What is GIS?

- Geographical Information Systems (GIS) can be regarded as the high-tech equivalent of the map.
- GIS integrates hardware, software, and data for capturing, managing, analyzing, and displaying all forms of geographically referenced information.

What is GIS?

- An individual map contains a lot of information which is used in different ways by different individuals and organizations.
- GIS allows us to view, understand, question, interpret, and visualize data in many ways that reveal relationships, patterns, and trends in the form of maps, globes, reports, and charts.

What is GIS?

- The power of a GIS comes from the ability to relate different information in a spatial context and to reach a conclusion about this relationship.
- Most of the information we have about our world contains a location reference, placing that information at some point on the globe.
What is GIS?

- When rainfall information is collected, it is important to know where the rainfall is located.
- This is done by using a location reference system, such as longitude and latitude, and perhaps elevation.

Weekend Rainfall Totals - May 1st & 2nd, 2010
Tennessee

What is GIS?

- This fact may indicate that these marshes are likely to dry up, and this inference can help us make the most appropriate decisions about how humans should interact with the marsh.

What is GIS?

- Comparing the rainfall information with other information, such as the location of marshes across the landscape, may show that certain marshes receive little rainfall.

What is GIS?

- Many computer databases that can be directly entered into a GIS are being produced by Federal, State, tribal, and local governments, private companies, academia, and nonprofit organizations.
- Different kinds of data in map form can be entered into a GIS.
What is GIS?

- Many computer databases that can be directly entered into a GIS are being produced by Federal, State, tribal, and local governments, private companies, academia, and nonprofit organizations.
- Different kinds of data in map form can be entered into a GIS.

- A GIS can also convert existing digital information, which may not yet be in map form, into forms it can recognize and use.
  - For example, digital satellite images can be analyzed to produce a map of digital information about land use and land cover.
  - Likewise, census or hydrologic tabular data can be converted to a maplike form and serve as layers of thematic information in a GIS.

- How can a GIS use the information in a map?
  - If the data to be used are not already in digital form, that is, in a form the computer can recognize, various techniques can capture the information.
What is GIS?

- How can a GIS use the information in a map?
- A GIS can be used to emphasize the spatial relationships among the objects being mapped.
- While a computer-aided mapping system may represent a road simply as a line, a GIS may also recognize that road as the boundary between wetland and urban development between two census statistical areas.

What is GIS?

- Since much of the information in a GIS comes from existing maps, a GIS uses the processing power of the computer to transform digital information, gathered from sources with different projections, to a common projection.

What is GIS?

- It is impossible to collect data over every square meter of the Earth's surface. Therefore, samples must be taken at discrete locations.
- A GIS can be used to depict two- and three-dimensional characteristics of the Earth's surface, subsurface, and atmosphere from points where samples have been collected.
- For example, a GIS can quickly generate a map with isolines that indicate the pH of soil from test points.
- Two- and three-dimensional contour maps created from the surface modeling of sample points from pH measurements can be analyzed together with any other map in a GIS covering the area.
**What is GIS?**

- Have there ever been gas stations or factories that operated next to the swamp?
- Were any of these uphill from and within 2 miles of the swamp?
- A GIS can recognize and analyze the spatial relationships among mapped phenomena.
- Conditions of adjacency (what is next to what), containment (what is enclosed by what), and proximity (how close something is to something else) can be determined with a GIS.

**What is GIS?**

- Sources of pollution are represented as points. The colored circles show distance from pollution sources and the wetlands are in dark green.

**What is GIS?**

- When nutrients from farmland are running off into streams, it is important to know in which direction the streams flow and which streams empty into other streams.
- This is done by using a linear network.
- It allows the computer to determine how the nutrients are transported downstream.
- Additional information on water volume and speed throughout the spatial network can help the GIS determine how long it will take the nutrients to travel downstream.

**What is GIS?**

- Using maps of wetlands, slopes, streams, land use, and soils, the GIS might produce a new map layer or overlay that ranks the wetlands according to their relative sensitivity to damage from nutrient runoff.

**What is GIS?**

- A GIS can simulate the movement of materials along a network of lines.
- These illustrations show the route of pollutants through a stream system. Flow directions are indicated by arrows.
Using maps of wetlands, slopes, streams, land use, and soils, the GIS might produce a new map layer or overlay that ranks the wetlands according to their relative sensitivity to damage from nutrient runoff.

The land use and land cover map for the two areas shows that the area is partly developed.

A critical component of a GIS is its ability to produce graphics on the screen or on paper to convey the results of analyses to the people who make decisions about resources.

Wall maps, Internet-ready maps, interactive maps, and other graphics can be generated, allowing the decision makers to visualize and thereby understand the results of analyses or simulations of potential events.

The land use and land cover map for the two areas shows that the area is partly developed.

The developed areas were eliminated from further consideration.

The U.S. Geological Survey (USGS), in a cooperative project with the Connecticut Department of Natural Resources, digitized more than 40 map layers for the areas covered by the USGS Broad Brook and Ellington 7.5-minute topographic quadrangle maps.

This information can be combined and manipulated in a GIS to address planning and natural resource issues.

Some of the streams in the study area were known to be unusable as drinking water sources. To avoid pulling water from these streams into the wells, 100-meter buffer zones were created around the unsuitable streams.
What is GIS?

- The map showing the buffered zones was combined with the land use and land cover map to eliminate areas around unsuitable streams from the analysis.

- This information was combined with the previous two map layers to produce a new map of areas suitable for well sites.

- Point sources of pollution are recorded by the Connecticut Department of Natural Resources. These records consist of a location and a text description of the pollutant.

- The map of surficial geology shows the earth materials that lie above bedrock. Since the area under consideration in Connecticut is covered by glacial deposits, the surface consists largely of sand and gravel, with some glacial till and fine-grained sediments.

- To avoid these toxic areas, a buffer zone of 500 meters was established around each point.

- Of these materials, sand and gravel are the most likely to store water that could be tapped with wells. Areas underlain by sand and gravel were selected from the surficial geology map.
Theses data were combined with the results of the previous selections to produce a map consisting of: (1) sites in underdeveloped areas underlain by sand and gravel, (2) more than 500 meters from point sources of pollution, and (3) more than 100 meters from unsuitable streams.

The resulting site selection map shows areas that are undeveloped, are situated outside the buffered pollution areas, and are underlain by 40 feet or more of water-saturated sand and gravel.

A map that shows the thickness of saturated sediments was created by using the GIS to subtract the bedrock elevation from the surface elevation.

Because of map resolution and the limits of precision in digitizing, the very small polygons (areas) may not have all of the characteristics analyzed, so another GIS function was used to screen out areas smaller than 10 acres.

For this analysis, areas having more than 40 feet of saturated sediments were selected and combined with the previous overlays.

The final six sites are displayed with the road and stream network and selected place names for use in the field.
What is GIS?

- Site selection analysis has many common applications, including transportation planning and waste disposal site location.

- The technique is particularly useful when several physical factors must be considered and integrated over a large area.

- More detailed information can be found about this presentation at: [http://egsc.usgs.gov/isb/pubs/gis_poster/](http://egsc.usgs.gov/isb/pubs/gis_poster/)

Any Questions?