# CRIME MAPPING

# CASE STUDIES

## SUCCESSES IN THE FIELD



POLICE EXECUTIVE RESEARCH FORUM

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CRIME MAPPING RESEARCH CENTER

CY LAVIGNE

JULIE WARTELL

# Crime Mapping Case Studies

# Crime Mapping Case Studies: Successes in the Field

*Edited by*

*Nancy G. La Vigne and Julie Wartell*

This anthology is published by the Police Executive Research Forum (PERF) as a service to its members and the general public. The opinions and recommendations expressed in these papers are those of the authors and do not necessarily reflect those of the PERF membership or staff.



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# Contents

## Apprehending and Convicting Offenders

# Preface



The use of computerized mapping technology, known as Geographic Information Systems (GIS), has spread significantly among law enforcement agencies in the United States and abroad. Whereas only a few years ago computerized crime mapping was considered "cutting edge," today it is a readily accessible analytic tool. Much emphasis has been placed of late on the importance of moving beyond "pin mapping" toward more sophisticated analytic methods. While this is an important goal, we believe that much value lies in the creative application of even the simplest of mapping efforts. We have observed that many criminal justice agencies are seeking practical examples of how this tool can best be used to support law enforcement and public safety efforts. This call for illustrations of crime mapping led to the partnership between PERF and NIJ to publish this volume.

PERF and NIJ both have long histories of supporting the exploration of GIS technology as a crime analysis tool. NIJ's Drug Market Analysis Program (DMAP), launched in 1990, promoted a number of partnerships between researchers and law enforcement agencies to experiment with computerized crime mapping for the analysis of the nature and distribution of drug markets. In that same year, PERF published its first book on crime mapping, *Geographic Factors in Policing,* by Keith Harries. A few years later, PERF published an edited volume of papers by law enforcement practitioners who were some of the first to experiment with GIS. During the 1990s, the momentum for the use of computerized crime mapping grew, leading NIJ to establish its Crime Mapping Research Center in 1997 to advance the use of analytic mapping in criminal justice research and practice.

What is unique about this volume is that all of its contributions are from practitioners in the field who offer real-life examples of successful applications of crime mapping. Examples include the use of mapping in support of problem-solving efforts, to assist in the investigative process or the apprehension of offenders, and to improve overall police operations. Each case study provides a unique approach to the use of computerized crime mapping; although the examples are unique, we believe that readers of this volume will find them easy to replicate.

We recommend this book to officers, analysts, and other criminal justice practitioners interested in understanding the power of com-

puterized crime mapping, as well as learning new and innovative applications for this tool. Further, researchers and community members will benefit from this book, as it offers examples of how they can collaborate with public safety officials in support of prevention and enforcement efforts.



*Chuck Wexler*
*Executive Director*
*Police Executive Research Forum*

*Jeremy Travis*
*Director*
*National Institute of Justice*

# Foreword



The chapters that appear in this volume were selected from a pool of 38 submissions from 30 agencies responding to a Call for Papers on what we termed "successful" crime mapping case studies. The Call for Papers was posted on the Crimemap listserv operated by NIJ's Crime Mapping Research Center, which consists of over 640 subscribers interested in the topic of crime mapping. Announcements were also sent to all PERF members, associations of crime analysts and police planners and others engaged in crime mapping. The Call for Papers was also posted in PERF's *Problem Solving Quarterly* and *Subject to Debate* publications and on both PERF's and NIJ's Web sites.

We defined a successful case study as the use of mapping to assist in

- a problem-solving, prevention or enforcement effort that met its stated goal;
- an improved police process (e.g., investigation, problem identification, staffing allocation); or
- the identification, apprehension or prosecution of suspect(s).

We received many excellent submissions, of which 15 were chosen for this volume. These papers were selected for their direct link to a successful outcome, as defined above. In addition, these papers were chosen to represent a variety of crime and disorder problems, geographic locations and agency size and type. Several agencies submitted more general descriptions of how they use mapping. While not linked directly to success, they nonetheless merit recognition. Two examples include the Charlotte-Mecklenburg, N.C., Police Department's case study on the experimental use of mapping to improve the serving of outstanding warrants and the Dallas Police Department's use of mapping in support of community policing.

This volume is organized in three sections: those cases that supported a problem-solving or community policing effort, those that helped improve law enforcement or criminal justice operations and those that led to the apprehension or conviction of an offender or offenders. By organizing the volume in this manner, we hope that it will serve as a practical guide to readers interested in exploring new ideas and analytic methods for the use of computerized crime mapping.

In closing, we would like to thank a variety of people for the conceptualization, development and production of this book. First, we'd like to acknowledge all of those agencies that submitted case studies. We were overwhelmed with the response and the quality of mapping applications in the field. This publication would not have been possible without the support of a number of dedicated individuals. Martha Plotkin, director of communications at the Police Executive Research Forum, recognized the importance of producing a practical crime mapping publication. She and Eugenia Gratto oversaw the production of the book. John Stedman, a senior research associate at the Police Executive Research Forum, assisted with the screening of submissions. Ellen Painter helped prepare the volume for publication, Elliot Grant designed the book layout and Marnie Deacon Kenney created the book cover.

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# Supporting Problem-Solving and Community Policing Efforts

2

# The Multiple Impacts of Mapping It Out: Police, Geographic Information Systems (GIS) and Community Mobilization During Devil's Night in Detroit, Michigan

*David Martin*
*Wayne State University*

*Erick Barnes*
*Detroit Police Department*

*David Britt, Ph.D.*
*Wayne State University*



## INTRODUCTION

The Detroit Police Department, with assistance from Wayne State University, utilized geographic information systems (GIS) technology to help tackle the problems of vandalism and suspicious fires during the infamous Devil's Night period. This effort, a prime example of police application of cutting-edge technology, fits nicely into the current interest in community policing and problem-oriented policing strategies. From a policy analysis standpoint, it also provides an example of how police departments may be well positioned to play a central role in community problem solving.

In this example, the Detroit Police Department demonstrated its ability to

- collect large amounts of geographically referenced data on special police initiatives and community mobilization;
- integrate databases from various city departments by using GIS software;
- create computerized maps to assist planning at the policy, operations and tactical levels; and
- translate these efforts into an increased capacity to understand the dynamics of Devil's Night fires and coordinate community resources in a longer-term effort to address problems in neighborhoods that generate Devil's Night fires.

As a result of these efforts, the Detroit Police Department is now positioned as a key resource for city government, citizens and com-

munity organizations that are working to improve the quality of life in Detroit. The crime analysis and planning functions demonstrated during the Devil's Night initiative are part of a new set of tools that police precinct commanders and specialized units have embraced.



# BACKGROUND

During the past decade, the Devil's Night phenomenon in Detroit has drawn media attention from around the world as fires burned in abandoned buildings, vehicles and vacant lots around Halloween each year. For a city formerly known as "the murder capital of the world," and still highly ranked in terms of urban crime rates, the association with Devil's Night has presented yet another difficult obstacle in the way of improving Detroit's image and attracting economic investment. The 1990 book *Devil's Night and Other True Tales of Detroit* described how suburbanites looked forward to the night when they could see the city burning (Chafets 1990).

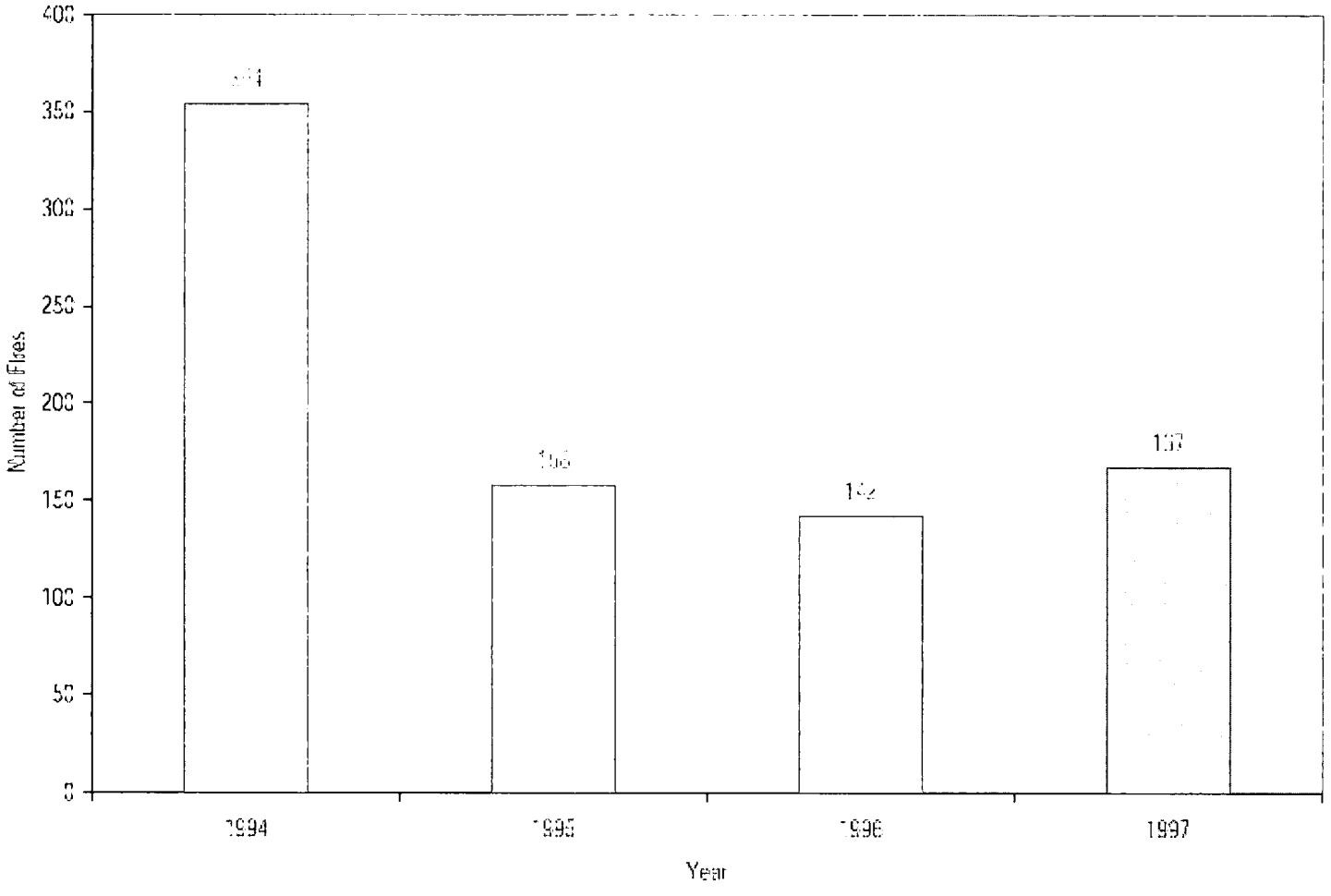
Today, however, suburbanites are among the estimated 25,000 to 30,000 volunteers who patrol the city's streets for vandals and arsonists during the annual three-day Devil's Night initiative. Detroit Mayor Dennis Archer recently renamed this period "Angel's Night" and allocated significant city resources to mobilize the Detroit community—and its suburbs.

The number of Devil's Night fires peaked in 1985 at 479 over the three-day period October 29–31. Anti-arson and community mobilization efforts during the tenure of Mayor Coleman Young (1974–1993) had resulted in a steady decline in the number of fires.

In 1994, however, under the administration of newly elected Mayor Dennis Archer, the number of fires increased dramatically to 354 (see Figure 1). Consequently, the Archer administration was widely criticized for its apparent lack of attention to the annual anti-arson initiative and the resulting negative impact on Detroit's image.

In 1995, it was no surprise that Devil's Night was at the top of the mayor's agenda. A citywide task force was convened early in the year to begin planning for anti-arson and community mobilization efforts. Also in 1995, the Detroit Police Department began to work with GIS software as part of a pilot project with Wayne State University. After experimenting with the technology, the department soon determined that computerized mapping would be very helpful in planning and implementing activities related to the Devil's Night problem. When the police department was summoned

**Figure 1**
**Number of Fires During October 29–31 for 1994–1997**



to participate in the task force, officers brought along their new computerized mapping capabilities.

Computerized mapping is not the sole reason that the number of Devil's Night fires significantly declined between 1994 and 1997. But the adoption of PC-based computerized mapping has had both direct, short-term and indirect, longer-term effects on the capacity of the police and their community partners to combat Devil's Night fires in Detroit. The direct effects are most visible. However, the indirect effects are deeper and longer-term; they include shifts in police department structure and culture and the ripple effects of map-based mobilization efforts on the Detroit community.

## The Short-Term Impact of Mapping: Identifying and Monitoring "Hot Spots"

MapInfo software was used to analyze fire patterns during past Devil's Night periods and to identify "hot spots." In 1995, Detroit Police Department crime analysts and Wayne State University researchers reviewed 10 years' worth of data on the locations of Devil's Night fires. These records, more than 4,000 in all, were geocoded and mapped. Spatial and Temporal Analysis of Crime (STAC) software, developed by the Illinois Criminal Justice Information Agency (ICJIA), was used to compute statistical hot spots. (STAC is available free of charge. See http://www.acsp.uic.edu/icjia/s95sumtc.htm.) Hot spots identify the geographic areas with the highest concentration of the targeted problem. Hot spots derived using STAC are computed irrespective of such boundaries as census tracts or police patrol areas. STAC requires only identifying the overall area to be analyzed and a few search parameters and works with most GIS software.

The hot spot analysis of past fire patterns was used to rank and prioritize neighborhood areas. Police scout car areas were then used as the main operational unit of analysis. The main short-term operational goal of police deployment and community mobilization strategies was to maintain continuous coverage of all hot spot areas. After the hot spots were covered, volunteers were deployed to the rest of the city.

Each year from 1995 to 1997, planning for the Devil's Night initiative began early in the summer. The effort included the massive annual police department survey of abandoned homes citywide. Police officers compiled a list of all abandoned buildings, the physical shape of the buildings and the neighborhood addresses. As described earlier, this list was geocoded and mapped. This list was also used for a

mailing to residents who live next to an abandoned building. The letter, signed by the mayor, requested residents' assistance in watching the abandoned buildings during the Devil's Night period. The letter included information about how to report suspicious activity.

Police officers and city personnel were deployed in special details across the city. Citizen volunteers were recruited and deployed via the network of neighborhood city halls. Volunteers could patrol their own neighborhoods or be assigned to another area. For example, if a volunteer's requested neighborhood was already sufficiently covered, the volunteer was asked to watch an adjacent neighborhood. Many volunteers wanted to be assigned to areas where there was likely to be some "action."



A command center in the city center coordinated the deployment of police and fire department resources and citizen volunteers. The crime analysis unit prepared maps of each scout car area illustrating the locations of abandoned buildings. These maps were distributed to both police officers and citizen volunteers. A master deployment map illustrated the number of volunteers and their patrol times by scout car area.

The system put in place to guide police and community efforts was a type of spatial decision support system. To date, the system is not fully computerized. Mapping and GIS-based analysis was performed at the crime analysis unit located at police headquarters. The command center collected data from neighborhood city halls by voice, fax and computer disk. A number of the neighborhood city halls had laptop computers available. Currently the Detroit Police Department is in the middle of a massive computerization project, and a wide area network will soon link police precincts with headquarters and many city departments. The network is critical to increased data sharing.

Wayne State University researchers constructed a set of social and economic data aggregated to census block groups. This data set was mapped and used as an overlay to describe the social and economic characteristics of fire hot spots. These data were supplemented by police data describing the locations of abandoned buildings. The police department collected the data on abandoned buildings by having police officers survey every city block. This massive effort was first completed in 1995 and has been conducted every year since in preparation for the Devil's Night initiative. Figure 2, for example, illustrates the locations of abandoned buildings in 1995 and 1994 fire hot spots in relation to 1990 census information on poverty rates.

Data describing the locations of community organizations, neighborhood associations, block clubs, citizen band radio patrols and neigh-

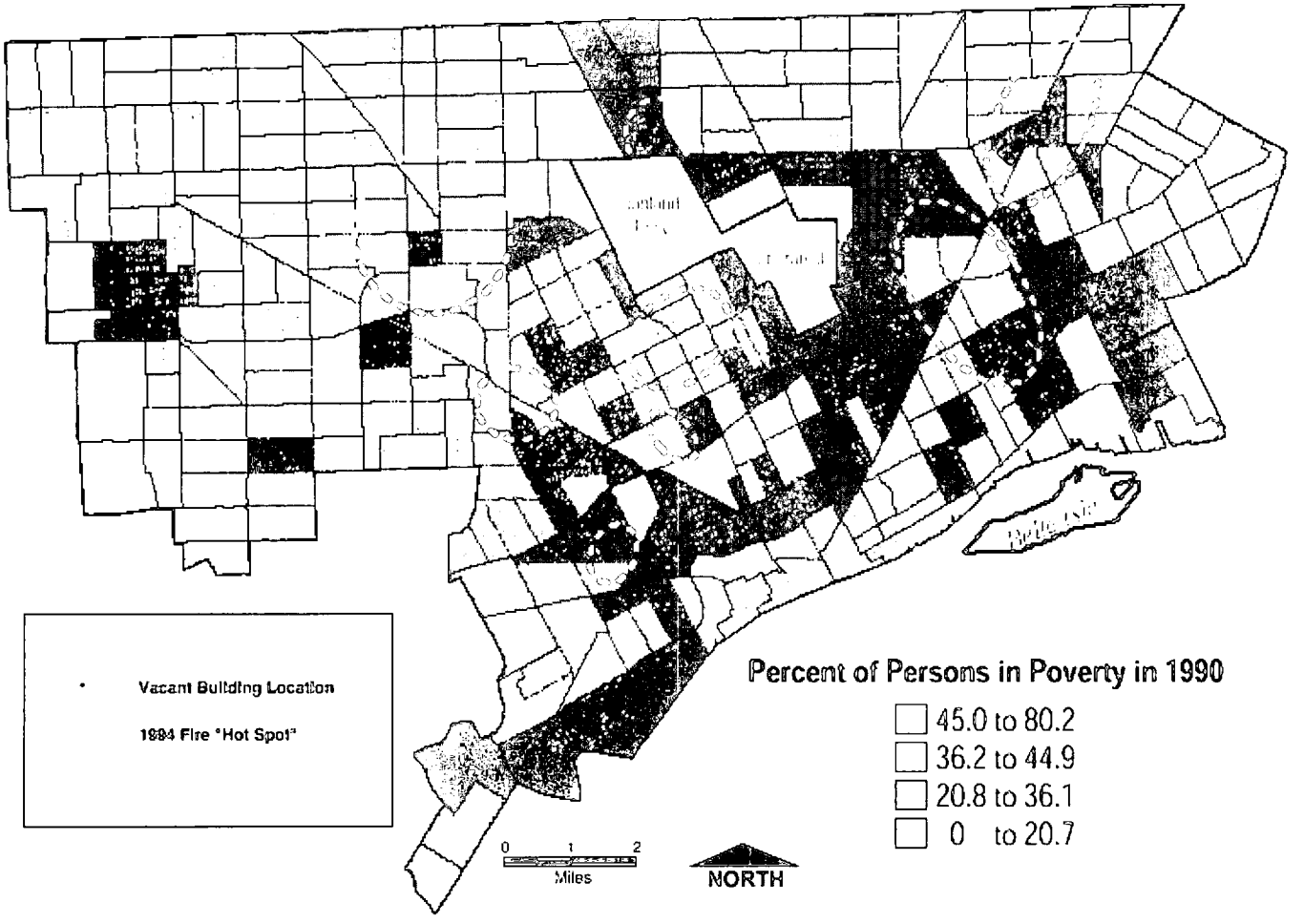



**Figure 2**
**1995 Vacant Buildings, 1994 Fire Hot Spots and Poverty Rates in Detroit**

borhood watch programs were geocoded and mapped to illustrate the landscape of community resources. The command center used these data to prepare phone lists to recruit volunteers and identify groups that would be out patrolling. The maps were also used to identify areas that were not well organized.



**Evaluation of the Short-Term Impact.** The use of GIS in planning and analysis is being promoted as a means to enhance the role of objective knowledge in public decisionmaking. In the Devil's Night Initiative, GIS assisted in the collection, analysis and visualization of relevant data. In the beginning, the maps helped create a shared perception of the various facets of the problem among task force participants. Similarly, after the initiative, the maps illustrated the tangible results of police and community efforts. Devil's Night fire hot spots were located in various parts of the city between 1994 and 1997. There were many fewer fires in 1997 than in 1994 (see Figure 1), and the number of hot spots was reduced (see Figure 3). Despite the decline, there were at least three neighborhoods that remained as "stubborn" hot spots in 1997.

The short-term trends between 1994 and 1997 were as follows:

- There were far fewer fires in 1995, 1996 and 1997, compared with 1994.
- The fire patterns were more random and less concentrated in hot spots.
- The number of hot spots declined, and some were eliminated.
- There are a number of stubborn hot spot areas where success was more limited. High violent and overall crime rates, large numbers of abandoned properties, little or no community organization activity and high poverty rates characterize these neighborhoods.

How to address stubborn hot spots is a major policy question for city officials. Potential approaches include deploying more volunteers to these areas, allocating police resources to saturate these areas, increasing the lighting during nighttime hours in these areas and focusing on the owners of likely target properties.

Some feel that the public still views the Devil's Night problem as a "youth" problem—mischievous youths setting fires and vandalizing property. Interestingly, the use of GIS-based analysis has led to the development of alternative theories. In recent years, increasing attention has been focused on absentee landlords, especially property owners who owe back taxes.

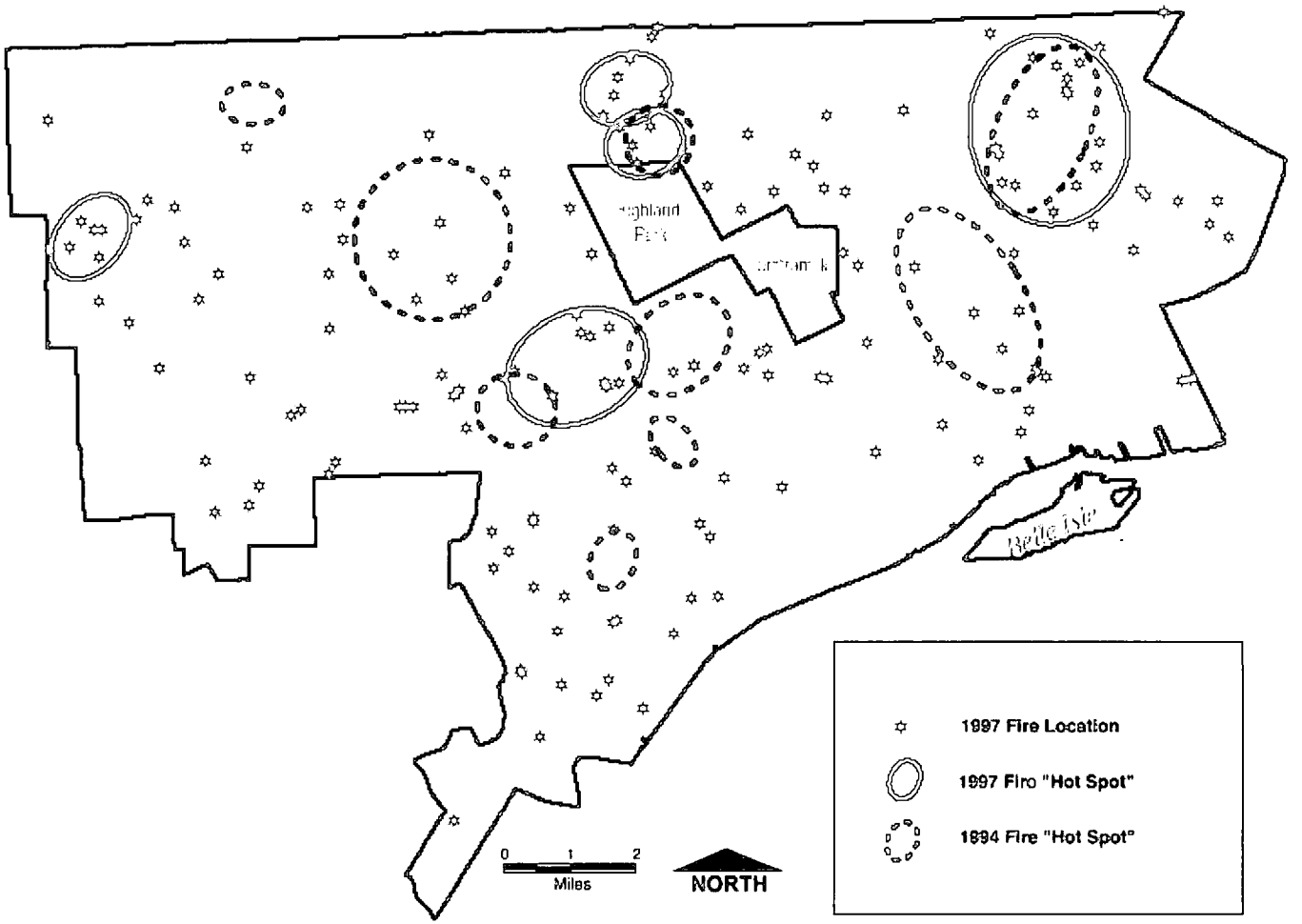



**Figure 3**
**1994 and 1997 Devil's Night Fire Hot Spots**

## The Longer-Term, Deeper Impact of Mapping

Figures 1 and 3 reflect the gross, short-term impact of mapping on Devil's Night fires. A more detailed examination of mapping's impact suggests that a mapping capability is *not* a magic bullet or a technological solution that can simply be imposed on the problem. A mapping capability may be closer to a magnifying glass that focuses attention on common problems. It is a capacity-building strategy both within police departments and their sister agencies and within neighborhoods as part of a broader community policing initiative.

Figure 4 illustrates this argument. The adoption of mapping involves the commitment of trained personnel and wedding them with new technologies. As mapping becomes better known, it can lead to better coordination of resources, a better shared understanding of problem dynamics and a shift in police departments' organizational culture toward more proactive, community-based efforts.

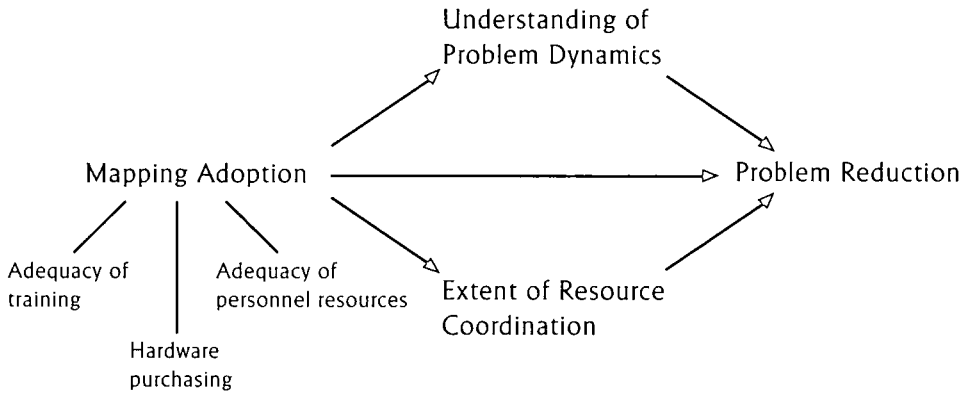



**Figure 4**
**The Multiple Impacts of Mapping**

Some indication of the longer-term, deeper impact of mapping is provided by examining how the results of this effort have been received within the police department. The recent success of efforts to reduce fires on Devil's Night has been, in part, attributed to use of GIS-based research and analysis. The success has helped to attract additional resources for the crime analysis unit, including both personnel and equipment to promote increased communication among headquarters, investigative units and patrol officers. Just as important, the officers involved in "mapping it out" have received recogni-

tion and commendation for their efforts. We interpret this as part of a cultural shift toward more research-based deployment and allocation strategies—strategies that are now being applied to fireworks displays and grand prix events and gradually working their way into other city departments as well.

A companion shift is also taking place toward community policing and community partnership efforts. Mapping creates a powerful tool for problem-driven policing, helping the police analyze and solve crimes, from carjacking to rape, that have been intractable in the past. Similarly, the maps have become the base of a compelling incentive package for community groups to recruit and implement neighborhood protection efforts in conjunction with the police—efforts that have staying power beyond the short period of time around Halloween.

In sum, although the community mobilization effort in Detroit during the Devil's Night period does not represent a typical community policing strategy that could be sustained all year, it does provide some indication of the potential impact of community involvement in the coproduction of public safety in urban areas. This project demonstrated a number of powerful GIS-based computer mapping functions. The use of GIS drew considerable attention that elevated the role of research in problem solving. As a result, the Detroit Police Department is now positioned as an important resource for a broad range of community problem-solving initiatives.

# References

Chafets, Z. 1990. *Devil's Night and Other True Tales of Detroit.* New York: Random House.



# About the Authors

**David Martin** is a Ph.D. candidate in political science at Wayne State University (WSU). He has been employed for six years as research director for the Urban Safety Program, a university program that works with police, community groups and other government agencies on crime and violence prevention initiatives. Martin's experience includes conducting citizen and police surveys and training police and citizen groups to use geographic information systems (GIS) for problem solving. Martin has taught a graduate-level course in spatial analysis using GIS for WSU's Department of Geography and Urban Planning. His dissertation research focuses on the implications that repeat victimization and crime hot spots may have on local policy responses to crime.

**Erick Barnes** directs the Community Policing Operations Section of the Detroit Police Department. Barnes oversees the implementation of grant-funded community policing and crime prevention programs. He has acted as the coordinator of the police department's efforts (patrol and community mobilization) during Detroit's anti-arson initiative. He is a Ph.D. candidate in sociology at Wayne State University.

**David Britt** is a professor of sociology at Wayne State University. His continuing substantive interests in the sociology of prevention, an area in which this chapter may be situated, are taking form in a series of studies of the implications of a preventive sociology for reproductive genetics and for the development of community institutions. More general interests include the use of models as vehicles for qualitative and quantitative social scientists to engage in forms of dialogue that will keep them close to their data and assumptions while doing research.

14

# Using Crime Mapping to Address Residential Burglary

*Susan Reno*
*Shreveport, La., Police Department*



The Shreveport, La., Police Department has been using desktop mapping for analysis of crime problems and staff deployment for the past 10 years. Currently, most maps are generated by the Crime Analysis Unit; the department is working to expand its mapping capabilities to all units. The Crime Analysis Unit generates maps weekly to assist patrol officers and investigators with their current crime problems. This case study illustrates how the department used mapping to analyze a residential burglary problem and assist in formulating a tactical plan to decrease burglary activity. Mapping was also used to illustrate the operation's outcome after deployment.

Monthly crime statistics indicated that residential burglaries in District 4 were above average for this area. Fifty-eight burglaries were reported for January 1998; any number over 25 is considered a problem that needs to be investigated. The district patrol captain asked the Crime Analysis Unit to produce an analysis that could help determine the best deployment and tactical plan to decrease burglary activity.

The analysis consisted of the following:

1. Maps of the residential burglaries.
    A. Total residential burglaries for District 4.
    B. Daytime residential burglaries for District 4.
    C. Nighttime residential burglaries for District 4.
2. Frequency reports of time and day of burglaries.
3. Activity reports of address, date, day, time and status of case.
4. An information bulletin containing information about suspects, property stolen and method of entry.

All information used to perform the analysis was taken from the Police Management Information System database, a mainframe system developed by the City of Shreveport Data Processing Department. Crime information is downloaded daily to a PC in the Crime Analysis Unit for easy and flexible analysis through PC tools.

The maps for this analysis were created in MapInfo. A database, exported from the main database and including the addresses of District 4 residential burglaries, was opened in MapInfo, geocoded and then mapped. The analyst first mapped all residential burglaries and then used SQL select to map the daytime and nighttime burglaries. Daytime burglaries occurred from 0600 hours through 1800 hours, and nighttime burglaries occurred from 1801 hours through 0559 hours. The burglaries that did not fit into either time frame were classified as unknown. If the time was unknown, they were excluded from the daytime and nighttime burglary maps, although they were included on the total burglary map. After the query was performed for daytime burglaries, the query was added as a layer, and the layer that contained total burglaries was made invisible. The same process was performed for the nighttime burglaries.

The analyst labeled each point with the address of the offense using the automatic labeling tool. If possible, this analyst prefers the exact address of each offense labeled instead of the streets being labeled, because it is then easier to match offenses to geographic locations. Often, trends can be established faster when the offenses can be grouped based on geographic concentration. Furthermore, when these maps are distributed to patrol officers, they are able to recognize the offenses they worked by having the address labeled on the map.

Producing maps using MapInfo is simple and fast once the user masters all of the software tools. The main problem with MapInfo is having an address field in your database that matches the address field used in the street file for geocoding. For this project, which used a base map from MapInfo, the crime analyst adjusted the database to address this problem. (Shreveport is developing a GIS system with a more detailed base map from ArcView that should eliminate the need for such adjustments.) Still, the four maps in this analysis took less than an hour to produce.

The two goals of mapping the residential burglaries in this district were to (1) determine if there was a geographic concentration of burglaries and (2) determine if the burglaries occurred more frequently during the day or the night. The first map created was for all residential burglaries for District 4 in January. As Figure 1 illustrates, the burglaries were occurring throughout the district, with concentration in three main areas and the greatest concentration in the area enclosed by an ellipse.

Maps were then generated to determine if there was any distinct concentration during the day or night. From these maps, the analyst determined that daytime burglaries (see Figure 2) were more preva-

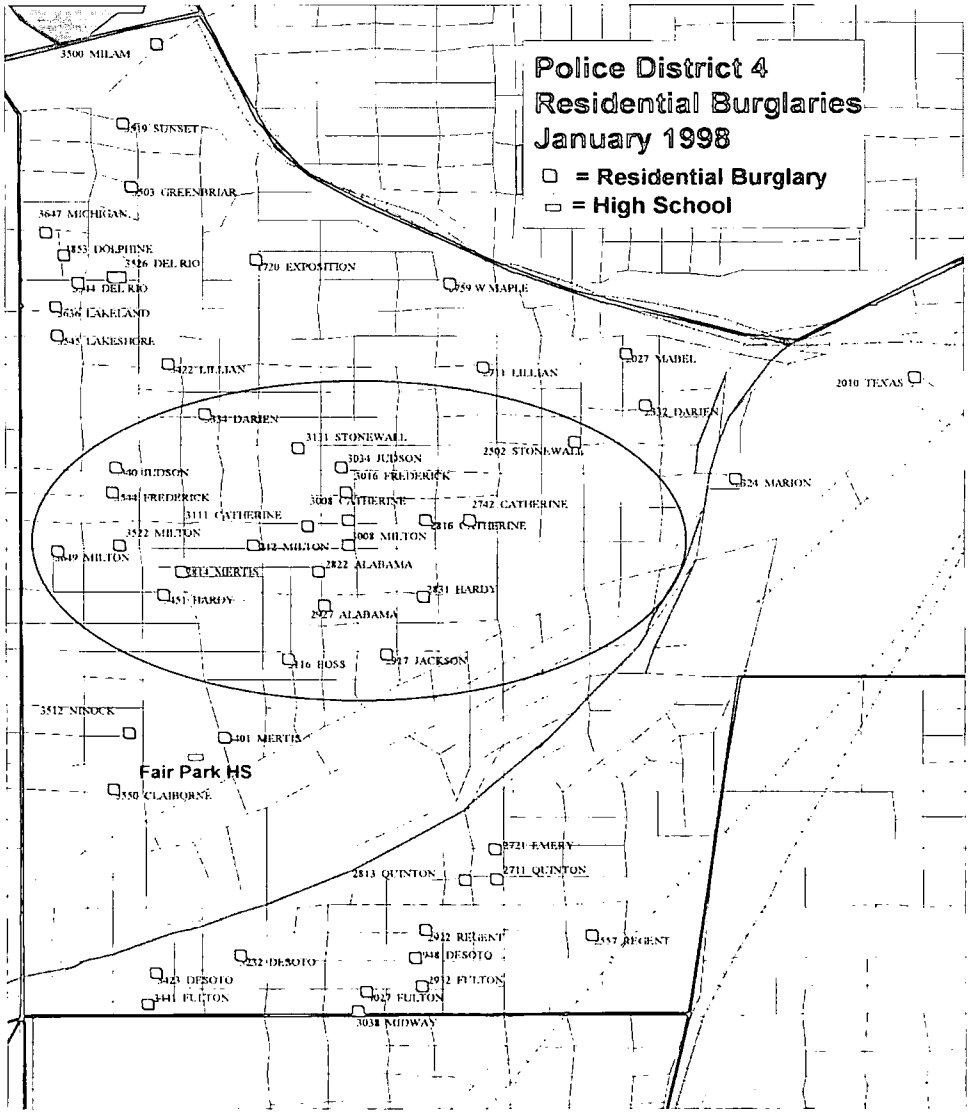

Police District 4
Residential Burglaries
January 1998
= Residential Burglary
= High School
Fair Park HS
3500 MILAM
3503 GREENBRIAR
3647 MICHIGAN
3426 DEL RIO
3720 EXPOSITION
3636 LAKELAND
3545 LAKESHORE
3422 LILLIAN
3027 MABEL
2010 TEXAS
3034 JUDSON
3016 FREDERICK
3008 CATHERINE
2742 CATHERINE
3522 MILTON
3008 MILTON
2822 ALABAMA
2927 ALABAMA
3512 NIMOCK
3401 MERTIS
3550 CLAIBORNE
2813 QUINTON
2711 QUINTON
2922 REGENT
2557 REGENT
2938 DESOTO
2932 DESOTO
2923 DESOTO
2912 FULTON
3441 FULTON
3038 MIDWAY

Figure 1

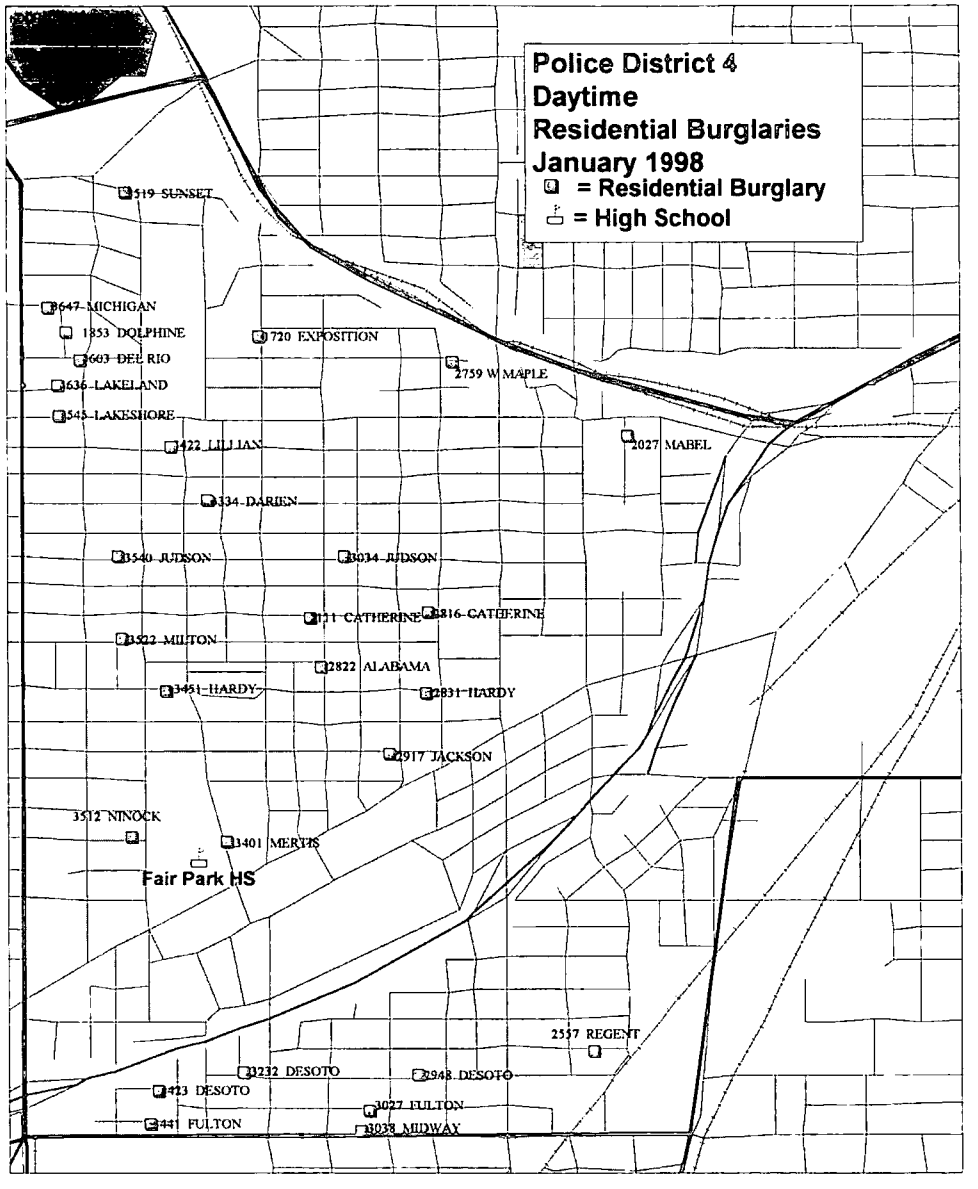

Police District 4
Daytime
Residential Burglaries
January 1998
= Residential Burglary
= High School
3519 SUNSET
3647 MICHIGAN
1853 DOLPHINE
3603 DEL RIO
3636 LAKELAND
3545 LAKESHORE
3422 LILLIAN
3334 DARIEN
3540 JUDSON
3034 JUDSON
3111 CATHERINE
3816 CATHERINE
3522 MILTON
2822 ALABAMA
3451 HARDY
2831 HARDY
2917 JACKSON
3512 NINOCK
3401 MERTIS
Fair Park HS
2759 W MAPLE
2720 EXPOSITION
2027 MABEL
2557 REGENT
3232 DESOTO
2948 DESOTO
3423 DESOTO
3027 FULTON
3441 FULTON
3038 MIDWAY

Figure 2

lent than nighttime burglaries. The concentration of daytime burglaries also coincided with the concentration of total burglaries.

The maps, the listing report, the frequency reports and the information bulletin were forwarded to the District 4 patrol captain. From this information, an operational plan was developed using the Shreveport Police Directed Patrol Unit, the District 4 patrol personnel and the district's community liaison officers. The Intelligence Unit and Detective Unit also forwarded information to the patrol captain and worked with officers on burglary suspects.



The map in Figure 1 was used to define a targeted area and strategically position personnel and resources effectively. This map also identified a possible juvenile truancy problem, clearly illustrating that the main concentration of burglaries was in close proximity to a high school. The operation orders were to deploy the Shreveport Police Directed Patrol in the targeted area for saturation of enforcement. District 4 community liaison officers and patrol personnel operated in close proximity to the directed patrol units to perform investigative stops. The community liaison officers also coordinated with the high school's officials to inform them of the operation and their intentions with the truancy problem. It was determined from the frequency reports that the deployment would begin at 0800 hours on a weekday.

The operation started in the last week of February and continued into the first week of March. The truancy problem in this area was corrected, burglary suspects were arrested and intelligence was gathered for further use. By the end of March, burglaries had decreased from 58 to 19 per month, a 67 percent decrease. The residential burglary problem remained low in the following months. Only a slight increase in activity was seen in June, when school let out. The Crime Analysis Unit mapped the residential burglaries in March to illustrate the level of activity after the operation (see Figure 3). This map was distributed to the patrol captain to monitor the remaining problem spots. The maps created for analysis of this problem were valuable tools in developing an operational order to deploy additional personnel in District 4 to decrease the residential burglaries.

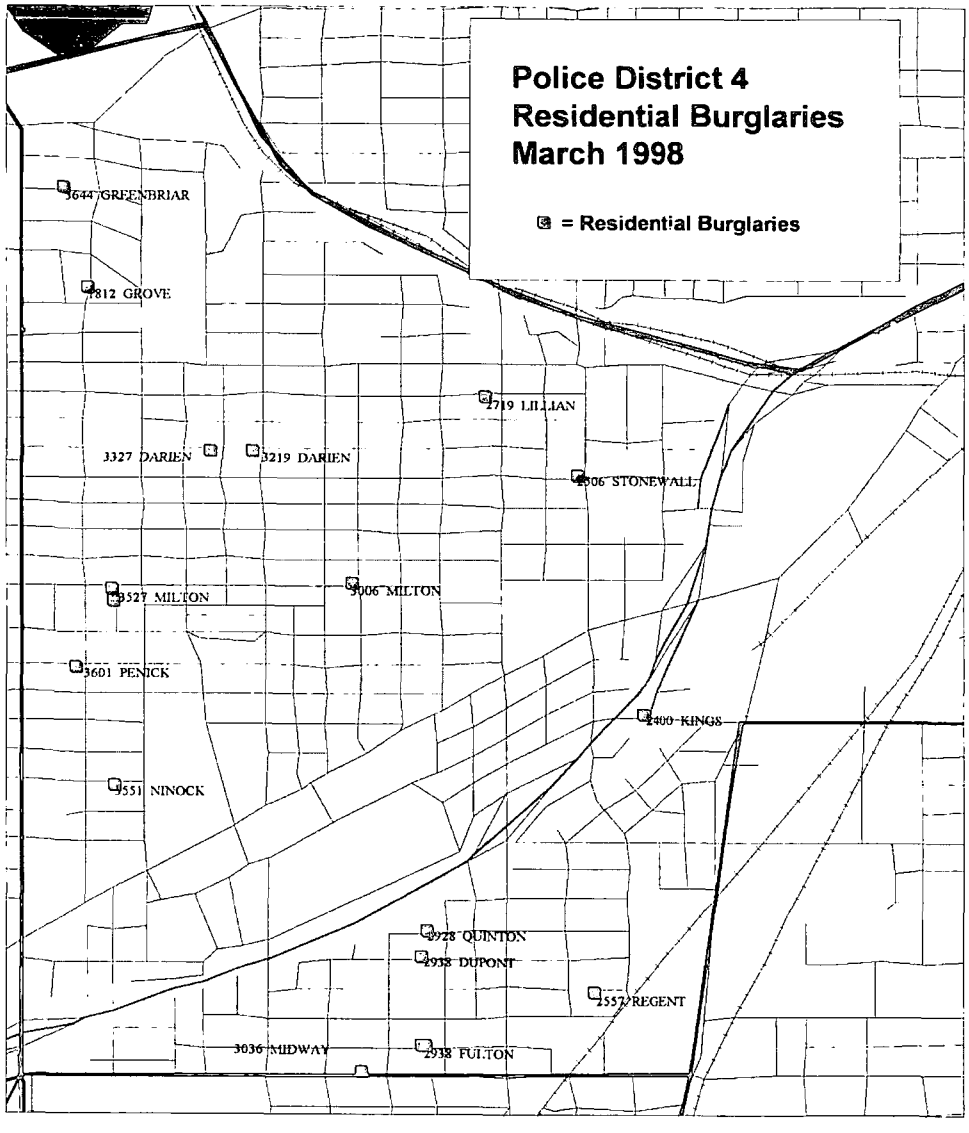

Police District 4
Residential Burglaries
March 1998
= Residential Burglaries
3644 GREENBRIAR
3812 GROVE
2719 LILLIAN
3327 DARIEN
3219 DARIEN
3006 STONEWALL
3527 MILTON
3006 MILTON
3601 PENICK
2400 KINGS
3551 NINOCK
2928 QUINTON
2938 DUPONT
2557 REGENT
3036 MIDWAY
2938 FULTON

Figure 3

# About the Author

**Susan Reno** is a crime analyst for the Shreveport, La., Police Department. She is a civilian with 11 years experience with the department's computer system, crime mapping and research. Reno holds a master's degree with emphasis in business research.

22

# Reducing Traffic Accidents Using Geographic Analysis

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*Illinois State Police*



Since 1986, the average yearly vehicle miles traveled in Cook County, Ill., has risen 16 percent. In addition to vehicle miles traveled (VMT), average daily traffic volumes on many of the major expressways have steadily increased. This combination of factors often results in traffic safety problem areas or high crash locations on specific sections of expressways. In 1996, fatal crashes on the Dan Ryan Expressway increased 157 percent from 1995. However, an intense enforcement strategy implemented from Feb. 1 through Apr. 30, 1997, reduced fatalities by 42 percent compared with the same period in 1996. Fatal crashes on the Dan Ryan continued a downward trend through December 1997.

The Illinois State Police Strategic Analysis and Mapping (SAM) Unit was formed in 1995 with the specific mission to utilize the latest technology to make data easily understood by customers. From the beginning, SAM personnel viewed mapping as an excellent way to display information. SAM strategic information analysts have been doing mapping and analysis of fatal crashes since its inception. In addition, SAM does maps and analyses for special projects. The following study was based on the annual fatality analysis report, as well as a request to do a spatial and temporal analysis of personal injury crashes.

To collect detailed location information on traffic crashes, SAM developed a crash database. The database contains all information from each state-police-handled crash and covers crash type (property damage, personal injury, fatality, etc.), location and the condition of the driver and roadway. A statewide fatality database contains information for all traffic fatalities within the state. Using these databases, analysts were able to extract information for the analysis. Information on the location, time of day and day of week/month of the crashes was extracted and transformed into charts, graphs and maps (see Figures 1 and 2). This information was graphically displayed using ArcView GIS. The most difficult aspect of the analysis was obtaining accurate and complete information for crash data. This process took approximately 20 working days. The maps illustrate specific segments of the expressways that have a high density of crashes. The maps also display changes in crash patterns due to road construction, etc.

Using computer mapping to illustrate the density and location of crashes on the expressways provided Illinois State Police command personnel with the necessary information for deploying enforcement resources to target specific areas and reduce fatalities and injuries associated with traffic crashes. Targeted and holiday emphasis patrols were used as interventions to attempt to reduce the number of fatalities. Two examples of these strategies included "wolfpack" details—concentrated enforcement efforts in high-accident sections of roadways—and "Fatal 5" enforcement, where officers allow zero tolerance for the five violations (e.g., speeding and following too closely) that analysts and researchers have found to be the leading causes of accidents in Cook County and Illinois.

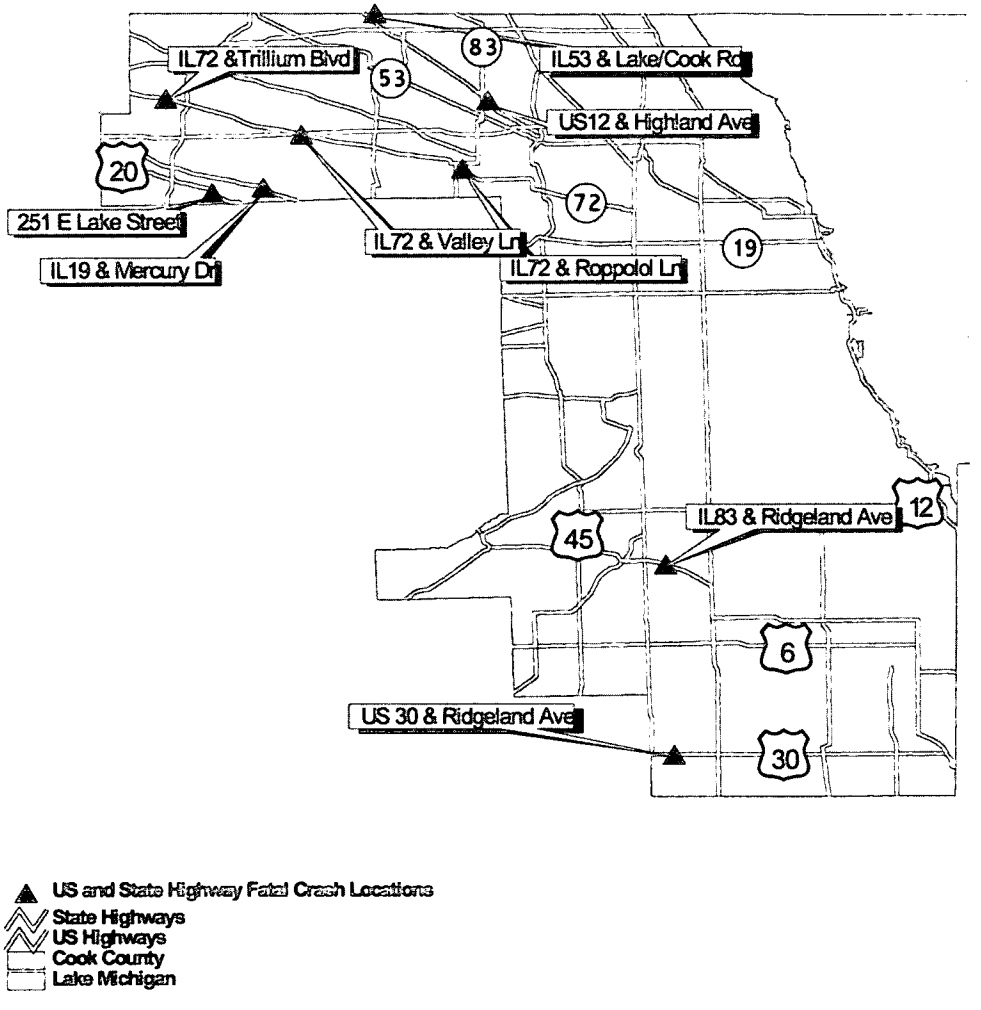



**Figure 1**
**1997 District Chicago**
**U.S. and State Highway Fatal Crash Locations**

After the state police introduced these measures, traffic fatalities on Cook County expressways decreased 35 percent in the first 6 months of 1998 compared with the first 6 months of 1997. The continued GIS analysis of traffic crash problems has been instrumental in this outcome. Such analyses have been well received by Illinois State Police leaders and have proven effective in the planning and allocation of resources. Since these analyses were conducted, more in-depth and geographically specific analyses have been requested. In addition, the personal injury crash analysis will likely be performed on an annual basis.



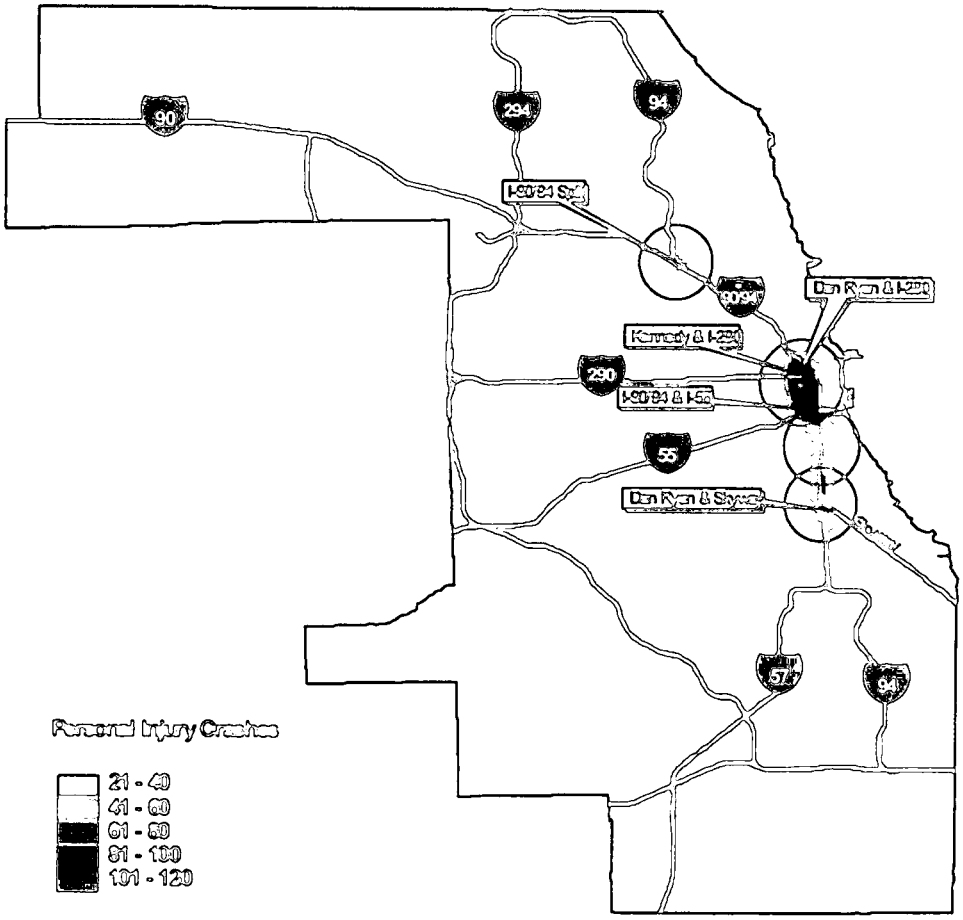



Figure 2
1997 Cook County Density Map
Personal Injury Crashes

# ABOUT THE AUTHORS

**Eric J. Rieckenberg** has been with the Illinois State Police for three years, first as an intern through the University of Illinois at Springfield and currently as an Executive I with the Strategic Planning and Analysis Bureau. Rieckenberg earned a bachelor of arts in administration of justice from Southern Illinois University at Carbondale and a master of public administration from the University of Illinois at Springfield.

**Tara Grube** has been with the Illinois State Police for three years, first as an intern through the University of Illinois at Springfield and currently as an Executive I with the Strategic Planning and Analysis Bureau. Grube earned a bachelor of arts in criminal justice from Sangamon State University and a master of legal studies from the University of Illinois at Springfield.

# Close the Door on Crime: A Mapping Project

*Susan Wernicke*
*Overland Park, Kans., Police Department*



Overland Park, Kans., is a suburb of Kansas City, Mo., with a population of 138,000 people and area of 56 square miles. It is the third largest city in Kansas. The police force is composed of 192 sworn officers and 73 civilians, which includes a civilian-staffed Crime Analysis Unit (CAU) organized in 1993. The CAU's mission is to provide timely, accurate and useful tactical and strategic criminal intelligence information to the patrol officers, detectives and command staff.

The CAU supports personnel assigned to each of the six divisions within the department. Analysis software includes FoxPro, Microsoft Excel, Microsoft Word, Microsoft PowerPoint, ArcView and Target Crime Analysis, an in-house, FoxPro-based program that contains more than 73,000 records.

Using Target Crime Analysis, the CAU tracks all target crimes, including all major persons and property crimes. The CAU also produces various weekly publications containing confidential tactical criminal intelligence information and computerized pin maps to keep officers informed of current criminal activity, crime trends and suspect information. Officers have successfully made arrests and solved crimes as a direct result of information provided in CAU publications.

The CAU provides bulletins to all Overland Park officers and to 52 other area law enforcement agencies. Other more specialized bulletins are produced in response to specific requests from officers, detectives, command staff, government officials and citizens. Through its information dissemination efforts, the CAU plays a vital role in the tactical and strategic deployment of the department's officers.

In April 1998, during their review of daily police reports, crime bulletins and weekly crime maps, several individuals in the department's Investigations Division, Sanders Patrol Division, Crime Prevention Unit and Crime Analysis Unit identified a marked increase in the number of reports of "garage shopping." (Garage shopping is a term used to describe thefts from garages, which are classified as residential burglaries.)

The units came together in a consolidated effort to combat the problem. Statistics prepared by the CAU showed a steady increase in

open garage burglaries (see Table 1). Personnel speculated that, as the weather warmed, citizens began leaving their overhead garage doors open for extended periods of time, even overnight, leading to increased thefts from garages.



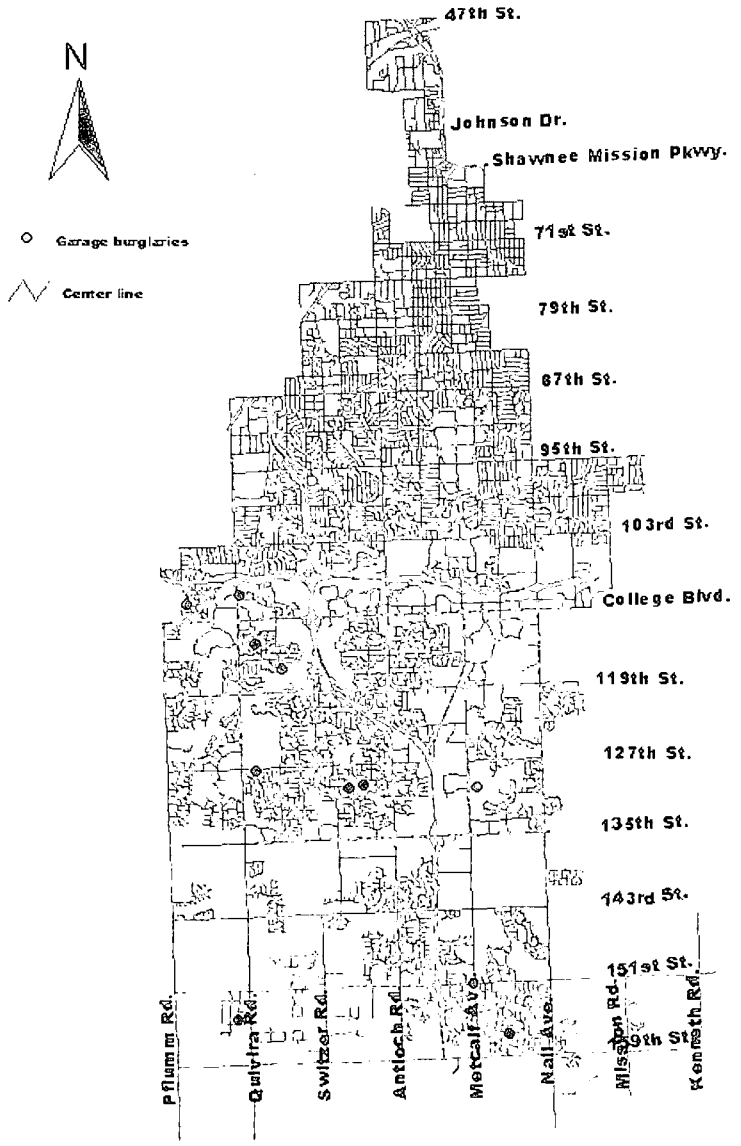
| January 1998 | February 1998 | March 1998 | April 1998 |
|---|---|---|---|
| 2 | 4 | 7 | 11 |

**Table 1**
**Open Garage Burglaries by Month**

Investigators used maps provided by the CAU to track where the incidents were occurring. Drawing on their analysis, the Property Crimes Unit organized a surveillance team strategically placed inside an open garage in the area hardest hit during May (see Figure 1). Although the surveillance netted no arrests, the detectives contacted numerous residents with open garages and asked them to close their garage doors.

In the meantime, the Crime Prevention Unit (CPU) developed a "Close the Door on Crime" campaign. The CPU and CAU designed a brochure that the patrol divisions handed out in the neighborhoods most affected. The CPU officers also began educating neighborhood watch groups on the importance of keeping garage doors closed. The officers emphasized that it wasn't just "another crime problem," but a specific crime problem that was occurring not just in their city, but specifically in their neighborhood.

Most incidents were occurring in the south half of the city, which has its own patrol division—the Sanders Patrol Division. A team of officers working the evening shift began informally contacting residents with open garages, as duty permitted. Due to heavy call loads, however, it was a hit-and-miss tactic. By the end of May, the team decided to tackle the problem head on, dedicating two officers in two cars, two hours a shift, three nights a week. These officers were taken off routine patrol and placed on special assignments. While on the assignments, they were not available for calls. These special assignment officers, using maps provided by the CAU, strategically targeted a residential area and flooded the area, contacting as many people as possible. At the end of the month, the officers turned in a list of the addresses contacted in an attempt to avoid recontacting the same resi-




Prepared by: Susan Wernicke
Prepared on: June 2, 1998

**Figure 1**
**May Map**
**Open Garage Door Burglaries**
**05/01/98 through 05/31/98**

dents at a later date, unless their garage was found open again. Although the project wasn't fully organized until the end of May, at least 74 residents were contacted and given a "Close the Door on Crime" brochure.

The midnight shift also got involved in the project and, as duty permitted, contacted residents whose garage doors were left open overnight. Since the evening shift actually circled (in green grease pencil) the areas they contacted on a city map after each shift, the midnight shift officers could resweep the area to ensure the residents had really gotten the message. After completing their shift, the midnight shift officers circled the areas they covered using an orange grease pencil.

In June, the day shift patrol unit was brought on board. Using a dedicated bike patrol unit, the shift joined in on contacting residents in the area. The bike patrol officers went one step further and contacted *every* resident in the targeted neighborhoods, instead of contacting only those with their garage doors open. The bike patrol unit turned in their totals to the evening shift lieutenant. As June concluded, the day and evening shift units had contacted 545 residents. However, despite their efforts of targeting the hardest-hit areas, the number of open garage door burglaries hit an all-time high of 14 in June.

By this time, the CAU was receiving requests for updated maps depicting open garage door burglaries as often as two or three times a week. Everyone involved wanted to keep current on where and how often the incidents were occurring. Both the Investigations Division and the Sanders Patrol Division realized that much more was needed to reduce the number of incidents. In response, a map was placed in the watch commander's office to track the incidents and the locations contacted by officers. Neighborhoods that had been educated once needed to be recontacted. The lieutenant continued tracking the addresses throughout July and, at the end of the month, noted that 455 additional residents had been contacted.

The effort paid off. The July total dropped to nine incidents. Seeing their success, the officers continued contacting residents as often as possible, both on routine patrol and on special assignments. August came and went with a total of only five open garage door burglaries. In September 1998, only one open garage door burglary was reported (see Figure 2).

The project was definitely considered a success at this point. More than 1,200 citizens had been contacted, and the number of open garage door burglaries had decreased back to a normal amount.

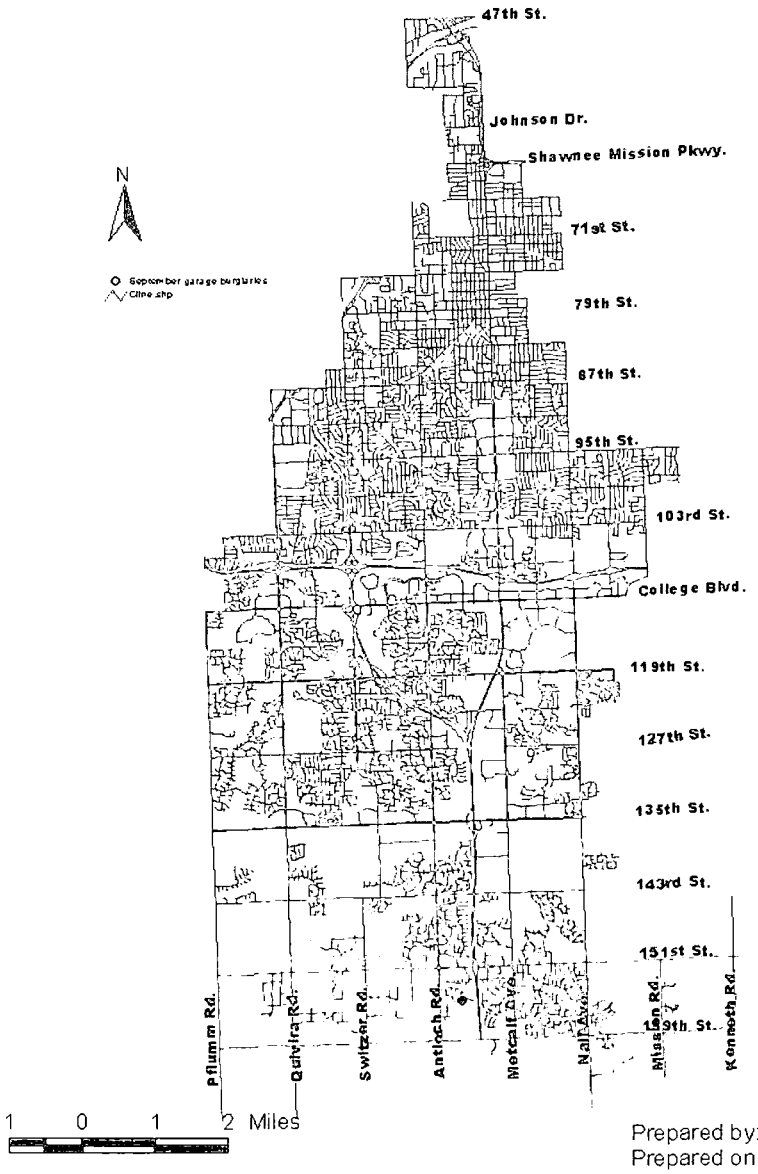



**Figure 2**
**September Map**
**Open Garage Door Burglaries**
**09/01/98 through 09/30/98**

The CAU continues to map out the incidents to ensure the number doesn't begin climbing again, and the Sanders Patrol Division plans to distribute glow-in-the-dark stickers and magnets that say, "The Overland Park Police Department asks: Is your garage door closed?" Officers will ask residents to affix the stickers at eye level by the door leading into the residence and to place the magnets on refrigerators. This effort, combined with the personal contact between officers and residents and the media attention drawn to the problem, will aim to keep the number of open garage door burglaries to a minimum.

Figure 3 illustrates the project's success. The graph shows the steady climb of incidents, a peak and a drastic decline after intervention. The quick response by several divisions based on the mapping provided by the CAU certainly placed the officers at an advantage over the crooks.

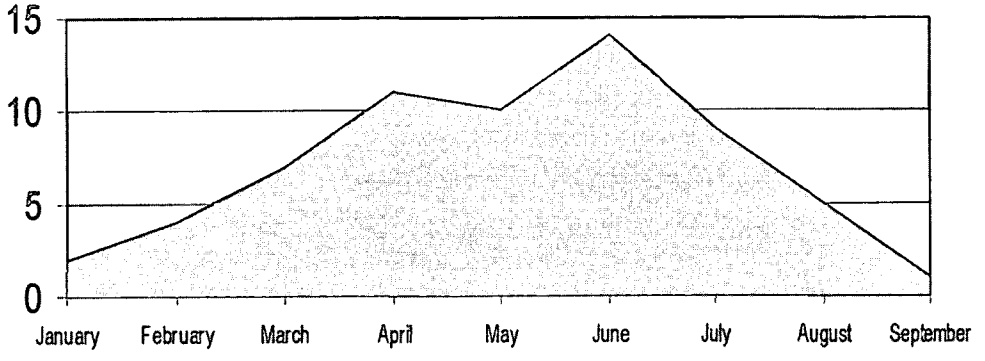



**Figure 3**
**Open Garage Door Burglaries in 1998**

# ABOUT THE AUTHOR



**Susan Wernicke** has been employed by the Overland Park, Kans., Police Department since August 1991. She has held the positions of communications officer, police report clerk and, since January 1997, crime analyst in the Administrative Services Division. She received an undergraduate degree in human services and criminal justice in May 1991 from Saint Mary College, Leavenworth, Kans., and is currently completing dual master's degrees in management and business administration.

34

# Crime Mapping by Community Organizations: Initial Successes in Hartford's Blue Hills Neighborhood

*Thomas F. Rich*
*Abt Associates*



This case study describes a National Institute of Justice–funded project to introduce crime mapping and analysis to community crime prevention organizations in Hartford, Conn. It details how one community organization—the Blue Hills Civic Association—is using crime mapping to get neighborhood residents more involved in preventing crime and to support the work of neighborhood block watches.

This project originated as part of Hartford's Comprehensive Communities Partnership (CCP) initiative, a citywide effort aimed at expanding community policing, implementing community-oriented government and mobilizing city residents around crime prevention and control. An important component of CCP involved forming problem-solving committees in each of the city's 17 neighborhoods. During an early CCP needs assessment, the problem-solving committees identified access to computerized police databases as one of the most critical information requirements for effective problem solving. This access could be provided in a number of ways. Increasingly, police departments are publishing aggregate crime statistics on the Internet. The San Diego Police Department, alternatively, disseminates *incident-level* crime information via the Internet, including the date, time, location and type of crime. In Hartford, the objective was to go one step further and provide community organizations with their own basic mapping and analytical tools to analyze incident-level data.

The project involved developing mapping and data analysis software for the community organizations, as well as developing systems and procedures for making incident-level police data available to that software. Because all 17 problem-solving committees, as well as other interested community organizations and city agencies, were to receive the software, a stand-alone executable program that does not require a base map or other commercial product (such as MapInfo or ArcView) was developed. The Windows 95–based software package—dubbed the Neighborhood Problem Solving, or NPS, system—was developed using Microsoft Visual FoxPro, Blue Marble Geographics GeoView LT (a mapping component, or OCX) and

Microsoft Graph. Given that the primary NPS users would be community organizers and activists whose computer skills were presumed to vary widely, project staff devoted considerable effort to making the system easy to use, yet flexible enough to encourage users to undertake basic analyses of the police data.

The system includes the following five basic reports, each of which can be applied to citizen-initiated calls for service, reported crimes or arrests: (1) a *detail list* shows in tabular form information about each event (e.g., calls for service, crimes or arrests); (2) a *top ten list* shows the 10 most common types of events; (3) an *event trend list* compares the number of different types of events in two different time periods (e.g., year-to-date 1998 vs. year-to-date 1997); (4) a *time trend graph* shows the number of events by day, week or month; and (5) a *map* shows the geographic location of events, with the size of the icon proportional to the number of events at that location. Date ranges, time ranges and sort orders can also be selected, as well as subsets of calls for service, crimes and arrests (e.g., only reported burglaries, only narcotics arrests).

Every two weeks, NPS users receive[1] via e-mail or computer disk a new data set containing the past 25 months of citizen-initiated calls for service, reported crimes and arrests originating in the user's area of concern. (The user areas range in size from a few city blocks to about two square miles.) The first step in creating the data sets involves running a MapInfo-based program that splits citywide calls for service, crime and arrest files into separate files for each NPS user, based on each user's area of concern. With the two-week delivery cycle (and because the police department enters calls for service and arrest information in real-time and crime information within a week of when the officer completes the crime report), NPS users have access to information that is only about one week old. In addition, the data are comprehensive; the crime data set, for example, includes information from all police incident reports—everything from homicides to animal complaints. Because of privacy concerns, no names or other identifying information are provided in the data sets.

After a beta-test period, installation of the NPS system began in June 1998 and will continue throughout 1998 and into 1999. Use of the system will be closely monitored to determine how use patterns

[1]Currently, Abt Associates provides new data sets to NPS users from their Cambridge, Mass., office. By the end of 1998, data sets will be shipped out from police headquarters in Hartford.

vary across the different organizations; what factors explain different use patterns; and what impact the system has on community mobilization, residents' perceptions of neighborhood safety and community-based crime prevention. In the end, the key policy question is whether other cities should go to the extra effort to provide this level of analytic capability to community organizations. The Hartford City Manager's Office and the Hartford Police Department have both supported this effort, as both view the project as a way to get the community more involved in community policing and in grassroots crime prevention activities. The police department, in particular, deserves credit for supporting this project, in light of the uncertainty about how the data would be used. If the experience of the Blue Hills Civic Association is a valid indicator, it appears that the data will be used for more effective community policing.

## Blue Hills Civic Association

The Blue Hills neighborhood of Hartford, located in the city's northwest section, has about 15,000 residents in a 1.8 square mile area. While the city has been one of the nation's poorest for a number of years (in terms of the percentage of residents living below the poverty line), the Blue Hills neighborhood is considered one of Hartford's more middle-class neighborhoods, with about 60 percent of the housing owner-occupied. For the Blue Hills Civic Association—the neighborhood's grassroots citizen organization—the key issues are increasing the rate of home ownership, improving the public schools, lowering crime and making the area more attractive to families looking to own a home in Hartford. The association supports a network of about 25 block watch groups, each headed by a block captain who runs periodic meetings with residents to discuss current problems and possible solutions.

The NPS software is installed on one of the association's office computers, which was provided by the city with funding from CCP. Association staff respond to a variety of requests from the neighborhood residents and can, as needed, produce crime maps or reports for residents. The association reacted enthusiastically to the system and alerted the neighborhood to its existence in a front-page article in the neighborhood newspaper. The association believes that "information is power" and, armed with information gleaned from the system, feels it will be in a much-improved position to request additional city resources.

# Increased Reporting of Drug Activity

The first use of the NPS software involved an effort to increase reporting of drug activity in Blue Hills. Street-level drug activity was a serious concern for many Blue Hills residents and a frequent topic of conversation at neighborhood and block watch meetings. The association felt that one method for addressing the problem was to encourage residents to report drug activity to the police, with the expectation that increased reporting would lead to a greater police presence, possibly including undercover operations or other anti-drug measures. At the same time, the association suspected that drug activity was grossly underreported and that many of the residents most concerned about drug activity were not reporting the problem to the police.

A report showing the number of citizen-initiated drug calls for service made in May 1998 confirmed the association's suspicions—only 10 calls had been received. This information was shared and discussed with neighborhood residents attending block captain and association meetings as a way of showing how drug activity was being underreported. The map in Figure 1, produced with the NPS software, shows the locations where the police responded to drug-related calls for service in May 1998.

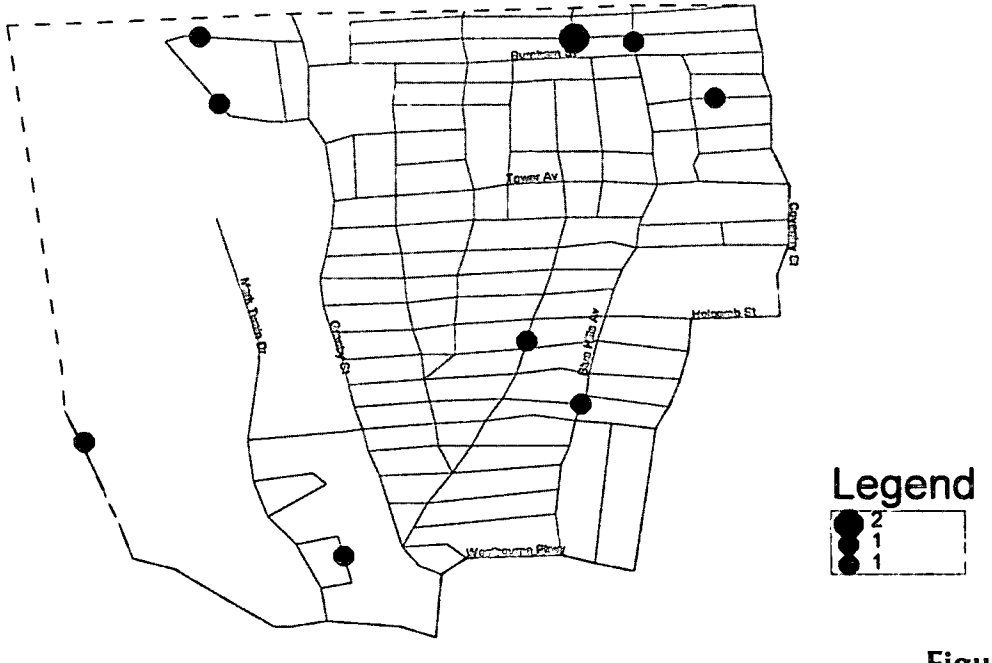



**Figure 1**
**Blue Hills Drug Crime Calls for Service: May 1998**

Following the association's outreach effort, the NPS software provided some evidence of initial success. Figure 2 is a map of the drug calls for service in June 1998. Compared with the previous month, there were substantial increases in both the number of drug calls for service (10 in May, compared with 27 in June) and the number of locations where the police went in response to these calls for service (8 in May, compared with 18 in June).

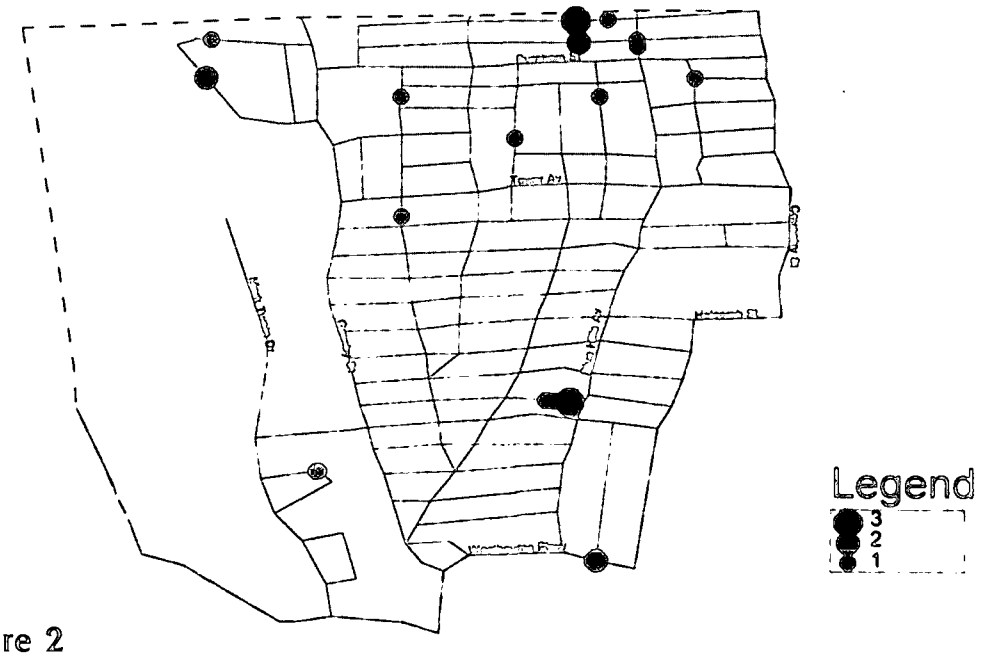



**Figure 2**
**Blue Hills Drug Crime Calls for Service: June 1998**

This 170 percent increase in the number of drug calls for service from May to June was particularly significant when compared with trends in other types of calls for service. The event trend list in Table 1 shows the percentage change in different groups of calls for service from May to June.[2] While property crime calls for service increased from 26 in May to 32 in June (a 23 percent increase), other crime calls for service (a catch-all category representing crimes other than seven Part I crimes and drug crimes) remained essentially unchanged (123 in May and 122 in June).

[2]Within each call-for-service group are several specific types of calls for service. For example, the property crime call-for-service group includes four types of property crime calls: breaking and entering, larceny, purse snatch and stolen vehicle. The call-for-service event trend list report computes changes at the group level, rather than at the individual type level.

| Call Group | First Period | Second Period | Change |
|---|---|---|---|
| Administrative | 4 | 0 | *** |
| Alarms | 95 | 148 | 55.78% |
| Community Assistance | 49 | 53 | 8.16% |
| Domestic Disputes | 78 | 58 | -25.64% |
| Drug Crime | 10 | 27 | 170.00% |
| Emergency Medical Service | 6 | 7 | 16.66% |
| Miscellaneous | 0 | 1 | *** |
| Other Crimes | 123 | 122 | -0.81% |
| Property Crime | 26 | 32 | 23.07% |
| Traffic Details | 50 | 80 | 60.00% |
| Violent Crime | 3 | 3 | 0.00% |

**Table 1**
**Event Trend List, Calls for Service**
**Blue Hills Neighborhood: May 1998 compared with June 1998**

More important than the fact that residents called the police more often to report drug activity were the immediate results from those calls. The NPS system allows users to determine whether the police, in response to a citizen call for service, filed a crime report or arrested one or more people. By running a drug arrest detail list report for June 1998, it was determined that the 27 drug calls for service in June led to the immediate arrest of 11 people. By comparison, in the previous month, the 10 citizen-initiated drug calls for service did not result in any immediate arrests.

While it is not known how much of the increased reporting was due to increased drug activity, as opposed to increased reporting with the same level of drug activity, the association felt that the statistical reports "got the point across" and encouraged residents to call the police. In turn, the increased reporting led to an increase in police presence and arrests.

## Other Uses in Blue Hills

The Blue Hills Civic Association has used the NPS system for other purposes as well. On Aug. 4, 1998, communities across the nation celebrated National Night Out, in which residents participate in outdoor activities designed to mark progress in "taking back the

night" from drug dealers and criminals. Blue Hills residents held more than a dozen block parties and cookouts. The association viewed National Night Out as an opportunity to stimulate discussions among residents about crime and crime prevention and used the NPS software to produce a two-page handout that included a number of different maps and tables depicting crime patterns in Blue Hills. It made about 100 copies of the handouts and delivered them to block party hosts. According to the association, residents' reactions to the handouts ranged from mild interest to solid enthusiasm. Favorable comments included the observation that the association and its block captains could now alert neighbors to threats such as an outbreak of burglaries. A number of residents, after seeing how few calls had been recorded from their blocks, observed that police cannot be expected to recognize "hot spots" without the help of citizens.



The NPS software also helps provide information to neighborhood block captains, who, in turn, can keep residents informed of crime trends, help prioritize problems, help develop crime prevention strategies and have more productive meetings with the police department's community police officers. Currently, a group of five "test" block captains receive handouts every two weeks depicting crime conditions in their block watch area, in addition to a neighborhoodwide handout like the one used in National Night Out. If the test group of block captains responds favorably to this effort, it will be expanded to include all block captains in Blue Hills.

# ABOUT THE AUTHOR

**Thomas F. Rich** has been an associate at Abt Associates in Cambridge, Mass., since 1994. Prior to that, he worked for 12 years at Queues Enforth Development, Inc., a criminal justice software and consulting firm. His experience spans criminal justice research and evaluation, criminal justice information systems, software development and geographic information systems. He has been involved in crime mapping since 1990, when he participated in Hartford's NIJ-funded Drug Market Analysis Program. In the early 1990s, he developed mapping software for a commercial police computer-aided dispatch system and installed the mapping system in several public safety dispatch centers. He is the author of two NIJ publications on crime mapping: *The Use of Computerized Mapping in Crime Control and Prevention Programs* and *The Chicago Police Department's Information Collection for Automated Mapping (ICAM) Program.* He is currently project director of an NIJ-funded effort to introduce crime mapping to community crime prevention organizations in Hartford.

# Improving Law Enforcement and Criminal Justice Operations

# The Perception of Crime Hot Spots: A Spatial Study in Nottingham, U.K.

*Jerry H. Ratcliffe and Michael J. McCullagh*
*University of Nottingham*



In South Nottingham, England, hot spot identification was combined with survey data to give a unique insight into the local crime awareness of police officers. The maps and analyses have resulted in a re-evaluation of police crime recording practices and intelligence information dissemination and have given police managers new insight into how police officers form a picture of crime on their beat.

Researchers Jerry H. Ratcliffe and Michael J. McCullagh at the School of Geography, University of Nottingham, performed the analysis. Previous collaborative work in crime mapping with Chief Superintendent Eddie Curtis, the local divisional commander at Trent division in Nottinghamshire Constabulary, had been successful, and the investigation of officers' perceptions of crime hot spots was an extension of the previous work. Nine maps were produced that covered three subdivisional areas and addressed three subject areas. Crime hot spots were plotted over a one-year period for domestic burglary, nondomestic burglary and motor vehicle crime. This information was then mapped and compared with the results of a survey of local officers who were asked to mark the position of hot spots in their areas. Trent division managers wanted to see how familiar their officers were with the worst areas of burglary and auto crime. These crime types are identified as local divisional (and constabulary) priorities, and these crime statistics are published locally. It was therefore important for local managers to assess whether their officers had the right information to combat these types of crime and knew where the crime problems were located.

This was a particularly timely analysis, as local crime recording practices had changed in the 12 months prior to the study. For a number of years, except in unusual circumstances, most motor vehicle crime reports were recorded over the telephone, and an officer did not attend the scene. Likewise, new practices for responding to burglaries meant that officers visited crime scenes less frequently. The analysis was a way of testing if officers' lack of personal contact with crime scenes had an effect on their knowledge of the local crime picture.

The maps combined the results of a hot spot detection program written by one of the authors with the results of a survey of the majority of officers in each subdivision. Police officers are familiar with maps, and their knowledge was used to perform the survey. Each officer received a number of maps of their beat and was asked to indicate the location of any crime hot spots of which they were aware. These estimates were digitized and mapped with the hot spot analysis using MapInfo. Information about the officers' experience, such as their tenure as an officer and how long they had served at their current station, was retained as attribute data with the digitized information.

The researchers considered a number of programs to detect the hot spots, including Vertical Mapper (an add-on for MapInfo), STAC and SCAS (available from the U.S. Department of Justice Criminal Division GIS staff). In the end, they decided to develop a customized system, drawing on the published spatial analysis algorithms available in the academic literature. This program, called SPAM (Spatial Pattern Analysis Machine), tests points locally on a grid lattice. In brief, a fine grid is placed over the geocoded crime locations, and at each lattice point a number of circles are superimposed over the study area, centered on the current grid intersection. Crime incidents that fall within the circle are used to produce a *crime intensity* calculation, using a quartic kernel algorithm. This was deemed preferable to the simple density count used by some other systems, as the points are weighted according to how close they are to the center of the circle. The intensity algorithm allows a measure of distance from the epicenter to be constructed. Integration between customized programs and geographic information systems (GIS) is vital to the eventual display and interpretation of the results. Although for computational speed the program was written in Visual C++ (and therefore is compatible with Windows 95), it was specifically written to output MapInfo Interchange files so that the crime intensity results could be immediately imported into MapInfo. While time-consuming to program and test, the effort was considered well worthwhile, as SPAM analyzes the crime incidents and outputs results exactly as desired, without the compromises of many off-the-shelf products.

The program can output a fine grid of vector cells giving raster-type appearance. When this is thematically mapped by MapInfo, the areas of highest crime intensity become immediately apparent. This process was seen as advantageous compared with some other programs, as the output more accurately reflects the urban geometry of the study area. STAC is a commonly used program, but hot spots are identified as standard deviational ellipses, and few housing develop-

ments or crime-ridden areas are conveniently elliptical in design with a hot spot center in the heart of the area. A moving-window approach, where the analysis is performed over a small moving circular area of data, presents results that more closely resemble the hot spots in the study area. If an area contains no housing, there will not be a domestic burglary hot spot focused on that location.



Figure 1 shows a map of burglary crime hot spots in the Meadows area of central Nottingham. The grid resolution is ten meters, and the grey bands show the intensity of domestic burglaries within a 100-meter radius of the center of the cell. Added to this are the estimates of crime hot spots from the survey of police officers in the area. Each diamond represents the center of a hot spot as perceived by one of the officers. The choice of a 100-meter radius was decided on from the survey results. Each officer had the opportunity to include as many sites as wanted but had to mark the most important one with a circle or some other shape. This shape was to represent the perceived extent of the hot spot. The larger the shape, the larger the perceived spatial spread of the hot spot. Analysis of these circles indicated that the majority of officers felt that a hot spot could be defined by a circle with a diameter of approximately 200 meters.

Using the same techniques and study area, Figure 2 shows the distribution of motor vehicle crime hot spots along with the perceived locations from the police officers. A comparison of both images shows the police officers achieved a fair degree of success in identifying the areas of concern with domestic burglary (Figure 1) but were less successful in identifying the motor vehicle crime hot spots (Figure 2), even though more than twice the number of car crime incidents occur in the study area. This has implications for the way that motor vehicle crimes are recorded and how information is disseminated to the operation officers charged with preventing these crimes. It also has raised questions about the perceived seriousness of motor vehicle crime, which, although it is a divisional priority, has received less crime prevention and detection effort than burglary for a number of years.

Trent division commanders have used the results of this analysis in a review of the local crime recording practices and have instigated change in the way that local crime information is disseminated to operational police officers and outside agencies. The analysis identified a problem that had not otherwise been apparent and provided the required impetus to reassess the relevant policing techniques. The main ramification has been a move away from textual briefing methods toward the use of overlay crime mapping to allow officers to visualize quickly the current crime displacement. This has been particularly

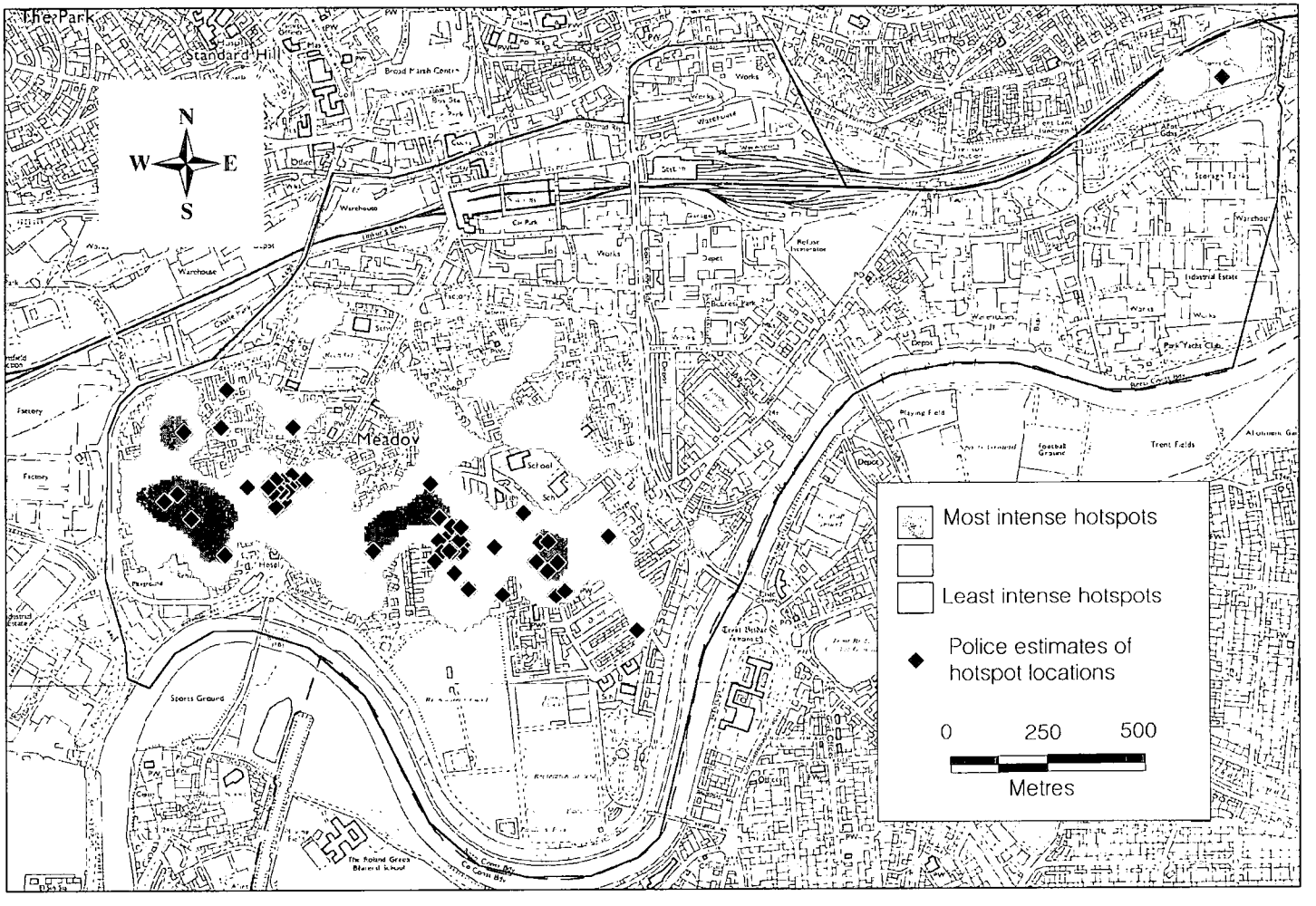
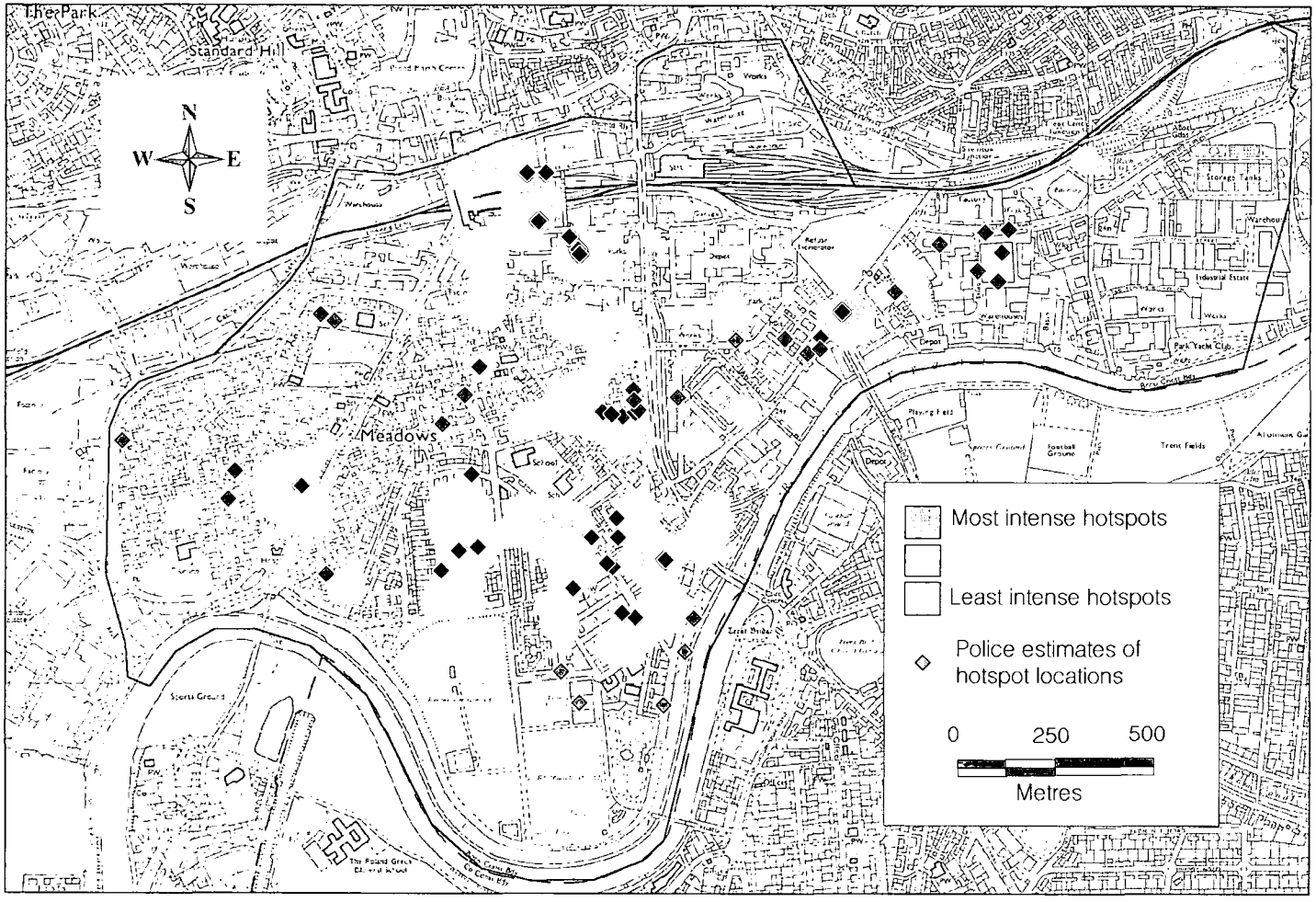





**Figure 1**
**Domestic Burglary Hot Spots and Police Perception in the Meadows Area of Nottingham**

## Figure 2
## Vehicle Crime Hot Spots and Police Perception in the Meadows Area of Nottingham



useful at West Bridgford police station, where the local community officers have taken the initiative to use crime mapping themselves as a direct result of the survey and analysis.

On a more cultural level, the survey (combined with post-analysis interviews) also highlighted the lower status of motor vehicle crime in the attitudes of police officers. Burglary is often seen as the *only* priority, instead of one in a list of many divisional and force priorities, including drugs and motor vehicle crime. The United Kingdom's leading position in motor vehicle crime statistics causes many to consider motor vehicle crime as an inevitability; this attitude is reflected in the system of allowing the public to record vehicle crime by telephone. The act of "going through the motions" when recording vehicle crime is in danger of becoming the predominant attitude when attempting to prevent and deter criminals from committing this type of crime. The maps produced in this study answered the questions asked, but more important, they highlighted other issues of which the local police commander was unaware and revealed questions not previously asked that must be addressed.

SPAM is freely available from the following Web site: http://www.geog.nottingham.ac.uk/~jerry/.

# ABOUT THE AUTHORS



**Jerry H. Ratcliffe** teaches geographic information systems (GIS) at the School of Geography, University of Nottingham, United Kingdom. His research interests include the integration and analysis of crime and incident data with GIS. For 10 years before his arrival at the University of Nottingham, he served as a police constable with the Metropolitan Police in London, first in the East End of London and as part of a diplomatic protection unit.

**Michael J. McCullagh** taught at the University of Kansas during the early 1970s and now teaches quantitative methods and geographic information systems (GIS) at the University of Nottingham, United Kingdom. His research and publication areas include terrain modeling, visualization, animation, cartography, retail GIS analysis, insurance hazard analysis and spatial aspects of crime.

# The Problem of Auto Theft in Newark

*Joseph J. Santiago*
*Newark Police Department*



Newark, N.J., was at one time considered the auto theft capital of the world. In the early 1990s, carjackings and auto thefts were popular crimes, often committed by the same individuals and/or linked as the literal vehicles for other crimes, including shootings and robberies. Auto theft continues to serve the demands of the chop shop and export markets, and "doin' donuts" at Avon Avenue and South 10th Street remains a badge of honor and rite of passage in Newark. ("Doin' donuts"—sometimes referred to as a rodeo—means that the driver of a vehicle enters an intersection at high speed and spins the car around, usually in front of a large group of onlookers.)

Over the past several years, a variety of strategies have been successfully implemented to reduce auto theft and carjacking, including the deployment of a street squad and the Union-Essex (Counties) Auto Theft Task Force. Yet auto theft has remained a proverbial hard nut to crack. In Newark's East District (one of the city's four police districts), an average of 38 to 42 vehicles were stolen each week in June and July 1997. This rate is actually low compared with previous weeks, which averaged 60 vehicles. A variety of efforts were used to address this problem; some worked for only a short period, while others were effective but cost too much. The observed reduction to 20 or so vehicle thefts per week is likely a result of "scaring off" the multitude of casual thieves. Thieves now operating in the area appear to be seasoned car thieves.

## Newark's Comstat Process

To halt this crime activity, the Newark Police Department decided to implement the Comstat process. This process helps police continually refine their understanding of a problem and evaluate their response to that problem. The key factor of Comstat is that the regular and attentive monitoring of a crime problem provides a platform upon which to reassess the problem and the strategies applied to combat it.

The Newark Police Department began holding Comstat meetings in April 1997. At these semimonthly meetings, the department reviewed police work, defined and monitored crime problems and planned strategies to combat the identified problems. Crime statistics formed the basis for analysis and were charted to show individual district and sector activity by type of crime. The crime analyst used MapInfo to generate maps from Microsoft Excel spreadsheets. Three auto theft and recovery maps were created for each meeting. One map showed auto thefts for the preceding two weeks; another showed recovered stolen vehicles for the same two weeks, both for local recoveries and for vehicles stolen out of other jurisdictions and recovered in Newark; and the third map was a combination of the theft and recovery maps.

By December 1997, statistics, maps and analysis were being combined into a Comstat Crime Book. This book was provided each week to each command in the department, as well as to various specialty squads (Robbery/Homicides, Auto Squad, etc.). The Comstat Crime Book documented crime information for the preceding two weeks and provided information on all crimes of violence (homicides, rapes, robberies, shootings), gun recoveries, burglaries, theft from auto and auto theft and recovery. For each crime, three maps depicted the two-week activity, the crime by tour and the crime by type. Figure 1 is the cover sheet to the Auto Theft Section.

The initial mapping efforts for Comstat were useful. As police personnel learned how to read them and use the base information, the maps and the accompanying statistics became even more popular. As a result, officers began to request more sophisticated information. The Comstat Crime Book and the accompanying maps have since been modified to meet these demands.

## COMSTAT AND AUTO THEFT

In May 1998, the police director instituted Crime Zones for each district. District commanders selected their most active and violent sector and scrutinized every crime in it at the Comstat meetings. Each responsible squad was pressed to devise more efficient and effective methods of dealing with the crime problems. In the East District, Sector 316 was selected. District patrol units' subsequent efforts to reduce auto theft activity there were successful, but auto theft then

Overview of Auto Thefts
7/10/98 - 7/23/98

During this two-week period, 172 auto thefts were reported to the City of Newark. This means that approximately 12.3 vehicles are stolen each day out of Newark. There were 253 vehicles recovered. Of these 253 recovered vehicles, 159 or 62.8 percent were reported as FOAs.

The table below shows the total theft and recovery activity by district and then by percent total theft and recovery activity. Note that of the 172 vehicles reported stolen only 89 were recovered during this two-week period.

| Auto Theft and Recovery by District for the period 7/10/98 - 7/23/98 | | | | | |
|---|---|---|---|---|---|
| | North | East | West | South | Total |
| Auto Theft | 56 | 52 | 25 | 39 | 172 |
| Percent of Total Thefts | 32.6 | 30.2 | 14.5 | 22.7 | 100.0 |
| Auto Recovery | 67 | 51 | 71 | 64 | 253 |
| Percent of Total Recovery | 26.5 | 20.1 | 28.1 | 25.3 | 100.0 |
| Total Activity | 123 | 103 | 96 | 103 | 425 |
| Percent of Total Activity | 29.0 | 24.2 | 22.6 | 24.2 | 100.0 |
| Stolen Vehicles Recovered | 32 | 27 | 14 | 16 | 89 |
| Percent of Stolen Recovered | 57.1 | 51.9 | 56.0 | 41.0 | 51.7 |

For this two-week period, the North District reported the greatest number of thefts, then the East, South and West Districts. The West District had the most recovered vehicles. The North and the South were very close with 67 and 64 respectively. The East District recovered the fewest stolen vehicles. For total activity, the North District experienced the most, then the East and the South were equal, and finally the West District.

The District tables below also show the sector activity. The sectors with the greatest amount of activity are: 315, 316, 217, 212 and 512.

The most popular cars to steal are the Honda (23), Chevrolet (14), Toyota (13), Oldsmobile and Dodge (12 each). There were 16 SUV's taken and 17 expensive cars taken. The most popular model years are 1986 (18), 1988 (17), 1990 and 1992 (15 each) and 1993 (14).

**Figure 1**
**Cover Sheet to the Comstat Crime Book's Auto Theft Section**

increased in adjacent areas. A unit from the Auto Theft Squad was deployed to reduce the effects of this displaced crime. Figure 2 shows auto thefts in the East District between July 10 and July 23, 1998.

Auto theft information was picked apart at the Comstat meetings. This analysis changed participants' perceptions of the auto theft and vehicle recovery maps from maps with dots to maps that showed weekly auto theft and recovery changes. As a result, profiles of auto theft and recovery for each district were added to the Comstat Crime Book.

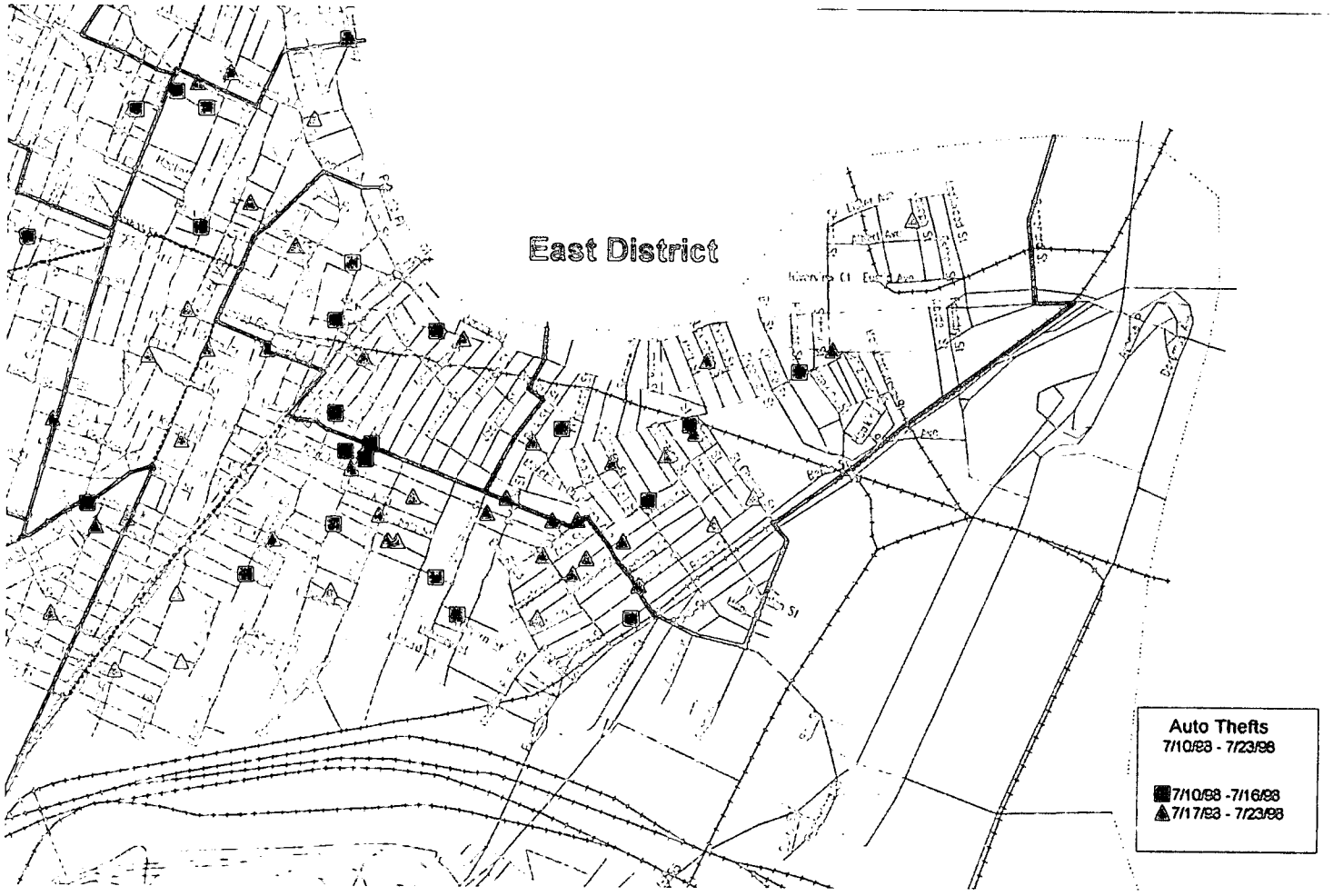
During the discussions, it became apparent that the time of day was a critical factor. Therefore, a column showing time ranges for auto theft in each sector was added to the auto theft and recovery profiles. These ranges were based on a per hour calculation to display the greatest frequency of incidents during an hour or a period of time. A second table showed day of the week activity by sector.

The most recent augmentation of the Comstat Crime Book's Auto Theft Section is the Last Known Address (LKA) Book, which lists people arrested in Newark for Receipt of Stolen Property-Auto. The LKA Book provides the user (usually a street supervisor) with information about the individual, the date and time that the vehicle was stolen and the vehicle characteristics. It also includes a map showing vehicle recovery locations and residences of people arrested for Receipt of Stolen Property-Auto. After a few weeks of using the map, operations sergeants asked that it show the Complaint Numbers of recovered vehicles. This would help them determine if an individual living near a cluster of recovered vehicles might be a good candidate for the thefts by comparing the LKA Book vehicle information with the types of vehicles currently being recovered. Figure 3 is a map from the LKA Book.

With the addition of the LKA Book, auto theft detectives and street crimes detectives began visiting listed persons to see if they could provide additional information about vehicles recovered in front of or near their homes. Their estimation of the book's value grew as officers in the East District began to find persons wanted on warrants for auto theft and the number of auto thefts began to decrease.

These tools have enabled patrol supervisors, the Auto Theft Squad and the Union-Essex Auto Theft Task Force to implement newer strategies, including road checks and directed patrol by time of day and day of the week. These strategies have in turn resulted in a decrease in auto thefts from an average of 40 vehicles each week to around 30 vehicles each week in the East District. The results are reviewed daily and at the Comstat meetings. The Comstat Crime Book maps clearly illustrate crime problems so police administrators, street supervisors and police officers can combat them more effectively and efficiently.

Figure 2
Auto Thefts in the East District, July 10–23, 1998



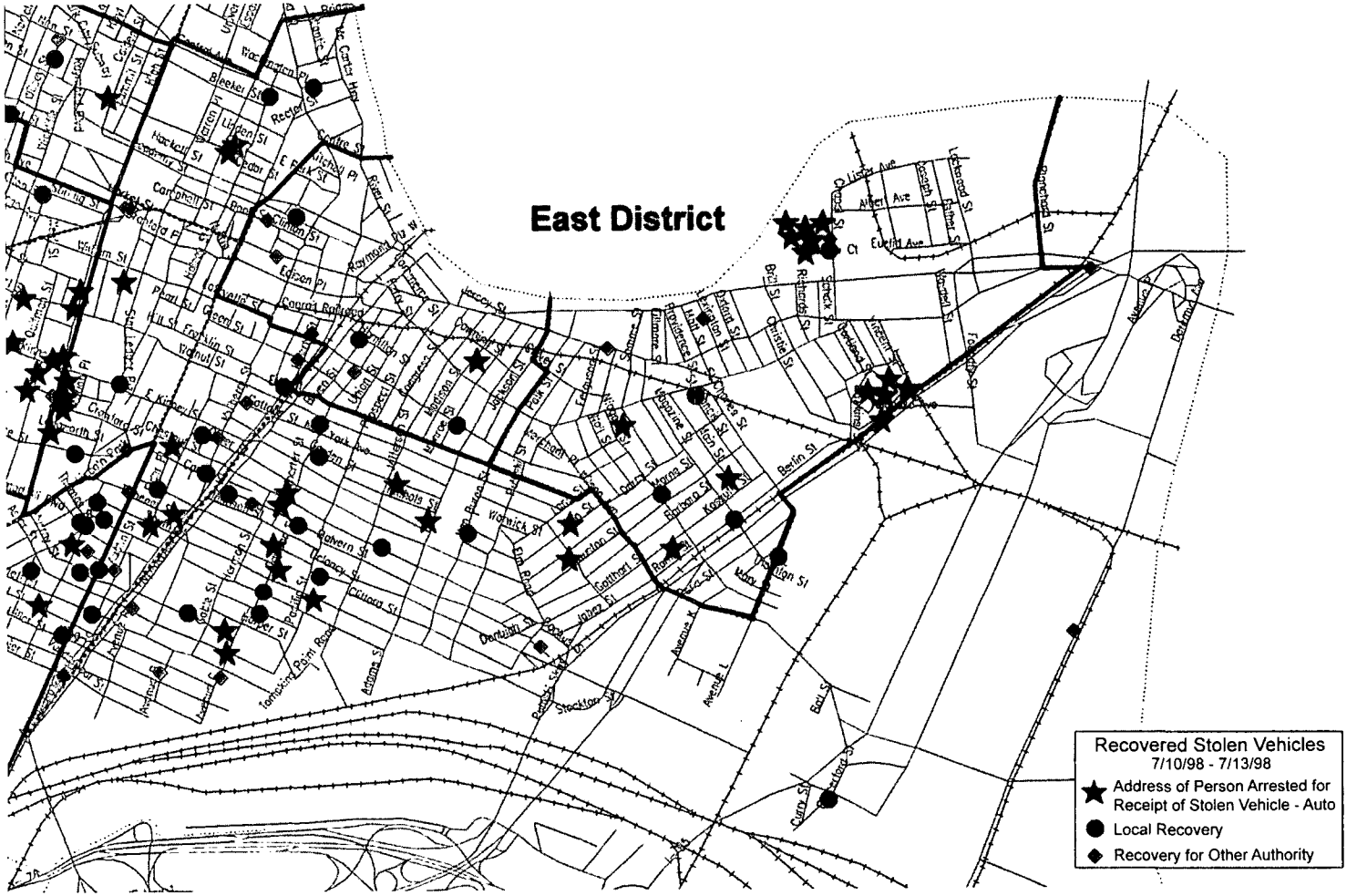



**Figure 3**
**Map of Recovered Stolen Vehicles from Last Known Address (LKA) Book**

# ABOUT THE AUTHOR

**Joseph J. Santiago** began his law enforcement career as a Newark Police Cadet in 1965. In September 1988, he left the Newark Police Department after being named Director of Public Safety for Essex County, N.J. After returning to the Newark Police Department, he achieved the rank of deputy chief in August 1991 and assumed command of the department's Field Operations Bureau. In 1994, he assumed command of the Internal Affairs Bureau, and in July 1996, he was named director of the Newark Police Department. Santiago is a graduate of Kean University, where he earned a bachelor of arts degree in history and political science and graduated with honors.

# Using Mapping to Increase Released Offenders' Access to Services

*Richard Harris, Charles Huenke and John P. O'Connell*
*Delaware Statistical Analysis Center*



One purpose of incarceration is to protect law-abiding citizens by removing those who disobey the law. Once released, however, many of these individuals return to the communities where they had lived prior to their incarceration. Depending on whether they had participated in counseling or treatment programs while incarcerated, many inmates are released into the community with the same problems that led to their incarceration. In most cases, these problems are related to substance abuse, behavioral or psychosocial problems, low educational attainment, chronic unemployment or underemployment or a lack of marketable job skills.

Many released offenders are ill equipped to deal with multiple problems of this nature without some form of assistance and continue to partake in criminal activity—especially if they have a substance abuse problem or are unemployed. A report by the Statistical Analysis Center entitled "Recidivism in Delaware, 1981 to 1984: Phase II" found that 47.5 percent of released offenders return to prison within three years.

An offender's continued involvement in criminal activity after release affects not only the crime victims but communities as well, since an increase in street crime can quickly erode the quality of life in a neighborhood. Therefore, ensuring that released inmates receive the assistance they need to become productive citizens benefits both the individual and the communities where they reside. The rate of recidivism in Delaware, however, indicates that post-prison rehabilitation services may not be optimally aligned. Service providers may not be close enough to former inmates, and people who depend on public transportation may not be able to get to the services.

The Delaware Criminal Justice Council's Executive Committee requested that the Statistical Analysis Center (SAC) examine the geographical distribution of services and post-prison offender location. The SAC has been involved in several research projects that employed mapping techniques. This case study illustrates how mapping was used to locate rehabilitative services for former inmates of the state department of corrections.

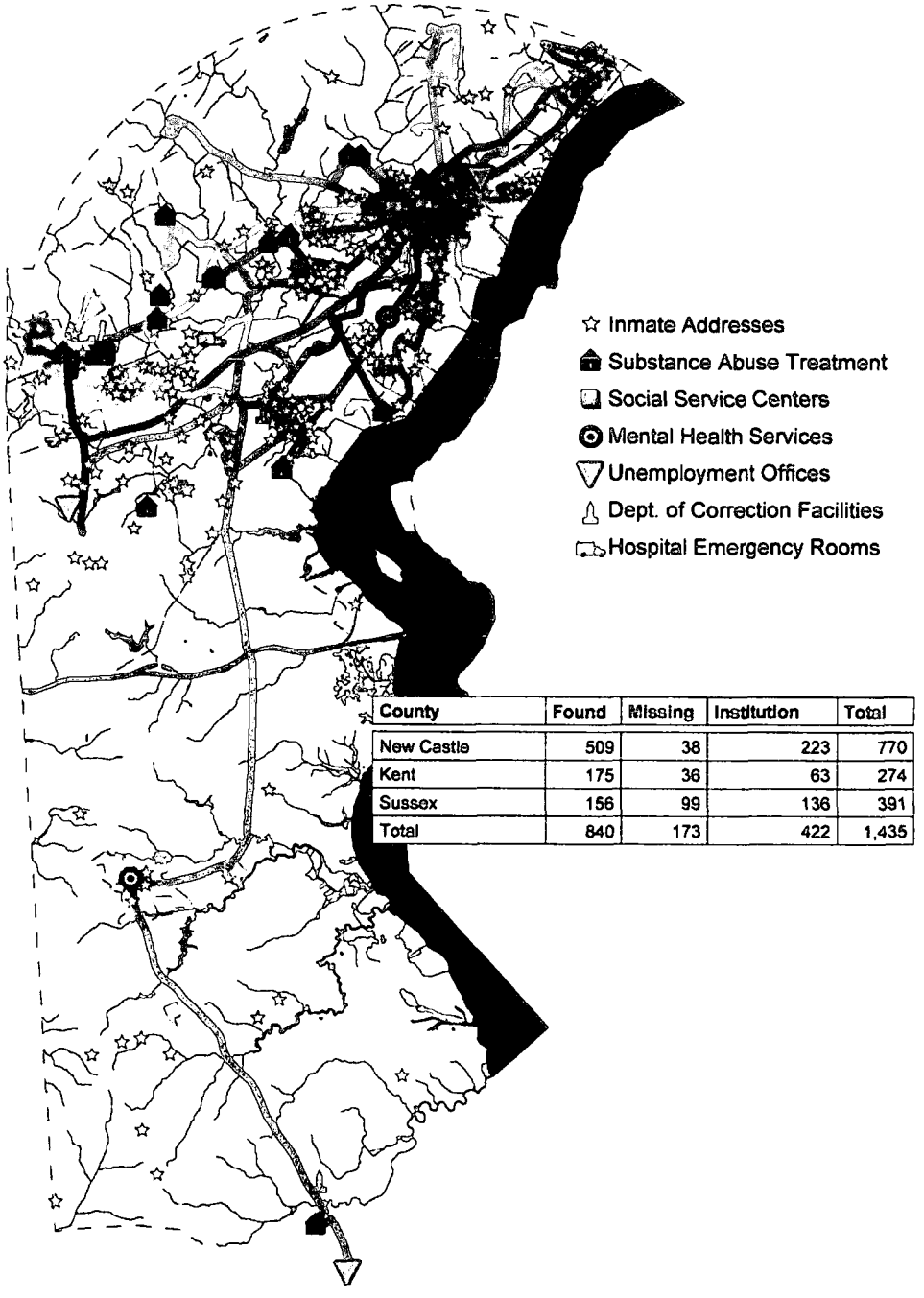
One purpose of the study was to show how accessible these services were for released inmates in each of Delaware's three counties. The maps and associated analyses were created using MapInfo. Two examples of maps used in this study (see Figures 1 and 2) overlay the addresses of released inmates with the locations of rehabilitative services. Inmate addresses are represented by stars, while the locations of service providers—substance abuse treatment, social service centers, mental health services, unemployment offices—are shown as symbols. Bus routes are shown as heavy gray lines.

Address information was obtained in the following manner. Prison inmates released during the fourth quarter of 1996 were identified from DOC records. Once identified, the offenders' ID numbers and release dates were extracted from the CJIS database. Address information was obtained by cross-referencing the offender names and ID numbers with an address database maintained by the State Bureau of Identification. The addresses were then mapped using two methods. The first method involved geocoding the addresses using mapping software. Many of the remaining addresses (usually rural or post office box numbers) were located manually using street maps with the assistance of probation and parole officers familiar with their clients' rural residences. Using these methods, 82.9 percent of the addresses were located and mapped.

The maps and Table 1 show that services were more accessible for inmates released to locations in New Castle County, particularly locations in the northern part of the county above the C & D Canal, than for those released in Kent and Sussex Counties. More services were located in New Castle County than in Kent and Sussex Counties combined, and most were located along or near bus routes. The services available in Kent and Sussex Counties were concentrated in Dover, Milford, Georgetown, Seaford and Laurel.

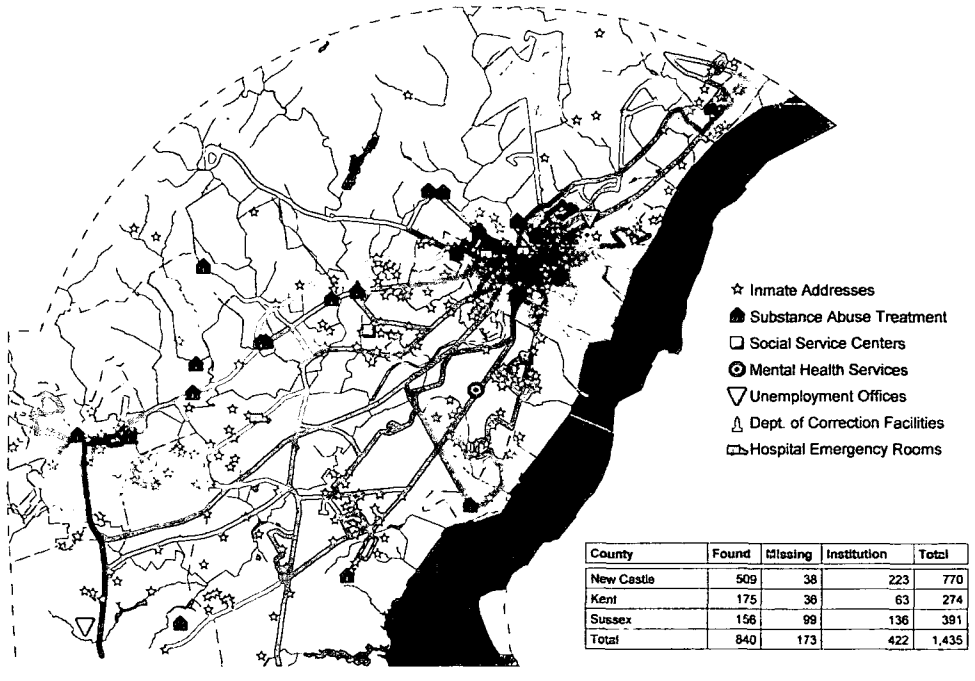
Public transportation was very limited in both Kent and Sussex counties, except for bus service in Dover. People living outside of areas served by public transportation had little opportunity to utilize services unless they had access to an automobile. The researchers also encountered problems locating the addresses of more than one-third of the inmates released in Sussex County because they were located in rural parts of the county. The maps for Sussex County, therefore, may misrepresent the degree to which services are not accessible to former inmates who live in that county. Improvements in the specificity of offenders' addresses are ongoing and will enhance future applications.

State criminal justice agencies and private service providers have begun discussing the association between the lack of available reha-




| County | Found | Missing | Institution | Total |
|---|---|---|---|---|
| New Castle | 509 | 38 | 223 | 770 |
| Kent | 175 | 36 | 63 | 274 |
| Sussex | 156 | 99 | 136 | 391 |
| Total | 840 | 173 | 422 | 1,435 |

**Figure 1**
**New Castle County**
**Home Addresses of DOC Inmates Released in 4th Qtr 1996**




| County | Found | Missing | Institution | Total |
|---|---|---|---|---|
| New Castle | 509 | 38 | 223 | 770 |
| Kent | 175 | 38 | 63 | 274 |
| Sussex | 156 | 99 | 136 | 391 |
| Total | 840 | 173 | 422 | 1,435 |

**Figure 2**
**Northern New Castle County**
**Home Addresses of DOC Inmates Released in 4th Qtr 1996**

bilitative services and the high rate of recidivism. More than one-half of released offenders are readmitted to incarceration within one year. This study played an important role in the Department of Correction's successful siting and authorization of the Kent County "Level IV" Community Drug Rehabilitative Program. The department used detailed maps of Kent County and the City of Dover in planning materials presented before both city and county review boards. The maps helped justify the need for drug rehabilitation for offenders who are starting their reintegration into the community.

## Table 1
## Locations of Rehabilitative Services by County

| County | City | Mental Health | Social Services | Substance Abuse TX | Total |
|---|---|---|---|---|---|
| **Kent County** | Dover | 1 | 1 | 8 | **10** |
| | Milford | 1 | 1 | 0 | **2** |
| **Total** | | **2** | **2** | **8** | **12** |
| **New Castle County** | Belvedere | 0 | 1 | 0 | **1** |
| | Claymont | 0 | 0 | 1 | **1** |
| | Delaware City | 0 | 0 | 5 | **5** |
| | Elsmere | 0 | 0 | 2 | **2** |
| | Greenville | 0 | 0 | 2 | **2** |
| | Middletown | 1 | 0 | 0 | **1** |
| | New Castle | 1 | 1 | 9 | **11** |
| | Newark | 1 | 1 | 4 | **6** |
| | Wilmington | 2 | 2 | 19 | **23** |
| **Total** | | **5** | **5** | **42** | **52** |
| **Sussex County** | Bridgeville | 0 | 1 | 0 | **1** |
| | Ellendale | 0 | 0 | 1 | **1** |
| | Georgetown | 1 | 1 | 5 | **7** |
| | Laurel | 0 | 1 | 0 | **1** |
| | Lewes | 0 | 0 | 1 | **1** |
| | Milford | 0 | 1 | 1 | **2** |
| | Seaford | 1 | 1 | 2 | **4** |
| | Selbyville | 0 | 0 | 1 | **1** |
| **Total** | | **2** | **5** | **11** | **18** |
| **GRAND TOTAL** | | **9** | **12** | **72** | **93** |

# About the Authors

**John P. O'Connell** is the executive director of the Delaware Statistical Analysis Center (SAC). Delaware SAC is presently involved in five major activities: analysis of sentencing reform, forecasting to assist with prison overcrowding, crime analysis, juvenile classification and population forecasting. Before becoming SAC Director in 1988, O'Connell was chief of forecasting for the State of Washington's Office of financial management (OFM) and was responsible for all forecasting affecting the state budget, including prison forecasting. O'Connell holds a bachelor's degree in sociology from the University of Washington and a master's in statistics from the University of Iowa. He also is a past president of JRSA.

**Richard Harris** has been employed by Delaware SAC since 1989. His areas of specialization are crime mapping and community crime analysis. Prior to his employment at SAC, he worked as a management analyst for the Delaware Criminal Justice Council and as an economic development analyst for the City of Wilmington. Harris has a bachelor's degree in urban studies from the University of Maryland.

**Charles Huenke** has worked as a research analyst at Delaware SAC since 1994. He previously worked for the Department of the Army as an operations research analyst. Huenke received a bachelor's degree in physics and mathematics from Delaware State College in 1984.

# Apprehending and Convicting Offenders

# Graphical Display of Murder Trial Evidence

*Robert S. Moland*
*St. Petersburg, Fla., Police Department*



In January 1997, a boater fishing near the famous City of St. Petersburg Florida Pier spied something drifting slowly along with a clump of seaweed in the gulf currents of Tampa Bay. On closer inspection, he found the ghastly remains of a young man who had died a horrible death from partial dismemberment and beheading. After the discovery of the victim's remains, detectives from the Homicide Squad of the St. Petersburg, Fla., Police Department launched a lengthy and complex investigation. Ultimately, they identified the victim, determined the facts of the case and brought his killers to justice. The final work of prosecuting the killers in trial was enhanced by mapping displays that aided in witness and jury understanding of the facts and events that occurred before, during and after the victim's murder.

Within days of finding the victim's floating remains, the primary investigators confirmed that the decomposing body was that of a 19-year-old male. Considered to be a "very bright kid," he had distinguished himself earlier in his teens as an accomplished Eagle Scout. Tragically, the youth had slipped into the local drug scene, becoming embroiled with a group of people selling drugs. In the weeks that followed the murder, the detectives discovered the deadly fact that the victim had bungled a drug deal involving the two primary suspects in the case. The young man apparently paid for this mistake with his life.

The investigation disclosed that the suspects plotted to meet with the victim at a local restaurant in Largo, Fla., take him against his will and transport him as captive across a bridge over Tampa Bay to an industrial site near the city of Riverview, in Hillsborough County, Fla. There he endured inquisition, torture and a horrible death at the hands of the suspects. These acts of horror were meted out by one particular suspect brandishing a samurai sword and nearly hacking off one of the victim's hands. At one point in this nightmare, the victim attempted escape. After chasing him down like an animal, the killers finally caught the victim, ending their torture and the young victim's life by chopping off his head in an execution-style slaughter.

Immediately after the gruesome murder, the suspects threw the victim's partially dismembered remains into two separate local waterways, hurling his severed head into a river near the crime scene and dumping his body off the Gandy Bridge over Tampa Bay. The suspects

also attempted to conceal the murder weapon by throwing the samurai sword off another local bridge. For a brief time, the primary assailant secured his desire for creating a fearful reputation as a cold-blooded killer, proudly bearing the title of "The Hit Man."

When the news first broke on the finding of the victim's body, two primary investigators were assigned the case. Their careful and deliberate follow-up identified the precipitating players and events and led to the offenders' arrest. However, as we all know, cases without confessions or eyewitnesses often do not lead to successful convictions.

This case presented the detectives with the many problems of connecting the suspects to the victim and all three to the crime. The forensic evidence was modest, and the statements and codefendant testimonies from the suspects were lean.

Early in his career as a homicide investigator, one of the primary investigators developed expertise in conducting DNR (Dial Number Recorder) electronic surveillance. Armed with probable cause and a court order, he had used the benign and undetectable recording of suspects' incoming and outgoing telephone call numbers, without actually intercepting the suspects' voice-over-wire conversations. In the course of this murder investigation, the detective once again used his skills in making telephone toll and DNR analyses and added the feature of tracking cellular telephone calls to and from the suspects. In this manner, the investigators determined the activities and possible whereabouts of the main players in the case before, during and after the murder. The motivation for this work was the fact that when one of the suspects was arrested, he was in possession of a functional cellular telephone, with an active account on file with AT&T and a series of prior calls he had made still nested in the cell phone's memory bank.

The detective analyst suggested and discussed with the investigating detectives the possibility of plotting the location of every relevant cellular telephone transmitter site in Pinellas and Hillsborough counties. He explained that by collating the data from the suspects' cellular telephone records against the antenna sites, they might be able to plot the spatial and temporal activities of the suspects before, during and after the homicide. With such information visually displayed on a series of maps that covered all the sites between Pinellas and Hillsborough counties, they would be able to pinpoint the times and locations of each of the suspects when they used their cellular phones. The analyst suggested that, in a sense, the killers would have left a "cellular phone map trail" and that this trail would help establish connections among the victim, the killers and the places where the events involving the death occurred.

This map trail would also serve to prove or dispute any alibis or statements discovered by the two detectives during their interviews with witnesses or suspects. They agreed to let the detective analyst try this analysis and display theory and show them what was possible. The only caveat involved was that the detectives were required to physically verify every single location of the involved cellular telephone antennae and confirm that each and every one was operating properly at the time of the murder.

In the course of this joint investigation, two trial attorneys from the Hillsborough County State Attorney's Office were working with the case detectives. They set about making the usual decisions of determining what witnesses and evidence would best serve their trial strategy but soon had to adjust the focus of the trial presentation. To their chagrin, the presiding judge ruled that the samurai sword would be excluded, saying it was "too prejudicial a piece of evidence" to show any jury. The prosecuting attorneys then had to consider the problem of telling this story in a visual way to simplify the linear complexity of the actions involving the victim, the location of all remaining evidence and the suspects.

To that end, the attorneys contacted an expert technician from AT&T and worked with him to obtain a list of cellular telephone antenna sites and information about the physics and reliability of cellular telephone technology. This verification process proved important when the information was presented on exhibit displays at trial and challenged by the defense attorneys. With this important factor established, the detectives focused on working with the trained technician, who was preparing them to use the testimony and expertise of a qualified telephone cell site technician in describing to the jury both the map trail and how these antennae pass off signals or confirm locations of individuals using cell phones while moving across any landscape. Through the combined efforts of the case detectives, the detective analyst, one AT&T expert and the two prosecutors, a cautious and conservative development of the technical evidence followed. Also as a result of this cooperation, the detective analyst created reliable trial mapping displays that ultimately passed muster for admissibility in court.

In part, the prosecution accomplished this by taking the original color maps and related spreadsheet information and making scale enlargements of them on white paper foam boards. Before these final "blow-ups" were created, the detective analyst worked closely with the prosecutors, making adjustments and corrections as necessary on the originals until they emerged worthy of being trial exhibits. The primary consideration for their design was that all information had to

be portrayed in a neutral manner, so as not to be construed as prejudicial against the two defendants. The displays also had to present the information about the cellular telephone antenna locations in a manner that allowed for the best description of cellular telephone technology by an AT&T expert.

In the end, the weight of the expert testimony provided by the two detectives, the AT&T cell phone technician and other witnesses was sufficient to convict the two suspects and sentence them to life in prison. This case shows how the difficulty of explaining complex, technical but verifiable information can be overcome by displaying such information in its purest form. The old expression "a picture is worth a thousand words" was proven during this trial. The maps helped describe and explain very complex events and technical information. After deliberating only two hours, the jury members concluded that both suspects were guilty of murder.

## The Mapping Process

Using Enhanced Tiger Line street-level files (vectored graphics) and boundary files of Pinellas and Hillsborough counties, a bicounty "backcloth" was constructed to establish the stage upon which to tell the story of the events leading up to this homicide. Because the entire story covered a number of cities between the two counties, a minimum of street line imagery was employed to reduce image clutter on the maps. In the areas of the maps requiring more detail involving nodal street referencing, only those street segments necessary for telling the story were displayed.

All of the mapping was done using MapInfo Version 3.0 (and later Version 4.5) to prepare the various map layers, boundary files, data sets and cosmetic information into color print layouts. These were later blown up to larger scale-sized diagrams on white paper foam boards and made ready for their introduction as acceptable evidentiary exhibits.

The following examples and descriptions provide the reader with an understanding of how the mapping displays were tied to analyzing the movements and actions of the suspects. The exhibit map layers consisted of the bicounty backcloth of Pinellas and Hillsborough counties, along with a combination of important location point files (geocoded to a street address level) and factual text information por-

traying the historical events and clarifying their temporal and spatial relationships to the crime. The polished and refined mapping exhibits that were finally presented at trial allowed the state attorneys to set a graphical stage as a scaffold upon which to visually unfold the case before the jury. This methodology helped to improve jurors' understanding of all the important case material.

At key points in the trial, the exhibits allowed the attorneys to prepare the jury for the more detailed technical information about cellular telephone technology. To that end, a data set containing the demographics of the physical locations of all AT&T cellular telephone antenna sites was created and geocoded to a point file for display. Each of these data sets was presented on separate maps and resolved as points at the physical locations of street addresses of all cellular antennae.

Figure 1 displays the location where the victim first made contact with the suspects at the Outback Steakhouse in Largo, Fla., and other key related locations in Pinellas and Hillsborough counties. The prosecuting state attorney sequentially described their relevance to the jury during the trial. This map provided an overview that aided the jurors' understanding of the facts of the case. (Note the absence of any direct commentary connecting the suspects to the particular incident locations on the map.)

Figure 2 displays the locations of all the AT&T cellular telephone antenna towers in Pinellas and Hillsborough counties. During the murder trial, the state attorney called on the case detectives to testify that each of these locations had been verified for spatial accuracy and actual physical presence. Then the AT&T cellular telephone expert was called to the stand to use this map to explain the operational technology and physics of cellular telephony to the jury.

For the trial, a spreadsheet attachment was included on a separate foam board display, listing the demographics of each telephone antenna (TA) with its corresponding number.

Figure 3 displays the individual antenna locations that were directly involved in the suspects' cellular telephone conversations and activity. The AT&T expert described the details of the hexagonal design of each radio transmission "cell" around each of the three subantenna units at each TA site. By showing that the RF (Radio Frequency) energy forms a 120-degree arc around each of the honeycomb-like radio antenna "cells," he was able to prove that by checking the historical records on the suspects' cellular activity log, he could precisely describe where the suspects were and in what direction they were moving when actually making their assorted calls.

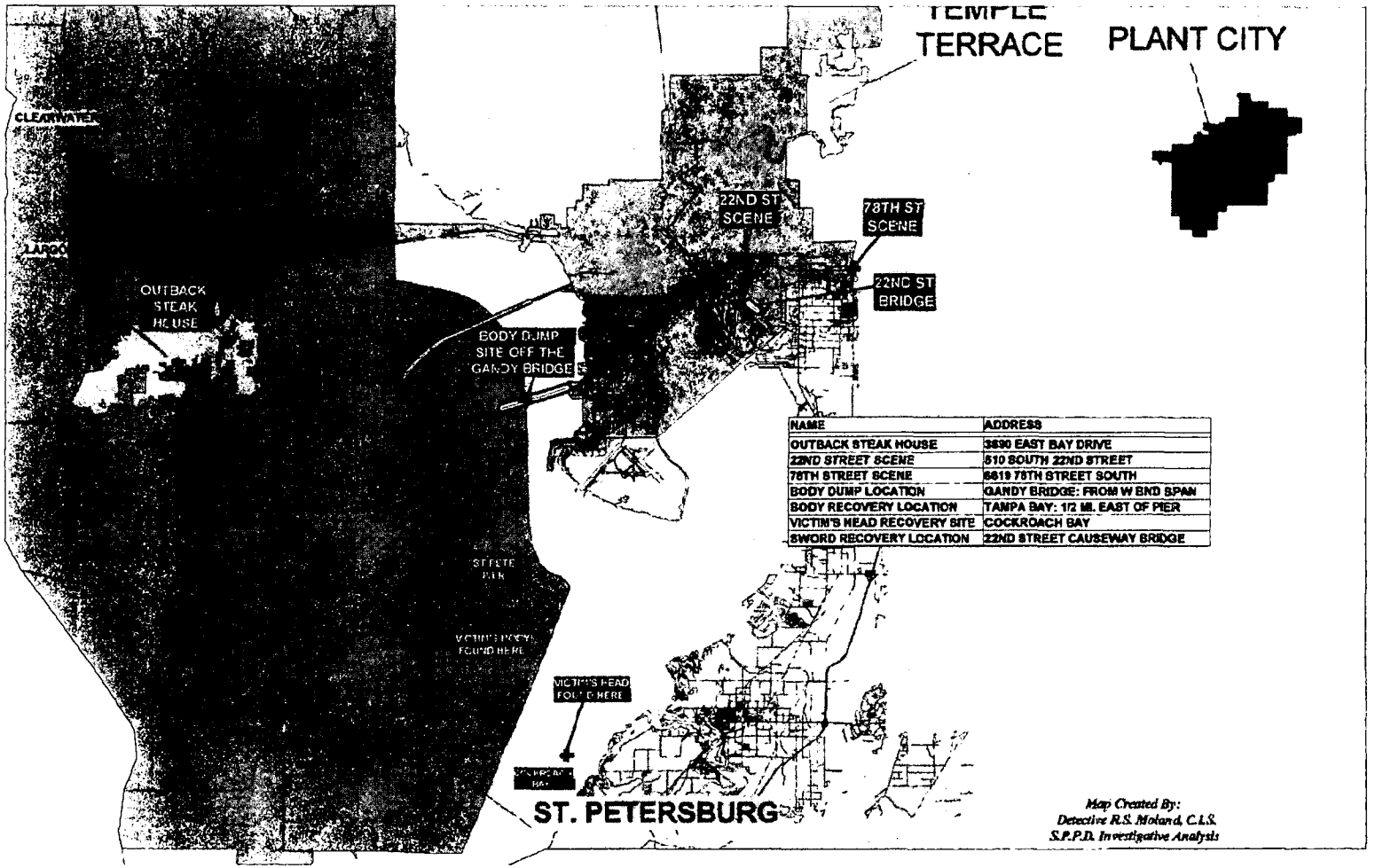
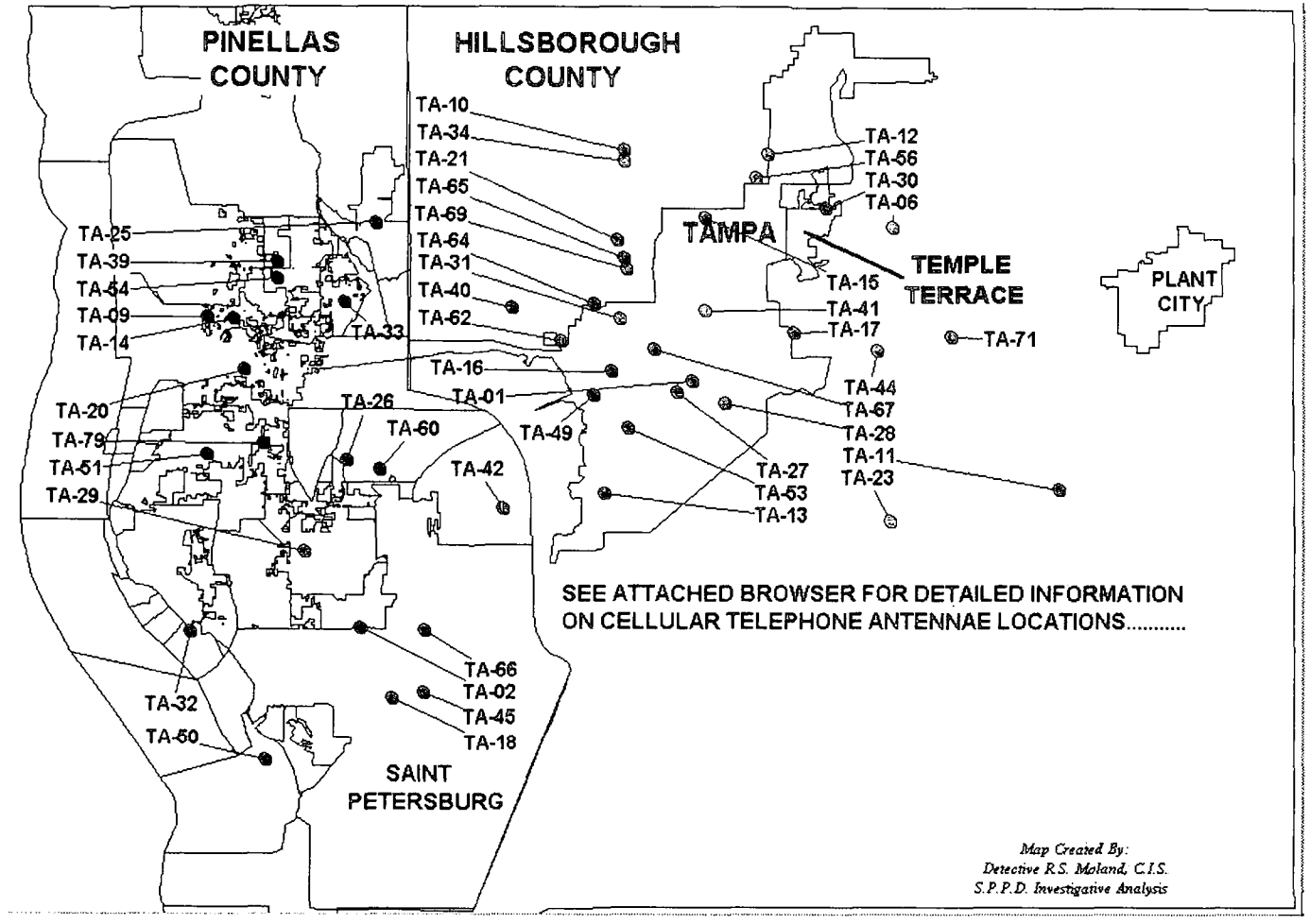
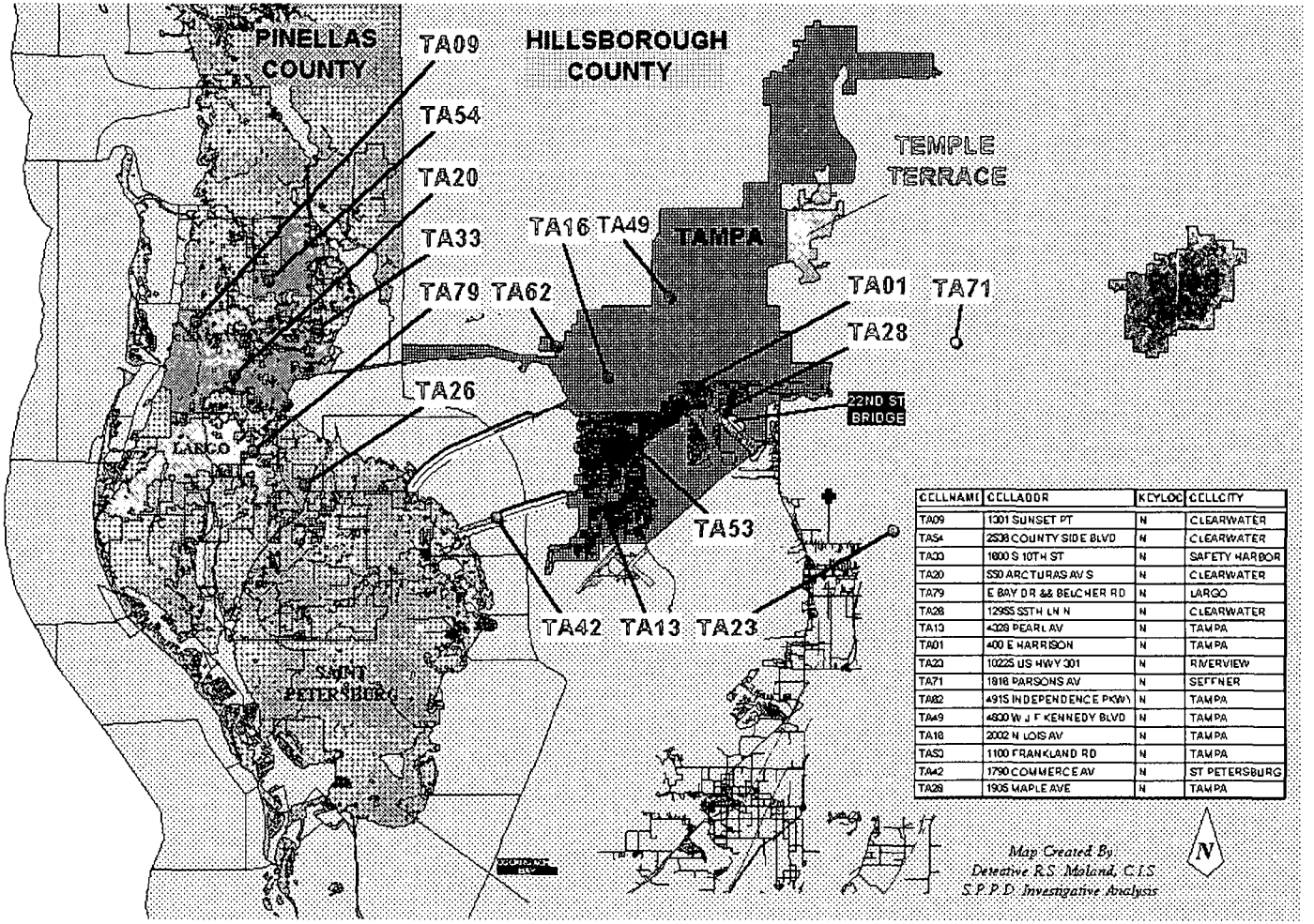



**Figure 1**
**Key Locations in Pinellas and Hillsborough Counties**

Figure 2
AT&T Cellular Telephone Antenna Towers in Pinellas and Hillsborough Counties






| CELLNAME | CELLADDR | KEYLOC | CELLCITY |
|---|---|---|---|
| TA09 | 1301 SUNSET PT | N | CLEARWATER |
| TA54 | 2538 COUNTY SIDE BLVD | N | CLEARWATER |
| TA33 | 1600 S 10TH ST | N | SAFETY HARBOR |
| TA20 | 550 ARCTURAS AV S | N | CLEARWATER |
| TA79 | E BAY DR && BELCHER RD | N | LARGO |
| TA26 | 12955 SSTH LN N | N | CLEARWATER |
| TA13 | 4328 PEARL AV | N | TAMPA |
| TA01 | 400 E HARRISON | N | TAMPA |
| TA23 | 10225 US HWY 301 | N | RIVERVIEW |
| TA71 | 1916 PARSONS AV | N | SEFFNER |
| TA62 | 4915 INDEPENDENCE PKWY | N | TAMPA |
| TA49 | 4900 W J F KENNEDY BLVD | N | TAMPA |
| TA16 | 2002 N LOIS AV | N | TAMPA |
| TA53 | 1100 FRANKLAND RD | N | TAMPA |
| TA42 | 1790 COMMERCE AV | N | ST PETERSBURG |
| TA28 | 1905 MAPLE AVE | N | TAMPA |

**Figure 3**
**Key Telephone Antenna Locations Involved in Suspects' Activity**

This information corroborated eyewitness testimony that the suspects were first observed with the victim at a certain time at the Outback Steakhouse in Largo, Fla. (Note that tower TA-79 is located directly across the street from the Outback Steakhouse.) As the suspects moved across the Tampa Bay area, they continued to make calls on their cell phone, causing the signals to be "handed off" from one TA tower to another. In this fashion, the suspects left a recorded radio signal trail that verified their association to all of the key sites involved in the murder.

There was little difficulty in creating the actual courtroom displays. The most significant problem was having to respond to constant requests from the prosecuting attorneys for changes, additions or deletions to the maps. This situation required the greatest amount of patience and the highest professional conduct on the part of the GIS Support Team to meet the goals of others. Given the tension and responsibilities attorneys face in preparing their cases for trials, it is paramount that the GIS expert provide as much support and guidance as possible to the prosecuting team. In this case, there was nothing less at stake than the possibility that the two killers might go free. This team synergy proved most successful during this investigation.

This mapping work synthesized a great deal of conventional investigative effort into easily understandable and seamless displays of the case issues and evidentiary material. This homicide case presented the detectives and prosecutors with difficult problems for courtroom presentation. The necessity of having to describe a great number of events—before, during and after the crime—to a lay jury without losing continuity was a most serious issue. Given the technical nature of much of the testimony, it certainly would have been more difficult to describe the case facts without having clear and precise mapping displays to assist jurors' understanding. Also, the technical evidence at the core of the state's case would have been even more problematic without expert testimony supported by graphical displays. Delving into the technical truth and connections to the case evidence could have been a baffling experience for the jury.

All in all, the maps provided a very high "understanding comfort level" for all concerned (with the possible exception of the suspects). Mapping technical and complex events spread out over a two-county area provided all of those responsible for understanding and deciding how to act upon this information with a "one over the world" view. Such capability clearly places the jury at an advantage. Since all participants were able to see an overview of everything, the prosecutor could help the jury study the case facts and view the evidence in a

storybook-like fashion. At the same time, the defense counsel was objectively provided an equal and uncommon opportunity to cross-examine or use all aspects of the provided visual data.

The GIS expert must rely on good science and a proper approach to the presentation of the facts and evidence in a way that will encourage the court to accept this kind of work as unbiased. Checking the spatial and temporal accuracy of reported facts, items, events, incidents and locations is paramount and must be done prior to their portrayal on maps, with complete neutrality and objectivity in mind.

After the trial, the attorneys, members of the jury and in particular the judge made very positive comments about how these mapping exhibits improved their understanding. One must imagine the weight of responsibility placed on every member of the jury when they must act as the "trier of the facts" involved in a murder trial. It follows that using any such devices in an unbiased manner to improve their understanding can only improve their decisionmaking.

## SUMMARY

The Hillsborough County prosecutors compared cellular telephone records from the suspects against verified locations of cellular telephone antenna towers as a means of proving the association among the victim, suspects, witnesses, evidence and crime scene. The reconstructions of the suspects' temporal and spatial activities were thus accurately described and scientifically defended by expert testimony. This type of comparative analysis translates well into any number and type of criminal investigation. As such, this GIS mapping solution can be employed anywhere in the world, because the technology has not changed since first conceptualized. As long as cellular antenna towers remain spatially persistent and telephone companies like AT&T continue to collect the variable transmission data from cellular telephones, such analysis can reproduce suspect time-versus-movement data with verifiable accuracy.

# ABOUT THE AUTHOR



**Robert S. Moland** is a sworn detective with the St. Petersburg, Fla., Police Department, with more than 24 years tenure. He has extensive police and investigative experience, with the latter part of his career focused on working homicide and major case crimes. For the last few years, he has been the sole manager of the information systems for the department's Criminal Investigation Section, also serving as their crime analyst. Moland lectures and trains often on the subject and tactics of conducting temporal and spatial analysis of crime through GIS mapping systems.

# Baltimore County's Autodialer System

*Philip Canter*
*Baltimore County, Md., Police Department*

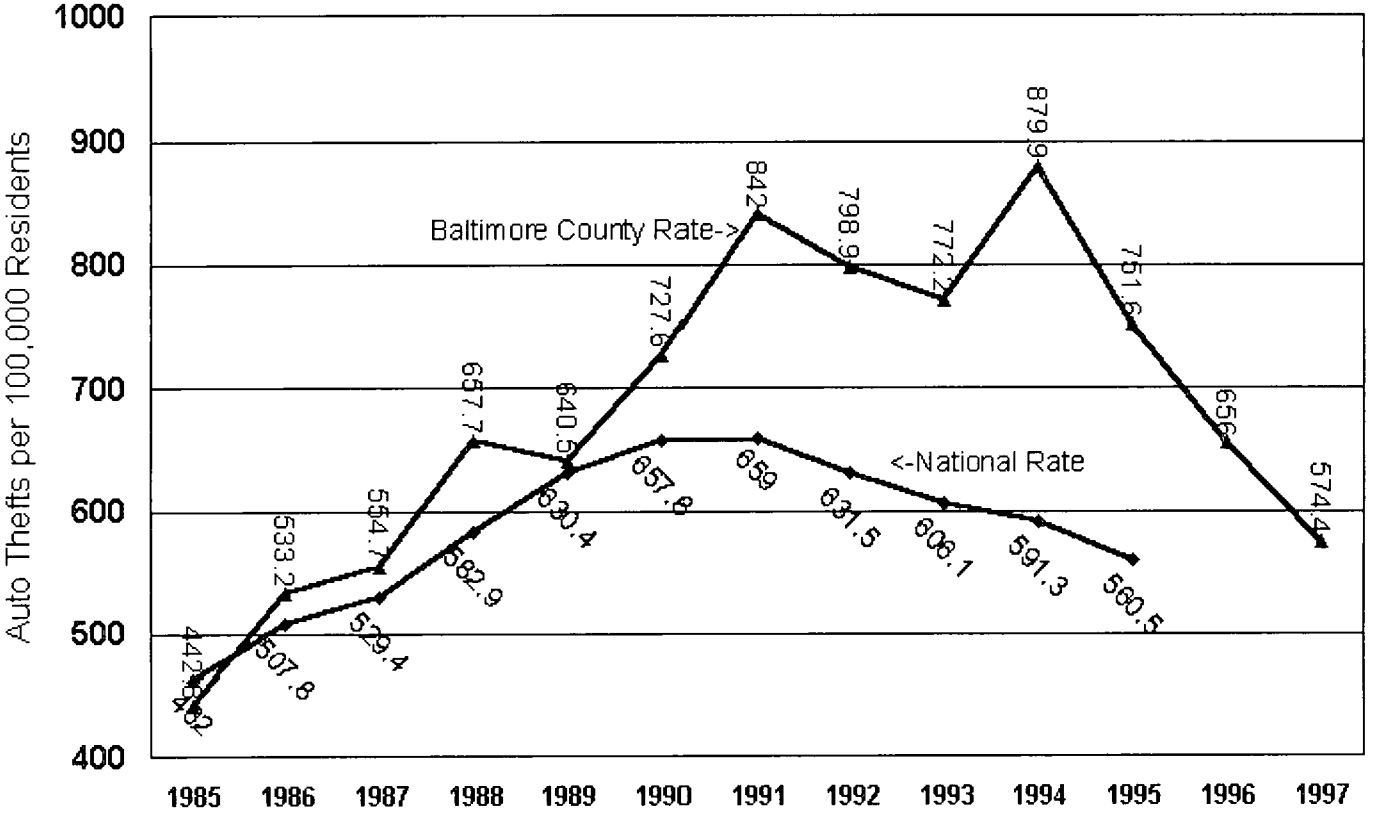


## INTRODUCTION

The Baltimore County, Md., Police Department's Crime Analysis Unit is responsible for collecting, analyzing and distributing crime trend information. Crime analysts inform commanders and officers about a crime problem through the release of crime bulletins and alerts. The crime bulletins and alerts identify a crime problem, provide information to assist in planning tactical responses and provide information for crime prevention activities.

Baltimore County police recognize the responsibilities and role of communities in preventing crime. The National Advisory Commission on Criminal Justice Standards and Goals (1973, p. 12) noted that citizen involvement in crime prevention is not only desirable, but necessary. A task force of the National Commission on the Causes and Prevention of Violence (1969, p. 278) concluded that "informed private citizens, playing a variety of roles, can make a decisive difference in the prevention, detection, and prosecution of crime." Lab (1992, p. 65) noted that "evidence tends to support the basic idea of communal action as a means of combating crime and the fear of crime." Individuals both inside and outside the police department need timely access to information to make informed decisions about either preventing crime or reducing the opportunity for crime.

In the late 1980s and early 1990s, one significant crime problem in Baltimore County was increasing rates of motor vehicle theft and other property crimes (see Figure 1). While motor vehicle thefts declined nationwide between 1990 and 1995, motor vehicle thefts in Baltimore County increased at a rate of 5 percent per year. In 1996, Baltimore County received grant funding from the Maryland Motor Vehicle Theft Prevention Council to develop and implement strategies aimed at reducing motor vehicle thefts. A study conducted by the Baltimore County Police Department in 1996 found that 95 percent of recovered vehicles did not have or did not use an antitheft device. For that reason, the motor vehicle theft reduction program encouraged crime prevention methods such as the use of kill-switches, keeping car doors and windows locked and removing car keys from unattended vehicles.




Sources: Baltimore County rate from Baltimore County Police Department (1998, p. 60); national rate from Bureau of Justice Statistics (1997, p. 306).

**Figure 1**
**Motor Vehicle Theft Rates, Baltimore County and National**

The department believed that many motor vehicle thefts, as well as other property crimes such as burglary, could be reduced by target hardening, increased community vigilance and greater police visibility in criminally active areas. As with any metropolitan police department, limited resources in connection with increasing demands for service precluded crime prevention officers or community outreach officers from contacting individual households in criminally active areas. After some debate and much discussion, the department decided to implement an automated phone dialing system similar to those used by telemarketing firms. The system would be capable of quickly delivering a message to (1) alert households that a crime problem had been identified in their community and (2) provide suggestions about how a household could reduce its chances of being criminally victimized.

## Baltimore County's Autodialing System

The telemarketing system, referred to as the autodialer system, uses a microcomputer to deliver a prerecorded message to households in communities experiencing a crime problem. Analysts use a geographic information system (GIS) to address-match (geocode) households with published phone numbers. Once geocoded, address locations are related to a target area, i.e., geographic areas experiencing a crime problem. A sample of published phone numbers corresponding to households in a target area is then extracted for use by the autodialer system.[1]

The analysis unit evaluated the autodialer system in 1996 and found that it was likely influencing actions by the community, offender and/or police (Canter 1996). There appeared to be greater community awareness, as indicated by a statistically significant increase in calls

[1]The sample size will vary depending on the size and number of households in a target area. Analysts will generally limit the number of phone numbers to fewer than 2,000 to ensure contact is made in a timely manner to households located throughout the target area. Analysts found that sorting and selecting the first 2,000 phone numbers provided a spatially random distribution of contacted households in a target area.

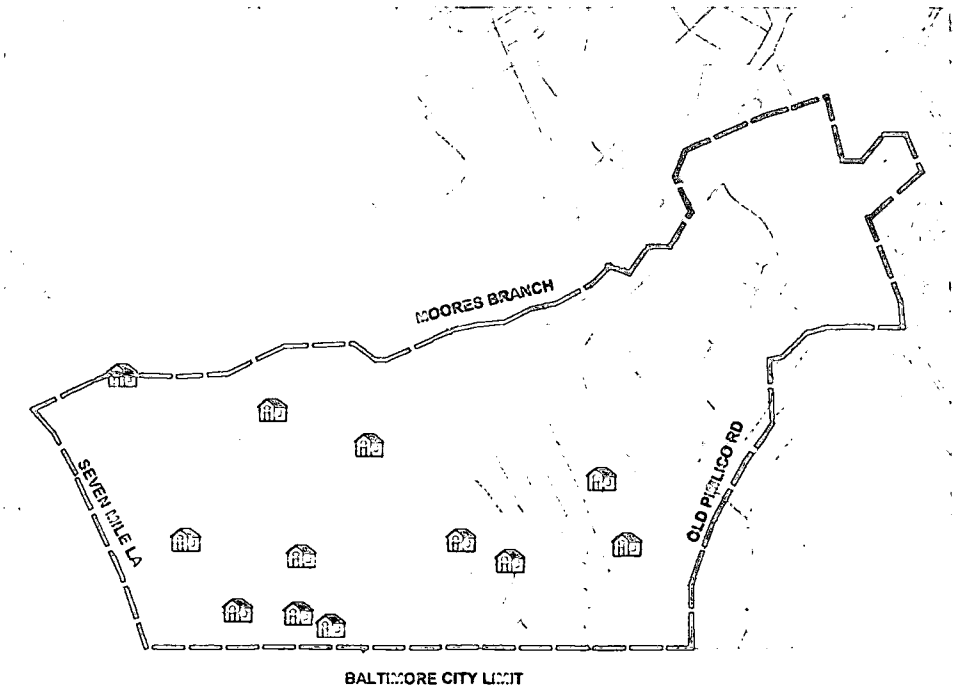
to 911 regarding suspicious persons, suspicious cars, open doors and open windows. Analysts noted decreases in or elimination of active crime patterns in target areas, as well as some displacement activity. Discussions with precinct commanders and investigative units indicated that target areas often received special attention in the form of high visibility patrols, surveillance and community outreach activities. Although admittedly the impact of an autodialer system on reducing crime requires further study, it appears to be a cost-effective strategy to both inform the community about a crime problem and reduce crime.

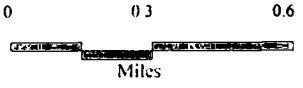
## CASE STUDY:
### USING AN AUTODIALER AND GIS IN RESPONSE TO BURGLARIES IN SMITH-GREENSPRING

The following case study is an example of how an autodialing system, in conjunction with a GIS, can be successfully used in response to an identified crime problem. In fact, the department's GIS is an important part of the entire process, from assisting crime analysts in initially identifying a crime problem to developing a list of phone numbers used as input to the autodialing system.

During April and May 1996, crime analysts reported an increasing number of residential burglaries involving sheds and garages in the Smith-Greenspring community (see Figure 2). The Smith-Greenspring community is located north of the Baltimore city line and is roughly bordered by Seven Mile Lane to the west, Moores Branch stream to the north and Old Pimlico Road to the east. The community consists of mixed land uses, which include several schools, commercial centers, duplex homes, apartment buildings and single-family homes. Median household incomes are average for Baltimore County, as indicated by the 1990 U.S. census. Inhabitants are predominantly white (non-Hispanic), although increasing numbers of African-Americans and Russian immigrants are moving to the area. From April 1 through May 15, the Smith-Greenspring community had a total of 12 residential burglaries, compared with two residential burglaries for the same time period in each of the previous three years. Lawn and garden equipment such as lawnmowers, hedge clippers and weed whackers were being taken.

The burglaries involved single-family homes, as indicated in Figure 3. Note that the building footprints shown have been highlighted to show land-use attributes matching single-family homes. State tax





Location Map
Baltimore County, Maryland

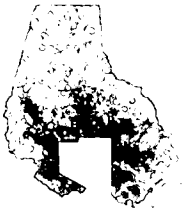


**Figure 2**
**Smith-Greenspring Community Residential Burglaries, April 1–May 15, 1996**


Gray building footprints identify single family homes.
Triangles represent locations of residential burglaries.

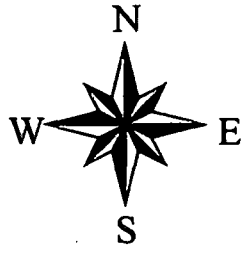



**Figure 3**
**Burglaries in a Section of Smith-Greenspring Community, April–May, 1996**

assessment records further confirmed the targets were single-family homes. Published phone numbers and respective address listings were obtained through a commercially available CD-ROM.[2] Once geocoded, the list of addresses and published phone numbers was matched by a GIS against a subset of Maryland's state tax assessment file containing addresses for single-family homes in the target area. (This was necessary because Maryland's tax assessment file does not contain phone numbers.) The result was a list of published phone numbers for households residing in single-family homes. The process of using a GIS to match land-use information maintained by state assessment agencies to a list of published phone numbers reduced the number of dial-outs while ensuring only potential locations most likely to be burglarized were contacted.



There was some concern that the autodialer would promote fear in the target community, so the department gave significant consideration to the format and content of the dial-out message. The department wanted to ensure the households contacted by the autodialer that the message was not being delivered by a telemarketing firm interested in selling a product or service. So the first sentence of the autodialer message was "This is the Baltimore County Police contacting you about an important crime problem in your community." The autodialing message had four parts. The first part of the message identified the caller as a commander with the Baltimore County Police. The second part identified the specific problem or reason for the call, such as a burglary problem occurring in the community. The third part provided details about the crime, such as type of property taken or any description of a suspect. The fourth part was dedicated to information on crime prevention, including phone numbers of the department's community outreach office and crime prevention office. Also included were phone numbers to the department's crime statistics hotline. The crime statistics hotline contains prerecorded information about recent crime trends for communities in Baltimore County. Analysts have noted that calls to the hotline during dial-out periods can increase by as much as 10 times the average daily call rate. The hotline enables the department to provide additional information about

[2]In some cases, a Criss-Cross® directory published by Stewart Directory is used to obtain an updated list of phone numbers. The Criss-Cross® directory is often used when dial-outs are made to apartment complexes containing transient populations.

crime occurring in an autodialer target area, including any newly acquired information pertaining to suspects or crime disposition.

The department used a GIS to carefully monitor any impact the autodialer had on subsequent criminal activity, such as displacement to a neighboring community. To date, some displacement of crime has been observed for residential burglary, although most areas targeted by the autodialer experienced either an abrupt termination or significant reduction in residential burglaries immediately following a dial-out period. It is not known whether this reduction was a result of target hardening, increased police presence or greater public awareness.

In the case of the Smith-Greenspring residential burglary problem, the autodialer system made 1,943 calls, with 1,378 messages delivered, resulting in a contact rate of 71 percent.[3] Dial-outs started on Thursday, May 16, and lasted through Sunday, May 19. Calls were made between 1300 hours and 2030 hours. On Monday, May 20, a Smith-Greenspring resident contacted 911 about seeing two unknown individuals walking down her street; one suspect was carrying a weed whacker. The caller mentioned that she had been contacted by the autodialer the previous evening and remembered that stolen property included lawn and garden tools. Within minutes of receiving the call, 911 was alerted to a burglar alarm reported at a residence around the corner from the caller's house. Police were already patrolling the area, so officers responded immediately to the burglar alarm. Upon arrival, the officers observed the suspects attempting to enter a garage through a broken window. The two suspects were immediately apprehended and later confessed to committing the residential burglaries in Smith-Greenspring.

## CONCLUSION

The autodialing system is used one or two times every month in response to identified crime problems involving residential burglary, street robberies and residential motor vehicle thefts. Follow-up sur-

[3]The autodialing system can track the number of completed calls made to each contacted household. Overall, the department averages a contact rate of 77 percent for single-family households.

veys of residents receiving a call from the autodialer have been favorable. For example, more than 40,000 households have been contacted to date, and only six people have requested that they not be contacted in the future.

The autodialer is believed to heighten public awareness, as measured by increases in calls for service to 911 during dial-out periods regarding suspicious cars or people and open doors and windows. The autodialer has either directly or indirectly contributed to arrests and case clearances through leads provided by call recipients to investigative units. Furthermore, the autodialer has increased awareness in the department about crime problems at the community level. For example, precinct commanders will generally allocate resources, sometimes on an overtime basis, to autodialing target areas in anticipation of community inquiries about the department's response to the crime problem. It is worth noting that current standard operating procedures on use of the autodialer require a precinct commander's approval; to date, no commander has requested that the autodialer not be used.



While an autodialing system can be used without benefit of a GIS, it would require significant amounts of time to process telephone listings for specific geographic areas. Furthermore, additional time would be required to cross-match land-use information to phone numbers for target refinement. It would be a waste of time and money to contact residents residing in an apartment complex to alert them about a burglary problem involving single-family homes. A GIS allows an analyst to define a target area based on mapped incidents and to identify potential victims residing in a target area who match a victim profile.

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# ABOUT THE AUTHOR

**Philip Canter** has been employed in local government since 1977. He has a bachelor's degree in geography from the University of Maryland, Baltimore County, and a master's degree in urban planning and policy analysis from Morgan State University. Canter has been employed with the Baltimore County, Md., Police Department since 1983 and currently serves as chief statistician for the Analysis Unit.

# The Greenway Rapist Case: Matching Repeat Offenders with Crime Locations

*Robert Hubbs*
*Knoxville, Tenn., Police Department*



The Greenway Rapist case study illustrates how the Knoxville, Tenn., Police Department uses mapping as an investigative tool and as a means of enhancing its community policing efforts. The geographic emphasis of community policing, and the need for neighborhood-level data analysis, puts electronic mapping at the forefront of methods for answering spatial questions about crimes, offenders and data.

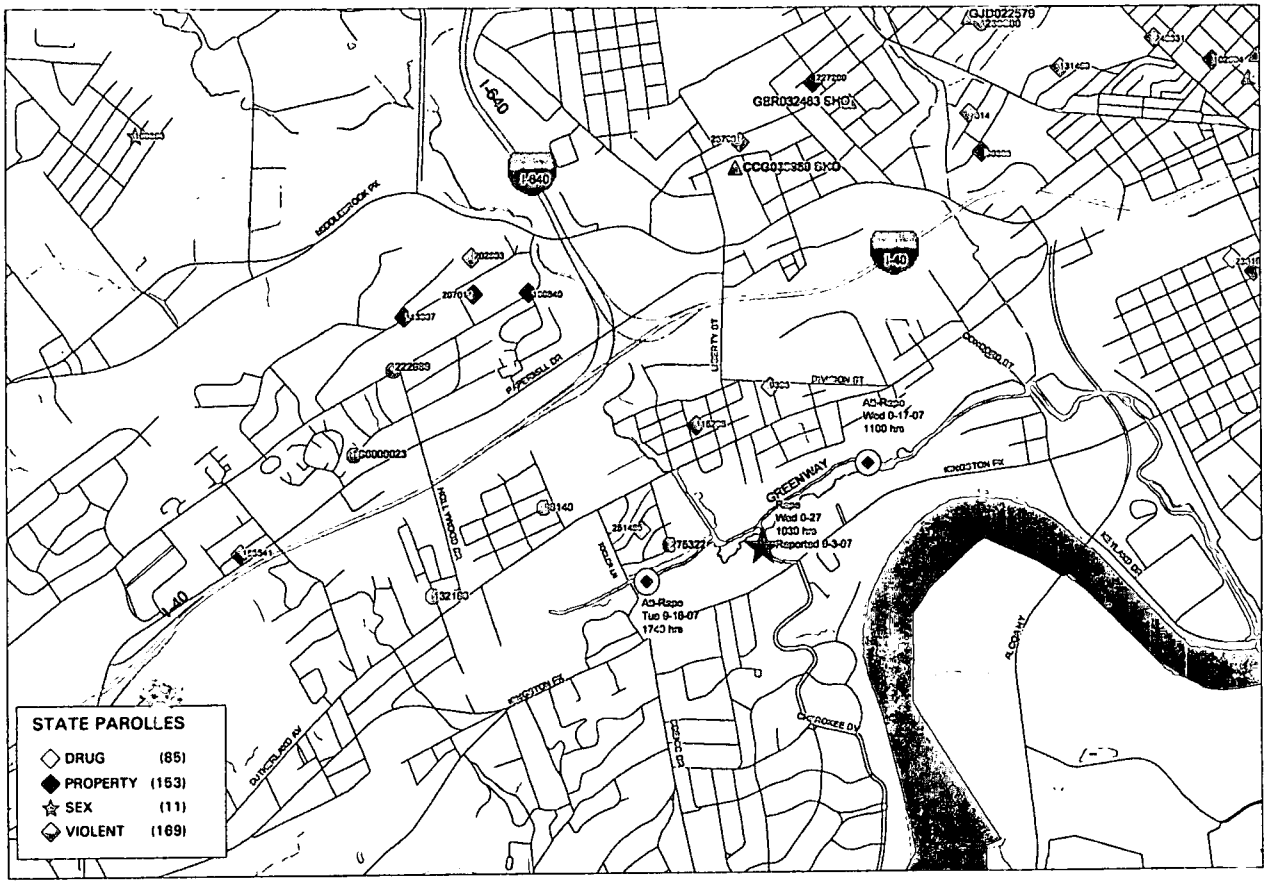
Using the layering technique of mapping, parolees, sex offenders and juvenile offenders are tracked and plotted against active crime cases. Symbols representing violent, drug, sex or property offenders cast light on the number of offenses in a neighborhood. Not only are offenders tracked and compared with crimes, but they are also compared with each other. Mapping can show how offenders interact. For example, mapping helped determine that a juvenile offender on intensive probation was living at the same address as a drug offender on parole. Police personnel dealing with repeat offenders could then address the situation.

The relationship of offenders to other events is important for problem analysis. Shots-fired calls, graffiti and their relationship to drug trafficking and known offenders can be illustrated, often before patterns and relationships would be apparent in the actual neighborhood.

Sergeant Robert Hubbs of the Knoxville Police Department's Crime Analysis Unit used mapping for suspect analysis and offender tracking in a case involving a repeat rapist.

On Aug. 27, 1997, a female walking along the Knoxville Greenway, a popular recreation trail through Knoxville, was raped. She was very traumatized, waiting about eight days to report the incident, and was unable to help in the initial investigation greatly. Investigators began staking out the area, and patrols were increased; however, they were stalled in the case and were trying to develop leads and possible witnesses.

A map was produced showing offenders living near the crime scene (see Figure 1). Five sex offenders were found living within two miles of the crime scene, along with more than 15 parolees and two juvenile serious habitual offenders. The map and additional data on the offend-




○ ***SEX OFFENDER ON TBI REGISTRY***

△ ***SERIOUS HABITUAL JUVENILE OFFENDER "SHO"***

SOURCE OF DATA:
STATE PAROLE BOARD INFORMATION
SERIOUS HABITUAL JUVENILE INFORMATION
T.B.I. SEX OFFENDER DATA

## Figure 1
## Offenders Living Near the Crime Scene

ers provided a focus for the investigation. However, the rapist struck again on Sept. 16 and 17, 1997. The victims of these attacks were able to give investigators a detailed description of their assailant.

Investigators obtained photos of the known offenders on the map and put together a photo lineup. The last two victims both immediately identified a sex offender who was living nearest the trail as their attacker (see Figure 2). Investigators confronted the suspect, who confessed to all three attacks and to one unreported rape. He was on the Tennessee Bureau of Investigation's Sex Offender Registry and on probation for a previous sex offense. However, without the spatial analysis of the offender databases layered on top of the crime scene map, the offender information would not have been readily known. He is awaiting trial, and a guilty plea is expected.

The Tennessee Bureau of Investigation's sex offender list includes more than 150 sex offenders from Knox County. It is a greenbar printout sorted alphabetically by the last name of the offender. Crime analysts enter this information into a database so it can be used in mapping. Long lists of names sorted alphabetically do little to aid the geographic analysis of offenders and their relationship to a crime. Without knowing every street near the attack scene from memory, a list user would have a labor-intensive job looking at all the offenders' addresses to see who lived near the crime scene. However, looking at a map and seeing suspects dotting the area where sex offenses have occurred has great investigative meaning. The data supplied by the Tennessee Board of Paroles, Tennessee Bureau of Investigation (sex offender data) and the Knoxville Police Department's Serious Habitual Juvenile Offender Program (SHOCAP) and Gang Task Force are instrumental in the daily tracking and analysis of offenders.

The Greenway Rapist maps were made in about one hour using MapInfo. The process is not difficult, but it takes time to initially geocode the databases and for the computer to draw the map layers. Higher numbers of layers and wider views slow the computer processing speed. Also, labeling and adding thematic dots, symbols and shading takes some precision. Newer computer processors work very well, but even a 486 processor will work. Also, printing a detailed color map sometimes takes up to 15 minutes, depending on the size of the map and the printer memory. Essentially, aesthetic considerations dictate the amount of time the user will spend creating a map. Finally, mapping requires a good color printer and a large map plotter.

Increasingly, the Knoxville Police Department is finding new data or ways that data can be mapped to take on new meaning. Most data produced in police departments have a geographic attachment and

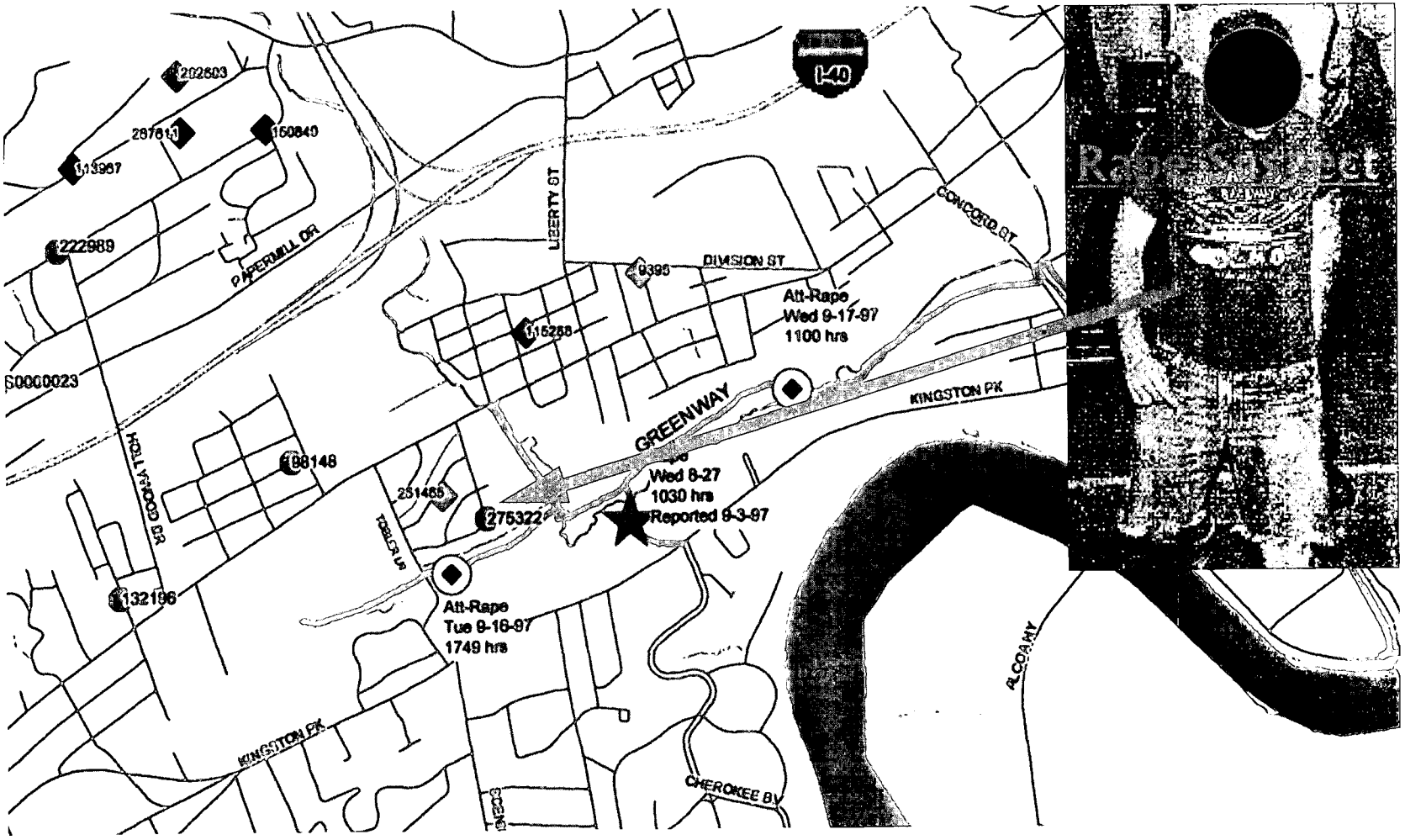



Figure 2
Suspect's Residence on Map of Offenders

significance. To "see" information is to know and understand it. Much as police car radios altered police response and understanding of crime in the 1920s, electronic mapping is doing likewise in the 1990s. We need to move mapping onto the laptop computer of every police car to help officers "see" the meaning of all the information they have available to them.

# ABOUT THE AUTHOR

**Robert Hubbs** began his career working downtown Knoxville on foot patrol after graduating from the Knoxville Police Academy in 1979. In 1982 he was transferred to the Patrol Division, where he ran a patrol beat, and in 1987 he was transferred to the newly formed Repeat Offender Unit. In 1989 he was promoted to criminal investigator, taking an assignment in the Organized Crime Section and the Criminal Intelligence Unit. In 1992 Hubbs was promoted to patrol sergeant, and in 1993 he was appointed unit supervisor of the Crime Analysis Unit. He is an instructor on crime analysis for the University of Tennessee's Institute for Public Service (Southeastern Community Oriented Policing Education Program) and has conducted training in crime analysis and the uses of computerized mapping to track parolees and sex offenders in South Carolina, Alabama, Utah, Iowa, Tennessee and Arkansas. Hubbs has an associate of science degree in criminal justice and a bachelor of arts degree in sociology from the University of Tennessee at Knoxville.

# Interdicting a Burglary Pattern: GIS and Crime Analysis in the Aurora Police Department

*Susan Brown*
*Aurora, Colo., Police Department*

*Dave Lawless and Xin Lu*
*Aurora Geographical Information Systems Group*

*D.J. Rogers*
*Aurora, Colo., Police Department*



## Introduction

Target crime patterns, unlike target activity clusters, are assumed to be persistent, interrelated phenomena susceptible to intervention. Analysts recognize that—depending on the community and the target crime selected—tactical interventions, based on even the best analysis, do not always produce pattern interdictions. And pattern interdictions, even under optimal circumstances, frequently do not produce the arrest of an offender. As analysts, we focus on increasing the tactical pattern awareness of our operational units via interaction, publications and bulletins.

This case study highlights the use of a relatively new geographic information system (GIS) tool to detect and interdict a burglary pattern. This case is a fine example of an optimal interdiction effort that did not result in an arrest for the target offense. Still, the intervention did result in offender displacement and illustrates the process by which an identified activity cluster develops into a target crime pattern.

## Critical Success Factors

Every deployment of a new ability or technology has critical junctures that bear heavily on the effort's success. As the Aurora, Colo., Police Department (APD) brought the new GIS technology into its resource kit for tactical crime analysis, there were two distinct operational choices that proved, in retrospect, to be essential to using analysis products to interdict crime activity.

The first critical success factor is the crime analyst's integration as an operational team member, rather than a simple "bulletin mill." In the context of this particular crime pattern, the interaction between the crime analyst and the Burglary Unit proved to be the most important factor in the intervention's success.

The second critical success factor was technological. As the case study will demonstrate, this interdiction would never have begun if not for the GIS product developed and maintained by the Aurora Geographical Information System Group. The GIS, as employed by the crime analyst, provided two invaluable assets in the identification and interdiction of this crime pattern:

1. The GIS provided a visual "tripwire" for the analyst, making emerging crime clusters easily identifiable. In a general sense, this functionality differs little from the pin maps of the past, with one notable exception. Underlying the GIS product is a wealth of detailed, qualitative information for each burglary event. Through multivariate analytical examination of the spatial activity cluster, the analyst can effectively separate spatial activity clusters (event groupings where the only common factor is geographic) from target crime patterns (event groupings sharing reasonable commonality among multiple descriptive factors). While both types of activity are addressed operationally, successful interventions require matching tactics to the type of crime pattern.

2. The GIS was a compelling presentation tool, allowing the analyst to visually communicate the existence of clusters and patterns to operational decisionmakers. We are certainly not exploring new territory when we suggest that the strength of the GIS is in how it allows information consumers to conceptually relate to the data, regardless of their technical sophistication. In our example, the pattern was confirmed by similarities in time of occurrence, target property and method of operation. None of this information, however, was as compelling to operational decisionmakers as the spatial visualization of the pattern offered by the GIS.

# GIS IN AURORA:
## AN OVERVIEW OF THE SYSTEM AND PROCESS



Aurora's GIS Crime Analysis Program (GCAP) is based on ESRI's ArcView desktop GIS software. Event-level database records from the Police Information Management Systems (PIMS) are stored in a Unix-hosted Informix database. The GIS staff developed ArcView applications to allow crime analysts to query the PIMS database. Typical queries involve crime category, geographic descriptor (location or address) and/or time of occurrence in various combinations. Query results are returned to the GIS and plotted, providing the analyst with display and hard copy presentation materials.

The system provides for thematic depictions of activity, including varied descriptive symbology and graduated map symbols. Near-term product development will focus on providing additional "hot spot" identification functionality incorporating ESRI's Spatial Analyst product.

The focus on in-house product development allows the agency, and the city, to maximize existing staff and technology resources while providing a tailored application product. The "homegrown" approach allows the design staff to add and modify product features in response to user requests, and the GIS staff's intimate understanding of the various source data systems minimizes data difficulties that so frequently plague externally implemented systems.

For tactical crime analysis, data elements are taken from burglary offense reports and entered into a separate crime analysis database, managed in Microsoft Access. That database supports a greater range of both qualitative event-level data and iterative querying. The tactical analyst uses this system to identify the case events that make up the selected pattern. These selected event records can then be exported as a .DBF file for use in the GIS. The file, once imported as a table in the GIS project, allows the creation of a crime theme (in this case, residential burglary with certain parameters) with the locations plotted as points on the map representing burglary events. To an analyst comfortable with the software (Access and ArcView), this process for transfer and production is very approachable and consumes a relatively small amount of time.

## Identification of the Burglary Cluster

By the third week of June 1998, crime analysts recognized the emergence of a serious crime rash. A cluster of residential burglaries was forming, and the crime analyst, noting the unusual spatial proximity of the events, began a pattern evaluation.

Aurora (located on the eastern edge of the Denver Metro Area) historically averages 261 burglaries a month. Before late 1997, with no tactical analysis functionality in place, analysts had difficulty identifying activity clusters. In addition, a relatively high level of residential burglary activity in northwest Aurora is not unusual. In a city divided into 551 geographic service grids, only 26 grids averaged more than 25 burglaries per year. Of those 26 high-activity grids, 15 are located in the northwest corner of the city.

In this context, the GIS proved its value. A small number of burglary events (nine between Jun. 6 and Jun. 19, 1998) in an area characterized by high levels of activity would have easily slipped past previous review processes. With the GIS, the cluster was apparent, and the underlying data allowed the analyst to determine that the activity in the area of 11th and Akron was unusual, in both historical and relative terms (see Figure 1).

## Identification of the Burglary Pattern

After identifying the spatial activity cluster, the analyst set about discerning the presence of a burglary pattern. To substantiate an identified spatial cluster, the analyst generally examines estimated day and time of occurrence, target location type, method of operation and target property data elements to determine if there is sufficient similarity in the events to classify them as a pattern.

The Research and Development Unit's analytical approach requires that the analyst document significant similarity between clustered events on at least three different classification elements. In practice, this means that a crime cluster might demonstrate reasonable similarity in location of occurrence (spatial proximity), estimated time of occurrence (temporal proximity) and method of operation.

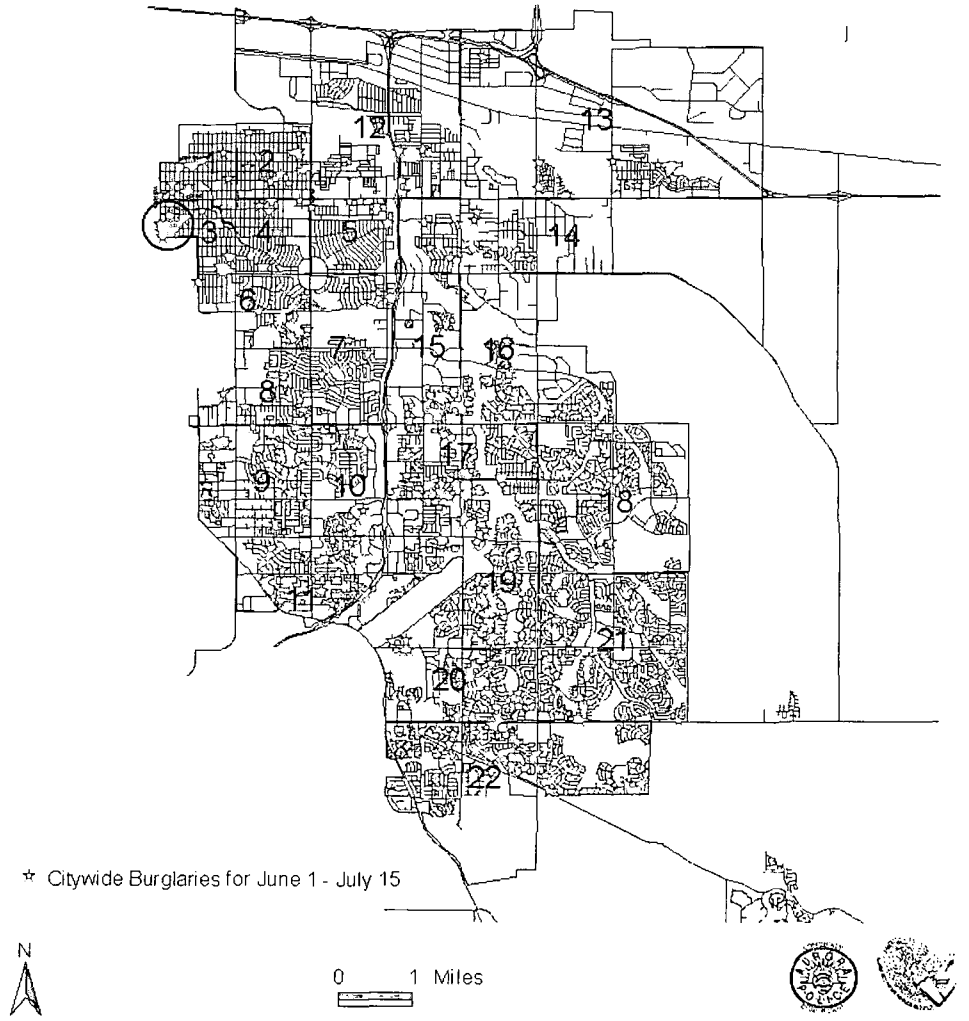



**Figure 1**
**Burglary Cluster—Northwest Aurora**

The pattern classification process revealed the following:

1. The events in the spatial cluster had no common estimated day of occurrence. The suspect(s) seemed to have no specific day-of-week preference.

2. The estimated time of occurrence data demonstrated a strong preference for afternoon events. After evaluating all burglary events in the spatial cluster, the analyst identified 1300 to 1400 hours on Monday, Thursday and Friday; 1600 hours on Tuesday; and 1800 hours on Wednesday as the high-probability event times.

3. The target location type data showed that the suspect(s) had a well-defined preference for single-family dwellings. This was noteworthy given that the majority of the housing in the area (and, therefore, the typical residential burglary targets) are multifamily residential dwellings or apartments.

4. The assessment of method of entry data also indicated that the suspect(s) preferred side or rear windows as points of entry. Window pries/screen removals accounted for 58 percent of reported entries, with window smashes composing the remaining 42 percent of cluster events.

5. There was also a strong similarity among events in the type of property taken. The suspect(s) appeared to prefer TVs, VCRs, stereo equipment, money or jewelry, or some combination thereof.

6. The suspect(s) had a distinct operational signature. During the burglary, the suspect(s) was/were prone to moving and damaging property in the residence that was not stolen. After some research, the analyst determined that there was a pattern of ongoing activity in eastern Denver with a very similar signature. The only disturbing difference in the Denver events, unmirrored in the Aurora pattern, was that the suspect(s) had, on occasion, excreted in various locations in the house.

At this point, the analyst had developed a workable pattern and took the critical next step required for successful crime analysis. Rather

than simply reduce her findings to paper and put a copy in all the relevant mailboxes, she proceeded to "sell" the pattern to operational decisionmakers.

The analyst had, before this specific series of events, established an excellent working relationship with the members of the APD Detective Bureau's Burglary Unit. The Burglary Unit was heavily involved in the complete redevelopment of the tactical crime analysis function. As the analyst began producing information, members' feedback contributed to the creation of valuable, and useable, analytical products.

## Developing the Suspect

Immediately upon the identification and classification of the burglary pattern, a pattern bulletin (textual description of pattern factors with a map attached for spatial reference) was disseminated to the Burglary Unit and the Patrol Bureau.

The assigned burglary detective, working from the pattern bulletin, began evaluating suspects known to operate in the defined area with the specific method of operation and targeted property preference. The detective immediately named a suspect who matched the pattern parameters and had an extensive burglary history. The suspect had been recently incarcerated for the burglary-related charge of false pawn declaration, but the detective learned that the suspect had been released one day before the first burglary event in the identified pattern. The suspect's listed address was almost dead center of the identified burglary pattern (see Figure 2).

## Investigative Approach

On June 19, 1998, four days after the Burglary Unit received the pattern bulletin, a surveillance detail was assembled to watch the suspect's residence. Officers from the Patrol Bureau, Police Area Representatives Section and the Burglary Unit were deployed in unmarked vehicles in an attempt to observe the suspect committing a burglary.

During two days of surveillance, police officers observed the suspect in and around his residence, but he was never observed in any criminal

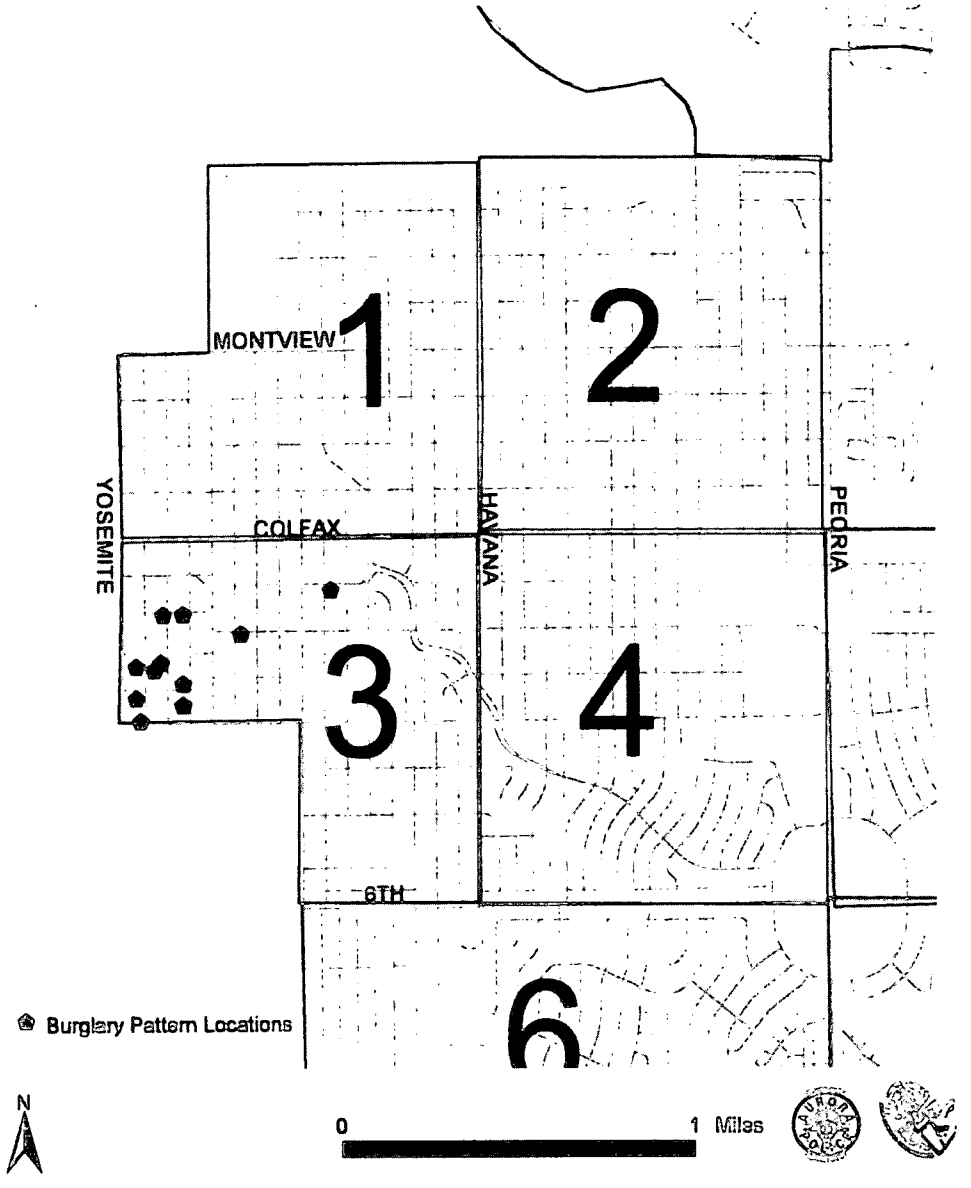



Figure 2
Burglary Pattern in Beat 3

or suspicious activity. The surveillance was discontinued after the second day, due to the resource cost associated with allocating staff for surveillance. Three additional burglary events that matched the suspect's method and area of operation occurred in the first nine days of July.

During the second week of July, a warrant was issued for the suspect's arrest for a probation violation in an unrelated drug case. Burglary detectives made several attempts to locate the suspect and effect the arrest. On Jul. 19, 1998, two burglary detectives contacted the suspect in front of his residence. When additional patrol units arrived on scene, the suspect ran. A brief foot chase ensued, and the suspect was eventually apprehended and jailed.

There have been no burglary events matching the suspect's method of operation in that area of northwest Aurora since Jul. 9, 1998. Similar burglary events in the Denver area have also stopped. The suspect has been incarcerated since Jul. 19, 1998, for the probation violation and subsequent revocation on the drug charge. There are two new burglary charges, one false pawn charge and one theft by receiving charge pending against the suspect. Several other burglary charges, including events identified in this pattern, are expected to be filed.

## Conclusion

This case study details an analytical process that resulted in an effective, if somewhat nontraditional, offender displacement (if one will allow a return to the care of the department of corrections to be so described). The origin of any such process is identifying developing crime patterns.

The GIS product has become the prime "tripwire" technology for tactical analysis in the Aurora Police Department. While we continue to develop additional technologies to identify temporal and MO clusters, our spatial analysis tool is the most widely used, understood and deployed.

Further, GIS has become an integral part of the analyst's "sales pitch" when approaching operational decisionmakers. With limited personnel resources and an unlimited universe of criminal activity from which to choose, the operational decisionmaker must have information to make the best possible use of resources. GIS allows complex material to be reduced to a form that is intuitive and compelling. The quick response and resolution detailed in this case study was possible largely because the analyst had a tool to create convincing evidence of patterns in the chaos of crime and disorder.

# ABOUT THE AUTHORS

**Susan Brown** is the primary tactical crime analyst for the Aurora, Colo., Police Department (APD) and has been working exclusively on a burglary reduction project in the northwest area of Aurora since joining the APD in 1997.

**Dave Lawless** is the software applications manager for the City of Aurora Information Technology Department. Lawless was extensively responsible for developing GIS capability in the city and was the lead contact on GIS products for a number of years.

**Xin Lu** is the GIS coordinator for the City of Aurora Information Technology Department. Lu was extensively involved in customizing ArcView for use by APD analysts and officers.

**D. J. Rogers** is the administrator of the APD Research and Development Unit, which houses the APD crime analysis function.

# Mapping and Serial Crime Prediction

*Paul Geggie*
*Los Angeles Police Department*



This case study illustrates the use of mapping to assist in the capture of serial criminals. In late January 1998, Officer Timothy J. Meicher was assigned to the Crime Analysis Detail in the Van Nuys area of the Los Angeles Police Department. Van Nuys detectives were investigating a series of three robberies in which the suspect, riding a Ninja motorcycle, was snatching the purses of elderly female victims walking through shopping center parking lots. The crook was named the Motorcycle Bandit. Officer Meicher had recently attended a California Department of Justice Crime Analysis Training based on the book *Crime Analysis: From First Report to Final Arrest* (Gottlieb et al. 1994) and decided to use some of the methods he learned to predict when and where this serial criminal would strike again.

Officer Meicher employed a methodology that uses averages and standard deviations of a sample. The methodology is applied to the time of day of each incident, the number of days between incidents and the locations of each incident expressed as *x,y* grid coordinates. For example, using time of day and assuming a normal distribution, we can predict that 68 percent of the incidents (including the next incident) will occur within one standard deviation of the average times of day of the incidents and that 95 percent of the incidents will occur within two standard deviations of the average.

Officer Meicher used a hand calculator to do the math and MapInfo software to draw a map based on the three known purse snatchings. The process took some time because of the newness of the methodology and the relative difficulty of using a pocket calculator to do complex mathematical computations. The analysis provided date ranges, time of day ranges and rectangles on a map that showed 68 percent and 95 percent probabilities that the next incident would occur within the two rectangles (see Figure 1).

For example, there was a 68 percent probability that the next occurrence would occur between January 25 and February 6, between 2045 hours and 2345 hours and within the smaller rectangle drawn on the map. Similarly, there was a 95 percent probability that the next incident would occur between larger date and time of day ranges and in the larger rectangle.

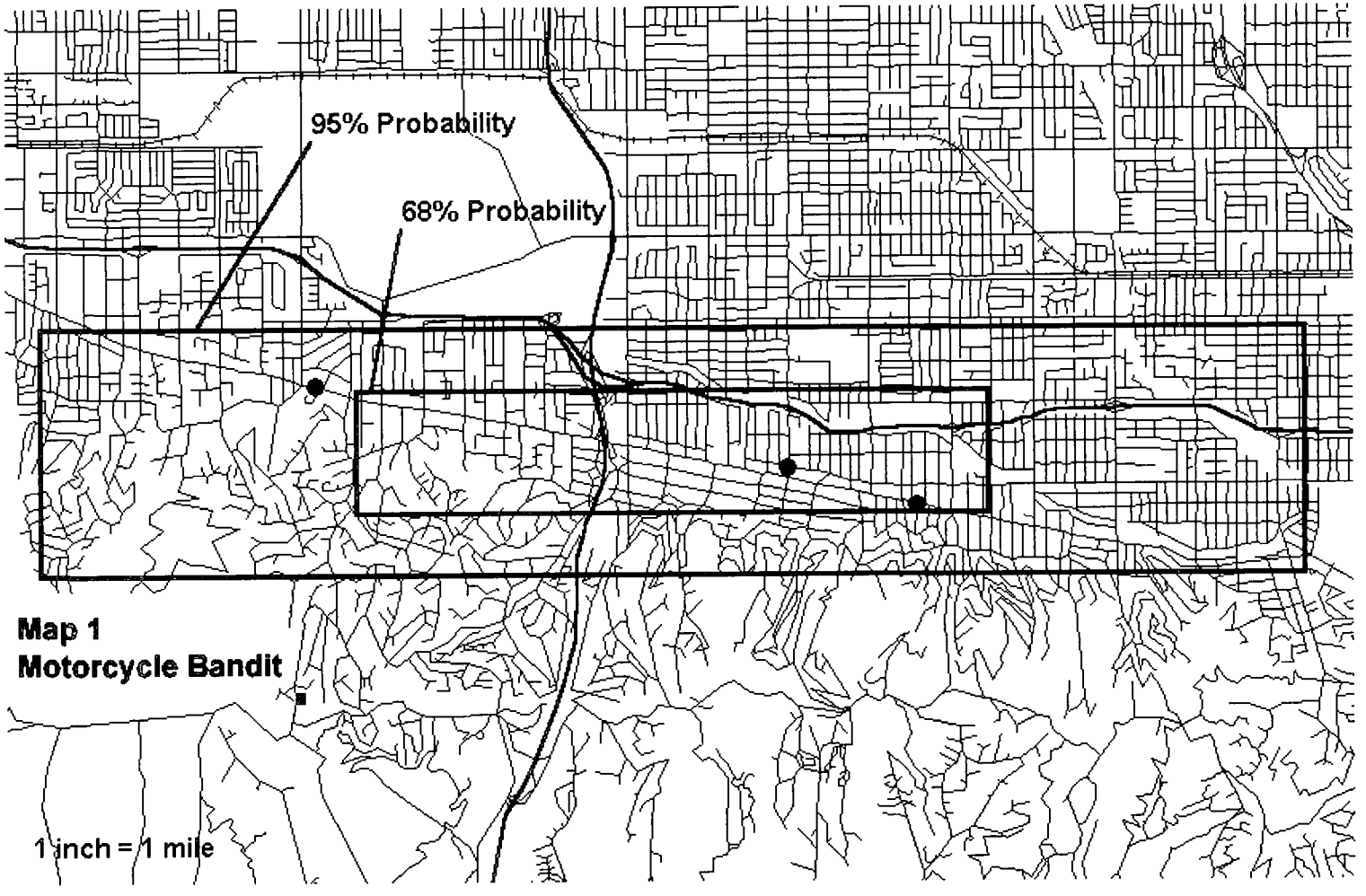

95% Probability
68% Probability
Map 1
Motorcycle Bandit
1 inch = 1 mile

Figure 1

The officer gave these results, including a map similar to Figure 1, to the investigating detective and his commanding officer to help them decide when and where to deploy officers to capture the suspect. They gave this first prediction a cool reception and decided not to deploy resources. The next morning, Officer Meicher learned that the suspect had struck again and that the date, time of day and location of the occurrence were all within the ranges he had predicted. The commanding officer asked Officer Meicher to make a presentation at the area crime control meeting.

Officer Meicher recalculated the predictions to include the fourth incident and drew a new map with MapInfo showing both the 68 percent and 95 percent predictions (see Figure 2). At his presentation to 40 to 50 officers, there still were a lot of eyes that rolled when he made his second prediction, but the captain decided to assign a special crime suppression unit to work the problem beginning that night. The units chose their locations based on the prediction maps, and in less than 45 minutes the suspect showed up at one of the observation posts and began to look for potential victims. The suspect made eye contact with officers in a marked car and immediately took off. A brief pursuit took place, but the suspect fled on the motorcycle in the rush hour traffic. As of this writing (seven months later), there has not been a similar incident. In addition, this case convinced officers and command staff of the value of this method of serial crime prediction.

Officer Meicher agreed to work with Lieutenant Paul Geggie from the LAPD Crime Analysis Section to automate as much of this process as possible. They created a Microsoft Excel worksheet to do the math. In the new process, the serial crime incidents are entered into MapInfo tables in chronological order and then geocoded and mapped. Then latitude and longitude columns in the incident table are updated to obtain latitude and longitude values for each incident. Next, the MapInfo table is copied and pasted into the Excel worksheet (see Figure 3). The worksheet displays the date and time of day range predictions and the MapInfo rectangle object coordinates. The worksheet also automatically creates charts showing how many incidents occurred each day of the week and the probabilities that the next incident would occur during each hour of the day. This helps in choosing the best hours if deployment for only part of the predicted time of day range is possible. Finally, the MapInfo rectangle object information from Excel is used to draw rectangles on the map of the incidents. These charts, along with the map and worksheet, document the series of incidents and provide specific information that investigating and command officers can use to develop tactical plans to apprehend serial criminals.

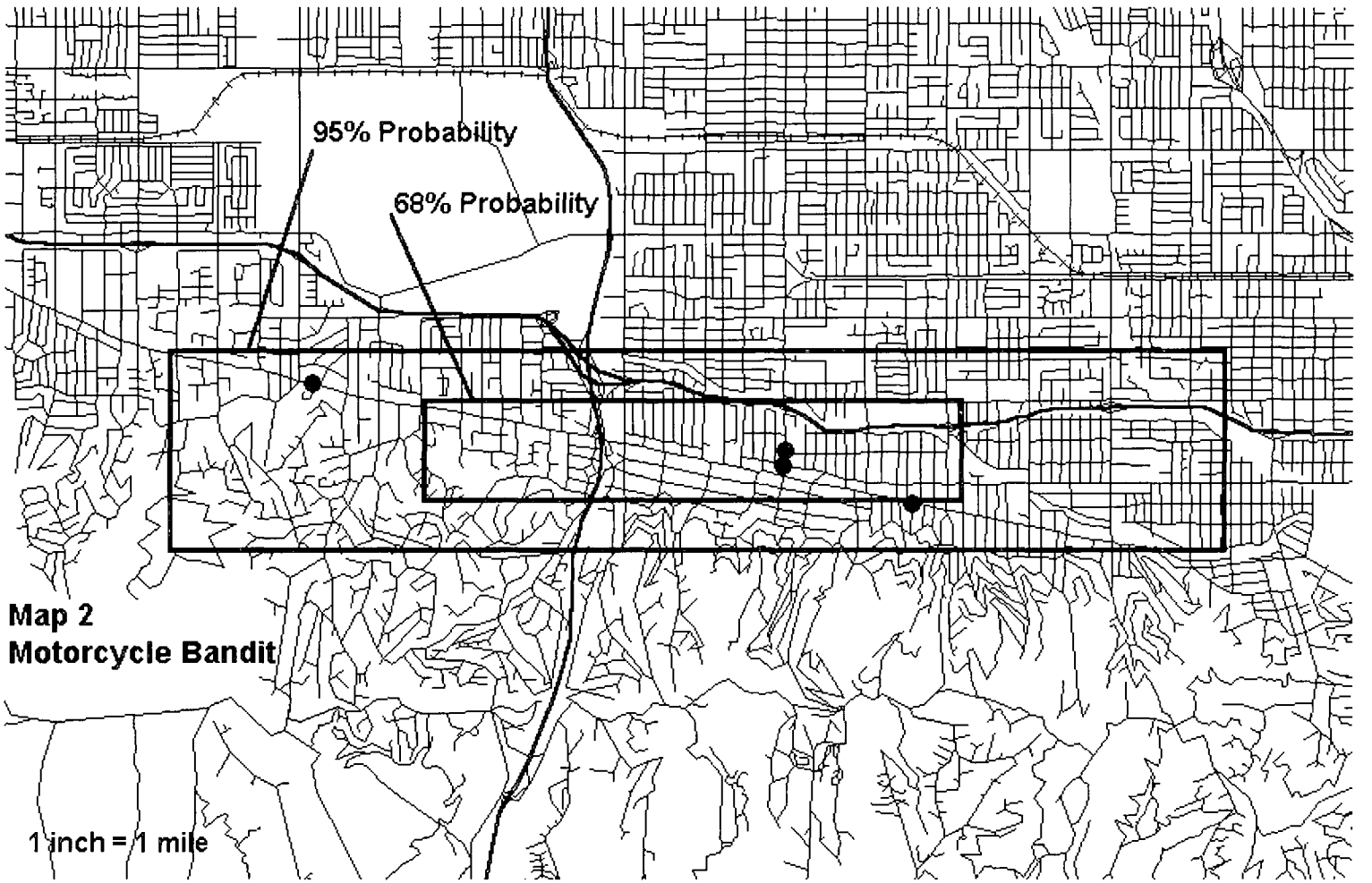

95% Probability
68% Probability
Map 2
Motorcycle Bandit
1 inch = 1 mile

**Figure 2**

## Figure 3

**LOS ANGELES POLICE DEPARTMENT CRIME SERIES PREDICTOR**

Series Title: Motorcycle Bandit

| Crime No. | Start Date | End Date | Start Time | End Time | Location | X Long. | Y Lat. | Day Of Week |
|---|---|---|---|---|---|---|---|---|
| 980904412 | 01/04/98 | | 2235 | | 14500 Moorpark St | -118.44817 | 34.151732 | Sunday |
| 980904912 | 01/08/98 | | 2230 | | 13900 Ventura Blvd | -118.43431 | 34.148417 | Thursday |
| 981006323 | 01/22/98 | | 2315 | | 16823 Ventura Blvd | -118.49875 | 34.159025 | Thursday |
| 980906941 | 01/24/98 | | 2020 | | 4500 Van Nuys Blvd. | -118.4479 | 34.153055 | Saturday |

########## DO NOT USE MORE THAN TEN INCIDENTS ##########

| 68% Prediction | | Dates | | Time of Day |
|---|---|---|---|---|
| | Bet. | 01/25/98 | Bet. | 2045 |
| | and | 02/06/98 | and | 2345 |

Rectangle Object

| | | | | | |
|---|---|---|---|---|---|
| Bounds X1: | -118.485678 | deg | Y1: | 34.148626 | deg |
| Bounds X2: | -118.428887 | deg | Y2: | 34.157488 | deg |
| Center X: | -118.457282 | deg | Y: | 34.153057 | deg |

| 95% Prediction | | Dates | | Time of Day |
|---|---|---|---|---|
| | Bet. | 01/19/98 | Bet. | 1930 |
| | and | 02/12/98 | and | 100 |

Rectangle Object

| | | | | | |
|---|---|---|---|---|---|
| Bounds X1: | -118.514073 | deg | Y1: | 34.144195 | deg |
| Bounds X2: | -118.400491 | deg | Y2: | 34.161919 | deg |
| Center X: | -118.457282 | deg | Y: | 34.153057 | deg |

Time of Day Method of Analysis

**NOTE:** All are exact time incidents, use Mid Point Chart.

The worksheet has been distributed both inside and outside the Los Angeles Police Department, along with training on its use; slowly, more and more people are using it. It still takes good investigation, good reporting and good analysis to first identify a crime series. And the patterns of a serial criminal may be obvious without using any of these methods. Predicting the future is never going to be an exact science; suspects change their patterns of behavior for a variety of reasons. However, if it is true that 80 percent of crime is committed by 20 percent of criminals, then having tools like these helps focus police resources on the right 20 percent—the serial criminals. These methods can also be used to identify the "hunting" patterns of parolees, sex offenders and other career criminals.

# References

Gottlieb, S., S. Arenberg and R. Singh. 1994. *Crime Analysis: From First Report to Final Arrest.* Montclair, Calif.: Alpha Publishing.



# About the Author

**Paul Geggie** received his bachelor of science degree in law enforcement from Michigan State University in 1973. He has been an officer with the Los Angeles Police Department since 1974 and is currently assigned to the LAPD Crime Analysis Section, where he has functional supervision of more than 100 crime analysts. He also provides staff support for the department's quality control process, modeled after the New York Police Department's Compstat.

# Geospatial Analysis of Rural Burglaries

*David R. Wood*
*Mid-States Organized Crime Information Center*



The criminal intelligence analysts at the Mid-States Organized Crime Information Center (MOCIC) in Springfield, Mo., routinely use analytical mapping or geospatial analysis to support approximately 900 federal, state and local law enforcement agencies in a nine-state area. Their support, and therefore their perspective, is oriented toward analysis that assists specific investigative or prosecutorial efforts. They therefore view analytical mapping as a "tactical" rather than "strategic" analysis tool.

In 1995, Detective Vickie Schaefer, of the McLean County Sheriff's Office in Bloomington, Ill., contacted Criminal Intelligence Analyst David Wood of MOCIC for assistance with a series of rural burglaries. McLean County had nearly 60 unsolved farm burglaries during 1993 through 1995, and all had a similar MO. McLean County investigators needed assistance organizing and assessing the data that they collected in their burglary investigations.

The MOCIC analyst began by producing an activity summary map that depicted the event locations color-coded by year. This map became the primary analytical product for the assessment and was essential in ultimately apprehending the perpetrators. The map was essentially an electronic pin map that arranged the events based on their physical locations.

The base map was produced using an inexpensive off-the-shelf software application, DeLorme's Street Atlas 3.0. Street Atlas is a very useful mapping program, but it has limitations in the scale (magnification) available and how much of the area is portrayed on the screen. To achieve the scale and level of detail needed, the analyst copied six map segments from Street Atlas and placed them into Canvas, a drawing program. The segments were aligned to produce a single map of the county onto which the events were plotted. The burglaries were all at rural homes, so determining the exact location required using both the street address database in Street Atlas and hand-drawn sketches/descriptions from the investigators. Creating the base map by piecing together the map segments and then finding the precise locations of rural farms was a time-consuming and exacting task.

This map became the basis for the written assessment report and the pattern/trend analysis done for the investigators. By depicting all

the events in relationship to each other, the topography of the county, the established road network and population centers, a very useful "picture" emerged of how the burglars were operating. The summary map (Figure 1) allowed both the analyst and the investigators to visualize the problem.

The burglaries were analyzed for frequency patterns by day, date, month and sector in the county and for proximity to main highways.

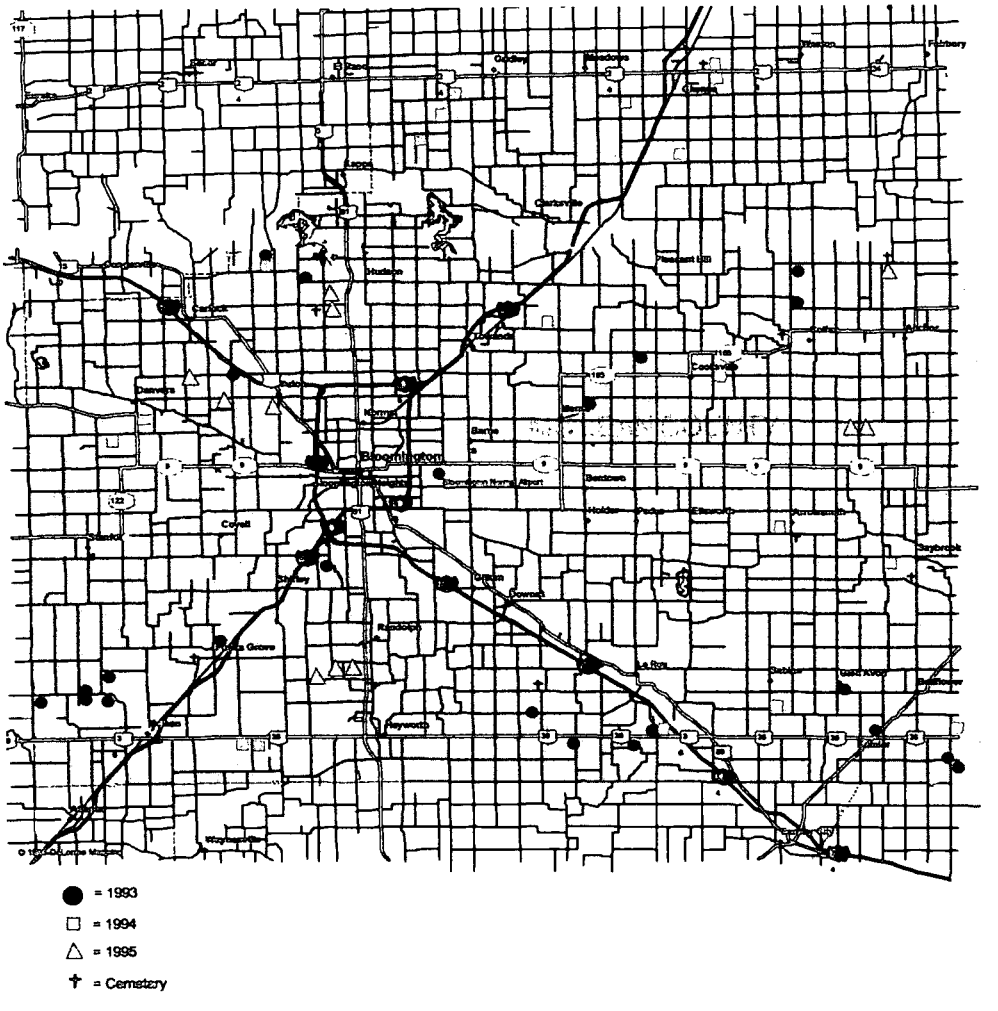



**Figure 1**
**McLean County Sheriff's Office**
**Farm Building Burglary Distribution, 1993–1995**

These statistical summaries were useful in determining when and where the burglars were likely to strike next. The proximity to main roadways was particularly important. The geospatial analysis revealed that all but one of the burglaries occurred within three miles of a major state or interstate highway, and most occurred less than one mile from a highway. This led to the assessment that the perpetrators were highly mobile and probably covered a wide area. This was confirmed by information from surrounding counties that revealed similar patterns. The investigators began to focus on traveling criminal bands that specialize in burglaries.

Interstates 55 and 74 intersect in Bloomington. I-55 is the major corridor between Chicago and St. Louis, and I-74 connects the Quad-Cities area on the Illinois/Iowa border with points east. McLean County was being victimized by a group of mobile, organized, multi-jurisdictional criminals who relied on the highways to provide quick escape after committing their crimes. Because of resource limitations, the investigators could not cast a wide net to apprehend their prey. Instead, they needed to focus their resources on the areas with the highest probability of success. The analyst noticed that there was a correlation between the location of the burglaries and the location of rural cemeteries—several nodes of activity appeared clustered around rural cemeteries. It appeared likely that the burglars were using the cemeteries as observation posts to case their targets and/or post lookouts, and possibly as staging areas for some of their crimes.

Based on this spatial analysis, the McLean County investigators responded with a tactical adjustment. In addition, patrols were increased in the high pay-off areas, including the cemeteries, and patrol officers were told to be particularly aware of activity around these areas. This vigilance led to the apprehension of several members of the group, commonly known as Irish Travelers. The suspects were questioned about these burglaries but, unfortunately, had to be released due to a lack of physical evidence.

The operation, however, had a successful outcome because the group ceased operating in McLean County following their law enforcement contact. This is indicated by a significantly reduced number of burglaries of this type in the jurisdiction (see Table 1). The crime prevention aspect of the case was a positive outcome, though the Irish Travelers continue to plague other jurisdictions.

A comprehensive application of the mapping techniques employed in this case to address the larger problem of crime associated with the Irish Travelers was discussed following the McLean success. However, serious resource limitations and competing priorities did not allow

| YEAR | NUMBER OF BURGLARIES |
|---|---|
| 1993 | 21 |
| 1994 | 19 |
| 1995 | 11<br>(data for partial year) |
| 1996 | 3 |
| 1997 | 4 |

**Table 1**
**McLean County Burglaries by Year**

for follow-up. The techniques used remain valid and could easily be implemented by a task force assembling and processing the data from numerous jurisdictions.

# ABOUT THE AUTHOR



**David R. Wood** is a criminal intelligence analyst at the Mid-States Organized Crime Information Center (MOCIC). He has more than 15 years experience as a professional intelligence officer and analyst. His duties include providing intelligence analytical support to MOCIC's 900 federal, state and local law enforcement agencies. He has assisted with the analysis of cases involving homicide, sexual assault, narcotics, fraud and theft. He regularly uses geospatial techniques to assist in analyzing these crimes. Before joining MOCIC in 1993, he spent 10 years in the U.S. Army as a counterintelligence (CI) officer. His previous experience includes four years as the special agent-in-charge of a CI Resident Office, three years as the CI operations officer in the Special Security Detachment for HQ U.S. Army Europe and two years as an instructor at the Army Intelligence School. He continues to serve as a major in the U.S. Army Reserve, where he provides strategic intelligence analysis support to the Defense Intelligence Agency. Wood has extensive training and experience in counterintelligence operations, counterespionage and counterterrorism. He is also the developer and course manager for Criminal Intelligence in Action, an intense one-week course in intelligence operations and analysis.

# Mapping a Murderer's Path

*Patrick Cook*
*Lowell, Mass., Police Department*



Just after noon on Monday, Oct. 7, 1996, the landlord of a Lowell, Mass., building needed to access the apartment of one of his tenants. The tenant's friend had become concerned after she didn't show for a luncheon date. Together, the landlord and the friend entered the woman's apartment and made a grisly discovery that ignited one of the most intensive murder investigations in Lowell in a decade.

On the floor of her Agawam Street apartment, Beverly Ramsay lay dead, her naked body riddled with nearly three dozen stab wounds, her throat sliced. The only signs of life inside her modest apartment were two kittens wandering aimlessly through the blood-spattered rooms.

In the two weeks that followed, more than 100 law enforcement officials, from Lowell police detectives to investigators from the FBI and Massachusetts State Police and cadets from the Lowell Police Academy, turned the Back Central neighborhood inside out in search of clues to the woman's killer.

In the end, the combination of dogged investigative work by detectives; hundreds of interviews with neighbors and city residents; and an exhaustive line search of woods, canals, mills and the nearby Concord River led to a first-degree murder case against Ramon Cortez. Amid all the police work and forensic investigations, two new and unlikely partners and tools emerged: the local gas company and a neighborhood map that allowed prosecutors to detail the killer's footsteps and slam shut the case against him.

From the outset, the slaying was not an easy one to solve. There was little physical evidence inside the victim's apartment. The motive was not easily discernible. Was it robbery? Rape? A burglary gone awry? There were no eyewitnesses to the attack. Ramsay had last been seen alive two nights before, leaving a neighborhood bar with a man who lived nearby. Witnesses said the neighbor, Ramon Cortez, was going to Ramsay's apartment to view her kittens, one of which he planned to adopt. On the way, the pair stopped at a package store and bought some beers, some of which they drank and discarded along the route to Ramsay's house. Cortez, however, vehemently said he never went to Ramsay's house and instead veered off at her street and went home.

In fact, he said, he had never even been inside Ramsay's apartment. During hours of questioning, he did not change his story. Two weeks later, his alibi came back to damn him, when the Massachusetts State Police positively identified Cortez from three bloody fingerprints found on a door inside Ramsay's home.

But in the days immediately after Ramsay's death, when information was slow in coming and clues were few and far between, investigators were getting worried. Most murders in the city were solved within the first two to three days. This one was dragging on for more than a week and attracting media coverage from across the state.

When it was decided that a comprehensive search of the congested neighborhood was required, 96 members of the Lowell Police Academy were tapped to help search the riverbanks, empty mills and canals in the densely populated neighborhood around Ramsay's home. During the two-day search, police uncovered a rambling trail of clues—Ramsay's pocketbook, photographs from her house, personal cosmetics, beer cans and jewelry boxes. Some of the evidence was found more than a half-mile from Ramsay's home, in the shadows of an electric mill and a youth boxing gymnasium.

Because of the expansive territory covered during the search, it was clear that a detailed and accurate document was needed to pinpoint and chronicle where all of the evidence was found in a way that would be understandable to a trial jury. For several months, the Lowell Police Department had been using MapInfo to do most of its internal mapping for statistical analysis and administrative functions. On several occasions in previous years, schematics of a crime scene were introduced at trials, usually depicting the interior of a home or a room where the crime had occurred. Often these were either blueprints of a home or a crude sketch of a neighborhood. But this case required a detailed map on a much larger scale. Besides needing a map at the mobile command post—one that could help coordinate extensive door-to-door canvassing for witnesses—investigators also needed a map depicting a large geographically correct area to accurately illustrate locations of evidence as well as the killer's likely escape route.

The Colonial Gas Company was using Automated Mapping/Facilities Management (AM/FM), the utility company's version of a geographic information system (GIS). Colonial's mapping project had evolved from a paper-based system in the 1970s to a computerized version developed in the early 1990s. The details on the Colonial maps are much more specific than those on most GIS applications, including those employed by the police department. For example, Colonial's maps indicate the location of gas mains; gas services; physical struc-

tures on a lot (e.g., houses, sheds, fences, pools or street lights); and such other features as alleyways, waterways and recreational areas.

The maps were created from overlapping aerial photographs of the city. The photos were then digitized using a method called stereo compilation. Colonial used the Massachusetts State Plane Coordinate System as the basis for its entire mapping. James W. Sewall Company of Old Town, Maine, was Colonial's consultant and provided the aerial photography, data conversion and software development. Colonial also used Northeast Corrosion Analysts and Bay State Piping for field mapping services; Geotelec of Norwalk, Conn., for database development; and Integrated Mapping Services of Holderness, N.H., for field mapping and data conversion.

Colonial's maps provide the company with detailed information that allows the company to easily track when gas mains and services require replacement. To operate its AM/FM system, Colonial uses MicroStation 95 on Windows NT.

Members of the Lowell Police Department's Management Information Systems department had spoken with Colonial in the past and knew of the company's mapping program. When a map was needed in the Ramsay case, the department contacted Colonial, and the gas company eagerly provided lead investigator Gerald Wayne from the department's Criminal Investigations Division with an overhead, to-scale map of Ramsay and Cortez' neighborhood (see Figure 1).

"The key to these maps was the fact that the gas company depicted each building, put a number on each piece of property for us and spelled everything out in a detailed yet simplified manner," said Wayne.

Because the evidence was spread out over such a large geographic area, most of which was connected by overgrown trails along the banks of the Concord River, Wayne wanted to use the map to keep everything in perspective for any jurors who would be unfamiliar with the area. The detailing of evidence was especially important during the trial, when prosecutors from the Middlesex County District Attorney's Office were able to virtually walk the jurors through the neighborhood, using the map to show them the path Cortez had likely taken after killing Ramsay. Prosecutors were also able to show the location of empty beer cans found beyond Cortez' home, on a route he would likely have taken to dispose of the victim's pocketbook and jewelry.

The maps were shown to the grand jury that indicted Cortez, as well as the jury that convicted him of first-degree murder in December 1997. The maps stayed affixed to a courthouse wall throughout the Christmastime trial and were continually referenced by witnesses, including Cortez, who took the stand in his defense.

A: Murder Scene (Ramsay apartment)
B: Suspect (Cortez) apartment
C: Suspected Escape Route
D: Empty Beer Cans
E: Victim's Pocketbook, Keys
F: Photographs of Victim's Cats
G: Full Beer Can, Lipstick, Make-Up, etc.
H: Victim's Bracelet Inside Jewelry Box
I: Location Suspect Claimed to Have Last Seen Victim

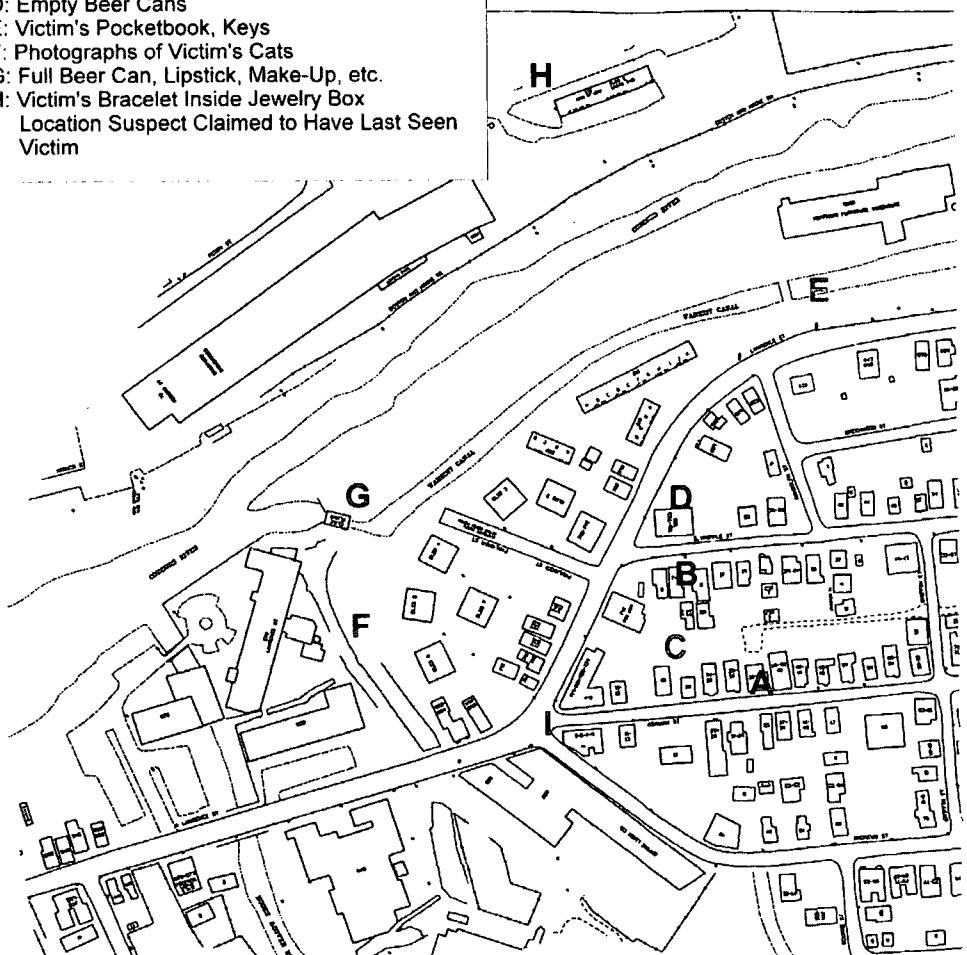



**Figure 1**
**Map of Crime Scene Neighborhood**

"We were able to get up in front of the jurors and show them a virtual photograph of the neighborhood," Wayne explained. "When we recreated what we believe happened before and after the murder, we were able to use the map to bring the jurors along with us. When we said Cortez probably ran through the alley to the back door of his home, it was easy for them to understand when they saw how close the houses actually were. These particular maps were very useful because they depicted the suspect's escape route." Cortez lived behind Ramsay's house, with just an alley and a tiny fence separating them. "The maps helped the jurors understand the lay of the neighborhood, the close proximity of the suspect and victim and the placement of key pieces of evidence.

"When we detailed where we found items that had been taken from Ramsay, or the beer cans the suspect had been carrying, the jurors understood the scope of our search and the trail that we were laying out for them. It was like we gave them a photograph of the neighborhood and then took them on a tour of it as we tried to bring a killer to justice," Wayne explained.

Wayne also praised the maps for their simplicity. "There's nothing fancy or confusing about them. They're something that every person can look at and clearly understand, and that's exactly what happened with the men and women on these juries," he said. "They didn't need a confusing map with legends, acreage, color coding or topography. What they needed was an overview of the last steps taken by a murder victim and the path her killer took after committing the brutal attack. And that's what they got in one nice and neat package on this map."

Since Cortez' life sentence to prison, Wayne has returned to the gas company to access maps for other cases, including another homicide, this one in a city park. But Wayne will never forget their role in helping him find Beverly Ramsay's killer.

"There's no questioning the value of maps in a case such as this," Wayne said. "They put everything into perspective for everybody involved with the case. Most important, they helped bring a killer to justice and put him behind bars."

# ABOUT THE AUTHOR

**Patrick Cook** has been the communications manager for the Lowell, Mass., Police Department since 1995. Before that, he worked for 11 years as a police reporter for the *Lowell Sun* newspaper. A graduate of the University of Lowell with a bachelor's degree in liberal arts, Cook currently supervises the Lowell Police Communications Center and serves as the public information officer for the Lowell Police Department.

# About the Crime Mapping Research Center



NIJ established the Crime Mapping Research Center (CMRC) with funds available under the technology assistance provisions of the 1996 Omnibus Appropriations Act amending the 1994 Crime Act. The CMRC is headquartered at the National Institute of Justice in Washington, D.C., and its permanent staff consists of seven full-time and two part-time employees with backgrounds in law enforcement, geography, criminology and anthropology.

The Crime Mapping Research Center promotes the research and development of crime mapping through

- research, including fellowships, in-house research projects and NIJ-funded grant awards;
- evaluation of best practices, GIS use in police departments and current criminal justice applications and needs;
- development of training programs and analytic software; and
- dissemination of information through conferences, workshops, a Web site and a listserv.

Through these actions, the Crime Mapping Research Center serves as a clearinghouse for crime mapping research and development in the United States and abroad.

# About PERF

The Police Executive Research Forum (PERF) is a national professional association of chief executives of large city, county and state law enforcement agencies. PERF's objective is to improve the delivery of police services and the effectiveness of crime control through several means:

1. the exercise of strong national leadership,
2. the public debate of police and criminal justice issues,
3. the development of research and policy, and
4. the provision of vital management and leadership services to police agencies.

PERF members are selected on the basis of their commitment to PERF's objectives and principles. PERF operates under the following tenets:

1. Research, experimentation and exchange of ideas through public discussion and debate are paths for the development of a comprehensive body of knowledge about policing.
2. Substantial and purposeful academic study is a prerequisite for acquiring, understanding and adding to that body of knowledge.
3. Maintenance of the highest standards of ethics and integrity is imperative in the improvement of policing.
4. The police must, within the limits of the law, be responsible and accountable to citizens as the ultimate source of police authority.
5. The principles embodied in the Constitution are the foundation of policing.

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