

# 1- GEOGRAPHIC INFORMATION SYSTEMS

## Nutshell

In this lesson, students use a Geographic Information System (GIS) to study the regional geography of their school forest. Students use geography terms to describe aspects of their community and region. They study Platt maps and county records that illustrate the land use history of their school forest and surrounding parcels. Students then use fGIS to analyze geographic data and print a map of Wisconsin and their school forest region.

## Big Ideas

Regions in Wisconsin differ in climate (e.g., precipitation, temperature) and the results of glaciation (e.g., soil, topography). These variations lead to different forest communities with differing species, thereby contributing to biodiversity. (subconcept 18)

Early logging, the resultant cutover, attempts to change land use, and the reforestation of pre-existing forest lands were activities that contributed to the need for forestry. (subconcept 21)

The lumber era shaped Wisconsin's economic, cultural, social, and environmental landscapes. Influences of this time period are still visible in Wisconsin today. (subconcept 22)

Wisconsin's forests are under private (e.g., industrial, non-industrial private forests), public (e.g., county, state, national forests), and tribal ownership; each may have different objectives. (subconcept 31)

## Objectives

*Upon completion of this lesson, students will be able to:*

- Describe the geography of their local region using common geography terms
- Identify geographic features in and around their school forest and describe the regional land use
- Explain how GIS is used to study geography
- Correlate map layers using fGIS to infer relationships between geographic data

## Subject Areas

Social Studies, Technology

## LEAF 9-12 Lesson Guide Connection:

### Lesson 2 – History of Succession

- Provides background on the geological, ecological, and human forces that have shaped the Wisconsin landscape.

### Lesson 3 – Forest Biodiversity: Tree Case Studies

- Provides background on Wisconsin's landscape diversity, including the geography of Wisconsin's natural divisions.

## Lesson/Activity Time

Total Lesson Time: 140 minutes

### Time Breakdown:

Introduction – Our Geography (10 minutes)

Activity 1 – The School Forest (30 minutes)

Activity 2 – Geographic Information Systems (30 minutes)

Activity 3 – School Forest GIS (60 minutes)

Conclusion – What Does our GIS Tell Us? (10 minutes)

## Teaching Site

Computer lab

## Vocabulary

- **Attribute** – The non-spatial information about a geographic feature in a GIS. For example, attributes of a river might include its name and length.
- **Digital Elevation Model (DEM)** – A raster representation of continuous elevation values over a topographic surface. DEMs are typically used to represent terrain relief.
- **Digital Raster Graphic (DRG)** - A raster image of a scanned USGS standard series topographic map. Source maps are georeferenced to the surface of the earth, fit to the Universal Transverse Mercator (UTM) projection, and scanned at a minimum resolution of 250 dpi.
- **Feature** – A representation of a real-world object on a map.
- **Image** - Data produced by scanning a surface with an optical or electronic device. Common examples include scanned documents, remotely sensed data (for example, satellite images), and aerial photographs. An image is stored as a raster dataset of binary or integer values that represent the intensity of reflected light, heat, or other range of values on the electromagnetic spectrum.
- **Orthophotograph** - An aerial photograph from which distortions owing to camera tilt and ground relief have been removed. An orthophotograph has the same scale throughout and can be used as a map.
- **Polygon** – On a map, a closed shape defined by a connected sequence of x,y coordinate pairs, where the first and last coordinate pair are the same and all other pairs are unique.
- **Projected Coordinate System** – A reference system used to locate x, y, and z positions of point, line, and area features in two or three dimensions. A projected coordinate system is defined by a geographic coordinate system, a map projection, any parameters needed by the map projection, and a linear unit of measure.
- **Raster Data** - A spatial data model that defines space as an array of equally sized cells (pixels) arranged in rows and columns. Each cell contains an attribute value and location coordinates. Groups of cells that share the same value represent the same type of geographic feature.
- **Shapefile** – A vector data file format for storing the location, shape, and attributes of geographic features.
- **Vector Data** – A coordinate-based data model that represents geographic features as points, lines, and polygons.

## Materials List

### For each student

- A folder for their school forest records
- a Platt map of the school forest and surrounding properties
- a map with the school forest boundaries and features
- county land records that describe the land use history on and around the school forest property (if available)
- Copy of Student Page  1, *fGIS School Forest Project*

### For each student pair

- A computer with internet capability and fGIS software

### For the teacher

- Wisconsin Land Cover Map
- Teacher Page  2, *fGIS Preparation*
- A computer with internet capability and fGIS Software
- LCD Projector

## Teacher Preparation

Order a Platt map from the County Clerks office. Scan the maps containing your school forest area or make enough paper copies for the entire class. Look for county land records that describe the land use history of the school forest and surrounding area. Again, scan the records or make enough copies for the entire class. Make copies of a school forest map from your fGIS project or use another copy as you see fit.

To teach the fGIS portion of this lesson, you will need to complete the steps outlined in Teacher Page  2, *fGIS Preparation*. You will then need to load the appropriate files and the software on the computers in your computer lab.

## Background Information

For background information on Wisconsin geography, see Lesson 2 – A History of Succession from the LEAF 9-12 Lesson Guide.

## Procedure

### Introduction – Our Geography (10 minutes)

1. Ask the class to define what geography is. Lead the discussion to include a definition similar to the following:

Geography - the study of earth and its life, including land, sea, air and the distribution of plant and animal life including people and cities.

2. Ask the class what understanding the local geography can tell them about the place they live. Hand each student a card from Teacher Page  1, *Geography Cards*. One by one, have the students read the word on the card to the class and describe the local region using their word (e.g., word = land use, description = the land use in our region is mostly dairy farming and corn farming).

If some students have difficulty describing the local region, have the class help them. Facilitate the discussion so the answers are complete and accurate.

Tell the class that understanding the regional geography will help them understand the social and ecological systems that sustain human populations. The knowledge will help them understand the role that they and their school forest can play in their local community.

### **Activity 1 – The School Forest (30 minutes)**

3. Have students gather around the Wisconsin Land Cover Map. Lead a group discussion to describe the map. Have students identify different land cover types, describe them, and identify the land cover type for their school and school forest.
4. Hand each student a folder and have them label it *School Forest Records* (You can have them make a computer folder if you have the resources in a digital format). Hand each student a copy of the following:
  - a Platt map of the school forest and surrounding properties
  - a map with the school forest boundaries and features (if available)
  - county land records that describe the land use history on and around the school forest property (if available)

Review each of the documents with the class, explaining their contents and use. Platt maps are sold in book format and show current land ownership for an entire county. They are often used to identify and contact landowners about issues that affect their property. County records can be researched to determine past land ownership and land use. They can be useful in determining the human land use history of a property.

5. Have the students use the records to discuss and answer the following questions:
  - How big is the school forest property?
  - What are the notable features on the school forest property?
  - Who owns the school forest property?
  - Who owns the land around the school forest property?
  - What type of land use surrounds the school forest property?
  - Who owned the school forest property in the past?
  - What was it used for?
  - How has the land use on and around the school forest property changed over time?

### **Activity 2 – Geographic Information Systems (30 minutes)**

6. Give student pairs a few minutes to review Wisconsin statewide maps on the WDNR website at <http://www.dnr.state.wi.us/landscapes/maps.asp>. Ask students to save/print a few maps that they think would be helpful in understanding their school forest and their local community. Have students identify the maps that they have chosen and describe why they think they are important.

Tell the class that comparing and correlating maps can help people understand the relationship between people and the landscape. Have students open the following two maps:

- Percent of Houses that are Seasonal in Wisconsin
- Land Cover of Wisconsin

Ask the students what they can determine by looking at the two maps together. (*Most seasonal houses are in forested areas*). Have students hypothesize about why the phenomenon occurs, and the effects that it might have.

7. Tell students that researchers now have a powerful computer-based tool to help them correlate geographic data and answer important questions that affect human populations. The tool is called a Geographic Information System (GIS). Have students read an overview of GIS on the web at [www.gis.com/whatisgis/index.cfm](http://www.gis.com/whatisgis/index.cfm).

Tell the class that they will use a Geographic Information System called forestryGIS (fGIS) to acquire, create, and correlate maps and information about their community and school forest.

### **Activity 3 – School Forest GIS (50 minutes)**

8. Prior to bringing your class to the computer lab, you will need to complete the instructions on Teacher Page 2, *fGIS Preparation* (this was done during the summer course).
9. Hand each student a copy of Student Page 1, *fGIS School Forest Project*. Work through the tutorial with your students using an LCD projector to demonstrate how each step is completed. Once the students have the fGIS project completed, have them print out the map views indicated and add them to the School Forest Records Folder.

### **Conclusion – What Does GIS Tell Us? (15 minutes)**

10. Ask the class what each of the maps in their fGIS project reveals about their school forest and surrounding region. Have students look for and share correlations they find between the maps.

### **Summative Assessment**

Have students use the information they have learned to write a geographic assessment of their school forest and surrounding region.

### **Extension**

Invite a subject matter expert (SME) to speak to the class about regional geography. A number of SMEs would be appropriate, including but not limited to:

- a forester from the Wisconsin Department of Natural Resources, US Forest Service, or local forest industry
  - a geologist from the US Geological Survey or Wisconsin Geological and Natural History Survey
  - a historian from a local or state historical society
  - a professor of geography, history, or geology from a local university
  - a community development expert from the local government or University of Wisconsin
- Extension

## Web Resources

- UWSP-CNR Oasis <http://oasis.uwsp.edu/index.htm>
- fGIS from the WDNR <http://dnr.wi.gov/forestry/GIS/Applications/FGIS/>
- Map resources from the Wisconsin State Cartographer's Office <http://www.sco.wisc.edu/maps/index.php>
- Platt Book resources from the Wisconsin State Cartographer's Office <http://www.sco.wisc.edu/maps/platbooks.php#online>
- The Geology of Wisconsin from UW-Green Bay <http://www.uwgb.edu/dutchs/geolwisc/geowisc.htm>
- The Natural Communities of Wisconsin from the WDNR <http://dnr.wi.gov/landscapes/community/>
- Wisconsin statewide maps from the WDNR <http://www.dnr.state.wi.us/landscapes/maps.asp>
- Ecological Landscapes (Land Type Associations) from the WDNR <http://www.dnr.wi.gov/landscapes/>
- Ecological Land Classification from the WDNR <http://dnr.wi.gov/forestry/ecolandclass/>
- Wisconsin Geological and Natural History Survey <http://www.uwex.edu/wgnhs/>
- ESRI – Teaching with GIS <http://www.esri.com/industries/k-12/education/teaching.html>

## Model Academic Standards

### AGRICULTURE EDUCATION B.12.1

#### *Technology/Information*

Standard is: Apply knowledge of technology to identify and solve problems (see SC H.12.3, H.12.4, H.12.5)

- use a software program to compile and analyze statistical data and prepare a presentation for a group

*Students use a geographic information system fGIS to analyze geographic data of the state of Wisconsin and their school forest regions. They analyze data layers to correlate topography, surface deposition, and political demarcations. They use fGIS to create a state map of Wisconsin and a map of their school forest region.*

### Social Studies A.12.1

#### *Geography: People, Places, and the Environment*

**Standard is:** Use various types of atlases and appropriate vocabulary to describe the physical attributes of a place or region, employing such concepts as climate, plate tectonics, volcanism, and landforms, and to describe the human attributes, employing such concepts as demographics, birth and death rates, doubling time, emigration, and immigration

*Students work together to describe their local community using geographic terms. They use a statewide maps and a geographic information system to analyze and describe their regional land cover and land use.*

### Social Studies A.12.2

#### *Geography: People, Places, and the Environment*

**Standard is:** Analyze information generated from a computer about a place, including statistical sources, aerial and satellite images, and three-dimensional models

*Students use fGIS to create a map of their school forest area, including aerial photography, school forest boundaries, and the location of school forest research plots.*

**Multiple Intelligences**

- Verbal-Linguistic
- Logical-Mathematical
- Visual-Spatial
- Interpersonal
- Intrapersonal
- Naturalistic

DRAFT

Teacher Page 1, Geography Cards

<b>Land Use</b>	<b>Climate</b>	<b>Human Communities</b>
<b>Human History</b>	<b>Natural History</b>	<b>Land Cover</b>
<b>Economics</b>	<b>Population</b>	<b>Food</b>
<b>Religion</b>	<b>Recreation</b>	<b>Government</b>
<b>Natural Communities</b>	<b>Industry</b>	<b>Education</b>

# Student Page , fGIS School Forest Project

## Learning Objectives

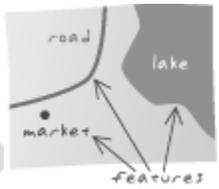
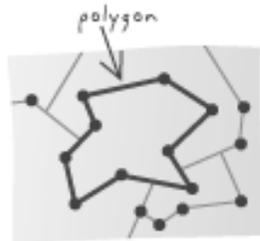
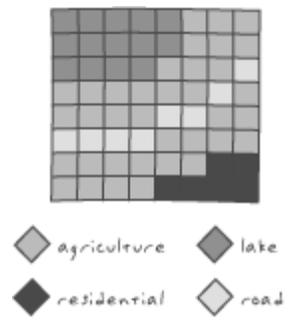
Upon completion of this session, you should be able to:

- Define GIS and describe its common uses
- Correlate map layers to find relationships between geographic features
- Create and print map layouts using FGIS and Microsoft Word.

## What is a Geographic Information System (GIS)?

According to [ESRI](#), a global leader in the development of GIS software, GIS is “a collection of computer hardware, software, and geographic data for capturing, managing, analyzing, and displaying all forms of geographically referenced information.” With a GIS, you can link information (attributes) to location data, such as people to addresses, forests to parcels, or streets within a network. You can then layer that information to give you a better understanding of how it all works together. You choose the layers to combine based on the questions you need to answer.

## GIS Terms ( from the ESRI on-line [GIS Dictionary](#))

- **Feature** – A representation of a real-world object on a map.
- **Attribute** – The non-spatial information about a geographic feature in a GIS. For example, attributes of a river might include its name, length, and sediment load at a gauging station
- **Vector Data** – A coordinate-based data model that represents geographic features as points, lines, and polygons.
  - **Polygon** – On a map, a closed shape defined by a connected sequence of x,y coordinate pairs, where the first and last coordinate pair are the same and all other pairs are unique.
  - **Shapefile** – A vector data file format for storing the location, shape, and attributes of geographic features.
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### **FGIS Overview**

[FGIS](#), or forestry GIS, is a simplified GIS program designed and used by forestry professionals in the Wisconsin Department of Natural Resources. It is a compact shapefile editing program, digitizer and GIS data query tool for Windows®. Designed for operational field managers like foresters and wildlife biologists, FGIS has essential tools tailored for precision mapping on a desktop computer. Use FGIS to customize layered views including aerial photos and other imagery, draw map objects, query and search spatial data, annotate maps for printing, and much more. The standalone program is unlimited, producing shapefiles and geo-referenced images compatible with commercial software in an enterprise GIS framework.

### **Effective User Strategies**

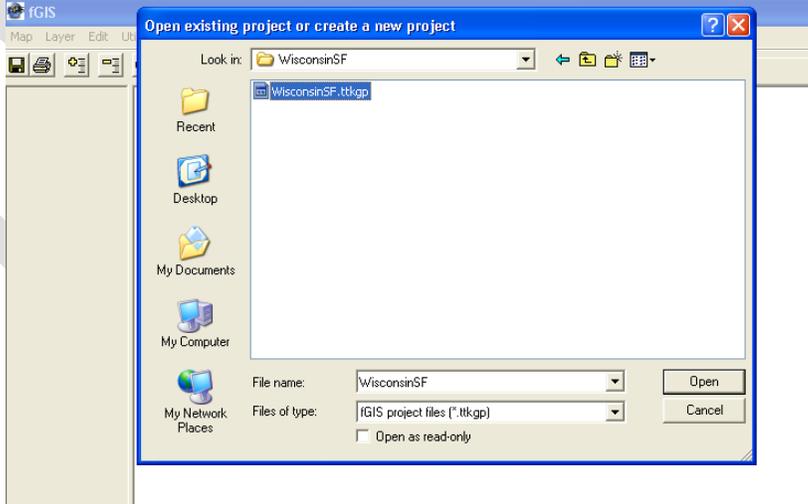
1. BE PATIENT! Let the program run. Do not hit buttons or click on icons while the program is running. Some data sets are very large and take time to process. Starting multiple tasks will only make the program run slower.
2. Keep your project file (.ttkqp) and all of your data files in the same folder. The folder and project file should have the same name.
3. Do not delete files that you don't recognize. All map layers have multiple files associated with them. The files contain attribute and other information necessary for the data to display properly in an FGIS project.

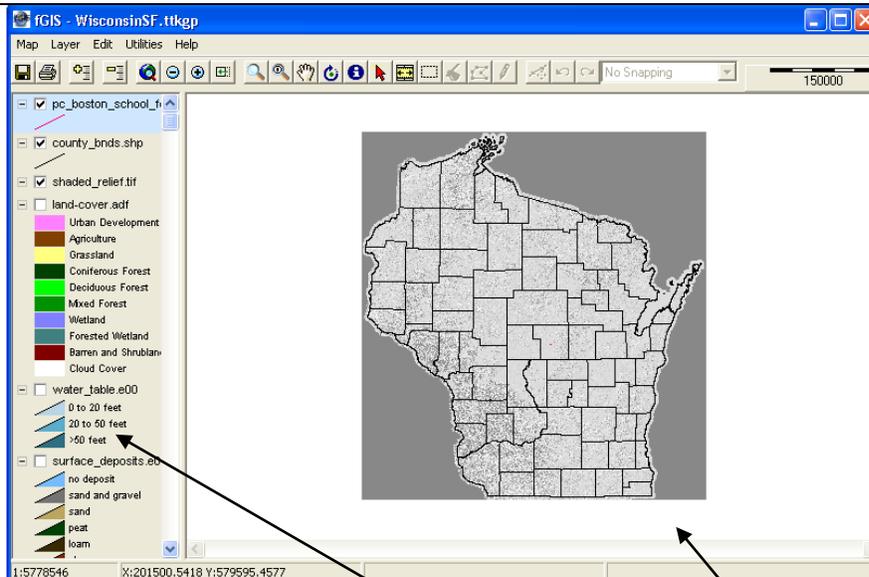
## STEP-BY-STEP FGIS PREPARATION

### Guiding Questions

What meaningful questions can GIS help us answer?

### FGIS Project Preparation

Getting to know FGIS		
<p><u>Step 1:</u> Log on to your computer</p>		
<p><u>Step 2:</u> Open the <b>WisconsinSF.ttkgp</b> project</p>	<p>Navigate to the folder <b>FGIS</b> on your computer network. You will see two folders: <b>FGIS Program</b>, and <b>FGIS Projects</b>.</p> <p>Open the <b>FGIS Program</b> folder and double click the FGIS Icon</p> <div style="text-align: center;">  </div> <p>Navigate to the <b>FGIS Projects</b> folder and open the <b>WisconsinSF</b> folder inside. Click on the FGIS project <b>WisconsinSF.ttkgp</b> and click open.</p>	
	<p>Once the project opens you should see a statewide view of a shaded relief map of Wisconsin.</p>	



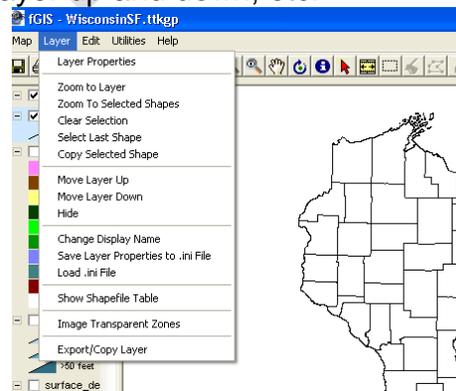
**Step 3:**  
View map layers and explore some FGIS features

An FGIS project incorporates a number of map layers and allows you to arrange and manipulate the **map layers** to create a **map view**.

**Displaying map layers** – Checking and un-checking the box on the upper left-hand corner of each layer, turns map layers on and off.

**Arranging map layers** – A map layer at the top of the left-hand column is displayed as the uppermost map view. A map layer can obscure the layers underneath. You can change the order of the layers by clicking and dragging a layer up or down the column. This will change the map view.

**Selecting a map layer** – Clicking on a map layer will highlight it in blue. Once highlighted, the layer can be manipulated in a number of ways. By selecting the “layer” drop down menu on the upper tool bar, you can see options for looking at the layer properties, zooming the layer, moving the layer up and down, etc.

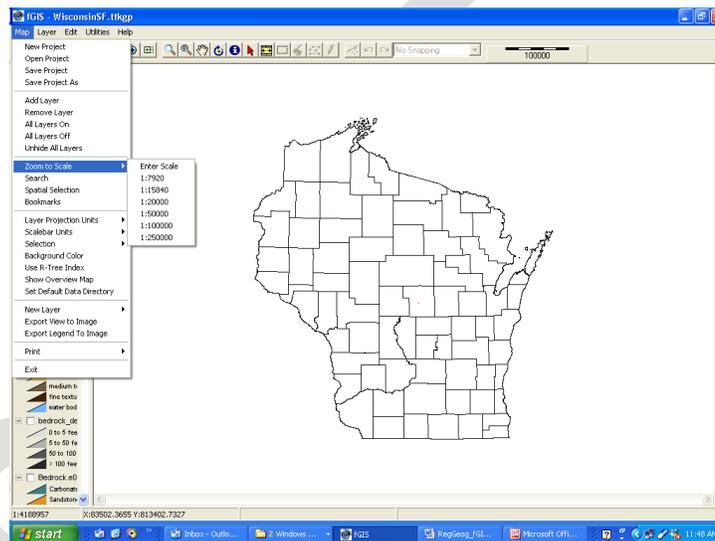


**Layer properties** – Clicking on “layer properties” in the “layer” drop-down menu will display the layer’s attribute table. The attribute table can be used to change the appearance of the map view, change the

legend, and manipulate the layer data. You will format layer properties when you create a project for your school forest.

**Add or remove layers** – You can add or remove map layers from the project with the   buttons on the upper toolbar.

**Zoom** – You can **zoom in or out** on the map view by using the   buttons in the upper toolbar. You can **zoom to a specific layer** by highlighting the layer and selecting “zoom to layer” from the layer drop-down menu. You can also **zoom to a specific map scale** by choosing “zoom to scale” from the “Map” drop down menu.



**Pan** – You can move the map in any direction by selecting the hand symbol  from the toolbar and dragging the map with it.

**Step 4:**  
Use FGIS to visually correlate map layers

Use the pan and zoom buttons to look for visual correlations between the, county boundaries, surface deposits, and shaded relief layers.

Study the map layers to answer the following questions:

- Do the county boundaries match the topography in the shaded relief map? What do you think the relationship is?
- Do the boundaries of the surface deposits correspond to features visible in the shaded relief map? What do you think the relationship is?
- What else do you notice when comparing the three layers?

Discuss the answers as a class.

**Step 5:**  
Print a map view using FGIS and

In this step, you will print a statewide map showing 1) Shaded Relief, 2) County Boundaries, and 3) Surface Deposits.

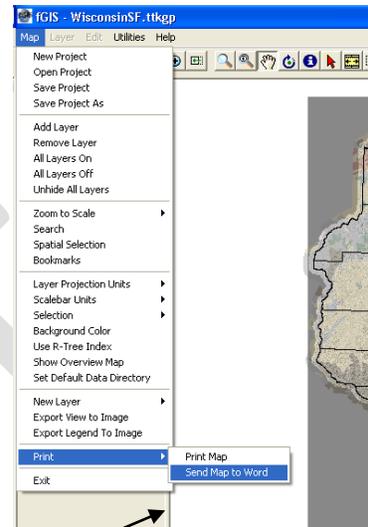
Map Layout

Microsoft Word.

- Activate the layers that you want to appear on your map and place them in order to show the desired map features.
- Set the scale so the screen view of the map area represents the map that you want to print
- Be sure that all lines, colors, and text in the map area are clear and legible. If they are not, you will need to edit them in the layer properties.

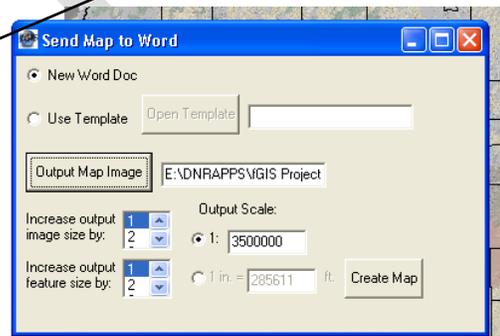
#### Legend Layout

- Hide all of the layers that you do not want visible in you map printout.
- Edit the display names of each layer in the legend so that they are clear, concise, and accurately describe the map layer.
- Make sure the graphical representation of each map element in the legend is present and correct.
- Use you cursor to expand the legend area so that all of the text is clearly visible.



#### Print – Send Map to Word

- Select “Send Map to Word” in the Map drop-down menu
- Locate and name output map image. The name should reflect the features of the map. The location should be convenient to remember and access (e.g., the ■WisconsinSF project folder).
- Set a map scale that is a rounded number similar to the map scale on the screen (e.g. 1:3,500,000)
- Click “Create Map.” A Microsoft Word document will appear with the map image exported into it.



#### Export Legend to Image

- Select “Export Legend to Image” from the Map drop-down box.
- Name the file and locate it in the same folder as the map image (i.e., the ■WisconsinSF project folder)
- Open the image, copy it, and paste it into the word document.



#### Format Word Document

- The map should have the following information: Title, Map,

Legend, Scale, North Arrow, Author, and Date  
Save the map in the ■WisconsinSF project folder and print it.

### Assignment: Print a Map of Your School Forest Research Plots

1) Create and print a school forest map from your school forest FGIS project

Work alone or with a partner to create and print a map of your school forest using FGIS and Microsoft Word. Open the FGIS Project for your school forest area. The map view should show an aerial photo of the school forest area, your school forest boundary, a 40 acre grid overlay, and the locations of 10 school forest research plots. Send a map of the view to Word following the same procedure you did before. Format the map in Word and print it out.

The map should include the following:

- Title (School Forest Research Plots)
- Legend
- Map Scale (1 inch: 400 feet)
- North Arrow
- Author
- Date

