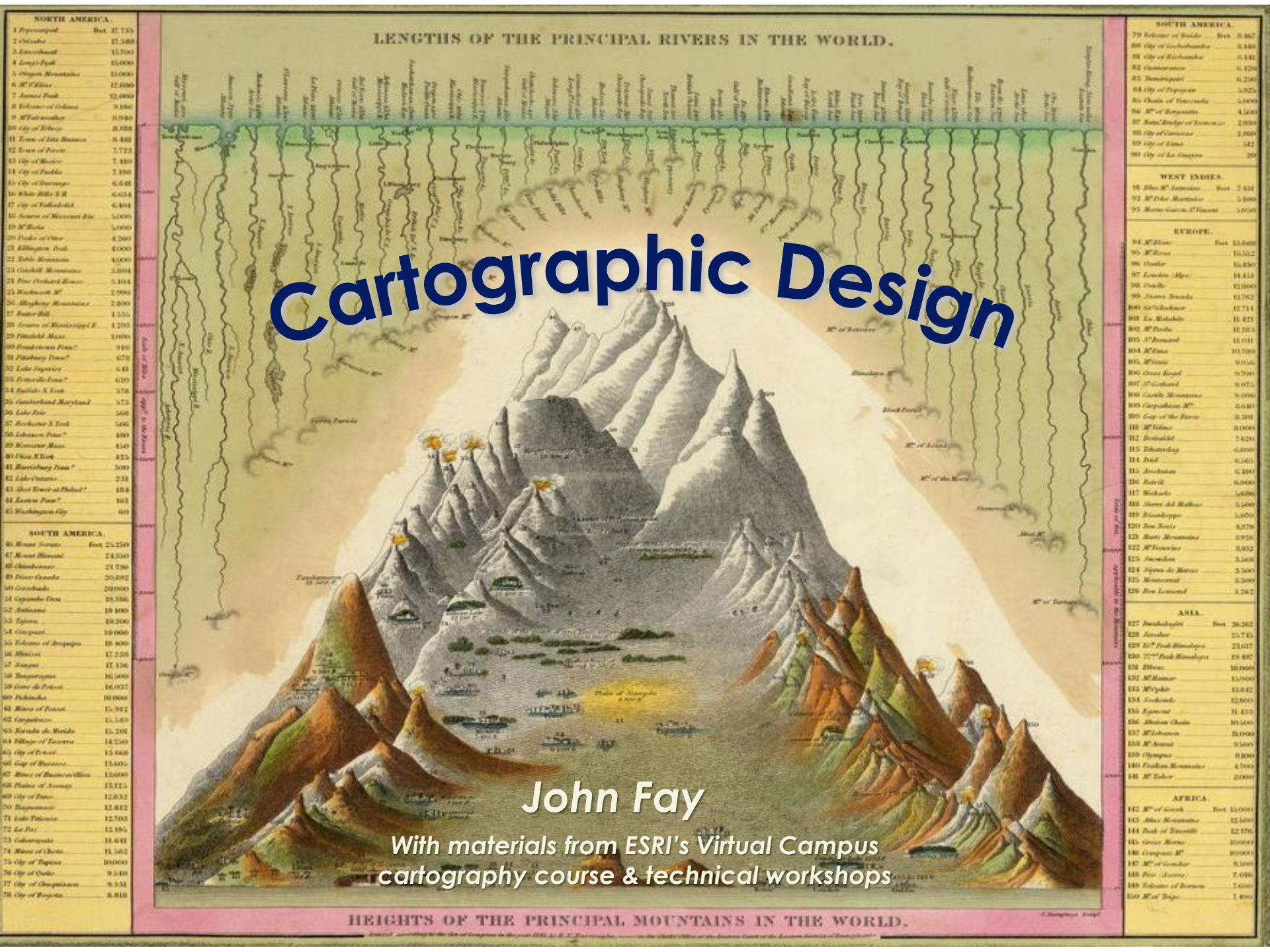


Cartographic Design

John Fay

With materials from ESRI's Virtual Campus cartography course & technical workshops

C ompromise

A

R

T

O pportunity

G

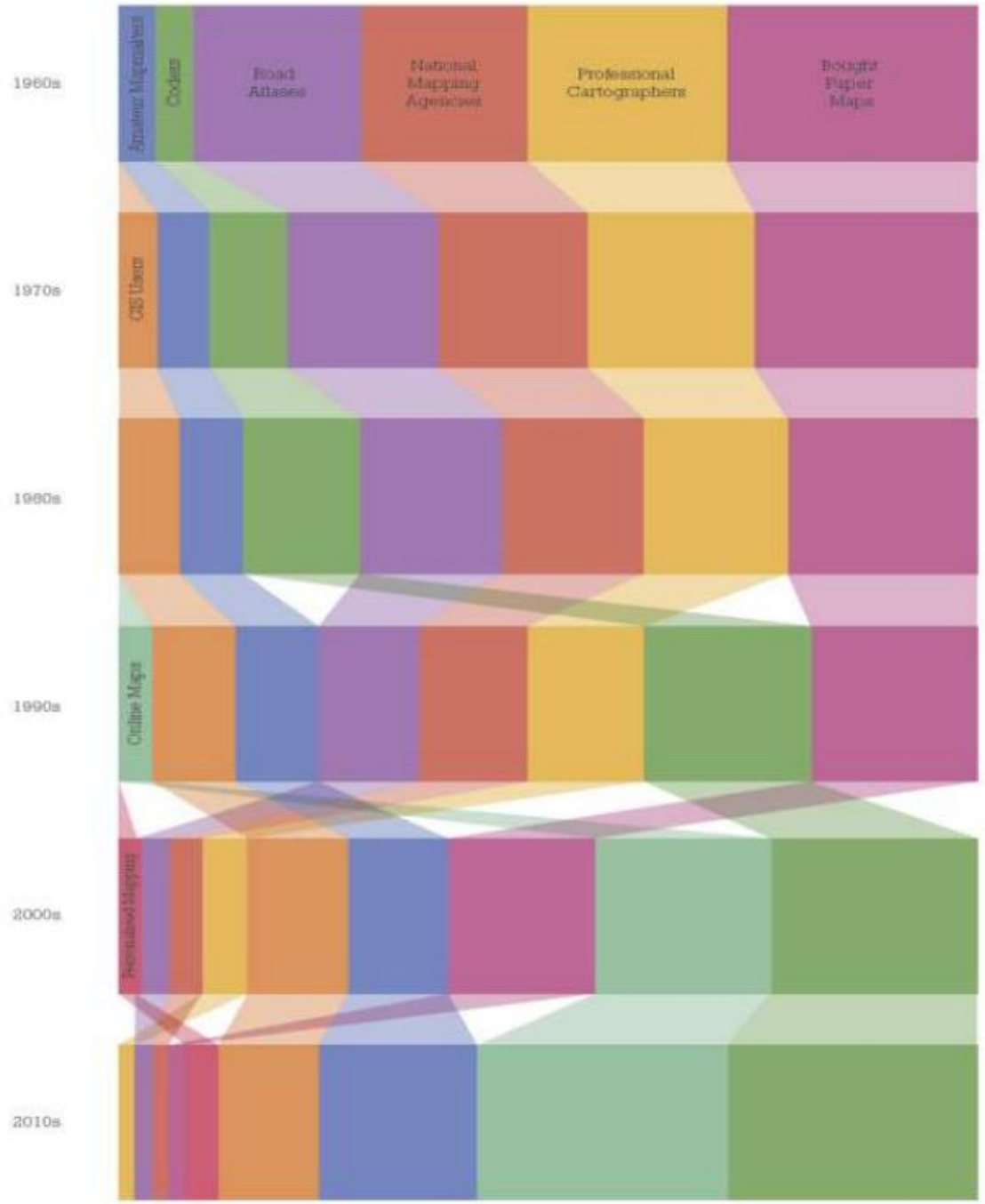
R

A

P

H

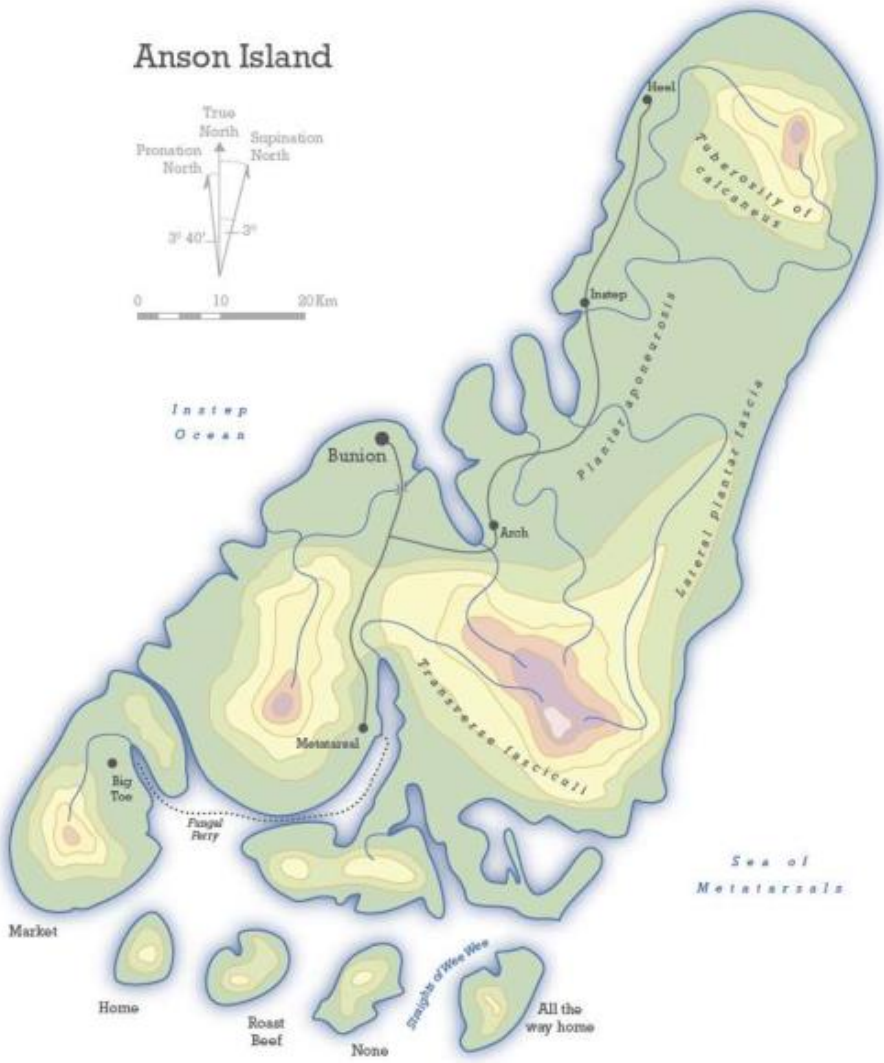
Y why?

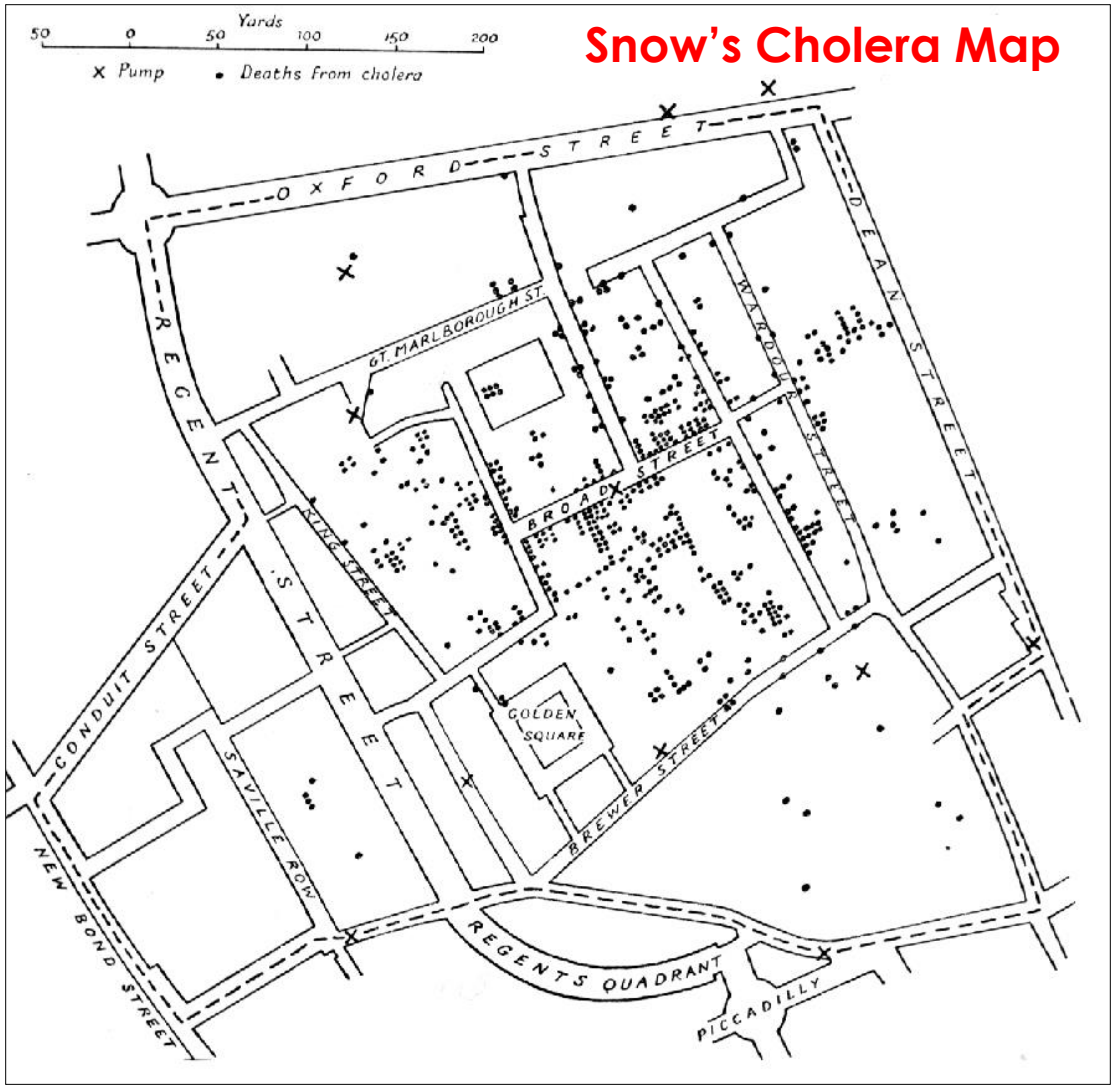


Serial, linear

Draw, stating your scale, a contoured map to show an island 65 km long from SW to NE which varies in width from 48 km in the SW to 16 km in the NE. The SW coast is much dissected by long, narrow fjord-like inlets, and is fringed by 5 small rocky islands of varying sizes. From this coast the land rises sharply to a plateau some 600 m above sea level and extending through about one-third of the island. The plateau descends to a low undulating plain about 25 km long and 20 km wide. From the plain a range of hills rises to the NE, flanked by a coastal plain about 8 km wide. From these hills, rivers flow to both plains and also from the plateau to the larger plain. The plateau is gritstone. The hills which run down to the coast in the NE, to form cliffs, are chalk. Much of the smaller coastal plain is marsh, but the larger plain, from which two estuaries open, is of well drained alluvial land. In addition to relief and topography, show drainage, possible sites of settlement and lines of communication. Name your island appropriately!

Parallel, non-linear





From: Tufte (1997) *Visual Display of Quantitative Information*

Good maps...

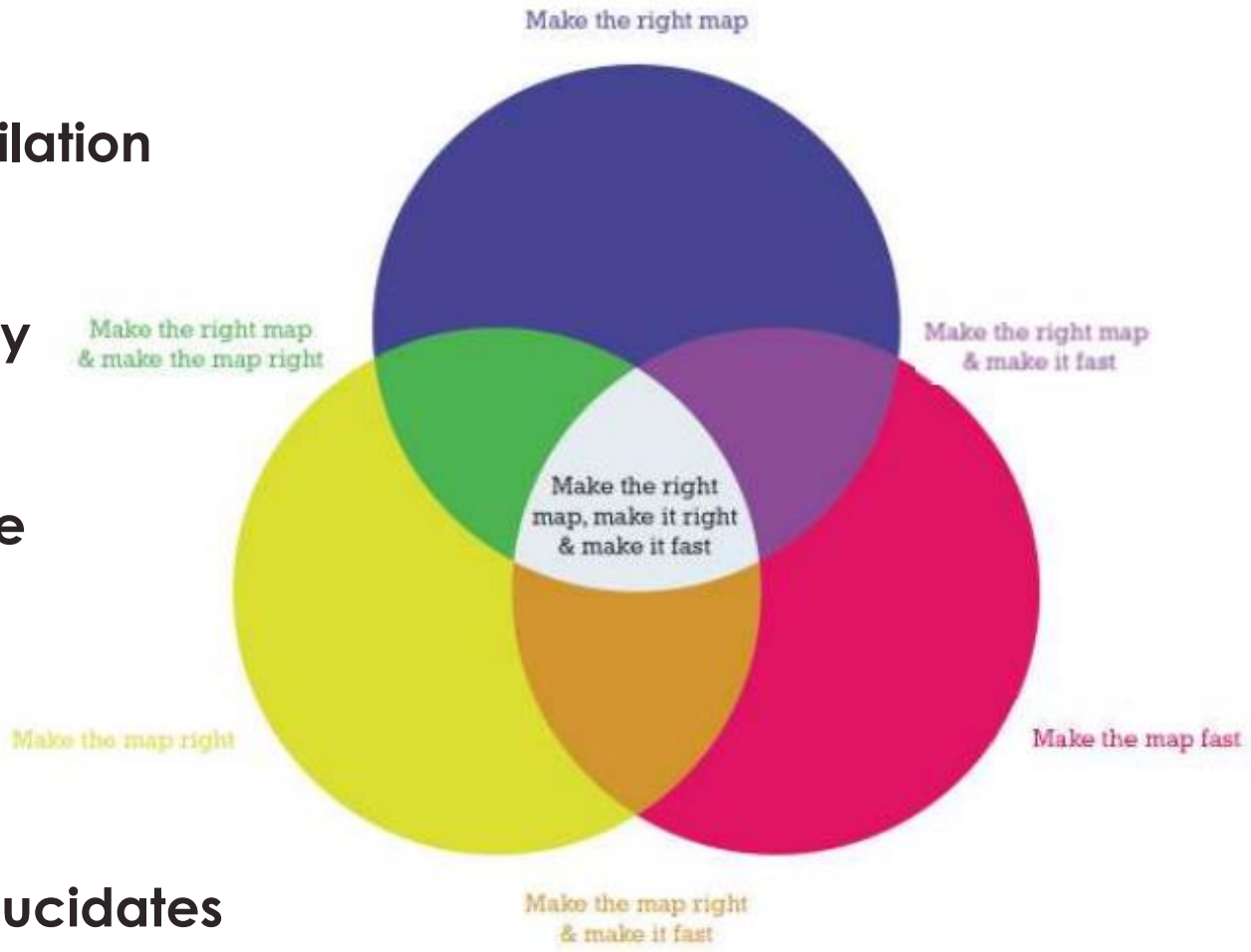
… speak a universal language

… facilitate decision making

… convey information aesthetically

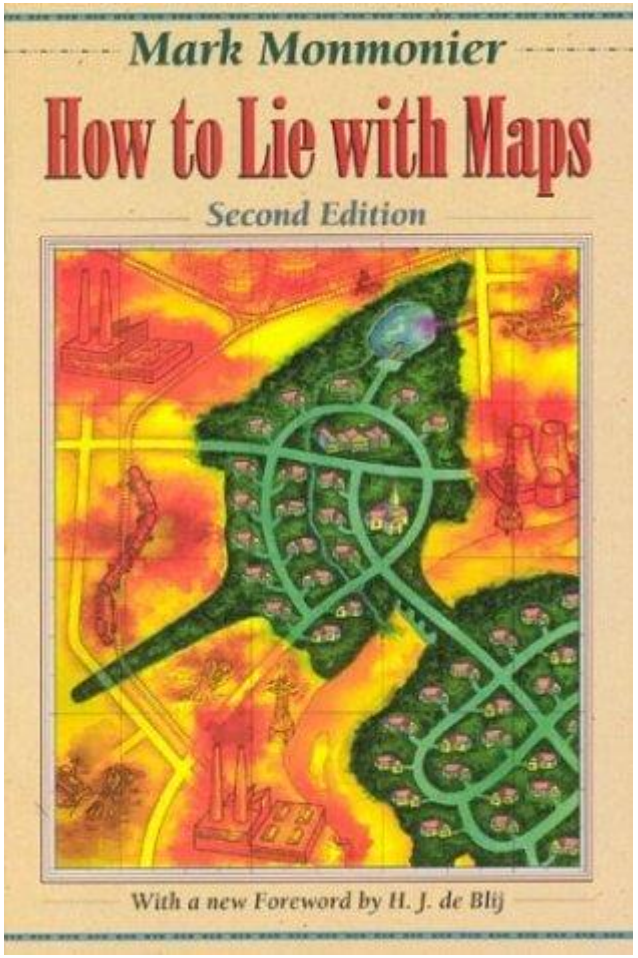
Principles of map design

- **Concept before compilation**
- **Hierarchy with harmony**
- **Simplicity from sacrifice**
- **Clutter to clarity**
- **Expresses, engages, elucidates**



Designing Maps with Purpose

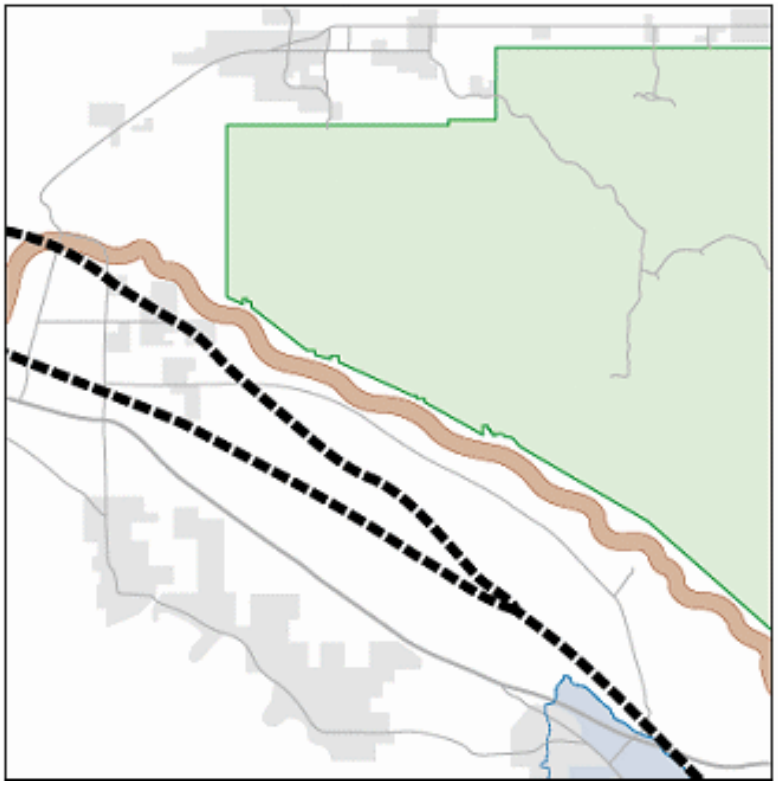
- What information is being mapped?
- Who will be reading the map?
- Is map content being coordinated with written text?
- What size will the map be?
- In what media will the map be used?
- What are the time and budget constraints?



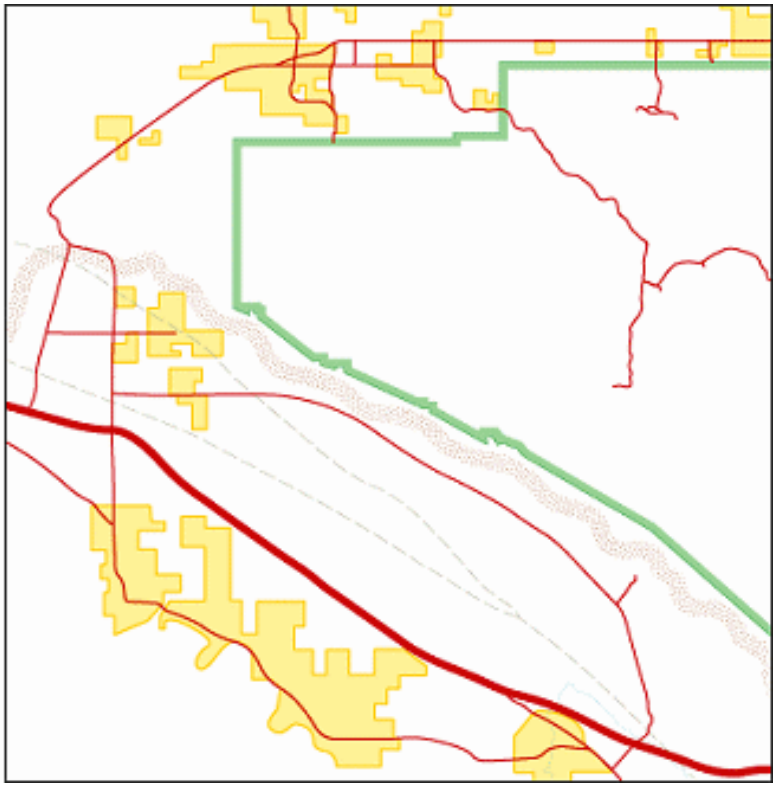
Designing Maps with Purpose

- What information is being mapped?

Joshua Tree National Park



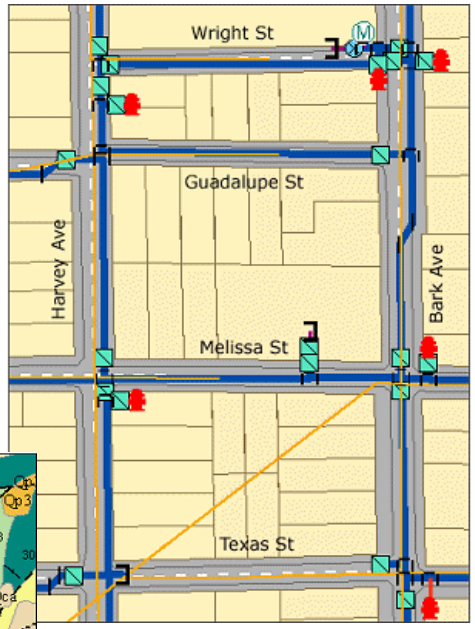
Physical features

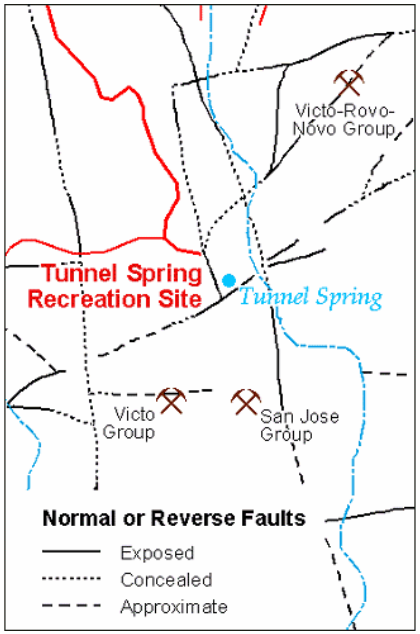


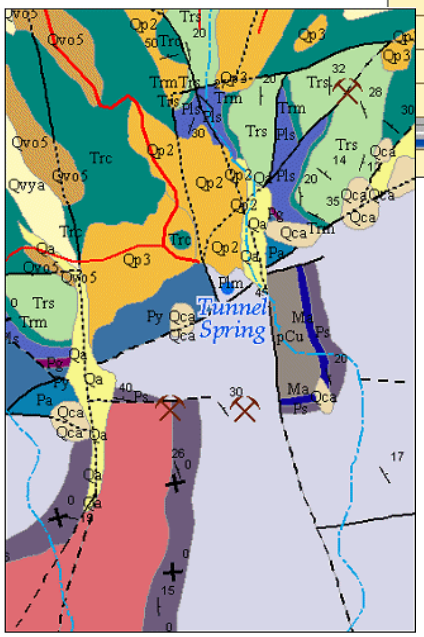
Cultural Features

Who will be reading your map?

Design maps to meet the **level of expertise** of your reader…





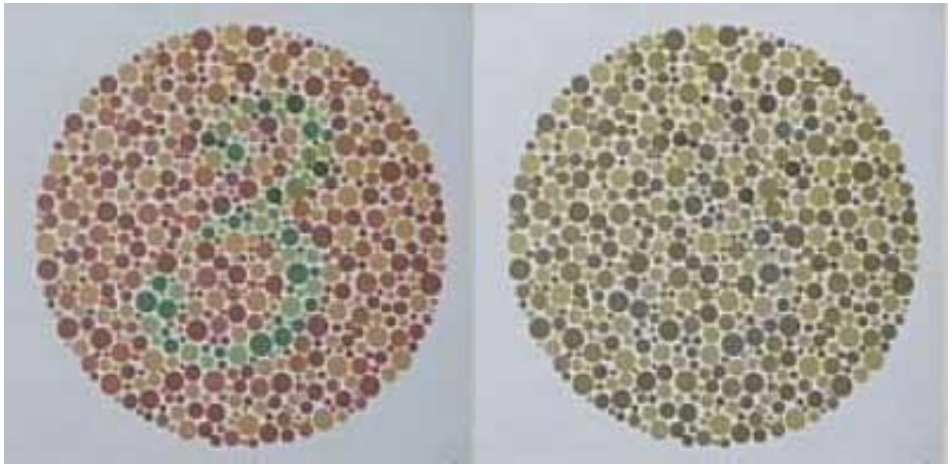


The more knowledge and time the audience brings to the task of reading your map, the more information you will be able to include.

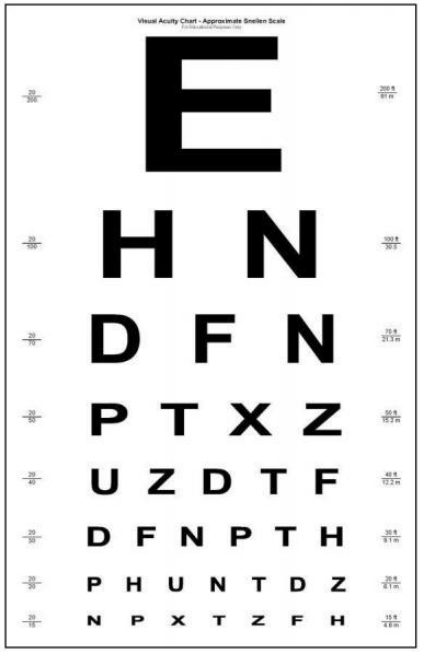
Who will be reading your map?

Special needs of audience…

Color blindness



http://www.vischeck.com/examples/



Small print

Resolution and Viewing Distance

Numerous media options:

- Computer screen
- Computer projected display
- Color laser prints
- Black & white laser prints
- Poster sized plots
- Professional glossy magazine
- Huge backdrop for trade show
- Supporting info on a TV show
- FAX sent to emergency response
- In-line display on a PDA or GPS
- Web page

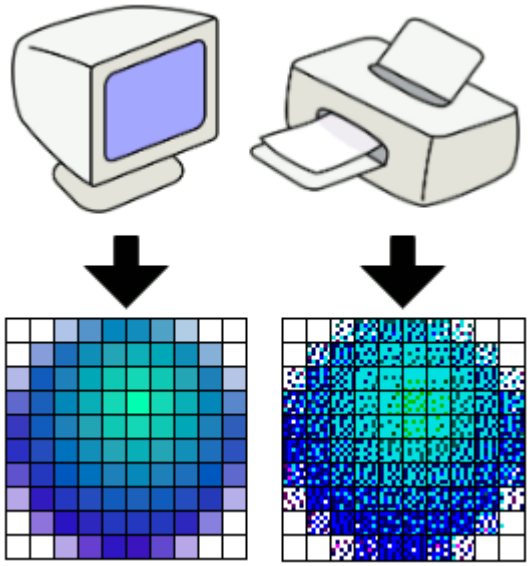
…each has its own resolution/display constraints

Resolution and Viewing Distance

Consider final media when setting resolution…

Approximate DPI (dots per inch) of various media:

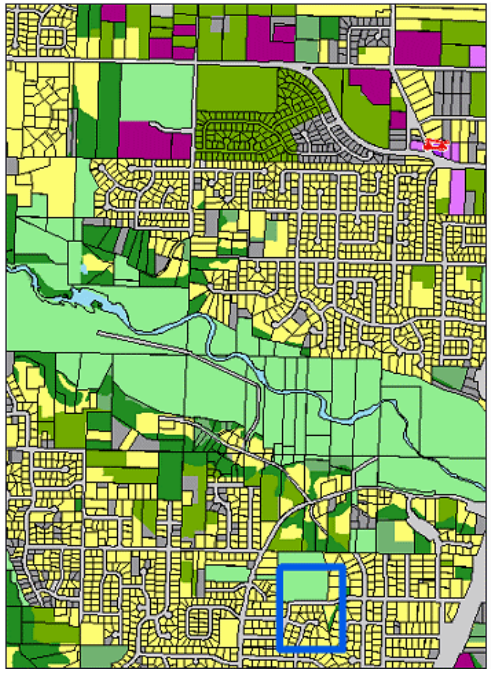
Household TV (27”):	26
Computer screen:	72
Laser printer:	1,200
Litho plate/offset printer:	12,000

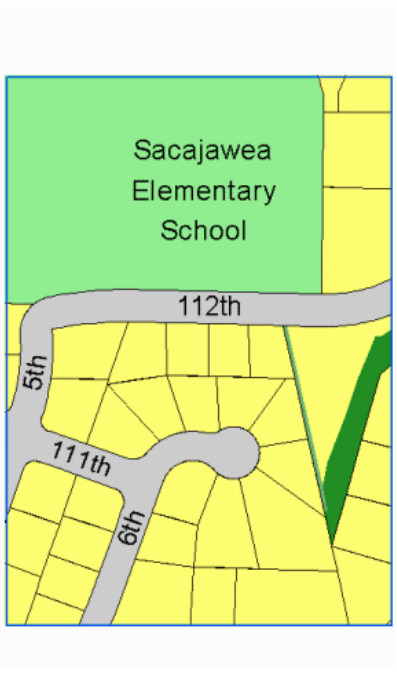


Letters 2” high seen from 14’ away are roughly equivalent to viewing 10-point type from 1’ away.

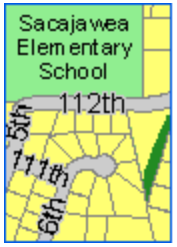
Resolution and Viewing Distance

Design your graphics for the size of the final output…

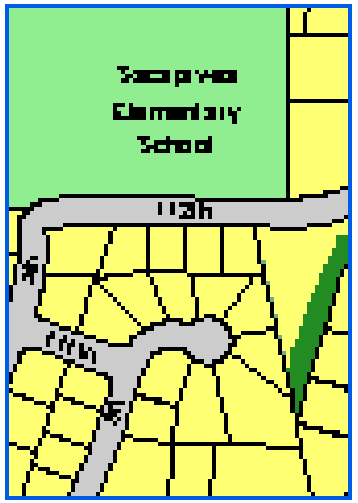




Not enough DPI on monitor to view at smaller size



Adjusted for smaller size/DPI



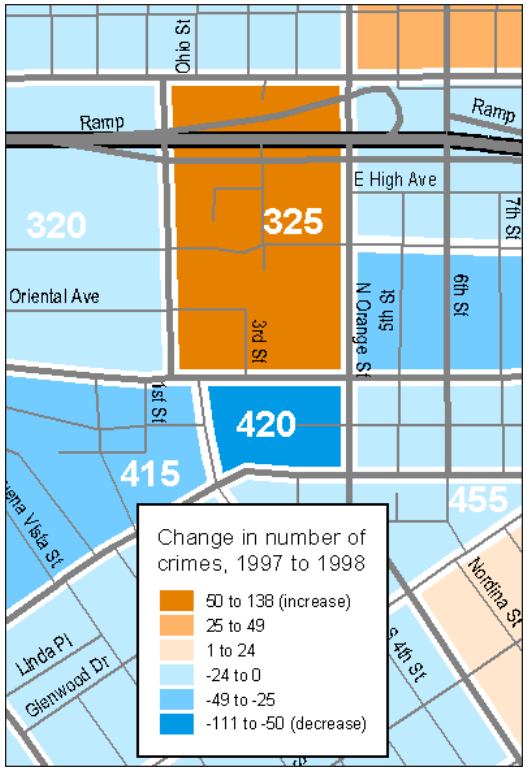
Enlargement of coarse image loses resolution

Generalisation Wheel
A Cartographer's Generalisation Palette

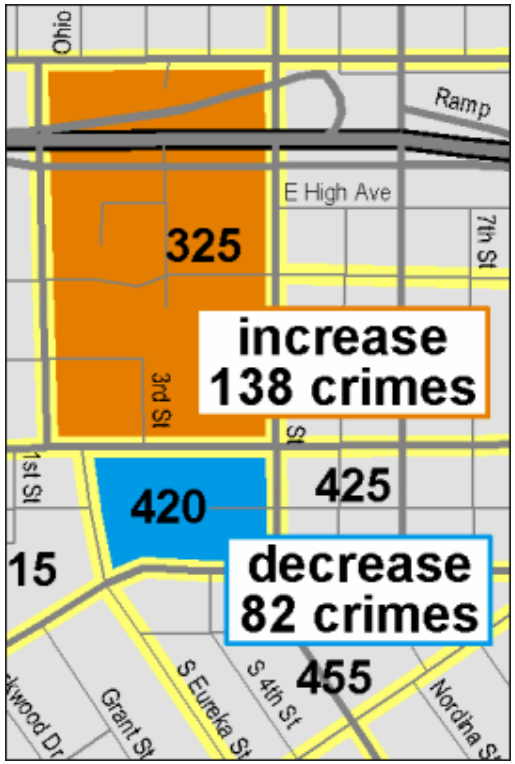
Color & Contrast

Set colors and contrasts for your different media…

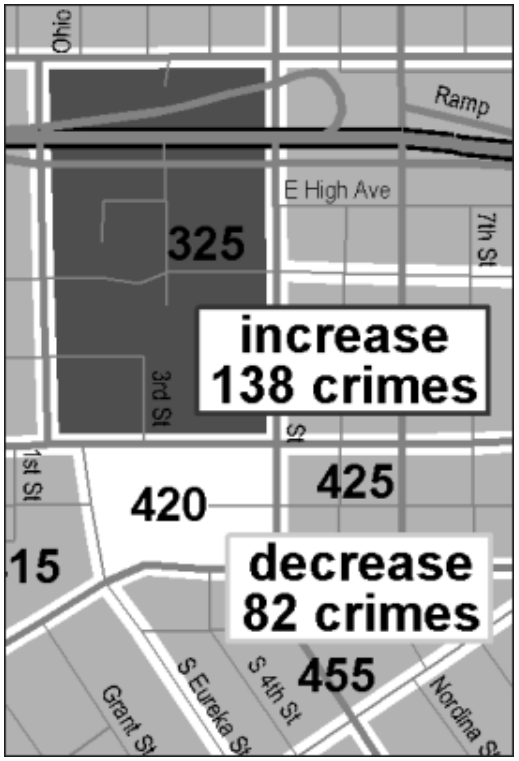
High-quality printing

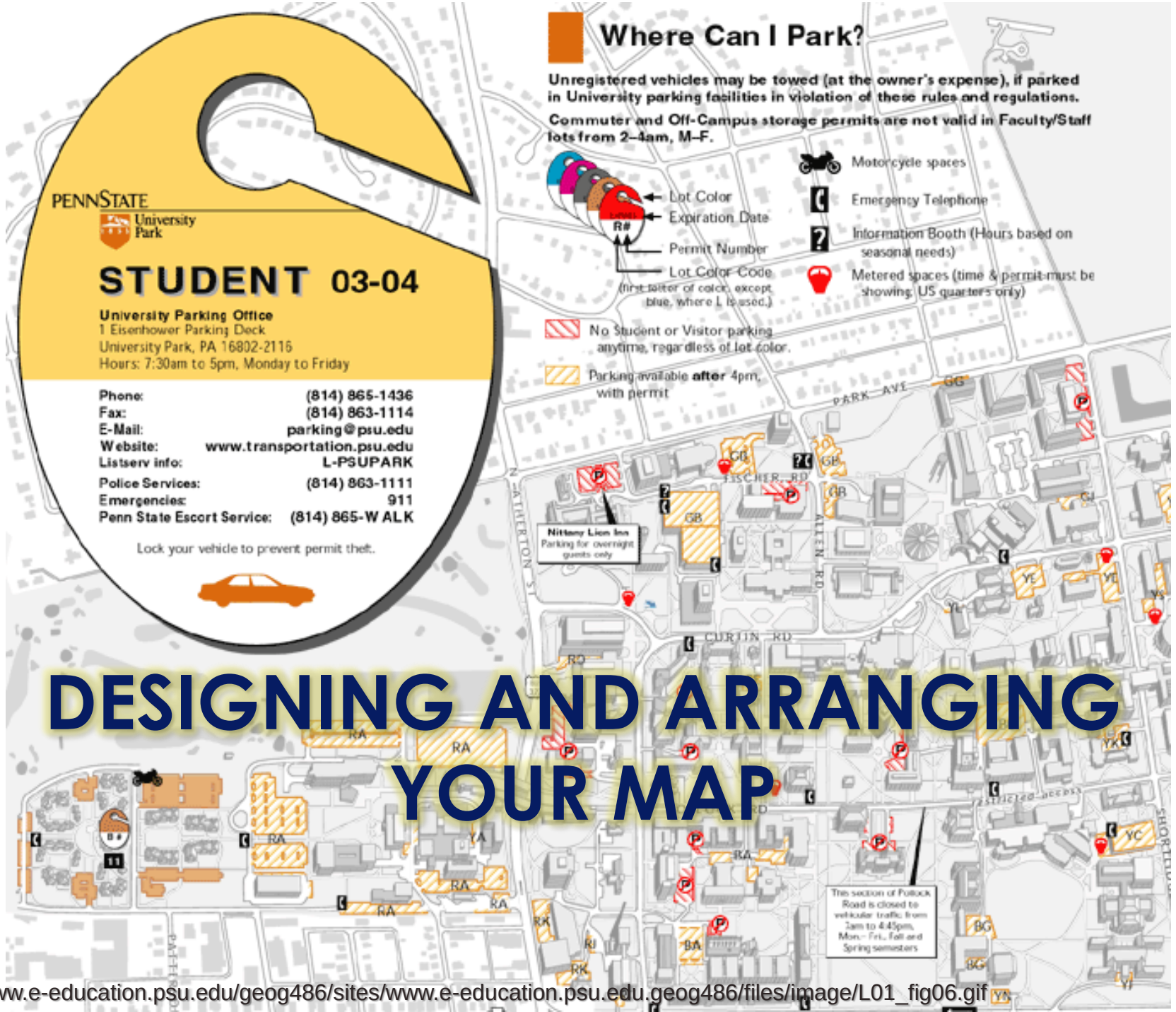


LCD Projection



Photocopying

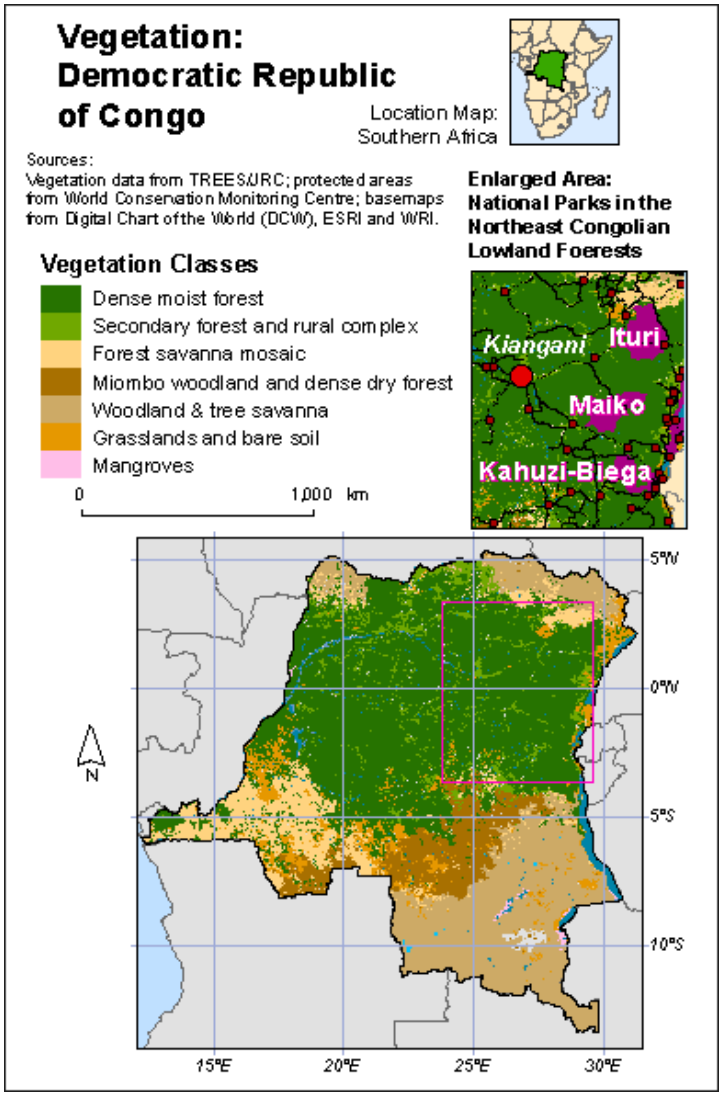




DESIGNING AND ARRANGING YOUR MAP

https://www.e-education.psu.edu/geog486/sites/www.e-education.psu.edu.geog486/files/image/L01_fig06.gif

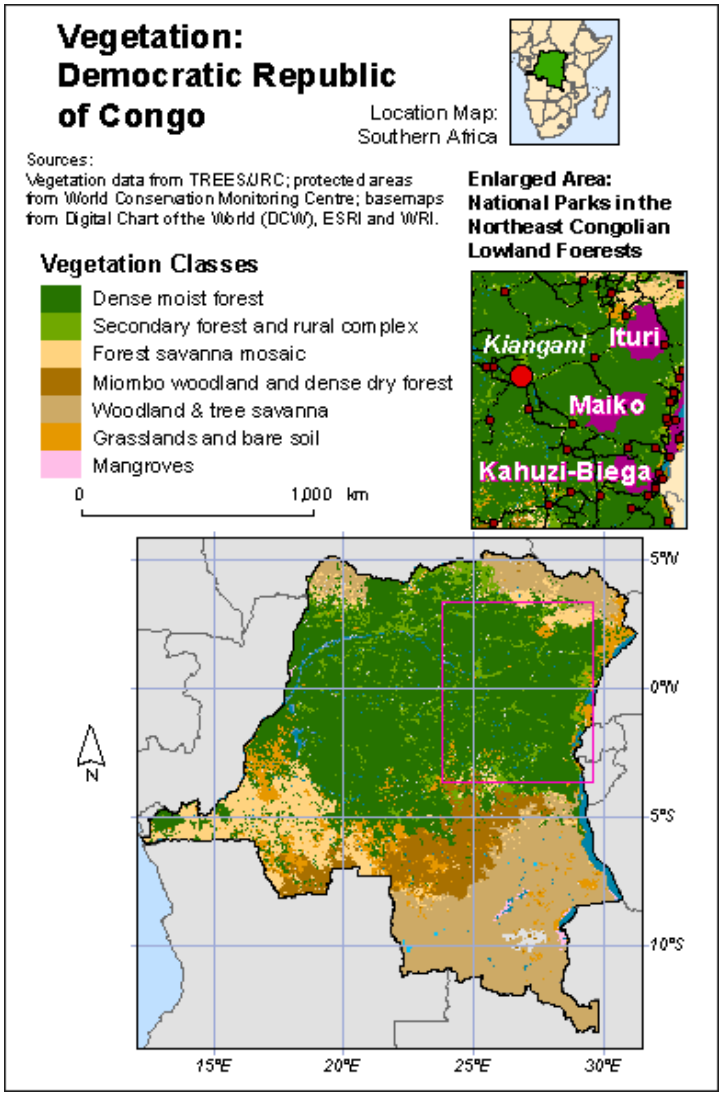
Visual Hierarchy



Make most important features most prominent by adjusting:

- Position
- Size
- Surrounding open space
- Color contrast
- Line weights and detail

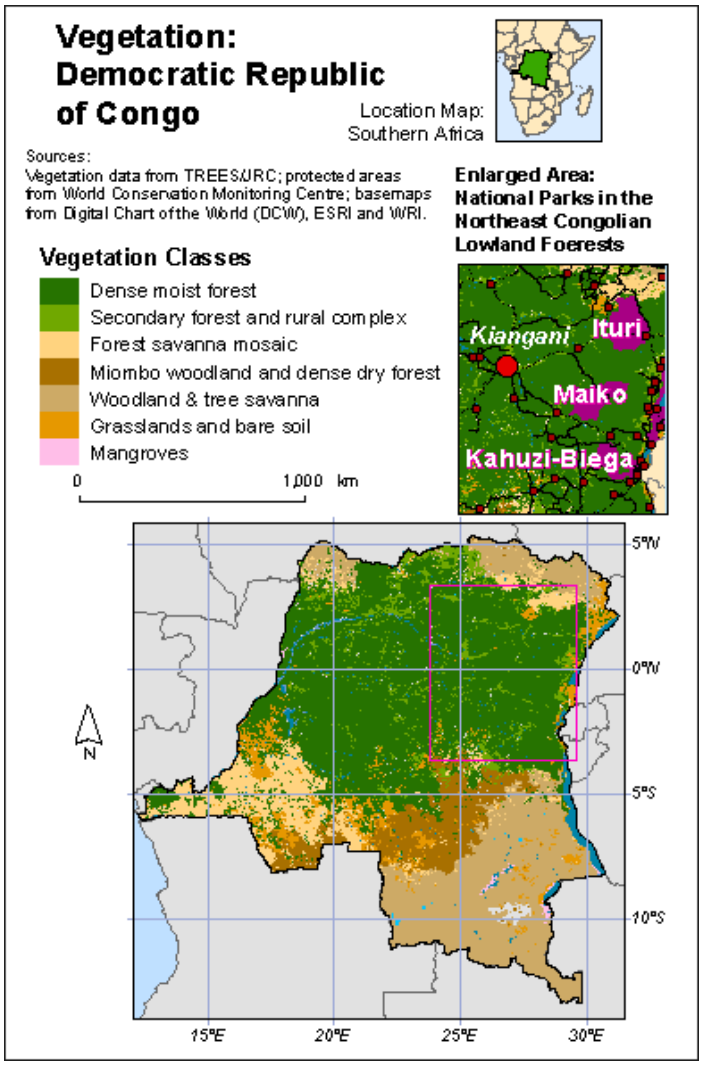
Visual Hierarchy



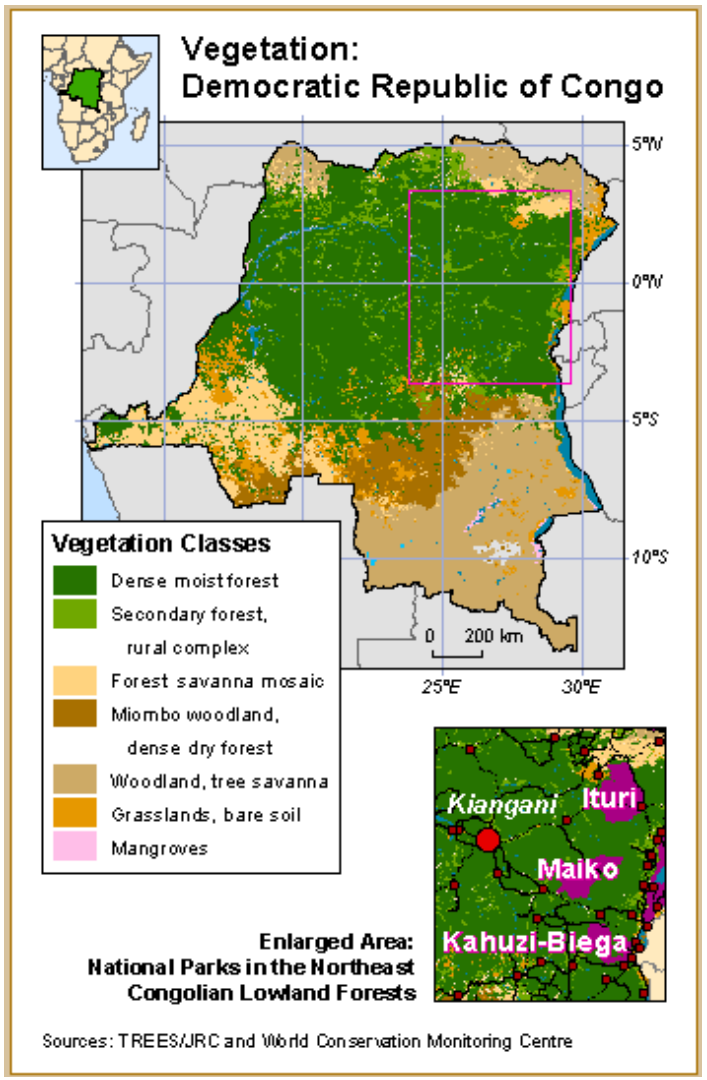
Map Elements

Main map
Smaller-scale inset maps showing location
Larger-scale inset maps showing detail or locations outside the area of the main map
Titles
Subtitles
Legends
Scale indicators
Orientation (direction) indicators
Graticule
Explanatory text notes
Source note
Neatline
Photos
Graphs

Visual Hierarchy

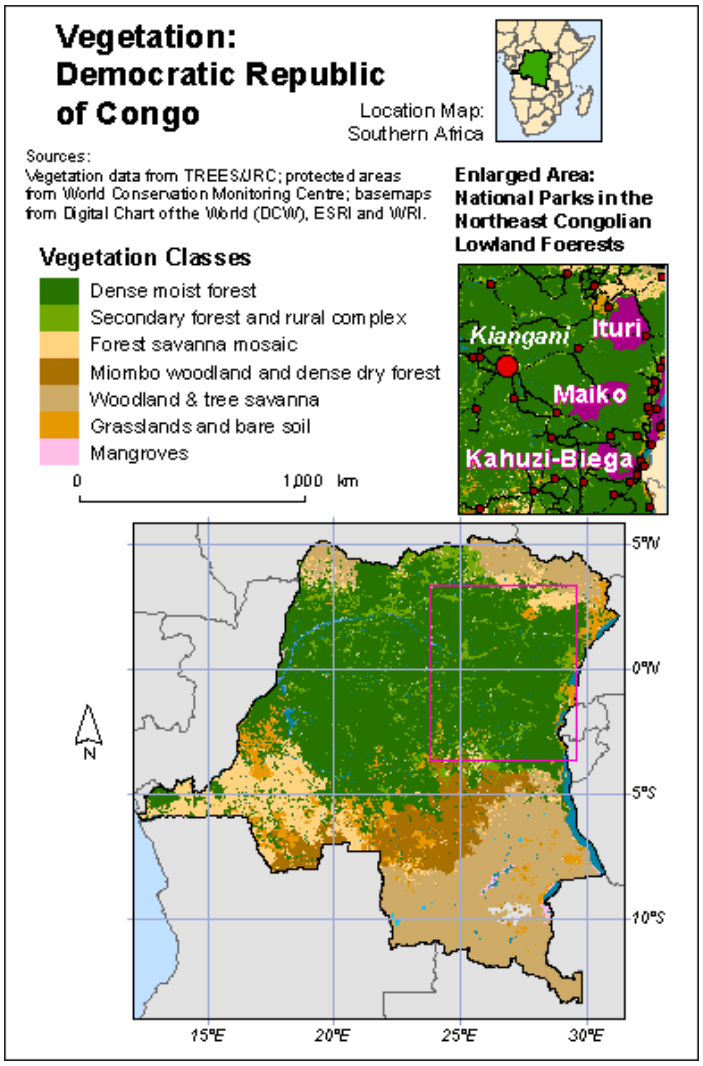


Original

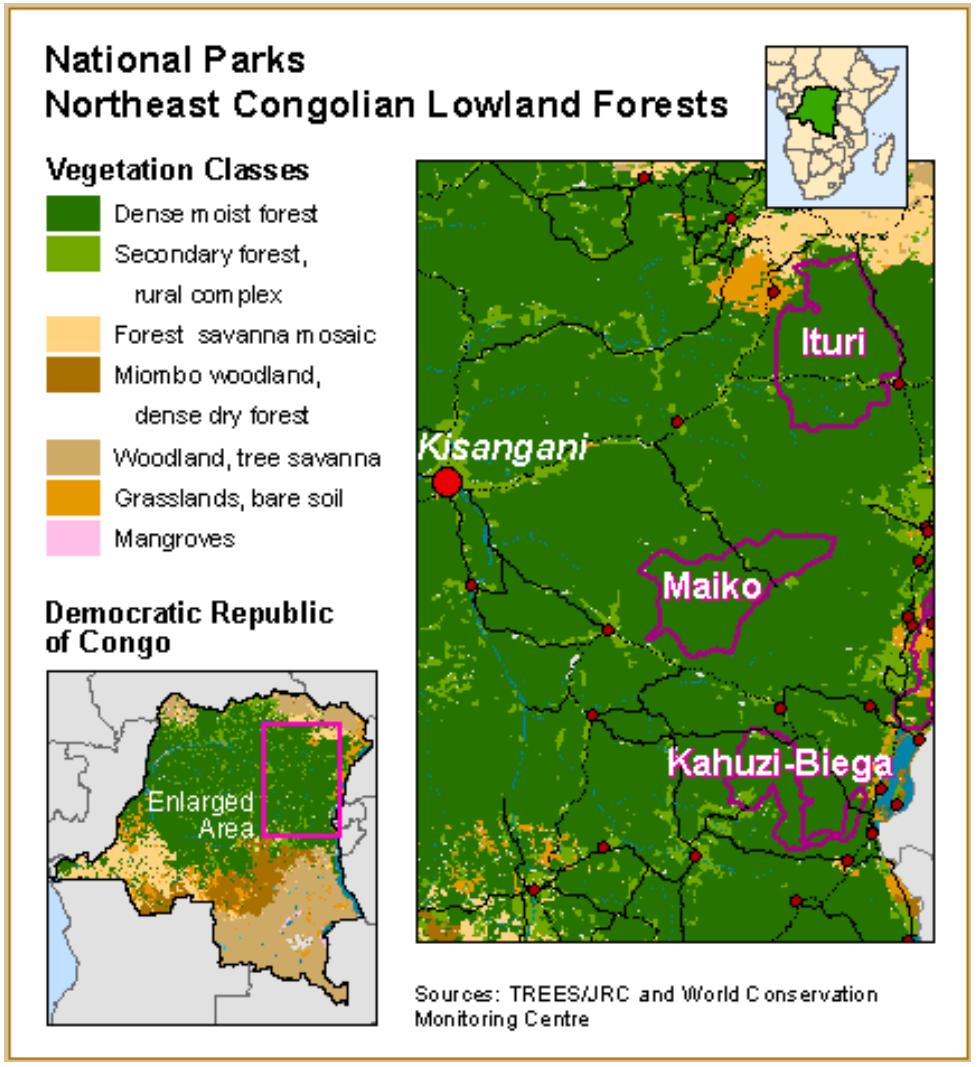


Emphasizes Congo Vegetation

Visual Hierarchy



Original

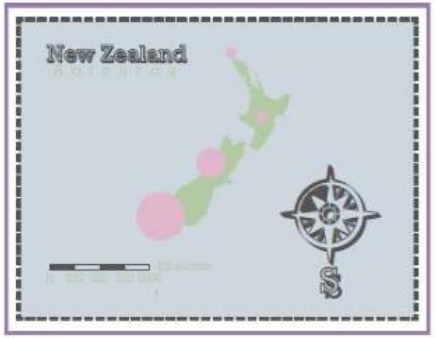


Emphasizes parks in Congo forest

Visual Hierarchy: The “blur test”

Better hierarchy

Poorer hierarchy



Better hierarchy greyscale

Poorer hierarchy greyscale

Better hierarchy squint

Poorer hierarchy squint

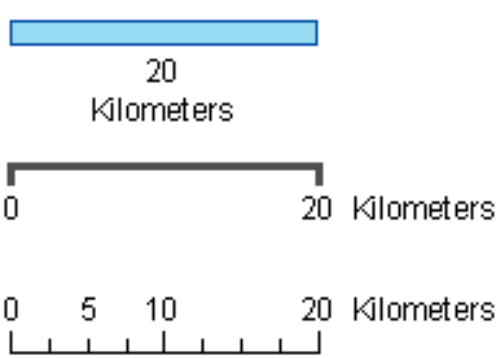
Better hierarchy small

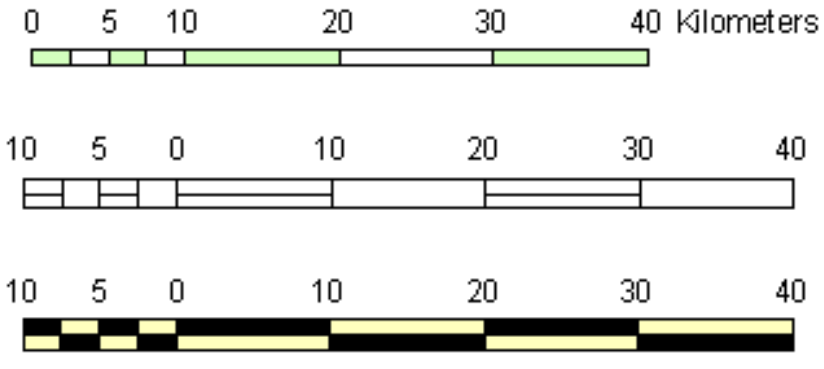
Poorer hierarchy small

Design Elements

Scale bars:

Thematic maps



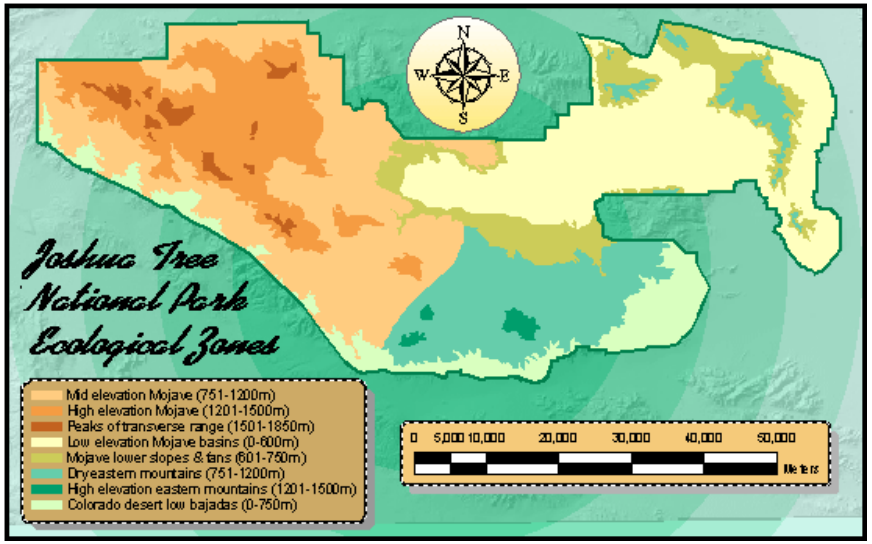


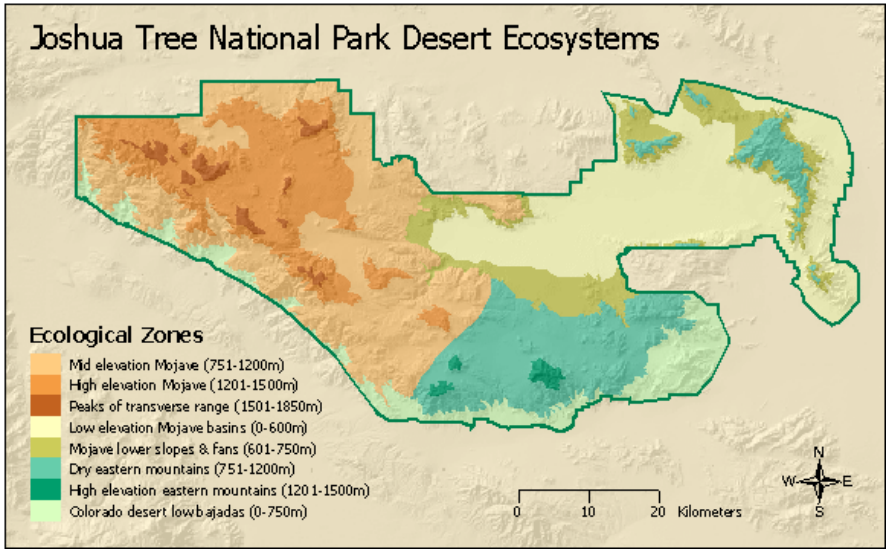
Reference maps

Design Elements

Decorative Elements:

- Drop shadows
- Line styles for frames
- Background patterns
- Compass rose
- Zoom lines
- Colorful logos
- Decorative type fonts



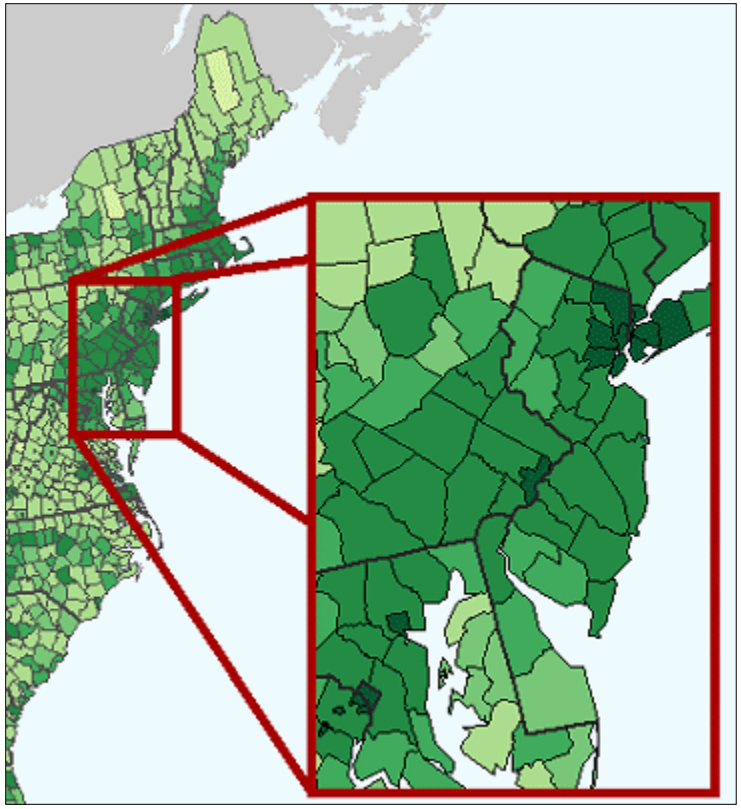


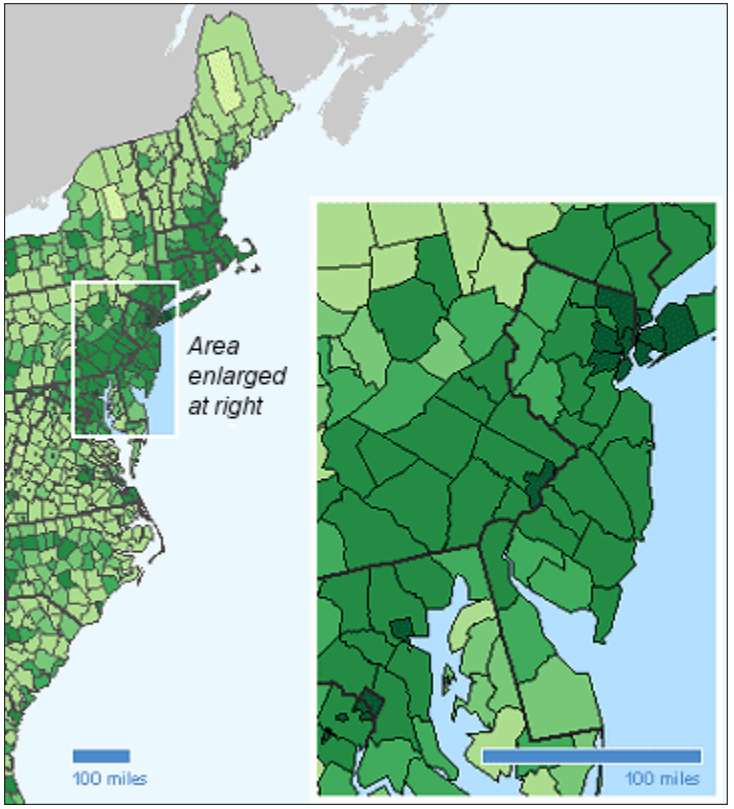
These features tend to distract. Use **with purpose**!

Design Elements

Decorative Elements

Keep focus on information, not element…

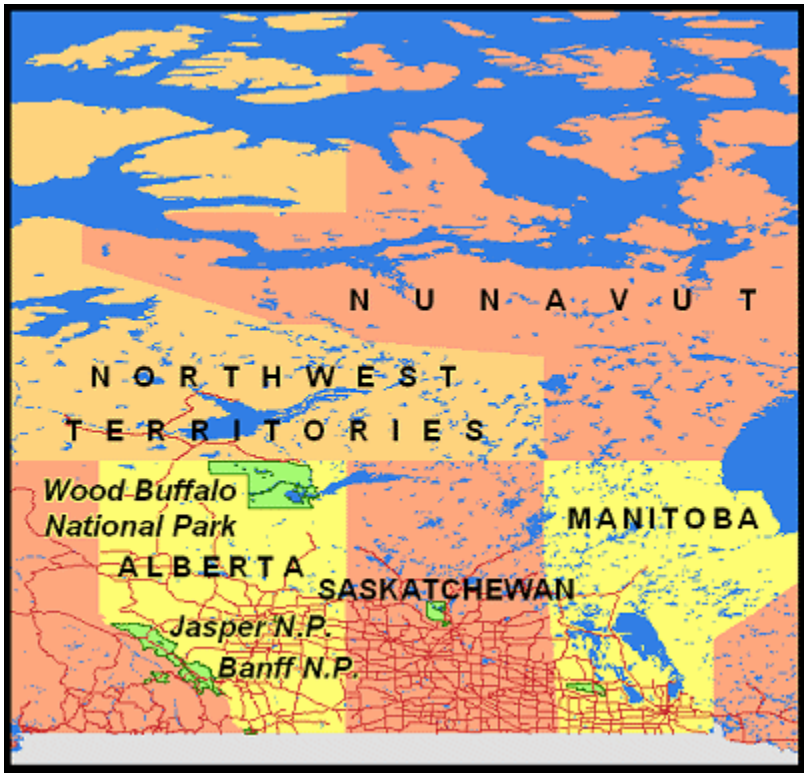




Choosing Map Projections

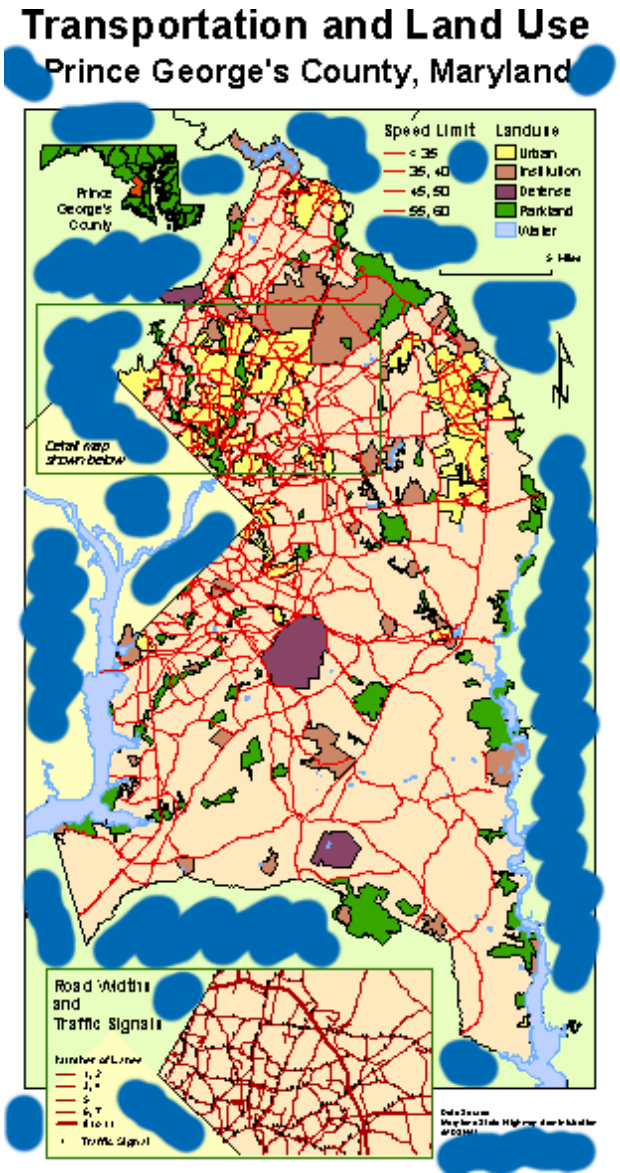
Which projection element to preserve:

Area? Shape? Distance?

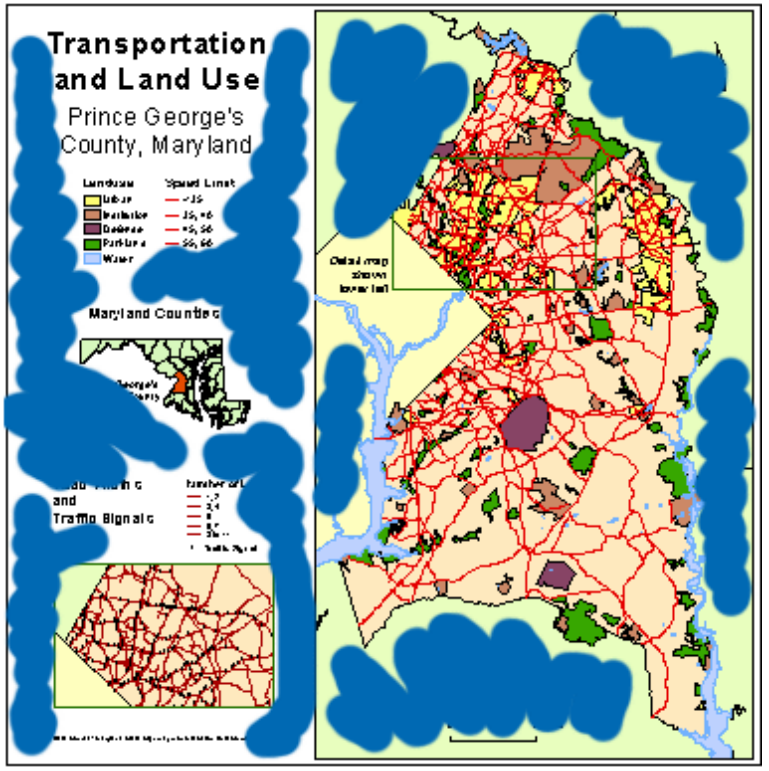


Preserving area is essential for density presentations

Balancing Empty Spaces

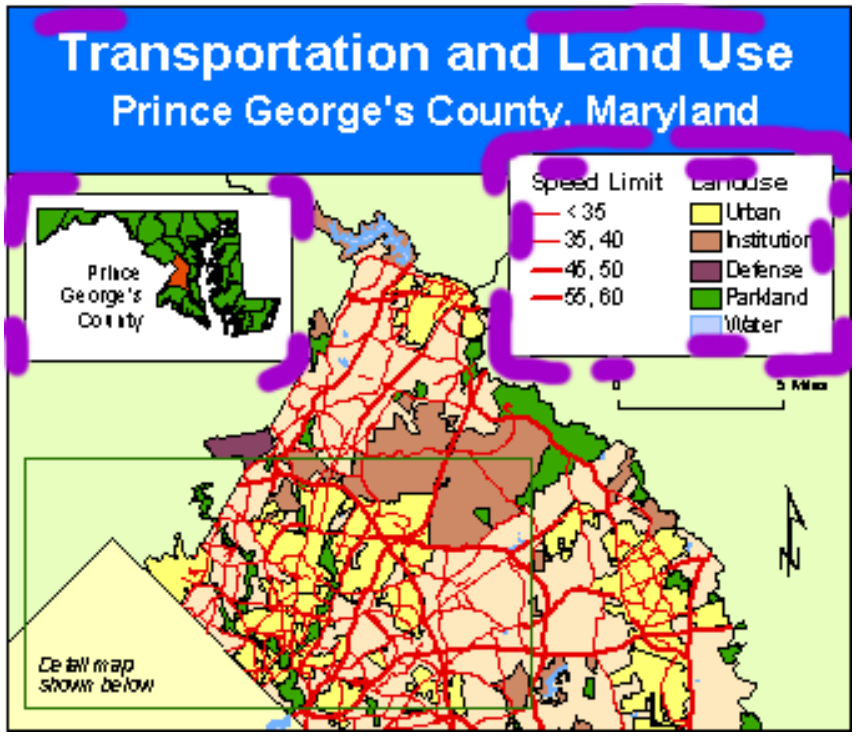


Learn to identify and balance **white space**. Use it as a design element.



Balancing Empty Spaces

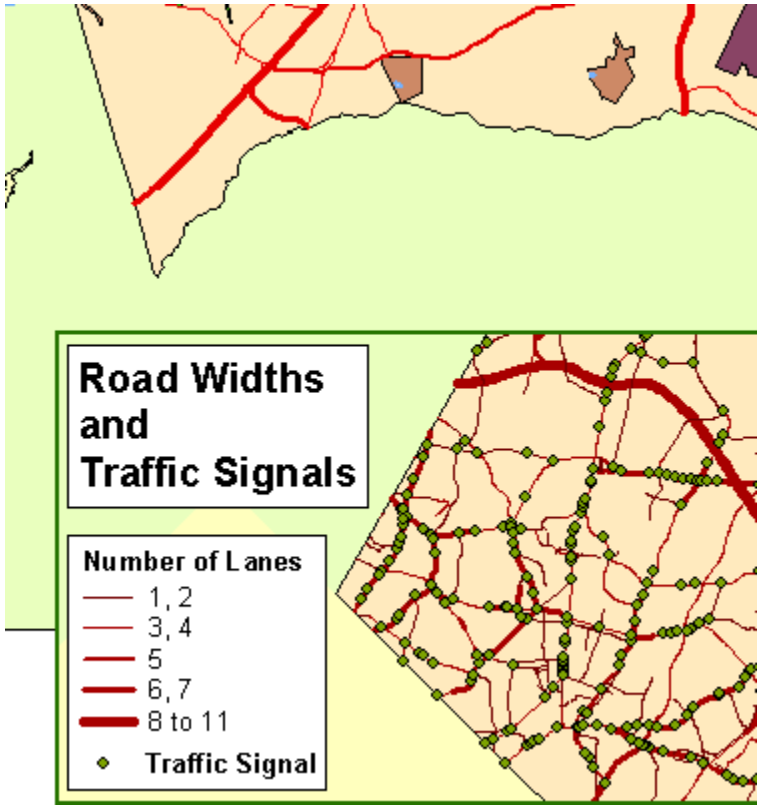
Boxes

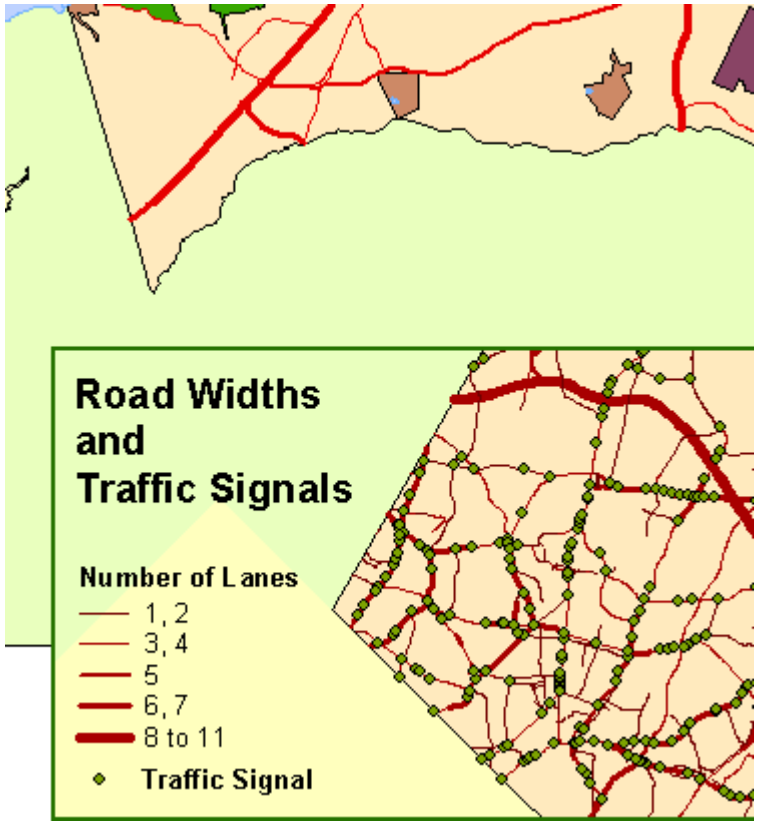


Boxes chop fluid open areas into areas inside and outside the box making more tight spaces…

Balancing Empty Spaces

Boxes …create a difficult and distracting set of pinched angles. Let empty spaces flow into each other.



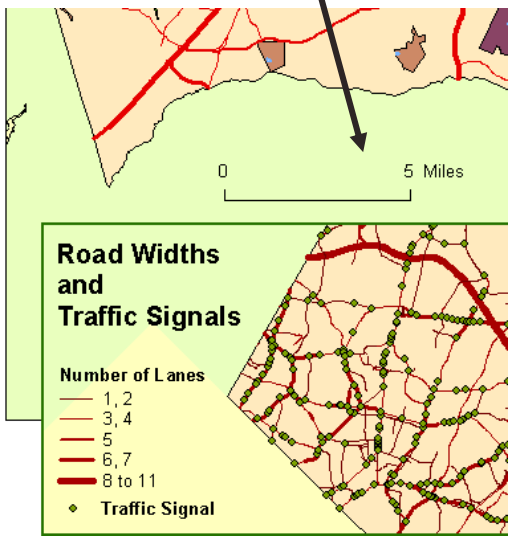


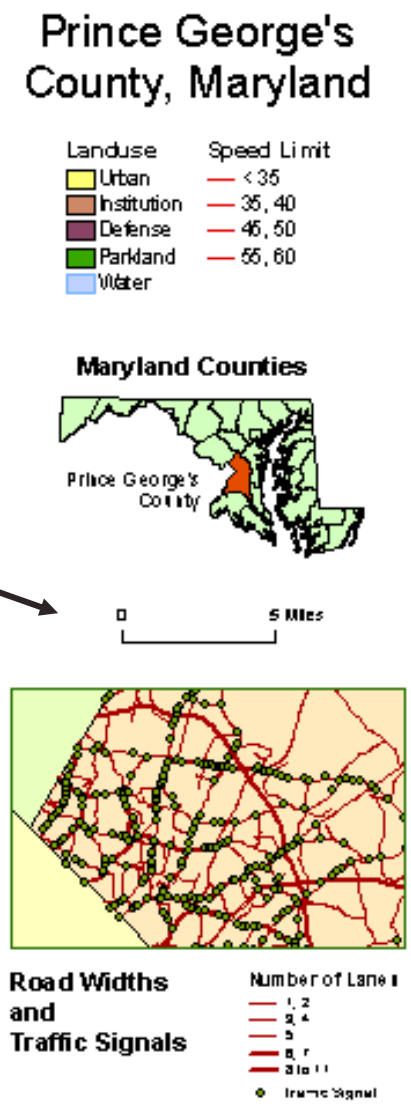
Boxes elevate the visual hierarchy of the elements it surrounds

Minimizing Ambiguity

Space objects so that related items are closer together…

To what maps are the scale bars referring??



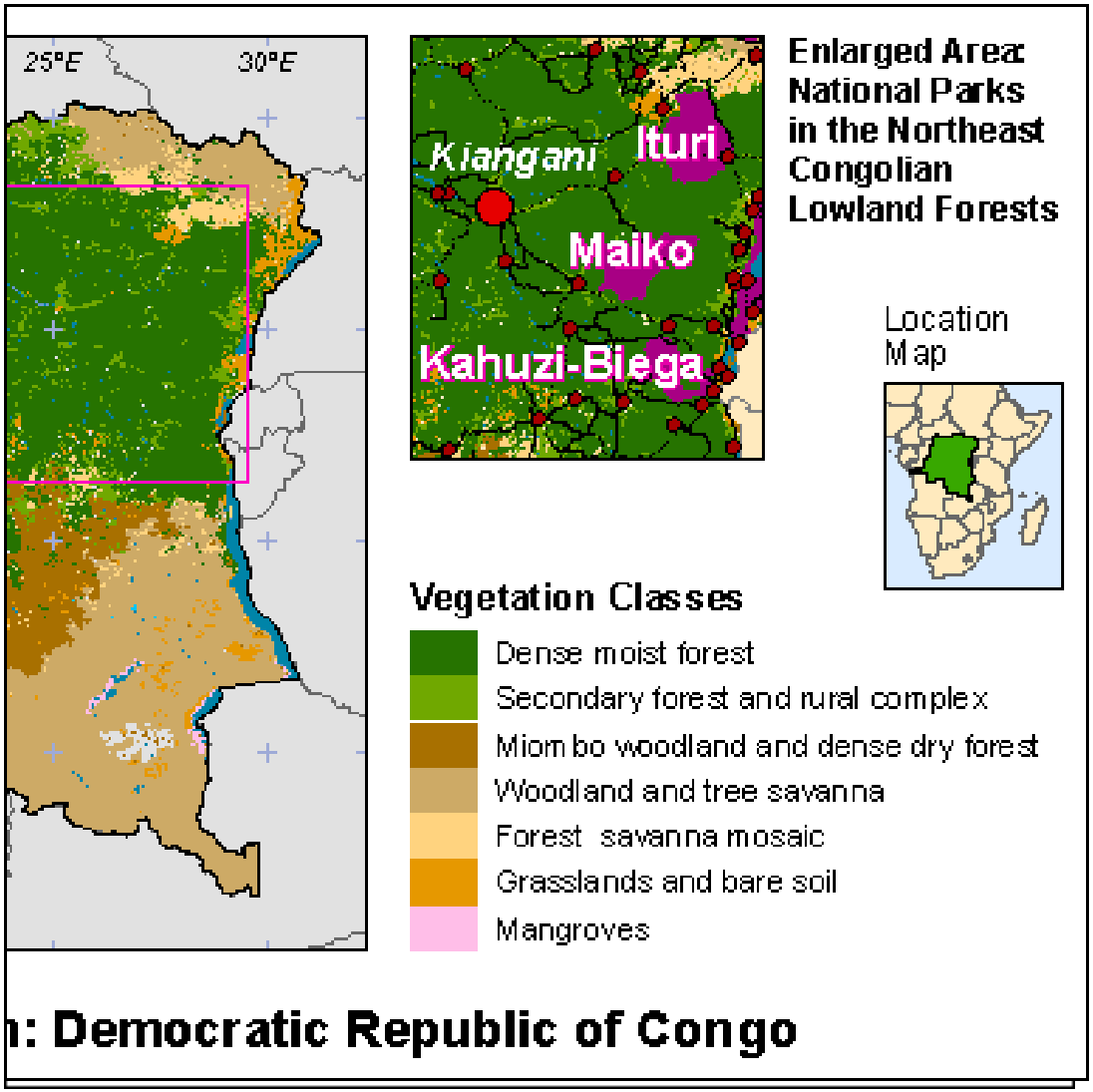


Element Alignment

Aligning all elements to each other creates an over-structured map.

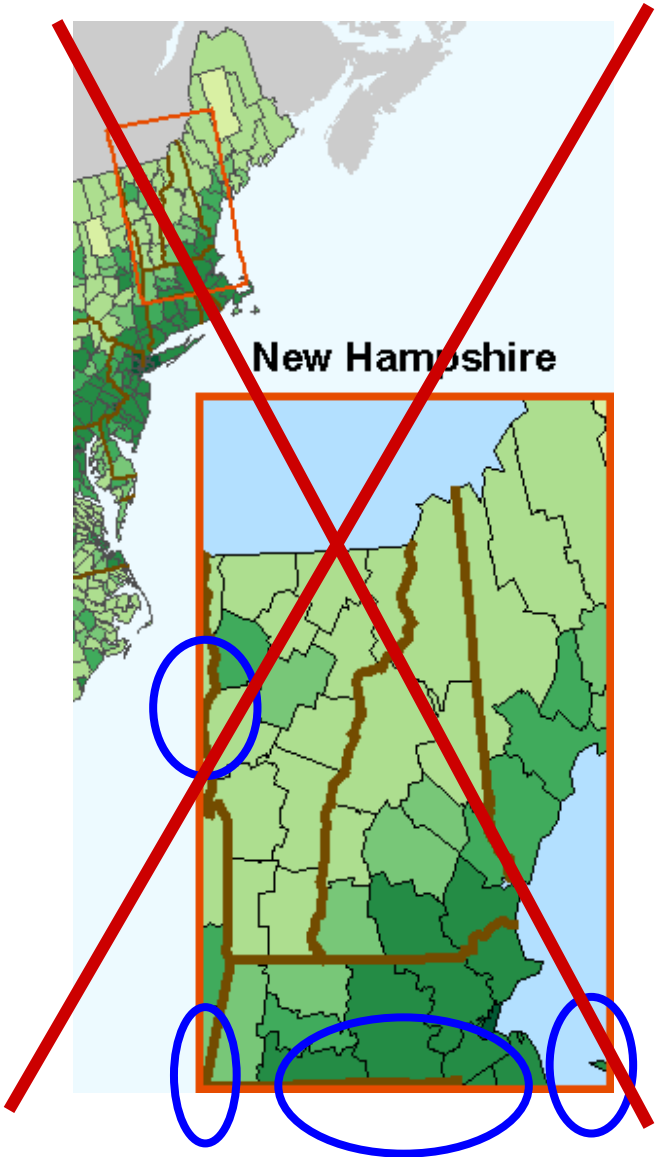
Haphazard alignment creates a sloppy map.

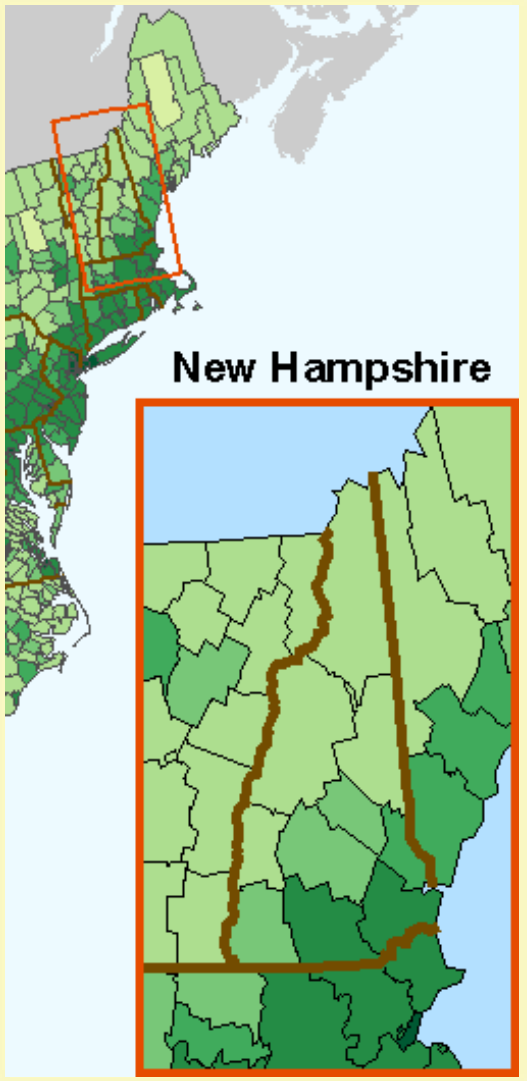
Selective alignment shows intention and can link elements.



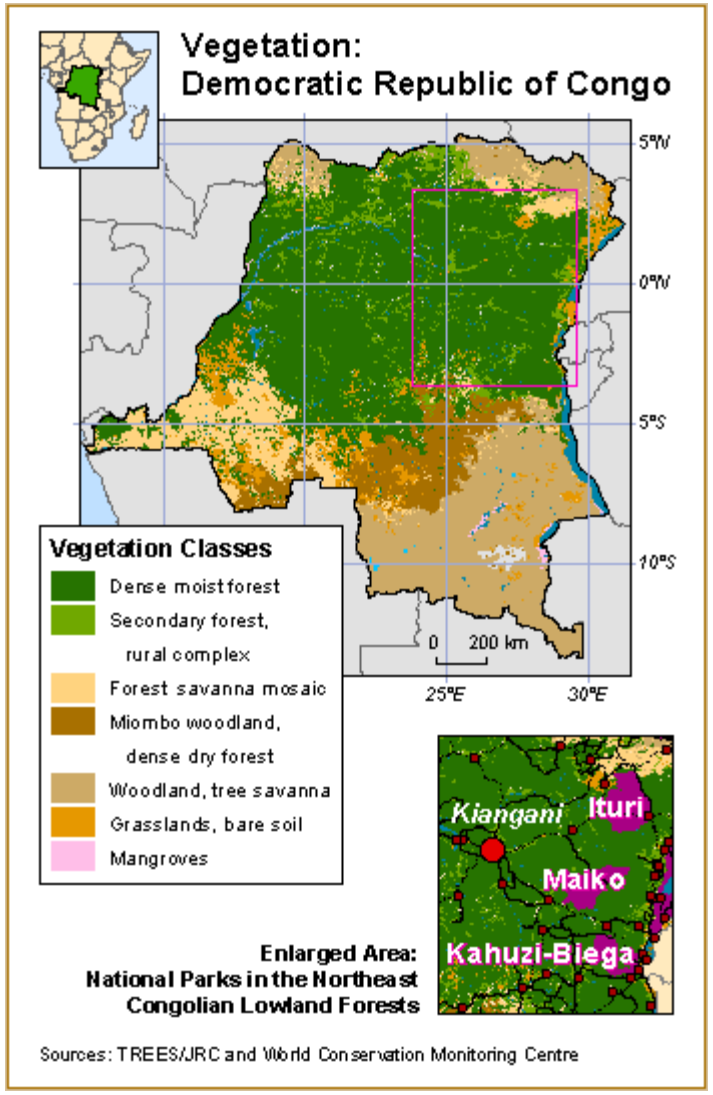
Frame Positioning

Avoid confusion between layout elements and geographic features

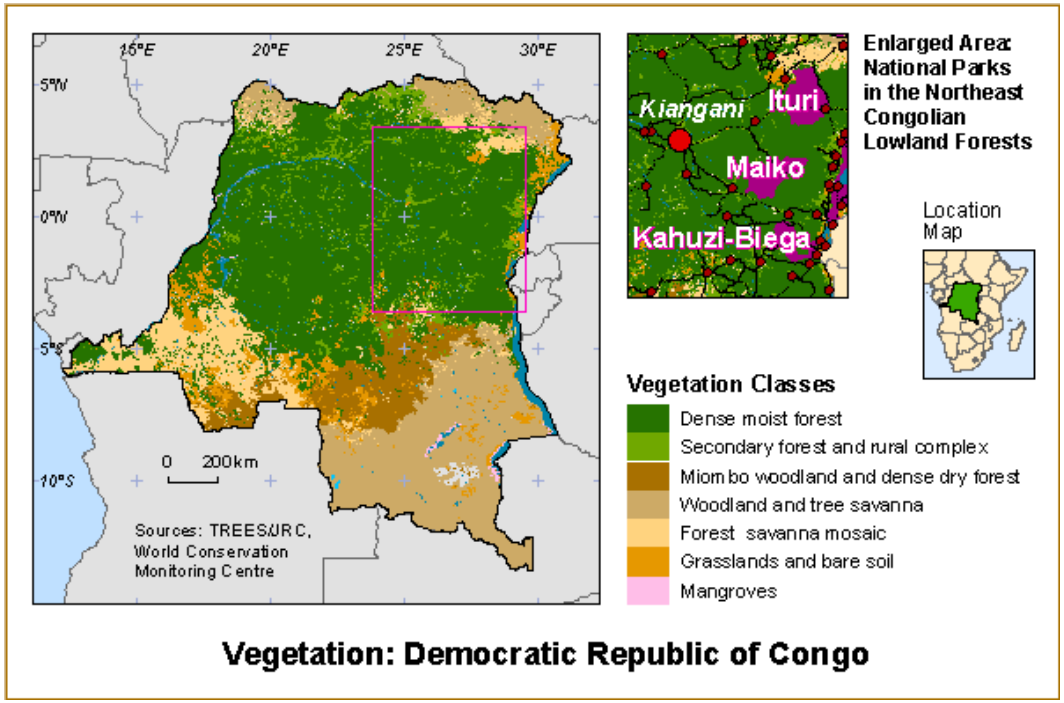




Experimentation/Critique



1. Create your map
2. Consider radically different layouts
3. Refine map
4. Invite critique



Exporting Maps

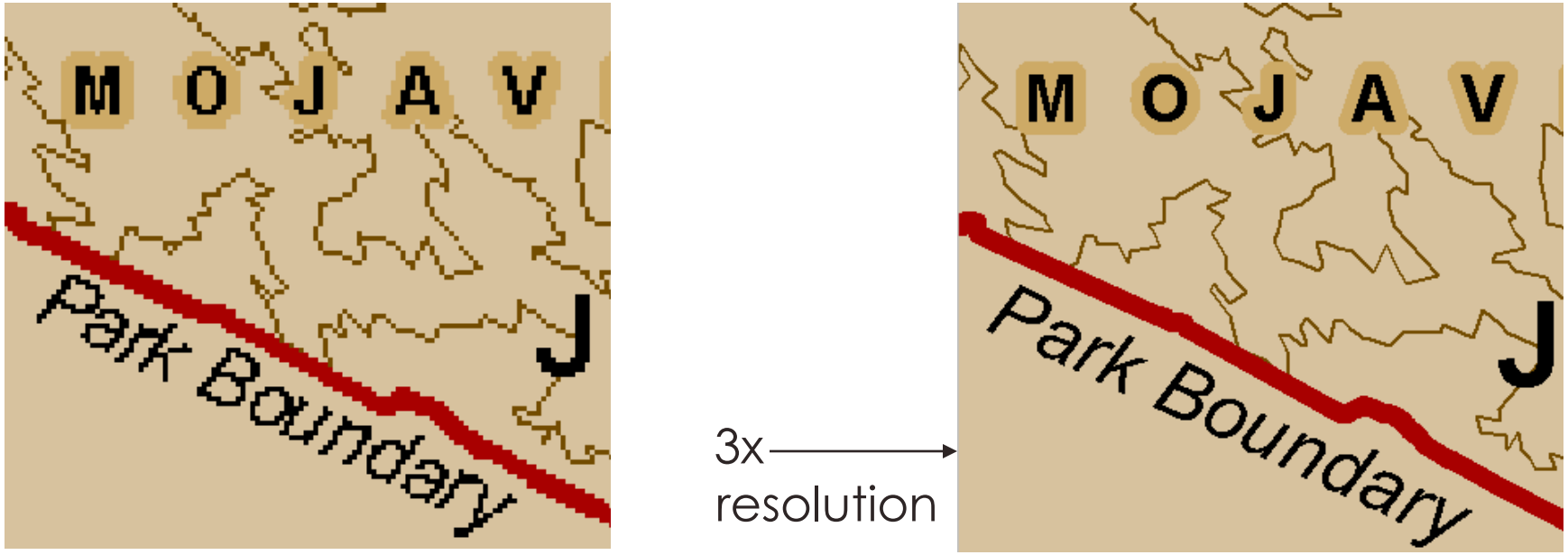
Raster export formats:

- Bitmap (.bmp)
- Tagged Image File Format (.tif)
- Joint Photographic Experts Group (.jpg)
- Portable Network Graphics (.png)
- Graphics Interchange Format (.gif)

Exporting Maps

Raster export formats:

- Produce pixel-by-pixel renditions of map (*WYSIWYG*)
- User sets height & width (pixels) and resolution (dpi).
- Larger, more resolute images are higher quality, but require more disk storage space.



Exporting Maps

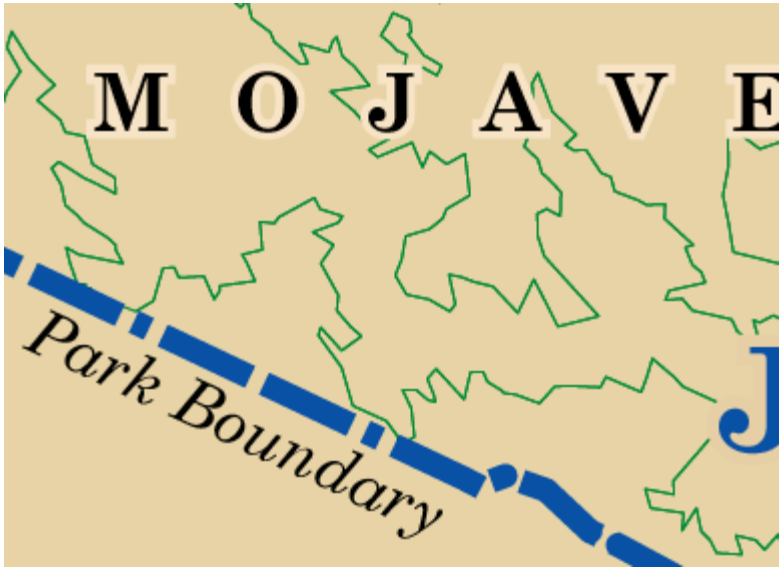
Vector export formats:

- Enhanced Metafile (.emf)
- Encapsulated Postscript (.eps)
- Adobe Illustrator (.ai)
- Scaleable Vector Graphics (.svg)
- Portable Document Format (.pdf)

Exporting Maps

Vector export formats:

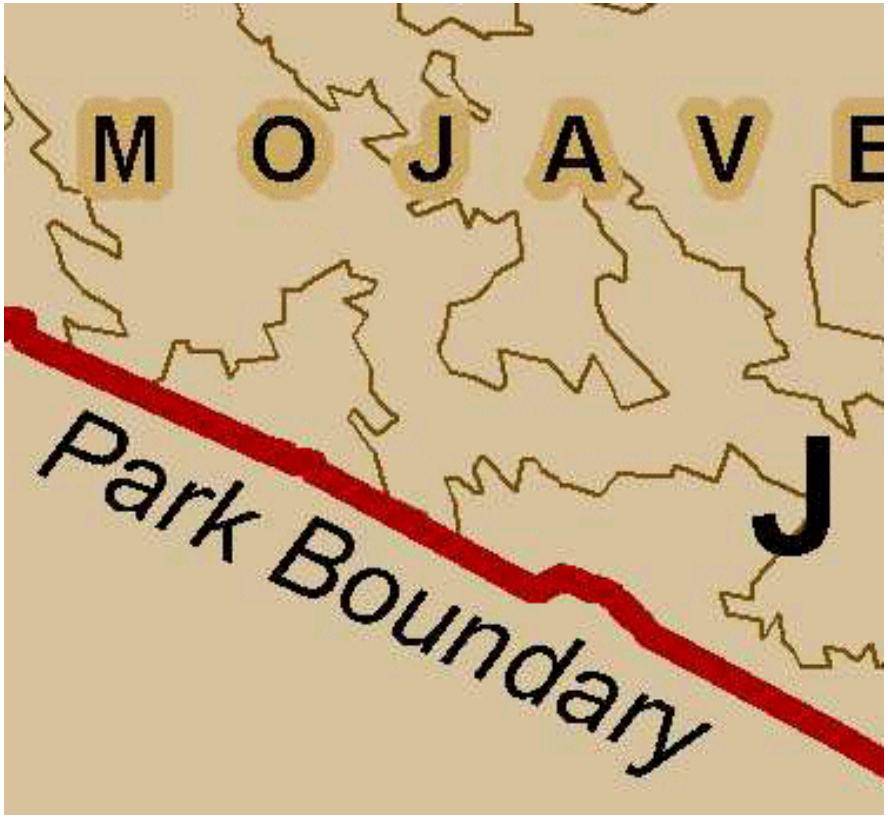
- Contain instructions on how to redraw elements.
- Elements may be editable after export.
- File size is much smaller, but can take time to draw.
- Reconstruction is not always exact; post editing



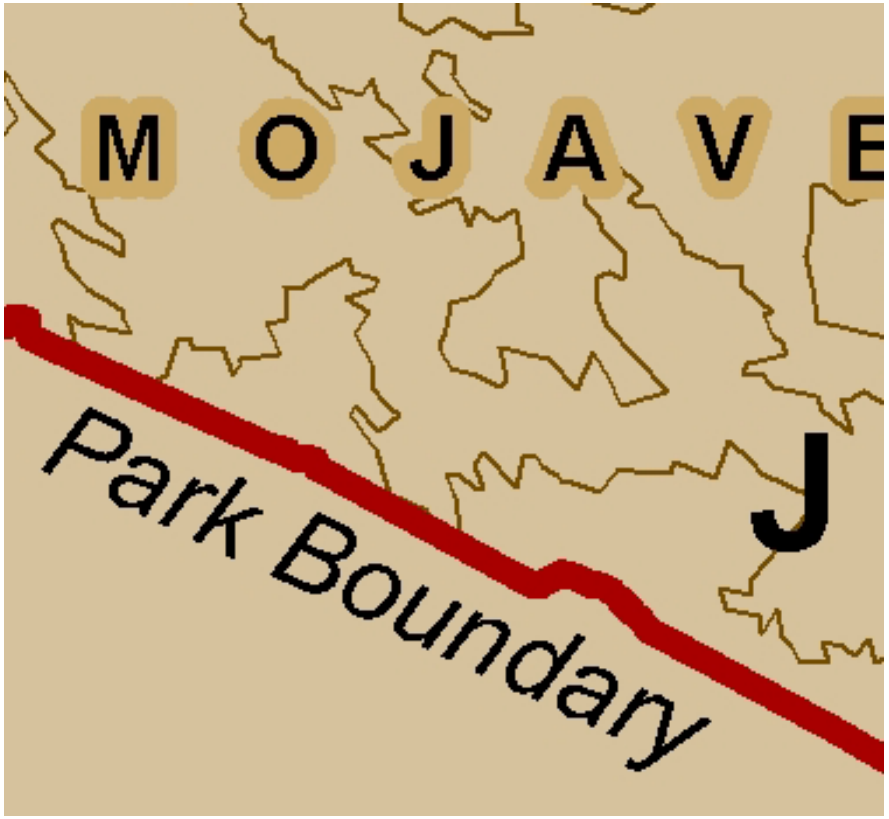
Exporting Maps

JPEG format:

- Size, resolution, and ***quality*** (compression) are specified



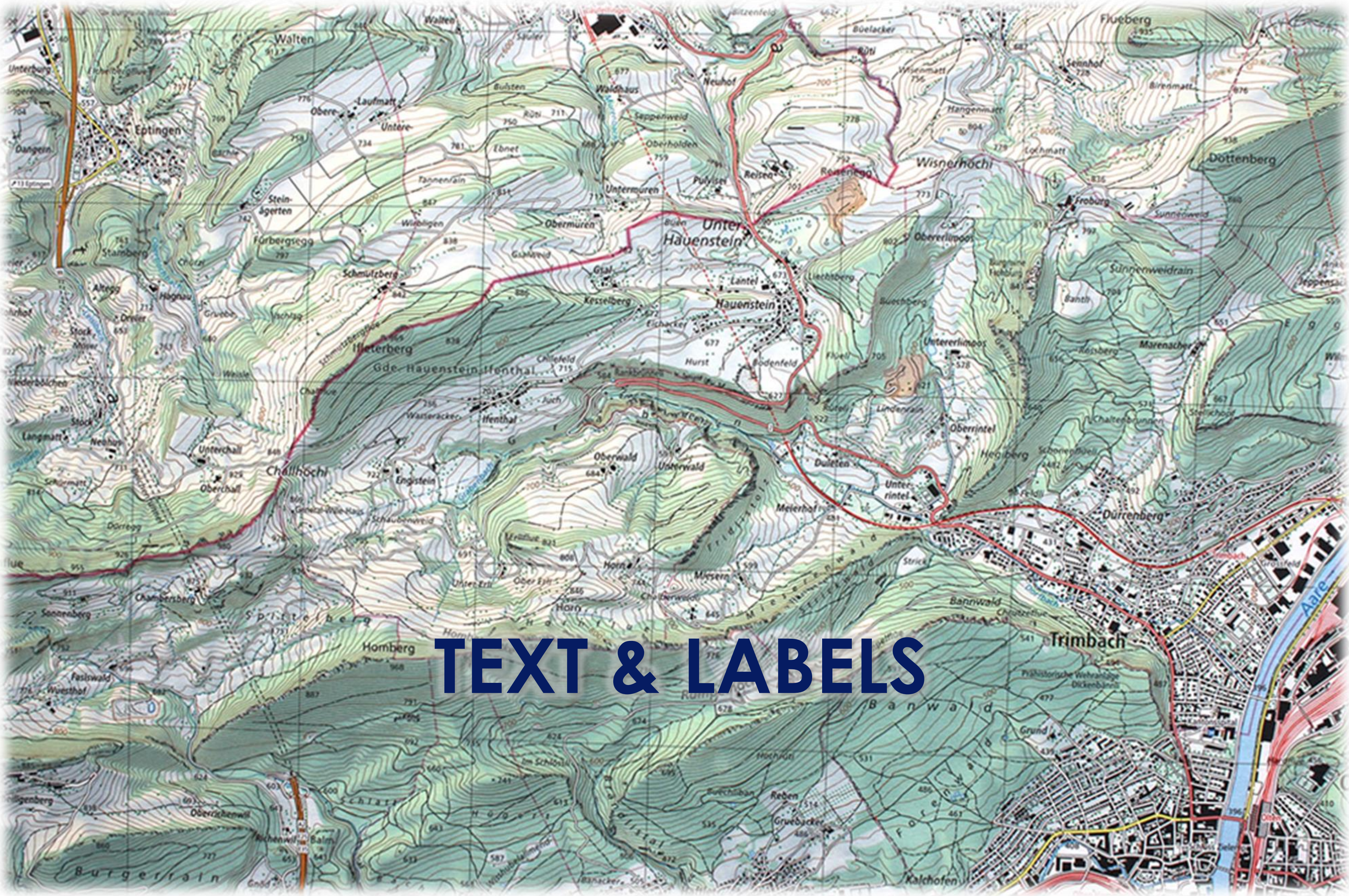
Low quality



High quality

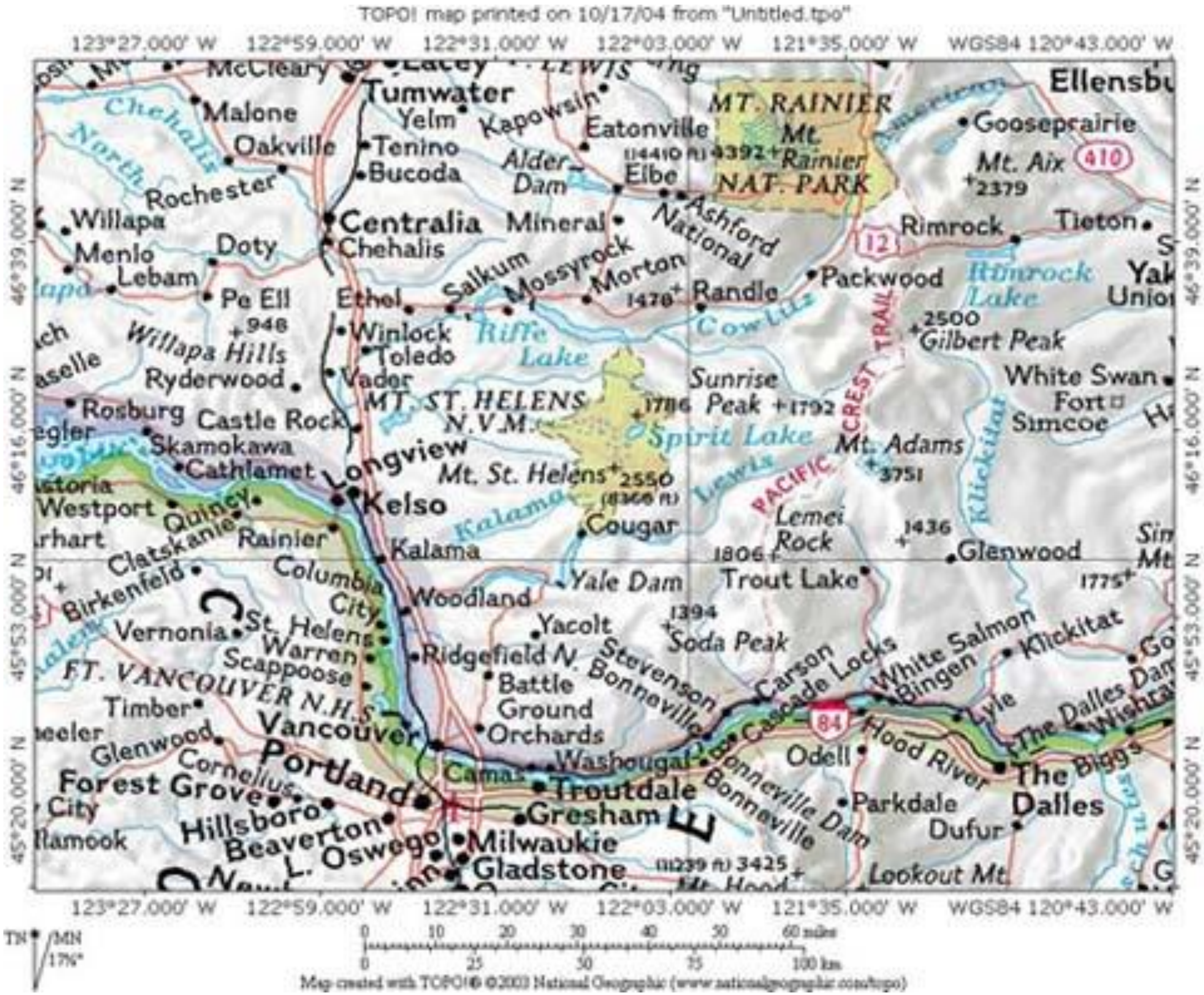
Map Design: Review

- A map's design is guided by its **purpose**, **audience**, and **viewing medium**
- **High resolution** media can support fine lines and subtle colors. **Low resolution** media requires big print and contrasting colors.
- **Visual hierarchy** is set to promote the most important map features.
- **Map projections** should be chosen to minimize distortion of the main map feature.
- The **balancing** and **alignment** of map elements should maximize flow and minimize ambiguity.
- Different **export file formats** have unique requirements


Walten
Eptingen
Unter Hauenstein
Hauenstein
Wisnerhochi
Dottenberg
Flueberg
Froburg
Sunnenweidrain
Marenacher
Ifleterberg
Chällhöchi
Homberg
Dürrenberg
Trimbach
Bannwald
Aare

TEXT & LABELS

Type Basics



TOPO! map printed on 10/17/04 from "Untitled.tpo"
123°27.000' W
122°59.000' W
122°31.000' W
122°03.000' W
121°35.000' W
WGS84 120°43.000' W
Tumwater
Ellensbu
MT. RAINIER
Mt. Rainier
NAT. PARK
Malone
Yelm
Kapowsin
Eatonville
Goosepraírie
Oakville
Tenino
Bucoda
Alder Dam
Elbe
Mt. Aix
2379
Rochester
Centralia
Mineral
Ashford
National
Rimrock
Tieton
Willapa
Chehalis
Menlo
Doty
Lebam
Pe Ell
Ethel
Salkum
Mossyrock
Morton
Randle
Packwood
Rimrock Lake
Willapa Hills
948
Winlock
Toledo
Riffe Lake
Cowlitz
2500
Gilbert Peak
Ryderwood
Vader
Sunrise Peak
White Swan
MT. ST. HELENS N.V.M.
Fort Simcoe
Rosburg
Castle Rock
Spirit Lake
Skamokawa
Mt. Adams
3751
Cathlamet
Longview
Mt. St. Helens
2550
Westport
Kelso
Quincy
Kalama
Cougar
Lemei Rock
1436
Rainier
Clatskanie
Glenwood
Kalama
Columbia City
Yale Dam
Trout Lake
Birkenfeld
Woodland
Vernonia
St. Helens
Yacolt
1394
Soda Peak
Warren
Scappoose
Ridgefield
N. Bonneville
Stevenson
Carson
Cascade Locks
White Salmon
Bingen
Klickitat
FT. VANCOUVER N.H.S.
Battle Ground
Timber
Vancouver
Orchards
Lyle
The Dalles Dam
Glenwood
Portland
Washougal
Odell
Hood River
The Dalles
Cornelius
Camas
Troutdale
Bonneville
Bonneville Dam
Forest Grove
Gresham
Parkdale
Hillsboro
Beaverton
Milwaukie
Dufur
L. Oswego
Gladstone
3425
Lookout Mt.
PACIFIC CREST TRAIL
46°39.000' N
46°16.000' N
45°53.000' N
45°20.000' N
0 10 20 30 40 50 60 miles
0 25 50 75 100 km
Map created with TOPO!® ©2003 National Geographic (www.nationalgeographic.com/topo)

Type Basics

Type, or lettering, is a major component of a map.

…can work both as **text** and as **symbol**

…both **categorizes** and **orders** features

Type elements in map making:

- Fonts
- Label size
- Type effects

Font tools available in Windows

Categories of Fonts

- Serif

  small finishing strokes on letters

  gqabj GIQWB &?147, Times New Roman

  gqabj GIQWB &?147, New Baskerville

  gqabj GIQWB &?147, Courier New

- Sans serif

  no finishing strokes

  gqabj GIQWB &?147, Arial

  gqabj GIQWB &?147, Tahoma

  gqabj GIQWB &?147, Futura

- *Display Fonts*

  Distinctive or decorative letter forms

  gqabj GIQWB &?147, Tiffany

  gqabj GIQWB &?147, Impact

  gqabj GIQWB &?147, Kaufmann

Categories of Fonts

Maps usually contains only two font types.

- A *serif* font is often used for water or other <u>physical</u> features

- A *sans serif* font is used for towns and other <u>cultural</u> features

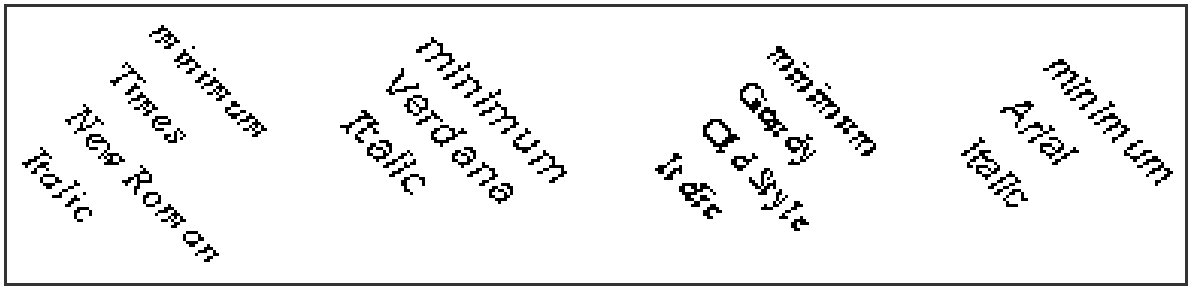
Font x-height and legibility

- **x-height** describes the height of the letter ‘x’ for a font
- **x-height** and **thinness** of letters are important considerations when small text size is used on maps

palouse palouse
Garamond Palatino

Bell Gothic Font (phonebook)
AaBbCcDdEeFfGgHhIiJjKk

- Some fonts also **angle** better than others



Type styles and font families

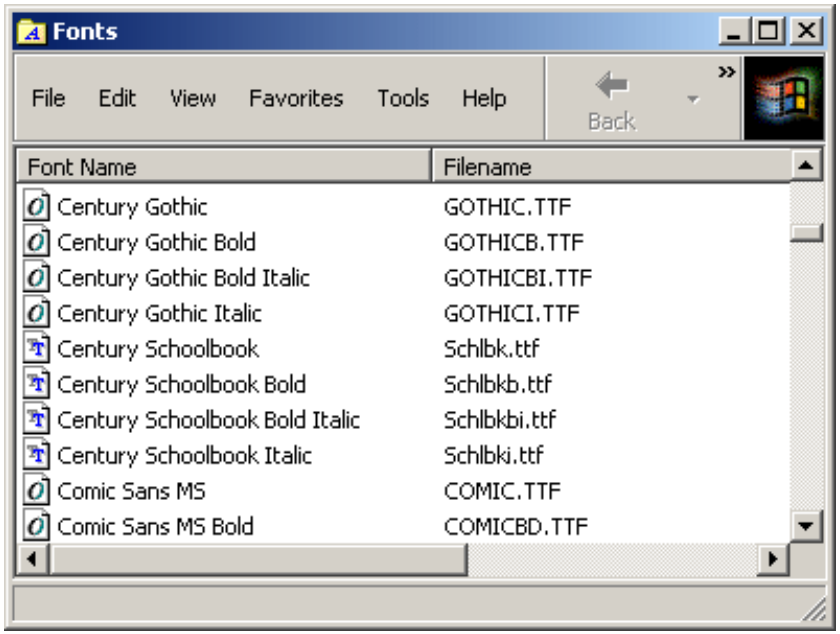
Regular… **Bold**… *Italics*… ***Bold italics***…

Arial Regular
Arial Bold
Arial Italic
Arial Bold Italic

Arial Narrow Regular
Arial Narrow Bold
Arial Narrow Italic
Arial Narrow Bold Italic

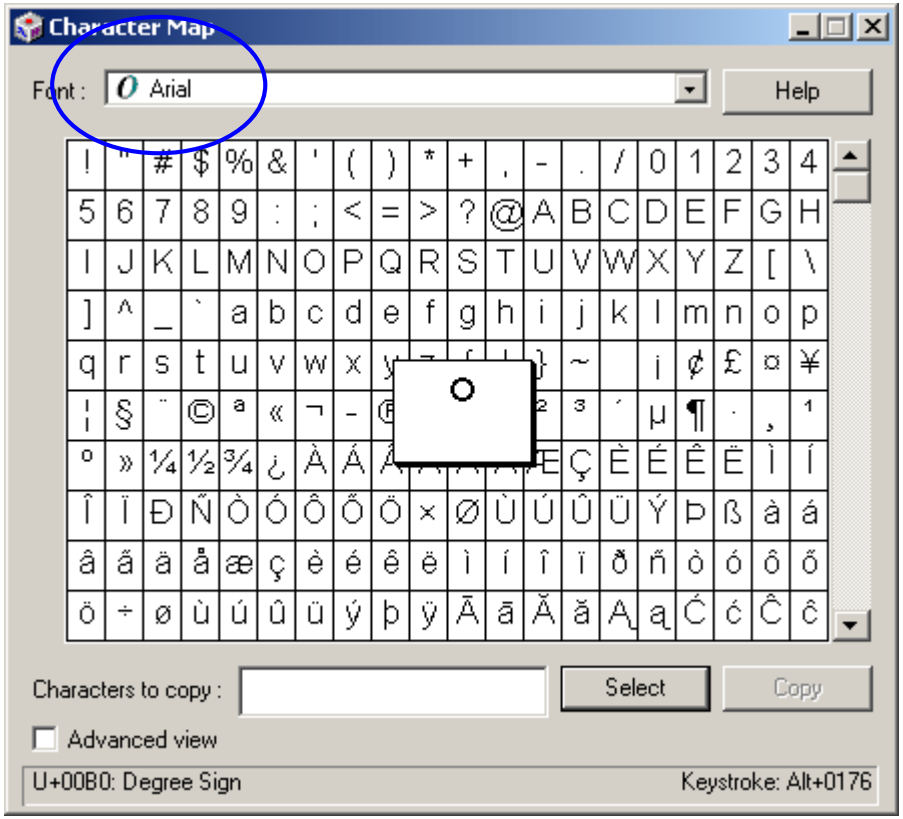
Arial Black Regular
Arial Black Italic

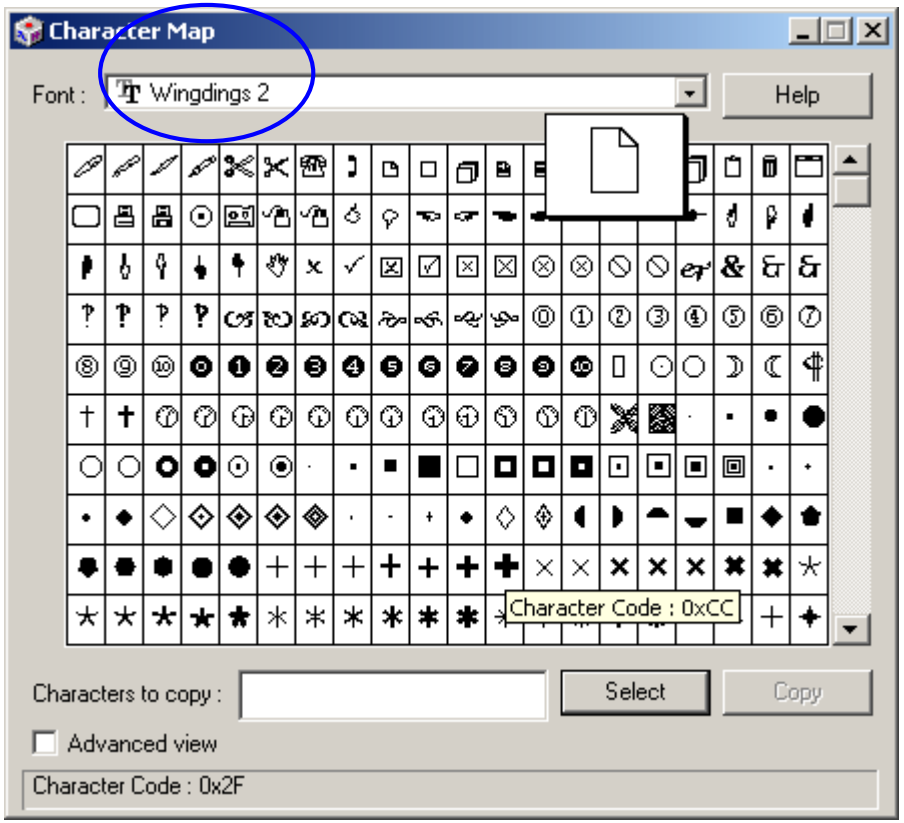
C:\WINDOWS\Fonts\



Special Characters

Windows Character Map tool

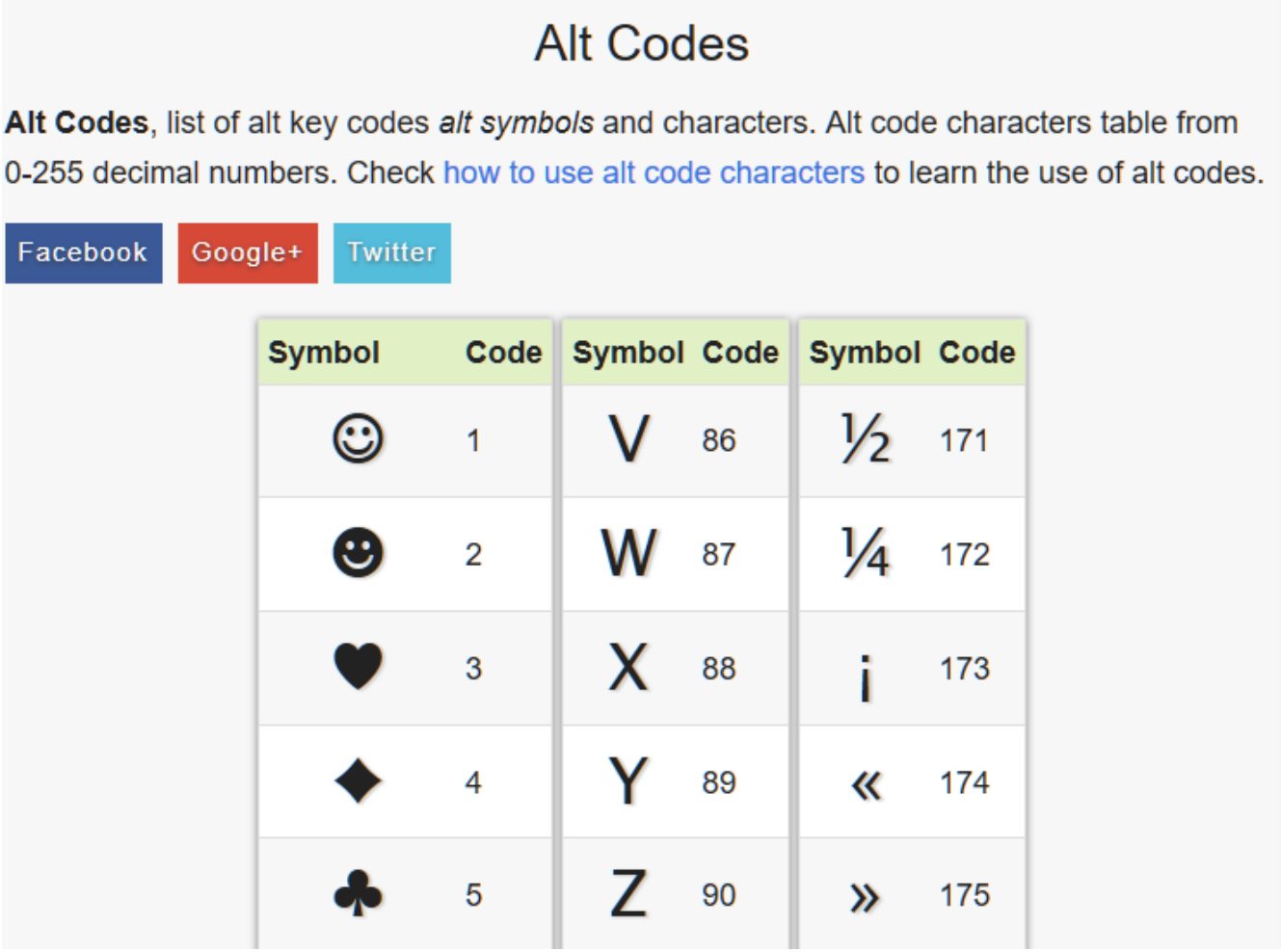




Special Characters

Alt-codes

http://www.alt-codes.net/



Alt Codes

Alt Codes, list of alt key codes *alt symbols* and characters. Alt code characters table from 0-255 decimal numbers. Check how to use alt code characters to learn the use of alt codes.

Facebook Google+ Twitter

Symbol	Code	Symbol	Code	Symbol	Code
☺	1	V	86	½	171
☻	2	W	87	¼	172
♥	3	X	88	¡	173
♦	4	Y	89	«	174
♣	5	Z	90	»	175

Type Size

Font size is measured in *points:*
→ One point is approximately 1/72 of an inch

However, different fonts can vary markedly in size even for a given point setting…

So, label placement may change if fonts change…

Character S p a c i n g

Units of character spacing are percent of point size.

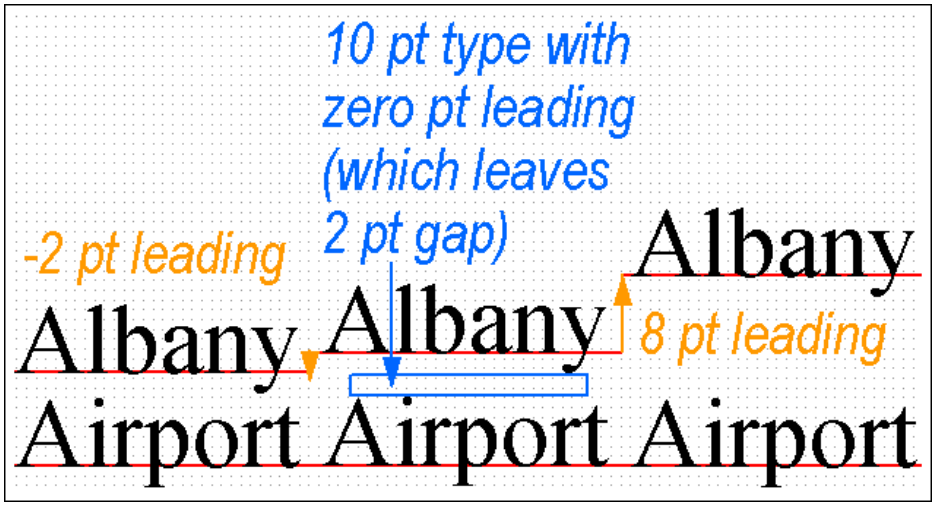
D E A R B O R N
H E I G H T S

200% character spacing

Spacing increases legibility of curved text.

Line Spacing

Leading is the spacing between lines

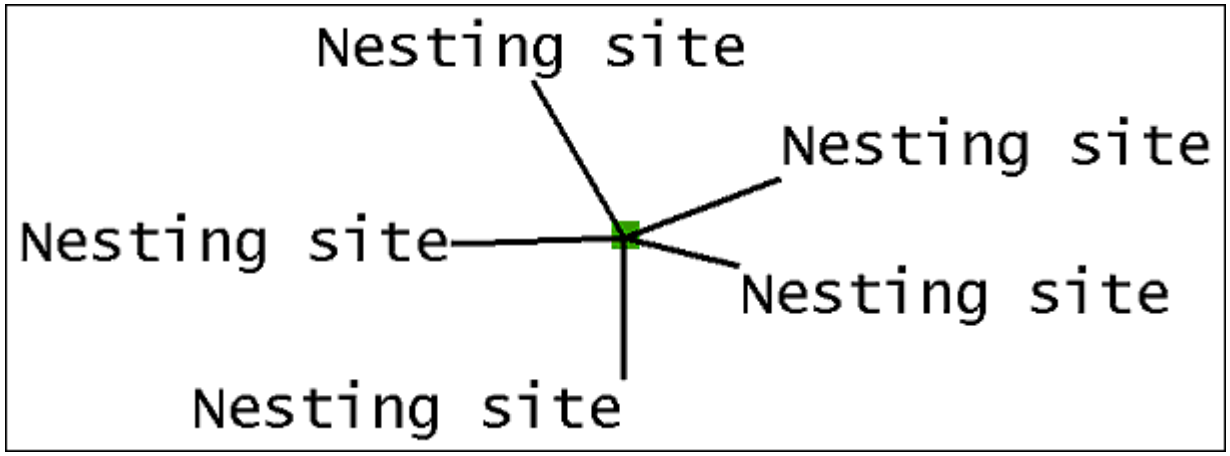


The default leading is 120% of letter height

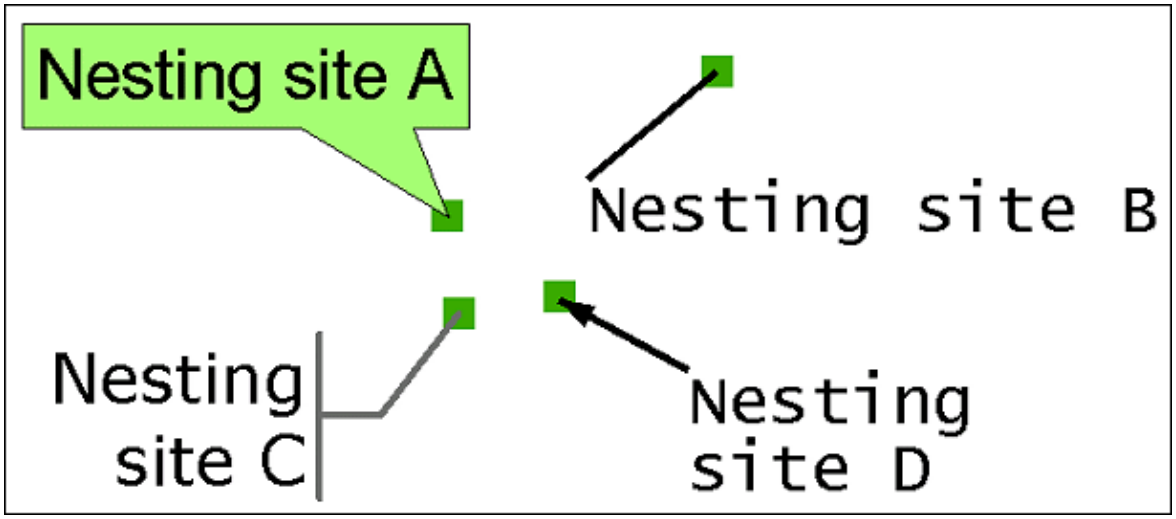
Line spacing can reduce ambiguity

Callouts

Callouts clarify the link between location and its label



Callout placement options...



Callout design options...

Shadows

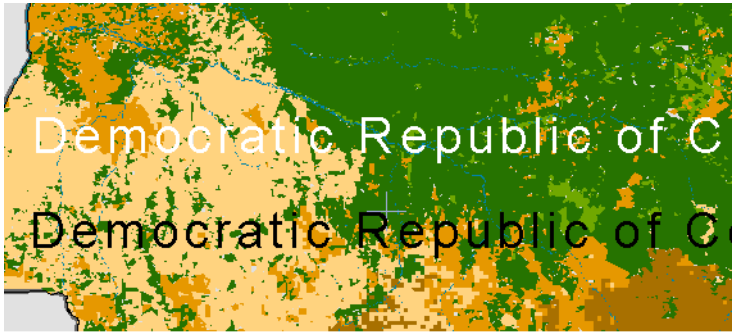
Shadows can increase the legibility of text on maps.

REVISED ZONING

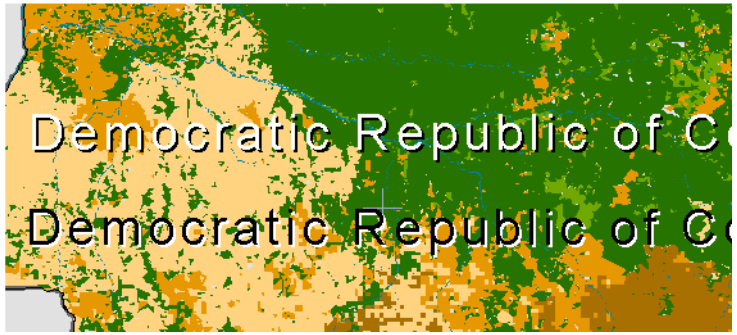
Large offset: floating text…

REVISED ZONING

Small offset: subtle effect…

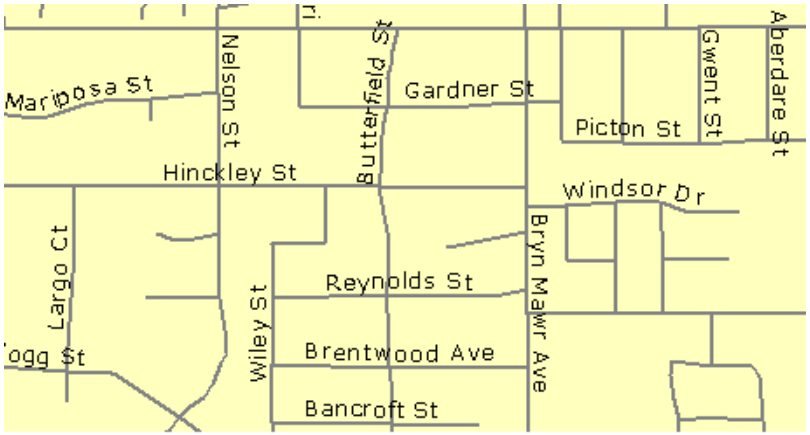


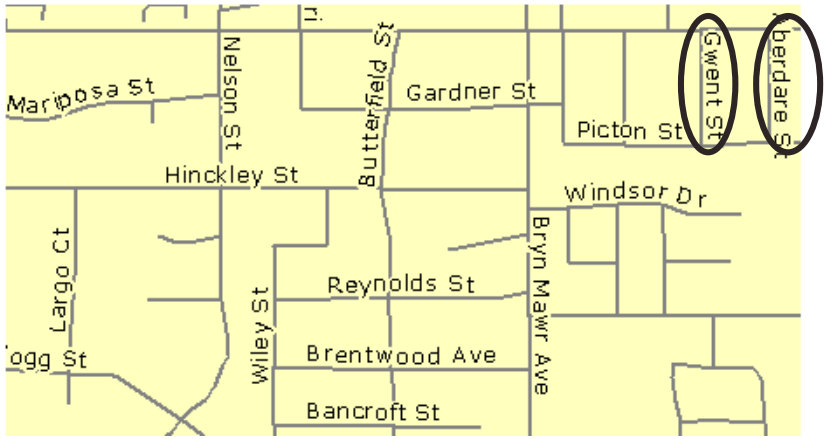
Adds contrast/clarity on colored backdrops

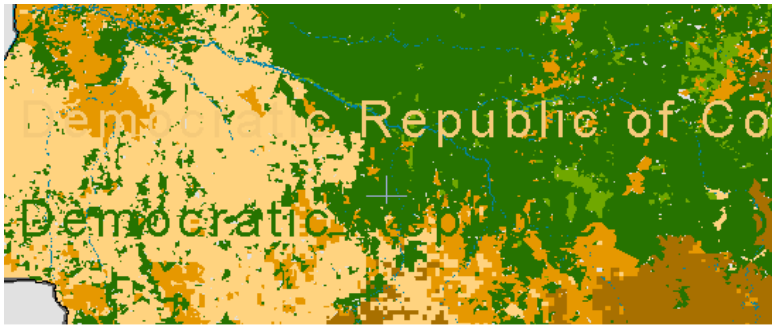


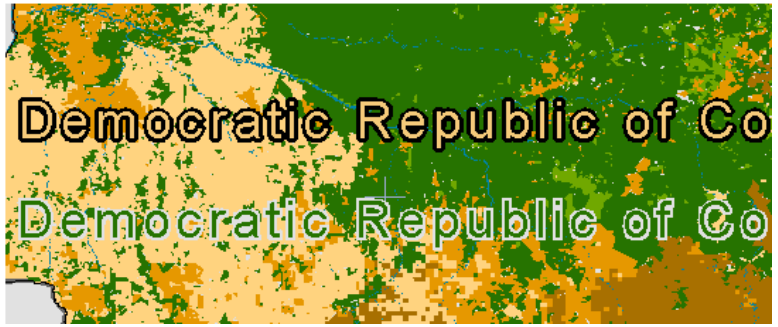
Halos

Like shadows, halos can increase legibility









Halos should mask as little underlying map as possible, but enough to minimize ambiguity

Type Effects: Review

- Well designed type adds clarity and professionalism to a map.
- Font types can be used as text and symbols simultaneously.
- Serif and Sans Serif fonts are often used to label physical and cultural objects, respectively.
- Decorative fonts should be used very sparingly. Good maps can often be drawn with as few as two font types.

Type Effects: Review

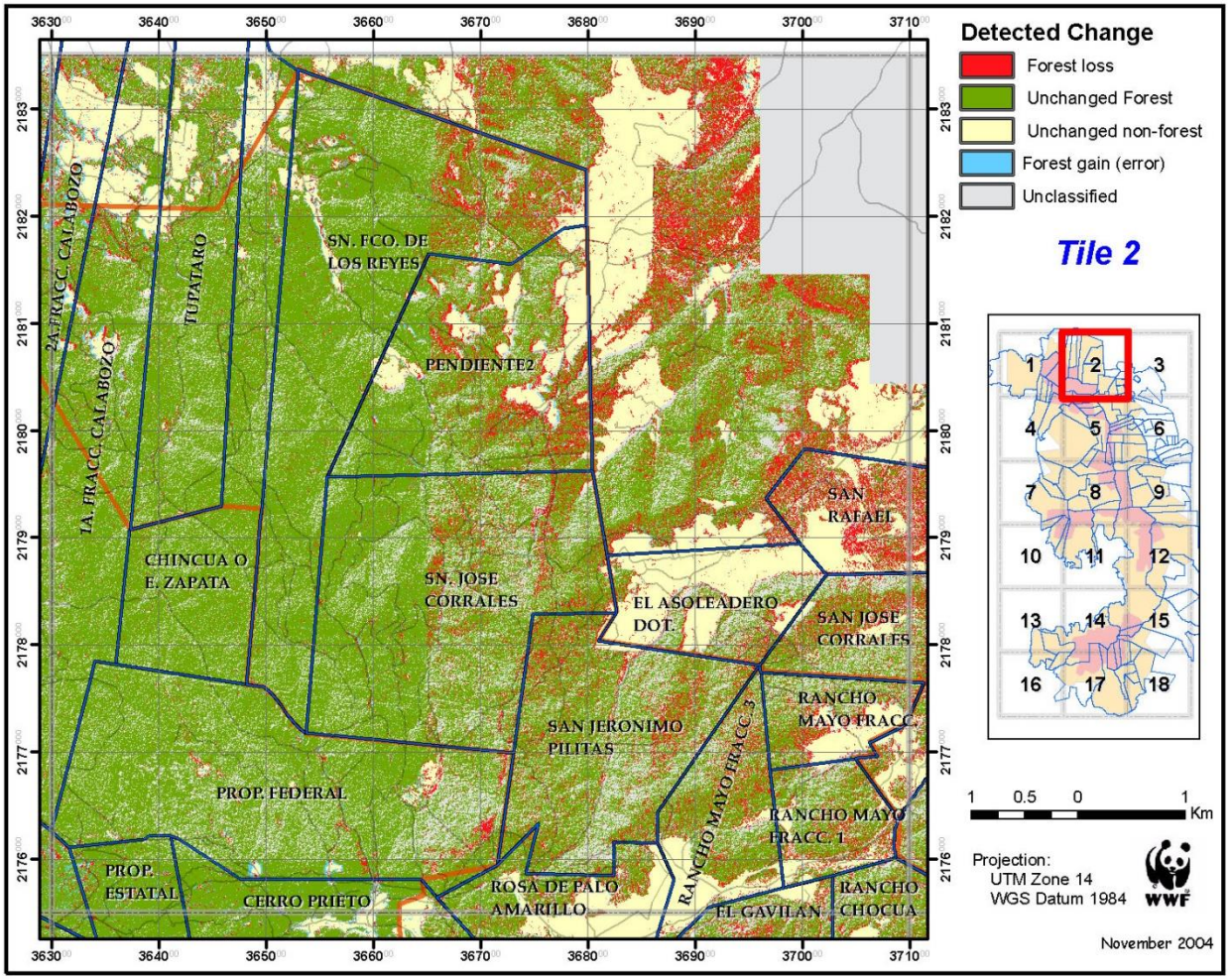
- Text point size, character spacing, and leading offer three ways to adjust the size of a text element on a map.

- Callouts, shadows, and halos are type effects that, when used appropriately, increase clarity and enhance map design.

- All text effects should be used with purpose. When used merely to decorate a map they often detract from the map's message.

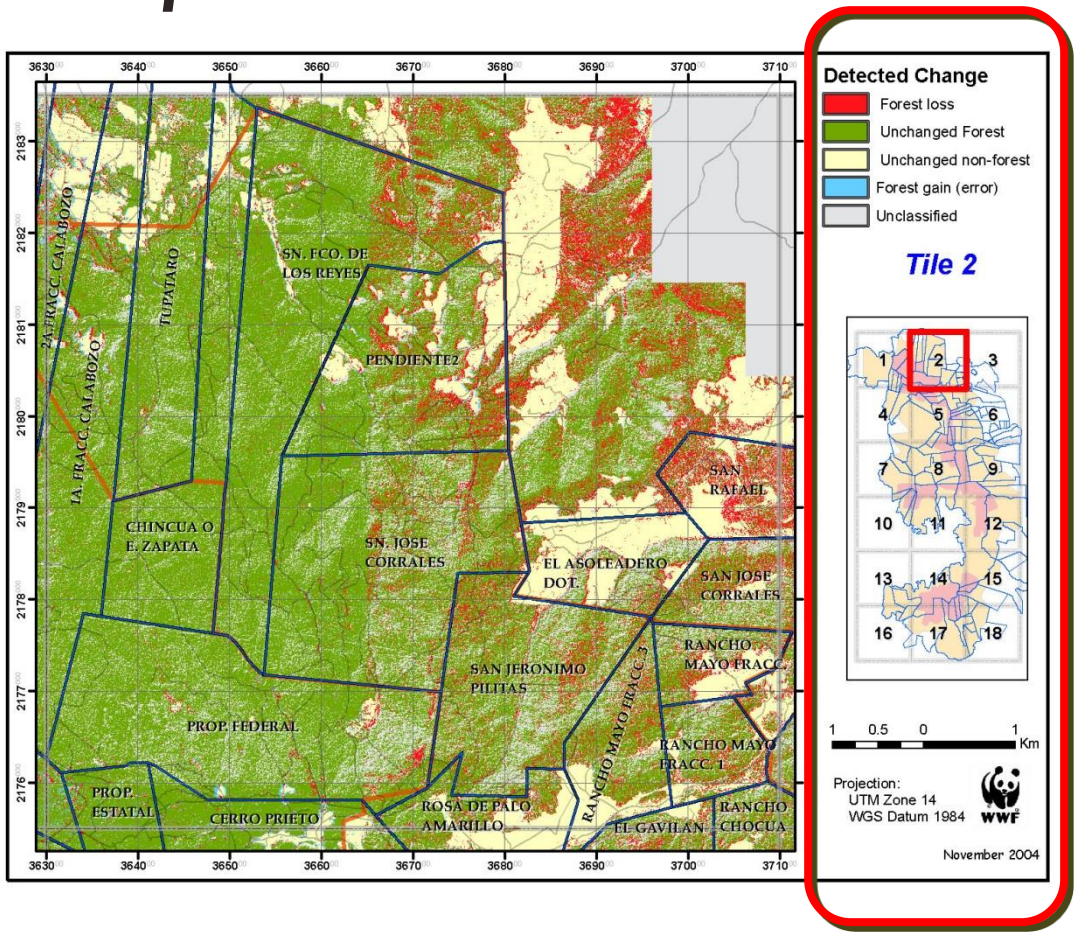
Effective Type in Map Design

When and where to use the many type effects available in ArcMap.



Strategies for Map Text

Graphic Text

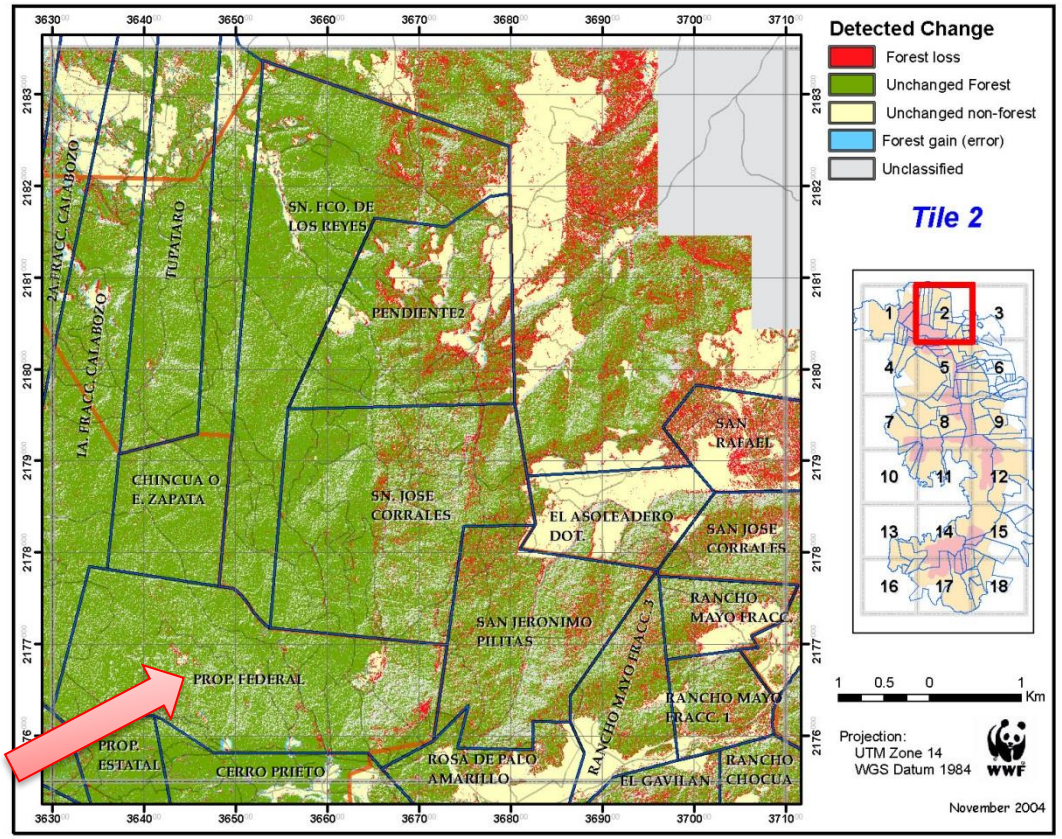


- Manually placed in ArcMap's Layout view (not seen in Data view)
- Text is not linked to spatial features or data frames
- Text remains static; position is unchanged by scale or extent
- Good for titles, subtitles, sources, or notes

Strategies for Map Text

Dynamic Feature Labels

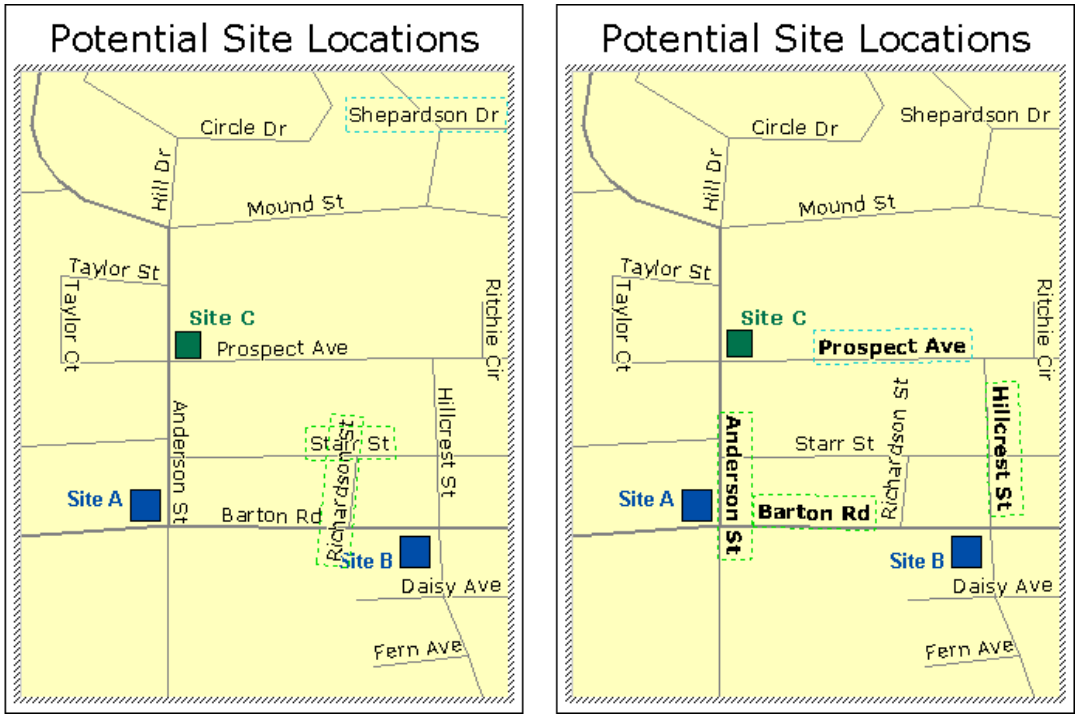
- Label text from a feature layer's attribute table
- Added in ArcMap Data view. Viewable in both Data and Layout views.
- Text characteristics can be set for many labels at once
- Size & position change dynamically with scale and extent changes to map



Strategies for Map Text

Annotation

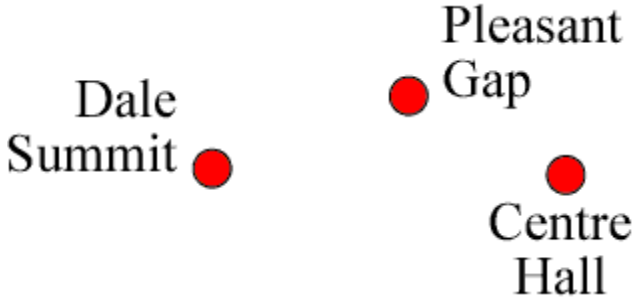
- Text associated with a data frame
- Created as individual text elements or by converting dynamic feature labels
- Stored either in the map document or in an annotation feature class
- More flexible than dynamic feature labels



Labels as symbols

Labels as indicators of location

- Labels can name AND help locate map features

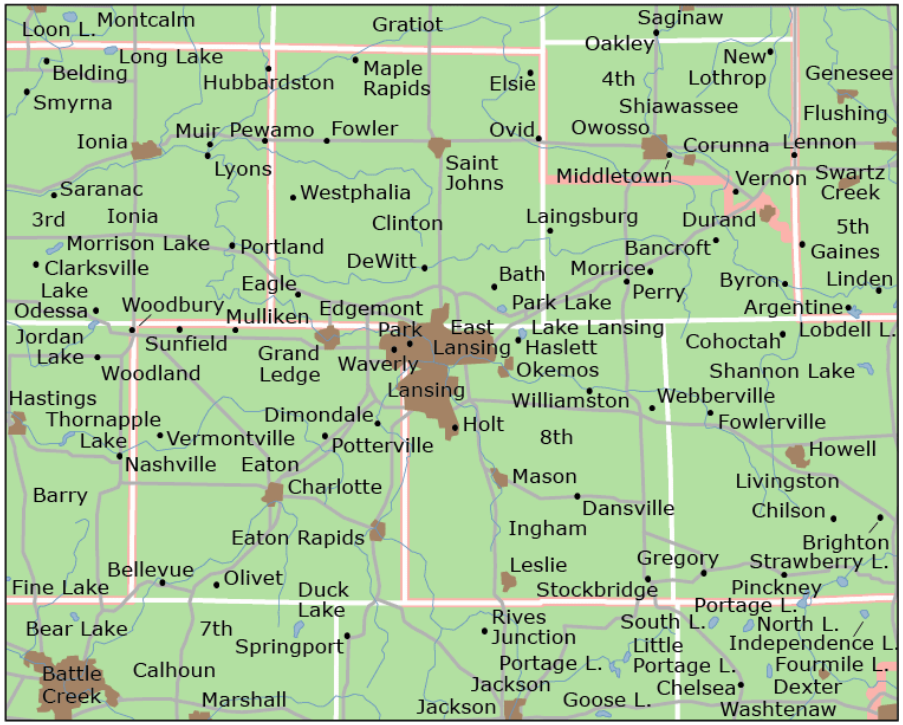


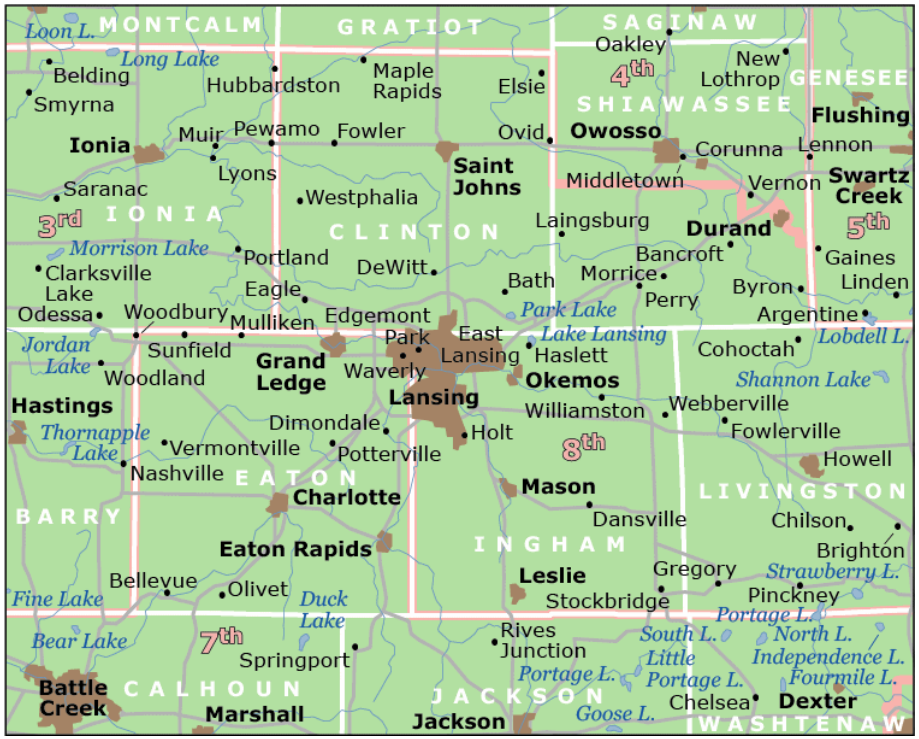
- Whenever possible, the relationship between location and label should be predictable.

Labels as Symbols

Labels as indicators of feature category

Categorizing features reduces the labels readers must search through





Categorize by:

Font, Posture (Roman v *Italic*), Color hue, Arrangement

Labels as Symbols

Distinguishing label categories

Different fonts

Nittany Mountain

Penn State

Different posture

S. Water Street

Spring Creek

Different arrangement

Harrisburg

Susquehanna

Different hue

Harrisburg

Susquehanna

Labels and Feature Hierarchy

Labels can be used to differentiate cities of different sizes or streams of different flow magnitudes

Type characteristics that help establish feature hierarchies:

Pittsburgh
State College
Boalsburg

Point size

Bellefonte
Pleasant Gap

Weight

Philipsburg
Port Matilda

Scaling

PATTON
FERGUSON
CENTRE

Lightnes
s

PENN STATE
Walker Building

Case

Labels and Feature Hierarchy

Category v. Hierarchy

The largest spatial features aren't necessarily the most important in a map, so sometimes large labels need to be demoted in the map hierarchy.

Label character spacing can lower feature hierarchy…

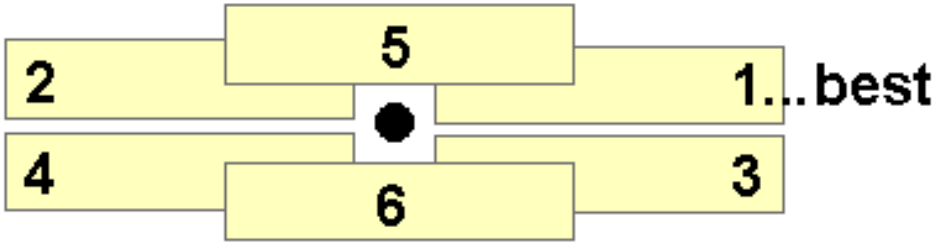
…as can label lightness…

…as can label contrast.

Label Placement: Points

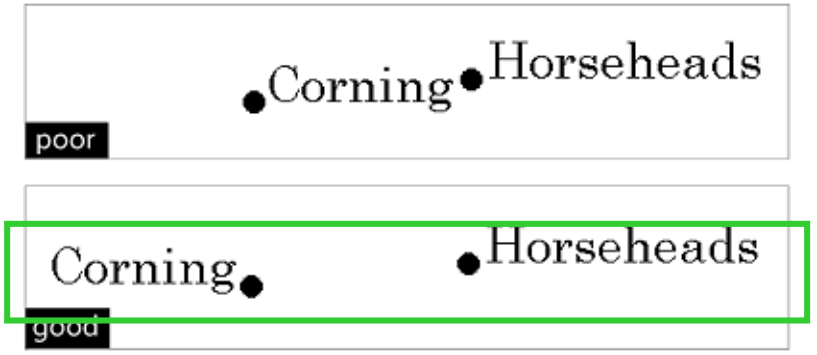
Point label placement

Predictable, unambiguous point label placement makes life easier for the map reader.



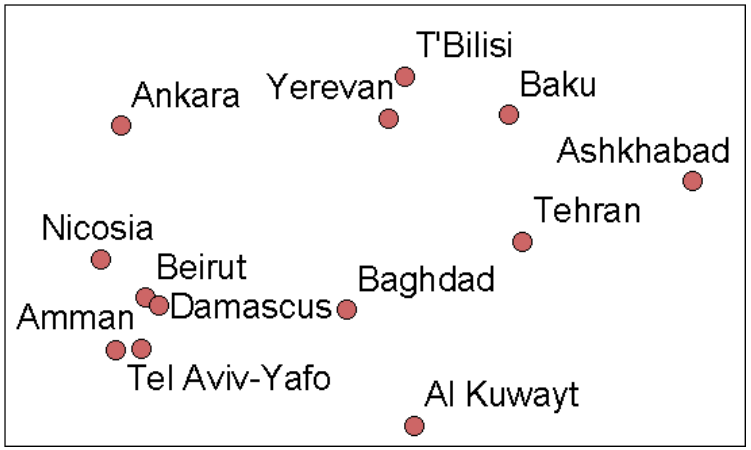
Order of preferred label placement

Slight shifts minimize confusion



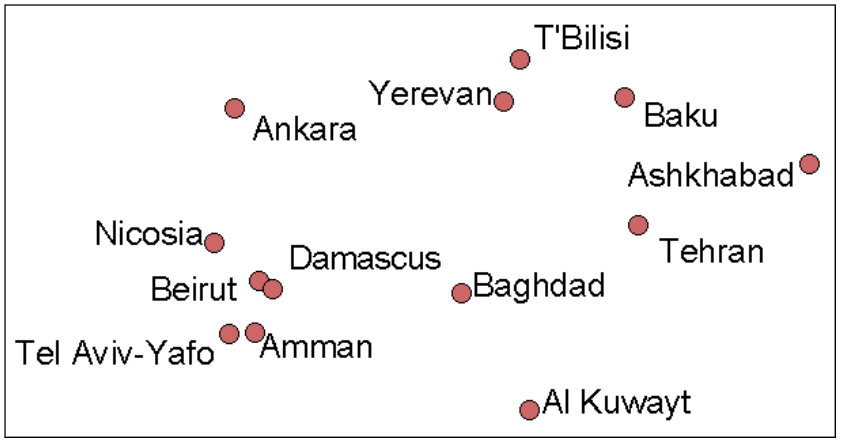
Proper placement reduces ambiguity

Label Placement: Points

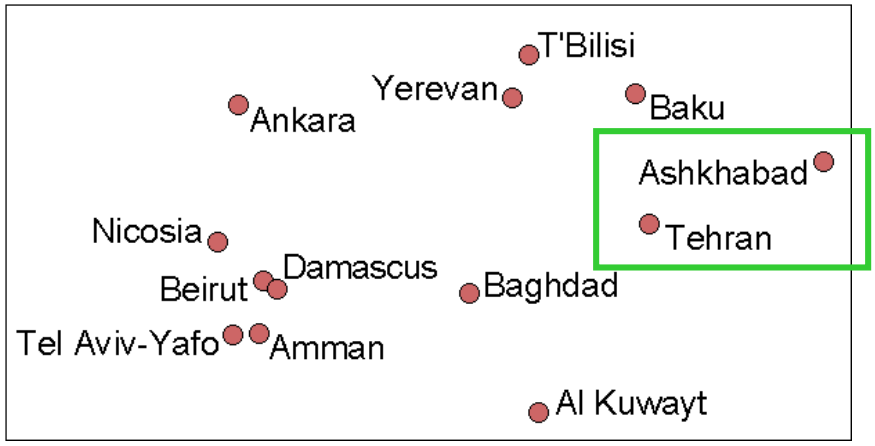


ArcMap default labeling

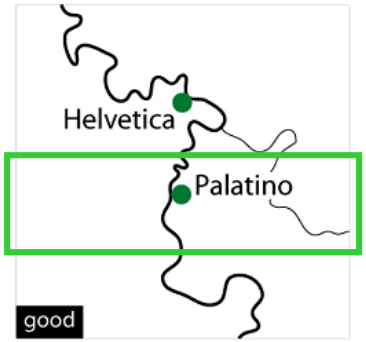
Custom edits: inconsistent gaps

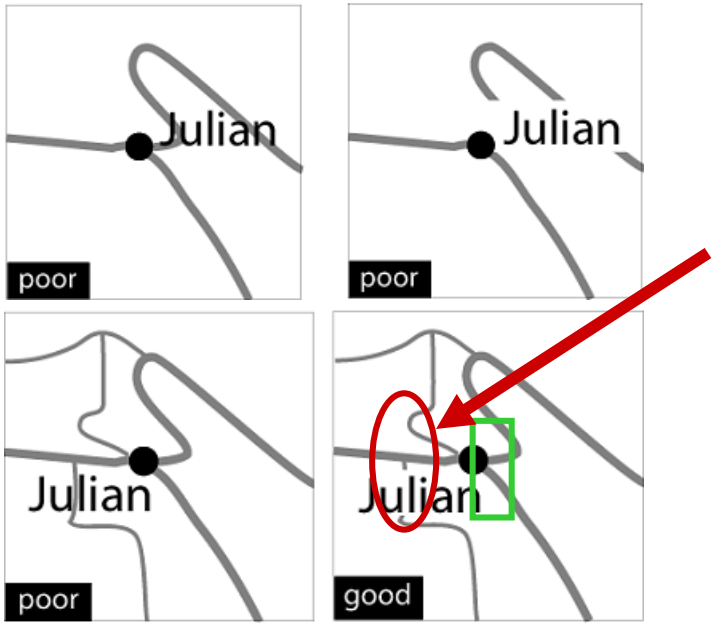


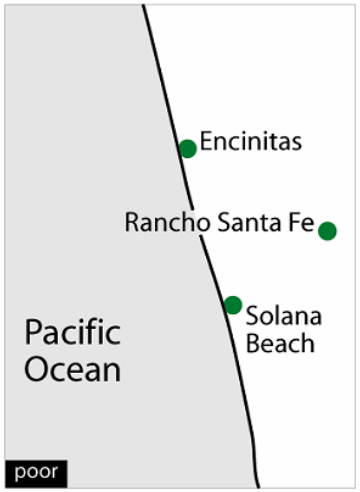
Custom edits: consistent gaps

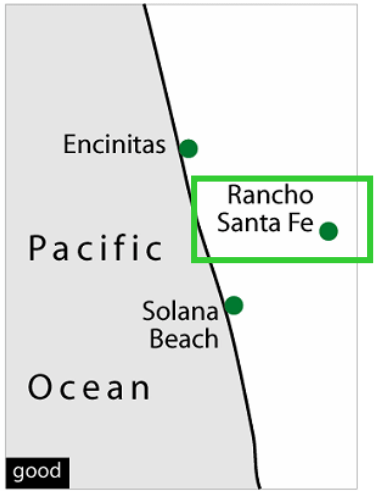


Label Placement: Points









Label Placement: Points

SUMMARY: Point label placement

- The best positions are next to and shifted up (right or left) from the point.
- Maintain a consistent distance between labels and points throughout the map.
- Break lines for type, but minimize the frequency of breaks.
- Position labels on the same side of a line feature as the point.
- Position labels for coastal features in water.
- Do not span land and water with a label.

Label Placement: Lines

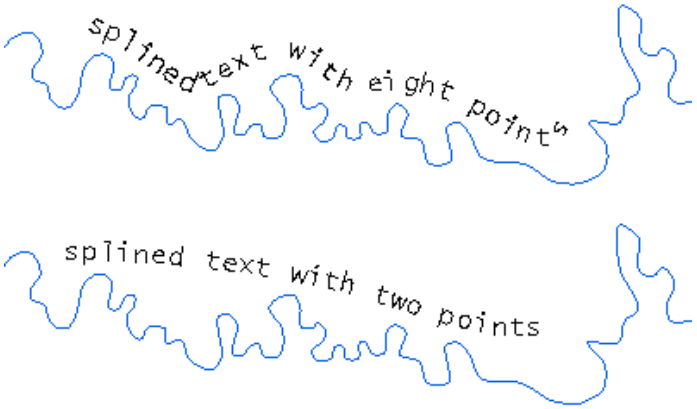
Line label placement

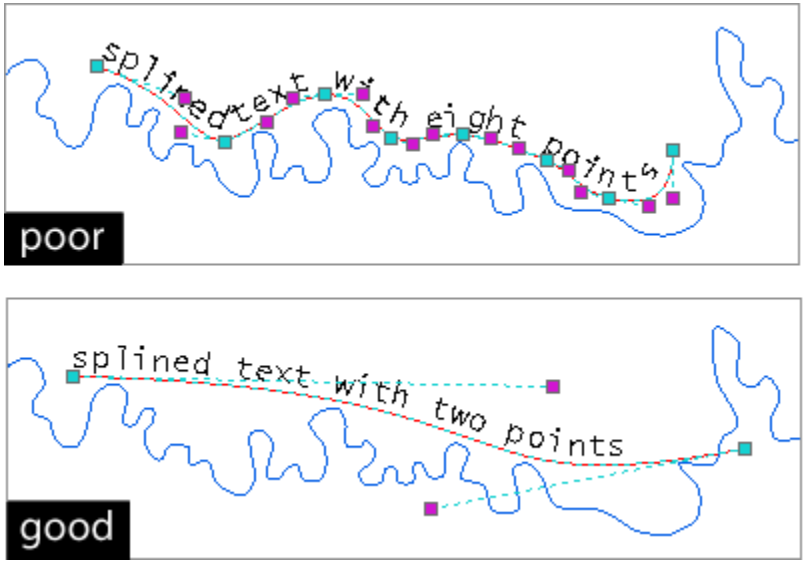
What's wrong with these labels?

Label Placement: Lines

Curves/Splines

Splines should be smooth approximations of the feature's shape





Label Placement: Lines

SUMMARY: Line Label Placement

- Position labels to follow lines.
- Use default character spacing.
- Repeat labels for long line features.
- Place labels at the straightest and most horizontal portion of a line.
- Break lines that run across text, but minimize the frequency of breaks by choosing positions carefully.

Label Placement: Lines

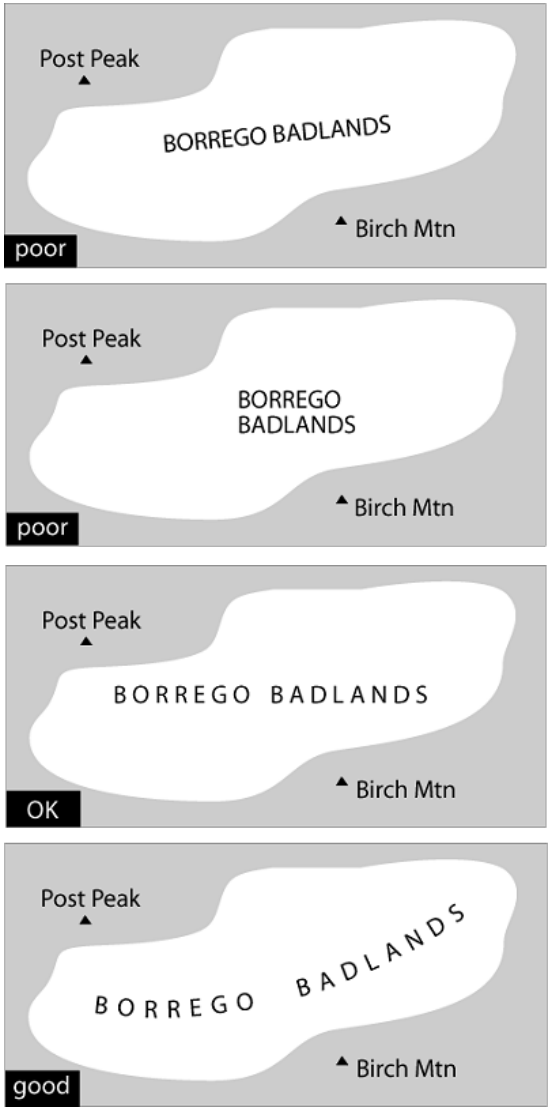
SUMMARY: Line Label Placement (cont'd)

- Position labels above lines when practical.
- Do not allow any portion of a label to tilt upside down.
- Use simple curves for labels so they fit loosely to lines with complex curves.
- Maintain a small and consistent gap between labels and lines throughout the map.

Label Placement: Areas

Area Label Placement

- Area feature labels indicate the extent of the feature by positioning.
- Use spacing, not size to show extent (size is for importance).
- SIMPLE curved type can be used for irregularly shaped areas.

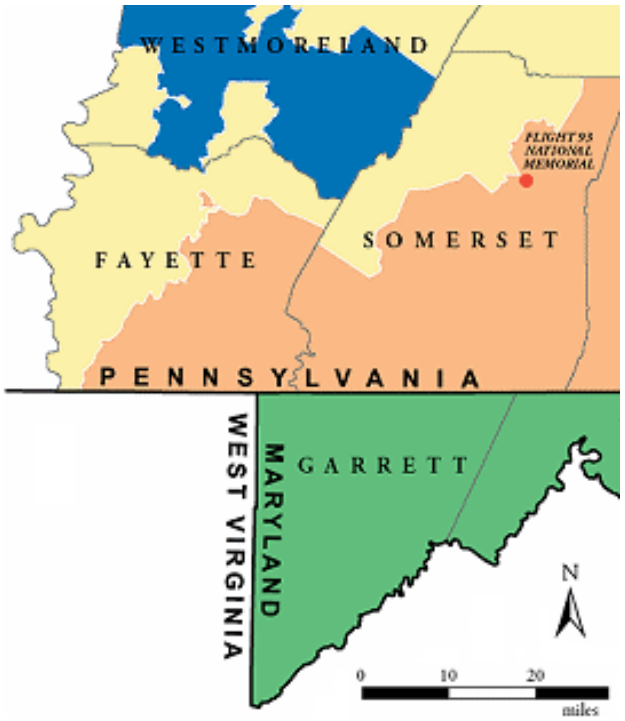


Label Placement: Areas

Spacing is better suited to uppercase lettering.

Find natural spots to place labels

Allow lettering to cross lines to avoid crowding

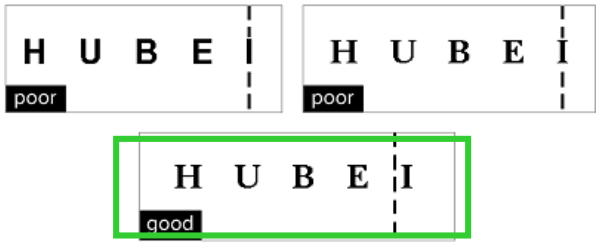


When showing a portion of a feature, placement along a boundary may work

Label Placement: Areas

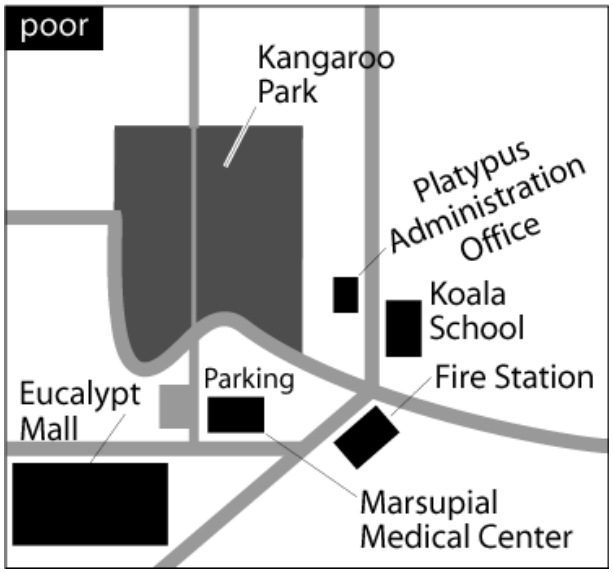
SUMMARY: Area Label Placement

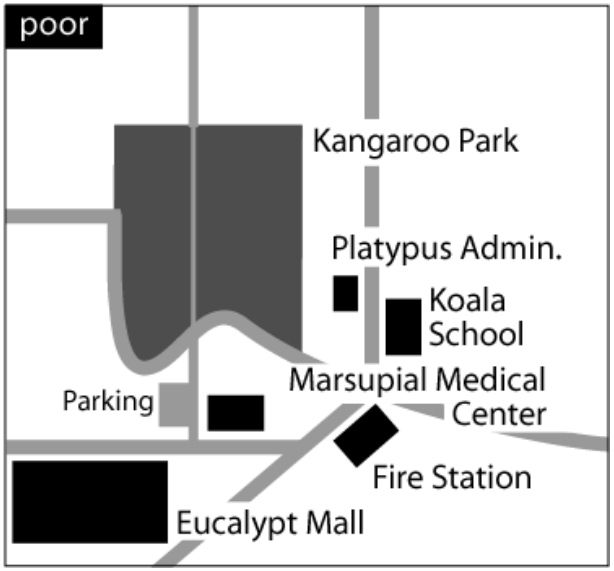
- Suggest the area's extent by label position, character spacing, line spacing, and simple curves.
- Use uppercase letters when spacing characters.
- Do not adjust text point size to fit labels into small areas or to fill large ones.
- Stagger horizontal alignments.
- Adjust label position so gaps fit across features (adjust gaps by small amounts if needed).
- Ensure that individual letters are notmistaken for symbols especially a sans serif *I*).

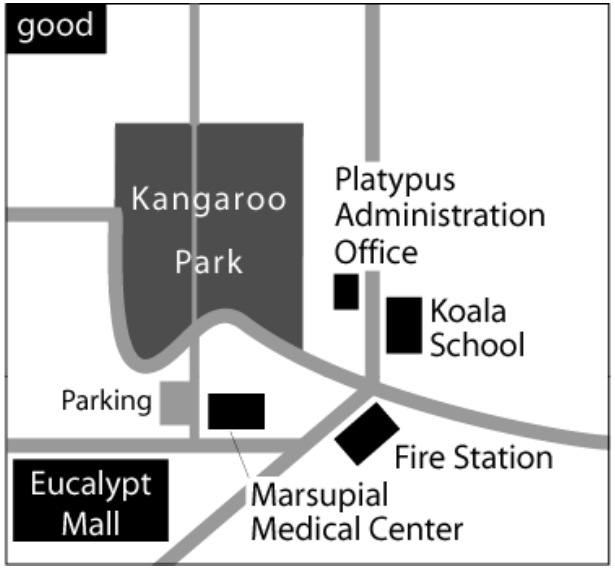


Label Placement: Dense Labels

Dense maps require simplification and rule breaking







Strive to reduce ambiguity and maximize readability

Effective Type: REVIEW

- Three Text types: Graphic text,
  Dynamic Feature Labels,
  Annotation

- When labeling many features, it's best to set type characteristics of dynamic feature labels and convert to annotation to customize individual labels.

- Labels indicate location and group features into categories and hierarchies.

Effective Type: REVIEW

- Consistency in label position reduces ambiguity and enhances a map's information content.
- Area feature labels should indicate the extent of the feature.
- Dense maps will require you to simplify categorizations and break placement conventions.

http://www.worldmapsonline.com/hs432usrrandmap.htm

Color Basics

Choosing colors is more than what looks prettiest…

Color choices should reflect natural tendencies (e.g. water is blue), but should also support the map hierarchy.

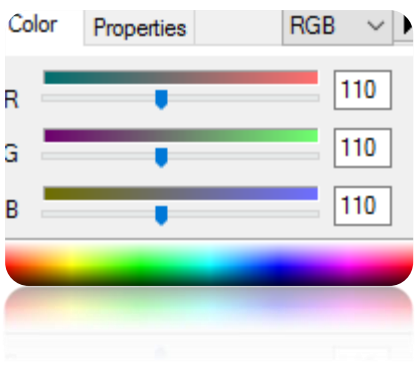
Color choices will also reflect the final media on which the map will be set.

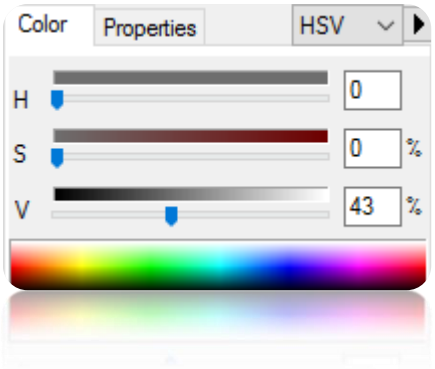
Ultimately, however, color is limited to what ArcGIS offers you…

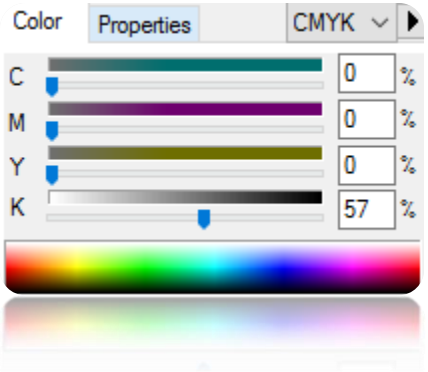
Color in ArcGIS

3 ways to specify color in ArcGIS

- Hue-Saturation-Value (HSV)
- Red-Green-Blue (RGB)
- Cyan-Magenta-Yellow (CMY)







Perceptual dimensions

Trained colorists can distinguish among a million colors!

*in pairwise comparisons… (*Tufte: Envisioning Information*)

Most people can discriminate up to 20,000 colors.

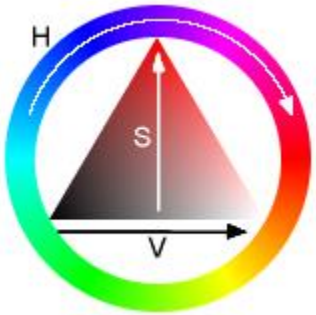
Color is a powerful cartographic tool!

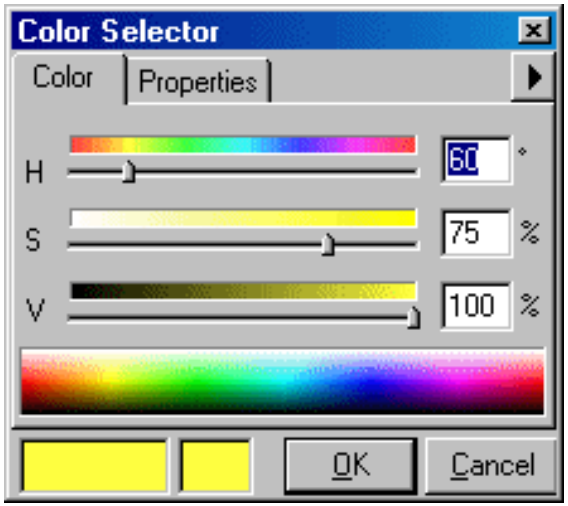
So how do we best use color in maps?

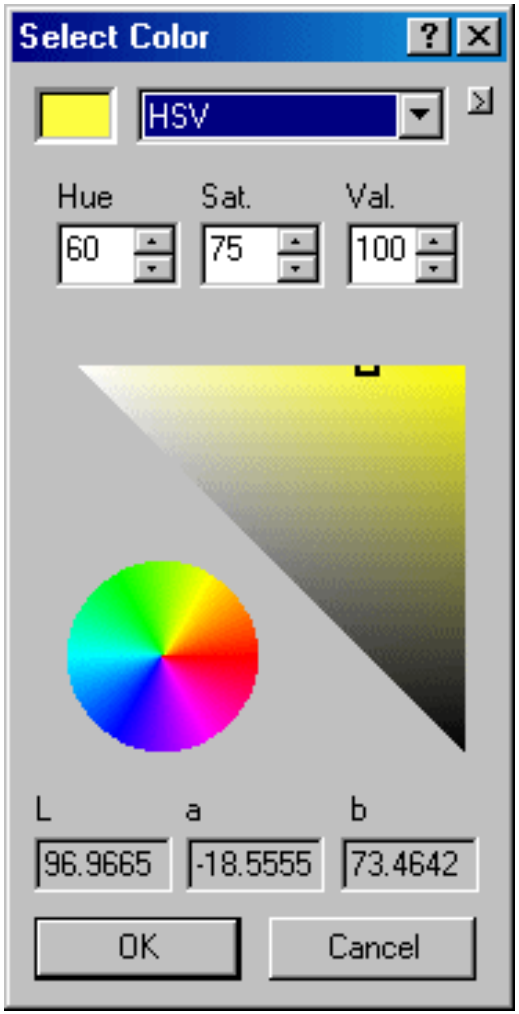
Perceptual dimensions: HSV

Color can be perceived in three dimensions:

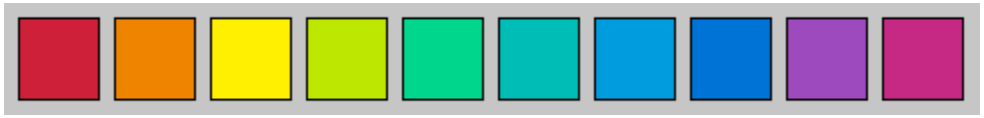
- Hue
- Saturation
- Value (Lightness)





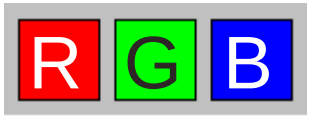


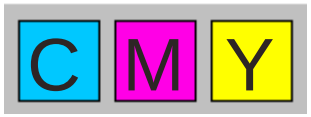
Perceptual dimensions: Hue



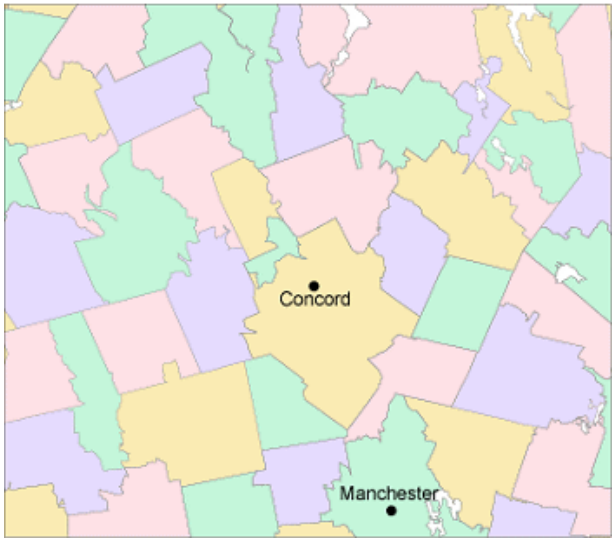
Hue is most related to what we think of as **color**

Additive (light)

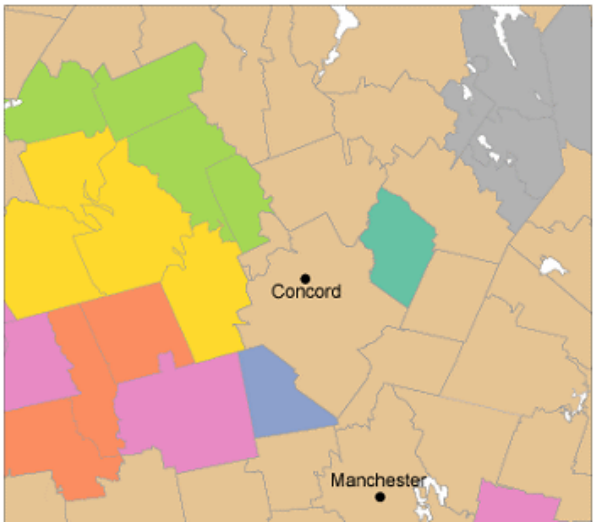




Subtractive (ink)



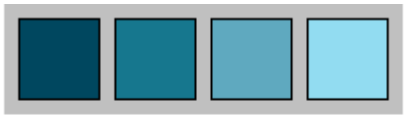
Two maps with features varying only ← in hue →

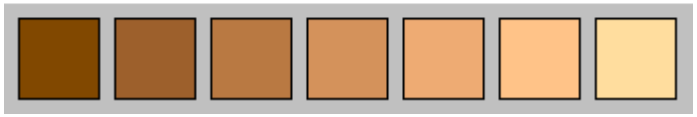


Perceptual dimensions: Value

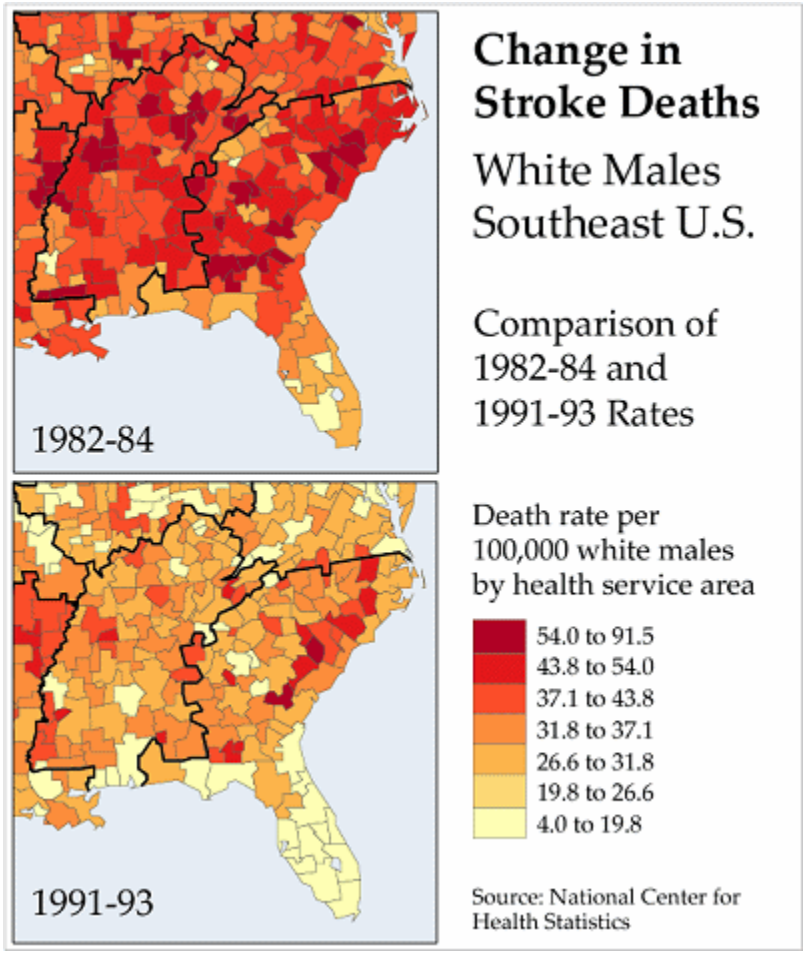
Value (or lightness) is most often used to show order within mapped data

Lightness is a relative measure describing how much light appears to reflect from an object.



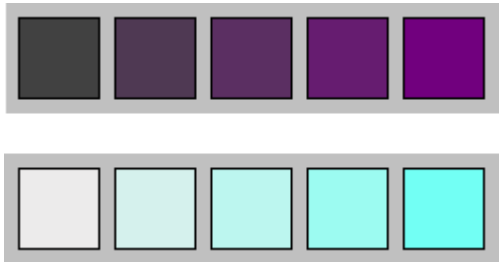


These colors vary only in lightness. Hue and saturation are kept constant.



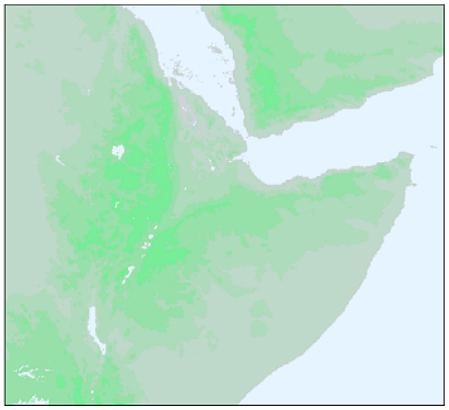
Perceptual dimensions: Saturation

Saturation is a measure of the vividness of a color.

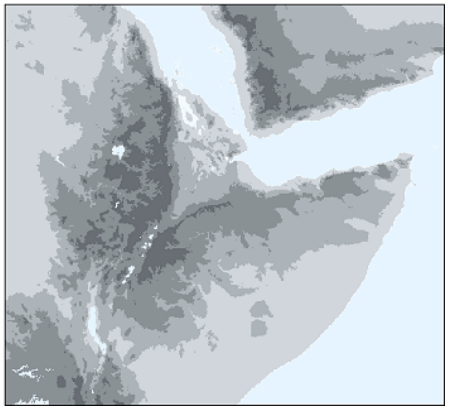


Low saturation values tend to be grayish

Variable saturation

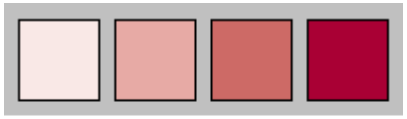


Variable lightness

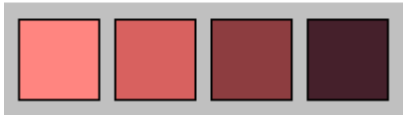


Saturation alone is usually insufficient to display data; its often used to reinforce value.

Constant hue



Increasing saturation

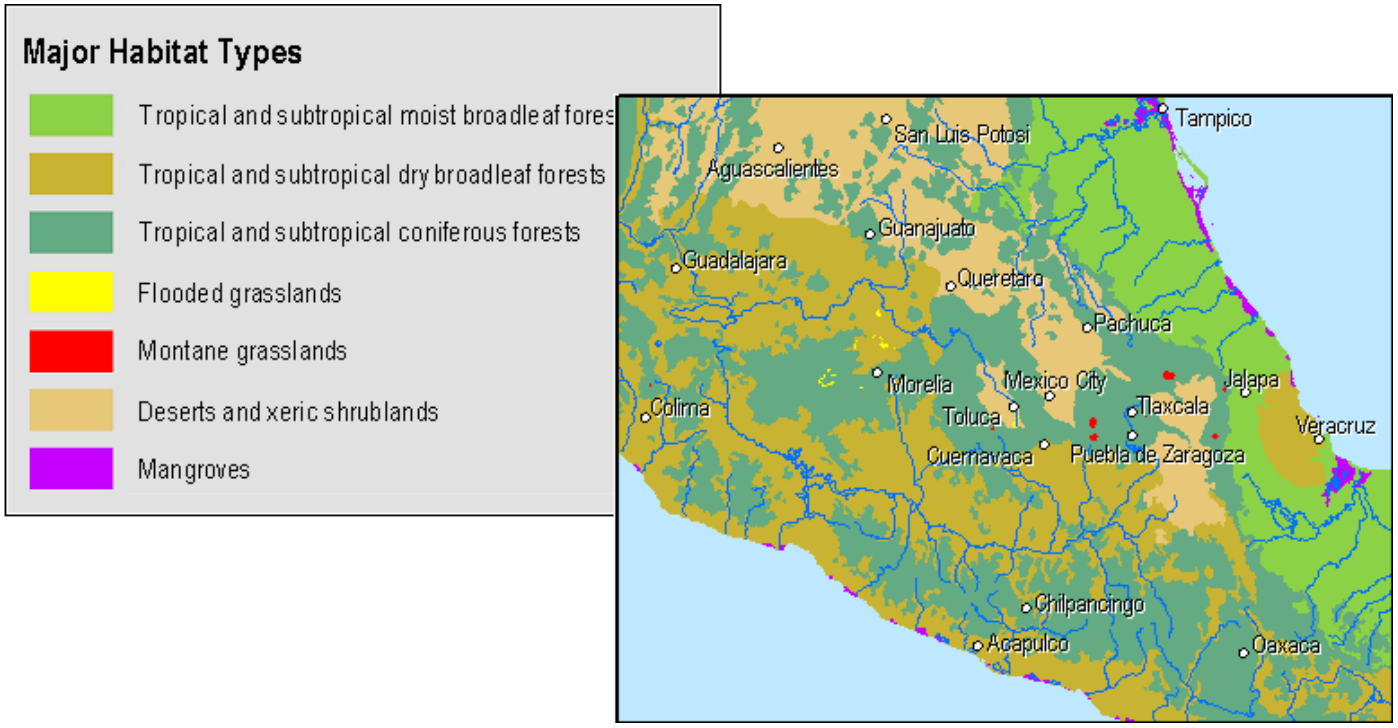


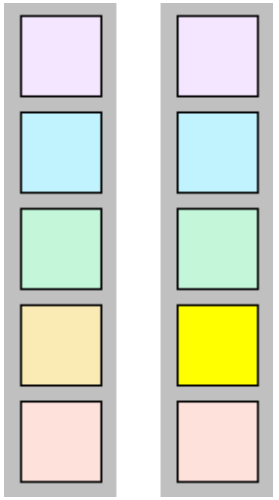
Increasing value

Perceptual dimensions: Saturation

Saturation is the most difficult dimension to use…

Ignoring saturation can alter the map hierarchy by displaying certain featured more vividly.





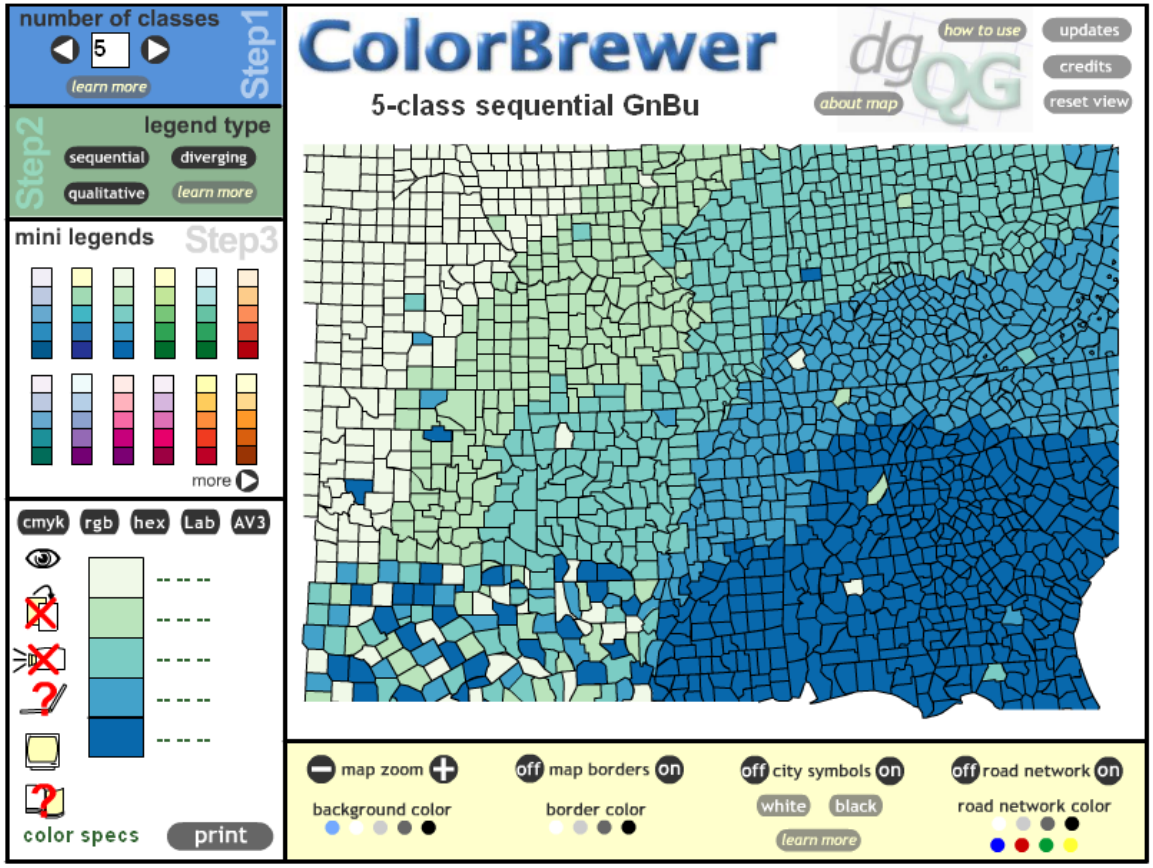
Which color has the highest saturation?

Color Schemes

Color scheme structures:

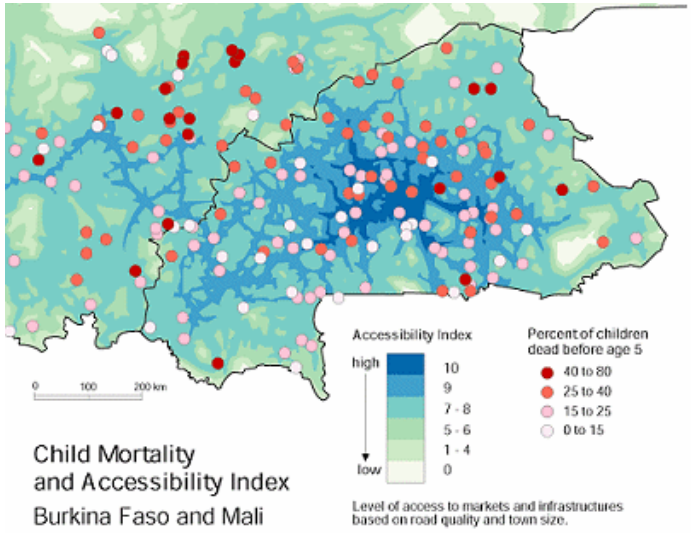
- Sequential
- Diverging
- Qualitative
- Binary schemes

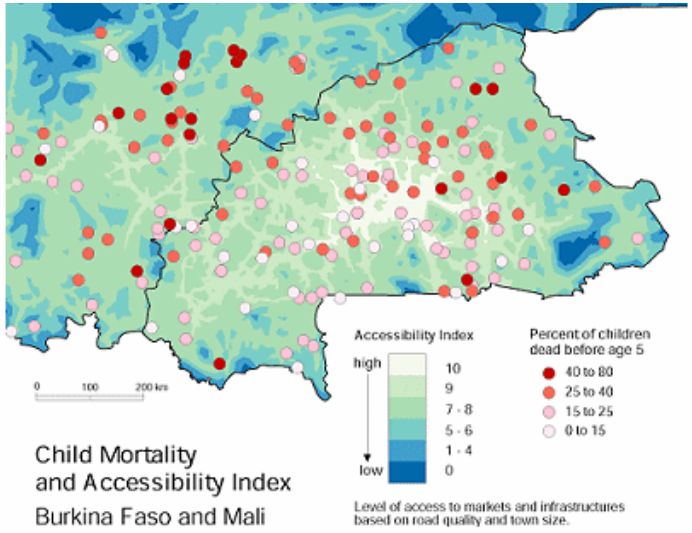
http://www.ColorBrewer.org



Sequential Color Schemes

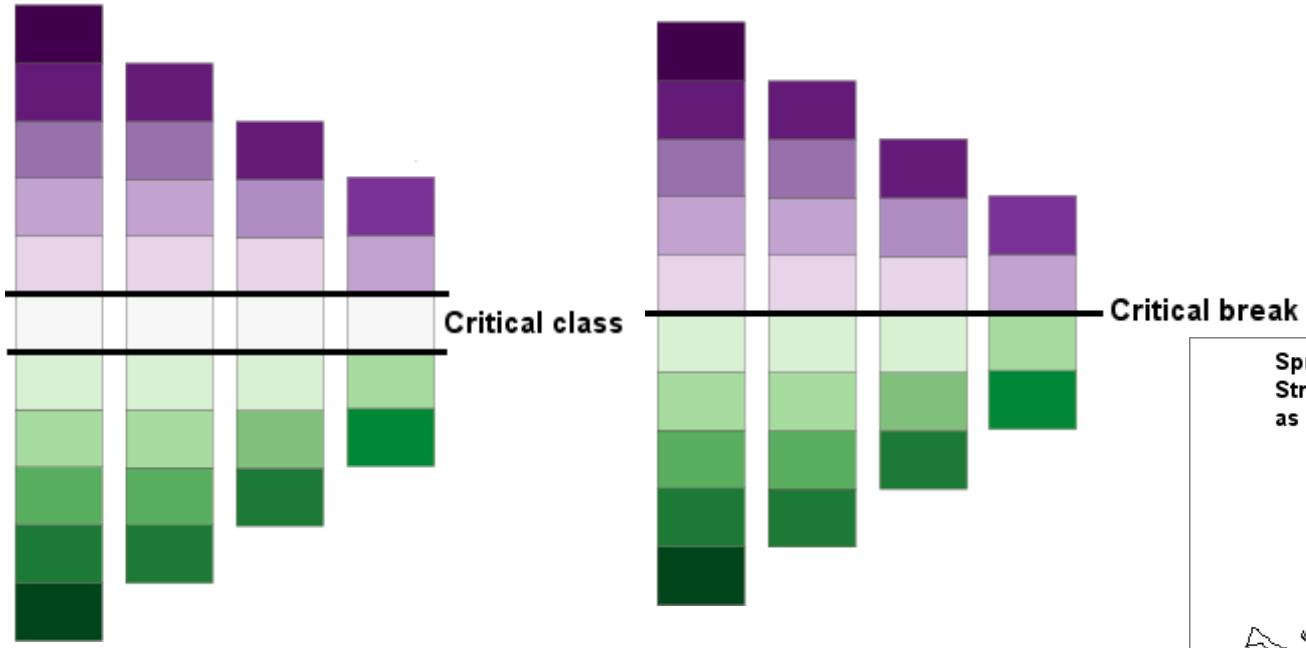
Value (lightness) is used primarily to represent ordered data, but *hue* can be used as well…

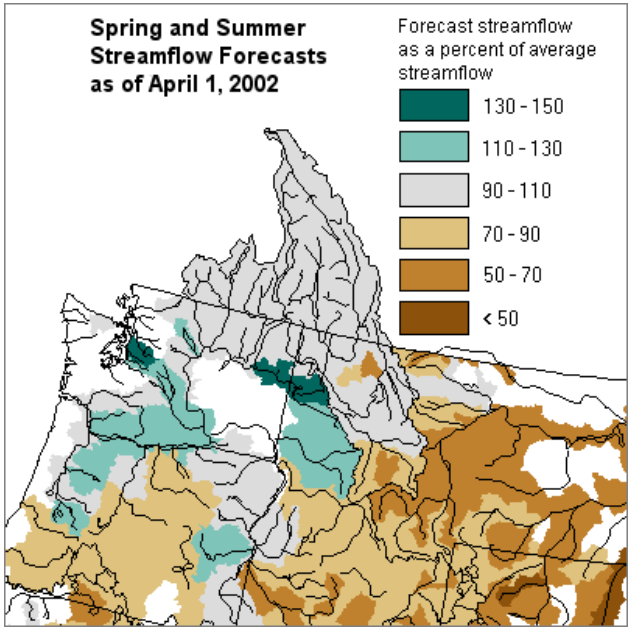




Diverging Color Schemes

Diverging color schemes emphasize both highs and lows by using variation in both hue and value.

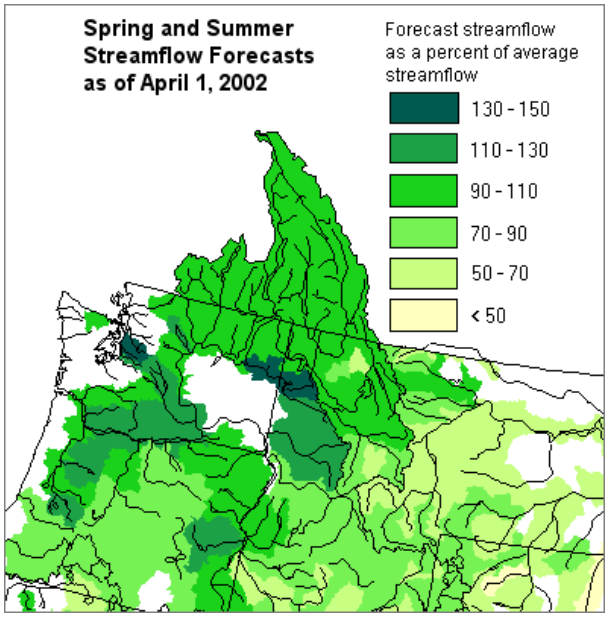




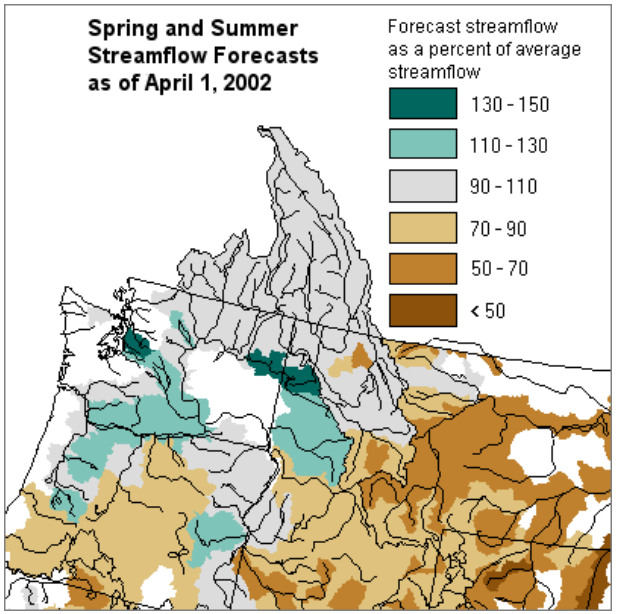
Colors are arranged symmetrically around a median, zero, or some threshold value.

Diverging Color Schemes

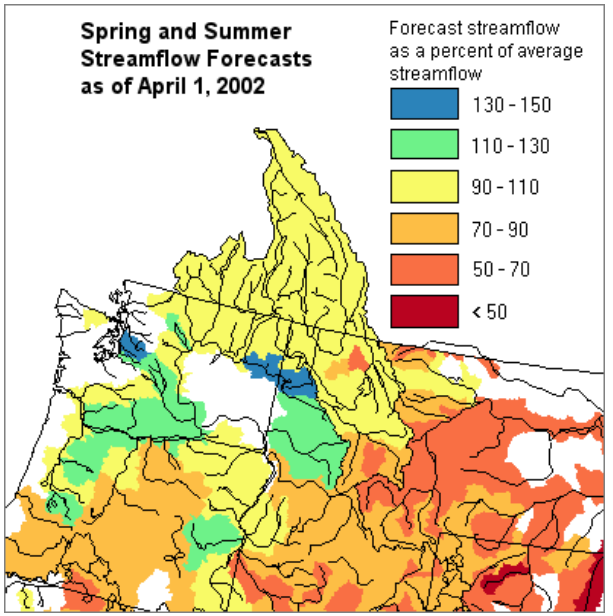
Variation in both lightness and hue can be used to identify a threshold.



Sequential with a different hue for negative values



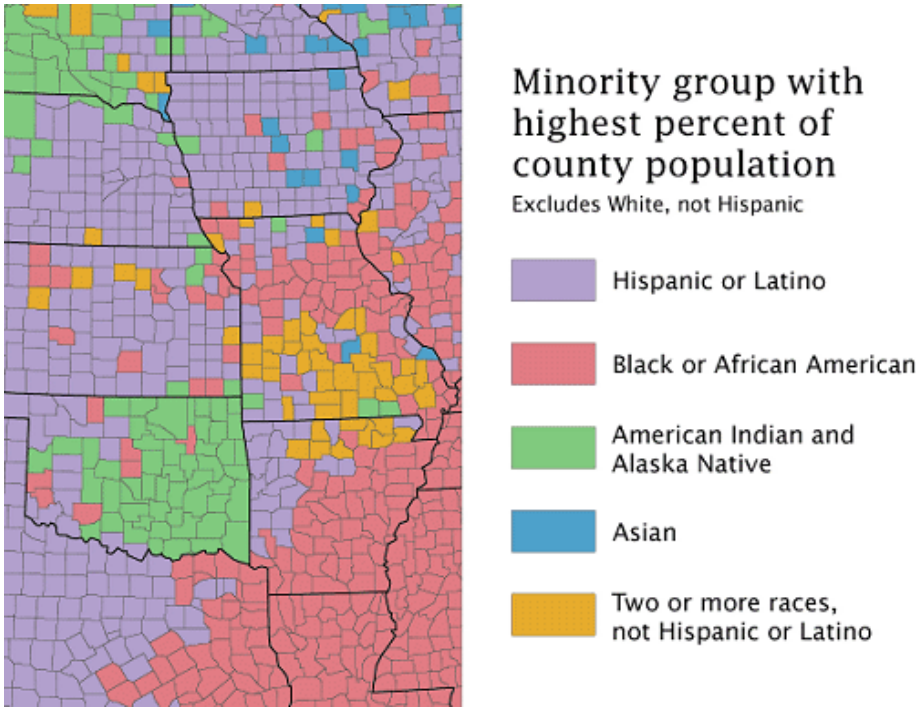
Lightness varied on two hues

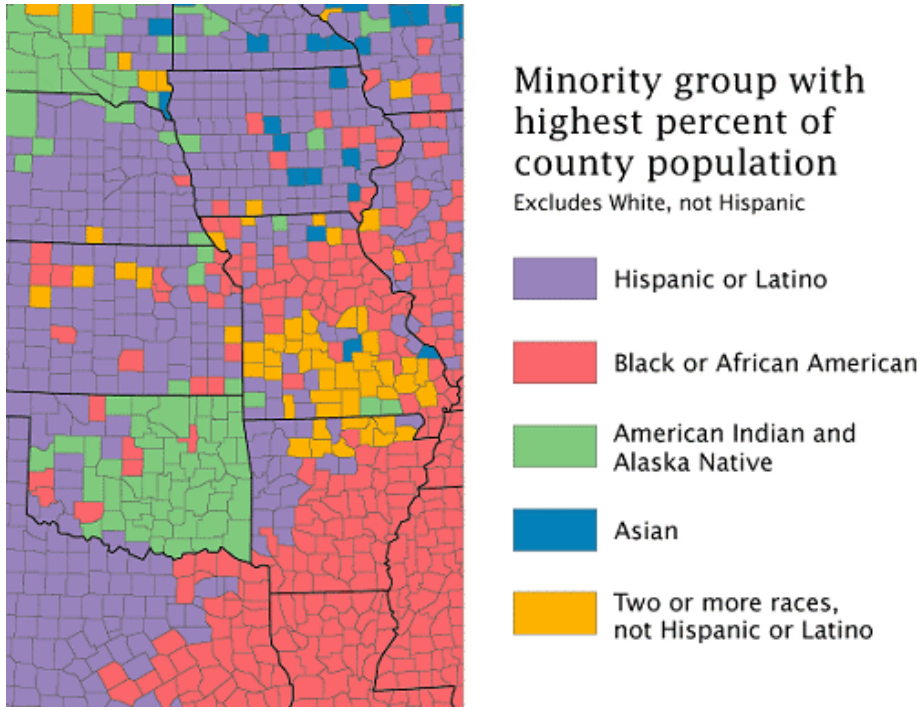


Multi-hue

Qualitative Color Schemes

Categorical differences in data are usually represented with differences in hue.

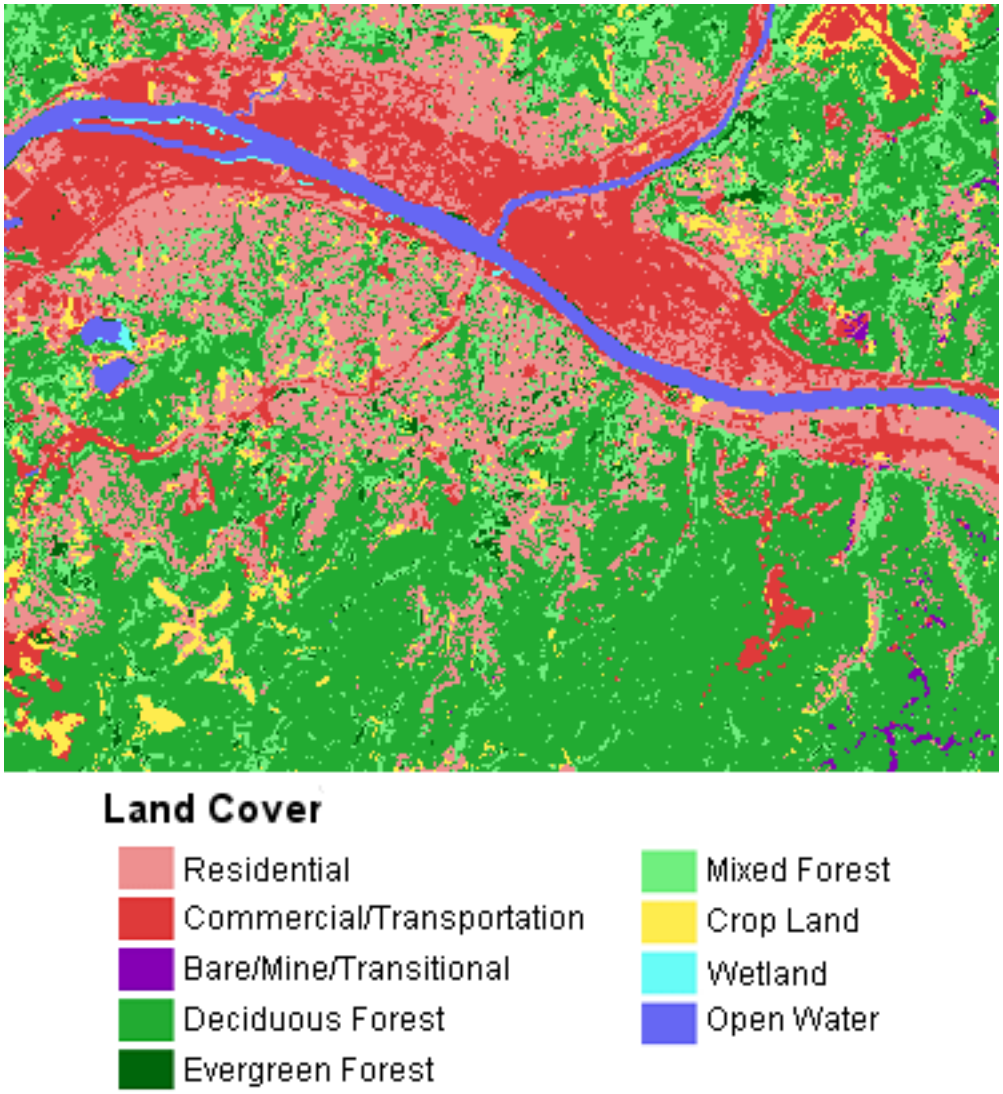




Variations in lightness can elevate some categories in the visual hierarchy.

Qualitative Color Schemes

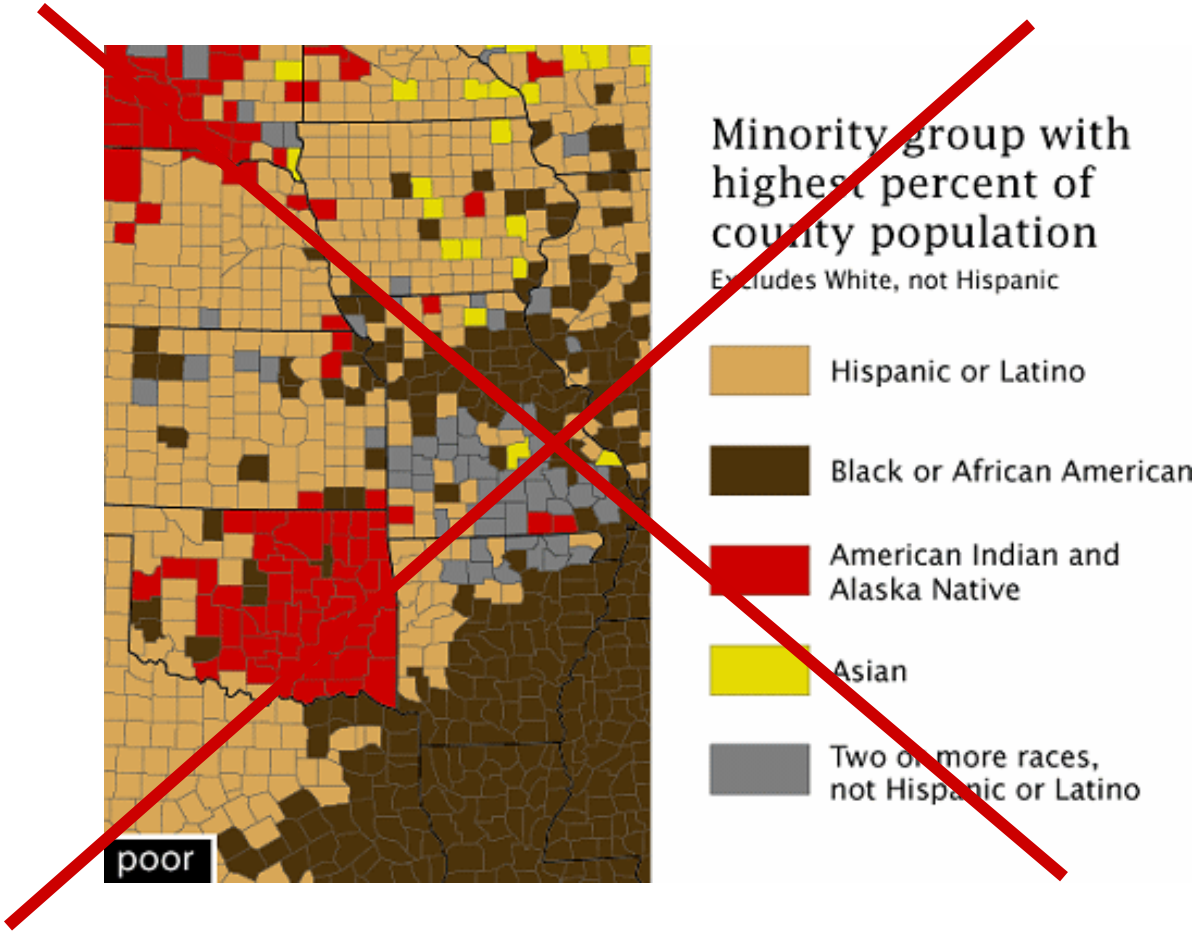
Exploit logical relationships between classes to create color hierarchies when possible.



Use more intense colors to make smaller classes more visible

Qualitative Color Schemes

Avoid offensive color combinations…

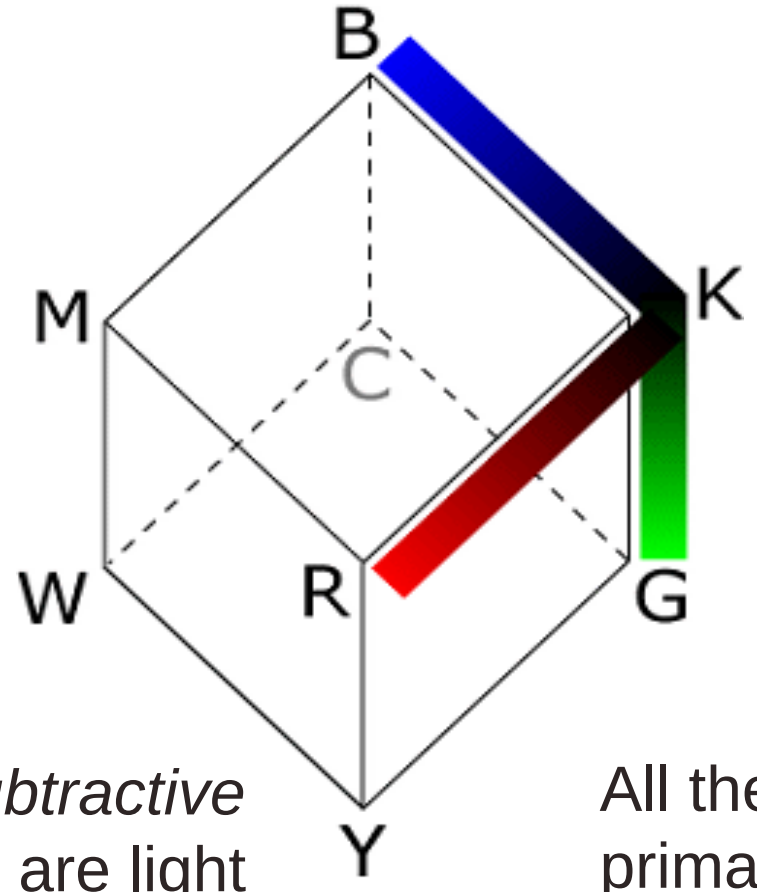


Binary Color Schemes

Binary schemes are a simple case of qualitative data with just two classes

Put more visual emphasis on one class if it is more important for the message of the map

The Color Cube



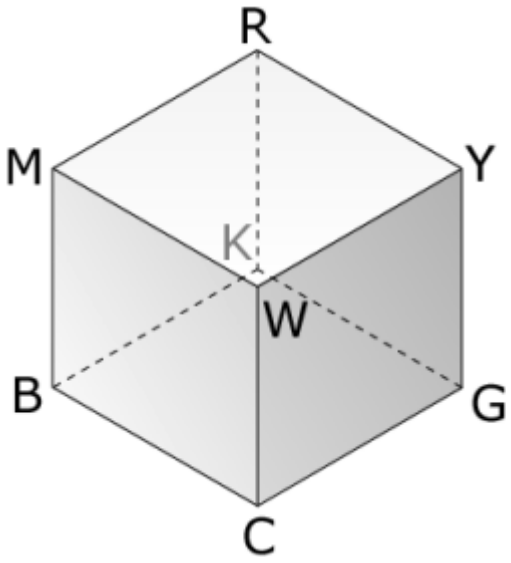
Subtractive
CMY

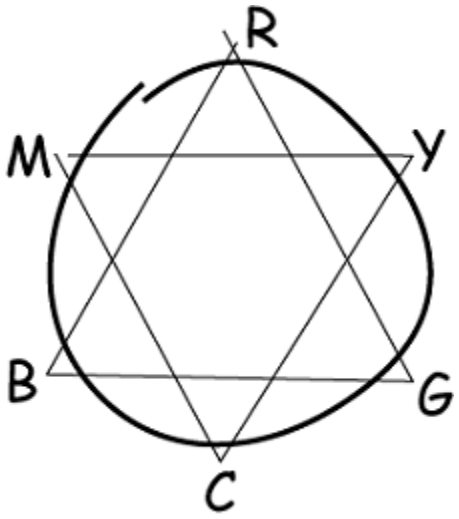
Additive
RGB

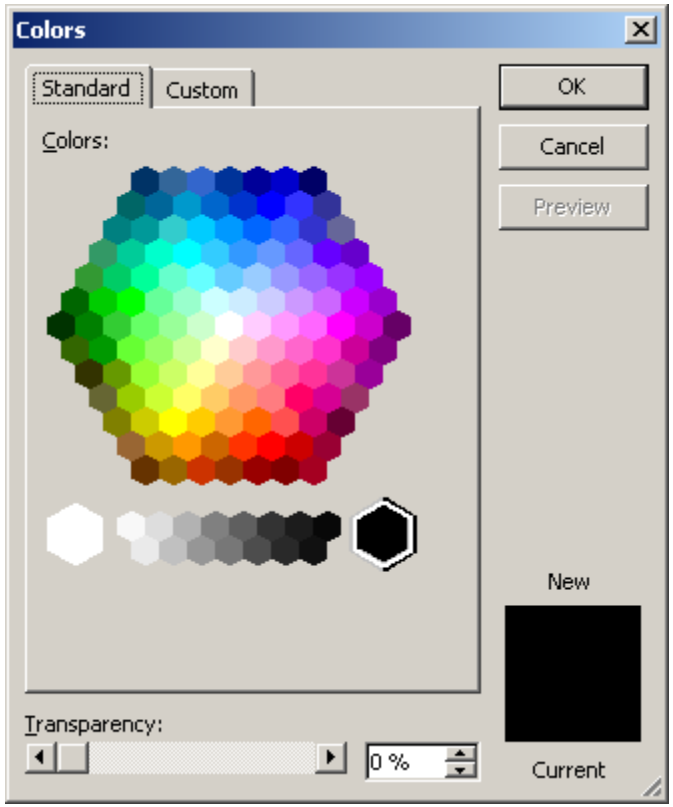
All the *subtractive* primaries are light colors

All the *additive* primaries are dark colors

Selecting Colors



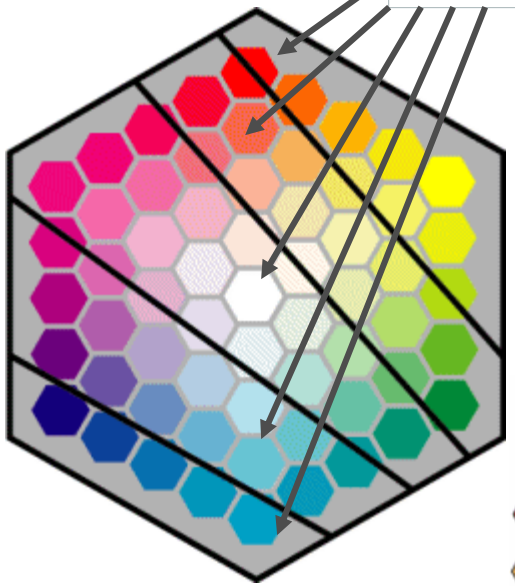




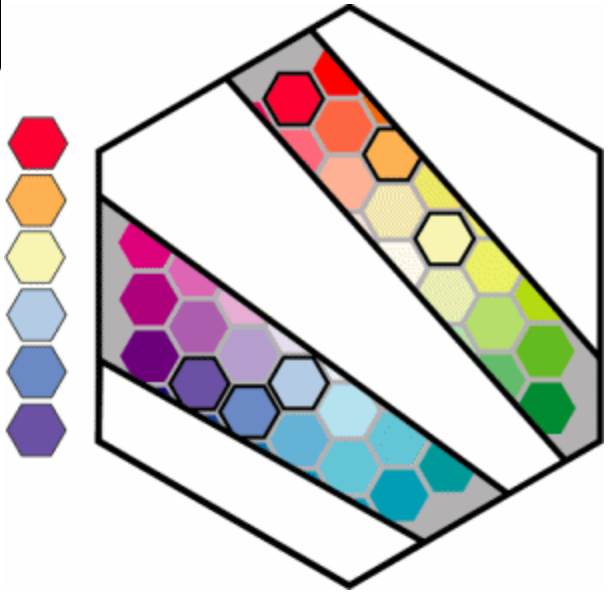
Colors for Colorblind

Good color combinations:

- red-blue
- red-purple
- orange-blue
- orange-purple
- brown-blue
- brown-purple
- yellow-blue
- yellow-purple
- yellow-gray
- blue-gray



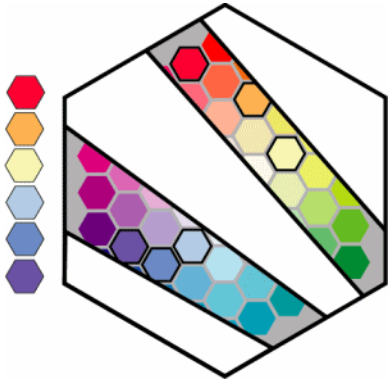
Choose colors two or more zones apart

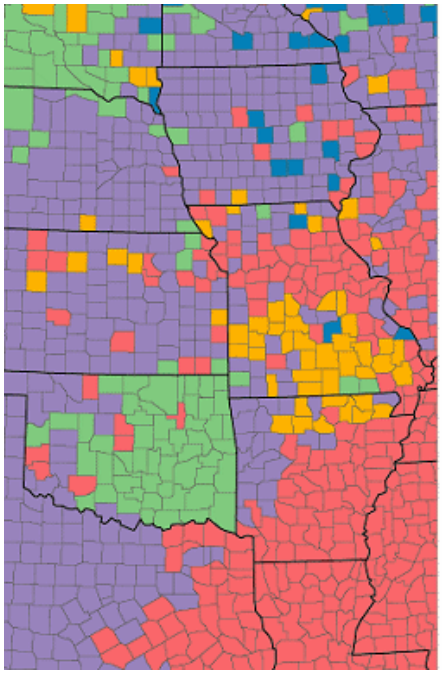


Choose pairs of hues from the list above and build a lightness sequence within each hue

Colors for Colorblind

Chose color pairs that are in separate color zones.

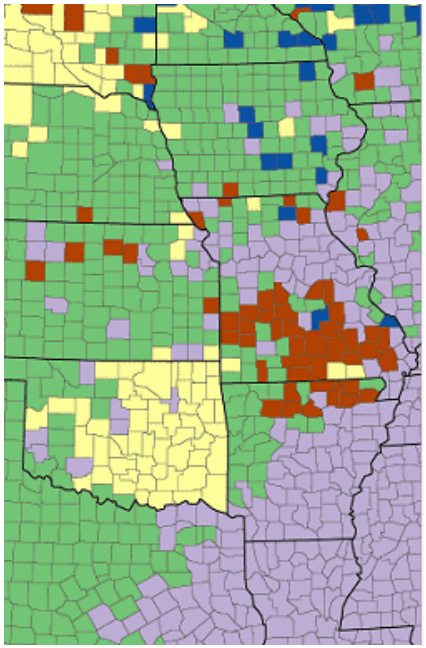




Minority group with highest percent of county population

Excludes White, not Hispanic

- Hispanic or Latino
- Black or African American
- American Indian and Alaska Native
- Asian
- Two or more races, not Hispanic or Latino



Minority group with highest percent of county population

Excludes White, not Hispanic

- Hispanic or Latino
- Black or African American
- American Indian and Alaska Native
- Asian
- Two or more races, not Hispanic or Latino

http://www.vischeck.com

Colors for photocopying

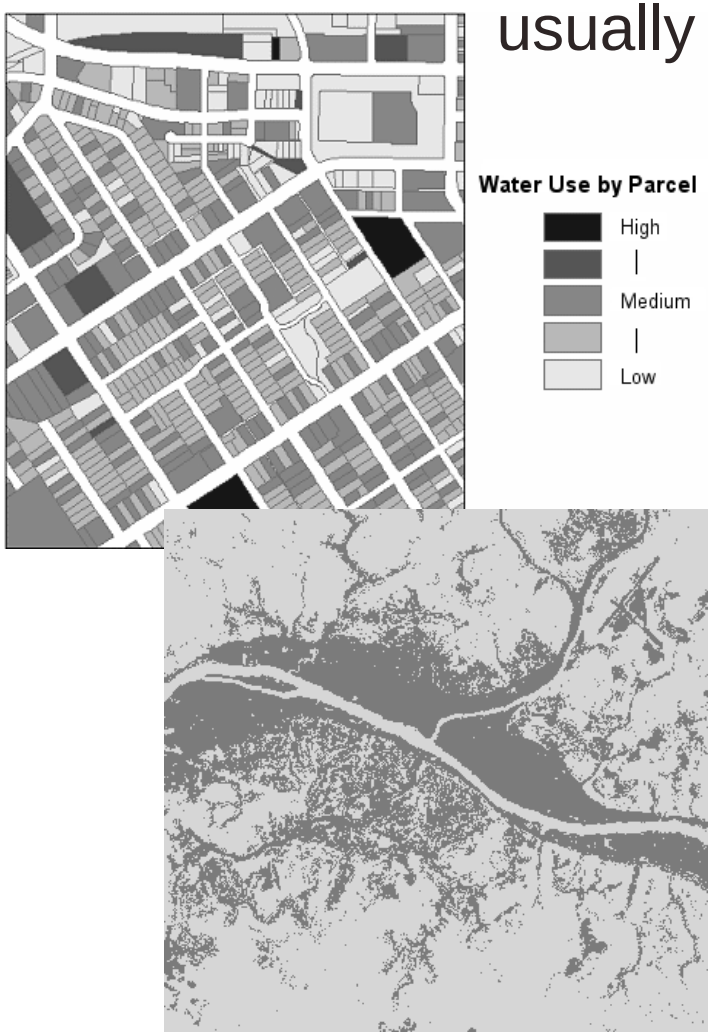
The key to making a color map that can be printed in black and white or photocopied is to include large differences in lightness between colors.

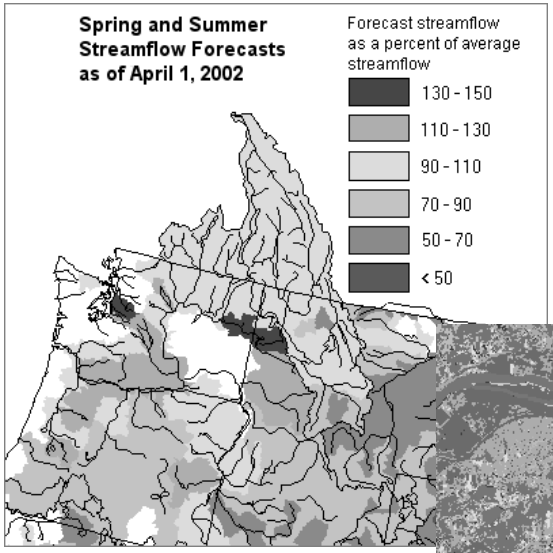
Useful process to test map for photocopying

1. Print the map.
2. Copy it.
3. Darken and lighten map colors.
4. Print.
5. Copy.
6. Adjust map colors.
7. Repeat as needed.

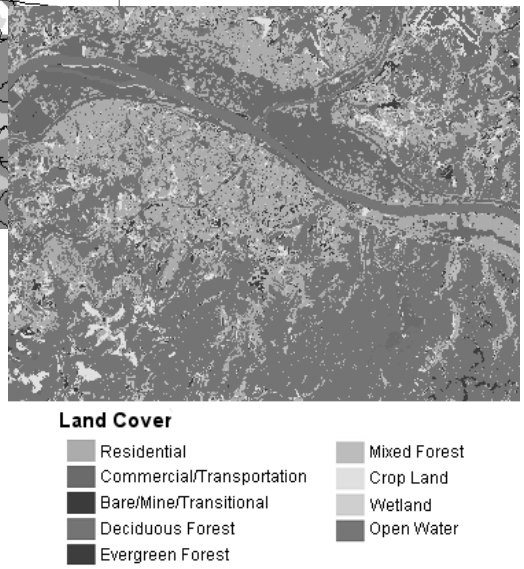
Colors for photocopying

Sequential and binary maps usually do well



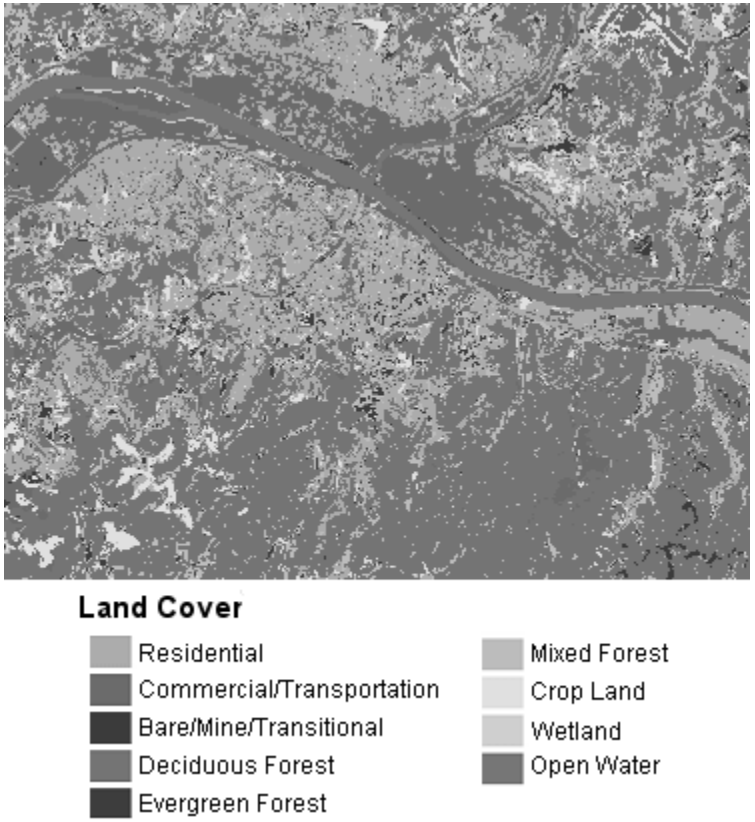


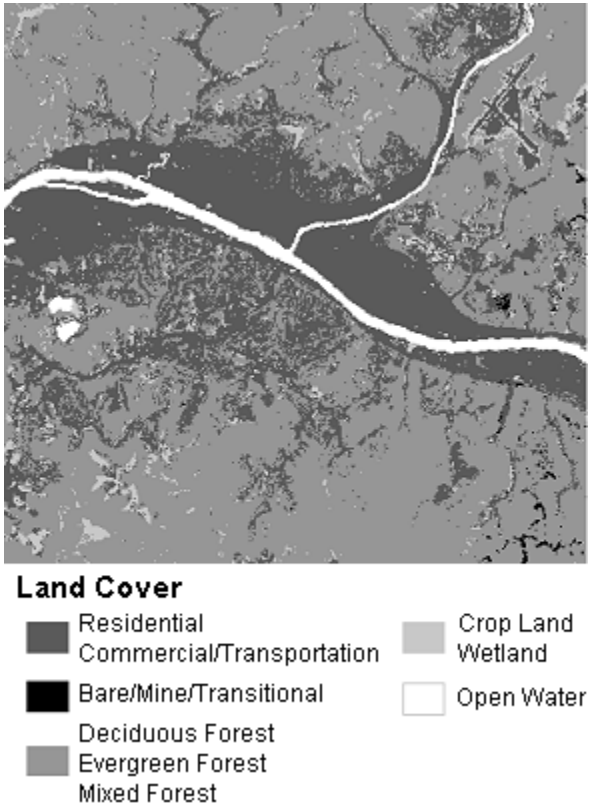
Divergent and qualitative maps often don't.



Colors for photocopying

The solution often requires redesign and simplification of the map



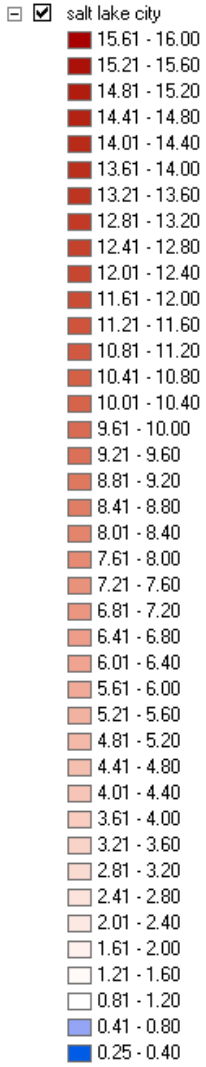


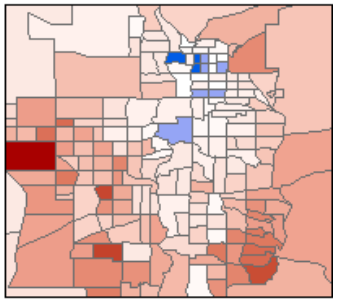
Colors in Context

Colors on maps need to be distinguishable.

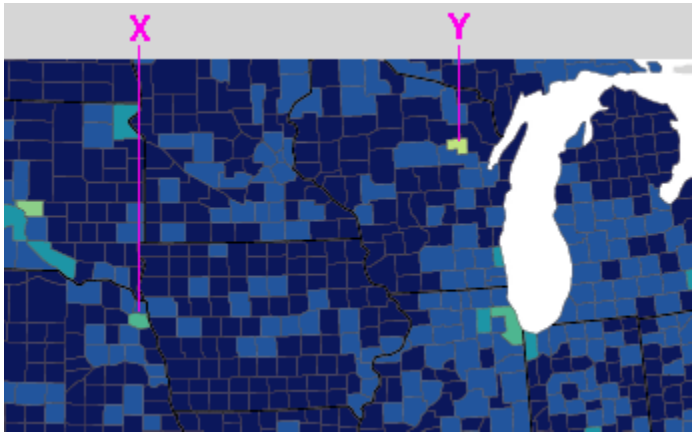
Some colors appear to change with different backgrounds

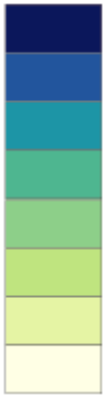
Colors in Context

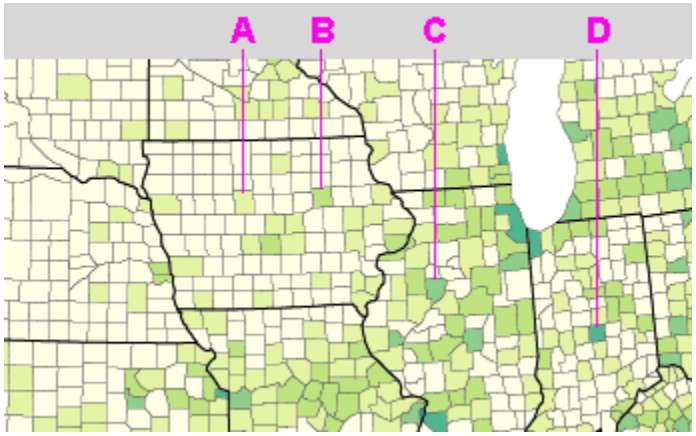


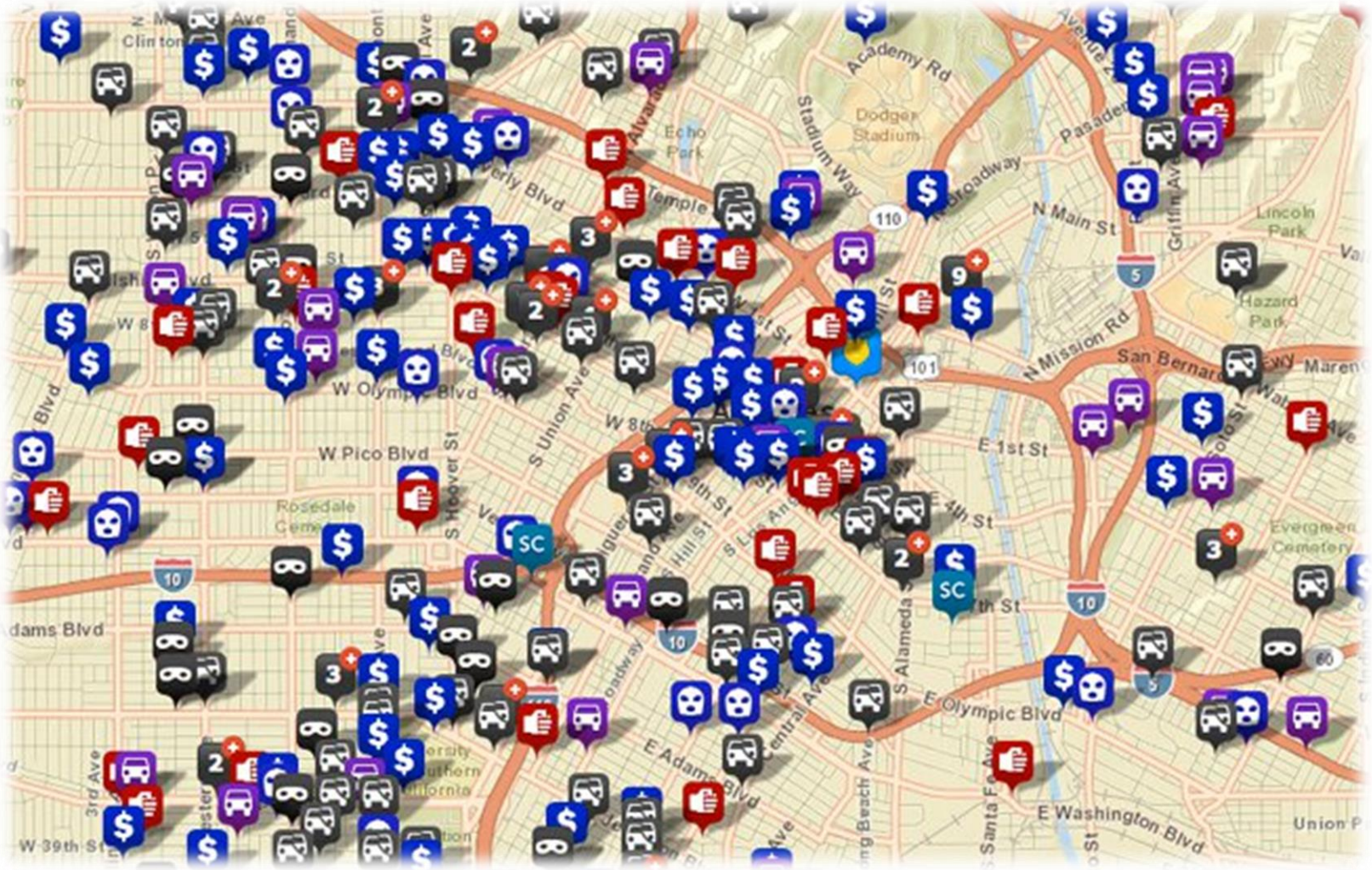


Avoid too many colors to relate to legend!








Academy Rd
Dodger Stadium
Stadium Way
Echo Park
Temple
Beverly Blvd
Broadway
N Main St
Griffin Ave
Lincoln Park
Hazard Park
N Mission Rd
San Bernardino
W Olympic Blvd
W Pico Blvd
S Union Ave
S Hoover St
W 8th St
E 1st St
4th St
7th St
Rosedale Cemetery
Evergreen Cemetery
S Alameda St
E Olympic Blvd
E Adams Blvd
E Washington Blvd
Santa Fe Ave
Long Beach Ave
Central Ave
Adams Blvd
W 39th St
3rd Ave
Union P
110
101
10
5
SC

SYMBOLOGY

Symbology: Points

Symbol characteristics:

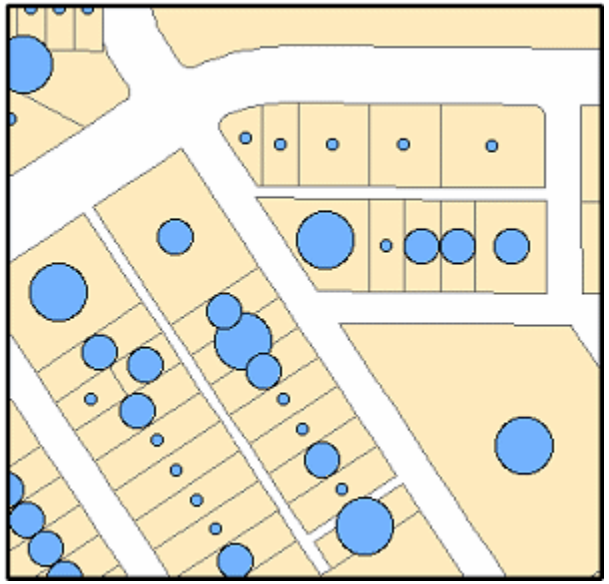
- Size
- Shape/ pictograms
- Angle
- Hue/lightness

Symbology: Points

Symbol size:

Often used to show quantitative differences

Street lamp illumination
(location and quantity)

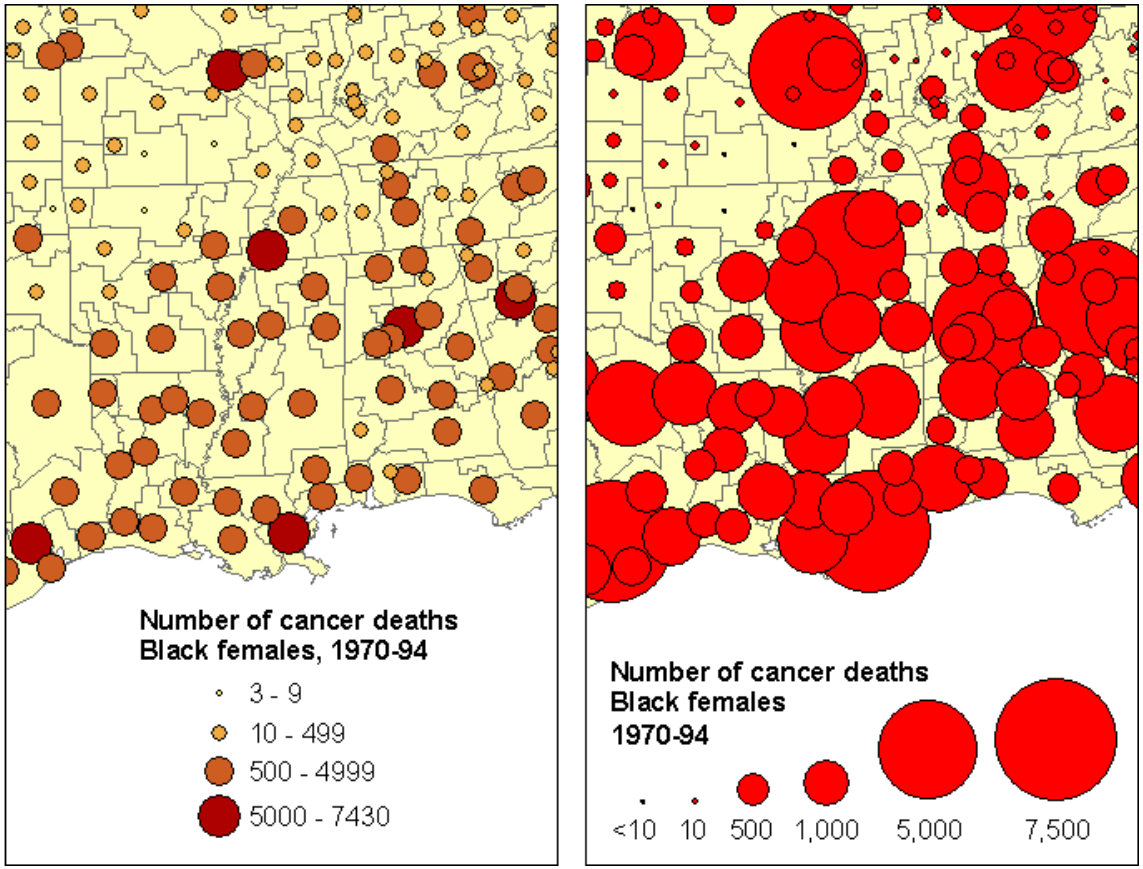


Household water usage
(quantity label)

Symbology: Points

Symbol size:

Graduated v. Proportional



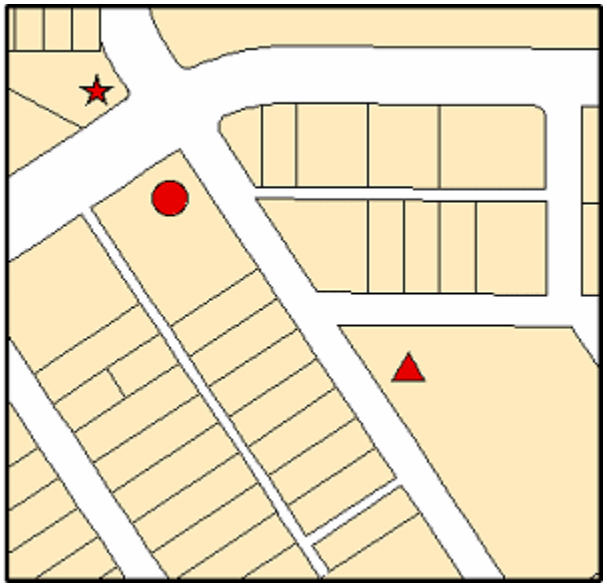
Graduated values indicate order

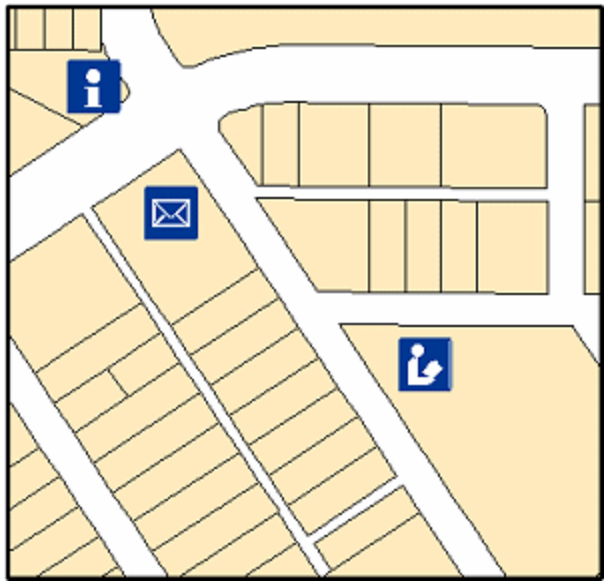
Proportional values indicate value or magnitude

Symbology: Points

Symbol shape:

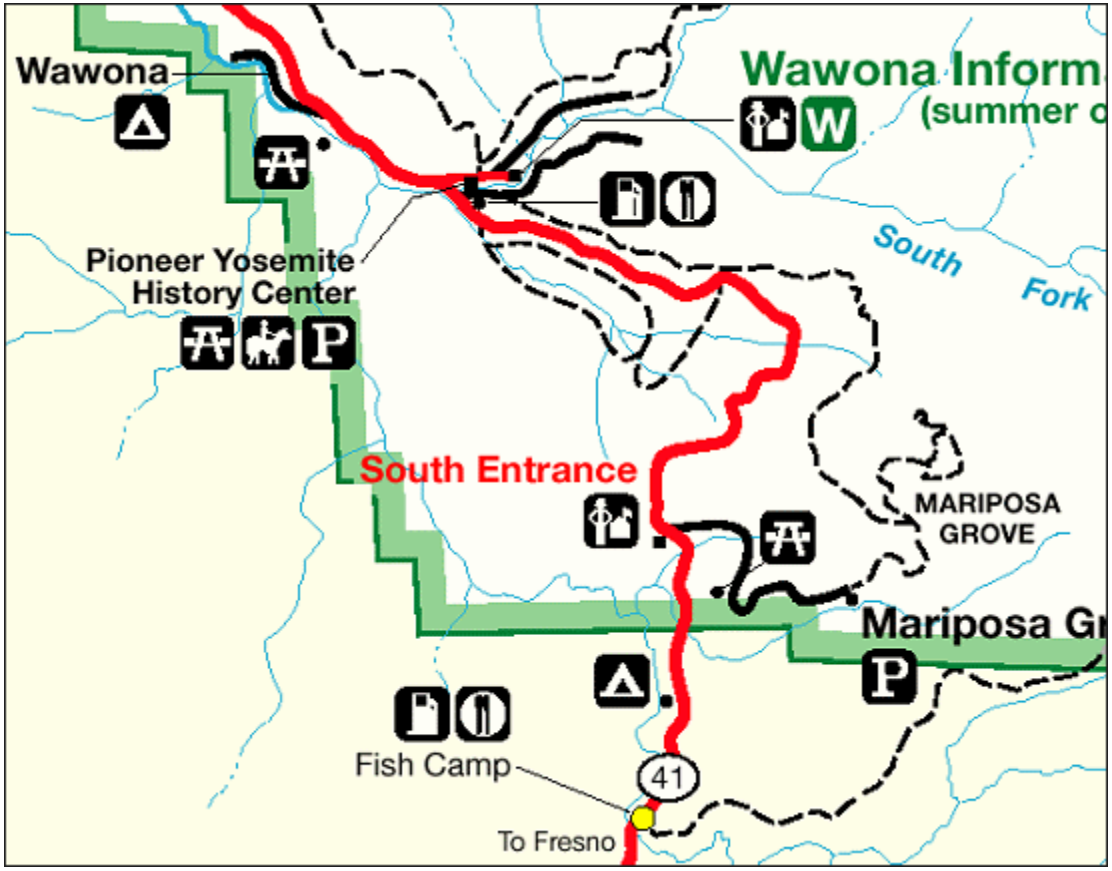
Often used to show qualitative differences





Symbology: Points

Pictograms:



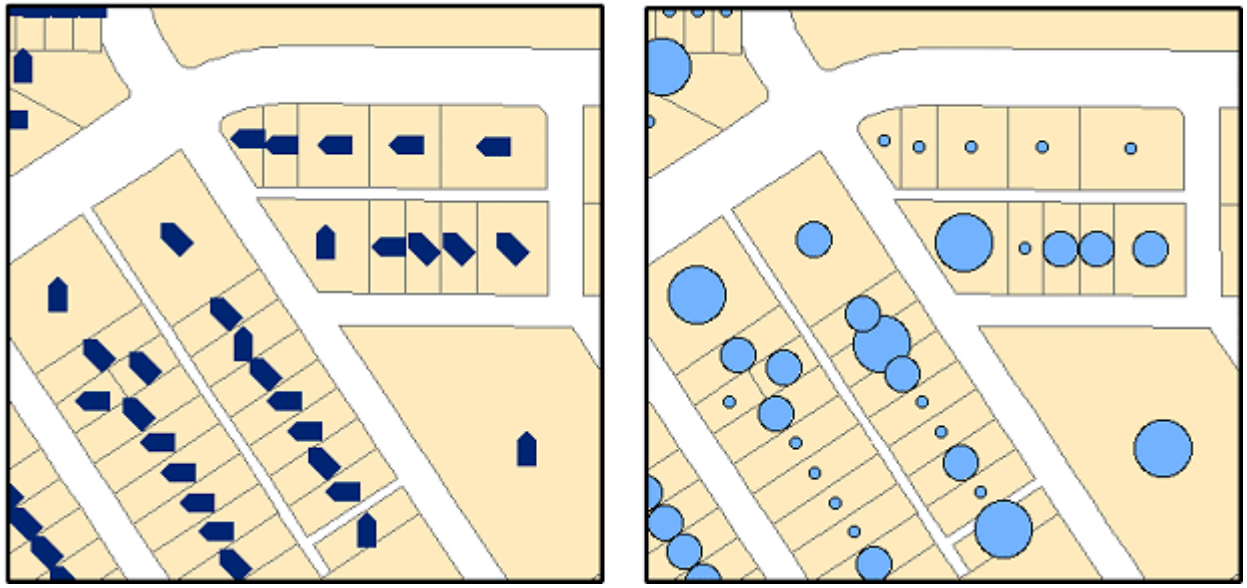
Enhance readability
Easy to translate

Ranger station	Horseback riding
Gas station	Campground
Food service and Lodging	High Sierra Camp (by reservation only)
Picnic area	Backpacker walk-in campground
Parking	Wilderness permit station (summer only)

Symbology: Points

Symbol angle:

Often used to show orientation



Symbology: Lines

Line characteristics:

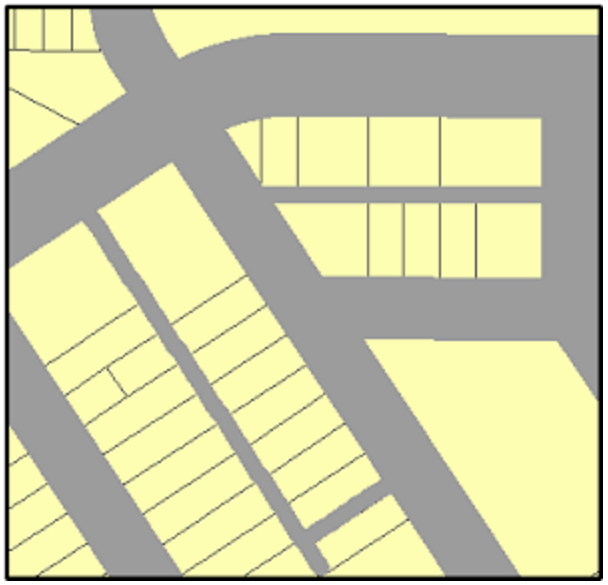
- Hue & lightness
- Size
- Separation
- Shape
- Arrangement
- Angle

Symbology: Lines

Line symbol size:

Size can be adjusted proportionally or gradually to show quantitative differences…

Number of lanes (graduated)

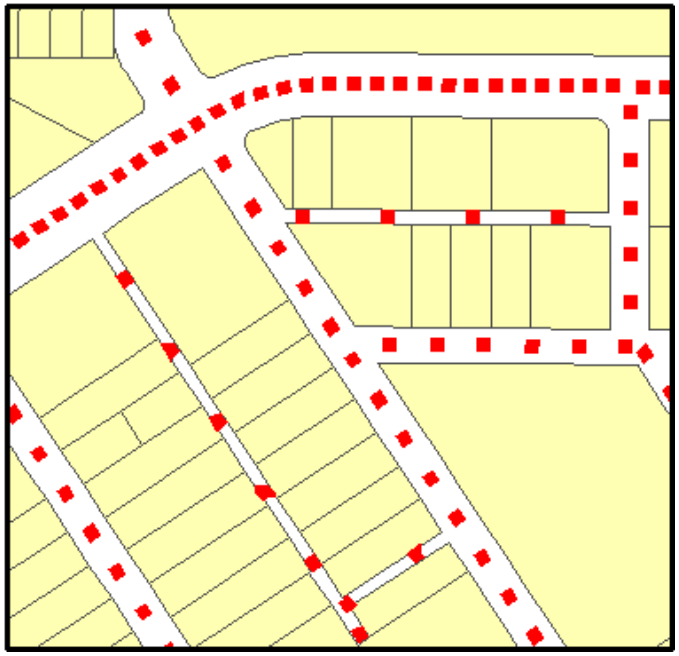


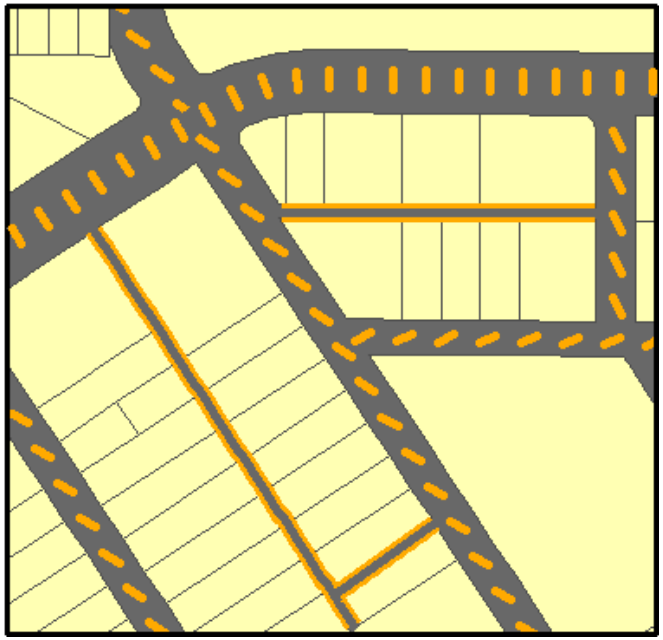
Traffic flow (proportional)

Symbology: Lines

Line pattern: *Dashing*

Symbols and separation can show qualitative differences in features. Separation and angle can also be used to show quantitative differences



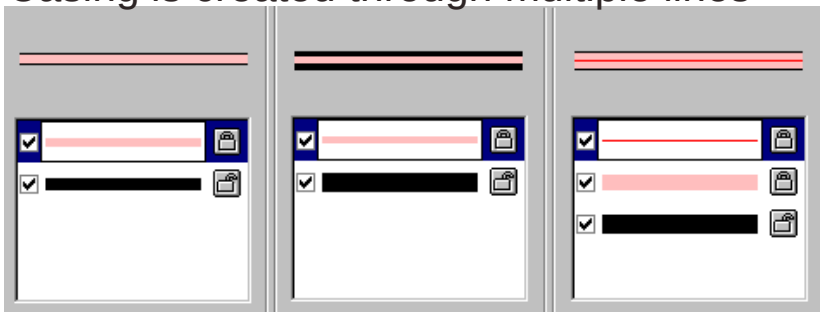


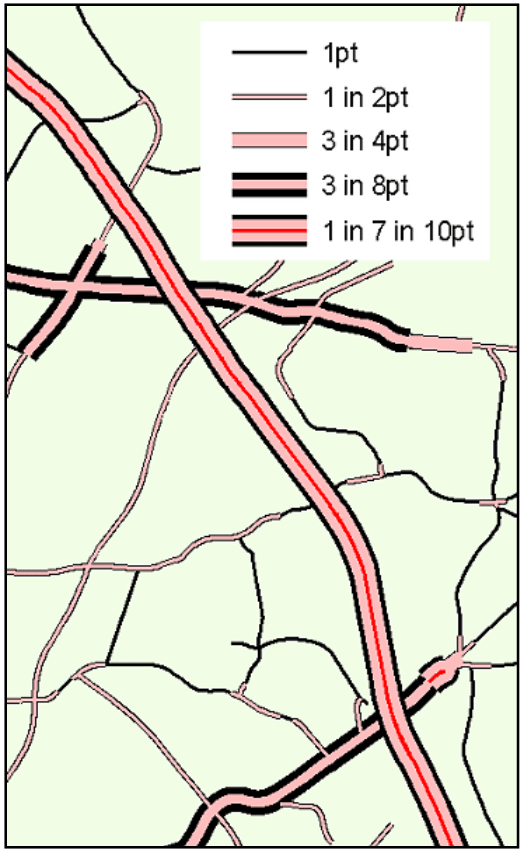
Symbology: Lines

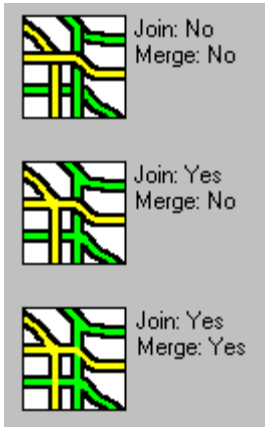
Line pattern: *Casing*

Casing can increase line visibility (like halos for text) without elevating its position in the map hierarchy.

Casing is created through multiple lines





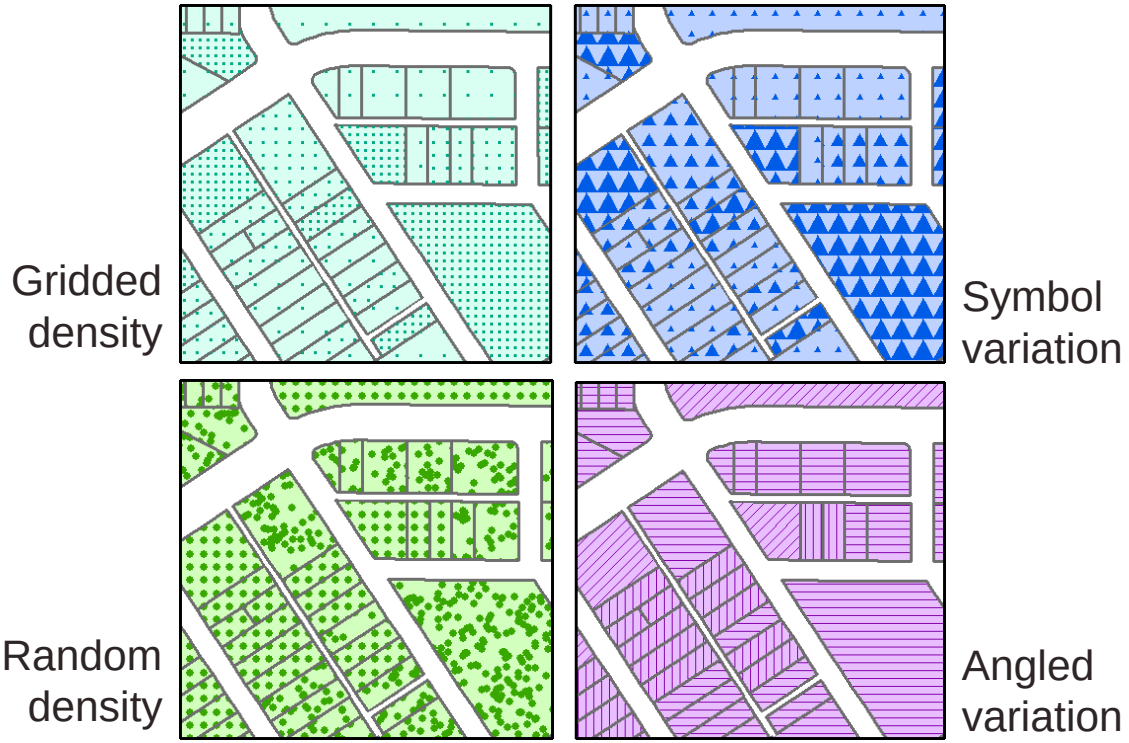


Join and Merge toggles in the Advanced Drawing Options settings control the way different cased line features intersect or break other lines.

Symbology: Areas

Area patterns can be literal or completely abstract.

Use patterns and textures that adhere to the map's visual hierarchy and follow guidelines for color



Symbology: Areas

This map combines hue, lightness, arrangement, angle, separation, shape, and saturation to create high-contrast area patterns for different land uses.

Visual Variables

7 visual variables

- Hue
- Lightness
- Size
- Shape
- Shape
- Separation
- Arrangement
- Angle

x 3 types of features

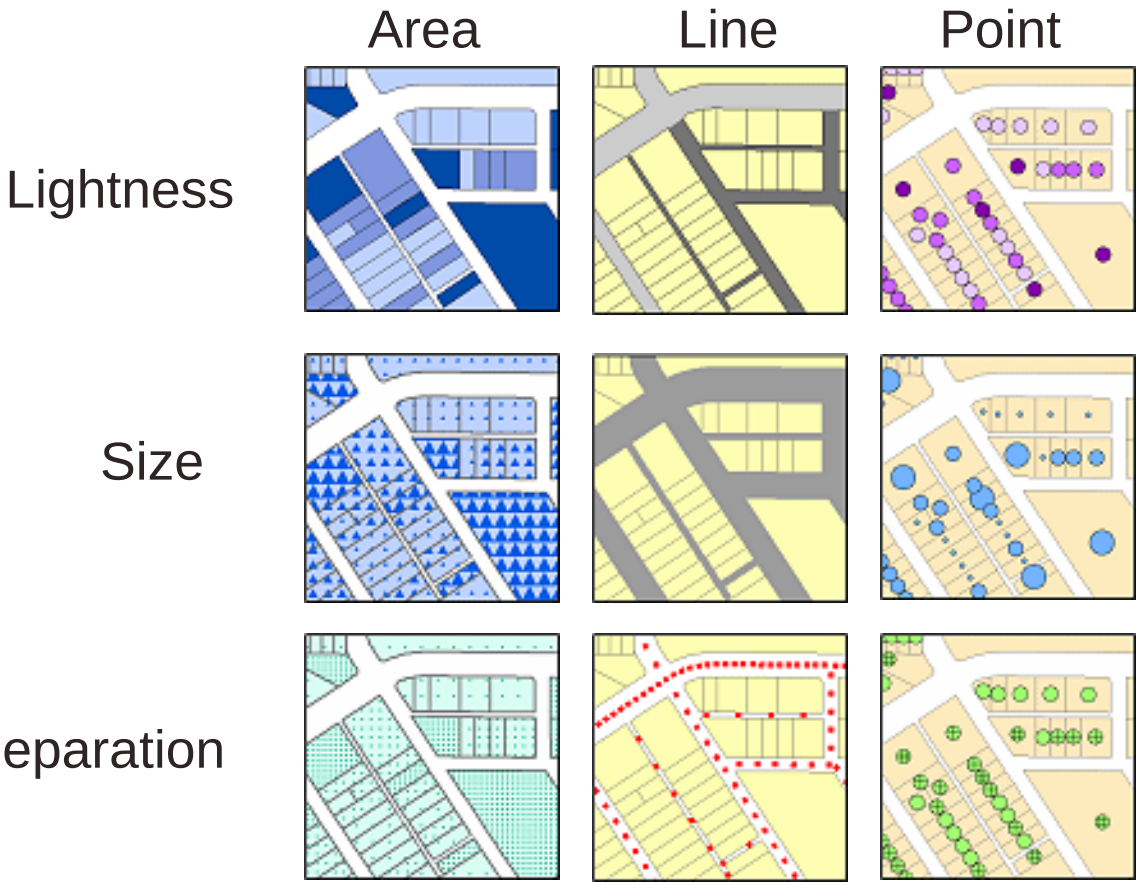
- Points
- Lines
- Areas

---

21 ways to vary symbols for representing mapped data!

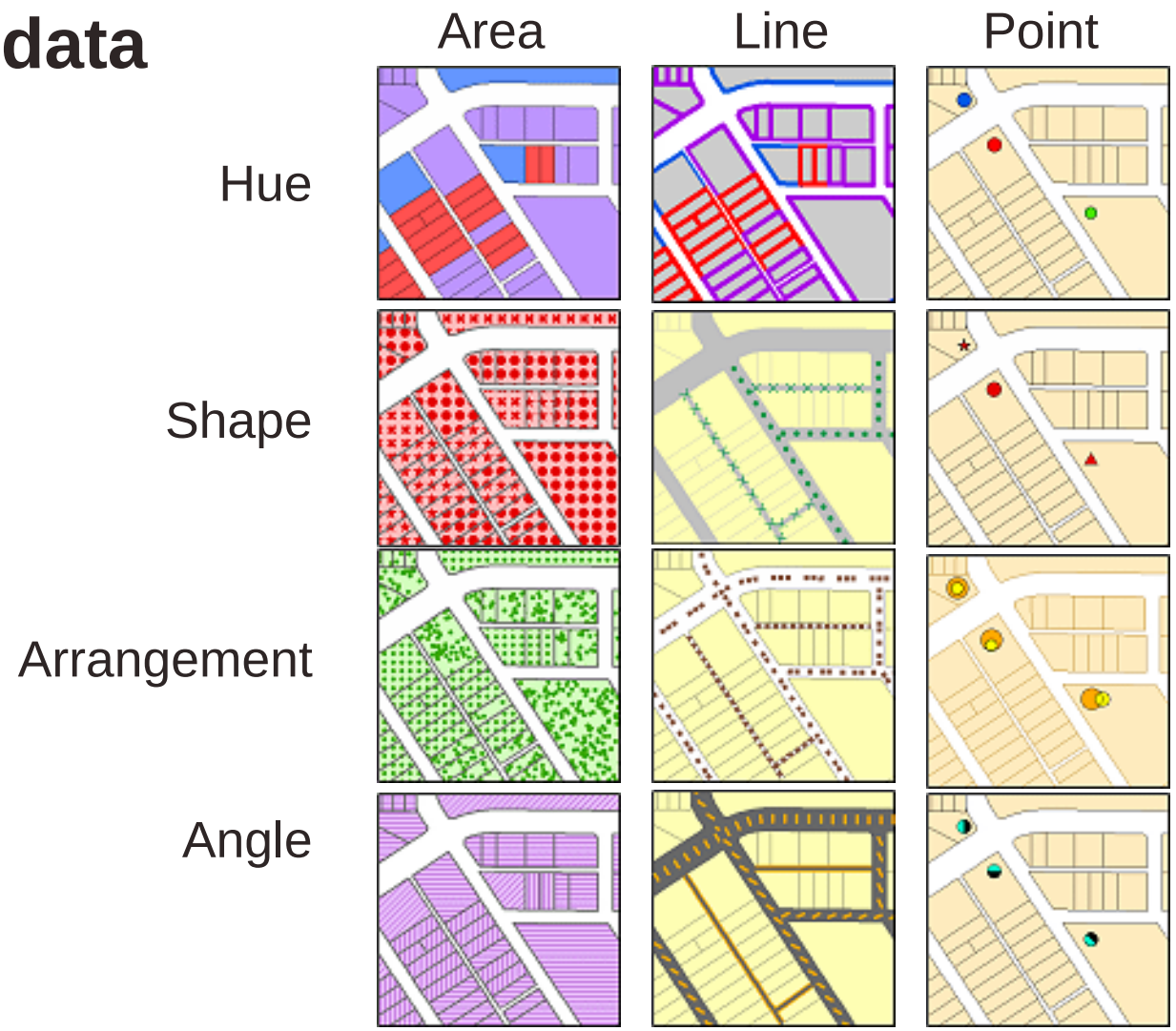
Visual Variables

Ordered data



Visual Variables

Qualitative data



Symbology: Review

- Size, shape, and angle as well as hue and lightness are the primary visual variables used to create point symbols.

- Point symbols can represent discrete features such as hydrants or telephone poles, or they can represent attributes of area features. When point symbols are used to represent quantitative data values for areas, larger symbols represent higher data values.

- Hue, shape, and arrangement are used to represent qualitative differences in data values (different categories of features).

Symbology: Review

- Lightness, size, and separation are visual variables used to symbolize ordered data.

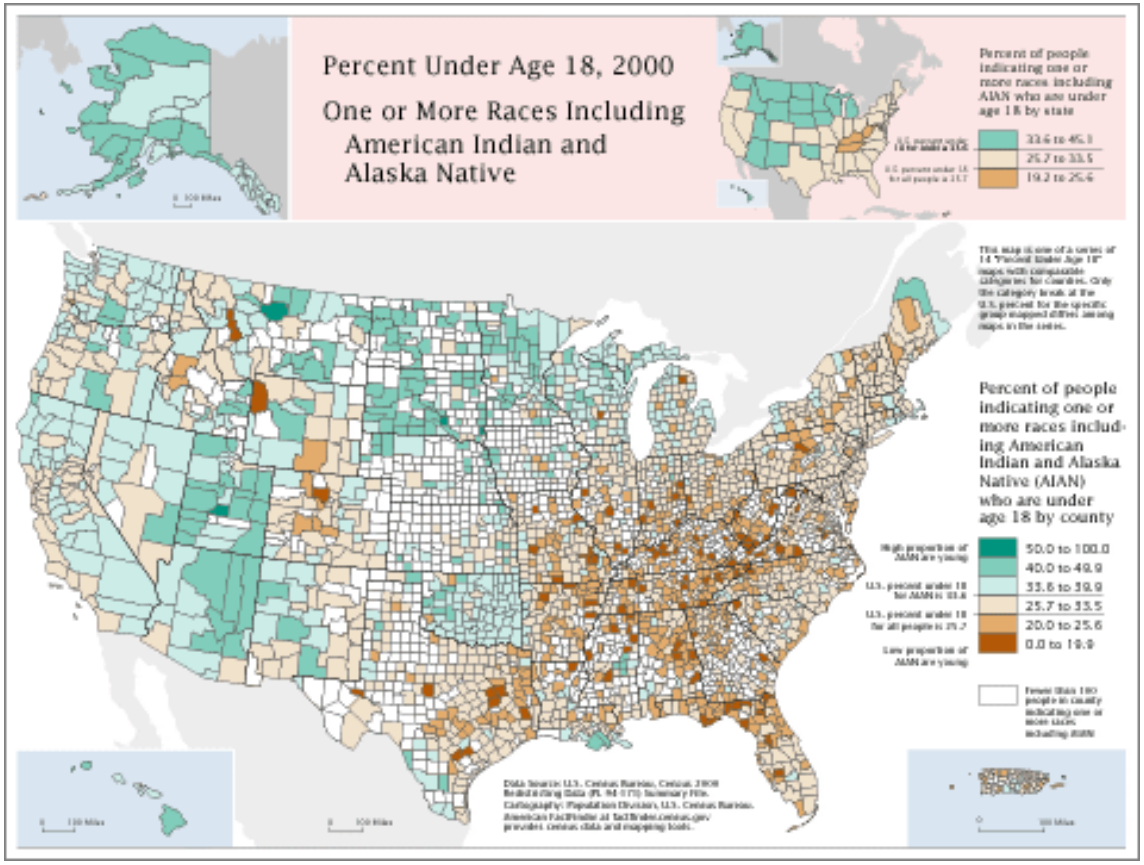
- Dashed and cased lines combine the visual variables of separation, shape, arrangement, and angle. Dashes add pattern to a line, while casing helps increase line visibility over multiple backgrounds.

- Area patterns should clearly represent logical relationships within the data. Patterns with coarse and fine textures are used to represent hierarchy in data values. You can use shapes of elements within a pattern to indicate qualitative differences in data. Angle and arrangement can also be used with area patterns to indicate qualitative differences.

PUTTING ALL TOGETHER

Putting it all together

How align map data and marginal map elements to create an informative, but not disruptive map layout.



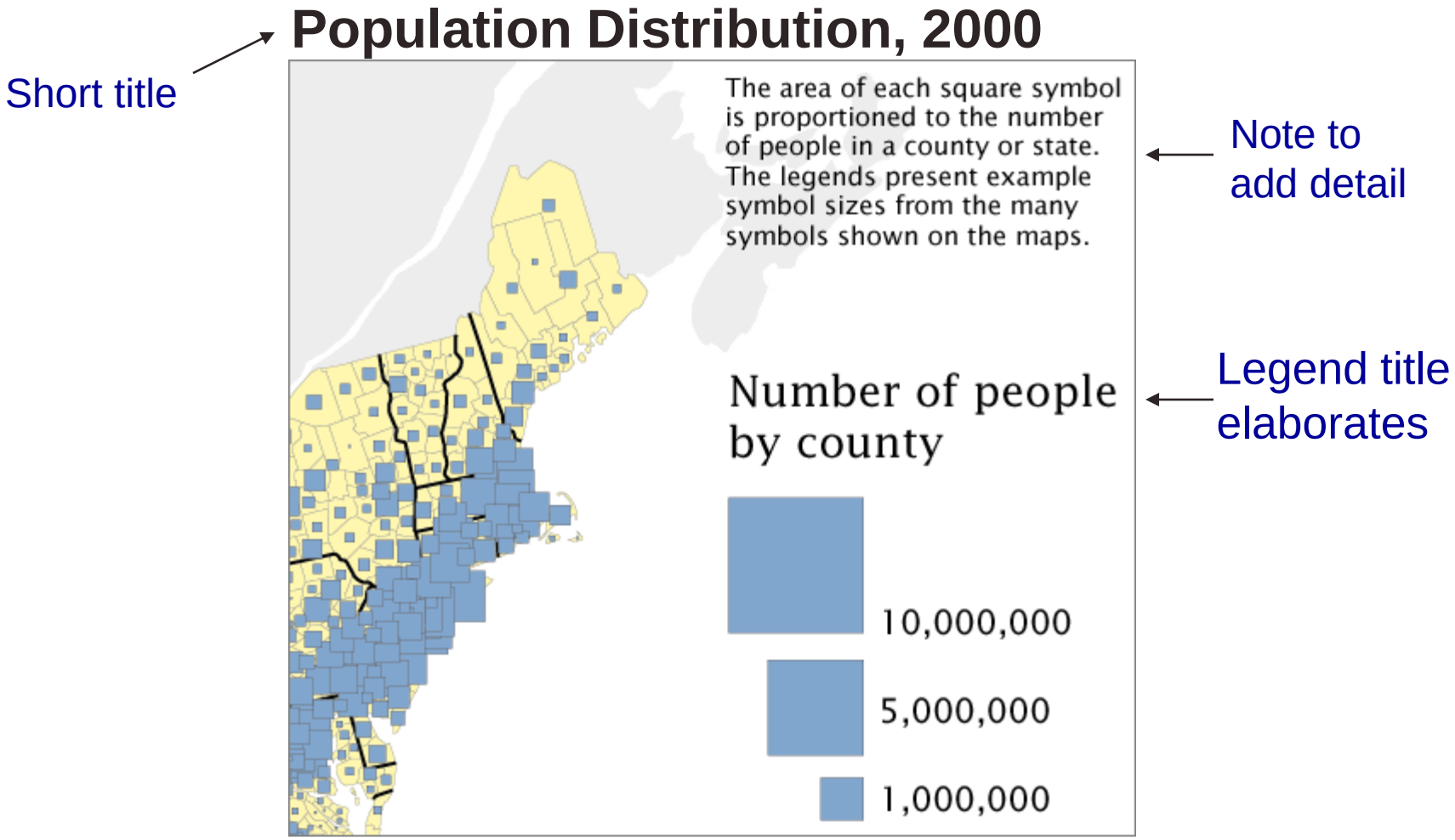
Putting it all together

GOALS:

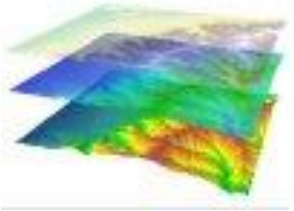
- Clearly communicate the map content using hierarchy of detail.
- Refine labels so that spacing within and between lines of text conveys clear associations with other map elements

Putting it all together

Simple map…



Map Titles

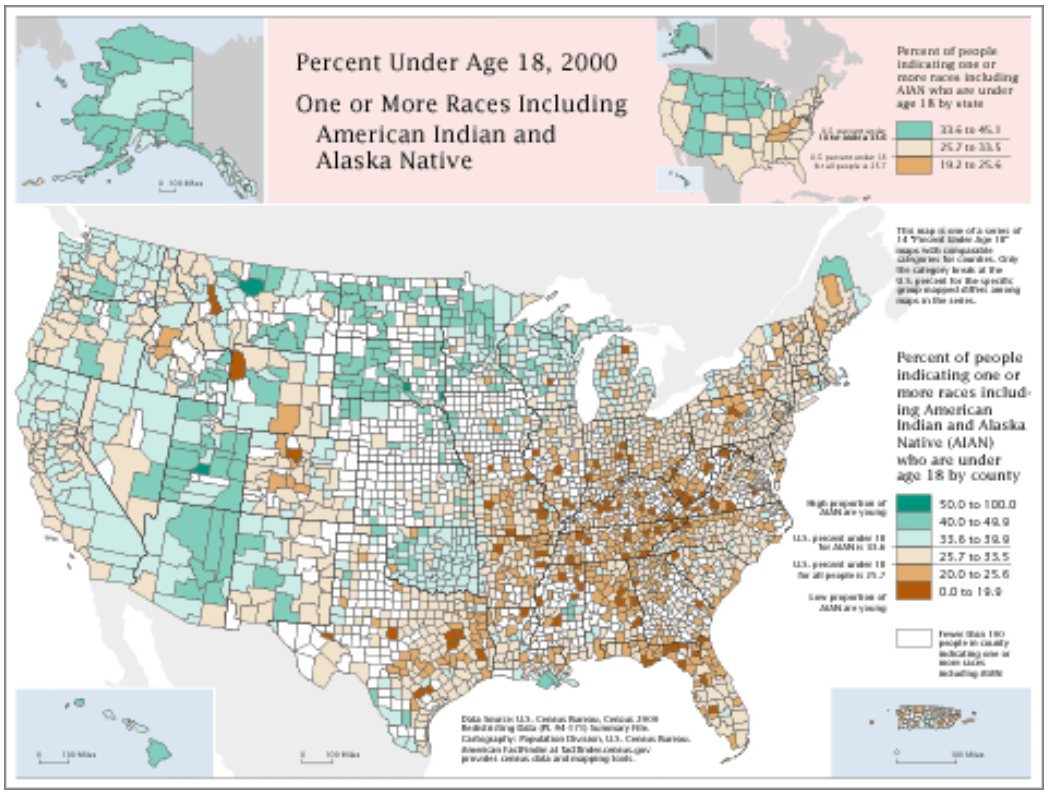


Include in legend

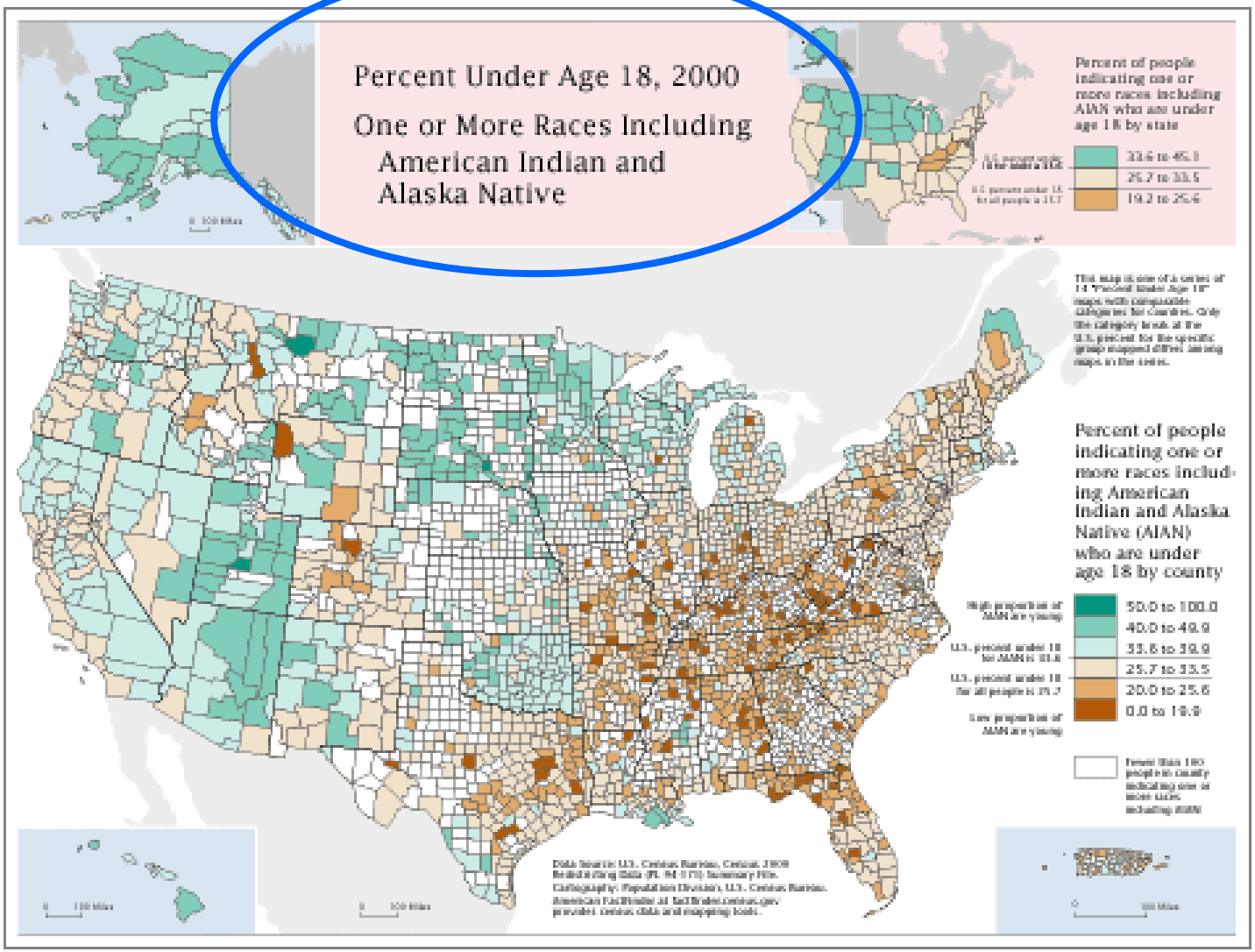
A map showing the distribution of the percent of people indicating one or more races including American Indian and Alaska Native who are under age 18 in 2000 by county in the United States prepared using Census 2000 Redistricting Data

It's obvious where…

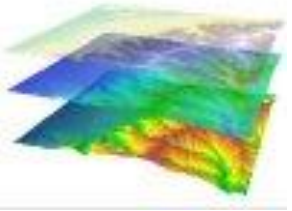
Add as note



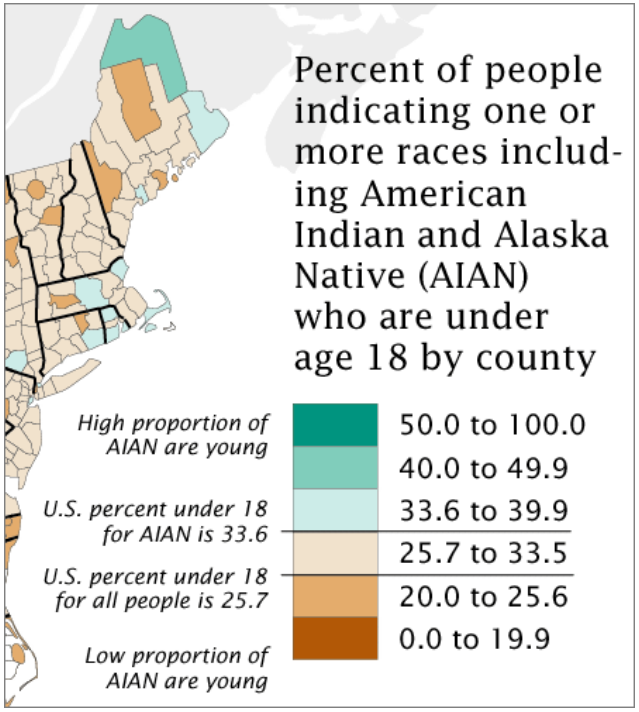
Map Titles


Percent Under Age 18, 2000
One or More Races Including
American Indian and
Alaska Native
Percent of people indicating one or more races including AIAN who are under age 18 by state
Percent of people indicating one or more races including American Indian and Alaska Native (AIAN) who are under age 18 by county
50.0 to 100.0
40.0 to 49.9
33.6 to 39.9
25.7 to 33.5
20.0 to 25.6
0.0 to 19.9

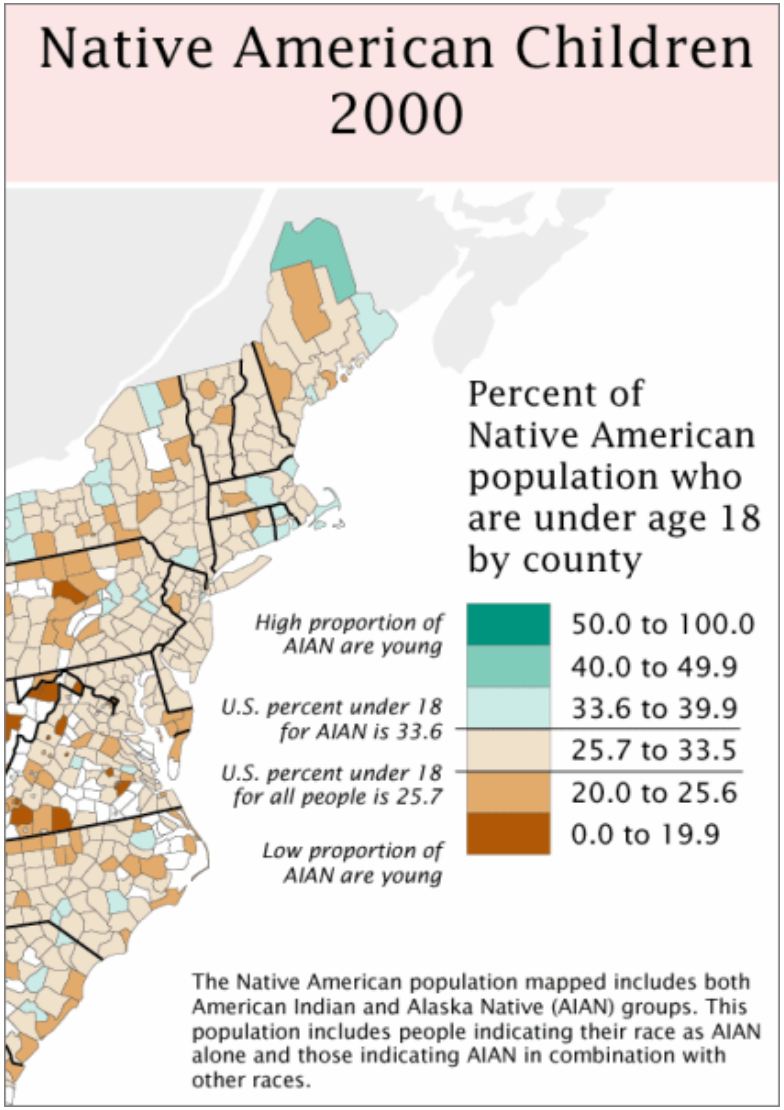
Map Titles



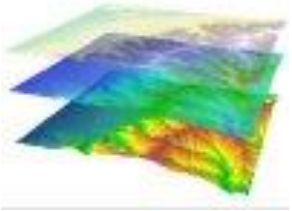
Titles can be simplified by adding text notes and detailed legends in the map



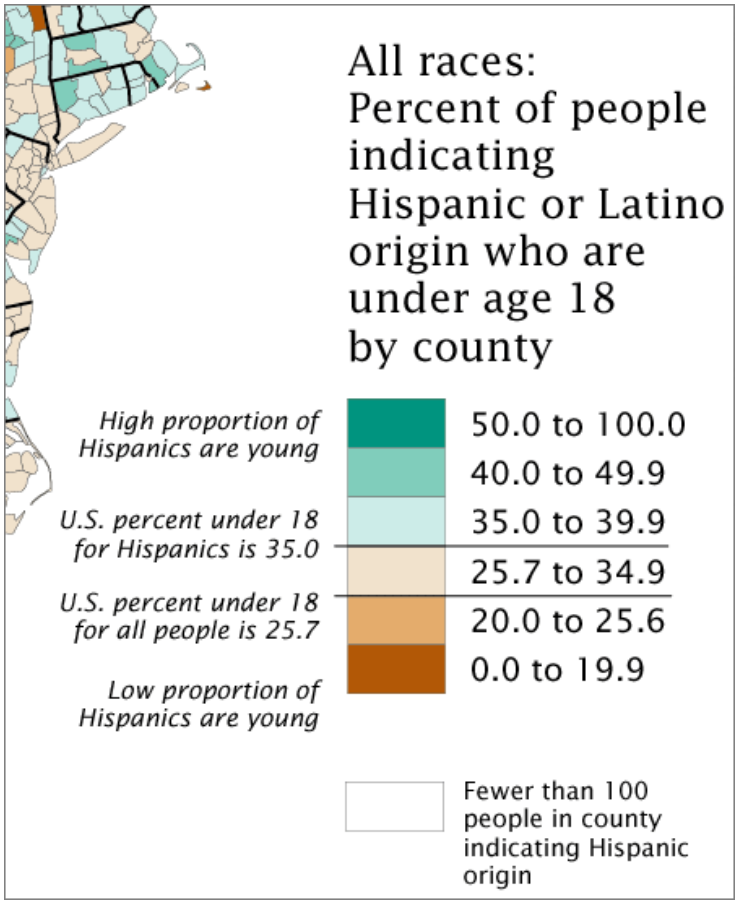
Notes should be low in the map hierarchy



Describing calculations



Describing the work used to derive the map is important but difficult to describe concisely.



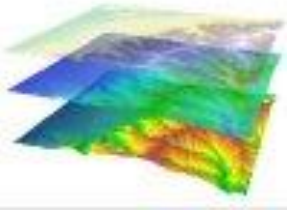
"Percent of people indicating Hispanic or Latino origin who are under age 18 by county" ***wordy***

"Percent Hispanic under 18 by county" ***ambiguous***

"Under 18 Hispanic percent by county" ***confusing***

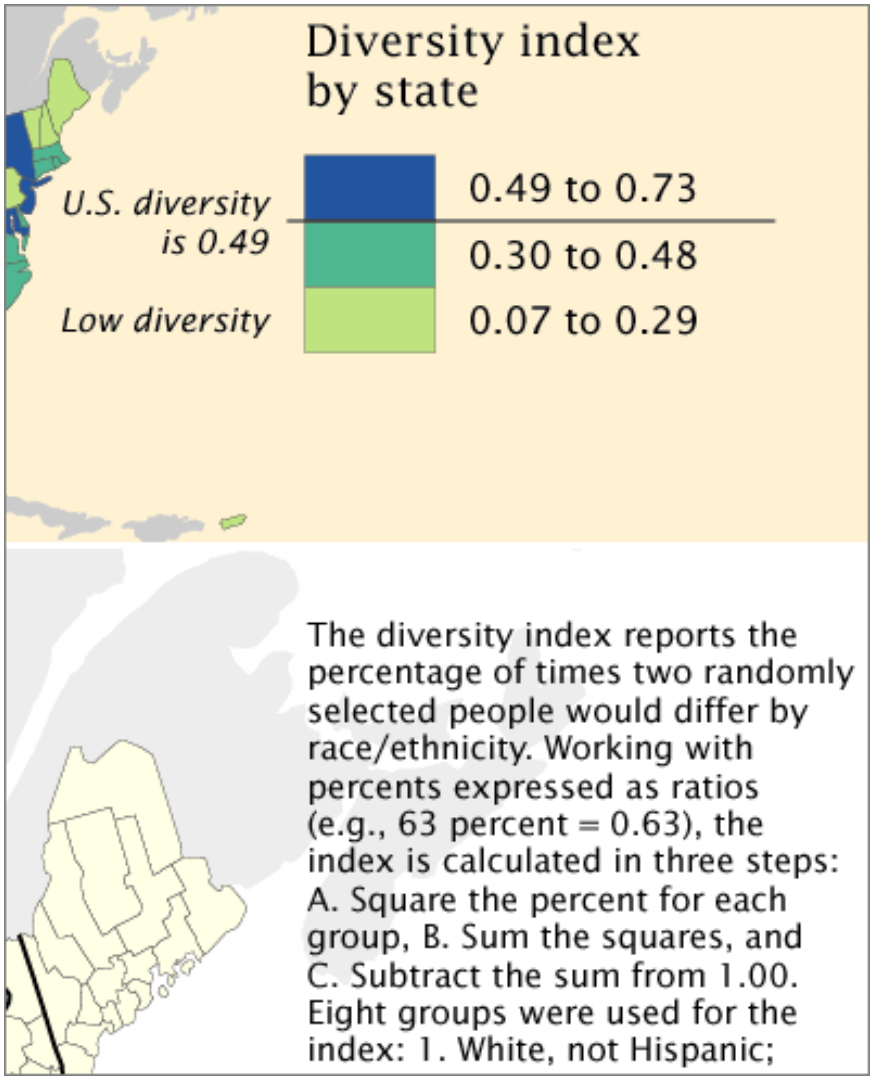
"Percent Hispanic who are under 18 by county " ***good***

Describing calculations

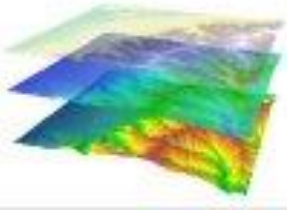


Brevity is good, but coherence is essential. Readers will gain more from the map if they are sure what it represents.

If you have difficulty describing your calculations briefly, add a text note to your map layout.



Legend nuances



Some thought into the spacing and alignment of legend elements makes for a far clearer legend.

Transportation and Land Use Prince George's County, Maryland

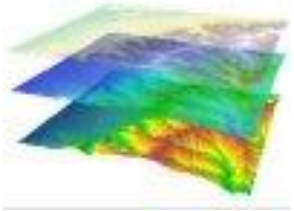
Land Use	Speed Limit
Urban	< 35
Institution	35, 40
Defense	45, 50
Parkland	55, 60
Water	

Transportation and Land Use

Prince George's County, Maryland

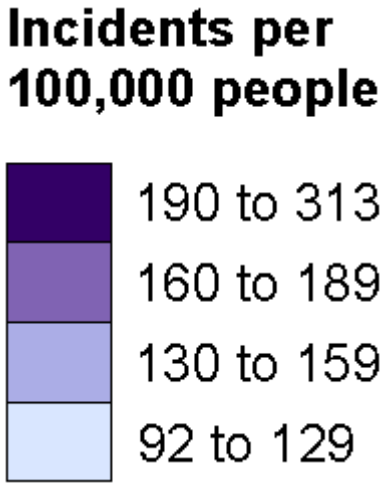
Land use	Speed limit
Urban	< 35
Institution	35, 40
Defense	45, 50
Parkland	55, 60
Water	

Legends



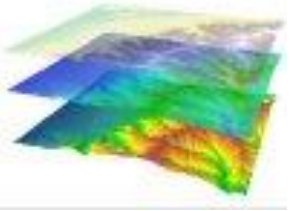
Choropleth maps

A thematic map in which areas are colored or shaded to represent the density of a particular phenomenon or to symbolize classes within it.



- Round numbers for breaks and within labels
- Increment labels (e.g., 0-10, 10-20 or 0-9, 10-19); this issue is linked to rounding
- Use the word "to" or a dash within ranges (this often depends on whether the data includes negative numbers)
- Label breaks between classes with single numbers rather than labeling class ranges
- Order classes with the highest numbers at the top (like the vertical axis on a graph) or at the bottom of the legend
- Label ranges with the actual values represented by the symbol, creating gaps between ranges
- Use the true maximum and minimum values in the data to label ranges or use statements such as "fewer than 100 people" or "more than 150 percent" for extreme ranges
- Add annotations to describe classes and assist map reading

Legends



Qualitative maps

Housing characteristics

- under construction
- siding (wood, vinyl, aluminum)
- stone or brick
- vacant building

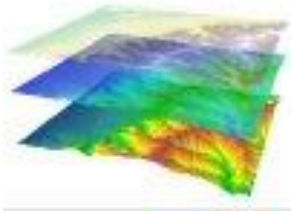
- Area symbols should present colors/patterns as close to as they appear on the map as practical.
- Use the same outline color and weight in the legend as in the map.

- Consider coloring the background of the legend to show colors as they appear on the map.
- Dot map legends should give example densities

Sample densities in people per square km

Each square represents 100 square km

Legends



Isoline maps

Isoline interval is 200 meters

Elevation in meters above mean sea level

- greater than 400
- 200 to 400
- 0 to 200
- below MSL

Elevation in meters above mean sea level

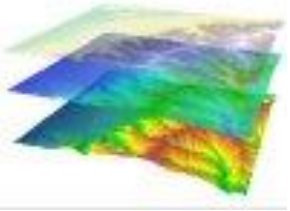
- 400
- 200
- 0

Proportioned point

Number of people

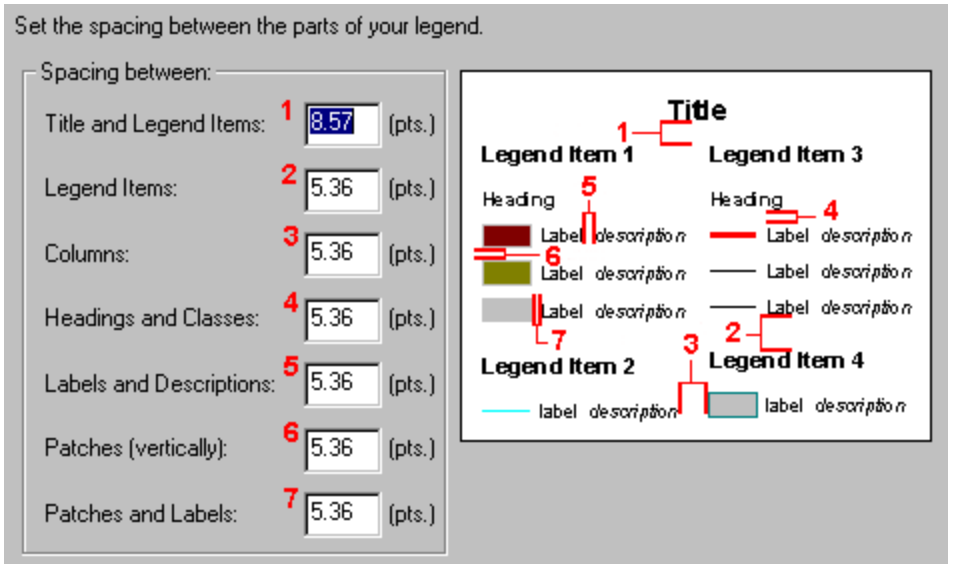
- 100
- 1,000
- 5,000
- 10,000

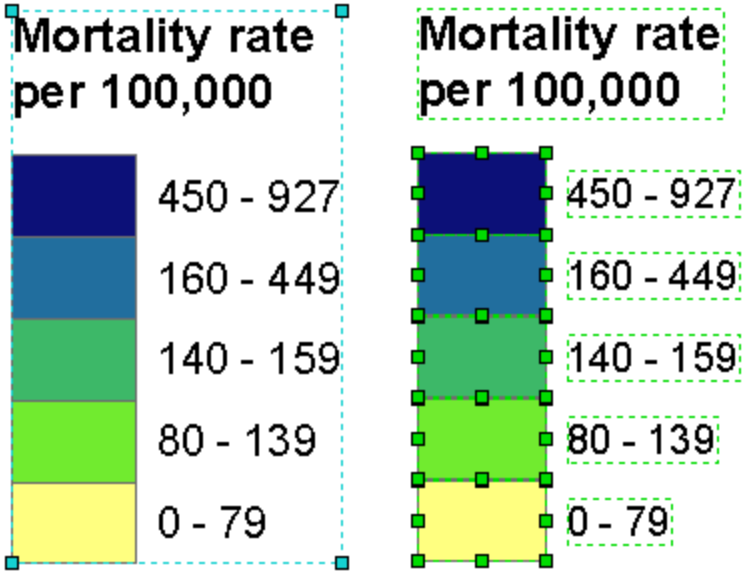
Legends



ArcMap and beyond

ArcMap allows some flexibility in the legend editor

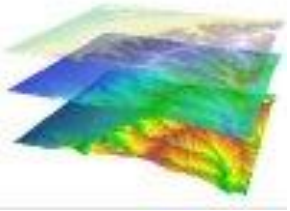




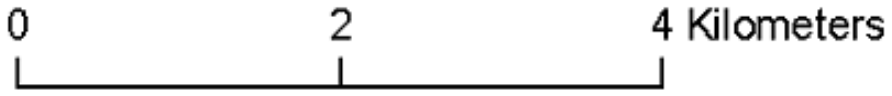
Converting the legend to graphics severs the ties to the data but adds much control over the layout.

Because the link is severed, this should be done at the end of creating the map.

Scale bars

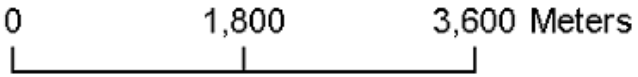


Graphic bar

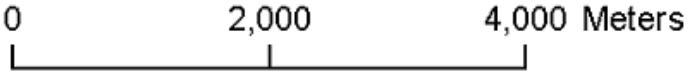


Verbal scale 1 centimeter equals 0.685 kilometers

Representative fraction 1:68,521



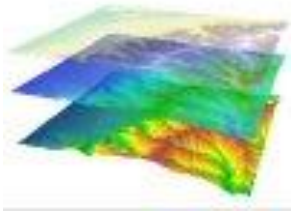
poor



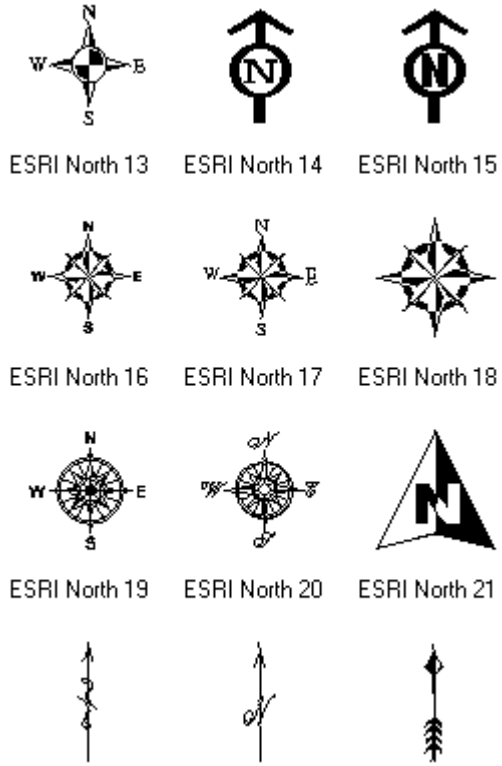
good

Use rounded numbers

Direction indicators

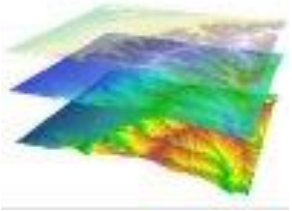


Compass roses



When direction is not constant, use a graticule

Summary



Cartography has many conventions and rules which often must be bent or broken.

The two most important rules, however, are:

- to keep your map on message by adhering to a sensible hierarchy of map elements, and
- always keep your audience in mind when choosing what to say and how to say it.