Modeling Urban Sprawl: from Raw TIGER Data with GIS

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Problem

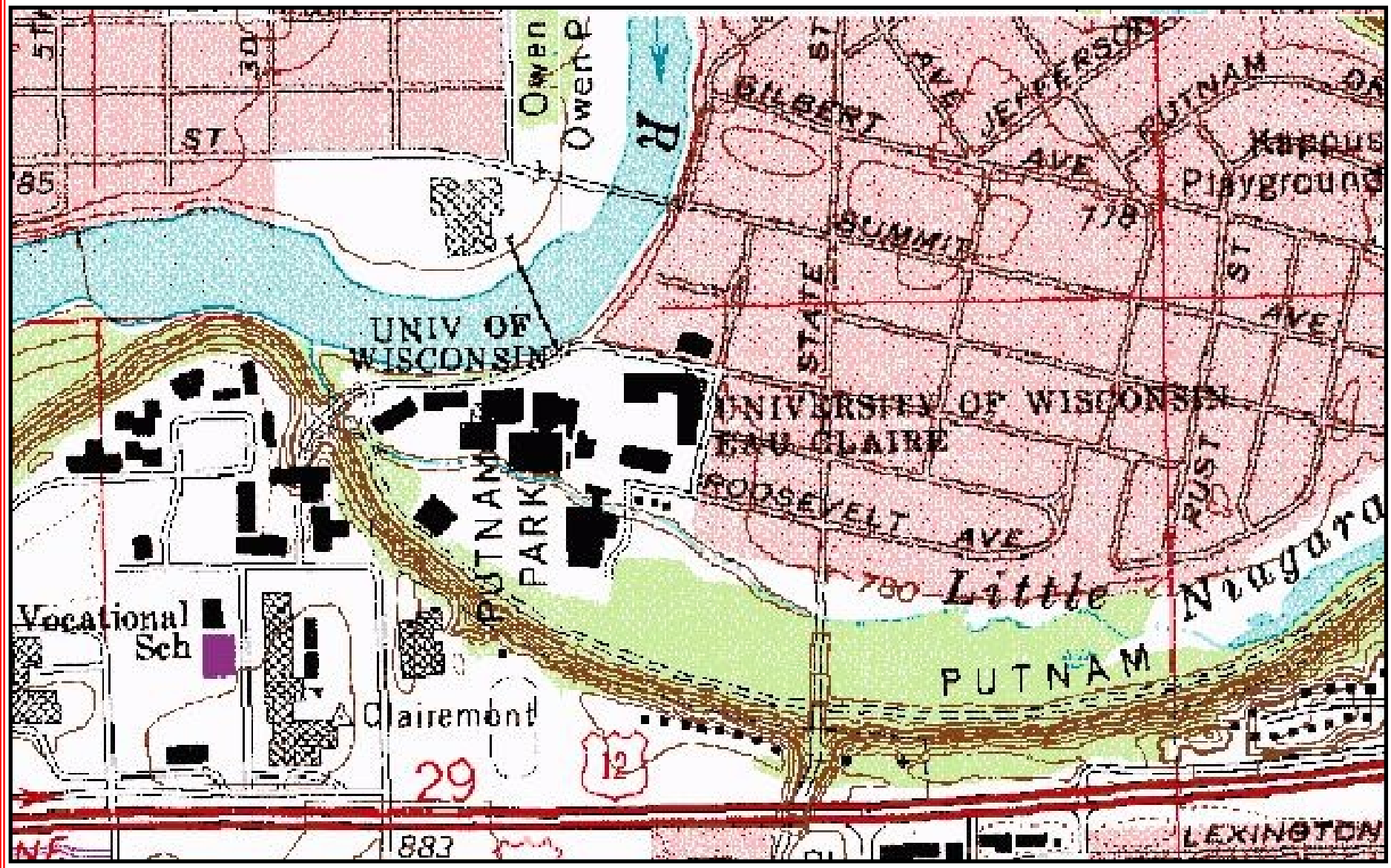
- How to model & predict urban expansion.
- Plan for:
  - City services.
  - Schools.
  - Traffic flows.

Traditional Methods

- Population density.
- Building density.
- Building permits.
- Utility hookups.
- All are difficult and expensive to collect.
- Hard to construct a time sequence.
- Most are “near real time”.

Borchert's Methodology

- Borchert, John “The Twin Cities Urbanized Area: Past, Present, Future”, *Geographical Review,* Vol. 51, No. 1 (January 1961), pp. 47-70.
- Counted street intersections per square mile off 7.5” topographic sheets.
- Key idea = development follows roads.
- Problems:
  - Sheets can be old.
  - Adjacent sheets published at different times.


Owen
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GILBERT
AVE
JEFFERSON
PUTNAM
Kappus
Playground
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WISCONSIN
UNIVERSITY OF WISCONSIN
EAU CLAIRE
ROOSEVELT AVE
RUST
PUTNAM
PARK
780
Little
Niagara
Vocational
Sch
PUTNAM
Clairemont
29
12
883
LEXINGTON

This Paper

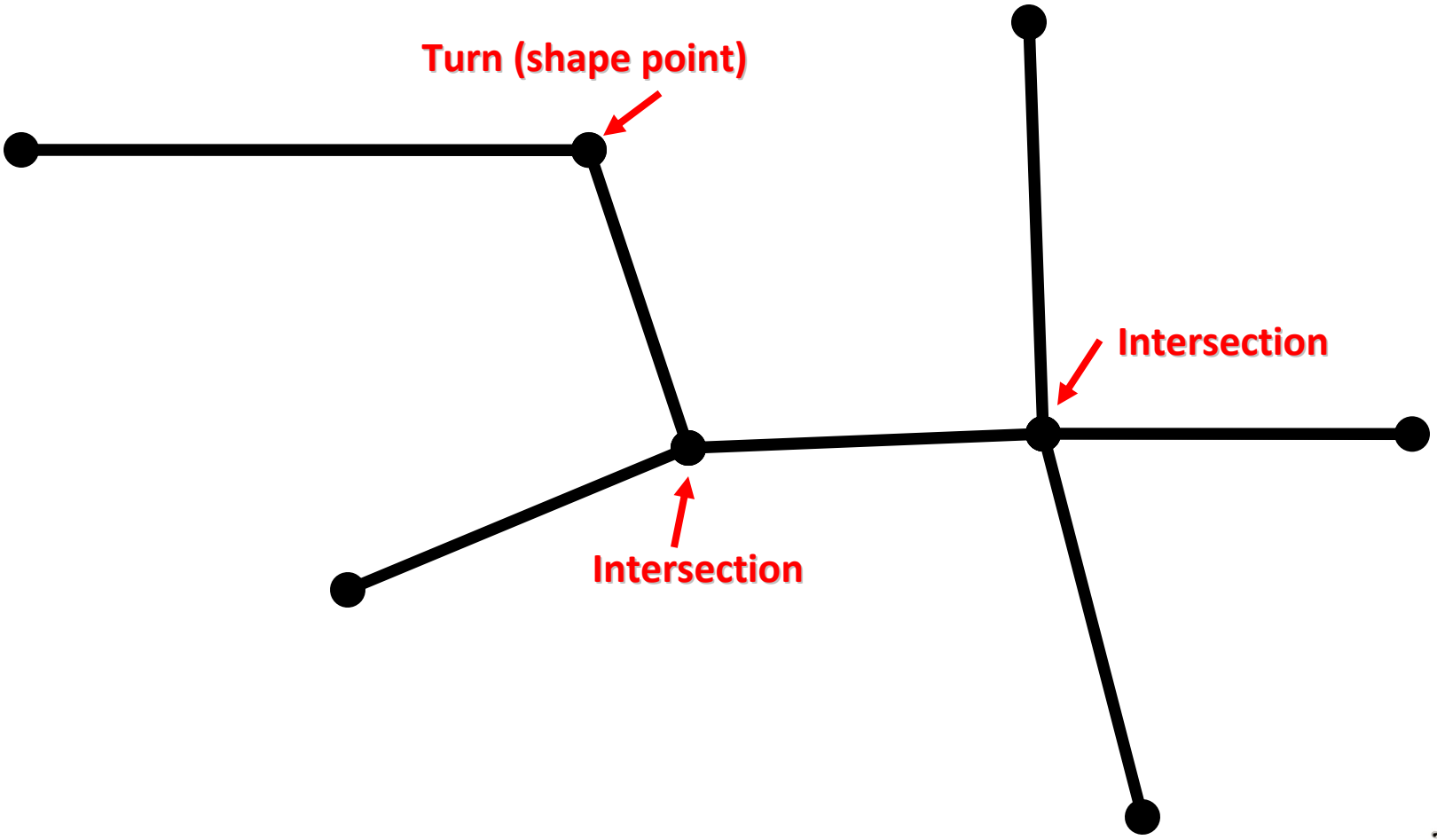
- Examines the use of raw Bureau of the Census TIGER data to model urban sprawl.
- Thesis:
- Network density is an excellent way to anticipate urban infilling.
- Annual updates of TIGER provide historical data that can be projected ahead using geostatistical analysis

TIGER

- Now released at least annually.
- Constant updating (positional accuracy).
- Constant updating (new roads/streets).
- Provides basis for determining intersections per square mile.

TIGER Basics

- File of nodes.
- Create lines and polygons with “connect the dots” routines using underlying database.
- Intersections = multiple nodes in same location.


Turn (shape point)
Intersection
Intersection

Intersection "Rules"

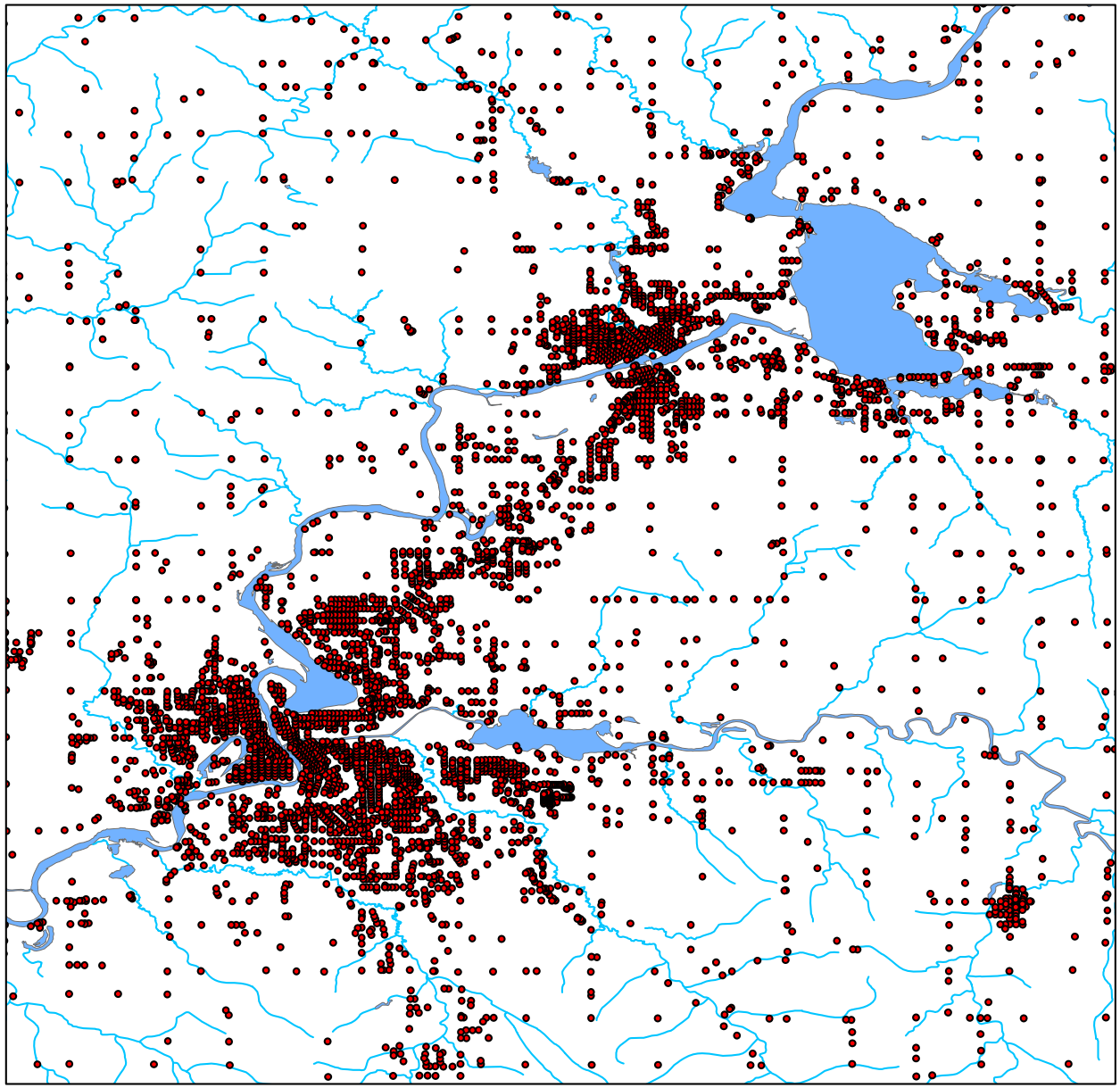
- Must be a street node (feature)
- Three or more street nodes with same location (lat/lon) = intersection.
- Grid for calculating intersections per square mile must be clipped with water features.

Raw TIGER

- Drop base file into dBase.
- Delete all non-street features.
- Concatenate lat/lon (alpha).
- Convert lat/lon to text (LATLON).
- Concatenate.
- Total on LATLON to new file.
- Delete any record where count < 3.
- De-concatenate LATLON to two numeric fields.
- Create event layer.

Intersections Eau Claire, WI Metropolitan Area

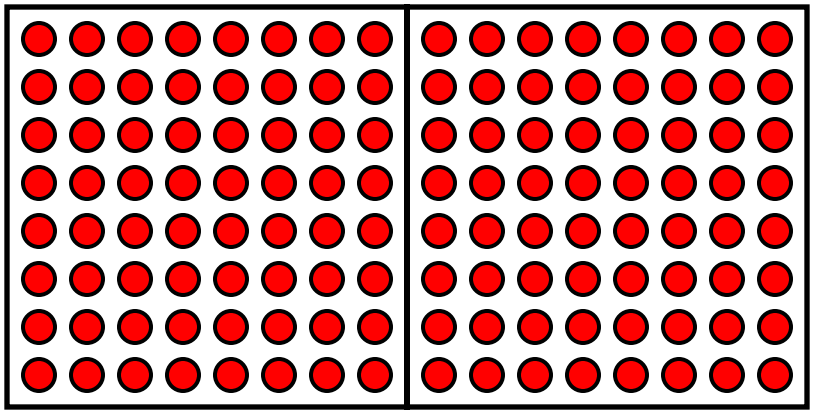
**Each dot =
1 intersection**

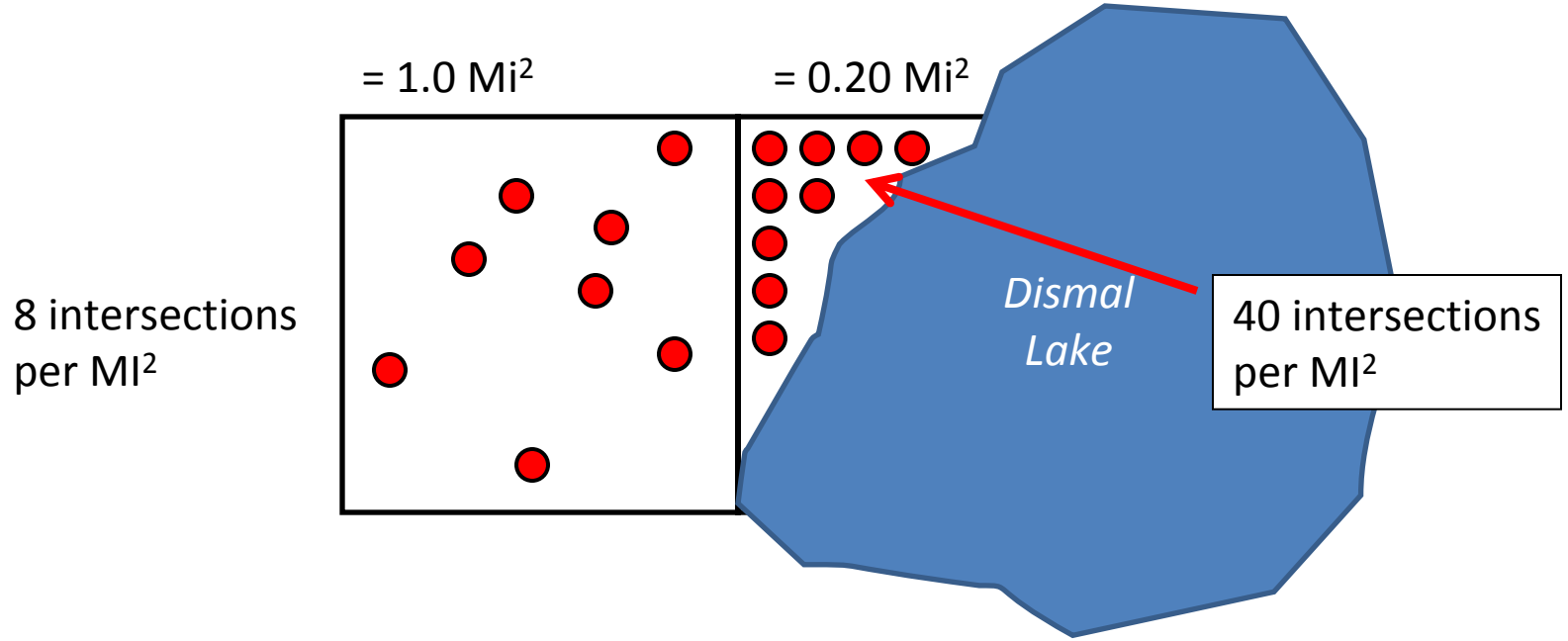


Intersections per Sqare Mile

- Generate grid (1 mile, ¼ mile, etc.)
- Spatial join to obtain per cell count.
- Problem – have to clip grid where housing is impossible (lake, river, ocean).

Each cell = on square mile.
Each cell has 64 intersections.
Intersection density = 64 per square mile





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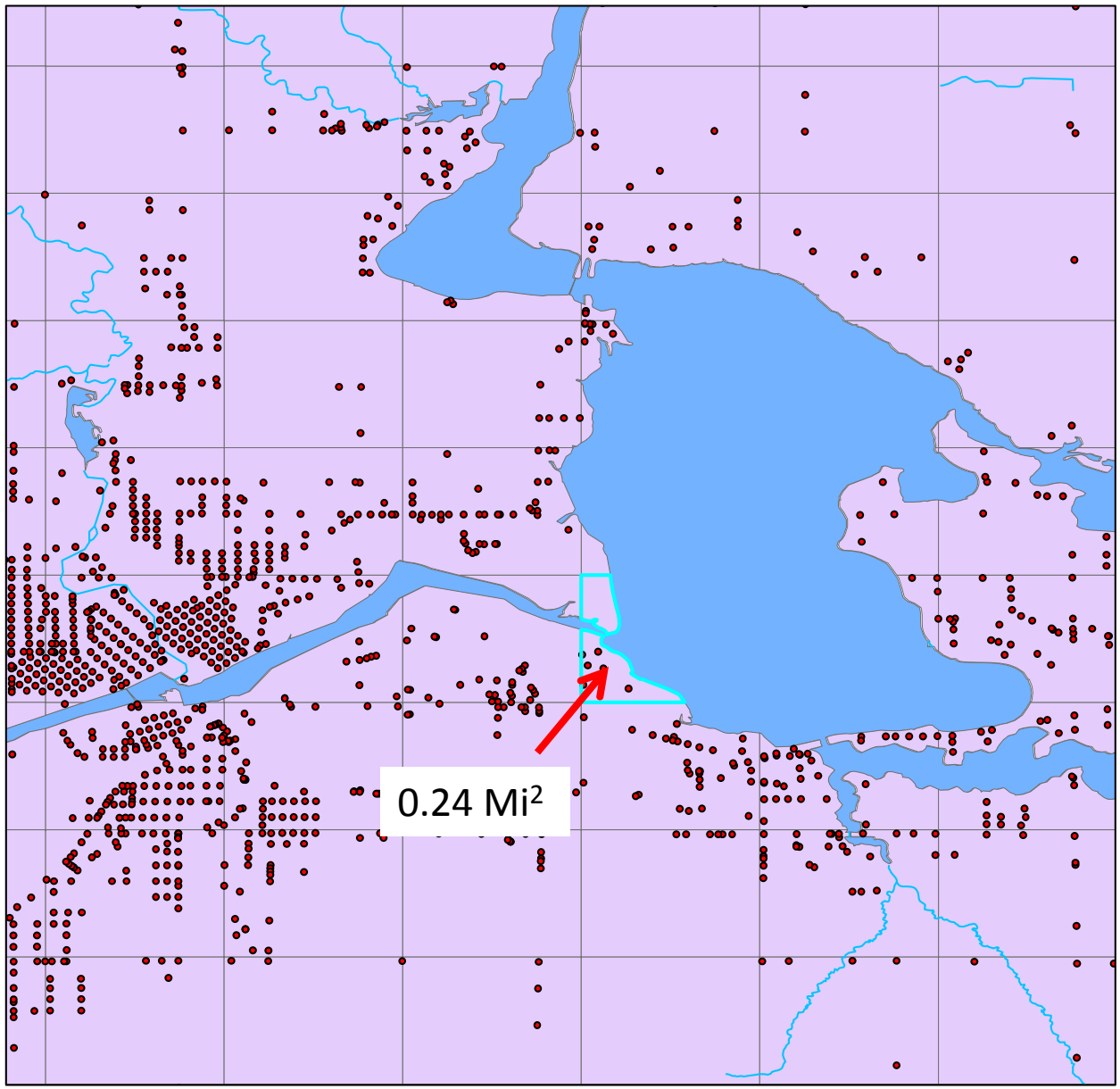
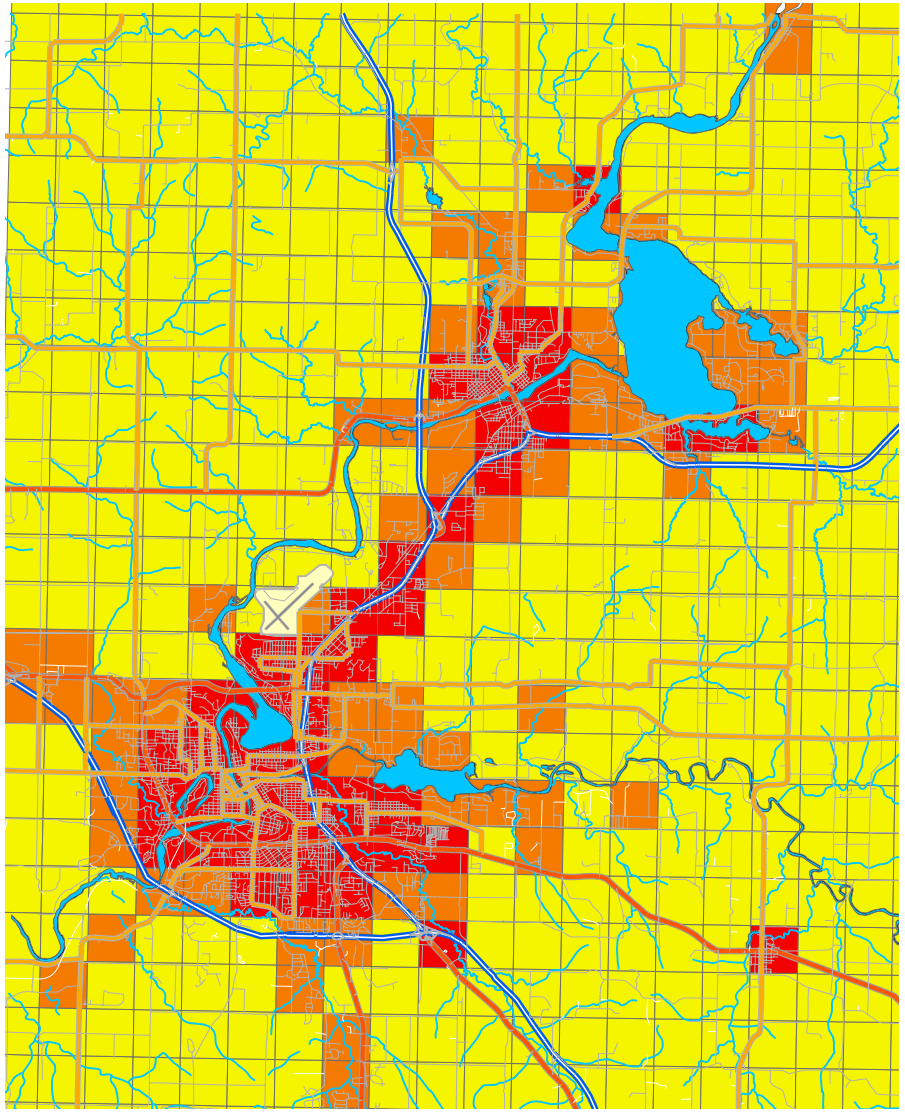


TIGER Intersections per Square Mile



1 Mile Grid

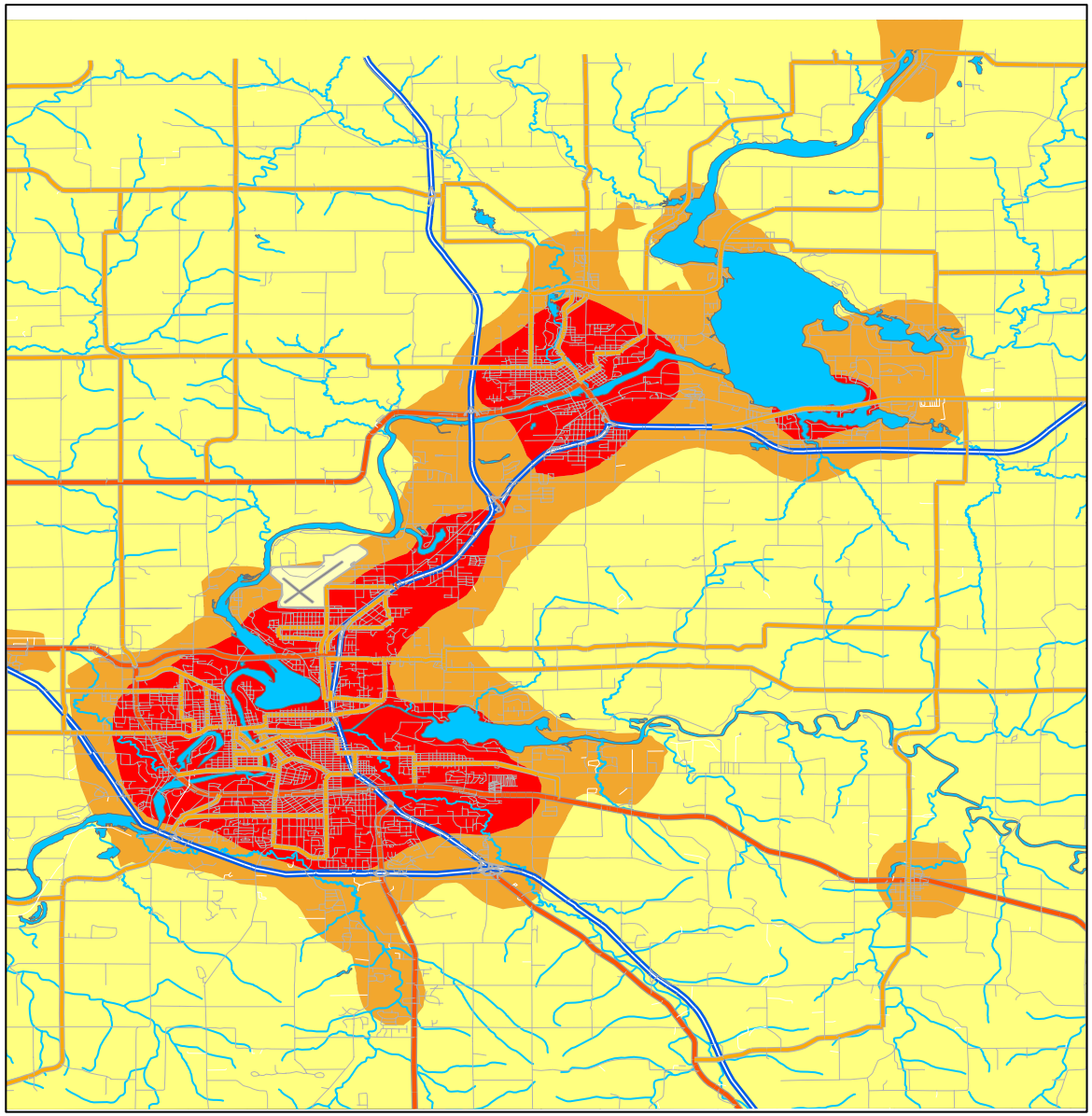
Categories

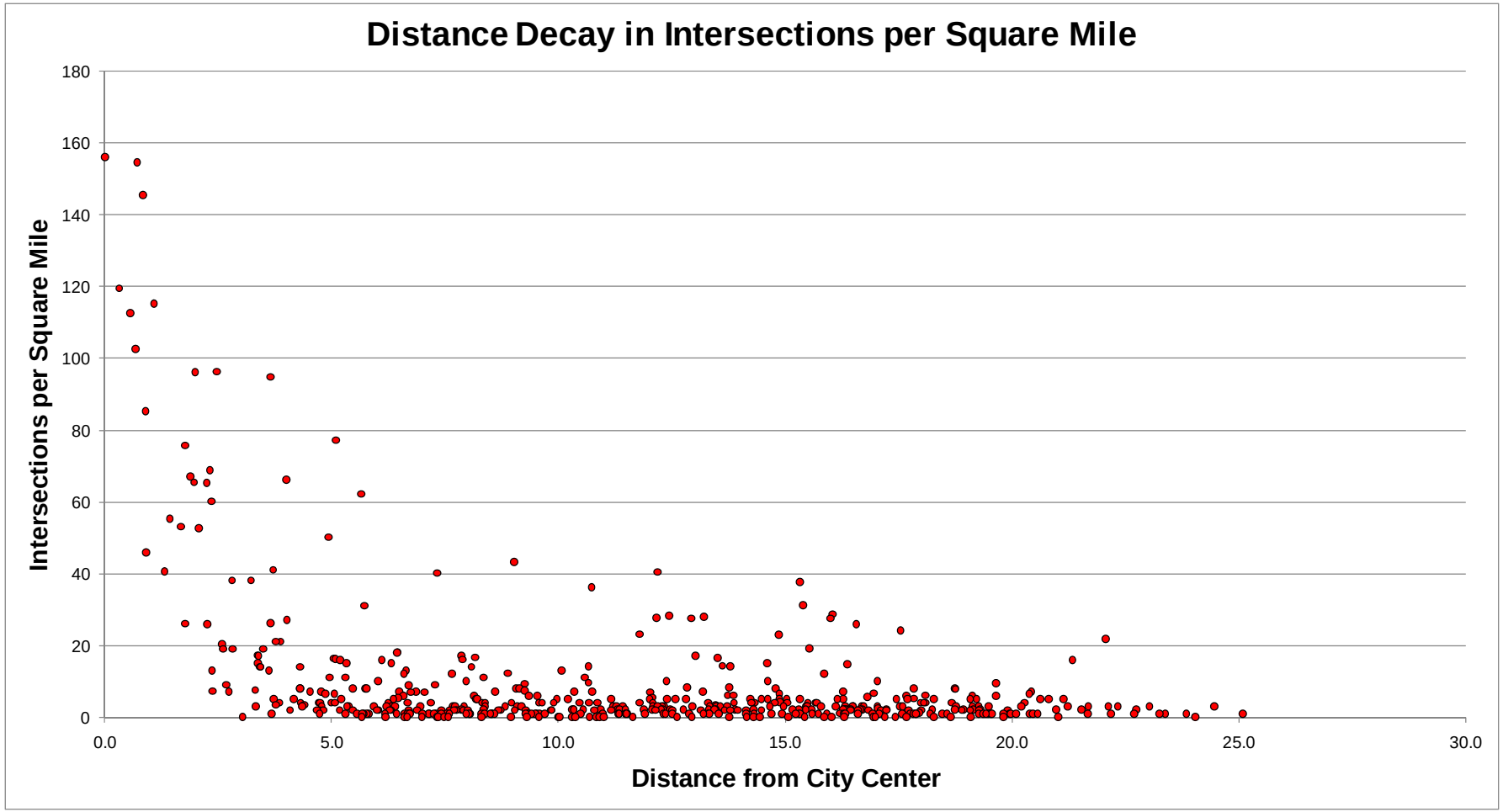
- Rural
- Fringe
- Urban

0 5 10

Miles

Intersections Per Sq. Mile Simple Kriging



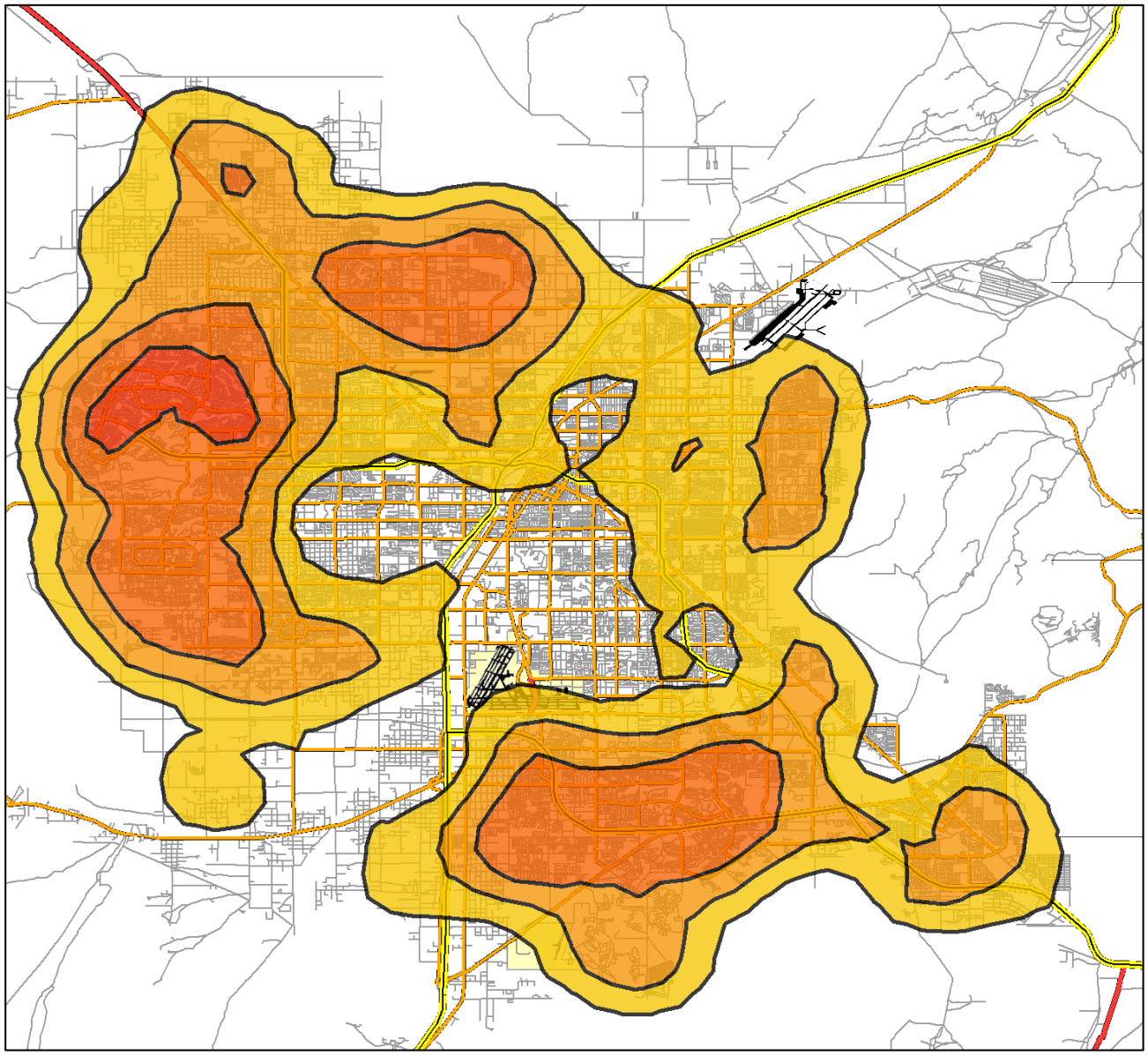

Distance Decay in Intersections per Square Mile
Intersections per Square Mile
180
160
140
120
100
80
60
40
20
0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
Distance from City Center

LAS VEGAS

Change in Street Intersections per Square Mile

1992-2006

Sources:
TIGER
1992, 2006



LAS VEGAS

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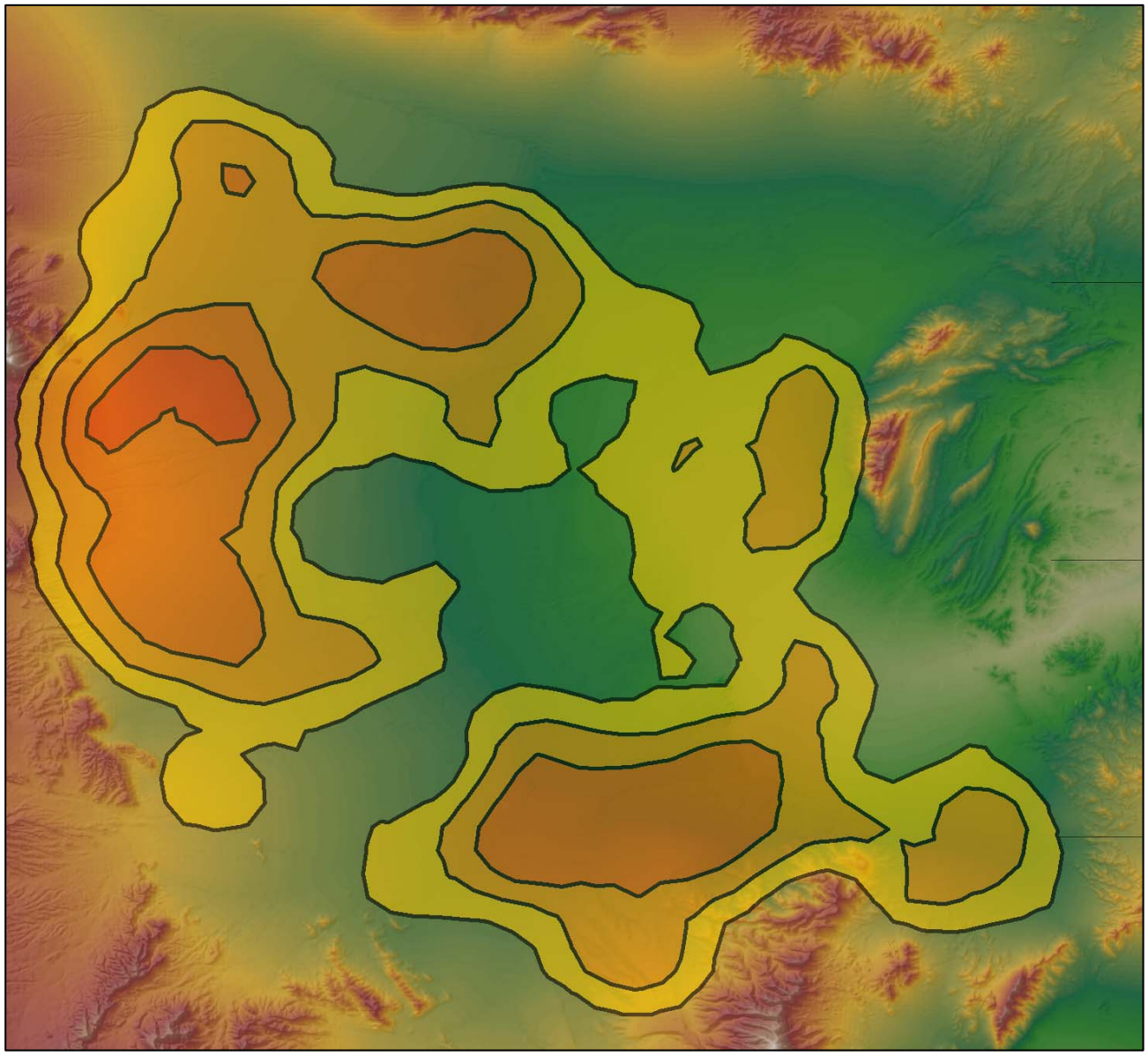

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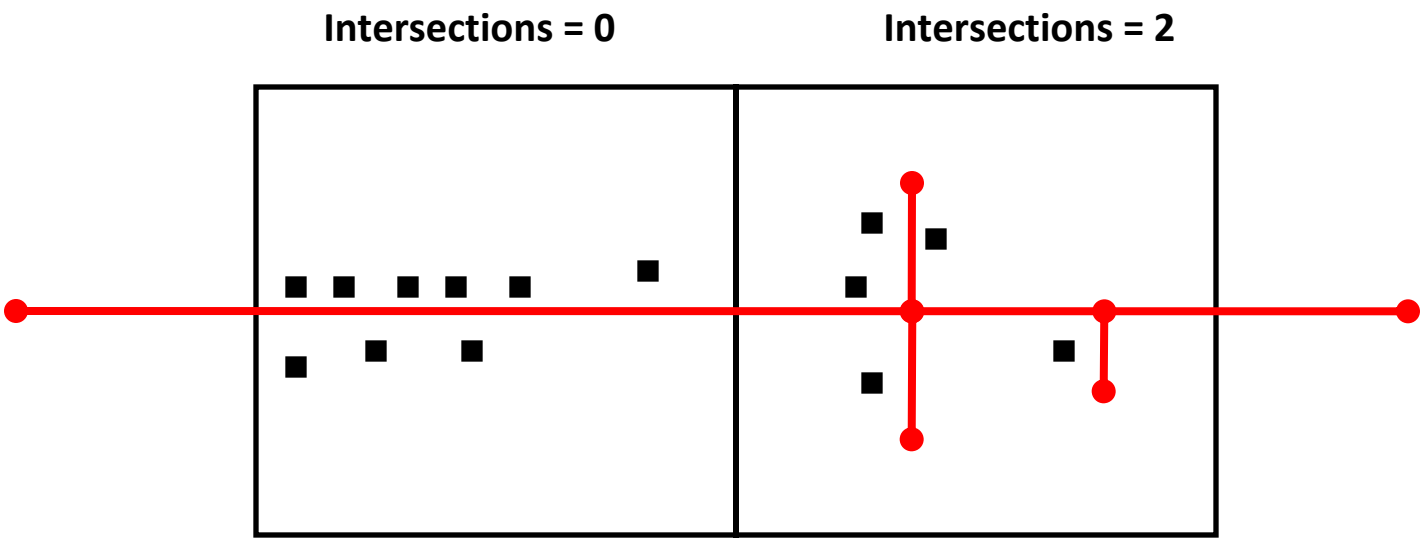
Census

- Decision to release TIGER in shapefile format.
- Shapefiles = defacto standard.
- “What everyone wants”.
- No plans to release raw TIGER data any longer.
- Intersections not easily obtained.

What now?

- Improvisation = key GIS skill.
- Could convert line file to nodes using ArcInfo routine.
- Roads may be a better predictor of sprawl than simple intersections.


Intersections = 0
Intersections = 2