

# GIS Summer 2019

# Cartography and Spatial

# Data Display

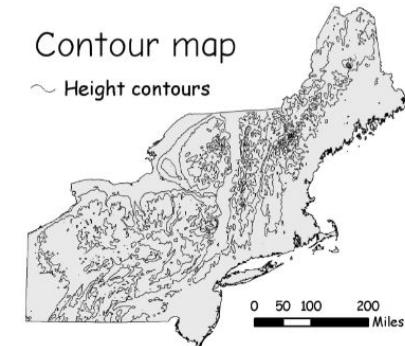
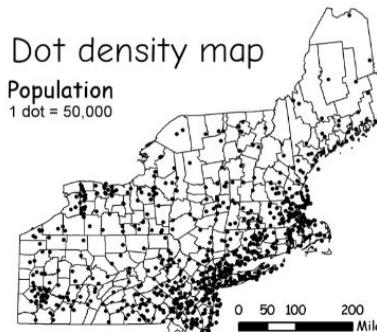
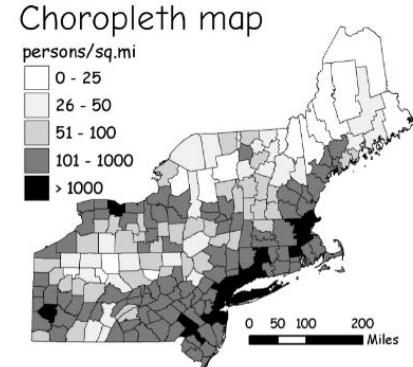
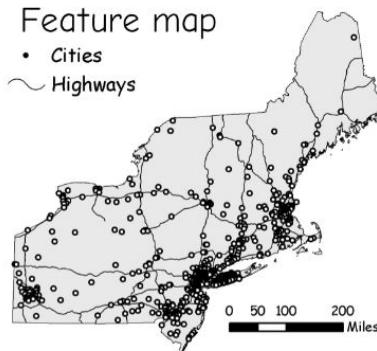
Randy Bucciarelli  
[randobucci@gmail.com](mailto:randobucci@gmail.com)

# Cartography & Spatial Data Display

- Types of maps
- Spatial data layers
- Symbology
- Map design
- Demonstration
- Lab

# Types of maps

- Location/Feature
- Qualitative
- Topographic maps
- Contour maps
- Thematic/Choropleth
- Density maps
- Proportional symbol
- Web maps



Source: GIS Fundamentals by P. Bolstad, 2015

# Map Scale Example

1:10,000,000 scale



Small Scale

1:34,000 scale

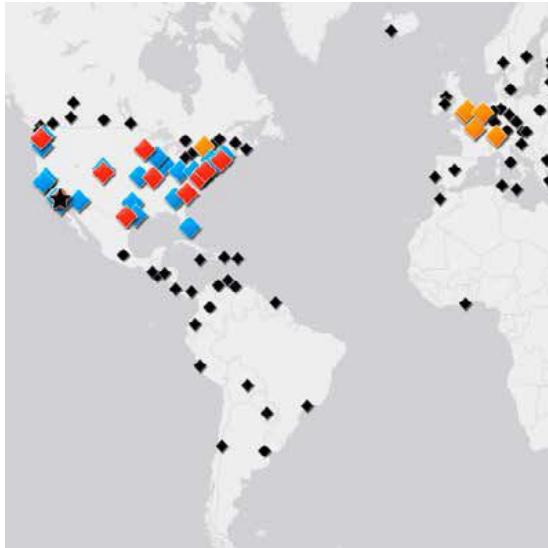


Large Scale

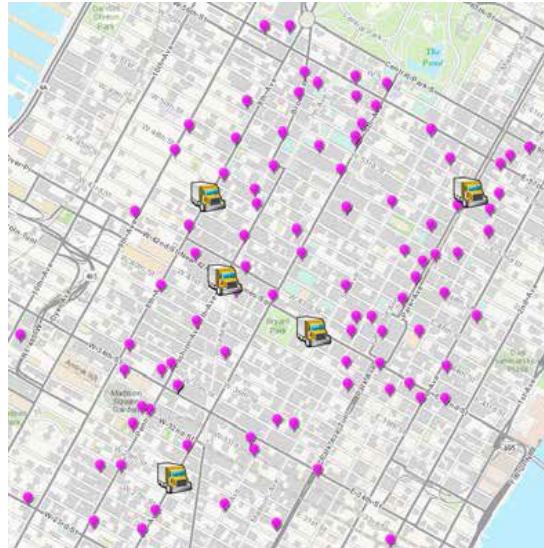
Source: <https://mgimond.github.io/Spatial/introGIS.html>

# Point Location Map

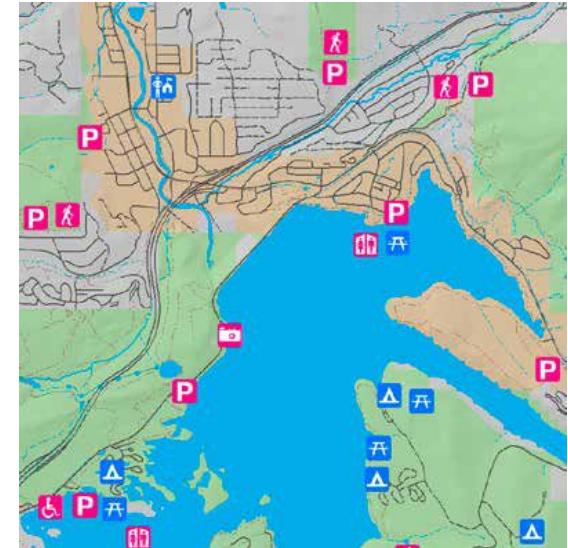
Where are my offices?



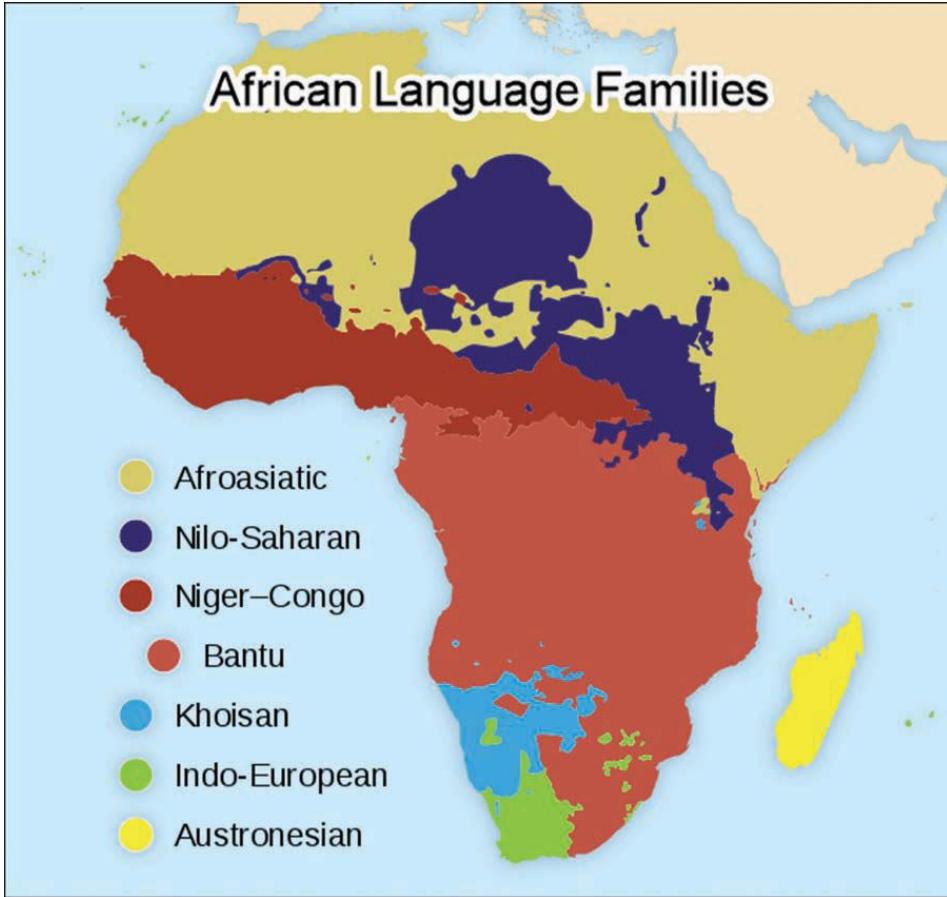
Where are the delivery trucks?



Where are the popular parks?

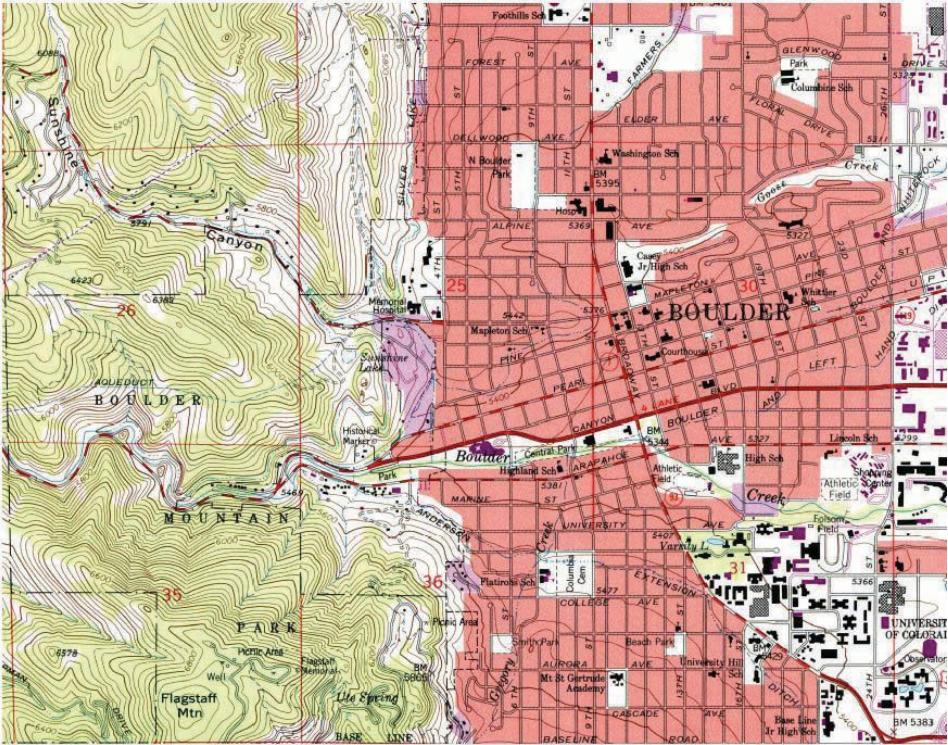


# Qualitative Map

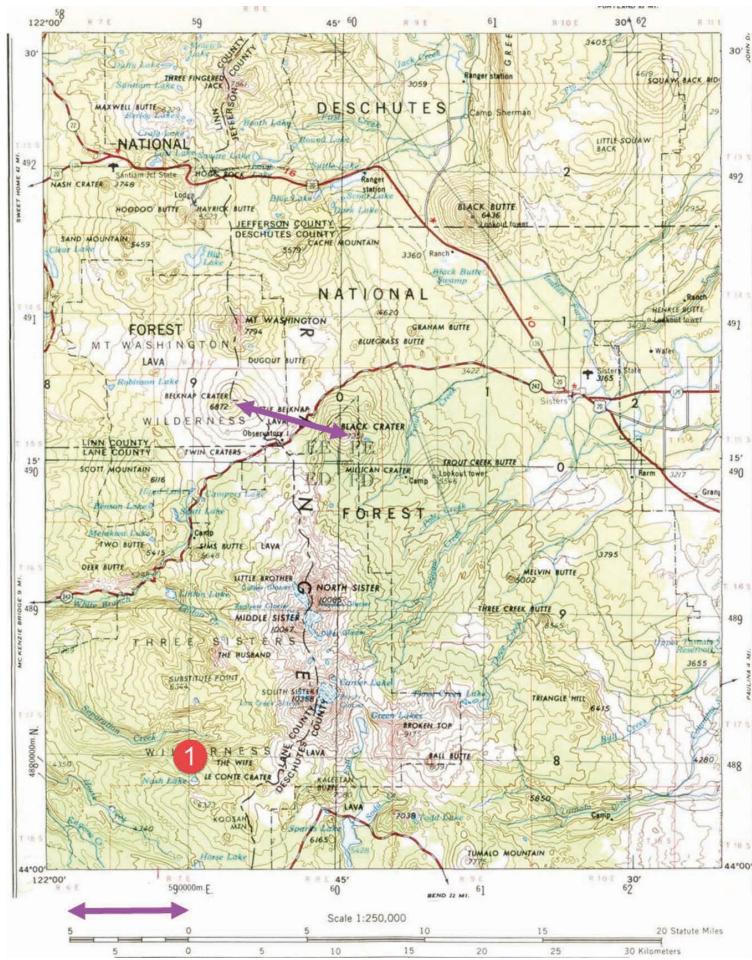


Source: GIS - An Introduction (McHaffie, 2019)

# Topographic Map

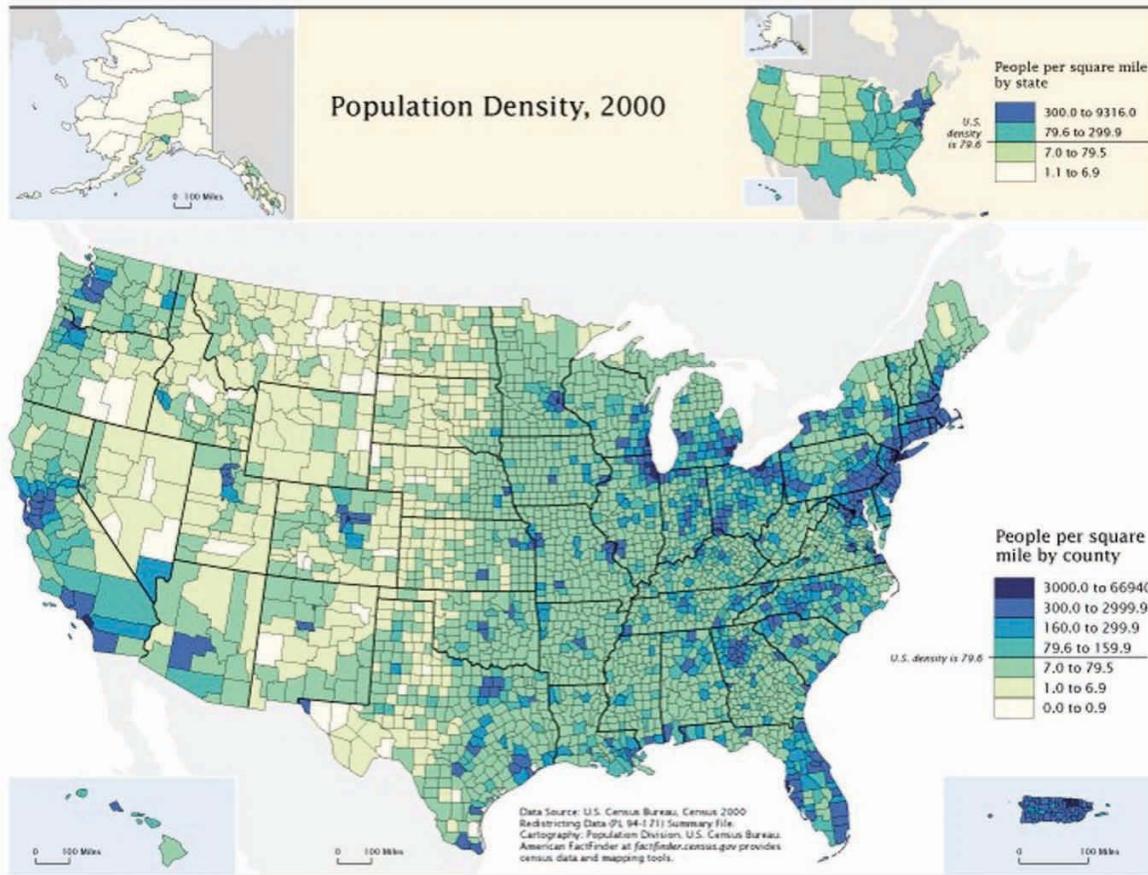


Source: Essentials of GIS (Campbell, 2011)

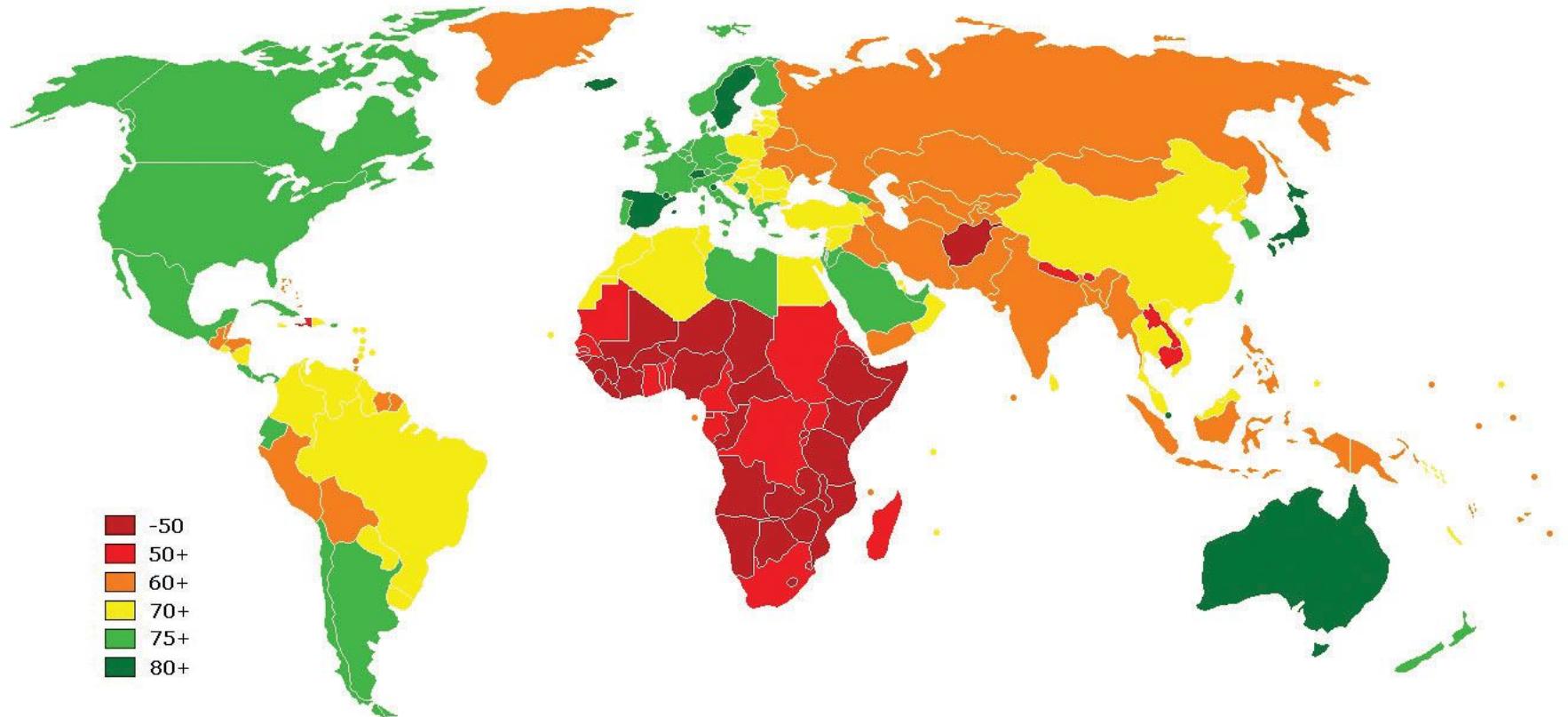


Source: GIS - An Introduction (McHaffie, 2019)

# Thematic or Choropleth Map

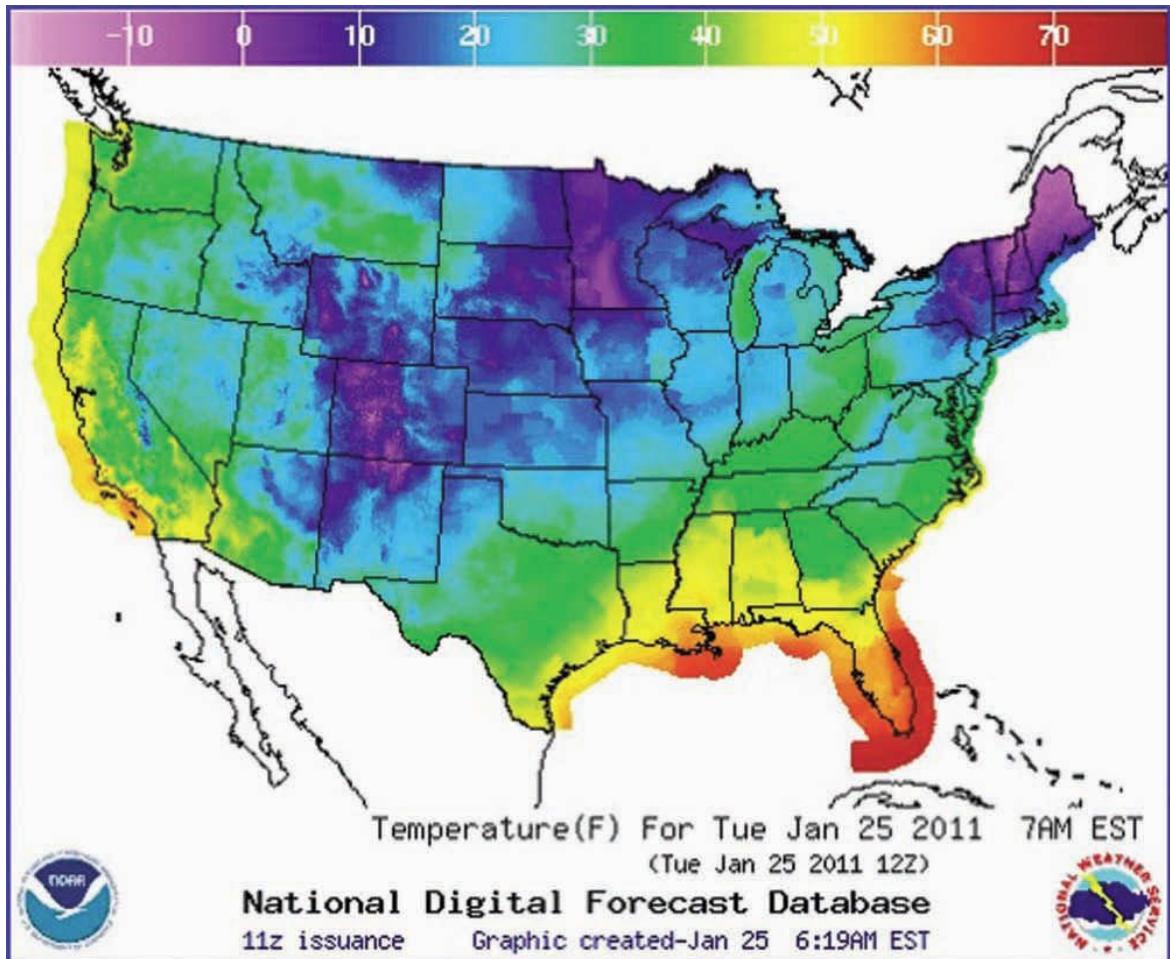


# Thematic or Choropleth Map



Source: Essentials of GIS (Campbell, 2011)

# Isarithmic map

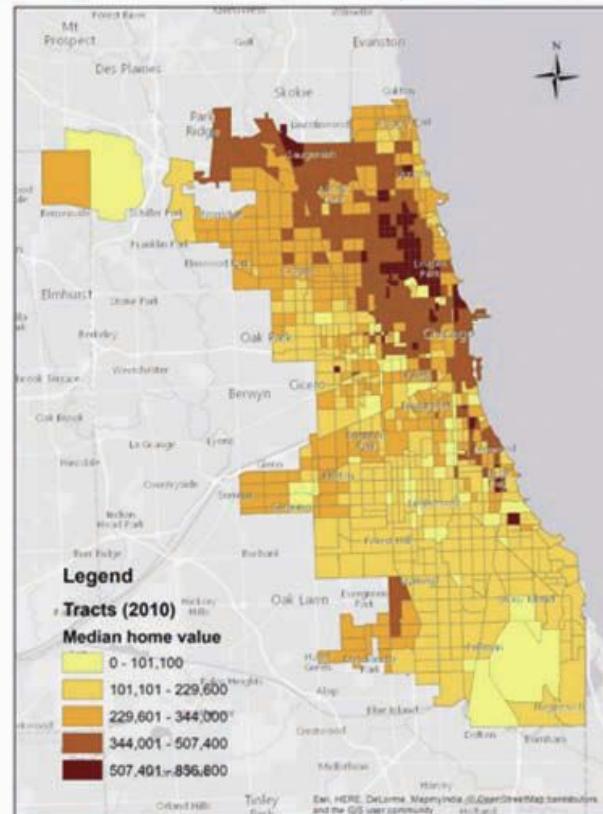


Source: GIS - An Introduction (McHaffie, 2019)

# Isopleth Map

## Choropleth map

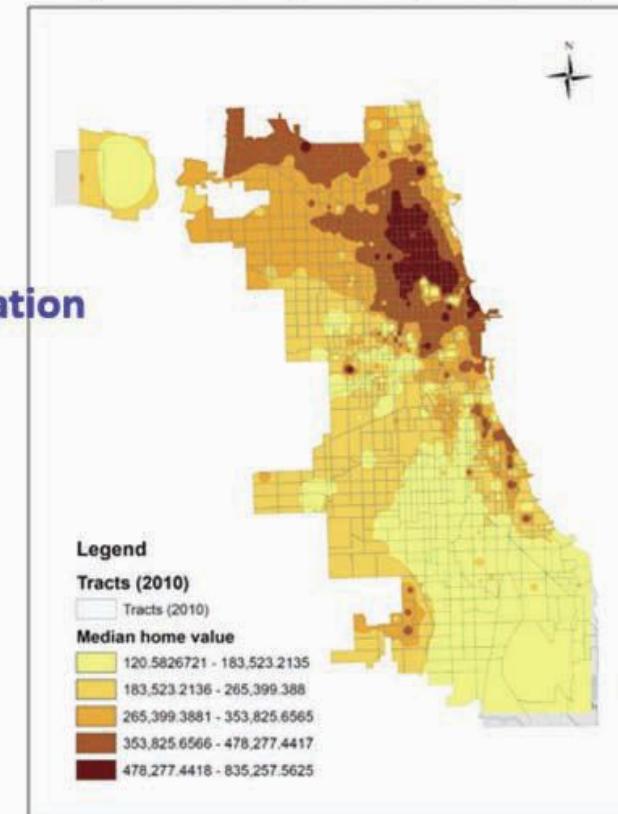
Median price of owner-occupied housing units by tracts (2010)



## Isopleth map

Median price of owner-occupied housing units by tracts (2010)

Spatial  
Interpolation



Source: GIS - An Introduction (McHaffie, 2019)

# Dot Density Map

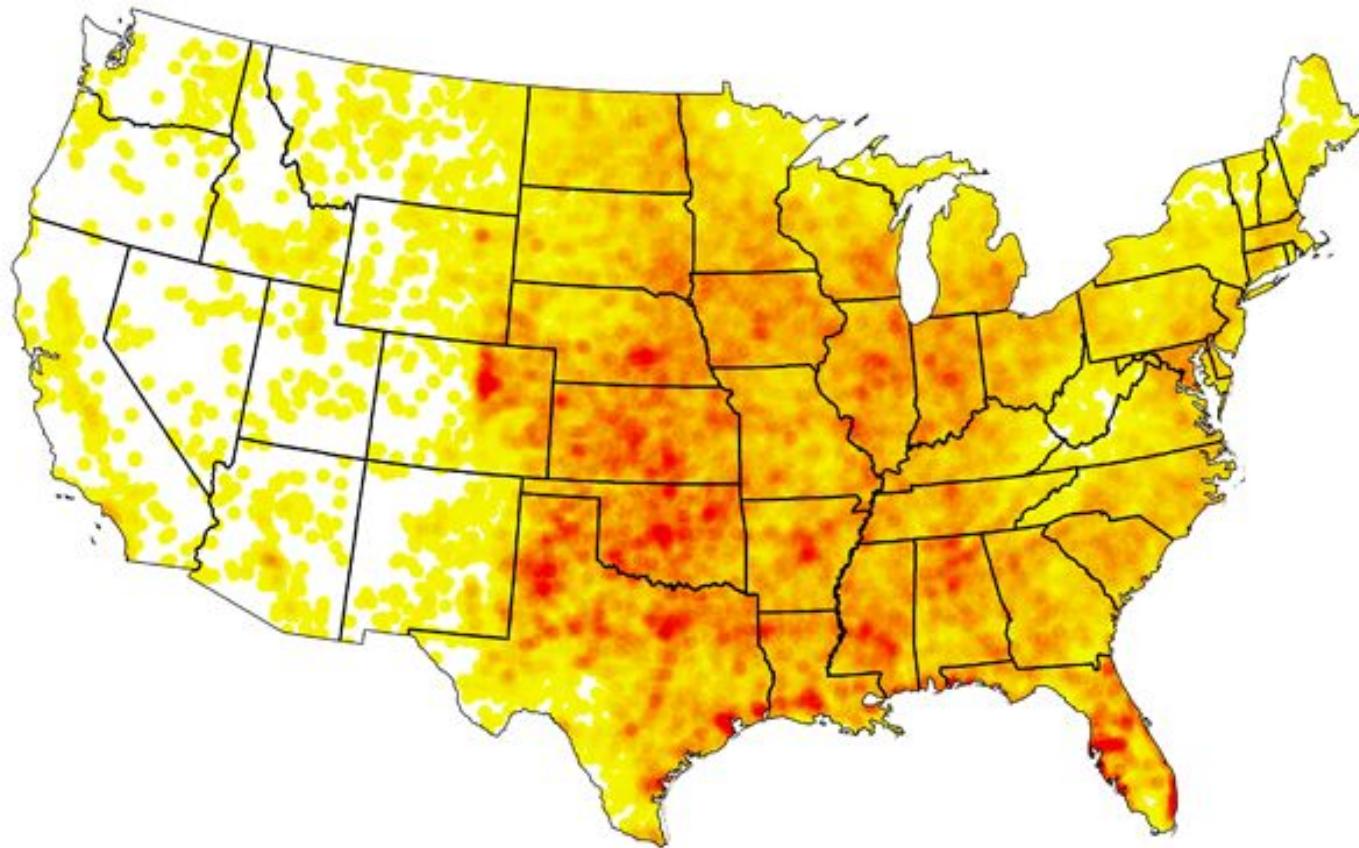
Cumulative U.S. AIDS Cases  
as of 7/89 N~100,000



Cumulative U.S. AIDS Cases  
as of 12/95 N~500,000

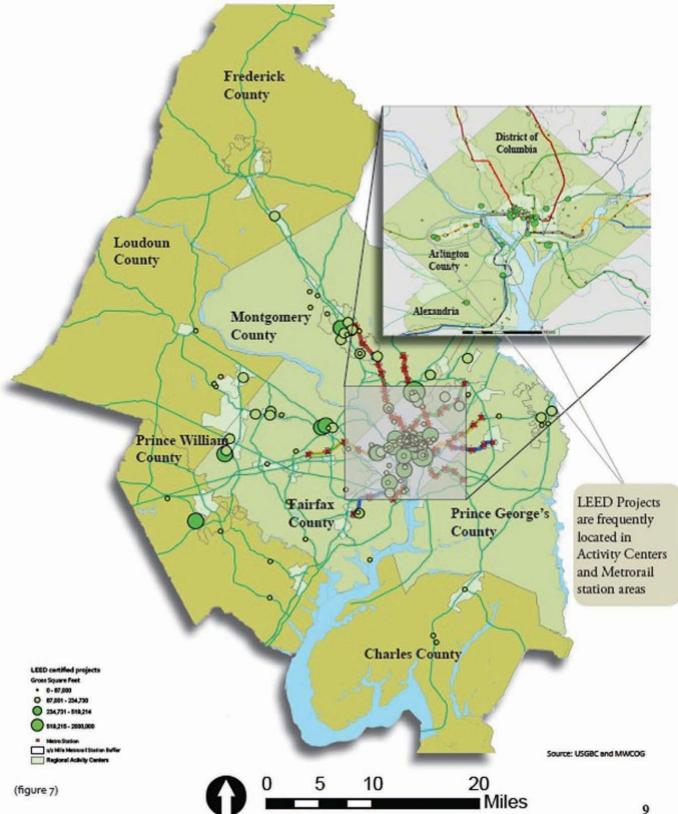


# Density Heatmap

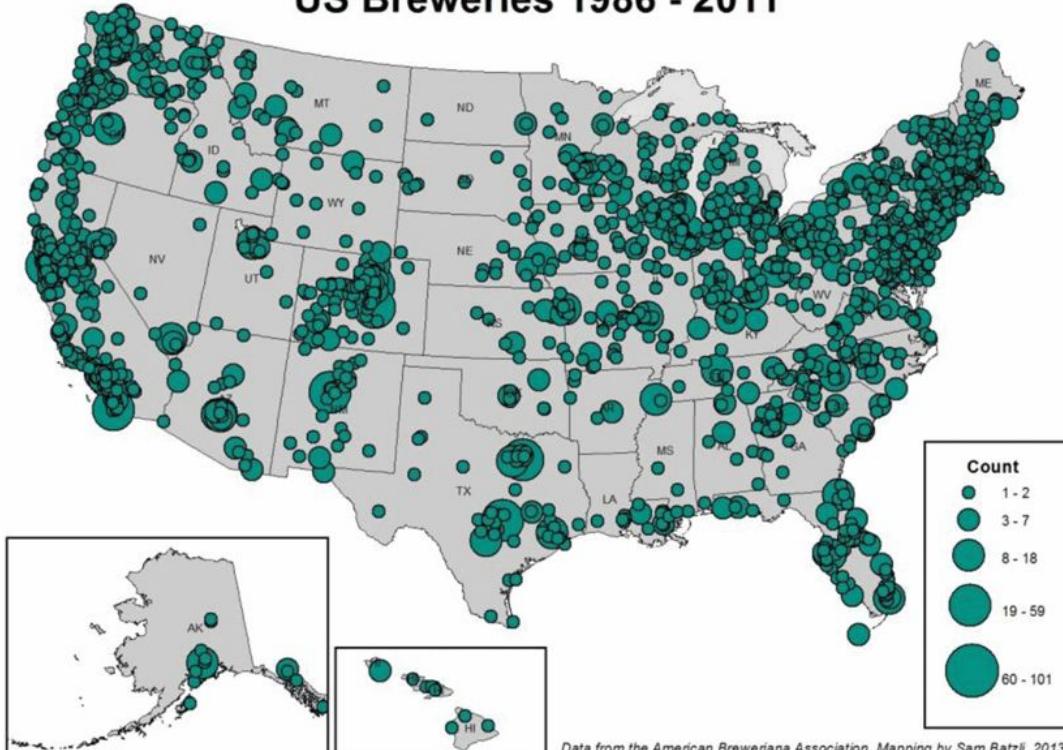


# Proportional Symbol Map

# LEED in The National Capital Region



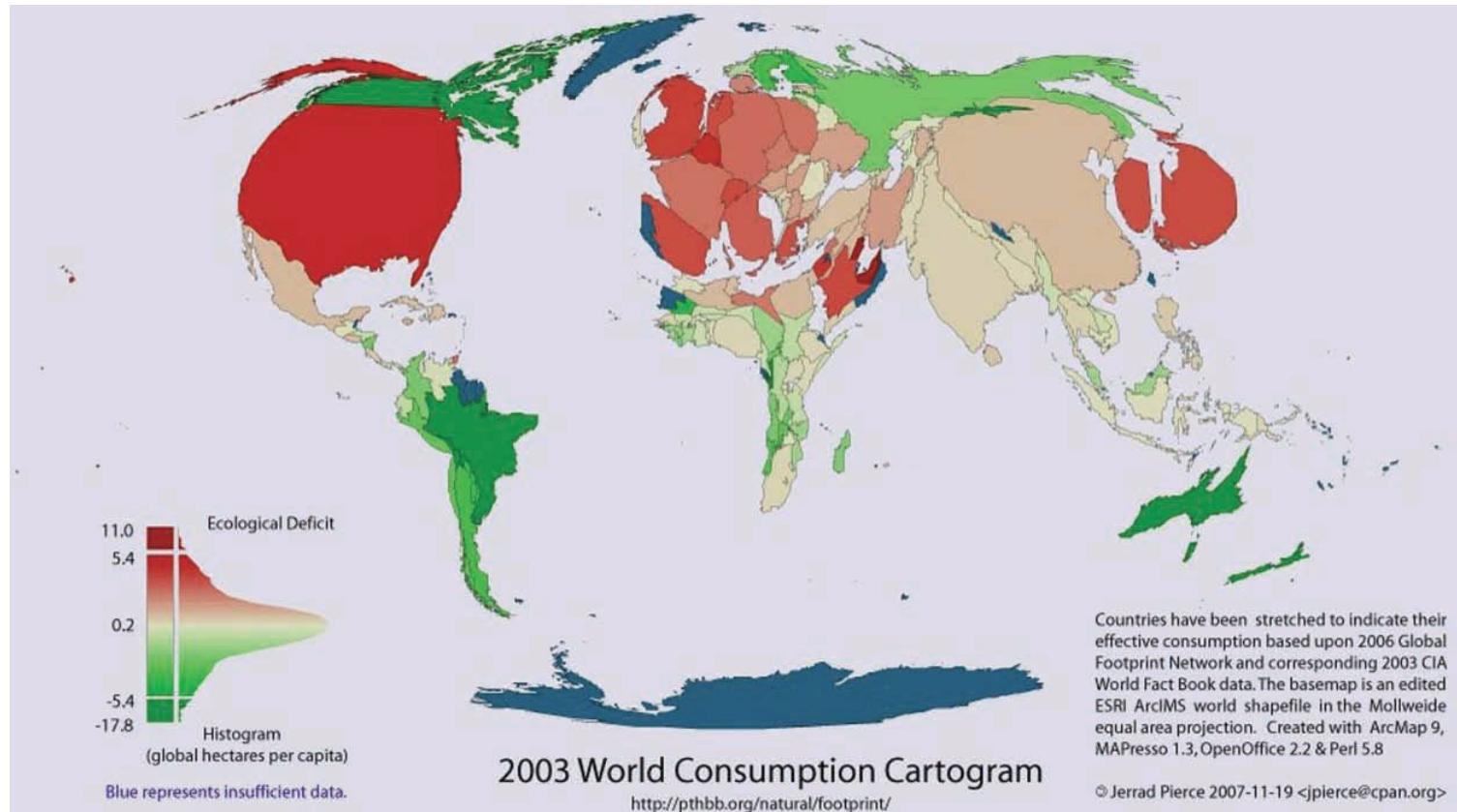
## US Breweries 1986 - 2011



Data from the American Breweriana Association. Mapping by Sam Batzli. 2013

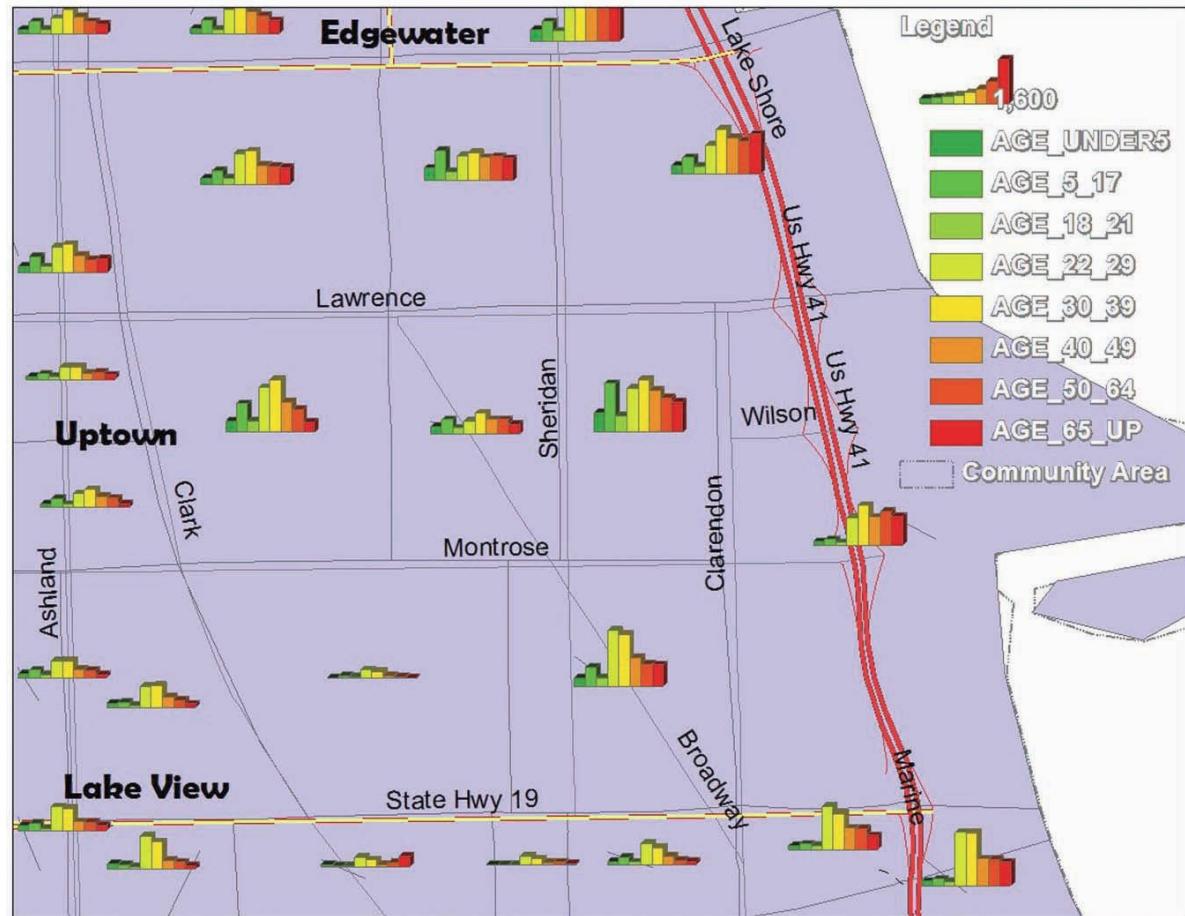
Source: GIS - An Introduction (McHaffie, 2019)

# Cartogram



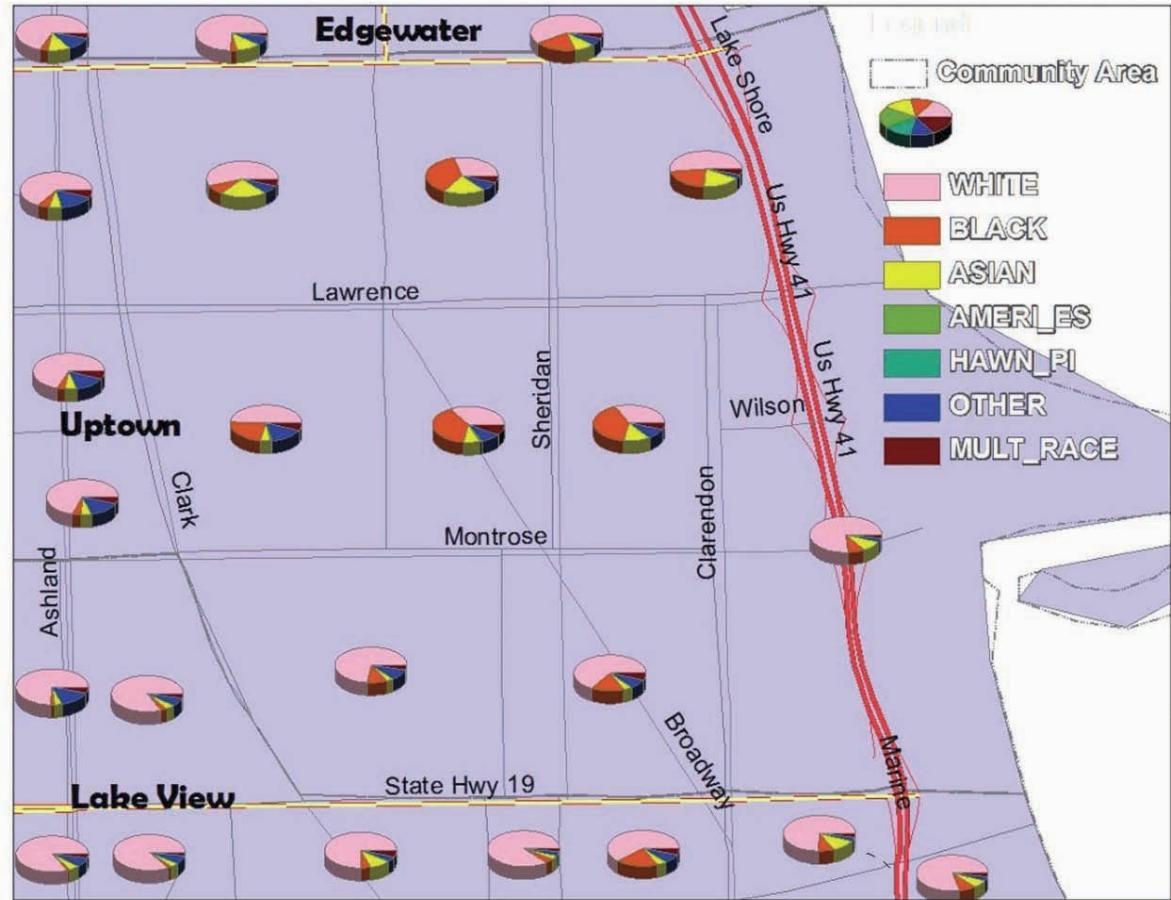
Source: GIS - An Introduction (McHaffie, 2019)

# Bar Chart Map



Source: GIS - An Introduction (McHaffie, 2019)

# Pie Chart Map



Source: GIS - An Introduction (McHaffie, 2019)

# Web Maps: Not Just a Pretty Picture

- Continuous and multiscale
- Pop-ups
- Real-time feeds
- Mashup culture
- Reach large audiences
- Easy to produce

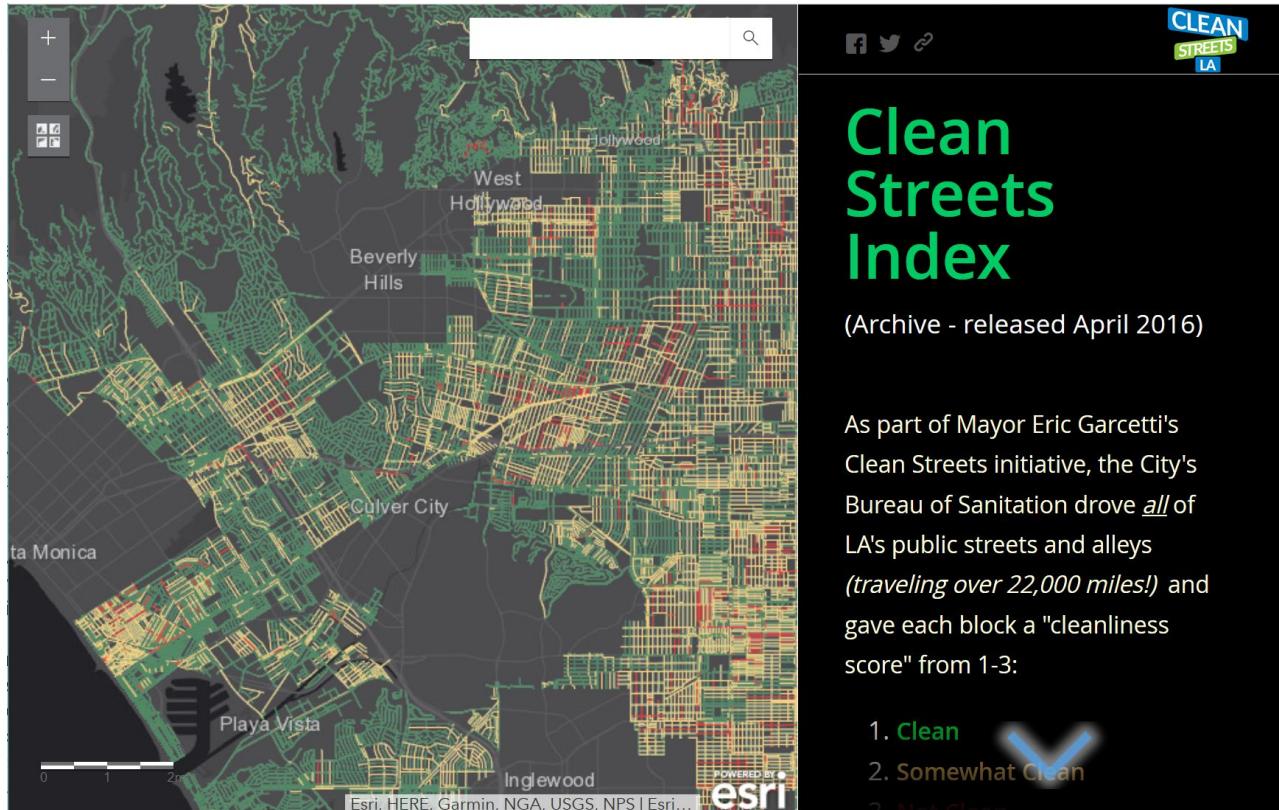


# Los Angeles Clean Streets Web Map

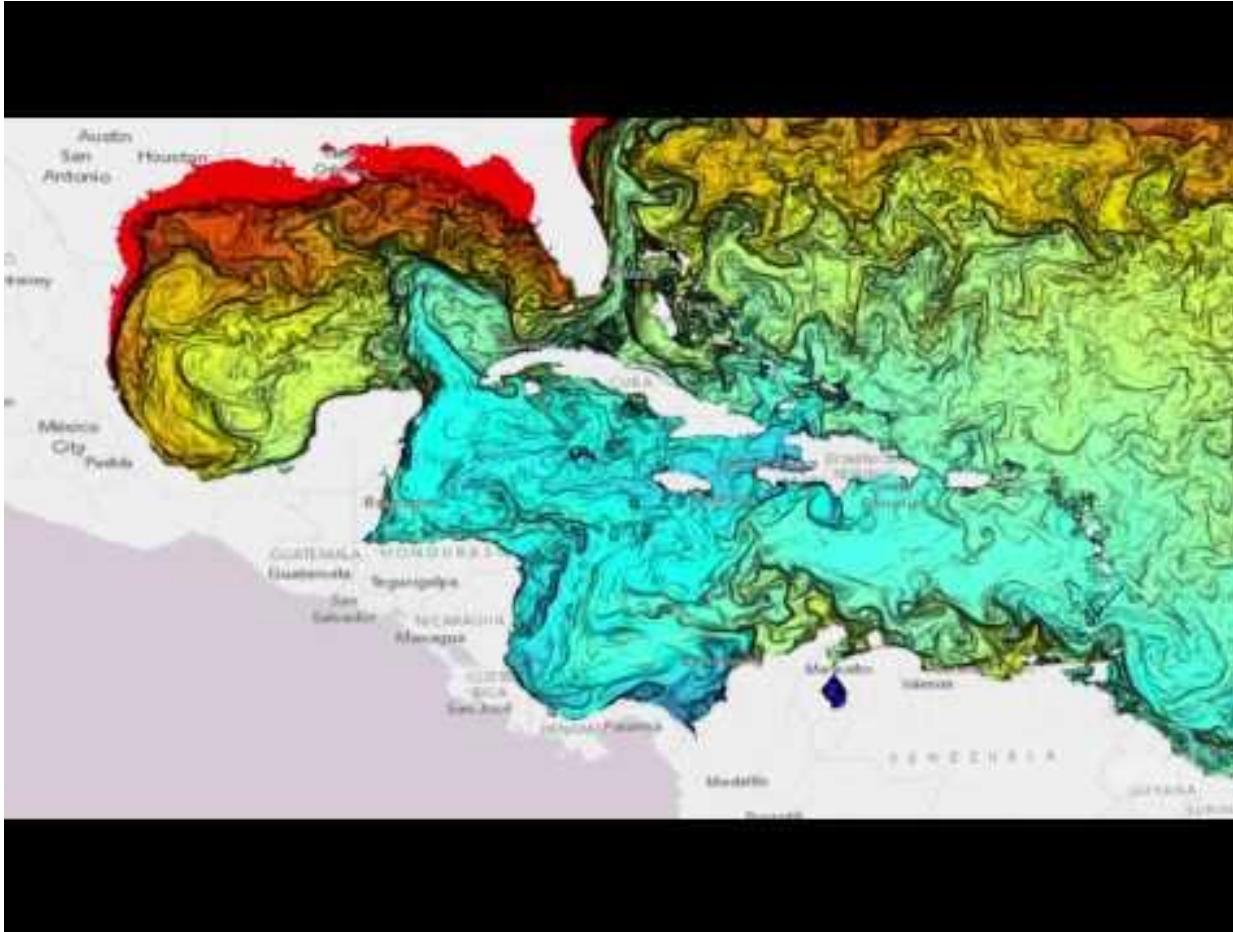
Web Map  
Example:

## L.A. Clean Streets

- [Maps we love](#)
- [Story map](#)



# The Importance of Maps



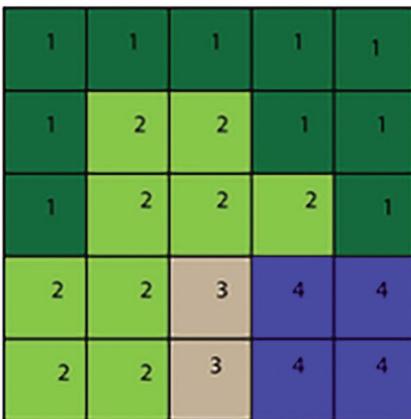
# Cartography & Spatial Data Display

- Types of maps
- Spatial data layers:
  - Vector layers
  - Raster layers
  - Basemap layers
- Symbology
- Map design
- Demonstration

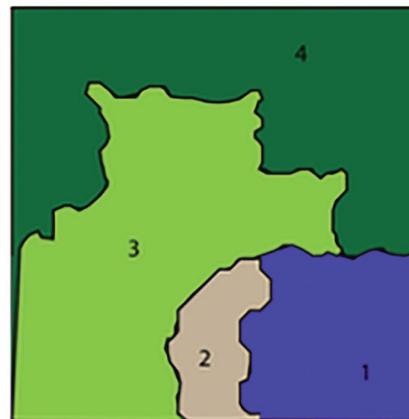
# Spatial Data Layers

- Raster
- Vector

Raster



Vector



How spatial data are represented in GIS

Records



| Values | Name   | Count |
|--------|--------|-------|
| 1      | Forest | 10    |
| 2      | Grass  | 9     |
| 3      | Beach  | 2     |
| 4      | Water  | 4     |

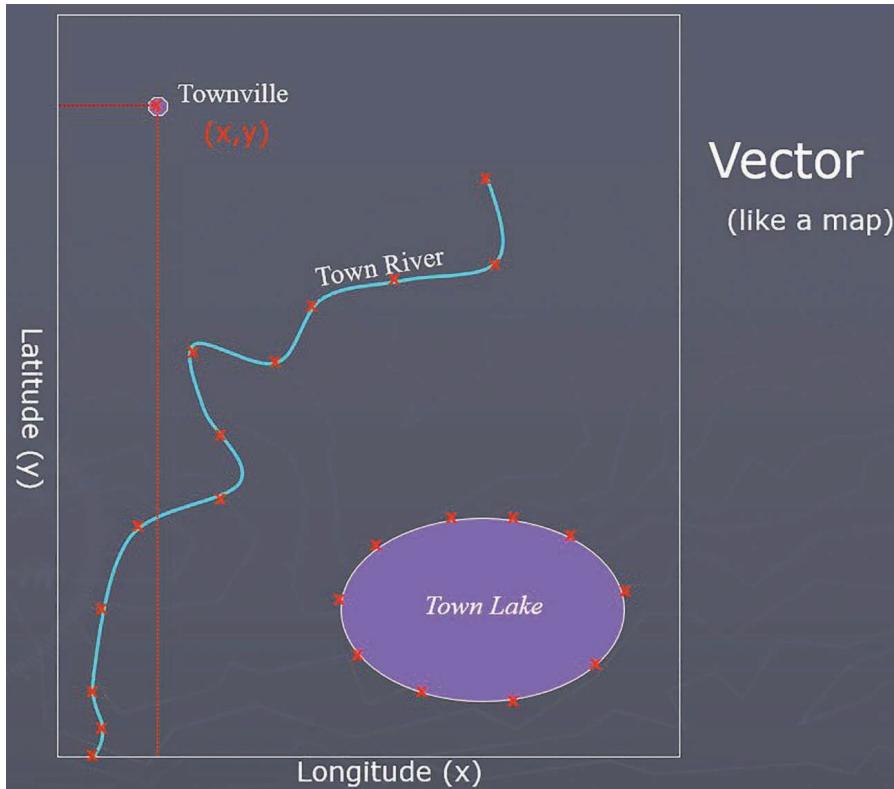
Fields

| FID# | Name   | value | Public? | Owner  |
|------|--------|-------|---------|--------|
| 1    | Water  | 4     | Yes     | State  |
| 2    | Beach  | 3     | Yes     | State  |
| 3    | Grass  | 2     | Yes     | State  |
| 4    | Forest | 1     | No      | Warner |

How non-spatial data are represented in GIS

# Vector Data Model

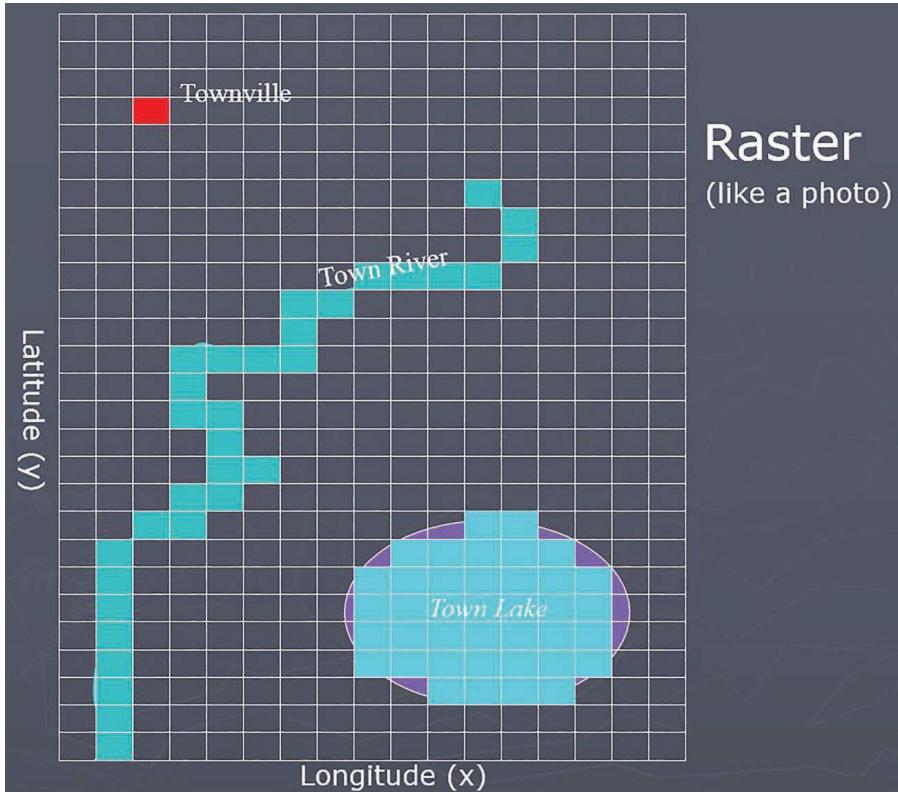
- Points
- Lines
- Polygons



Vector  
(like a map)

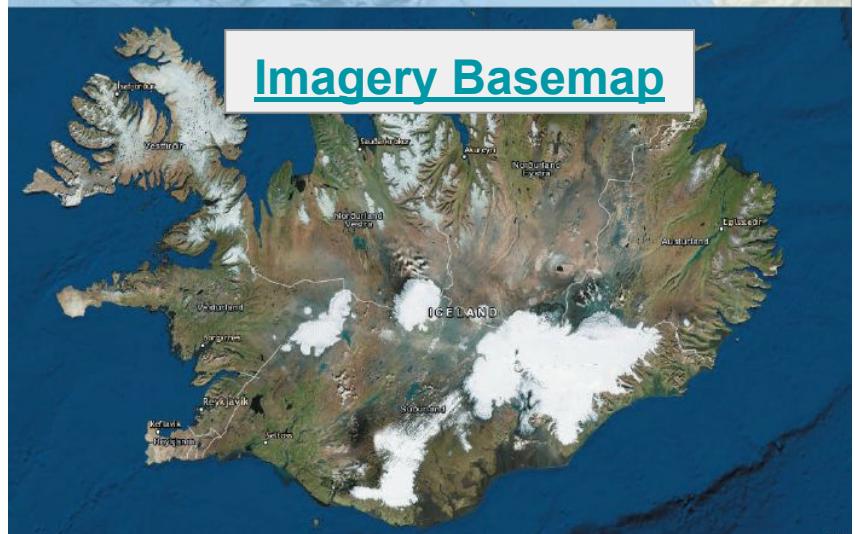
# Raster Data Model

- Grid based
- Equal sized cells
- Like an image



# Basemaps

- Provide digital canvas
- Each has a theme:
  - Terrain
  - Roads
  - Oceans
  - Imagery
- Multiple zoom levels
- Global scales



# ArcGIS Basemaps

Untitled - Map - ArcGIS Pro

Project Map Insert Analysis View Edit Imagery Share

Basemap Add Data Add Preset Select Select By Attributes Location Attributes Clear Infographics Measure Locate Inquiry Pause View Unplaced More Convert To Annotation Download Map Labeling Offline

Clipboard Navigate

Contents

Imagery Imagery with Labels Streets

Topographic Dark Gray Canvas Light Gray Canvas

National Geographic Terrain with Labels Oceans

OpenStreetMap USGS National Map USA Topo Maps

Catalog

Project Portal Favorites History

Search

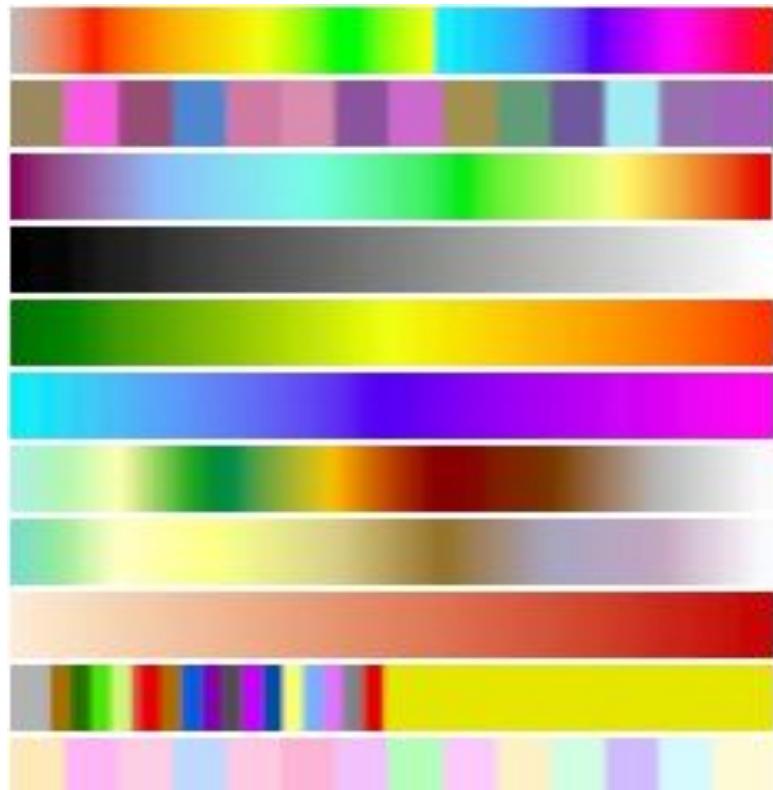
Maps Toolboxes Databases Styles Folders Locators

1:38,393,541 95.4252595°W 38.7395500°N Selected Features: 0

The screenshot displays the ArcGIS Pro application window. The top menu bar includes Project, Map, Insert, Analysis, View, Edit, Imagery, and Share. The ribbon below shows Basemap, Add Data, Add Preset, Select, Select By Attributes, Location, Attributes, Clear, Infographics, Measure, Locate, Inquiry, Pause, View Unplaced, More, Convert To Annotation, Download Map, Labeling, and Offline. On the left, the Contents pane lists Imagery, Imagery with Labels, Streets, Topographic, Dark Gray Canvas, Light Gray Canvas, National Geographic, Terrain with Labels, Oceans, OpenStreetMap, USGS National Map, and USA Topo Maps. A Drawing Order section shows 'Map' selected and 'Topographic' checked. The main workspace shows a map of North America with labels for major cities like Ottawa, Montreal, Boston, New York, Philadelphia, Washington, Chicago, Detroit, Atlanta, Miami, Havana, Port-au-Prince, and Santo Domingo. The Catalog pane on the right lists Project, Portal, Favorites, and History, with sections for Maps, Toolboxes, Databases, Styles, Folders, and Locators. The bottom status bar shows a scale of 1:38,393,541 and coordinates of 95.4252595°W 38.7395500°N, along with a note about selected features.

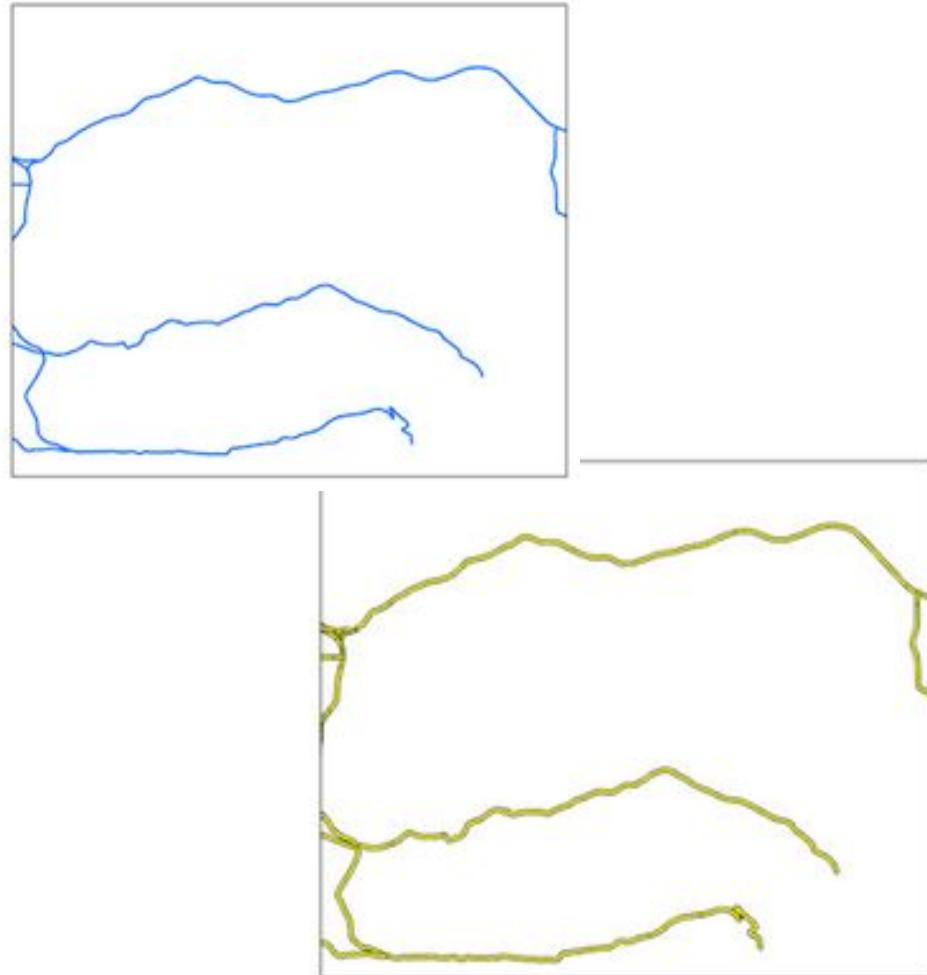
# Cartography & Spatial Data Display

- Types of maps
- Spatial data layers:
- **Symbology**
  - Qualitative data
  - Quantitative data
  - Classification methods
- Map design
- Demonstration



# Symbology

- Symbols give meaning in maps
- Choosing appropriate symbols make map:
  - More useful
  - Easier to interpret



# Symbology: Qualitative Data

Symbolize **qualitative** data in two ways:

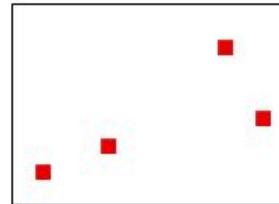
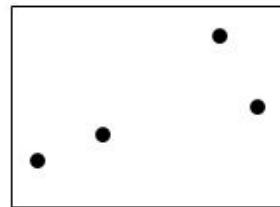
- Single symbols: shows spatial distribution
- Unique values: shows categories



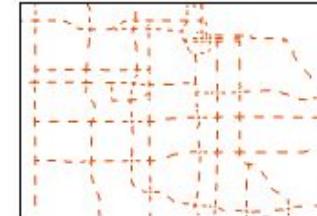
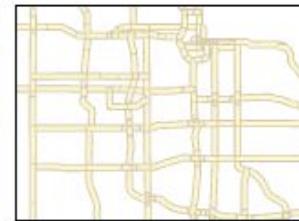
Roads in Utah symbolized using unique values.  
The attribute used for symbology categorizes roads as: Highway, State, or County

# Symbology: Single Symbols

Points: alter shape, size, inner fill color, outline color, and angle



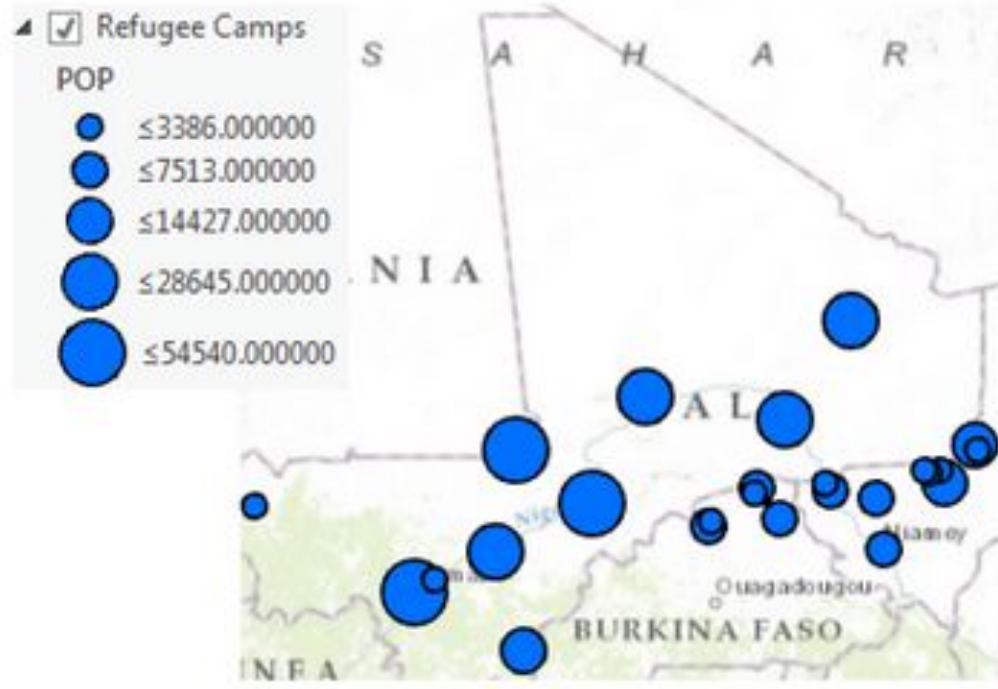
Lines: adjust color and width. Line effects, such as dashes, are also alternatives to the standard solid line



# Symbology: Quantitative Data

Symbolize **quantitative** data by showing relative size or color between classes

- Graduated symbols
- Graduated color



Graduated symbols show the relative population of refugee camps

# Symbology: Classification Introduction

When displaying features by value there are two methods:

1. Use a different symbol for each value

- All data are shown

2. Group values together for display

- Patterns easier to visually discern
- Not all values are shown

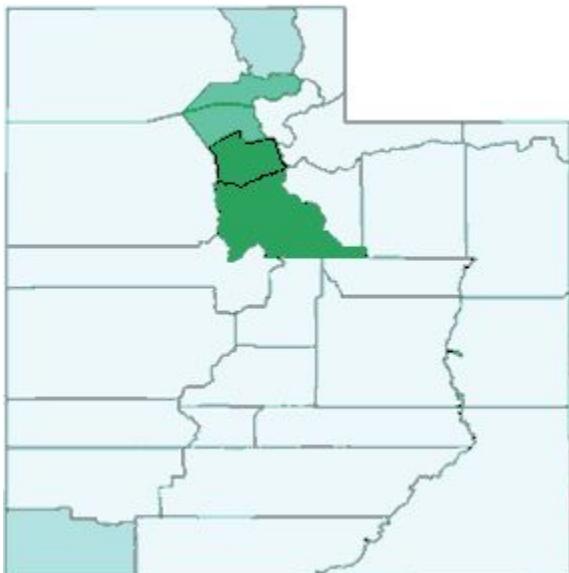
# Symbology: Classification Introduction

- When using graduated symbols or colors, there are several classification methods available.
- Factors to consider when choosing:
  - Data Type
  - The variability across attributes values
  - The number of values in each class

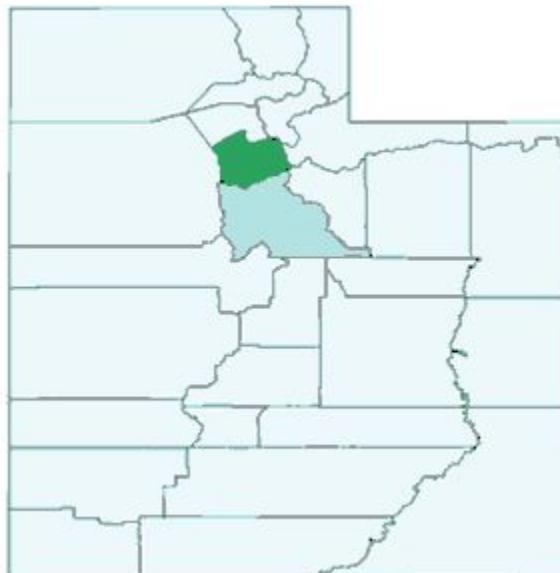
# Symbology: Classification Methods

Same data, but different display

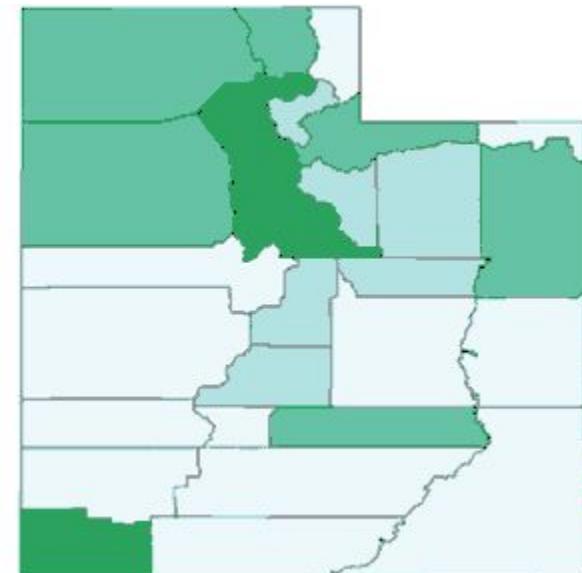
Natural Breaks (Jenks)



Equal Interval

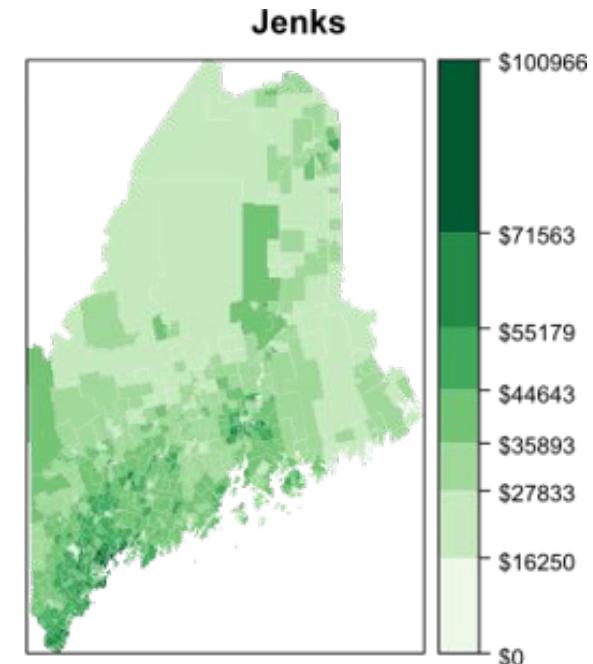
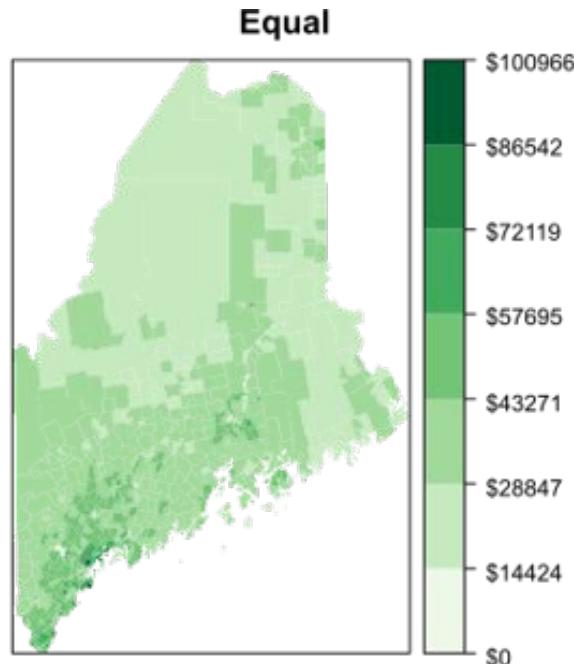
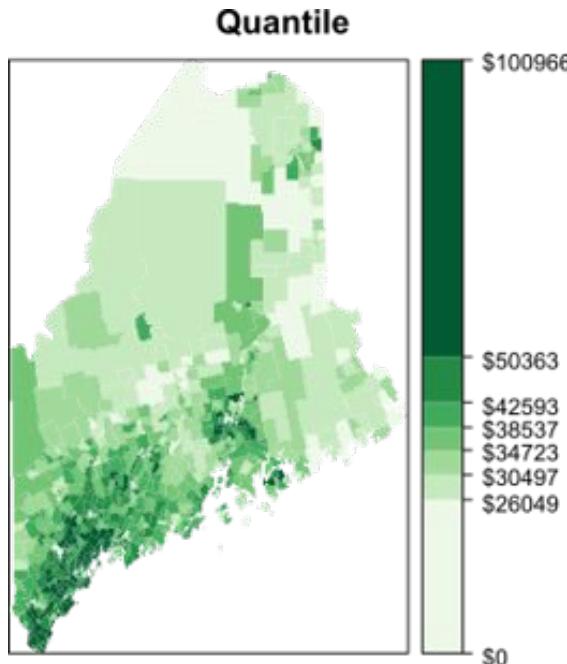


Quantile



# Symbology: Classification Example

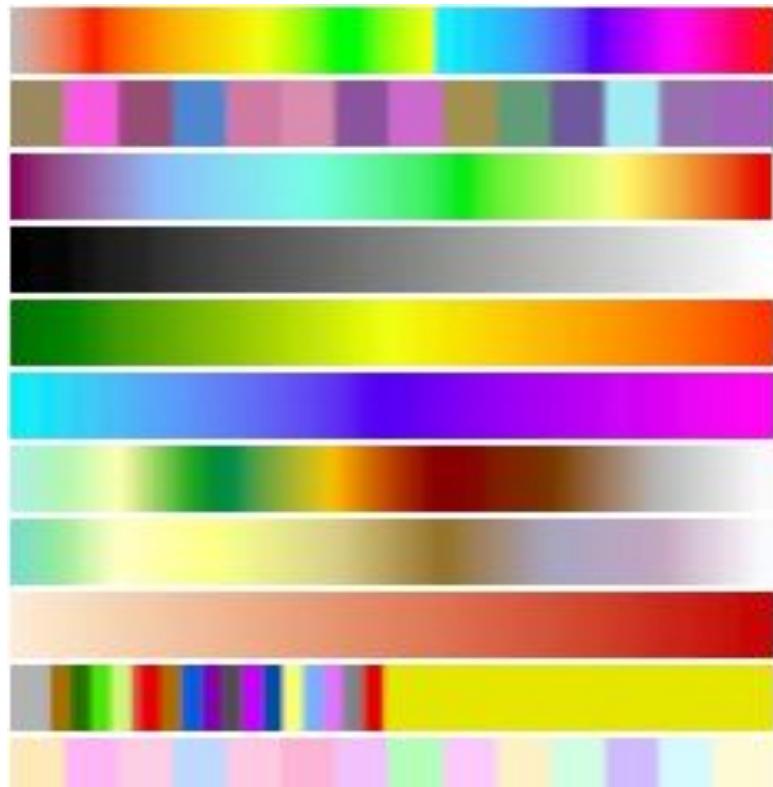
Household Income, North East USA



Source: <https://github.com/mgimond/Spatial>

# Cartography & Spatial Data Display

- Types of maps
- Spatial data layers
- Symbology
- Map design
- Demonstration



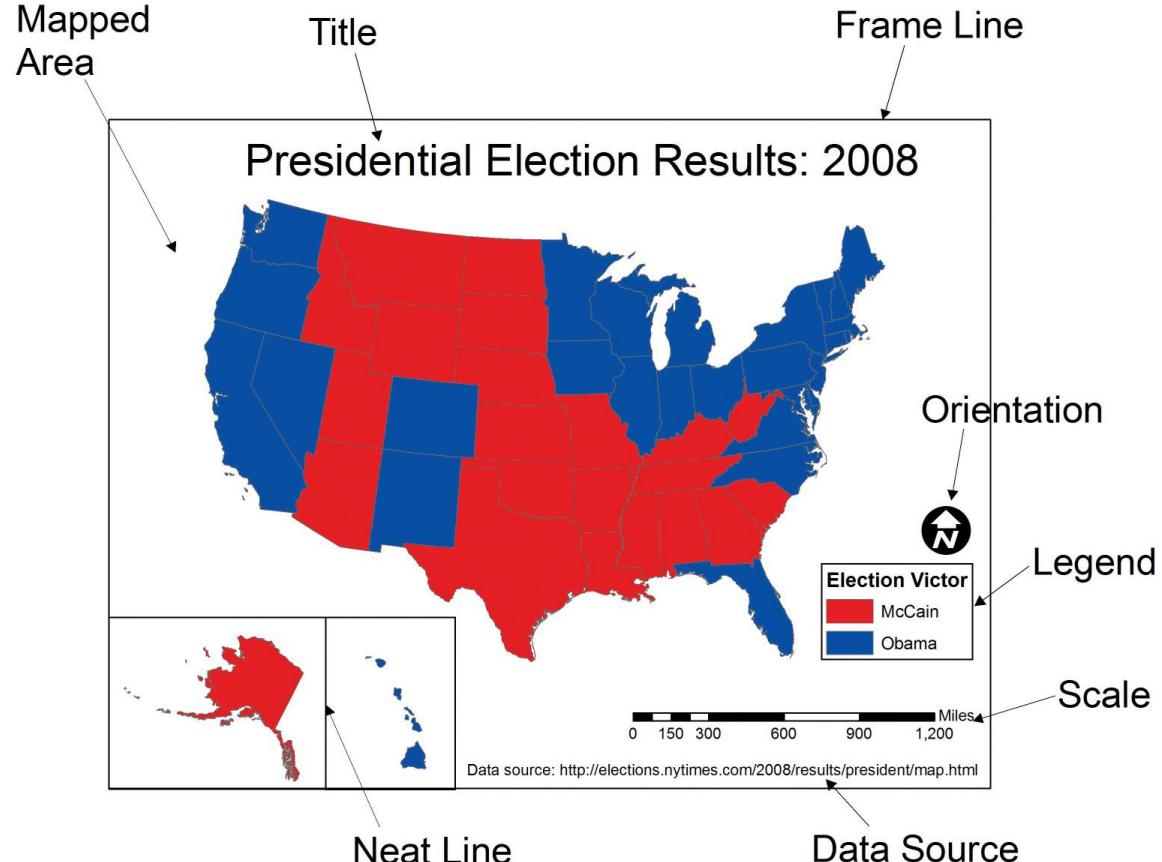
# Good Map Design

## Elements of a map:

- Map body
- Legend
- Title
- Scale
- Inset map
- Source information
- Author/Contact info



# Map Elements

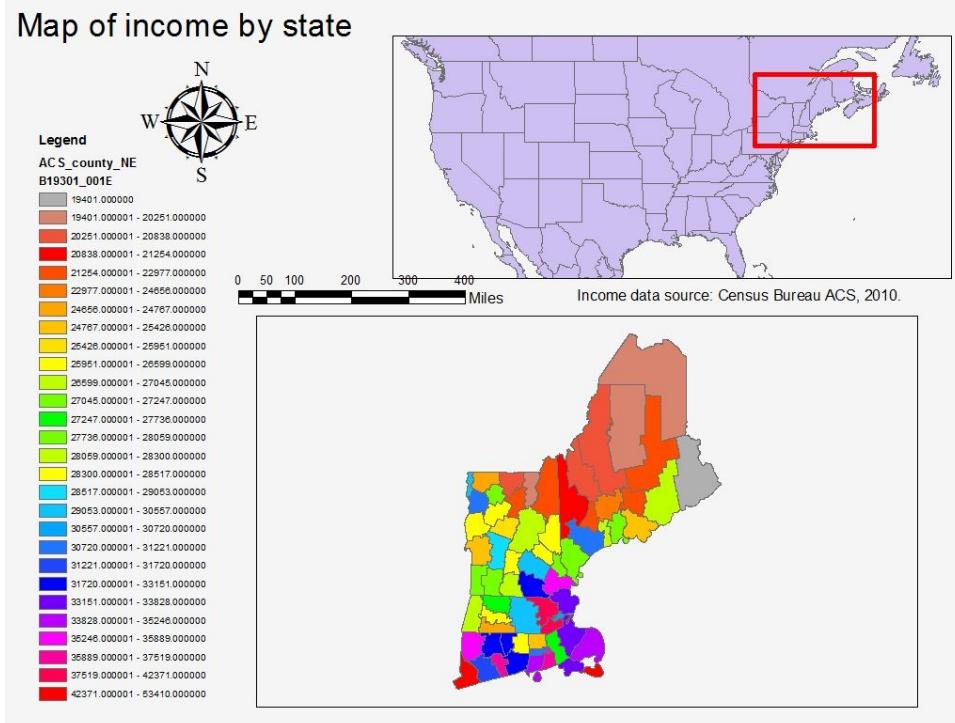


Source: Essentials of GIS (Campbell, 2011)

# Bad Map Design

Example of “bad” map

- Legend: less classes, format numbers
- Inset map: too big
- Scalebar is confusing: which map?
- Too many colors
- etc ...



Source: <https://mgimond.github.io>, 2018

# Good Map Design

## Good Practices:

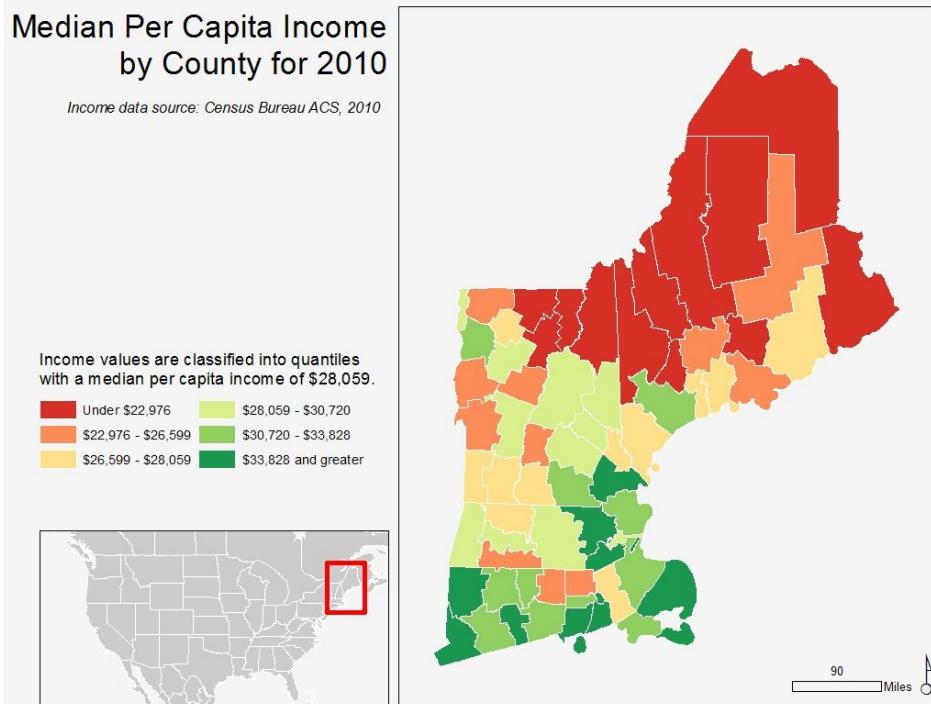
- Visual hierarchy: top-to-bottom
  - Top elements: main map body, title and legend
- Limit colors
- Use logical classification scheme
- Scale bar size: keep simple
- Title: concise

Median Per Capita Income by County for 2010

Income data source: Census Bureau ACS, 2010

Income values are classified into quantiles with a median per capita income of \$28,059.

|                     |                      |
|---------------------|----------------------|
| Under \$22,976      | \$28,059 - \$30,720  |
| \$22,976 - \$26,599 | \$30,720 - \$33,828  |
| \$26,599 - \$28,059 | \$33,828 and greater |



Source: <https://mgimond.github.io>, 2018

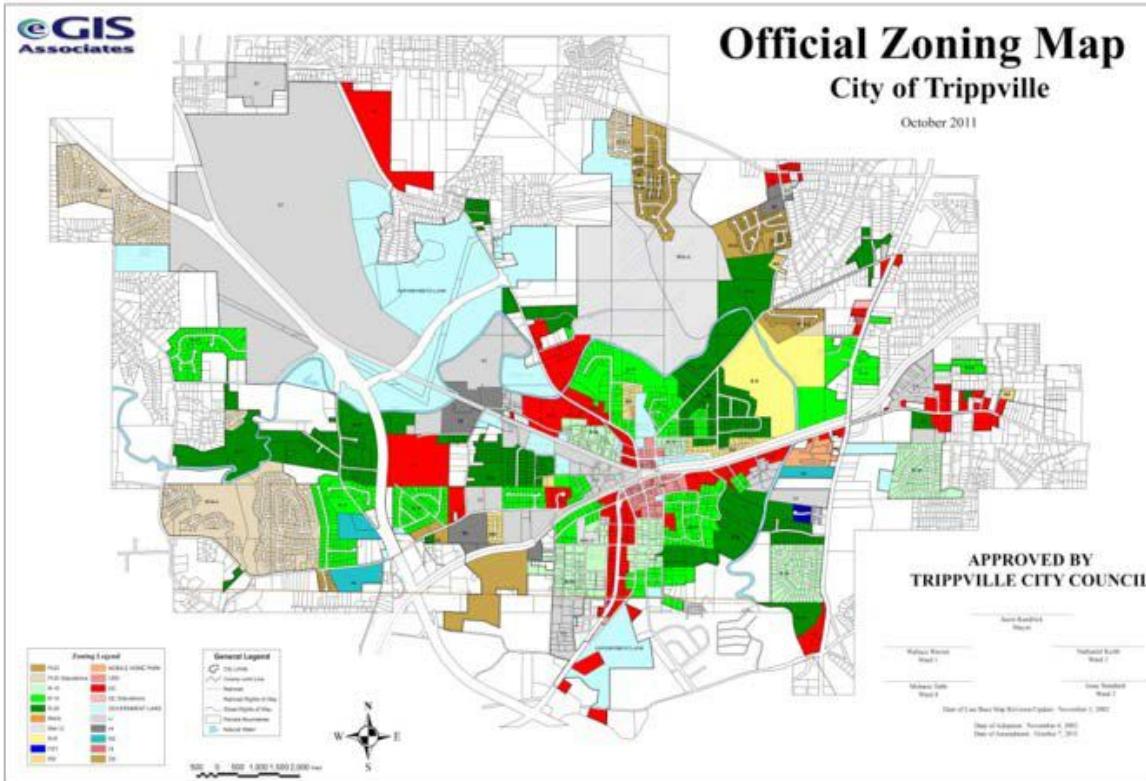
# Considerations When Designing Layout

- Layout frames all the hard analysis work in GIS
- Important to put thought and planning into layout creation
- Three basic factors to address:
  - Purpose
  - Audience
  - Usage

# Purpose of Map

- The purpose defines the overall theme of the map
- Helps determine what content to be included
- Common purposes may include:
  - Show location of features
  - Highlight specific attributes associated with features
  - Show spatial relationships
  - Present the results of the analysis
  - Meet legal requirements (e.g. Tax Map or Land Use)

# Map Purpose: Meet Legal Requirements



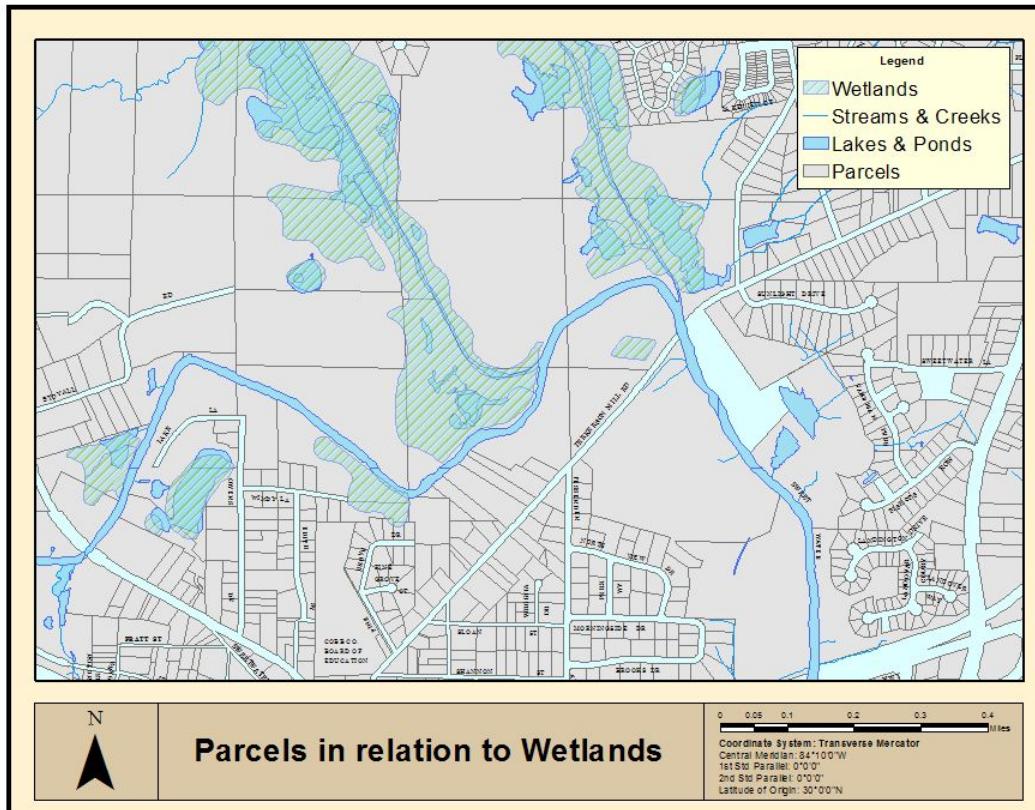
Source: Learning ArcGIS Pro (Corbin, 2015)

# Map Purpose: Location Map



Source: Learning ArcGIS Pro (Corbin, 2015)

# Map Purpose: Show Spatial Relationship



Source: Learning ArcGIS Pro (Corbin, 2015)

# Map Intended Audience

- The intended audience will impact map design
- Considerations:
  - Age
  - Education or knowledge level
  - Physical abilities or disabilities

# Map Intended Usage

- How will map be presented and used
  - Digital or printed?
  - Used in presentation or hung on wall or taken into field?
  - Is it a legal document?

# Activity: Map Book Gallery

Explore [Map Book Gallery](#)

- Published annually
- By GIS users worldwide
- Choose 3 maps and record:
  - Author or Organization
  - Reason or problem
  - Layers included

