Finding a Geographic Denominator in a Diverse Urban Setting

Sr. Cpl. Chad Smith

Dallas Police Dept.

Dr. Larry T. Hoover

Sam Houston State University

"Hot Spot" Policing Strategy

Hot Spot strategic approaches should emphasize crime-specific tactics. Crime-specific tactics emphasize targeted enforcement aimed at specific offenses committed by specific offenders at specific times and specific places.

Hot Spot Evaluations
A Sampling

- ☐ Minneapolis RECAP Matched Addresses
- ☐ Kansas City Gun Reduction Experiment
- ☐ St. Louis POP in Drug Locations
- ☐ Minneapolis Hot Spots Patrol Program
- ☐ Jersey City DMAP Program
- ☐ Jersey City POP at Violent Places
- ☐ Indianapolis Directed Patrol
- ☐ Jersey City Displacement Study
- ☐ Houston Targeted Beat

7 of 9 reported crime reductions

Primary Source: Braga, A.A. (2001) The Effects of Hot Spots Policing on Crime. The ANNALS of the American Academy of Political and Social Sciences.

Targeted Response Components

- Instant and detailed crime analysis
- Immediate responsive deployment of resources
- Proactive, “aggressive” enforcement
- **Concentration upon a defined geographic entity**
- Real time monitoring centered upon crime reduction

Introduction

- Existing boundaries where rejected:
  - Inconsistent size and demographic profile
  - Simply “counting the dots” was inadequate to evaluate sites
  - Reduces the importance of spatial relationships between events

Methodology

- Datasets:
  - Non-family violence gun crimes (murder, rape, robbery, aggravated assault) from Dallas Police Department for 2007.
  - Arrests for drugs, weapons and prostitution from Dallas Police Department for 2007.
  - 2000 Census Tracts
- Tools:
  - ArcGIS 9.2
  - Hawth's Tools
  - Sitation (location-allocation modeling).

Methodology

- Kernel density analysis
- Cluster/Outlier Analysis (Anselin Local Moran's I)
- Maximum Covering Location Problem

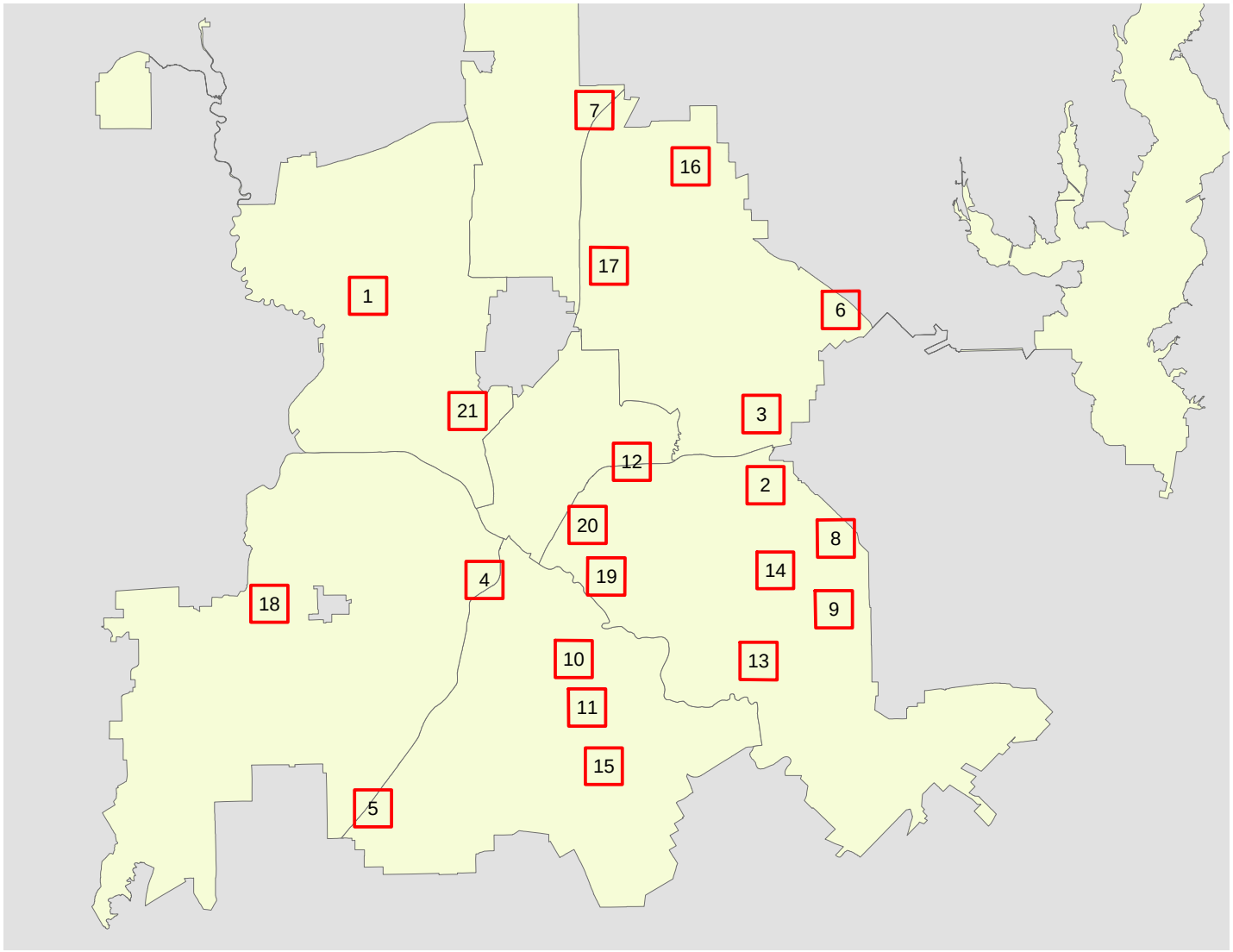
Kernel Density

- Search radius varied
  - Patrol operational area
  - Average Nearest Neighbor
- Output cell size kept very low to increase resolution along boundaries.
- Results were overlayed with demographic information from Census Tracts.

Cluster/Outlier Analysis

- Weighted the data using grids with differing sizes.
  - Spatially join event data to grid.
  - Summarize the grid ID field to acquire count of events within each grid.
  - Join the count table to the event data using the grid field as the common field.
- Identified events with *z*-score greater than 1.96 (two standard deviations).

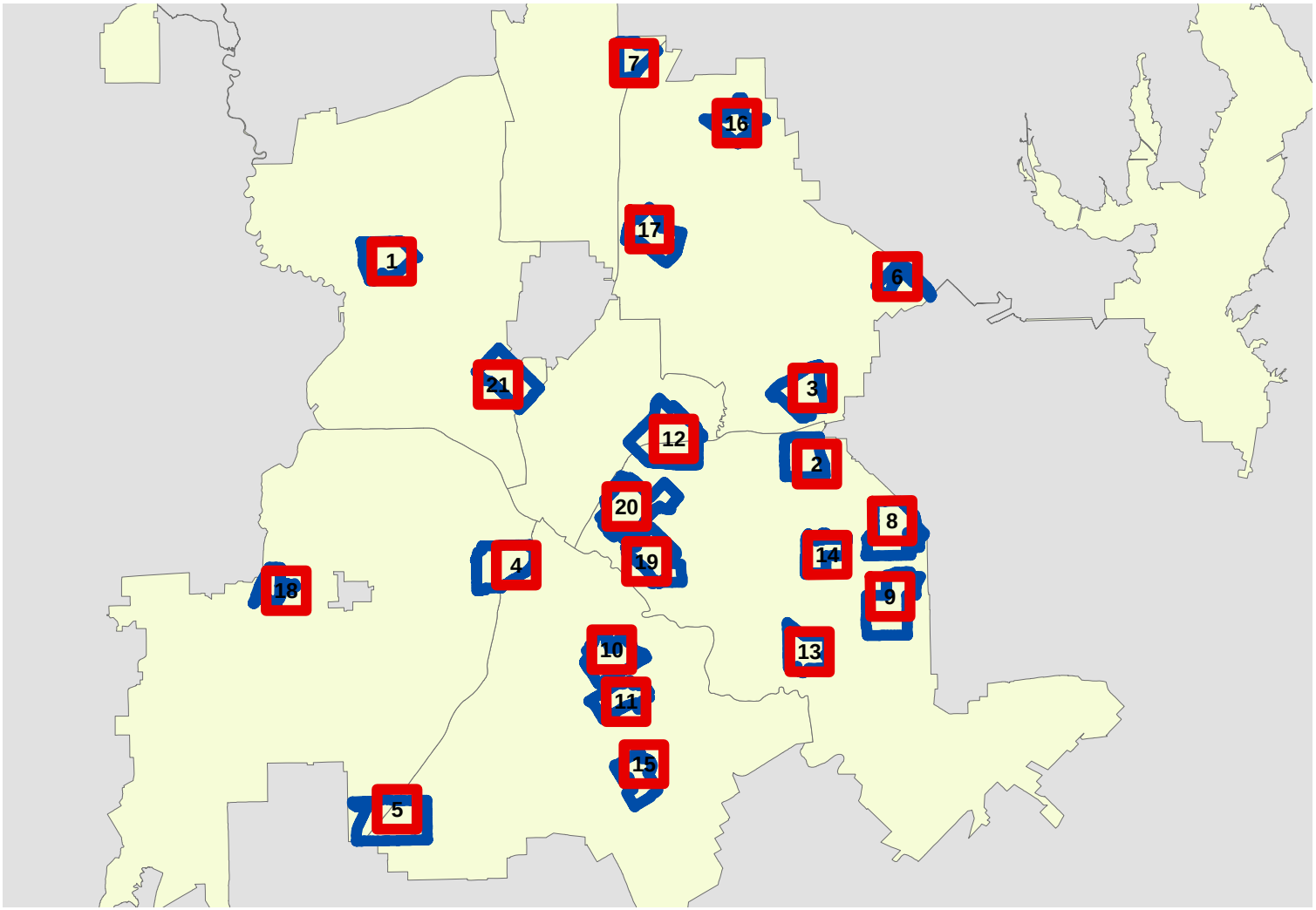
“Statistical” Boundaries



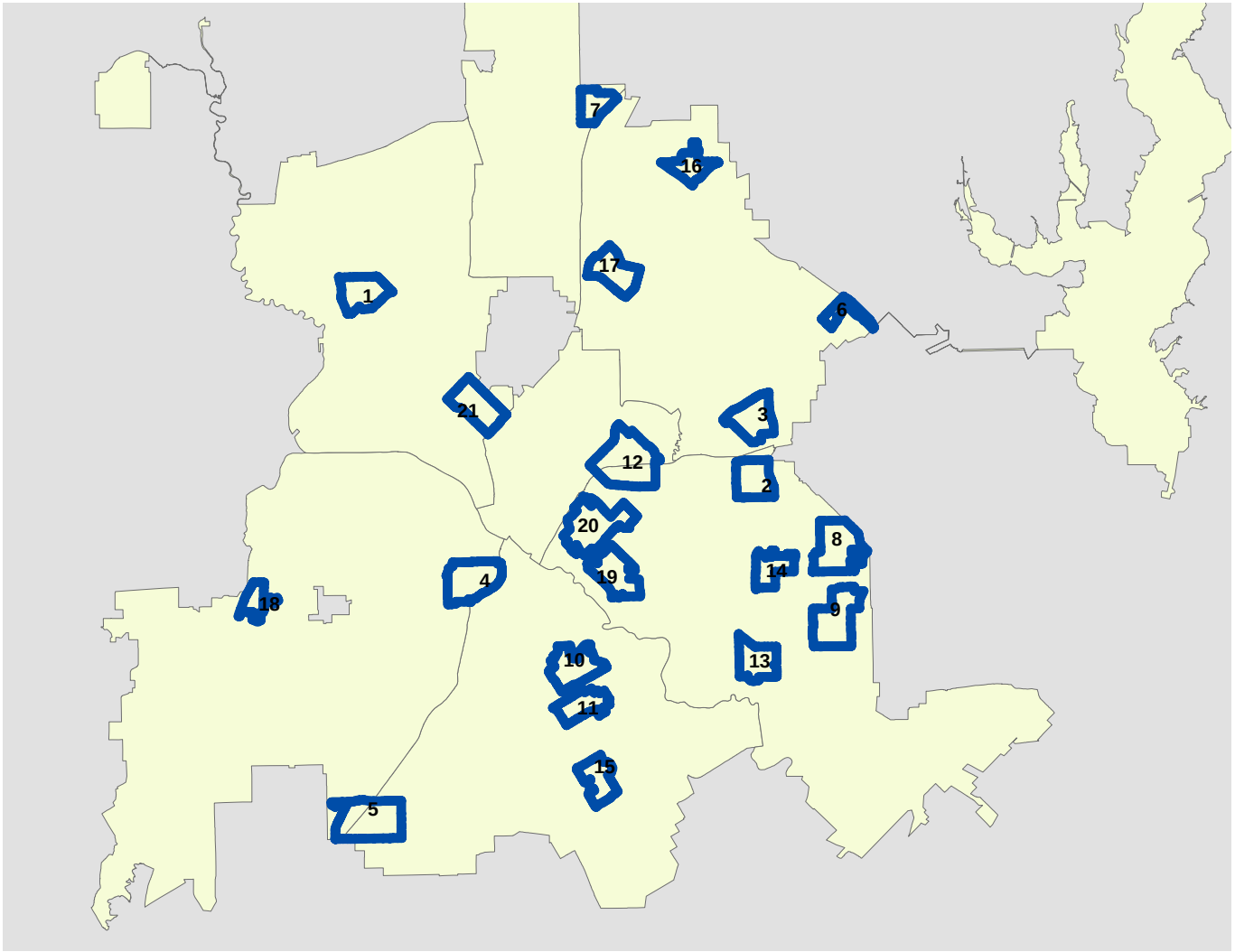
Defining Useable Target Areas

- SHSU researchers overlaid these grids with GIS street maps of Dallas with both violent and property crime plots overlaid, and through several iterations and meetings with Dallas PD command staff defined a target area bounded by Dallas City Streets.
- Per square mile crime rates were then calculated to correspond to these new geographic definitions.

Major Street Overlay



Street Defined Hot Spots



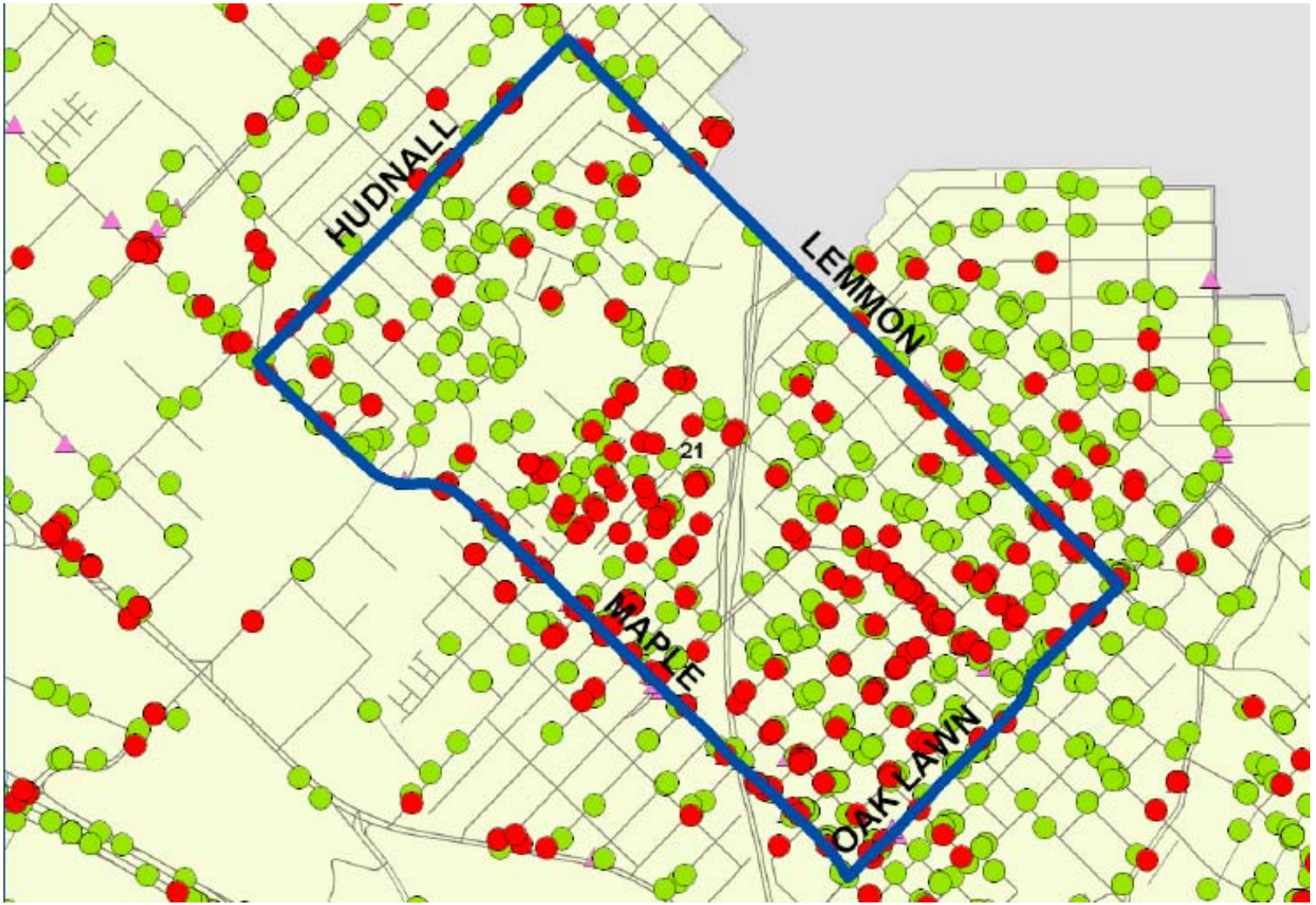
2007 Crime - Dallas City Wide & Grid Counts/Percents

City Wide	violent				property			
	12866				46394			
	Square Grid		Street Defined		Square Grid		Street Defined	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Grid 1	284	2.21	301	2.34	568	1.22	596	1.28
Grid 2	71	0.55	68	0.53	193	0.42	214	0.46
Grid 3	158	1.23	184	1.43	369	0.80	414	0.89
Grid 4	179	1.39	178	1.38	279	0.60	284	0.61
Grid 5	117	0.91	89	0.69	308	0.66	330	0.71
Grid 6	116	0.90	68	0.53	266	0.57	193	0.42
Grid 7	123	0.96	114	0.89	289	0.62	273	0.59
Grid 8	83	0.65	121	0.94	250	0.54	371	0.80
Grid 9	84	0.65	77	0.60	178	0.38	203	0.44
Grid 10	146	1.13	148	1.15	228	0.49	261	0.56
Grid 11	151	1.17	153	1.19	188	0.41	197	0.42
Grid 12	119	0.92	158	1.23	203	0.44	310	0.67
Grid 13	104	0.81	132	1.03	214	0.46	222	0.48
Grid 14	76	0.59	72	0.56	193	0.42	185	0.40
Grid 15	116	0.90	129	1.00	166	0.36	250	0.54
Grid 16	239	1.86	176	1.37	604	1.30	384	0.83
Grid 17	398	3.09	385	2.99	758	1.63	702	1.51
Grid 18	65	0.51	32	0.25	160	0.34	79	0.17
Grid 19	128	0.99	177	1.38	185	0.40	262	0.56
Grid 20	190	1.48	242	1.88	221	0.48	299	0.64
Grid 21	147	1.14	223	1.73	411	0.89	623	1.34
	24.05		25.08		13.43		14.34	

How Hot Is Hot?

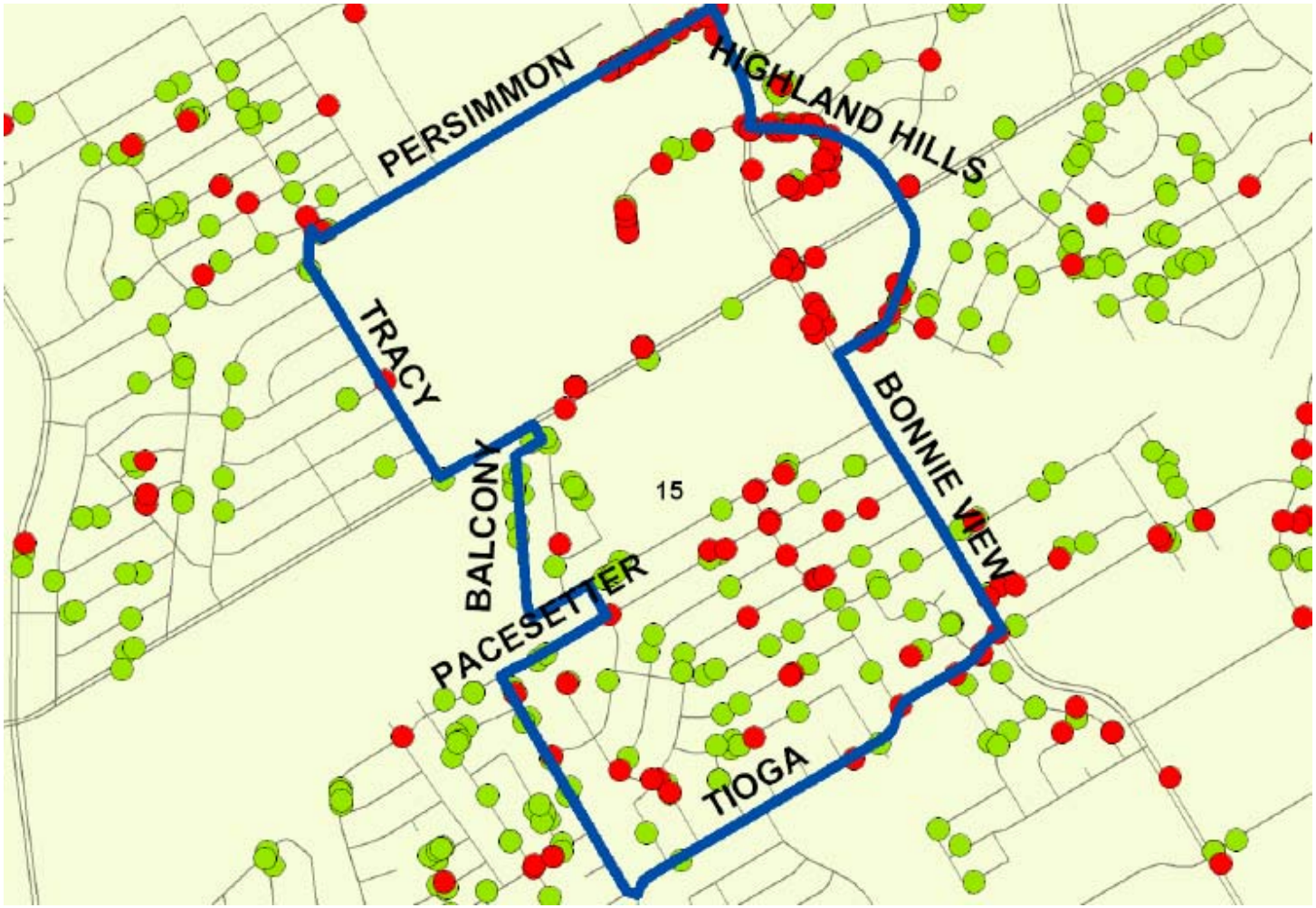
- Top 21 Dallas Hot Spots (21 square miles of the 385 land square miles in the city, 5% of the city's area) Contain 25% of the Violent Crime, but only 14% of the Property Crime
- The Top 12 Hot Spots (of the 21) Contain 20% of the Violent Crime – Stated Differently One Must Add Nine Additional Hot Spots to the Top 12 to Gain 5% More of the Violent Crime in Dallas

High Crime Stressed Neighborhood



Blighted Commercial Strip

Crime Ridden Apartment Complex



Maximum Covering Location Problem

- Kernel Density Raster Results
  - Created polygons from raster results.
  - Created centroids for polygons.
  - Selected centroid point for each “peak.”

Maximum Coverling Location Problem

- Kernel Density Raster Results:
  - Added “demand” to each point by counting events within operational distance.
  - Export the results and convert to text file for input into MCLP model.
  - Use operational distance as “coverage” distance. Cost per mile was left as $0.
  - Performed Lagrangian Relaxation Algorithm for pre-selected number of sites.

Maximum Covering Location Problem

- Grid Weighted Event Data
  - Created centroids for each grid.
  - Created “demand” by counting events within operational range of each point.
  - Exported events in text file for import into MCLP model.
  - Used operational range as Coverage range.
  - Performed Lagrangian Relaxation Model.

Problems

- Network distances where not available for this analysis.
- Modifiable Aerial Unit Problem must be considered.
- Demographic data isn’t available for small aerial units (within budget, i.e. free).
- Methods are time consuming and constant review will be cumbersome.
- Location-allocation software has a 150 point limit for analysis points.

Conclusions

- Aerial unit is vital to understanding target areas.
- Kernel Density vs Grid-Based Analysis
- Outcomes provide decision makers with statistically significant data that can maximize the confidence in the analysis.