A Data Model for Named Features of the Natural Landscape

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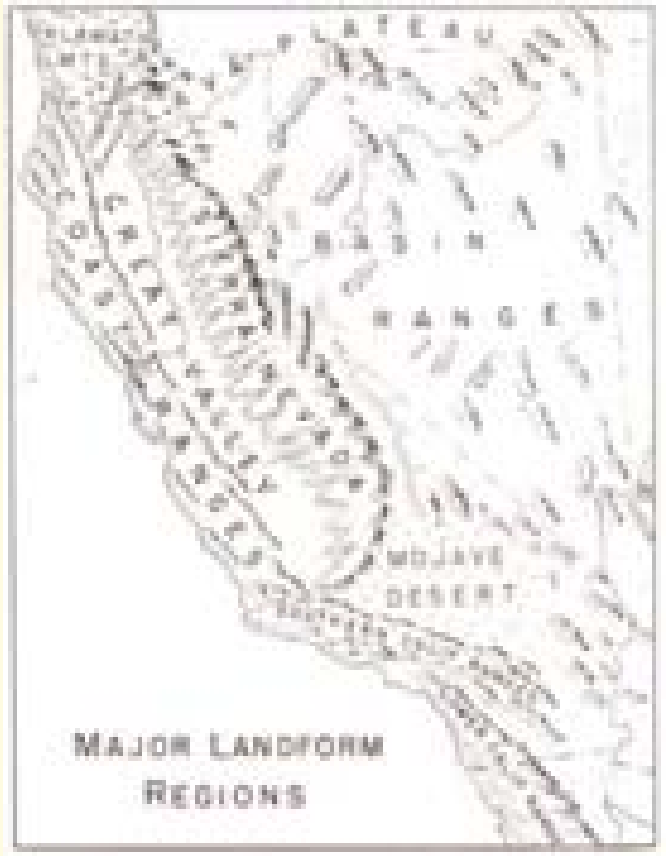
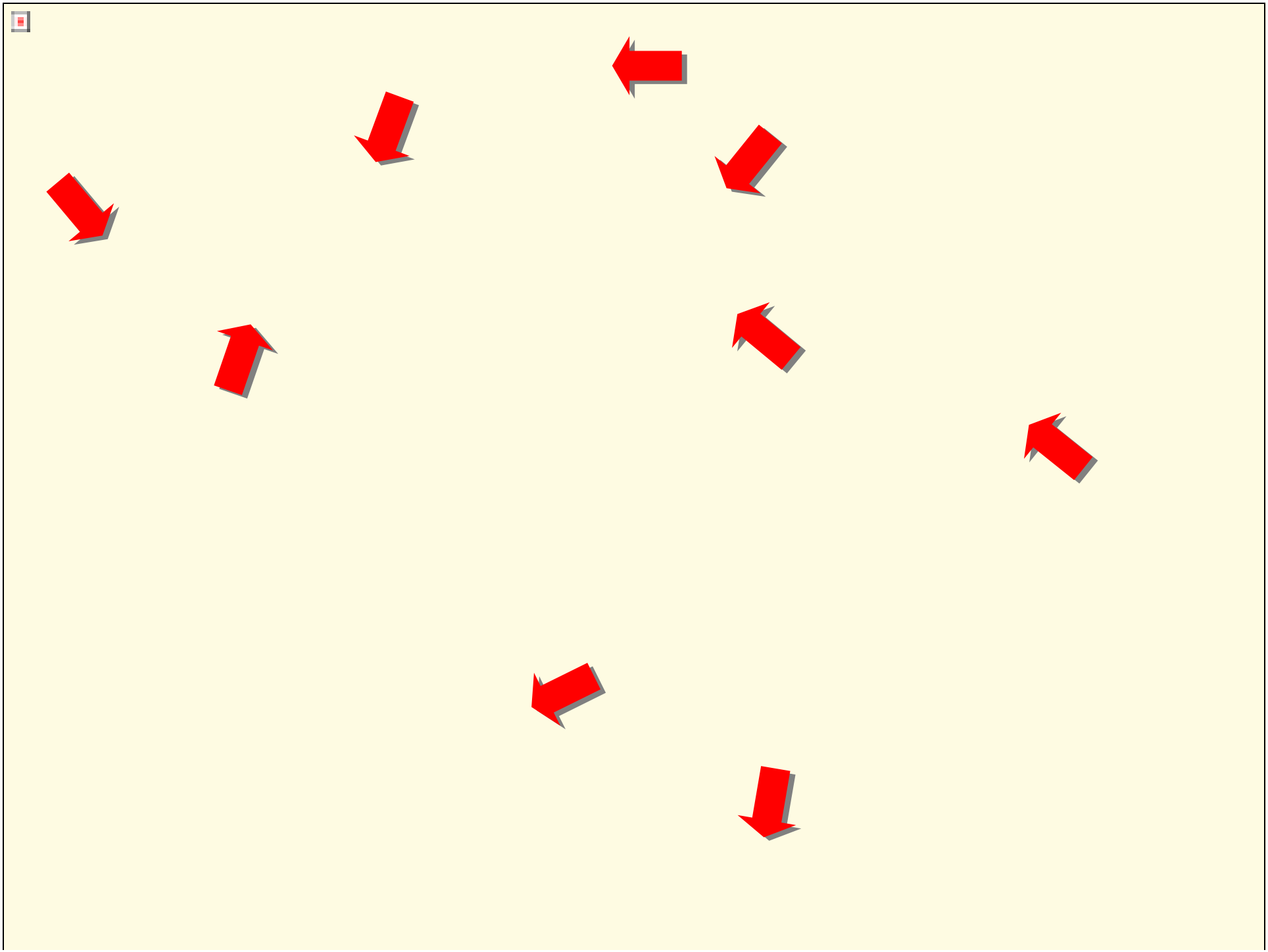
Agenda

- What features we are talking about?
- How should they be modeling in GIS?
- How should they be captured from source materials?
- How are they used for mapping?
- What are the implications of all this?


PLATEAU
BASIN
RANGES
MOJAVE
DESERT
MAJOR LANDFORM
REGIONS



What are these features?

TYPES OF FEATURES WITH INDETERMINATE BOUNDARIES	GIS THEME	TOPOLOGY	DATABASE REPRESENTATION
Named Marine Water Bodies	Hydrography	No Overlaps	Text: Binary
Named Physiographic Features	Physiography	May Nest or Have Partial Overlaps	Text: Binary
Islands and Island Chains	Physiography and Hydrography	Nested, No Overlaps	Text Binary
Neighborhoods and Districts/ Vernacular Regions	Cultural and Transportation	May Nest or Have Partial Overlaps	Text: Binary
Land Cover, Geology, Soils and Other Surface Overlays	Surface Overlays	No Overlaps	Text and Symbol: Predominant

Physiographic Features

- Badlands
- Bar
- Basin
- Bend, Land
- Bend, Water
- Bluff
- Butte
- Canyon
- Cape
- Carolina Bay
- Cliff
- Crater
- Delta
- Desert
- Dunes
- Escarpment
- Fault Zone
- Gap
- Hill
- Hills
- Incline Flow
- Incline Flow, Earthen
- Incline Flow, Lava
- Incline Flow, Rockslide
- Incline Flow, Slope
- Island
- Isthmus
- Landfall
- Lowlands
- Mesa
- Moraine
- Mountain
- Mountain Range
- Natural Arch
- Natural Bight
- Pass
- Peak
- Piedmont
- Pinnacle
- Plains
- Plateau
- Playa
- Promontory
- Ridge
- Saddle
- Terrace
- Uplands
- Valley
- Volcano, Active
- Volcano, Inactive

Named Marine Water Bodies

- Bay
- Bight
- Channel
- Firth
- Gulf
- Inlet
- Ocean
- Passage
- Sea
- Sound
- Strait

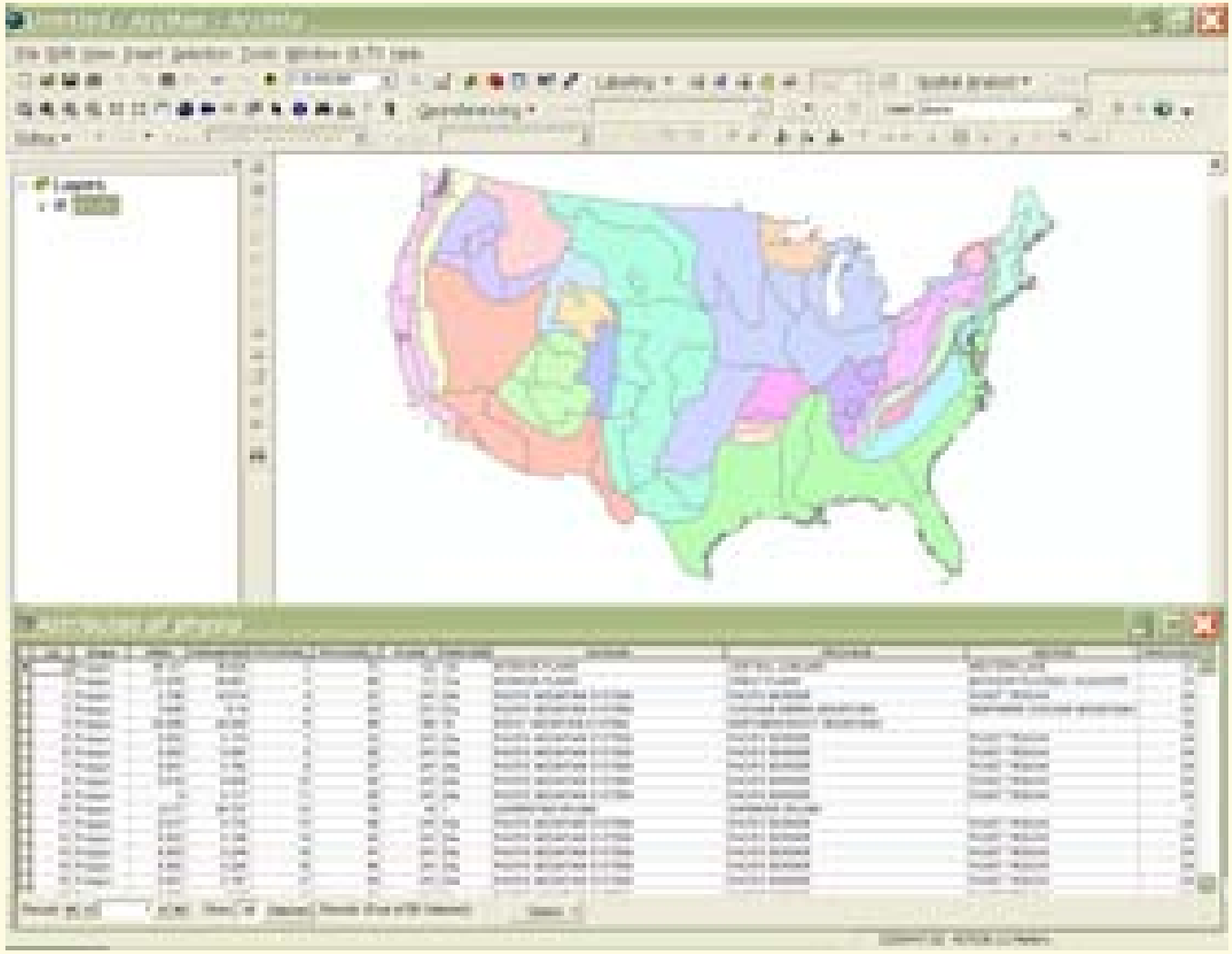
- Infamous Region
- Antiquated Name

How should they be modeled in GIS?

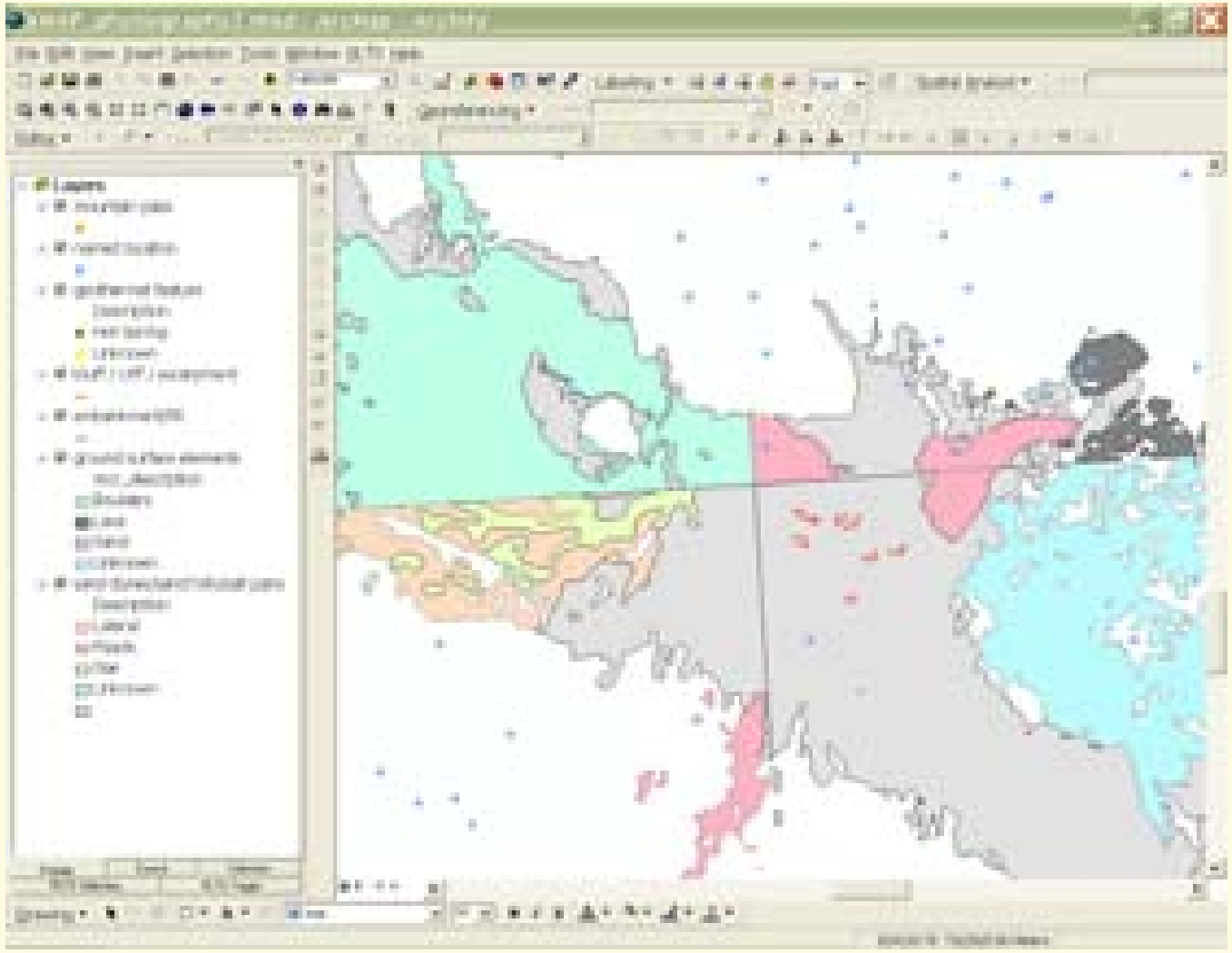
- Geometry: Polygons or sometimes points
- Attributes: Those necessary for map display and data management

- Polygons allow for map products at various scales or scale-less (Internet zoom-able) maps.

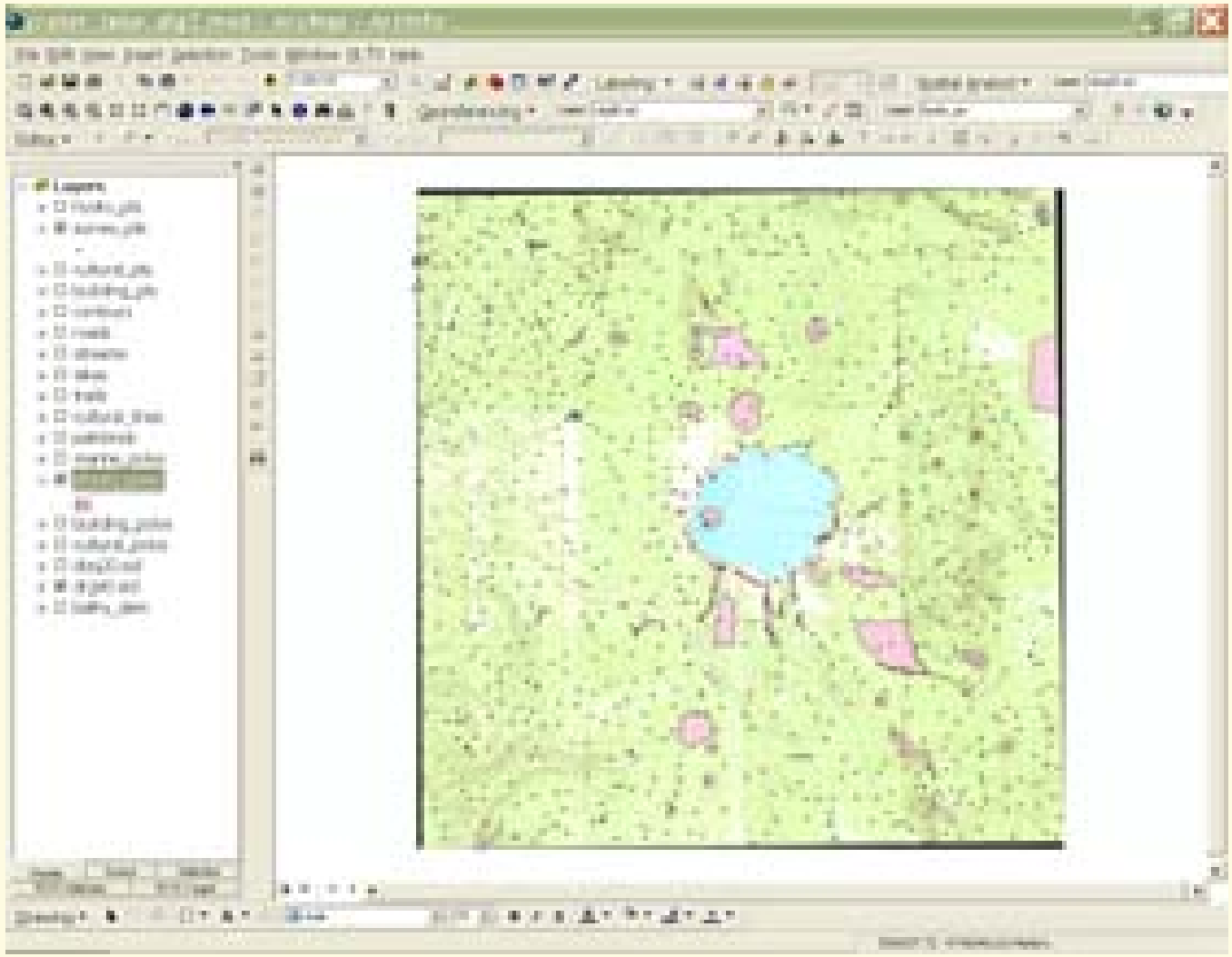
USGS Physiographic Features Dataset

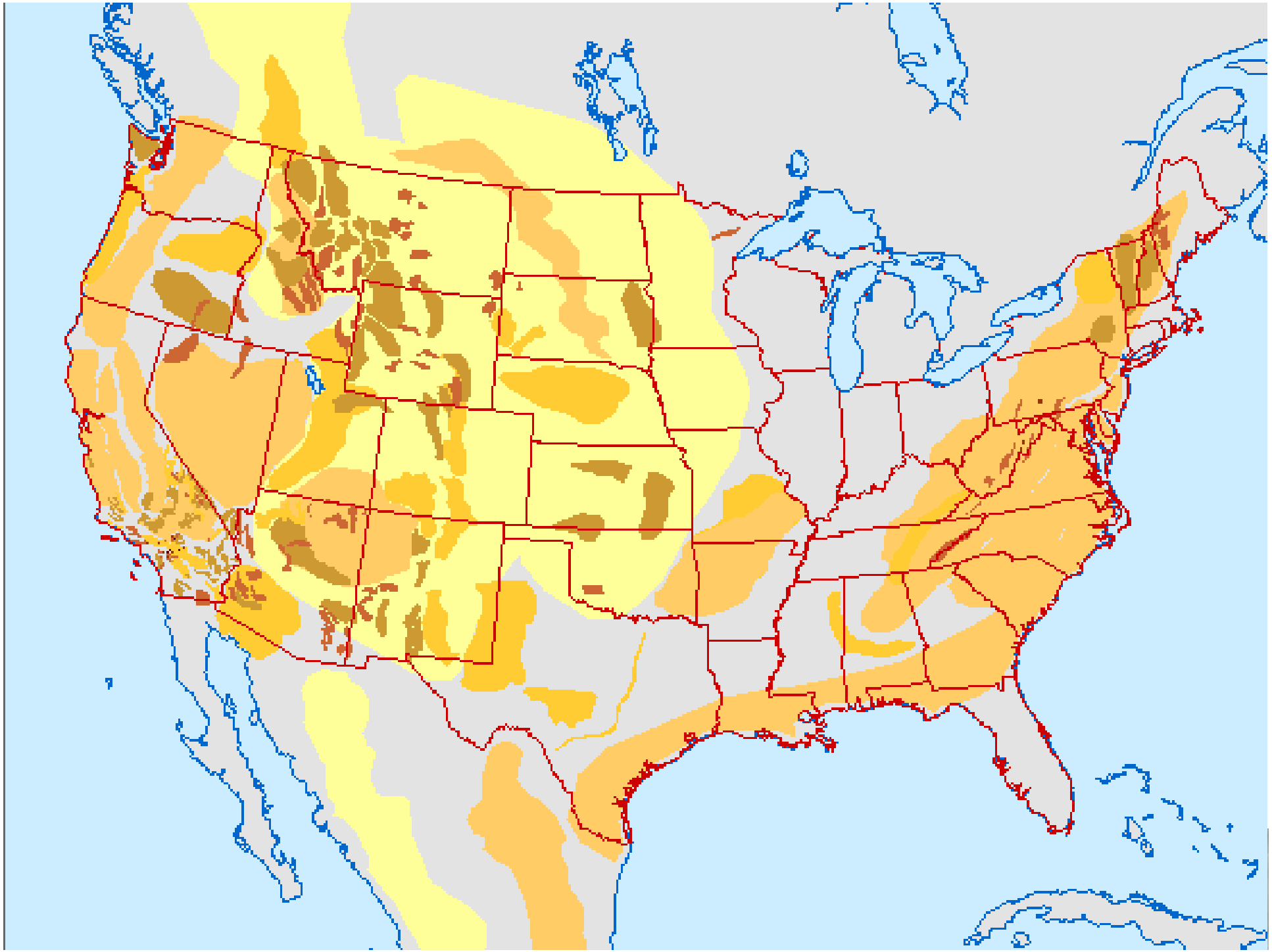


VMAP Physiographic Features Dataset



Frye-Buckley Dataset





Named Marine Water Body Polygon Attributes

- **Name** [Text]: The proper name of the feature as it would appear on the map.
- **SizeClass** [Integer]: Based on the area of the polygon and is used for two purposes: first to determine whether the feature will be represented on a map at a particular scale, and second to determine the size of the text that will be used to represent that feature at that scale.
- **FeatType** [Integer]: For the most part, this is informational, but in cases where the semantics of the name do not match the actual type of feature, this attribute stores the actual feature type.
- **Sources** [Integer]: Ideally used as a primary or foreign key for a join to a look-up table of sources. Unless an agency has performed the primary research to determine the name of a feature, this field can be used to identify at least three independent sources demonstrating that the feature name exists in the public domain.
- **PolyID** [Integer]: Used as a primary or foreign key in a join or relationship to the named physiographic polygon features.

Named Physiographic Point Feature Attributes

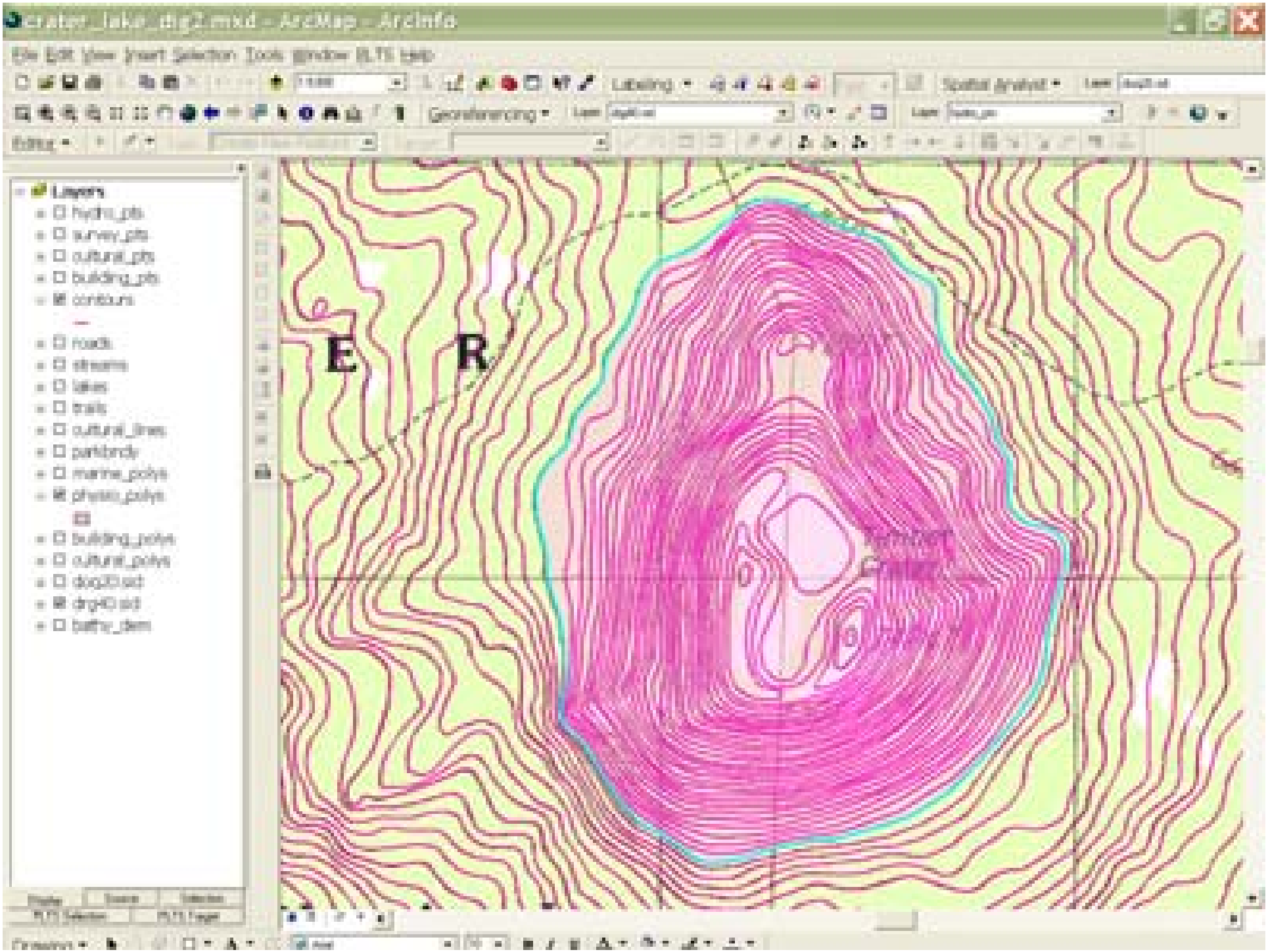
- **Name** [Text]: The proper name of the summit as it would appear on the map.
- **Elevation** [Integer]: An integer only because most maps do not require specification of elevations at the sub-foot or -meter level.
- **FeatType** [Integer]: Used for filtering out smaller features like hills, or for showing only mountain top elevations.
- **Units** [Short Integer or Boolean]: Used to denote whether the elevation is in feet or meters.
- **Sources** [Integer]: Ideally used as a primary or foreign key for a join to a look-up table of sources. Unless an agency has performed the primary research to determine the name of a feature, this field can be used to identify at least three independent sources demonstrating that the feature name exists in the public domain.
- **PolyID** [Integer]: Used as a primary or foreign key in a join or relationship to the named physiographic polygon features.

Named Physiographic Polygon Feature Attributes

- **Name** [Text]: The proper name of the feature as it would appear on the map.
- **FeatType** [Integer]: Used for filtering out smaller features or for showing only selected features.
- **Order** [Integer]: In general, a classification of the size of the features, although the values of this attribute for individual features could also be modified to reflect their notoriety.
- **Sources** [Integer]: Ideally used as a primary or foreign key for a join to a look-up table of sources. Unless an agency has performed the primary research to determine the name of a feature, this field can be used to identify at least three independent sources demonstrating that the feature name exists in the public domain.
- **PolyID** [Integer]: Used as a primary or foreign key in a join or relationship to the named physiographic polygon features.

How should they be captured?

- Digitizing
- Automated Feature Extraction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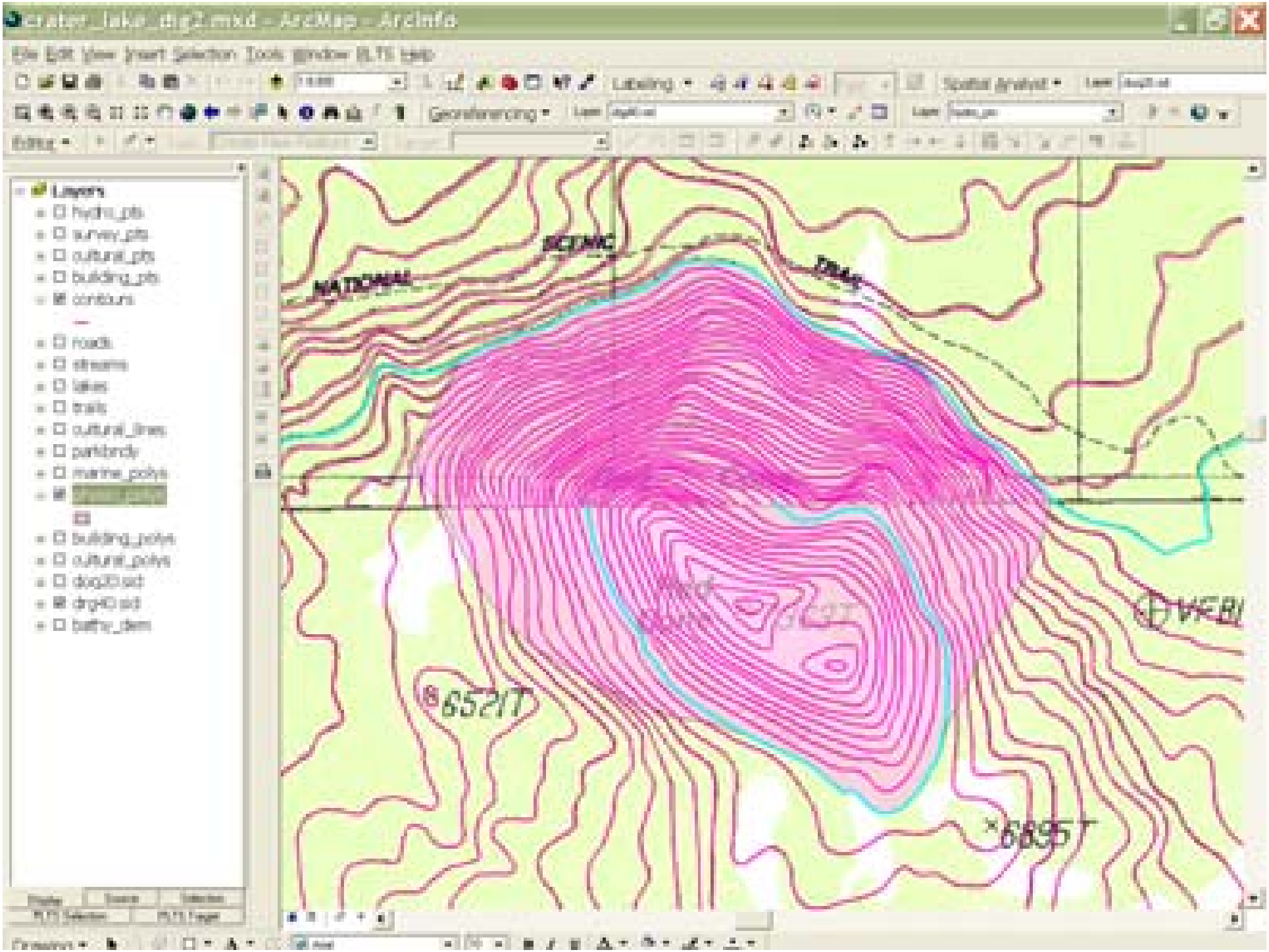
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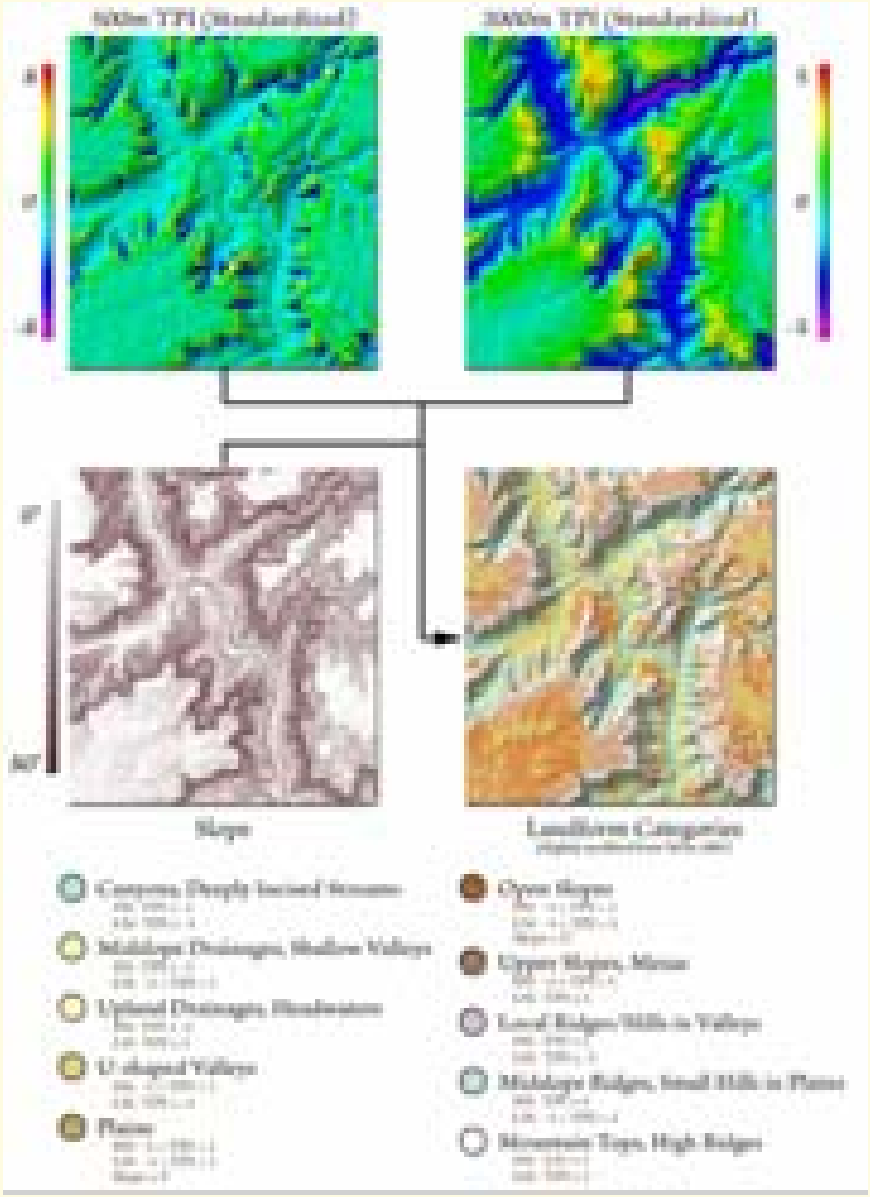
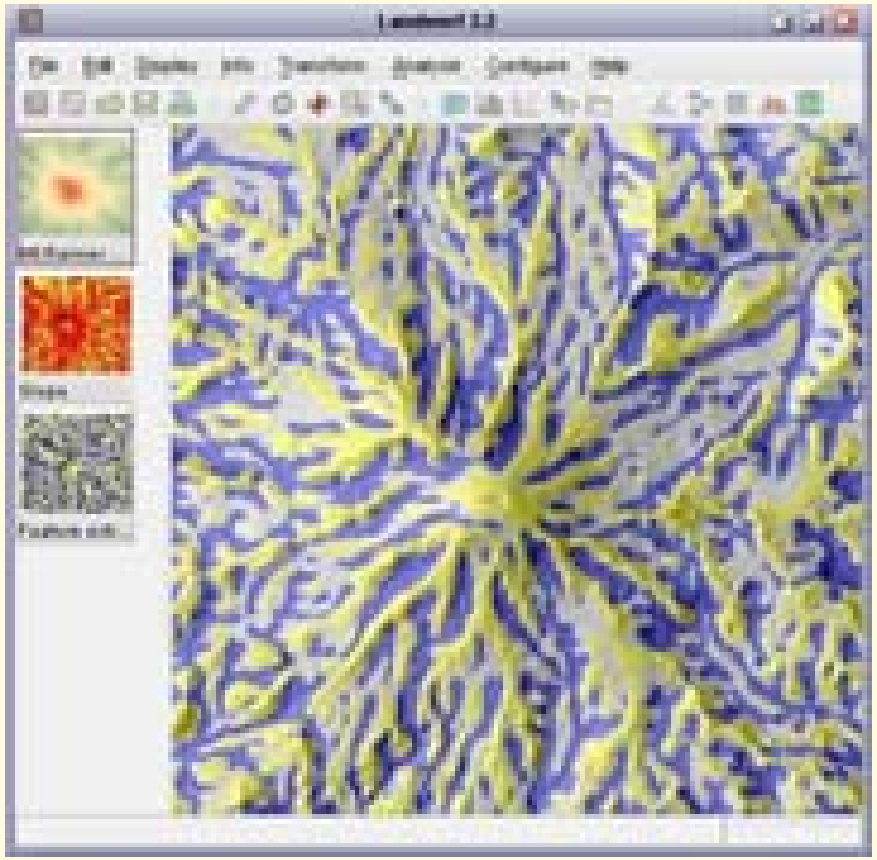
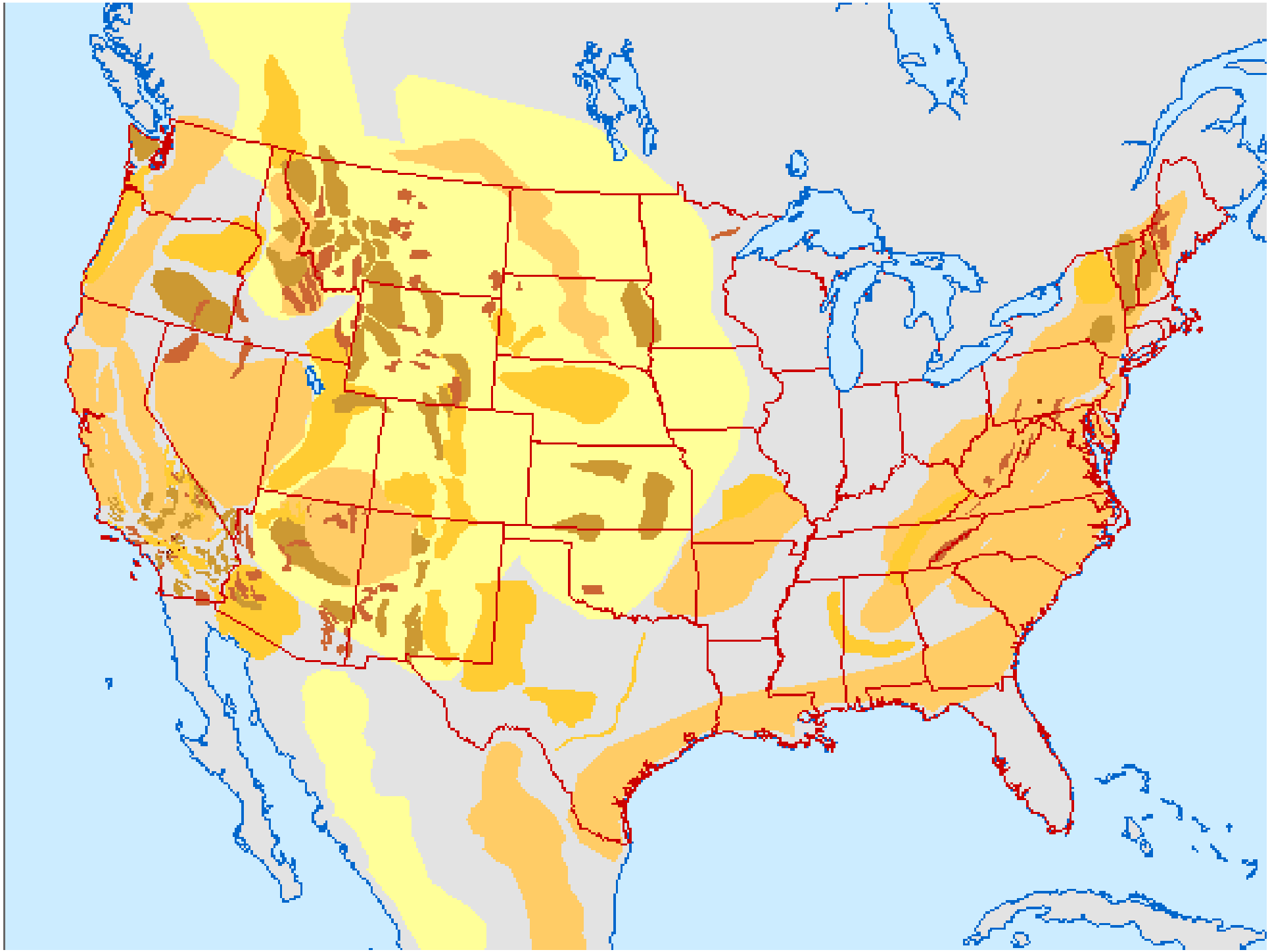
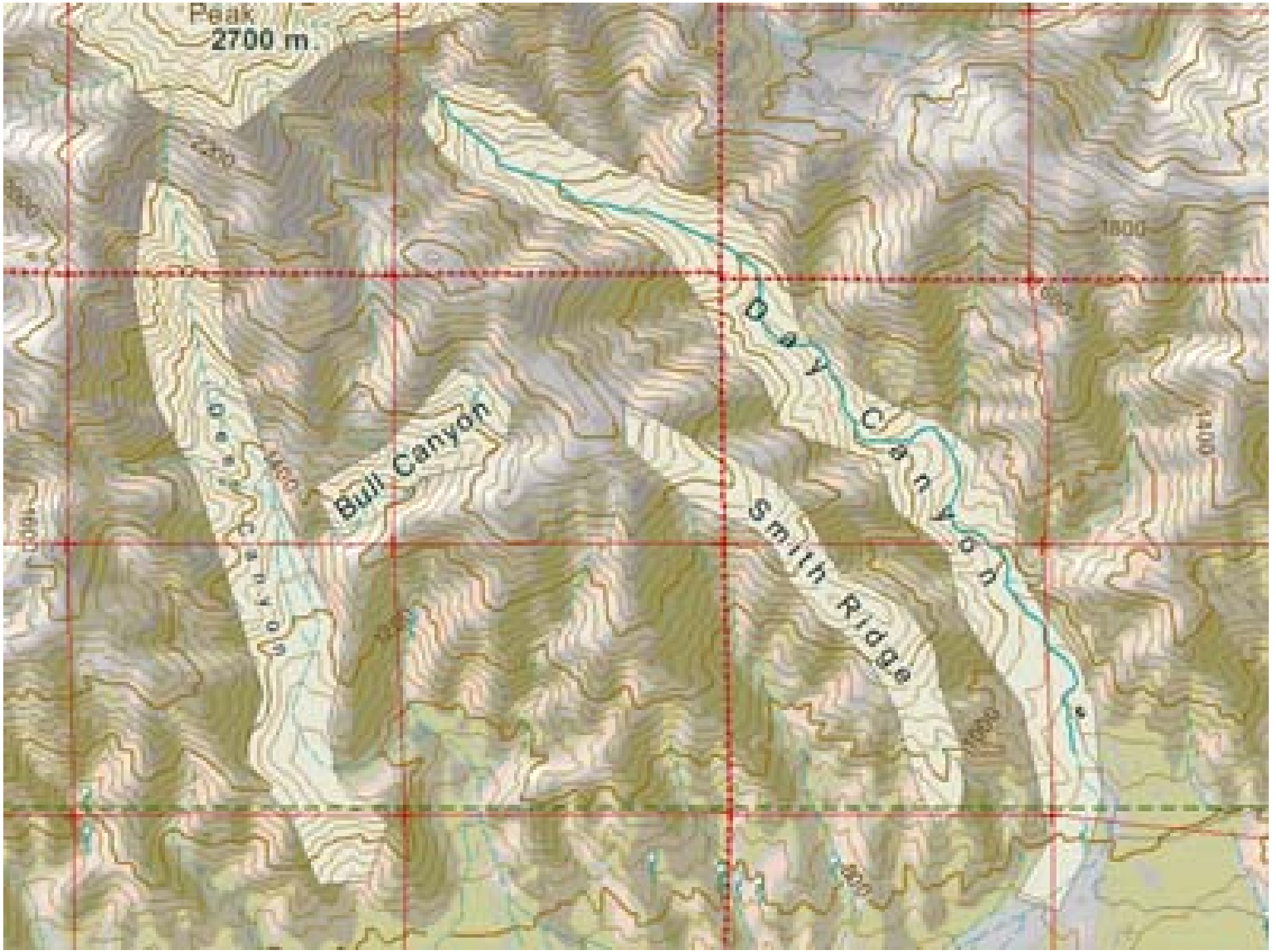




Pit Channel Pass Ridge Peak Planar

How are they used for mapping?




Peak
2700 m.
Bull Canyon
Day Canyon
Smith Ridge
1800
1400

Overview

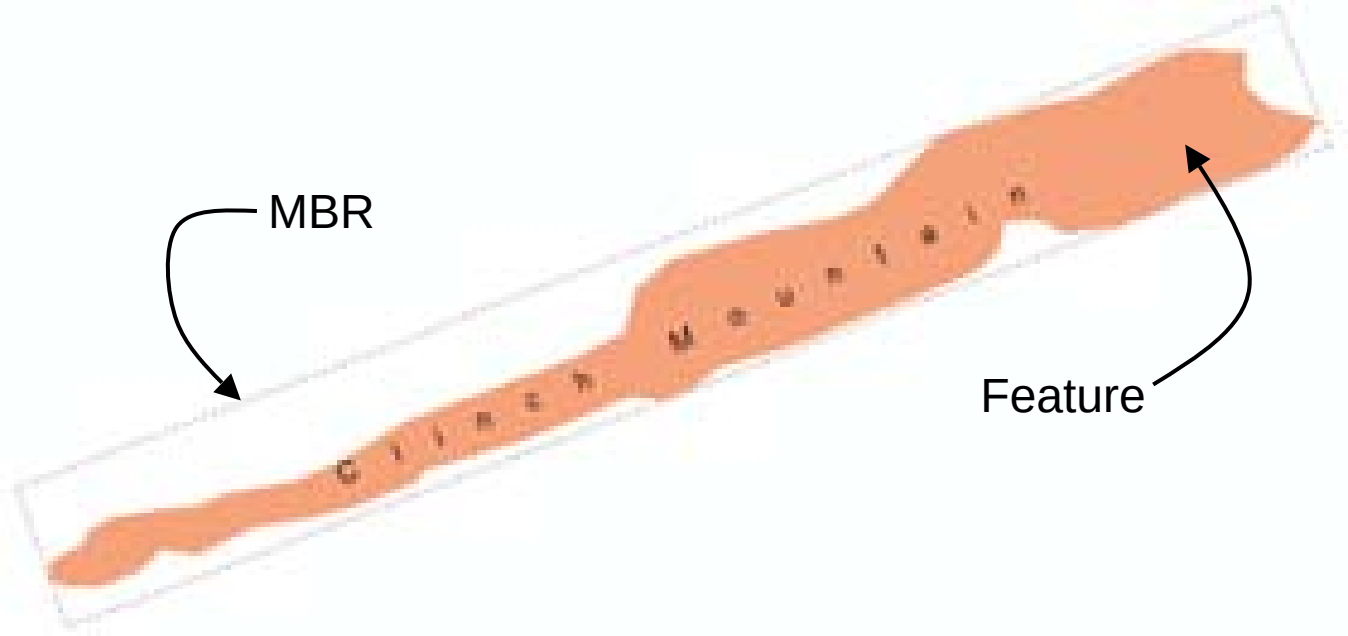
- While Maplex does label many kinds of features very well, one area of deficiency is not being able to tell how to label polygons when faced with a wide variety of shape types
- Thus, the goal is to fill a need to differentiate polygons based on their shape as it relates to Maplex text placement rules and options

Problem

- We need a way to tell when a feature should be labeled with a horizontal or a curved label
  - At a high level, Maplex does not distinguish between polygons that are long versus round
  - Many features are not simply long or round

Methodology

- Use information about how each polygon relates to its Minimum Bounding Rectangle (MBR)
  - Shape_Area/MBR_Area as %
  - Ratio of MBR Length to Width



7 Types of Shapes for Labeling Natural Feature Polygons

1. Roundish
2. Oblong
3. Long
4. Long and Skinny
5. Splotch
6. Snaky or Pronged
7. Snakey or Pronged and Skinny

Steps for Deriving Shape Types

- Add Fields (attributes) to data to contain
  - Label Type
  - MBRArea (optional for tuning and analysis)
  - L2WRatio (optional for tuning and analysis)
  - SizeClass (optional)
- Calculate MBRs
  - ArcGIS 9.2 Geoprocessing method
    - **`Geometry.HullRectangle`**
    - Returns a string with 8 coordinates (x_1,y_1,x_2,y_2,x_3,y_3,x_4,y_4)

Logic for Assigning Label Types

- If RatioL2W < 4 and MBRArea > 60%
  - Label Type = “Roundish”
- Elseif RatioL2W < 8 and MBRArea > 25%
  - LabelType = “Oblong”
- Elseif RatioL2W >= 8 and MBRArea > 10%
  - LabelType = “Long”
- Elseif RatioL2W >= 8 and MBRArea <= 10%
  - LabelType = “Long and Skinny”
- Else
  - If RatioL2W < 4 and MBRArea >= 20%
    - Label type = “Splotch”
  - Elseif RatioL2W < 8 and MBRArea > 12%
    - Label Type = “Snaky or Pronged”
  - Elseif RatioL2W < 8 and MBRArea <=12%
    - Label Type = “Snakey or Pronged and Skinny”

Physiography

Roundish

- L2W = 2
- MBR = 60%
- Maplex Labeling
  - Placement = Curved
  - Try Horizontal First = True
  - May Stack = True
  - Character Spacing = Up to 200%

Physiography

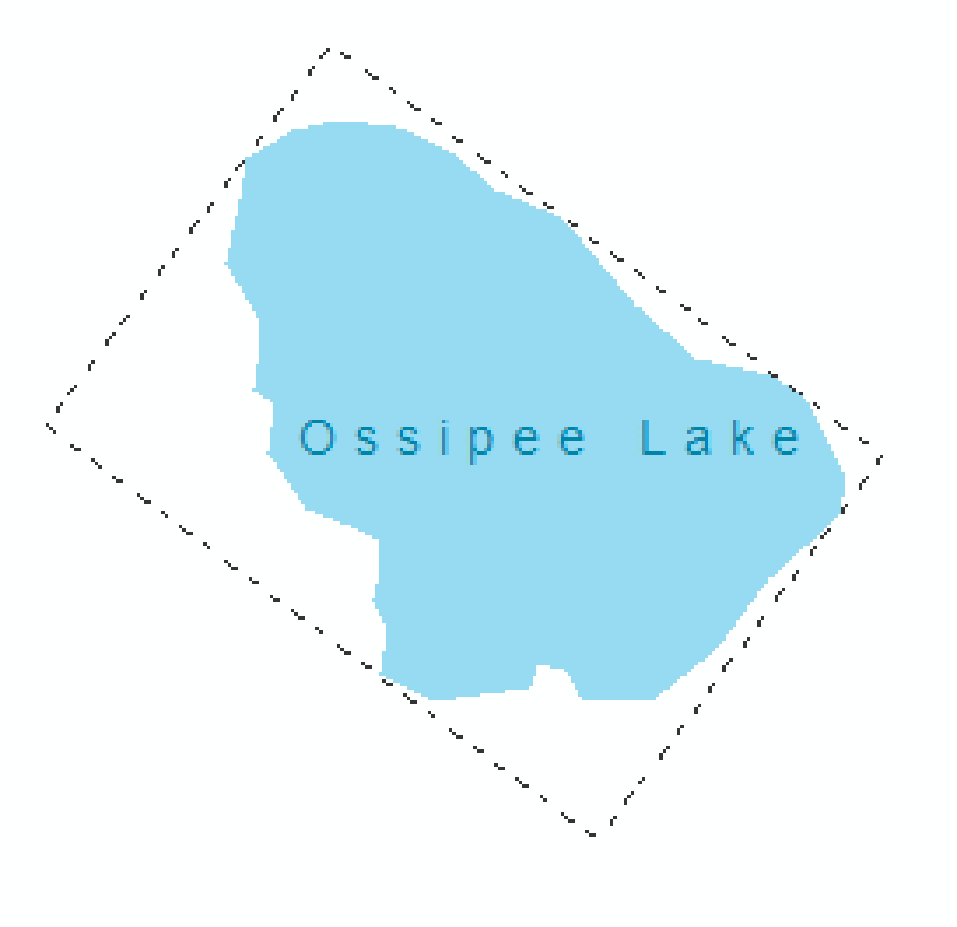
Roundish – Alternate

- L2W = 2
- MBR = 60%
- Maplex Labeling
  - Placement = Curved
  - May Overrun by 36 pts
  - Character Spacing = up to 200%

Hydrography

Roundish

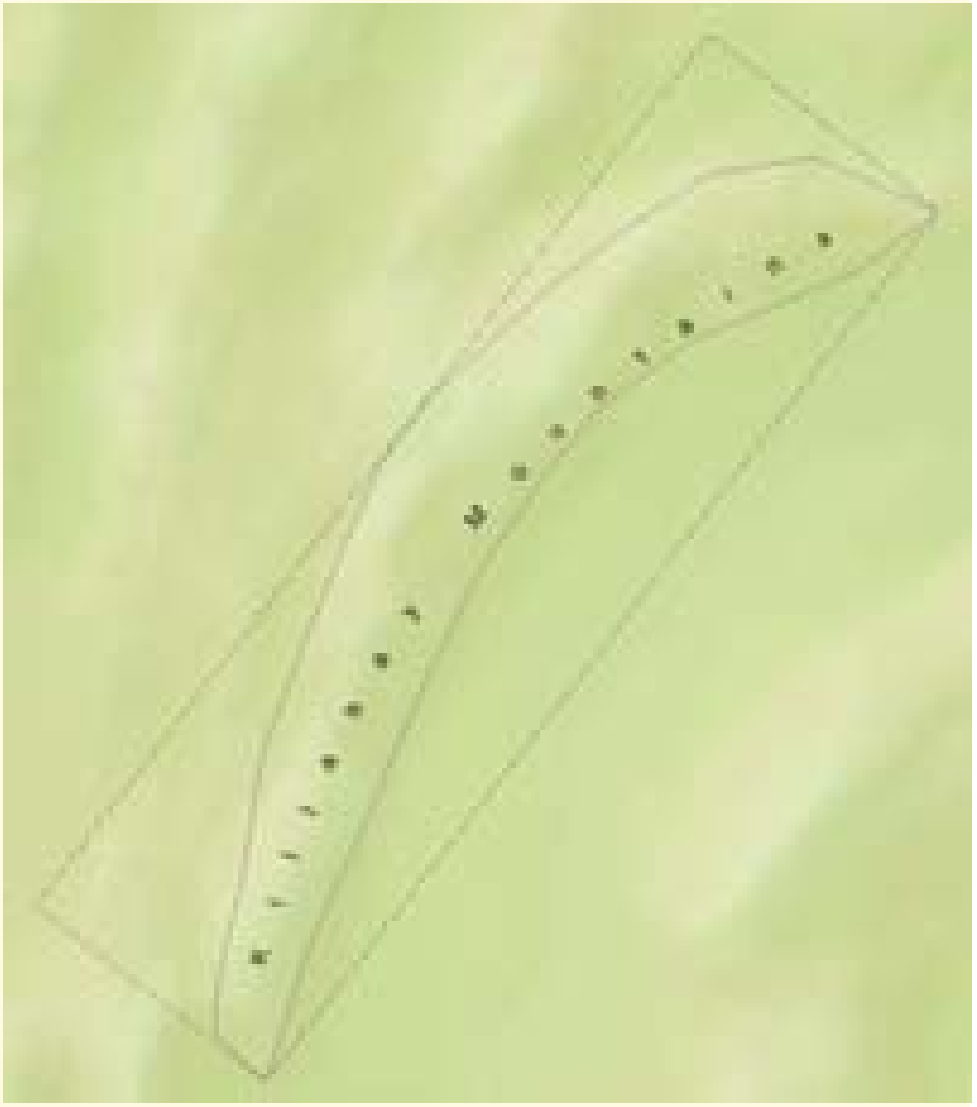
- L2W = 1
- MBR = 69%
- Maplex Labeling
  - Placement = Curved
  - Try Horizontal First = True
  - May Stack = true
  - May Overrun by 36 pts
  - Character Spacing = up to 180%



Physiography

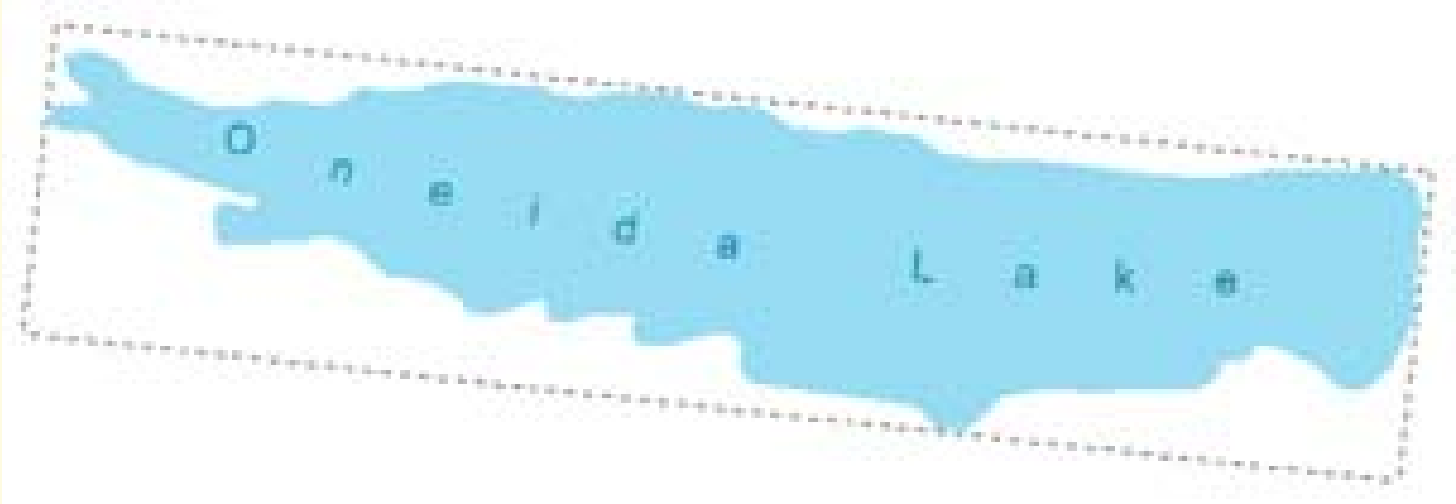
- L2W = 4
- MBR = 43%
- Maplex Labeling
  - Placement = Curved
  - May Overrun by 36 pts
  - Character Spacing = up to 200%

Oblong



Hydrography Long

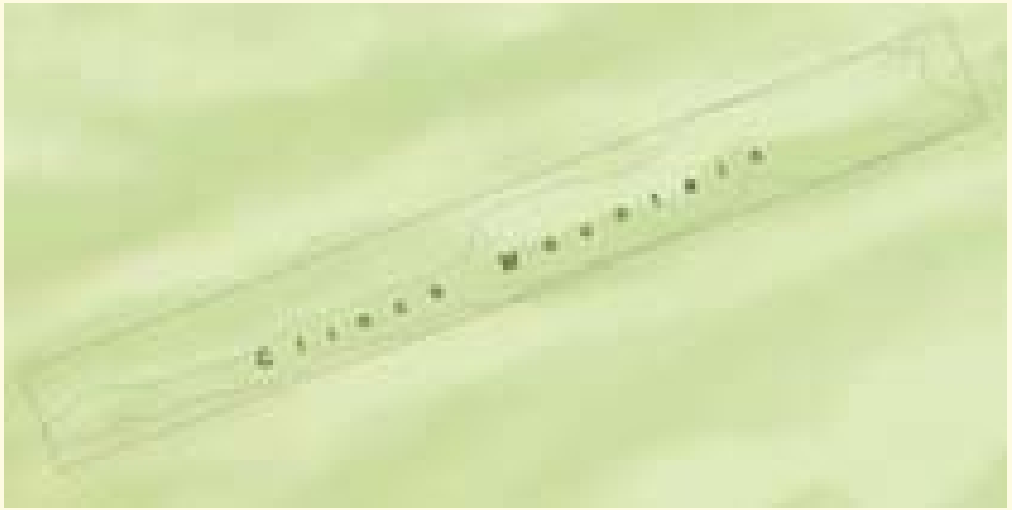
- L2W = 4
- MBR = 64%
- Maplex Labeling
  - Placement = Curved
  - Reduce Font from 14 to 10 by 1 pt increments
  - Character Spacing = up to 300%



Physiography

Long

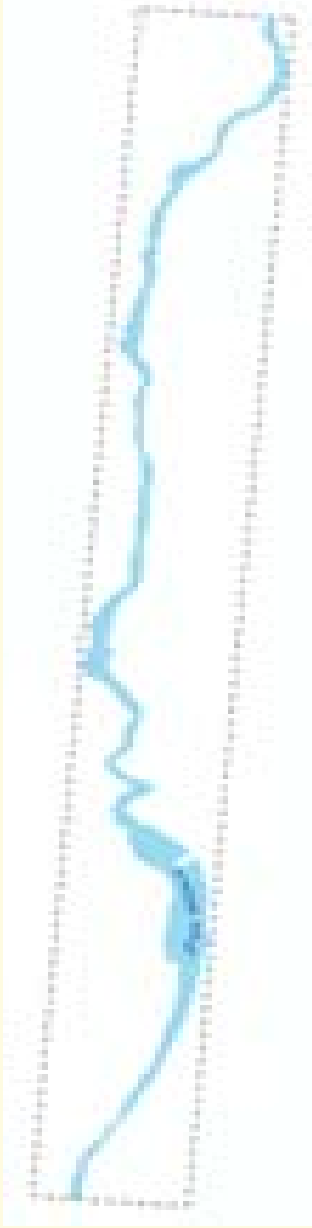
- L2W = 9
- MBR = 57%
- Maplex Labeling
  - Placement = Curved
  - May Overrun by 36 pts
  - Character Spacing = up to 300%



Hydrography

Long

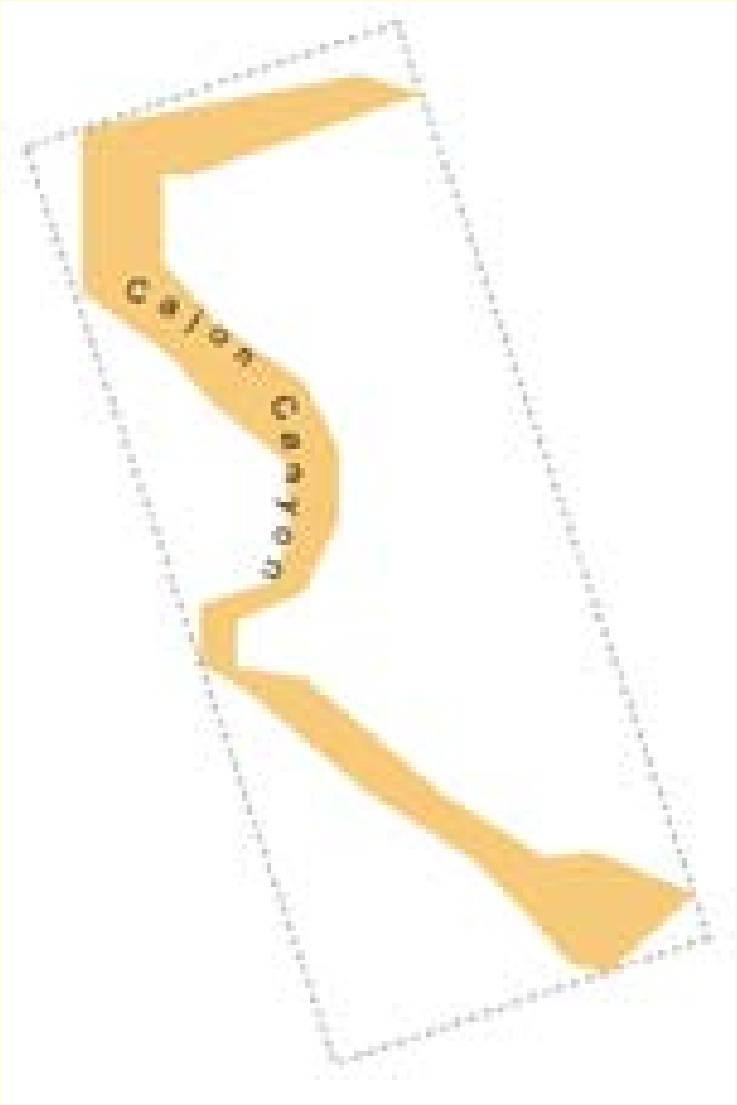
- L2W = 9
- MBR = 11%
- Maplex Labeling
  - Placement = Curved
  - May Overrun by 12 pts
  - Character Spacing = up to 300%



Physiography

- L2W = 2
- MBR = 21%
- Maplex Labeling
  - Placement = Curved
  - Reduce Font from 15 to 11 by 1 pt increments

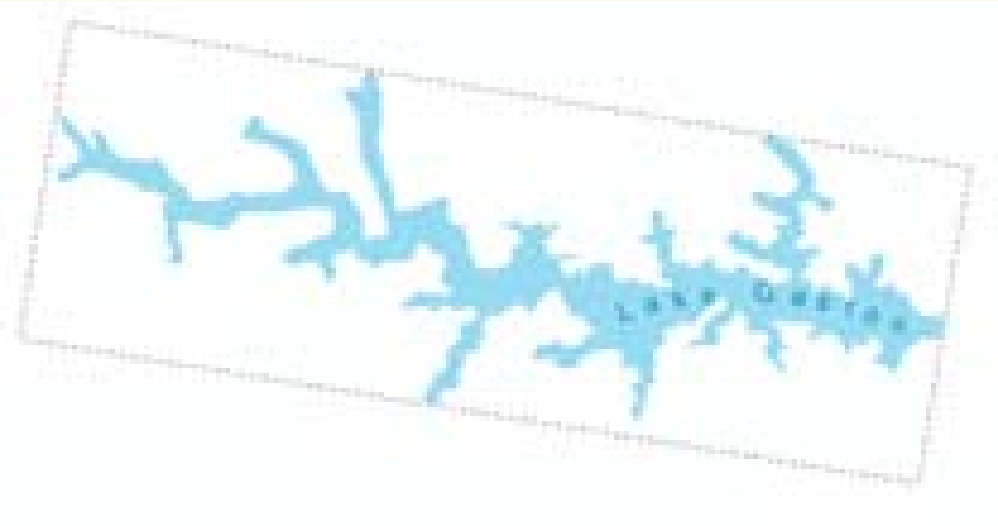
Splotch



Hydrography

Splotch

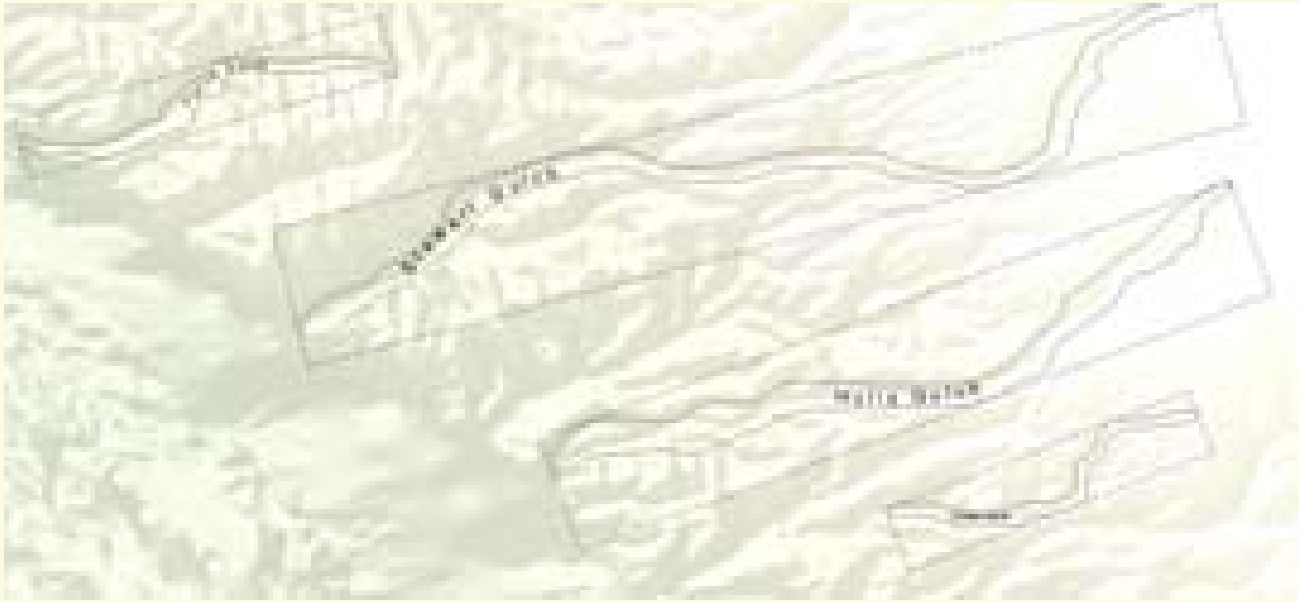
- L2W = 3
- MBR = 20%
- Maplex Labeling
  - Placement = Curved
  - Character Spacing = up to 500%



Physiography

Snaky or Pronged

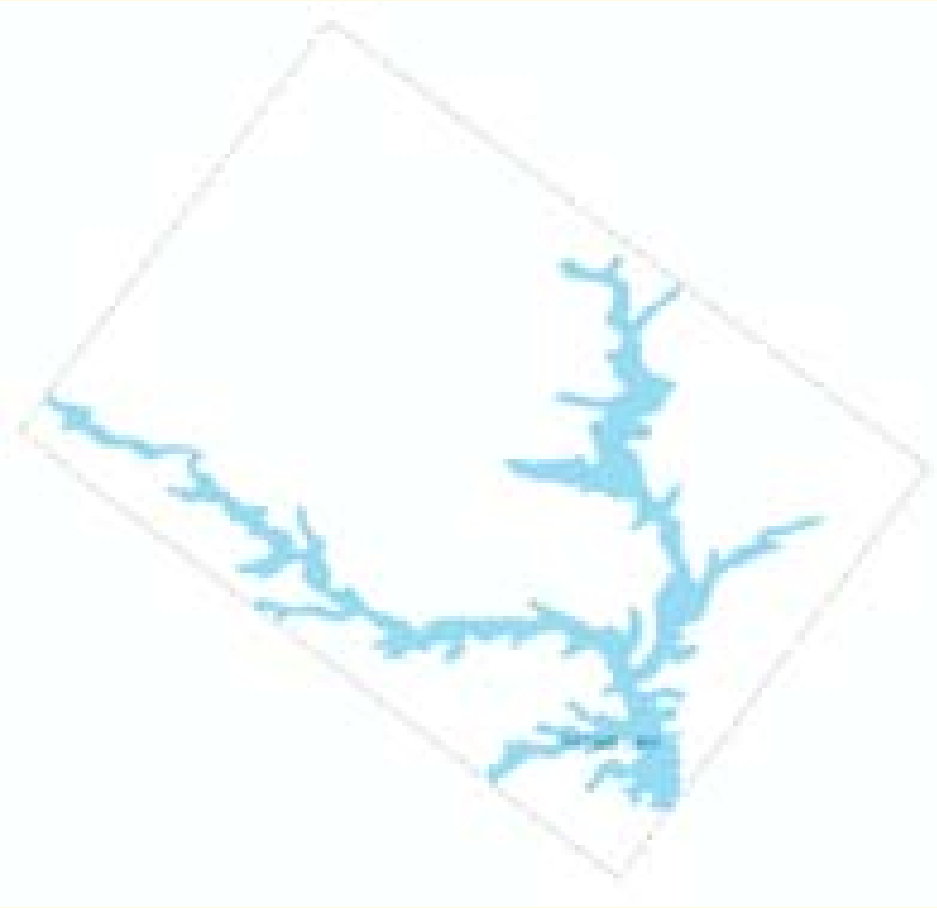
- L2W = 7
- MBR = 15%
- Maplex Labeling
  - Placement = Curved
  - May Overrun by 12 pts
  - Character Spacing = up to 400%



Hydrography

Snaky or Pronged

- L2W = 1
- MBR = 12%
- Maplex Labeling
  - Placement = Curved
  - May Overrun by 17 pts
  - Reduce font from 14 to 8 by 2
  - Character Spacing = up to 400%
- Note – horizontal placement is Maplex's last resort solution



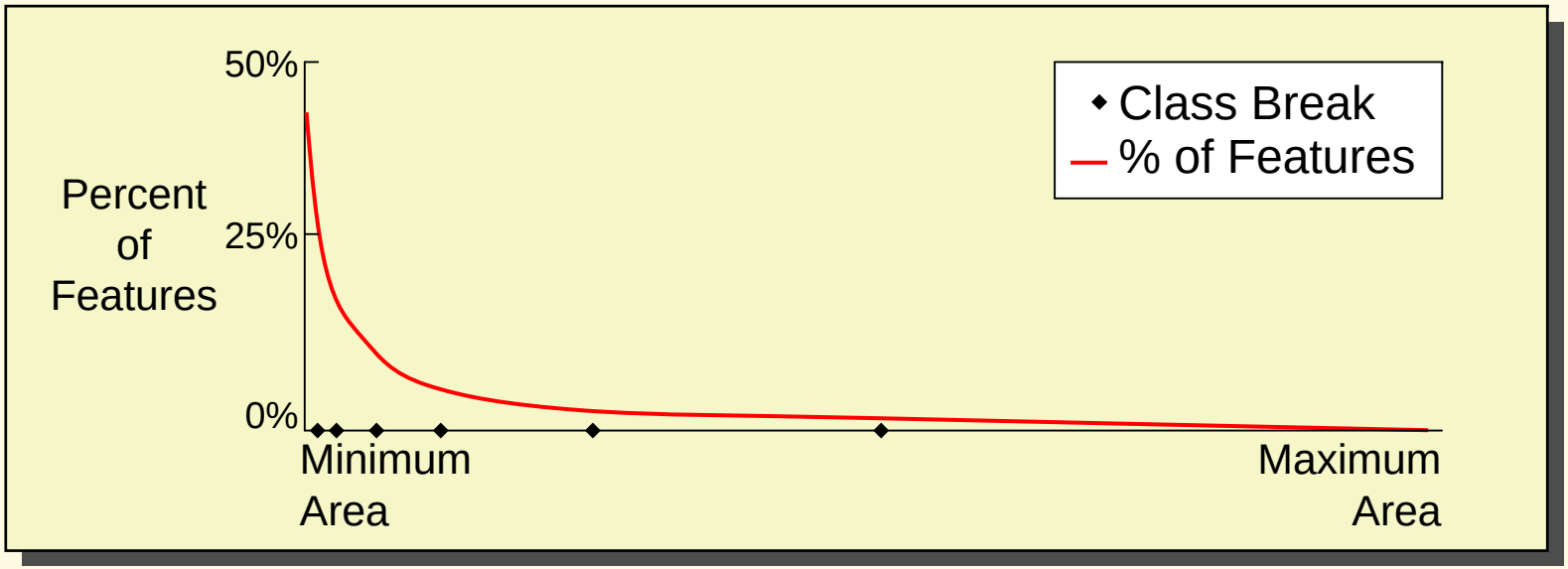
Hydrography

- L2W = 2
- MBR = 4%
- Maplex Labeling
  - Placement = Boundary
  - May Place Outside = True
  - Offset = 4 pts
  - Character Spacing = up to 240%
  - Background Label = True
- OR use these features to select lines and label the lines instead of these polygon features

Snaky or Pronged and Skinny

Logic for Assigning Size Classes

- Method 1: Equal interval
  - Divide range of Shape_Area evenly by number of size classes
  - Good for just 2 or 3 classes
- Method 2: Binary Regression
  - f(½x) where x is the remaining area
  - Good for 4+ classes



What are the implications of all this?

- This approach could be used for other types of features
  - Regions: “Eastern Europe”, “Ancient Greece”
- Leads to the production of data sets that can be used by many for many things
- Leads to better maps!