GIS Introduction

CSP7100

Fall/Winter 2012-2013

Offered by:

U.S. FISH AND WILDLIFE SERVICE
National Conservation Training Center

TABLE OF CONTENTS
GIS INTRODUCTION - CSP7100

Welcome!

During this course we will be working together to help you [1] understand the basic principles underlying geographic information systems (GIS) and [2] learn to use ArcGIS 10 (ArcInfo) software to work with GIS data. Fully developed technical skills are not born in several days' time. However, we hope that you will return to your office with a solid foundation in this technology and the tools to further develop your ability to apply GIS data to your work.

We encourage your full participation and welcome your questions at any time.

This workbook is yours to use during the course and keep as a reference. We recommend perusing the Table of Contents in the front of the book to familiarize yourself with the topics that will be covered in the course. Also note that in addition to course lectures and exercises, we have provided auxiliary information after many of the exercises. Metadata on the Moosehorn dataset can be located through ArcCatalog and within the accompanying thumb drive.

Course Objectives

Upon completing this course, you will be able to:

- Define GIS and ArcGIS Desktop 10.0 software (ArcInfo License)
- Describe the capabilities and functionality of ArcMap, ArcCatalog and ArcToolbox
- Display, manipulate, create and organize data layers using ArcGIS Desktop10.0
- Use ArcGIS Desktop 10.0 Desktop to answer specific spatial questions

Discussion/Lecture: What is a Geographic Information System?

Session Objectives: At the conclusion of this session, you will be able to:

- Define GIS
- Identify Vector & Raster data
- Define and describe Coordinates
- Define and describe table Attributes
- Define and describe Map Topology
- Identify 5 questions a GIS can answer

Materials created primarily by Greg Sepik. Some material was written by Melinda Walker of the BLM.
Revised: April 2011 by Mark Richardson and Christopher Bryant
Notes: ArcMap 10

Notes:

Notes:

Notes:

Notes:

Exercise 1: Introduction to the ArcMap Interface

Session Objectives: At the conclusion of this session, you will be able to:

- Start ArcMap
- Open a map document (.MXD)
- Describe the components of the ArcGIS map interface
- Set up Toolbars
- Zoom In/Out on selected locations
- Turn layers on and off (Display and Un-display)
- Create a Bookmark
- Use the Measure tool
- Use the Help function

Extra – Extend your GIS Skills

- Create your own toolbar

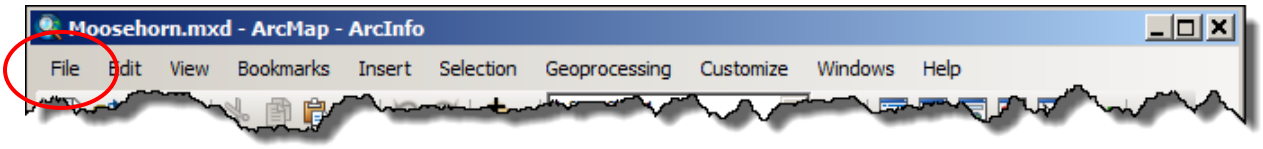
Materials created by: Todd Sutherland, Matt Mullenax, Marcia McNiff , Mark Richardson and Karen Klinger

Revised: July, 2012 by Mark Richardson
Notes: ArcMap 10, Service Pack 4

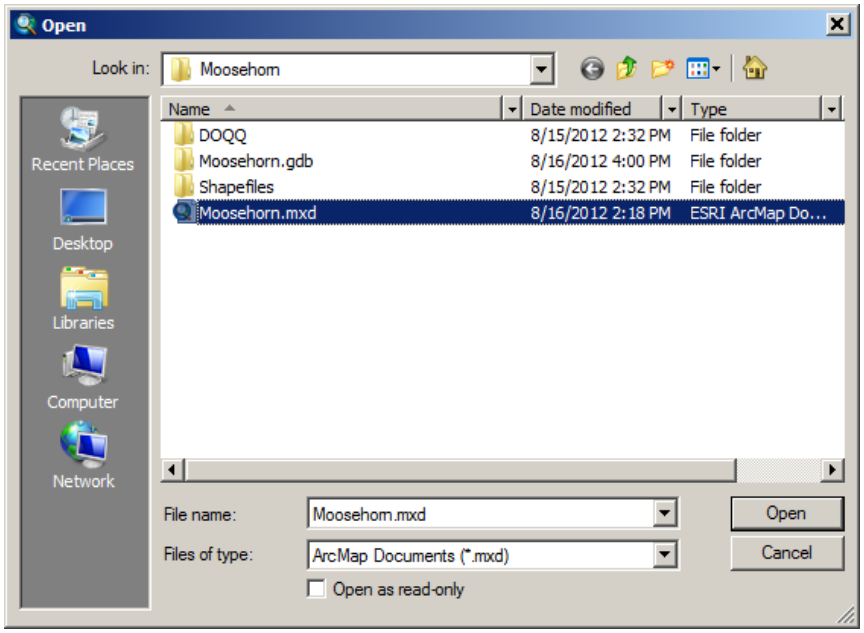
This exercise will allow you to familiarize yourself with some of the basics of using ArcMap. For those with previous experience using ArcGIS 9.x, you will undoubtedly find many similarities as well as some differences.

SECTION 1 - Starting ArcMap and Opening a Map Document (.mxd)

1. Start ArcMap by double-clicking the **ArcMap 10** icon on your desktop.



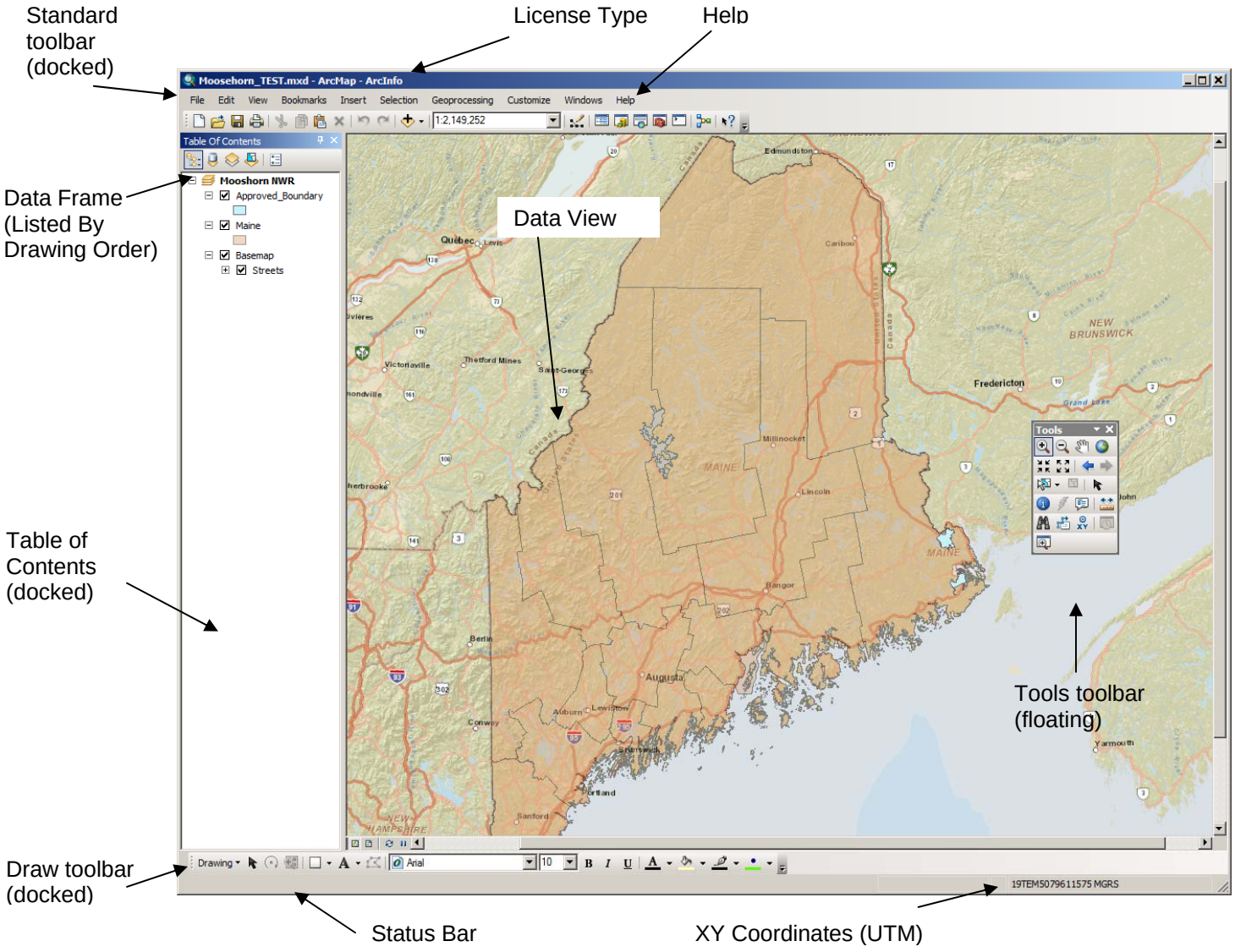
2. Go up to the Main Menu> **File** >**Open**



3. Navigate to *D:\CSP7100\Moosehorn*. Select **Moosehorn.mxd** (Moosehorn GIS Map Document) and click **Open**.

SECTION 2- ArcMap Interface

The ArcMap 10 interface is composed of 3 major components; The Table of Contents, Data View and Tool bars – depending upon which ones are activated or displayed. The window on the left side is the Table of Contents which holds individual data layers (Approved Boundary, Maine, Basemap) contained within a Data Frame (Moosehorn NWR). These layers are displayed or drawn in the Data View (right window) according to their sequence in the table of contents, going from the bottom to the top.



Notice that the title for the **Moosehorn NWR** data frame appears in bold. This means that Moosehorn NWR is currently the active data frame. Only layers within the active data frame are displayed within the Dataview

Note - if the ESRI **Basemap** does not draw within 30 seconds, un-check this layer in the Table of Contents

SECTION 3 - Toolbars

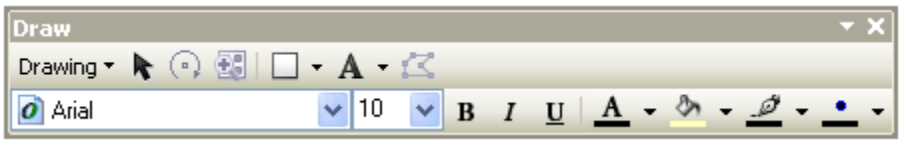
The ArcMap interface can easily be customized. Toolbars can be hidden or displayed and moved around the interface. The toolbars also may float on the desktop or be docked. ArcMap itself retains the location and visibility of the toolbars (your personal settings) in a file called the normal template (normal.mxt). Therefore, each time you start an ArcMap session, the toolbar environment appears in the same state as your previous session.

1. Right click on the empty space on the **Main Menu** > **Standard**

2. Toggle the standard toolbar on and off. Take note of the toolbar location. After determining where this toolbar resides, ensure the Standard toolbar is visible.

3. Repeat the procedures in step 1 for the **Tools** toolbar.

4. Repeat the procedures in step 1 for the **Draw** toolbar.



5. Repeat the procedures in step 1 for the **Layout** toolbar.

6. Click and hold the **title bar** of the **Standard** toolbar and drag to the right side of the table of contents. The toolbar will snap into place (become docked) along the right edge of the table of contents.

✓TIP: Grab the dotted bar (usually on the left edge or on top of the toolbar) to move toolbars that are docked. A floating toolbar can be moved by clicking anywhere on the title bar.

7. Reposition the **Tools** toolbar.

8. Reposition the **Draw** toolbar.

9. Reposition the **Layout** toolbar.

Now that you are comfortable moving and docking toolbars, let's set up the standard interface we are going to use throughout the course.

10. Dock the **Layout** toolbar along the left edge of the data view. Move all other toolbars back to their original locations. Your interface should now look similar to the example on the next page.

✓TIP: Double-clicking on a floating toolbar will automatically anchor it in the Standard toolbar

11. From the **Main** menu, click **View** and check **Status Bar**. Take note of its location (at the bottom left corner of the ArcMap interface). The status bar is useful for getting help about the functions of buttons. Ensure the status bar is visible.

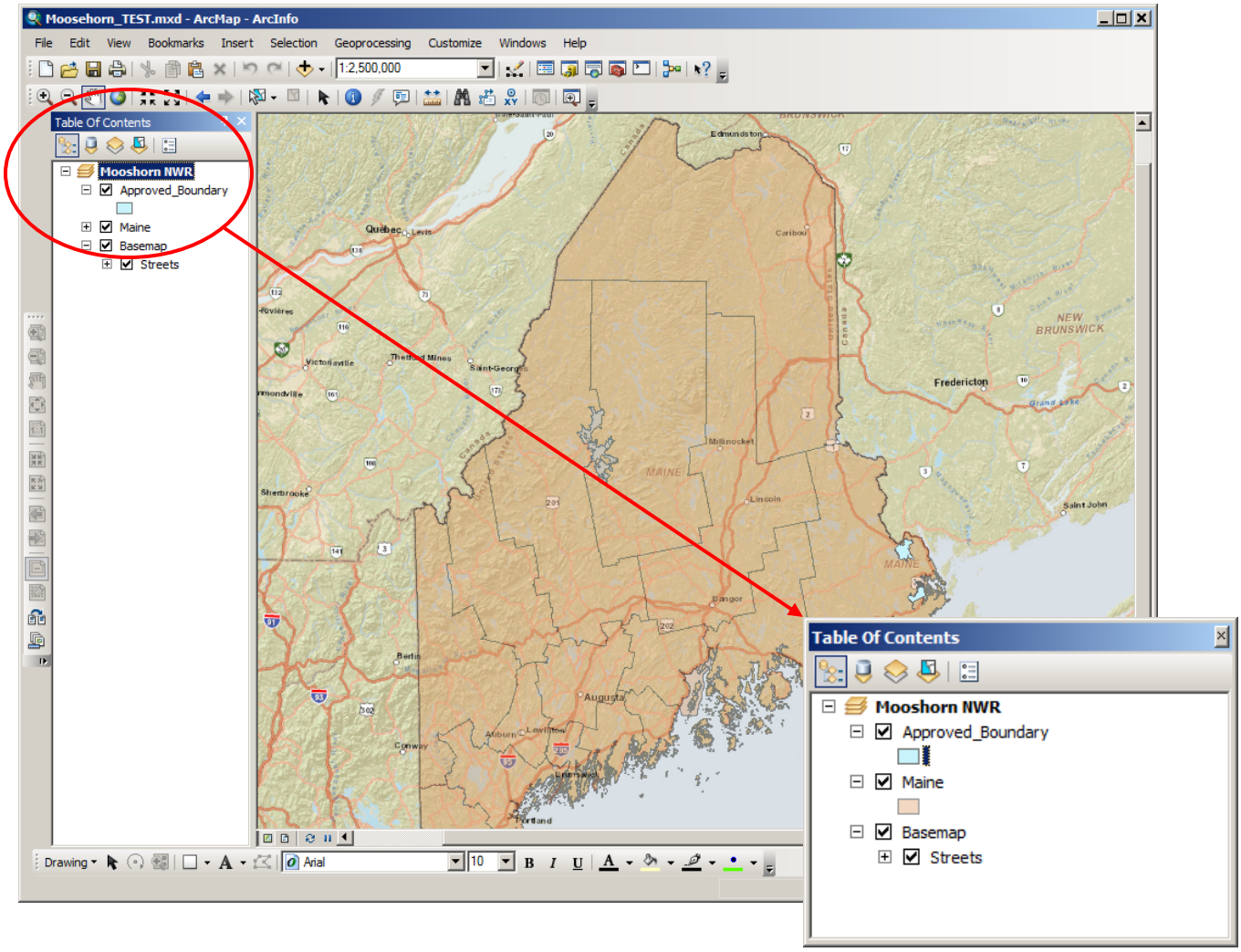
12. Move your mouse over any icon/button located on the **Tools** toolbar. The name of that icon will be displayed in a callout. Additionally, a brief description of the function will be displayed in the **Status Bar**.

✓TIP*: For more details on the function of an icon, click the **What's This?** button located on the **Standard** toolbar. Then try clicking on some icons you wish to get more details from.*

13. Repeat the procedures in step 12 for icons on the **Standard, Draw and Layouts** toolbars.

SECTION 4 - Table of Contents

Like Tool bars, the Table of Contents Window and other windows can be customized. They can be docked and or toggled into **auto hide** to un-clutter the Data View.



1. In the Table of Contents, click on the **Auto Hide Pin** control (white push pin on the Title bar). This reduces the Table of Contents Window to a **Tab**, depending upon where you have it docked. Click on the **Tab** to make the Table of Contents visible again.

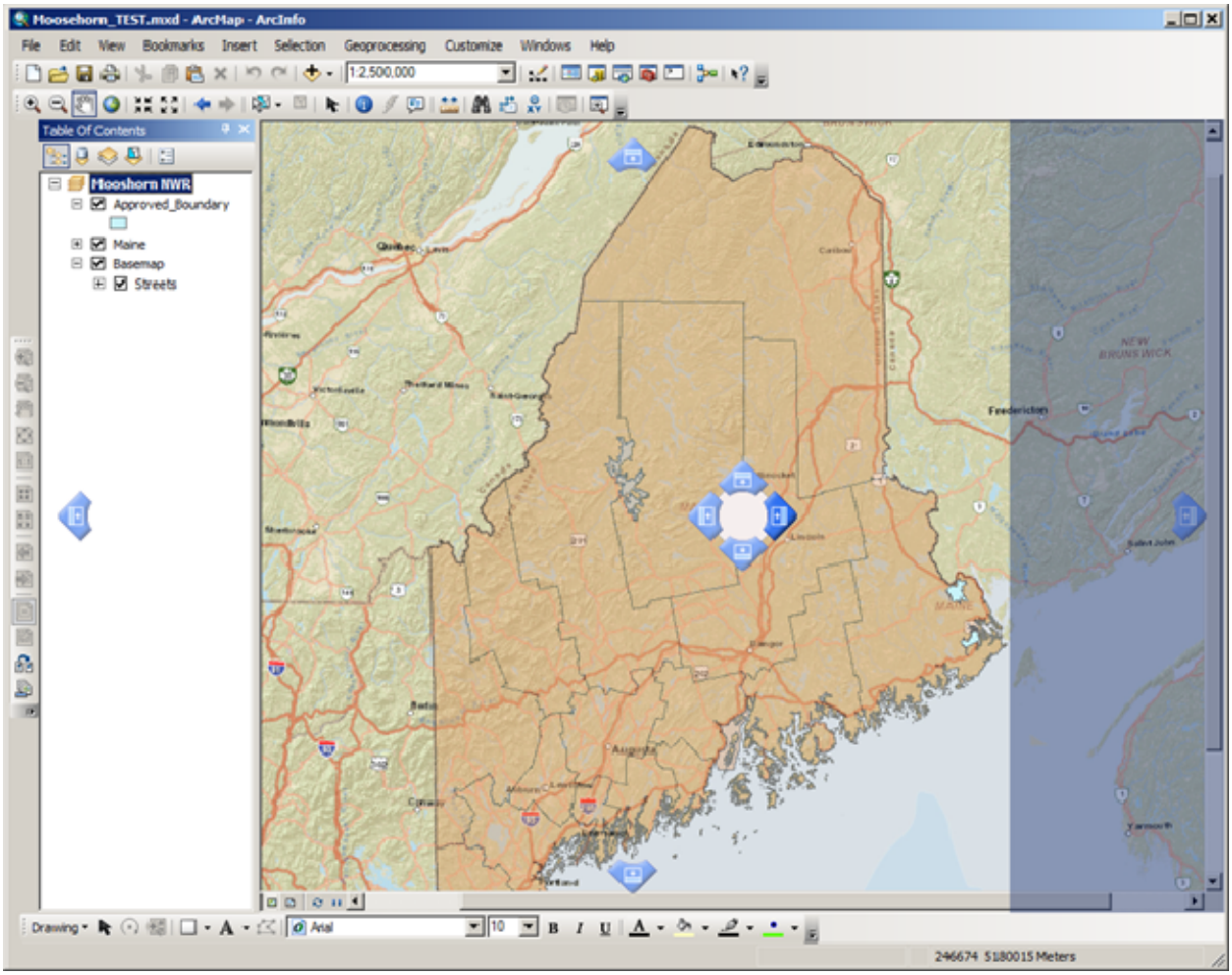
2. Click anywhere on the Data View to hide the **Table of Contents** window.

The Table of Contents along with other Windows (Search, Catalog, Toolbox, Python and Model Builder) can be moved or docked to other locations within the Data View.

3. Click on the **Table of Contents Tab.**

4. Click on the **Auto Hide Pin**. The Pin will switch to a vertical position. The Table of Contents Window is now ready to be docked (moved).

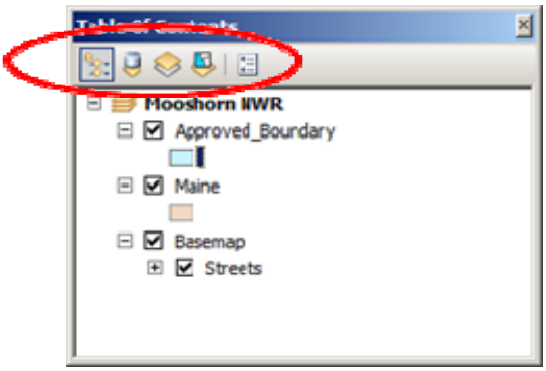
5. Grab the **Title bar** with the mouse Pointer. A Blue box and Targets will appear on the Data View, indicating where you can dock the Window.



6. Drag the blue box to the right, (while holding down the left mouse button) and hold the **mouse pointer over the blue directional arrow** – release. The Table of Contents docks to the left side of the Data View.

7. Move the Table of Contents back to the left side.

8. Notice the 5 icons at the top of the table of contents labeled: **List By Drawing Order, List By Source, List By Visibility and Options**. What happens when you toggle between these?

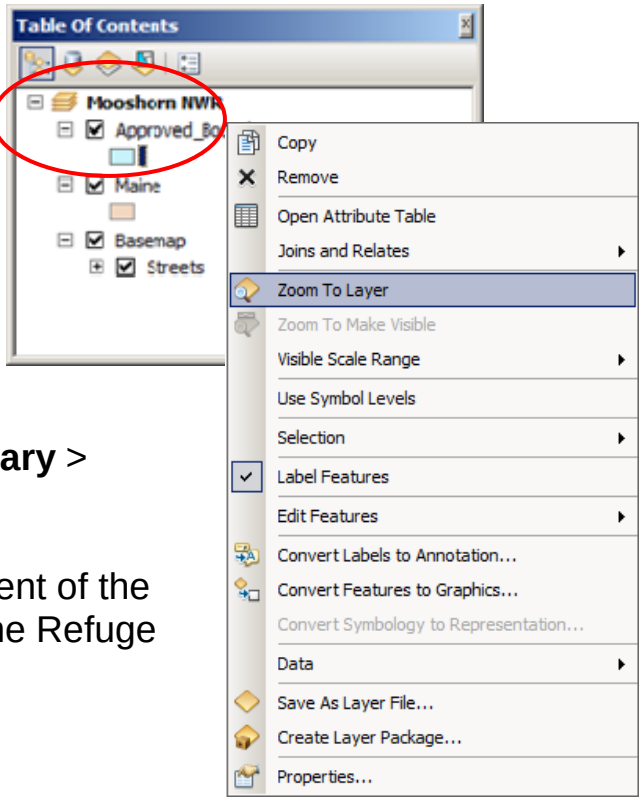


✓*TIP: To make the Auto Hide Pin to re-appear, double click on the title bar.*

9. Click on **List By Drawing Order.**

STOP -PLEASE STOP HERE BEFORE GOING ON TO THE NEXT SECTION- STOP

SECTION 5 - Displaying Layers and Creating a Bookmark



1. In the Table of Contents, toggle (check/un-check) the **Basemap, Maine** and the **Approved_ Boundary** layers off and on.

2. Re-draw (check) all the layers so they are visible within the Data View.

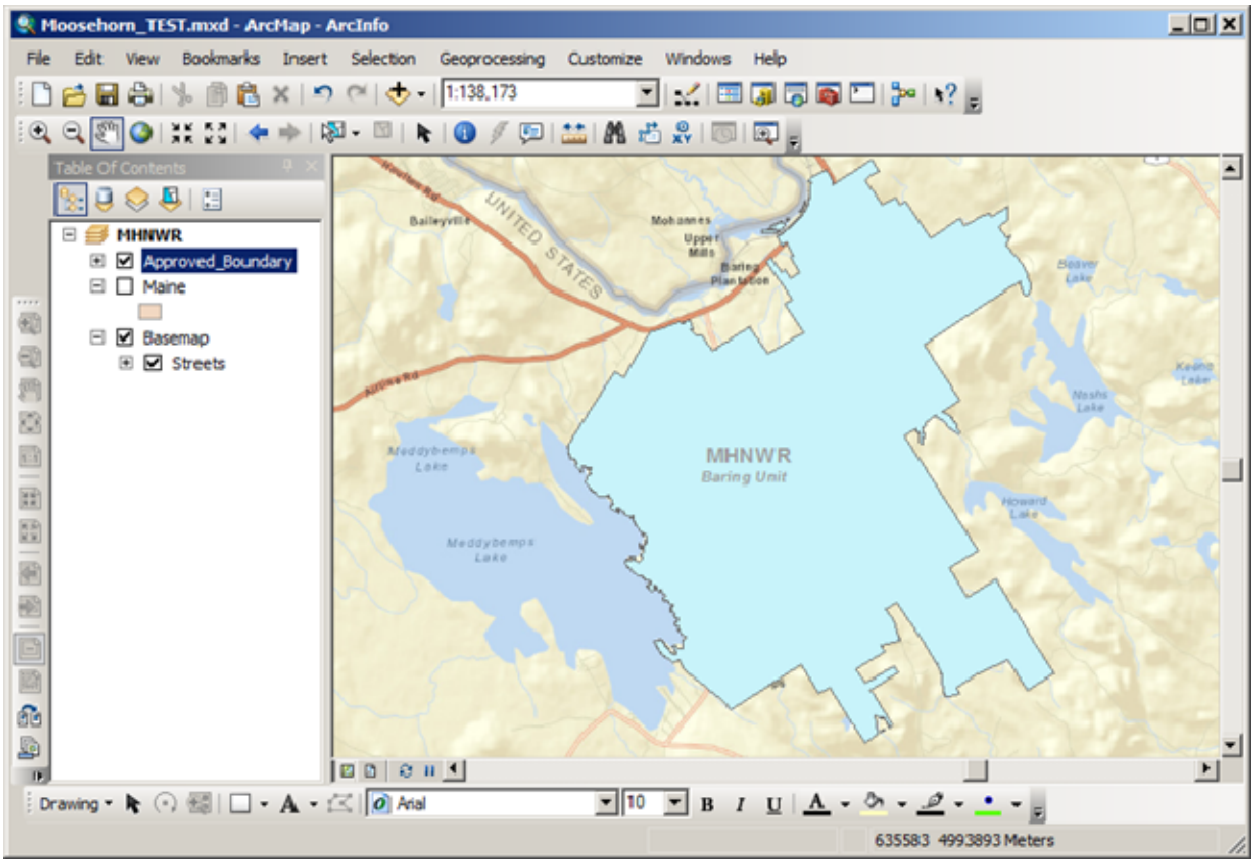
3. Right click on the **Approved_Boundary** > **Zoom To Layer**.

   ArcMap zooms down to the map extent of the Baring and Edmunds units. Notice the Refuge unit labels appear.

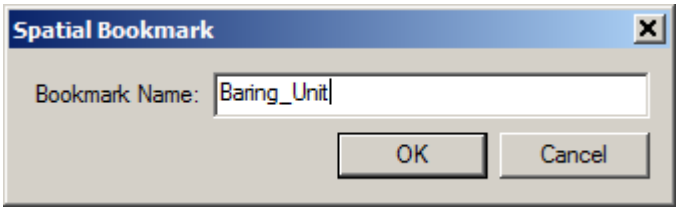
4. Click on the plus box next to the Approved_Boundary layer.

   Notice how the layer's legend symbology is now visible, showing how the layer is represented on the map. Click on the minus box to hide the legend.

5. Click on the **Zoom tool**. Draw a box around the **Baring Unit** of the Refuge and zoom down to this boundary.



6. Go up the Main menu, select **Bookmarks**> **Create Bookmarks**. Name the bookmark **Baring_Unit**, Click **OK**.



7. Go back to the Table of Contents, Right click on **Maine**> **Zoom To Layer.**

   This returns the display to showing the entire State of Maine and the county boundaries.

8. Return back to **Bookmarks** > **Baring_ Unit.**

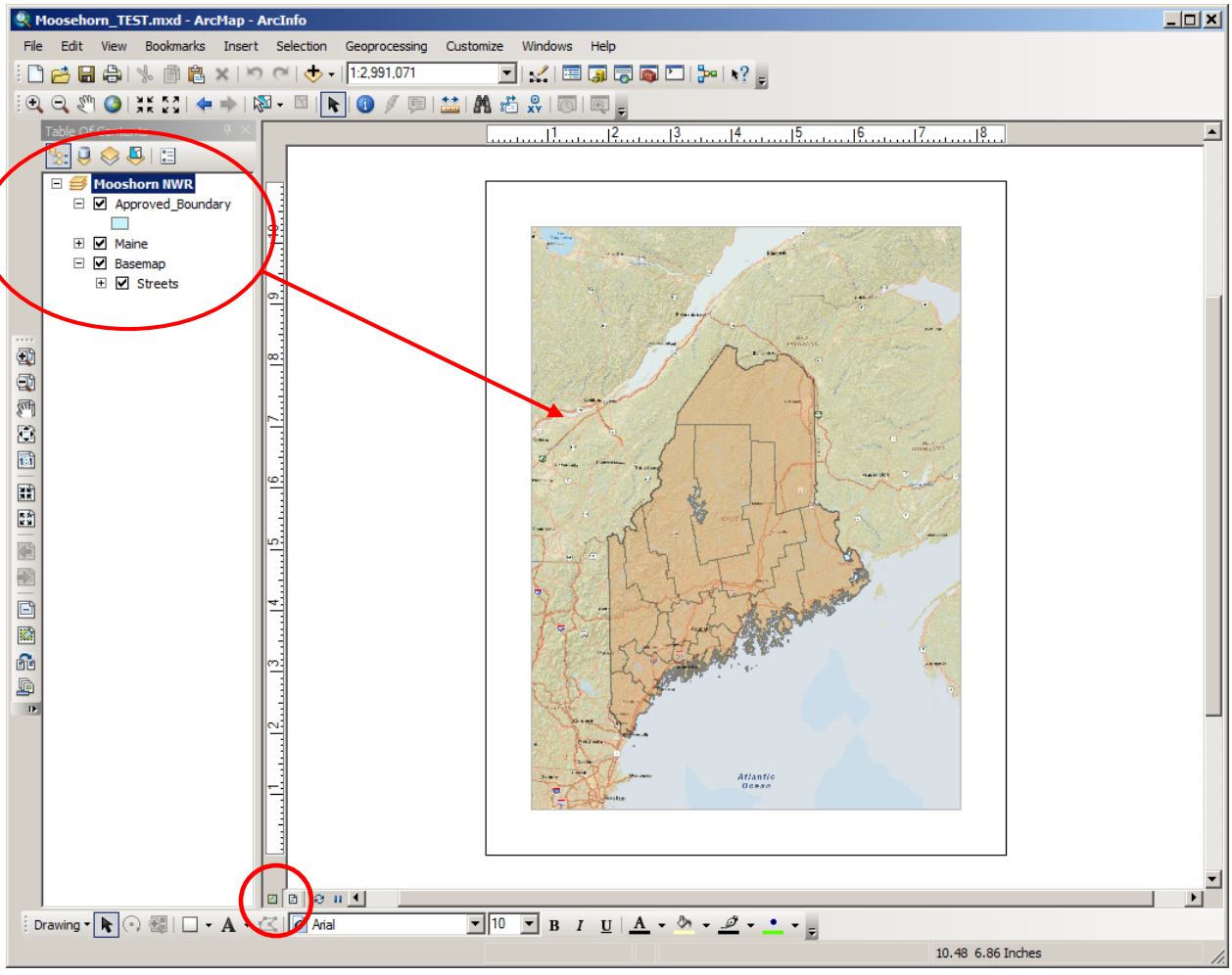
What happen?_____

6. Once again, Right click on **Maine** > **Zoom To Layer.**

SECTION 6 - Data View V.S. Layout View

Within the ArcMap interface, there are actually two main views. One is the Data View shown above, which allows the user to manipulate the data and perform analysis. The other is the **Layout View**. This is where you can compose a map, including title, legend, and other map elements. You can also manipulate the data within the Layout View, however it is recommended to do this while in the **Data View**.

1. Click on the **Layout** button circled lower left.



2. Note, while in the Layout view, the data frame and corresponding layers (checked) are visible within the Table of Contents. The Layout View and this topic will be reviewed in-depth in Exercise 15.

3. Go to Main Menu> **View** >**Data View.**

4. Experiment with the zoom options on Tools tool bar. Explore the various layers from different zoom levels.

✓*TIP: You can also use the scrolling wheel on the mouse to zoom in and out.*

Quiz 1: Describe the effects of the following actions:

A. Zoom to Full Extent  _____

B. Fixed Zoom In/Out  _____

C. Go Back to Previous Extent  _____

D. Zoom In Tool  _____

E. Zoom Out Tool  _____

F. Pan Tool  _____

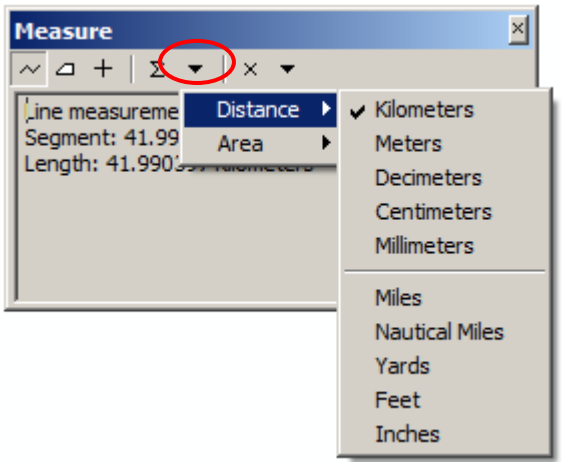
SECTION 7- Using the Measure Tool

The ruler icon allows users to measure distance and area within the active data frame. Measuring units are set after opening the tool.

1. Right Click on the **Approved_Boundary** layer > **Zoom To Layer**

2. Click on the **Measure tool** icon located on the Tools toolbar. Pass the cursor over each icon to view the description of each tool. By default the line tool is enabled.

   Note that the cursor changes to a framing square with a crosshair



> ✓*TIP: If you close the Measure tool and need to reopen it, as long as the Measure icon is depressed just click anywhere in the Data View box and the tool will reappear.*

3. Click on the **Choose Units** >**Distance**>**Kilometers**. (The unit can be selected before or after a measurement is taken.)

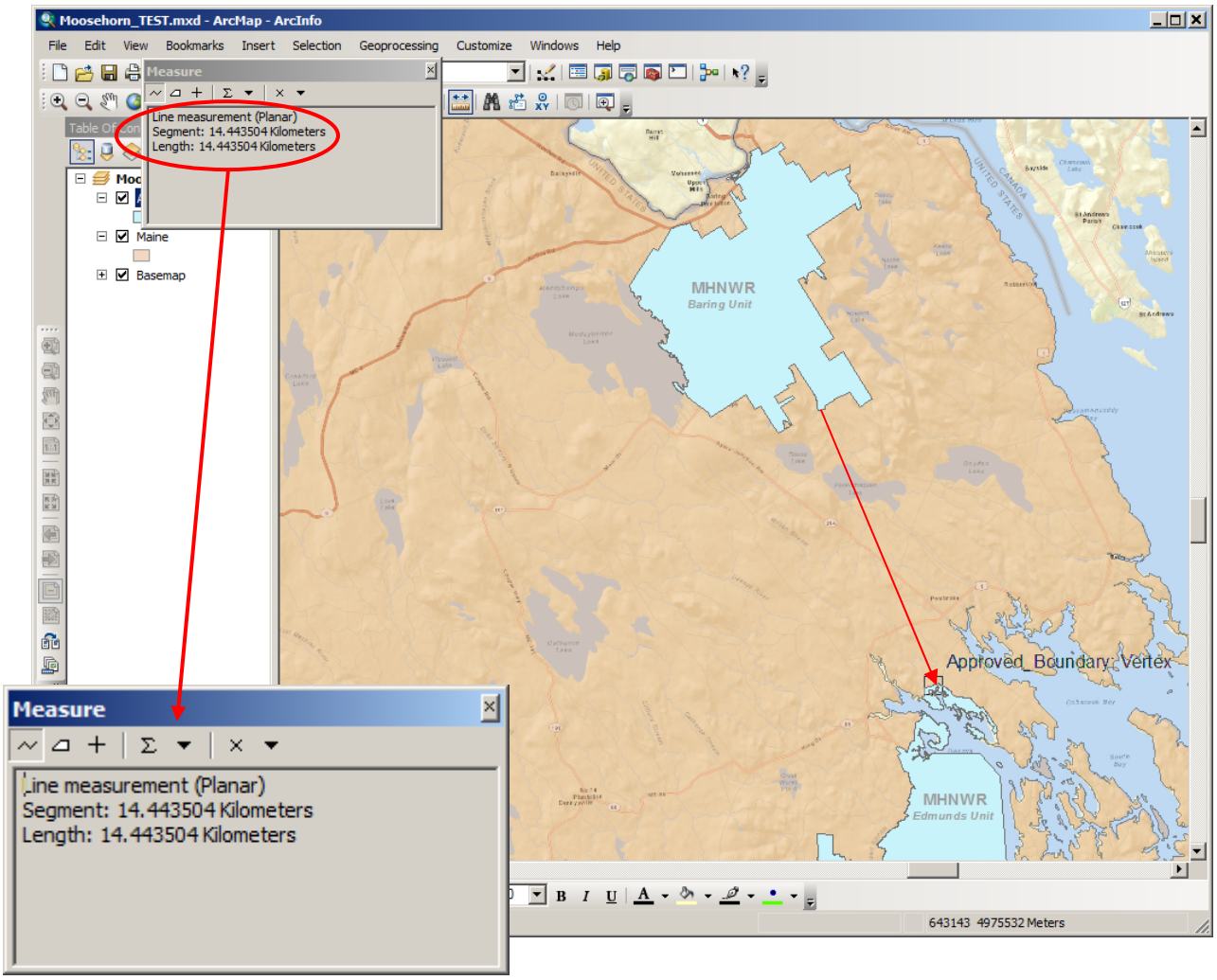
   The default unit of measurement is based on the coordinate system shown in the **Map Units** under the General tab in the Data Frame Properties.

4. Starting at the **Southern** tip of the Baring Unit boundary, click the left mouse button once to begin measuring and move the mouse to the **Northern** tip of the Edmunds Unit

> ✓*TIP: To measure a curved line, follow the contour by left-clicking once at each variation in the line.*

5. Double-click the left mouse button to end the measurement.

6. The length of the line segment is displayed in the window in Kilometers. (The data in the window can be copied and pasted for use in other applications.)

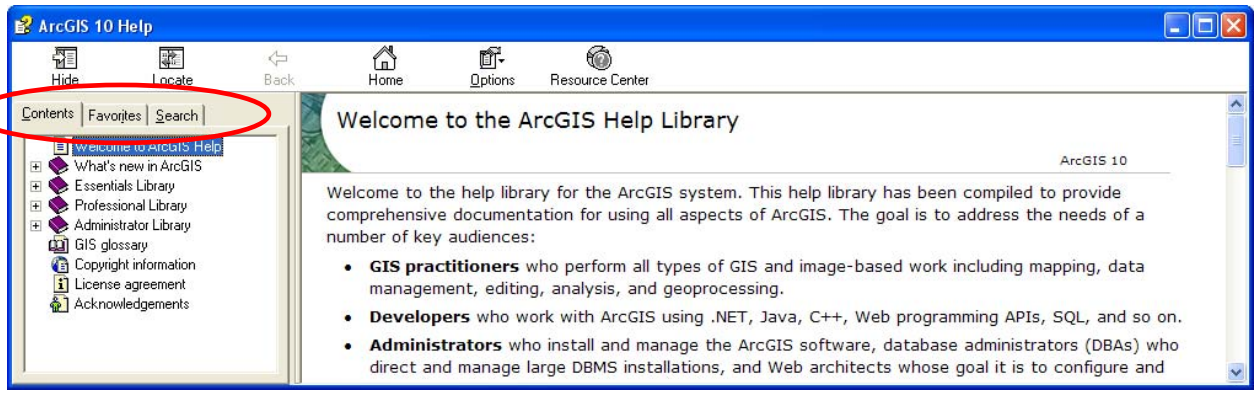


Quiz 2: How can you measure the length of a winding road using this tool? Zoom down on the **Basemap** layer and measure the length of any road. Choose feet as your measuring unit.

SECTION 8 - Using Help

1. From the **Main Menu**> **Help** > **ArcGIS Desktop Help**.
   (A shortcut to help is pressing **F1**).

   Notice the three tabs: Contents, Favorites, and Search. These give you several options.



   a. **Contents** - manually search the table of contents for *ArcGIS Desktop Help*

   b. **Favorites** - bookmarks commonly used help topics

   c. **Search** – search *ArcGIS Desktop Help* using key words

2. Click on the **Search** tab and type “zooming.”

3. Below your query, you will note there are several topics that relate to zooming. Select the topic under zooming entitled in and out. ArcMap Help provides information in the window on the right.

Quiz 3: Use **ArcGIS Desktop Help** to answer the question “How do you change the name of a Layer?”

Extra – Extend your GIS skills: Create your own toolbar

Designing your own toolbar gives you access to tools you might find more useful than the default toolbars. You can select any combination of tools and name the toolbar. For example, the toolbar created in the following steps would aid in working with data frames.

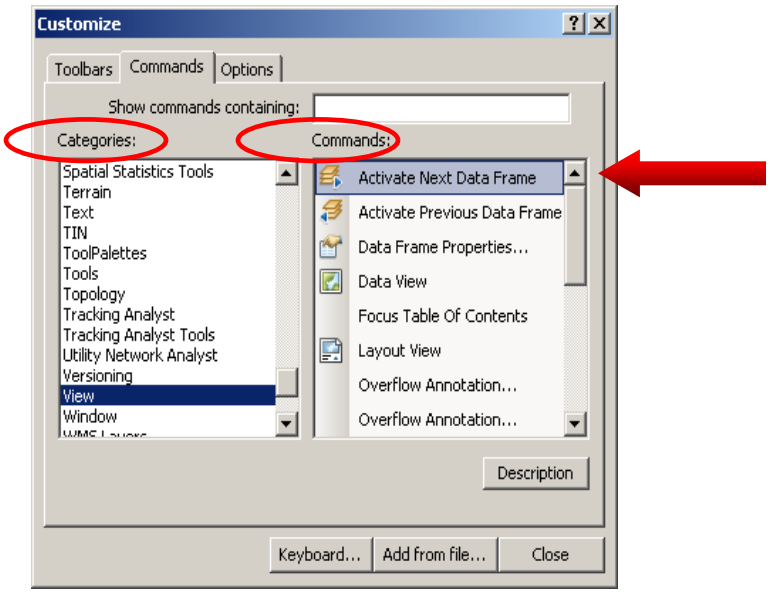
1. On the **Main Menu** go to **Customize** > **Custom Mode.** You can also click on the down arrow at the top right of any tool bar to access the same screen.

2. The **Customize** dialog box opens on the **Toolbars** tab. Click on **New**.

3. For the **Toolbar Name** replace "Custom Toolbar 1" with your "**first name**" (or whatever descriptive name you'd like) and click **OK**. The new toolbar will appear empty and unanchored on the screen, and the name will temporarily show at the bottom of the **Toolbars** list (after closing the box it will be automatically alphabetized).

4. Next, click on the **Commands** tab. In the **Categories** list scroll down and select **View**.

5. In the **Commands** list click on the **Activate Next Data Frame** icon and drag and drop it into your personal toolbar.



6. What other commands would be applicable to use with data frames? Drag and pull over several more commands. Close the dialog box and then test the icons in your new toolbar. Is the new toolbar helpful?

Notes:

Discussion/Lecture: What is ArcGIS?

Session Objectives: At the conclusion of this session, you will be able to:

- Describe ArcGIS software
- Identify ESRI and locate their site on the web
- Identify alternative GIS software manufacturers
- Explain the difference between ArcView, ArcEdit and ArcInfo
- Distinguish between ArcMap, ArcToolbox and ArcCatalog

Materials created by:
Revised: April 2011 by Mark Richardson and Christopher Bryant
Notes: ArcMap 10

Notes:

Notes:

Notes:

Notes:

Discussion/Lecture: Vector File Formats Overview

Session Objectives: At the conclusion of this session, you will be able to:

- Identify ESRI vector file formats
- Define and identify shapefiles
- Define and identify 3 types of geodatabases
- Identify the components of a geodatabase
- Cite the benefits of using a geodatabase

Materials created by:
Revised: January 2011 by Eric Kelchlin
Notes: ArcMap 10

Notes:

Notes:

Notes:

Notes:

Exercise 2: ArcCatalog 10 and Catalog Window

Session Objectives: At the conclusion of this session, you will be able to:

- Define and utilize ArcCatalog and Catalog Window
- Make a folder connection
- View Data Sources/Files within ArcCatalog and ArcCatalog Window

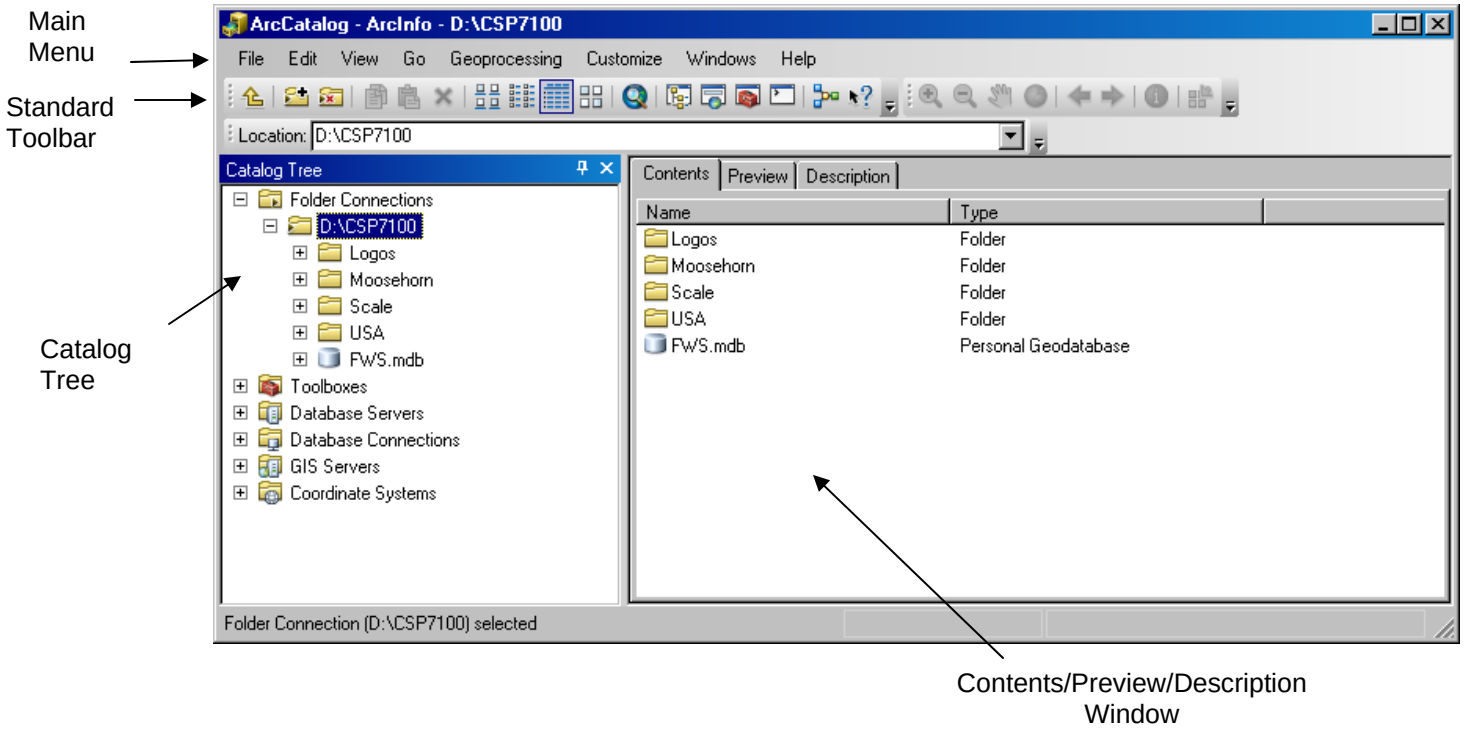
Materials created by: Todd Sutherland, Mark Richardson and Karen Klinger
Revised: February, 2012 by Mark Richardson
Notes: ArcMap 10.0 Service Pack 1

SECTION 1 – Opening ArcCatalog 10

What is ArcCatalog10? ArcCatalog is a stand alone program which allows the user to manage and preview geographic data files on the computer's hard drive or network. With ArcCatalog10 you can create folder connections, view data sets, create new file types, and create metadata on individual layers.

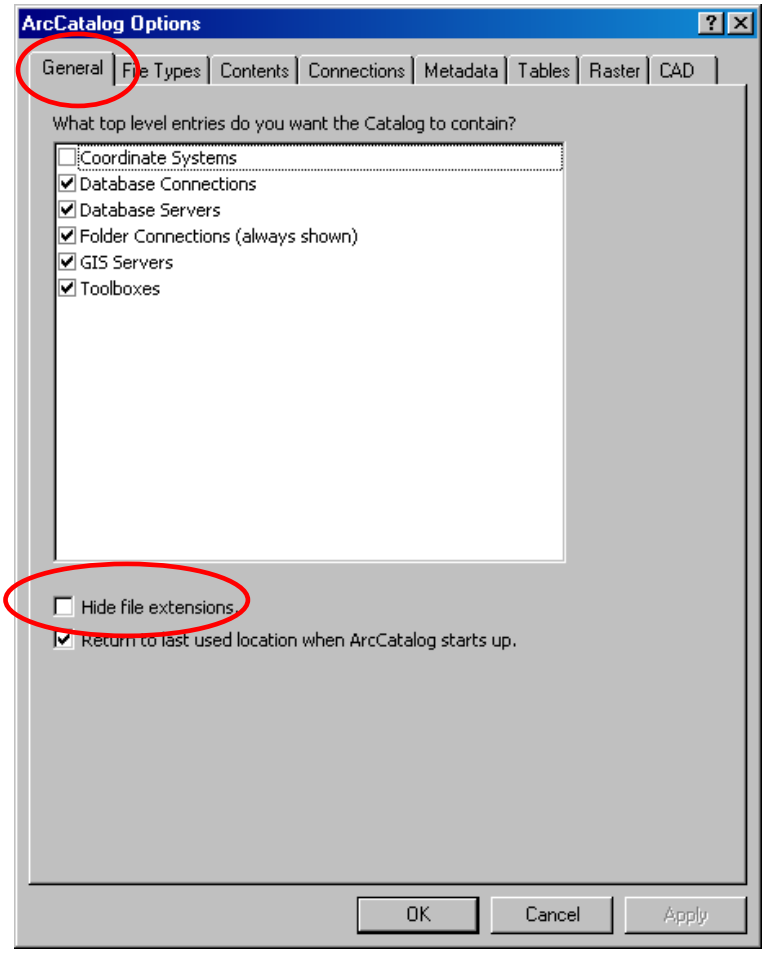
1. Click on **Start** on the Windows task bar> Programs > ArcGIS > **ArcCatalog 10**

   This launches the ArcCatalog 10 program. Two main dialog windows appear. The left window shows the catalog tree or the directory structure on your computer's hard drive. The right window displays the contents of the hard drive or the contents of the folder. ArcCatalog functions very much like Windows Explorer.



2. Navigate to the **Main** menu and select **Customize** and then **ArcCatalog Options**.

3. Select the **General** tab and uncheck the [Hide file extensions] option and Click **OK.** Note what this option does.



Uncheck this option if you would prefer to see extensions for the data and file types shown in the catalog. By default extensions are hidden, so a shapefile called **states** will just appear as **states** in the catalog. This helps to make the catalog listings less cluttered and easier to understand.

Users may prefer to see extensions. For example, a shapefile called **states** will appear as **states.shp** in the catalog. For some data types, such as raster data, the file extension can be useful in enabling advanced users to distinguish quickly between different file types.

SECTION 2 - Establishing a Folder Connection

To view the contents of a computer drive (D:\) or see the data files within a folder using ArcCatalog you need to create a folder connection.

1. If the Catalog Tree Window is not visible. Click on the **Catalog Tree Window** button located on the Standard Tool bar.

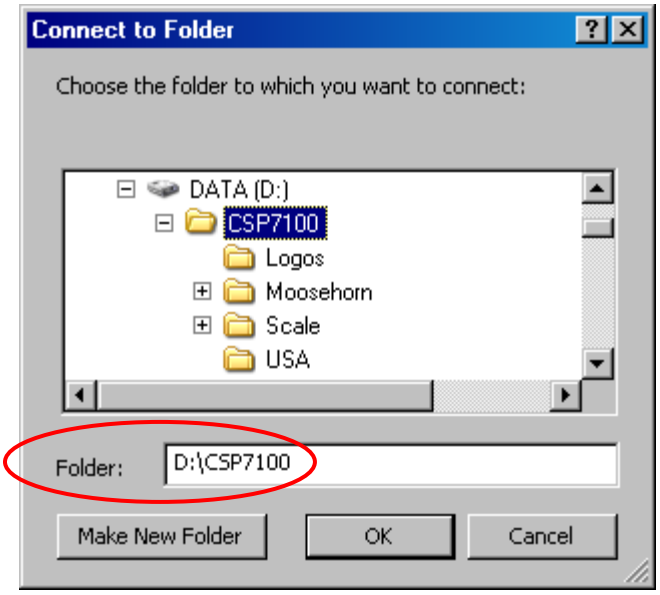
2. Click the **Connect To Folder icon** located on the **Standard** toolbar.

3. In the **Connect To Folder** navigate to My computer>**D:**>CSP7100

   Depending on your workstation setup, the drive location is the location where the datasets reside. This could be C:\ , E:\ , D:\ , S:\, etc.

4. Click **OK**.

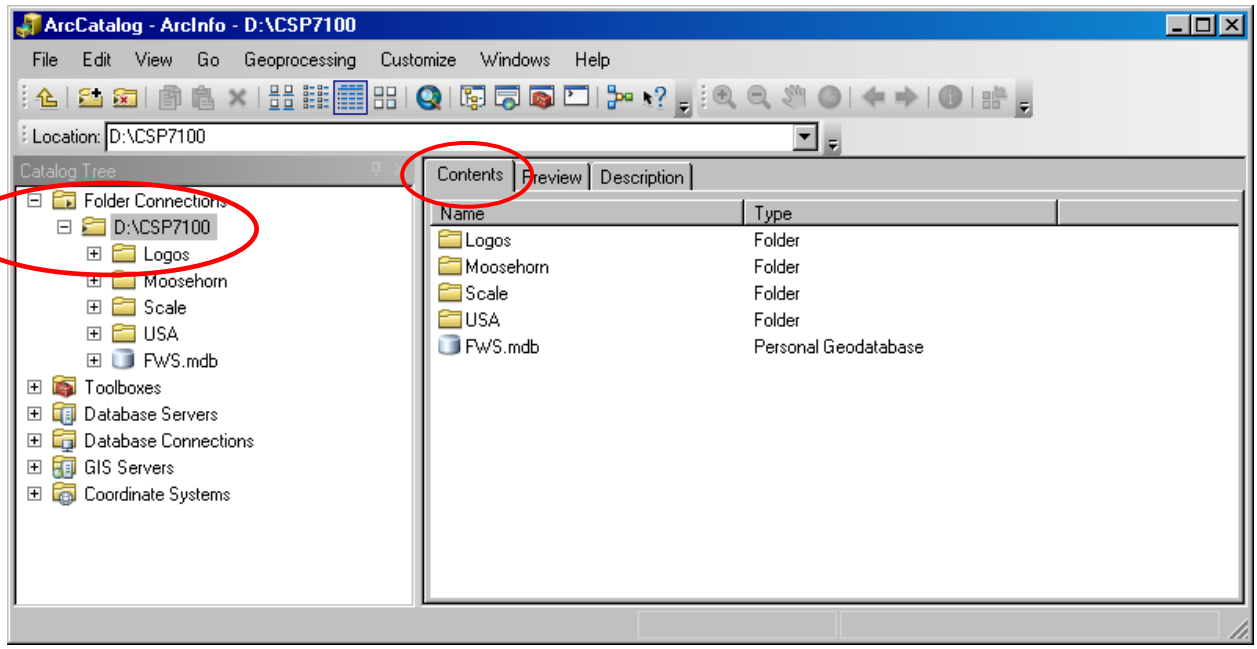
   Note a **connection** to **D:\CSP7100** is created near the top of the catalog tree under **Folder Connections.**



SECTION 3- Exploring the Catalog Tree

1. Ensure the **Contents** tab is selected.

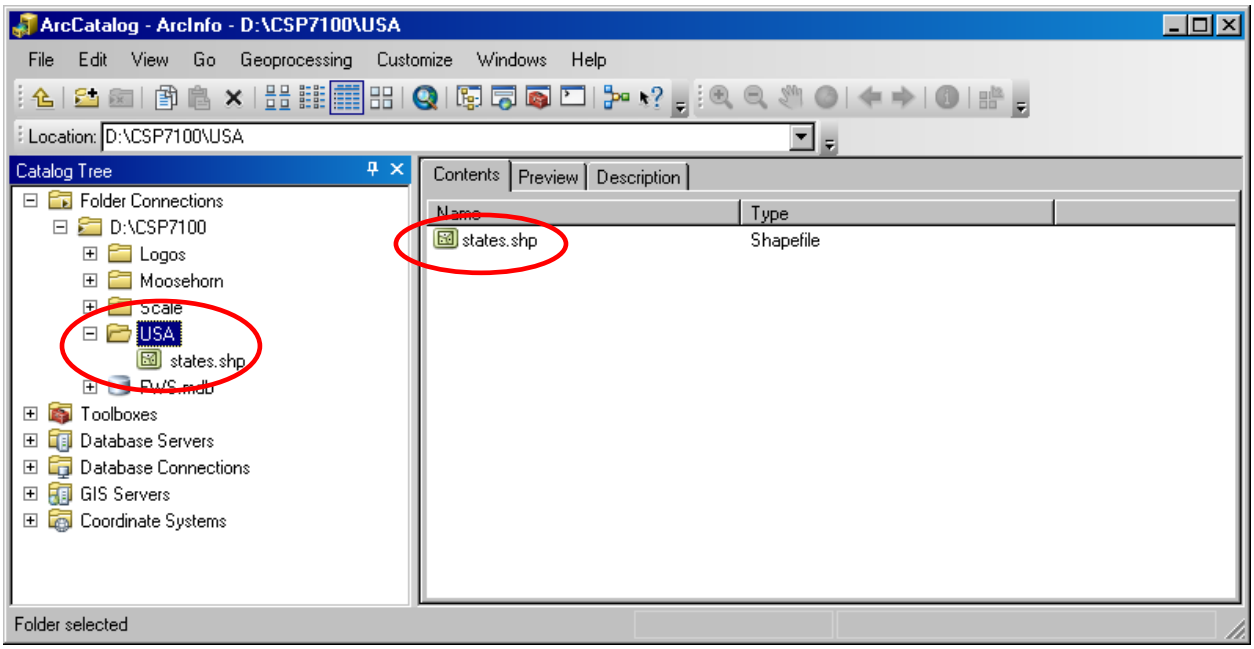
2. In the Catalog Tree Window, click on the **plus** symbol to the left of the **D:\CSP7100** to expand the directory. All of the subfolders appear in the Contents window.



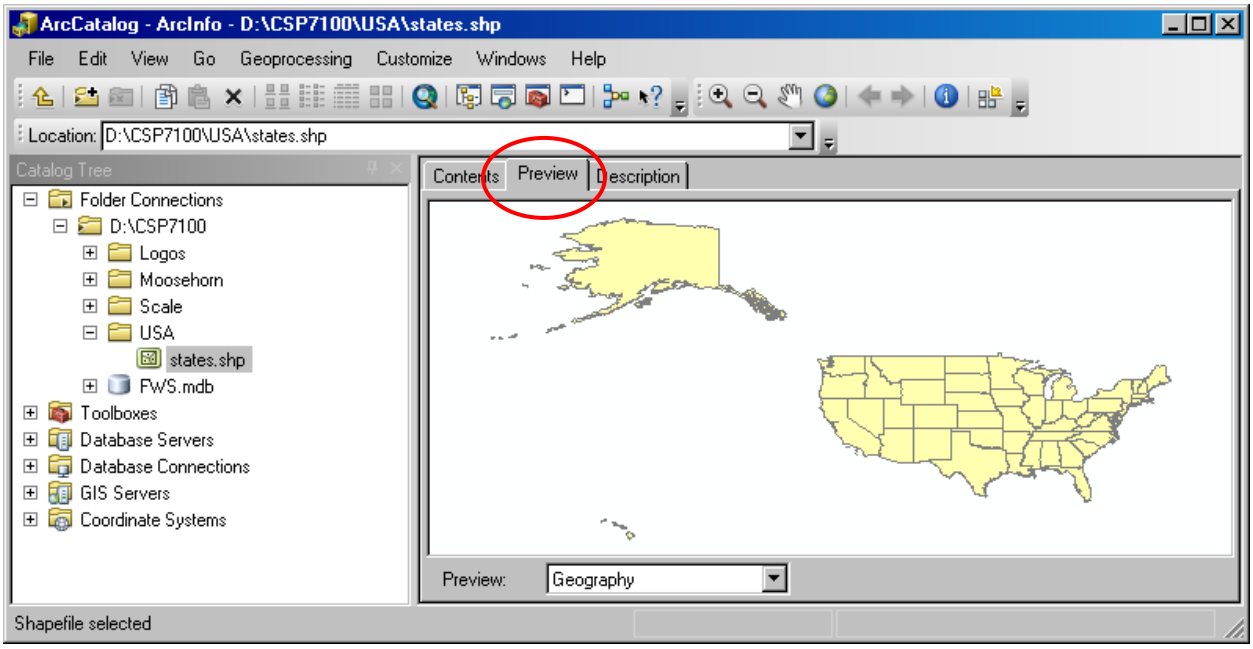
✓TIP: Double-clicking on the folder in the Catalog Tree also displays the folder's contents in the tree and in the Contents window.

3. In the Catalog Tree click on the **USA** folder.

4. A thumbnail of the polygon icon is presented and the file type is specified. (You may have to click the preview tab first, and then go back to the **Contents** tab to see the thumbnail).



5. Select the **states.shp** file in the catalog tree. Click the **Preview** tab. This layer is presented in the catalog display area. You can interact with the layer while in preview mode.

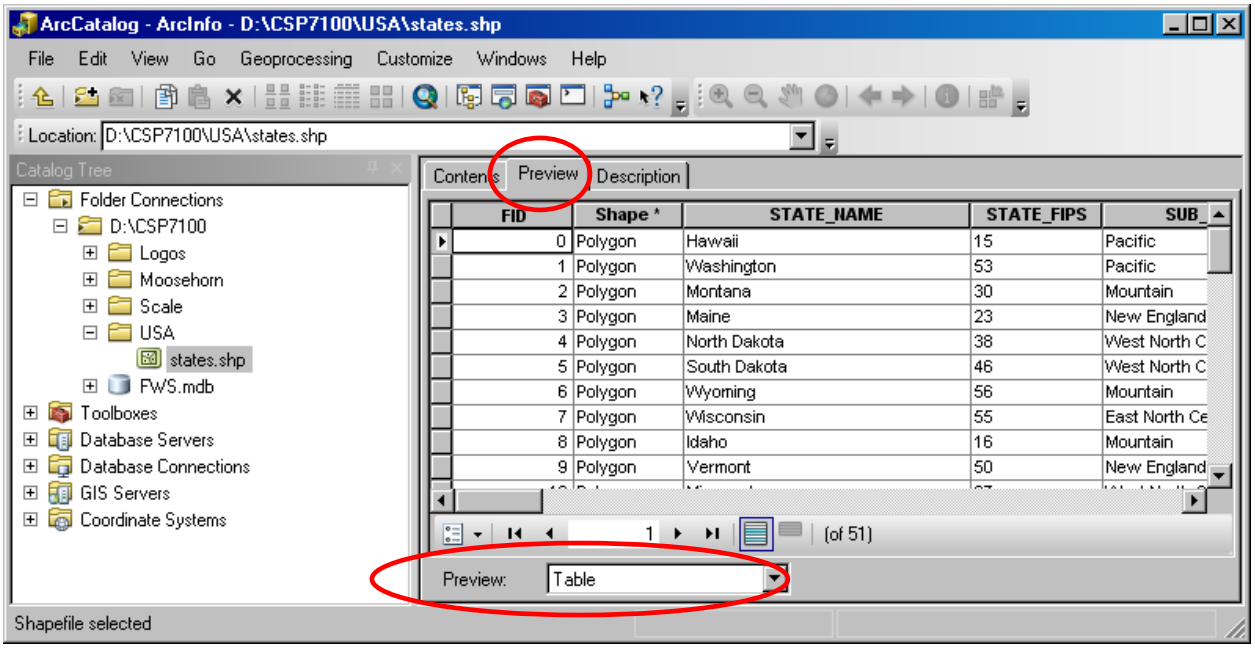


6. Use the **Identify** tool 

and click on your favorite state. When you are finished viewing the attributes, close the *Identify Results* dialog.

7. Now utilize the pan and zoom tools 
which are located on the same toolbar as the Identify tool (Geography toolbar). Become familiar with moving around the catalog display to preview your layer.

8. At the bottom of the catalog display, click on the dropdown arrow and change the preview display from Geography to **Table.**



9. You are now presented with the entire database or table associated with the **states** shapefile. Examine the database and take note of the information available for each state.

10. Change the preview back to **Geography**.

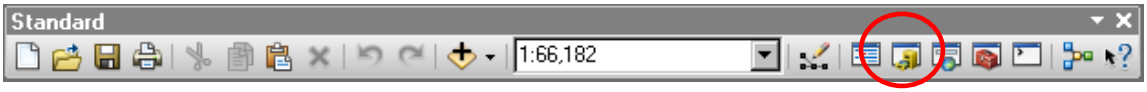
11. Close out Arc Catalog.

Note - Click on the **Launch ArcMap** button located on the **Standard Tool** bar if ArcMap is not open.

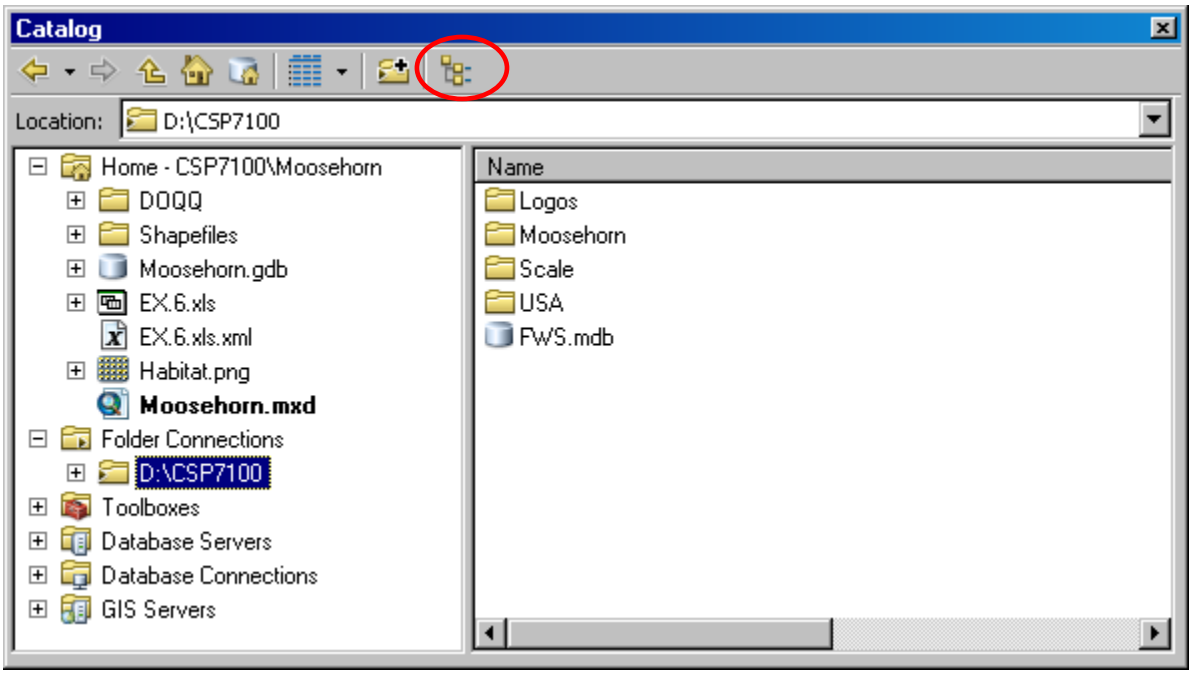
SECTION 4 - Examining files using ArcCatalog Window (ACW)

What is ArcCatalog Window? ArcCatalog Window is a new feature in ArcMap 10 which allows users a convenient way to view the catalog tree without launching ArcCatalog. ArcCatalog Window has the same basic functions as Catalog but not as many options.

1. In Arcmap, Click on the **Catalog Window** located on the **Standard Tool Bar.**



2. Click on **Show Next View** button.

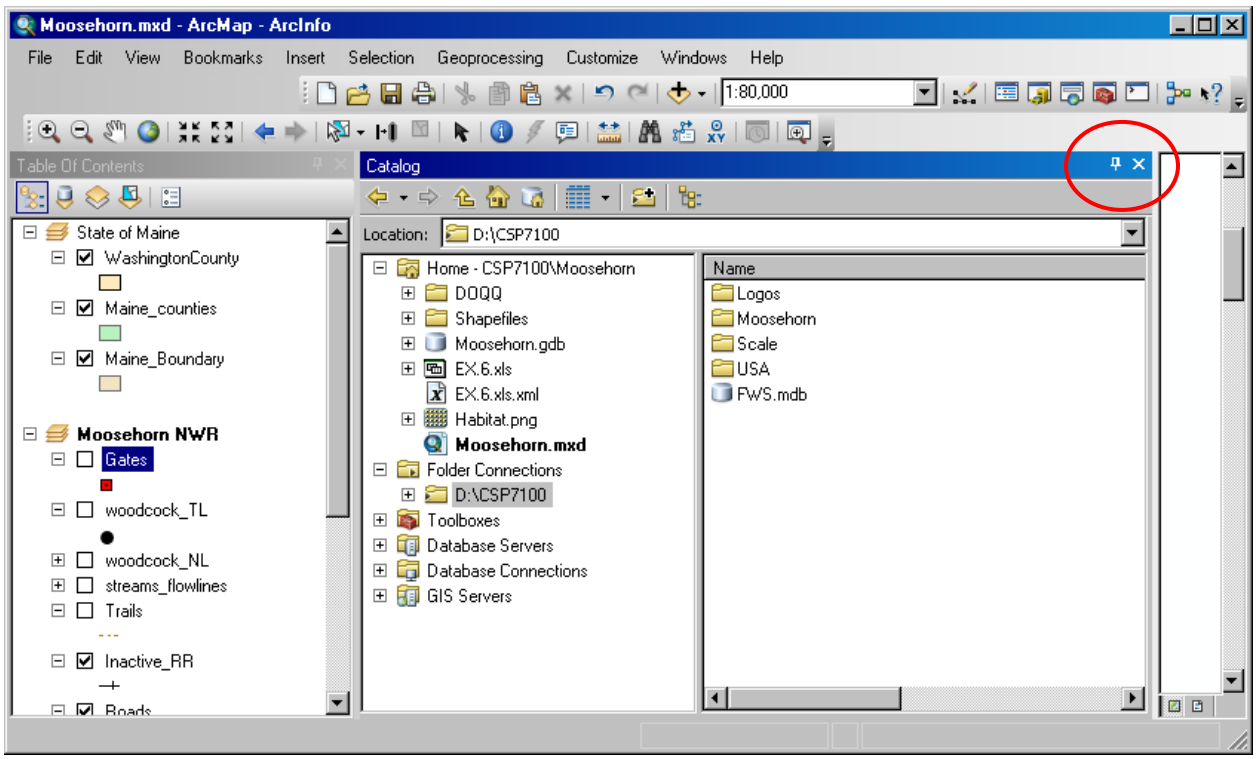


3. Expand the **Home Folder** located at top of the Catalog Tree. Four folders appear in the Contents Window: Logos, Moosehorn, Scale, and USA. There is also a FWS Geodatabase.

   Note, by default the Catalog Tree Window automatically shows the "Home" folder. The **Home** folder displays the directory structure depending upon what .mxd you have open. In this case, it is CSP7100\Moosehorn.

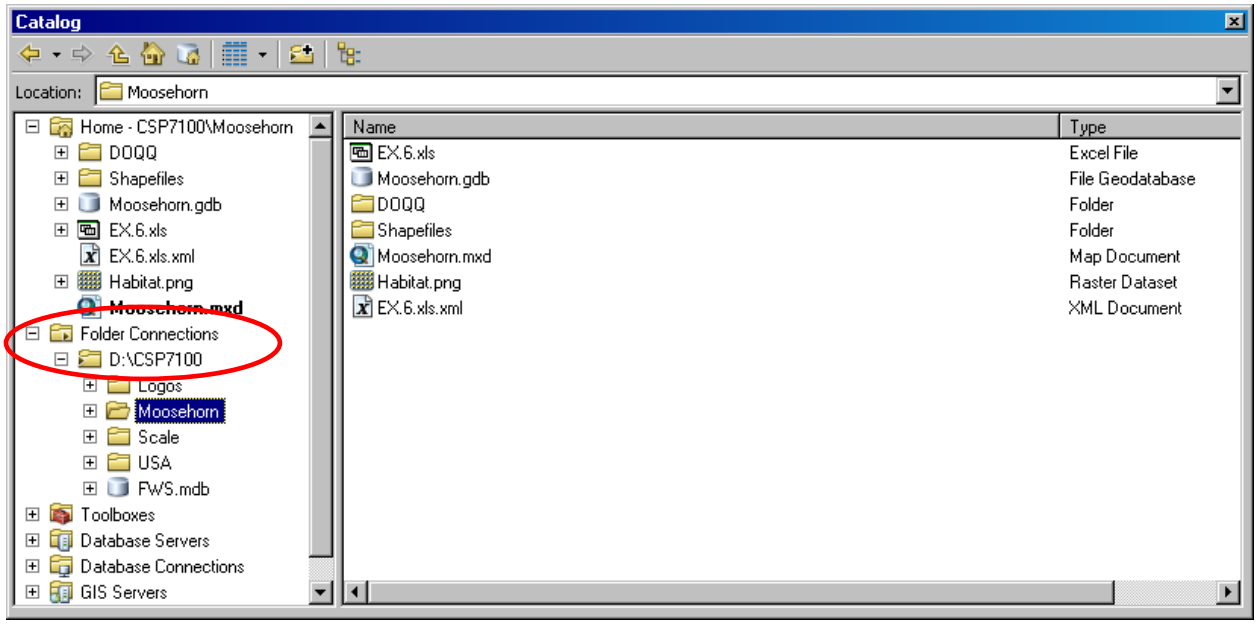
4. Double Click on the title bar of the Catalog Window. The window will dock onto the Data View. A white push pin appears on the right end of the title bar.

5. Click on the push pin. The window minimizes as a Tab.



6. Click on the **Catalog Tab** and again on the Push Pin to un-dock the window.

7. Click on the **Folders Connection >(Just under the Home folder) D:|CSP7100>Moosehorn**. Two folders appear in the Contents window: *DOQQ* and *Shapefiles*. There is also a Moosehorn Geodatabase and the Moosehorn.mxd.



8. Click on the **Moosehorn.mxd.**

A. What is a (.mxd) file?

_____

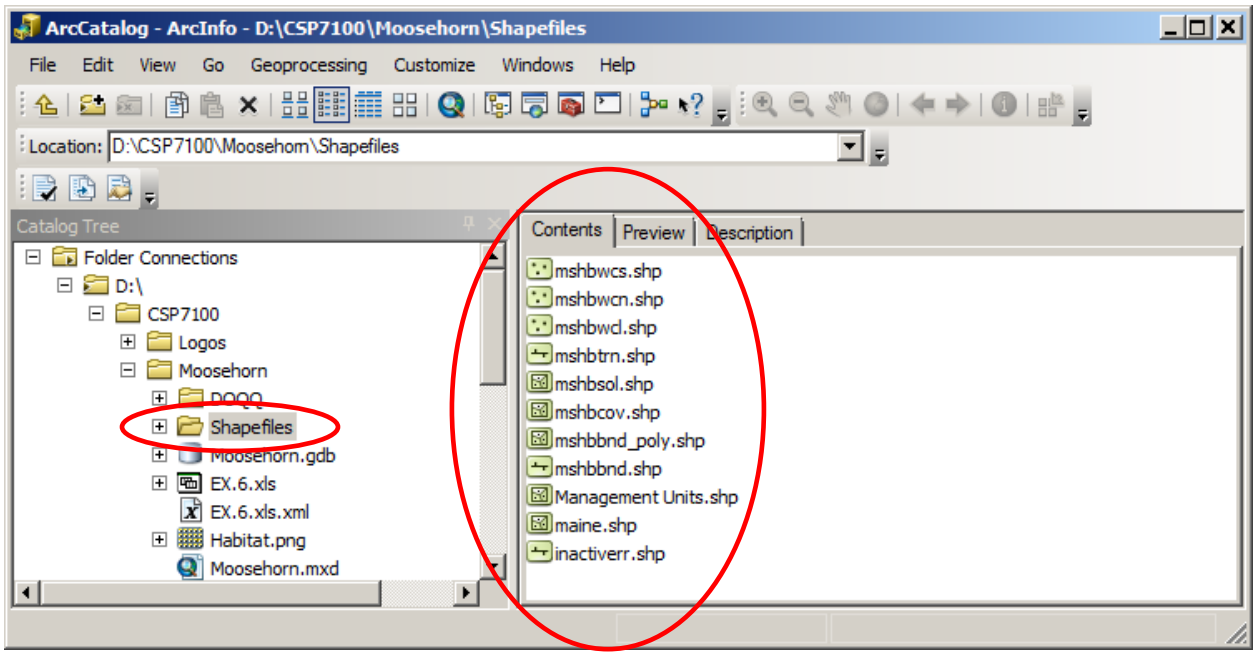
✓TIP: Use the handouts found at the end of this tab to locate a definition or use Help.

STOP -PLEASE STOP HERE BEFORE GOING ON TO THE NEXT SECTION- STOP

SECTION 5 - Viewing Shapefiles and Geodatabases in ACW

1. Double Click on the ***Shapefiles*** folder in the **Contents Window** panel.

B. What is a shapefile?



C. List the number of geographic feature types (Polygon, Point and Line) contained in the ***Shapefiles*** folder

Polygon files_____?

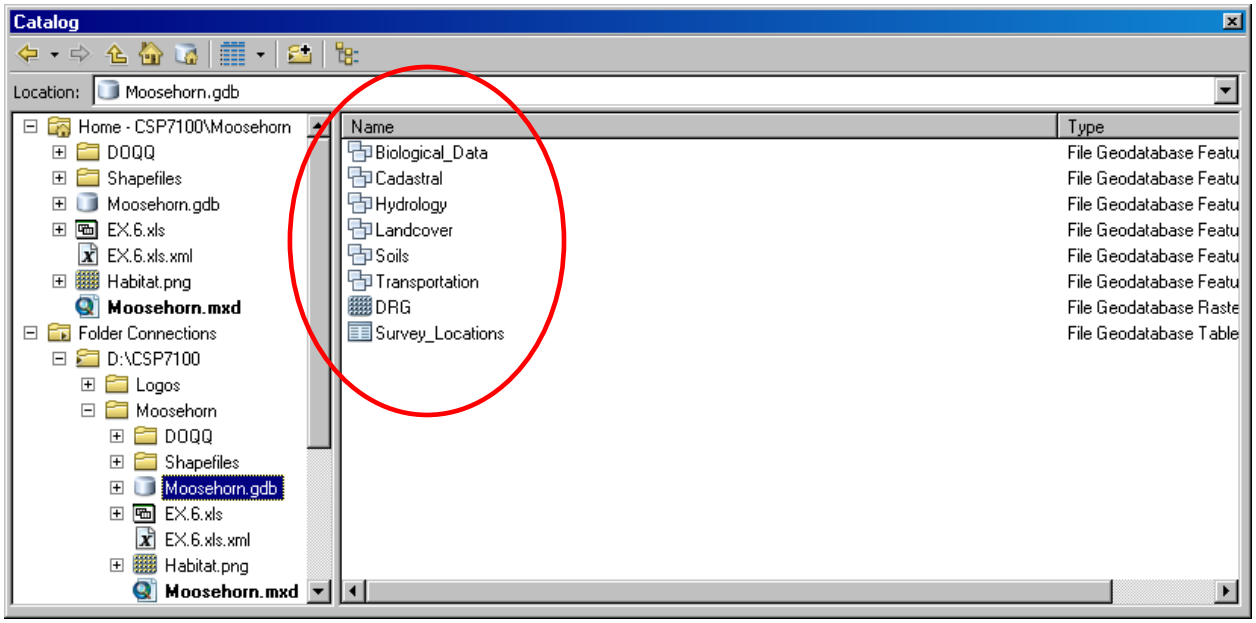
Point files_____?

Line files_____?

D. What icons are used to identify Polygons, Points and Lines?

_____

2. Double-click on the **Moosehorn.gdb** in the catalog tree.



E. What is a .gdb?_____

F. How many **Feature Datasets** are there under **Moosehorn.gdb**?

_____

3. Click on the plus symbol to the left of **Biological_Data** (Feature Dataset).

G. List and identify the **Feature Classes** under:

Biological_Data	
Cadastral	
Landcover	
Soils	

Transportation	

Notes:

Shapefile Definitions - From the ESRI GIS online Dictionary:

Shapefile:

A vector data storage format for storing the location, shape, and attributes of geographic features. A shapefile is stored in a set of related files and contains one feature class.

http://support.esri.com/index.cfm?fa=knowledgebase.gisDictionary.gateway

Overview:

The Shapefile format was developed by ESRI in the 1990's. At minimum the .dbf .shp & .shx files are needed to display data and attributes in ArcGIS.

- Shapefile (.shp) - holds the actual vertices.
- Shapefile database files (.dbf) - holds the attributes in xBase (dBase) format.
- Shapefile index files (.shx) - holds index data pointing to the structures in .shp
- And sometimes by auxiliary files that store the spatial index of the features (.sbn & .sbx).

http://ioc.unesco.org/oceanteacher/resourcekit/M3/Formats/Integrated/SHP/shp.htm
http://shapelib.maptools.org/
http://coastwatch.noaa.gov/cw_form_shp.html
http://exchange.manifold.net/manifold/manuals/5_userman/mfd50Export_Drawing__SHP_Shapefiles.htm

Summarized from the ESRI Shapefile Whitepaper:

http://www.esri.com/library/whitepapers/pdfs/shapefile.pdf

Shapefile Technical Description

An ESRI shapefile consists of a main file, an index file, and a dBASE table. The main file is a direct access, variable-record-length file in which each record describes a shape with a list of its vertices. In the index file, each record contains the offset of the corresponding main file record from the beginning of the main file. The dBASE table contains feature attributes with one record per feature. The one-to-one relationship between geometry and attributes is based on record number. Attribute records in the dBASE file must be in the same order as records in the main file.

Naming Conventions

All file names adhere to the 8.3 naming convention. The main file, the index file, and the dBASE file have the same prefix. The prefix must start with an alphanumeric character (a–Z, 0–9)[It is better to start the file name with a letter, because of some ArcGIS extensions] , followed by zero or up to seven characters (a–Z, 0–9, _, -). The suffix for the main file is .shp. The suffix for the index file is .shx. The suffix for the dBASE table is .dbf. All letters in a file name are in lower case on operating systems with case sensitive file names.

Main file: nctc_boundary.shp

Shapefile record contents consist of a shape type followed by the geometric data for the shape. The length of the record contents depends on the number of parts and vertices in a shape. For each shape type, we first describe the shape and then its mapping to record contents on disk.

Index file: nctc_boundary.shx

The index file is identical in organization to the main file. The *I'th* record in the index file stores the offset and content length for the *I'th* record in the main file.

dBASE table: nctc_boundary.dbf

The dBASE file (.dbf) contains any desired feature attributes or attribute keys to which other tables can be joined. Its format is a standard DBF file used by many table-based applications in Windows™ and DOS. Any set of fields can be present in the table. There are three requirements, as follows:

- The table must contain one record per shape feature.
- The record order must be the same as the order of shape features in the main (*.shp) file.
- The year value in the dBASE header must be the year since 1900.

eXtensible Markup Language: nctc_boundary.shp.xml

Files with the extensions **.shp.xml** contain the metadata associated with the Shapefile. This file can be opened with notepad but is best viewed and edited using the Metadata tools in ArcGIS. This file is automatically created the first time you edit metadata for a Shapefile.

Projection file: nctc_boundary.prj

The extension **.prj** is a text file that contains the projection information for a shapefile. It is human readable and can be opened with most text editors. Note: this is the same extension that was used for older ESRI software, but it is not the same file format.

Map Document Definitions - From the ESRI GIS online Dictionary:

Map document:

> In ArcMap, the file that contains one map, its layout, and its associated layers, tables, charts, and reports. Map documents can be printed or embedded in other documents. Map document files have a .mxd extension.
>
> http://support.esri.com/index.cfm?fa=knowledgebase.gisDictionary.gateway

Overview:

Map documents (.mxd files) are compound files. The information describing the map, layout, and any embedded objects saved in the map is organized into units called storages and streams. In general terms, map documents save a snapshot of your current working environment in ArcMap:

- The paths to all of the data you have loaded into your Table of Contents
- All formatting and Symbology options you have selected
- Annotations
- Extension toggle state (on/off)
- Extension options & working environment
- Toolbar toggle state and placement
- Data Frame properties
- Map Document Properties (use relative paths)
- To keep .mxd file size down occasionally use "Save As" instead of "Save"

http://support.esri.com/index.cfm?fa=knowledgebase.techarticles.articleShow&d=20872

Geodatabase – Form the ESRI GIS online Dictionary:

Geodatabase:

A collection of geographic datasets for use by ArcGIS. There are various types of geographic datasets, including feature classes, attribute tables, raster datasets, network datasets

http://support.esri.com/index.cfm?fa=knowledgebase.gisDictionary.search&searchTerm=geodatabase

Geodatabase data model:

The schema for the various geographic datasets and tables in an instance of a geodatabase. The schema defines the GIS objects, rules, and relationships

Geodatabase feature dataset:

In a geodatabase, a collection of feature classes stored together so they can participate in topological relationships with one another. All the feature classes in a feature dataset must share the same spatial reference; that is, they must have the same coordinate system and their features must fall within a common geographic area. Feature classes with different geometry types may be stored in a feature dataset. In ArcGIS, feature classes that participate in a geometric network.

Overview:

The geodatabase provides a framework for geographic information and supports topologically integrated feature classes. These datasets are stored, analyzed, and queried as layers similar to the coverage and shapefile models. The geodatabase also extends these models with support for complex networks, topologies, relationships among feature classes, and other object-oriented elements. This framework can be used to define and work with a wide variety of different user- or application-specific models.

The geodatabase supports both vector and raster data. Entities are represented as objects with properties, behavior, and relationships. Support for a variety of different geographic object types is built into the system. These object types include simple objects, geographic features, network features, annotation features, and other more specialized feature types. The model allows you to define relationships between objects and rules for maintaining referential and topological integrity between objects.

Designing the geodatabase:

How data is stored in the database, the applications that access it, and the client and server hardware configurations are all key factors to a successful multiuser geographic information system (GIS). Setting up a single-user system involves fewer considerations. In both cases, though, successfully implementing a GIS starts with a good data model design. Designing a geodatabase requires planning and revision until you reach a design that meets your requirements. You can either start with an existing geodatabase design or design your own from scratch. Once you have a design, you can create the geodatabase and its schema by creating new database items with ArcCatalog, importing existing data, using Unified Modeling Language (UML) and Computer-Aided Software Engineering (CASE) tools, or a combination of these.

Creating and managing the geodatabase:

The main tools you will use to create and edit geodatabases are found in ArcCatalog and ArcMap. ArcCatalog has various tools for creating and modifying your geodatabase schema and ArcMap has tools for analyzing and editing the contents of your geodatabase. Using ArcCatalog, you can establish relationships between objects in different object classes, connectivity rules for geometric networks, and topological rules for features in topologies. You can continue to use the geodatabase management tools in ArcCatalog to refine or extend a geodatabase once it has been designed and implemented

ArcInfo Coverage from the ESRI support center: Online.

Coverage:

1. A digital version of a map forming the basic unit of vector data storage in ArcInfo. Coverages stores geographic features as primary features (such as arcs, nodes, polygons, and label points) and secondary features (such as tics, map extent, links, and annotation). Associated feature attribute tables describe and store attributes of the geographic features.
2. A set of thematically associated data considered as a unit. A coverage usually represents a single theme such as soils, streams, roads, or land use.

ArcInfo Coverage:

A single E00 file describes a complete ArcInfo coverage. The file itself is actually an archive of several smaller files, referred to here as *subfiles*. Some of these subfiles have fixed names which do not vary from coverage to coverage, and follow a predefined data format. These are referred to as the *standard subfiles*. The remaining subfiles contained within an E00 are *info files*. These files may contain user-defined attributes, and have names which vary from coverage to coverage.

Geometry Composition

There are essentially four types of geometry defined in E00 files:

- arcs (lines)
- points
- polygons
- text

The geometries are formed by forming relations between certain standard subfiles and certain info files.

Discussion/Lecture: Datums, Map Projections and Coordinates

Session Objectives: At the conclusion of this session, you will be able to:

- Describe a Geodetic Datum
- Describe and identify various map projections
- Differentiate coordinate systems
- Define UTM coordinates

Materials created by: Mark Richardson
Revised: April 2008 by Mark Richardson and Christopher Bryant
Notes: ArcMap 10

Notes:

Notes:

Notes:

Notes:

USGS
science for a changing world

The Universal Transverse Mercator (UTM) Grid

Fact Sheet 077-01 (August 2001)

|| Map Projections || Grids || The Universal Transverse Mercator Grid ||
|| Determining a UTM Grid Value for a Map Point || Information ||

Map Projections

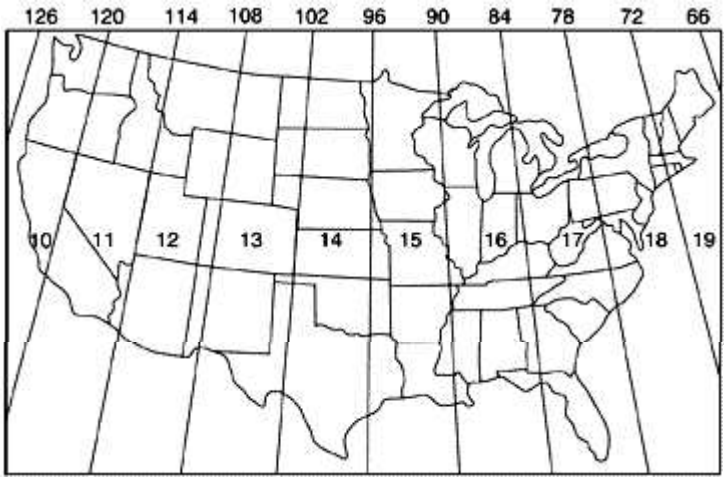
The most convenient way to identify points on the curved surface of the Earth is with a system of reference lines called parallels of latitude and meridians of longitude. On some maps, the meridians and parallels appear as straight lines. On most modern maps, however, the meridians and parallels appear as curved lines. These differences are due to the mathematical treatment required to portray a curved surface on a flat surface so that important properties of the map (such as distance and areal accuracy) are shown with minimum distortion. The system used to portray a part of the round Earth on a flat surface is called a map projection.

|| Top || Main Table of Contents ||

Grids

To simplify the use of maps and to avoid the inconvenience of pinpointing locations on curved reference lines, cartographers superimpose on the map a rectangular grid consisting of two sets of straight, parallel lines, uniformly spaced, each set perpendicular to the other. This grid is designed so that any point on the map can be designated by its latitude and longitude or by its grid coordinates, and a reference in one system can be converted into a reference in another system. Such grids are usually identified by the name of the particular projection for which they are designed.

The Universal Transverse Mercator Grid



The National Imagery and Mapping Agency (NIMA) (formerly the Defense Mapping Agency) adopted a special grid for military use throughout the world called the Universal Transverse Mercator (UTM) grid. In this grid, the world is divided into 60 north-south zones, each covering a strip 6° wide in longitude. These zones are numbered consecutively beginning with Zone 1, between 180° and 174° west longitude, and progressing eastward to Zone 60, between 174° and 180° east

Figure 1. The Universal Transverse Mercator grid that covers the conterminous 48 United States comprises 10 zones—from Zone 10 on the west coast through Zone 19 in New England.

longitude. Thus, the conterminous 48 States are covered by 10 zones, from Zone 10 on the west coast through Zone 19 in New England (fig. 1). In each zone, coordinates are measured north and east in meters. (One meter equals 39.37 inches, or slightly more than 1 yard.) The northing values are measured continuously from zero at the Equator, in a northerly direction. To avoid negative numbers for locations south of the Equator, NIMA's cartographers assigned the Equator an arbitrary false northing value of 10,000,000 meters. A central meridian through the middle of each 6° zone is assigned an easting value of 500,000 meters. Grid values to the west of this central meridian are less than 500,000; to the east, more than 500,000.

Virtually all NIMA-produced topographic maps and many aeronautical charts show the UTM grid lines.

|| Top || Main Table of Contents ||

Determining a UTM Grid Value for a Map Point

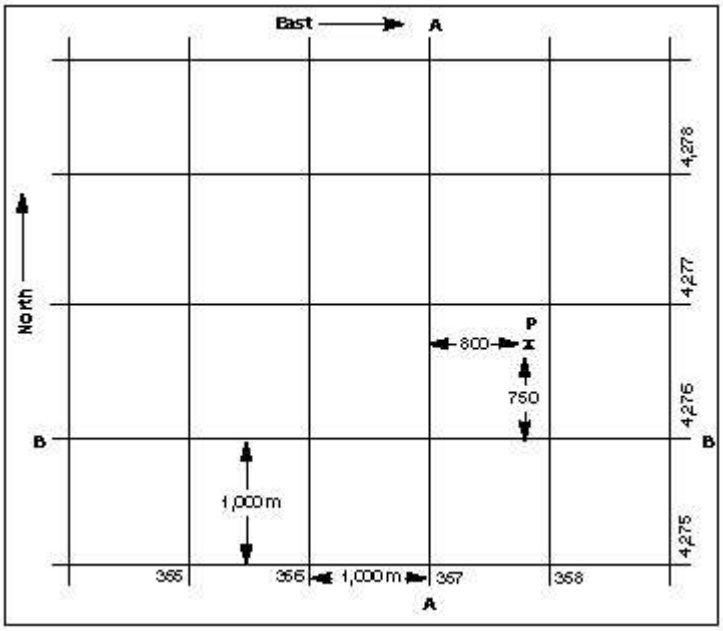


Figure 2. The grid value of line A-A is 357,000 meters east. The grid value of line B-B is 4,276,000 meters north. Point P is 800 meters east and 750 meters north of the grid lines; therefore, the grid coordinates of point P are north 4,276,750 and east 357,800.

The UTM grid is shown on all quadrangle maps prepared by the U.S. Geological Survey (USGS). On 7.5-minute quadrangle maps (1:24,000 and 1:25,000 scale) and 15-minute quadrangle maps (1:50,000, 1:62,500, and standard-edition 1:63,360 scales), the UTM grid lines are indicated at intervals of 1,000 meters, either by blue ticks in the margins of the map or with full grid lines. The 1,000-meter value of the ticks is shown for every tick or grid line. In addition, the actual meter value is shown for ticks nearest the southeast and northwest corners of the map. Provisional maps at 1:63,360 scale show full UTM grids at 5,000-meter intervals.

To use the UTM grid, you can place a transparent grid overlay on the map to subdivide the grid, or you can draw lines on the map connecting corresponding ticks on opposite edges. The distances can be measured in meters at the map scale between any map point and the nearest grid lines to the south and west. The northing of the point is the value of the nearest grid line south of it plus its distance north of that line; its easting is the value of the nearest grid line west of it plus its distance east of that line (see fig. 2).

On maps at 1:100,000 and 1:250,000 scale, a full UTM grid is shown at intervals of 10,000 meters and is numbered and used in the same way.

Information

For information on USGS products and services, call 1-888-ASK-USGS, or visit the general interest publications Web site on mapping, geography, and related topics at erg.usgs.gov/isb/pubs/pubslists/.

For additional information, visit the ask.usgs.gov Web site or the USGS home page at www.usgs.gov.

| Top | Main Table of Contents | Mapping Publications | Eastern Region Geography | Geography Home |

This document has undergone official review and approval for publications established by the National Mapping Discipline, U.S. Geological Survey. Some figures have been modified or added to improve the scientific visualization of information.

U.S. Department of the Interior — U.S. Geological Survey — 509 National Center, Reston, VA 20192, USA
URL: *http:// erg.usgs.gov /isb/pubs/factsheets/fs07701.html* — **Page Maintainer:** USGS Eastern Region Geography
For information on the USGS or USGS products contact: ask@usgs.gov
For comments or suggestions on this page please use the ERG feedback form
Last modified: 10:16:41 Fri 20 Feb 2004 — USGS Privacy Policy and Disclaimers — Accessibility

Exercise 3: Changing Map Projections

Session Objectives: At the conclusion of this session, you will be able to:

- Define Data Frames
- Change the Coordinate display in the Status Bar
- Change Map Projections
- Create Coordinate Favorites

Materials created by: Khemarith So, Karen Klinger, Christopher Bryant and Mark Richardson
Revised: August, 2012 by Mark Richardson
Notes: ArcMap 10, Service Pack 4

What is a Data Frame?

A data frame is a data element in the Table of Contents which contains the map layers. The data frame properties (map projection, coordinate system and datum) determine how the layers will be **displayed** or **projected** in the **Data View**. Individual maps (.mxd) can have one or multiple data frames. Data frames are analogous to chapters in a book or atlas. As a result, multiple data frames can allow the user to view the same layer in entirely different map projections.

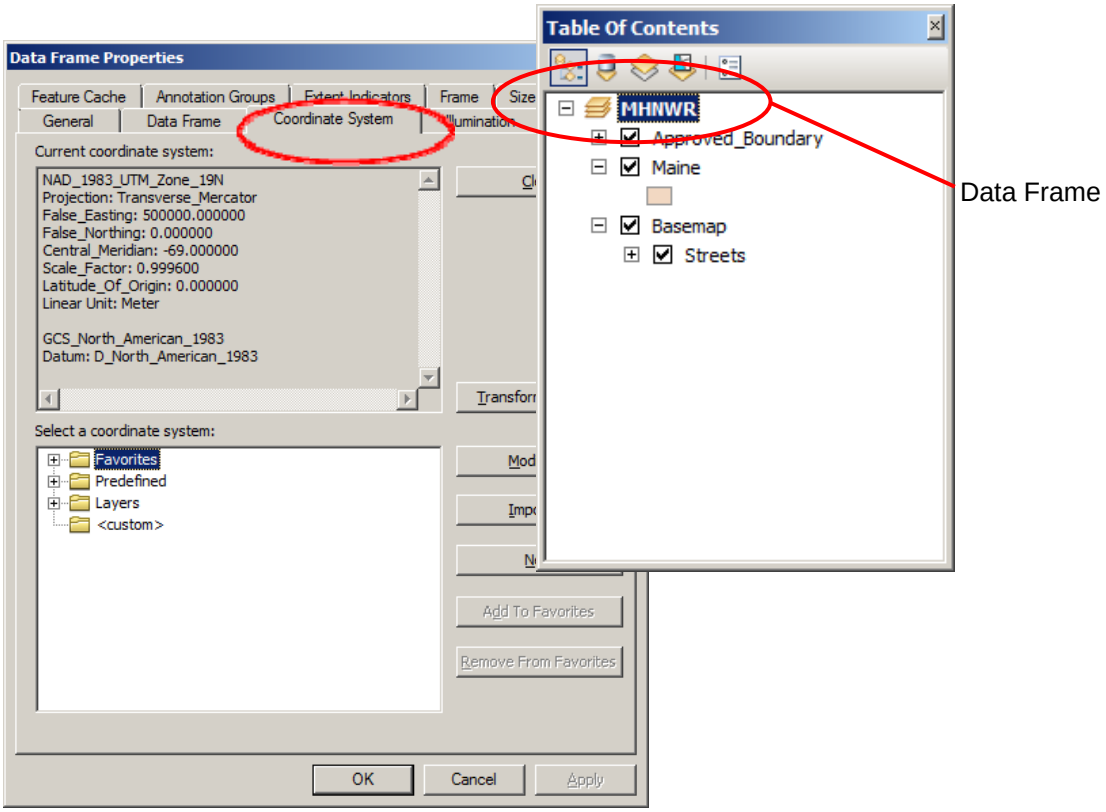
SECTION 1- Viewing the current Map Projection

1. Go up to the **Main menu**>**View**> and ensure the **Status Bar** is checked

2. Right Click **Maine** data layer>**Zoom To Layer** .

3. Right Click on the **MHNWR** data frame>**Properties** .

4. Click on the **Coordinate System** tab.



✓TIP: Other ways to activate the data frame are to select the data frame in the Table of Contents and press F11 or hold down Alt and click on the data frame.

A. What is the current Coordinate system and Datum?

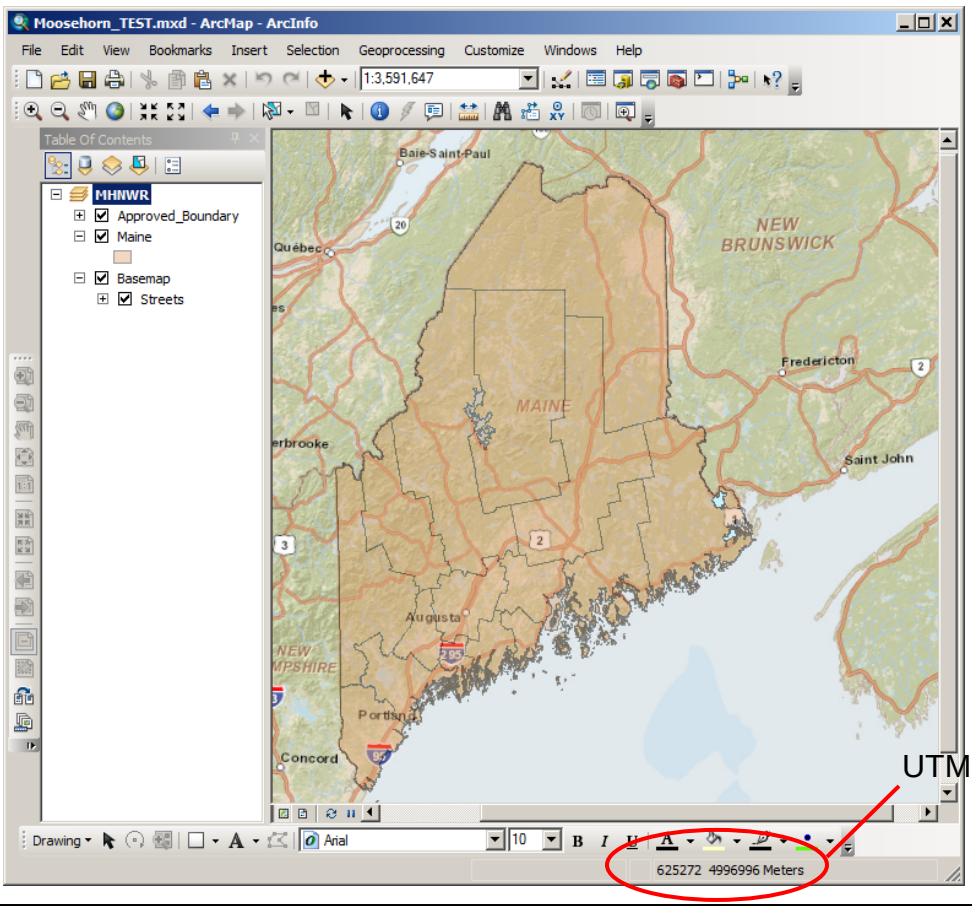
Coordinate System_____

Datum_____

5. Click **Cancel** to close the **Data Frame Properties** Window.

6. Move the mouse pointer over the Data View and observe how the coordinate values (Northing and Easting) change in the **Status Bar** as you move the mouse pointer.

7. Now, move the mouse point over the MHNWR Baring Unit (approximate center) and over Augusta, ME. Record their approximate UTM Coordinates values below:



B. Baring Unit - Easting_____Northing _____

C. Augusta, ME - Easting_____Northing _____

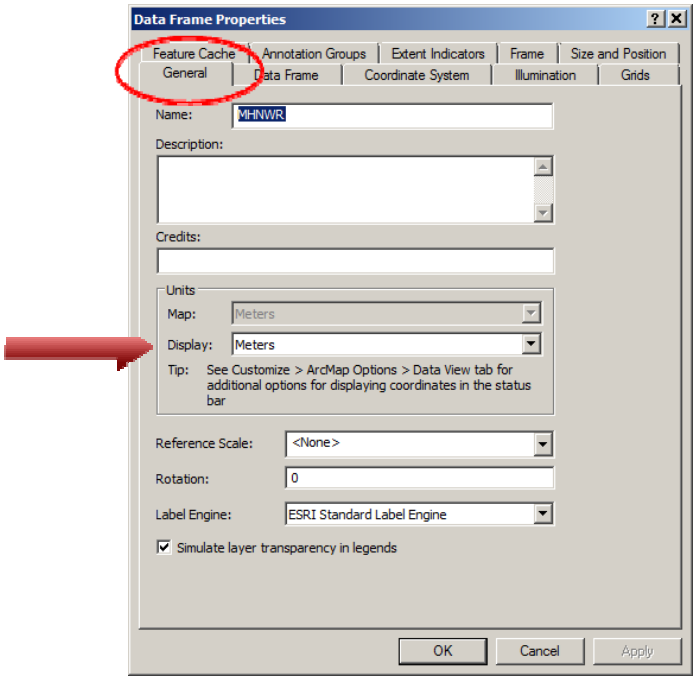
✓*TIP: The number of decimal places can be changed and commas can be added in the coordinate display at the bottom status bar. Go to* ***Customize*** *in the standard toolbar >* ***ArcMap Options*** *>* ***Data View*** *>****Coordinates***

SECTION 2- Changing the Coordinate Display

Data frames have a set of properties that define their characteristics, including how coordinates units (UTM, DMS or SPCS) are displayed on the **Status Bar** within the Data View.

1. Right Click on the **MHNWR** data frame>**Properties.**

2. Click on the **General** tab.



3. Under Units, note the **Display** is set to **Meters** and the **Map** (grayed out) is set to Meters as well. Why?

4. Change **the Display** to **Degrees Minutes and Seconds** (DMS).

5. Click **OK.**

6. Mouse over the Data View again, notice how the Status Bar displays in **DMS** instead of UTM coordinates

D. What are the approximate coordinate values for the Baring Unit in DMS?

Degree____Minutes___Seconds____

7. Double click on **MHNWR** data frame and change the display back to **Meters** in the Data Frame Properties Window.

SECTION 3 - Changing the Coordinate System

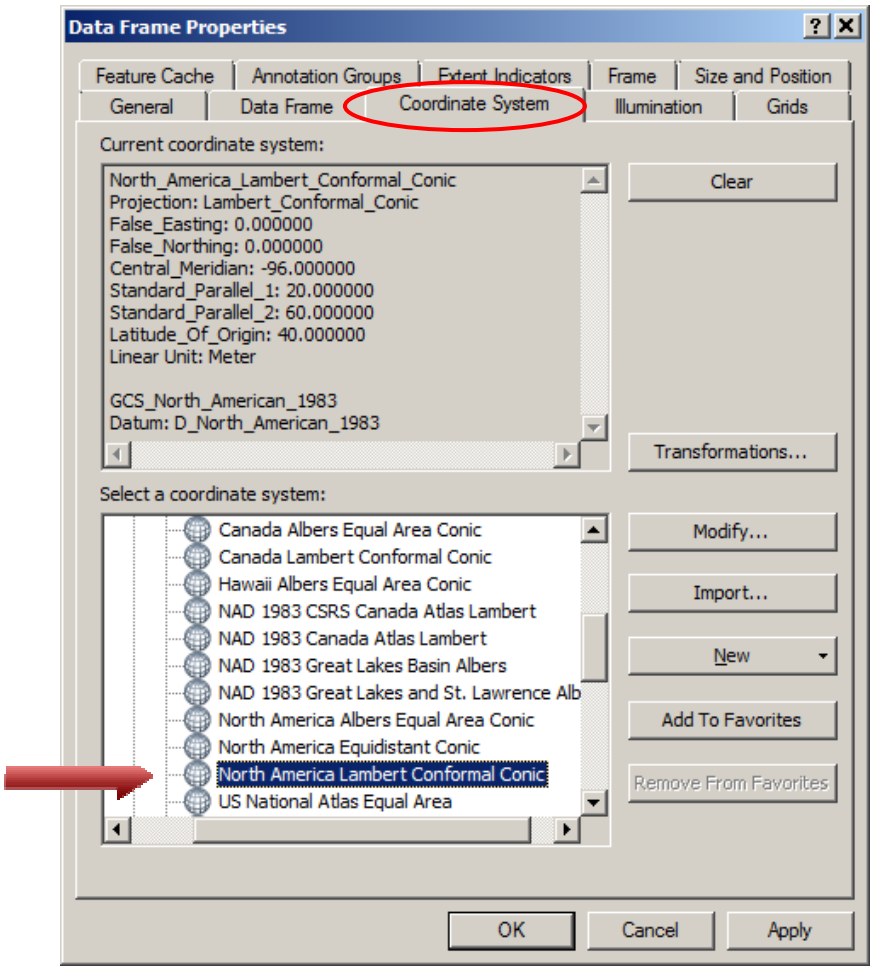
1. Un-check the **Basemap** and **Approved_Boudary** layers.

2. Right Click on **Maine**>**Zoom To Layer** .

3. Double-click on the **MHNWR** data frame to open up the Data Frame Properties window.

4. Click on the **Coordinate System** tab.

5. In the **Select Coordinate System** dialog box navigate to **Predefined > Projected Coordinate Systems**>**Continental**> **North America**



6. Scroll down the list and select >**North American Lambert Conformal Conic**

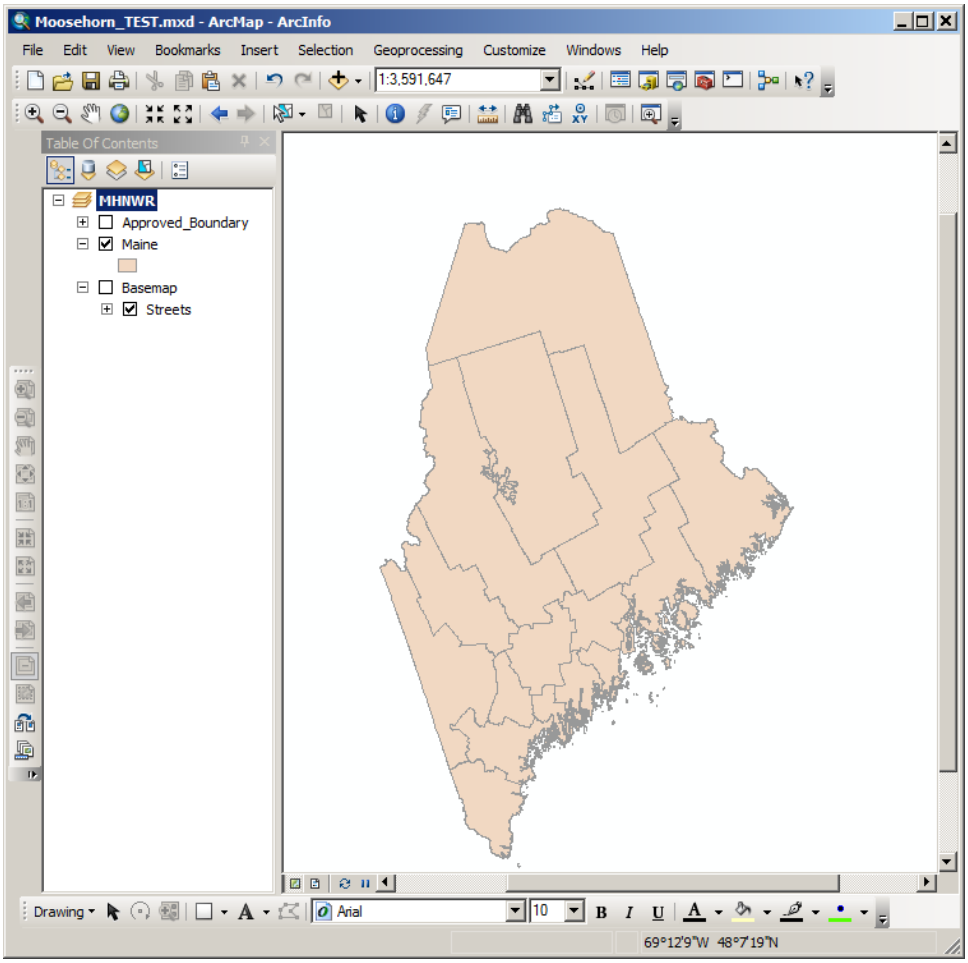
7. Click **OK.**

The State of Maine is now being (temporarily) displayed in the North American Lambert Conformal Conic map projection.

E. What changes in the map display did you observe?

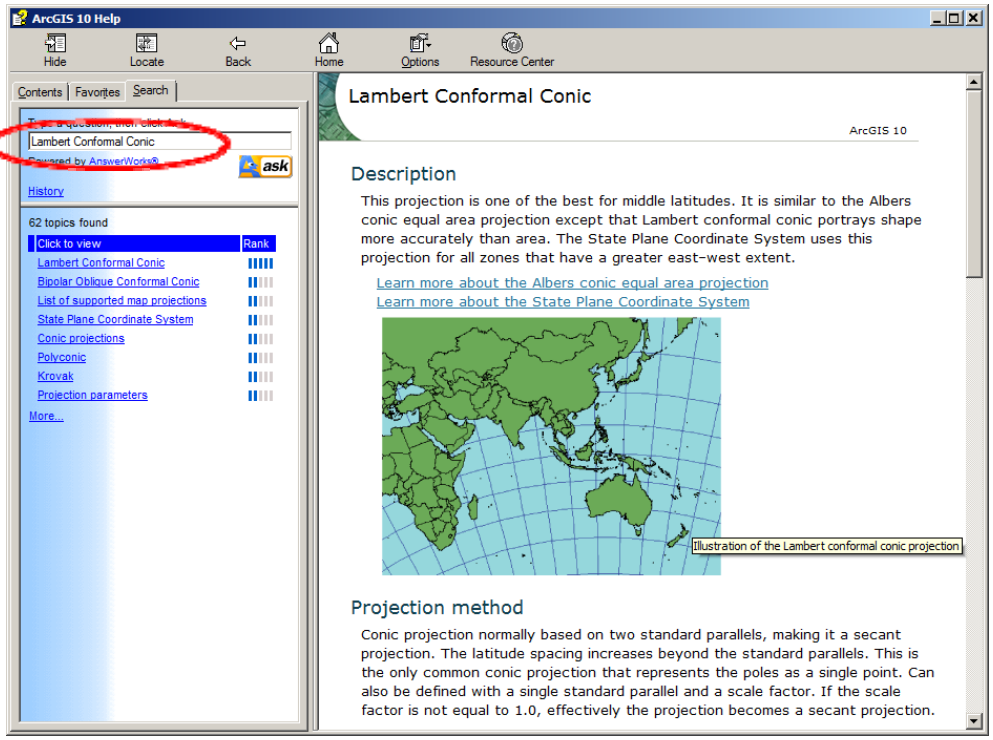
_____

_____



8. Go to **Help>ArcGIS Desk Help**

9. Conduct an individual search on **Lambert Conformal Conic** and **Universal Transverse Mercator.**



F. Based on your search results, fill in the chart below identifying the **general** (don't get hung-up with the technical details!) uses, properties and limitations for each map projection:

Projection	Lambert Conformal Conic	Transverse Mercator
Description/Uses		
Properties		
Limitations		

Return to the Data Frame Properties for **MHNWR** and change the map back to **NAD83, UTM Zone 19**

Notes:

Exercise 4: Inserting New Data Frames and Layers

Session Objectives: At the conclusion of this session, you will be able to:

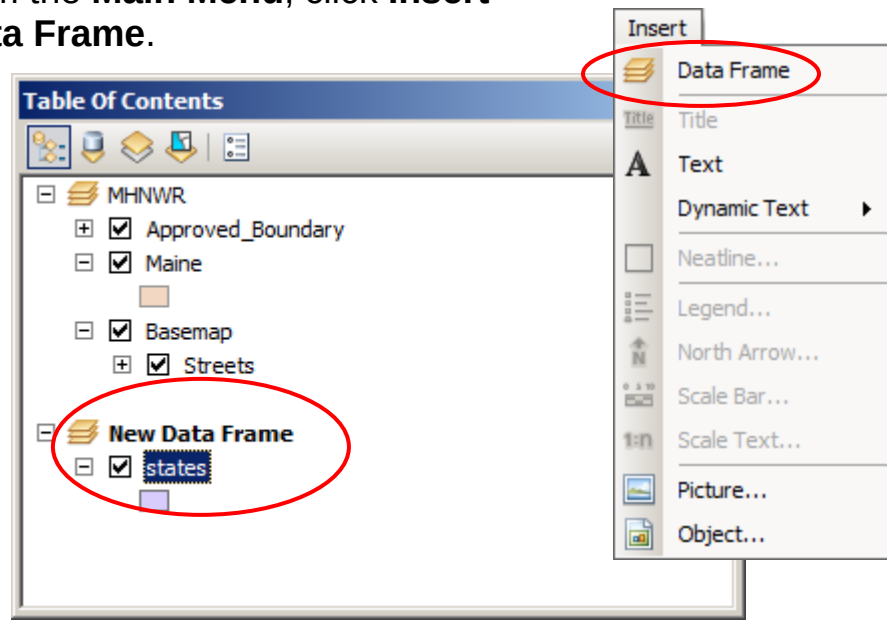
- Activate, insert and modify Data Frames
- Add and modify layers
- Add a online base map from ESRI

Materials created by: Khemarith So and Karen Klinger, Christopher Bryant and Mark Richardson

Revised: August, 2012 by Mark Richardson
Notes: ArcMap 10, Service Pack 4

SECTION 1 - Inserting Data Frames

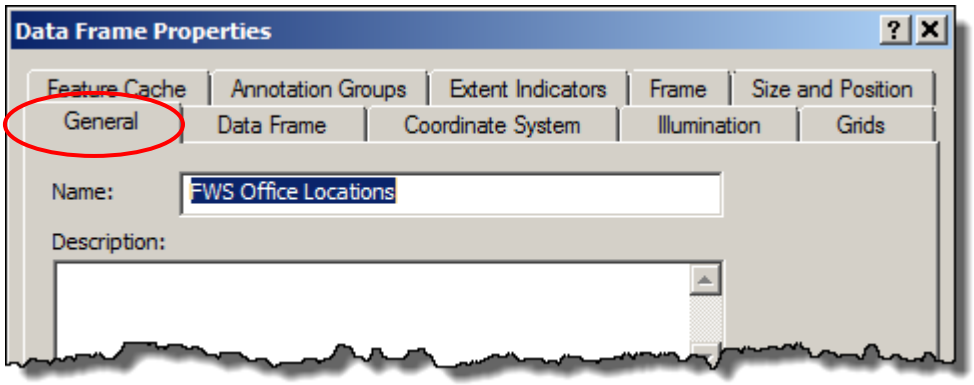
1. From the **Main Menu**, click **Insert** > **Data Frame**.



Note - the new data frame, by default, is **Active**.

2. Double Click **New Data Frame**> **Properties**.

3. Click on the **General** tab. Change the name from **New Data Frame** to **FWS Office Locations**. Click **OK**.



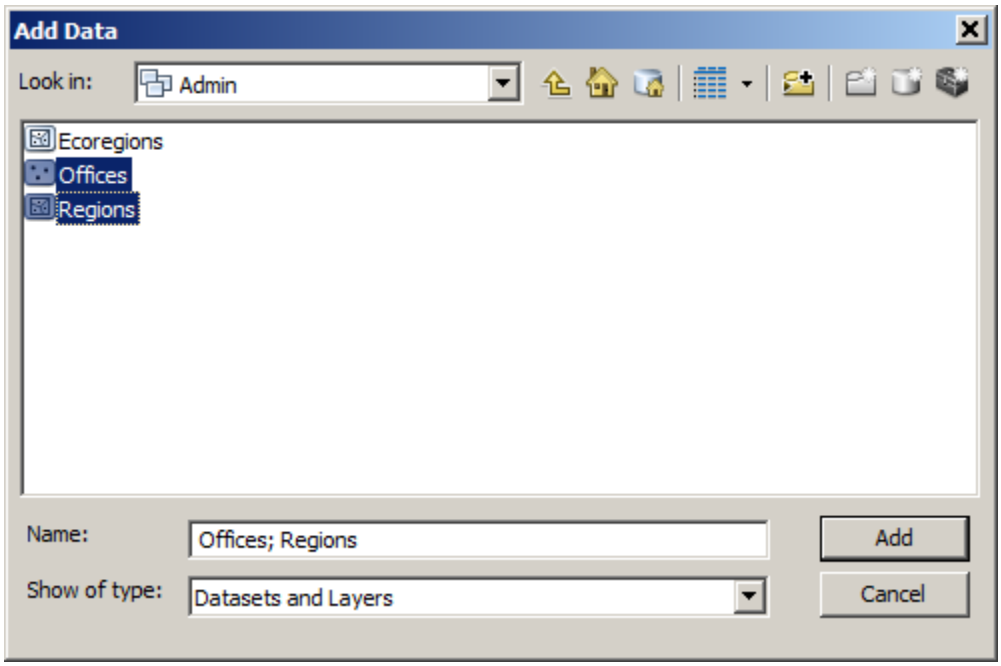
SECTION 2 - Adding layers from a Geodatabase

1. Click on the **Add Data** button. Navigate to the **D:** drive and open the **CSP7100** folder.

2. Double-click on the **FWS.mdb**> **Admin** (Feature Dataset).

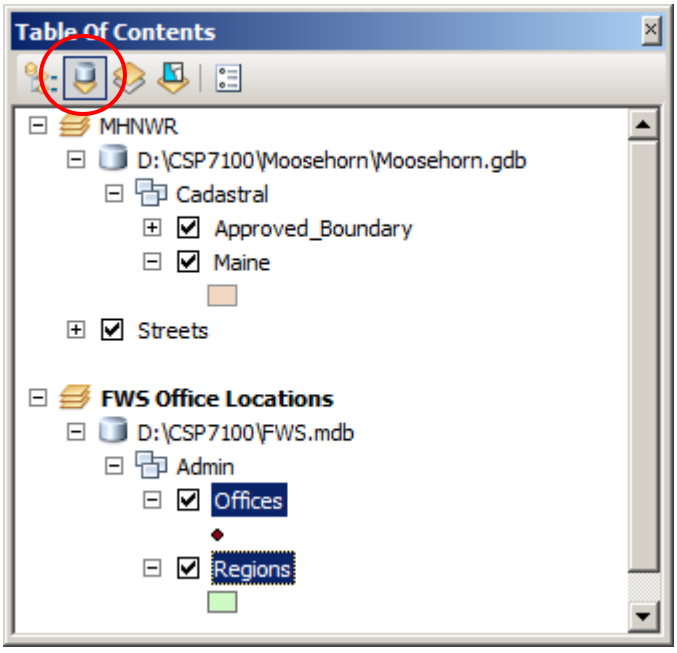
> ✓*TIP: Additional data frames can be used as (1) insets or overviews to highlight areas that don't overlap the main data frame, or (2) to compare different layers side by side.*

3. Select **Regions** (Feature Class) and, holding down the **Shift** key or **Ctrl** key, select **Offices** (Feature Class). Click **Add**.



4. Click on the **List by Source** icon at the top of the **Table of Contents**.

Notice how the Table of Contents shows the FWS Geodatabase icon and location of the source file.



5. Click on the **List by Drawing Order**. Turn off (uncheck) the **Offices** layer.

6. Right click on the **Regions** >**Zoom To Layer**.

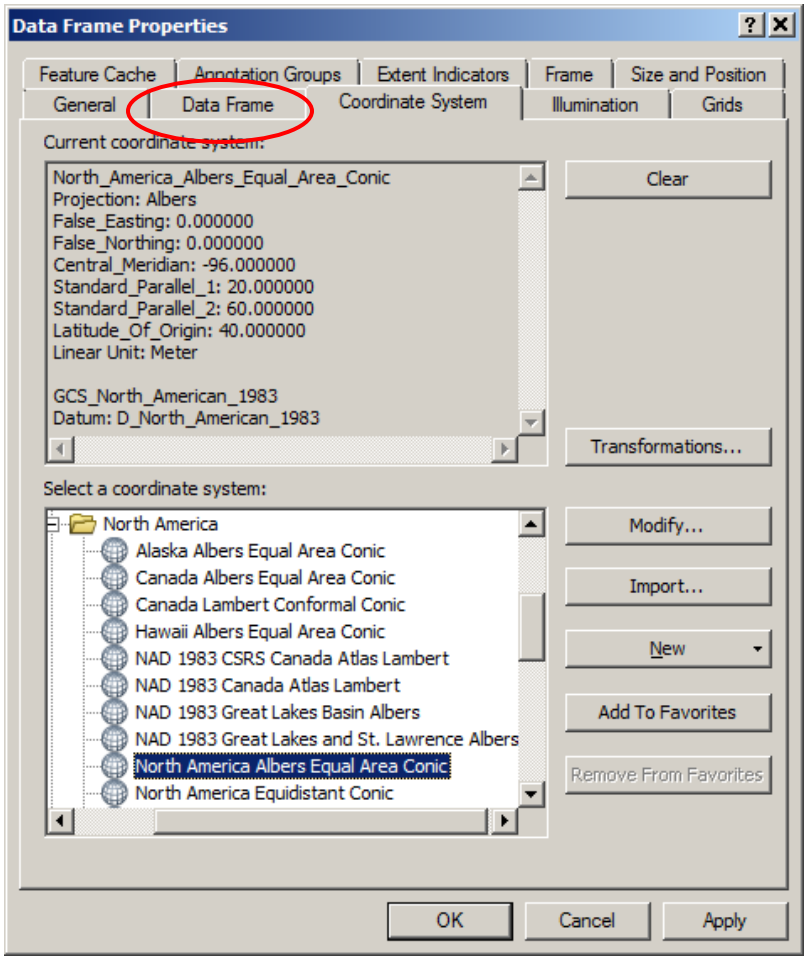
7. Double click **FWS Office Locations**> **Properties**.

8. Click on the **Coordinate System** tab.

   Notice the current coordinate system is GCS_North_American_1983

9. In the **Select a coordinate system** box, click **Predefined** > **Projected Coordinate Systems** > **Continental** > **North America** > **USA Contiguous Albers Equal Area Conic**.

10. Once your screen matches the one below, click **OK**.



Look at how the visual display of the United States has changed by changing the coordinate system.

11. Turn on the **Offices** layer.

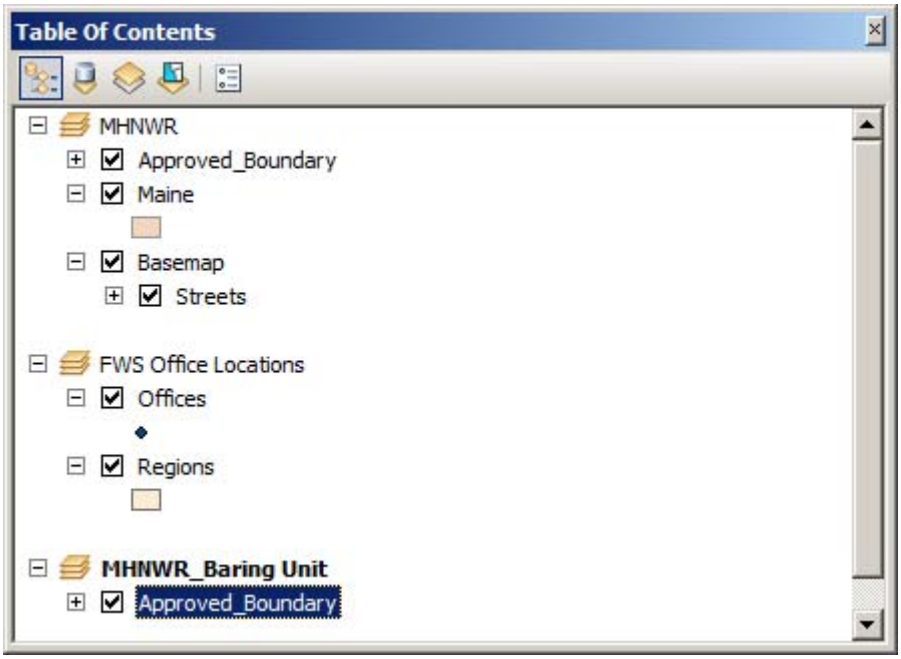
✓TIP: To expand or collapse all data frames in the Table of Contents, hold down the Ctrl key and click on the plus or minus box next to one data frame name.

SECTION 3- Working with Layers

1. From the **Main Menu**> **Insert** > **Data Frame**.

2. Double Click **DataFrame 2**. In the Data Frame Properties re-name the Data Frame to **MHNWS - Baring Unit.**

3. With the mouse pointer, grab the **Approved_ Boundary** layer from **MHNW** Data Frame (above) and drop it into the new Data Frame.



4. Go up to the **Main Menu**>**Bookmarks**>**Baring_Unit**

5. Click on **Add,** navigate to D:\CSP7100\Moosehorn

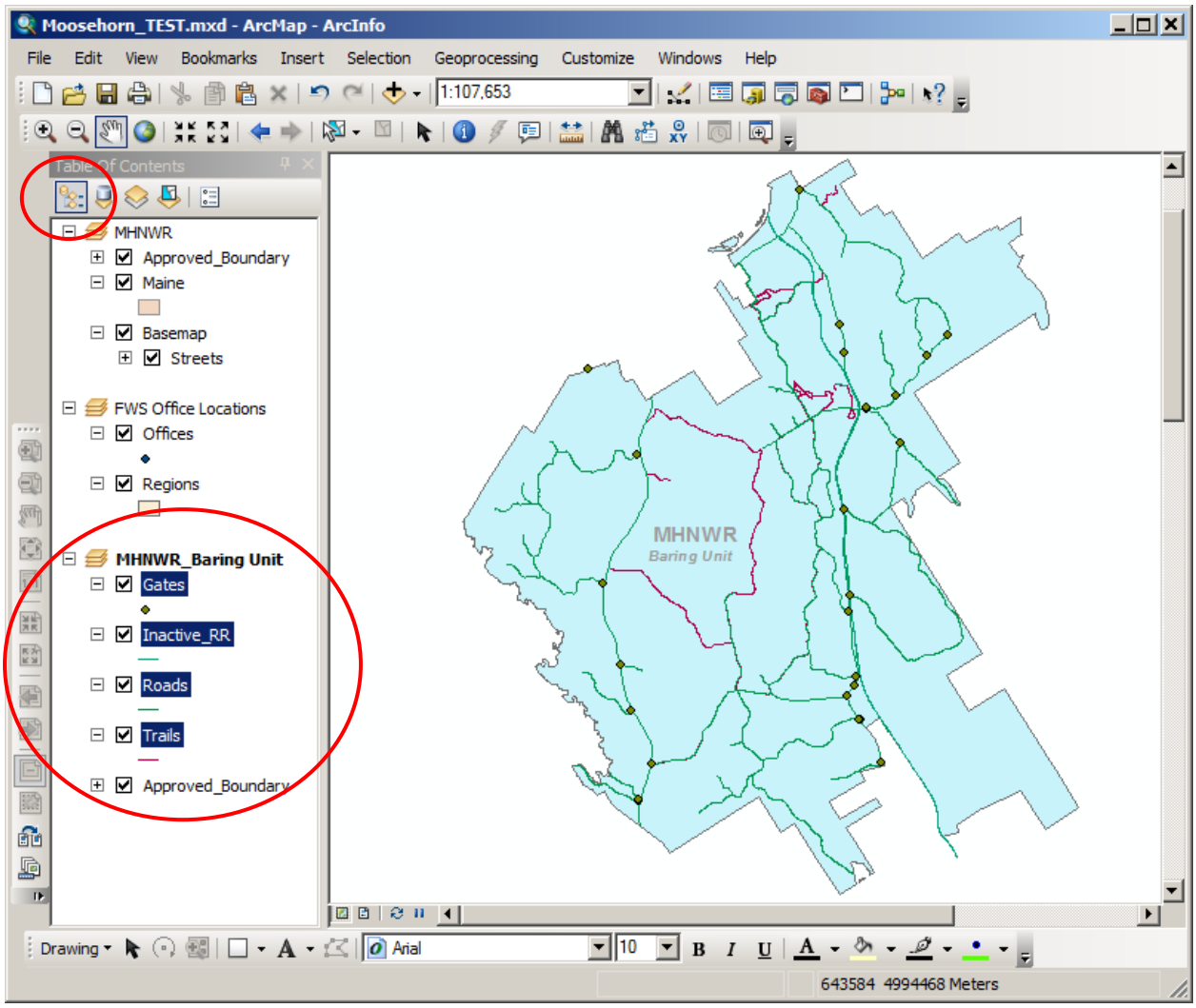
6. Double click on **Moosehorn.gdb**>**Transportation** (feature class)

7. Holding down the **Ctrl** key, select and add the following layers to **MHNWR- Baring Unit** Data Frame:

   Roads, Gates, Trails and Inactive_RR.

8. Click **Add**.

   Your data view should look similar to the screen below:



9. Click on the **List by Drawing Order** icon at the top of the Table of Contents.

10. Grab and drag the **Roads** layer with the mouse pointer to a position below the **Approved_Boundary** layer.

11. A. What happens to the roads?

_____

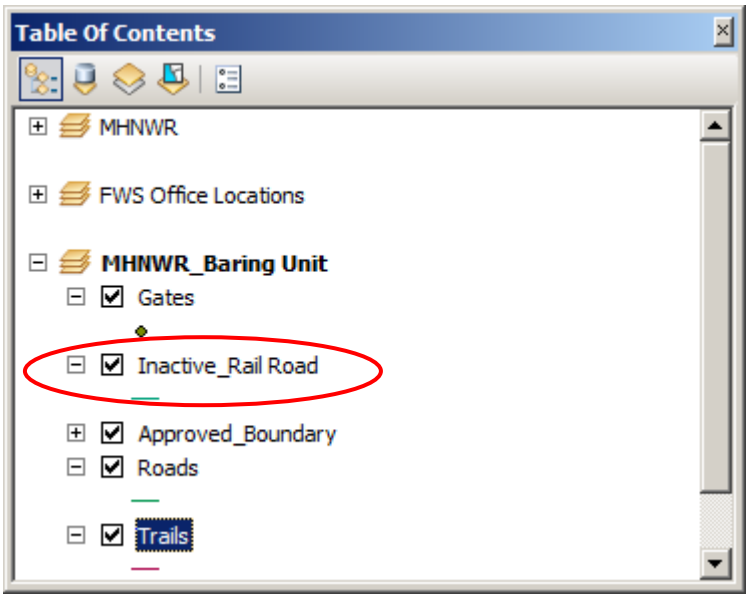
12. Now move the **Roads** layer to a position above the **Approved_Boundary** layer.

B. What happens to the roads now?

_____

13. Double click on the **Inactive_RR** layer. In the Layer Properties window change the name to **Inactive Railroad**. Click **OK.**

Changing the name does not change the name of the raw file within the geodatabase but only with the Table of Contents.



✓TIP: Layers can be dragged and dropped from one data frame into another without pulling the layer out of the original data frame. It's an easy way to copy the same layer when needed.

14. Add the **Trans_county** layer to the Table of Contents .

15. Right click on Trans_county>**Zoom To Layer**

C. Does the additional transportation layer add value/information to the map?

_____

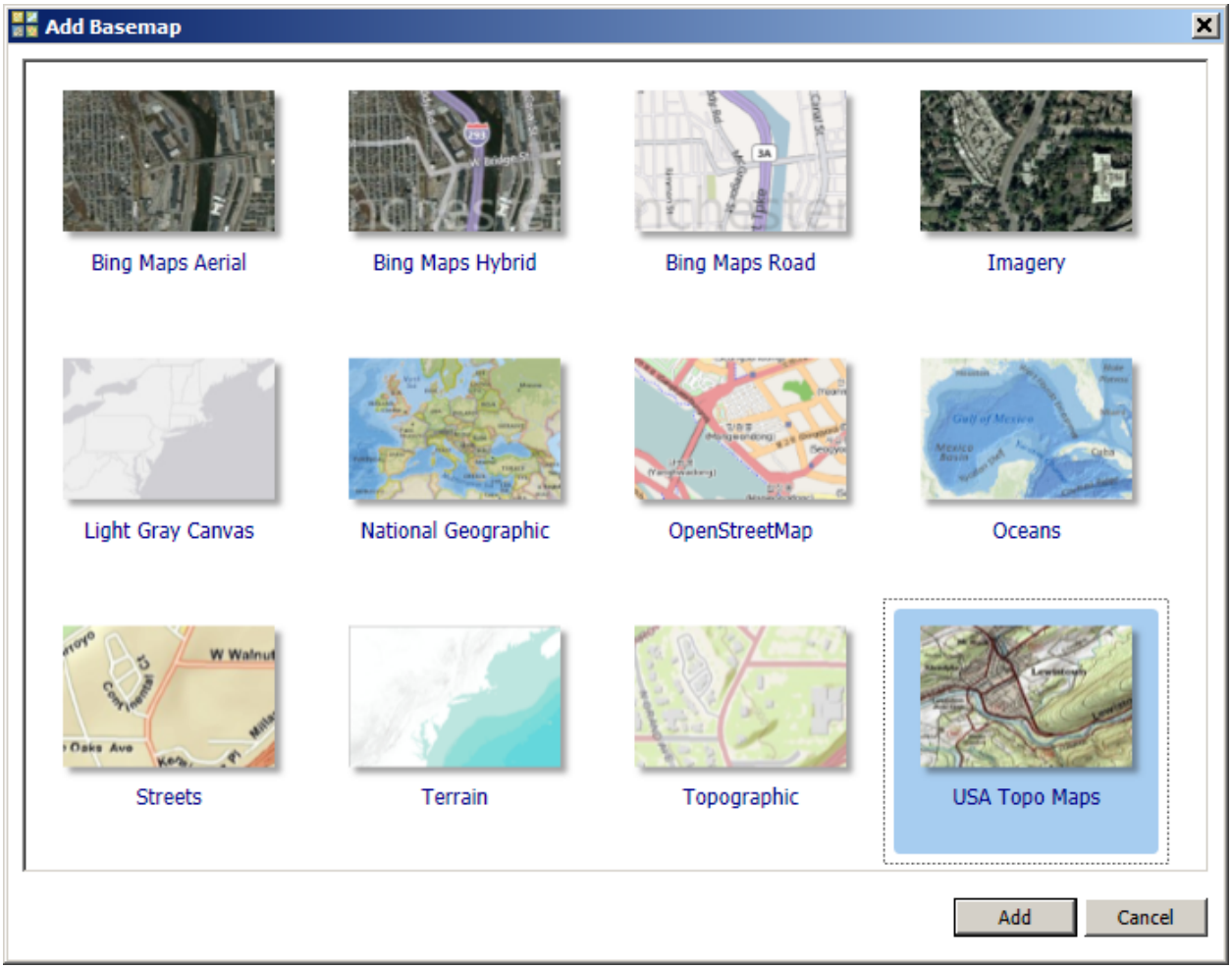
16. Right key on the **Trans_county**> **Remove.**

SECTION 4 - Adding ESRI Base Layers

1. Click on the **pull-down arrow** just to the right of **Add Data**.

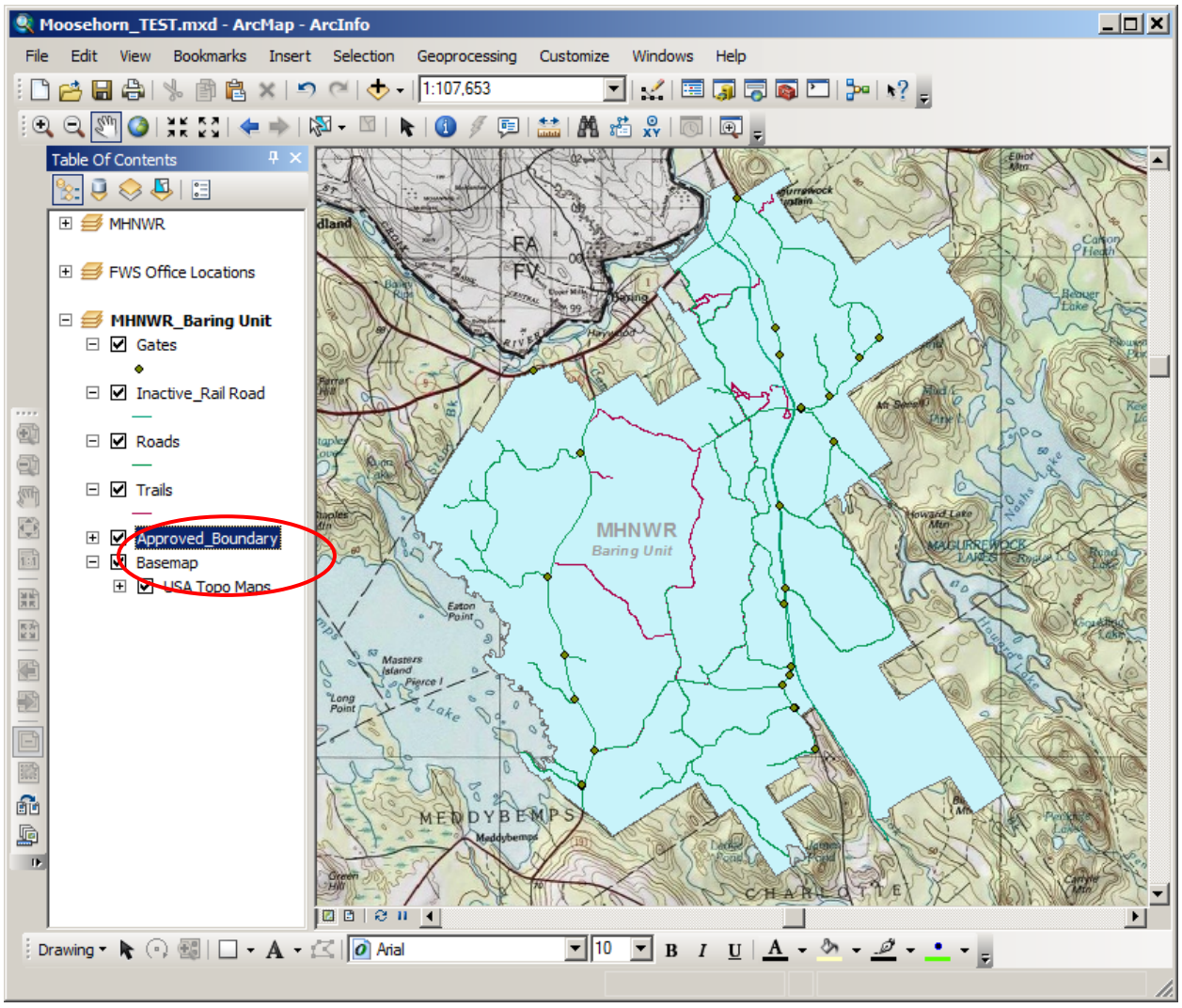
2. Select **Add Base Map**.

   A whole gallery of base map selections from ESRI are available to choose from. Note, you must have a fairly robust internet connection to utilize this service.



4. A Geographic Coordinate Systems Warning Window may appear. Click **Close**.

5. The USA Topo Maps base map of the region will draw and the layer (basemap) will appear at the bottom of the Table of Contents.



Quiz 1: When you click on the Full extent button on the Tools tool bar, the data view extends out to the data layer with the largest area. Now the Edmunds Unit of the Moosehorn NWR is visible. How do you restrict the full extent so it only displays just beyond the Baring Unit boundary when this tool is used? Why would you want to do this?

STOP -PLEASE STOP HERE BEFORE GOING ON TO THE NEXT SECTION- STOP

Notes:

Exercise 5: Symbology

Session Objectives: At the conclusion of this session, you will be able to:

- Use the Layer Properties to change symbols, line styles, fill patterns, colors, and fonts
- Define and create a layer file
- Edit Legend text
- Create interactive labels with the label tool

Materials created by: Mark Richardson, Lynn Rutz, Karen Klinger and Christopher Bryant
Revised: August, 2012 by Mark Richardson
Notes: ArcMap 10, Service Pack 4

SECTION 1 - Introduction to Layer Properties /Symbology

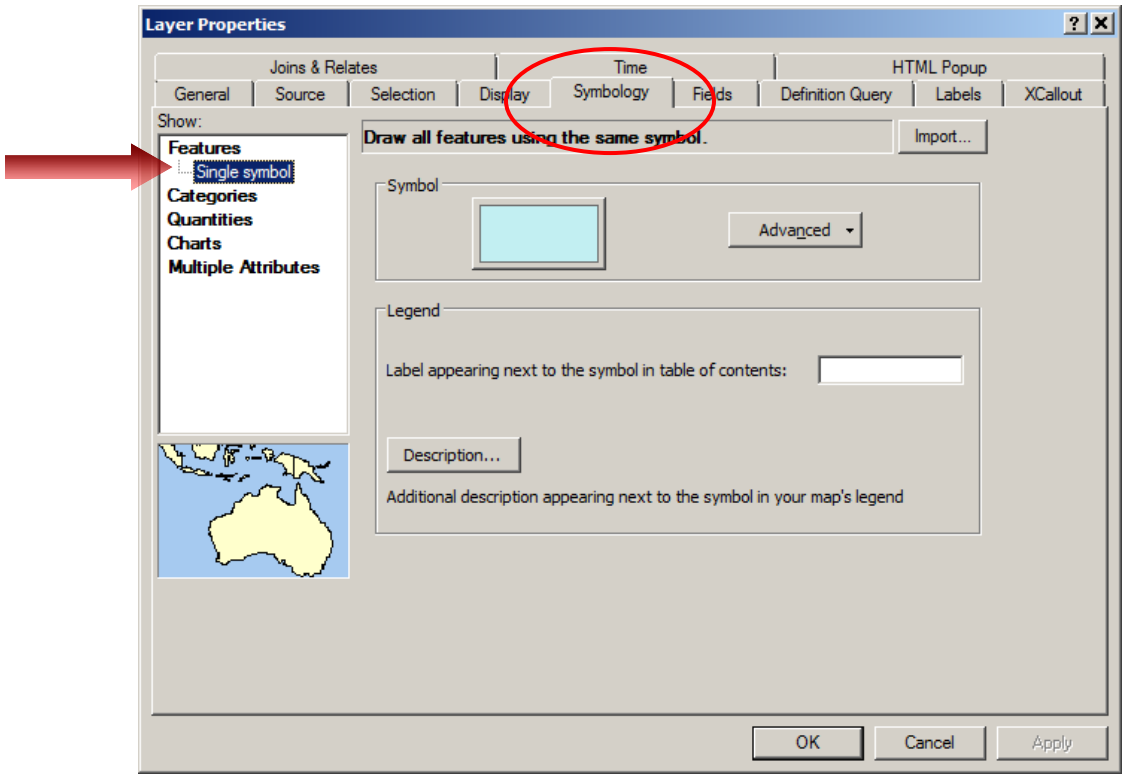
The layer attributes and their display characteristics (e.g., the color, line width, font size) can be changed using the Symbol Selector and the Layers Properties.

1. Go to the Main menu >**Bookmarks**>**Baring_ Unit**

2. Add the **Mgt_Units** layer from **Biological _Data** feature data set within the Moosehorn geodatabase.

3. Double-click on the **Mgt_Units** layer in the table of contents to open the Layer Properties window.

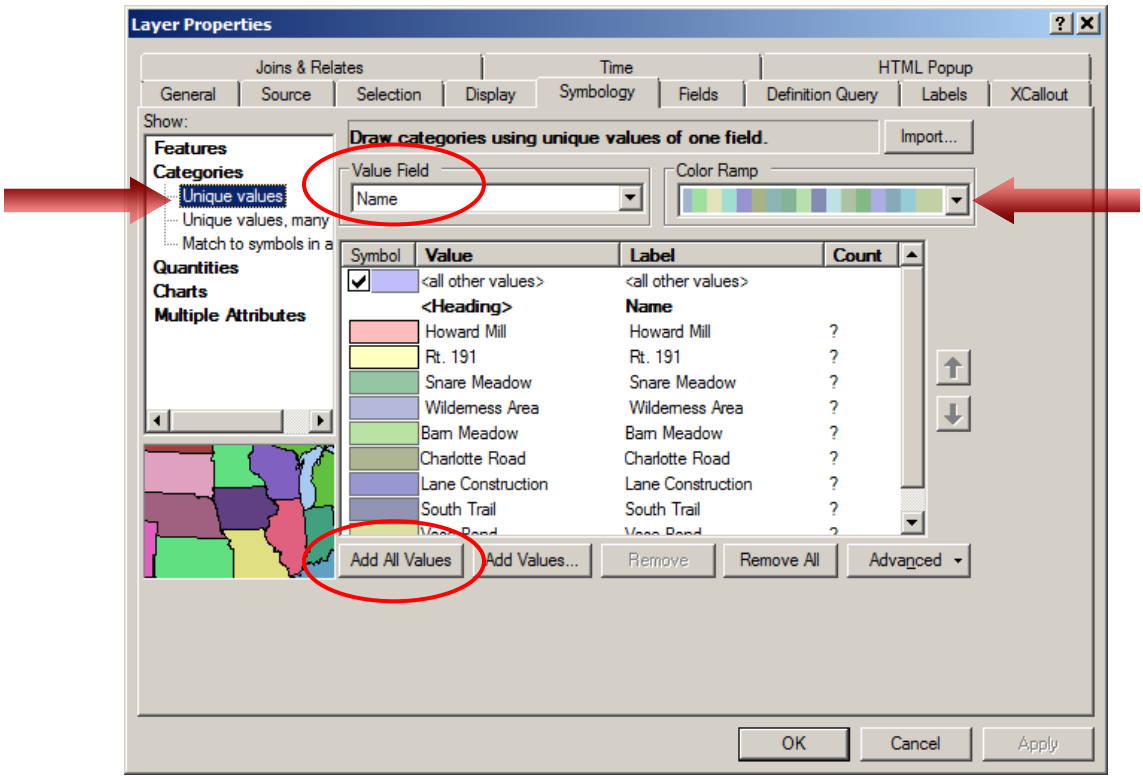
4. Click on the **Symbology tab**. Notice in the left dialog box **Show**, the data **Feature** is being displayed as **Single Symbol.**



By default, polygon feature classes are loaded as Single symbol sets

5. Click on **Categories**

6. Under **Value Field,** click the dropdown arrow. This lists all of the fields (from the attribute table) for the **Mgt_Unit** layer.



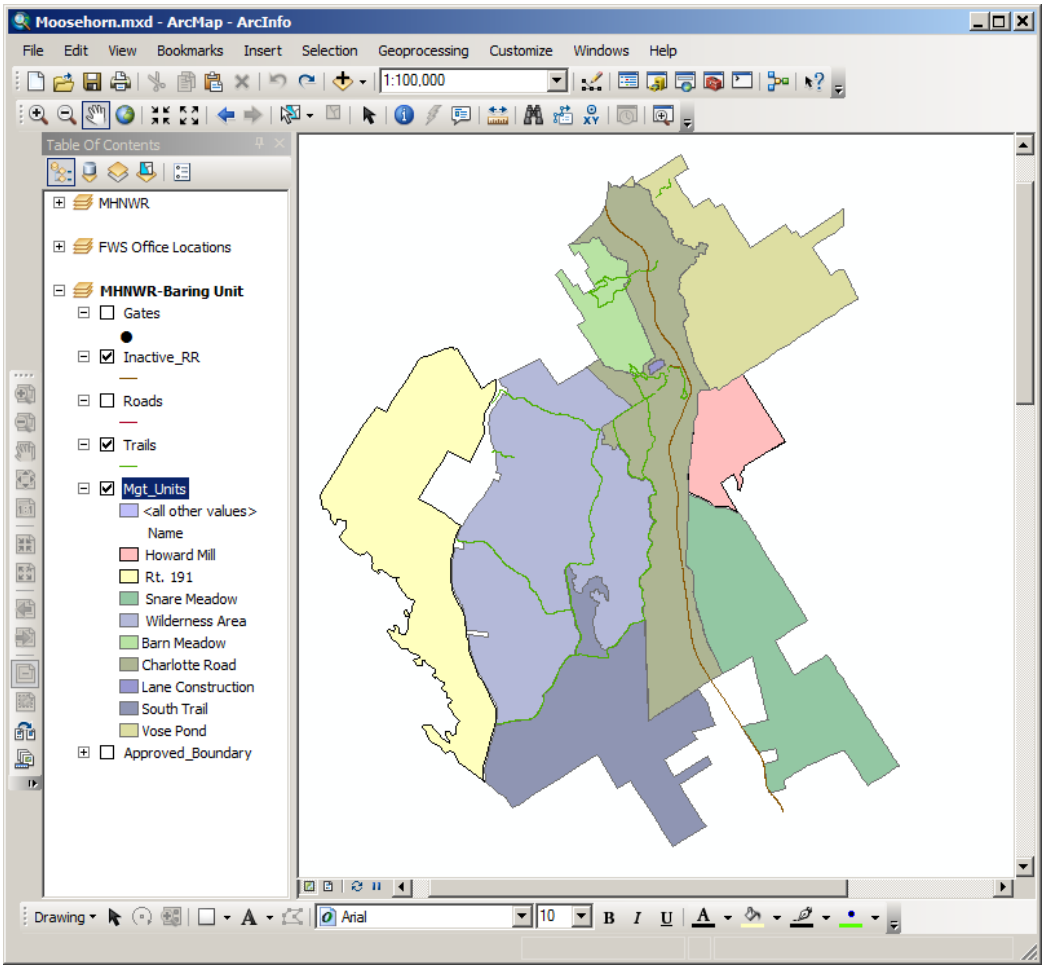
7. Change the **Value Field** from **Id** to **Name.**

8. Click on the **Add All Values** button. All of the values associated with the **Name** field are now listed.

9. Under **Color Ramp**, click the drop down arrow. Scroll down and observe all of the color schemes you can use to display the polygon data for **Mgt_Units**.

   Also observe, the Symbols and Labels values correspond to what is shown in the table of contents

10. Chose a color scheme (your choice!) and click **Apply**.



11. Close out the **Layer Properties** window.

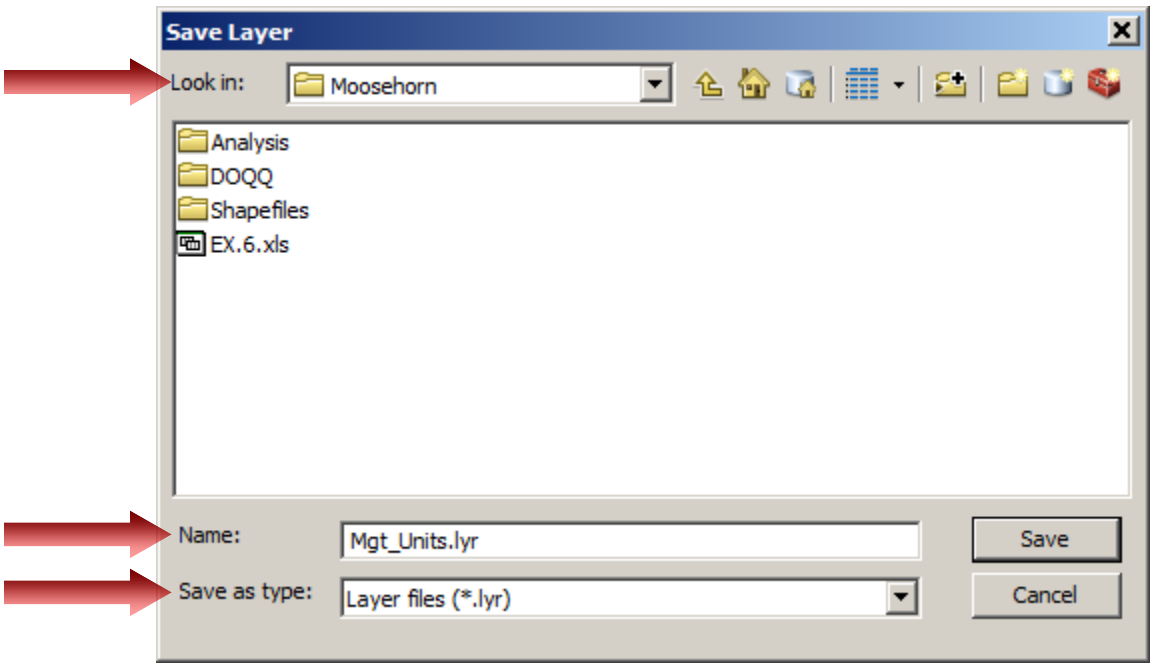
What if we want to preserve or save all the colors displayed for **Mgt_Units** that you chose? The next section shows you how.

SECTION 2 – Creating and using a Layer File

What is a layer file? A layer file allows the user to preserve the original symbology properties or changes a user makes to a specific data layer. The saved file can then be imported for later use or shared by other users.

1. In the table of contents right click on **Mgt_Units**> **Save As Layer File…**

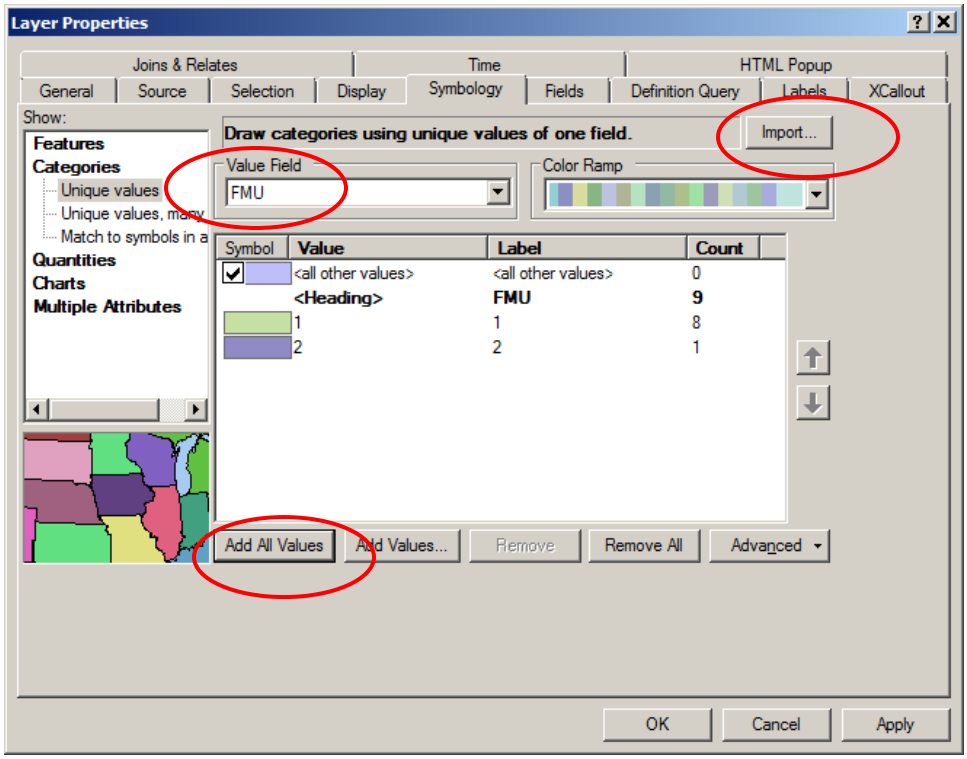
2. Name the layer file **Mgt_Units** (Save as type: Layer files) in the Moosehorn folder and click **Save**. This layer file contains our current symbology.



3. Double-click on the **Mgt_Units** layer name in the table of contents to open the Layer Properties window.

4. Click on the **Symbology** tab.

5. Under **Value Field** change the value from **Name** to **FMU.**



6. Click on the **Add All Values** button. All of the values associated with the **FMU** fields (2 values) are now listed.

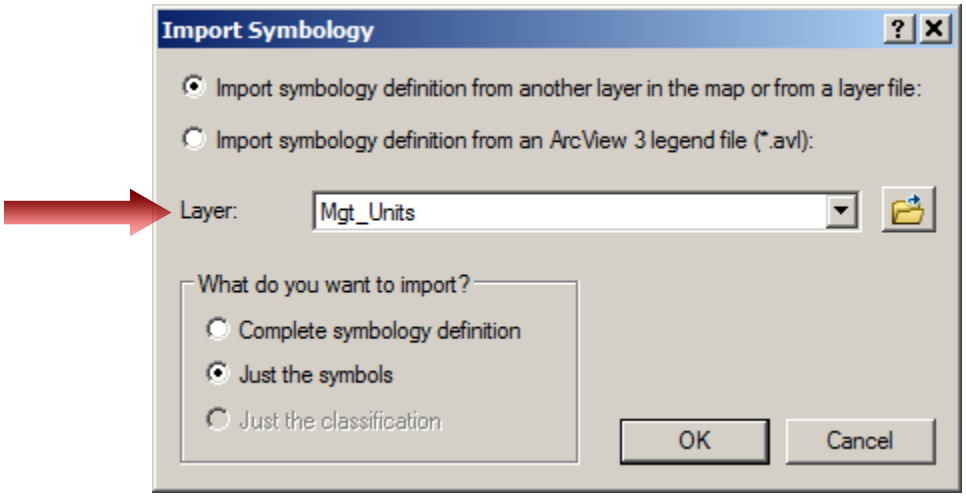
   FMU's are Fire Management Units

7. Click the **Apply** button. This applies your changes to the Data View.

8. Drag the Layer Properties window off to the side. Note the changes in the data view.

9. Move the Layer Properties window back to the center of the screen. Change the **Value Field** back to **Name** and click **Add All Values** and **Apply**. Notice that we do not have our original color scheme that we chose earlier.

10. Click on the **Import…** button. Use the browse icon to select the layer file (**Mgt_Units.lyr**) we created in the beginning of this exercise and click **Add**.



11. Click **OK.** Ensure that the **Name** value field matches the **Name** field.

12. Click **OK** to apply our original symbology and then close the Layer Properties window.

> ✓*TIP: You don't have to accept the default order of colors in the color ramp you've chosen. Click on the ramp and re-select it when the ramp selections open. Watch the colors rotate in the Symbol field.*

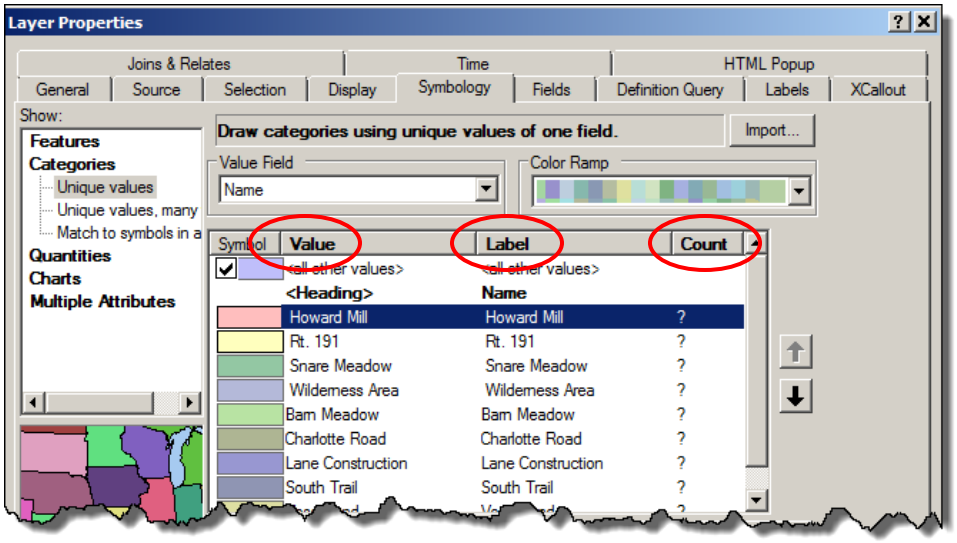
SECTION 3 - Symbol Selector

There are two ways to change a feature's appearance in ArcMap. The first uses the **Layer Properties window** and the second method modifies symbology from the table of contents **Legend**. First we will use the Layer Properties method.

Changing Symbology through Layer Properties

1. Double-click **Mgt_Units** in the table of contents to open the Layer Properties window.

2. Click the **Symbology** tab.



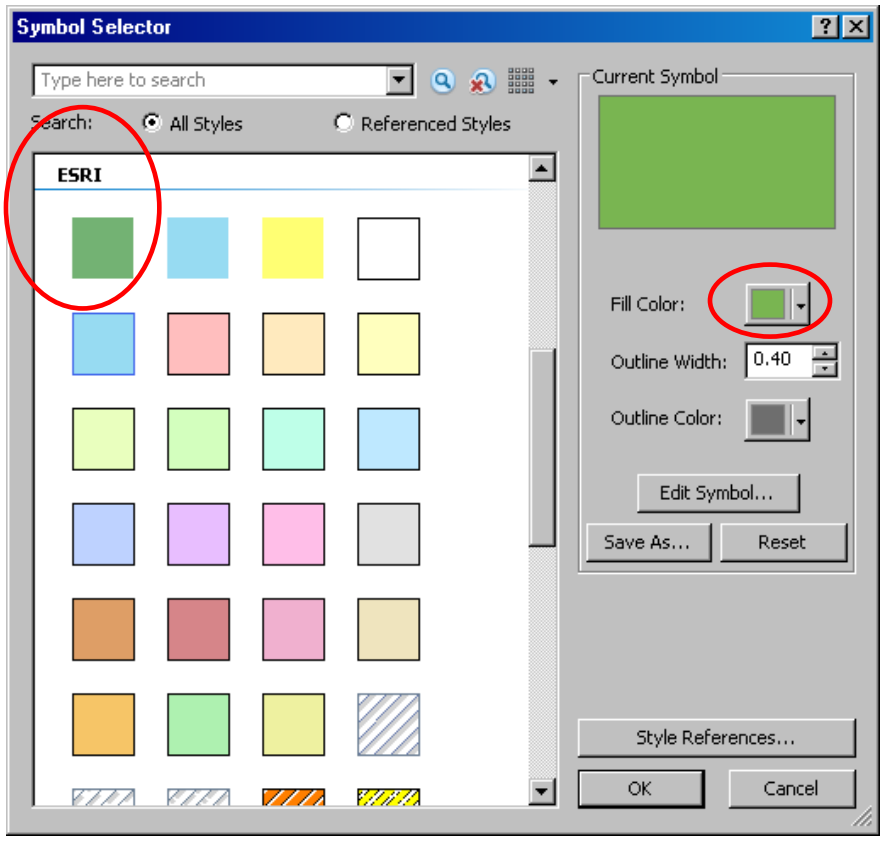
Here we see a listing of the Symbol, Value, Label, and Count of all of the different management unit (**Mgt_Units**) values within Moosehorn NWR.

> ✓*TIP: If question marks appear in the Count column, click on the Count heading and numbers will show. These are totals of all of the vector shapes for that particular value.*

3. Double-click on the symbol/legend box next (left) to **Howard Mill**

This opens the Symbol Selector window. The Symbol Selector window allows you to manipulate a polygon feature's fill color, outline width, and outline color. Notice in the upper right hand corner you see a preview of the changes that you are about to make.

4. Change the color of Howard Mill management unit by clicking on the Green solid fill symbol under ESRI

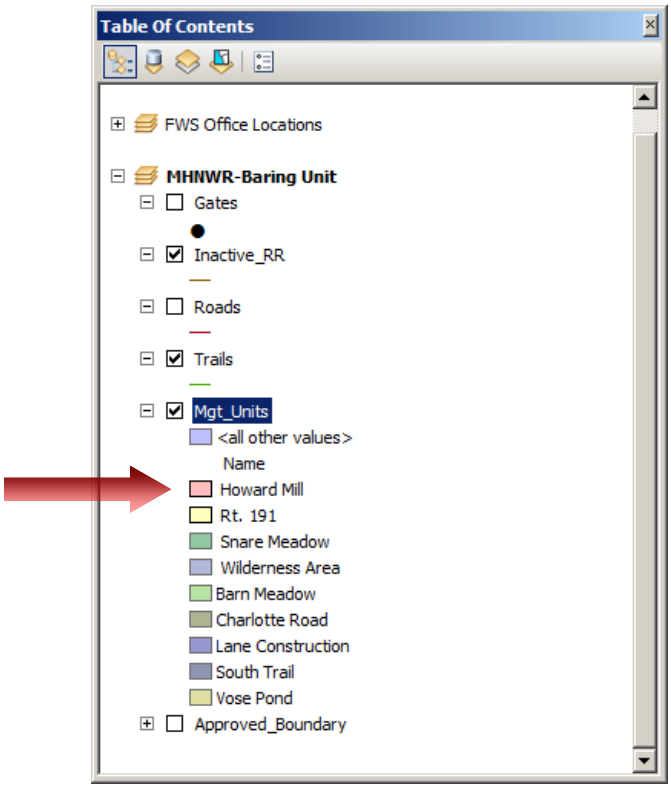


5. Click **OK**, to save and close the Symbol Selector window.

6. Click **OK** again to exit out of the Layer Properties window. Note the change to **Howard Mill** management unit in the data view.

Changing Symbology through the Legend

1. Click the legend symbol patch next to **Howard Mill** in the table of contents under Mgt_Units.



This takes you back into the Symbol Selector window, where you can make any symbology changes as necessary.

STOP -PLEASE STOP HERE BEFORE GOING ON TO THE NEXT SECTION- STOP

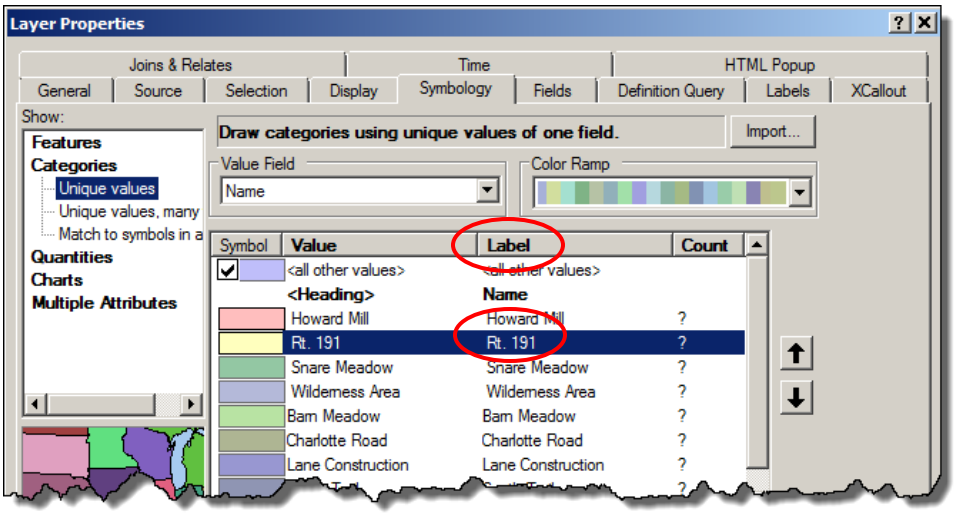
SECTION 4 - Changing Table of Contents Labels

There are two ways to change the Table of Contents labels in ArcMap. The first uses the **Layer Properties** window and the second method modifies the label from the **Legend**.

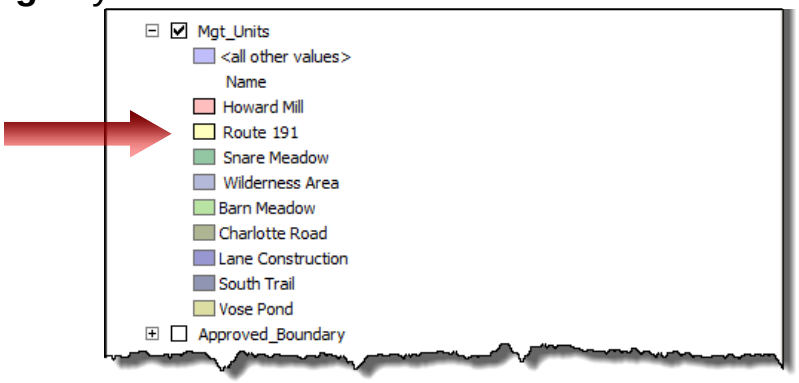
Changing Table of Contents labels through Layer Properties

1. Double-click **Mgt_Units**>**Symbology** tab.

2. Click on the **label** for the **Rt. 191** management unit. Now you have a cursor in place to change the label.



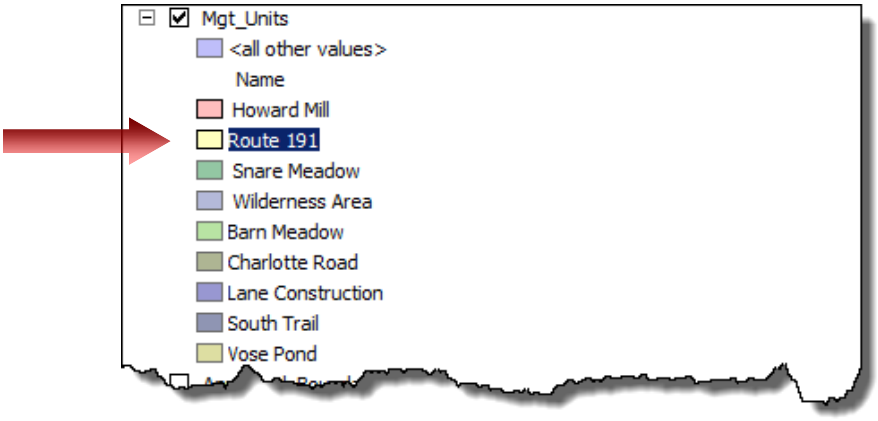
3. Type **Route 191.** Notice the name in the table of contents has **not changed** yet.



4. Click **OK**. The edit is now reflected in the table of contents in the data view.

Changing Table of Contents Labels through the Legend

1. In the table of contents Click on **List By Source.**
2. Under **Mgt_Untis**, hold your cursor over the **Route 191**value.



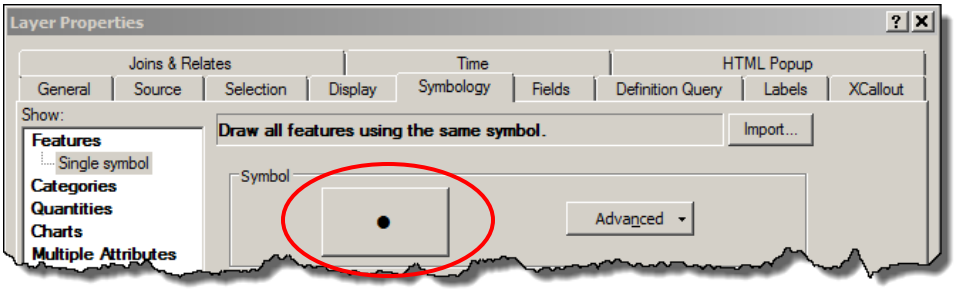
3. Click **once** to highlight **Route 191**. Click again to edit.
4. Change “Route 191 to **“Rt. 191”** and press the **Enter** key.

SECTION 5 - Adding New Symbols

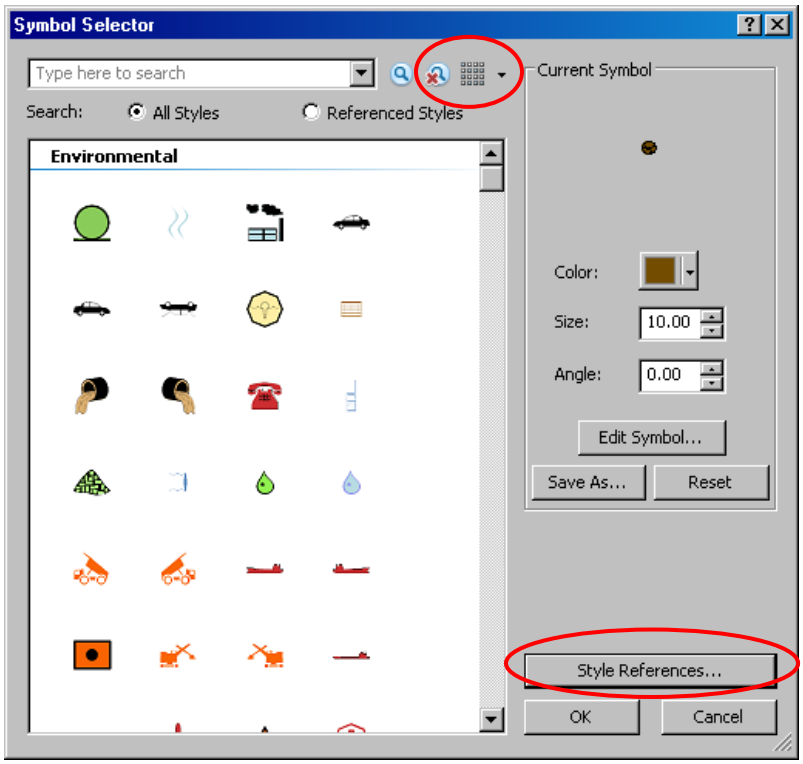
By default ArcMap loads only a handful of symbol sets for you to use. The current set of symbols may not suit your specific needs. For example, you may want an outline of a tree or some other graphic to represent your vegetation survey plots. Follow these steps to load a new symbol set:

1. Ensure the **Gates** layer is checked (visible).

2. Double-click on **Gates** to open the **Layer Properties** Window.



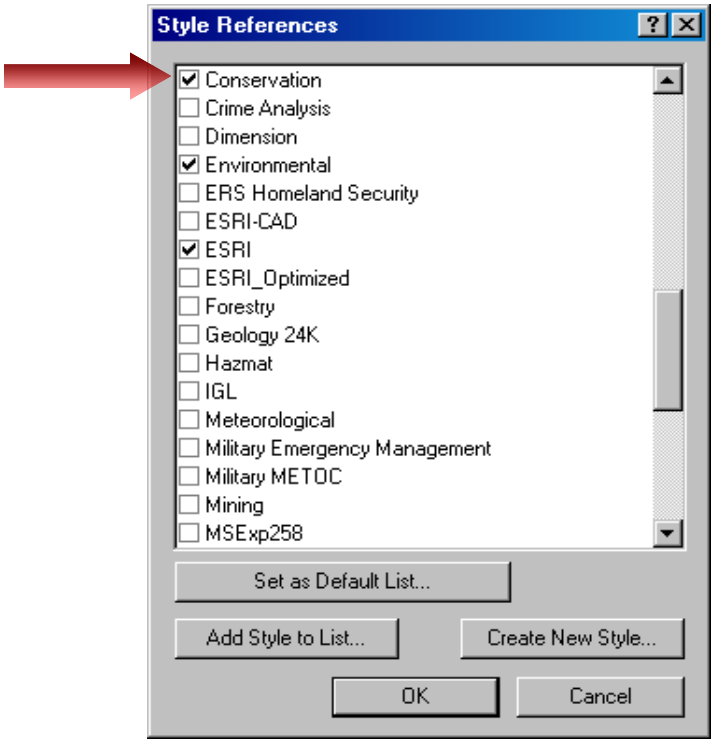
3. Click on the **Symbol** button to bring up the **Symbol Selector.**



4. Click on the **View Options** and check Group by Style and Compact View

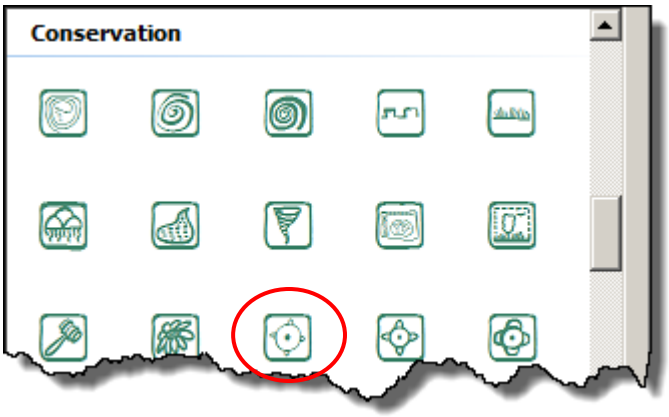
5. Scroll down through the list of symbols to see what is available.

6. Click on the **Style References** button



ArcMap automatically lists all of the default palettes for point features when you click on the **Style References** button.
If you had a set of unique ESRI Style Set files (*.style), you could add those symbols by clicking on the **Add Style to List** button and then navigating to those files.

7. Scroll down and check **Conservation**. This loads a new symbol set to the Symbol Selector Window.



Scroll down through the various symbols. Notice the addition of conservation-based symbols. ArcMap has many different symbol palettes that it can load from, from Business to Real Estate to Hazmat.

8. Select the **Land Trust 1** symbol and then **OK**

9. Click **OK** again in the Layer Properties window to activate the change.

> ✓*TIP: The default marker can easily be changed in appearance as a quick solution. Click on the Properties button in the Symbol Selector to change the style, color, and size.*

10. Click **Cancel** to exit out of the Symbol Selector window.

11. Click **Cancel** to close the Layer Properties window.

Symbology Challenge

Now that you know how to alter the appearance of the individual layers within the MSHNWR data frame, change the symbology for Roads, Trails, Interactive Rail Road, Gates, Approved_ Boundary and the Mgt_Units to your liking. Note - change the background (fill) of all the Approved_Boundary to be 100% transparent with a solid outline.

> **Quiz 1:** Change the outline colors for all of the polygons in the **Mgt_Units** layer. This change can be done all at once instead of individually. Can you figure out how to do this? Use online help if necessary.

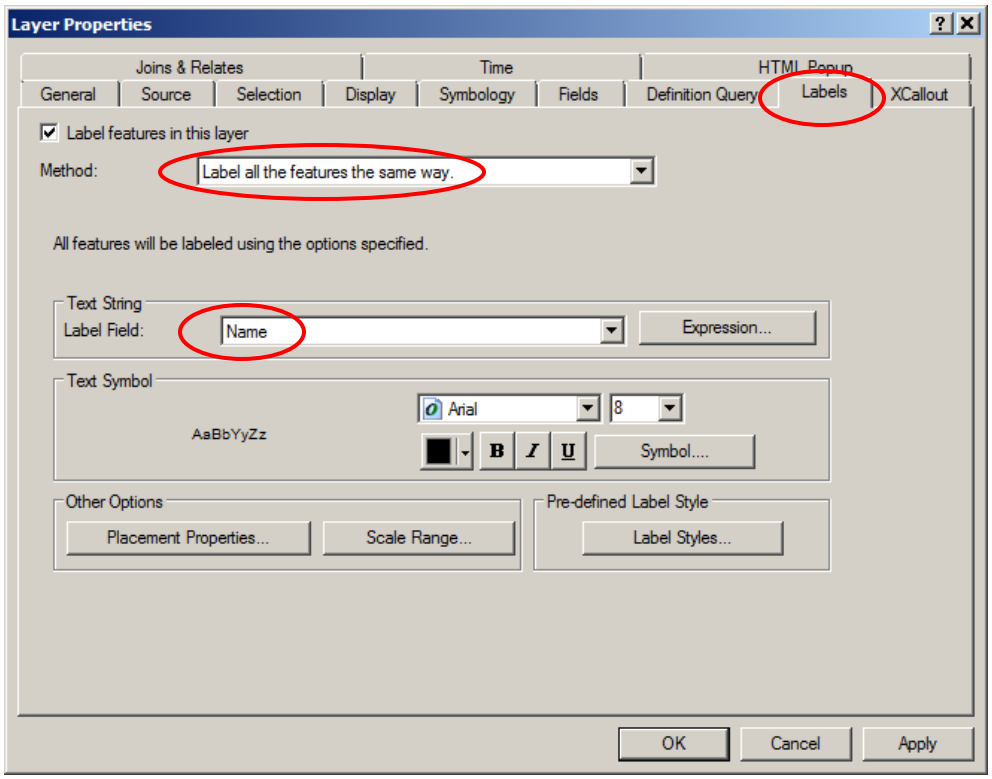
SECTION 6 - Label Tool

The label tool interactively labels the features (polygon, point, or line) you click. The label name is derived from the attribute field of the active layer. This tool is used when you want to label individual features on the **Data View** instead of creating a text boxes or have ArcMap automatically labeling features for you.

1. Activate the **Draw Toolbar,** if it is not already activated.

2. Double-click the **Mgt_Units** layer to open the **Layer Properties**.

3. Click on the **Labels** tab.



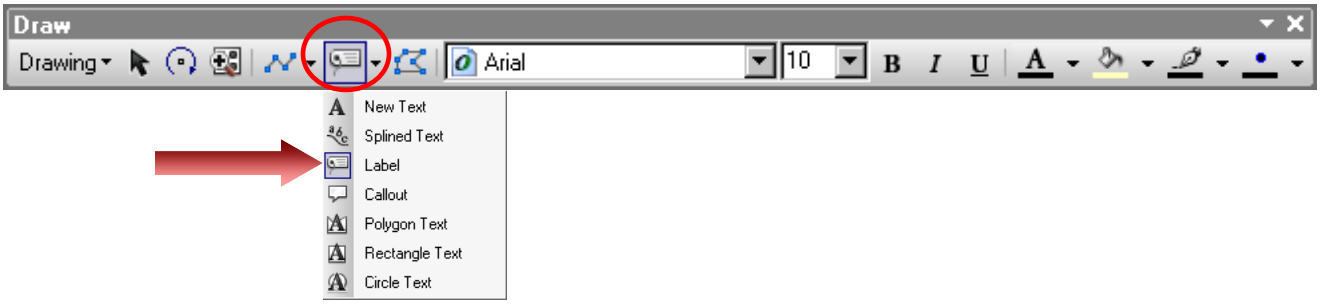
4. The Method should be **Label all the features the same way.**

5. Make sure that **Name** is selected as the **Label Field** and check **Label features in this layer**. This means that the layer will be labeled based on the values in this attribute field.

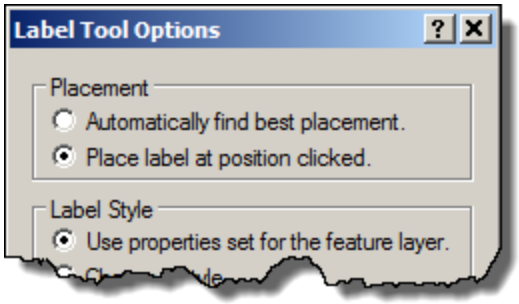
6. Change the font to **Arial** and size **8**.

7. Click **OK** in the Layer Properties window, returning to your data view.

8. Click on the drop-down arrow next to the **New Text** icon.



9. Click on the **Label** tool. The Label Tool Options window will appear.

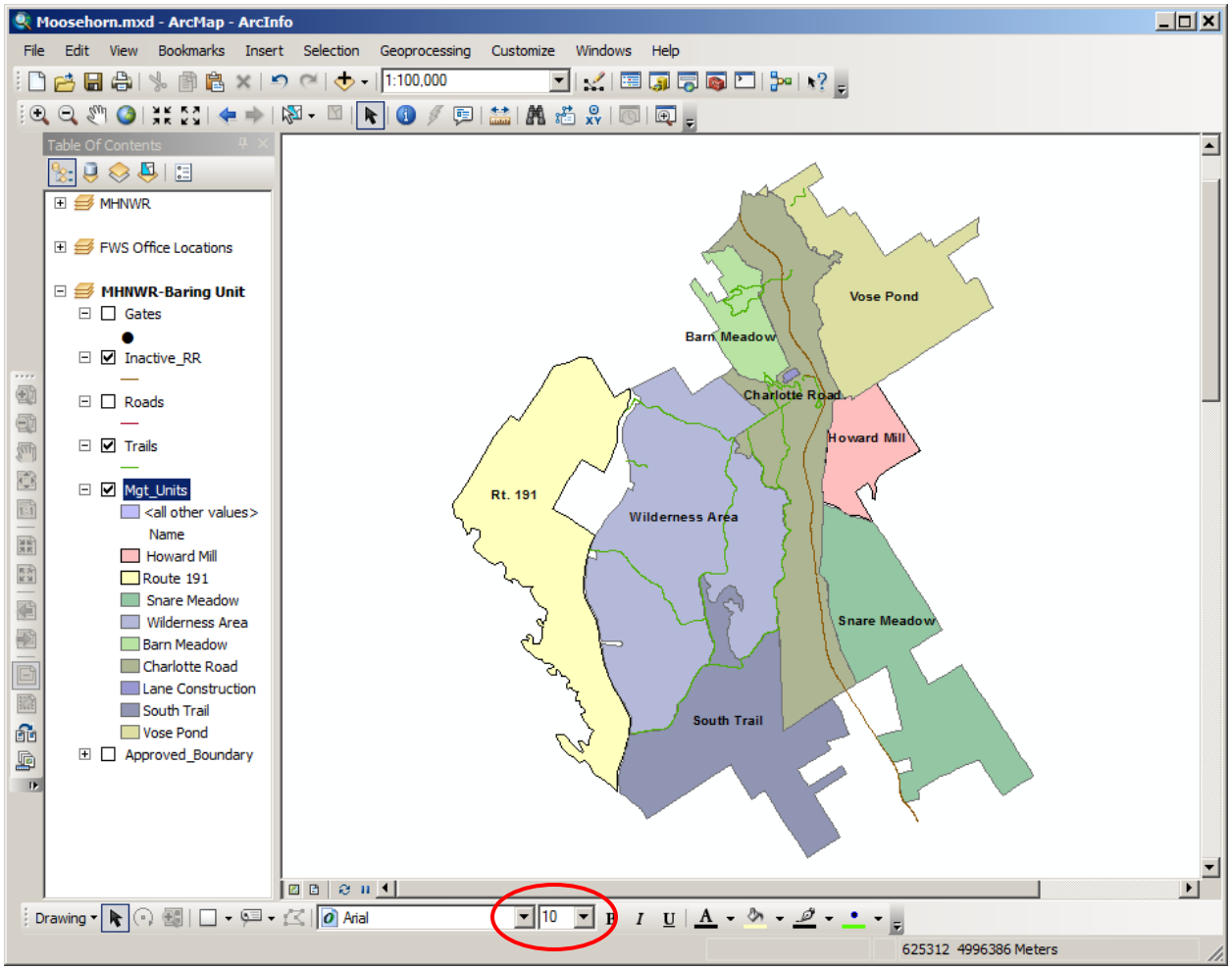


Under Placement check **Place label at position clicked** and under Label Style check **Use properties set for the feature layer**.

10. Click on the **X** to close the window.

11. Turn off all of the layers except for **Mgt_Untis**.

12. In the data view, click on the center of a polygon (Management Unit) with the **Label** tool. The Management unit name represented by that polygon will be displayed as a label.



Note: Your label is surrounded by a blue dashed line. This shows the label is active for editing. You can change the font, size, or style from either the **Draw toolbar** or by right-clicking on the label and selecting **Properties** from the menu produced, then clicking the "Change Symbol" button. However, changes you make on your active label will not be reflected in other labels (because they are not selected).

12. Change the font size of the label to **10** on the **Draw toolbar**.

13. Move to another polygon and label it. Note that this label's font size remains **10** (which we set earlier). Label a few more polygons.

Editing Labels

1. Click on the **Select Elements** tool. Move the arrow over a label and click on it.

The label can be moved by placing the cursor arrow within the active label box. Note that a four-way arrow appears. Depress the left mouse button, keep it depressed, and move the label to the desired position and release the button.

2. Change the font size of one of the labels to **16.** The label can be resized only by changing the font size. Notice how the size of the label increased.

Deleting Individual Labels

1. Select the label with the pointer and then hit the **Delete** key on your keyboard.

Deleting All Labels

1. Go to **Edit** on the Main menu and select **Select All Elements**. This activates all of the labels.

Notice that one label is surrounded by a blue highlight, while the others are surrounded by a green highlight.

✓*TIP:* While all labels are active, the blue indicates which label would be the source label if inter-label changes were to be made (this means if you tried to make all the labels the same size, the labels highlighted green would become the width of the label highlighted in blue).

2. Hit the **Delete** key.

Notes:

Exercise 6: Manipulate, Select, and Sort Records in a Table

Session Objectives: At the conclusion of this session, you will be able to:

- Identify specific features and display their associated records
- Display the entire data table for a layer
- Set selectable layers
- Select records in a layer
- View selected records
- Sort records in a table

Materials created by: Mark Ely and Karen Klinger
Revised: October, 2012 by Mark Richardson
Notes: ArcMap 10, Service Pack 1

SECTION 1 - Identifying Records from a Layer

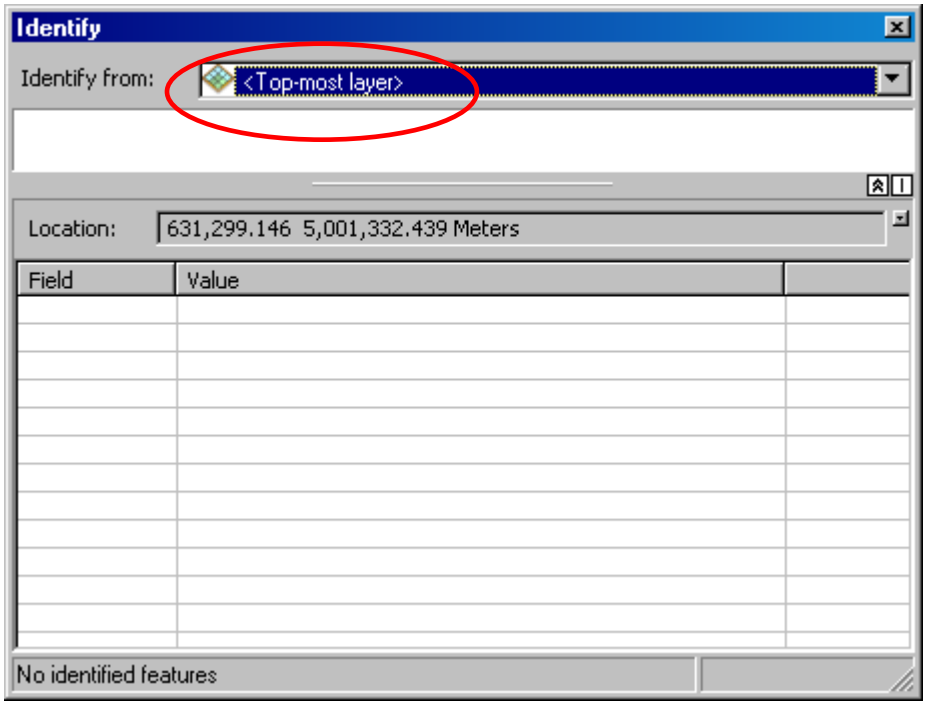
Information associated with each spatial feature can be viewed using the **Identify** tool. We can begin asking "what is…?" questions using this tool.

1. Click on **Add**. Navigate to the **Landcover** Feature Dataset within the Moosehorn Geodatabase . Add the **Cover_Type** Feature Class to the Table of Contents.

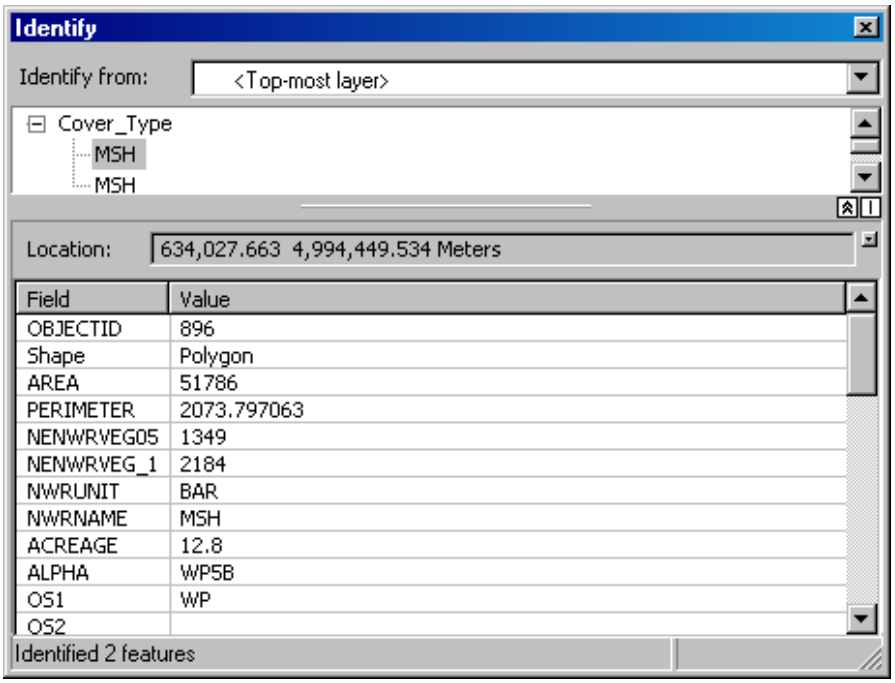
2. Right click on **Cover_Type**>Properties>Symbology. Change the symbology from a Single Symbol to a Category. Do you remember how to do this? Hint: Exercise 4 - Section 1

3. Select the **Identify** tool.

The **Identify** dialog box opens with **<Top-most layer>** as the default. Thus, if you click in an area where two layers overlap, only the attributes for the feature highest in the table of contents will be identified, not the layer beneath it. You can also use the dropdown arrow to select a specific layer for identification.



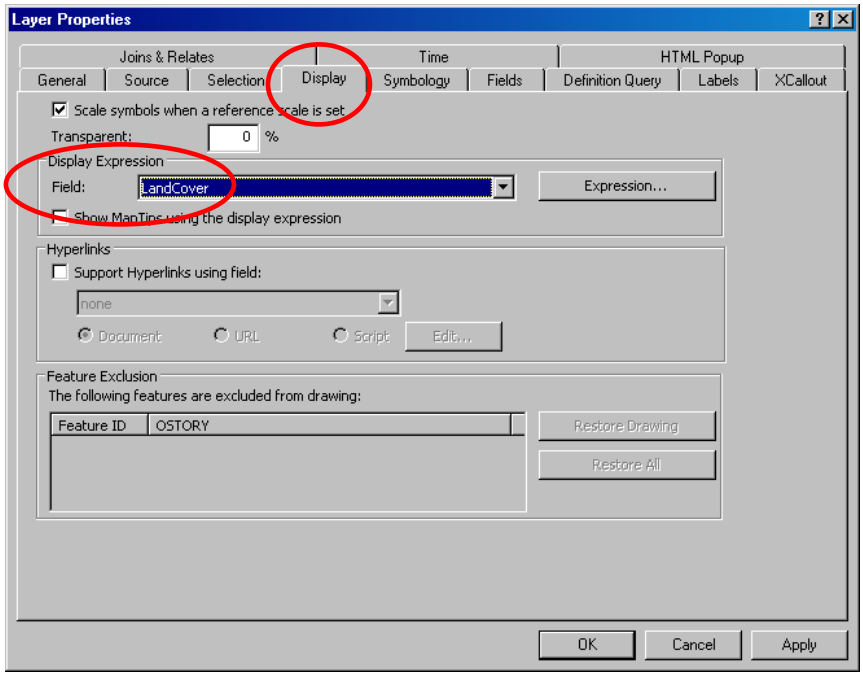
4. Position the **Identify** tool over any polygon feature and single-click the left mouse button. (Results will vary from the example on the



next page depending on which feature you choose.)

5. View the attributes for the selected polygon by scrolling up and down using the scrollbar to the right of the **Identify** window. Notice that when Cover_Type features are selected, the attribute value of **MSH (NWR Name)** displays for each selected polygon.

6. Right click on **Cover_Type** in the Identify Window**> Layer Properties** >**Display**. Change the Field Expression to **LandCover** and click OK.



7. Click on another feature and view the results. Remember, your results will vary depending on the feature you click.

✓TIP: Multiple features can be accumulated in the Identify window. Using the Identify tool click on one feature then hold down the shift key and select other features. You can click on each feature in the window to view its associated attributes. To remove features from the window, right-click and select "Remove from Tree."

8. To clear the window, click on any empty point on the map.

9. Close the **Identify** window.

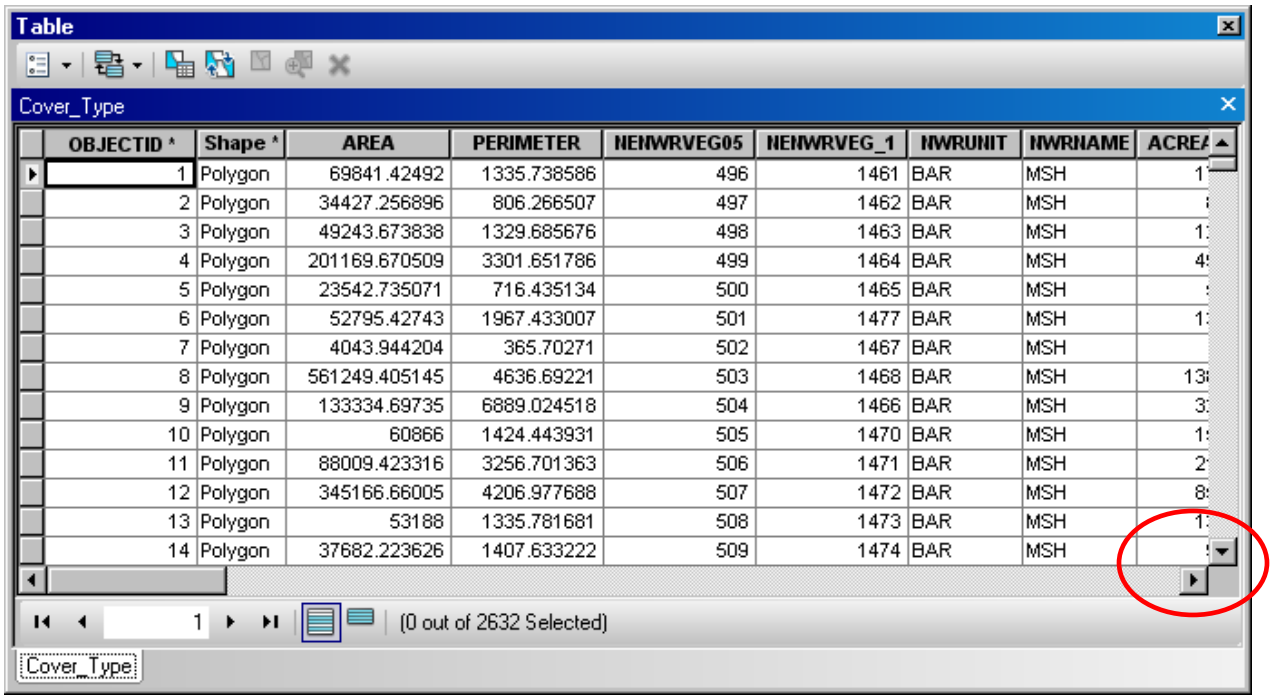
SECTION 2 - Viewing all the Records in a Layer

The attribute information or database associated with any layer can also be viewed in a tabular format rather than just one record at a time.

1. Select the **Cover_Type** layer.

2. Right mouse click and select **Open Attribute Table**.

3. Maximize the **Attributes of Cover Type** window.



OBJECTID *	Shape *	AREA	PERIMETER	NENWRVEG05	NENWRVEG_1	NWRUNIT	NWRNAME	ACREA
1	Polygon	69841.42492	1335.738586	496	1461	BAR	MSH	1
2	Polygon	34427.256896	806.266507	497	1462	BAR	MSH	
3	Polygon	49243.673838	1329.685676	498	1463	BAR	MSH	1
4	Polygon	201169.670509	3301.651786	499	1464	BAR	MSH	4
5	Polygon	23542.735071	716.435134	500	1465	BAR	MSH	
6	Polygon	52795.42743	1967.433007	501	1477	BAR	MSH	1
7	Polygon	4043.944204	365.70271	502	1467	BAR	MSH	
8	Polygon	561249.405145	4636.69221	503	1468	BAR	MSH	13
9	Polygon	133334.69735	6889.024518	504	1466	BAR	MSH	3
10	Polygon	60866	1424.443931	505	1470	BAR	MSH	1
11	Polygon	88009.423316	3256.701363	506	1471	BAR	MSH	2
12	Polygon	345166.66005	4206.977688	507	1472	BAR	MSH	8
13	Polygon	53188	1335.781681	508	1473	BAR	MSH	1
14	Polygon	37682.223626	1407.633222	509	1474	BAR	MSH	

4. Use the arrow buttons to scroll both horizontally and vertically through the table.

5. Minimize the table. Note the table minimizes to the bottom left corner of your monitor and not into the task bar.

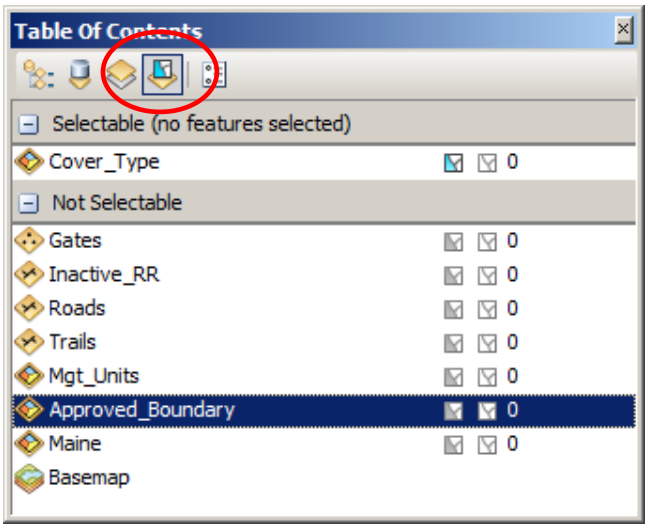
> ✓*TIP: You can also use the arrows in the bottom left status bar next to Record to scroll through consecutive records or jump to the first or last records in the table.*

SECTION 3 - Selecting Records

One or more spatial features can be selected from the data frame for display in a tabular format.

1. In the Table of Contents, click on the **List by Selection** icon.

   Notice that the two categories containing layers can easily be moved and rendered **Selectable** or **Not Selectable** by clicking the toggle button .



2. Click on the Cover_Type layer and move all the other layers to **Not Selectable**.

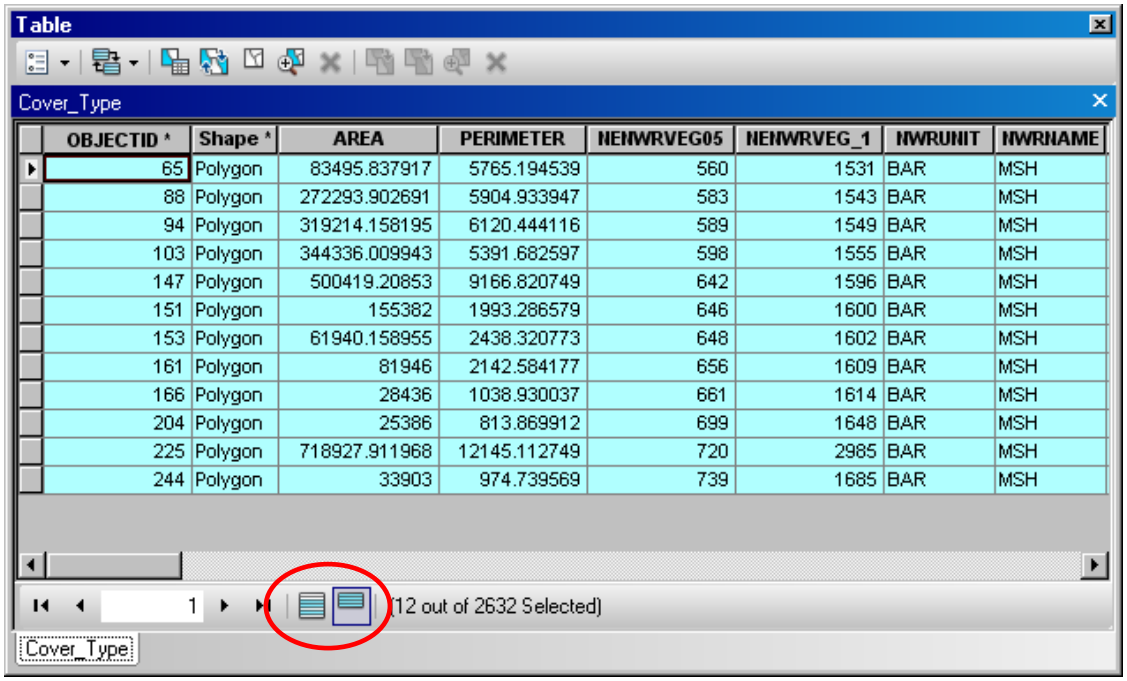
3. Click on the **Select Features** tool.

4. While holding down the Shift key, move the cursor and click (select) on any of polygon(s). The selected polygon(s) will now be highlighted in cyan.

*✓TIP: By default ArcMap uses a cyan color to show selected records and features. To change the default selection color for **all** layers go to **Selection**> **Selection Options**. In the **Selection Color** box, click on the color to open the palette. Changes will be stored in the map document as properties of the map.*

5. Expand the **Attributes of Cover_Type** window.

6. At the bottom of the window, notice two buttons which appear as a full list and a half list (circled). Click the half list button; these are your **Selected Features** within your **Cover_Type** layer. The polygon(s) you selected in the data frame now appear in a separate table.

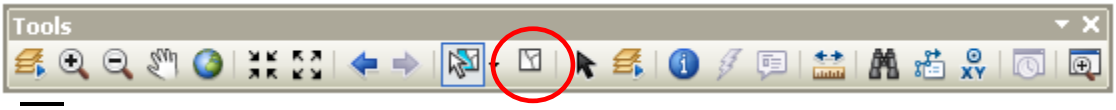


7. Click the full list button located on the left to return to the entire Cover_Type table.

✓*TIP: To change the selection properties for a single layer, right-click on the layer and go to* ***Properties*** > ***Selection*** to choose an outline or fill selection color.

8. Click **Options** (Top Left) > **Clear Selection**. The selected feature on the map and corresponding selected records in the table are now cleared.

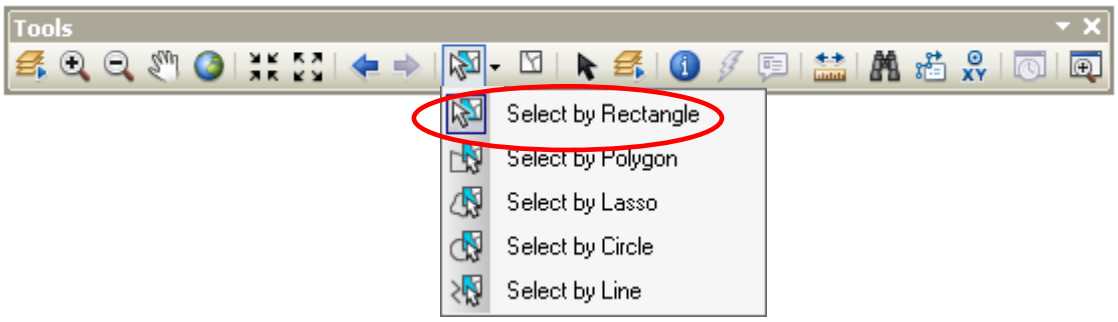
   This can also be done by clicking on the **Clear Selected Features** tool



s.

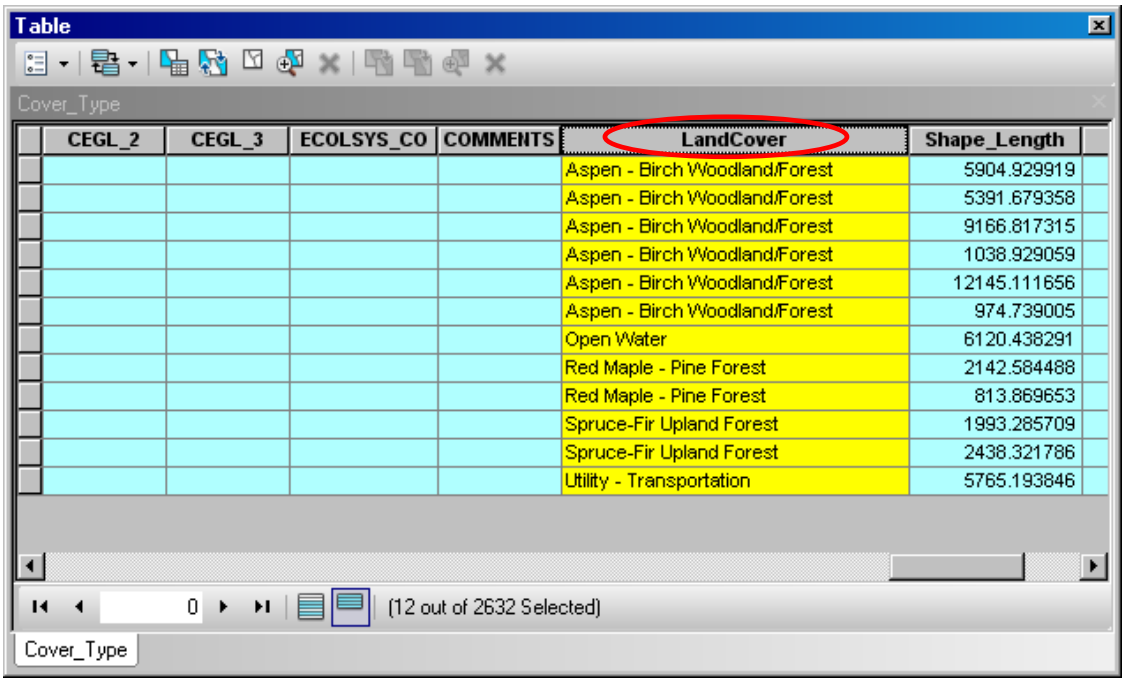
9. Close the **Attributes of Cover_Type** window.

10. Click on the pull down arrow to the right of the **Select Tool** and activate the **Select by Rectangle**. Move the pointer to any area within the Approved_Boundary layer. Depress and hold down the left mouse button, and move the mouse in any direction. A box will appear. When you are satisfied with the box size and location, release the left mouse button. All polygons within or touching the box are now selected and will be highlighted with the blue outline.



11. Restore the **Attributes of Cover_Type** window.

12. Scroll the table to the right until you see the **LandCover** field. Right click on LandCover (column heading) and then select **Sort Ascending.** Notice that all records are now sorted in ascending order by LandCover.



CEGL_2	CEGL_3	ECOLSYS_CO	COMMENTS	LandCover	Shape_Length
				Aspen - Birch Woodland/Forest	5904.929919
				Aspen - Birch Woodland/Forest	5391.679358
				Aspen - Birch Woodland/Forest	9166.817315
				Aspen - Birch Woodland/Forest	1038.929059
				Aspen - Birch Woodland/Forest	12145.111656
				Aspen - Birch Woodland/Forest	974.739005
				Open Water	6120.438291
				Red Maple - Pine Forest	2142.584488
				Red Maple - Pine Forest	813.869653
				Spruce-Fir Upland Forest	1993.285709
				Spruce-Fir Upland Forest	2438.321786
				Utility - Transportation	5765.193846

13. Close the **Attributes of Cover_Type** window.

Quiz 1: Having an affinity for roast woodcock, you want to start a woodcock farm and need some eggs and an idea as to where the birds nest. The Baring Unit of Moosehorn NWR is rumored to have nesting woodcock. Is this true? If so, how many nests were on the Unit in 1987? (Hint - if you find the correct layer, the field you will be interested in is ***yearfd***.) Solve this quiz **using the techniques you learned in this exercise**.

Notes:

Notes:

Exercise 7: Joins and Spatial Joins

Session Objectives: At the conclusion of this session, you will be able to:

- Define a Join and Spatial Join
- Join a Excel spread sheet onto a existing layer
- Perform a Spatial Join

Materials created by: Christopher Bryant and Mark Richardson
Revised: January 2012
Notes: ArcMap 10, Service Pack 1

SECTION 1 - Adding and Viewing an Excel Spread Sheet

Joining tables and spread sheets to an existing layer is a useful and common practice. Our first step is to view the spread sheet and see what additional data (fields) with will be appending to the Gates Layer.

1. Right Click on the **Gates** layers and open the attribute table for this layer.

2. Grab the bottom slider bar and view all the fields from left to right.

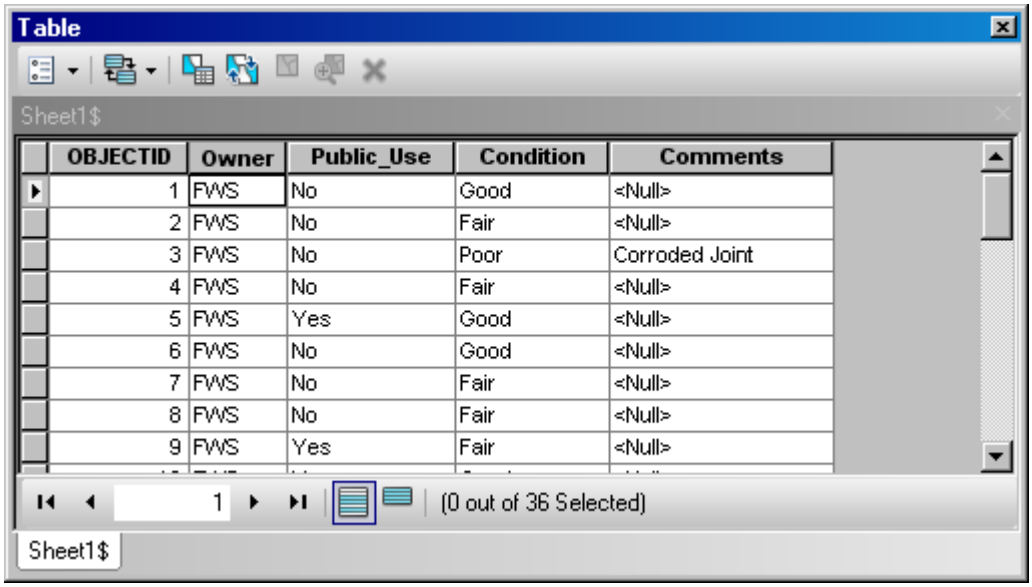
3. Close out the **Gates** attribute table.

4. From the Standard Tool bar **Add** the **Ex.6.xls** Excel spread sheet located in **D:\CPS7100\Moosehorn.**

5. Click on **Sheet 1**and then **Add.**

   Note, how the Excel spread sheet shows up at the bottom of the table of contents and toggles over to the **List by Source View.**

6. Right Click on **Sheet 1** and then **Open** the spread sheet .

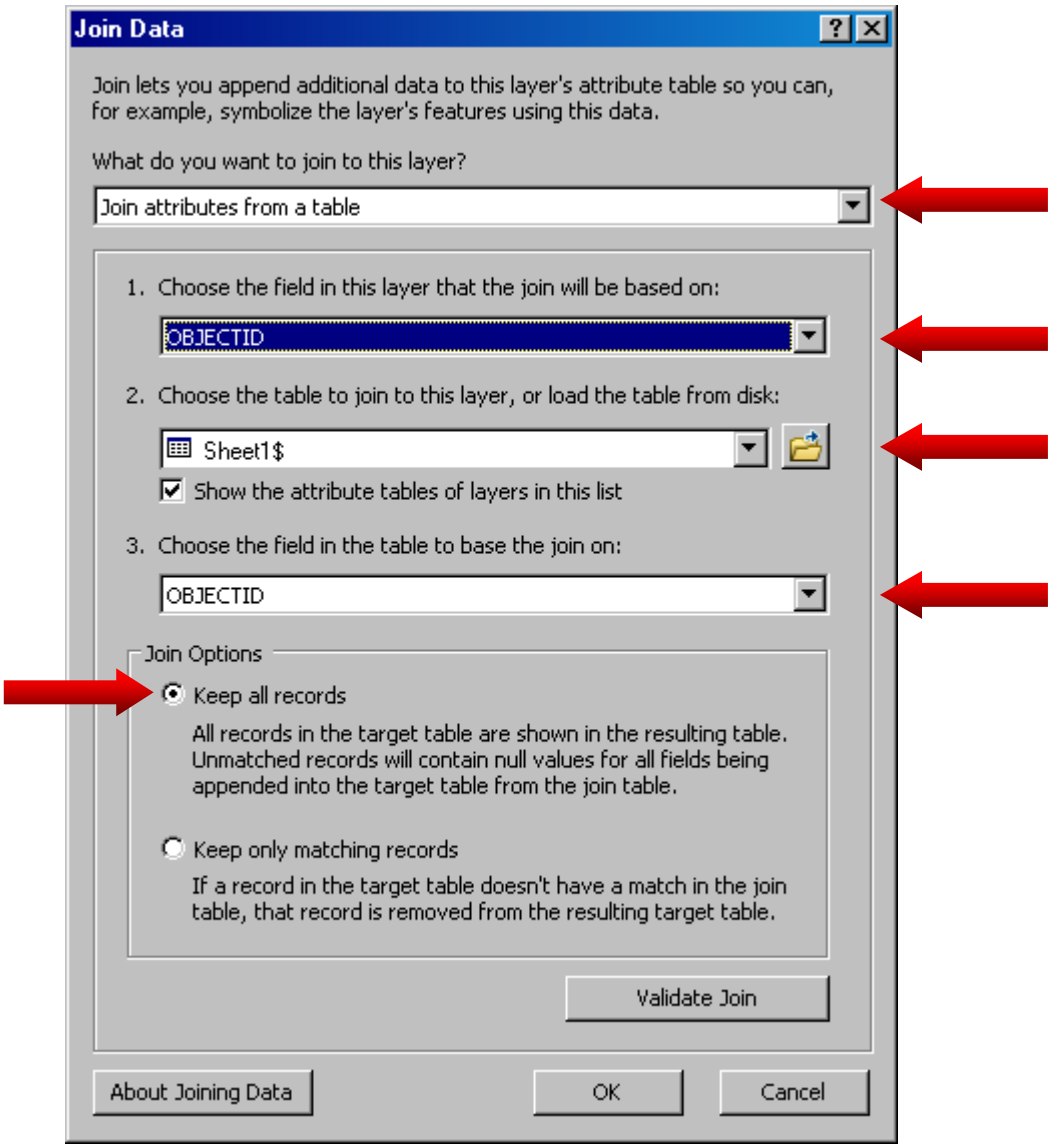


As you can see , we will be appending the **Owner, Public Use, Condition and Comments** field to the Gates Layer. Our next step is to Join Sheet 1 to the Gates Layer.

SECTION 2 - Joining a Table

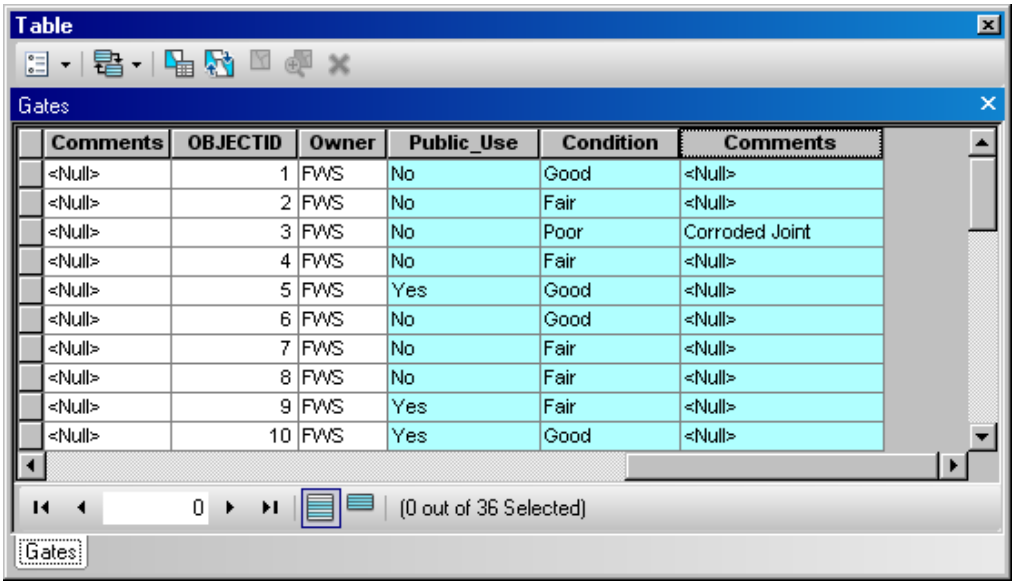
1. Right Click on the **Gates** layer and select **Joins and Relates** >**Joins**

2. In the Join Data window, change the fields to match the window shown below:



3. Click **OK.**

4. Open the attribute table of the **Gates** Layer.



Notice how the new fields from the Excel spread sheet have been temporarily appended to the Gates Layer – congratulations!

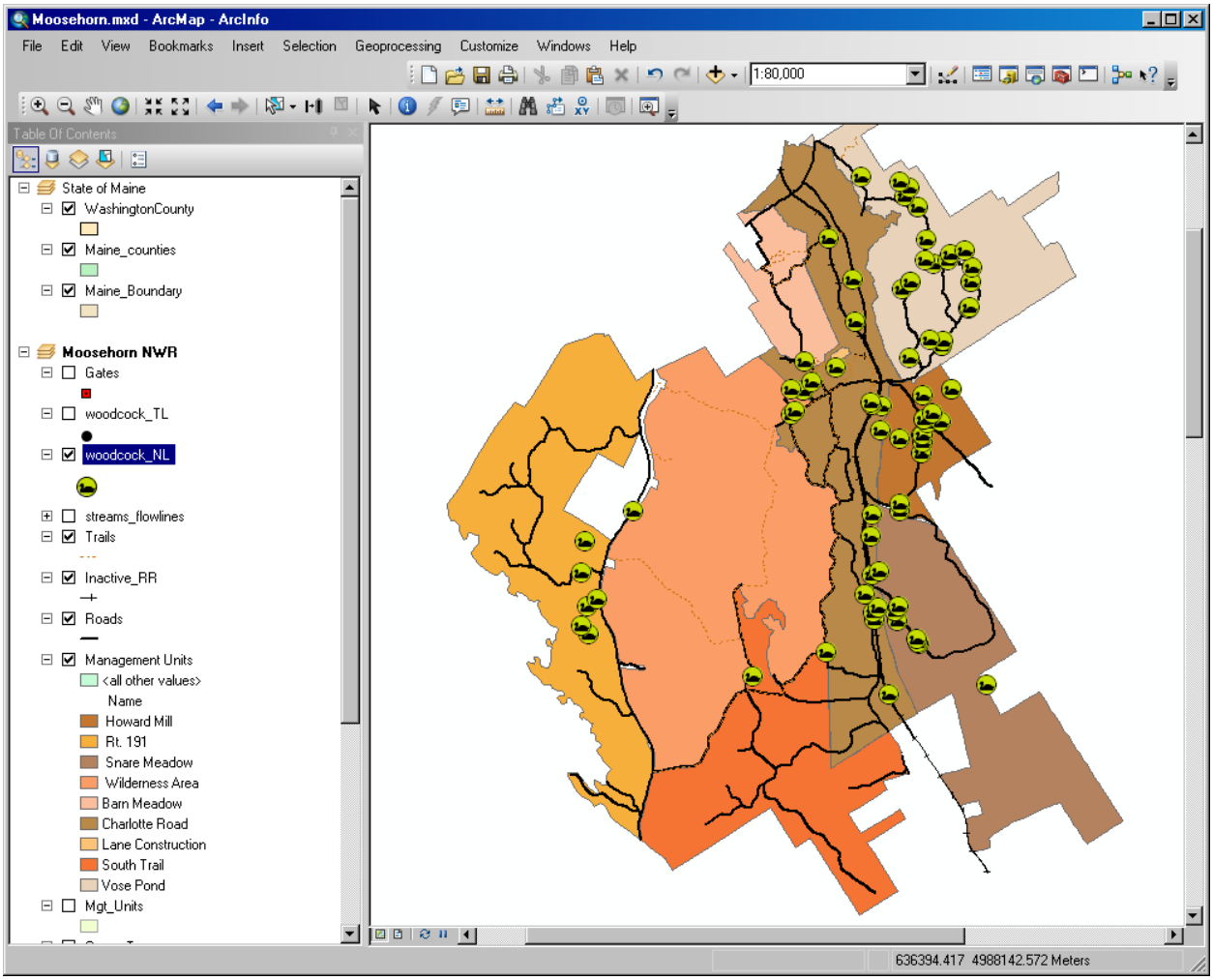
5. Right click on the Gates and select Joins and Relates >**Remove Joins.**

SECTION 3 - Performing a Spatial Join

Instead of joining an existing table to layer, in this exercise, we are going append attributes from a point layer using the spatial features (polygons) from another layer. In this case, we are going to tally the number points from Nest locations and then append the attributes to the Management Units layer.

1. Turn off all the layers in the table of contents except **Woodcock_NL** , **Roads** and **Trails**.

2. Add the **Mgt_Units** layer (feature class) from the **Biological_Data** Feature dataset located within the Moosehorn geodatabase.

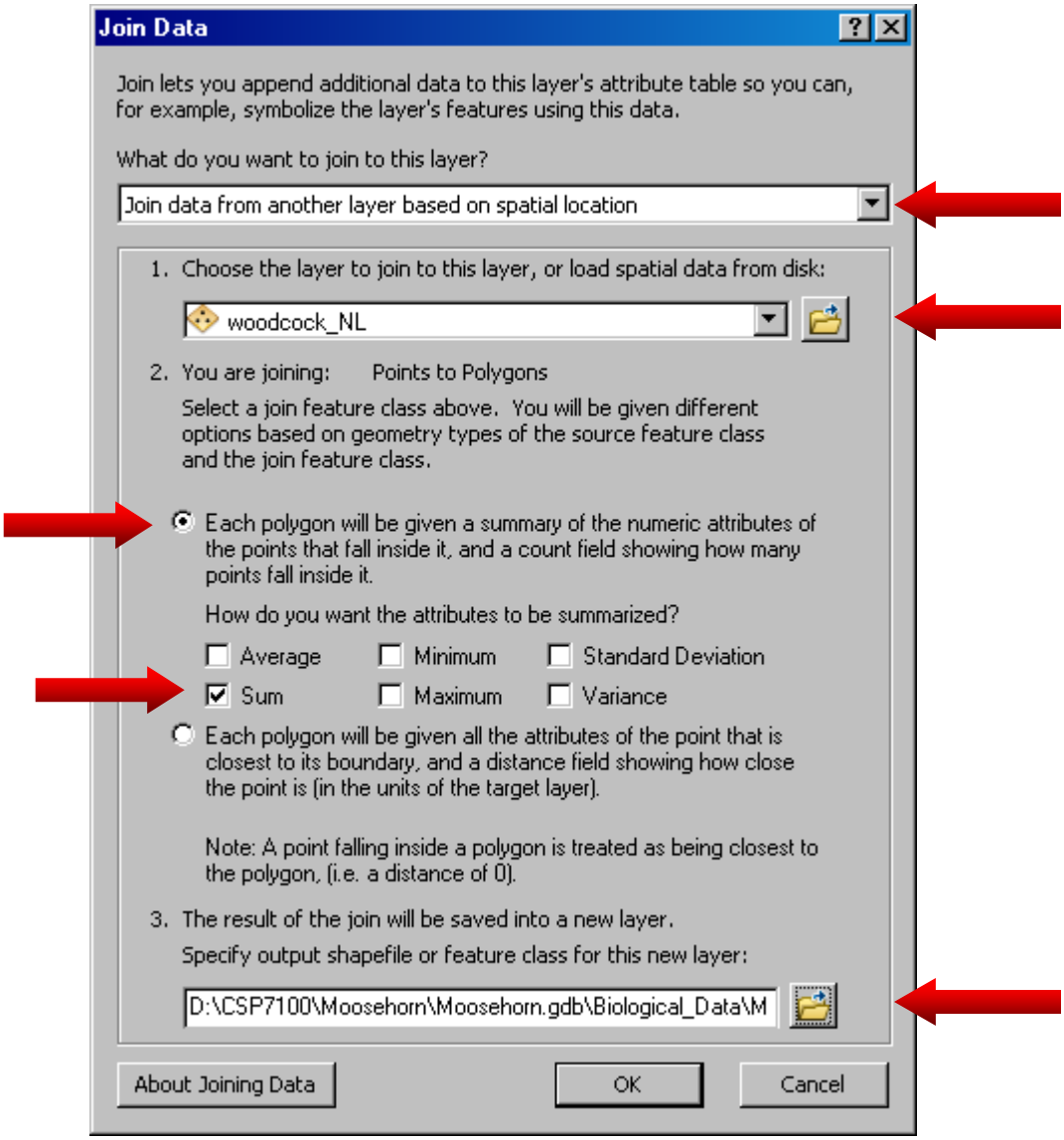


3. Open the attribute table and view the various fields that make up the Mgt_Units feature dataset. Note, there is a **name field** and each management unit has a unique name and number assigned to them.

4. Close out the Mgt_Units attribute table.

5. Right Click on the Mgt_Units data layer and select Join and Relates >Join

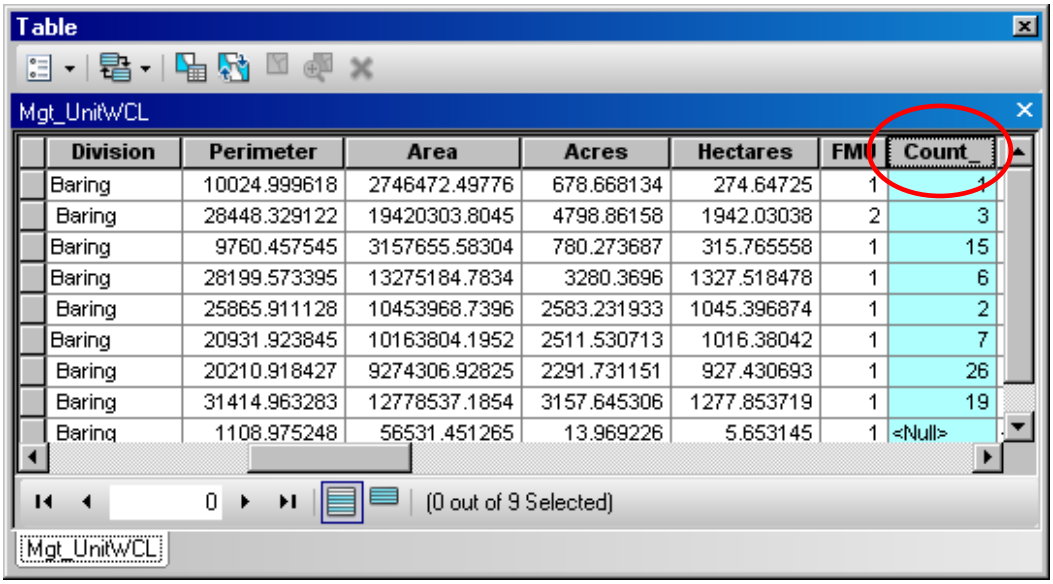
6. In the Join Data window, change the fields to match the window shown below: Tip - be sure to change the first dialog box to Join data from another layer based on spatial location and check the **Sum** box.



7. Save the new layer as a feature class and name it **Mgt_UnitsWCL.**

8. Click **OK**. A new layer will appear in the table of contents.

9. Open the new **Mgt_UnitWCL** layer attribute table. Notice a Count field has been added. All the nest locations have been tallied for each individual management unit – cool!



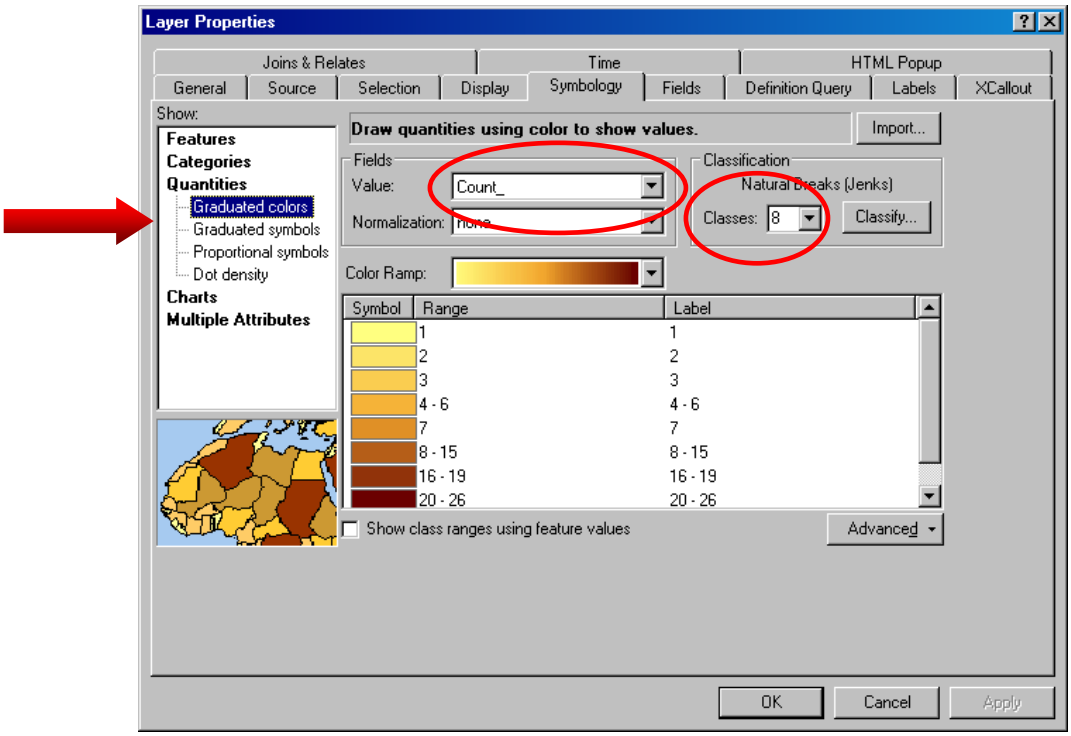
Division	Perimeter	Area	Acres	Hectares	FMU	Count_
Baring	10024.999618	2746472.49776	678.668134	274.64725	1	1
Baring	28448.329122	19420303.8045	4798.86158	1942.03038	2	3
Baring	9760.457545	3157655.58304	780.273687	315.765558	1	15
Baring	28199.573395	13275184.7834	3280.3696	1327.518478	1	6
Baring	25865.911128	10453968.7396	2583.231933	1045.396874	1	2
Baring	20931.923845	10163804.1952	2511.530713	1016.38042	1	7
Baring	20210.918427	9274306.92825	2291.731151	927.430693	1	26
Baring	31414.963283	12778537.1854	3157.645306	1277.853719	1	19
Baring	1108.975248	56531.451265	13.969226	5.653145	1	<Null>

SECTION 4 - Changing the Symbology

By default, the Mgt_UnitWCL has been added into the table of contents and displays as one color or a single symbol. Not much to look at and really does not tell you anything spatially – let's change that.

1. Right click on the **Mgt_UntWCL** and select **Properties.**

2. Click on the **Symbology** tab.



3. In the **Show box** click on **Quantities** and select **Graduated Colors**.

4. Change the **Value** to **Count** and the number of **Classes** to **8**.

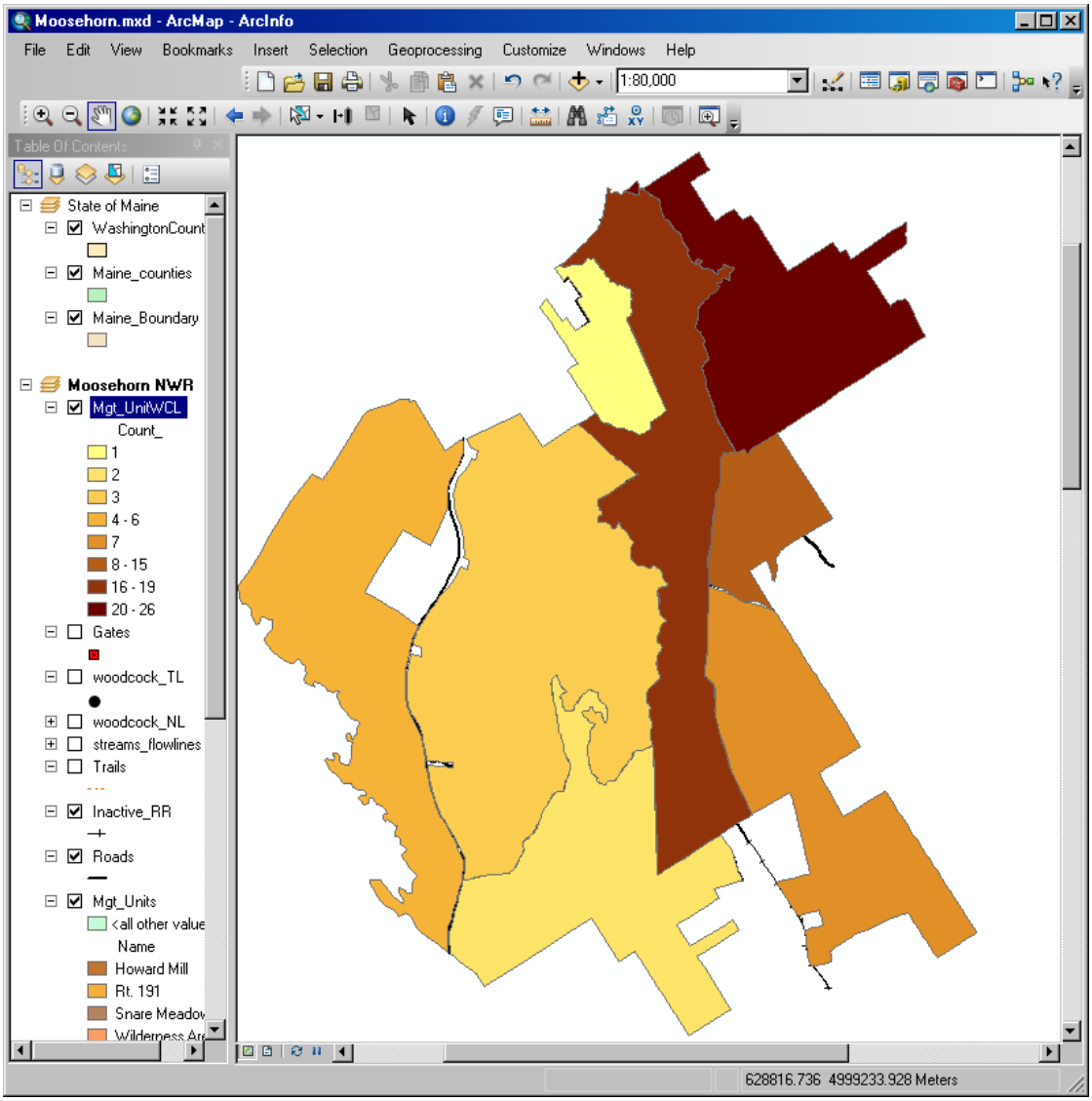
   A. Why 8 classes? _____

5. Select a Ramp Color of your choice.

6. Click **OK.**

Your data view should look similar to the one shown below.

B. What do the darker polygon represent VS the lighter ones? How can you verify this? _____



Exercise 8: Constructing Queries

Session Objectives: At the conclusion of this session, you will be able to:

- Perform two types of queries: Select by Attributes and Definition
- Export the results of your query as a shapefile

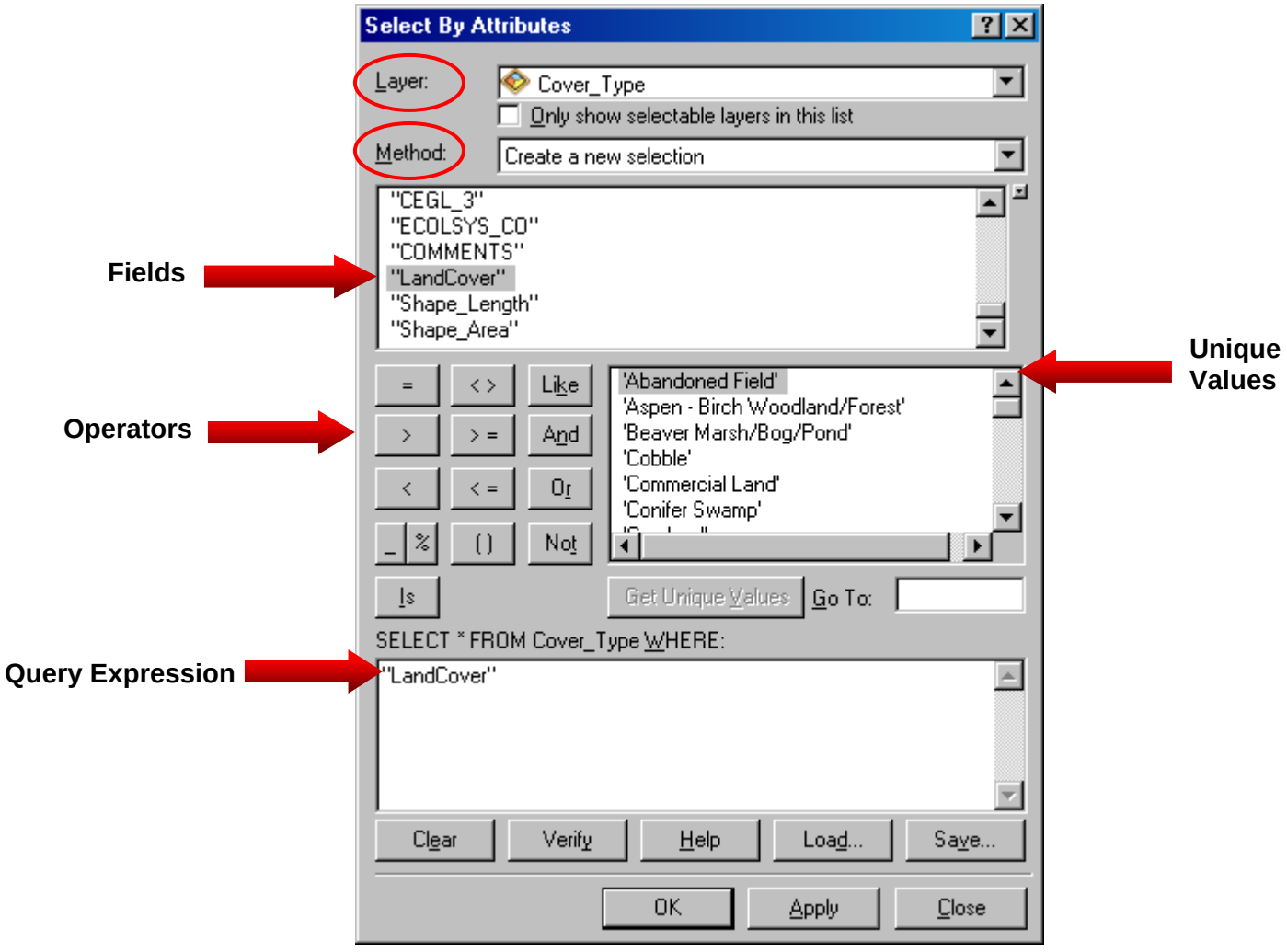
Materials created by: Mark Richardson and Doug Newcomb
Revised: April, 2011 by Mark Richardson
Notes: ArcMap 10, Service Pack 1

SECTION 1 – Basic Queries (Select By Attributes)

We are going to select features within a layer that meet a set of criteria we define. These selected features can then be used for later analyses such as summaries (which we will demonstrate in Exercise 7).

1. Click on **Selection** > **Select By Attributes** on the main menu toolbar at the top of your screen. The **Select By Attributes** window appears.

   Notice you have two dropdown menus at the top dealing with Layer and Method.



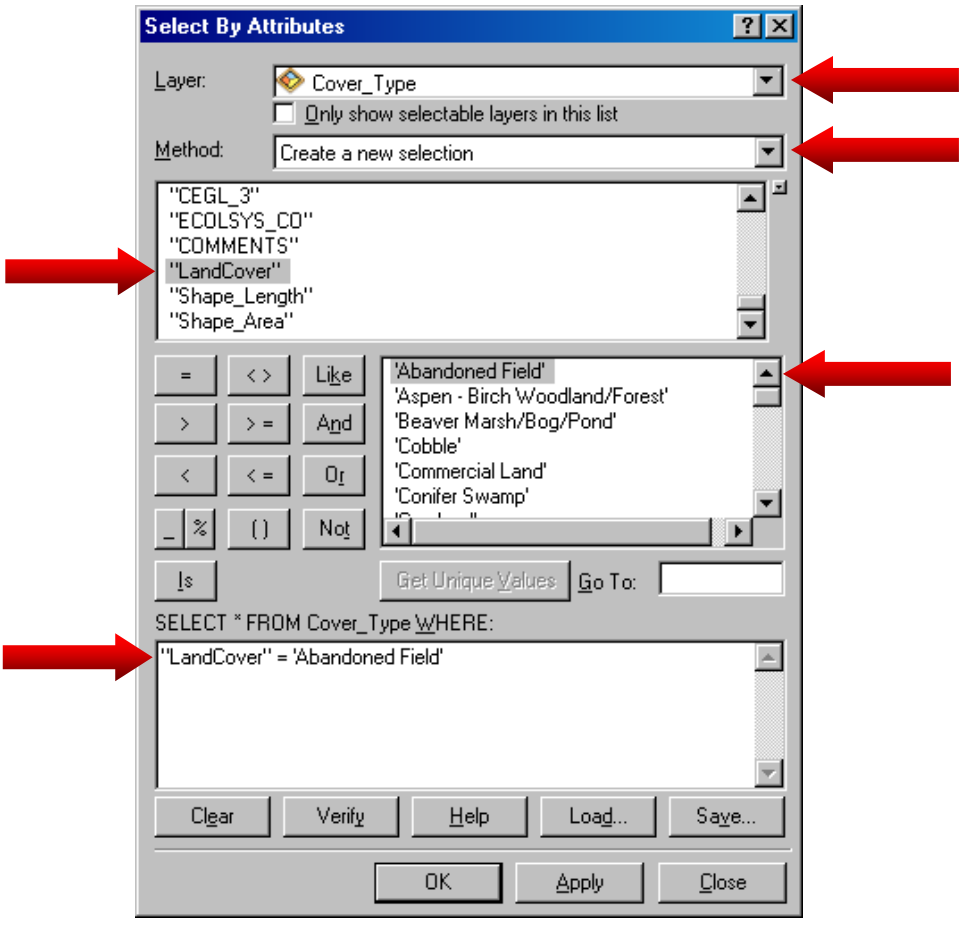
2. Click on the dropdown arrow beside **Layer** and select the **Cover Type** layer. Notice after you did this there were changes in the types and number of fields listed. The **Method** you want is to **Create a new selection.**

3. In the **Fields** dialog, double-click on the **LandCover** field. The word LandCover will appear in the window below as the first building block of your query expression.

4. **Single-click** on the equal sign "=." It will be added to the query expression being built in the window below.

5. Click on **Get Unique Values** button.

6. Double-click on the value "Abandoned Field" in the **Values** box. Make sure it is added to the query expression in the window below. The entire constructed query should now be in the window.



7. Click the **Apply** button, then the **Close** button.

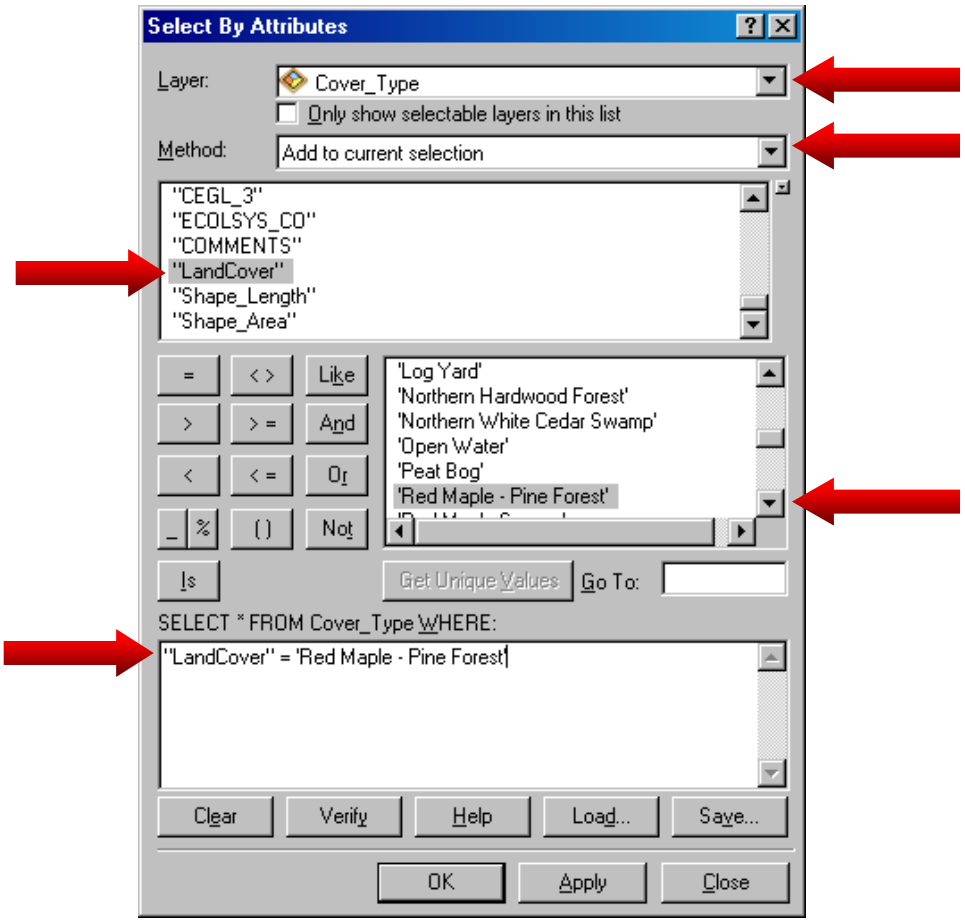
   What happened in your Data View? Notice that all of the Abandoned Fields have their boundaries highlighted.

8. Choose **Select By Attributes** again from the **Selection** menu.

9. Press the **Clear** button at the bottom left to clear out the bottom window.

10. Again choose **Cover_Type** as the layer you want to query, but this time choose **Add to current selection** for the **Method**.

11. Create the query: “LandCover” = ‘Red Maple - Pine Forest’



12. Click **Apply** and then click **Close**. Notice that the Red Maple-Pine Forests are now added to the selection of Abandoned Fields.

13. Right-click on the **Cover_Type** layer, choose **Selection**, and select **Clear Selected Features**. What happens?

✓TIP: The Help dialog is very useful in explaining how to build queries if you are unfamiliar with using SQL expressions.

SECTION 2 – Constructing Compound Queries

In this section, we are going to select multiple records within the same field using a compound query. In this example, we will select all Abandoned Fields and Peat Bogs under the Land Cover.

1. Click on **Selection > Select By Attributes** on the Main Menu.

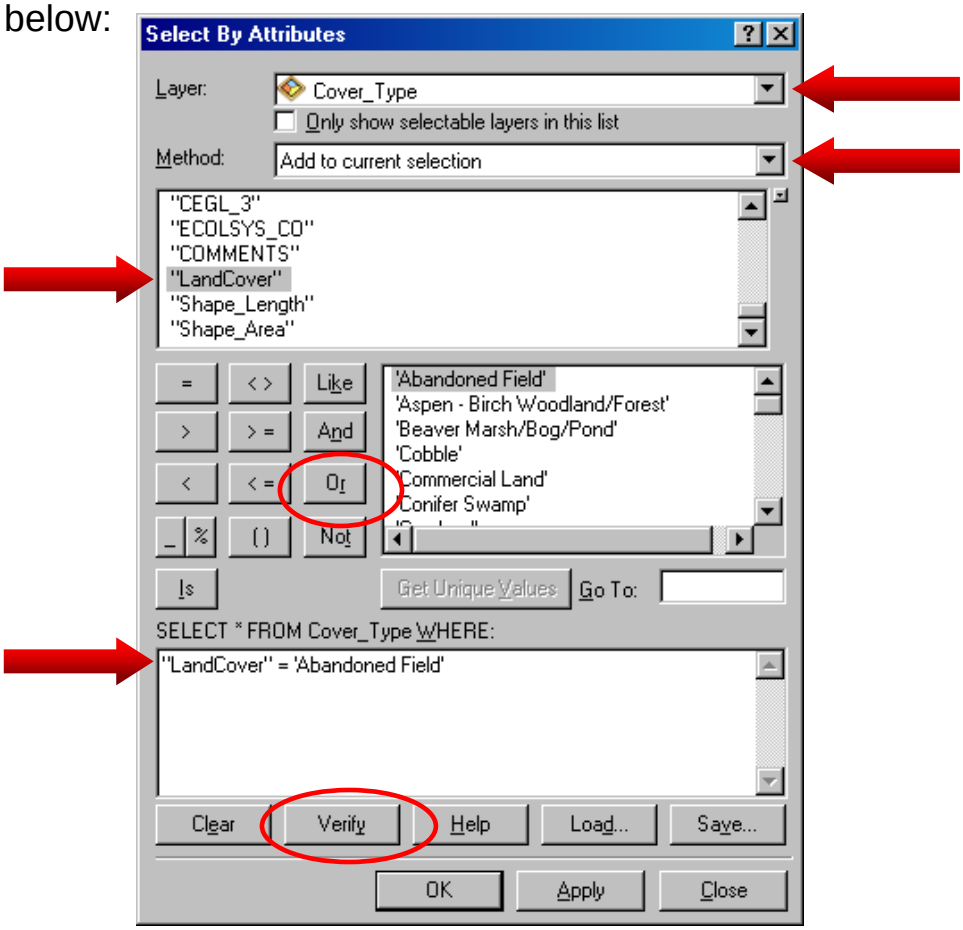
2. Click on the dropdown arrow beside **Layer** and select the **Cover Type**

3. Choose **Create a New Selection** for the Method**.**

4. Double-click on the **LandCover** field.

5. **Single-click** on the equal sign "=" It will be added to the query expression being built in the window below.

6. Click on **Get Unique Values** button. Double-click on **Abandoned Field** in the **Values** box. The first section of the query should appear as shown below:



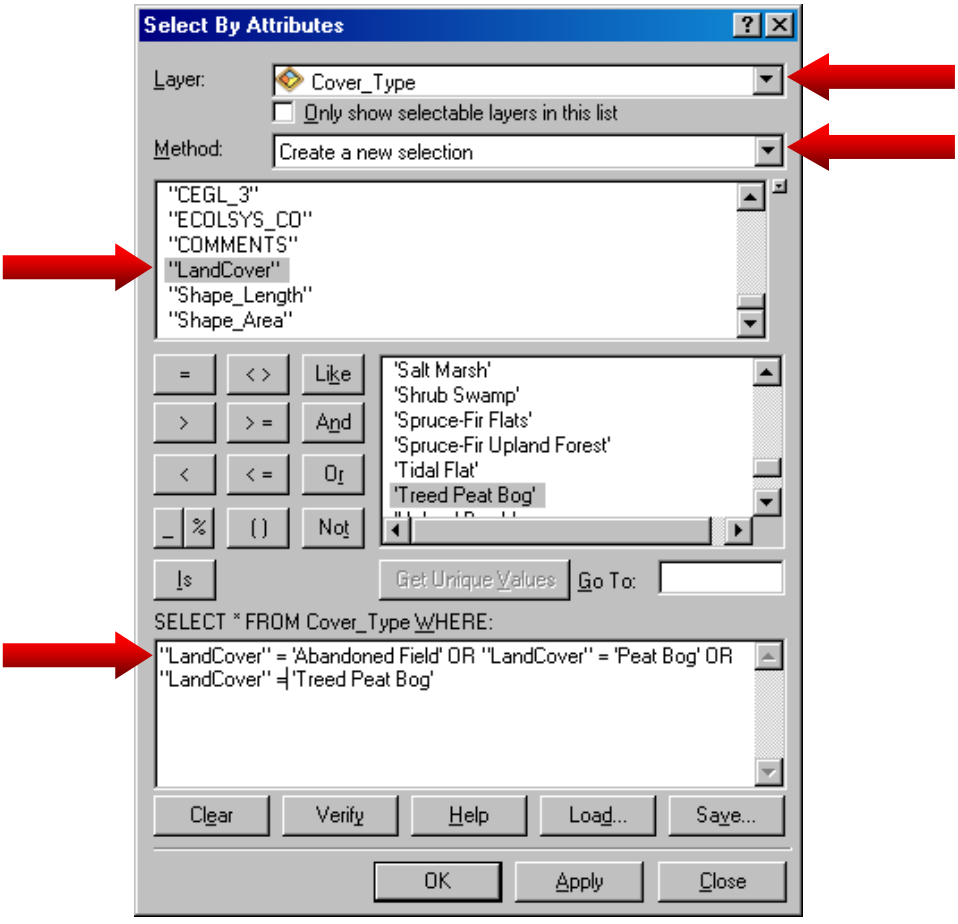
7. Click on the **OR** button to add this operator.

   Why are we choosing the **OR** operator and not using AND? What is the difference?

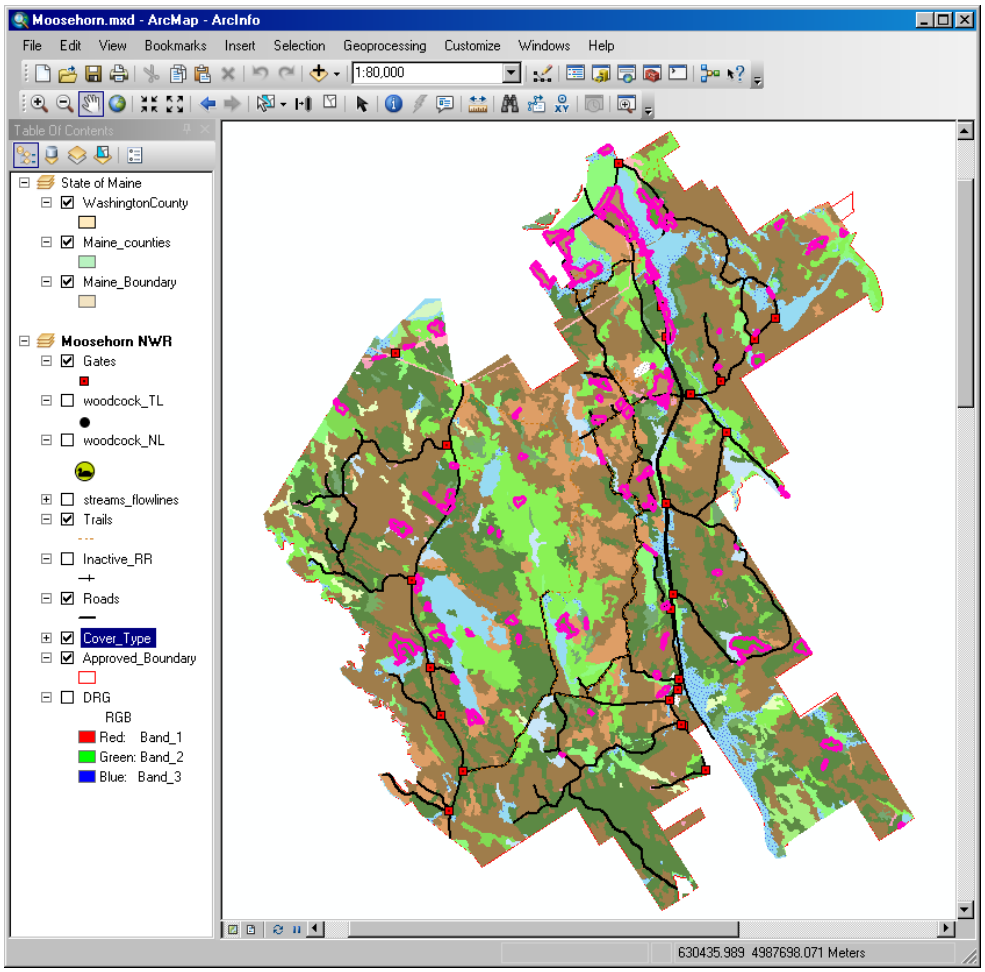
8. Double click on **LandCover =** as you did before, but this time click on '**Peat Bog'** in the Unique Values list.

9. Click on the **OR** button once again to add this operator.

10. Double click on **LandCover =** again, but this time click on '**Treed Peat Bog'** in the Unique Values list to complete the expression. The final expression should look like the one shown below:



11. Click **Verify** to ensure that the compound expression was constructed correctly. Then click **Apply**.



12. Click **OK** to close the window. All the Abandoned Fields and Peat Bogs and Treed Bogs are **selected** as illustrated above.

STOP -PLEASE STOP HERE BEFORE GOING ON TO THE NEXT SECTION- STOP

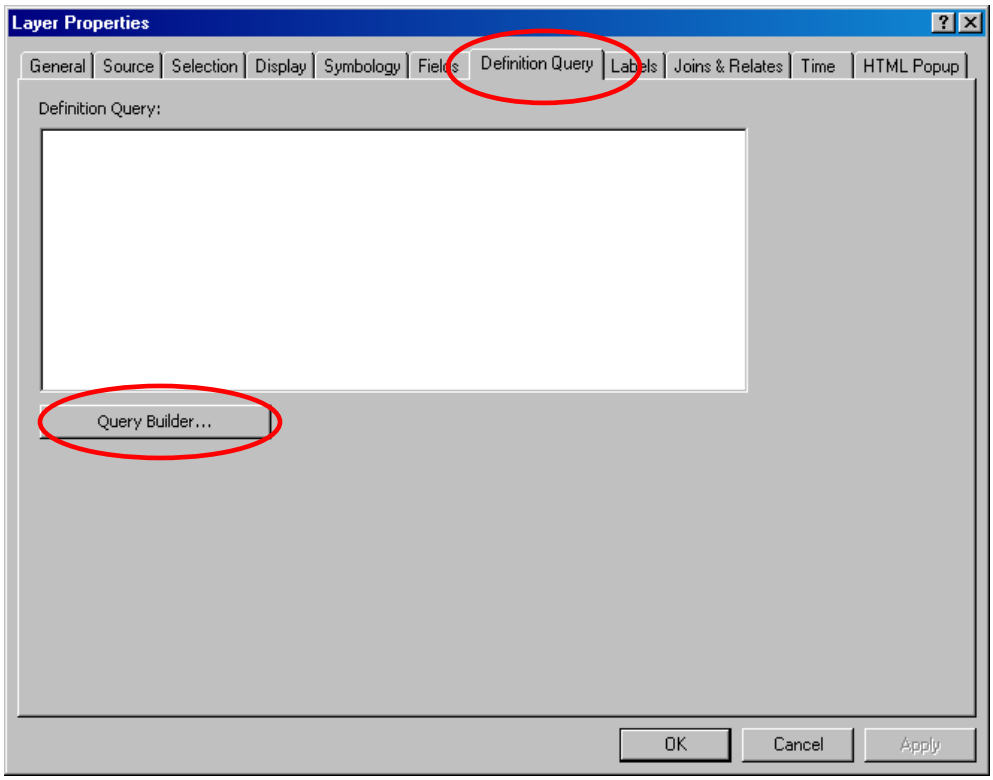
Quiz 1**:** Build a compound query (SQL expression) selecting all the swamp types within Cover_Type layer. Hint – there are 4 swamp classification types listed within the LandCover data **field.**

SECTION 3 – Layer Definition Queries

Now we are going to define features within a layer that we want to include in our view, *excluding the features we do not want*. This is accomplished through the **Layer Properties** window. Queries performed from here *restrict* the features in a layer to those that meet the criteria of the query. This is different from a basic query, which simply *selects* the features.

1. Right-click on the **Cover_Type** layer and select **Properties**. This opens the Layer Properties window.

2. Click on the **Definition Query** tab. Now click on the **Query Builder…** button.

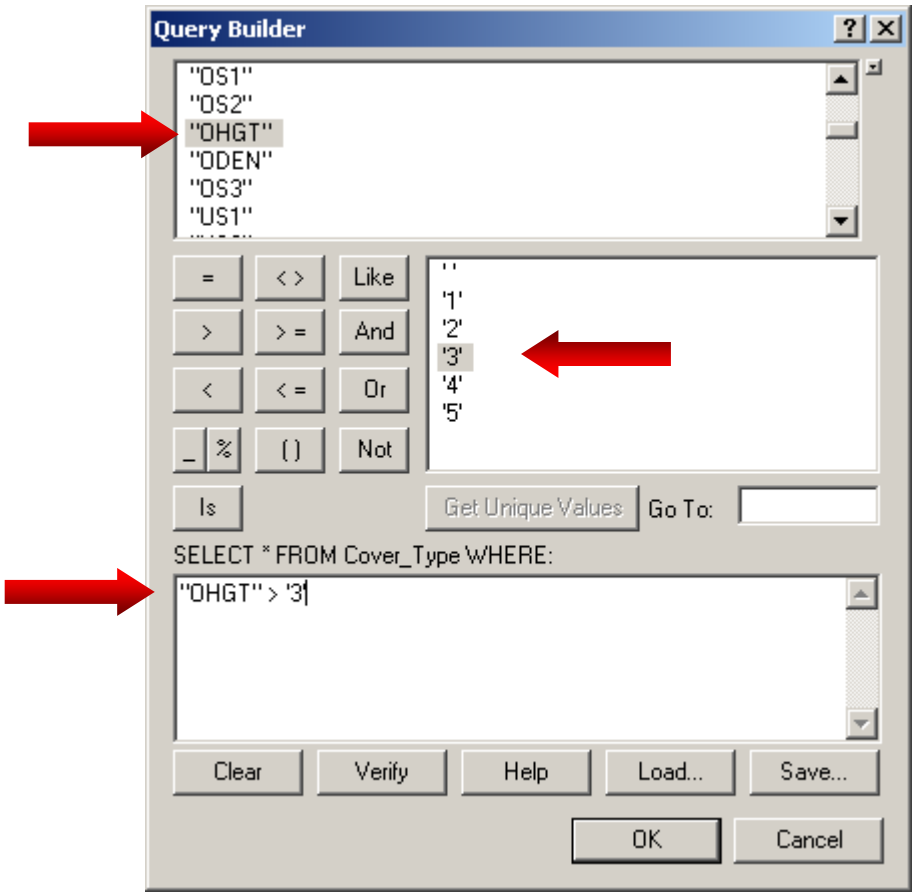


This opens the Query Builder window. Notice it looks similar to the **Select By Attributes** window except for differences in some of the buttons at the bottom.

3. Queries are constructed in the same way as before. Scroll down in the field box, double-click on **OHGT** (Average Height of Overstory Components) and then single-click on the **>** sign. Both appear in the window below.

4. Click on **Get Unique Values.**

5. Double-click on **'3'** to set the Query for Average Height of Overstory > 50 ft.



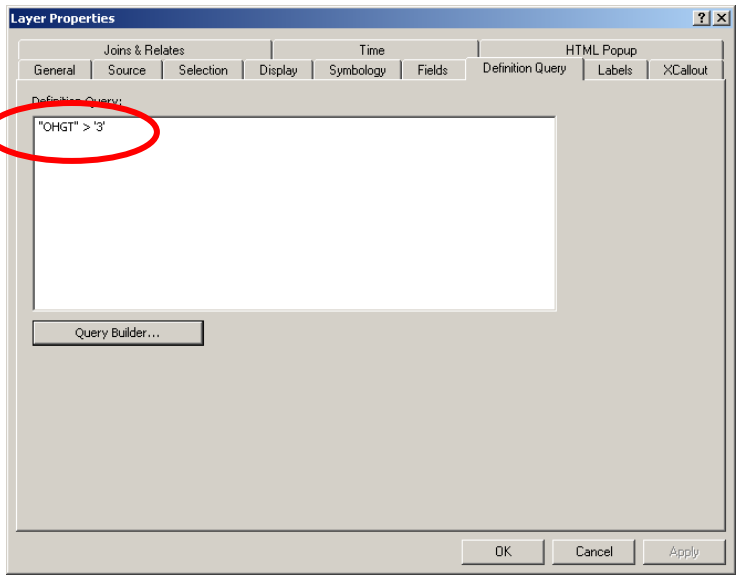
6. Click **OK** to close the **Query Builder**. Notice that the query appears in the Query Definition dialogue window.

7. Click **OK** to close out of the **Layer Properties** window and submit your query.

Only Overstory greater than 50 ft appear in the **Data View** window and nothing is highlighted.

8. Right-click on the **Cover Type** layer and select **Open Attribute Table**. What is missing from the table? Close the attribute table and return to the **Data View**.

9. Double-click on the **Cover_ Type** layer and go back to the Definition Query tab. Notice that your query expression is highlighted in dark blue.



10. Press the **Delete** key. Now the expression is gone. Click **OK** in the Layer Properties window, and notice that your **Data View** has all of the cover types visually present again.

✓*TIP: To update the legend in the table of contents to match the Definition Query, click on the Symbology tab in the Layer Properties window and select* ***Add All Values****. Only values that match the Definition Query will appear. Click OK to apply the changes.*

Quiz 2: Explain the difference between (1) building your query using the Select By Attributes method and (2) building your query using the Layer Properties>Definition Query method? How are the results different?

SECTION 4 – Saving Queries as Shapefiles

Shapefiles are a format for storing the location, shape, and attribute information of geographic features. When you create a shapefile from the results of a query (either basic or layer definition), the currently selected features will be saved as a new data set that is a subset of the original. This smaller data set can be manipulated much more quickly than the entire source data set.

1. **Clear all your selections** from previous parts of this exercise.

   You can clear all selected features without going to each individual layer that has a selection. To do this, go up to the **Selection** menu, click on it, and select **Clear Selected Features**. If this function is disabled or grayed out, no features are currently selected.

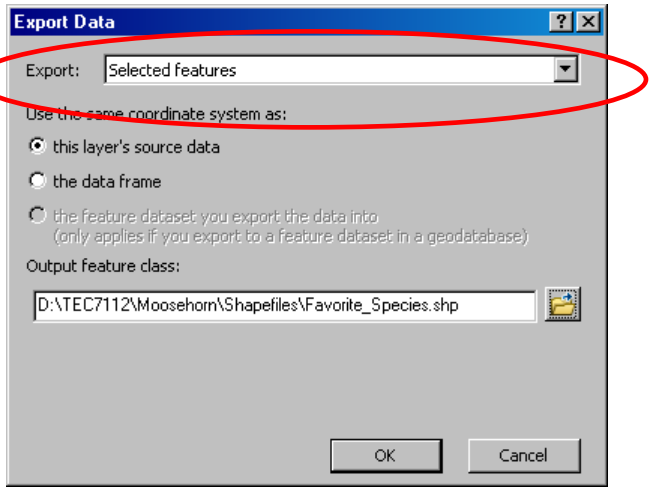
2. Choose **Select By Attributes** from the **Selection** menu.

3. Using the **Cover_Type** layer, build a query that will highlight your two or three favorite species or cover types.

   ✓TIP: Use the Help menu to determine when the "AND" or "OR" operators should be used.

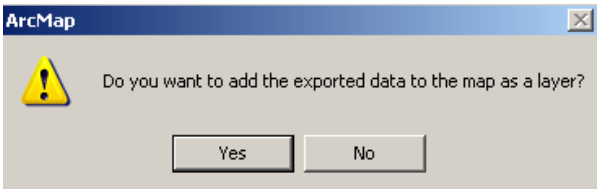
4. Make sure at least two tree species are highlighted in the data view.

5. Right-click on the **Cover_Type** layer, highlight **Data**, and select **Export Data**.



Make sure that you have "Selected features" chosen to export. You want to use the same Coordinate system as the layer's source data. In the last box, you can navigate to the directory you want and rename the shapefile that you are about to create.

6. Click **OK** when satisfied.



7. ArcMap will ask you…

8. Click **Yes**.

9. The shapefile will appear above the Cover_Type layer in the table of contents in the Moosehorn NWR data view.

10. Click on the new shapefile and turn it on. You may want to turn off Cover Type. Notice that it contains only the species that were selected through the Select By Attributes query. Open the attribute table if you'd like to double check.

✓TIP: You can also SAVE the query expression created in Query Builder so you don't have to rebuild it each time you use it. It will be saved with an .exp extension. Just load the file and it will populate the dialog box.

Quiz 3: Display all woodcock survey locations that had greater than two singing male woodcocks in 1995 (Z995 > 2) overlayed on Aspen-Birch Woodland/Forest and WhitePine – Hemlock stands. Do a definition query on the Cover_Type layer and peruse the display. Do you see a difference in the number of locations between the two cover types? (**Hint:** you will need to add the woodcock_SGS layer. Do you remember how to do this?)

Notes:

Notes:

Exercise 9: Spatial Analysis

Session Objectives: At the conclusion of this session, you will be able to:

- Create a summary table
- Create a summary table in conjunction with a query
- Generate statistics on numeric fields
- Perform select by location queries

Materials created by: Kimber Sprankle, Greg Stepic, Mark Richardson, and Lynn Rutz
Revised: February 2012, by Mark Richardson and Christopher Bryant
Notes: ArcMap 10, Service Pack 1

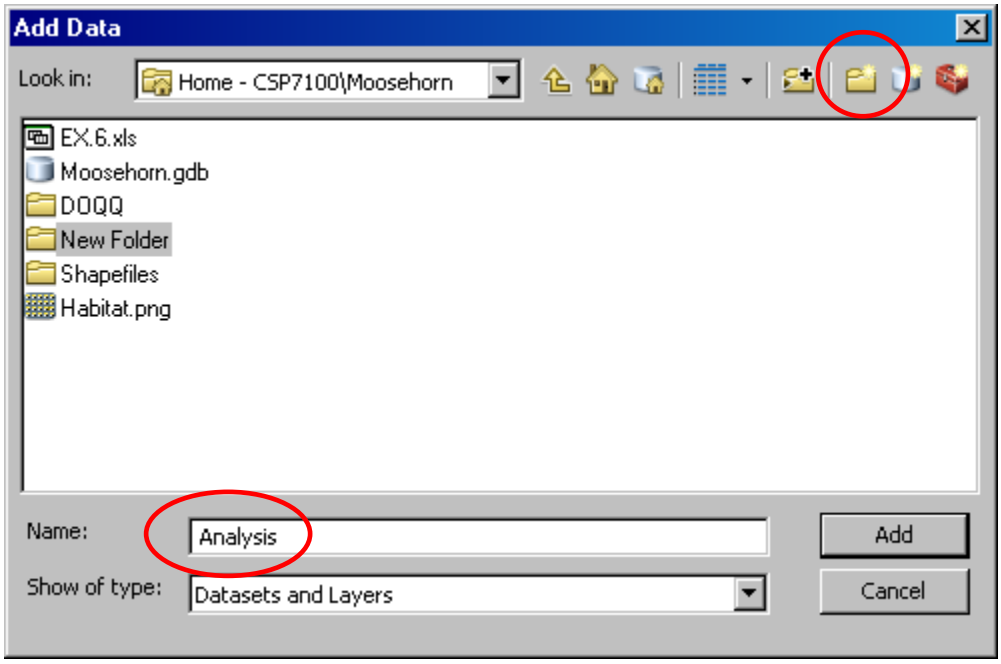
Section 1 - Preparing for Analysis

Before we begin this section, create a folder where you can put the results of your analysis. We recommend creating this folder directly under CSP7100/Moosehorn and naming it **Analysis**.

1. Click on the **Add Data** button located on the Standard Tool bar.

2. Navigate to D:\CSP7100\Moosehorn

3. Click on **Create New Folder**



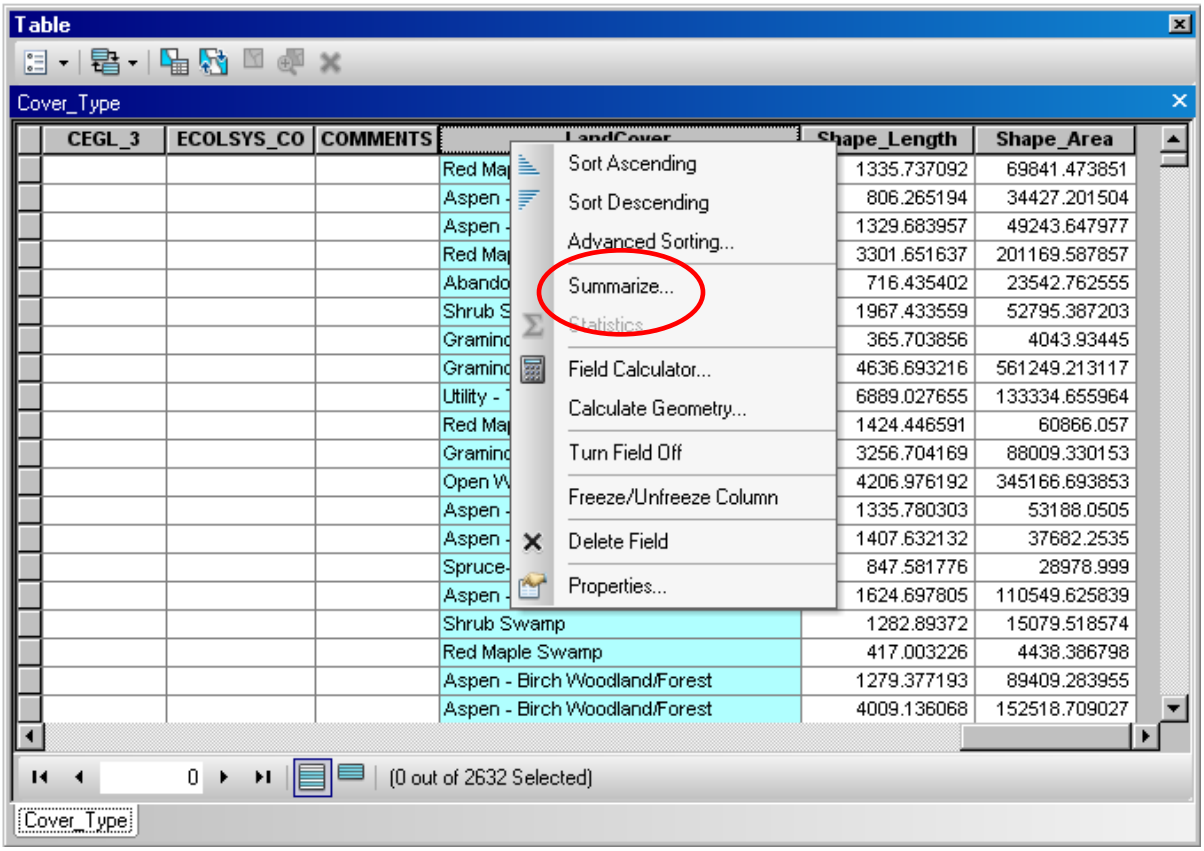
4. Change the New Folder name to **Analysis** and then enter Analysis into the Name dialog box.

SECTION 2 - Summarizing (for category fields)

Tabular data can be summarized using a variety of statistical parameters including sum, standard deviation, variance, and average.

1. Open the Moosehorn map document and make sure that the Moosehorn NWR data frame is activated.

2. Right-click on the **Cover_Type** layer and select **Open Attribute Table**.

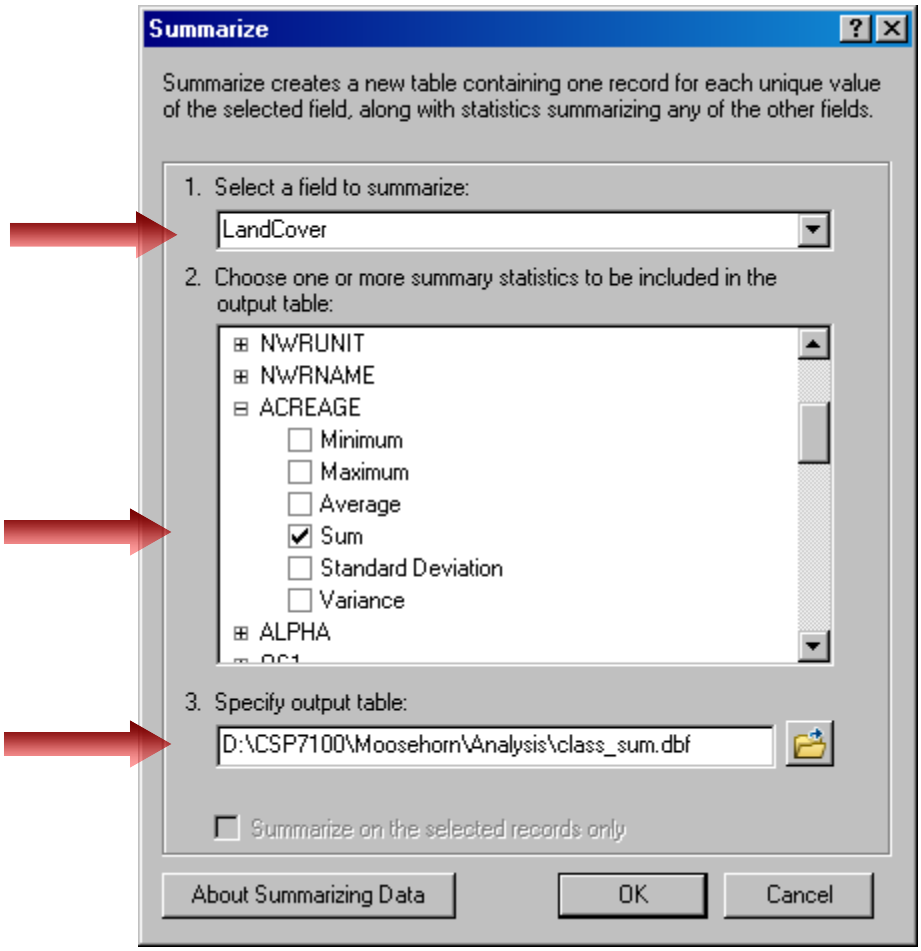


3. Right-click on the **LandCover** field header and select **Summarize**. This opens the Summarize window.

4. Fill in the fields to match the window shown below:

   Click on the "+" sign beside ACREAGE and check **Sum.**

   This will give you the total acreage for each land cover class in a summary output table.



5. Click **OK**.

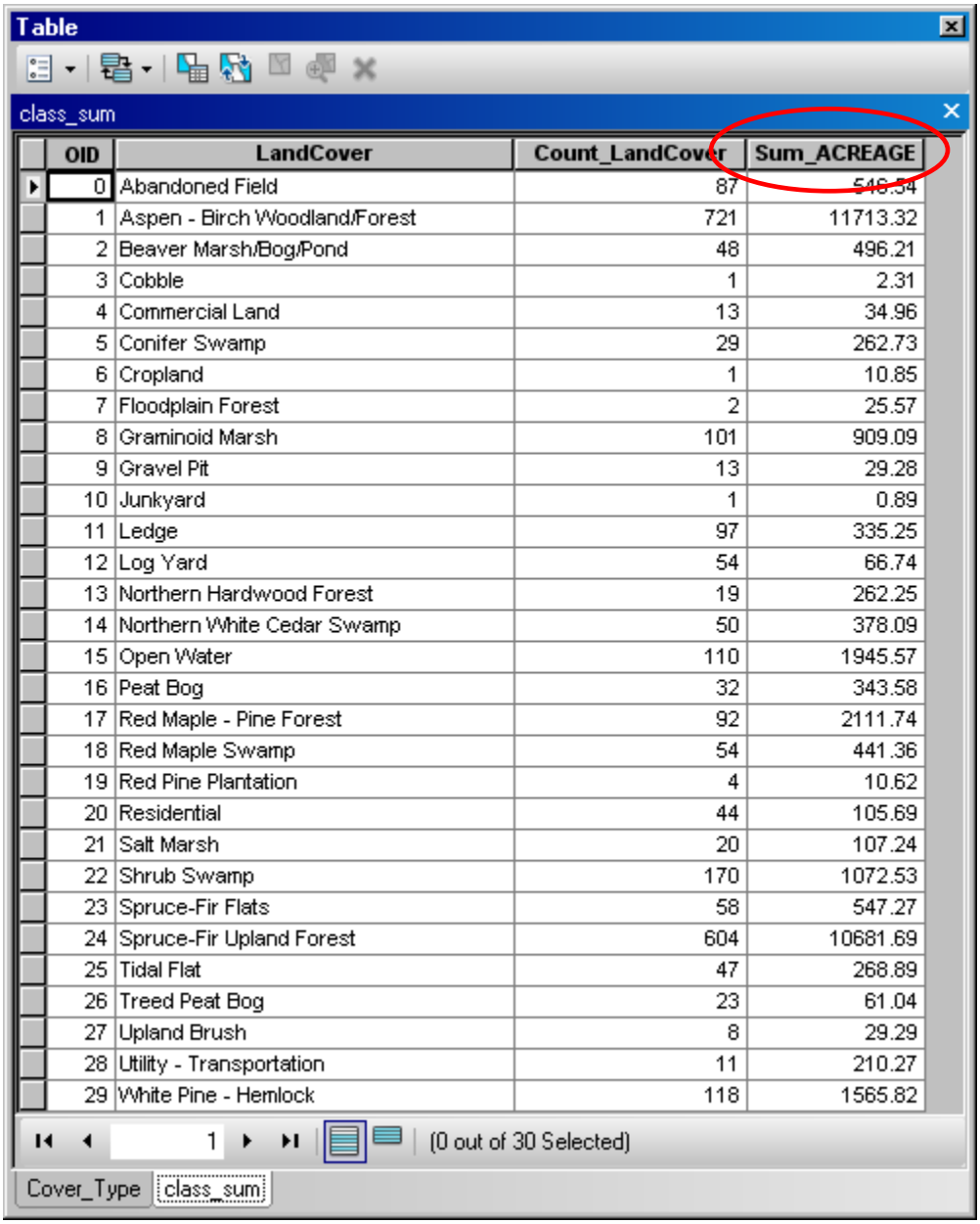
6. ArcMap will ask you… Do you want to add the result table in the map? Click on **Yes**.

7. Close the Attributes of Cover_Type table.

8. Notice that at the bottom of the Table of Contents you have **"class_sum"** database file added. Also note that the table of contents is now shown in the source mode.

8. Right click and open the **class_sum** table in the table of contents.

9. You should have four fields: OID (ObjectID), LandCover, Count of each land cover class, and the **Sum of Acreage** for each cover type class.



Table

class_sum

OID	LandCover	Count_LandCover	Sum_ACREAGE
0	Abandoned Field	87	548.54
1	Aspen - Birch Woodland/Forest	721	11713.32
2	Beaver Marsh/Bog/Pond	48	496.21
3	Cobble	1	2.31
4	Commercial Land	13	34.96
5	Conifer Swamp	29	262.73
6	Cropland	1	10.85
7	Floodplain Forest	2	25.57
8	Graminoid Marsh	101	909.09
9	Gravel Pit	13	29.28
10	Junkyard	1	0.89
11	Ledge	97	335.25
12	Log Yard	54	66.74
13	Northern Hardwood Forest	19	262.25
14	Northern White Cedar Swamp	50	378.09
15	Open Water	110	1945.57
16	Peat Bog	32	343.58
17	Red Maple - Pine Forest	92	2111.74
18	Red Maple Swamp	54	441.36
19	Red Pine Plantation	4	10.62
20	Residential	44	105.69
21	Salt Marsh	20	107.24
22	Shrub Swamp	170	1072.53
23	Spruce-Fir Flats	58	547.27
24	Spruce-Fir Upland Forest	604	10681.69
25	Tidal Flat	47	268.89
26	Treed Peat Bog	23	61.04
27	Upland Brush	8	29.29
28	Utility - Transportation	11	210.27
29	White Pine - Hemlock	118	1565.82

(0 out of 30 Selected)

Cover_Type class_sum

10. Close this table and return to your data view. Feel free to try some more summaries with different statistics included.

> ✓*TIP: In step 2 of the Summarize box, fields with text values default to the non-statistical options of "first" and "last" and cannot produce any mathematical output.*

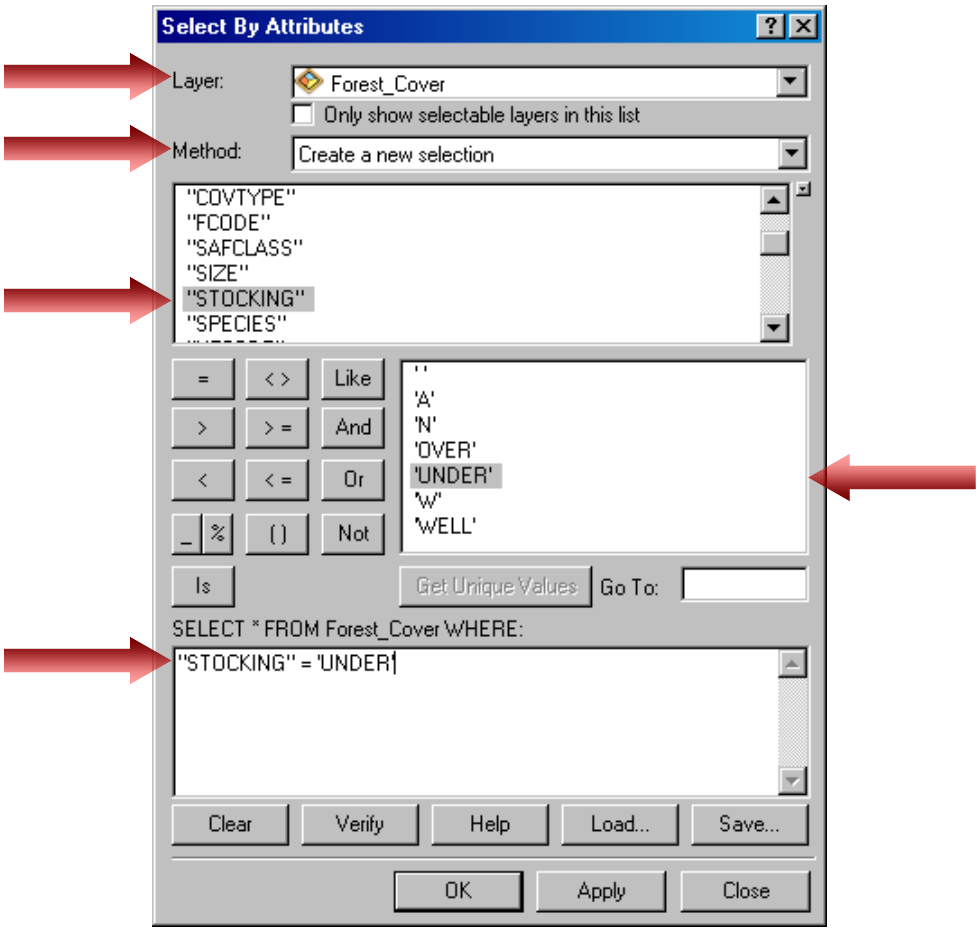
SECTION 3 - Combining a Query with a Summary

Combining a query with a summary can provide a powerful tool for more complex analysis. This allows us to summarize from a selected set. In this exercise we will calculate the acreage of each species that is under stocked.

1. Add the **Forest_cover** data layer from the Moosehorn geodatabase, Landcover feature dataset. Turn off (uncheck) the Cover_type layer.

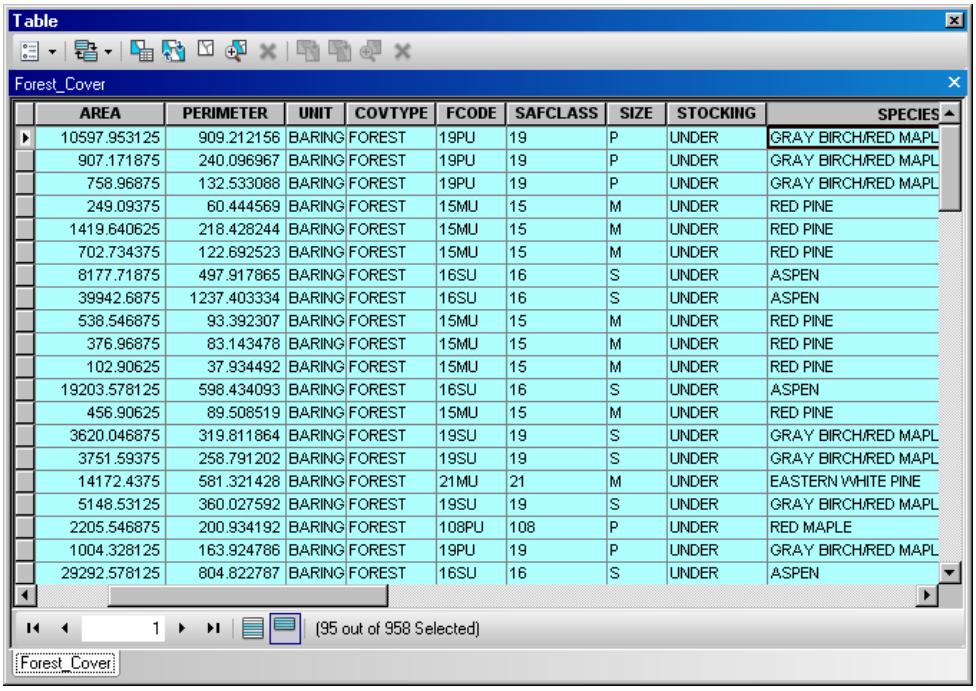
2. In the **Forest_cover** Layer Properties, Definition Query tab, create a definition query where **"COVTYPE" = 'FOREST'**

3. Go to the Selection menu and click on **Select By Attributes**, fill in the fields to match the window shown below:



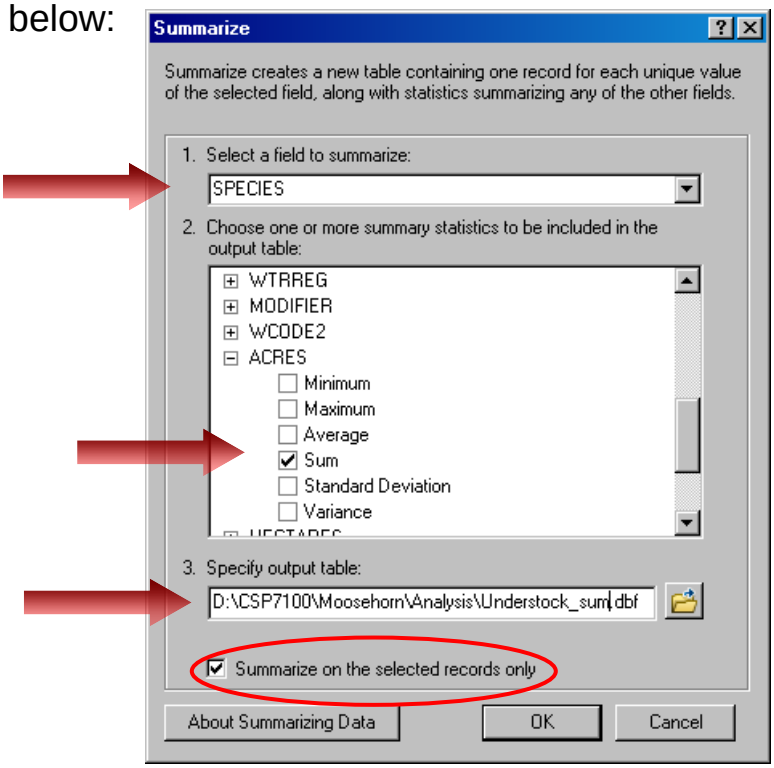
4. Click the **Apply** button and the **OK** button to return to your data view.

5. Right-click on the **Forest_cover** layer, highlight **Selection**, and select **Open Table Showing Selected Features**. This allows us to view only those records we have selected through our query.



AREA	PERIMETER	UNIT	COVTYPE	FCODE	SAFCLASS	SIZE	STOCKING	SPECIES
10597.953125	909.212156	BARING	FOREST	19PU	19	P	UNDER	GRAY BIRCH/RED MAPL
907.171875	240.096967	BARING	FOREST	19PU	19	P	UNDER	GRAY BIRCH/RED MAPL
758.96875	132.533088	BARING	FOREST	19PU	19	P	UNDER	GRAY BIRCH/RED MAPL
249.09375	60.444569	BARING	FOREST	15MU	15	M	UNDER	RED PINE
1419.640625	218.428244	BARING	FOREST	15MU	15	M	UNDER	RED PINE
702.734375	122.692523	BARING	FOREST	15MU	15	M	UNDER	RED PINE
8177.71875	497.917865	BARING	FOREST	16SU	16	S	UNDER	ASPEN
39942.6875	1237.403334	BARING	FOREST	16SU	16	S	UNDER	ASPEN
538.546875	93.392307	BARING	FOREST	15MU	15	M	UNDER	RED PINE
376.96875	83.143478	BARING	FOREST	15MU	15	M	UNDER	RED PINE
102.90625	37.934492	BARING	FOREST	15MU	15	M	UNDER	RED PINE
19203.578125	598.434093	BARING	FOREST	16SU	16	S	UNDER	ASPEN
456.90625	89.508519	BARING	FOREST	15MU	15	M	UNDER	RED PINE
3620.046875	319.811864	BARING	FOREST	19SU	19	S	UNDER	GRAY BIRCH/RED MAPL
3751.59375	258.791202	BARING	FOREST	19SU	19	S	UNDER	GRAY BIRCH/RED MAPL
14172.4375	581.321428	BARING	FOREST	21MU	21	M	UNDER	EASTERN WHITE PINE
5148.53125	360.027592	BARING	FOREST	19SU	19	S	UNDER	GRAY BIRCH/RED MAPL
2205.546875	200.934192	BARING	FOREST	108PU	108	P	UNDER	RED MAPLE
1004.328125	163.924786	BARING	FOREST	19PU	19	P	UNDER	GRAY BIRCH/RED MAPL
29292.578125	804.822787	BARING	FOREST	16SU	16	S	UNDER	ASPEN

6. Right-click on the field **"Species"** and select **Summarize**. The Summarize window appears. Fill in the fields to match the ones shown below:



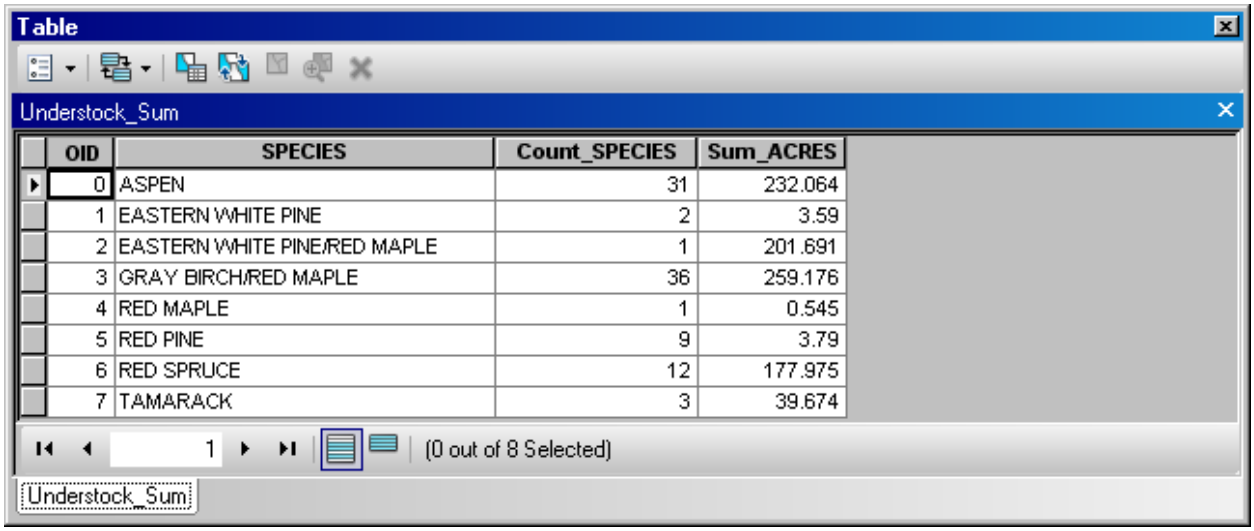
You want a summary of the total acreage of each under stocked tree species.

7. Make sure that you place a check mark beside **Summarize on the selected records only**. Once your screen matches the example above, click **OK**.

8. Click **Yes** to add the **UnderStock_sum** table to your table of contents.

9. Scroll down the table of contents and locate the **UnderStock_sum** table.

10. Right click and open the table to view the records.



11. Close all of your open windows except for your data view.

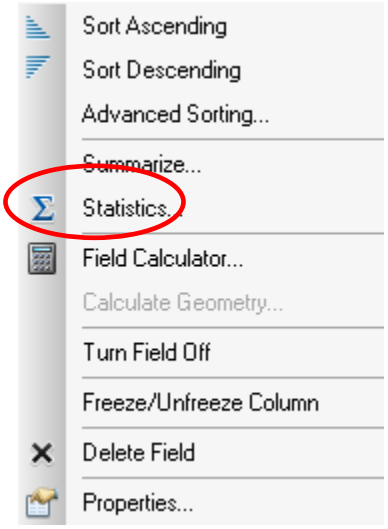
12. Clear all selected features.

You may want to try some other summaries with more statistics.

✓TIP: In the Select by Attributes box, if there is an extended list of unique values, you can either enter the value or just the first letter of the value in the Go to field to quickly locate the value.

SECTION 4 - Statistics (numeric fields)

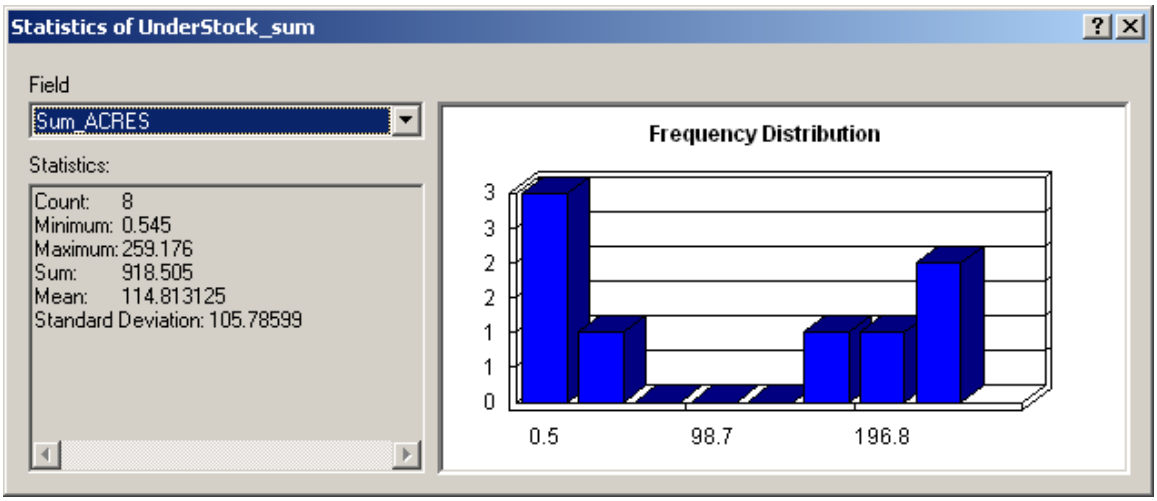
The complete range of statistics for a numeric field can be obtained using the Statistics command.



1. Open the UnderStock_sum table.

2. Right-click on the **Sum_ ACRES** field header and select **Statistics**.

   The statistics information is displayed in a new window. On the left-hand side is some useful information on the data field, such as total acreage of the under stocked tree species for the layer. On the right-hand side you have a frequency distribution histogram. Note that this is simply a display window and no new table or .dbf is created.



3. Close the statistics window. Also, close the **UnderStock** table.

✓TIP: The data in the Statistics box can be copied by holding and dragging the mouse over the text and using the shortcut keys of "Ctrl + C" to copy and "Ctrl + V" to paste. To copy the entire graph box hold down "Alt + Print Screen" and then paste.

Quiz 1: How many acres of **Poorly Drained** soils (there are 3 types; poorly, very poorly and somewhat poorly) are contained on the refuge? You will need to add the **Ssurgo** feature class (soils for Moosehorn) to your data frame. Query this layer using the **drclasssdcd** field to come up with your answer. Display your results. (Hint: it may be helpful to use the help button within the Select by Attributes dialog window).

SECTION 5 - Selection by Location I

Find all of the woodcock nests that are completely within Aspen-Birch Woodland/Forest stands within the Baring Unit at Moosehorn NWR.

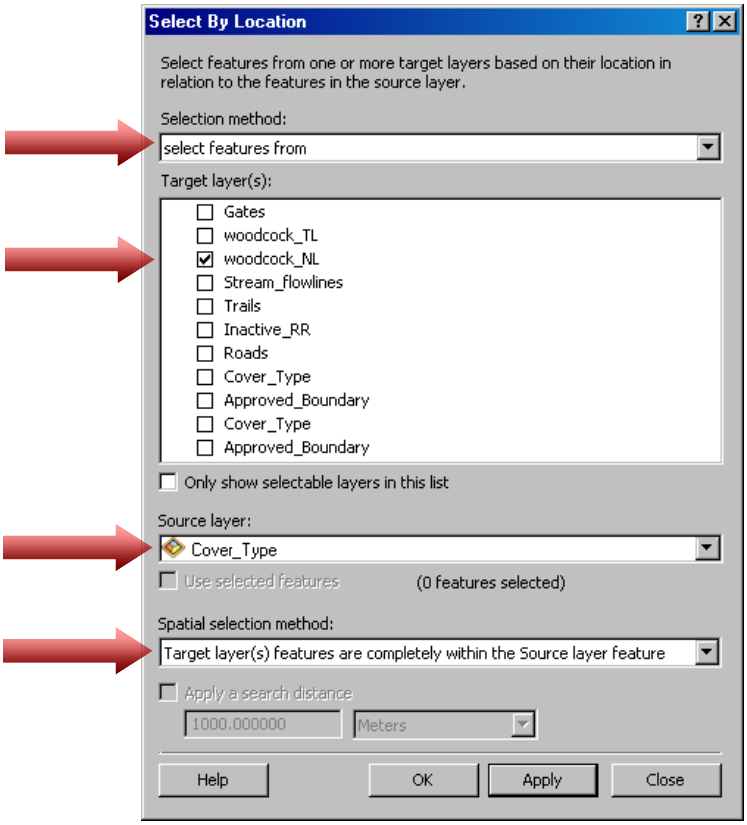
1. Open the Moosehorn map document and make sure that the Moosehorn NWR data frame is activated.

2. Activate the Cover_Type feature class and turn off the Forest_Cover layer. Ensure that the woodcock_NL layer is turned on.

3. Use the **Select By Attributes** function to select all of the **Aspen-Birch Woodland/Forest** stands from the Cover_Type layer. Do you remember how to do this?

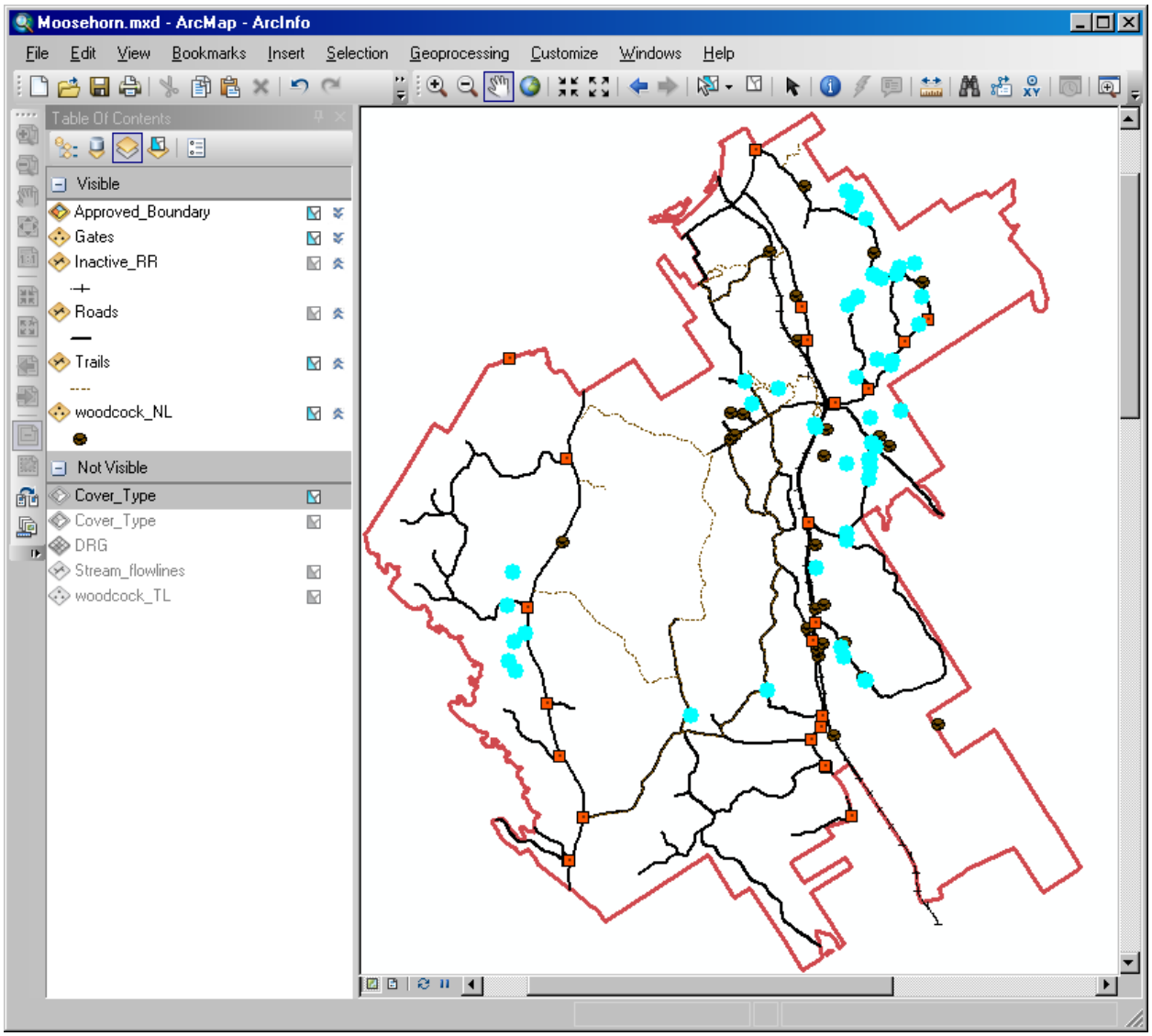
4. Go up to **Selection> Select By Location**.

5. Fill in the fields to match the window shown below:



6. Click **Apply**, and then click **Close**.

7. Uncheck the Cover_Type layer. Now you can see the selected Woodcock nest locations easier.



8. Open the Attribute Table of the **Woodcock_NL** layer.

9. Click on the **Selected** button. These are the records of all nest locations that are completely within Aspen-Birch Woodland/Forest.

10. Go to **Selection** on the main menu and select **Clear Selection**.

11. Close the **Selected Attributes of Woodcock_NL** table.

Extra: Can you think of another way to derive your solution?

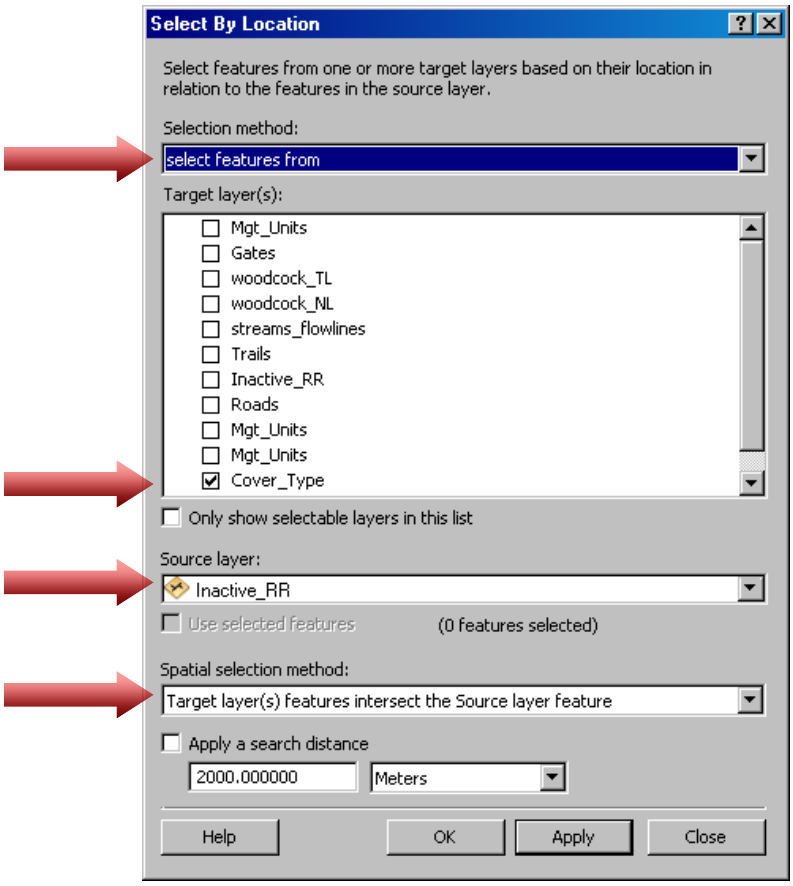
SECTION 6 - Selection by Location II

Let's find all of the Beaver Marsh/Bog/Pond and Shrub swamps that **intersect** the inactive railroad at Moosehorn NWR.

1. Use the **Definition Query** to select and display only Beaver Marsh/Bog/Pond and Shrub swamps under the field **LandCover**.

2. Turn off all of the layers except for **Cover_ Type**, **Approved_ Boundary,** and **Inactive_RR** layers.

3. Go up to the **Selection** menu and click on **Select By Location**. Fill in the dialogue box so it matches the one shown below.



4. Click **Apply**, and then click **Close.** Notice all of the Beaver Marsh/Bog/Ponds and Shrub swamps that **intersect** the inactive railroad are now highlighted in cyan.

Quiz 2: If this railroad were to become active, how many acres of Beaver Marsh/bog/ponds and Shrub Swamps would be affected using this type of analysis?

SECTION 6 - Selection by Location III

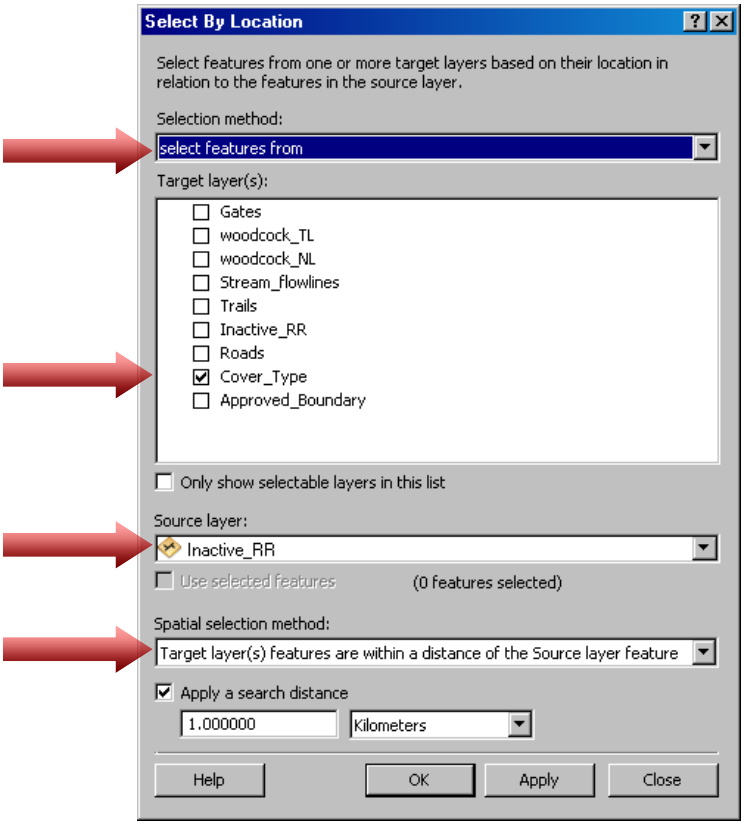
Find all of the Beaver Marsh/Bog/Ponds that are within 1 **kilometer** of an inactive railroad at Moosehorn NWR.

1. Clear all of your selected features. Change your Definition Query to show only Beaver Marsh/Bog/Ponds.

2. Go up to the **Selection** menu and click on **Select By Location**.

   Select features from the **Cover_Type** layer that are within a distance of 1 kilometer from the **inactive railroads** layer

   Your screen should match the example below:



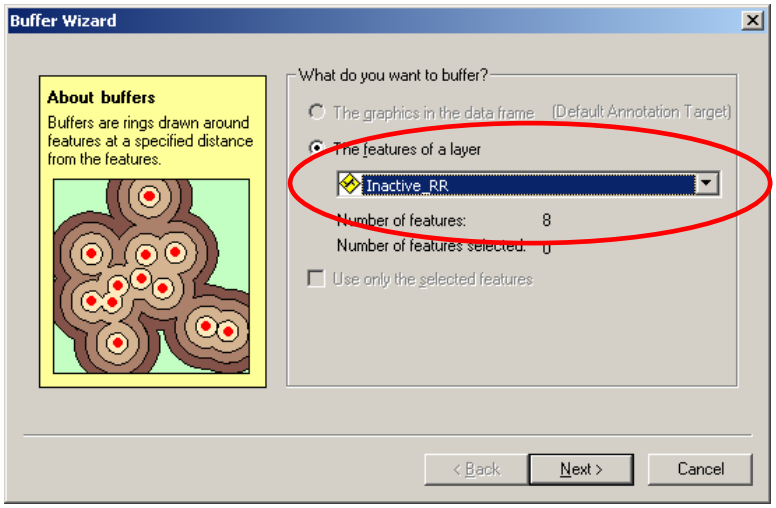
3. Click **Apply**, and then click **Close**.

   All of the Beaver marsh/bog/pond polygons that are within 1 kilometer of an inactive railroad are now highlighted.

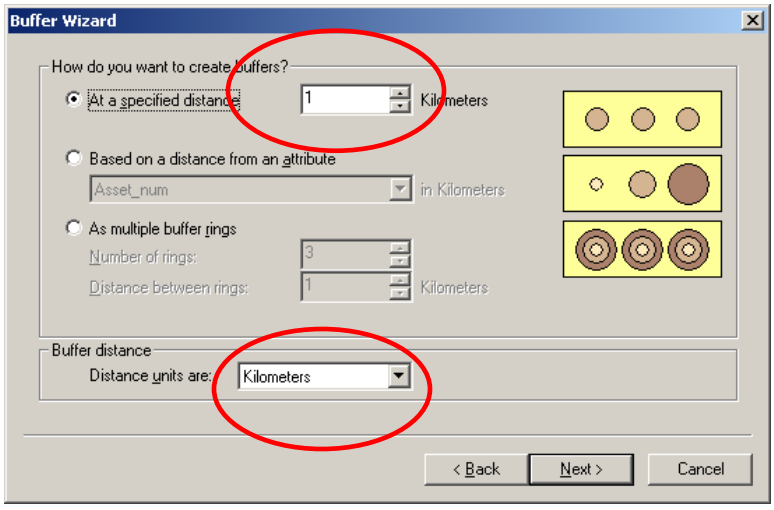
Remember, just a portion of a Beaver marsh/bog/pond polygon may be within 1 kilometer – not necessarily the entire polygon, since this includes any polygon that has any part within a kilometer of the wetland. To visualize this we are going to create a 1 kilometer buffer surrounding the inactive railroad by using the **Buffer Wizard Tool**.

4. Click on the **Buffer Wizard** tool located on the Tools tool bar.

5. Change the features of a layer to **Inactive_RR** and click on **Next**.

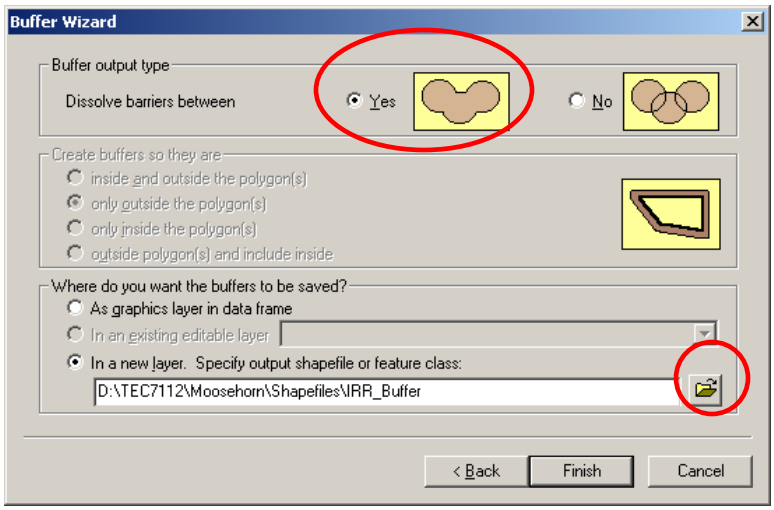


6. Change the Buffer distance units to **Kilometers** and specified distance to **1 kilometer**. Click Next.

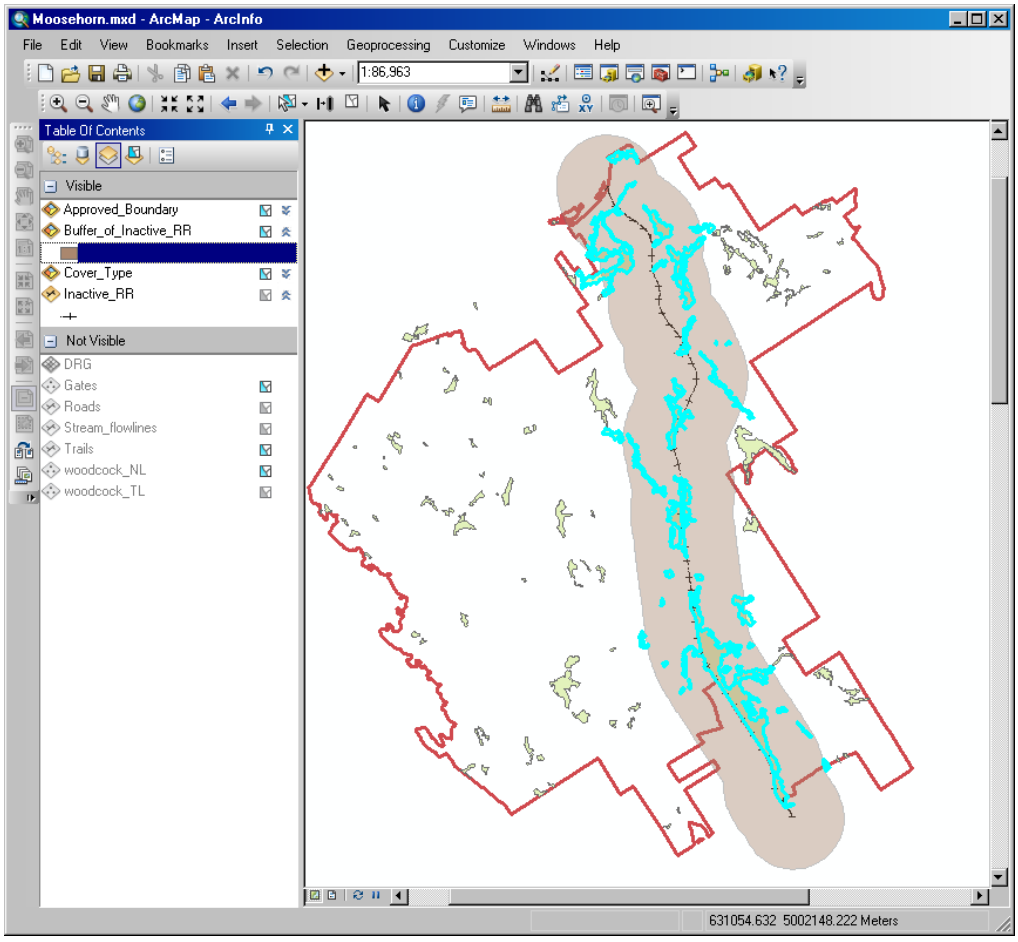


7. In the buffer output type select **YES** to dissolve barriers.

8. In a New layer dialog box specify where you want to store the shape file and name the buffer. Click on **Finish.**



A 1 kilometer buffer with be generated and automatically added to the table of contents. You may need to move the newly created buffer below the other layers of Cover_Type and the Inactive railroad. Your buffer and other layers should appear similar to the one shown below.



✓*TIP: Use the Help button in the Select by Location box for a description of each location operation.*

Quiz 3: Find all of the woodcock nest locations within 25 meters of an Aspen – Birch Woodlands. How many eggs hatched (NOEGGHT) from those nests? And finally, how many eggs hatched from all other nests? (Hint: you will want to utilize the **Switch Selection** function located under **Options** in the attribute table to easily determine this value.)

Exercise 10: Scale

Session Objectives: At the conclusion of this session, you will be able to:

- Describe the effect of scale on mapped data

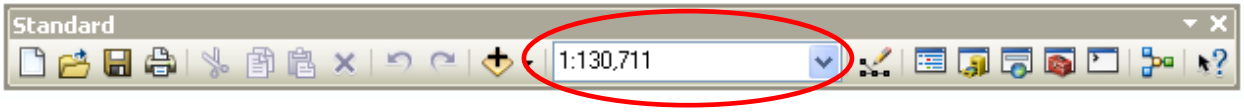
Materials created by: Karen Klinger and Mark Richardson
Revised: March 30, 2011 by Christopher Bryant
Notes: ArcMap 10, Service Pack 1

Map scale is a confusing topic for most people new to GIS and to non-Geographers . This self paced exercise will help the user understand the concept of scale and how it effects specific layers. Follow the steps outlined below to complete the exercise:

1. Open the **scale.mxd** map document file located under the Scale folder CSP7100\Scale\Scale.mxd. It contains a data frame named **View 1** with four layers.

2. Turn on the **States2m** layer.

3. Right-click on this layer and select **Zoom To Layer** to view all 5 states. Manipulate the map scale either by scrolling the mouse wheel up and down or by manually inputting a scale into the scale bar.



A. What range of scale is the **States2m** layer best viewed at?

_____

✓ *TIP: You can change your scale setting preferences from the dropdown menu in the scale box>Customize This List.*

4. Click on the **Full Extent** icon to return to the full extent of the **States2m** layer.

5. Turn on the **Hydro2m** layer to view the hydrography of Maryland and Delaware.

B. How well does the **Hydro2m** layer seem to represent the surface waters at this scale?_____

C. What scale is displayed on the Standard Tool Bar?_____

6. Right-click on the **Shepnwi** layer and select **Zoom To Layer.** Please DO NOT turn this layer on yet.

   D. How well does the **Hydro2m** layer seem to represent the surface waters at this scale?_____

   E. What scale is displayed on the Standard Tool Bar?_____

   F. The state line (black) is actually the Potomac River. Does it line up with the dark blue line of the **Hydro2m** layer? _____

   G. Why or why not?

   _____

   H. Is this a problem? _____

   _____

7. Turn on the **Hyd100k** layer.

   I. How do these lines (light purple) compare with the **Hydro2m** layer?

   _____

   J. **Hydro2m** and **Hyd100k** were developed at scales of 1:2,000,000 and 1:100,000, respectively. How does this affect what scales they are best viewed at?

   _____

   K. If a large scale map shows objects in more detail, which layer has the larger scale? _____

8. Turn on the **Shepnwi** layer.

   L. The **Shepnwi** layer was developed at a scale of 1:24,000. How does it compare to the other layers?

   _____

9. Use the **Zoom In** tool to zoom in on the two islands shown at the top of the **Shepnwi** layer.

M. Do these islands appear in the other layers? _____

N. Why or why not? _____

10. Click the **Full Extent** icon.

O. How do the **Shepnwi** and **Hyd100k** layers look from this zoom level?

_____

P. Which layer is most appropriately used when:

Zoomed out? _____

Zoomed in? _____

Explore the differences in the levels of detail of these layers. When you are finished, please open the **Moosehorn.mxd**.

Quiz 1: Using Help, find out how you can specify a range of scales at which a layer will be shown. Specify a minimum and maximum range.

✓TIP: You can specify a relative map value in the scale box and ArcMap will calculate an absolute scale. For example, if you wanted 1 inch to equal 100 miles on the States2m layer, enter 1 in = 100 mi in the scale box and ArcMap would convert the calculation to an absolute value of 1:6,336,000. For more details, go to Help> map scale, customizing.

Notes:

Discussion/Lecture: Acquiring Geospatial Data

Session Objectives: At the conclusion of this session, you will be able to:

- Identify where to acquire Geospatial data
- Identify who generates Geospatial data
- Describe 3 methods of generating vector data

Materials created by: Ron Salz and Marcia McNiff.
Revised: December 2011 by Mark Richardson and Christopher Bryant
Notes: ArcMap 10

Notes:

Notes:

Notes:

Notes:

Acquiring GeoSpatial Data

FWS
FWS GIS Data Sets: http://www.fws.gov/gis/data/national/index.html
FWS-GIS List Serve - to subscribe email: fws-gis@lists.fws.gov

USGS
The National Map: http://nationalmap.gov/
Earth Resources Observations and Science Center (EROS): http://eros.usgs.gov/
GAP Analysis: http://gapanalysis.nbii.gov/portal/server.pt
Maps, Imagery and Publications: http://www.usgs.gov/pubprod
Geospatial Data Clearinghouse: http://www.fgdc.gov/dataandservices
USGS Earth Explorer: http://edcsns17.cr.usgs.gov/EarthExplorer/
National Map Seamless Server: http://seamless.usgs.gov/
National Biological Information Infrastructure (NBII): http://www.nbii.gov
National Land Cover Data: http://www.mrlc.gov/index.php

USDA NRCS
Soils, aerials & more: http://datagateway.nrcs.usda.gov/

BLM
PLSS by state: http://www.geocommunicator.gov/GeoComm/lsis_home/home/index.htm

Census Bureau
TIGER data: http://www.census.gov/geo/www/tiger/index.html

EPA
Surf your Watershed: http://cfpub.epa.gov/surf/locate/index.cfm
BASINS: http://www.epa.gov/OST/BASINS/
GeoGateway: https://geogateway.epa.gov/geoportal/catalog/main/home.page

NPS
National Park Service's GIS Homepage: http://www.nps.gov/gis
Integrated Resource Management Application: https://irma.nps.gov/

Other Data Sites
The Federal Geospatial Platform: http://www.geoplatform.gov/home/ (NEW!)
Data.gov: http://www.data.gov/
Microsoft's Terraserver: http://www.terraserver.com/
GIS Data Depot: http://www.gisdatadepot.com
State GIS Data: http://libraries.mit.edu/gis/data/datalinks/statedataweb.html

LIDAR
USGS LIDAR: http://lidar.cr.usgs.gov/
NOAA Coastal LIDAR Data: www.csc.noaa.gov/ldart

Online Mapping Applications
FWS Lands Mapper (boundaries and parcels): http://gis.fws.doi.net/fwslands_mapper/
Critical Habitat Mapper: http://criticalhabitat.fws.gov/
ArcGIS Explorer: http://explorer.arcgis.com/

ESRI ArcGIS Sites
ArcGIS Data: http://www.esri.com/data/find-data.html
ArcGIS Resources: http://resources.arcgis.com/
ArcGIS Scripts and Models: http://resources.arcgis.com/gallery/file/geoprocessing

USFWS GIS Contacts by Region

Region	Contact	Phone	Email
National	Chris Lett	(303) 274-3574	Chris_Lett@fws.gov
R1	Mark Kildow	(503) 231-2371	Mark_Kildow@fws.gov
R1 (field rep)	David Hines	(360) 604-2500	David_Hines@fws.gov
R2	Ric Riester	(505) 248-6851	Ric_Riester@fws.gov
R3	Mary Balogh	(612) 713-5490	Mary_Balogh@fws.gov
R4	Jason Duke	(931) 528-6481 x216	Jason_Duke@fws.gov
R5	BJ Richardson	(413) 253-8335	BJ_Richardson@fws.gov
R6	Mark Ely	(303) 236-4368	Mark_Ely@fws.gov
R7	Steve Kovach	(907) 524-3251	Steve_Kovach@fws.gov
R8	Pat Lineback	(916) 414-6559	Pat_Lineback@fws.gov
R8 (field rep)	Tony McKinney	(760) 431-9440 x259	Tony_McKinney@fws.gov
R9 Endangered Species	Linda Purviance	(703) 358-2079	Linda_Purviance@fws.gov
R9 Federal Aid	CJ Huang	(303) 275-2344	CJ_Huang@fws.gov
R9 Fire Management	Bill Leenhouts	(208) 387-5584	Bill_Leenhouts@fws.gov
R9 Migratory Bird Mgmt	Kathy Fleming	(301) 497-5902	Kathy_Fleming@fws.gov
R9 NCTC	Mark Richardson	(304) 876-7470	Mark_Richardson@fws.gov
R9 Fisheries & Habitat Conservation	Tom Dahl	(608) 783-8425	Tom_Dahl@fws.gov

Exercise 11: Creating New Data

Session Objectives: At the conclusion of this session, you will be able to:

- Use ArcCatalog Window to create a new shapefile
- Trace and digitize new polygon features
- Import XY coordinates from a table into ArcMap
- Export XY events layer to a shapefile

Materials created by: Mark Richardson and Karen Klinger
Revised: April 2011 by Mark Richardson & Christopher Bryant
Notes: ArcMap 10, Service Pack 1

SECTION 1 – Creating a new shapefile

ArcCatalog Window is the application you will use to create a new shapefile. In this section you will create a polygon shapefile. The file will be named **Habitat.**

1. Click on the **ArcCatalog Window** button.

2. In the **directory tree**, navigate to the \CSP7100\Moosehorn\Shapefiles folder.

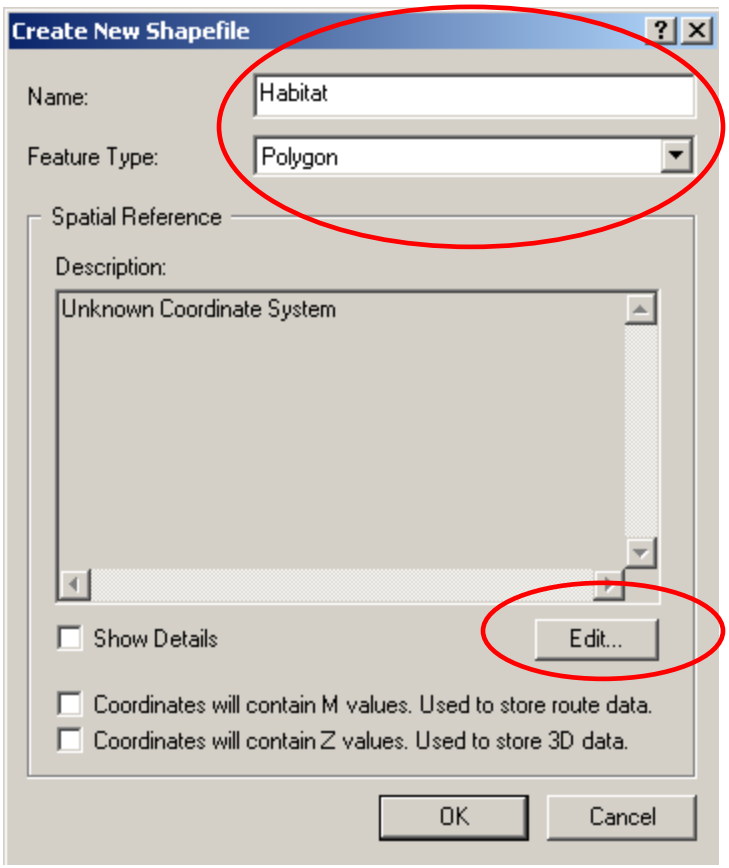
3. Right-click on the **Shapefiles** folder, select **New** and click on **Shapefile**. This opens the Create New Shapefile dialog.

4. In the Name section type **Habitat**.

5. For Feature Type choose **Polygon**.

   Now you need to assign the projection and datum information for your new shapefile.

6. Click the **Edit** button to open the Spatial Reference Properties dialog.

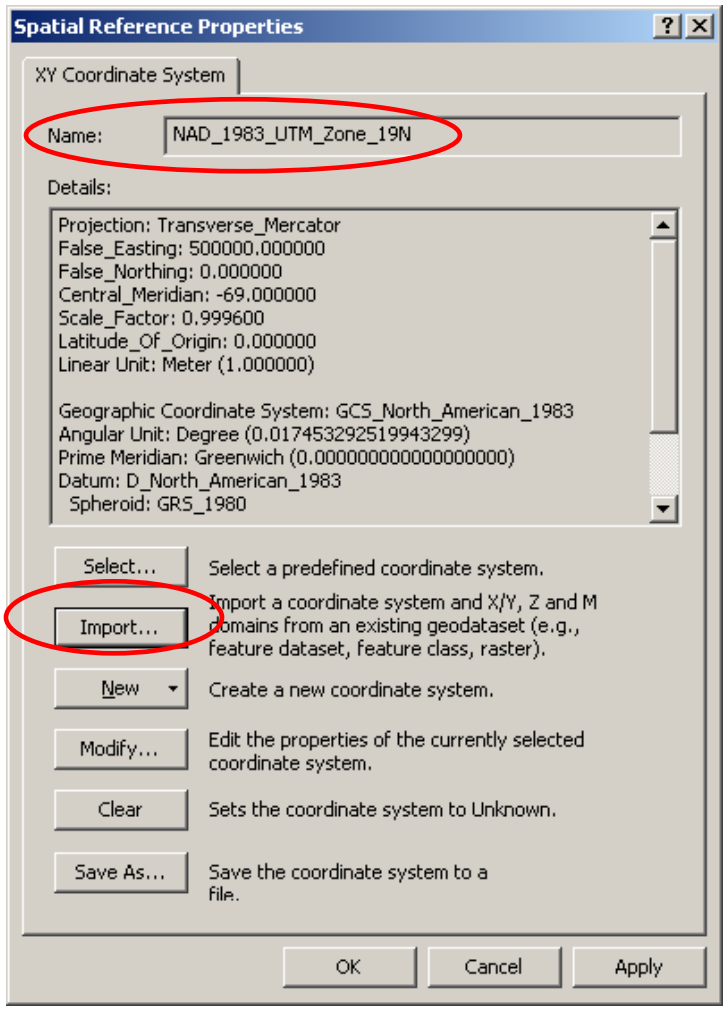


✓TIP: Several default columns are automatically generated with a new shapefile. One is the ID column, which may be deleted if not needed after new attributes have been added to the table.

Since you will be digitizing new habitat features for the Baring Unit, we need to choose the standard projection/datum used by the Refuge. Moosehorn's existing shapefiles already have spatial reference information assigned; we can simply import this information from one of these files.

7. Click on **Import**. Navigate to and select any shapefile which appears in the *\CSP7100\Moosehorn\Shapefiles* folder. Click **Add**.

8. Your screen should match the example below:



9. Click **OK** to accept the coordinate system. Click **OK** again to create the new **Habitat** shapefile. ArcMap will automatically move/copy the new Habitat layer into the Table of Contents under the active data frame – Moosehorn NWR

10. Go to the catalog tree and right click on your new **Habitat layer.** Click on **Properties** and open the **XY Coordinate System tab**. View the metadata to confirm that the projection information is there and in the correct projection.

SECTION 2 - Digitize new polygon features

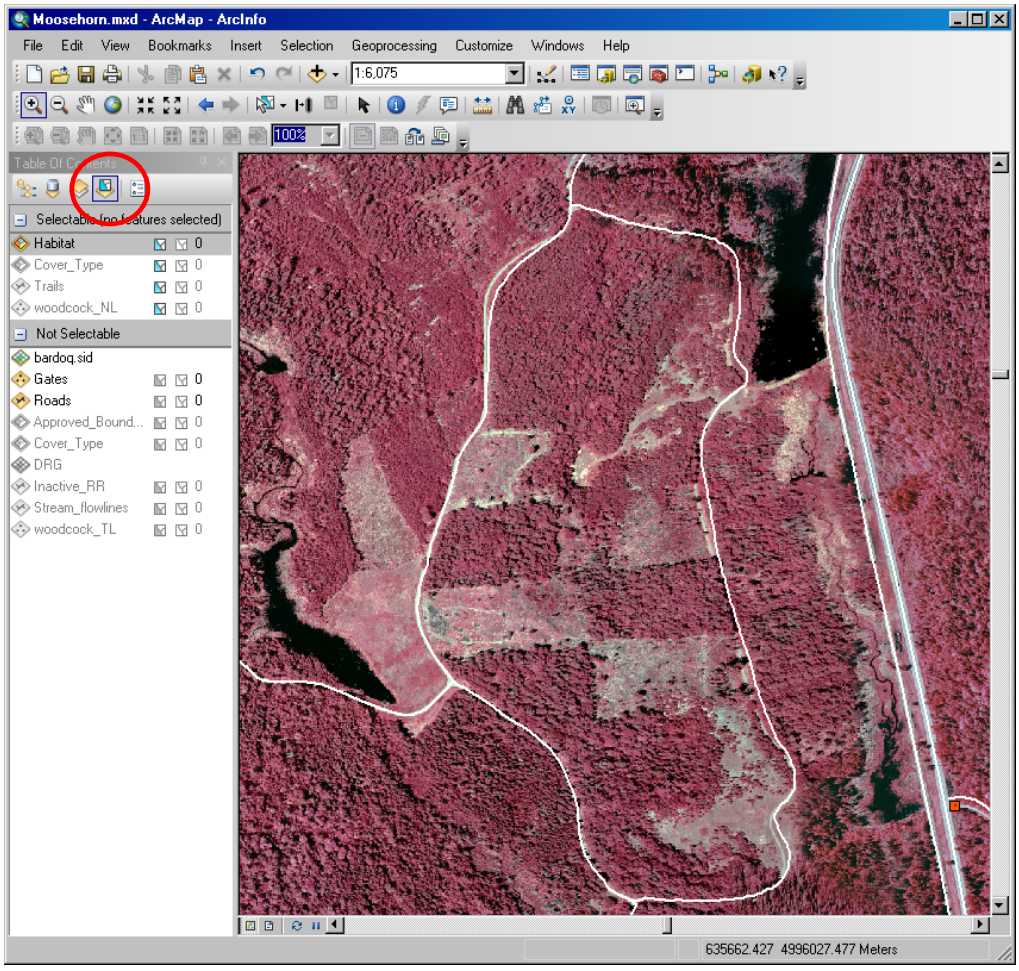
You will create 4 new polygons of wood lots within the Baring Unit, which will be identified later as habitat_1, 2, 3 and 4 in the next exercise. A spatial bookmark has been established to expedite this exercise.

1. Add and turn on the **bardoq** (Baring Unit Digital Ortho Quad) data layer (from the **DOQQ** folder) in the Table of Contents. Turn off all the others layers except **Habitat, bardoq** and **Roads**.

2. Turn the **Roads** layer white (Do you remember how? See Tab I).

3. Click on **Bookmarks> Digitize Area**. You are now zoomed to the feature which you will digitize.

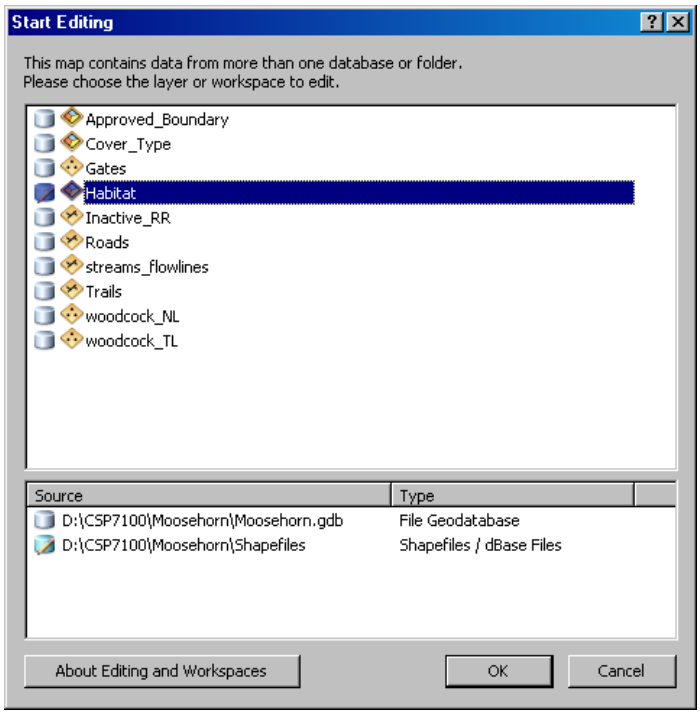
4. Click on the **List by Selection** button at the top of the Table of Contents and turn all the selectable layers **off** except **Habitat.**



5. Add the **Editor** toolbar to the DataView.

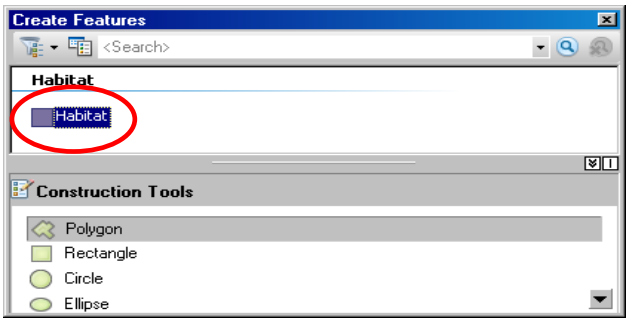
6. Click on the dropdown arrow next to **Editor** and choose **Start Editing**.

7. In the **Start Editing** select the Habitat layer. It will then show where the edits will be saved under the Source window.

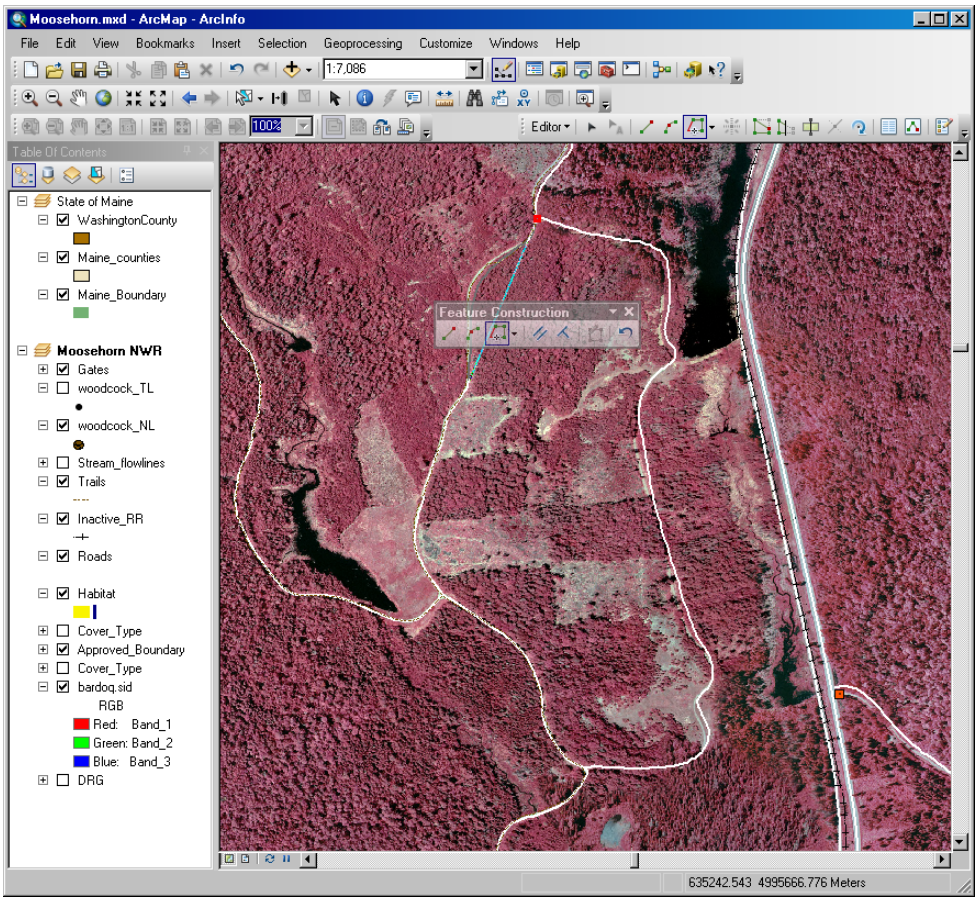


8. Next, click on (select) the **Habitat** layer which appears in the **Create Features** Window.

Note: If the new **Habitat** polygon does not appear in your **Create Features** window, follow the steps outlined on page 17 to remedy the problem. If the Habitat polygon does appear, continue onto step 9.



9. Under the Construction Tools window, select the Polygon as the tool type. Your arrow pointer changes to a crosshair. Move the crosshair over the Roads layer. A box will appear identifying the feature with text - **Roads Vertex**.

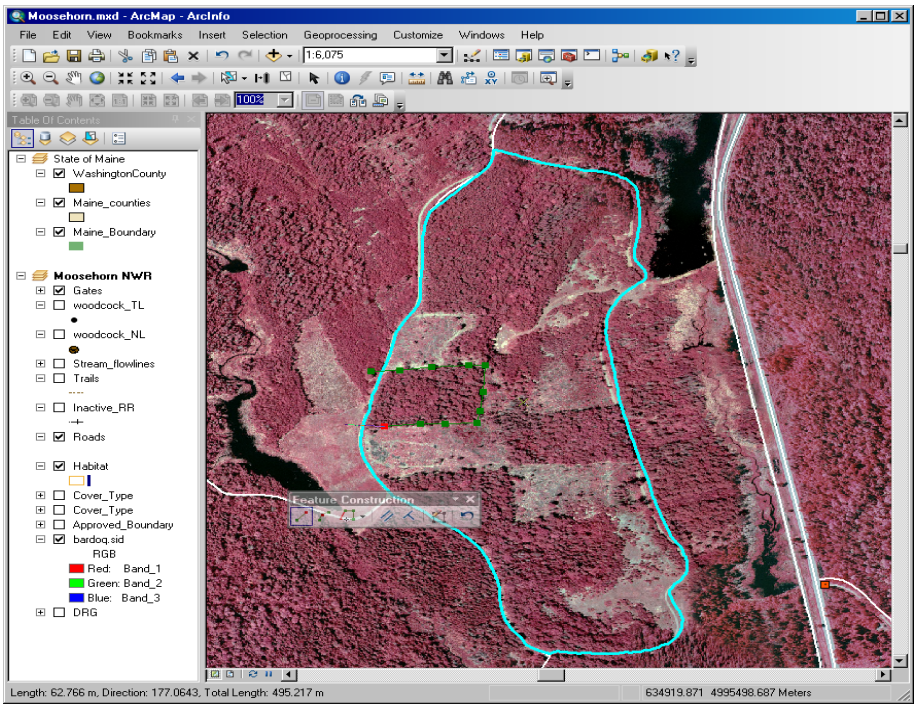


10. Double Click on the upper road intersection (Red square shown above) to activate the tool and start digitizing. Click the left mouse button as follow the perimeter of the road; left click to add vertices (points).

11. **Double click** the when you return to the starting road intersection. A filled polygon on top of the road layer will appear.

12. Double Click on the **Habitat** layer symbol patch in the **Table of Contents.** Change the Fill Color to **none** within the Symbol Selector. We want the new habitat layer to be “transparent”

13. Activate the **Cut Polygons Tool** on the Editor Tool Bar

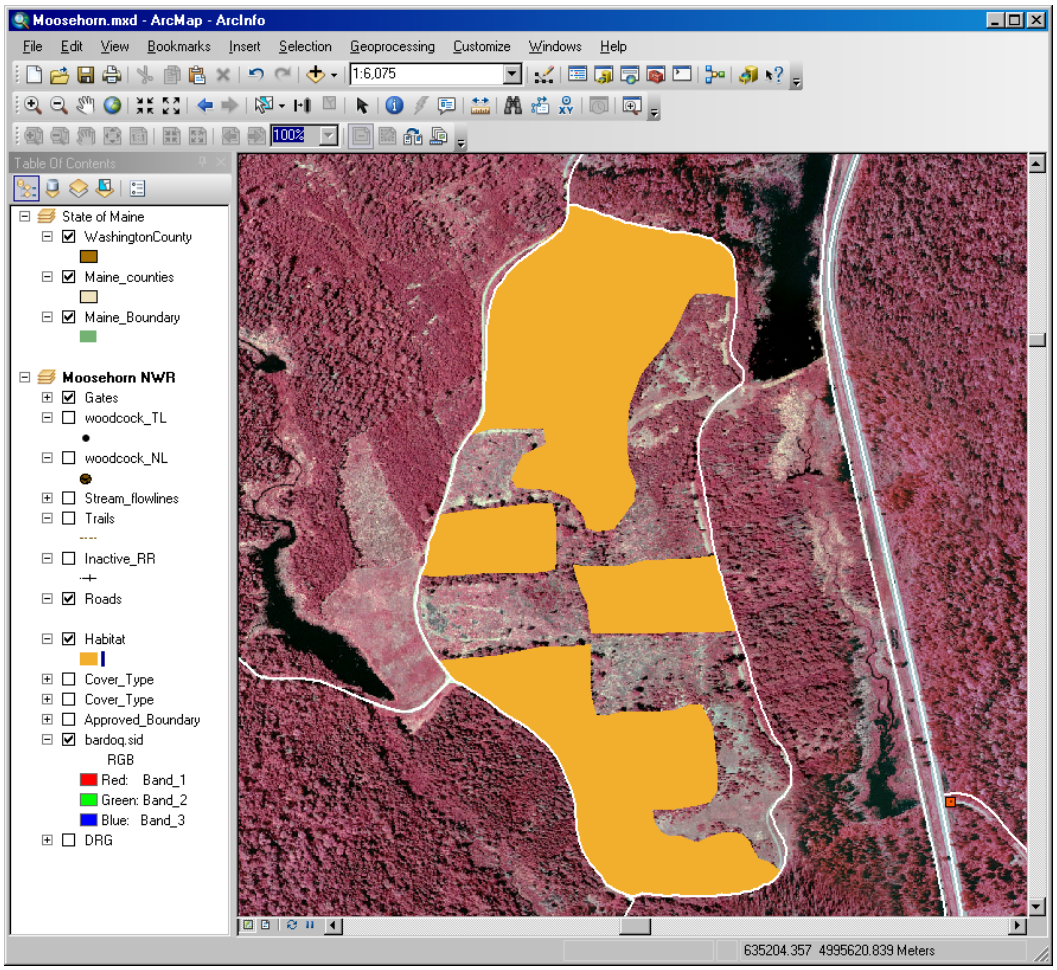


14. Cut out/digitize around the 4 wooded polygons. Choose one wood lot to start digitizing.

    Click on the **outside** of the road polygon once with the left mouse button to position a single vertex. Move your cursor to the right around the wood lot and enter another vertex. Continue to add vertices around the wood lot edge until you completely sketch the outside perimeter. Note, you must **start** and then **finish** on the **outside** of the road polygon.

15. Repeat this process for each of the 3 remaining wood lots.

16. Select the **Edit Tool** located on the Editor Tool bar. Select the **inside** polygon which defines the open areas within the road boundary –not the woodlots. Hit the delete key on the key board.



17. Double Click on the **Habitat layer** in the **Table of Contents** and change the Fill Color to the color of your choice. Your screen should appear like the one shown above.

18. When all 4 polygons are complete, go to the **Editor tool bar** and select **Save Edits** and then **Stop Editing**.

Quiz 1: How do you remove or add vertices? How do you move vertices?

SECTION 3- Importing XY Coordinates

Point data can be imported from a database table (.dbf) or Excel (.xls) spreadsheet into ArcMap. The database or spreadsheet needs to contain X and Y coordinate fields and the data must be in either UTM or decimal degrees formats. This exercise will demonstrate how to import coordinates of the Baring Unit woodcock survey locations using an existing table.

1. Add the **Survey_Locations** table to the Table of Contents. It is found within the Moosehorn Geodatabase. Notice that once you have added **Survey_Locations**, your Table of Contents has toggled from Display to **List by Source**.

   A spreadsheet or database table is only composed of tabular data; it has no ties to any geographic features.

2. Right-click on **Survey_Locations** and select **Open**. Take note of the various field names.

3. Close the attribute table. Go to **File**>Add Data> **Add XY Data**.

4. Choose **Survey _Locations** as the table you want to import. In the specify fields pull down window make sure that **X_COORD** is in the X Field and **Y_COORD** is in the Y Field.

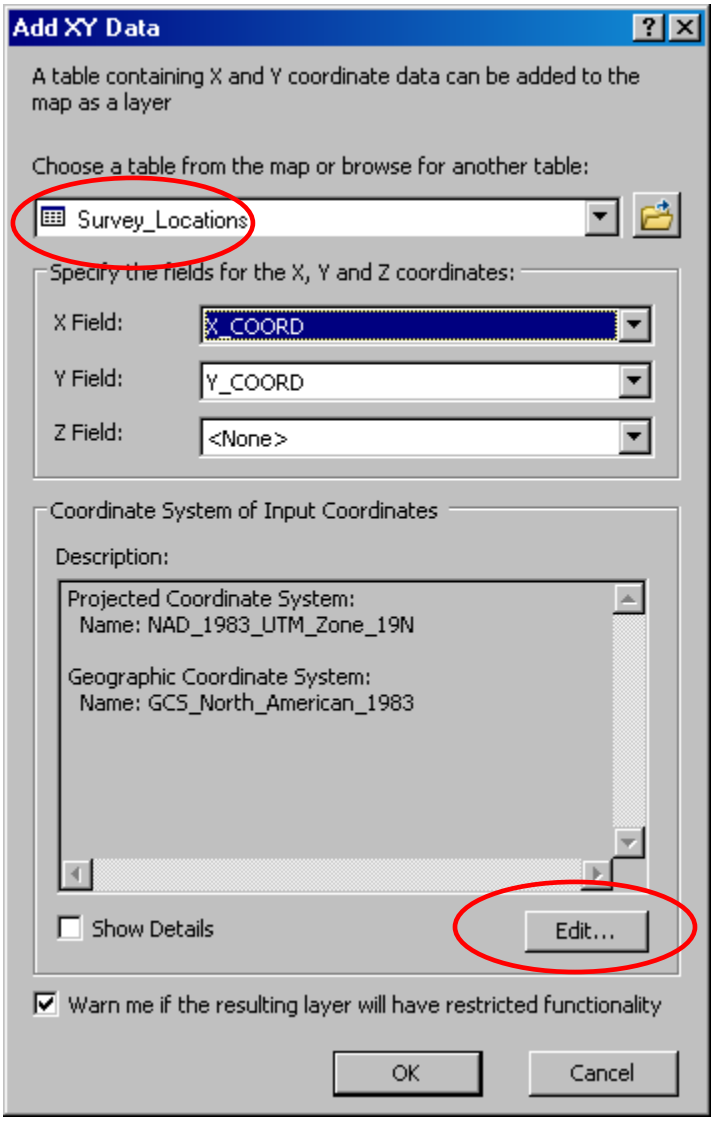
✓TIP: Use the browse icon to choose a table not loaded in your map. For an Excel file, double click on the .xls file and select the worksheet with your xy data. Note: worksheets have $ at the end.

5. Click on the **Edit** button. We want to assign the appropriate coordinate system to the event layer we are about to create.

6. Click on the **Select** button. Navigate to Projected Coordinate System > UTM > NAD 1983> NAD 1983 UTM Zone 19N.prj.

7. Double-click on **NAD 1983 UTM Zone 19N.prj**. This will bring you back to the Spatial Reference Properties window.

8. Click **OK**. Your screen should match the one below.

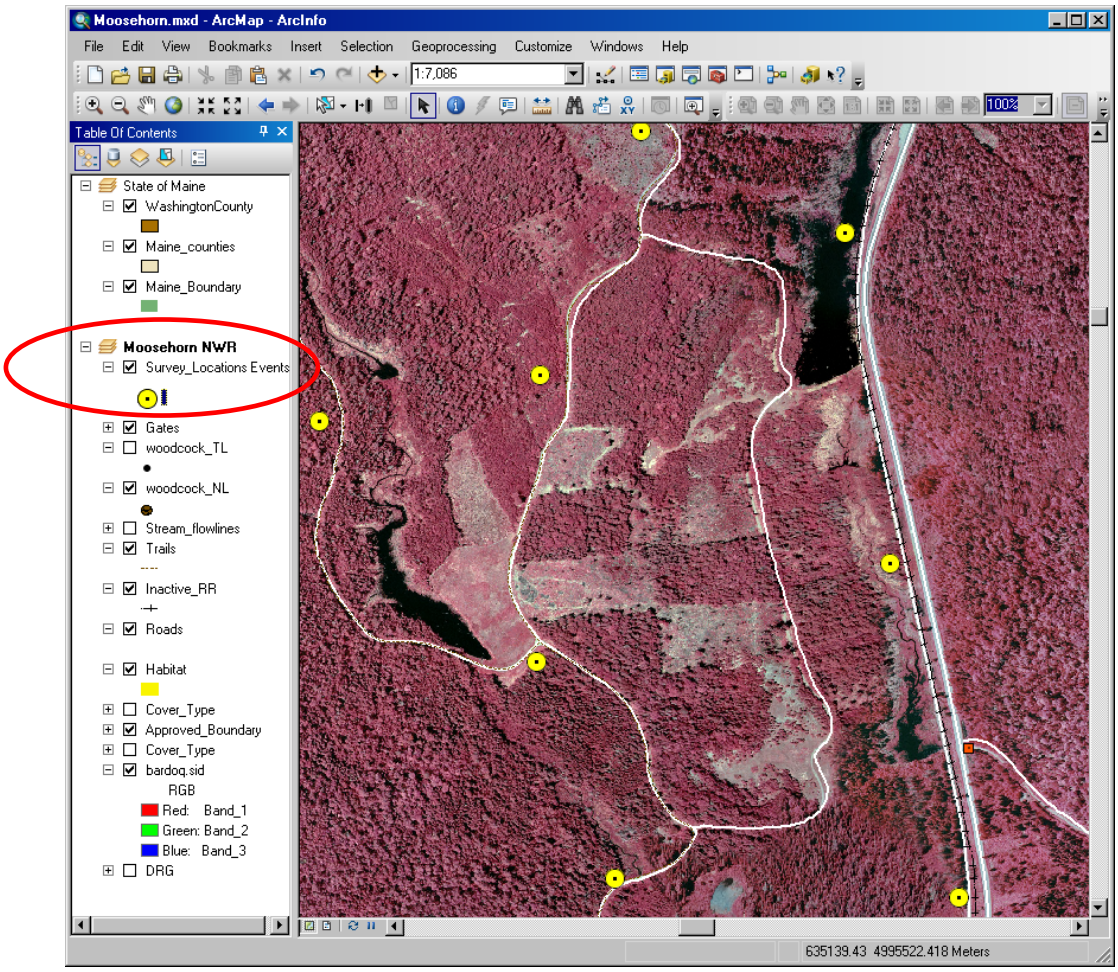


9. Click on **OK** again.

   The **Survey_Locations** events layer appears under the Moosehorn Data Frame. You might want to change the layer's color (yellow) and symbology to be able to see the survey locations better.

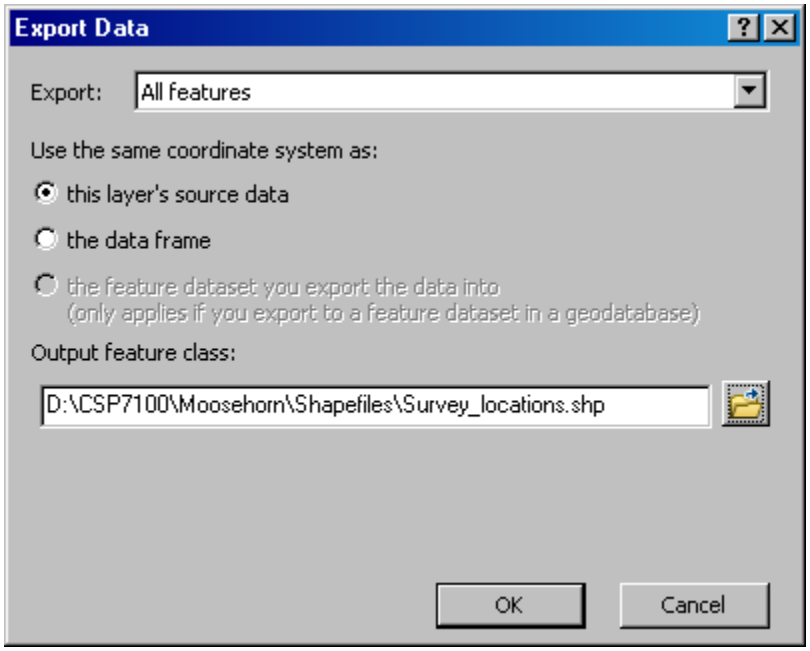
10. Uncheck/Turn off the **Habitat** Layer

11. Now we have an **Events** layer, which is not a permanent shapefile. Right-click on **Survey_Locations Events> Data**> **Export Data**.

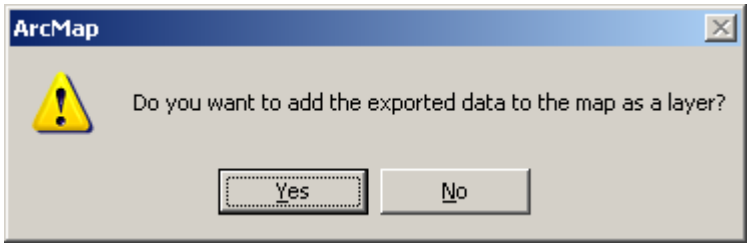


You want to **export** this data with the same coordinate system as the Moosehorn data frame. The **Survey_Locations** lines up with the other layers because we assigned its coordinate system in the previous step.

12. Save this data under \CSP7100\Moosehorn\Shapefiles as **Survey_Locations.shp**. Once your screen matches the next graphic, click **OK**.



13. ArcMap will ask you…



14. Click **Yes**.

    Now you have your new **shapefile** added to the Table of Contents. You imported XY coordinates into ArcGIS! Congratulations!

15. Right click and remove the **Survey_Locations Events** layer

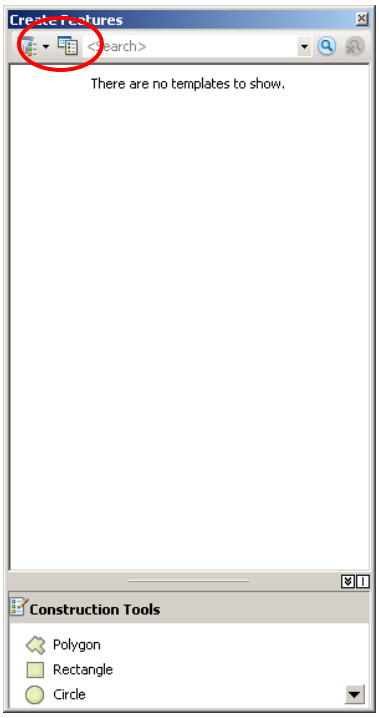
16. Save your map document (.mxd).

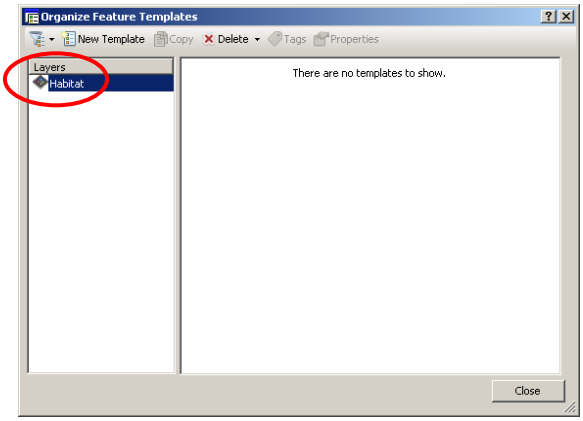
Notes:

Create New Features – Missing Template

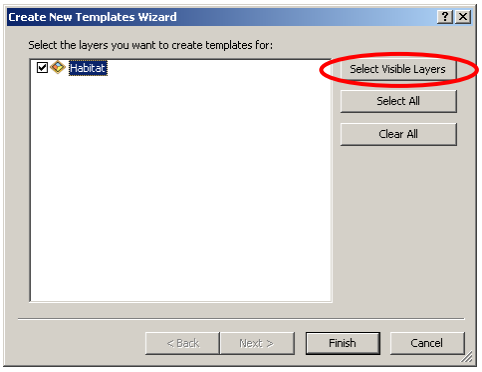
1. Click on the **Organize Templates** button

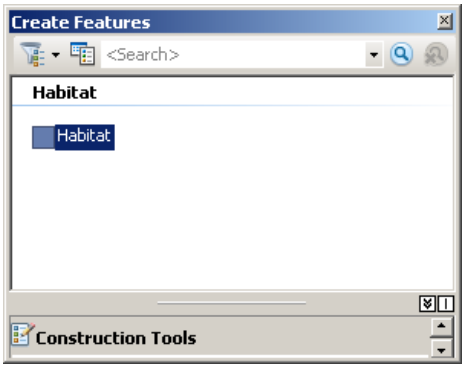
2. A window will open with the **Habitat** file you created in the left column. Highlight **Habitat** and then click on **New Template**.





3. The **Create New Templetes Wizard** Window will open. Click the **Select Visible Layers button** > **Finish**





4. Close the **Organize Feature Templates** window.

Once the Habitat appears in your Create Features window, you can start digitizing polygons.

The polygon under the Create Features table will not appear if the **editor session was still running** when you created a new (habitat) olygon feature in ArcCatalog. Be sure to stop editing before you create any new shape file.

Notes:

Exercise 12: Building Attributing Tables

Session Objectives: At the conclusion of this session, you will be able to:

- Add a new field to a table
- Populate data fields
- Use XTools Pro to add new fields and calculate acreage
- Use the Field Calculator to populate fields
- Create aliases and hide data fields

Materials created by: Mark Richardson and Karen Klinger
Revised: March, 2011 by Christopher Bryant and Mark Richardson
Notes: ArcMap 10, Service Pack 1

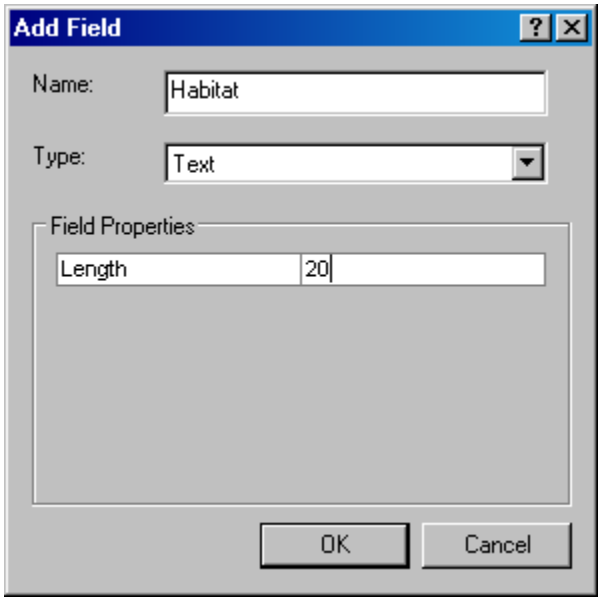
SECTION 1- Adding and Editing Attributes

We've just created four new polygons as part of the Habitat shapefile. ArcMap automatically supplies and populates three fields (FID, Shape, and ID) for each of the polygons. However, we need to provide more information about the polygons. We will add 7 new fields including a label, area calculations, and a source field.

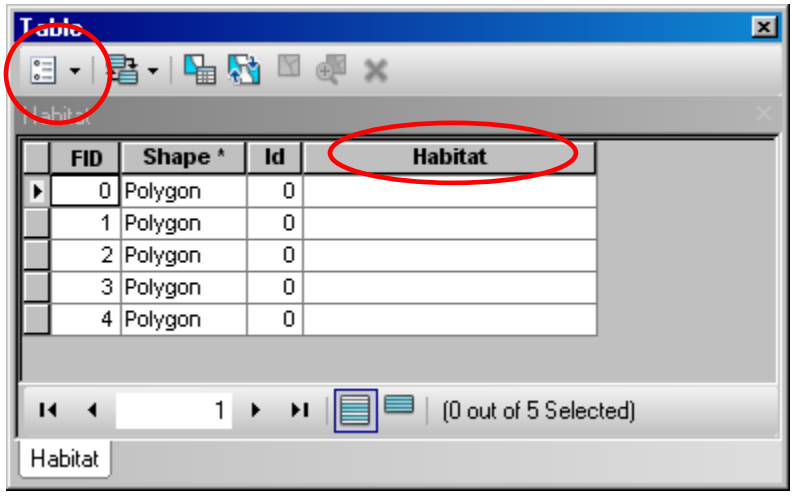
1. Right-click on the **Habitat** shapefile and select **Open Attribute Table**.

2. Click on the **Options** button and select **Add Field**. This opens the Add Field window.

3. Make the name of the new field "**Habitat**." Change the type of field to **Text** and the field length to 20. When your screen matches the one on the right, click **OK**.



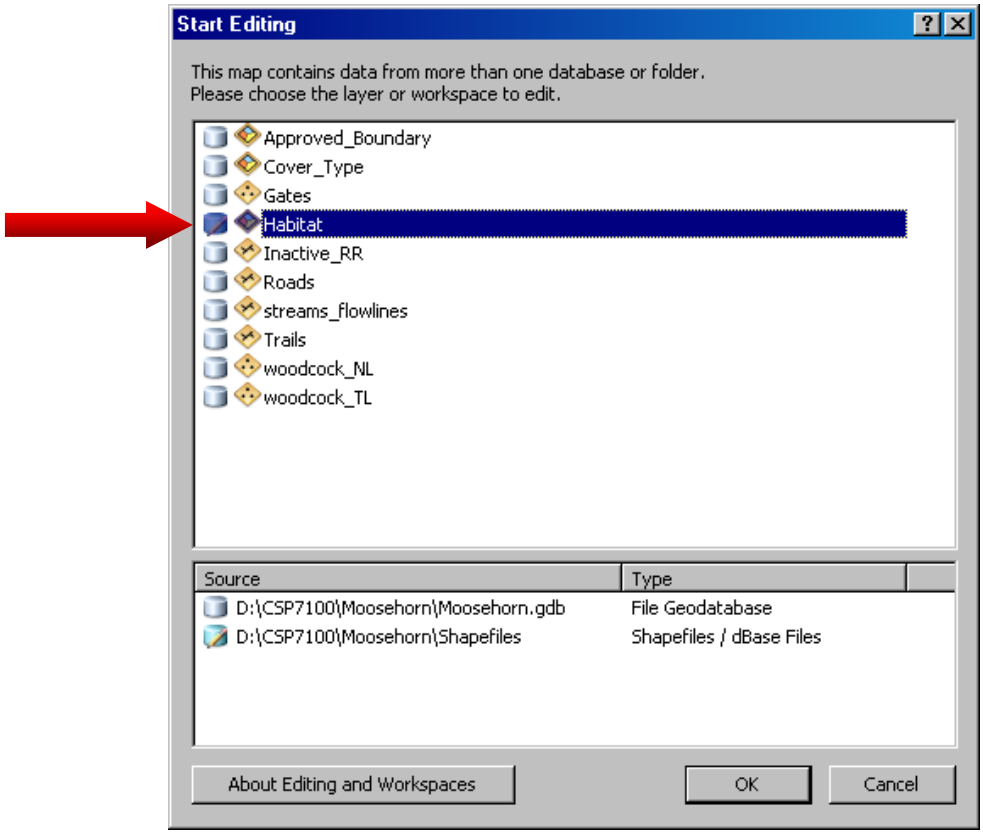
Notice the addition of the **Habitat** field at the end of the table.



4. Move the **Attributes of Habitat** table so the habitat polygons are visible OR dock the Table Window to the side.

5. Activate the **Editor** Toolbar if it is not already there.

6. Select the Editor button and click on **Start Editing**. Click on the **Habitat l**ayer in the Start Editing Window. Note, once Habitat is selected the Source window indicates where the data resides.

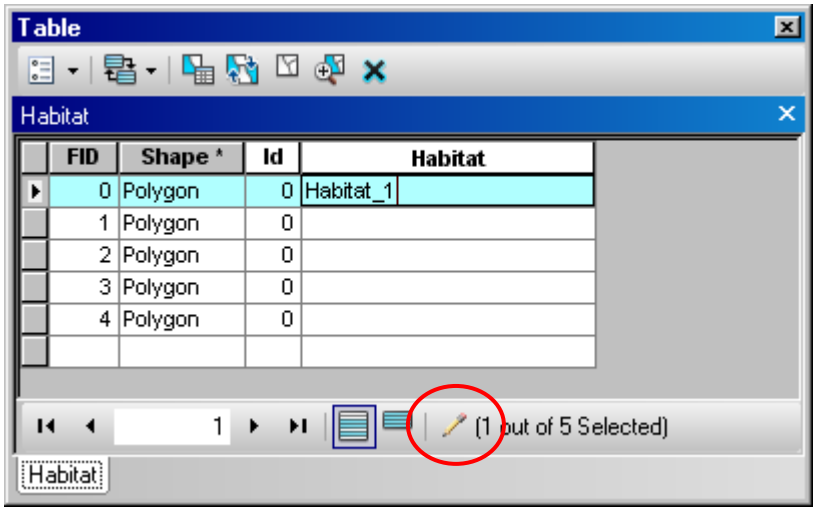


7. On the **Editor** Toolbar, select the **Edit Tool.**

8. Select any one of the polygons you created. The polygon outline and the record field in the table will turn cyan.

Notice that the names of the editable fields (FID and Shape cannot be edited) are now white and an extra row is added. A pencil icon appears in the bottom to indicate being in edit mode.

9. Double click in the highlighted Habitat cell and type **Habitat_1**



10. Repeat steps 8 and 9 for the second, third, and fourth polygons you created, labeling them **Habitat_2, Habitat_3, and Habitat_4,** respectively.

11. Click on the **Editor** button again.

12. Click on **Save Edits**. Once saved, click on **Stop Editing** in the same drop down menu.

13. Verify your edits in the Habitat attribute table and close the table when finished.

✓TIP: You can also edit field labels with the Attributes icon on the Editor toolbar:

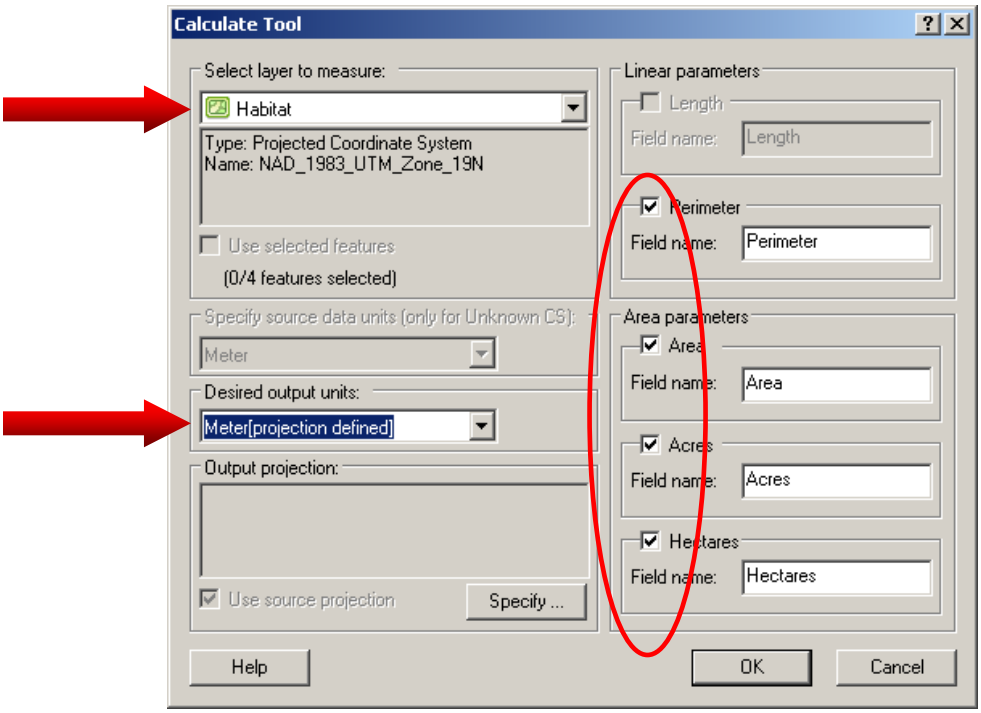
Click in the Value field to make your edits.

SECTION 2 - Adding Acreage using XTools Pro

XTools is an ArcGIS extension which has been pre- installed for the purpose of this exercise and features numerous specialized tools which many natural resource professionals will find very helpful. One of the most frequently used functions is calculating acreage of a selected area/polygon. XTools will automatically append new fields and calculate the perimeter, area, and acreage on the units you choose. Follow these steps to calculate the acreage of the polygons you just created and update the existing table:

1. From the Main Menu go to **View** then **Toolbars** and click on **XTools Pro**.

2. From the XTools Pro toolbar click on the XTools Pro down arrow button and select **Table Operations** then **Calculate Area, Perimeter, Length, Acres and Hectares.**



3. Under **Select layer to measure** choose **Habitat**.
Note: the dialog shows the projection for the selected layer.

4. In the **Desired output units** dialog box select **Meter [projection defined]**.

5. In the right column check **Perimeter, Area, Acres, and Hectares**. Note: you have the option of changing the Field name if you wish.

6. Click **OK**.

7. In the Habitat attribute table view the additional fields XTools added.

✓*TIP: You can also calculate area using the Calculate Geometry feature in any attribute table. Open an editing session, right-click the top of the field you want to calculate area for, select Calculate Geometry, and follow the instructions.*

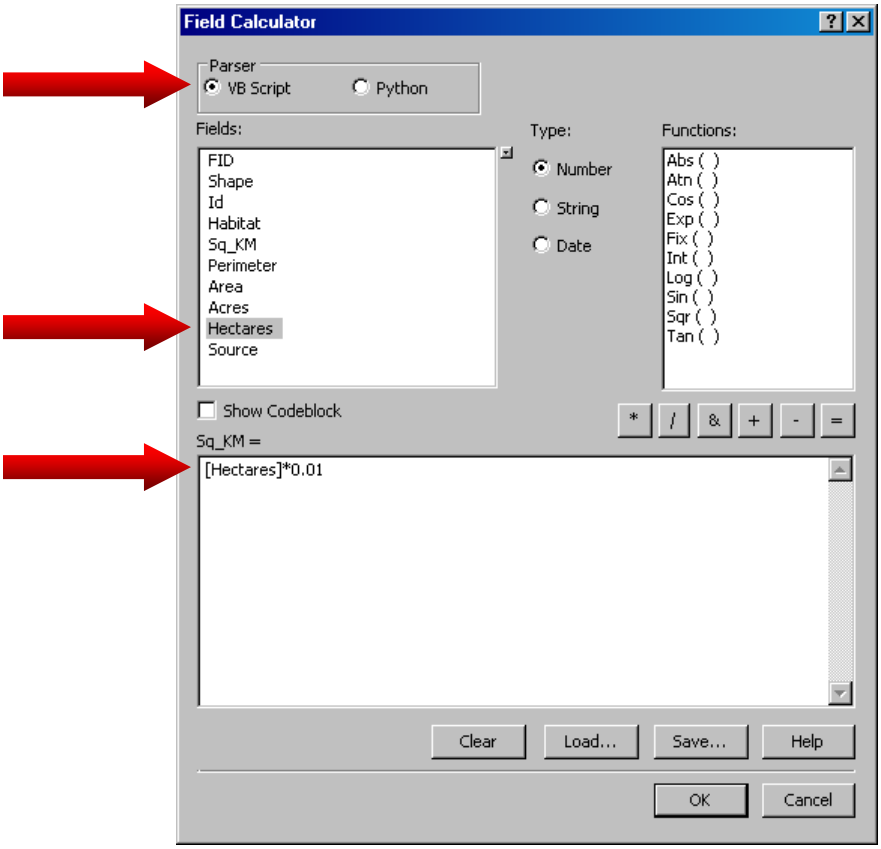
SECTION 3 - Using the Field Calculator

The **Field Calculator** is a special application which allows the user to populate data fields (selected or all fields) using simple or complex Visual Basic commands. Use the Help function on the main menu to learn more about making complex calculations. The following are two simple but practical examples:

1. In the **Habitat Attribute Table**, add a new field called **Sq_Km** with the type as **Double**.

2. Right Click on the new field (Sq_Km) header and select **Field Calculator**.

3. Ensure the **VB Script** and **Number** radio button is checked



4. In the Fields: text box double click on **Hectares** so that it appears in the bottom field. Click on the asterisk once and type in 0.01. The following expression should appear in the as shown above.

5. Click **OK**. Notice the calculation was performed and populated on each record.

SECTION 4 - Using the Field Calculator on Text fields

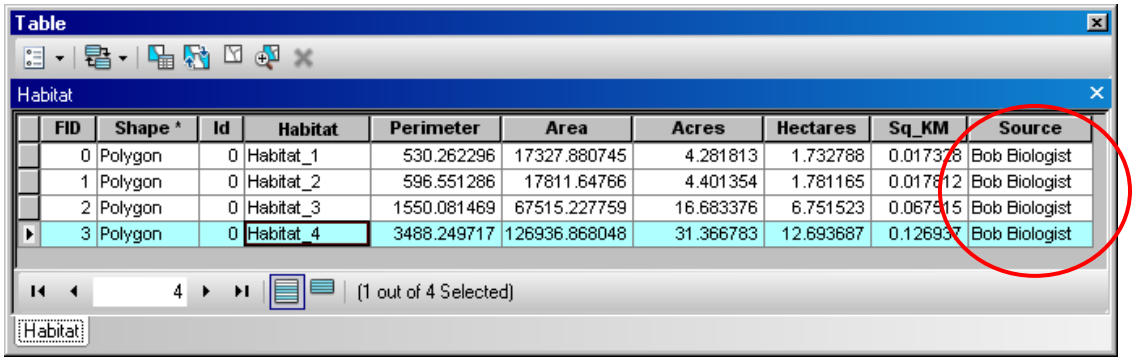
This is an easy way to populate multiple records with the same value. It also works on selected records as well.

1. Add a new field named **Source** with the type as **Text** and the length as **25**.

2. Right-click on the new field, select **Field Calculator**.

3. Type **"Bob Biologist " or "your name"** in the bottom text box and click **OK**. Note text strings are to be enclosed in double quotes.

   The Source field is now populated with **Bob Biologist** in the attribute table.



SECTION 5 - Aliases and hiding fields

1. In the Habitat attribute table, grab the bottom scroll bar with your mouse and scroll to the right to view all the new fields that were added to the table. Does anything on the screen show how many records there are?

2. Look at the field entitled **Habitat**. An alternative name to this field could be **Wood Lot** or something more descriptive. For this exercise let's change the name to **Wood Lot**.

3. Close the table and return to your data view.

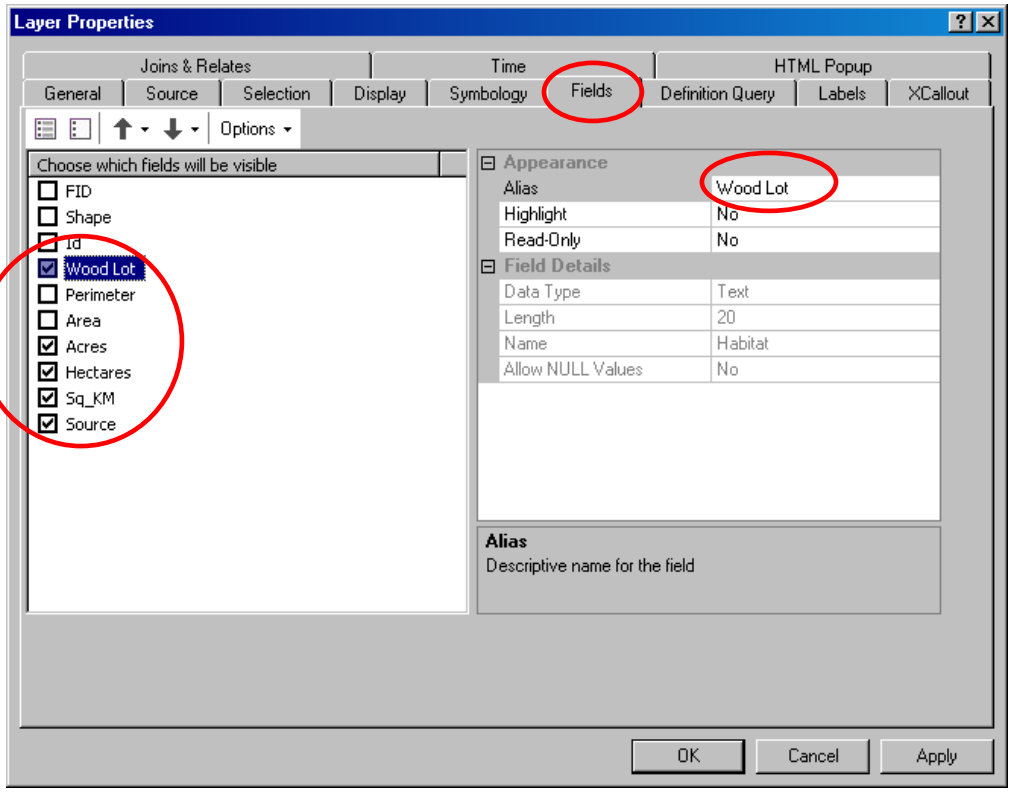
4. Double-click on the **Habitat** layer to open the **Layer Properties** window.

5. Click on the **Fields** tab.

6. Under **Appearance** on the right side of the window, notice the **Alias** box and the corresponding **Habitat** name. Delete the name **Habitat** and change it to **Wood Lot**. Notice on the left side of the screen **Choose which fields will be visible**, the name has changed to Woodlot.

   The name **Wood Lot** has now become the alias and will be visible in the table. This is useful when the field name is obscured or hard to remember. Note: the data is not affected; only the field title appears differently.

7. In the **Choose which fields will be visible** notice each field is listed, and there is a check box to the left of each field name. Uncheck the visibility box for **FID**, **Shape, Id, Perimeter** and **Area**. Click **OK** when done.



8. Open the attribute table for **Habitat** and notice the change in field name from **Habitat** to **Wood Lot** and note which fields are visible.

9. Click on the Options button and note the check mark next to **Show Field Aliases**. Click on **Show Field Aliases** to turn this option off. Notice the change to the Wood Lot field name.

Quiz 1: Calculate the acreage of the field just to the left of the service road on the Baring Unit CIR DOQQ. You can locate the field by going to Quiz_Acreage bookmark on the main menu.

ArcGIS - Field Types

Short Integer
Precision

Long Integer
Precision

Float
Precision
Scale

Double
Precision.
Scale

Text
Length

Date

Blob
Length

Precision - Refers to the number of **significant digits** used to store coordinate values. Precision is important for accurate feature representation, analysis, and mapping. ArcInfo supports single and double precision.

Double precision - Refers to a high level of coordinate accuracy based on the possible number of significant digits that can be stored for each coordinate. ArcInfo datasets can be stored in either single or double precision. Double-Precision coverages store up to 15 significant digits per coordinate (typically 13 to 14 significant digits), retaining the accuracy of much less than one meter at a global extent. See also Single precision.

BLOB - Binary large object. The binary data type of a column in an RDBMS table that stores large image, text, or geometry data as attributes.

Field precision and scale - The precision and scale of a field describe the maximum size and precision of data that can be stored in it. The precision describes the number of digits that can be stored in the field, while the scale describes the number of decimal places for float and double fields. When creating a new field in a geodatabase feature class or table, you can specify the field's type, precision, and scale. When the field is actually created in the database, the field type may be changed based on the precision and scale values you specify**.**

Use the following guidelines for choosing the correct field type for a given precision and scale:

- When you create a float, double, or integer field and specify 0 for precision and scale, the geodatabase will attempt to create a binary type field if the underlying database supports it. Personal geodatabases support only binary type fields, and precision and scale are ignored.
- When you create float and double fields and specify a precision and scale, if your precision is greater than 6, use a double; otherwise use a float. If you create a double field and specify a precision of 6 or less, a float field is created in the database. If you create a float field and specify a precision greater than 6, a double field is created.
- If you specify a scale of 0 and a precision of 10 or less, you should be creating integer fields. When creating integer fields, your precision should be 10 or less or your field may be created as double.

Required fields

All tables and feature classes have a set of required fields that are necessary to record the state of any particular object in the table or feature class. These required fields are automatically created when you create a new feature class or table, and cannot be deleted. Required fields may also have required properties such as their domain property. You cannot modify the required property of a required field.

For example, in a simple feature class, OBJECTID and Shape are required fields. They do have properties such as their aliases and geometry type that you can modify, but these fields cannot be deleted.

You will see that some types of feature classes have a number of required fields.

Shapefile, dBASE field to geodatabase geometry type mapping

Each different shapefile and dBASE field type maps to a single geodatabase type independent of field size. The exception is the Number type field, which will map to a long integer if its number of decimals is zero, and to a double integer if its number of decimals is greater than zero. The shapefile and dBASE field type to geodatabase field type mapping is summarized in the following table.

Field type	Field width	Geodatabase field type
date	-	date
string	1–255	text
boolean	-	short integer
number	1–4 (decimals=0)	short integer
number	5–9 (decimals=0)	long integer
number	10–19 (decimals=0)	double
float	1–13	float
float	14–19	double
number	1–8 (decimals>0)	float
number	9–19 (decimals>0)	double

Exercise 13: Constructing a File Geodatabase

Session Objectives: At the conclusion of this session, you will be able to:

- Create a file geodatabase
- Import shapefiles into a feature class
- Copy a feature class into a geodatabase

Materials created by: Mark Richardson and Karen Klinger
Revised: April, 2009 by Christopher Bryant and Mark Richardson
Notes: ArcMap 10, Service Pack 1

SECTION 1 - Creating a File Geodatabase

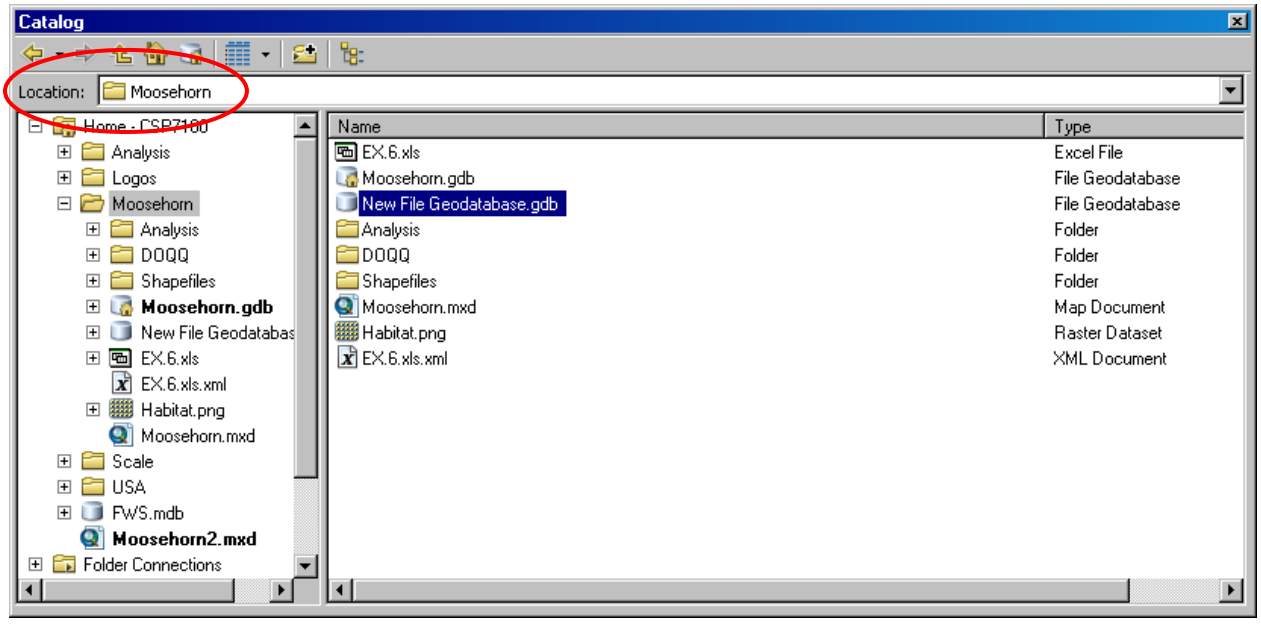
A file geodatabase is a file structure used primarily to store, query, and manipulate spatial data. Geodatabases store geometry, a spatial reference system, attributes, and behavioral rules for data. Feature datasets organize your geodatabase into different subgroups. Data layers within the geodatabase are referred to as feature classes.

1. Open **ArcCatalog Window**.

2. Under Folder Connections, navigate to \CSP7100\Moosehorn within the Catalog tree.

3. Right-click on the **Moosehorn** folder and select **New > File Geodatabase**.

4. Change the name of the File Geodatabase to **Baring_Unit**. Note: you do not need to add the .gdb extension.



SECTION 2 - Creating a Feature Dataset

1. Right-click on the **Baring_Unit.gdb** and select **New > Feature Dataset**.

2. Enter **Biology** for the name of the feature dataset. This feature dataset will contain biological data like the habitat and survey location layers we just created.

3. Click **Next**. The following screen will allow you to assign a spatial reference to the feature dataset.

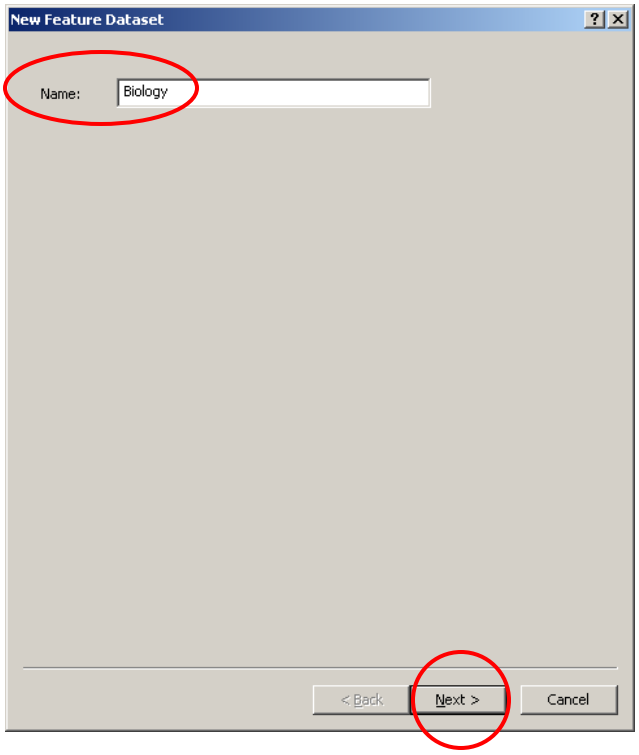
4. Click on **Import**.

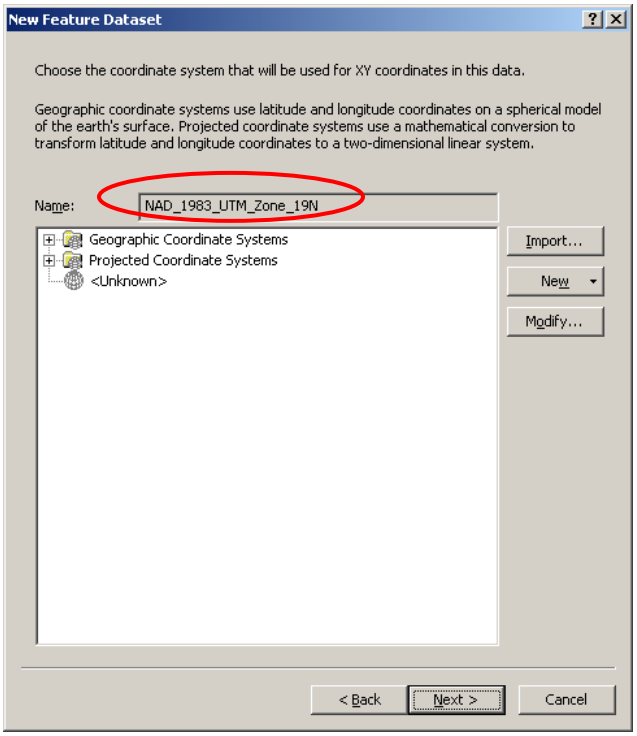
5. If necessary, navigate to the \CSP7100*Moosehorn**shapefiles* folder.

6. Select the **Habitat.shp** and click **Add**. **NAD_1983_UTM_Zone_19N** appears in the **Name** box.

   By choosing import when assigning a spatial reference we are "borrowing" the coordinate system from an existing file.

7. Click **Next** on this screen and the succeeding screen.



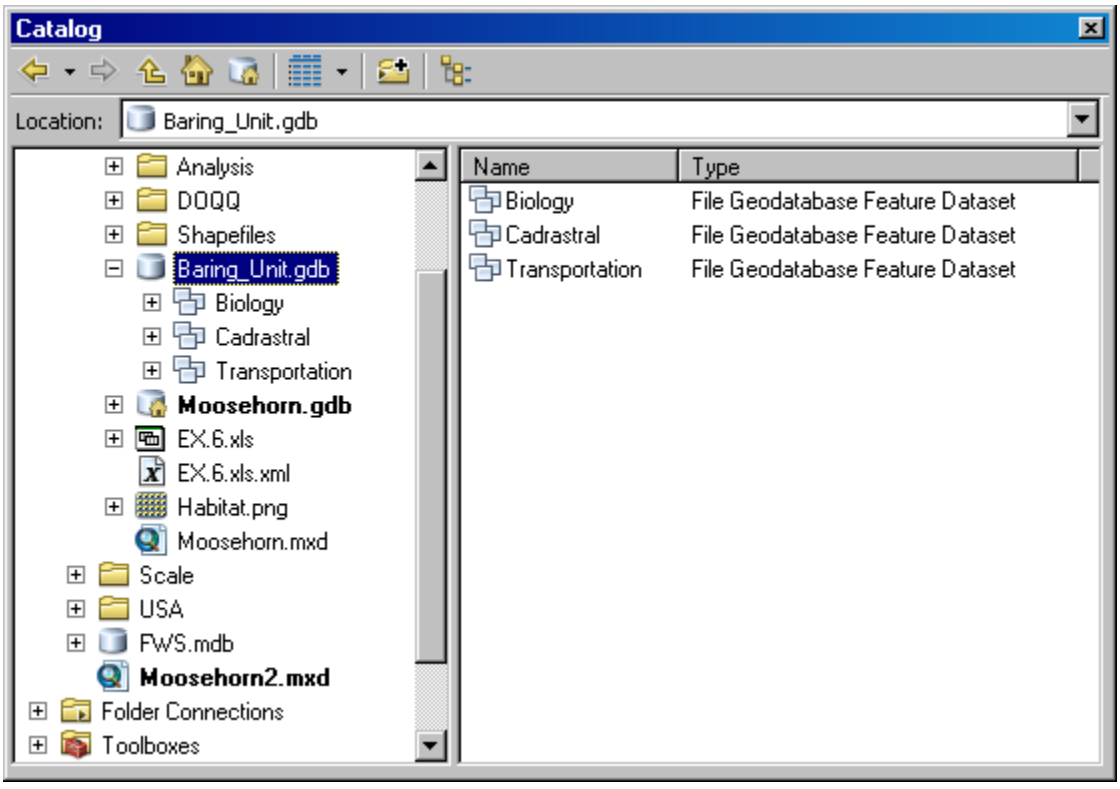


8. Accept the default for the XY tolerance and click on **Finish** to create the new feature dataset. Note how the **Biology** feature dataset appears in the contents window of ArcCatalog.

9. Repeat steps 1-8 and create 2 more feature datasets called **Cadastral** and **Transportation**

   We want these new feature datasets to have the same spatial reference – NAD83 UTM Zone 19N.

10. When finished your Contents window in ArcCatalog should look like the one below:



If your Contents window looks different from what is shown above, click on the Details button located on the Standard toolbar.

STOP -PLEASE STOP HERE BEFORE GOING ON TO THE NEXT SECTION- STOP

SECTION 3 - Importing Shapefiles

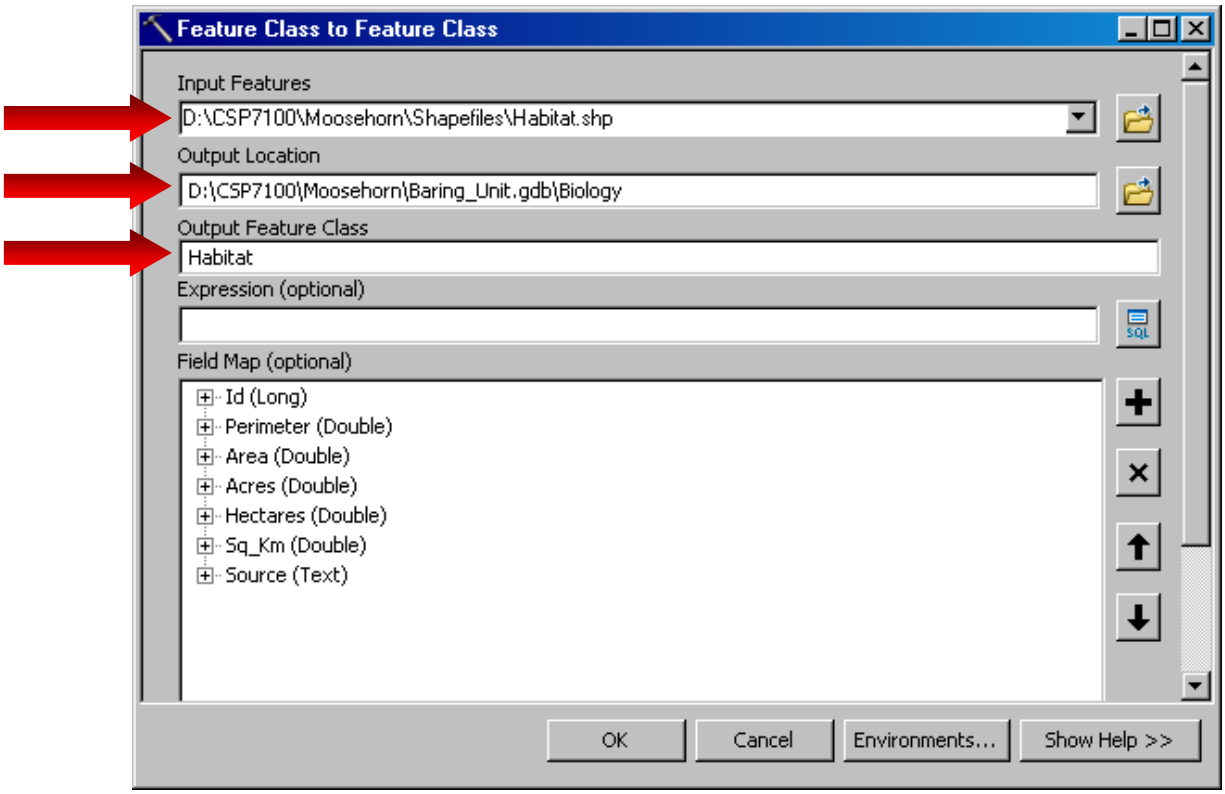
1. Right-click on the **Biology** feature dataset.

2. Select **Import > Feature Class (single)**.

3. In the **Input Features** box click on the browse icon and navigate to CSP7100\Moosehorn\Shapefiles folder. Select **Habitat.shp** and click **Add**.

   Take note of **where** the feature class will be created.

4. In the **Output Feature Class** enter **Habitat**. Click **OK**.



5. Close out the Feature Class to Feature Class dialog when completed.

   Congratulations! You just converted a shapefile into a Feature Class within a Geodatabase!!

6. Repeat steps 1-5 and **Import** the following shapefiles into the feature datasets we just created:

Input Feature	Output Location	Output Feature Class
Survey_Locations.shp	Biology Feature Dataset	Survey_Locations
maine.shp	Cadastral Feature Dataset	Maine

SECTION 4- Creating New Feature Classes

Now we will create a new empty feature class that can be edited in ArcMap (just as we edited the Habitat shapefile).

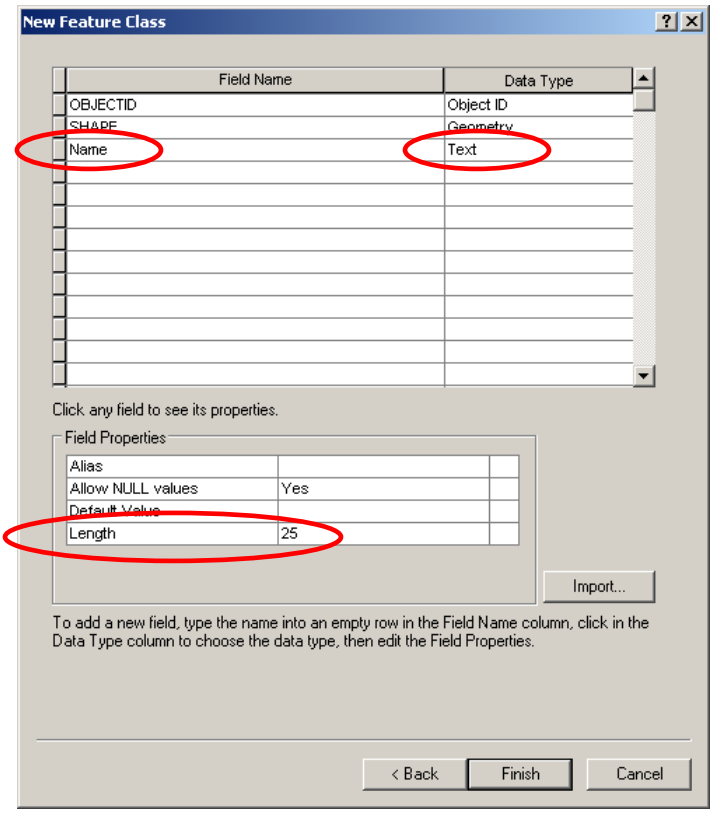
1. Right click on the **Transportation** feature dataset, highlight **New**, and select **Feature Class**.

2. In the Name section type **Parking_Lots**. Leave the Alias field blank.

3. Leave the Type as **Polygon Features**. Click Next.

4. Click Next to accept the default configuration.

   This last page shows the attribute fields of our new feature class. OBJECTID and SHAPE are automatically added. We need to add one more attribute field for the parking lot names.



5. Click the **Field Name** cell under Shape and type **Name**.

6. In the **Data Type** column, click the cell under Geometry and select **Text** from the dropdown list.

7. In the **Field Properties** box, click the cell next to Length and type 25. Your screen should look like the example to the right.

8. Click **Finish** when done.

SECTION 5 - Copying Feature Data Sets from existing .GDB's

Now we will add a feature class from an existing geodatabase (Moosehorn.gdb) to our **Baring_Unit** Geodatabase.

1. In the Catalog Tree, click on the plus to the left of the **Moosehorn.gdb**.

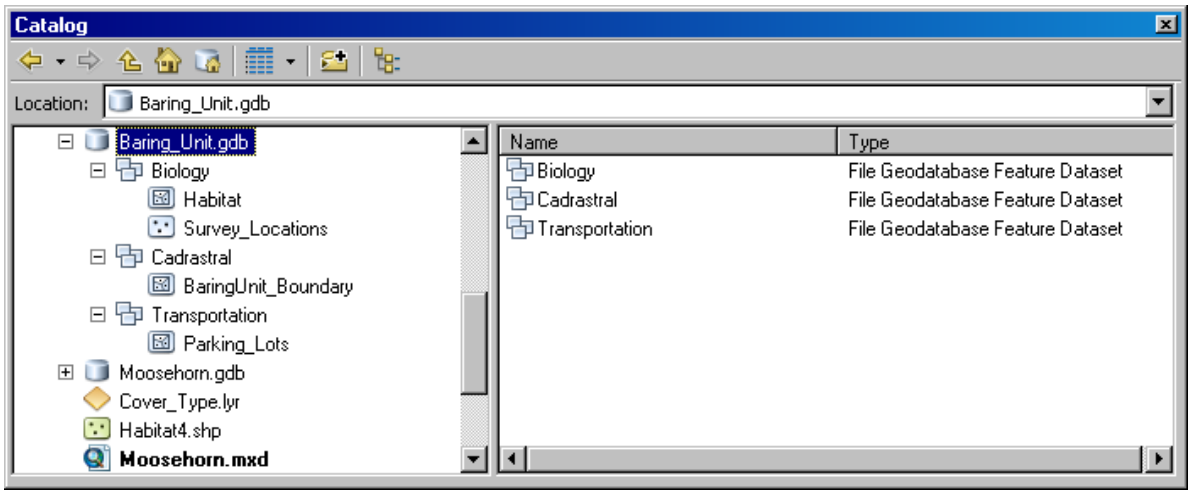
2. Open the **Cadastral** Feature dataset.

3. Right click on the **BaringUnit_Boundary** feature class and select Copy.

4. Navigate to the **Baring_Unit.gdb**.

5. Right click on the **Cadastral** Feature dataset. Select **paste** and click OK.

6. Your Geodatabase structure should match the one shown below:



Quiz 1: What are attribute domains and subtypes and why would you want to use them?

Notes:

Discussion/Lecture: Metadata

Session Objectives: At the conclusion of this session, you will be able to:

- Define Metadata
- Explain the Metadata Content Standard
- Name the seven main sections
- Identify Metadata tools
- Describe why Metadata is important

Materials created by: This module was developed primarily by Ron Salz with additions and updates by Marcia McNiff.
Revised: April 2011 by Mark Richardson and Christopher Bryant
Notes: ArcMap 10

Notes:

Notes:

Notes:

Notes:

Exercise 14: Generating Metadata

Session Objectives: At the conclusion of the session, you will be able to:

- Peruse Metadata using ERSI and FGDC style sheets
- Use Metadata to answer questions about the data
- Generate Metadata

Materials created by: Todd Sutherland, Mark Richardson, and Karen Klinger
Revised: January, 2012 by Christopher Bryant and Mark Richardson
Notes: ArcMap 10, Service Pack 1

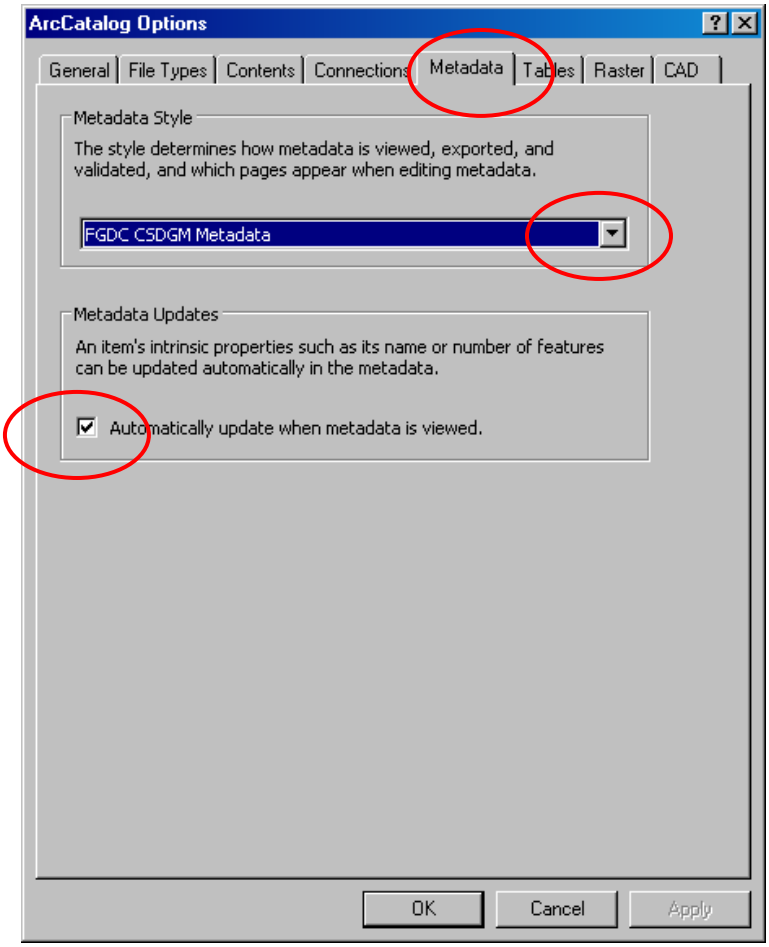
Section 1 - Peruse metadata

Metadata gives us information about our data including, but not limited to, when, where, why, and how it was created as well as contact and distribution information.

1. Open **ArcCatalog 10**. Navigate to D:*CSP7100**Moosehorn*\ *Moosehorn.gdb**Landcover* feature dataset and select the **Cover_Type** feature class.

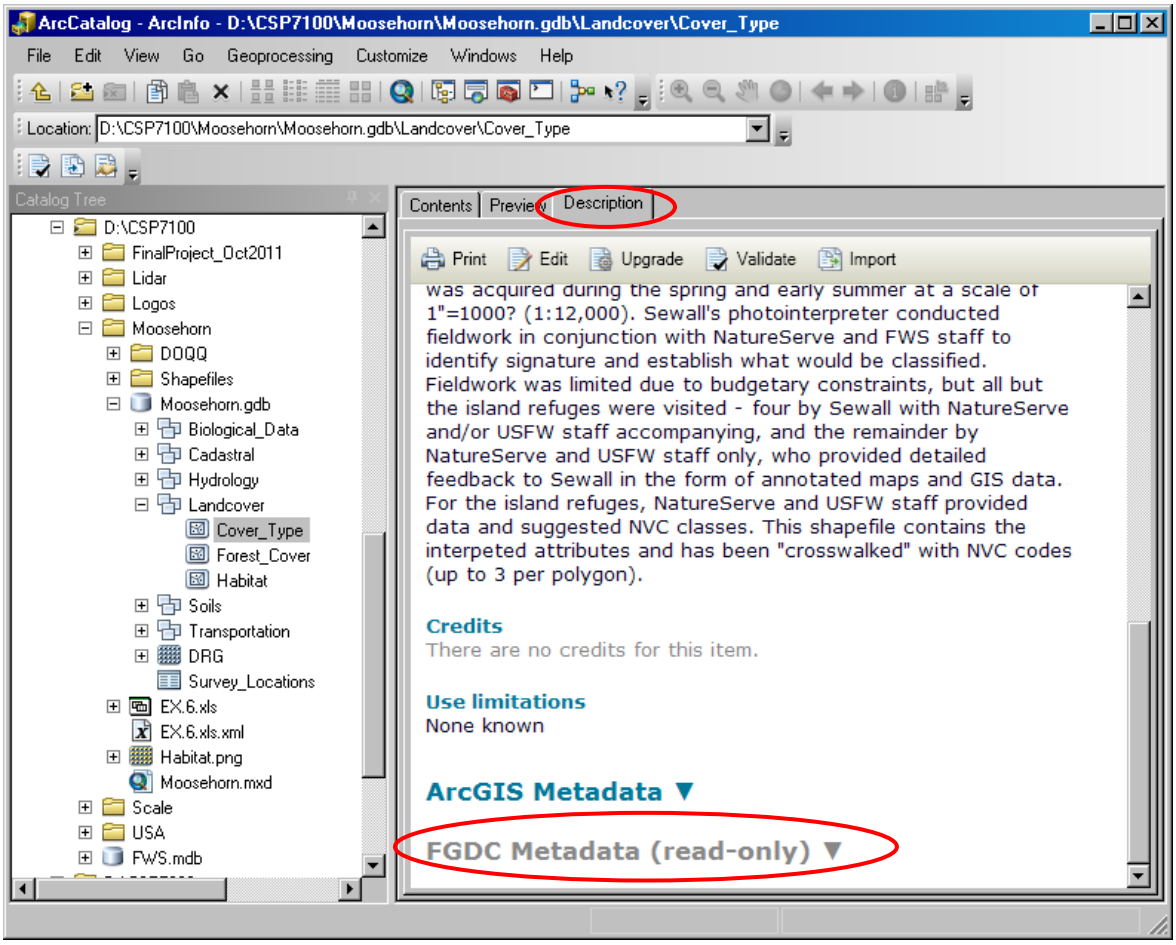
2. From the **Customize** menu, select **ArcCatalog Options**. Click on the **Metadata** tab.

3. In the Metadata Style drop down select **FGDC CSDGM** (Content Standard for Digital Geospatial Metadata). Ensure that the "Automatically update when metadata is viewed" box is checked as shown below. Click **OK**.



4. Click on the **Description** tab.

5. Click on the **ArcGIS Metadata** and then **FGDC Metadata (read - only)** link.



6. Navigate down to the **Entities and Attributes** section.

   A. What is the attribute definition source?_____

7. Click on the **Identification** tab.

B. What was the purpose for creating this dataset?

_____

_____

C. Who created the dataset?

_____

_____

8. Scroll back up the page and click on the **ArcGIS Metadata**

D. What coordinate system is this feature class in?

_____

E. What datum is used?

_____

9. Switch back to the **FGDC Metadata** tab.

F. In which metadata section do you find the abstract information?

_____

G. What is the positional accuracy of this dataset?

_____

H. What scale was the dataset produced in? _____

I. Who should you contact for questions about the data?

_____

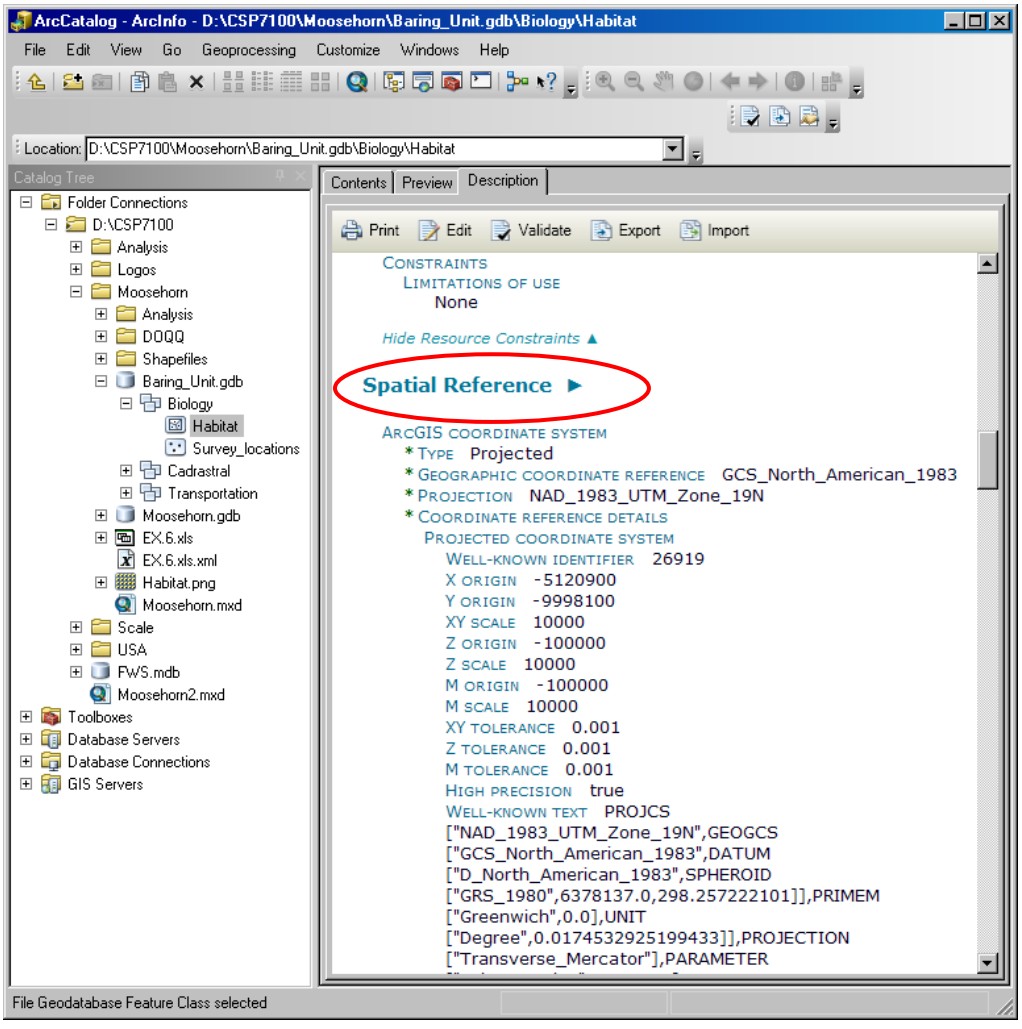

STOP
-PLEASE STOP HERE BEFORE GOING ON TO THE NEXT SECTION-
STOP

Section 2 - Generating Metadata

Currently, the **Habitat** feature class that was created in Exercise 9 has no metadata. For the purposes of this exercise, we are only going to complete a few of the required fields to give a sense how the new ArcGIS 10 metadata module functions.

1. In the Catalog tree, navigate to theD:\ CSP7100\Moosehorn\ Baring_Unit.gdb\ Biology feature dataset and select the **Habitat** feature class.

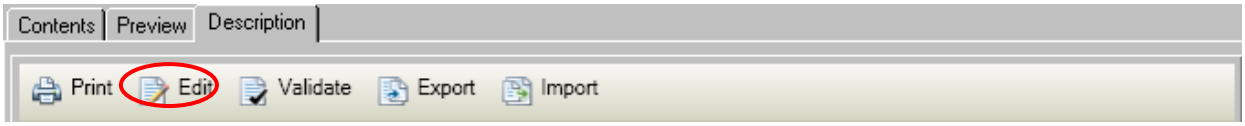
2. In the Description Window, Click on **ArcGIS Metadata** and scroll down to **Spatial Reference**. Notice the coordinate system and spatial extent (bounding coordinates) appear because ArcCatalog automatically extracted this information from the layer..



3. Click **ArcGIS Metadata** link again to roll up the page.

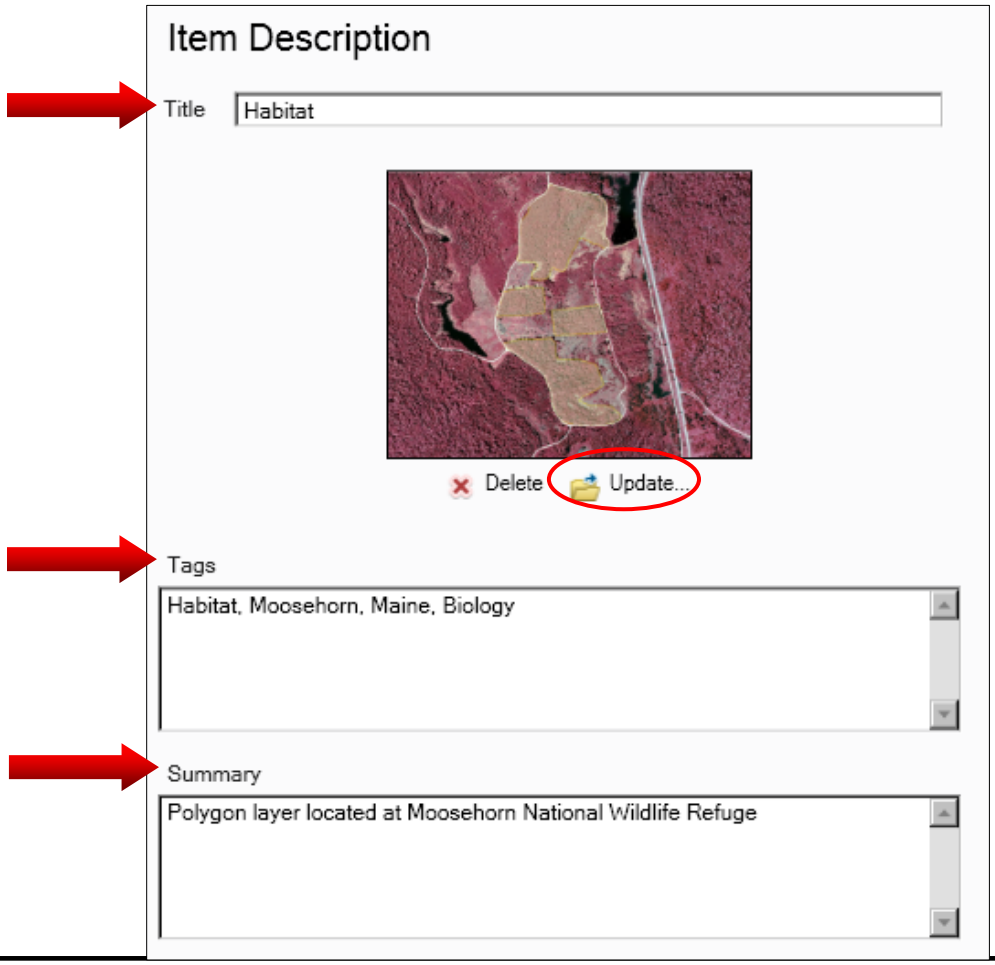
> ✓*TIP: Shapefiles must have a projection file (.prj) in order for coordinate system information to be automatically populated into the form.*

4. Within Description Window, click the **Edit** icon.



Notice the Thumbnail, Tags, Summary, Description, Credits and Access and Use Limitations are blank. Now, we will enter some additional metadata and fill in all the blank fields mentioned.

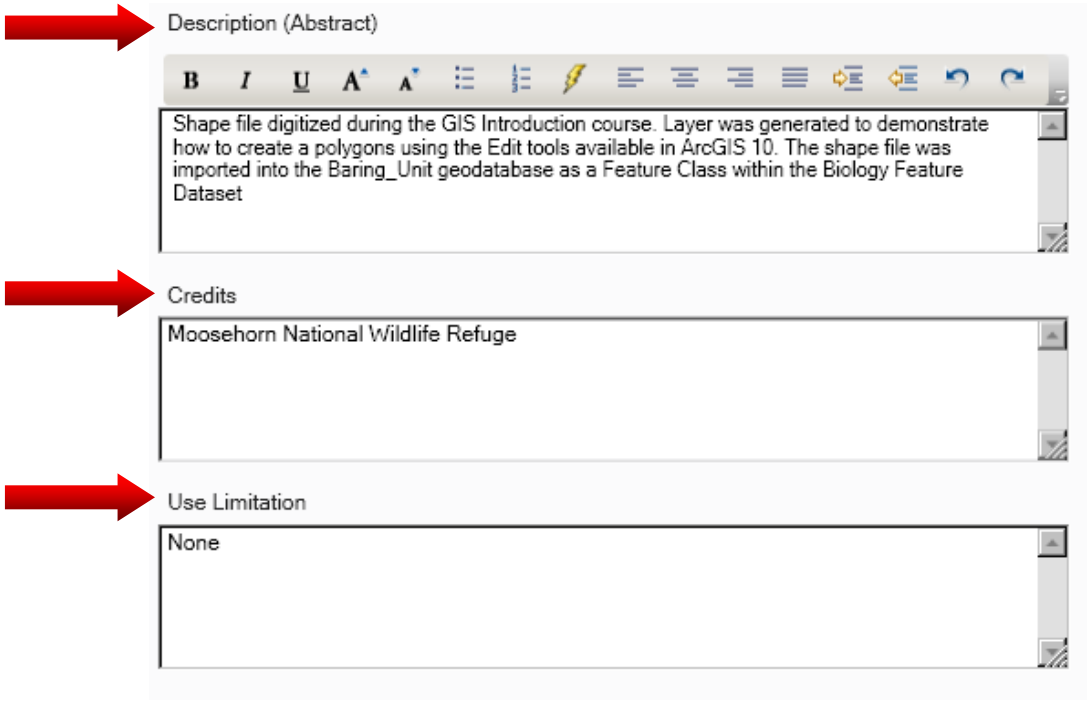
5. Fill in the Title, Tags and Summary fields as shown below – please feel free to change the wording as you see fit:



Next, let's add a thumb nail image of the habitat data layer which has already been created for this exercise.

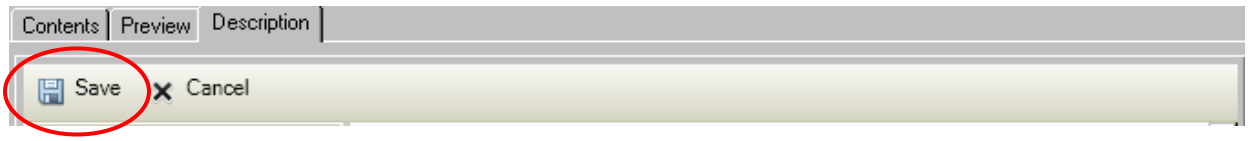
6. Click on the **Update** folder. Navigate to the Moosehorn folder and select the **Habitat.png**. Click **Open**.

7. Fill in the remaining **three** fields, Description, Credits and Use Limitations as shown below:



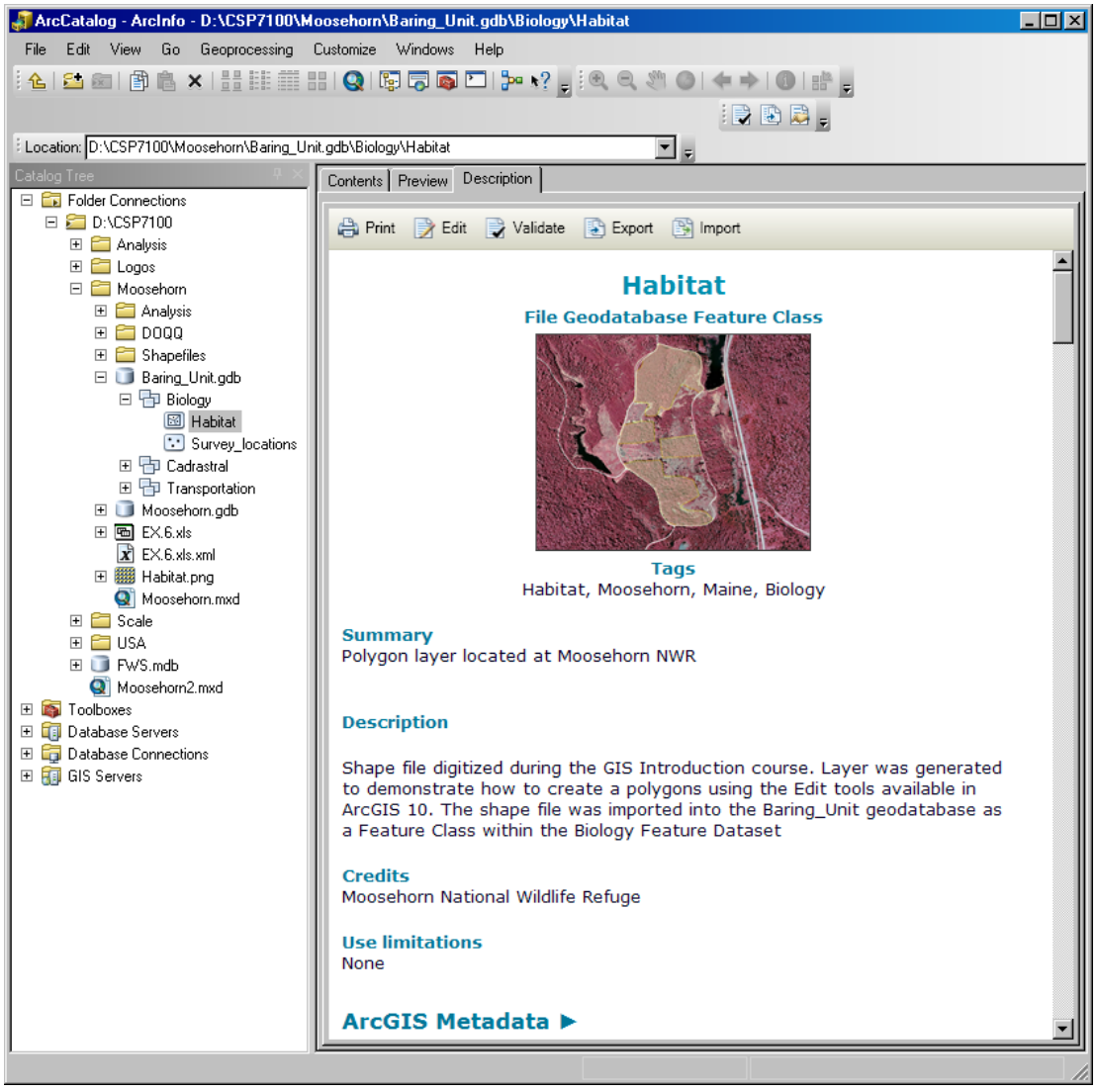
Notice, once you move the cursor into a field, a brief field description appears at the bottom of the window.

8. When all the fields are complete, click on **Save**



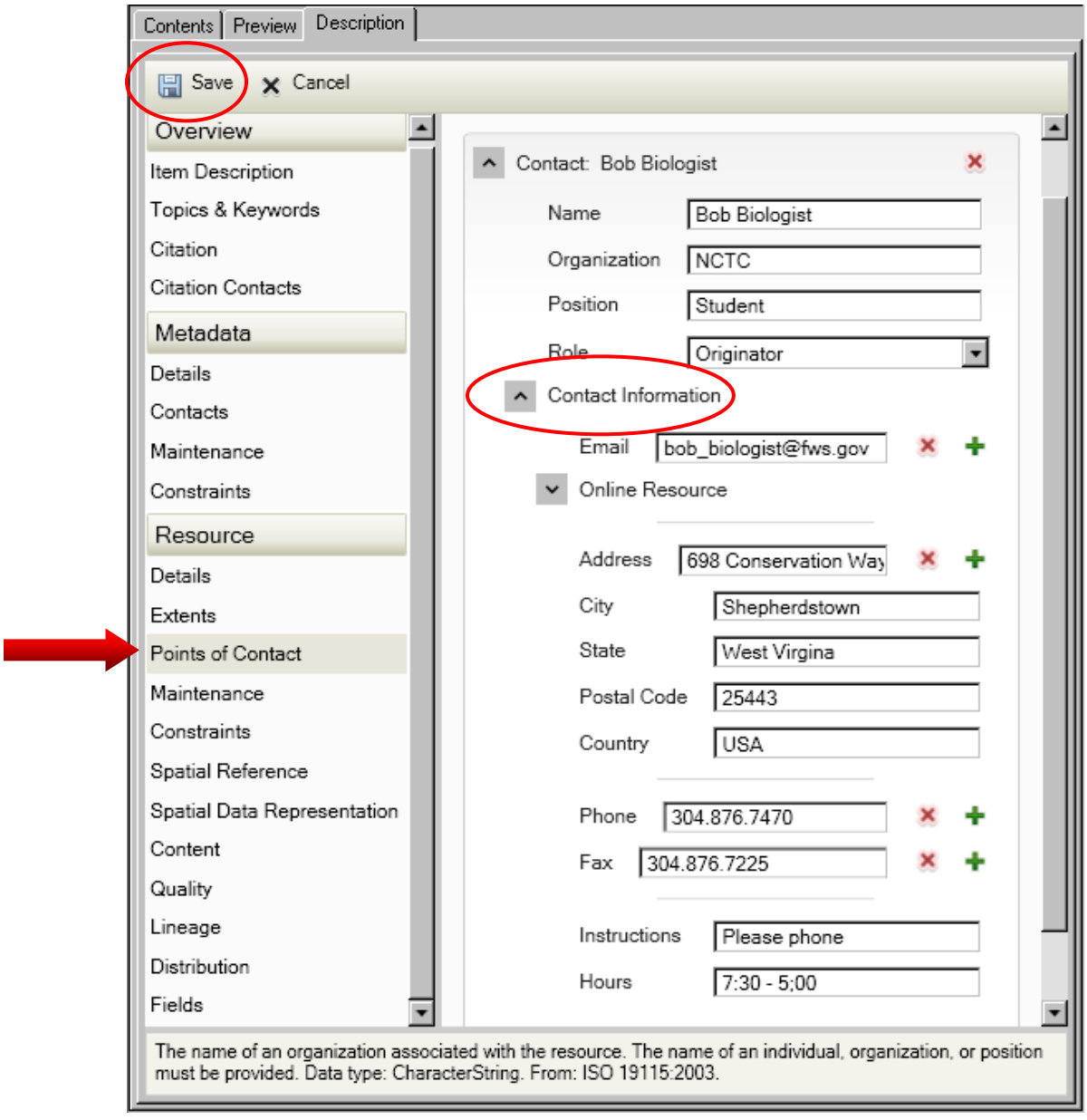
✓TIP: When editing metadata, copying and pasting data saves time. Save information that will be used repeatedly in a word document. Then copy and paste the specific data in the required boxes.

Your Habitat metadata description page shown look like the one shown below: Notice how this page gives the user a quick outline of what this data layer is about without drilling down into ArcGIS or FGDC links.



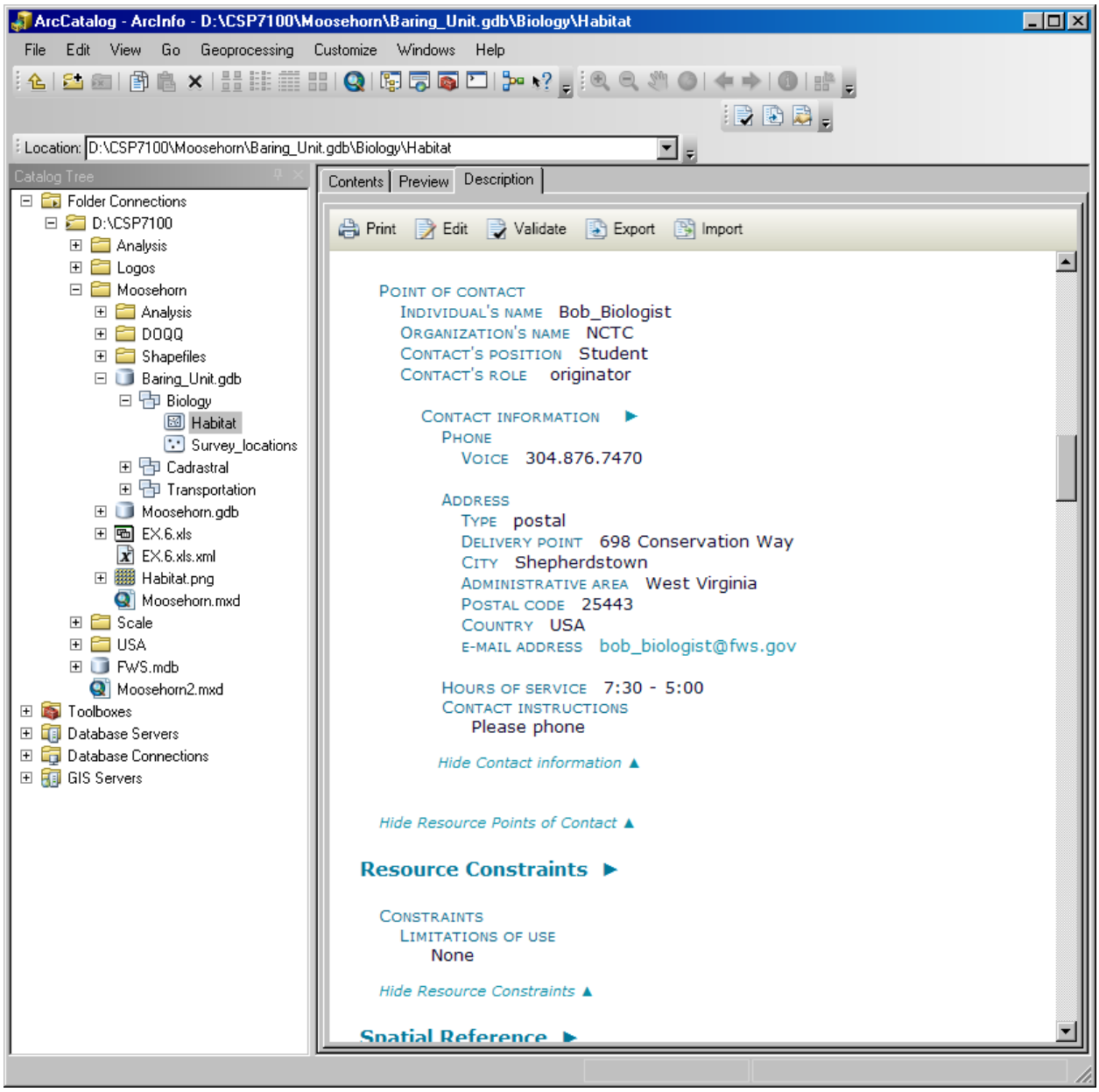
9. Click on the **Edit** icon again and select **Points of Contacts.**

   Fill in all the contact fields as shown below. You will need to click on the **Contacts** down arrow to expand the remaining fields.



10. Click on **Save.**

11. Click on the **ArcGIS Metadata** link. Grab the slide bar on the right side of the window to peruse metadata you have just entered.



12. Slide up to the very top of the window and click on **ArcGIS** again to collapse the window.

Congratulations! You just generated metadata for the Moosehorn habitat layer. Of course, you could need to go back to the remaining sections and fill in those fields to have complete documentation.

Quiz 1**:** In what section of ArGIS metadata can you view all the Contact information you entered earlier?

Notes:

Discussion/Lecture: Designing Good Maps

Session Objectives: At the conclusion of this session, you will be able to:

- Identify the purpose of cartographic design
- Describe the seven habits of effective cartographers

Materials created by: PowerPoints originally created by Frank Kenney. Modifications by Mark Richardson
Revised: April 2011 by Mark Richardson and Christopher Bryant
Notes: ArcMap 10

Notes:

Notes:

Notes:

Notes:

Exercise 15: Creating a Map Layout

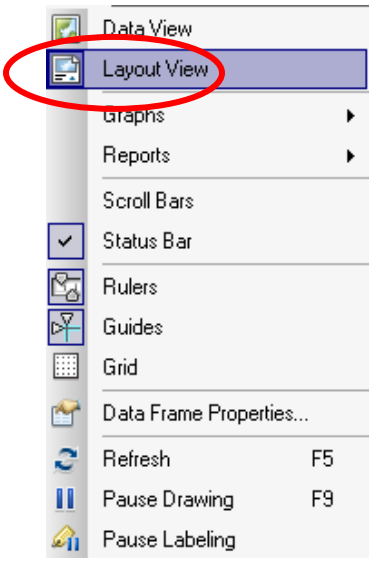
Session Objectives: At the conclusion of this session, you will be able to:

- Create and print a map layout
- Define Layout View
- Define frames
- Create, edit, and manipulate frames
- Label map features

Materials created by: Mark Richardson and Karen Klinger
Revised: April 2011 by Mark Richardson & Christopher Bryant
Notes: ArcMap 10, Service Pack 1

SECTION 1 - Introduction to Layout View & Setup Preparations

The Layout View is where you create maps within ArcMap. The Layout View reflects what is displayed in the Data View, as well as other frames within your map document (.mxd). These can be text, legends, North Arrows, images and scale bars.



1. Open the Moosehorn map document and activate the **Moosehorn NWR** data view.

2. Uncheck all the layers in the Table of Contents except for **Cover_Type** and the **Approved_Boundary.**

3. Right-click on the **Cover_Type** in the Table of Contents and select **Zoom to Layer**.

4. Go to **View**> **Layout View**

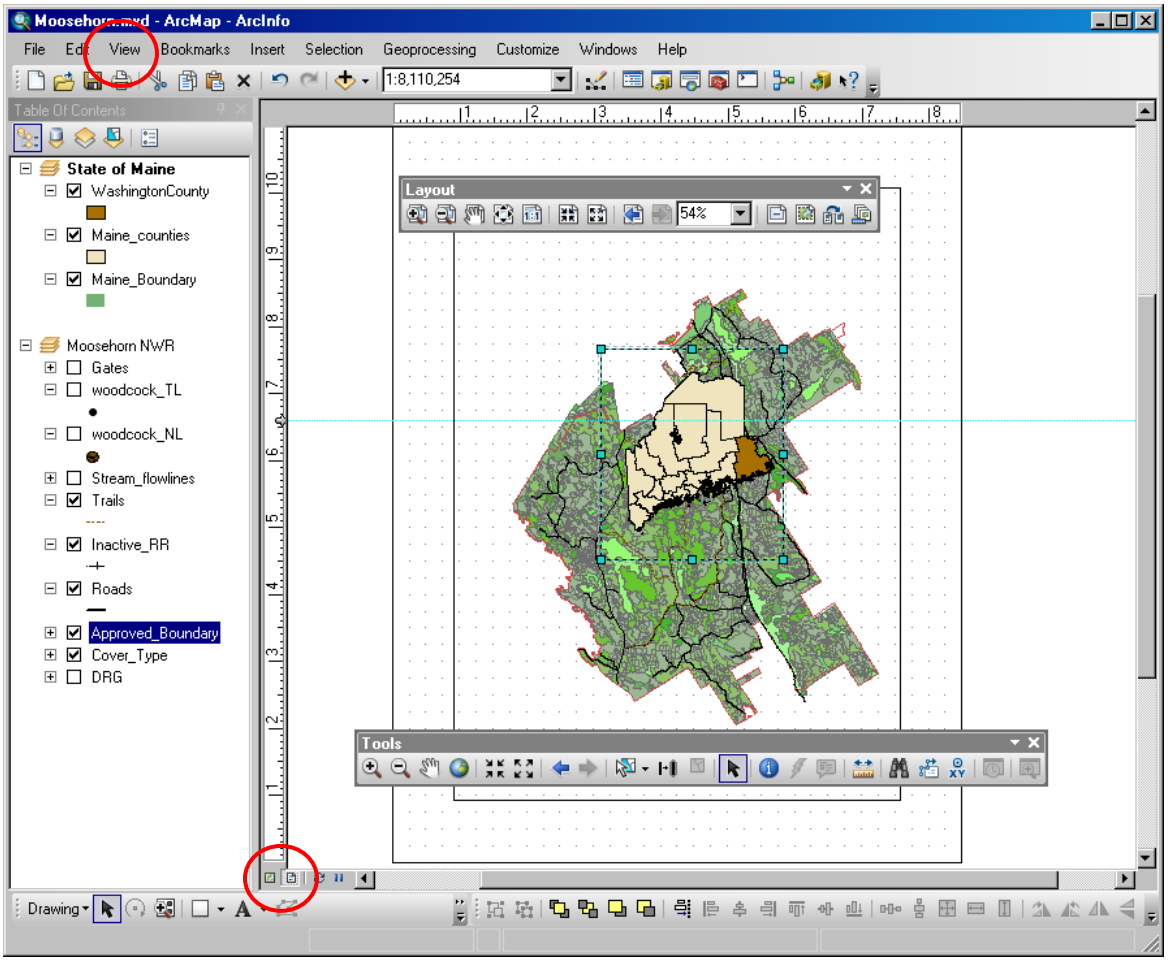
   Note: There are two ways to toggle between the Layout and the Data View. One is to click on the **View** pulldown menu and select either **Layout View** or **Data View**. The other is to use the icons found at the bottom **left-hand corner** of your view.

5. Make sure the **Layout** and **Graphics** toolbars are visible. You will need to use this frequently in this exercise. Do you remember how to do this?

✓TIP: It's a good idea to keep the Layout toolbar away from the Tools toolbar because they have similar looking icons but have very different results when used. It's easy to get them mixed up – so keep them separate!

6. Go to **View** on the **Main Menu** and activate **Rulers**, **Guides** and **Grid**. These visual aids can be very helpful in laying out your map composition. If you do not care to use them turn them off.

*✓TIP: Rulers, guides and grid properties can be changed by right-clicking your mouse and selecting **Options.** Click on the Layout View tab to make your changes. A guide can be created by clicking inside the horizontal or vertical ruler. Right-click to modify the guides.*



7. Click anywhere on the white background or virtual page of the layout view (outside of the data frame).

8. Click on the right mouse button and select **Page and Print Setup**.

The Page and Print Setup window appears. Before map composition begins, the printer and printer settings should be checked. Skipping this step could lead to **unanticipated** results!

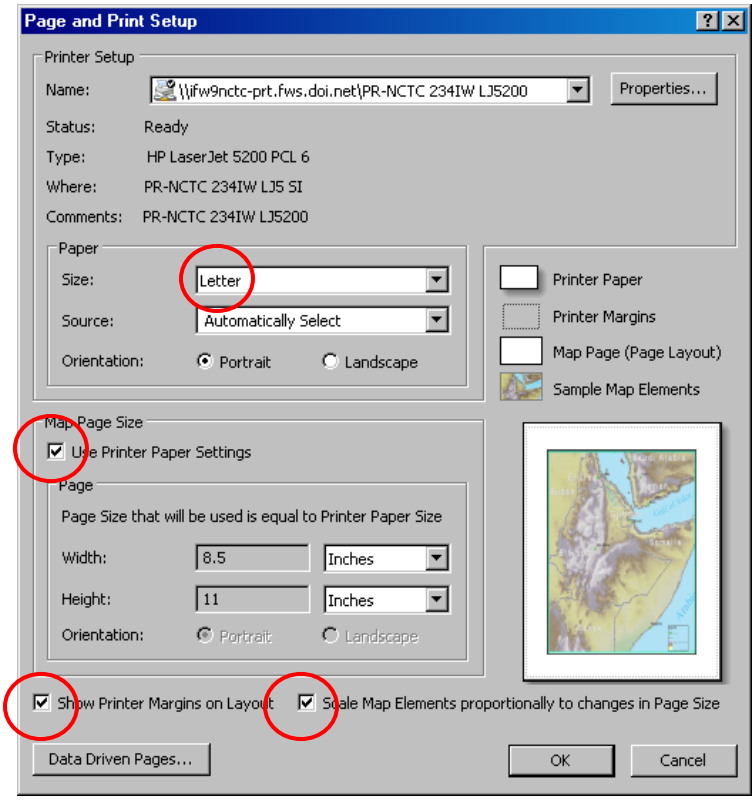
The best settings to choose depend on the printers available and their current setup. The most important settings are the page orientation and size. If these are not set correctly, the final product will be a real surprise. For instance, if you wanted your map in a landscape orientation and the page orientation is set to portrait, the output will be cropped.

9. Under Paper Size select **Letter**, and under Orientation select **Portrait.**

10. Under Map Page Size check **Use Printer Paper Settings.**

11. Below the Map Page Size, check the boxes **Show Printer Margins on Layout** and **Scale Map Elements proportionally to changes in Page Size**.

12. Click **OK**.

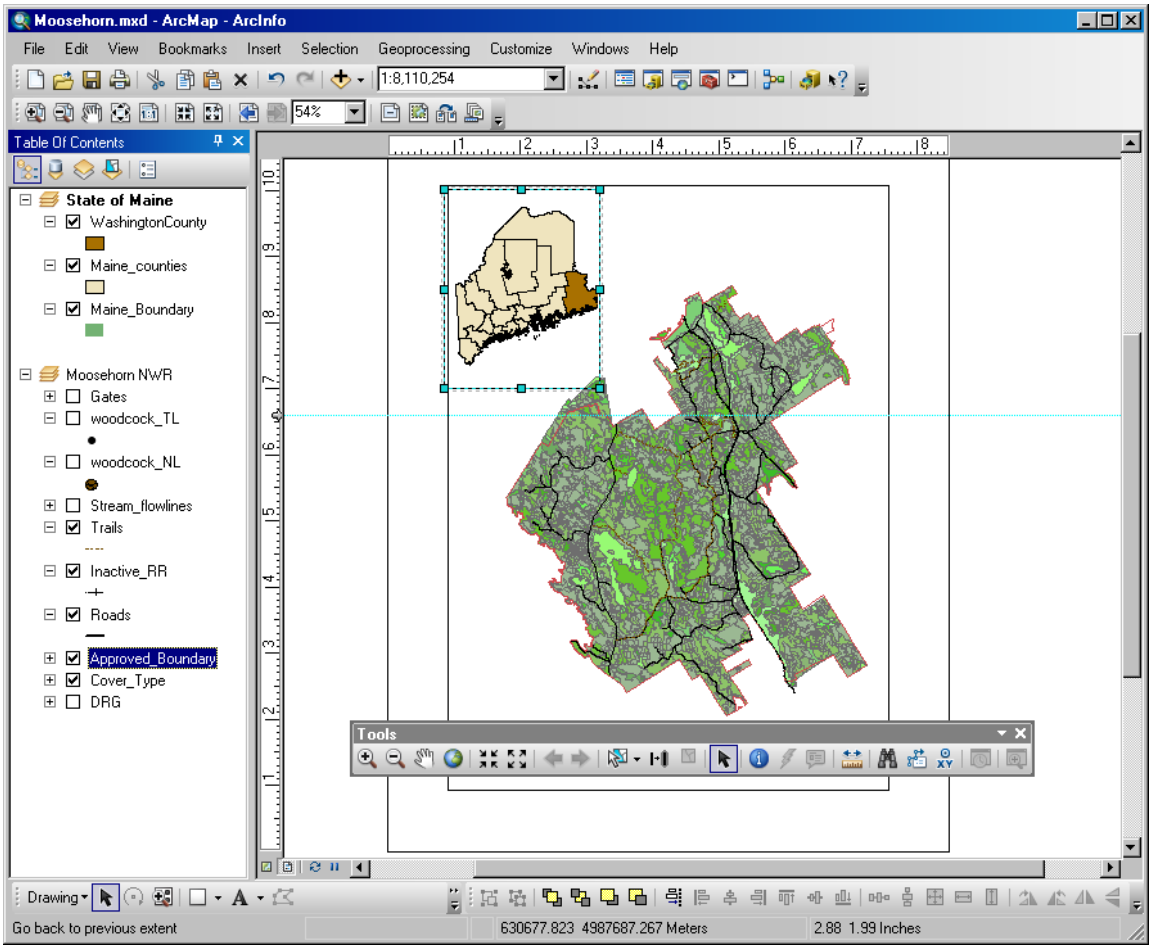


SECTION 2 - Manipulating Data Frames

1. Click on the **State of Maine** data frame with the pointer tool.

   Notice how a blue highlight with handles (black boxes) appears around the **State of Maine** data frame. This lets you know that it is the active frame. The **State of Maine** name in the table of contents is in bold. There are two data frames in the layout view; Moosehorn NWR and the State of Maine. Each frame can be moved, resized, edited or deleted.

2. Click and hold the left mouse button on the **State of Maine** data frame and drag the box to the upper left corner of the Moosehorn NWR data frame.



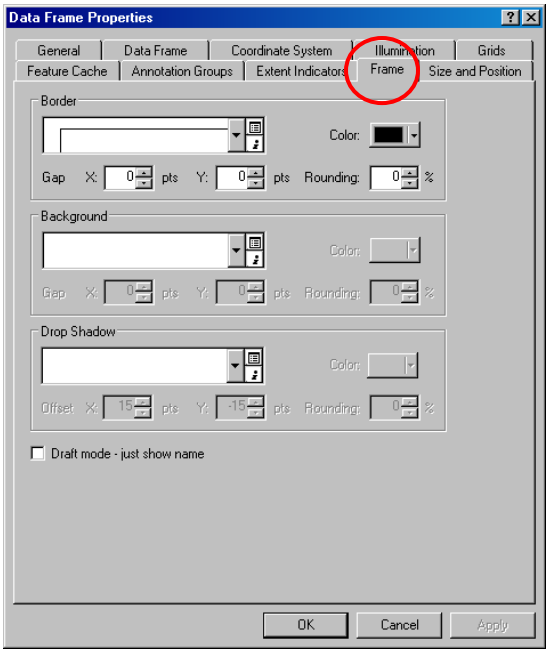
3. Select the Moosehorn NWR data frame. Grab one of the corners of the frame with the pointer tool and resize the frame. Notice how you can freely move the frame within the layout.

4. Move the pointer inside the Moosehorn NWR data frame, click on the right mouse key and select **Properties.**

5. Click on the **Frame** tab.

6. In the center panel labeled **Background** change the background to a light blue or some other light color of your choice.

7. Click on **Apply** and then **OK**. Notice how the background of the data frame changed.



8. Click once on the **Fixed Zoom In** button on the Tools toolbar.

Notice the change in scale of the Moosehorn NWR.

9. Spend a few minutes altering the size and position of the data frame and adjusting the extent of the Moosehorn NWR within the layout view. Try using both the **Tools** and **Layout** toolbars.

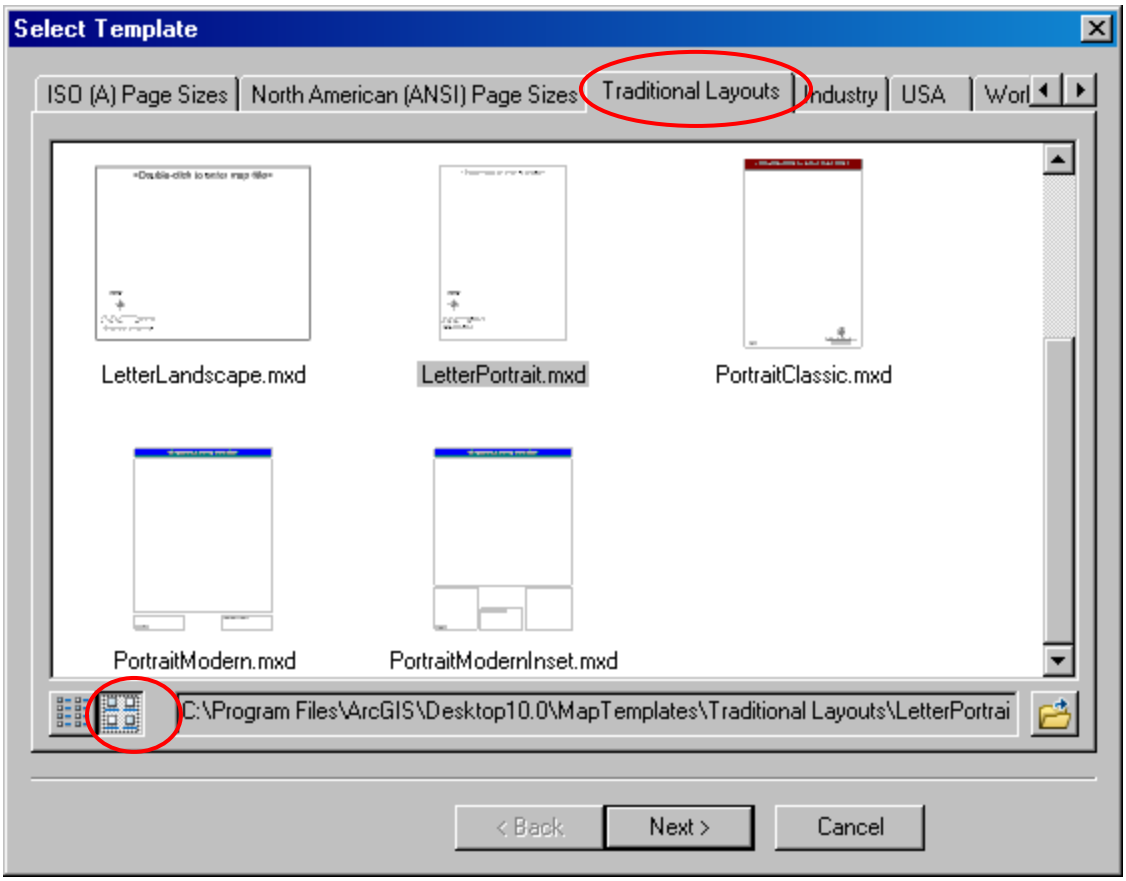
Quiz 1: What is a Extent Indicator? How would you incorporate this feature into a map composition?

-PLEASE STOP HERE BEFORE GOING ON TO THE NEXT SECTION-

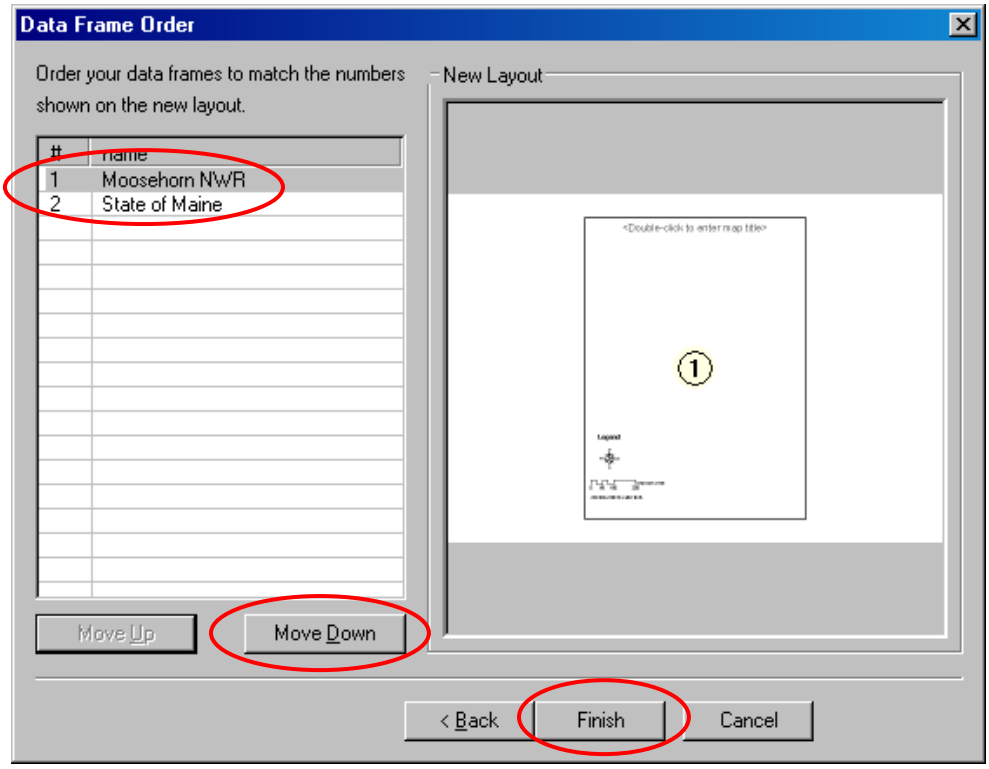
SECTION 3 - Using and Changing Templates

1. Click on the **Change Layout** icon on the layout tool. This opens the Select Template window. A template is a layout with empty frames that have views, legends, and graphics associated with them.

2. Click on the **Traditional Layouts** and select **LetterPortrait.mxd**. Toggle between the Thumbnail view and List view to see the various types of Templates.



3. Click on the **Next** button to advance to the **Data Frame Order** window.



4. Notice that the "State of Maine" data frame is at the top of the list. With **State of Maine** selected, click **Move Down** to move it below Moosehorn NWR. This will make Moosehorn NWR the primary data frame. Click **Finish** to select this template.

A. What map elements have been added to the layout?

_____

_____

Experiment with the other available template styles under the General tab. Which one do you like the best? When finished experimenting change back to the **LetterPortrait.mxd** to continue with this exercise.

5. Click on the virtual page (the white space outside of the data frame).

6. Right mouse click and select **Page and Print Setup**.

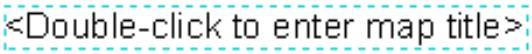
7. Some of the map elements may be out of place. Manipulate them to fit the template or as you would like them to appear.

✓*TIP: Check the Show Printer Margins on Layout box to view the margins in the layout.*

Quiz 2: What is the difference between **Draft Mode** and **Focus Data Frame**? Why would you want to use either one?

SECTION 4 - Editing Text/Title Frames

1. At the top of your layout locate the text reading **"Double-click to enter map title."**



2. Double-click on the text. This opens the **Properties** window.

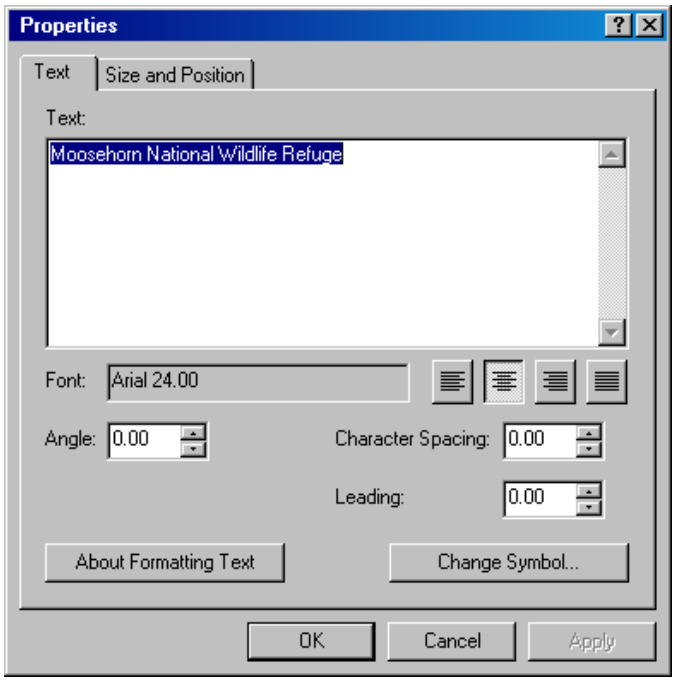
3. Type in **Moosehorn National Wildlife Refuge**.

4. Click on the **Change Symbol** button. This opens the Symbol Selector window. Change the font size to **24**.

5. Click **OK** in the Symbol Selector window.

6. Click **OK** again in the Properties window. Now you have a title for your map.

7. Click outside the virtual page or layout area to unselect the text.



Quiz 3: How do you change the color of the font and add a drop shadow to text?

SECTION 5 - Inserting Text Frames

Text labels or text frames can be added to the layout using the Text tool. For this section we will be adding some critical metadata to our map layout.

1. Zoom down to the lower left hand corner of the map using the **Zoom In** tool located on the Layout toolbar. Only the lower 1/3 of the map should be visible.

2. Change the font size to 20 using the Font Size dropdown arrow located on the Draw toolbar.

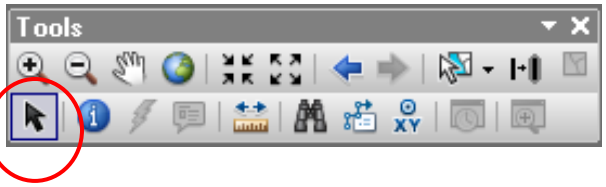
3. Activate the **New Text** tool found on the Draw toolbar. This turns the pointer into a crosshair with an **"A"** under it. Click the cursor anywhere within the lower left hand corner of the map to place the text box.

4. Click outside of the text box and then double-click on the text box.

5. Enter the following and hit OK:

   Map produced by: "Your full name"
   Projection: Universal Transverse Mercator (UTM) Zone19
   Datum: NAD83
   "Today's Date"

6. Activate the Select Elements tool. Select the newly created text frame and position the metadata to the lower center portion of the map.



7. Position the pointer outside the layout and click to deactivate the text frame.

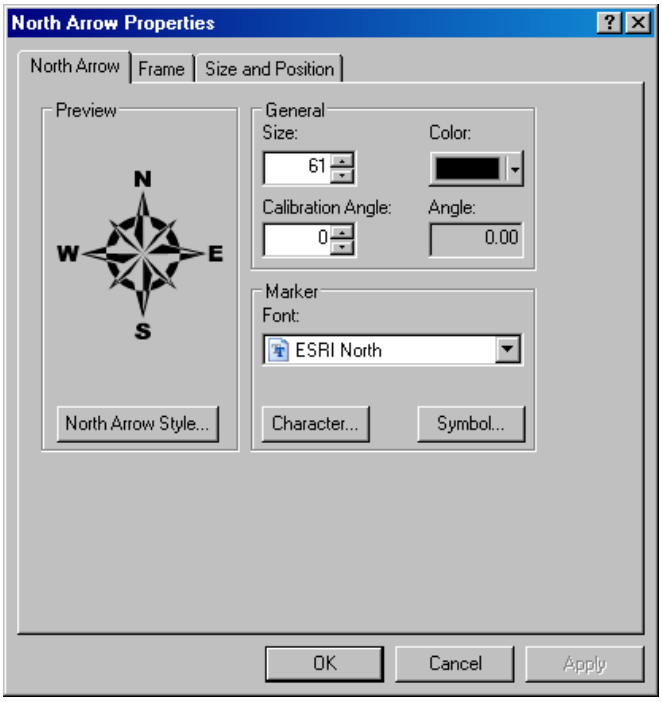
8. Click on the **Zoom Whole Page** button to see what you have created.

9. Resize and move the text again to a location where you feel appropriate.

SECTION 6 - North Arrows

The purpose of the North arrow is to orient the user with which way to face the map. When using ESRI templates a North Arrow and scale bar are automatically inserted into the layout. In this section, we will be deleting these and re-inserting new ones.

1. Using the **Select Elements tool**, click on the North Arrow to select it.
2. Press the **Delete** key.
3. Go to **Insert** on the **Main menu** and select **North Arrow**…the North Arrow Selector window appears.
4. Use the slider bar to view the various choices. Select a North Arrow you like.
5. Click **OK.**



✓*TIP: Like with all frame properties you can change the color, style and size of the selected north arrow.*

6. Grab the new arrow with the pointer tool and drag it to the lower right-hand corner of the map or any desired location.
7. Using the **Zoom In tool** on the Layout toolbar, zoom down to the lower right-hand corner of the map.

8. Select the North Arrow frame with the Select Elements tool. Grab any corner of the frame. Stretch out the box while holding down your left mouse key to resize the symbol to the desired size.

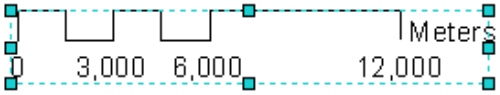
9. Click on the **Zoom Whole Page** button to see what you have created.

SECTION 7 - Manipulating Scale Bars

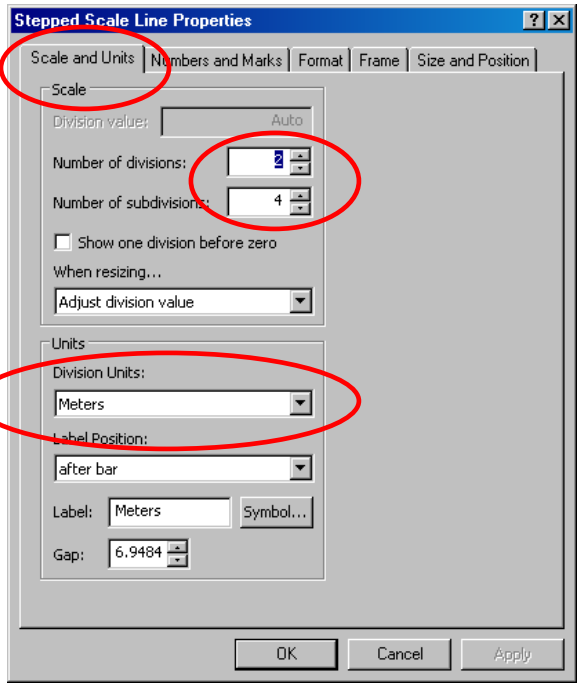
Another critical element of a map is the representative scale bar. The scale bar lets a user make measurements and gives them a sense of the "scale" or size of the map. When inserting a scale bar or editing an existing one, ArcMap will automatically adjust the scale bar according to the scale you choose or zoom to.

1. Zoom down on the scale bar to make it more visible.

2. Activate the **Select Elements** tool.



3. Double-click on the scale bar. The **Double Alternating Scale Bar Properties** window opens.



4. Click on the **Scale and Units** tab.

5. Change the Division Units to **"Miles."**

6. Click on the **Format** tab.

7. In the **Style** box use the pull-down arrow and select a scale bar style of your choice. Like the North Arrows, there are plenty of selections.

8. Click on the **Scale and Units** tab again. In the Scale area change the number of divisions and subdivisions of the scale bar to something different from the default setting – see what happens.

   Note: In the other tabs, you can change the scale bar style, color, font size and style. Feel free to experiment.

9. Click on **OK.**

10. Hold down the **Ctrl** key. Select the scale bar and then the data frame.

11. Right-click and select **Align** while still holding the pointer tool over the scale bar.

12. Select **Align Center**. Your scale bar is now perfectly aligned in the center of your page layout.

13. Note: these same align functions can be found on the Graphics toolbar.

14. Click on the **Zoom Whole Page** button to see your composition.

Quiz 4: How do you change/set the default settings for text?

STOP -PLEASE STOP HERE BEFORE GOING ON TO THE NEXT SECTION- STOP

SECTION 8 – Legends

Legends help identify the features within the map layout. They can be simple or complex depending on the detail of your map. ArcMap makes inserting and editing legends easy with their built in Legend Wizard. Notice a legend was automatically inserted since we selected a predefined template. Follow these steps to change the legend in our map:

1. Activate the **Zoom In** tool on the Layout toolbar. Zoom in to the area around the legend.

> ✓*TIP: The legend portrays only the layers that are drawn or checked in the table of contents of the Data View.*

2. Activate the **Select Elements tool**.

3. Double-click on the Legend. The Legend Properties window appears with four tabs.

4. The first tab is the **Legend** tab.

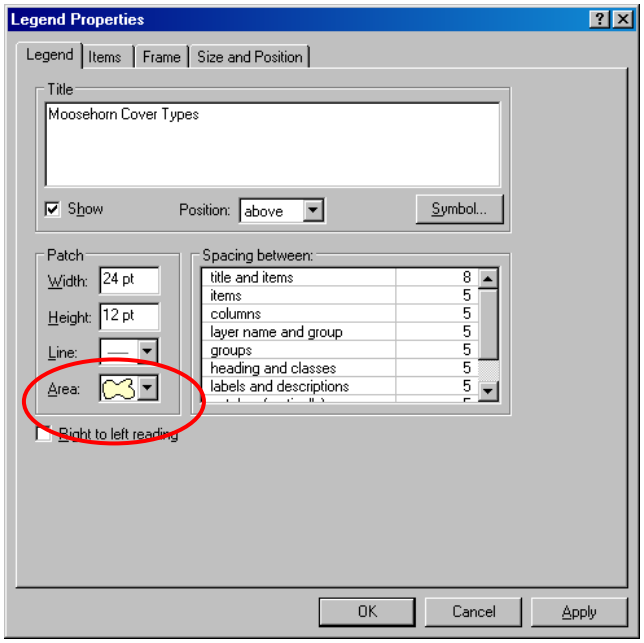
5. In the **Title** dialog box type in "Moosehorn NWR Covertypes."

6. In the **Patch** dialog section change the Area to **Natural Area**. The default is Rectangle.

7. Click on the **Items** tab.

8. In the **Legend Items** box remove all layers except **Cover_Type** using the left arrow button. See image on next page.

9. Select **Cover_Type** and change the number of columns to **3.**



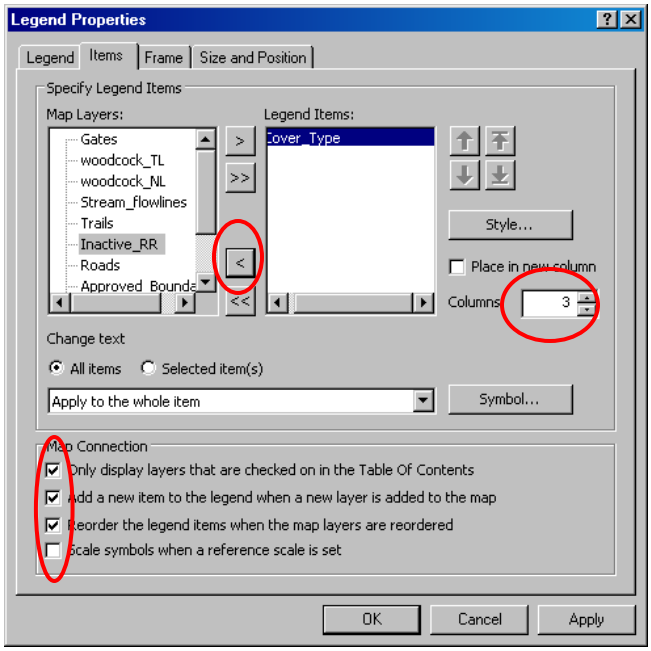
10. Make sure all the **Map Connections** are checked. Pay particular attention to the first item.

11. Click on the **Frame** tab.

12. Change the Border size to 1.0 (points) and leave the color as black. Leave the Background color and Drop Shadow as they are. You can always go back and change these if you wish.

13. Click on **OK.**

14. Select the revised legend frame.



15. Move the frame to a desired location and resize the frame if you wish.

16. Click on the **Zoom Whole Page** button on the Layout toolbar to see your composition.

✓*TIP: If you do not like the way the legend looks you can always go back and edit it by double clicking the legend frame to bring up the* ***Legend Properties****. Alternatively, you could delete the entire legend and insert a new one and start over.*

SECTION 9 - Inserting Graphics

Photographs and logos can be easily added to the Layout View using the **Insert** menu.

1. Go to **Insert** on the main menu located at the top of your screen and select **Picture**.

2. Navigate to ****CSP7100\Logos. Here you will find two **.gif** files: one is the U.S. Fish & Wildlife Service logo and the other is the Department of the Interior's 150th Anniversary logo.

3. Select the **FWSlogo.gif** file.

4. Click on **Open**. The FWS logo now appears on your map!

5. Select the image frame with the pointer.

6. Resize and move the logo to the upper right hand corner of the layout or to a location you feel appropriate.

7. Insert the Interior logo and place it in the location of your choice.

Quiz 5: Why would you want to convert the map legend to graphics? Hint: Select the legend and right click – right click rules!

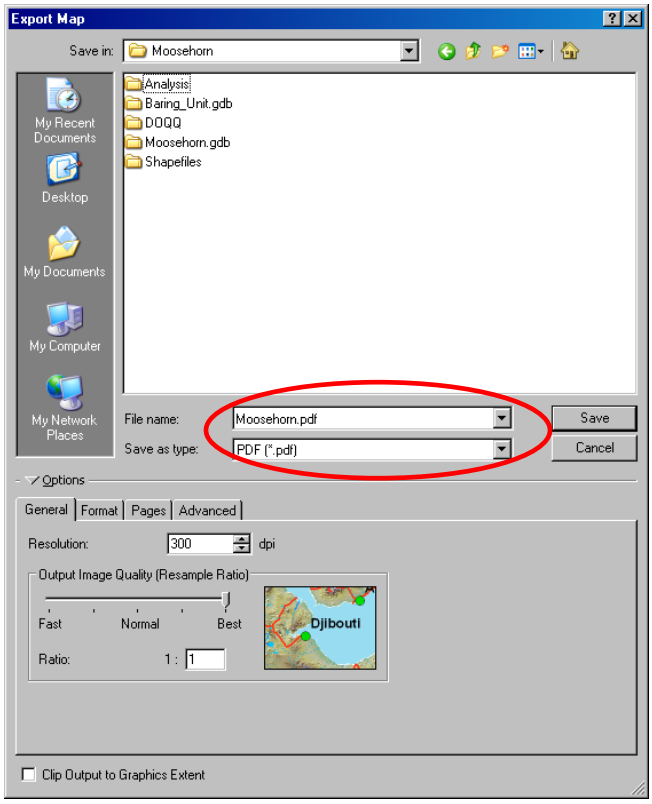
SECTION 10 – Saving and Exporting the Layout/Map

A layout can be saved and stored as part of the map document (*.mxd).

1. If you are happy with the way the layout looks, simply go up to **File** on the main menu and select **Save.** You can now exit the program if you wish and your layout will be saved. Note: you can only have **one layout per map document**.

   A layout can be exported as a separate file format (e.g., *.emf, *.jpg, *.pdf, *.tif) so it can be used in other graphic programs.

2. Select **Export Map** from the **File** pull down menu. The Export Map window appears.



3. Give the file a name in the “File name” dialog box.

4. Navigate to the folder where you wish to put the file.

5. Select **PDF** in the **Save as type** pulldown menu.

6. Click **Save** – Congratulations! You have just exported your Layout!

Notes:

Notes:

Final Project:

Create a map of the Moosehorn NWR showing the location of the most successful woodcock nests. Also include specific cover types, roads and unit boundary.

Given your affinity for roast woodcock, decide and plot where you'd locate your new business venture: a fried woodcock fast food restaurant. Be prepared to show and justify your decisions. In addition to the layers mentioned above your map must contain the following:

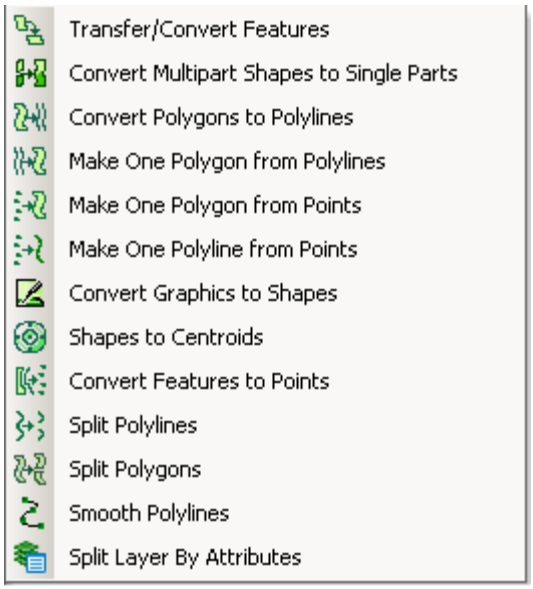
- ❑ Some type of query (definition or select by attributes) on the Woodcock nests (to isolate the most successful nests). Use unique symbology for the Woodcock nests (do not use the default). (Exercise 8, Sections 1-3 and Exercise 5, Section 3, 5)
- ❑ Definition query on Aspen-Birch Woodland & White Pine-Hemlock (Cover_Type). Use a unique color/fill scheme for the cover types (do not use the defaults). (Exercise 8, Section 3 and Exercise 5, Section 3)
- ❑ New point **feature class** representing the location of your new business. (Exercise 2, Section 4, Exercise 11, Section 1-2 and Exercise 13, Section 3)
- ❑ State of Maine (locator map) data frame in Lambert Conformal Conic, NAD83. (Exercise 3, Section 3)
- ❑ Several Text Labels. (Exercise 5, Section 7 OR Exercise 15, Section 5)
- ❑ Title - be creative! (Exercise 15, Section 4,5)
- ❑ Text box (your full name, date, datum and map projection of the primary map). (Exercise 15, Section 5)
- ❑ North Arrow. (Exercise 15, Section 6)
- ❑ Scale Bar. (Exercise 15, Section 7)
- ❑ Legend (showing only the layers visible in your map). (Exercise 15, Section 8)
- ❑ Graphic (USFWS logo or photo from the web). (Exercise 15, Section 9)
- ❑ Export your final map as a .PDF. Name the document after yourself

XTools Pro 7 for ArcGIS

XTools Pro 7 provides a suite of functionality to work with your geospatial data sets. The tool is categorized by types of functionality.

Below are some of the key functions.

Feature Conversion:



Transfer/Convert Features: Copy spatial features from one layer and paste them into another layer.

Convert Multipart Shapes to Single Parts: Changes features that are made up of multiple parts associated with one record into individual parts, each with its own record.

Convert Polygons to Polylines: Changes a polgon layer into a polyline (arc/line) layer.

Make One Polygon from Polylines: Creates a single polygon out of the polyline feature or selected features.

Make One Polygon from Points: Creates a single polygon from points or selected points.

Make One Polyline from Points: Creates a single polyline from points or selected points.

Convert Graphics to Shape: Creates a shapefile out of graphics or selected graphics.

Shapes to Centroids: Creates a point shapefile of the centroid of the polygon or polyline features.

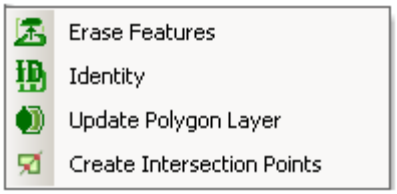
Convert Features to Points: Creates a point shapefile for the polygon or polyline layer. Can create points at an equidistance apart, x number of equidistant points, create points at all vertices, create points at the endpoints.

Split Polylines: Splits lines into smaller segments baed on various means: at vertices, specified lengths, specified number of segments, at intersections, by another layer.

Smooth Polylines: Smooths polylines based on two smoothing algorithms.

Split Layer by Attributes: Splits layers into separate datasets by attributes.

Layer Operations:



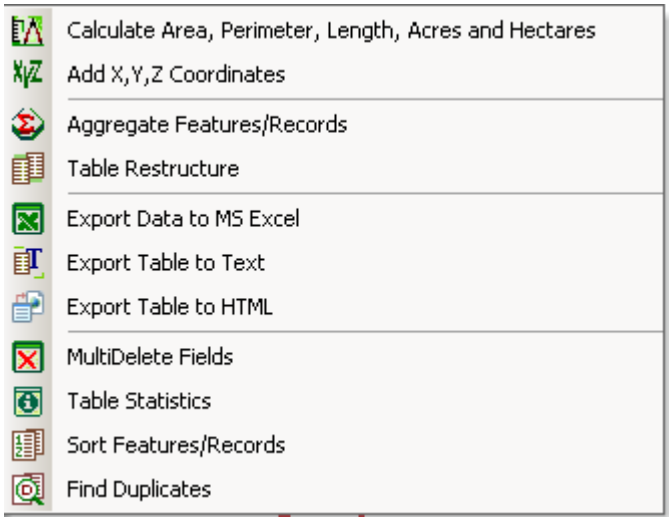
Erase Features: Removes/Cuts (erases) the region of a layer that falls within the overlay polygon layer. It works on points, lines, and polygons. Resultant layer is of features that fall outside of the overlay layer.

Identity: Conducts an Identity function on overlapping layers.

Update Polygon Layer: Creates a new polygon layer based on the overlay of two polygon layers. The overlay layer replaces the area it overlaps in the input layer.

Create Intersection Points: Intersects two input layers and outputs intersection points. Input layers can be polylines and polygons, if the same layer is used as both the input and intersection layers then self intersection points will be created.

Table Operations:



Calculate Area, Perimeter, Length, Acres and Hectares: Calculates or updates the area and perimeter of polygon features in the input layer. It calculates acres/hectares for the polygon features and length for line features.

Add X,Y,Z Coordinates: Adds x,y,z coordinates for features within the input layer. Coordinates based on layer's projection or another selected coordinate projection.

Aggregate Features/Records: Aggregates features or records based on specified parameters.

Table Restructure: Changes the structure of your attribute table.

Export Data to MS Excel: Exports your attribute table into an MS Excel spreadsheet.

Export Table to Text: Exports attribute tables or standalone tables to text files

Export Table to HTML: Exports an attribute table or standalone table to HTML format

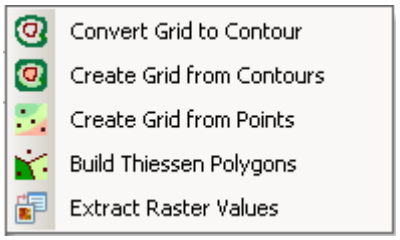
MultiDelete Fields: Allows you to delete multiple fields within an attribute table at one time.

Table Statistics: Runs suite of statistics on the selected fields of your attribute table.

Sort Features/Records: Performs a permanent sort of features/records in an attribute table.

Find Duplicates: Finds duplicate features/records within an attribute or standalone table.

Surface Tools:



Convert Grid to Contour: Allows you to take a GRID and change it into a contour layer (isolines).

Create Grid from Contours: Creates a GRID from contours (isolines).

Create Grid from Points: Creates Grid raster models from points using Spline methods. The tool is provided for interpolating any Grids (not only DEMs).

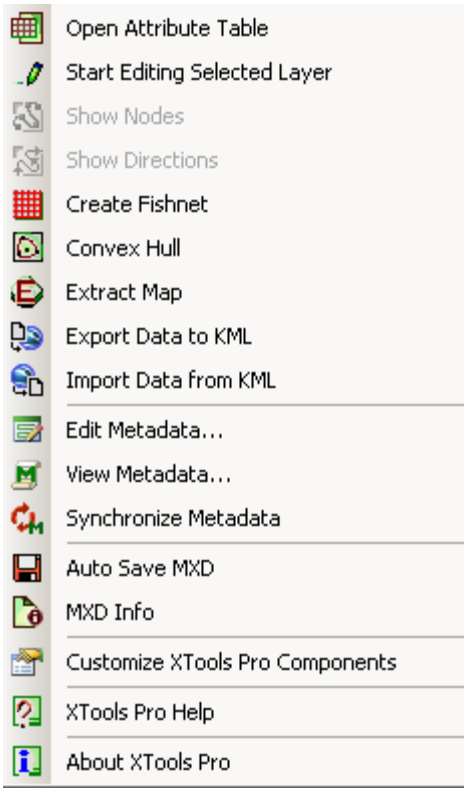
Build Thiessan Polygons: Builds Thiessan polygons based on point layer.

Extract Raster Values: Extracting input raster values at the existing points as the points attributes.

Go to Operations:

Go to tools: Allows you to view your current map location displayed in the ArcMap data frame in the online maps services Microsoft Bing Maps and Google Maps, and in the Google Earth or ArcGIS Explorer desktop applications.

Additional Tools:



Open Attribute Table: Opens the attribute table for the selected layer.

Start Editing Selected Layer: Places selected layer in edit mode.

Show Nodes: Displays the nodes for the features within the selected layer.

Show Directions: Toggles on and off direction arrows for the direction of arcs within a polyline or polygon layer

Create Fishnet: Creates a fishnet that is used for 3-D draping of layers

Convex Hull: Creates convex hulls for specified layer

Extract Map: Clips all the layers within specified parameters, makes copies of the layers and saves to specified folder.

Export Data to KML: Import data from .kml/.kmz files.

Import Data from KML: Import data from .kml/.kmz

Edit Metadata: Allows for creating and editing advanced and custom metadata directly in ArcMap.

View Metadata: View metadata for the selected layer.

Synchronize Metadata: In case you've made some changes in the data and wish that your data and metadata match, you can always synchronize them by pressing the "Synchronize metadata with data" button on the toolbar.

Auto Save MXD: Auto save .mxd map documents

MXD Info: View information about MXC documents without actually opening them in ArcMap

Customize XTools Pro Components: This where you register your copy of XTools Pro and customize the available tools. ***USFWS employees only:*** Go to our GIS intranet (https://intranet.fws.gov/region9/data/GIS/index.html) select XTools Pro Global License Information. Then click on “Download the FWS Global License and follow the directions to register your copy” to obtain the registration information.

XTools Pro Help: Brings up Online Help documentation for XTools Pro.

About XTools Pro: Give information on the version of XTools Pro you are running.