Categories"** and choose the (**Polygon:CODE)** in the **Value Field** drop down list, then click on the **Add All Values** button. Under the **Colour Ramp** choose a colour scheme that is appropriate for vegetation. Click on the Apply button to see the result of changes (you may need to turn some of the other layers off). Click OK.

`Take a few minutes to investigate the options under the other tabs in this dialog and think of the way in which these might help you to display geographic information.



Vegetation Layer Properties -Thematic Display (Categories)

Part B – Spatial and Attribute Data

11) Now zoom to the extent of the vegetation layer by right mouse clicking over the **Vegetation** layer in the "Table of Contents" and selecting "Zoom To Layer". Now select the ***Open Attribute Table*** option to display the attribute data for this layer, **also by right clicking on the layer**.

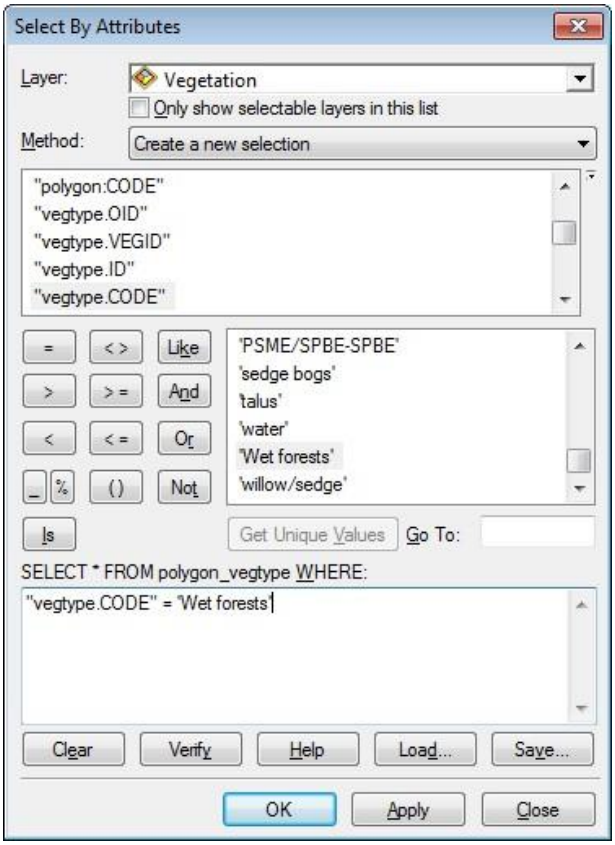
12) Use your mouse to select a row/record from the attribute table – what happens in the map display? Right mouse click the layer in the Table of Contents and select the ***Selection>Zoom to Selected Features*** option.

Question 4
What are the benefits of linking attribute data to spatial data (graphical data)?

13) Clear the selected features (***Selection>Clear Selected Features***) and use the feature selection tool to select some features graphically (on the map display). Open the attribute table and display the attribute data for the features you have selected. Once you have finished investigating your selected features from the attribute table, clear your selected features.

Feature Selection Tool

14) GIS also provides tools to query and search features. This is a powerful capability of GIS as it allows us to search for geographic features using text (alpha numeric) information. In the main toolbar, open the Select By Attributes tool under the Selection tab. Ensure vegetation is your chosen layer and enter the query information shown in the figure below (take care to ensure you have all the correct options set). You can construct the query by double clicking the field names (on the right) and selecting the operator buttons (including the "Get Unique Values" button), then select ***Apply***.



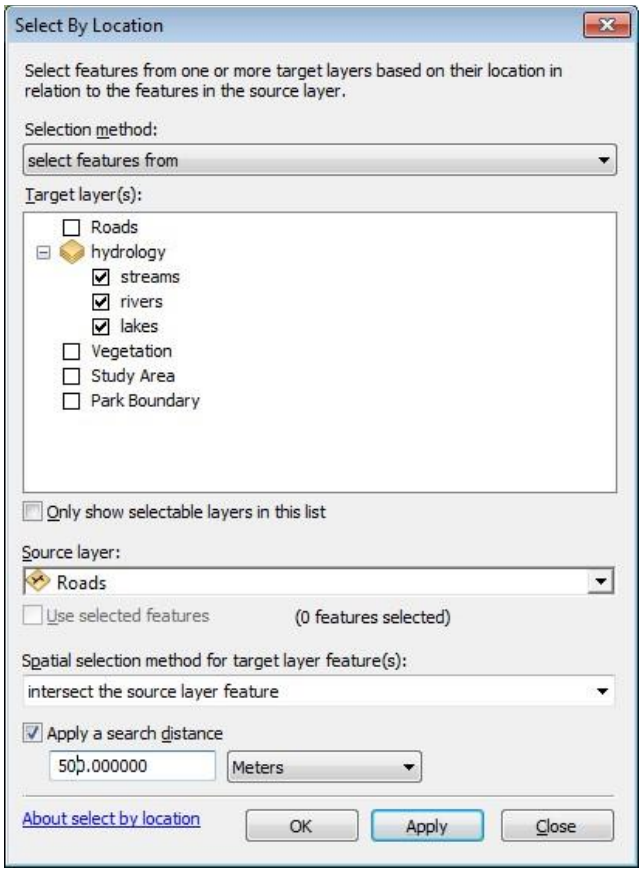
Part C – Introduction to GIS Analysis

The ability of GIS to identify relationships between features in different layers is perhaps one if it's most important capabilities. Let us look at two examples.

(i) Suppose we want to know how many houses were flooded in the "great flood of February 2005" along the Merri Creek. To answer this question, we need to identify a spatial relationships – "what houses (polygons) were within (or crossed by) the high water mark of the flood (polygon). Of course, this assumes we have a layer of "houses" and a layer showing the extent of the flood.

(ii) Suppose we want to know how many houses will be affected by a possible explosion at a chemical store in the suburb of Brunswick (as a number of residents have been lobbying to have this site closed down). If the chemicals explode, everything within 500m will be "liquidated". To answer this question, we need to understand the relationship between the chemical site (point) and the surrounding houses (polygons) – for example, select all polygons within a 500m radius of this point

15) Clear any previous selections (***Selection>Clear Selected Features***) and open the Select by location dialog (***Selection>Select by Location***) from the main toolbar. We will now select all hydrology features (rivers, streams and lakes) within a distance of 500 metres of roads. Use the figure below as a guide.



Question 5

Open the attribute table for each layer and note down the number of selected features for the streams, rivers and lakes layers.

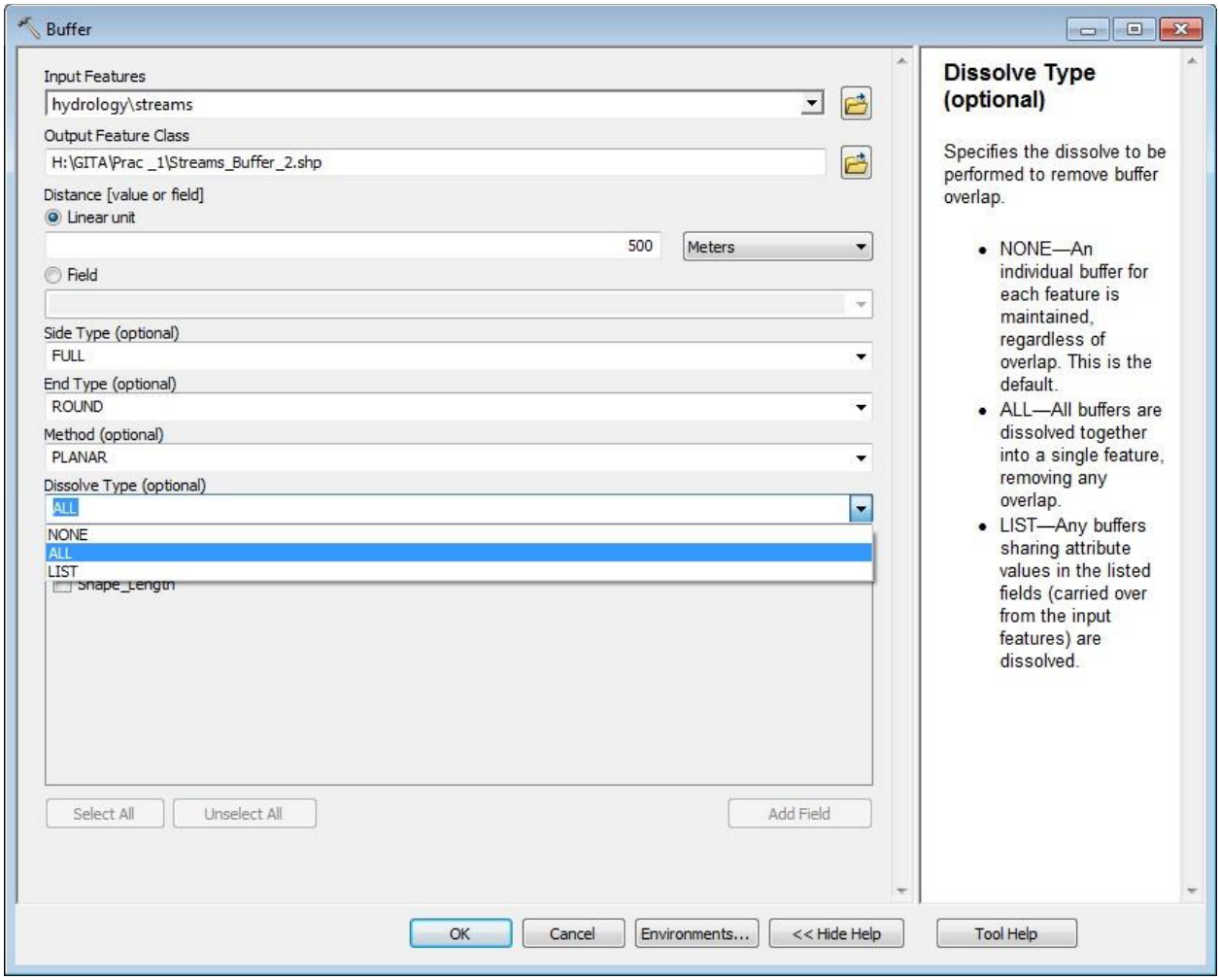
16) After clearing your selection, once again, use the select by location dialog for vegetation polygons that lie within a distance of 300 metres of roads. Check your results by zooming around the study area.

17) Select the "Toolbox" icon  to display the ArcToolbox window. This dialog contains all of the analysis tools available within ArcGIS.

We are now going to create a "buffer" around streams to identify (visually) areas that logging should not be conducted in (in order to protect water quality etc). Open the buffer dialog (***Analysis Tools>Proximity>Buffer***) shown below. Buffer "streams" using a distance of 500 metres.

** Make sure you change the default output feature class to be the Prac_1 folder you connected to at the start of the session.

- Make sure the **Dissolve Type** option is set to **All**.



(Note you can also find the "Buffer" tool under ***Geoprocessing>Buffer***).

Question 6

Describe a possible "next" step if we wanted to determine the area of each species of forest "preserved" by this stream buffer.

Hint: Investigate some of the tools in the ArcToolbox to see what might be an appropriate tool, Specifically, look at the diagrams in the Tool Help.