Data

In this Chapter you will learn

- About different types of geographic data types and how to add those to your map
- How to add ESRI Basemaps to your map and how to find data using ArcGIS Online
- How to add a GIS Web Service to your map
- About the anatomy of a shapefile since this will give you some insight into one of the simpler ways in which geographic data is stored

1 Geographic Data Types

The ArcCatalog screenshot in figure 1 shows some of the common geographic data types found in ArcGIS.

1. A **Shapefile** is the simplest data model and consist of a group of files, including a .dbf file that contains the attribute table and a .shp file that contains a string of (X, Y) coordinates.

2. **Coverages** are old, from a GIS technology point of view. They used to be widespread and can still be found occasionally but have mostly been replaced by personal-, file – and SDE geodatabases.

3. A **Personal geodatabase** is a Microsoft Access database that can store multiple GIS layers in one database. A major advantage is that data stored in the same database can interact with each other in a manner that is not possible with shapefiles or coverages.

Figure 1. Most common Geographic Data Types in ArcGIS

4. **File geodatabases** contain a collection of various types of GIS datasets held in a file system folder. It can hold more data than a personal geodatabase since it is not tied to MS Access or the Windows operating system. While multiple people can view Personal- or File Geodatabases simultaneously, a given dataset can only be edited by one person at a time.
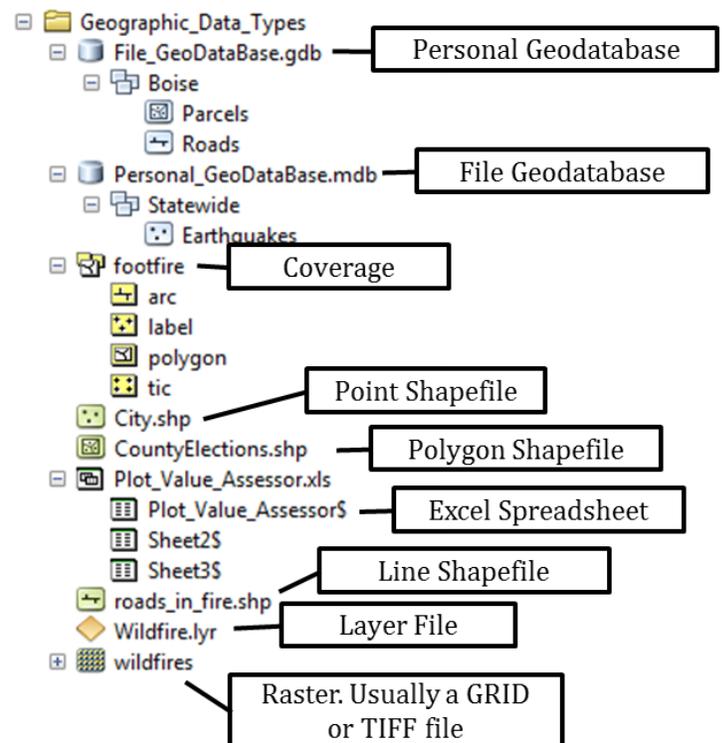
5. **The ArcSDE Geodatabase** can be used in conjunction with different database management systems such as Oracle and Microsoft SQL server. It has built-in tools for versioned editing that allows multiple people to edit the same GIS layer at the same time.

6. **Rasters** can be stored in different formats such as the ESRI GRID, TIFF, BMP, JPG and a number of other formats.

Personal, File, and SDE Geodatabases are organized into **feature datasets** and **feature classes** as illustrated in figure 2. Feature classes residing in the same feature dataset can interact with each other, for example you can check where features from different GIS layers overlap or you can link features together to form a network.
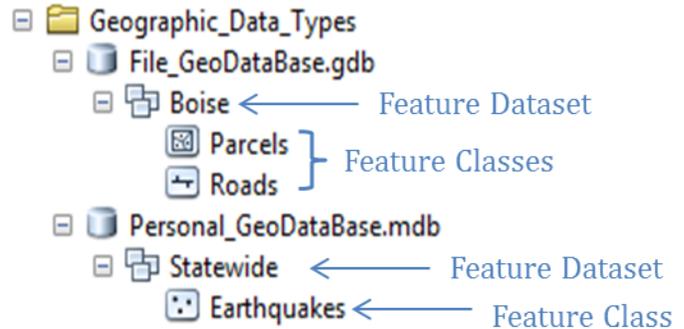

Figure 2. Personal, File and SDE Geodatabases are organized into Feature Datasets that contain Feature Classes.
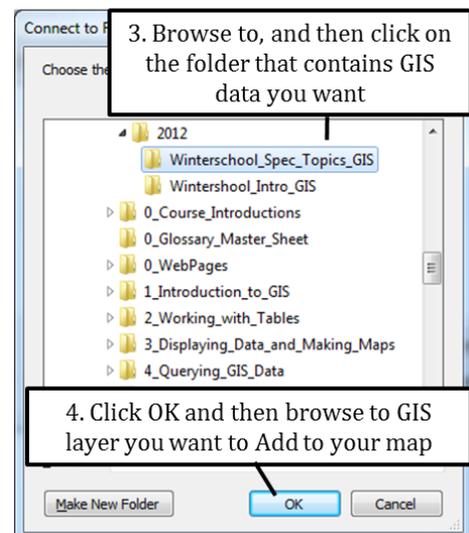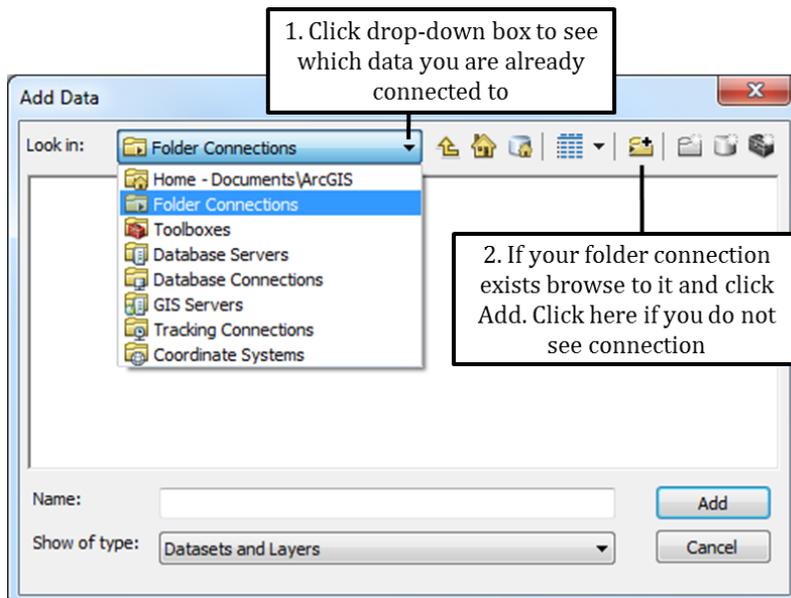
2 Adding Data to your Map

Exercise 1: Adding data to your map in ArcMap

1. Start ArcMap and open a new map document. Click on the Add Data button on the Standard Toolbar to open the Add Data dialog box. Follow the instructions below to connect to the Start folder and add the Caribou_County.shp and Waterpoints_BearLake.shp files to your map.
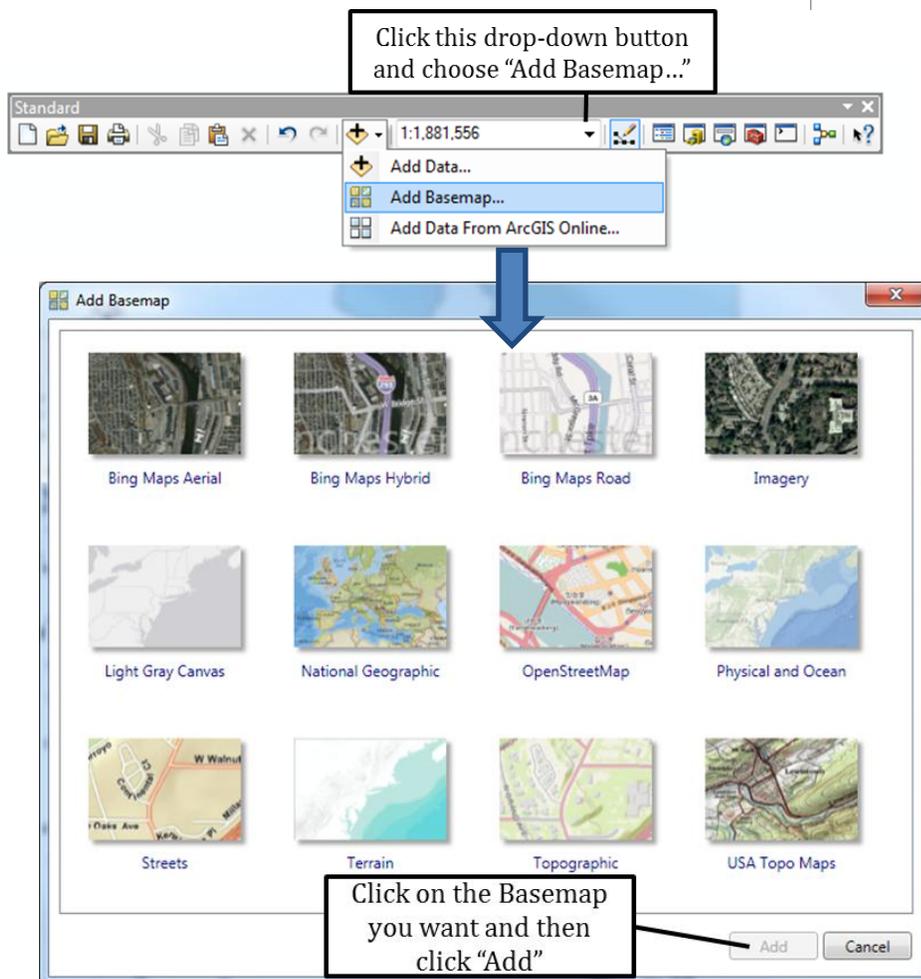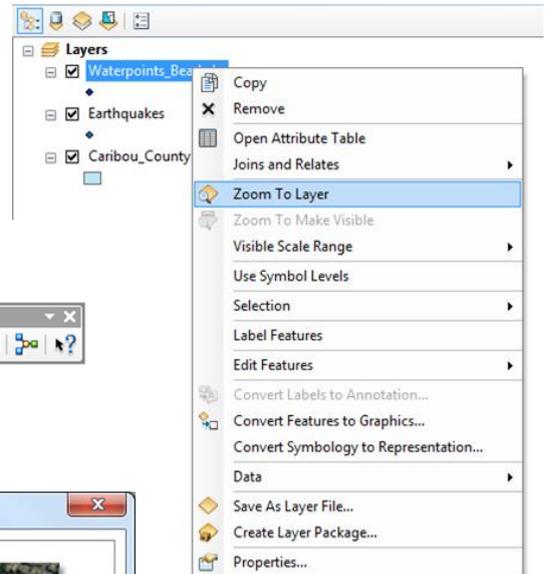

1.6: Adding Data to your Map

2. You can add multiple layers simultaneously by holding down the CTRL button as shown on the right. You can also use the SHIFT button to select a contiguous list of GIS layers.

3. Click the Add Data button again and open the Disaster personal geodatabase. Then double-click on the Earthquakes_FD feature dataset to open it. Click on the Earthquakes feature class and click "Add"
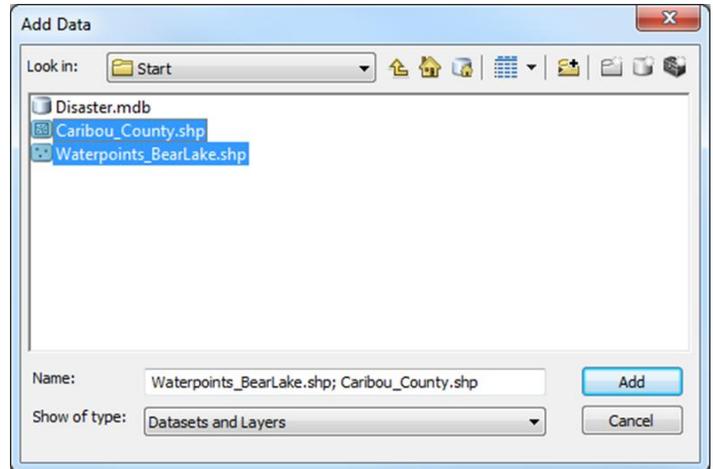
Note: you need an internet connection to complete the remainder of this exercise

4. Right-click on the Waterpoints_BearLake layer in the table of contents and click zoom to layer. This will bring us in a little close before adding an ESRI Basemap.

5. Add a Basemap as illustrated below. Choose any basemap you like.

Click this drop-down button and choose "Add Basemap…"

Click on the Basemap you want and then click "Add"

6. Finally, we will add data from ArcGIS Online. Click the drop-down button next the "Add Data" button again, but this time click on "Add Data from ArcGIS Online…"

1. Type a key word (for example "Soil")

2. Click here to start the search

3. Click on the Details button for more information, or click Add to bring the data into your map

7. Try adding another dataset into your map document using ArcGIS Online. Pick any keyword you like, for example try typing in the name of your County.

3 Adding a GIS Web Service to your map

In the following two exercises you will show you how to set up a GIS service for the 2011 NAIP Imagery which is provided to the public by the USDA.

Exercise 2: Setting up a GIS Service

1. Open ArcCatalog (Start > All Programs > ArcGIS > ArcCatalog)

2. Double-click on "GIS Servers" as shown on the right. Then click on "Add ArcGIS Server".

3. Complete the dialog boxes as shown below, including the Server URL, which is "http://gis.apfo.usda.gov/ arcgis/services". You do not need to type in a User Name or Password for this particular service. Click Finish.
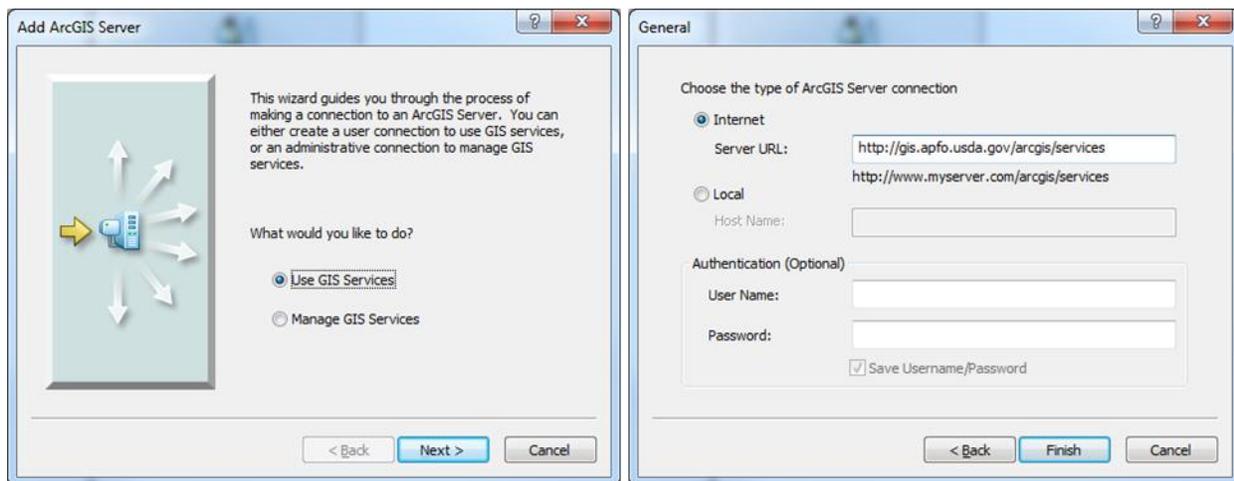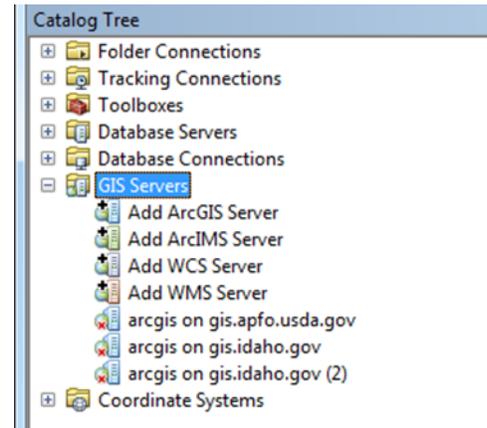
4. Note that the GIS service you just set is listed in ArcCatalog as shown on the right.

5. Close ArcCatalog.
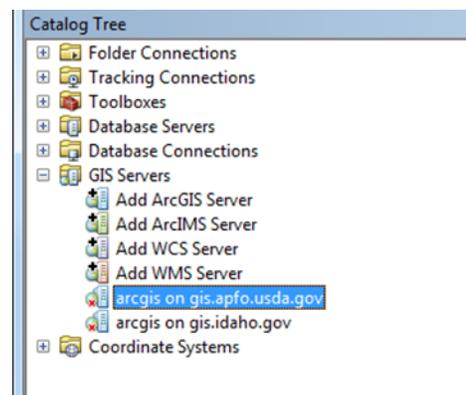
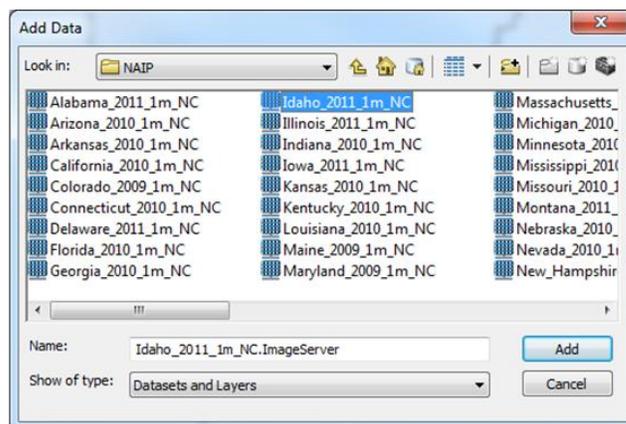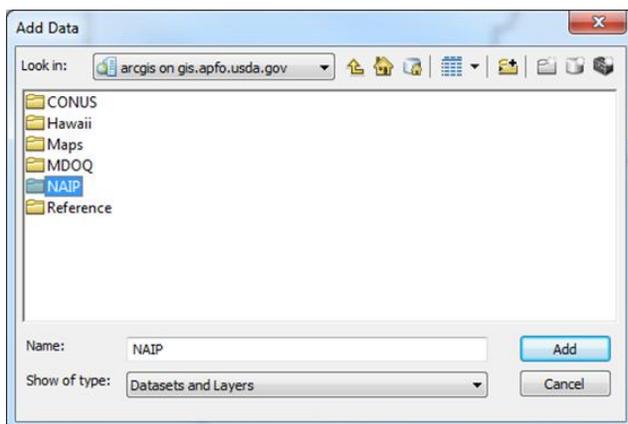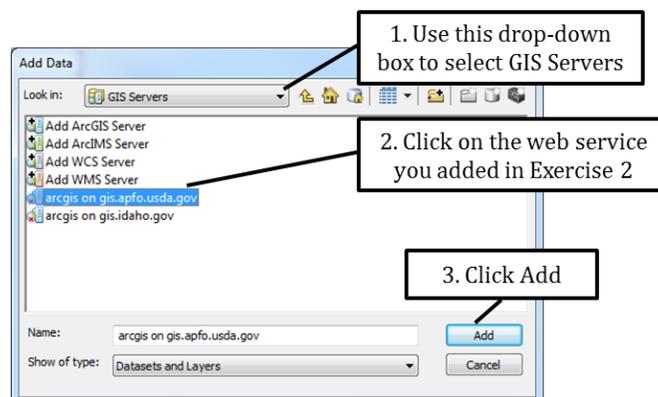**Exercise 3: Adding a GIS Service to ArcMap**

1. Open ArcMap. You can either use a new map document, or add the imagery to a map document you already have.

2. Click the "Add Data" button. Then add the web service as shown on the right.

3. Select the NAIP Imagery for Idaho as shown below.

1. Use this drop-down box to select GIS Servers

2. Click on the web service you added in Exercise 2

3. Click Add

4. Click "Add". You should now be able to see the 2011 NAIP imagery in your map.

4 Setting up database connections in ArcCatalog
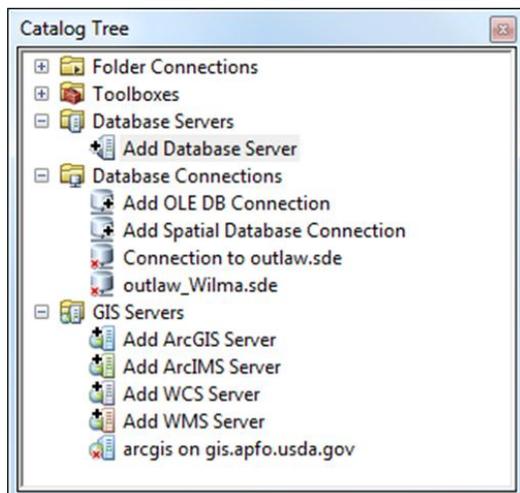
In the previous example we set up a connection to an ArcGIS Server. There are a number of different types of connections you can make to a variety of database types as shown on the left.

When you have ArcSDE you would use the "Add Spatial Database Connection" to create a connection that allows you to add this data to your map. Use "Add Database Server" to connect to SQL server.

5 Finding GIS Data

There is a wealth of GIS information available online that you can download and add to your map. As a rule of thumb you should not pay for data unless you are absolutely sure you cannot download the same data for free from a different site.

We have already seen that ESRI provides users with extensive Basemaps and that you can search an almost unlimited amount of GIS data through ArcGIS Online. Some of the data, such as all basemaps and most of the ArcGIS online content can only be viewed and you will be unable to open an attribute table, export data and do analyses on this data. Therefore, it may be necessary to download and store some GIS data locally.

Below is a list of websites to get you started on your search for Idaho specific GIS data. This list is by no means comprehensive, and we plan to update and improve this list as time goes on.

GIS Data Portals:

- www.arcgis.com (Provided by ESRI)
- www.insideidaho.org (Idaho Specific)
- http://geo.data.gov/geoportal/catalog/main/home.page (Country wide)
- http://datagateway.nrcs.usda.gov/ (Country wide, you can download the 2011 NAIP here)

Specific Data Sets:

- http://nhd.usgs.gov/ (Water datasets)
- http://seamless.usgs.gov/ (Elevation data and Imagery)
- http://www.idwr.idaho.gov/GeographicInfo/GISdata/gis_data.htm (Water related datasets for Idaho, also some statewide general datasets for transportation, flood plains and cities)
- http://tax.idaho.gov/i-1073.cfm (Tax Code Areas)
- http://tax.idaho.gov/i-1074.cfm (Miscellaneous Idaho datasets, including PLSS)

Exercise 4: Finding GIS Data (Note: Internet required)

1. Visit some of the sites listed above to find information that may be of interested to you or your organization.

6 Brief Anatomy of a shapefile

Figure 4 shows the various individual files that together make up a single shapefile.
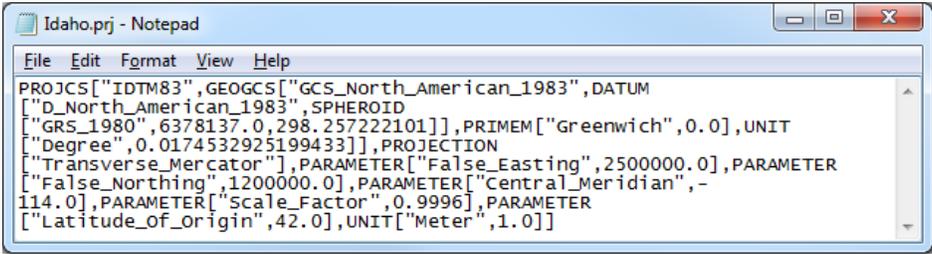
Idaho.shp contains a string of [X, Y] coordinates that describe the location and shape of all the polygons in this shapefile.

The **Idaho.shx** is an index file for the .shp file and lists where in the string of coordinates those for a specific polygon can be found.

The **Idaho.dbf** file is the attribute table associated with this shapefile, and can be opened and edited in Microsoft Excel if needed.

The **Idaho.shp.xml** file contains the metadata for this shapefile which is a text document that describes the purpose, author and other details relevant to this dataset.

Idaho.prj states the coordinate system of this shapefile as shown below.

Figure 4. Shapefile depicting Idaho along with all its associate files.

```
Idaho.prj - Notepad
File  Edit  Format  View  Help
PROJCS["IDTM83",GEOGCS["GCS_North_American_1983",DATUM
["D_North_American_1983",SPHEROID
["GRS_1980",6378137.0,298.257222101]],PRIMEM["Greenwich",0.0],UNIT
["Degree",0.0174532925199433]],PROJECTION
["Transverse_Mercator"],PARAMETER["False_Easting",2500000.0],PARAMETER
["False_Northing",1200000.0],PARAMETER["Central_Meridian",-
114.0],PARAMETER["Scale_Factor",0.9996],PARAMETER
["Latitude_Of_Origin",42.0],UNIT["Meter",1.0]]
```
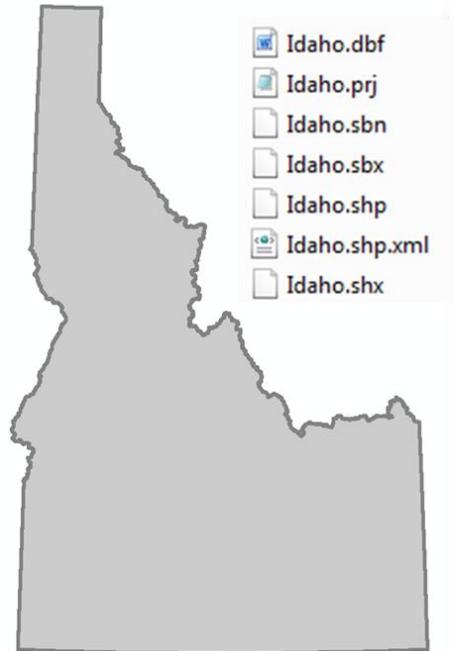
All the polygons in a shapefile are drawn independently so it is possible to draw overlapping polygons as illustrated in Figure 5. For some applications it is important that polygons don't overlap, for example parcels should not overlap with other parcels.

Topology consists of rules that govern how points, lines and polygons share geometry. A common topological rule is that neighboring parcels, counties, states or countries need to share a boundary without gaps or overlaps.

Figure 5. Shapefiles do not preserve topology so it is possible to have overlapping polygons.

To enforce topology you need ArcGIS Standard or Advanced (formerly known as ArcEditor or ArcInfo) and store your GIS data in a Personal, File or SDE geodatabase.

7 Organizing your data

"Where is my file?" is a very common question for a person providing GIS support. This question is similar to asking "Where did I put my left sock?". The file (and your sock) can be found at the place where you last left them.

Some organizations have a hodge-podge of data thrown together in a couple of folders which makes it hard to find just that one layer that you need right now. Spending a little time setting up a organizational structure will save you a lot of time later on and is especially invaluable if multiple people deposit and use GIS data on the same server.
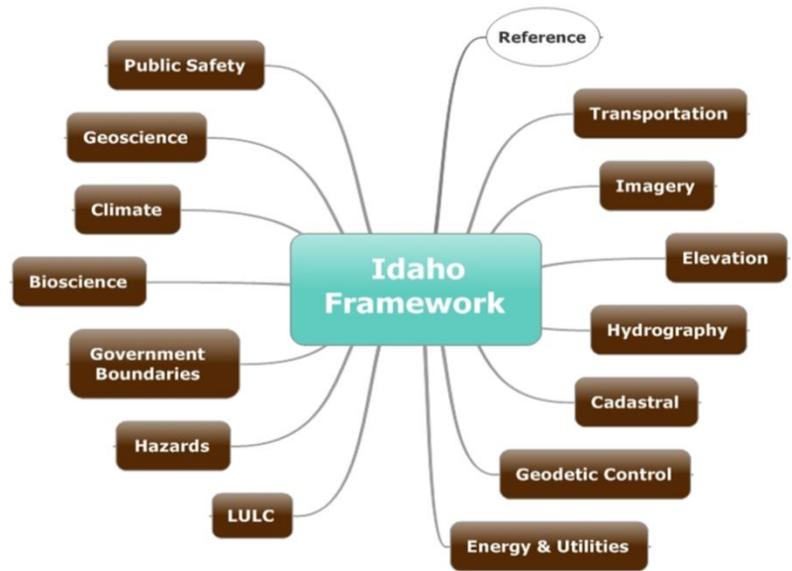

Figure 6. The Idaho Framework developed by the Idaho Geospatial Office provides one way to organize your data.

Just like the way you like to organize your closet, setting up a structure for GIS data is a personal or organizational choice. Figure 6 provides one way to separate your data into different themes. For example all transportation related layers, such as roads, trails, railroads, *etc*. would reside together in the "Transportation" folder. Anything to do with geodetic control, such as a PLSS layer, GCDB layer and a file with control points can reside together in "Geodetic Control". The "LULC" folder contains datasets related to Land Use and Land Cover. It may contain information about management areas, federal lands as well as vegetation cover information.

It is a good idea to keep your completed GIS layers separate from projects you may be working on. For example, if you are working on an inventory of forest roads in your County, it is wise to store all the work-in-progress, including all intermediary steps separate from your main GIS layers and only copy them to the Transportation folder with your are finished.

Exercise 5: Setting up an organizational structure

1. Open ArcCatalog and open the Start folder where you will find a folder called "GIS_Data" which contains folders for the various GIS themes found in figure 7.6. The contents of the "GIS_Data" folder are also displayed in the figure on the right hand side.

2. Inside ArcCatalog copy and paste the Counties.shp and PLSS_Townships.shp to the appropriate folders inside "GIS_Data".

3. Open the Projects folder inside the GIS_Data folder. One way to organize your day-to-day GIS projects is to store them by time as illustrated on the left. Another way would be to store them by topic, or by the name of the person you are doing a specific project for.
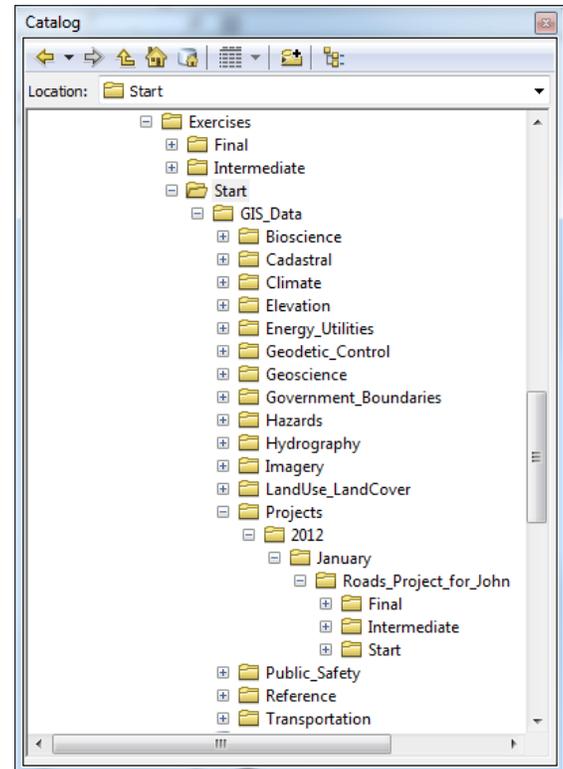
It is good practice to use three folders for a project. The **start folder** contains the input data you need to get your project started. All your edits and analyses can be stored in the **intermediate folder**, and the final product should be stored in the **final folder**.

There are number of reasons to follow this best-practices folder setup. First, at some point you will mess up an analysis, make an editing error or simply have ArcMap crash. By keeping the "input" data separate in your start folder you make sure you preserve the data you started with. Second, when someone needs the final product of the work you have done, you know to look for it in the "Final" folder where it is undiluted from all the temporary steps in between. If you ever need to delete files to preserve space you will also know not to delete the contents from the Final folder, but you may be able to delete the Start and Intermediate folders.

Let me emphasize once more that organizational structure depends on personal preference. Do whatever works for you. This section is simply meant to provide you with some ideas to organize your data.