BANGLADESH METEOROLOGICAL DEPARTMENT

LOCAL TRAINING

MODULE 7: GEOGRAPHICAL INFORMATION SYSTEMS (GIS)

Project: Strengthening Meteorological Information Services and Early Warning Systems (Component-A)

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Aims and objectives:

- To provide delegates with an appreciation of the fundamental concepts of GIS including its strengths and limitations.
- To introduce the core functionality of ESRI's ArcGIS software package.
- To teach the fundamental skills needed to obtain, import, manipulate, analyse, interpret, manage and output spatial data in order to investigate topics in the delegate's area of interest.
- To demonstrate real-world uses of GIS.

Delivery and Description:

Methodology:

This module is designed in such a way that the participants get explicit idea regarding the GIS terms and concepts. Besides, we also wish that the participants will be enhance their official works. To achieve this objective, we have made the sessions based on the most important topics of GIS that are used in everyday life. We have included sufficient practical exercises to ensure that the participants not only learn how to use GIS, but they can also implement them.

Key learning outcomes:

By the end of the course, delegates will have a knowledge and understanding of:

- What a GIS is, what spatial data is, raster and vector data models
- The core tasks involved in a GIS analysis e.g. data acquisition and input, data storage and management, data manipulation and analysis; and data presentation and output
- The core functionality of ArcMap, ArcCatalog and the embedded ArcToolbox
- Importing data from various sources, including scanned paper maps
- Handling tables including selections and queries
- Georeferencing raster images
- Creating and editing spatial data
- The steps required to produce paper maps from base data
- Basic geoprocessing tasks e.g. buffering and clipping

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SESSION 1: INTRODUCTION TO GIS

1.1 What is GIS?

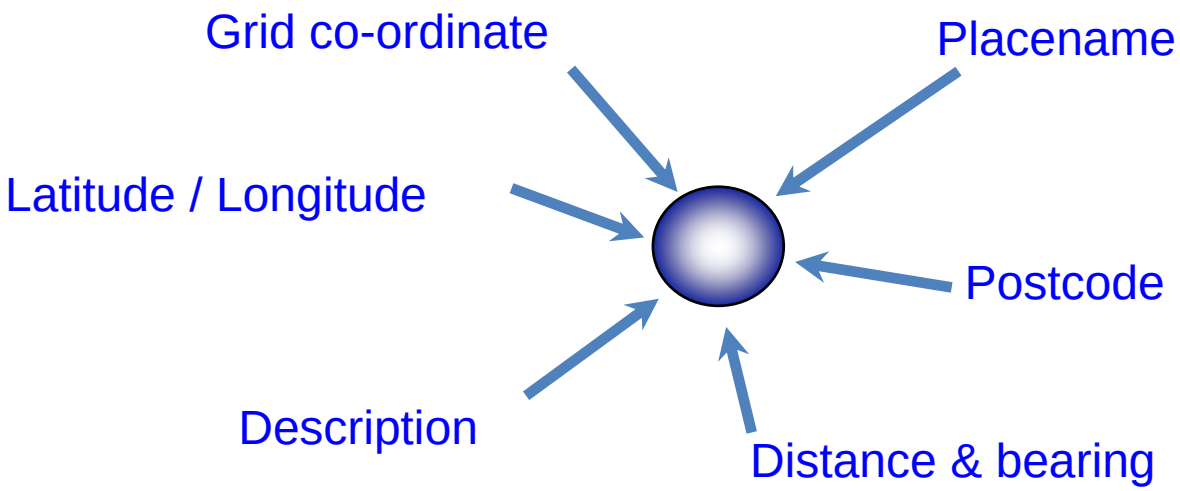
Everything we experience from day to day happens somewhere in geographic space. As a result, we can represent our world and our experiences in it by using maps. We use those maps to find places, save time while traveling, decide where to locate a new store, plan cities, guide the development of wildlife preserves, and satisfy hundreds of other applications. In this day of digitized everything, the maps we use to represent the world reside inside the computer, and we now have at our fingertips the ability to search those maps, find objects and routes, and plan related activities. The computer systems that enable us to store and access all this information are collectively called geographic information systems (GIS). GIS uses special information about what is where on the Earth's surface. It is an information handling strategy about modeling and mapping places and things to assist people in better decision making.

ESRI (2006) defines GIS as a "collection of computer hardware, software, and geographic data for capturing, managing, analyzing, and displaying all forms of geographically referenced information." GIS is a computer program used for storing, retrieving, analyzing, and displaying data – it can combine two or more kinds of information or databases. It allows information in stored databases to be worked with. A GIS database has data about the locations and shapes of geographic features. These can be recorded as points, lines, polygons, etc.

1.2 What is Spatial Data?

Spatial data have spatial reference: they have coordinated values and a system of reference for these coordinates. As a simple example, consider the locations of volcano peaks on the Earth. We could list the coordinates for all known volcanoes as pairs of longitude/latitude decimal degree values with respect to the prime meridian at Greenwich and zero latitude at the equator. The World Geodetic System (WGS84) is a frequently used representation of the Earth.

Following things make a data spatial.



1.3 GIS Data Types and Model

Geographic data commonly represented in two formats. These are___

- Vector formats
- Raster formats

Vector Formats

Hardware Specific Formats

There are two types of formats, those that preserve and use the actual ground coordinates of the data and those that use alternative page coordinate description of the map. Page Coordinates are used when a map is being drafted for display in a computer-mapping program or in the data display module. In the late 1970s, programs came out that were device independent.

The Hewlett-Packard Graphics Language (HPGL) is a page description language designed for use with plotters and printers. Each line of the file contains one move command, so a line segment connects two successive lines or points. It is unstructured and does not store or use topology.

PostScript

PostScript is a page definition language that is usually used to export or print a map rather than data. It supports graphics in both vector and raster formats. Postscript is used commonly by Adobe, and most printers are able to read it.

Digital Exchange Format (DXF)

DXF is an external format for transferring files between computers or between software packages. It is produced by Autocad. It does not have topology, but offers good detail on drawings, line widths and styles, colors, and text. DXF is typically constructed in 64 layers. Each layer consists of different features; allowing the user to separate features.

Omaha Public Power District uses this kind of software. It is a turn-key system with street and power line layers. The problem is that you can not tell what street the power line is on or closest to because it lacks topology and spatial analysis.

Digital Line Graph (DLG)

DLGs are distributed by the government, and are available at 1:100,000 and 1:24,000 scales. Features are in separate files that most GIS packages will import, although extra data manipulation is often necessary. DLGs consist of line work with the contours removed, therefore elevation is not available.

TIGER

TIGER format was first distributed by the US. Census Bureau in 1990. It includes block level maps of every village, town, and city in the United States. It includes geocoded block faces with address ranges of street numbers. This means than that they include topology and can address match. The maps are a combination of DLG and DBF/DIME files. They used the 1980 Census Bureau's maps along with the USGS's DLG maps, thus combining urban and nonurban areas.

TIGER consist of an arc/node type arrangement with separate files for points (zero cells), lines (one cells) and areas (two cells) that are linked together by cross-indexing. Cross-indexing means some features can be encoded as landmarks that allow GIS layers to be tied together.

Shapefile

A shapefile is a vector data 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.

Scalable Vector Graphics

An SVG is an image that is an extension of the XML language. Any program that recognizes XML can display the SVG image. The scalable part of the term emphasizes that you can zoom- in on an image and not lose resolution. SVG files also have the advantages of being smaller, and arriving faster, than conventional image files such as GIF, PDF, and JPEG.

Arc-Info Coverage

This is a data model for storing geographic features using ArcInfo software. A coverage stores a set of thematically associated data considered to be a unit. It usually represents a single layer, such as soils, streams, roads, or land use. In a coverage, features are stored as both primary features (points, arcs, polygons) and secondary features (tics, links, annotation). Feature attributes are described and stored independently in feature attribute tables. Coverages cannot be edited in ArcGIS.

Arc-Info Interchange File (.e00)

An ArcInfo interchange file, also known as an export file, is a file format used to enable a coverage, grid or TIN and an associated INFO table to be transferred between different machines. ArcInfo interchange files have a .e00 extension, which increments to .e01, .e02, and so on, if the interchange file is composed of several separate files.

GeoDatabase

A geo-database is an object-oriented data model that represents geographic features and attributes as objects and the relationships between objects but is hosted inside a relational database management system. A geodatabase can store objects, such as feature classes, feature data sets, nonspatial tables, and relationship classes.

1.4 Raster Formats

Standard Raster Format

Many of the formats are based on photographic formats. The file structure has a header with a fixed length and a keyword or "magic number" to identify the format. In the header the length of one record in bits and the number of rows and columns can be found. Often the header also has a color table. This explains what colors to project.

Tagged Image File Formats (TIFF)

This format is associated with scanners. It saves the scanned images and reads them. TIFF can use run length and other image compression schemes. It is not limited to 256 colors like a GIF.

GEO-TIFF

As part of a header in a TIFF format, it puts Lat/Long at the edges of the pixels.

Graphic Interchange Format (GIF)

Graphic Interchange Format. A file format for image files, commonly used on the Internet. It is well-suited for images with sharp edges and relatively few gradations of color.

Joint Photograph Experts Group (JPEG)

JPEG is a common picture format. It uses a variable-resolution compression system offering both partial and full resolution recovery.

DEM

Digital Elevation Models or DEM have two types of displays. The first is 30-meter elevation data from 1:24,000 seven-and-a-half minute quadrangle map. The second is the 1:250,000 3 arc-second digital terrain data. DEMs are produced by the National Mapping Division of USGS.

Band Interleaved by Pixel (BIP), Band Interleaved by Line (BIL)

BIP and BIL are formats produced by remote sensing systems. The primary difference among them is the technique used to store brightness values captured simultaneously in each of several colors or spectral bands.

RS Landsat

Landsat satellite imagery and BIL information are used in RS Landsat. In one format, using BIL, pixel values from each band are pulled out and combined. Programs that use this kind of information include IDRISI, GRASS, and MapFactory. It is easy to exchange information from within these raster formats.

1.5 GIS layers/ Mapping in layer

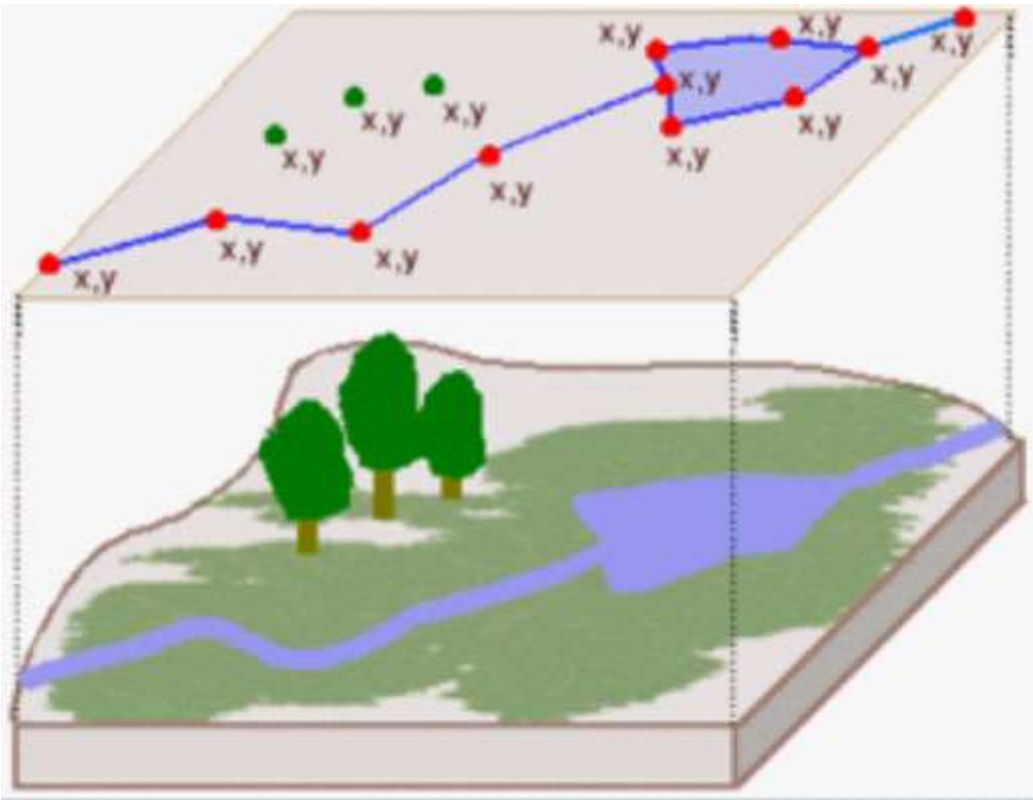


Fig 1.1: Representing real world features in point, line and polygon

Any object or features of real world can be presented in three common forms:

Points

- A point is a 0 dimensional object and has only the property of location (x,y)
- Points can be used to Model features such as a well, building, power, pole, sample location etc.
- Other names for a point are vertex, node, 0-cell

Lines

- A line is a one-dimensional object that has the property of length
- Lines can be used to represent road, streams, faults, dikes, maker beds, boundary, contacts etc.
- Lines are also called an edge, link, chain, arc, 1-cell
- In an ArcInfo coverage an arc starts with a node, has zero or more vertices, and ends with a node

Polygons

- A polygon is a two-dimensional object with properties of area and perimeter
- A polygon can represent a city, geologic formation, dike, lake, river, etc.
- Other name for polygons face, zone 2-cell
- Scale matters

1.6 Coordinate Systems and Projections

Latitude and longitude define location on the Earth's surface in terms of angles with respect to well-defined references: The Royal Observatory at Greenwich, the center of mass, and the axis of rotation. As such, they constitute the most comprehensive system of georeferencing, and support a range of forms of analysis, including the calculation of distance between points, on the curved surface of the Earth. But many technologies for working with geographic data are inherently flat, including paper and printing, which evolved over many centuries long before the advent of digital geographic data and GIS. For various reasons, therefore, much work in GIS deals with a flattened or projected Earth, despite the price we pay in the distortions that are an inevitable consequence of flattening. Specifically, the Earth is often flattened because:

- paper is flat, and paper is still used as a medium for inputting data to GIS by scanning or digitizing and for outputting data in map or image form
- rasters are inherently flat, since it is impossible to cover a curved surface with equal squares without gaps or overlaps; photographic film is flat, and film cameras are still used widely to take images of the Earth from aircraft to use in GIS
- when the Earth is seen from space, the part in the center of the image has the most detail, and detail drops off rapidly, the back of the Earth being invisible; in order to see the whole Earth with approximately equal detail it must be distorted in some way, and it is most convenient to make it flat

The Cartesian coordinate system (Figure 1.2) assigns two coordinates to every point on a flat surface, by measuring distances from an origin parallel to two axes drawn at right angles. We often talk of the two axes as x and y, and of the associated coordinates as the x and y coordinate, respectively. Because it is common to align the y-axis with North in geographic applications, the coordinates of a projection on a flat sheet are often termed easting and northing.

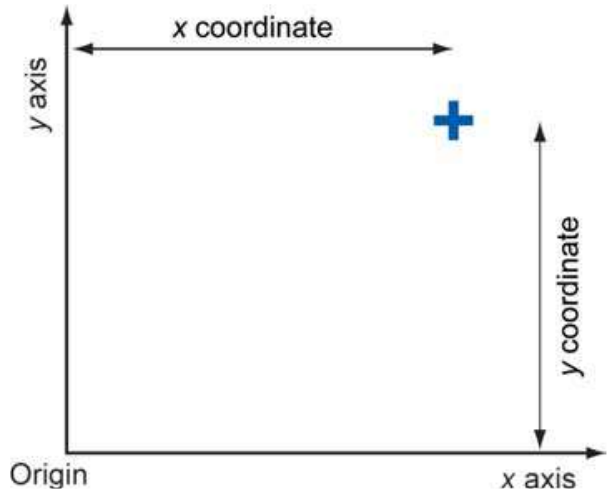


Figure 1.2 A Cartesian coordinate system, defining the location of the blue cross in terms of two measured distances from the Origin, parallel to the two axes

Although projections are not absolutely required, there are several good reasons for using them in GIS to flatten the Earth. One way to think of a map projection, therefore, is that it transforms a position on the Earth's surface identified by latitude and longitude (φ, λ) into a position in Cartesian coordinates (x, y). Every recognized map projection, of which there are many, can be represented as a pair of mathematical functions.

Many of these functions have been implemented in GIS, allowing users to work with virtually any recognized projection and datum, and to convert easily between them. Two datasets can differ in both the projection and the datum, so it is important to know both for every data set.
Projections necessarily distort the Earth, so it is impossible in principle for the scale of any flat map to be perfectly uniform, or for the pixel size of any raster to be perfectly constant. But projections can preserve certain properties, and two such properties are particularly important, although any projection can achieve at most one of them, not both:

- the conformal property, which ensures that the shapes of small features on the Earth's surface are preserved on the projection: in other words, that the scales of the projection in the x and y directions are always equal
- the equal area property, which ensures that areas measured on the map are always in the same
- proportion to areas measured on the Earth's surface.

The conformal property is useful for navigation, because a straight line drawn on the map has a constant bearing (the technical term for such a line is a loxodrome). The equal area property is useful for various kinds of analysis involving areas, such as the computation of the area of someone's property. Besides their distortion properties, another common way to classify map projections is by analogy to a physical model of how positions on the map's flat surface are

related to positions on the curved Earth. There are three major classes (Figure 5.12):

- cylindrical projections, which are analogous to wrapping a cylinder of paper around the Earth, projecting the Earth's features onto it, and then unwrapping the cylinder
- azimuthal or planar projections, which are analogous to touching the Earth with a sheet of flat paper
- conic projections, which are analogous to wrapping a sheet of paper around the Earth in a cone

In each case, the projection's aspect defines the specific relationship, e.g., whether the paper is wrapped around the Equator, or touches at a pole. Where the paper coincides with the surface the scale of the projection is 1, and where the paper is some distance outside the surface the projected feature will be larger than it is on the Earth. Secant projections attempt to minimize distortion by allowing the paper to cut through the surface, so that scale can be both greater and less than 1 (Figure 1.3; projections for which the paper touches the Earth and in which scale is always 1 or greater are called tangent).

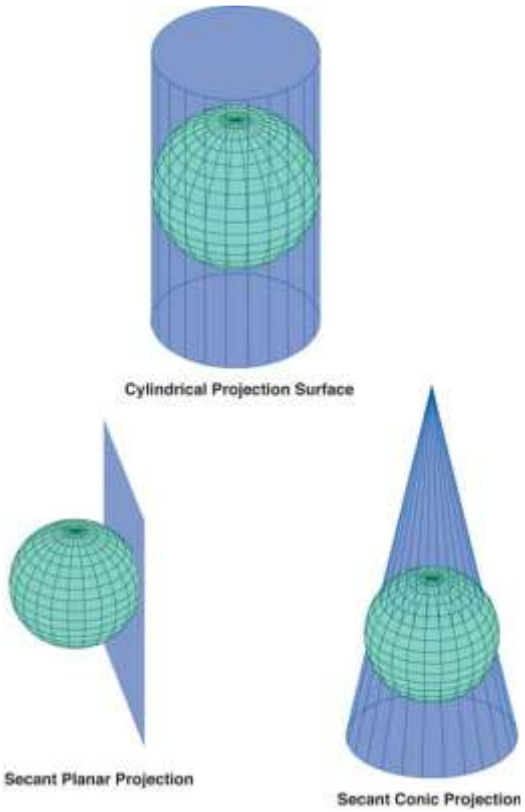


Figure 1.3 The basis for three types of map projections – cylindrical, planar, and conic. In each case a sheet of paper is wrapped around the Earth, and positions of objects on the Earth's surface are projected onto the paper. The cylindrical projection is shown in the tangent case, with the paper touching the surface, but the planar and conic projections are shown in the secant case, where the paper cuts into the surface

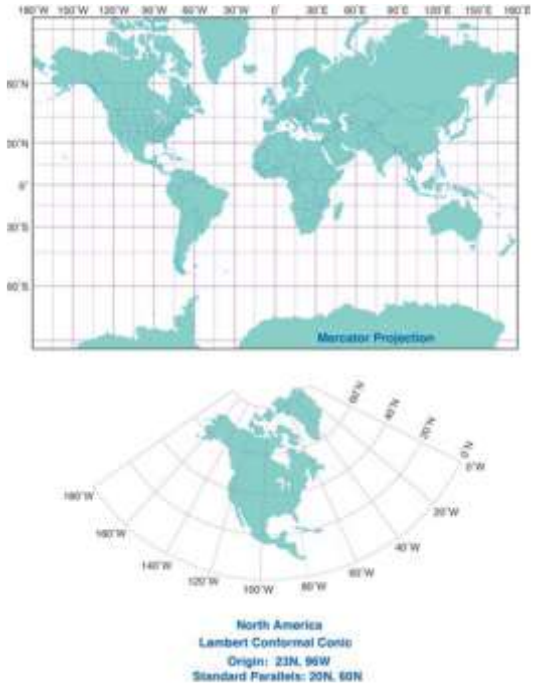


Figure 1.4 Examples of some common map projections. The Mercator projection is a tangent cylindrical type, shown here in its familiar Equatorial aspect (cylinder wrapped around the Equator). The Lambert Conformal Conic projection is a secant conic type. In this instance, the cone onto which the surface was projected intersected the Earth along two lines of latitude: 20 North and 60 North

All three types can have either conformal or equal area properties, but of course not both. Figure 1.4 shows examples of several common projections and shows how the lines of latitude and longitude map onto the projection, in a (distorted) grid known as a graticule.

SESSION 2: INTRODUCTION TO ARCVIEW

GIS software is the processing engine and a vital component of an operational GIS. It is made up of integrated collections of computer programs that implement geographic processing functions. The three key parts of any GIS software system are the user interface, the tools (functions), and the data manager. All three parts may be located on a single computer or they may be spread over multiple machines in a departmental or enterprise configuration. Four main types of computer system architecture configurations are used to build operational GIS implementations: *desktop, client-server, centralized desktop and centralized server*. The market leading commercial GIS software vendors are ESRI, Intergraph, Autodesk, and GE Energy (Smallworld).

2.1 ArcView- Some History

ArcView started as a graphical program for spatial data and maps made using ESRI's other software products. Over time more and more functionality was added to ArcView and it became a real GIS program capable of complex analysis and data management. Its simple GUI was preferred by many over the less user friendly, more powerful ARC/INFO.

ArcView 1.0 was released in 1995 to provide access to GIS for non-traditional users of the technology. ESRI's flagship professional GIS at the time, Arc/INFO, was based on a command line interface and was not accessible to users that only needed view and query capability. The release did not support Shapefiles at the time.

ArcView 1 was very popular, and ESRI promised a more functional 2.x version of the product. This product was developed using a multi-platform windowing environment called Neuron Data, which allowed the product to be supported on the increasingly popular Windows 95 and Windows 2000, UNIX, and Mac OS 9 platforms. This product, when finally released (18 months after its initial release date) was very successful for ESRI and brought GIS technology to many people who had not used it before.

ArcView 3.x included even more full-featured GIS functionality, including a geoprocessing wizard and full support of extensions for raster and 3d processing. It was eventually renamed "ArcView GIS" by ESRI.

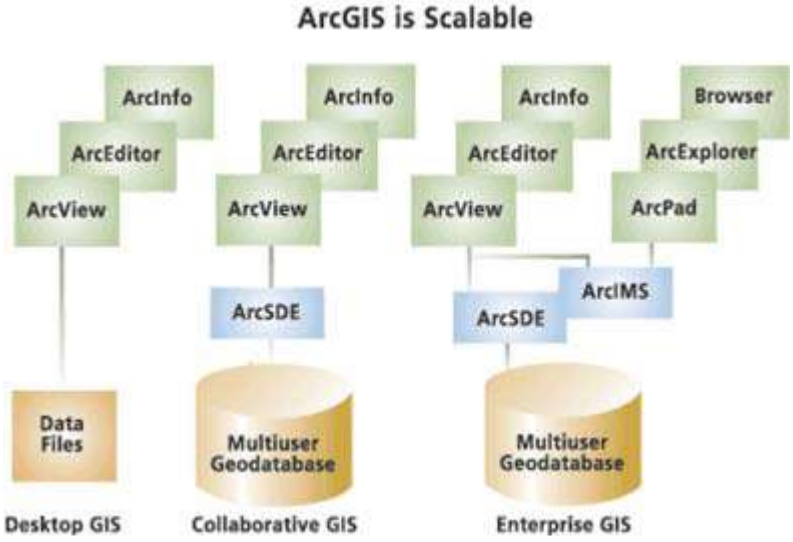
In 1997, ESRI released its final version supporting Mac OS9 (3.0a). It is still available, although it only runs on older (PowerPC-based) Mac systems, under Mac OS9. The last release of ArcView GIS was version 3.3 (May 22, 2002), and was offered for both Unix and Windows variants. The release cannot be installed on Windows Vista or later versions. It can be installed/copied from an Windows XP machine to Vista and Windows 7.

2.2 ArcGIS Family

ArcWhatever: A Short Explanation of Some ESRI Products

ArcGIS is a complete, single, integrated system for geographic data creation, management, integration, and analysis. ArcGIS is scalable since it can be deployed on an individual desktop or across a globally distributed network of people. ArcGIS Desktop refers to a suite of four integrated core applications: ArcReader, ArcView, ArcEditor and ArcInfo.

- The ArcGIS Desktop products (ArcView, ArcEditor, and ArcInfo) are Internet-enabled and can seamlessly integrate data from any ArcIMS server for analysis with local data.
- Organizations deploy the software and extensions of ArcGIS, ArcView, ArcEditor, ArcInfo, ArcSDE, and ArcIMS in a configuration appropriate for their needs.



Complete GIS

- *ArcReader* is a free, easy-to-use product that allows anyone to view, explore, and print published map files.
- *ArcView* includes all the functionality of ArcReader and provides data visualization, query, analysis, and integration capabilities along with the ability to create and edit simple geographic features.
- *ArcEditor* is the complete GIS desktop system for editing and managing geographic data. ArcEditor is a member of the ArcGIS family of GIS products and includes all the functionality of ArcView in addition to comprehensive GIS edit tools.
- *ArcInfo* is the most complete and extisible GIS available. It includes all the functionality of Arcview and ArcEditor and add advanced geoprocessing and data conversion capabilities. Professional GIS users use ArcInfo for all aspects of data building, modeling, analysis, and map display for screen and output.
- ArcSDE is a server software product used to access massively large multiuser geographic databases stored in relational database management systems (RDBMSs). It is an integrated part of ArcGIS and a core element of any enterprise GIS solution.
- ArcIMS is the solution for delivering dynamic maps and GIS data and services via the Web.
- ArcPad software is mobile mapping and geographic information system (GIS) technology.

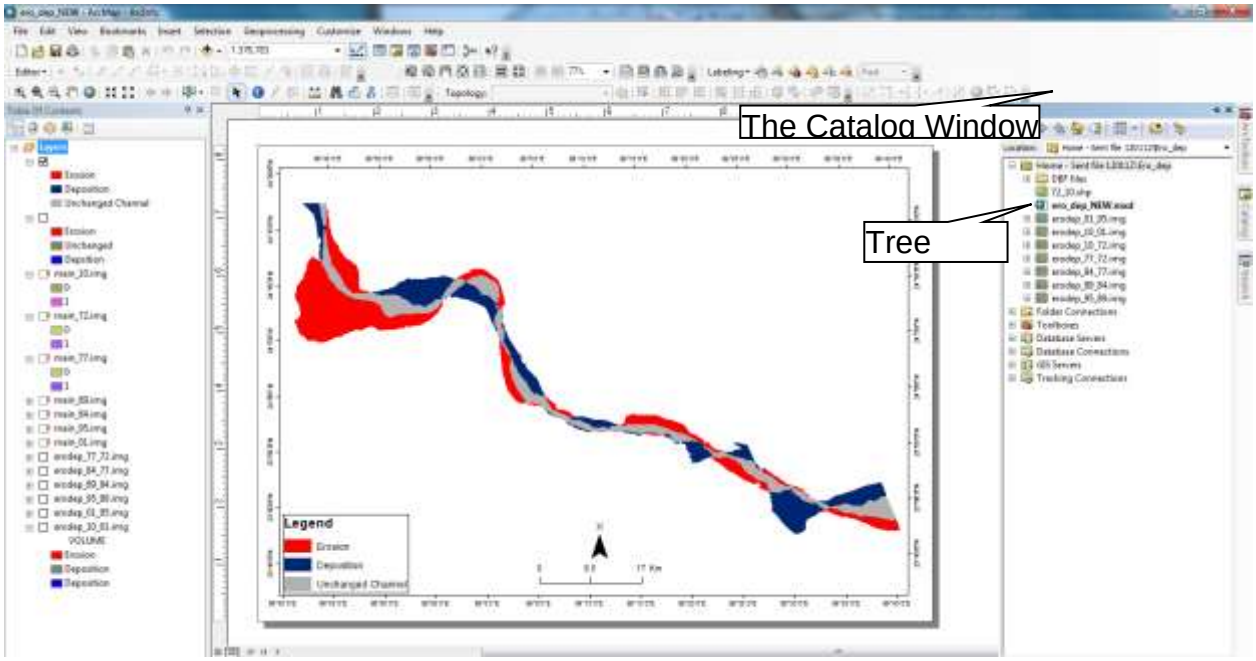
ArcCatalog

ArcGIS applications include a catalog window that is used to organize and manage various types of geographic information as logical collections—for example, the data, maps, and results of your current GIS project that you work with in ArcGIS. These include the following:

- Geodatabases
- Raster files
- Map documents, globe documents, and layer files
- Geoprocessing toolboxes

- GIS services published using ArcGIS Server
- Standards-based metadata for geographic datasets

The Catalog window provides a tree view of file folders and geodatabases. File folders are used to organize your ArcGIS documents and files. Geodatabases are used to organize your GIS datasets.

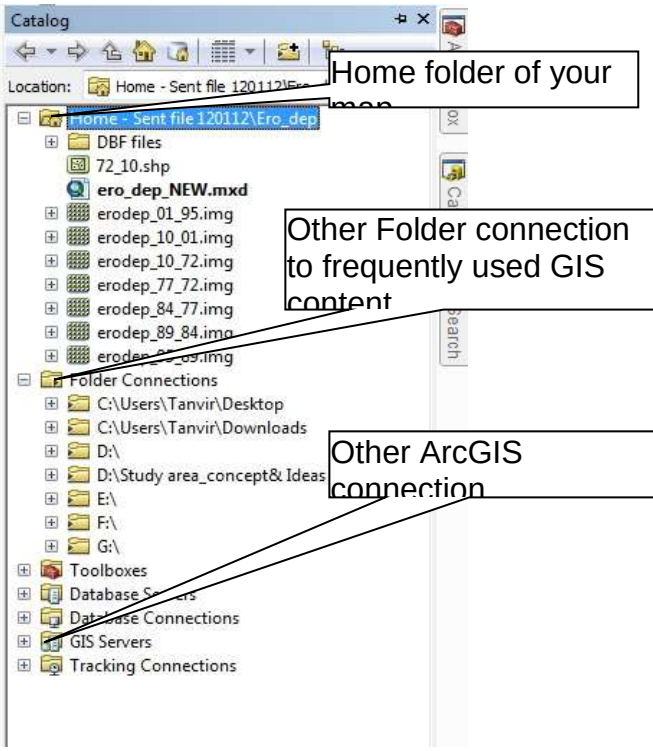


The Catalog window provides tools to accomplish the following:

- Browse and find geographic datasets to add to your map.
- Record, view, and manage datasets and ArcGIS documents.
- Search for and discover GIS data on local networks and the Web.
- Define, export, and import geodatabase data models and datasets.
- Create and manage the schemas of geodatabases.
- Add connection to and administer ArcSDE geodatabases.
- Add connection to and administer an ArcGIS server.
- You can work with the Catalog window in ArcMap, ArcGlobe, and ArcScene.

Working with the tree view in the Catalog window

Using the tree view in the Catalog window is much like using Windows Explorer, except the Catalog window focuses on viewing and working with GIS information. It shows you a list of folder connections, geodatabases, and GIS services. You can use the Location control as well as the tree view to navigate to workspace folders and geodatabases.



In the Catalog window, you'll see your GIS contents organized in a tree view series of nodes—for the map's Home folder, other folder connections containing GIS contents you frequently use, and other types of ArcGIS connections.

2.3 ArcMap

This section provides an introduction and overview to ArcMap, which is the central application used in ArcGIS. ArcMap is where you display and explore GIS datasets for your study area, where you assign symbols and where you create map layouts for printing or publication. ArcMap is also the application you use to create and edit datasets.

ArcMap represents geographic information as a collection of layers and other elements in a map. Common map elements include the data frame containing map layers for a given extent plus a scale bar, north arrow, title, descriptive text, a symbol legend, and so on.

Typical tasks performed in ArcMap

ArcMap is the primary application used in ArcGIS and is used to perform a wide range of common GIS tasks as well as specialized, user-specific tasks. Here is a list of some common workflows you can perform:

- *Work with maps*—You can open and use ArcMap documents to explore information, navigate around your map documents, turn layers on and off, query features to access the rich attribute data that is behind the map, and to visualize geographic information.
- *Print maps*—You can create maps, from the simplest to very sophisticated print-quality cartography, using ArcMap.
- *Compile and edit GIS datasets*—ArcMap provides one of the primary ways that users automate geodatabase datasets. ArcMap supports scalable full function editing. You select layers in the map document to edit and the new and updated features are saved in the layer's dataset.
- Use geoprocessing to automate work and perform analysis—GIS is both visual and analytical. ArcMap has the ability to execute any geoprocessing model or script as well as to view and work with the results through map visualization. Geoprocessing can be used for analysis as

well as to automate many mundane tasks such as map book generation, repairing broken data links in a collection of map documents, and to perform GIS data processing.

- *Organize and manage your geodatabases and ArcGIS documents*—ArcMap includes the Catalog window that enables you to organize all of your GIS datasets and geodatabases, your map documents and other ArcGIS files, your geoprocessing tools, and many other GIS information sets. You can also set up and manage geodatabase schemas in the Catalog window.
- *Publish map documents as map services using ArcGIS Server*—ArcGIS content is brought to life on the web by publishing geographic information as a series of map services. ArcMap provides a simple user experience for publishing your map documents as map services.
- *Share maps, layers, geoprocessing models, and geodatabases with other users*—ArcMap includes tools that make it easy to package and share GIS datasets with other users. This includes the ability to share your GIS maps and data using ArcGIS online.
- *Document your geographic information*—A key goal in GIS communities is to describe your geographic information sets to help you document your projects and for more effective search and data sharing. Using the Catalog window, you can document all of your GIS contents. For organizations who use standards-based metadata, you can also document your datasets using the ArcGIS metadata editor.
- *Customize the user experience*—ArcMap includes tools for customization, including the ability to write software add-ins to add new functionality, to simplify and streamline the user interface, and to use geoprocessing for task automation.

2.4 ArcToolbox

In any ArcGIS Desktop application, you open the ArcToolbox window with the Show/Hide ArcToolbox Window button found on the standard toolbar or by clicking Geoprocessing > ArcToolbox.

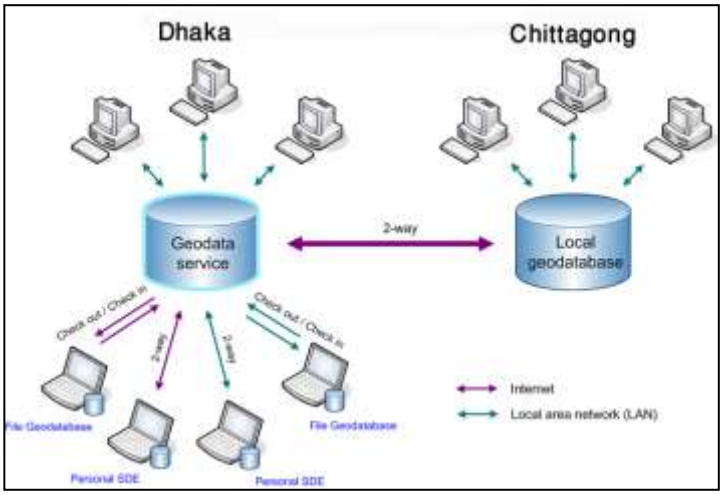
ArcGIS.com

ArcGIS.com (www.ArcGIS.com) is a Web site for working with online GIS maps and applications. It includes

- A gallery of ready-to-use Web maps and applications, published by ESRI and the ArcGIS community, that you can use in your Web browser and on mobile devices without having to download special GIS software
- A browser-based map viewer that you can use to create and share your own Web maps
- A way for user communities and groups to organize and share information
- Free ArcGIS Web APIs for JavaScript, Flex, and Silverlight for use by Web developers
- The ArcGIS.com Web site is where professional GIS users share information with all kinds of Web GIS users. The professional GIS community uses ArcGIS Desktop and Server to create and publish rich maps and geographic information services that are mashed up and referenced in Web maps. They can share their Web maps online with the ArcGIS community.

Many ArcGIS professionals create and share their maps and geographic information using ArcGIS.com. This enables the ArcGIS community to include anyone with Web access to discover and use this shared content. No software is required to use ArcGIS.com—just a Web connection. If you can use a consumer Web map (like Google Maps or Bing Maps), you can use and apply ArcGIS.com.

This is the hub Web site where you can register, discover, use, and mash up ArcGIS maps and services.



2.5 GeoDatabases

The geodatabase is a "container" used to hold a collection of datasets. There are three types:

1. *File geodatabases*—Stored as folders in a file system. Each dataset is held as a file that can scale up to 1 TB in size. The file geodatabase is recommended over personal geodatabases.
2. *Personal geodatabases*—All datasets are stored within a Microsoft Access data file, which is limited in size to 2 GB.
3. *ArcSDE geodatabases*—Stored in a relational database using Oracle, Microsoft SQL Server, IBM DB2, IBM Informix, or PostgreSQL. These multiuser geodatabases require the use of ArcSDE and can be unlimited in size and numbers of users.

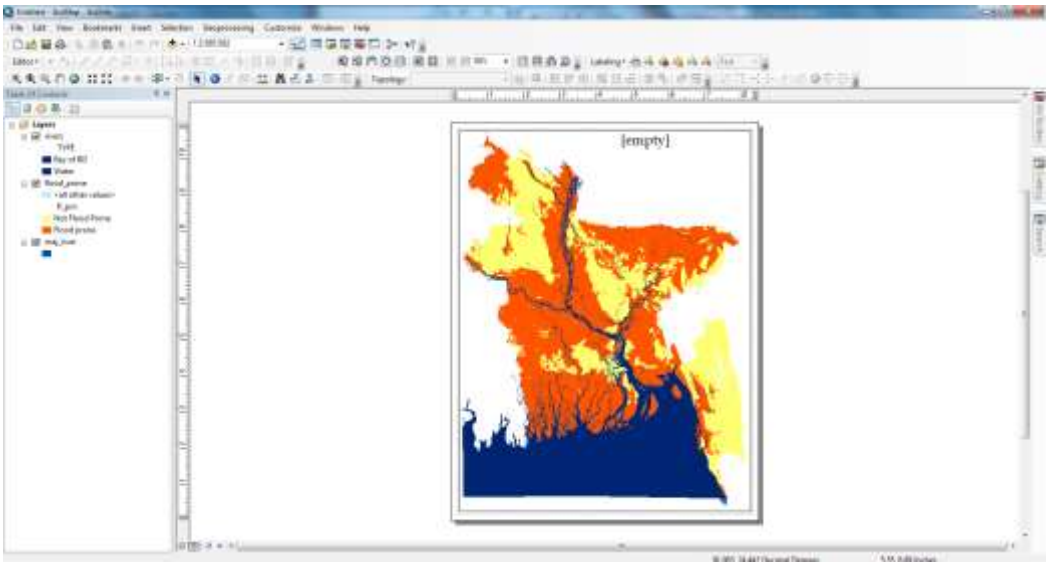
2.6 Map Documents

Map documents containing tool layers can be published to ArcGIS Server as a geoprocessing service. Each tool layer in the map document becomes a task within the geoprocessing service. The workflow for configuring and preparing a map document containing tool layers for publication includes:

- Setting geoprocessing options
- Setting the scratch workspace environment
- Creating tool layers
- Opening and running tool layers to create output datasets
- Changing layer symbology if necessary
- Removing unneeded layers
- Making sure all layers are connected for result map services

SESSION 3: USING ARCMAP

ArcMap is an application for displaying maps and investigating them for analyzing maps to answer geographic questions and producing maps that make analysis persuasive. The ArcMap application window consists of a map display for viewing spatial data, a table of contents for listing the layers shown in the display, and a variety of toolbars for working with the data.



You can change the way ArcMap looks to suit your preferences and the kind of work you do. Toolbars can be hidden or shown. New commands can be added to them. They can be docked at different places in the application window or can float independently of it. To dock a floating toolbar, drag it to the interface. To undock it, click the vertical gray bar at its left edge and drag it away from the interface. To hide or show a toolbar, dick the Customize menu, point to Toolbars, and check or uncheck the toolbar name.

Alternatively, some windows (such as Catalog or Search) can be docked to the interface. These windows have the ability to collapse into a tab or expand to show its entirety. To dock a floating window, drag it to the interface. The window turns blue and four arrows point at locations where the window can be docked. When the window is docked. Click the Auto Hide button to enable the tabbed behavior. To remove the tab, click the Auto Hide button and undock the window.

This manual assumes that you are working with the default interface. The exercise graphics reflect this, with one exception-tool bars are always shown horizontally.
Changes you make to the interface are applied to subsequent ArcMap sessions, so if you dock a toollbar or window in one session, it will be docked the next time you start ArcMap, and if you resize the application window, it will keep the new size in the next session. Changes like this will not significantly affect the exercises, but may give you slightly different results for such operations as labeling that are influenced by the size and scale of the map display.

For more information about customizing the interface, click the Contents tab in ArcGIS Desktop Help and navigate to *Customizing and developing with ArcGIS > Customizing the User interface*.

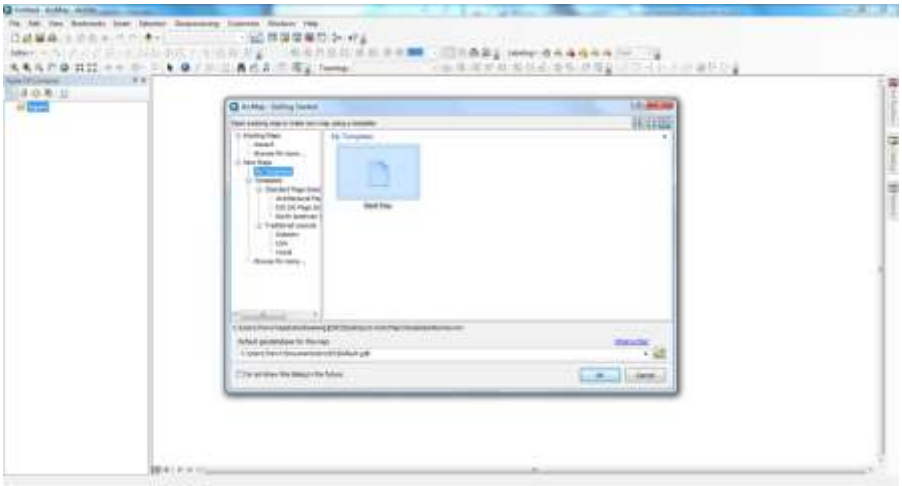
3.1 Displaying Map Data

In this exercise, you'll learn how to display data in ArcMap. You' ll learn how to navigate maps and get information about map features. You will be able to do the exercises only if you have installed the ISO-day trial version of ArcView 10 that comes with this book, or if you have a licensed version of ArcEditor 10 or Arcinfo 10 software on your computer. Keep in mind that using a previous version of ArcGIS means that certain tools, functions. Windows, or dialog boxes mayor may not be present. You may encounter steps in the exercises where a workaround may be necessary.

Exercise 1

You work for a developing agency that is working with disaster risk management of flood prone areas of Bangladesh. In this regard, they collected flood data from different sources and prepare a spatial data. You have been asked to manage a GIS project that will help to identify the flood prone districts of Bangladesh.

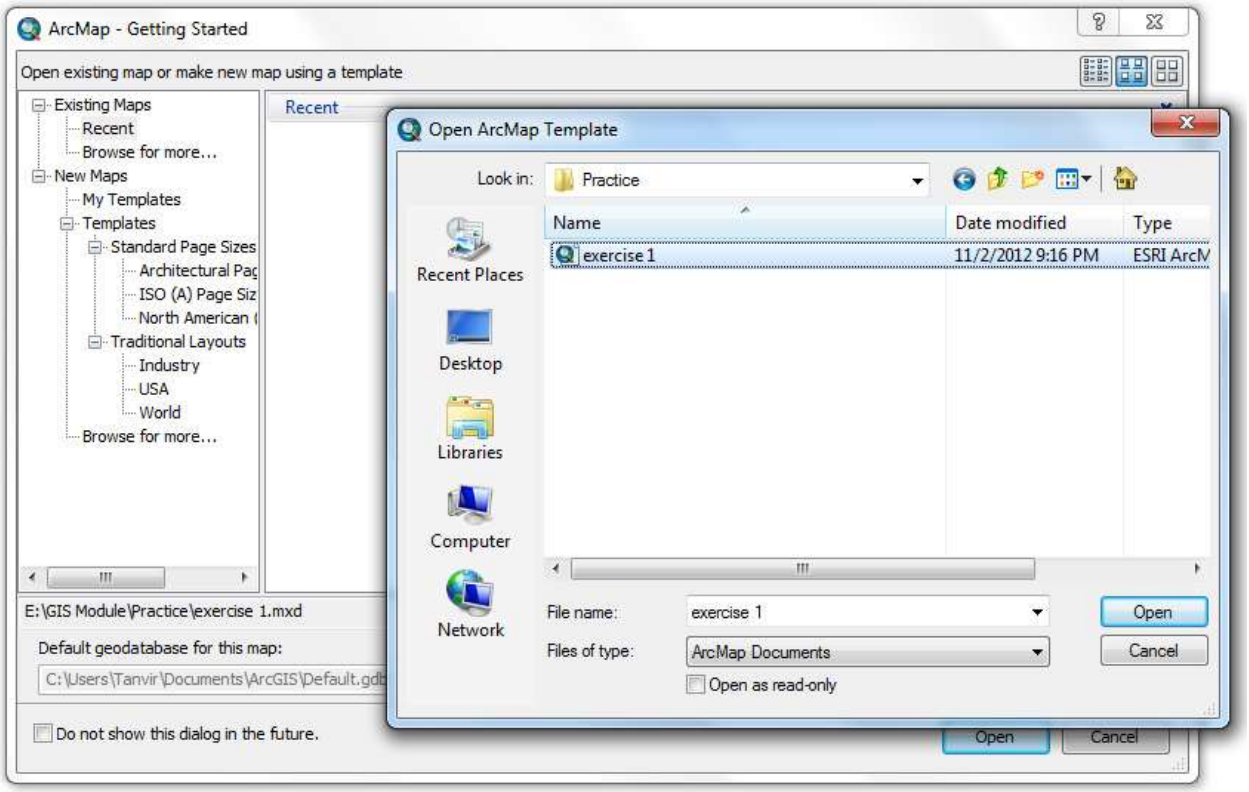
1. Start Arc Map by clicking the Start button on the Windows taskbar, point to All Programs, point to ArcGIS 10, and click ArcMap 10.



When ArcMap opens, you see the Getting Started dialog box on top of the main application window. This dialog box allows you to quickly start a new map, open an existing map or template

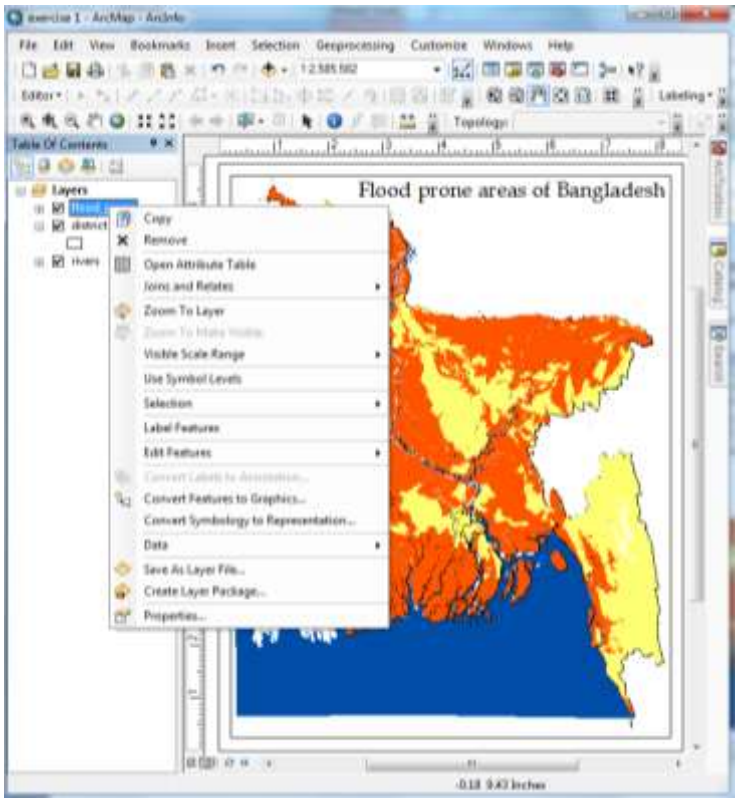
2. In the Getting Started dialog box, under the Existing Maps section, click "Browse for more ...

3. In the Open dialog box, navigate to D:\Practice and click exercise01.mxd, as shown in the following graphic and click Open.



4. In the table of contents, click the check box next to the district layer to turn it off.
5. In the table of contents, click the district check box to turn it back on. Click the check box next to the flood_prone layer to turn it on as well.

The flood_prone layer is checked but you still can't see the areas. This is because data is displayed on the map in the order of the layers in the table of contents. The flood_prone layer is covered by the district.

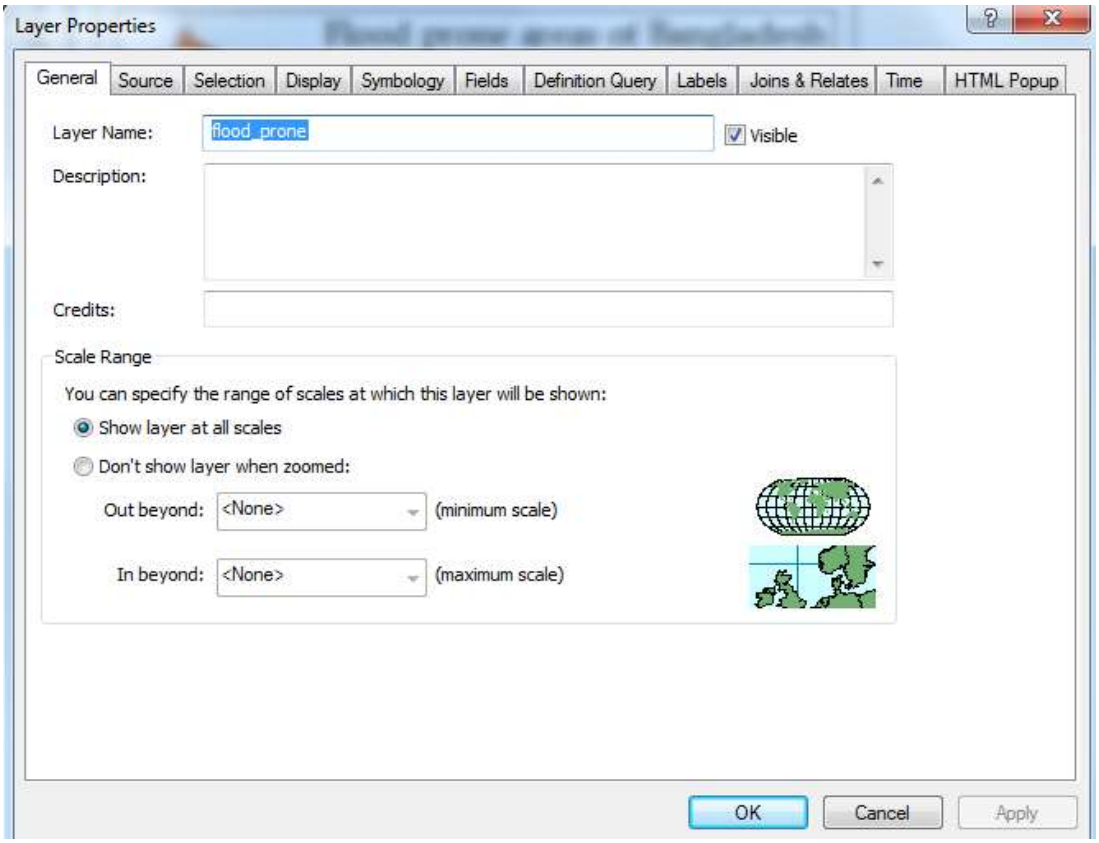


6. In the table of contents, click the flood_prone layer name to highlight it. Click and drag the layer to the top of the table of contents, then release the mouse button. As you drag the layer, a horizontal black bar indicates its position.
Now you can see the flood_prone on the map. You'll change the layer name to make this clear.

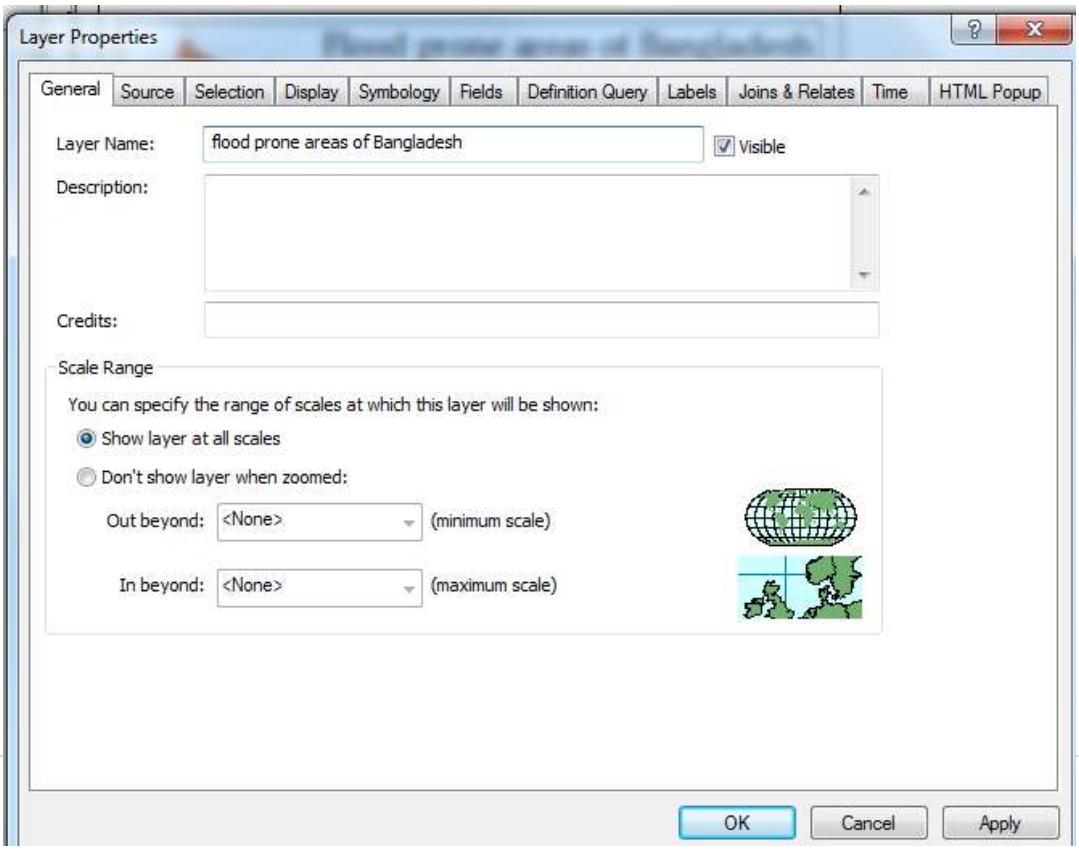
7. In the table of contents, right-click the

flood_prone layer name. A context menu opens. Many ArcMap operations are started from context menus. On the context menu, click Properties to open the Layer Properties dialog box.

8. In the Layer Properties dialog box, click the General tab.

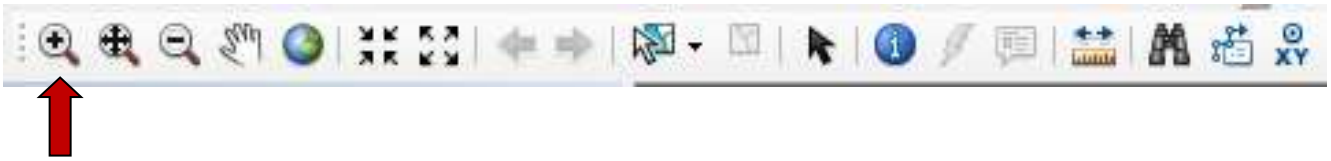


9. In the Layer Name text box, the name "flood_prone" is highlighted. Type 'flood prone areas of Bangladesh'. Make sure that your dialog box matches the following graphic, then click OK.



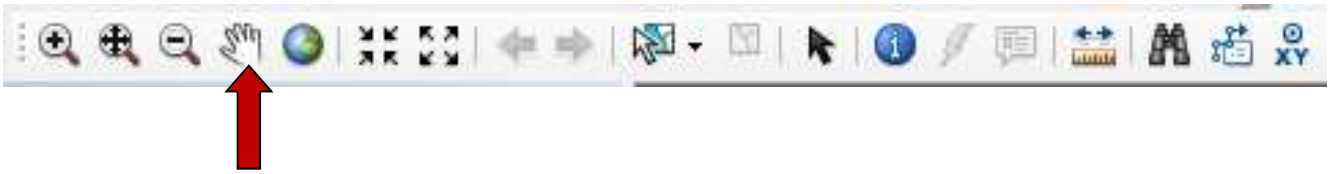
The layer is renamed in the table of contents.

10. On the Tools toolbar, click the Zoom In tool. (Move the mouse pointer over it to see its name.) Your tool bar may be oriented vertically. You can change its orientation if you like by dragging one of its corners.

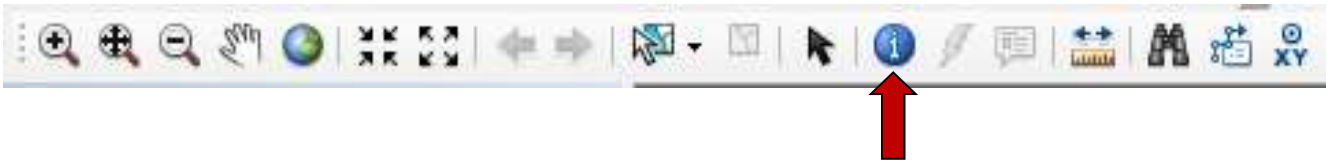


11. Move the mouse pointer over the map. The cursor changes to a magnifying glass. Drag a box around the Bangladesh, approximately as shown in the following graphic. (If you make a mistake, click either the Full Extent or Go Back to Previous Extent buttons and try again.)

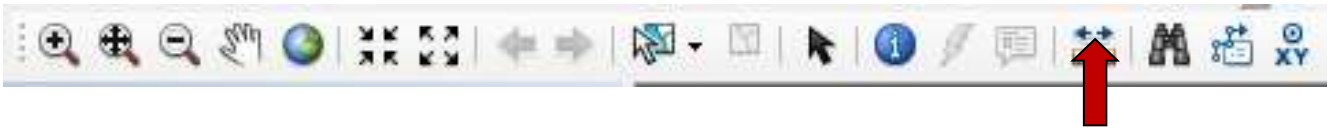
12. On the Tools toolbar, click the Pan tool. Move the mouse pointer over the map. The cursor changes to a hand. Click and drag the display up and to the upper left corner of the window. Release the mouse button.



13. On the Tools toolbar, click the Identify tool. When you click the tool, the Identify window opens. If it covers most of the map display, move it out of the way.



14. On the Tools toolbar, click the Measure tool. The Measure window opens. Click the Choose Units drop-down arrow, point to Distance, and click Kilometers.



Looking at feature attributes

In a GIS, a feature on a map may be associated with a great deal of information-more than can be displayed at any given time. This information is stored in an attribute table. A layer's attributes table contains a row (or record) for every feature in the layer and a column (or field) for every attribute or category of information.

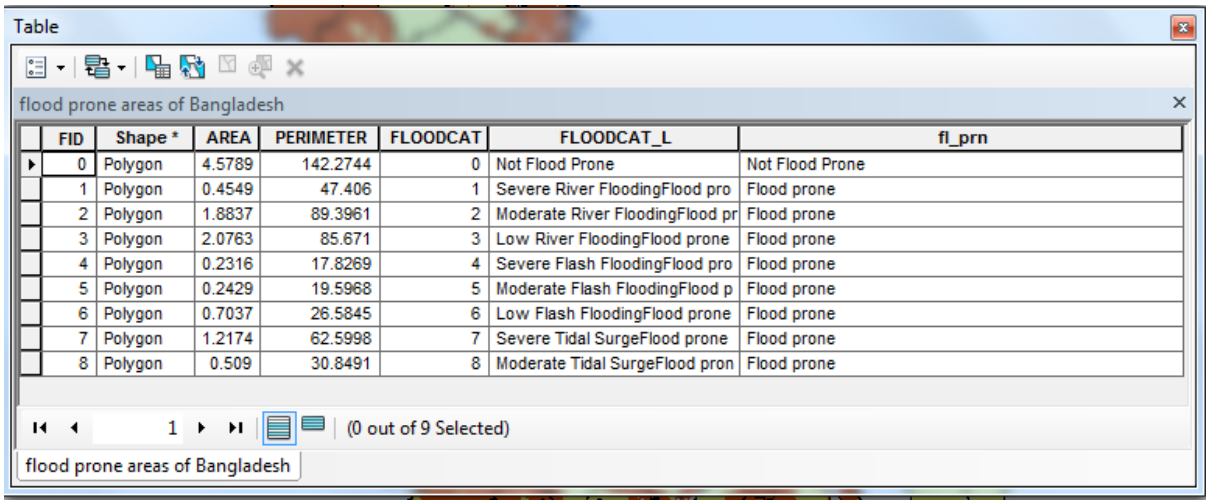
In this exercise. you will look at the attribute tables for two map layers. You will learn how to change a table's appearance and how to get statistical information from it.

Exercise 2

1. Start ArcMap. In the ArcMap---Getting Started dialog box, under the Existing Maps section, click Browse for more. (If ArcMap is already funning, click the File menu and click Open.) Navigate to D:\Practice\ exercise02.mxd, and click Open.

Now you will open the attribute table for the flood prone areas of Bangladesh layer.

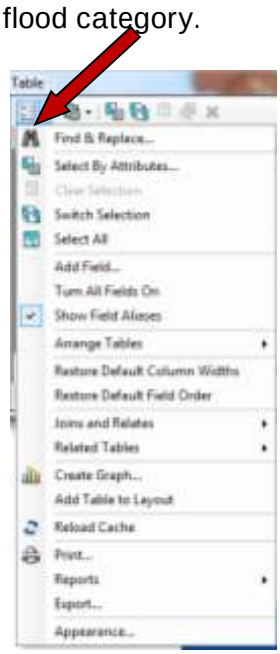
2. In the table of contents, right-click the *flood prone areas of Bangladesh* layer and click Open Attribute Table.



FID	Shape *	AREA	PERIMETER	FLOODCAT	FLOODCAT_L	fl_prn
0	Polygon	4.5789	142.2744	0	Not Flood Prone	Not Flood Prone
1	Polygon	0.4549	47.406	1	Severe River FloodingFlood pro	Flood prone
2	Polygon	1.8837	89.3961	2	Moderate River FloodingFlood pr	Flood prone
3	Polygon	2.0763	85.671	3	Low River FloodingFlood prone	Flood prone
4	Polygon	0.2316	17.8269	4	Severe Flash FloodingFlood pro	Flood prone
5	Polygon	0.2429	19.5968	5	Moderate Flash FloodingFlood p	Flood prone
6	Polygon	0.7037	26.5845	6	Low Flash FloodingFlood prone	Flood prone
7	Polygon	1.2174	62.5998	7	Severe Tidal SurgeFlood prone	Flood prone
8	Polygon	0.509	30.8491	8	Moderate Tidal SurgeFlood pron	Flood prone

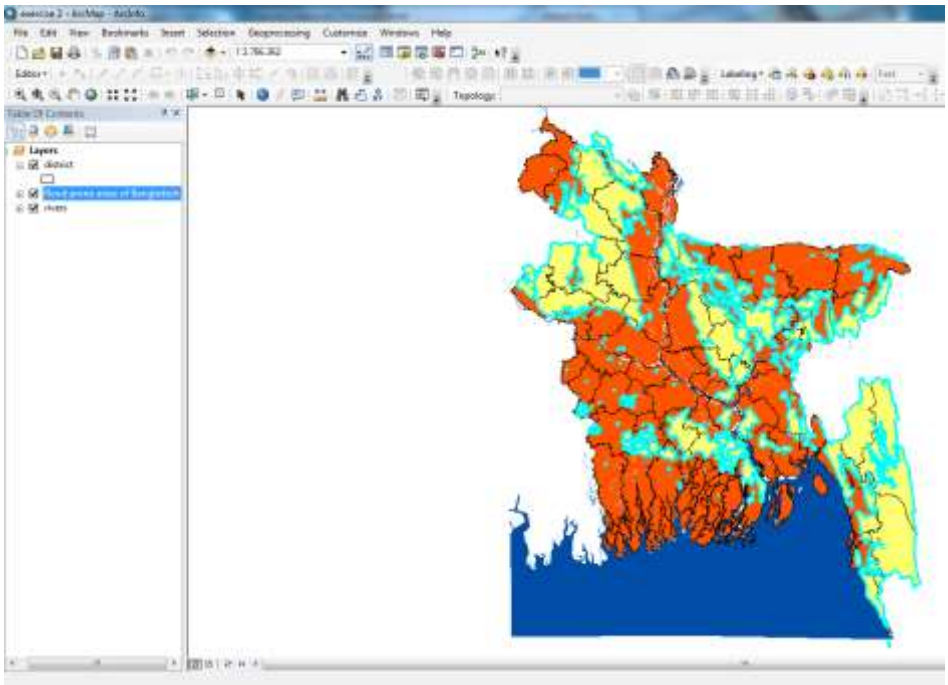
3. Scroll down through the table. There are nine records or rows and seven attributes, or fields. The FID field contains a unique identification number for every record. The Shape field describes the feature geometry. The other attributes describe the area, perimeter, and flood category.

4. Click on table option then you will see a drop down menu appear.

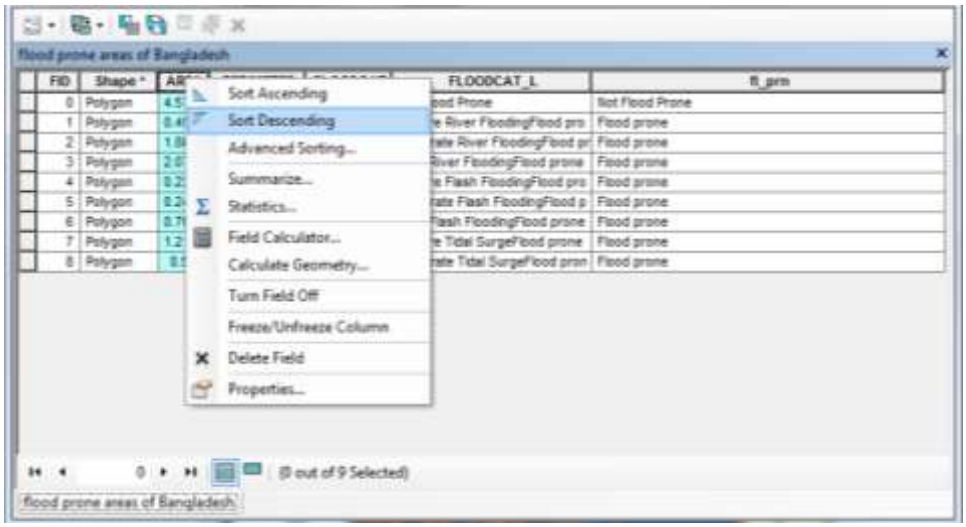


5. Click the gray tab at the left edge of the first record in the table. The record is selected.

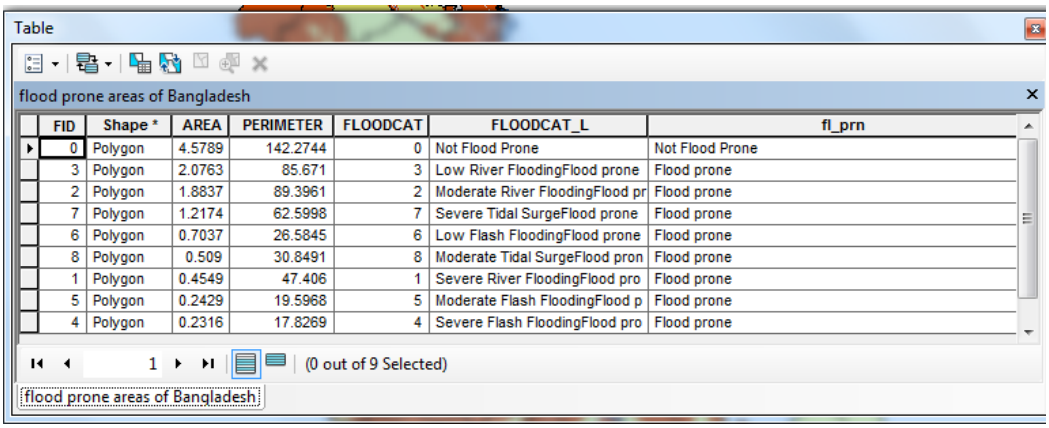
The selected record will be highlighted in map.



6. Right-click the AREA field name and click Sort Descending.



The records are ordered by area of Right segment from longest to shortest.



Table

flood prone areas of Bangladesh

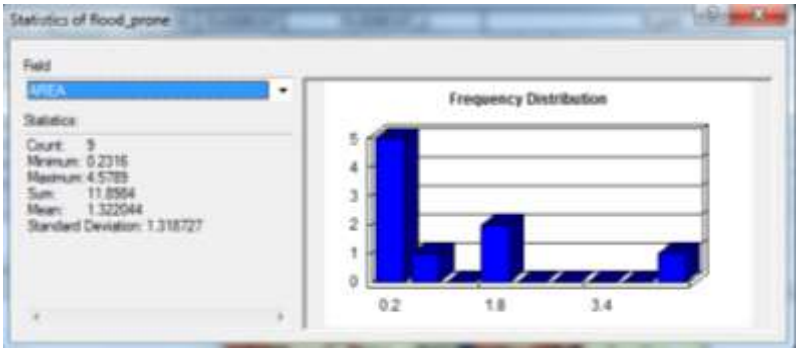
FID	Shape *	AREA	PERIMETER	FLOODCAT	FLOODCAT_L	fl_prn
0	Polygon	4.5789	142.2744	0	Not Flood Prone	Not Flood Prone
3	Polygon	2.0763	85.671	3	Low River FloodingFlood prone	Flood prone
2	Polygon	1.8837	89.3961	2	Moderate River FloodingFlood pr	Flood prone
7	Polygon	1.2174	62.5998	7	Severe Tidal SurgeFlood prone	Flood prone
6	Polygon	0.7037	26.5845	6	Low Flash FloodingFlood prone	Flood prone
8	Polygon	0.509	30.8491	8	Moderate Tidal SurgeFlood pron	Flood prone
1	Polygon	0.4549	47.406	1	Severe River FloodingFlood pro	Flood prone
5	Polygon	0.2429	19.5968	5	Moderate Flash FloodingFlood p	Flood prone
4	Polygon	0.2316	17.8269	4	Severe Flash FloodingFlood pro	Flood prone

1 (0 out of 9 Selected)

flood prone areas of Bangladesh

Sorting a field is useful for seeing high and low values, but ArcMap can give you more detailed information.

7. Right-click the AREA field and click Statistics. The Statistics of statistics of flood_prone window opens. Close the Statistics window.

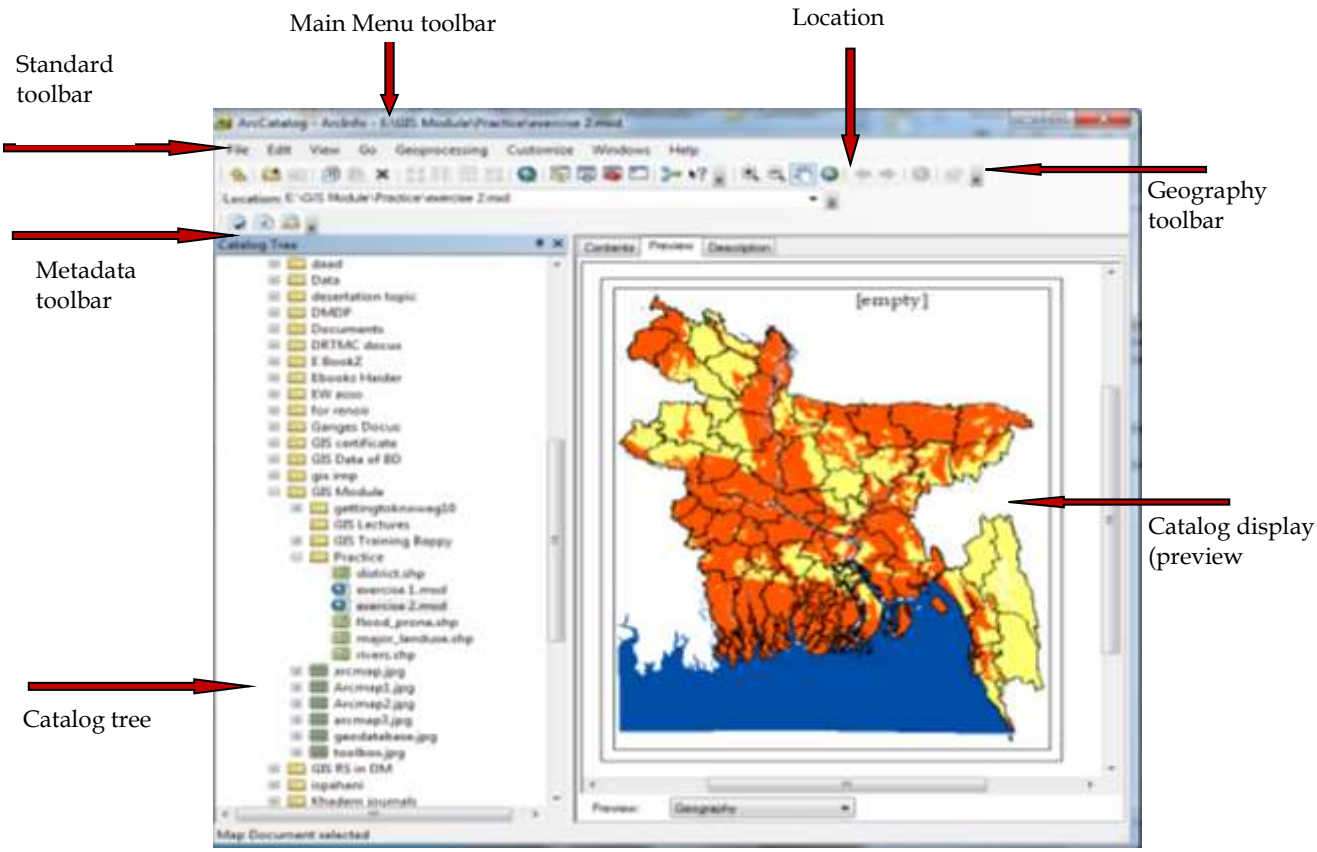


8. Close the Statistics window. Close the Attributes of flood_prone table.
In the next chapter. You will see how the data for the project is managed in ArcCatalog.

SESSION 4: USING ArcCatalog

Overview

ArcCatalog is an application for managing geographic data. You can copy, move, and delete data; search for data; look at data before deciding whether to add it to a map; and create new data. The ArcCatalog application window includes the catalog display for looking at spatial data, the catalog tree for browsing data, and several toolbars.



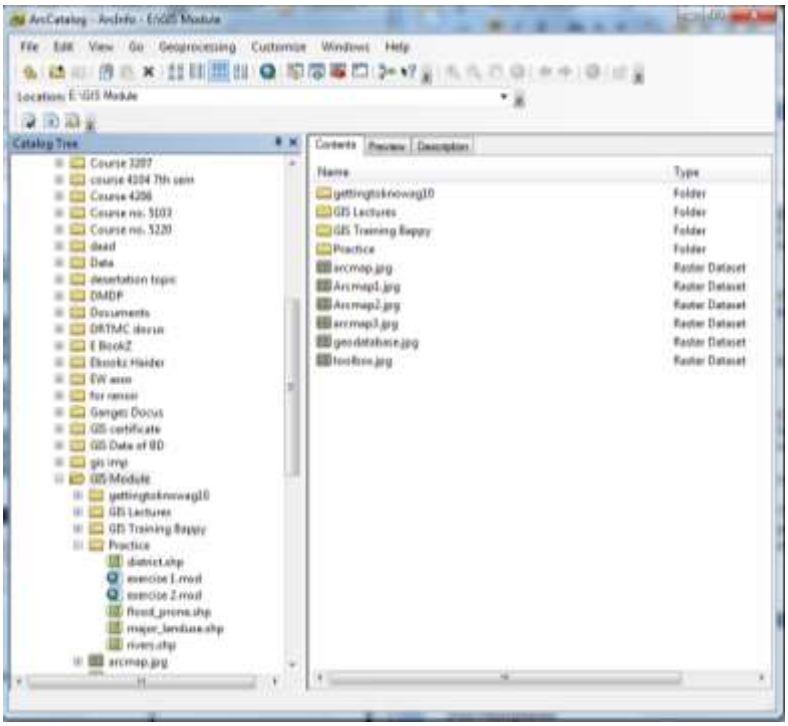
Spatial data comes in many different formats, including geodatabases, coverages, shapefiles, CAD (computer-aided design) files, raster's, and T INs (triangulated irregular networks). Each format is identified by its own icon in ArcCatalog. The shapefile icon, for example, is a green rectangle. Different patterns on the green rectangle distinguish point, line, and polygon shapefiles.

In this book, you'll use geodatabase, shapefile, and raster data. You'll also use layer fi les, which are not spatial datasets, but rather instructions for displaying spatial datasets with certain colors, symbol markers, line widths, and so on. Layer files, too, have their own ArcCatalog icon.

You'll learn more about layer files and spatial data formats throughout this section.

Exercise 3

Whenever you work in GIS you need to be familiar with its spatial data. You' ll use ArcCatalog to look at this data and get information about it.

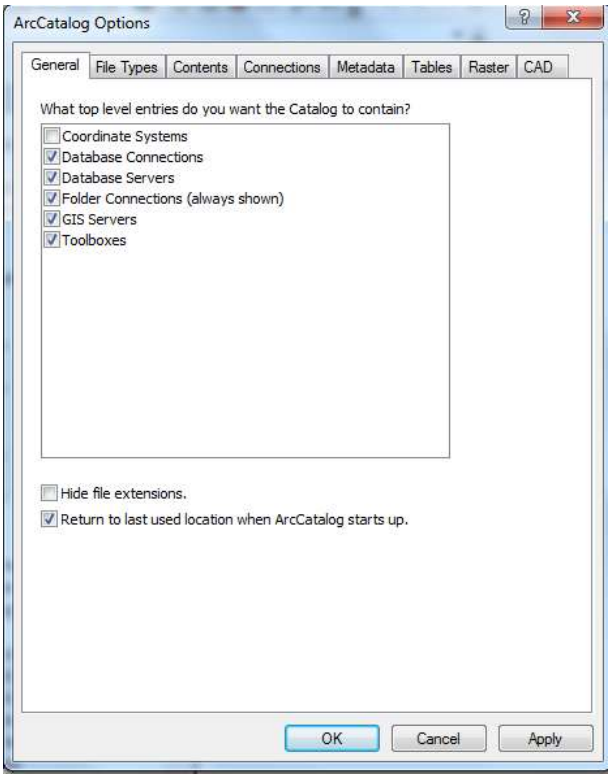


1. To open ArcCata log, click the Start button on the Windows taskbar, point to All Programs, point to ArcGIS 10, and click ArcCatalog 10.

The ArcCatalog application window opens. The Catalog Tree lists the data and services that ArcCatalog is connected to. This is where connections to local drives on your computer are made. Your application may look different from the following graphic depending on the drives you have connected.

You can also connect to subdirectories, network drives, databases, Internet servers, and other services. Once you connect to a folder, you can access the data it contains. In this exercise, it will be helpful to see the file extensions of different spatial datasets, so you will make sure that ArcCatalog is set to display these extensions.

2. Click the Customize menu and click ArcCatalog Options. In the ArcCatalog Options dialog box, click the General tab.



The ArcCatalog Options dialog box lets you specify the types of data ArcCatalog displays and the information it shows about them (file name, file size, date modified, and so on). You can distinguish folders containing spatial data from those that don't, and make many other customizations to the way data is displayed.

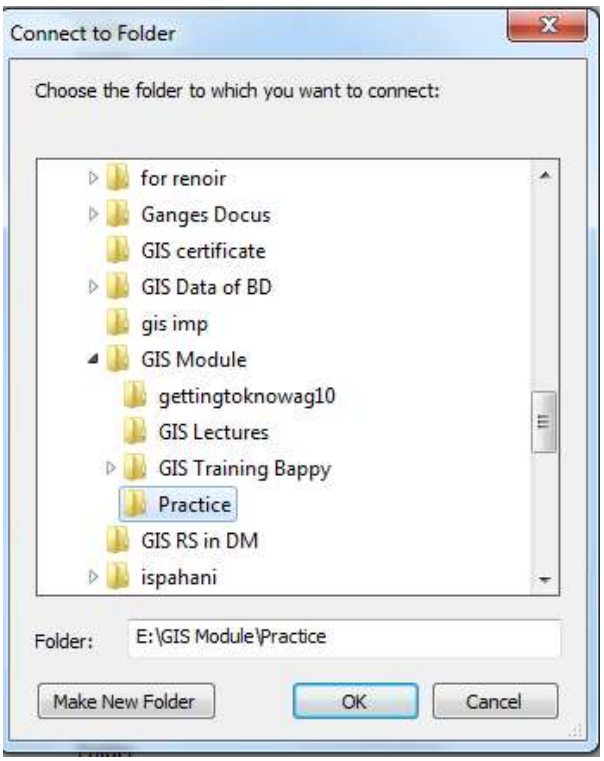
3. If necessary, uncheck Hide file extensions, then click OK.

To access the spatial data more quickly you can create a connection to it.

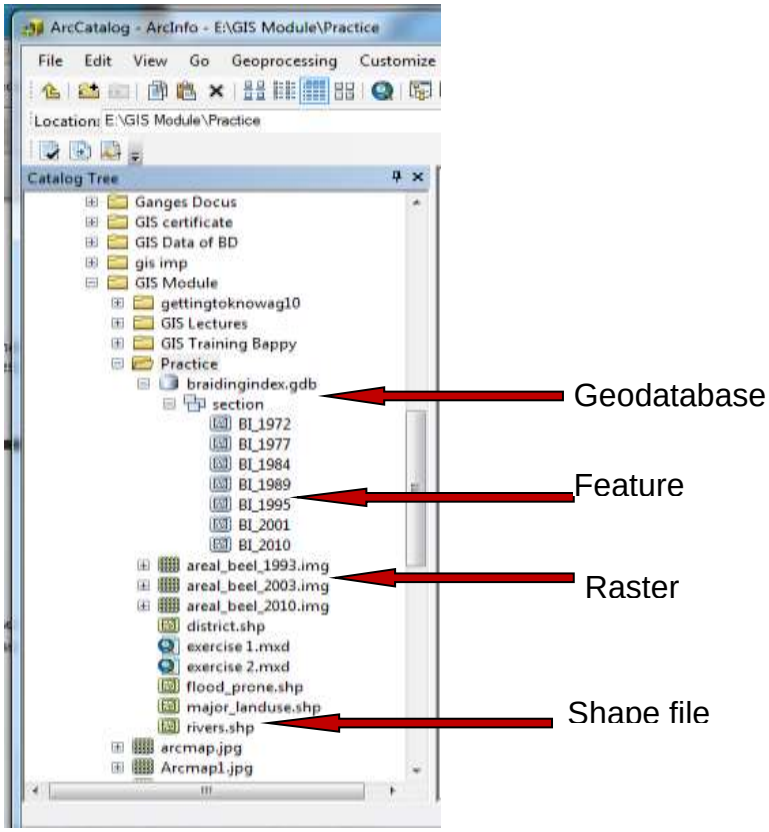
4. On the Standard tool bar, click the Connect to Folder button.

5. The Connect to Folder dialog box opens. Your dialog box may look different depending on your local and network drives.

6. In the Connect to Folder dialog box, click the drop down arrow next to said drive to view its contents. Click the drop down sign next to the GISModule folder to expand it. Click the Practice folder as shown in the following graphic, and then click OK.

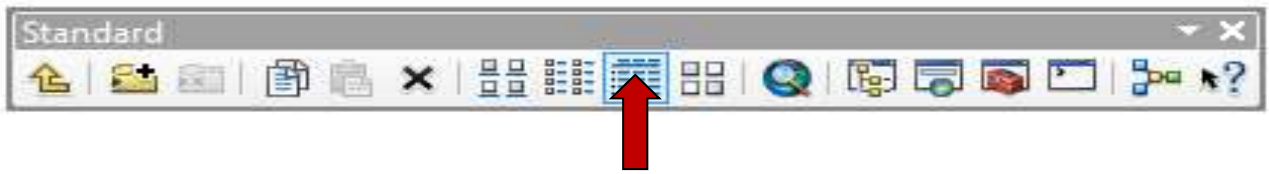


A connection is made to D:\GIS Module\Practice

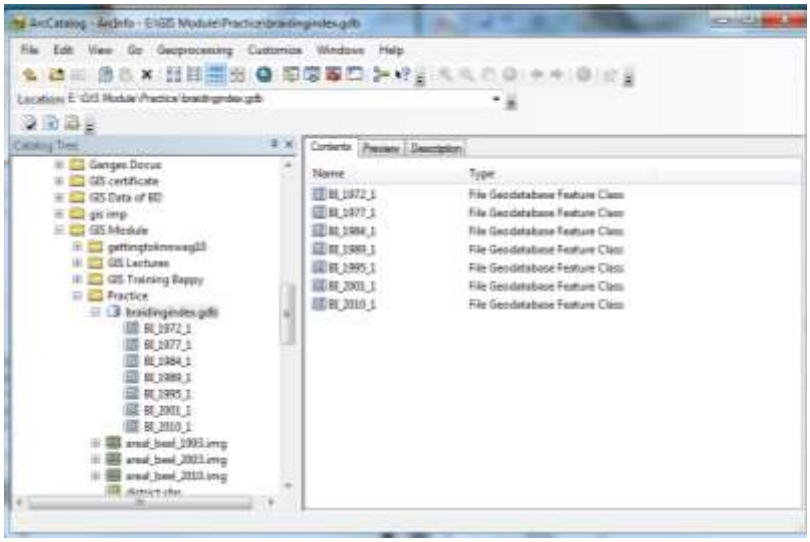


The geodatabase contains four feature classes. A feature class is a group of points, lines, or polygons representing geographic objects of the same kind. The cities feature class contains point features; the other three contain polygon features.

7. On the Standard tool bar, make sure the Details button is selected.



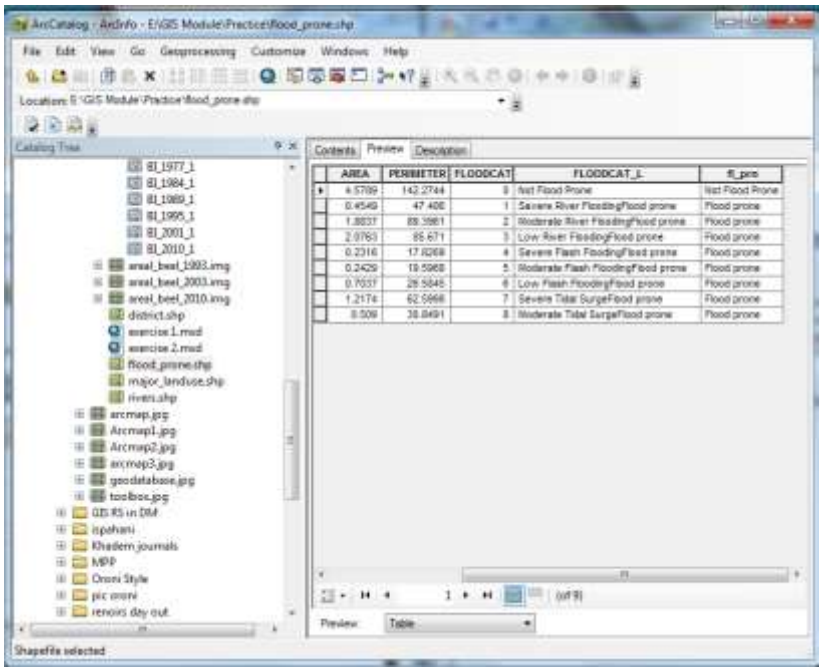
8. In the catalog tree, click braidingindex.gdb. In the catalog display, make sure the Contents tab is active.



Four adjacent buttons on the Standard toolbar change how files look on the Contents tab. The Large Icons button displays large icons horizontally. The List button displays small icons horizontally. The Details button is like the List button except that it also shows the file type- in this case, geodatabase feature classes. The Thumbnails button

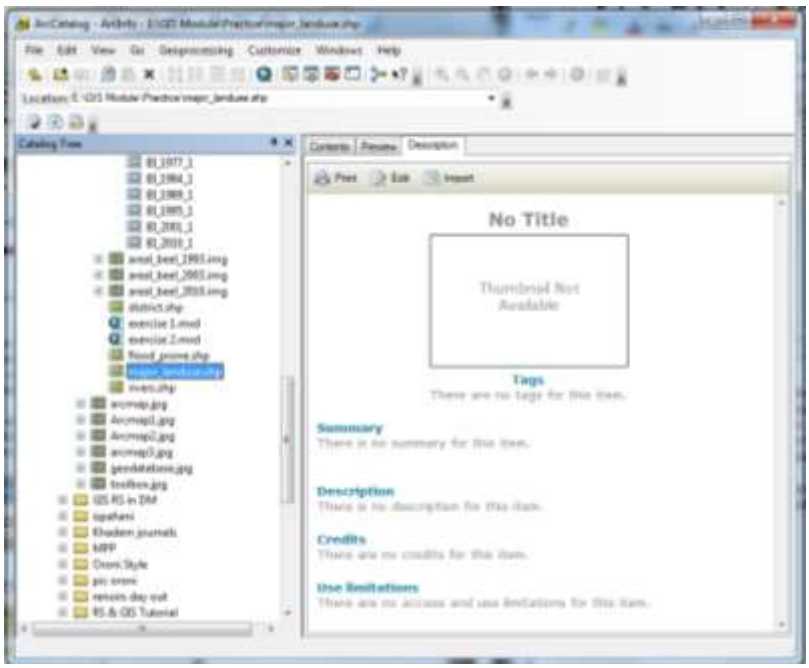
allows you to view small images of spatial datasets. Whenever a folder or a geodatabase is highlighted in the catalog tree, these four buttons are enabled.

9. At the bottom of the catalog display, click the Preview drop-down arrow and click Table. The display shows you the attribute table of the flood_prone features class.



The third tab in the catalog display is the Description tab. Metadata provides information about a dataset, such as its coordinate system, its spatial extent, and descriptions of its attributes. It may also explain how and when the data was created, what standards of accuracy it meets, and what its appropriate uses are. A great deal of metadata is maintained automatically by ArcCatalog; some, however, must be maintained by the people who use and manage the data. ArcCatalog doesn't require you to maintain metadata, but you should.

10. In the catalog display, click the Description tab. If needed, scroll down to see the thumbnail you created, tag words, summary, description, and other information.



SESSION 5: USING TABLES

Adding fields

You can add fields to your table using ArcCatalog or ArcMap. In ArcCatalog, you need to open the layer or table's Properties dialog box and add the field to the list on the Fields tab. In ArcMap, you can add a field through the attribute table of a layer or through the Catalog window by accessing the same Properties dialog box and Fields tab. Inside either application you can also use the Add Field geoprocessing tool.

You can add or remove fields as long as the following conditions are met:

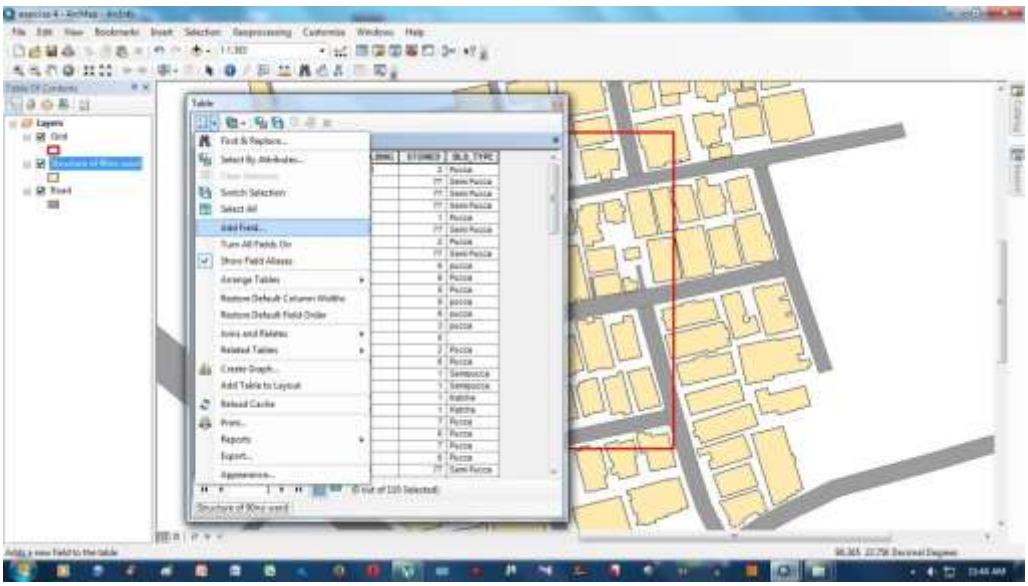
- You have write access to the data.
- You're not currently editing the data in ArcMap.
- No other users or applications are accessing the data including other ArcMap or ArcCatalog sessions.

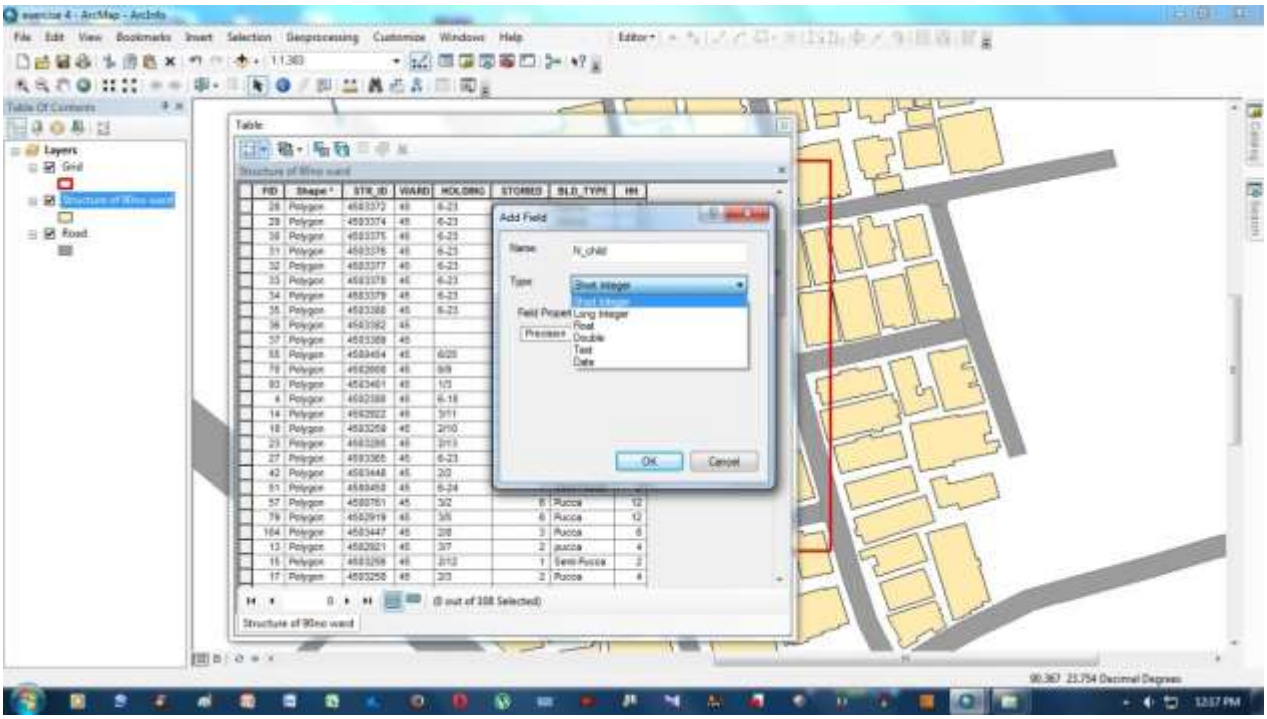
Steps:

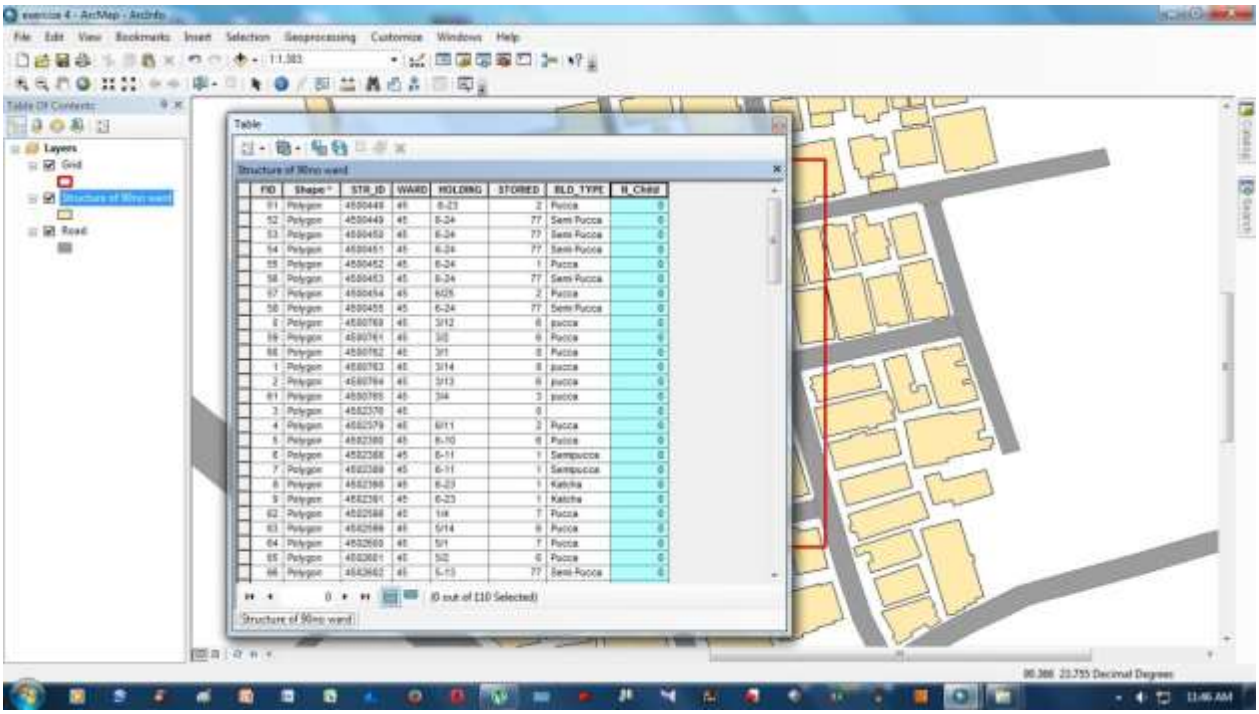
1. Right-click the table or layer in the table of contents and choose Open Attribute Table.
2. Click the Table Options button in the table window.

   You can make calculations without being in an editing session; however, in that case, there is no way to undo the results.

3. Click Add Field.
4. Type the name of the field.
5. Click the Type arrow and click the field type.
6. Set any other field properties as necessary.
7. Click OK.







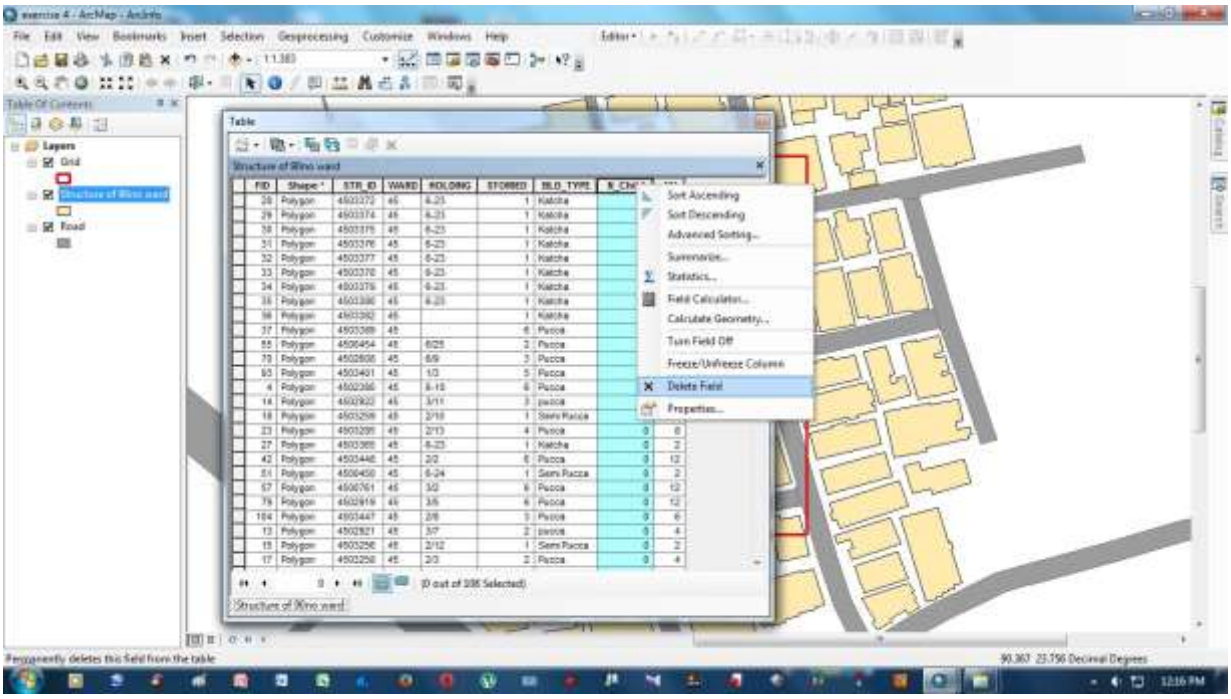
Delete field:

You can delete fields from your table using ArcCatalog or ArcMap. In ArcCatalog, you need to open the layer or table's Properties dialog box and delete the field from the list on the Fields tab. In ArcMap, you can delete a field through the Catalog window by accessing the same Properties dialog box and Fields tab or through the attribute table of a layer. Inside either application you can also use the Delete Field tool.

Steps:

1. Right-click the table or layer in the table of contents and choose Open Attribute Table.
2. Right-click the field header in the table window of the field you want to delete and click Delete Field.
3. Click Yes to confirm the deletion.

   Deleting a field cannot be undone.

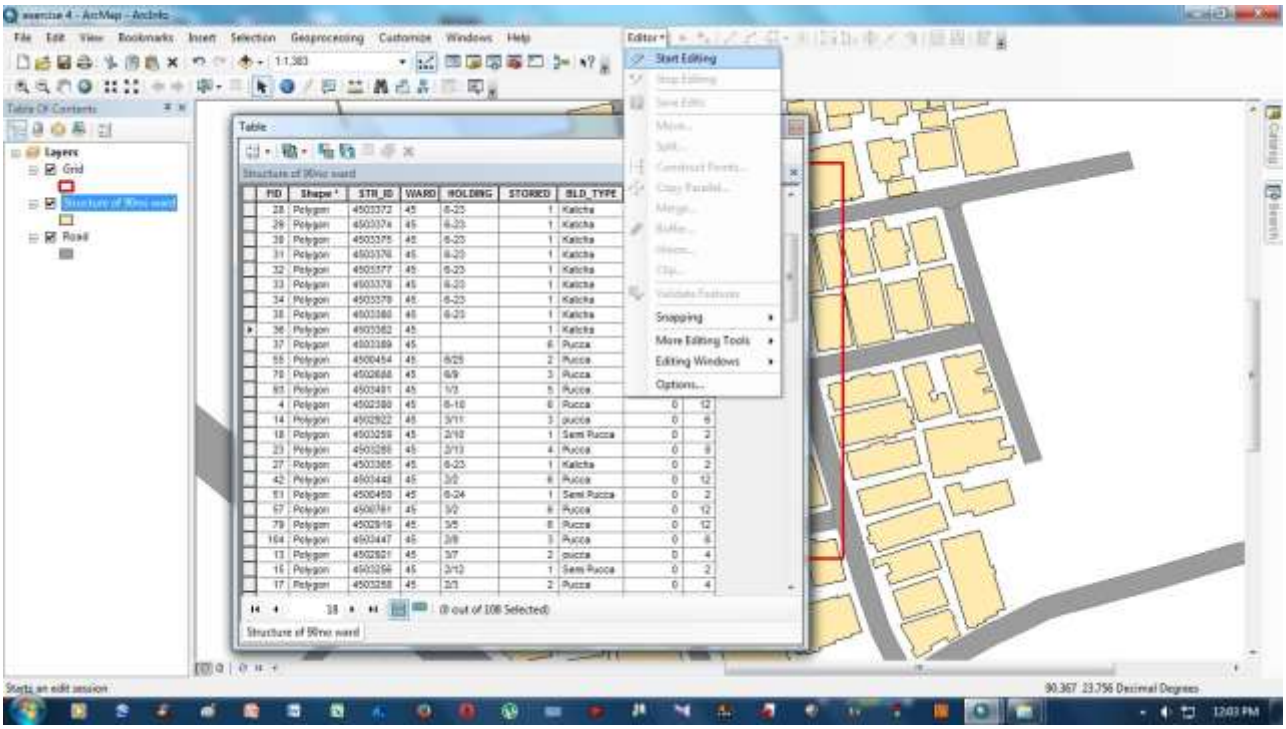


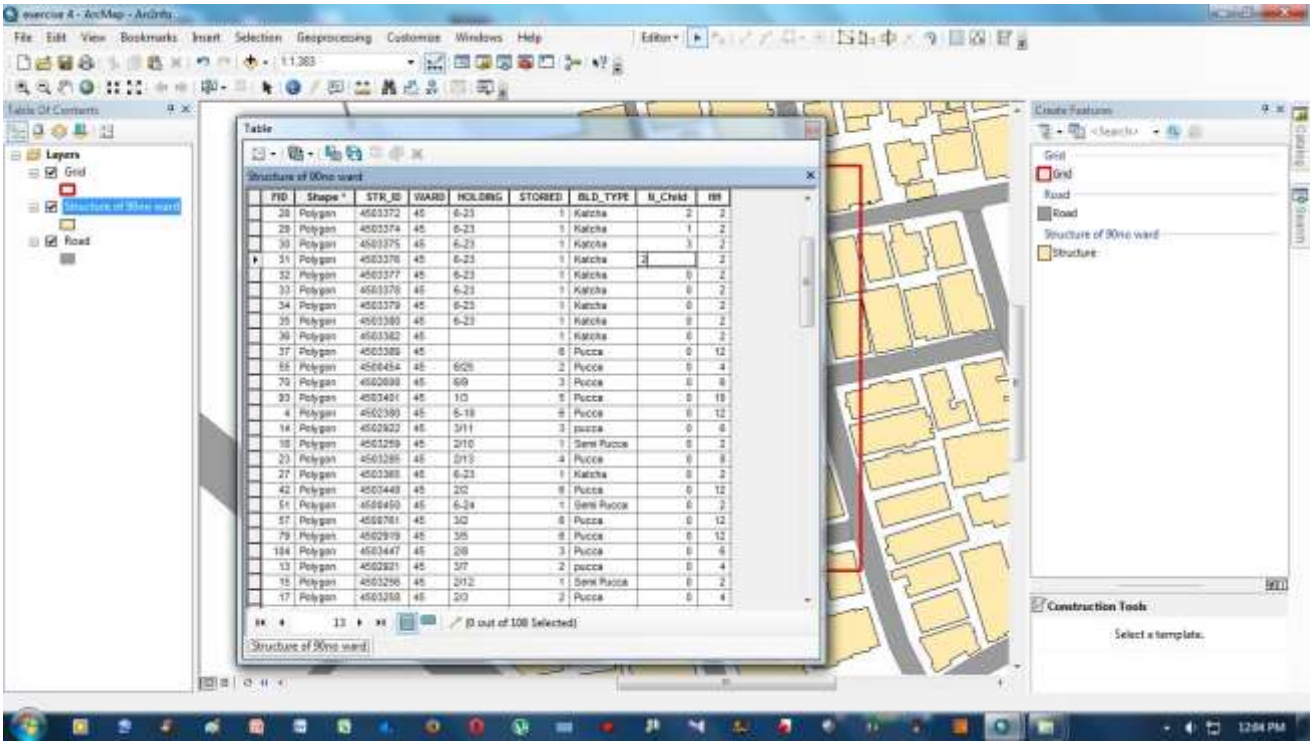
Editing values

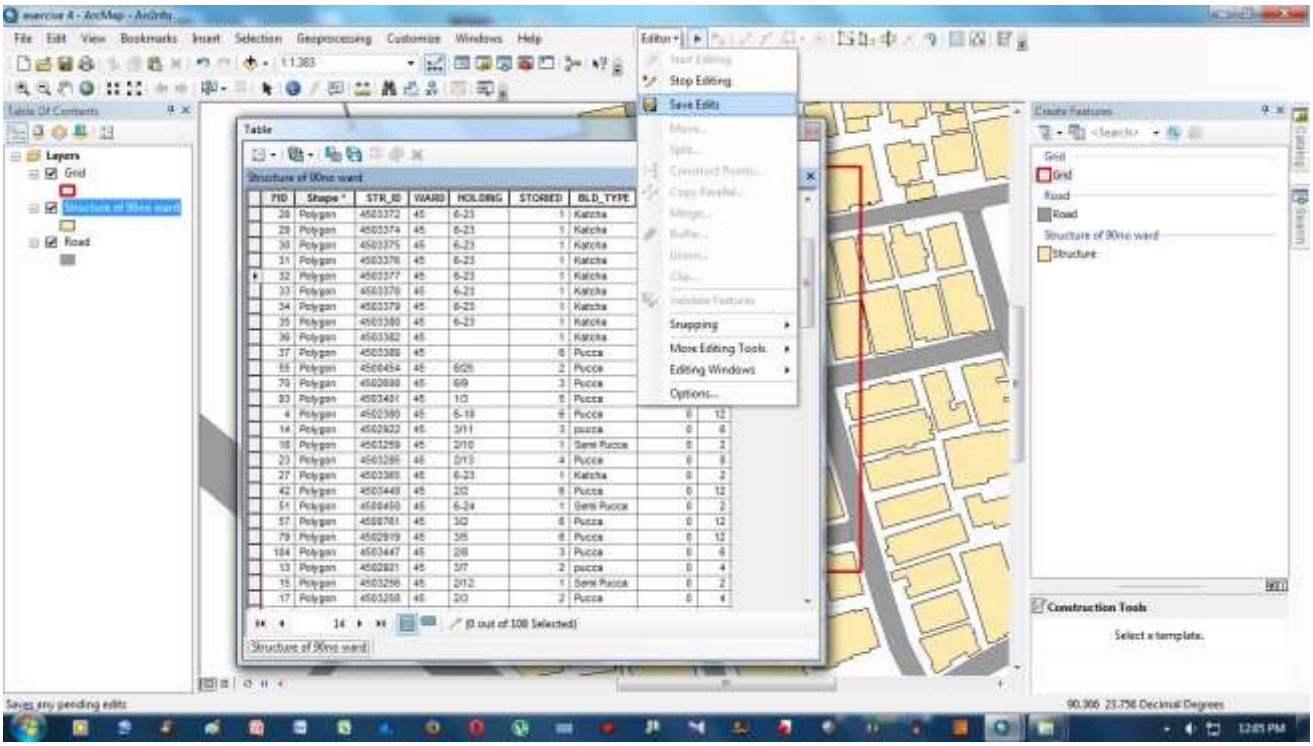
There are two ways you can edit attribute values in ArcMap. You can open the table and edit in the Table window, or you can open the Attributes dialog box. As with editing map features in ArcMap, editing the attributes of features and values in tables takes place within an edit session. When you've completed your edits, you can save them and end the edit session.

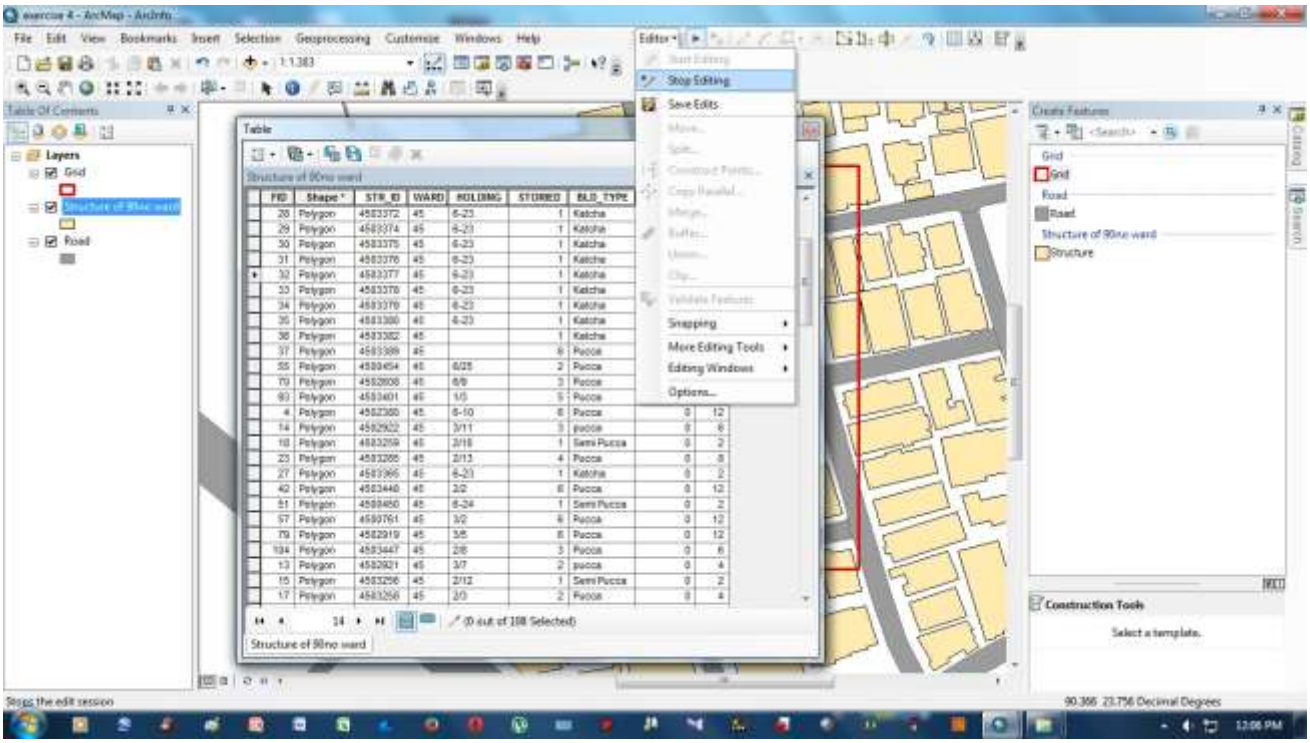
Steps:

1. Click the Editor menu on the Editor toolbar and click Start Editing.
2. Right-click the table or layer in the table of contents and choose Open Attribute Table.
3. Click the cell containing the attribute value you want to change.


File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
Editor
Start Editing
Snapping
More Editing Tools
Editing Windows
Options...
Table Of Contents
Layers
Grid
Structure of 90no ward
Road
Table
Structure of 90no ward
FID Shape * STR_ID WARD HOLDING STOREID BLD_TYPE
(0 out of 108 Selected)
Starts an edit session
90.367 23.756 Decimal Degrees


File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
Editor
Table Of Contents
Layers
Grid
Structure of 90no ward
Road
Table
Structure of 90no ward
FID Shape * STR_ID WARD HOLDING STOREID BLD_TYPE N_Child HH
(0 out of 108 Selected)
Create Features
Grid
Road
Structure of 90no ward
Structure
Construction Tools
Select a template.





Field Calculator

There are two ways to perform field calculations in ArcMap: through the attribute table or by using the Calculate Field geoprocessing tool. Both options use the same functionality.

To calculate date values to a field in the attribute table, follow the steps below:

Steps:

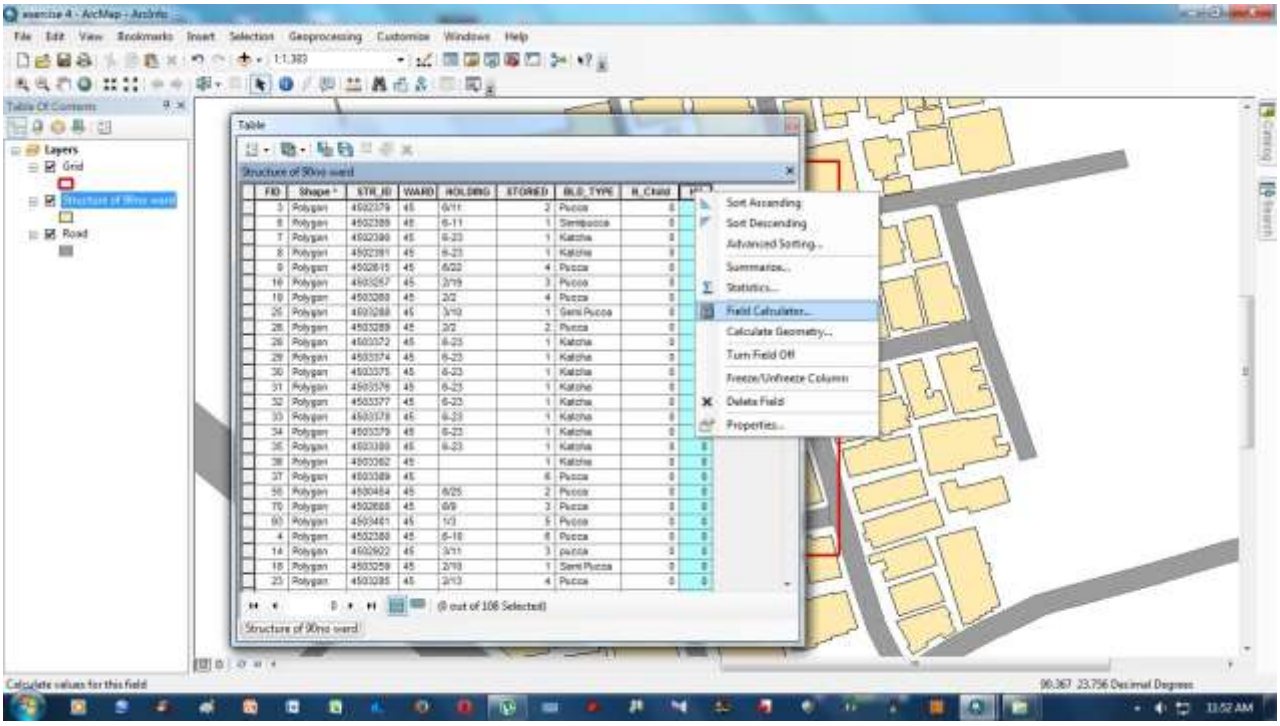
1. Click the Editor menu on the Editor toolbar and click Start Editing.

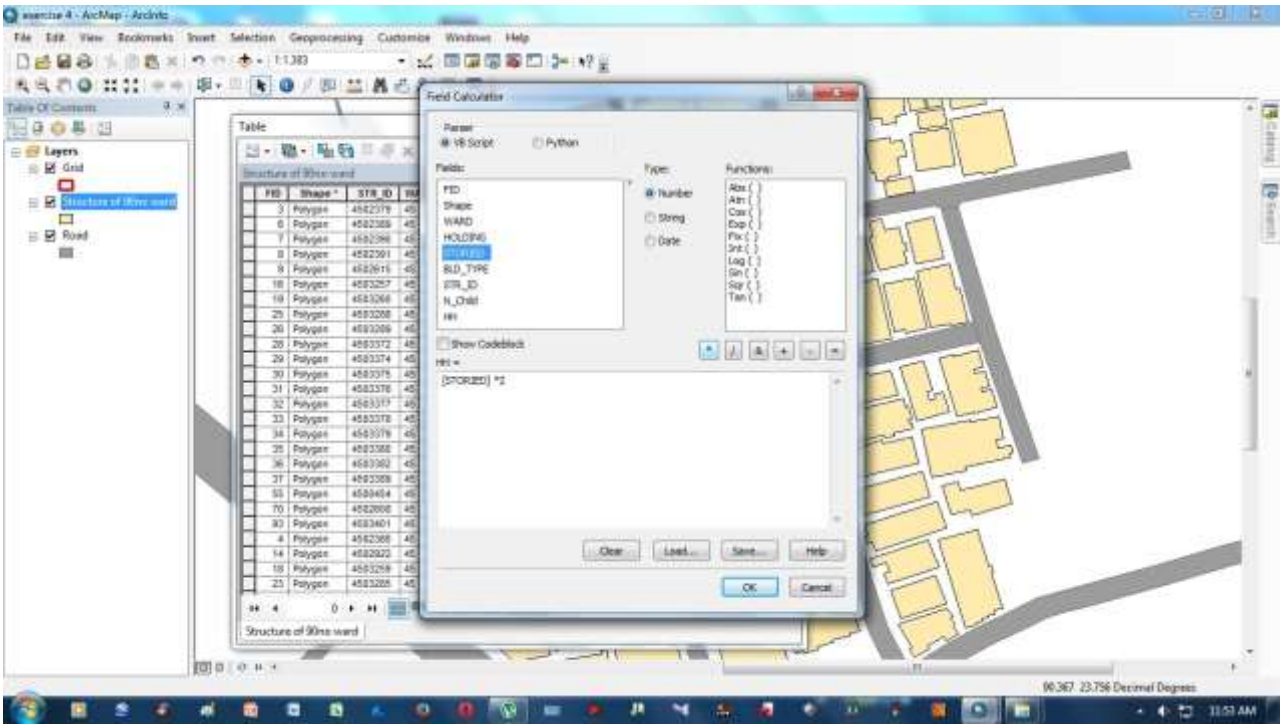
   You can make calculations without being in an editing session; however, in that case, there is no way to undo the results.

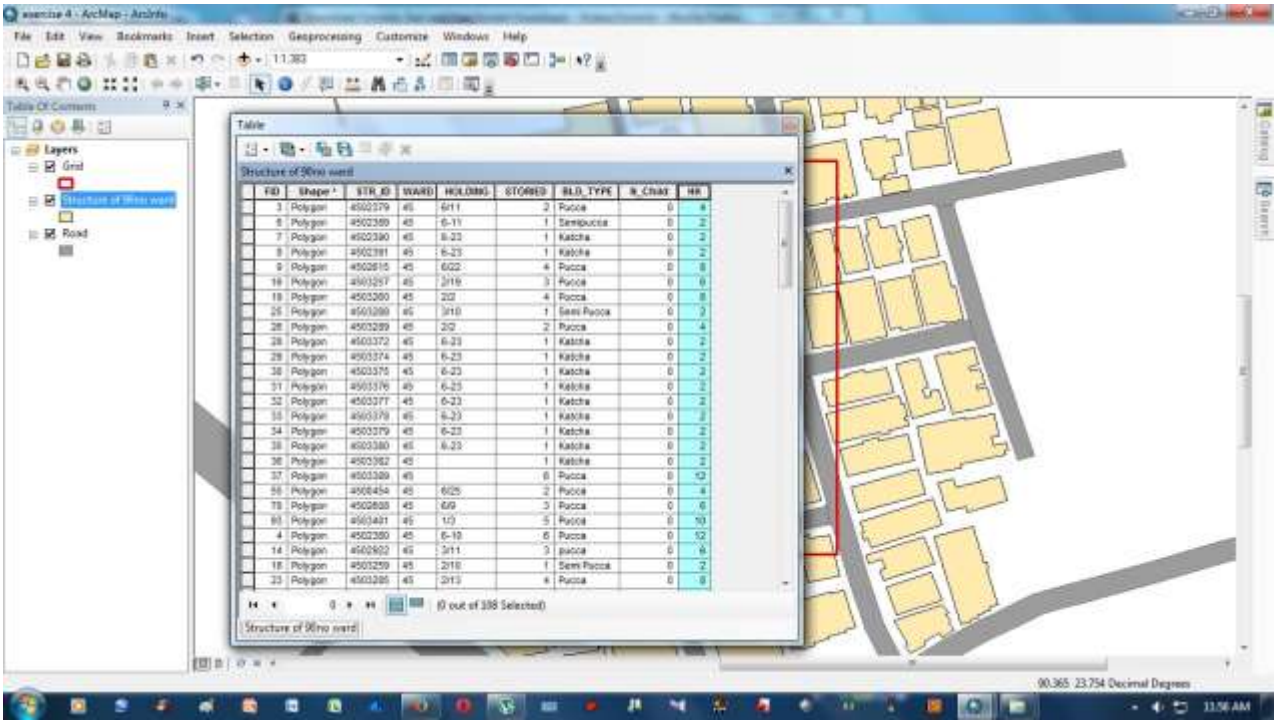
2. Click the List by Source button on the table of contents.
3. Right-click the table or layer in the table of contents and choose Open Attribute Table.
4. Right-click the heading for the date field and click Field Calculator.

   If there is no field for date values, add a new date field by clicking the Options button and clicking the Add Field option. To add a new field, you need to exit the editing session.

5. Use the Fields and Functions lists to build a date field calculation expression. You can also edit the expression in the text area below or type your own valid expression.
6. Click OK.







Field Statistics

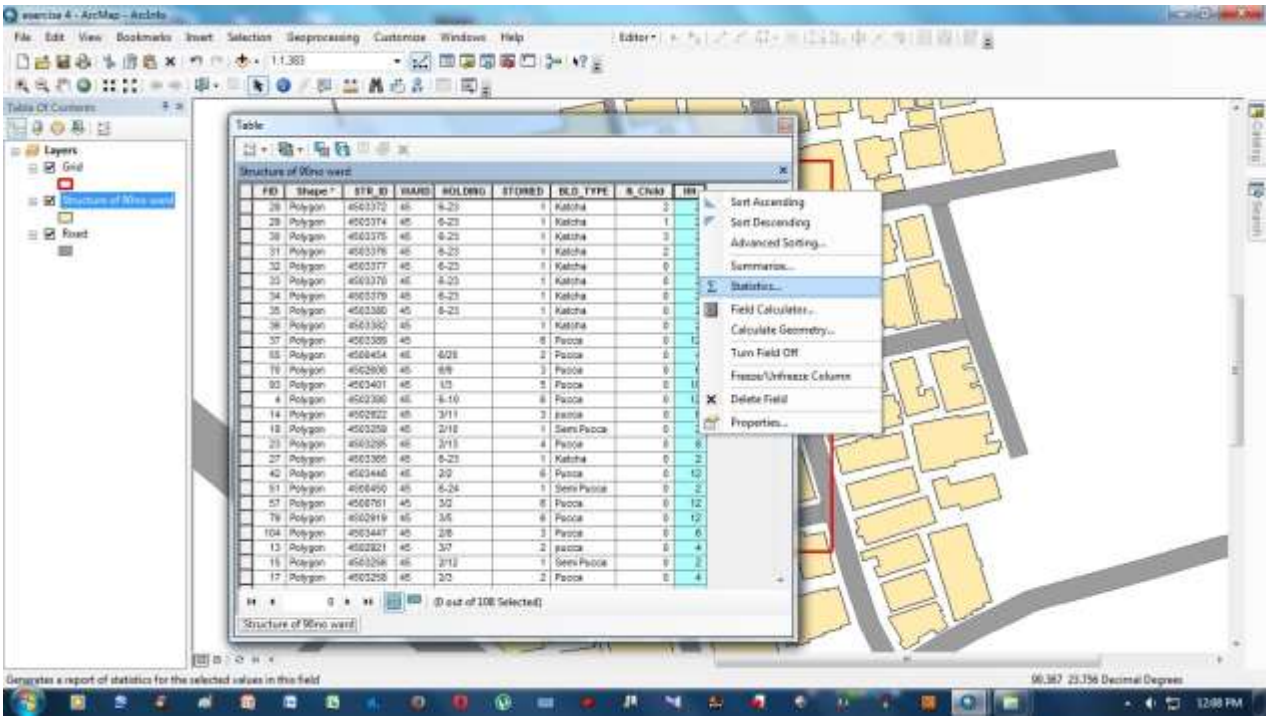
When exploring a table, you can get statistics describing the values in numeric columns. You'll see how many values the column has, as well as the sum, minimum, mean, maximum, and standard deviation of those values. A histogram is also provided showing how the column's values are distributed. Statistics are calculated for all numeric columns in the table. To see a description of another column's values, click its name in the Field list.

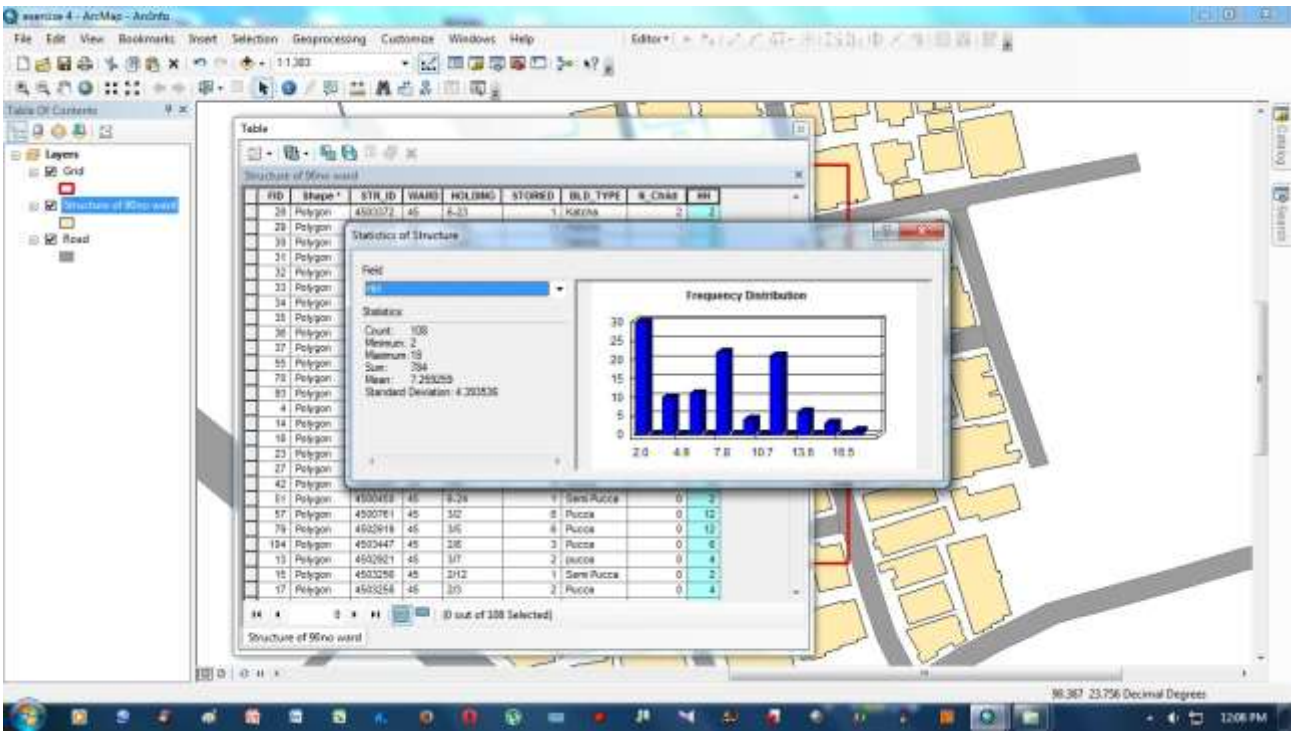
Steps:

1. Right-click the heading of a field that contains numeric data and click Statistics.

   On the Statistics dialog box, you'll see information about the values in the field whose heading you clicked.

2. If you want to see statistics for another numeric field, click the Field arrow and click the field's name.
3. Click the Close button when you are finished exploring statistics.

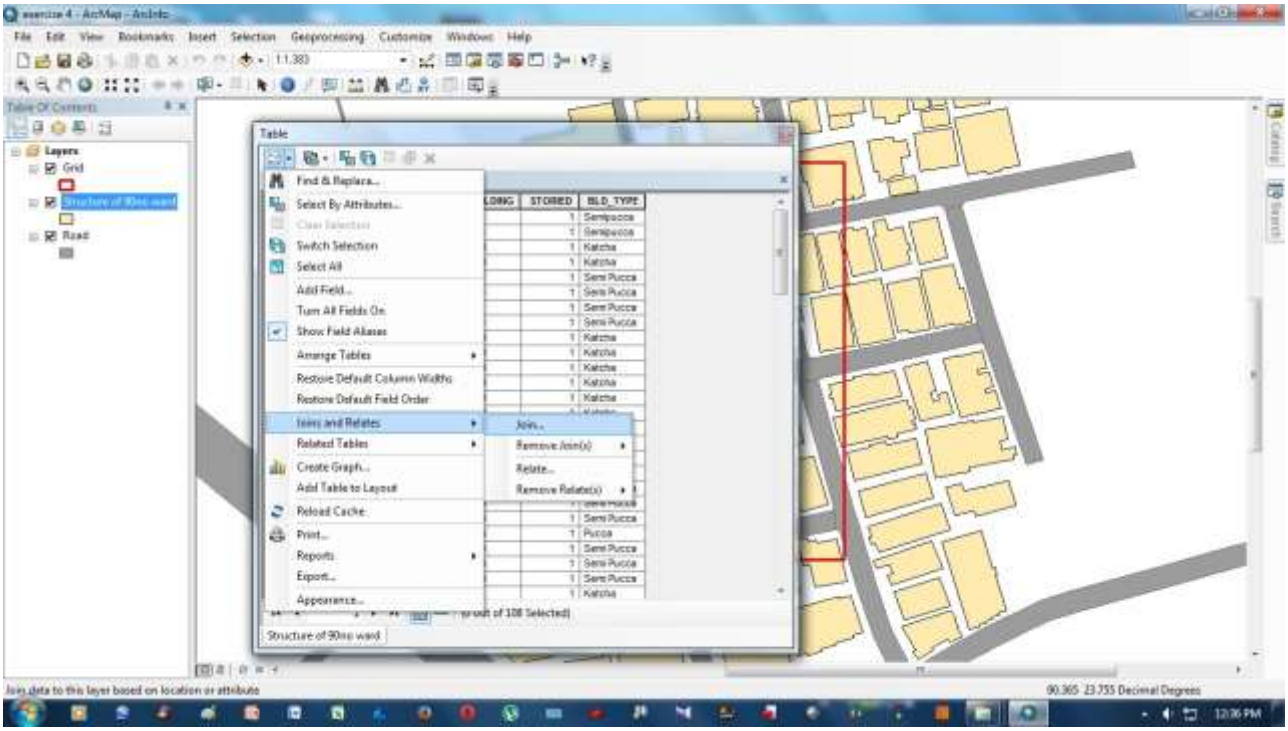


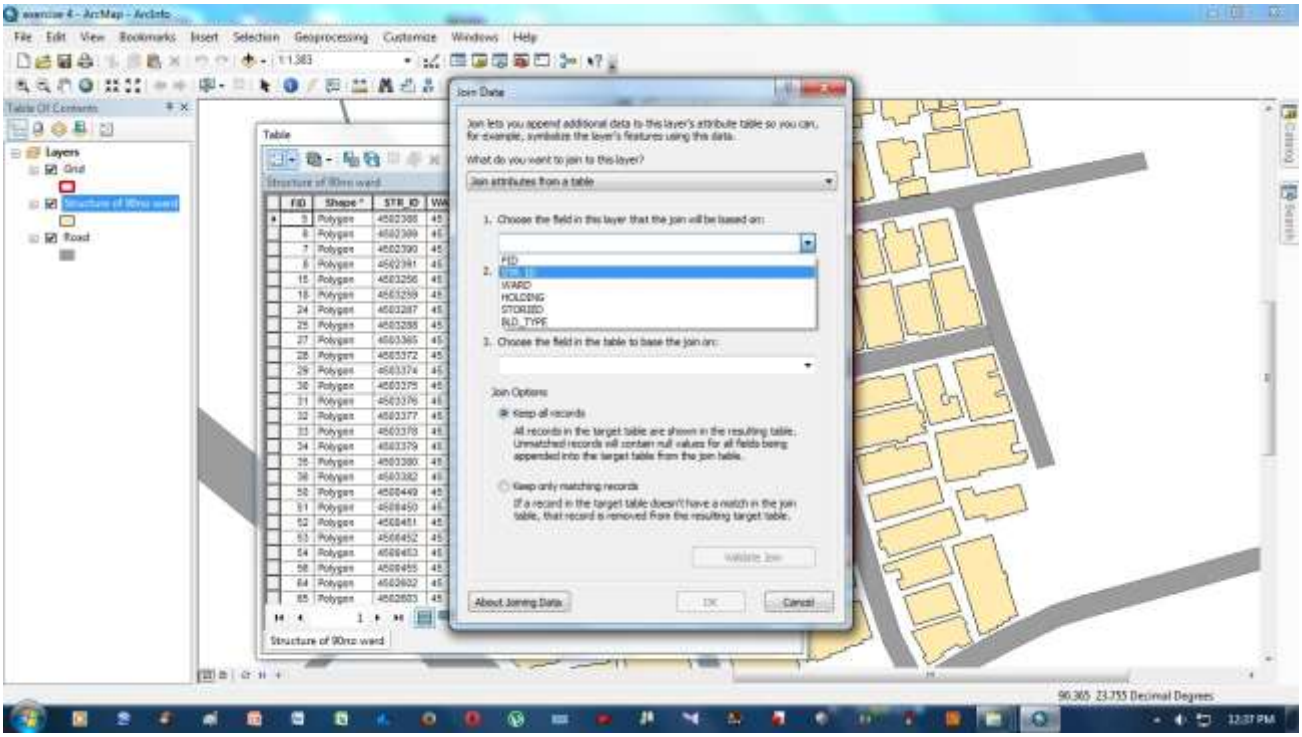


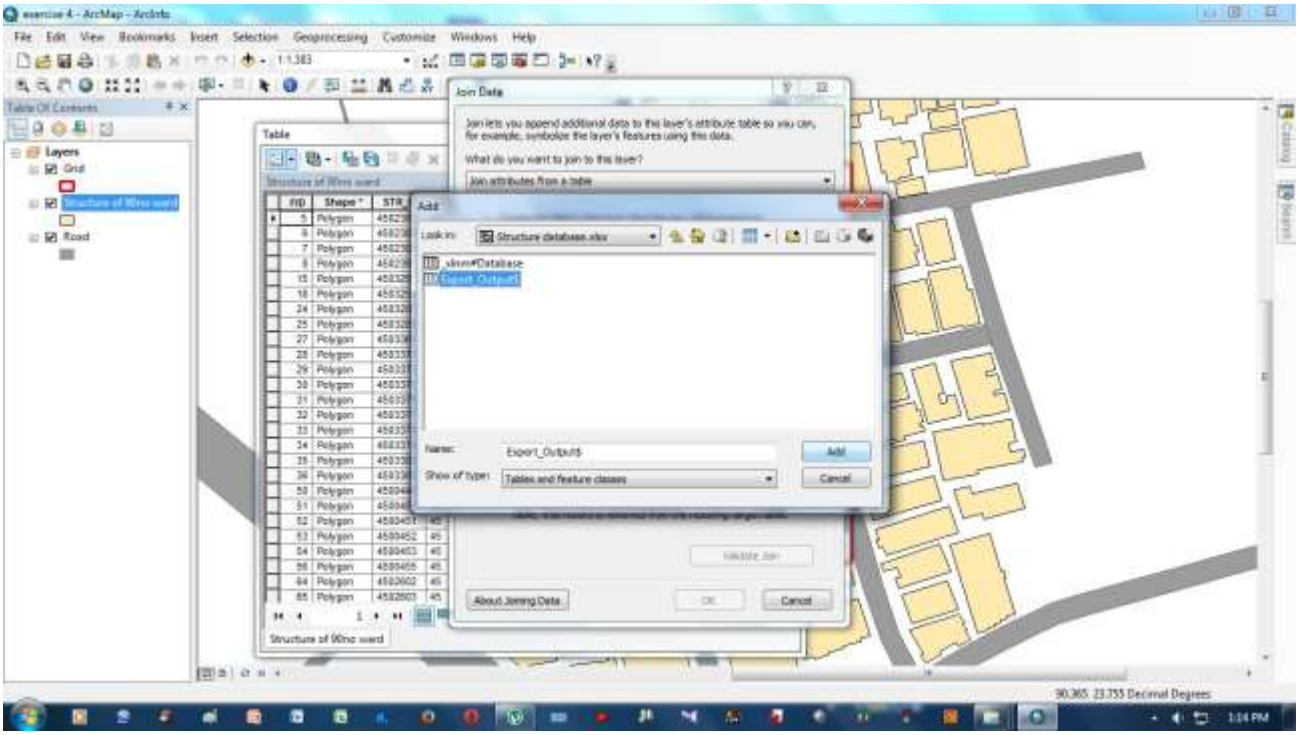
Join data

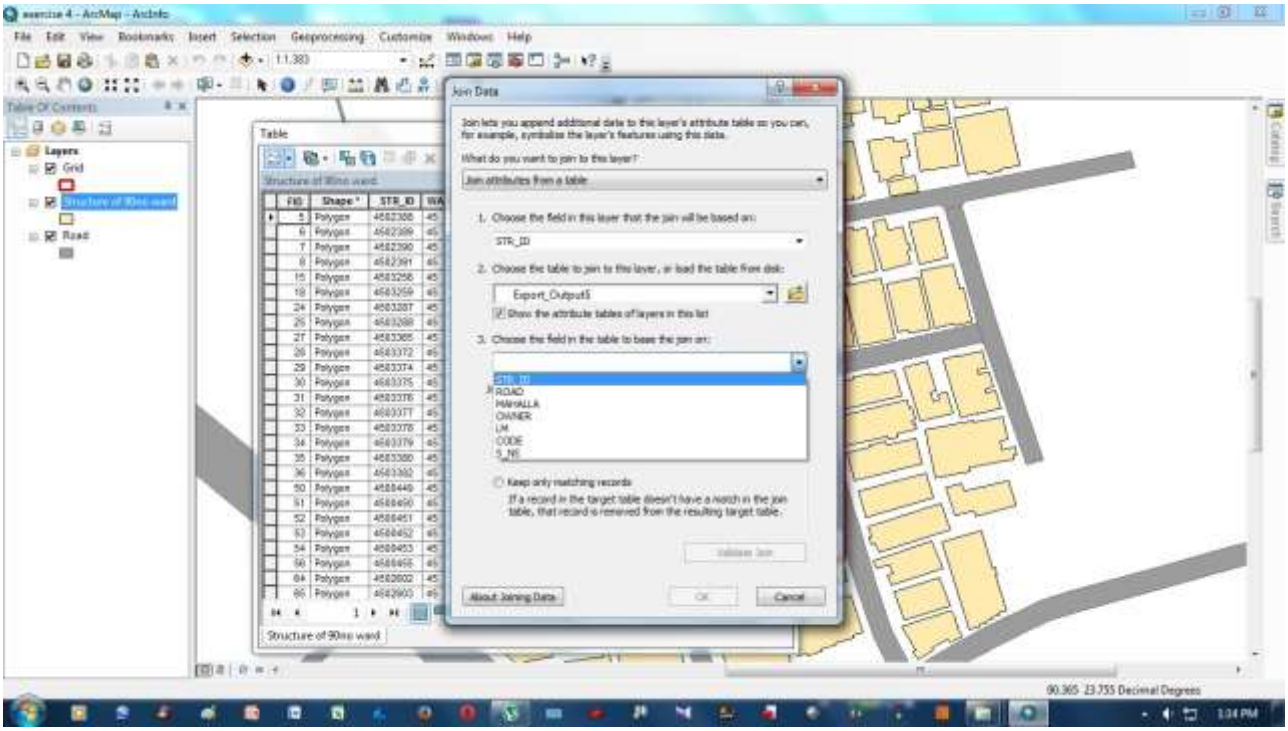
Joins the contents of a table to another table based on a common attribute field. The input table is updated to contain the fields from the join table. You can select which fields from the join table will be added to the input table.

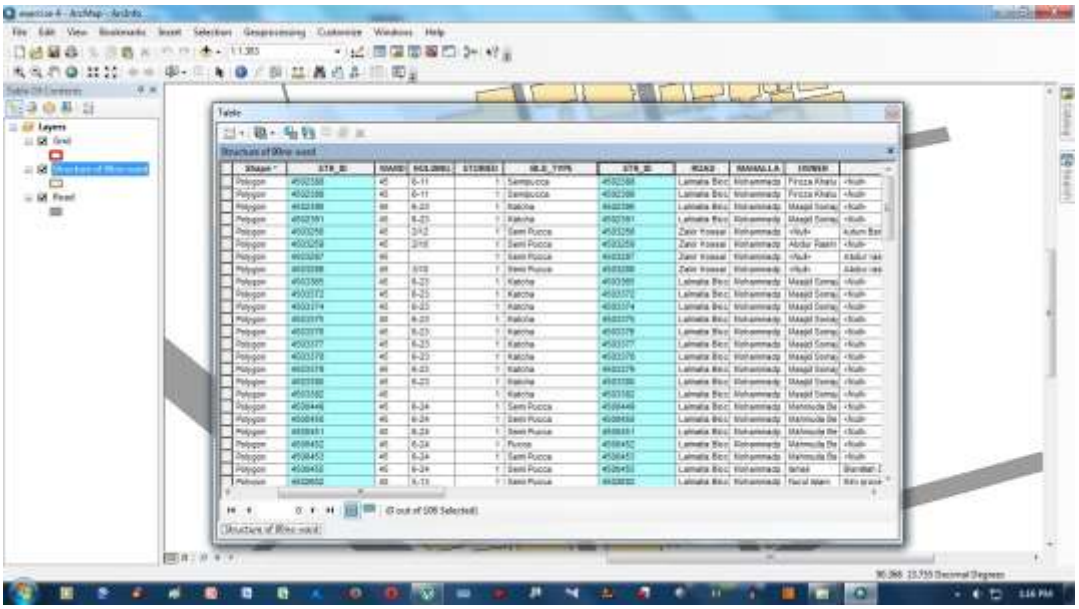
The records in the Input Table are matched to the records in the Join Table based on the values of Input Join Field and the Output Join Field. Optionally, only desired fields can be selected from the Join Table and appended to the Input Table during the join.

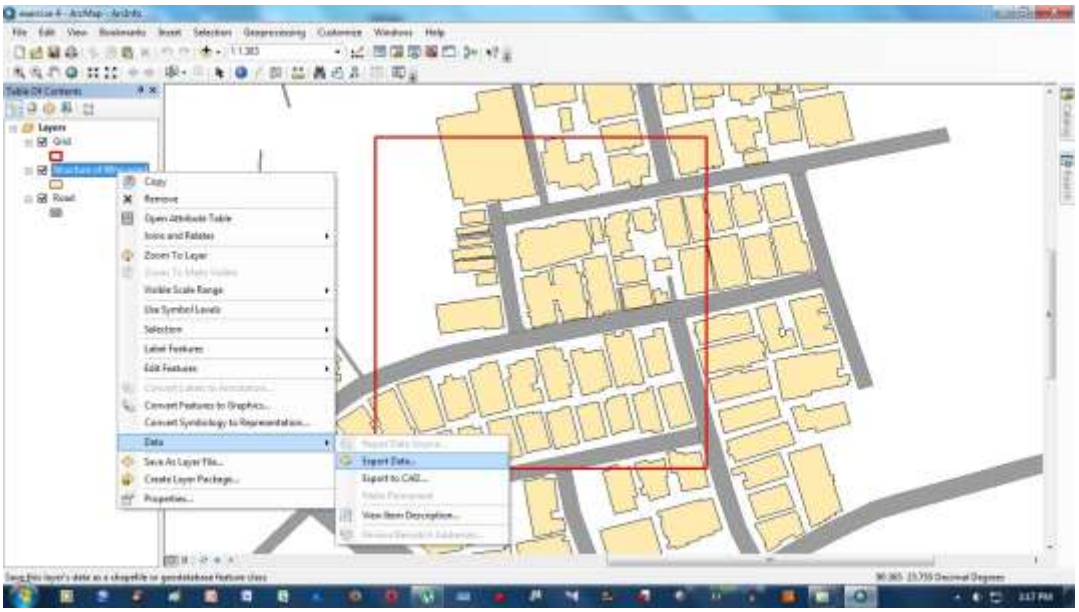


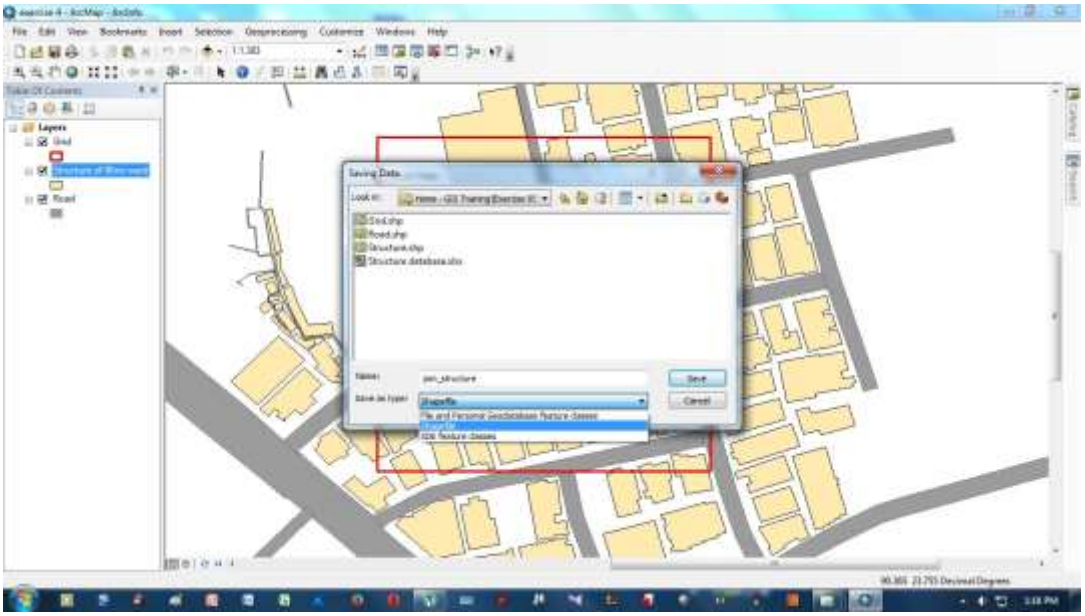



exercise 4 - ArcMap - ArcInfo
File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
Table Of Contents
Layers
Grid
Structure of 90no ward
Road
Table
Structure of 90no ward
Join Data
Join lets you append additional data to this layer's attribute table so you can, for example, symbolize the layer's features using this data.
What do you want to join to this layer?
Join attributes from a table
Add
Look in:
Structure database.xlsx
xlsx$Database
Export_Output$
Name:
Export_Output$
Show of type:
Tables and feature classes
Add
Cancel
About Joining Data
OK
Cancel
90.365 23.755 Decimal Degrees
1:04 PM

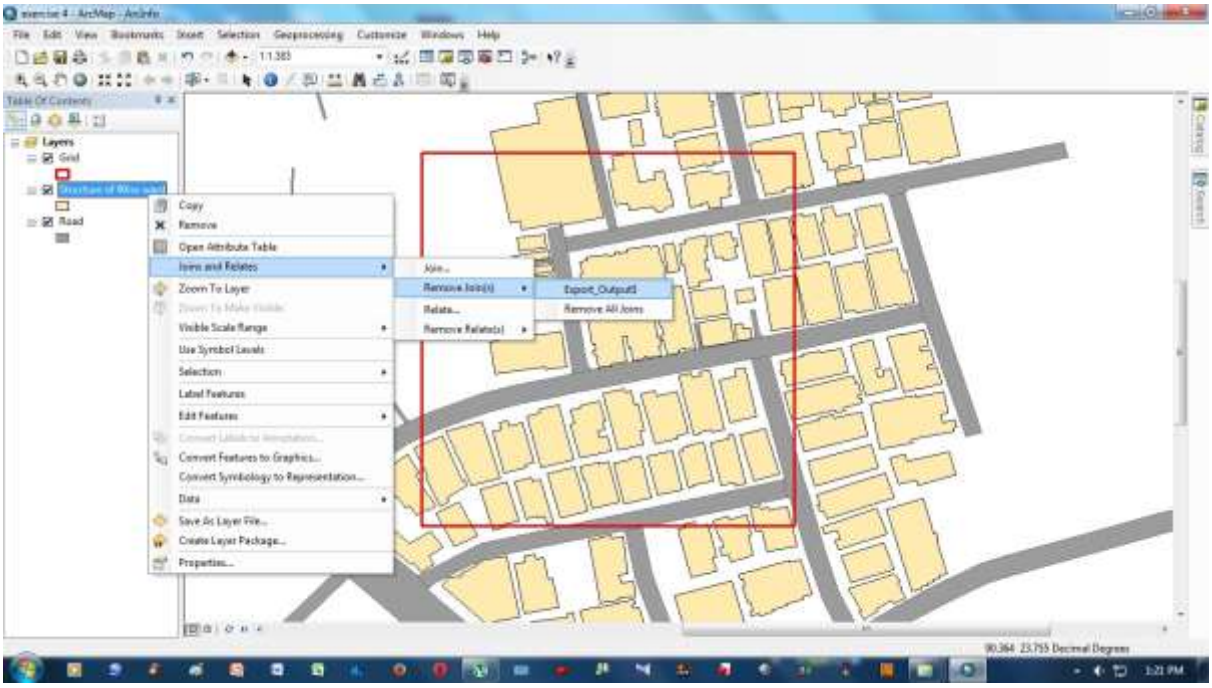

exercise 4 - ArcMap - ArcInfo
File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
Table Of Contents
Layers
Grid
Structure of 90no ward
Road
Table
Structure of 90no ward
Join Data
Join lets you append additional data to this layer's attribute table so you can, for example, symbolize the layer's features using this data.
What do you want to join to this layer?
Join attributes from a table
1. Choose the field in this layer that the join will be based on:
STR_ID
2. Choose the table to join to this layer, or load the table from disk:
Export_Output$
Show the attribute tables of layers in this list
3. Choose the field in the table to base the join on:
STR_ID
ROAD
MAHALLA
OWNER
LM
CODE
S_NE
Keep only matching records
If a record in the target table doesn't have a match in the join table, that record is removed from the resulting target table.
About Joining Data
OK
Cancel
90.365 23.755 Decimal Degrees
1:04 PM



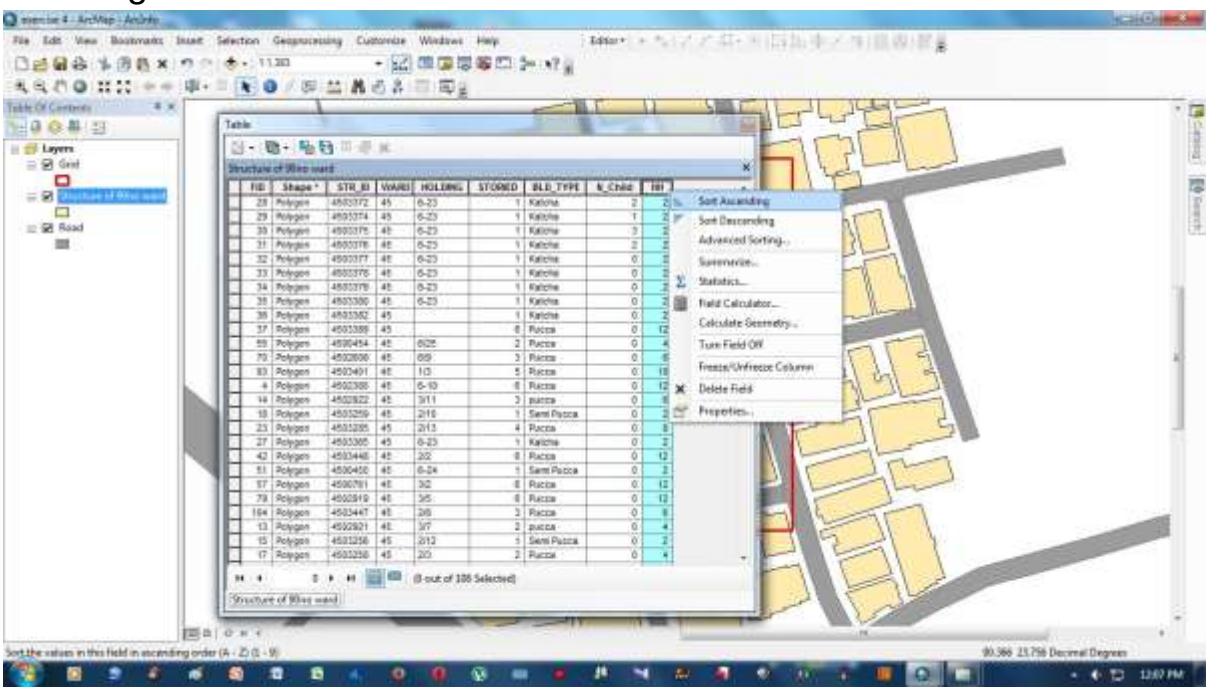




Remove join

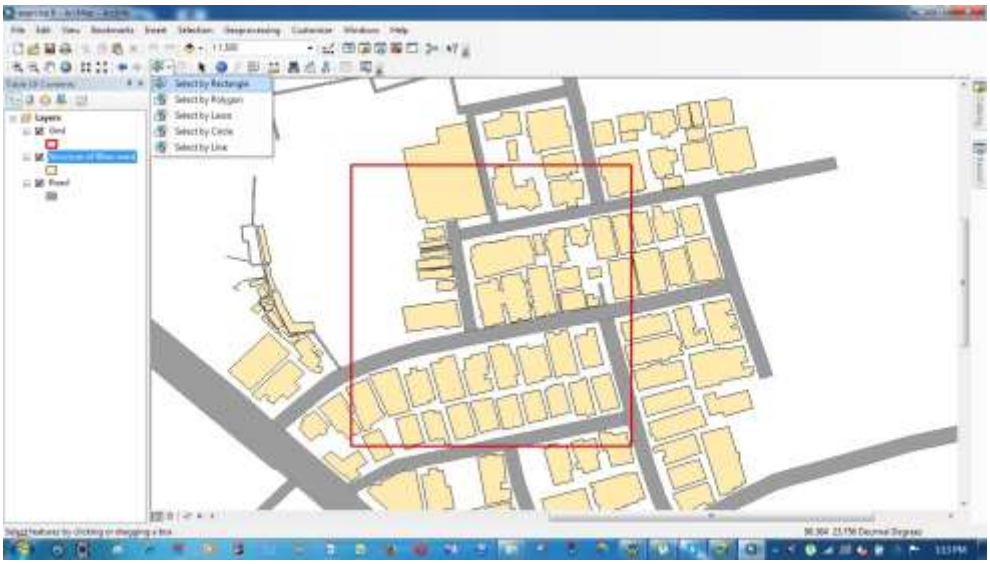


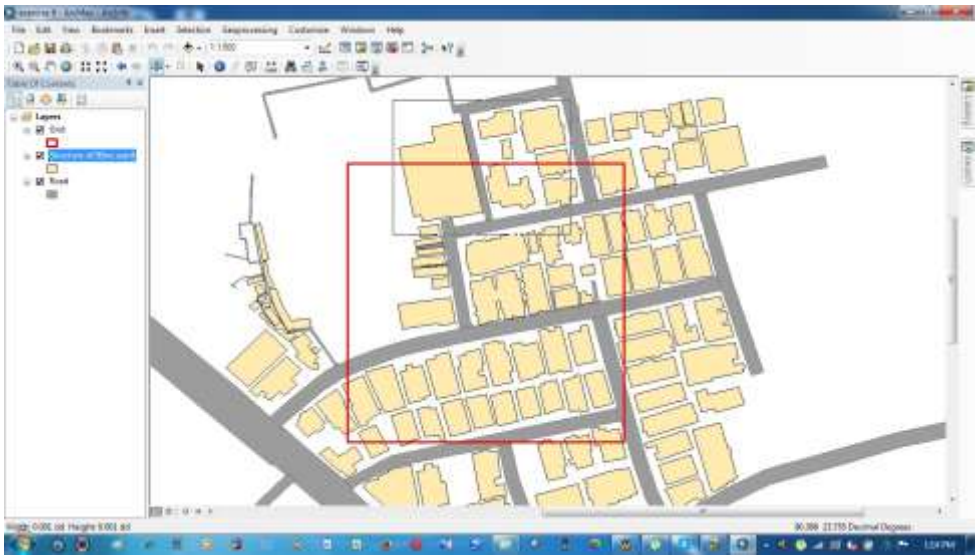
Shorting table

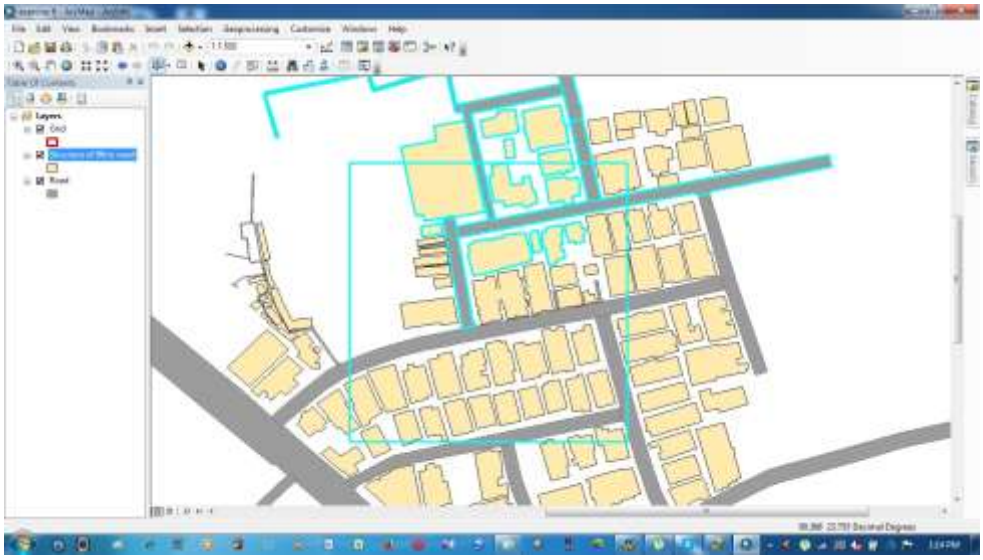


SESSION-6: SELECTIONS AND QUERIES

Selection







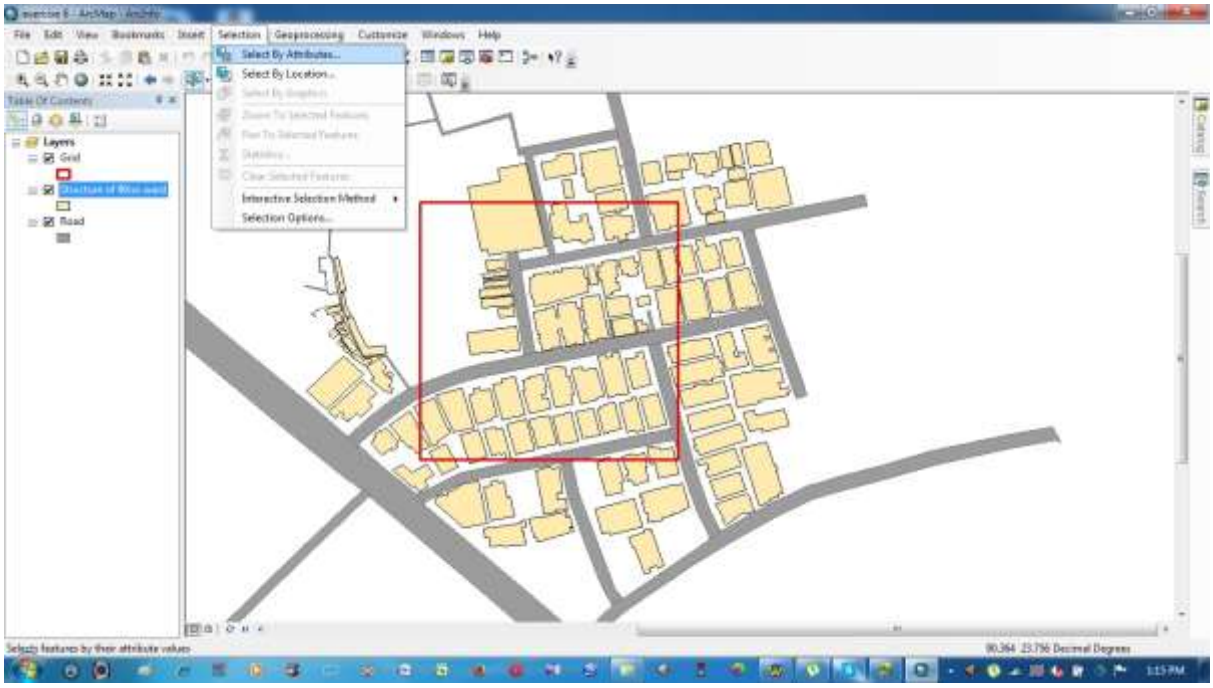
Selection by Attribute

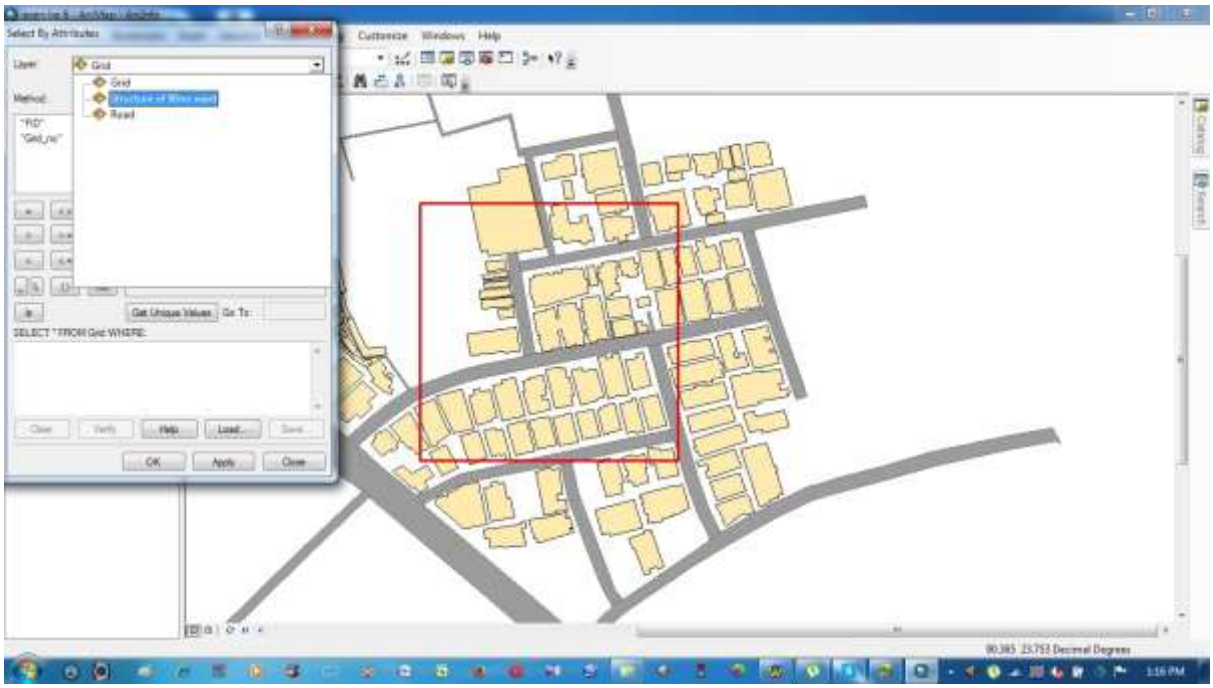
One of the selection methods you can use to select features in a layer is to select features using an attribute query. This is performed using the Select by Attributes tool, which is described here.

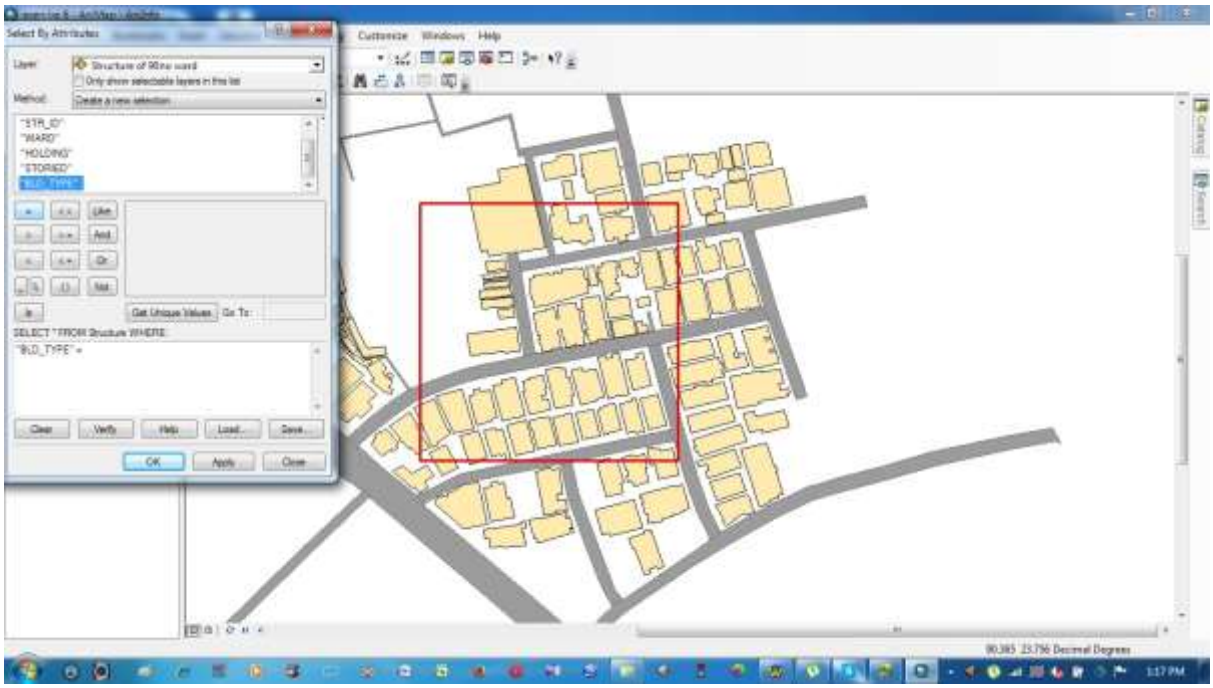
Select by Attributes allows you to provide a SQL query expression that is used to select features that match the selection criteria.

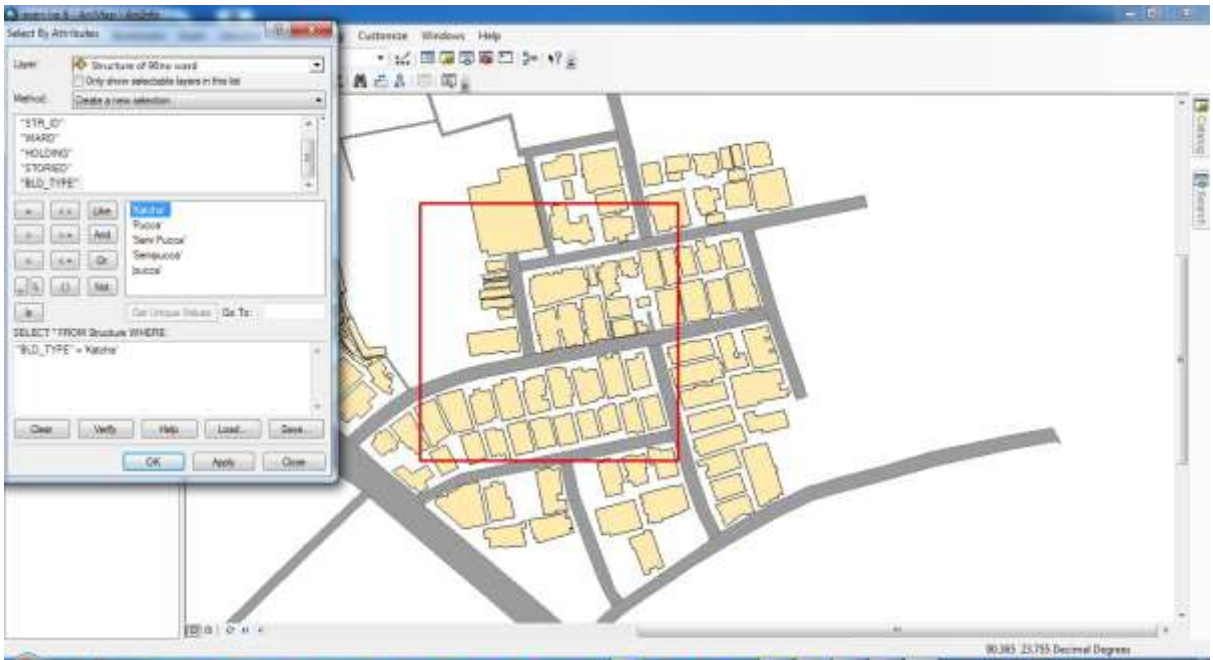
Steps for using Select by Attributes

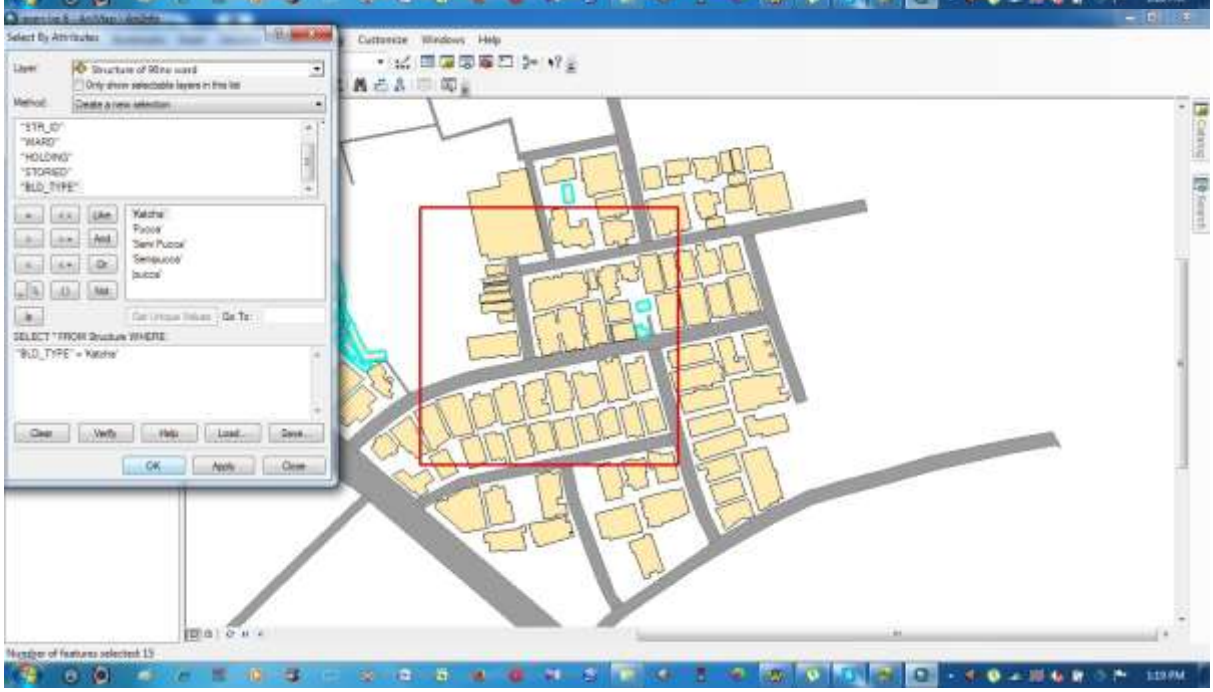
1. Click Selection > Select by Attributes to open the Select by Attributes dialog box.
2. Choose the layer to perform the selection against.
3. Specify the selection method.
4. Enter a query expression using one of the following methods:
    a. Create a query using the expression building tools.
    b. Type a query into the selection window.
    c. Load a query saved to disk.
5. Validate your query expression by clicking Verify.
6. Click OK or Apply to execute your selection expression and work with the selection results.
7. Optionally, you can save your query expression for later reuse before closing this dialog box.

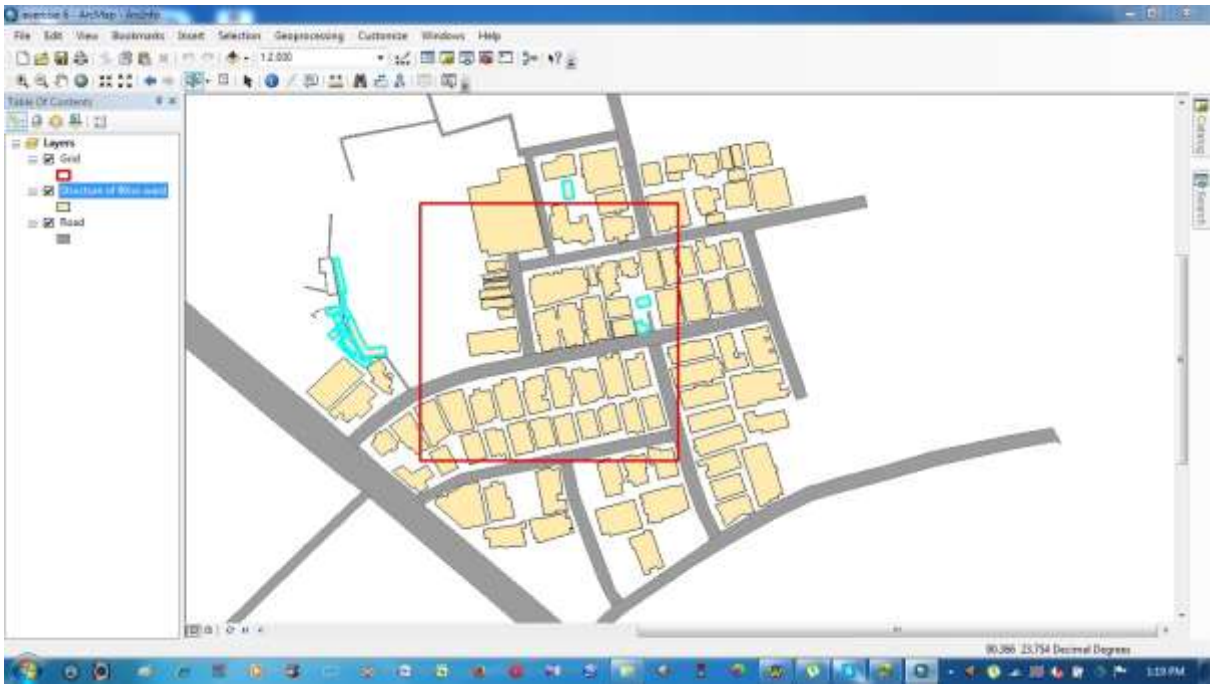



Select By Attributes
Customize
Windows
Help
Layer
Grid
Structure of Wire ward
Road
Method
Get Unique Values
Go To:
SELECT * FROM Grid WHERE:
Clear
Verify
Help
Load...
Save...
OK
Apply
Close


Select By Attributes
Customize
Windows
Help
Layer
Structure of Wire ward
Only show selectable layers in this list
Method
Create a new selection
"STR_ID"
"WARD"
"HOLDING"
"STORIED"
"BLD_TYPE"
Get Unique Values
Go To:
SELECT * FROM Structure WHERE:
"BLD_TYPE" =
Clear
Verify
Help
Load...
Save...
OK
Apply
Close


Select By Attributes
Customize
Windows
Help
Layer
Structure of Wine ward
Only show selectable layers in this list
Method:
Create a new selection
"STR_ID"
"WARD"
"HOLDING"
"STORIED"
"BLD_TYPE"
Kaccha
Pucca
Semi Pucca
Semipucca
pucca
Clear
Verify
Help
Load...
Save...
OK
Apply
Close
SELECT * FROM Structure WHERE:
"BLD_TYPE" = 'Kaccha'
90.385 23.755 Decimal Degrees
1:18 PM


Select By Attributes
Customize
Windows
Help
Layer
Structure of Wine ward
Only show selectable layers in this list
Method:
Create a new selection
"STR_ID"
"WARD"
"HOLDING"
"STORIED"
"BLD_TYPE"
Kaccha
Pucca
Semi Pucca
Semipucca
pucca
Clear
Verify
Help
Load...
Save...
OK
Apply
Close
SELECT * FROM Structure WHERE:
"BLD_TYPE" = 'Kaccha'
Number of features selected: 15
1:19 PM



Select by Location

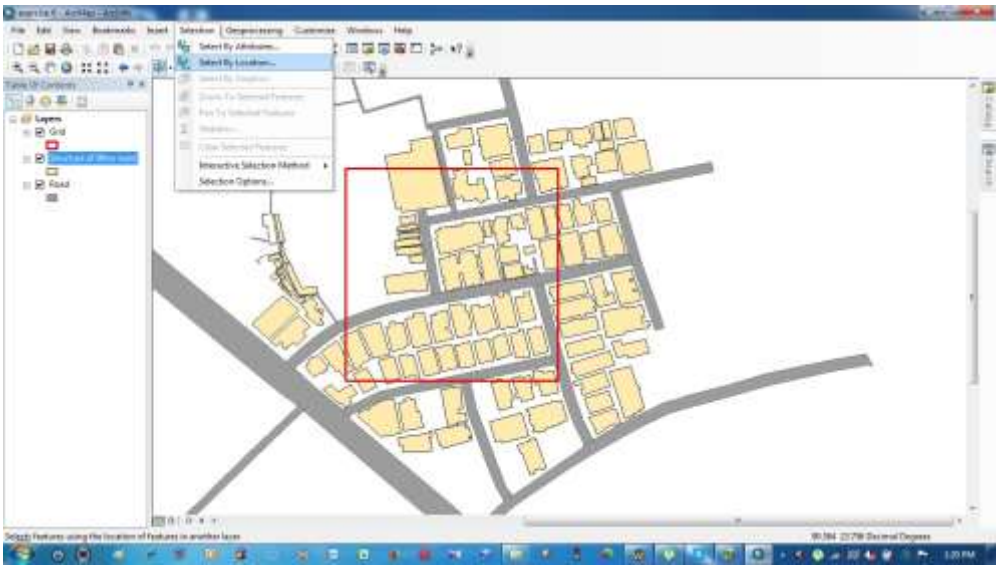
The Select by Location tool lets you select features based on their location relative to features in another layer. For instance, if you want to know how many homes were affected by a recent flood, you could select all the homes that fall within the flood boundary.

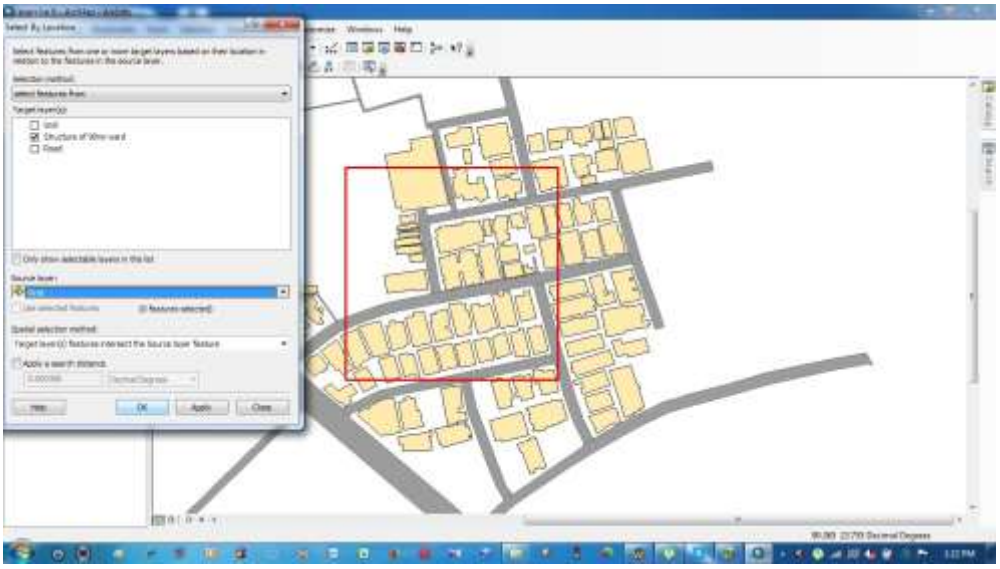
You can use a variety of selection methods to select the point, line, or polygon features in one layer that are near or overlap the features in the same or another layer.

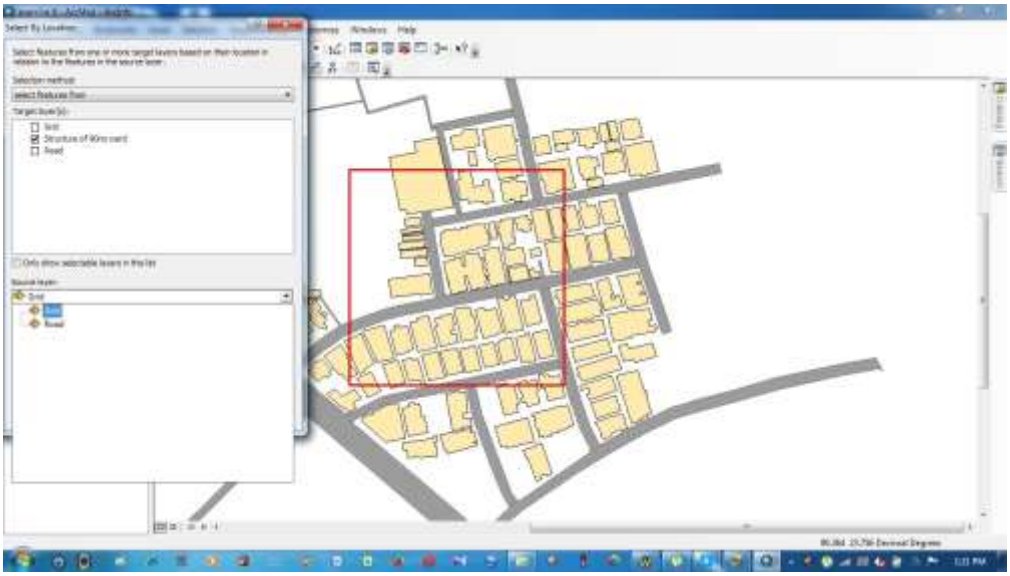
Steps for using Select by Location

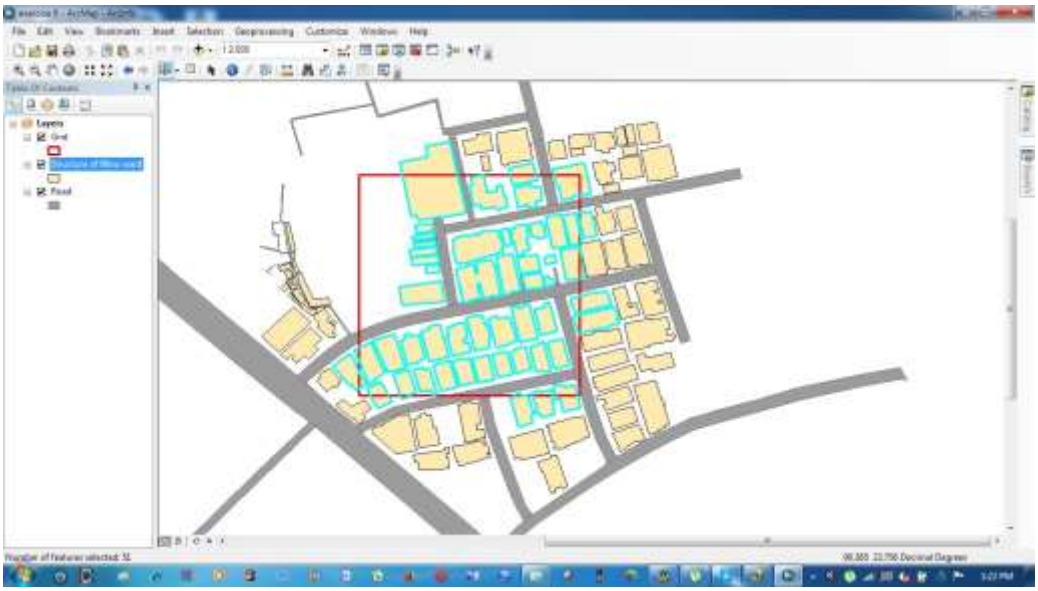
Use the following steps to apply the Select By Location tool. Note that you select features from a layer (or a set of layers) that have a spatial relationship with features from a source layer. For example, select features from USA Counties that touch the boundary of the features in the layer named "Texas." The dialog box guides you in specifying each selection property.

1. Click Selection > Select By Location to open the Select by Location dialog box.
2. Choose the type of selection that you want to make. Click the drop-down arrow to see your choices.
3. Identify the target layer(s) from which features will be selected and check them on.
4. Choose the spatial relationship rule that will be used for selection.
5. Specify the source layer that will be used to select features from the target layer.
6. To complete your Select by Location specification, you can optionally specify if you want to
    a. Use selected features in the source layer to identify the features to select.
    b. Use a buffer distance in your search (buffer distances are only used with some selection options).

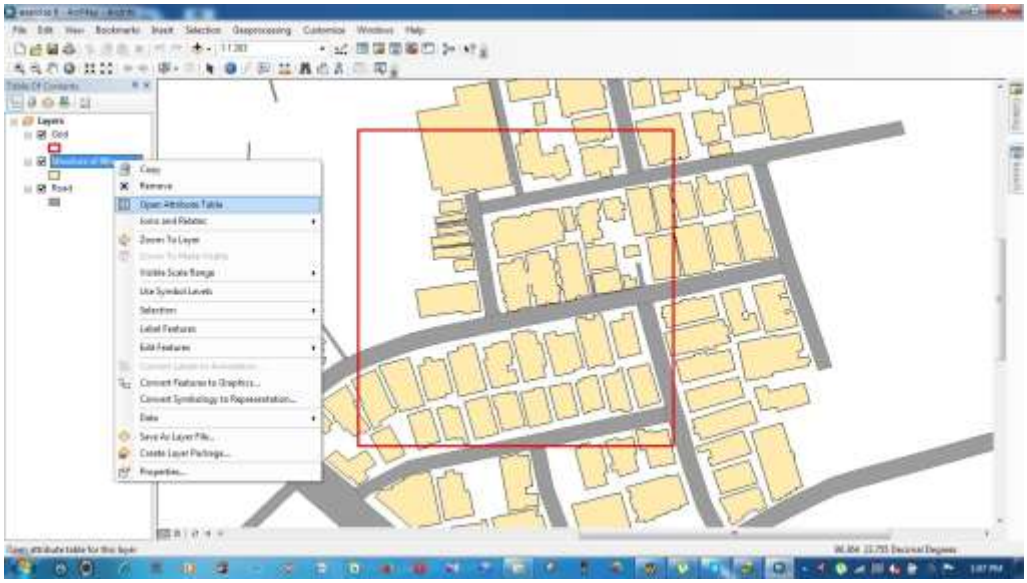


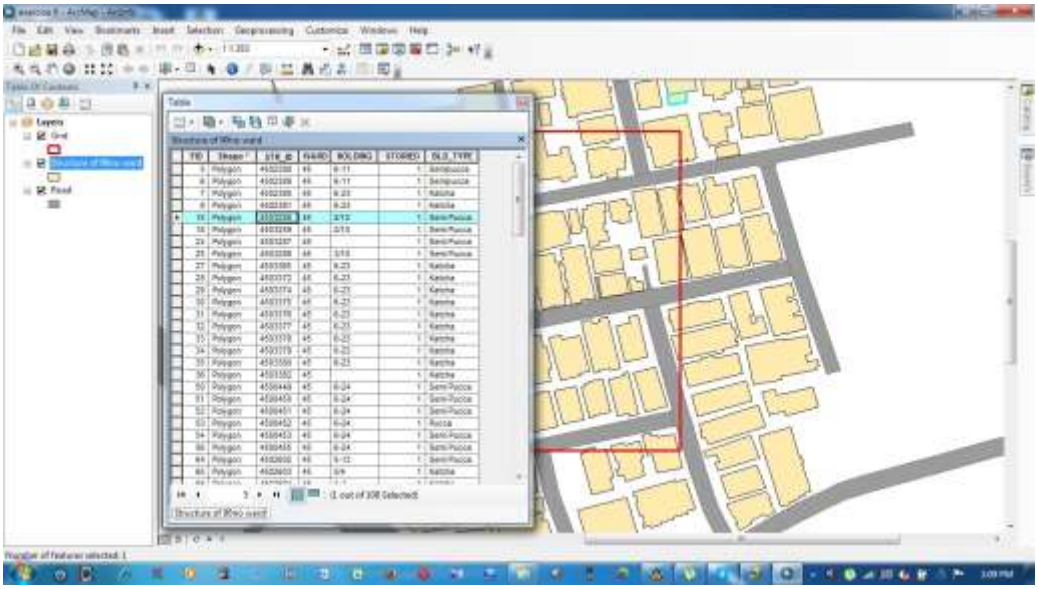


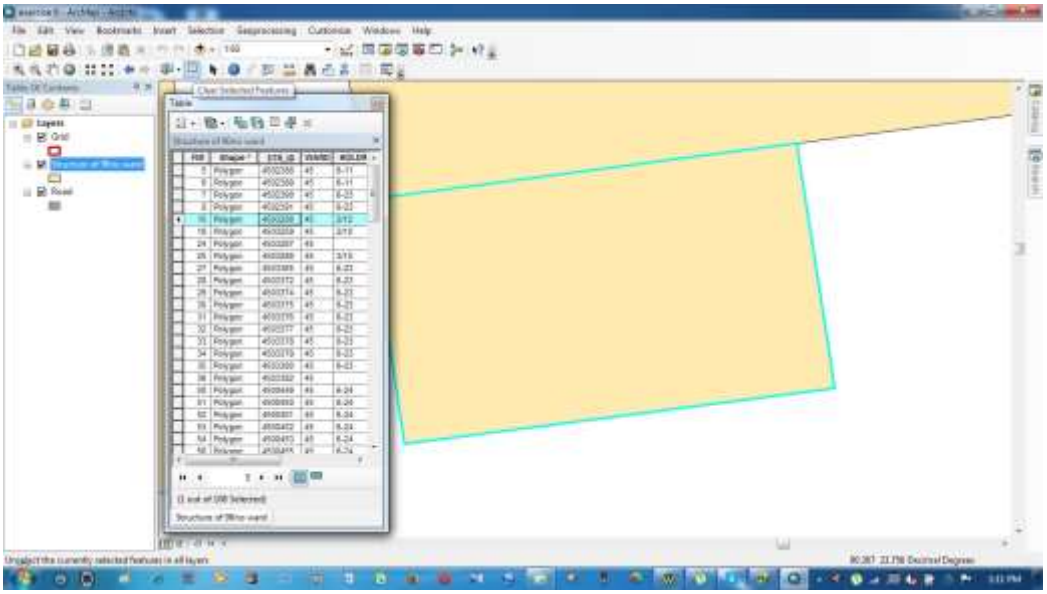


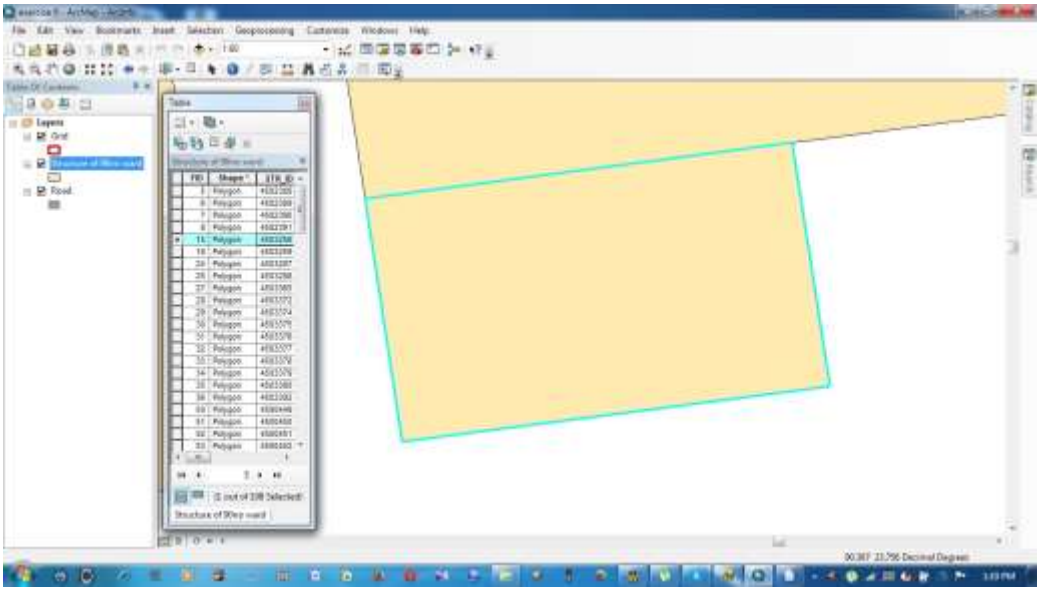


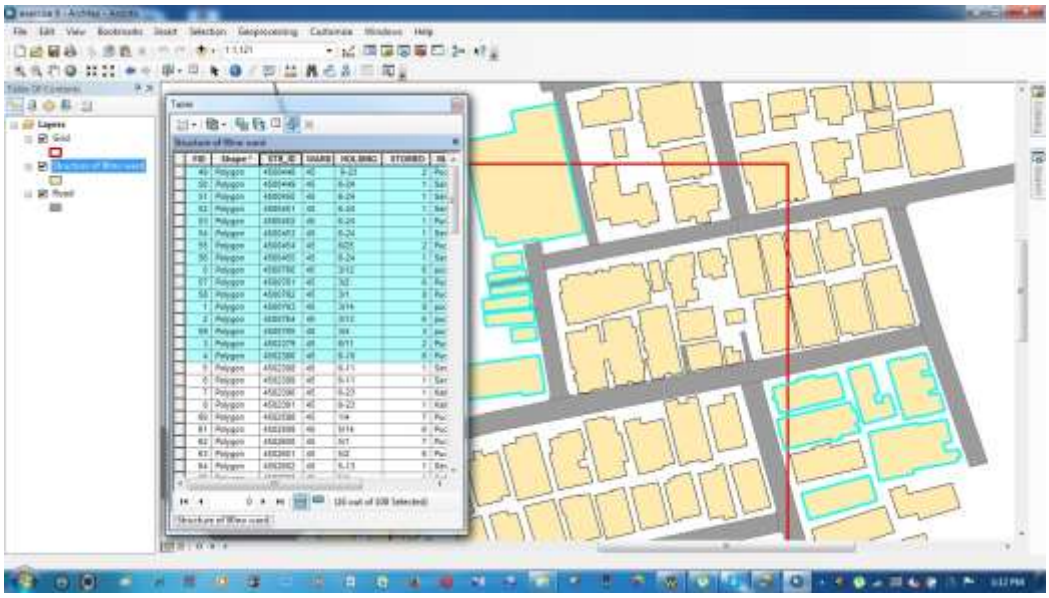
Selection from attribute Table











SESSION-7: GEOREFERENCING A SCANNED MAP

You first have to a connection to the folder of the scanned jpg image . open the image jpg on Arcmap

You will navigate around the map by experimenting with the zoom and navigation tools:

1. Adjust the scale of the view with the  Zoom In  and Zoom Out tools.

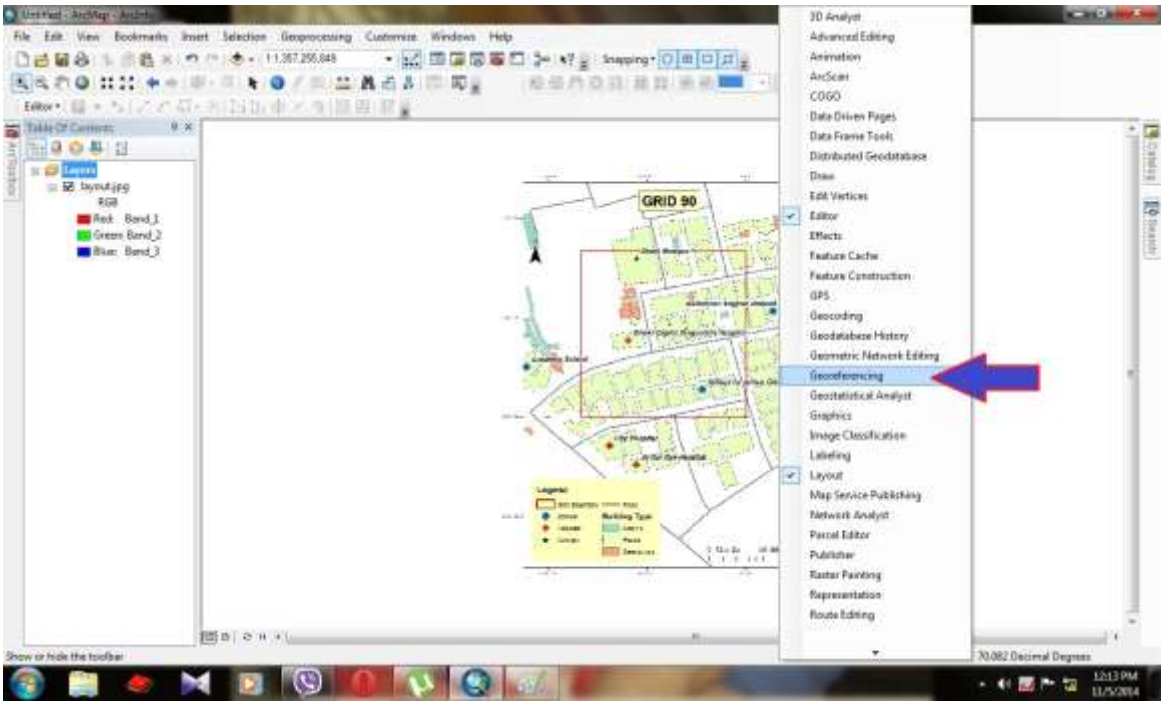
2. Zoom in at a fixed increment with the other two  and ). zooming tools

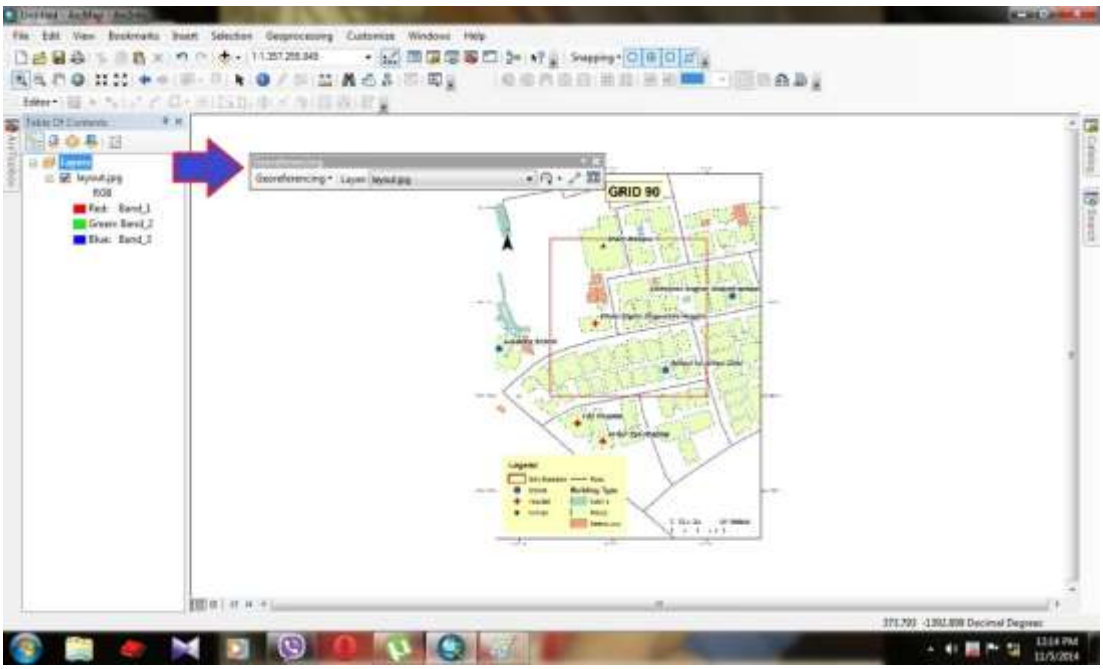
3. To zoom out to a scale that encompasses all of the data in the map, click  Zoom to Full Extent

4. To zoom out to the full extent of a single layer, right-click that layer's name and chooses Zoom to Layer.

Georeferencing scanned maps

1. To begin with we must activate the Georeferencing toolbar in ArcMap.
- Right click on a gray area at the top of the screen. For example, under the toolbars
- Then choose "Georeferencing"
- This will activate the Georeferencing toolbar





2. First, find the projection and datum for the map.

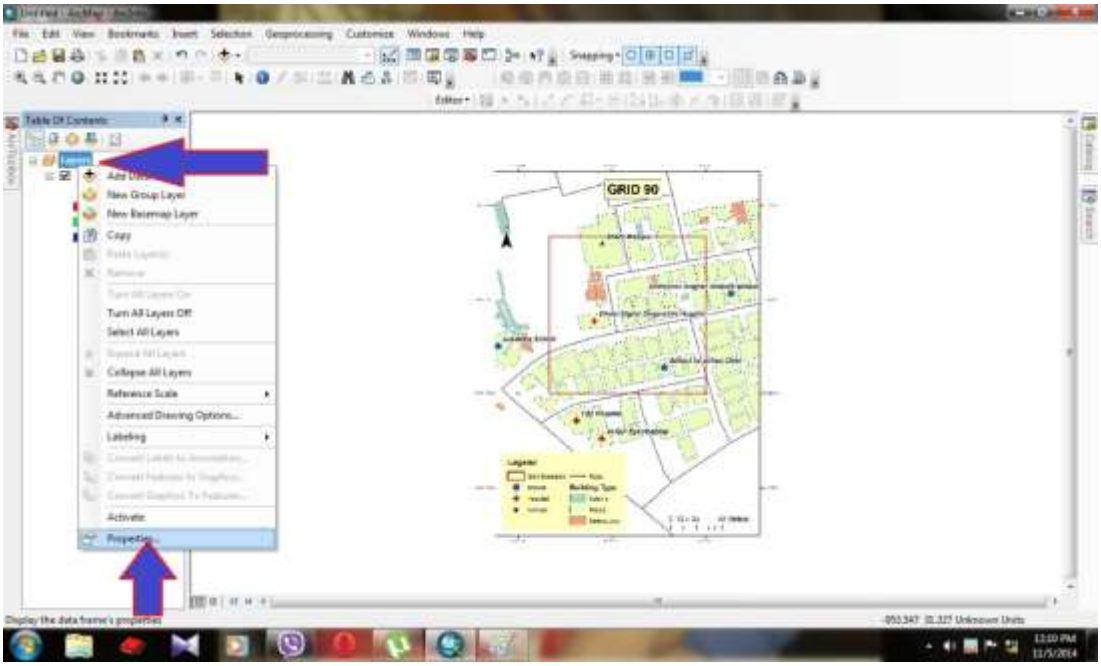
i. Make sure (the bottom half) is visible.

ii. Zoom to the bottom and look at the coordinates.

3. These are clearly in Latitude and Longitude, so we are dealing with a Geographic Coordinate System.

4.Access the Data Frame Properties by either double clicking Layers in the Table of Contents or right clicking and choosing Properties

- Go to the Coordinate System tab. It should initially say No Coordinate System under the Current Coordinate System: section
- In the top part of the window, navigate to Geographic Coordinate Systems → Everest Bangladesh



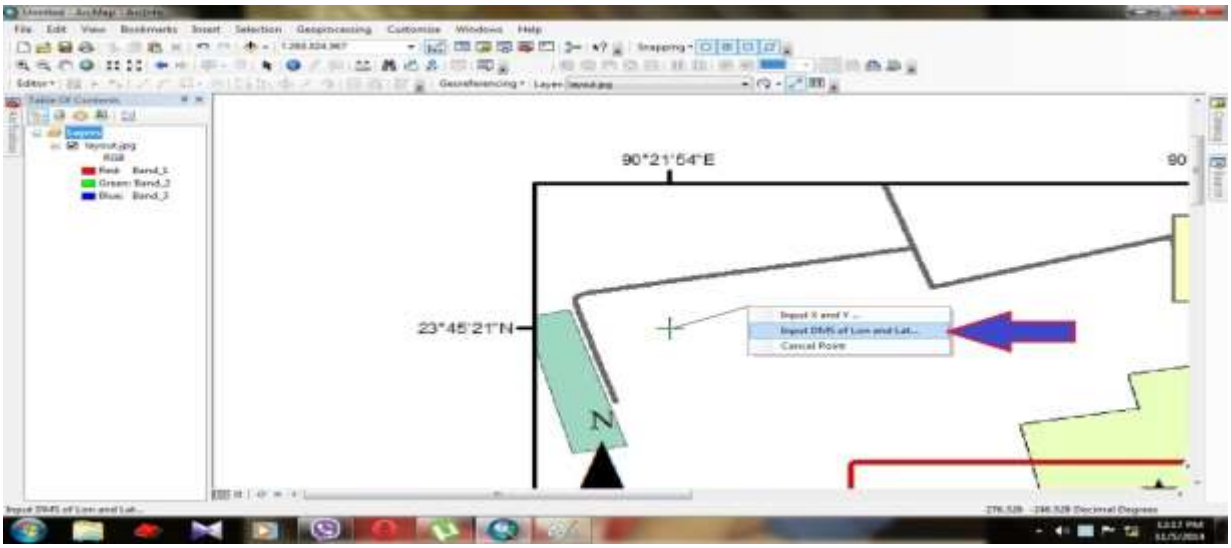
5.Now we will begin defining Ground Control Points and telling ArcMap the coordinates for them

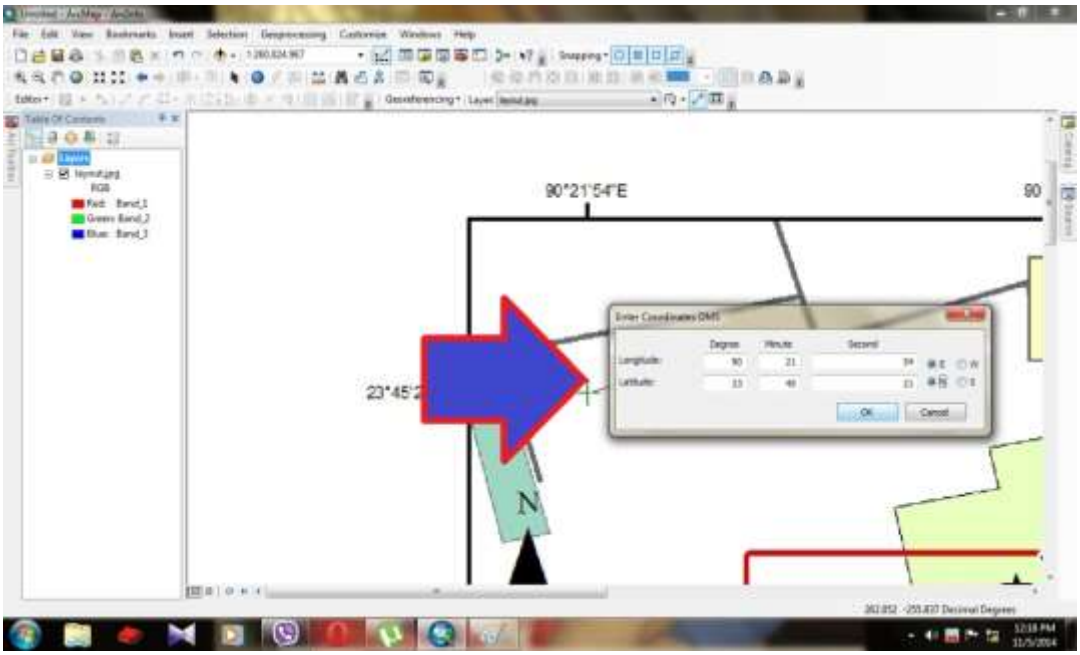
- We need 4 Control Points in the jpg image which are located in tic mark in 4 corners.
- Activate the Add Control Points tool ( ) and click once on the bottom left corner of the map
- If you move the mouse it should now show you the line connected to that point.
- To set the coordinate, right click on the corner of the map and choose Input DMS of Lat/Long

  If you have a map in decimal degrees or UTM you would choose the other option
- Enter the coordinates as shown on the map and choose OK.

  - Longitude is 90° 21' 54" East

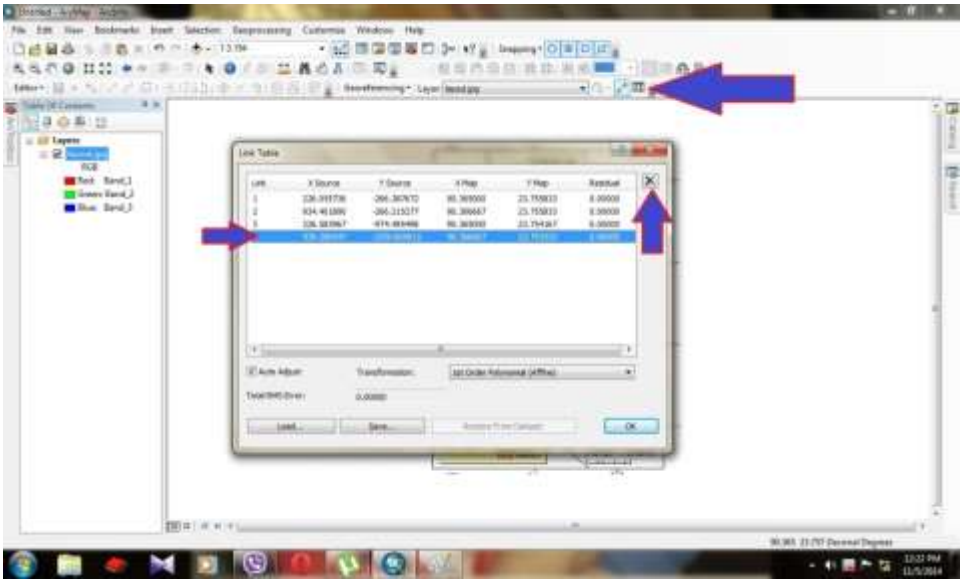
  - Latitude is 23°45' 21" North





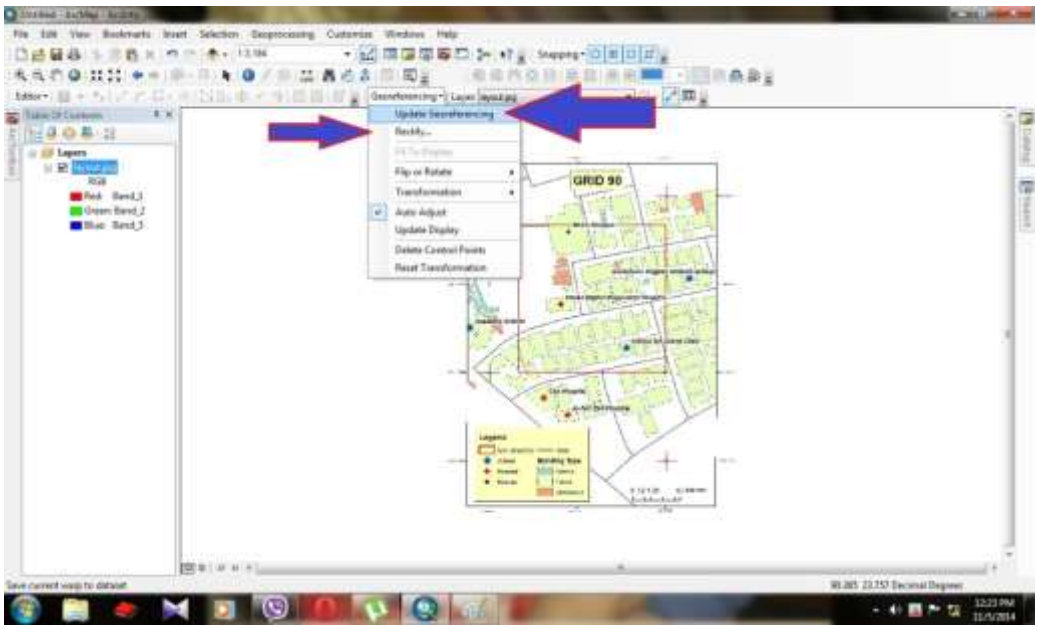
- The map should now disappear, it has moved to its accurate location.
- To find it again right click on the layer in the Table of Contents and choose Zoom to Layer Extent
- Now zoom in on the bottom right corner and enter that coordinate and repeat the previous steps for the other points.

- If error occur than check the error using display the GCPs by clicking the button on the Georeferencing toolbar

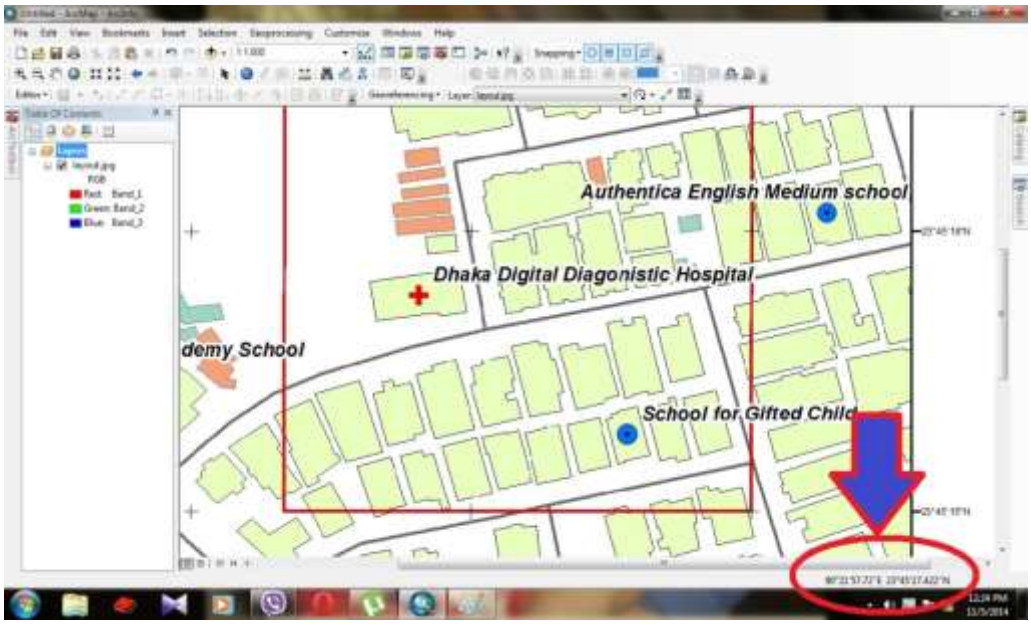


- Now, you can either save this referencing information to display the image or totally change the file.
- To update the referencing information of the file choose Georeferencing → Update Georeferencing

- To save everything in a new file choose Georeferencing → Rectify



- Now we can see that the in-degree minute second shows in the lower part of the Arcmap window



SESSION-8: CREATING AND EDITING LAYERS

Creating new Shapefile

You can create new shapefiles in ArcCatalog or by using the Create Feature Class tool. When you create a new shapefile, you must define the types of features it will contain, whether those features will represent routes (m-values), and whether those features will be three-dimensional (z-values). These properties can't be modified after the shapefile has been created. You can also define the coordinate system of the shapefile. If you choose to define the shapefile coordinate system later, it will be classified as Unknown until then.

The process of defining the new shapefile's attributes is separate from creating the shapefile itself. After creating the item, define its attributes by right-clicking it in ArcCatalog and clicking Properties. Because it must contain at least one attribute column, ArcCatalog adds a default column to the shapefile when it is created. For shapefiles, an integer column named Id is added as an attribute. Add the appropriate attributes to your shapefile. After the new attributes have been added as part of the shapefile, you can delete the default column if you decide you don't want to use it.

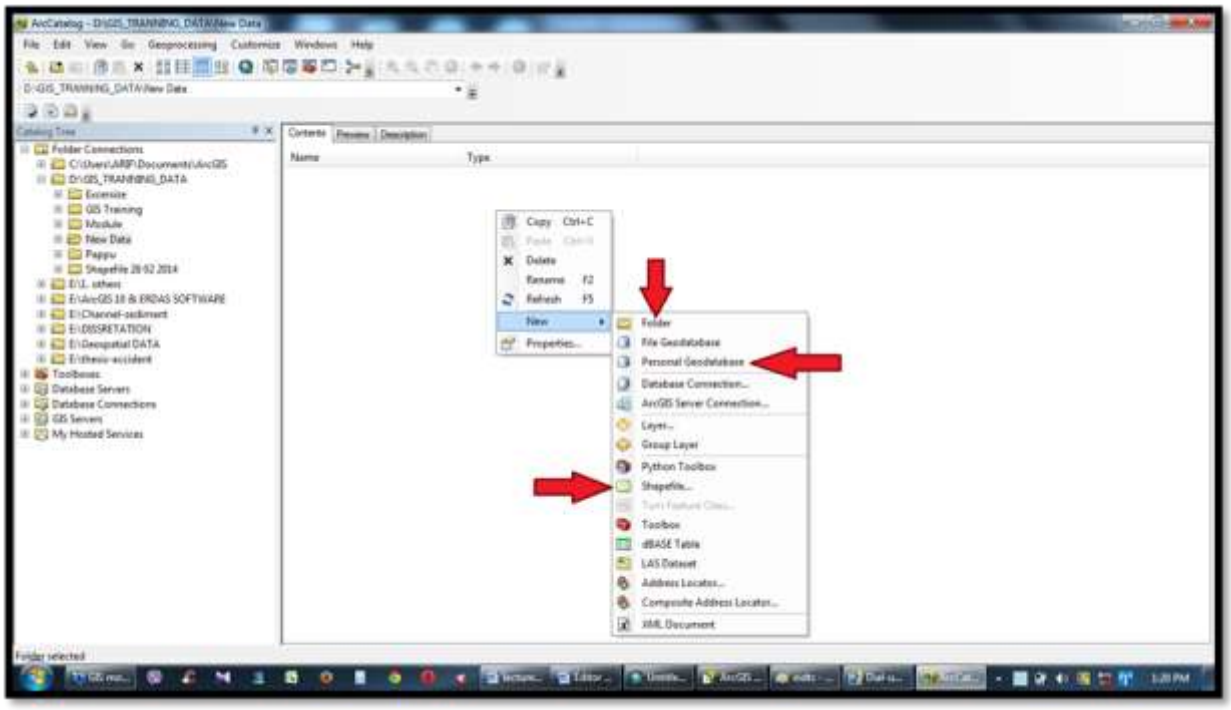
Steps:

1. Select a folder or folder connection in the Catalog tree.
2. Click the File menu, point to New, then click Shapefile.
3. Click in the Name text box and type a name for the new Shapefile.
4. Click the Feature Type drop-down arrow and click the type of geometry the shapefile will contain.
5. Click Edit to define the shapefile's coordinate system.
6. Select, import, or define a new coordinate system.

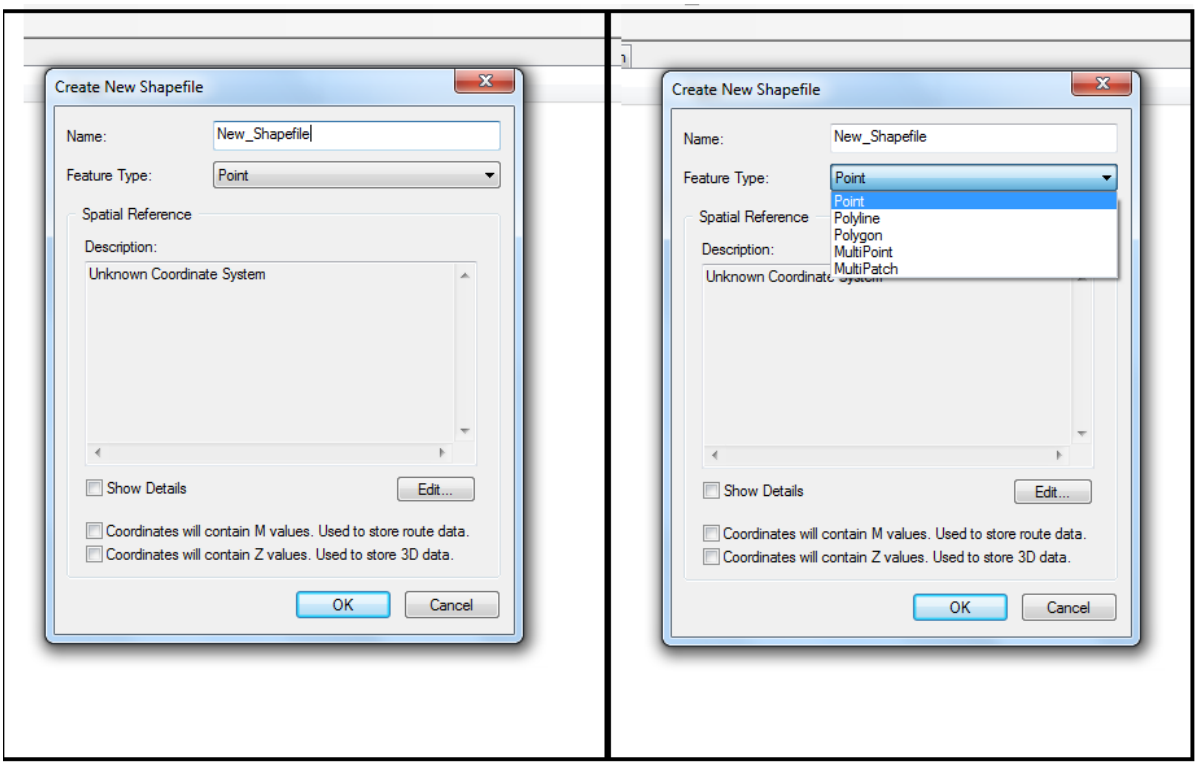
   It's highly recommended that you define the shapefile's coordinate system now; however, you can postpone this step until a later time. For more information, see Fundamentals of a shapefile's coordinate system.

7. Click OK.
8. If the Shapefile will store polylines representing routes, check Coordinates will contain M values.
9. If the Shapefile will store three-dimensional features, check Coordinates will contain Z values.
10. Click OK.

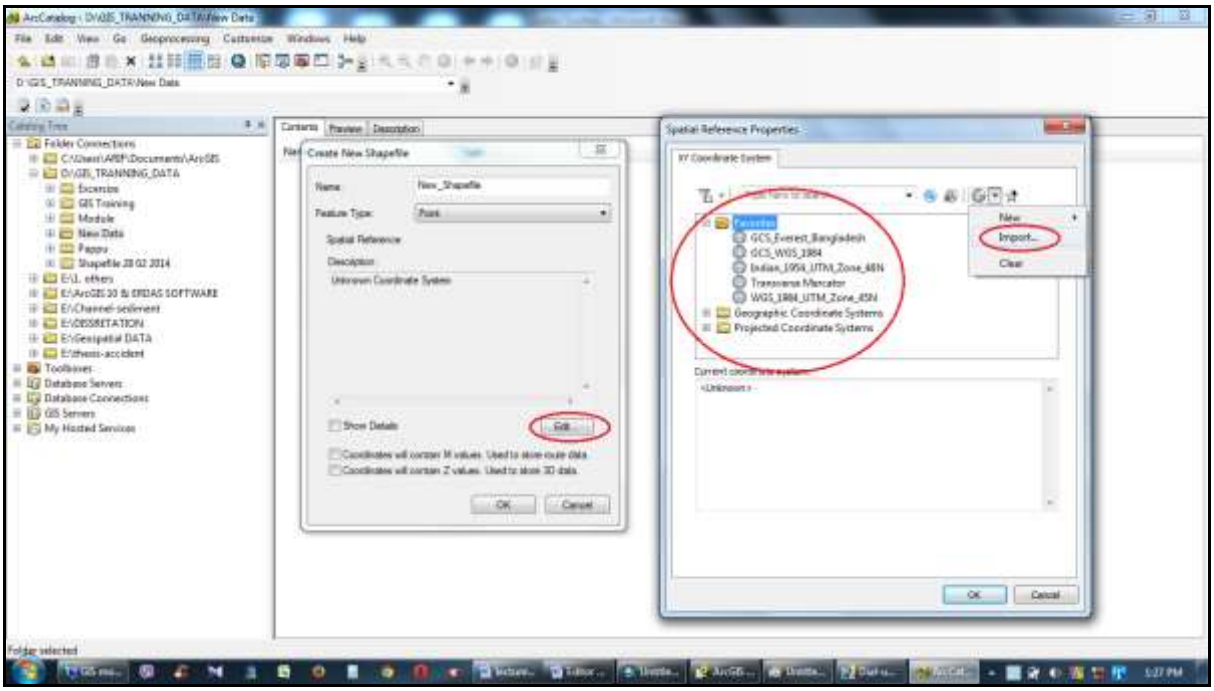
The new Shapefile appears in the folder's contents.



Create New Shapefile



Coordinate System



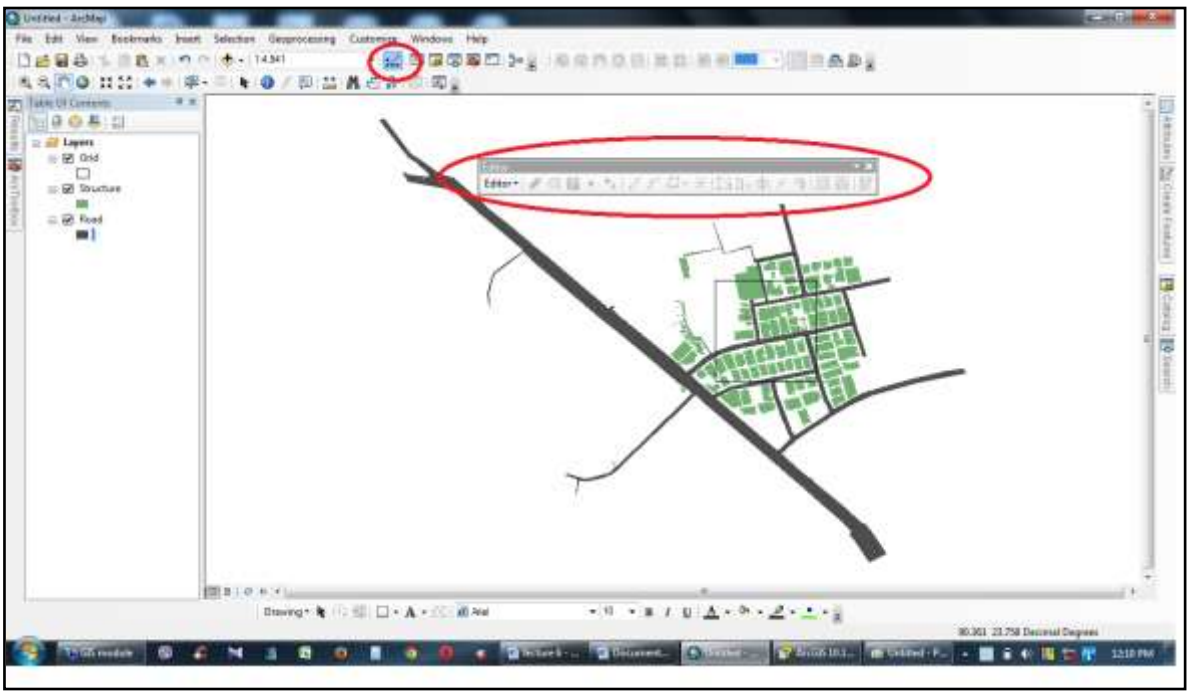
Adding the Editor Toolbar

The Editor toolbar contains the various commands you will need to edit your data. From the Editor toolbar, you can start and stop an edit session, access a variety of tools and commands to create new features and modify existing ones, and save your edits. To edit data, you need to add the Editor toolbar to ArcMap by clicking the Editor Toolbar button on the Standard toolbar.

To use additional or more specialized editing tools, you must add other editing toolbars to ArcMap. These include Advanced Editing, COGO, Geometric Network Editing, Representation, Route Editing, Spatial Adjustment, Topology, and Versioning.

Steps:

1. Start ArcMap.
2. Click the *Editor Toolbar* button  on the *Standard* toolbar to display the Editor Toolbar.



Editor Toolbar

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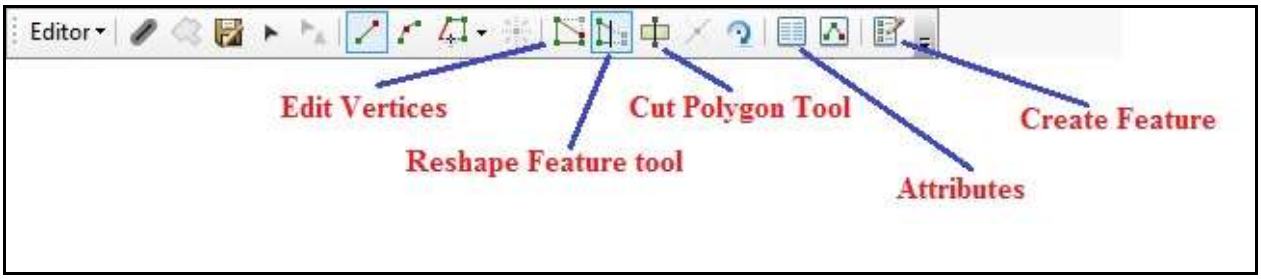
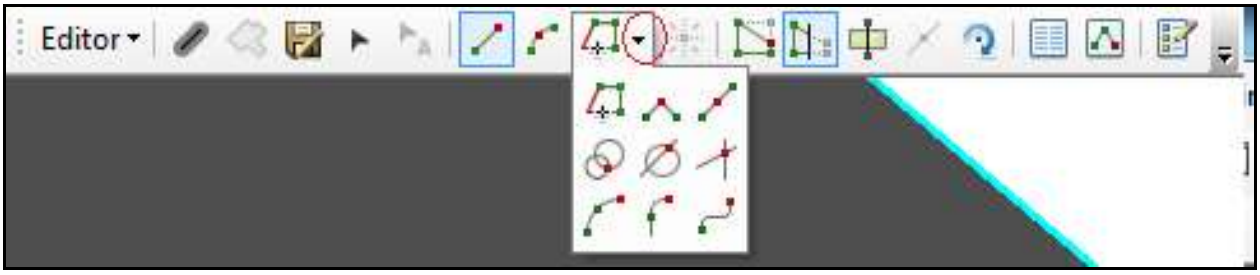
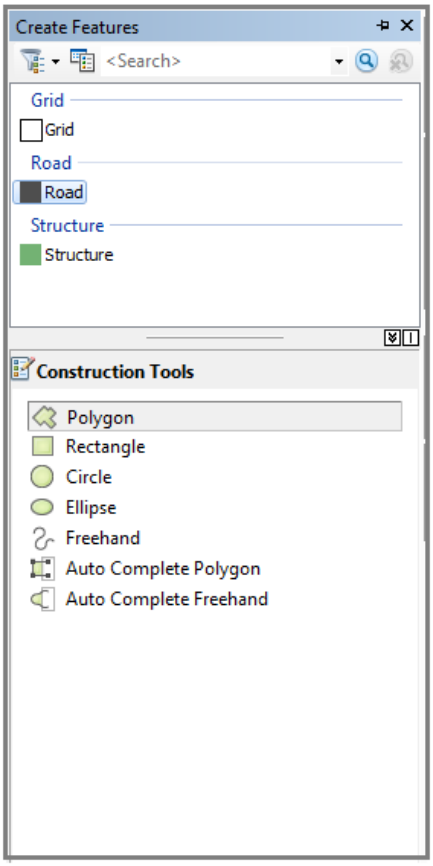
Edit Tools





Create Features window

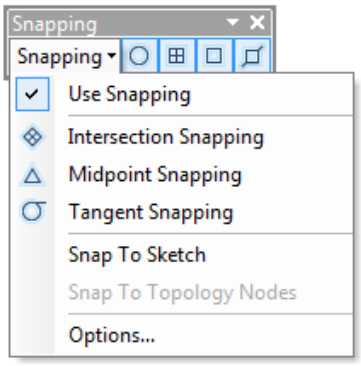
Anytime you create features on the map, you start with the Create Features window. You can open it by clicking the Create Features button on the Editor toolbar. Choosing a feature template on the Create Features window sets up the editing environment based on that feature template's properties; this action sets the target layer in which your new features will be stored, activates a feature construction tool, and prepares to assign the default attributes to the feature you create. To reduce clutter, templates are hidden on the Create Features window when layers are not visible.



The top panel of the Create Features window shows the templates in the map, while the bottom panel of the window lists the tools available to create features of that type. The availability of the feature creation tools, or construction tools, depends on the type of template you have selected at the top of the window. For example, when a line template is active, you can see a set of tools for creating line features. If you choose an annotation template instead, the available tools change to those that can be used to create annotation.

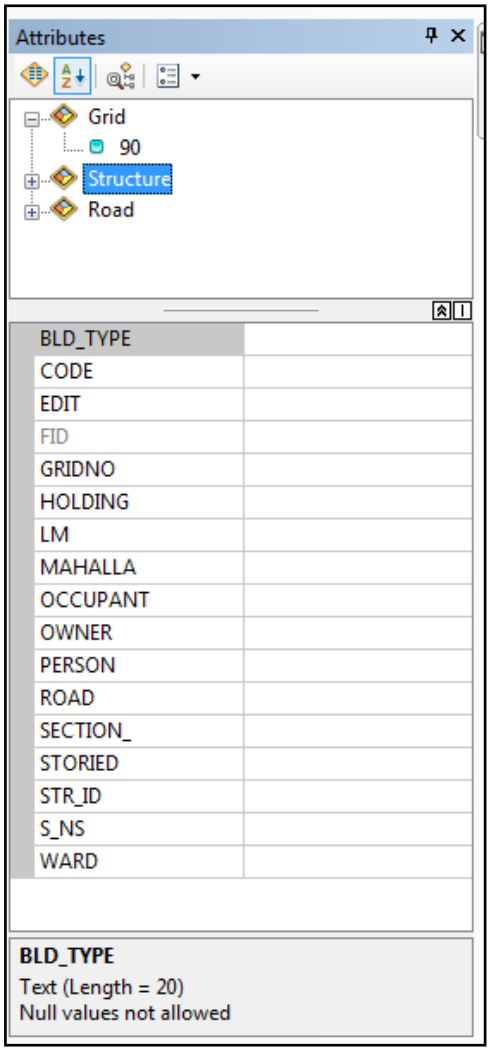
Snapping toolbar

Snapping allows you to create features that connect to each other so that your edits are more accurate and have fewer errors. With snapping, your pointer will jump, or snap to, edges, vertices, and other geometric elements when it nears them. This enables you to position a feature easily in relation to the locations of other features. As you move your pointer around the map, it snaps automatically to points, endpoints, vertices, and edges. All the settings you need to work with snapping are located on the Snapping toolbar, including enabling and disabling snapping types and setting snapping options. The main snap types are buttons on the toolbar, but additional ones are available on the Snapping menu.



Attributes window

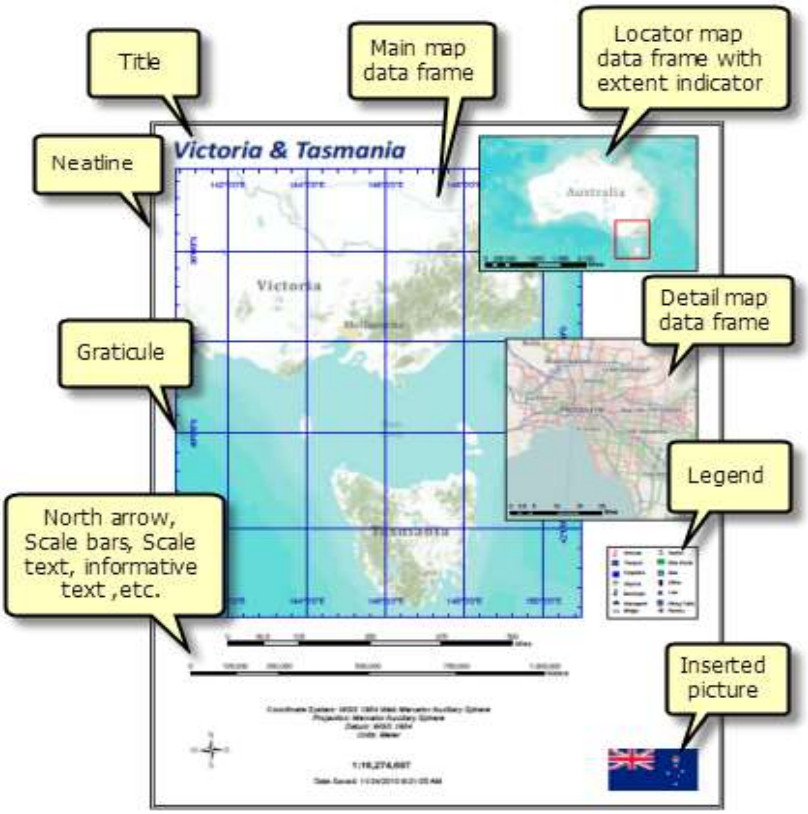
The Attributes window displays attributes of selected features and allows you to edit the values. The top panel of the window shows the layer to which the selected feature or features belong, while the bottom panel shows the attribute values of that feature—including any related or joined information. The properties and order of fields reflect the settings on the Fields tab of the Layer Properties dialog box. For example, if you turn off the visibility for a field, set a field alias name, or change how numbers are displayed in a field, these changes will all be reflected in the Attributes window. You can also set a field to be read-only, which means that you can view but cannot edit that field, regardless of the file or database permissions.



SESSION 9: PRODUCING MAPS

What is a page layout?

A page layout (often referred to simply as a layout) is a collection of map elements organized on a virtual page designed for map printing. Common map elements include one or more data frames (each containing an ordered set of map layers), a scale bar, north arrow, map title, descriptive text, and a legend. For geographic *reference, you can add grids* or graticules.



Elements of a page layout

Adding a data frame to the page layout

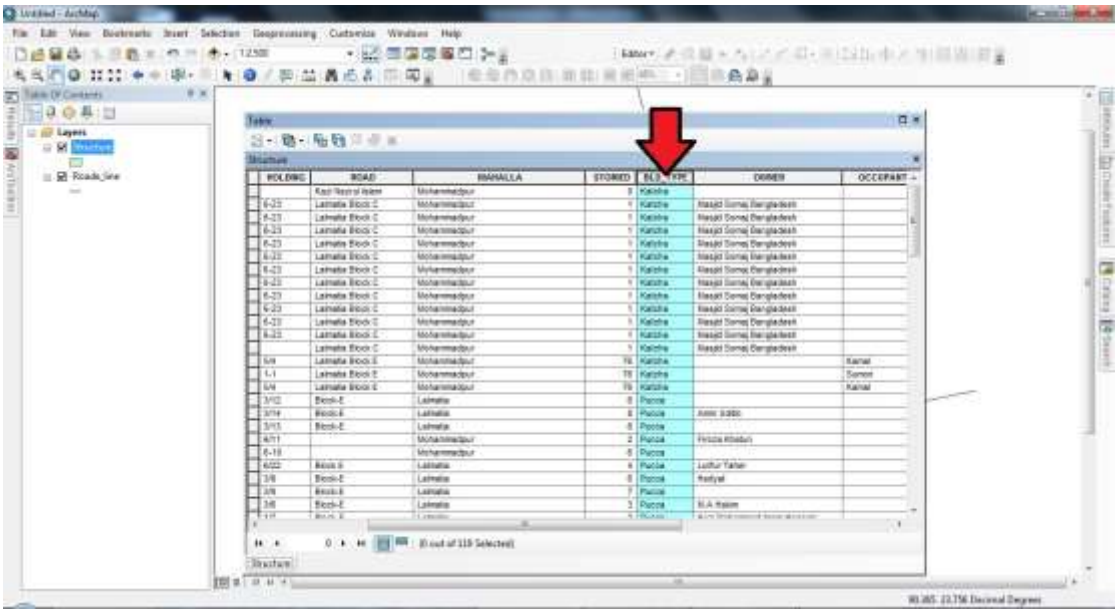
The data frame displays a collection of layers drawn in a particular order for a given map extent and map projection. You add a data frame to the page layout using theInsert menu.

From this menu, you can insert additional data frames. These additional data frames may be for locator or detail maps. If you are using multiple data frames you may want to consider using extent indicators to show the extent of one data frame within another data frame. A good locator map will also contain an indicator, such as an outline, showing where the extent of the detail map fits within a larger extent. For example, your locator map might show the location of a state within a country.

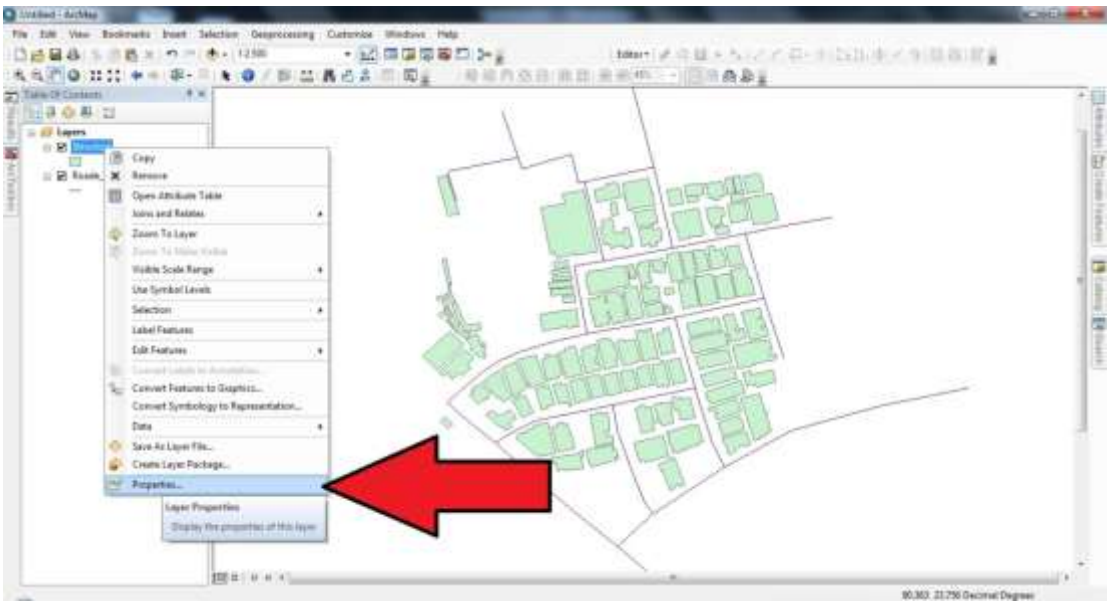
Symbology of Data

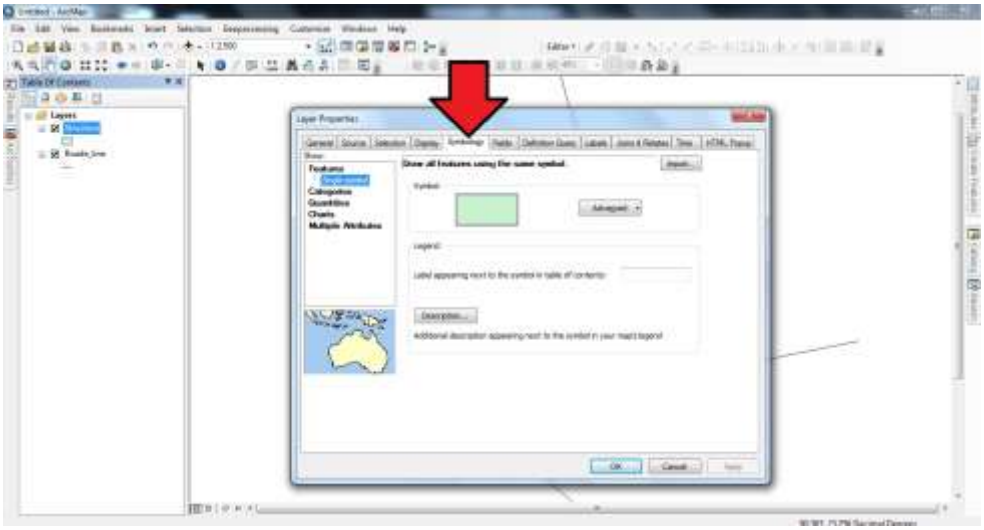
In ArcGIS various data visualization can be done through SYMBOLOGY. For symbolized of different categories of a variables the following processes

1. A definite field should be recognized which will be the base of visualization.

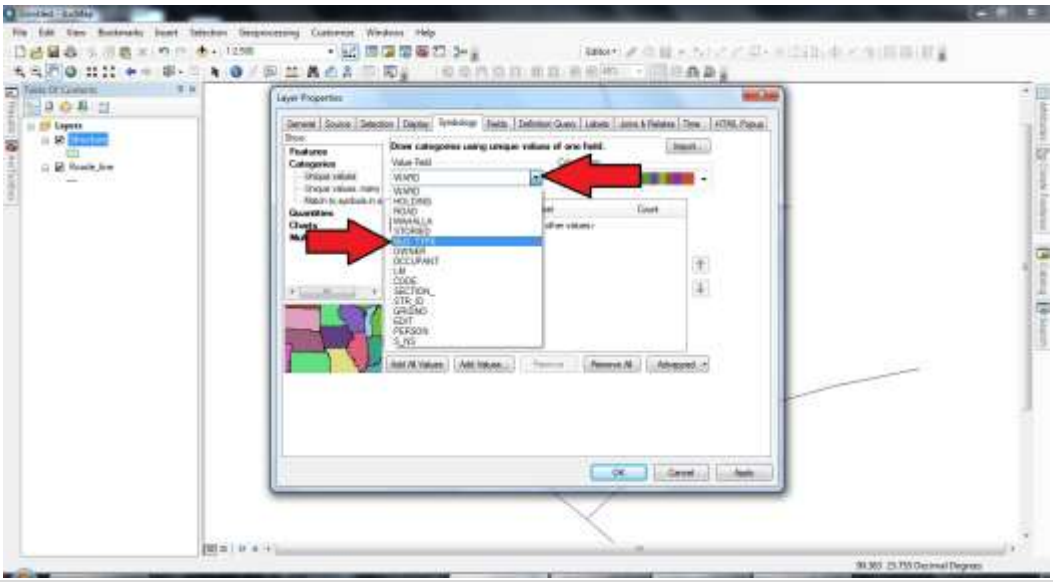


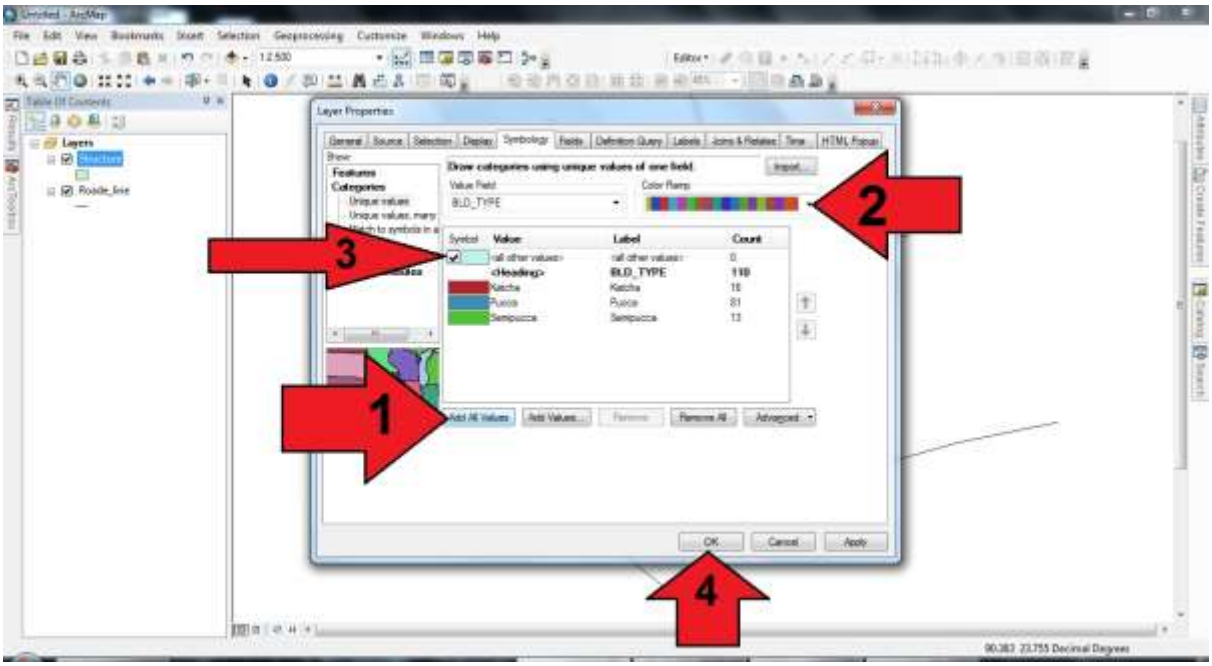
2. After recognized the field of a particular layer opens the <u>SYMBOLOGY TAB</u> from the properties of a layer. Than select the <u>Categories/ Unique Values</u>

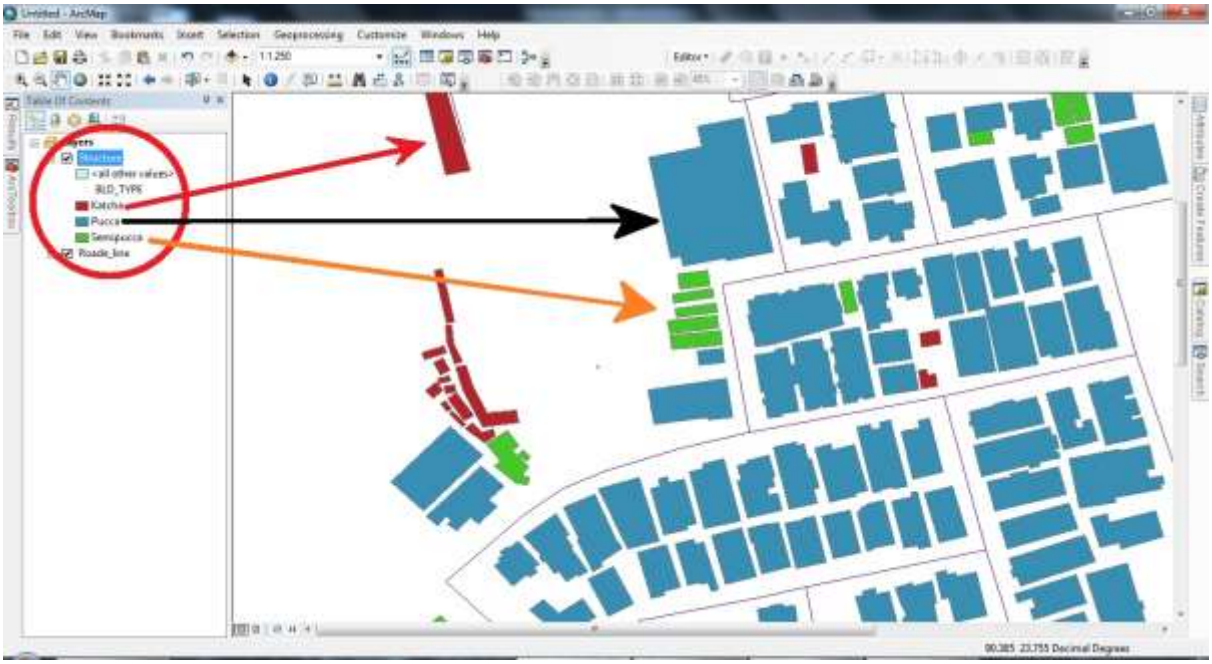




3. Select the definite FIELD from the Value Field (e. g. BLD_TYPE). Then click on Add Al Values. The categories feature can the visualized throughout various color scheme.







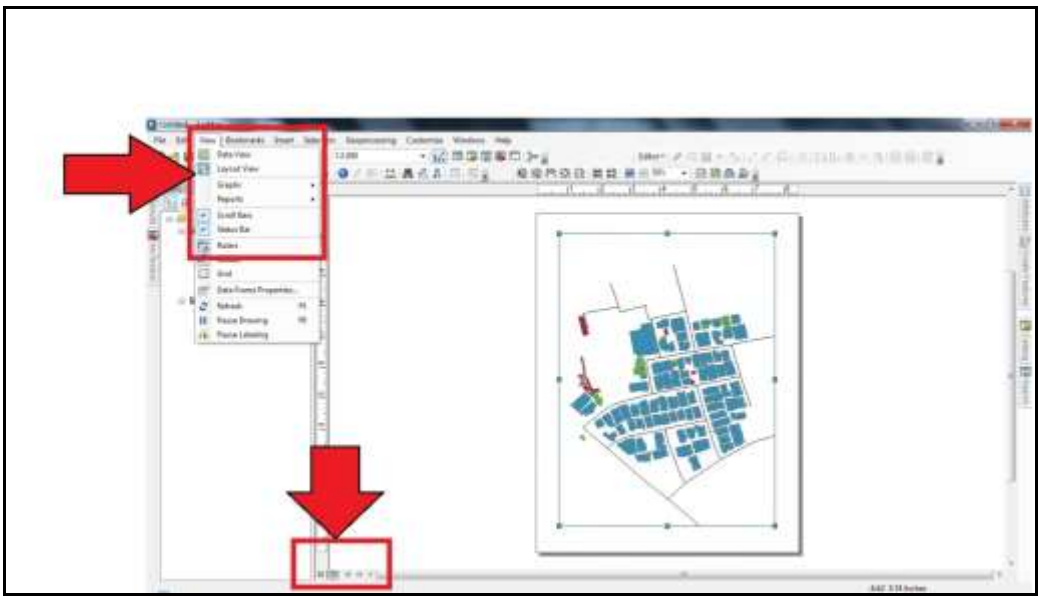
Creating a map layout

Below are the general steps for laying out a map in ArcMap:

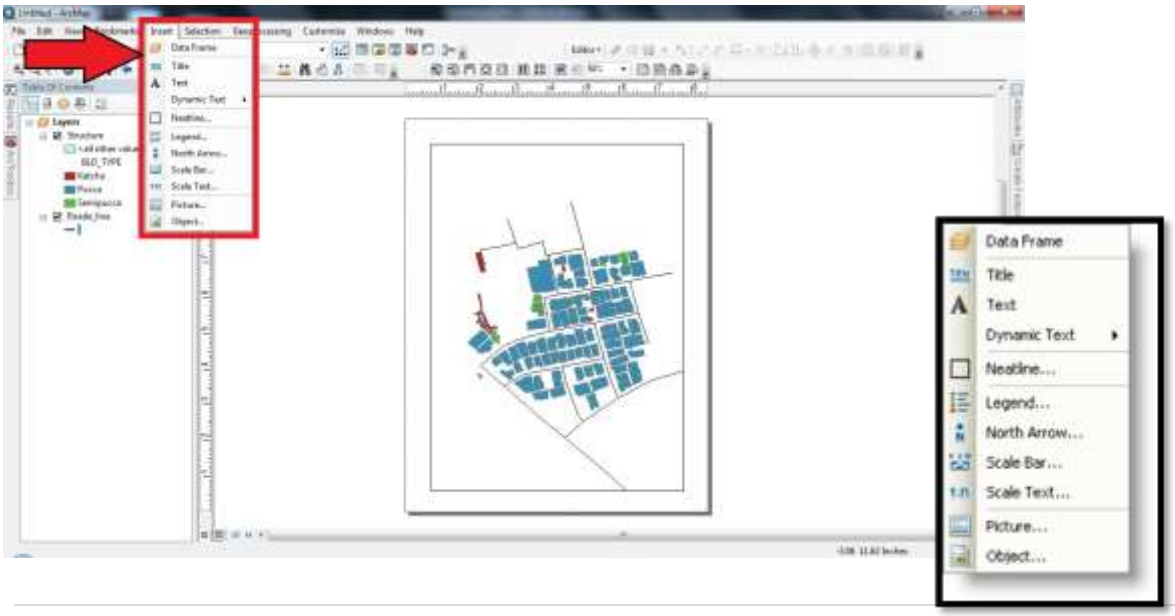
- Before starting in ArcMap, it's wise to design the arrangement of the elements onto the map page and plan your layout

- Start by setting your layout's page size and dimensions
- Create, edit, and symbolize your data as appropriate in your data frame(s).
- In layout view, click the Insert menu to add elements onto your layout. If you have more than one data frame in your map, the elements you insert will relate to the active data frame (to activate a data frame, right-click its name and choose Activate).

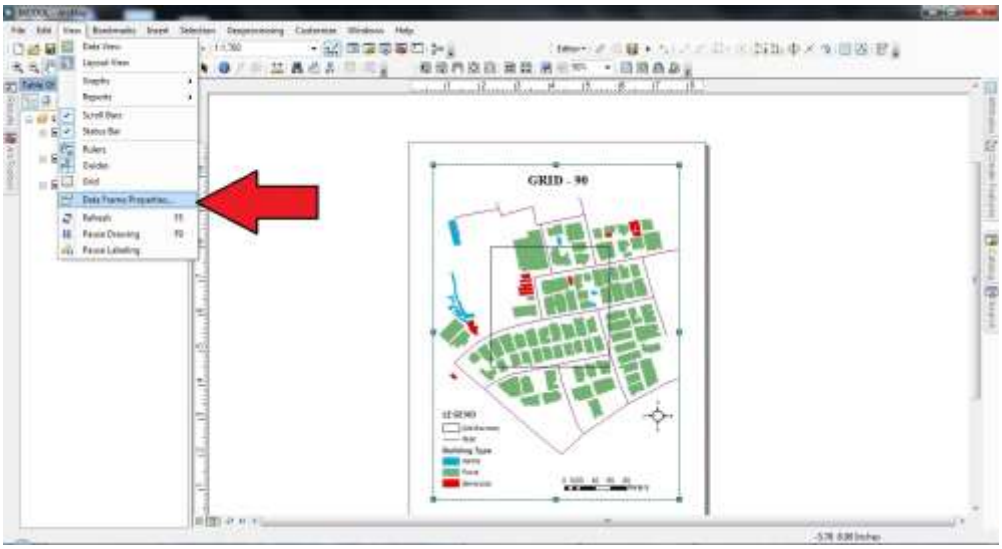
1. *The Arc map content both data view and layout view. For export a map with various map element layout view is necessary.*

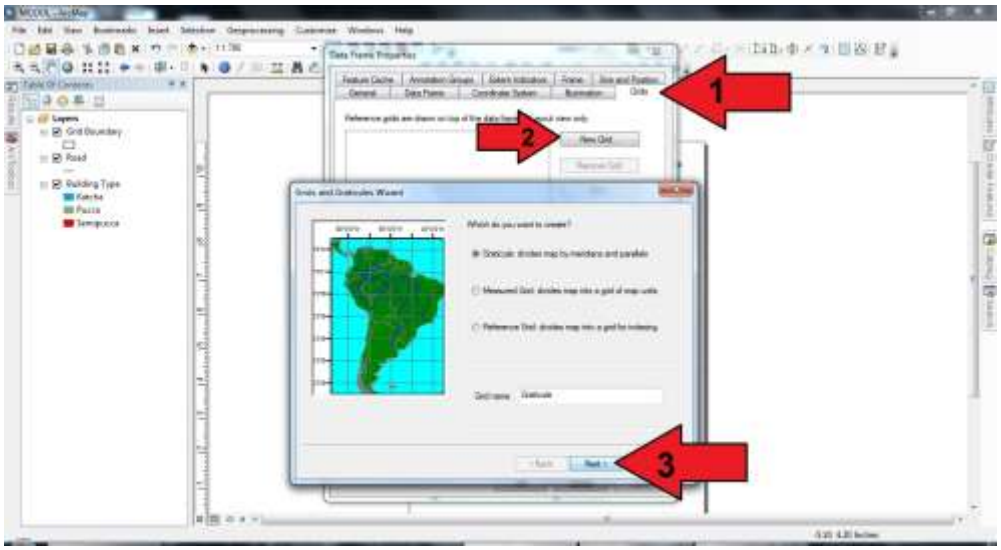


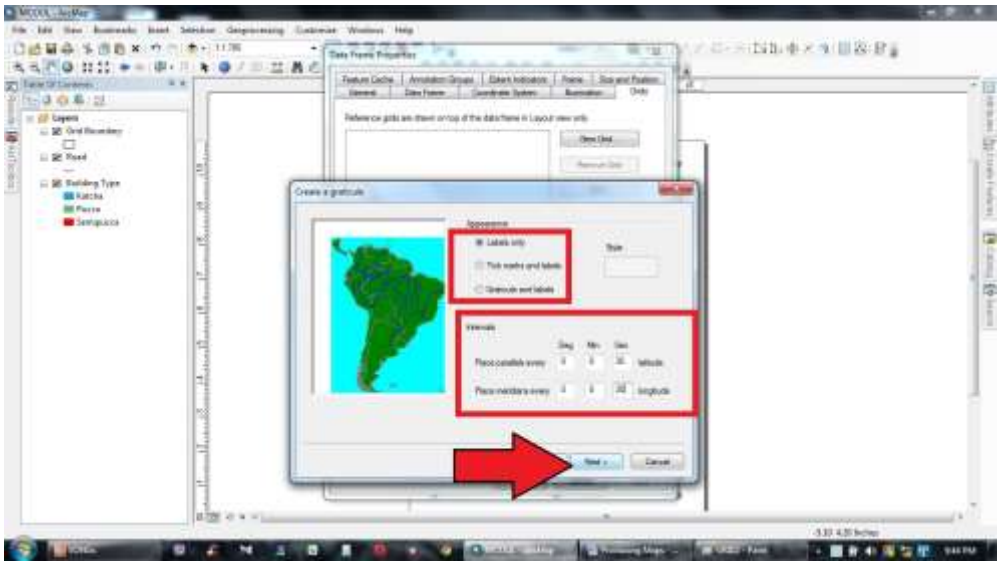
2. For adding the map elements like Title, North arrows, Scales, Legend etc click on <u>INSERT</u>. Than a box will pop up where various map elements are listed.

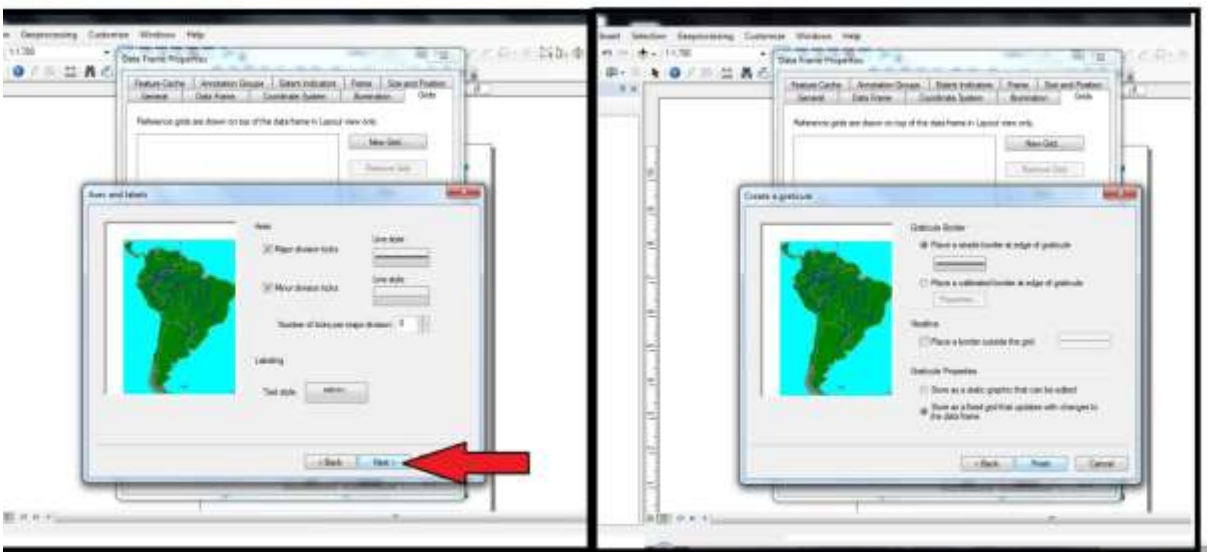


3. *After inserts all map element a graticule grid must be specified on the layout using Data Frame Properties ……..*

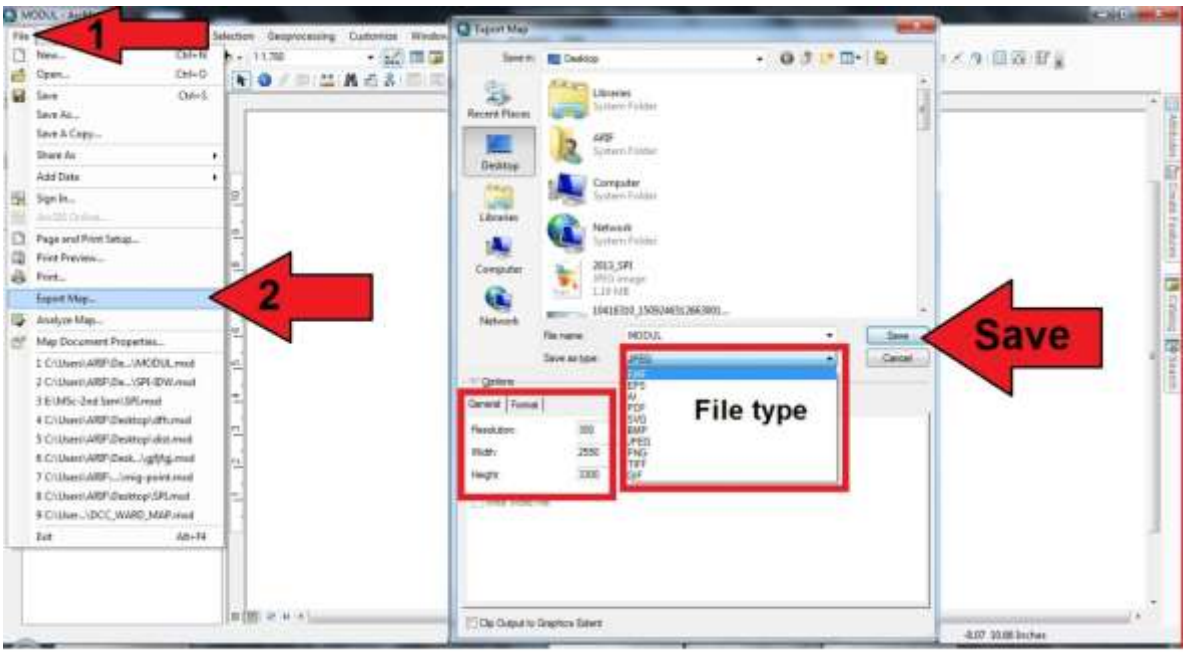








1. Once creating the graticule grid properly, the buildup layout will ready for expert as image file.



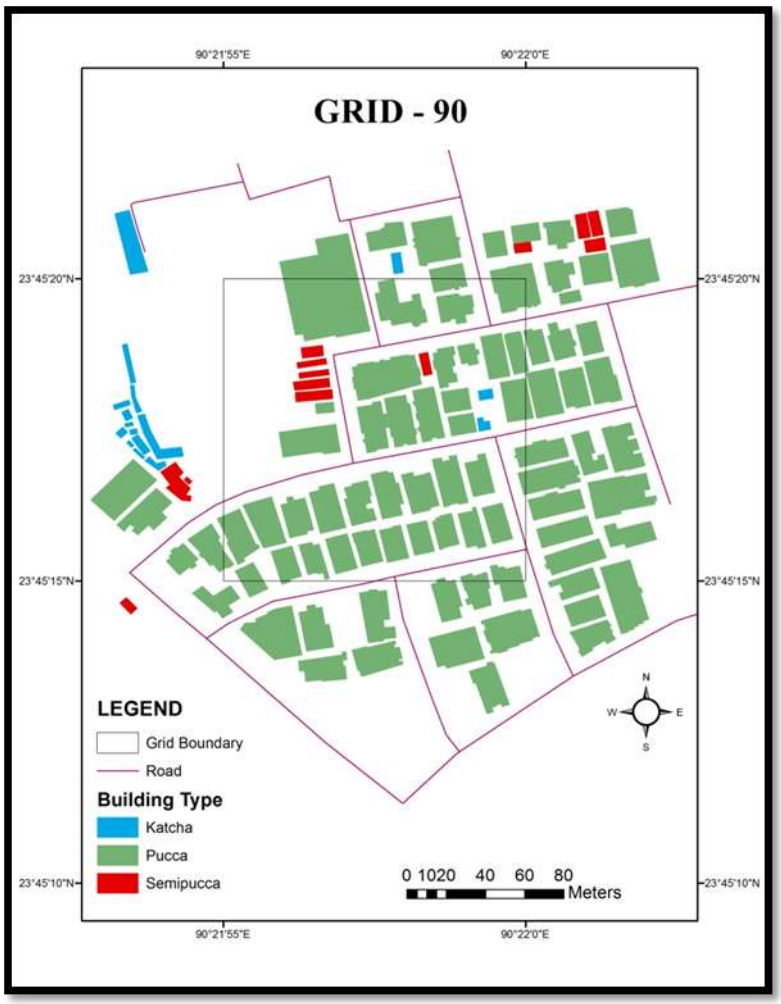
North arrows

North arrows indicate the orientation of the map. A north arrow element maintains a connection to a data frame. When that data frame is rotated, the north arrow element will rotate with it. North arrow properties include its style, size, color, and angle.

The size of the north arrow is in points. Decimal fractions can be entered here.

You can control the alignment of the north arrow by selecting one of the following options:

- Data Frame Rotation—North arrow angle uses the rotation of the data frame.
- True North—North arrow angle uses geodetic north, or the direction to the north pole. The true north calculation is based on the coordinate system using the center point of the data frame.



Scale bars

Scale bars provide a visual indication of the size of features and distance between features on the map. A scale bar is a line or bar divided into parts and labeled with its ground length, usually in multiples of map units such as tens of kilometers or hundreds of miles. If the map is enlarged or reduced, the scale bar remains correct.

When you insert a new scale bar onto a map, this defaults to the Display Units specified on the General tab on the *Data Frame Properties* dialog box.

When you add a scale bar to a map, the number and size of the divisions might not be exactly as you want them. For example, you might want to show four divisions rather than three or show 100 meters per division instead of 200. You might also want to

change the units that the scale bar shows or adjust how those units are represented. You can adjust many characteristics of a scale bar from the *Scale Bar Properties* dialog box.

You can control the behavior of the scale bar when it is resized or when the map scale changes by selecting one of the following options:

- Adjust width—Preserves the division value and number of divisions; adjusts scale bar width if map scale changes
- Adjust division value—Preserves the number of divisions and tries to preserve scale bar width by adjusting the division value
- Adjust number of divisions—Preserves the division value and tries to preserve scale bar width by adjusting the number of divisions

When you add a scale bar to a map, the number labels and tick marks might not be exactly as you want them. For example, you might want to label the endpoints of the scale bar but not the divisions, or you might want larger tick marks at the major divisions of the bar than at the minor ones.

By default, the units label on a scale bar is the same as the scale bar units. Sometimes you might want to change the label of the scale bar, for example, from Kilometers to km. Just type the new scale bar label in the Label text box. To control the distance between the label and the bar, enter a value in the Gap text box. This is either vertical or horizontal depending on the unit label position. Positive gaps move the label to the right or upwards; negative gaps move the label to the left or downwards.

Legends

A legend tells a map reader the meaning of the symbols used to represent features on the map. Legends consist of examples of the symbols on the map with labels containing explanatory text. When you use a single symbol for the features in a layer, the layer is labeled with the layer's name in the legend. When you use multiple symbols to represent

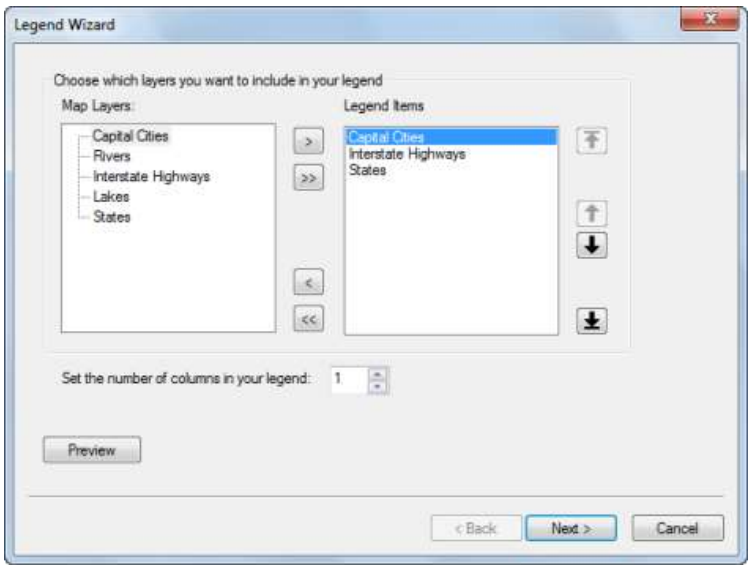
features in a single layer, the field you use to classify the features becomes a heading in the legend, and each category is labeled with its value.

Legends have patches that show examples of the map symbols. By default, the legend patches are points, straight lines, or rectangles that match the map symbols. You can customize the legend patches, for example, so areas are represented with patches of another shape, or rivers are drawn with a sinuous rather than a straight line.

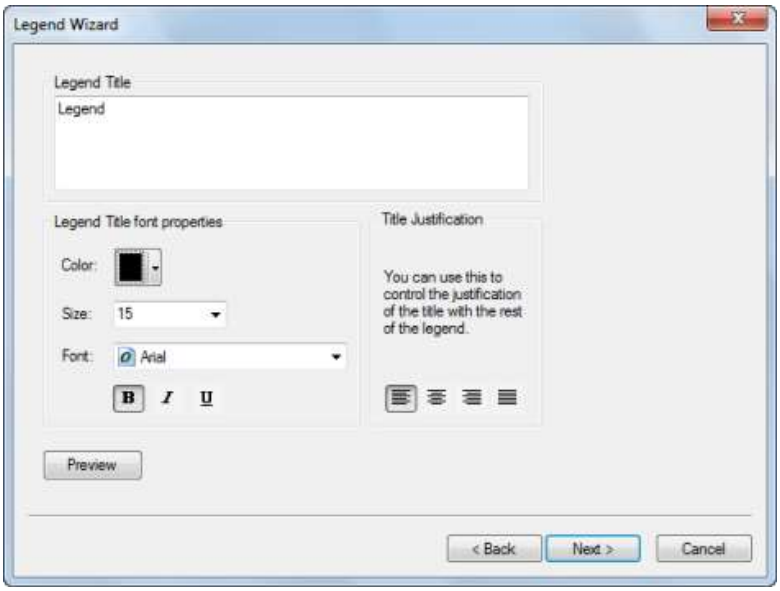
The *Legend Wizard* provides an easy, quick way to add a legend to your map. The wizard allows you to

- Choose which map layers you want to be part of the legend.
- Set the number of columns in the legend.
- Create and symbolize a legend title.
- Create and symbolize a border and background for the legend.
- Customize the shape and size of legend patches.
- Set the spacing between legend elements.

When you first access the wizard, you will see the list of layers in your map that will make up the legend.



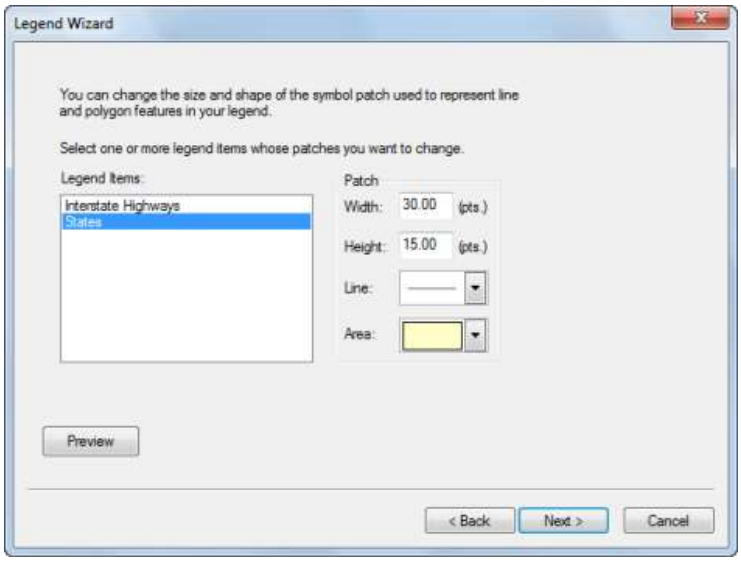
The next panel provides a place for you to enter a legend title.



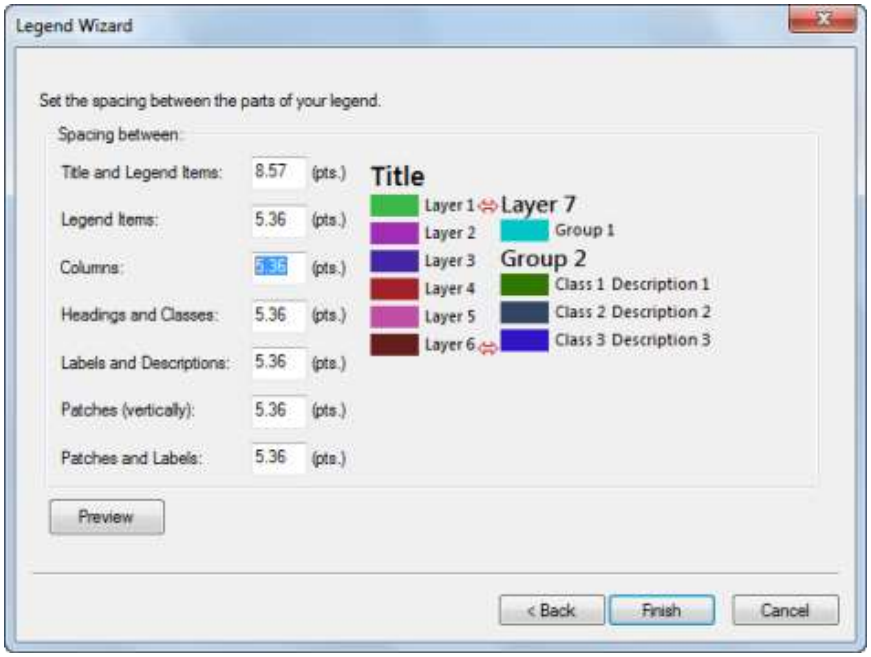
Along with typing in the title text, you can choose the color, size, font, and justification of the text.

The next panel offers choices to customize a border, background, and drop shadow for the legend.

The next to last panel gives you the opportunity to set patch properties for line and polygon symbols.



The last panel allows you to specify the spacing between legend elements.



SESSION 10: SPATIAL DATA PROCESSOR

Attribute Extraction

Structured Query Language (SQL) is a powerful language you use to define one or more criteria that can consist of attributes, operators, and calculations. For example, imagine you have a map of road and want to find only National highway road. You would select the road with this expression: "ROAD_TYPE" = 'National Highway'. Note that the road layer must contain the road type information in the attribute database. In this exercise, you will open Attribute Extraction. mxd in GIS File directory.

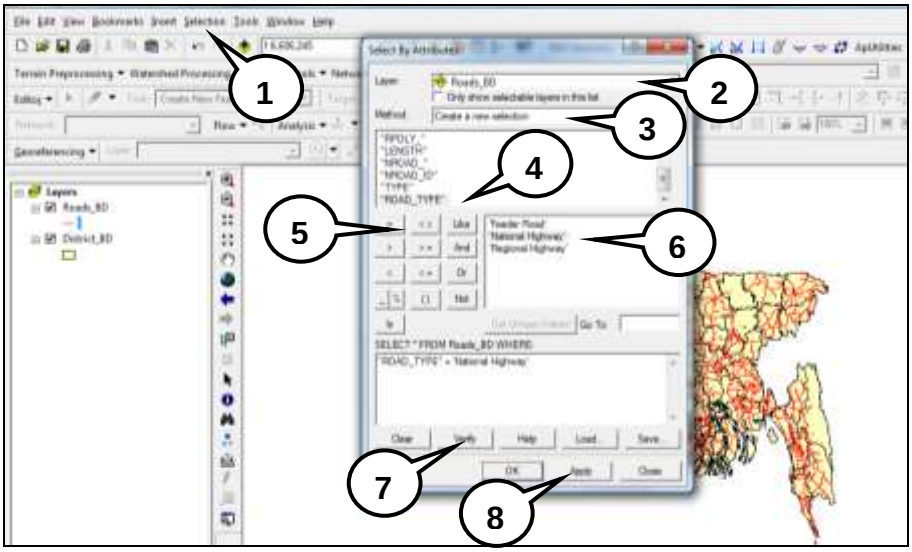
How to select features by attributes

1. Click Selection on the Main menu and click Select By Attributes.
2. Click the Layer drop-down arrow and click the layer containing the features (Road_BD) you want to select.
3. Click the Method drop-down arrow and click a selection method. Chose Create a new selection option.
4. Double-click a field (ROAD_TYPE) to add the field name to the expression box.
5. Click an operator to add it to the expression. Here, choose "=" as an operator.
6. Click Get Unique Values to see the values for the selected field. Double-click "National Highway" to add it to the expression.
7. Click the Verify button to see if you are using proper syntax or if the criteria you've entered will select any features.
8. Click Apply.

The status bar at the bottom of the ArcMap window tells you how many features are selected.

The files used to save the queries have a .exp extension but can be edited with any text editor. Only the content of the expression box is saved in the file, not the complete expression.

9. Click Close when you are finished selecting features.



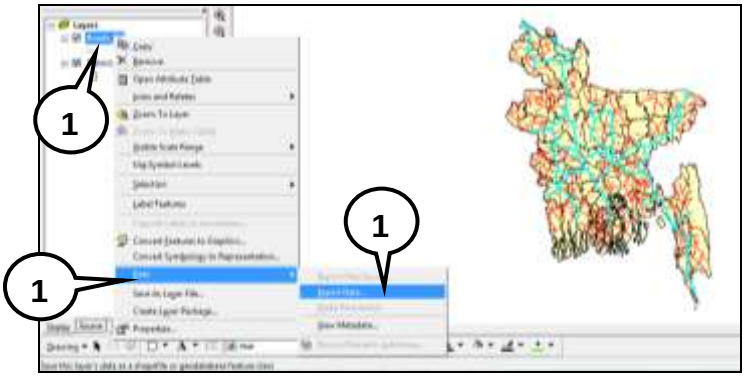
Export Selected Features

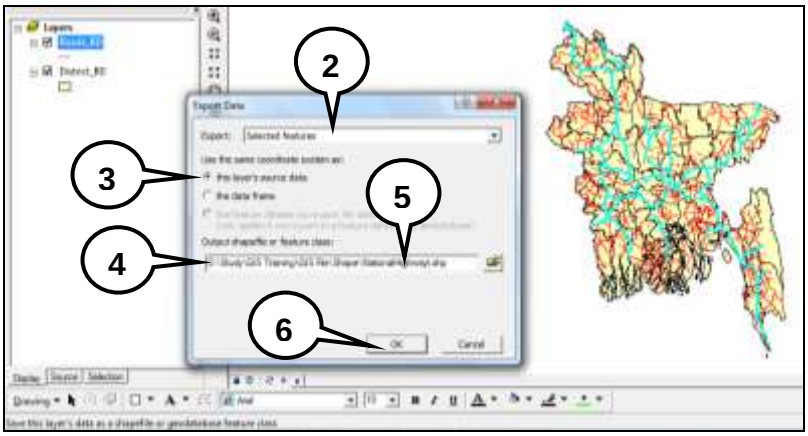
With ArcMap, you can export the data for a layer to another location, format, or as a subset of the features from the original data source. ArcMap can write new data to either shapefile or geodatabase. This data can include all the original data, a selected set of the features, or only the features visible in the map's current extent. ArcMap can also save the data so it uses the data frame's coordinate system or the coordinate system of a feature dataset in a geodatabase.

In this exercise, you will export the National highway feature that you have selected earlier.

How to export feature

1. Right-click the Road_BD layer in the table of contents, point to Data, then click Export Data.
2. Click the Export drop-down arrow and click Selected features.
3. Click the option for the output coordinate system you want to use. Choose "the layer's soure data"
4. Click the Browse button and navigate to a location to save the exported data.
5. Type the name (NationalHighway) for the output data source.
6. Click OK.





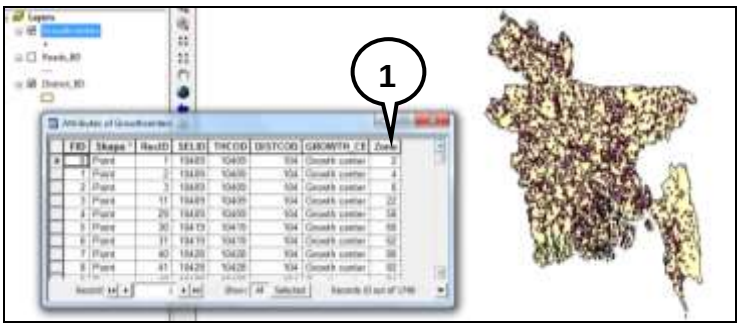
Location Proximities

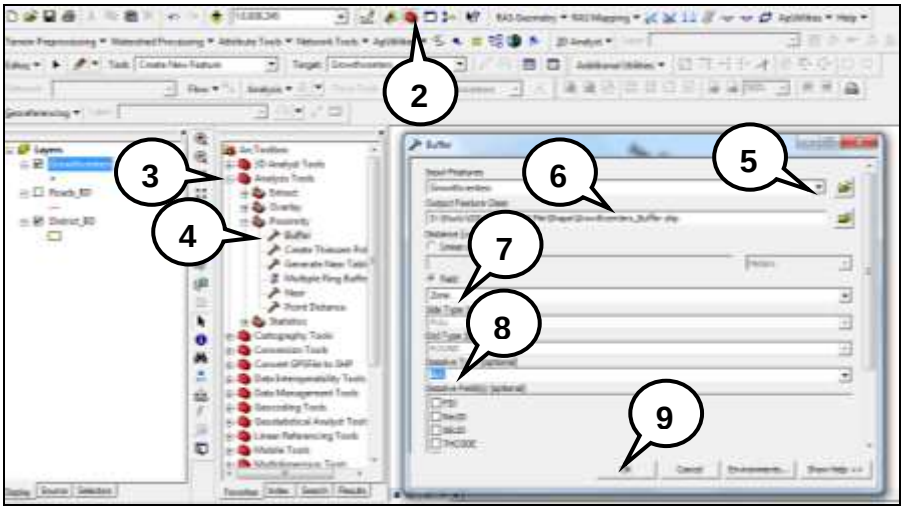
For feature data, the Proximity toolset in the Analysis toolbox can be used to discover proximity relationships. These tools output information with buffer features or tables. Buffers are usually used to delineate protected zones around features or to show areas of influence. For example, you might buffer a school by one mile and use the buffer to declare it as a zero sound zone. In this exercise, you will make a zone of influence of growth center according the attribute database of each growth center.

Buffering Point Features

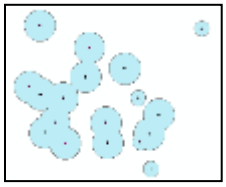
1. Add the Growthcenter layer in GIS File Directory. Open the attribute of the layer and see a record containing Zone where you will find numeric value of areal extent of each growth center.
2. Open the ArcTool Box Window.
3. Click on Analysis Tools in ArcTool Box Window.
4. Click Proximity and then choose Buffer. A Buffer dialog box will appear.
5. In Buffer dialog box, choose GrowthCenter as Input features.

6. Choose Output feature name and location. Here, Growthcenter_Buffer has been choosen.
7. Check the Field box and choose Zone.
8. Choose "All" as Dissolve Type.
9. Click Ok.





The output feature (Growthcenter_Buffer) looks like as follows.



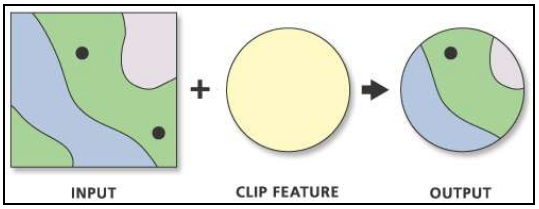
Geoprocessing Tools

Geo-processing tools are used for manipulating GIS data in order to special objective. For example, you would like to determine the number of affected building due to road extension. In that case, you have to have road extension areal extent and building location data and finally you will have to find out the common area between them from that you would be able to determine how much building would be affected. Usually following tools are used to solve spatial and statistical problems:

- Clip: Extracts those features from an input feature class that overlap with features from a

clip feature class.

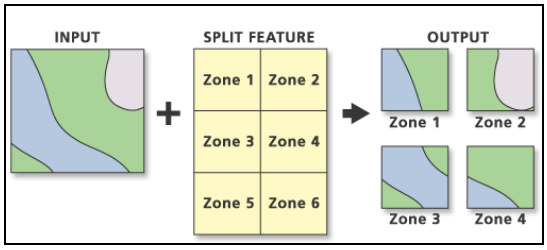
Clip<in_features><clip_features><out_feature_class>{cluster_tolerance}



- The output feature class will have the attributes of the input features.
- The input features may be any geometry type, but clip features must have polygon geometry.

- Split: Clips the input features and stores them in multiple output datasets.

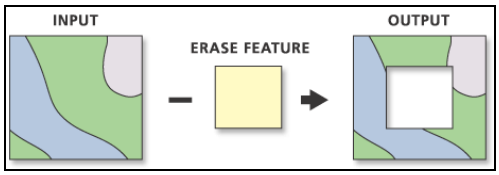
Split<in_features><split_features><split_field><out_workspace>{cluster_tolerance}



- The split field data type must be character. The output feature classes will be named for split field values; therefore, they must start with a valid character.
- The number of output feature classes equals the total number of unique values in the split field.

- Erase: Copies input features falling outside the erase polygon feature boundaries to the output.

Erase<in_features><erase_features><out_feature_class>{cluster_tolerance}

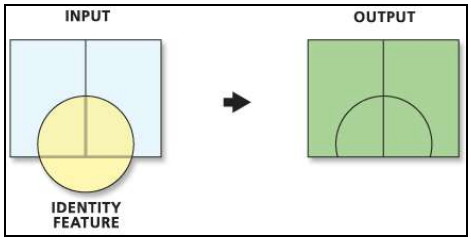


- Input feature polygons that are coincident with erase feature polygons will be removed.
- The erase features must be polygons.

- Identity: Intersects two feature classes. The output contains the input features as well as those overlapping features of the identity feature class.

Identity <in_features> <identity_features> <out_feature_class> {ALL | NO_FID | ONLY_FID}

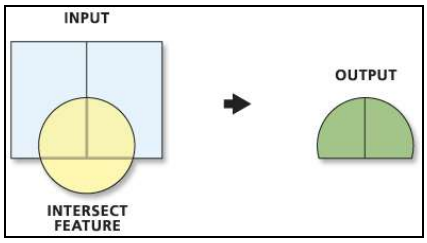
{cluster_tolerance}{NO_RELATIONSHIPS|KEEP_RELATIONSHIPS}



- The input features must be point, multipoint, line, or polygon. The inputs cannot be annotation features, dimension features, or network features.
- The identity features must be polygons.

- Intersect: Creates an output feature class containing features that fall within the area common to both input datasets.

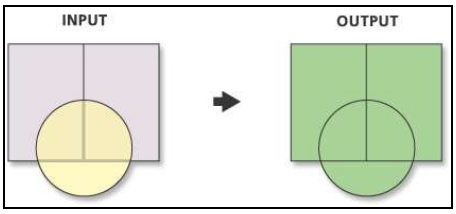
Intersect <features {Ranks};features {Ranks}...> <out_feature_class> {ALL | NO_FIDONLY_FID}{cluster_tolerance}{INPUT|LINE|POINT}



- The input features must be point, multipoint, line, or polygon. The inputs cannot be annotation features, dimension features, or network features.
- If the inputs have different geometry types (that is, line on poly, point on line, and so on), the output feature class geometry type will default to the same as the input features with the lowest dimension geometry.

- Union: Creates an output feature class containing all features from both inputs.

Union<features{Ranks};features{Ranks}...><out_feature_class>

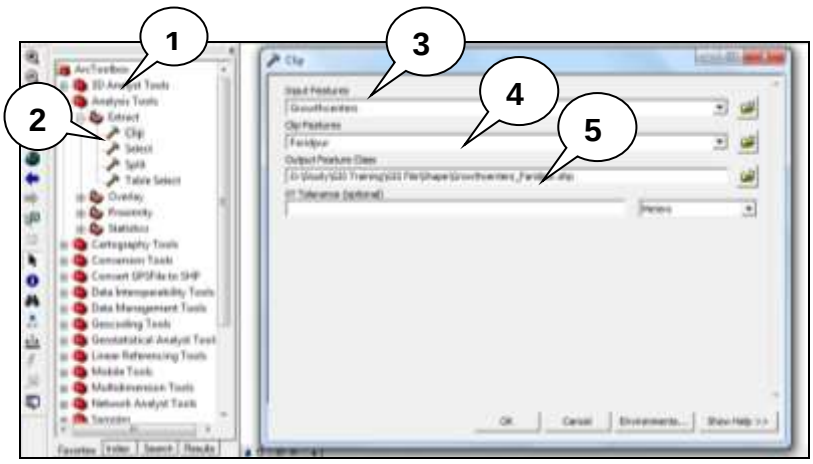


All input feature classes and feature layers must have polygon geometry.

In this exercise you will find out how much area of growth center's zone of influence (Assume 3 km buffer) in Faridpur District have been affected due to the Ganga River over flooded area (8 km). For this exercise, open the Geoprocessing.mxd file in the GIS File directory.

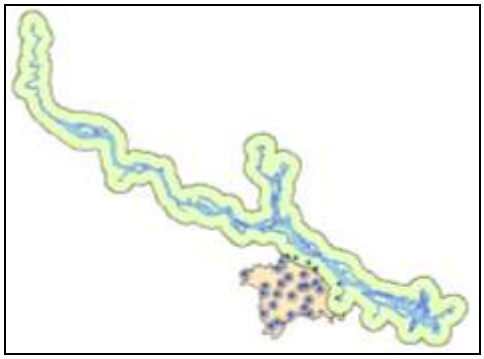
Clip growth centers according to Faridpur district boundary

1. Click on Analysis tool in ArcTool box window
2. Choose Overlay and then Clip tool.
3. Select Growthcenters as Input Features in Clip window.
4. Select Faridpur as Clip Features in Clip window.
5. Name the new output feature as Growthcenter_Faridpur.



Buffer Growth centers and the Padma river

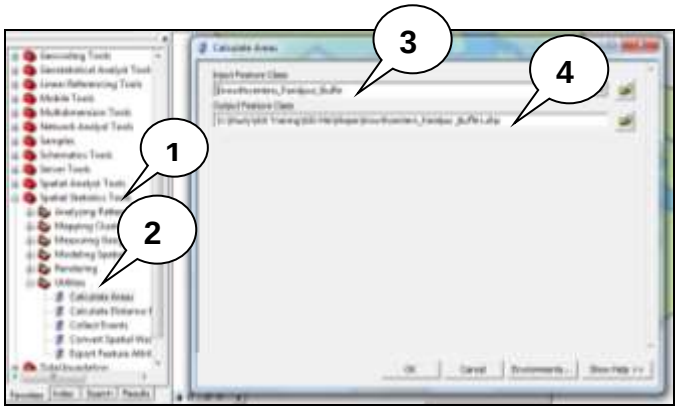
This task is similar to the earlier one. After 3km buffering all of growth center it looks like

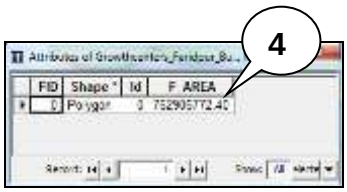


Area calculation

In this section you will determine the total area of growth centers' zone of influence.

1. Click on Spatial Statistics tools in ArcTool box window
2. Choose Utilities and then Calculate Areas.
3. Choose "Growthcenters_Faridpur_Buffe" as Input Feature Class
4. Name "Growthcenters_Faridpur_Buffe1" as Output Feature Class
5. Open the attribute table of Growthcenters_Faridpur_Buffe1 feature. Here, the total area has been found is 762906772.40 sq.m.



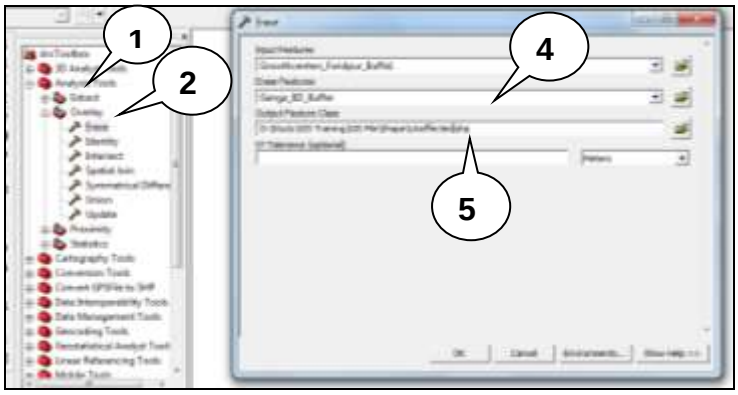


Erase 3km buffered growth center area and 8km buffered Padma over flooded area

This task will erase the intersected or common area between growth center zone of influence and Padma over flooded area. After erasing, if the total area becomes less than from previous, then that less amount would be affected area due to Padma over flooded.

1. Click on Analysis tool in ArcTool box window
2. Choose Overlay and then Erase tool.
3. Choose "Growthcenters_Faridpur_Buffe" as Input Feature Class
4. Choose "Ganga_BD_Buffer" as Erase Feature
5. Name "Unaffected" as Output Feature Class. Here, common area will be erased so the rest of the area would be unaffected.

3



Now you will need to calculate the area of Unaffected portion. Now it looks like as follows.

Here, the total calculated area is 612601591.168 sq. m which is 150305181.232 sq or 150.30 sq.km which is less than from total area of growth center zone. So, 150.30 sq. km area has been affected due to the Padma River over flooded.

SESSION 11: Cloud GIS

What is Cloud GIS?

The cloud computing technology has revolutionized the way one works. Although GIS has been a late adopter of the cloud technology, the many advantages are compelling organizations to shift their geospatial functions to the cloud. Cloud-based tools are accessed for web-based geographic information system. Data generated as maps are helping analyze and optimize operations in real-time. Apps in the cloud are helping manage isolated silos of GIS workflows and geodatabases.

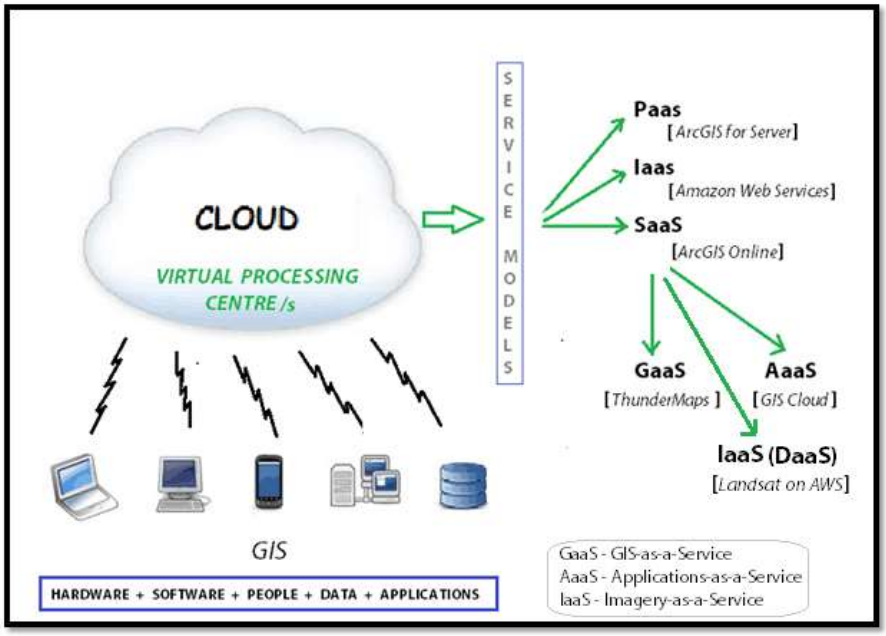
Thus, Cloud GIS could be defined as a next generation on-demand GIS technology that uses a virtualized platform or infrastructure in a scalable elastic environment.

How does Cloud GIS work?

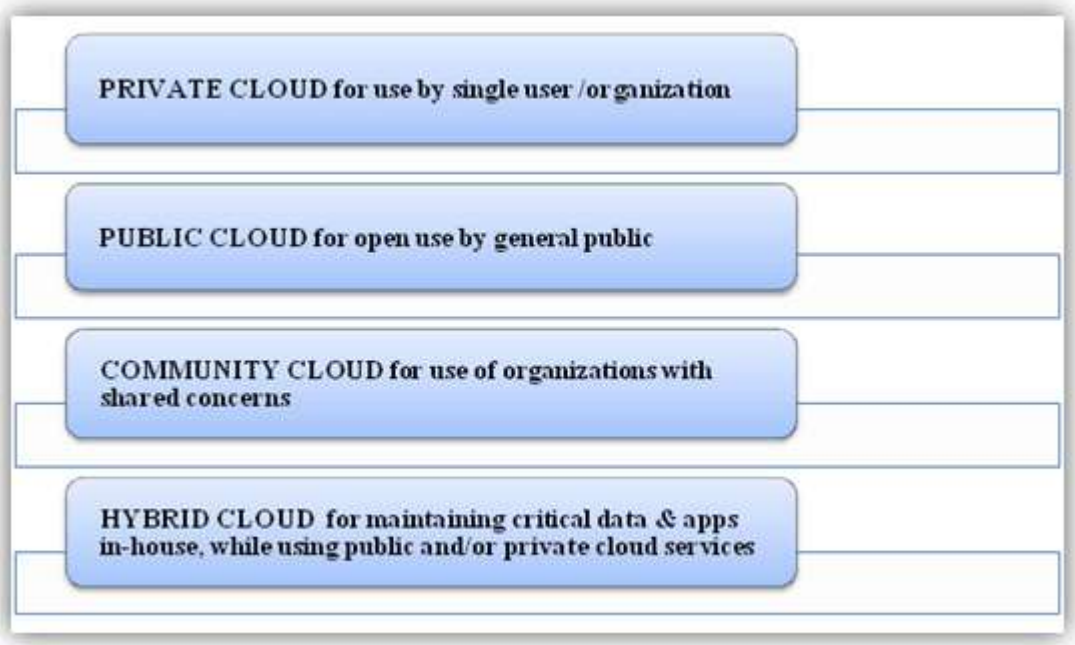
The cloud computing environment offers three base service models – Software-as-a-Service (SaaS); Platform-as-a-Service (PaaS); and Infrastructure-as-a-Service (IaaS). In the geospatial environment, the Cloud SaaS supports three other service models

- GIS-as-a-Service (GaaS),
- Applications-as-a-Service (AaaS)
- Imagery-as-a-Service (IaaS), where ready-to-use GIS datasets are available as Data-as-a-Service (DaaS)

These are accessed as private, public, and hybrid or community cloud services, depending upon the organization's need for security, collaboration and ownership.



Cloud GIS service models



Cloud GIS service models

Key Benefits of GIS in the Cloud

GIS in the Cloud can put out information in the public domain, for continuous updates and open access.

GIS decisions are made easier with the ability to integrate latest databases, merge disparate ystems, exchange information internally and externally, leverage Public cloud and sync field data with the whole workflow process.

The functionality of the Cloud helps geospatial operations to move beyond the proprietary vendor formats and operations - making data retrieval easy when opting to switch vendor allegience.

GIS in the Cloud supports shared resource pooling [networks, servers, apps, service, storage, databases] useful for communities and participating organizations, with common or shared goals.

Key benefits of GIS in the cloud

Other Benefits of Cloud GIS

- On demand service of online maps, geospatial data, imagery, computing or analysis
- Large volumes of data handling, app management and geospatial analysis possible

- Supports viewing, creating, monitoring, managing, analyzing and sharing maps and data with other users
- Facilitates inputs, validation and collaboration by a global mobile workforce in real time
- As optimizing with spatio temporal principles is possible, it provides effective geospatial validations and analysis
- Managed services prevent data and work loss from frequent outages, minimizing financial risks, while increasing efficiency
- Competitive advantage – shorter time to share and publish maps, with always on always available data / maps; and effective ROI
- Choice of various deployment, service and business models to best suit organization goals
- Supports offerings of client-rich GIS software solutions as a software plus service model – geocoding, mapping, routing, and more

Applications

- Earth observation data
- Citizen and social science
- Road infrastructure projects
- Mobile data collection and integration
- Traffic management
- E-commerce and geo-targeted advertising
- Geo-referenced Weather Service
- Crime analysis
- Web mapping
- Research
- Public safety and emergency response

Google Earth Platform

Google Earth is a computer program that renders a 3D representation of Earth based primarily on satellite imagery. The program maps the Earth by superimposing satellite images, aerial photography, and GIS data onto a 3D globe, allowing users to see cities and landscapes from various angles. Google Earth is able to show various kinds of images overlaid on the surface of the earth and is also a Web Map Service client.

Google Earth is not a Geographic Information System (GIS) with the extensive analytical capabilities of ArcGIS or MapInfo, but is much easier to use than these software packages.

The Three Versions of Google Earth

Free - Intended for home and personal use, this product has many features, including displaying satellite and aerial imagery, a growing set of layers of mappable data, the ability to display third party data, tools for creating new data, and the ability to import GPS data.

Pro - This version, developed for commercial use, adds movie making, as well as importing ESRI shapefiles and MapInfo tab files, can measure areas of circles and polygons, and can print and save high-resolution images.

Enterprise - This product makes imagery and other geospatial data available to employees within organizations such as corporations.

Share Map ArcGIS to Google Earth Platform

To share data from ArcGIS platform to Google Earth platform GIS dataset need to convert in Google Earth format. It is very easy to convert shapefile or layer into Google Earth kml format.

Steps

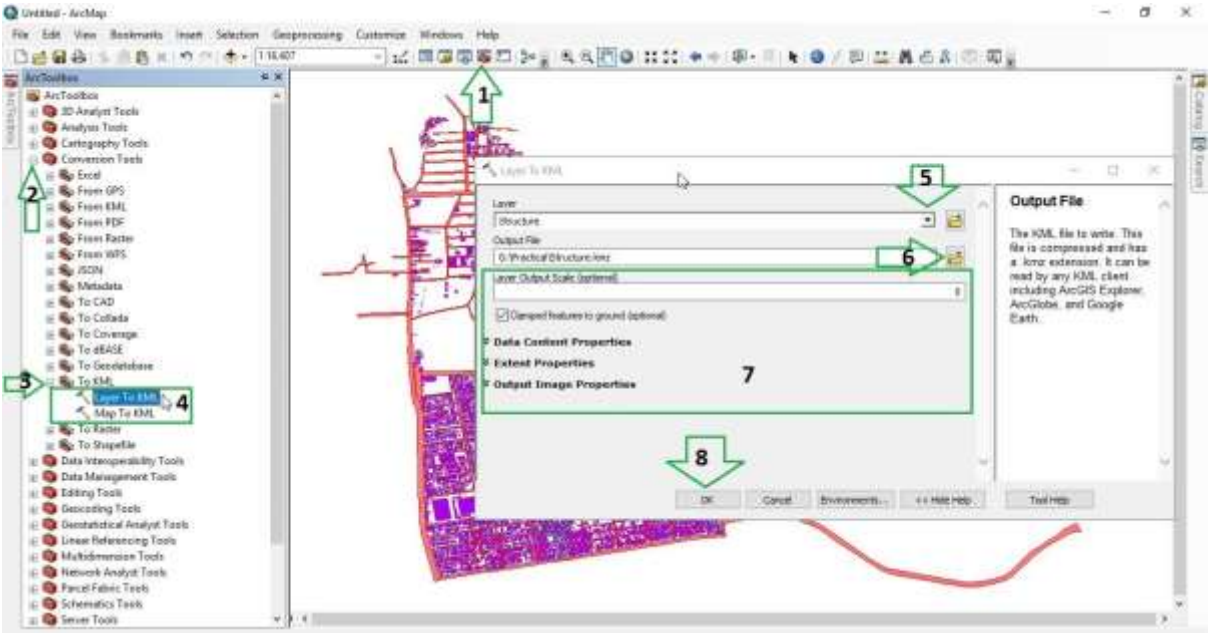
Open ArcMap and add the dataset which will be converted in Google Earth format. Now follow the following steps;

1. Click on the ArcToolbox icon from standard toolbar
2. Expand the conversion tools
3. Expand To KML
4. Here are two tools,

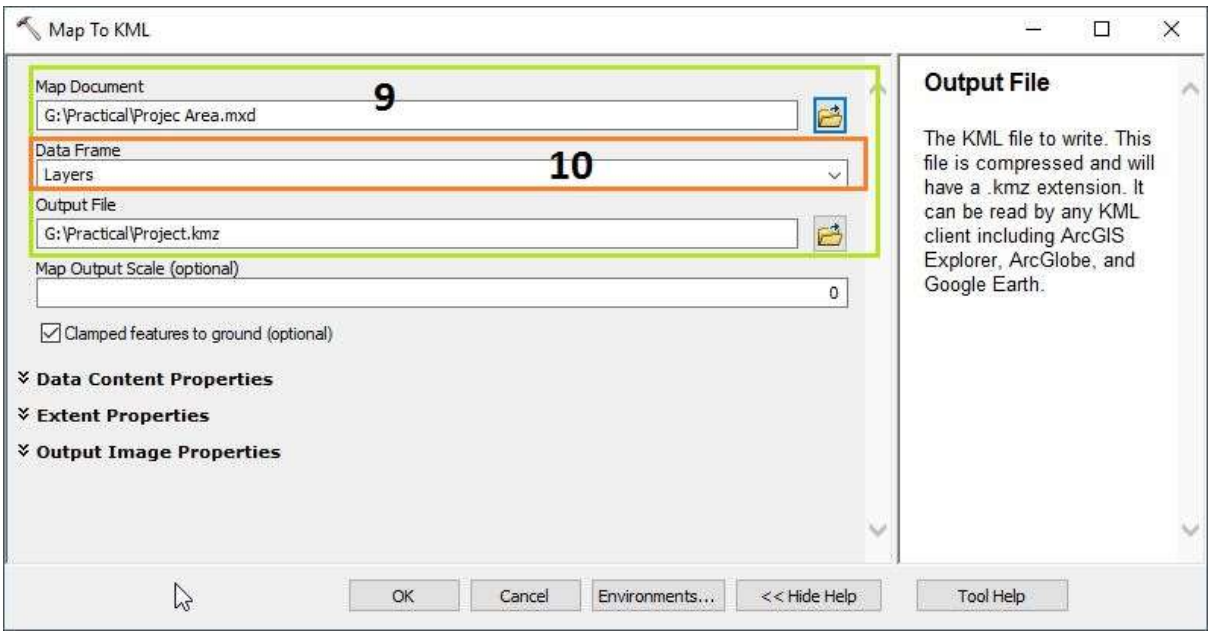
   Layer to KML – This tool will convert single layer into KML

   Map to KML – This tool will convert the whole map/data frame into KML
5. Double click on Layer to KML. This will open a new window. Here select the target layer from the dropdown menu.

6. Select the location and give it a name
7. Leave the others input as default
8. Click OK to complete the process.

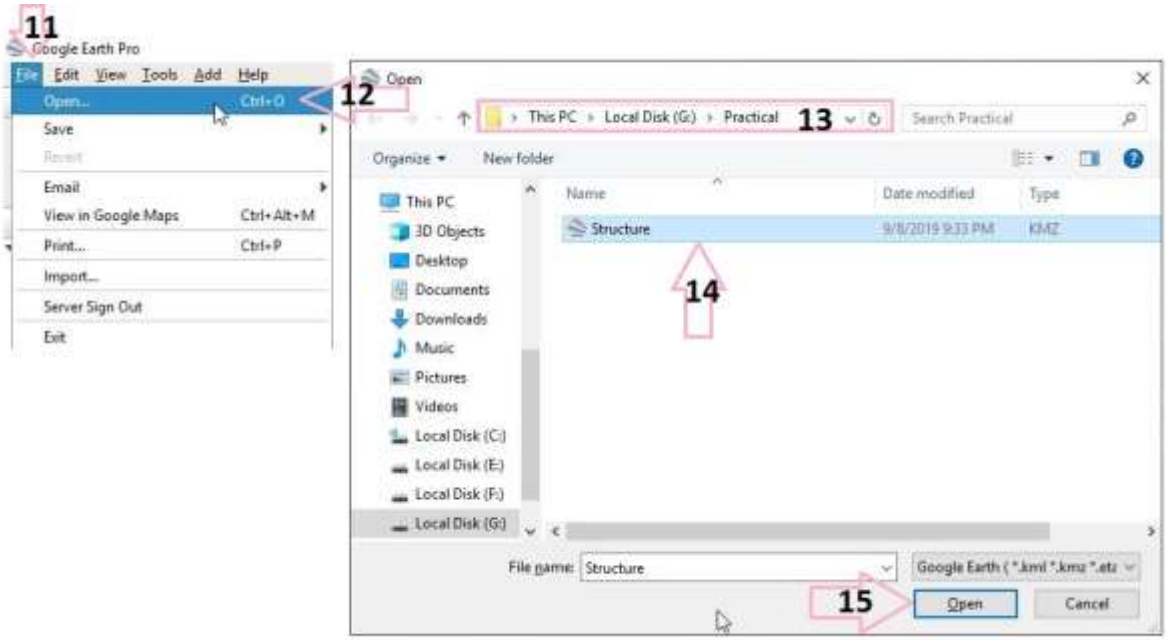


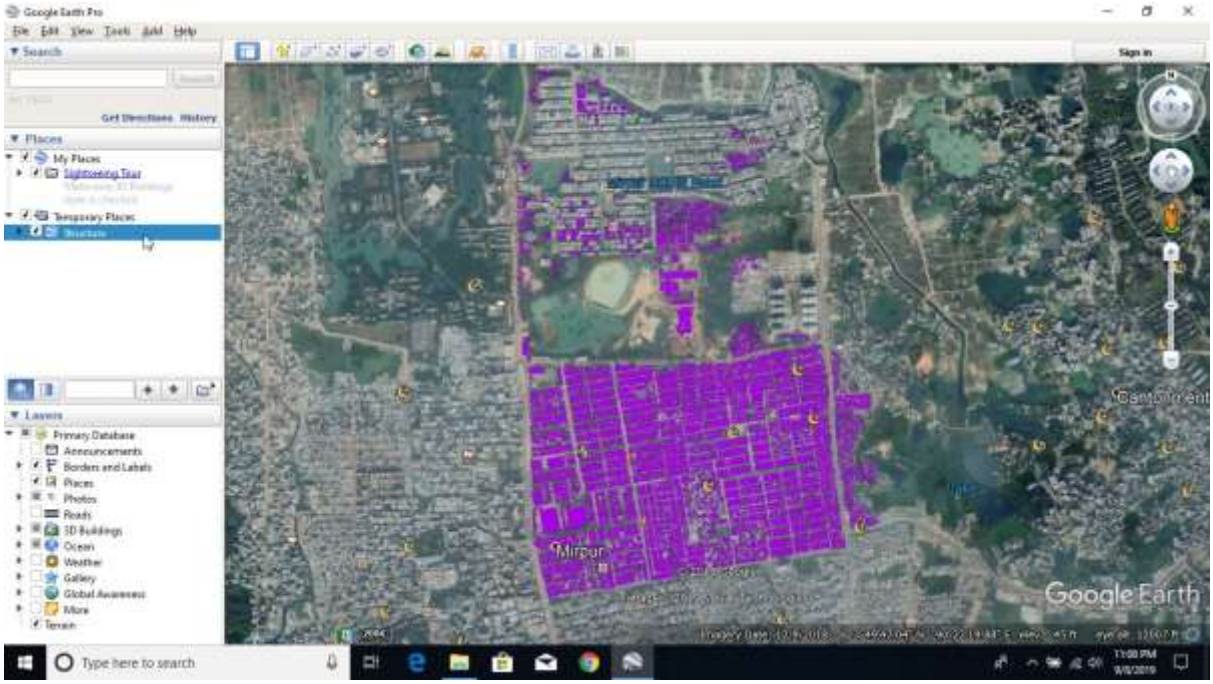
9. To convert Map/Data frame open Map to KML from 4. Select the ArcMap MXD file from folder navigation.
10. Select the data frame if more than one data frame is present. Now select OK to finish.



11. To open converted KML file in Google Earth go to File from the menu bar
12. Select Open and this will open a new window

13. Navigate to the folder where KML file is located
14. Select the target KML file
15. Click Open to open the KML file in Google Earth.





ArcGIS Online as WebGIS

What is ArcGIS Online?

ArcGIS Online is a cloud-based mapping and analysis solution. Use it to make maps, analyze data, and to share and collaborate. Get access to workflow-specific apps, maps and data from around the globe and tools for being mobile in the field. Your

data and maps are stored in a secure and private infrastructure and can be configured to meet your mapping and IT requirements.

What can you do with ArcGIS Online?

Work with smart, data-driven styles to explore and visualize 2D and 3D data. Share your maps with anyone, anywhere or keep them private. Work collaboratively with your colleagues to build maps and apps. Access intuitive analysis tools that help you better understand your data. All this and more is possible with ArcGIS Online.

Create maps, scenes, and apps

ArcGIS Online includes everything you need to create web maps, create 3D web scenes, and create web apps. Through Map Viewer and 3D Scene Viewer, you can access a gallery of basemaps and smart styles for exploring and visualizing your data. You also have access to templates and widgets for creating web apps that you can publish to ArcGIS Online.

Share and collaborate

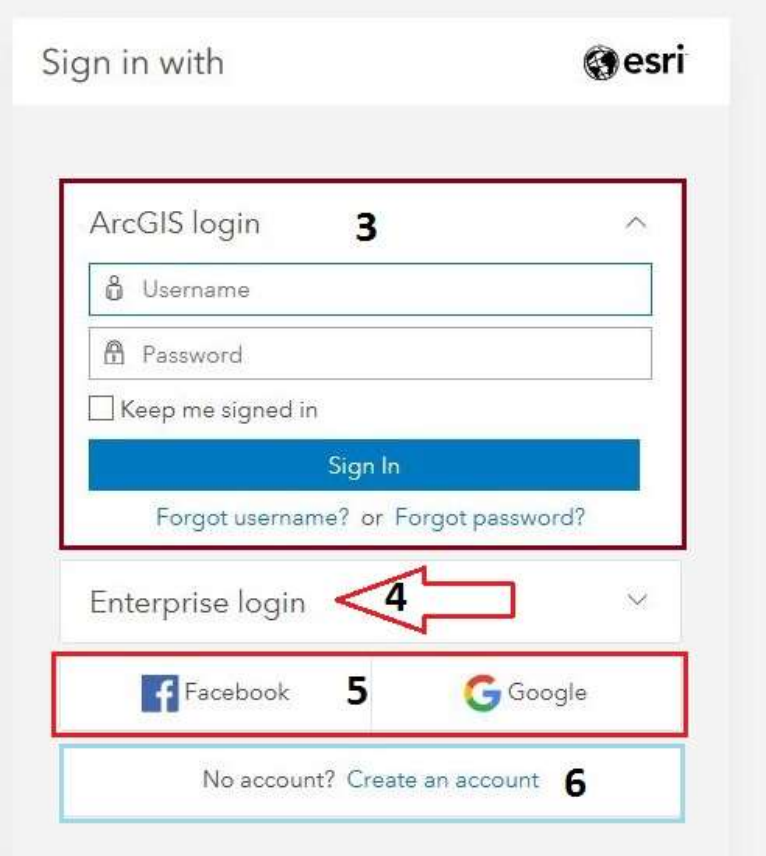
It's easy to share content with others inside and outside your organization. You can set up groups that are private and by invitation only, or public groups that are open to everyone. You can also share maps by embedding them in web pages, on blogs, in web apps, and through social media. Use focused apps to collaborate with colleagues in the field, office, or community.

How to Use ArcGIS Online?

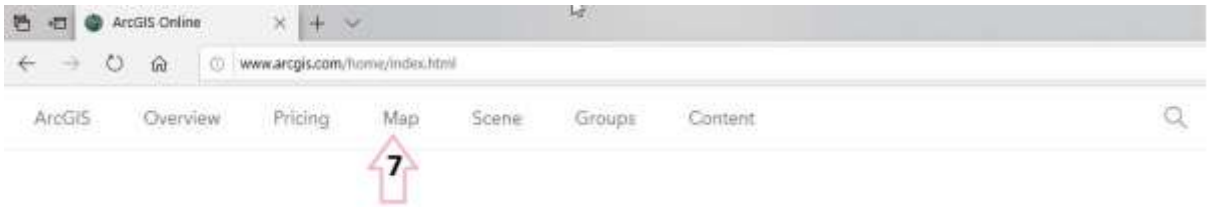
To use ArcGIS Online as WebGIS platform follow the steps below;

1. Open a browser and go to www.arcgis.com
2. Click on Sign in and it will go to a new web page

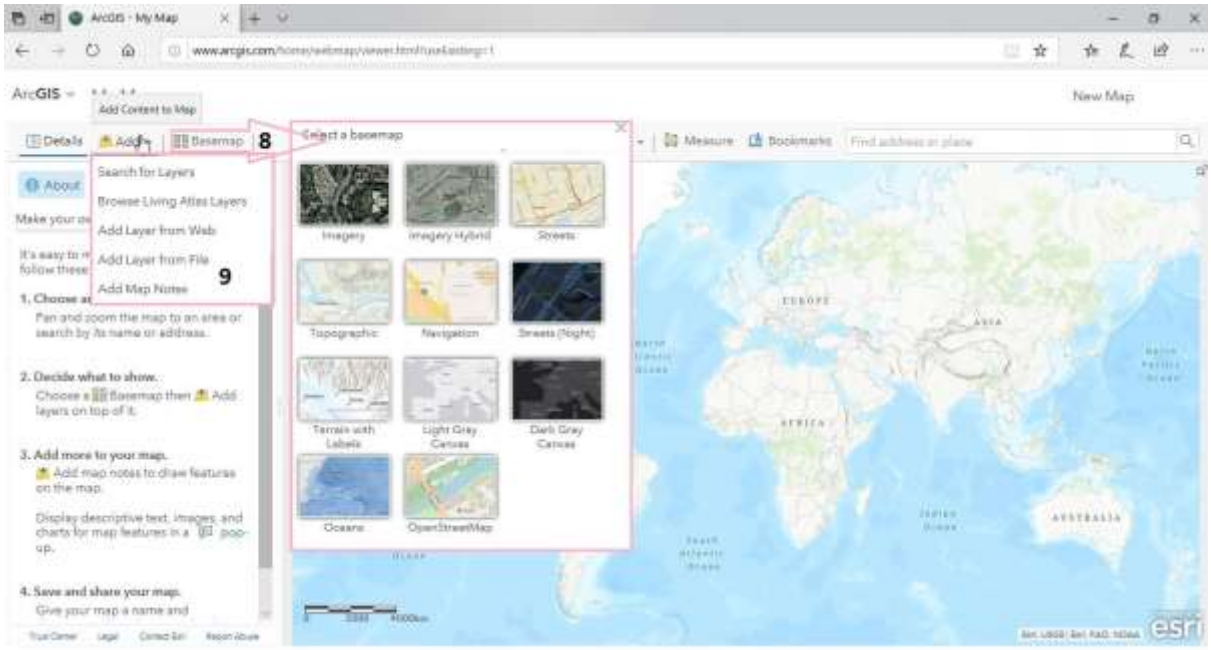
3. One can login using existing ArcGIS Online account
4. Enterprise login is for the enterprise solution
5. One can simply login using his/her existing Google Mail or Facebook account
6. One can create a free account by creating a new account



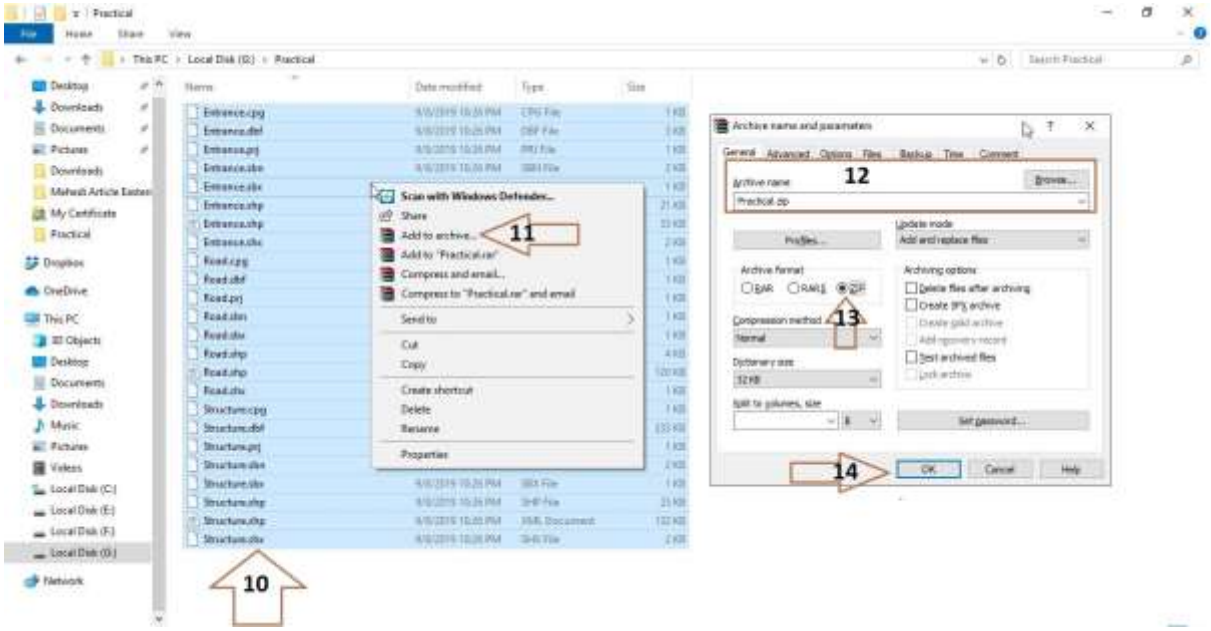
7. After signing in it will open a new web page and click on the Map tab from the new web page



8. The current web page is the target webpage for adding data, preparing map, save map, share and print the map. Basemap can be changed from the Basemap tab as necessary
9. Data can be added from online, local desktop i.e. shapefile and new data can be created

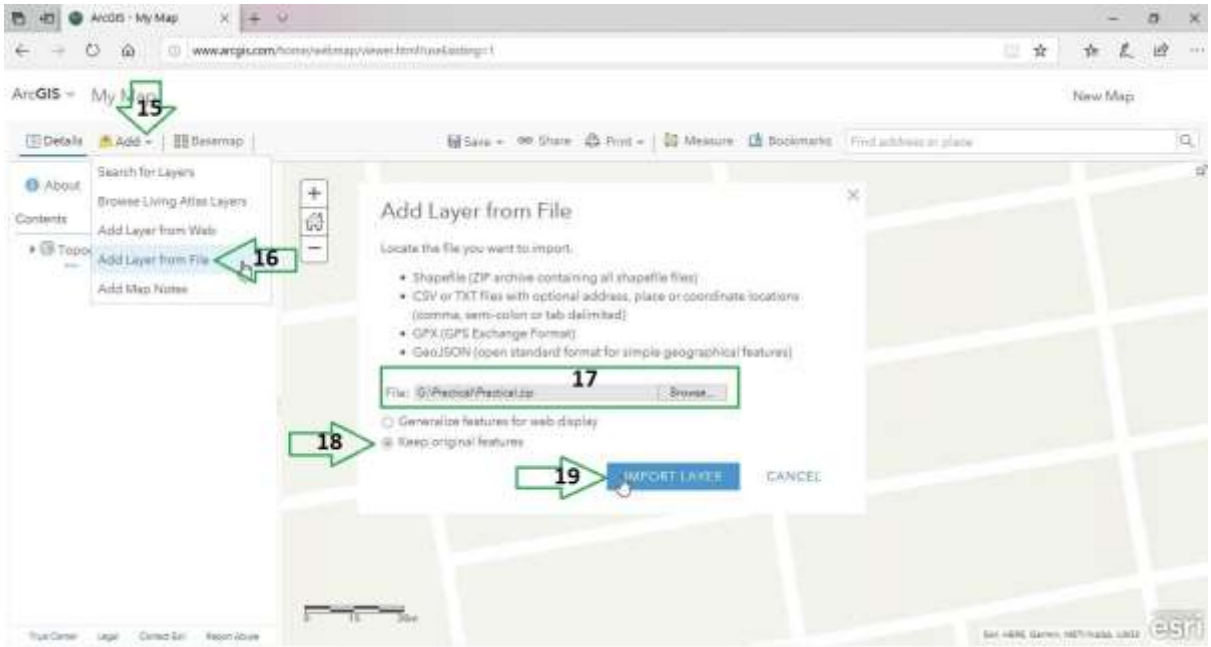


10. To open shapefile from desktop all the shapefile associated file need to compress as a single zip file. To make a single zip file select all the file associated with shapefile and click right mouse button
11. Select add to archive (it may vary by software here WinRar is used) a new window will open
12. Navigate to the folder where the zip file will be saved and give it a name
13. Select archive format as Zip
14. Now click OK to finish the archive

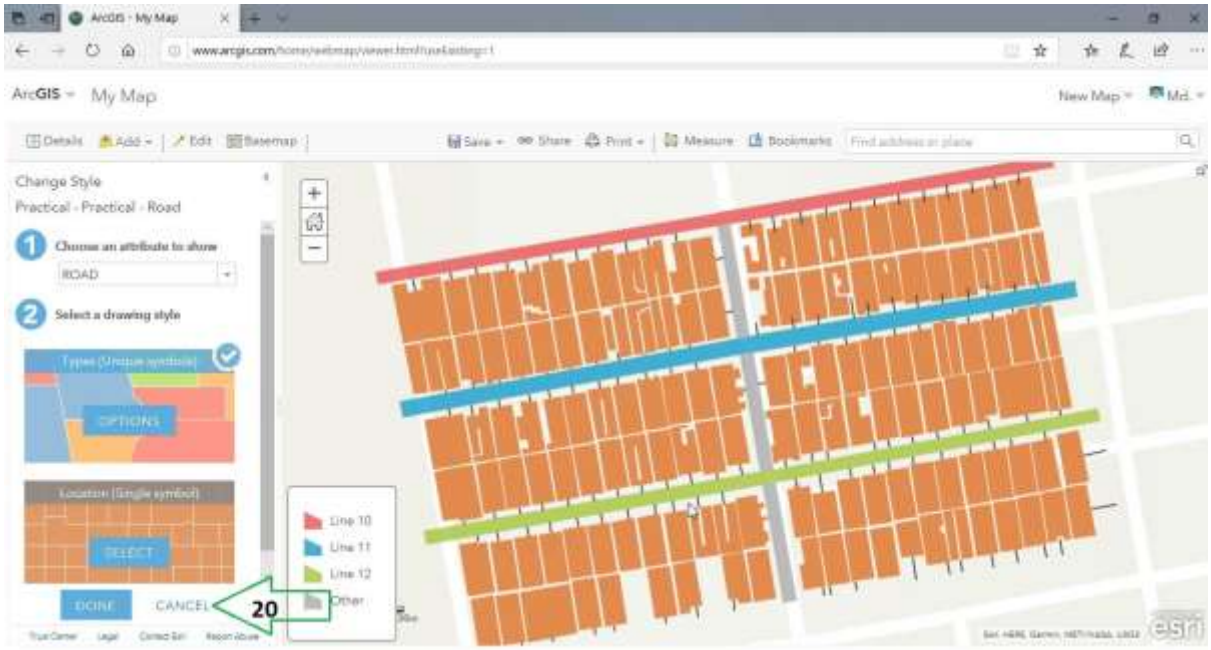


15. To add shapefile to ArcGIS Online go to browser and Click on Add dropdown menu
16. Click Add Layer from File

17. Click on Browse and locate the zip file
18. Do not select Generalize features for web display select Keep original features because Generalize feature will distort the shapefile if it is polygon
19. Now click Import Layer to import the data from desktop GIS to ArcGIS Online

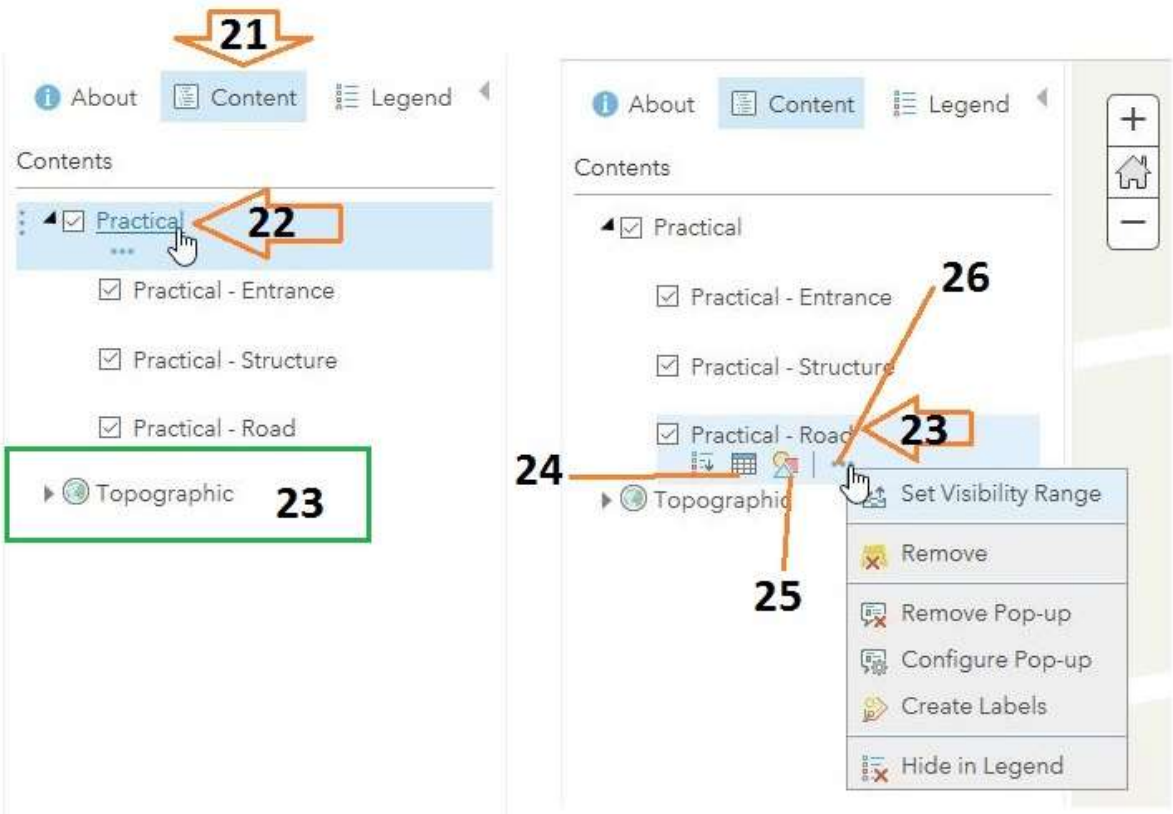


20. After importing all layer the window will look like the following and just cancel it



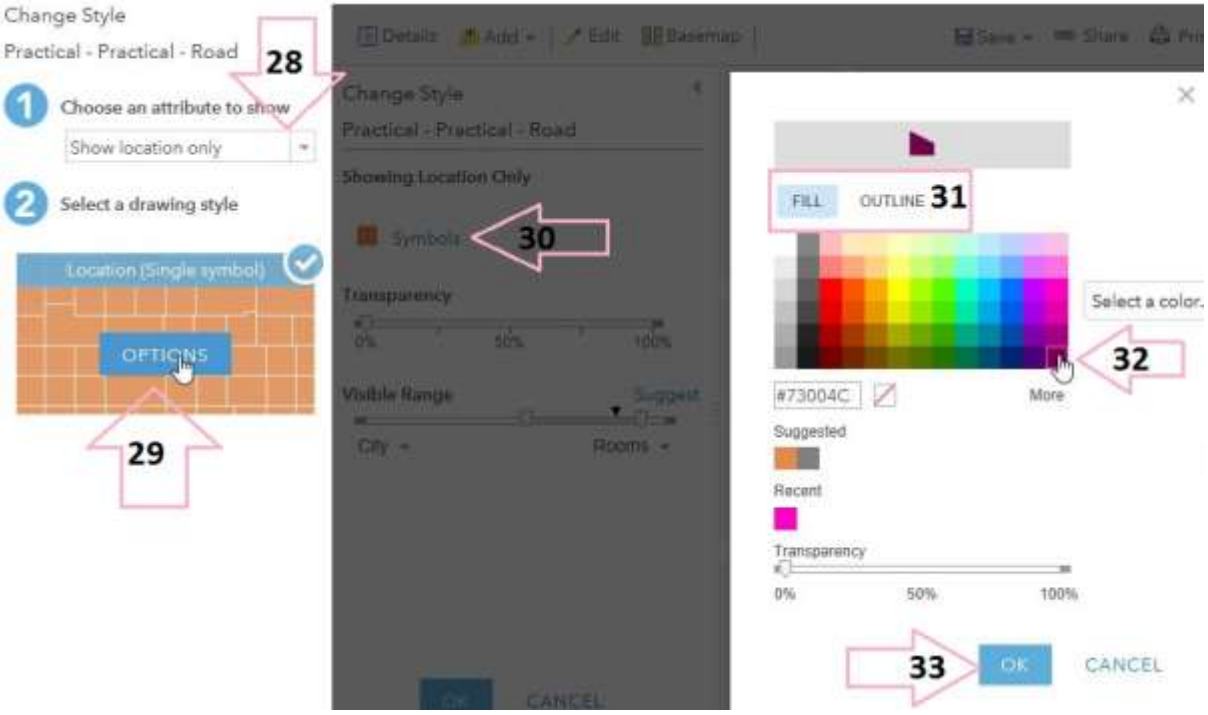
21. To see the table of contents click on the Contents. Practical is showing as we have zipped all the layer and upload as practical so ArcGIS Online is treating it as a layer package

22. To see the individual shapefile or layer click on Practical. Here is three feature i.e. Entrance, Structure and Road
23. Topographic is the base map layer which can be changed from 8
24. To see the attribute table just put the mouse pointer on any feature it will pop up some properties. Click on the table under the feature name it will open the attribute table of the shapefile
25. To change the Symbology click on the geometry and it will pop up a new window which is for symbolize the map
26. To set the visibility range or remove the single layer/shapefile click on the option below the features and click what you want.



27. To change the shape color click on geometry from 25 and it will open a new window
28. To symbolize based on an attribute i.e. categories or any quantities symbology select the attribute table and if just want to use one color for all features in a shapefile select show location only
29. Select options to change the layer style and it will open a new window
30. From new window symbol, visible range and transparency can be select. To change the symbol click on the geometry left side of Symbols and it will open a new window
31. From the new window what you want to change i.e. fill color or outline color just click on that

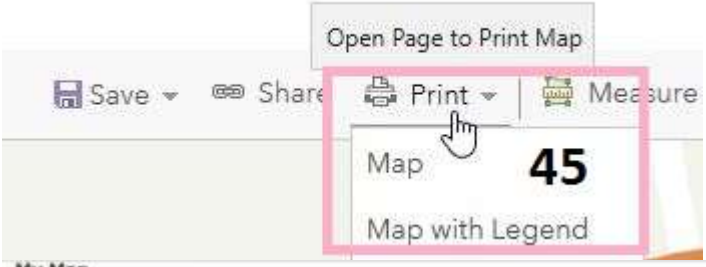
32. Now select the color from the color ramp or go to more color if required. From here transparency of the color can be select
33. After selecting all requirements click on OK to perform the change



34. After clicking OK the window will be extent to all layer and symbolize as specified earlier
35. To see the legend click on the Legend from the left window
36. Now legend will be shown on the left side of the window
37. To save the map click on the Save from the upper tab and it will show two option i.e. Save and Save As. Click any one from them and it will open same window if the map is not saved earlier. If the map is saved earlier clicking save will just update the setting has been changed
38. From the new window give it a title, give some tags and give a brief summary of the map
39. Now select the save in folder which is not in desktop it is location in arcgis online if more than one folder is created
40. To finish the save click on the Save Map. It will save and close the window

41. To share the map online click on the share tab from the upper menu bar. It will open a new window
42. From the new window if you want to share as public give tick to the Everyone otherwise it will remain as private
43. Now the map can be shared by copying the link or share the link on Facebook or Twitter or embed in website or make an web application
44. Click Finish to close the window

45. Map can be print from ArcGIS Online by clicking the Print from the Menu bar. It will pop up two options one is for Map without legend and with legend. Both has been shown below


Open Page to Print Map
Save
Share
Print
Measure
Map
45
Map with Legend


My Map
30m
Esri, HERE, Garmin, METI/NASA, USGS


My Map
Practical - Entrance
Practical - Structure
Practical - Road
30m
Esri, HERE, Garmin, METI/NASA, USGS