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ASSESSMENT OF DATA-DRIVEN DEPLOYMENT BY THE MEMPHIS POLICE DEPARTMENT

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MESSAGE FROM THE EXECUTIVE DIRECTOR

The Public Safety Institute (PSI) at the University of Memphis is an interdisciplinary part of the University community committed to identifying and advancing best practices in the field of public safety.

Under an agreement between the University and the Memphis Shelby Crime Commission, the PSI is to assess the impact of various objectives in the local Safe Community Plan designed to prevent and reduce crime.

One of the key objectives of the Safe Community Plan is deployment of resources by local law enforcement in a data-driven manner.

The PSI has conducted a total of three assessments on the impact of data-driven deployment by the Memphis Police Department covering three separate calendar years. Each assessment has pointed out both benefits and room for possible improvement.

I thank the PSI's research assistant, James "Max" Helms, for taking the lead on this third assessment and the Memphis Police Department for its cooperation, without which this assessment would not be possible.

Bill Gibbons, Executive Director
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TABLE OF CONTENTS

INTRODUCTION

Data-driven policing has been a priority for the Memphis Police Department (MPD) for over ten years. The initial Safe Community Plan (2007 – 2011), called for expansion of MPD's data-driven ability by updating the technology used and increasing its personnel. The next two Safe Community Plans (2012-2016 and 2017-2021) reiterated the importance of a data-driven approach to MPD's use of resources. According to the Real Time Crime Center website, its technology allows MPD "to receive instant information on recent criminal activity in a radius around a crime, existing crime patterns in the neighborhood, and a history of people with arrest records who may frequent the area." Successful policing should have good data and intelligence gathering abilities, such as hotspot analysis. Hotspots can help police identify areas in which to deploy additional resources. The objective of this assessment is to examine if MPD is deploying its resources effectively through data-driven deployment. This is the third assessment created by the Public Safety Institute (PSI) of data-driven deployment by MPD. This assessment covers calendar year 2020.

LITERATURE REVIEW

The Evolution of Data-Driven Policing: Computers in Law Enforcement

Throughout the history of policing, electronic data use has increased as use of technology has become more common. Computer use by police departments was first implemented in the St. Louis Police Department in the mid-1960s (Colton, 1979). The beginnings of wide-spread technology use by law enforcement can be traced to the Omnibus Crime Control and Safe Streets Act of 1968 (Northrop, Kraemer, & King, 1995). This led to the creation of the Law Enforcement Assistance Administration (LEAA), which contributed approximately $50 million to law enforcement agencies to enable them to access police technology (Northrop et al., 1995). Surveys conducted in the early and mid-1970s showed that implementation of police technology was slower than anticipated (Colton, 1979).

Police use of technology became more common during a crime spike in the 1960s and 1970s when a "demand gap" emerged and it was evident that traditional policing techniques were not getting the job done (Ratcliffe, 2016). In the 1970s, technology use within law enforcement agencies markedly improved, most notably in data entry and management (Ratcliffe, 2016). Managing crime data more effectively allowed for the creation of a "strategic picture of crime" (Ratcliffe, 2016, p. 2). The demand gap led to "greater calls on the police for effectiveness and

efficiency" (Ratcliffe, 2016, p. 2). The public wanted more professionalism from the police, with increased access to information. While the factors listed above helped increase data management technology within departments, rising levels of organized crime that ignored jurisdiction and state lines meant that police departments needed a better way to collaborate with each other.

Crime Mapping

Early crime maps were noted as early as 1829 in France and were known as choropleth maps. Chamard (2016, p. 1) defined these as "maps that display quantities of things in areas. More specifically, in choropleth maps geographical areas are divided into multisided figures called polygons, which are then shaded depending on the value of the variable being displayed." Election maps are a modern example of choropleth maps. During the 1900s, sociologists at the University of Chicago mapped the homes of delinquent children using another type of map called a point map. These maps used dots or points to mark geographical points of interest and were completed without the aid of computers, which took hours of work. Crime mapping in a true sense did not appear until the ability to run crime mapping programs on desktop computers.

Before mapping programs became widely available, police departments used a basic pushpins and paper technique. These maps allowed for elementary detection of clustered activity but lacked the ability for more advanced analyses that incorporated other factors, such as time of offense. Even with the availability of computers, digitizing crime maps was still a significant undertaking. Due to the labor involved, many police departments could not afford to computerize their maps. A study conducted in the late 1990s showed that larger departments were much more likely to have a computerized crime mapping system than their smaller counterparts (Charmard, 2016).

Crime mapping has advanced with the development of Geographical Information System technology (GIS), which began in planning for the 1970 census and improved from there. As satellite images of Earth became available and the military was able to create a platform for these images to be viewed, GIS technology quickly came to be useful for gathering intelligence. The ease of attaining computer hardware that came with a reduction in price in the 1980s combined with improved computer systems and more advanced software has had a positive impact on the widespread use of GIS technology. However, early use of GIS crime mapping was met with several setbacks, such as organizational problems, information sharing issues, technical problems, and geocoding problems. These problems have not entirely disappeared, and new problems have emerged over time (Chainey & Ratcliffe, 2013).

CompStat, short for "Compare Statistics," is a program introduced in New York City in 1994. The idea for CompStat stemmed from failures in traditional policing (Weisburd, Mastrofski, McNally, Greenspan, & Willis, 2002). To counter these failures, data-driven decision making was emphasized. CompStat was intended to be an organizational device that used crime information to target crime reduction. This organizational tool allowed agencies to more effectively use their data, and its emergence was followed by an impressive decrease in crime.

Current Technology

Police use of technology has grown and changed over the years. Crime mapping has moved from merely describing where crimes have happened to becoming a predictive tool for preventive measures. Current technologies can gather data on police activity, indicate where crime reduction projects are in place, detail crime incidents, and more (Chainey & Ratcliffe, 2013). Data are used in police briefings as indicators of where future crimes may occur and in targeting crime hotspots. Data gathered on crimes can also be applied to analysis of crime reduction projects in areas where those have been deployed (Chainey & Ratcliffe, 2013). Many other policing technologies employed today have not always been readily available, including "wiretapping, fingerprints, DNA research, database coupling, data mining and profiling, camera surveillance and network analyses" (Custers, 2012, p.62). Other less well-known methods of computerized data collection are also in use now, such as 3D crime scene imaging and through-the-wall radar technology (Solar, 2015). Technology is integrated into police officers' everyday lives via use of body-cameras. This video footage can be used in court as evidence (Solar, 2015).

According to Willis, Koper, & Lum (2018), 60% of all large police departments currently use license plate readers (LPRs), high-speed cameras that can read and instantly analyze license plates. The LPR stores pictures of the plates and compares them to a database of plates of interest to law enforcement. These could be the plates of stolen vehicles or plates connected to known criminals. Along with the plate information itself, data such as the date, time, description of the vehicle, and the location of the vehicle are available to officers to aid in investigations.

Another technology currently being used by law enforcement is gunshot detection technology (GSD). GSD was developed in the mid-1990s and works by triangulating multiple sensors that can detect sound waves produced by a gunshot. Systems generally require three or more sensors to detect the sound wave for optimal accuracy. Data gathered from these sensors is then sent to law enforcement with the location, and an identification of the noise (whether it was an actual gunshot or another sound, like vehicle backfire). Previously, gunshots were reported mainly through citizen reports, which can be inaccurate. With the innovation of GSD, law enforcement is hoping to "increase the perceived risk of firing a weapon," mainly through more rapid dispatch and response times, and to reduce gun crime overall (Choi, Librett, & Collins, 2014, p.51).

The Use of Data in Policing

According to Lum, Koper, and Willis (2016, p.135), "technology has become a major source of expenditure and innovation in law enforcement and is assumed to hold great potential for enhancing police work." Police departments use data from this technology in many ways. For example, crime mapping data is used to "locate crime and traffic crash hotspots, thus enabling

law enforcement officials to target these areas with highly visible traffic enforcement" (Hardy, 2010, p.1). Data not only are collected but are also analyzed. Analyses are used to inform decisions on "local partnerships; strategic operations; information sharing and outreach; monitoring, evaluating, and adjusting operations; and measuring outcomes" (Hardy, 2010, p.2). All the data gathered by police can then be used to increase proactive measures. In Chicago, for example, the police department currently focuses on a "heat list" of offenders that risk analysis programs have shown to be possible future risks (Joh, 2014). Even Homeland Security is employing computer systems into their preventive measures, with their systems filtering out potentially threatening words (Joh, 2014).

In New York, the NYPD has developed a "Domain Awareness System" that links data gathered from several computerized systems such as CCTV footage and LPR technology (Joh, 2014). New York has been active in data-driven policing beginning with CompStat in the 1990s, the system that allowed them to use pinpointed crime maps to target specific areas and more efficiently allocate resources based on the maps. This system led to significant decreases in crime rates (Hyunseok, Hoover, & Joo, 2010).

"Real-Time Crime Centers" (RTCCs), such as the one within MPD, are a great example of how high-end police technology interacts with data-driven policies. The software employed at the Memphis RTCC can receive instant updates on criminal activity, identify crime patterns, and monitor high-risk offenders. The RTCC uses Blue C.R.U.S.H. (Crime Reduction Using Statistical History) data gathered on hotspot crimes, including time of day, day of the week and location to better allocate resources to those hotspots. Additionally, a wall of LCD monitors that display live feeds from areas of interest (such as the locations of GSD and LPR technologies) aids in providing real-time responses.

Research with the Mesa Police Department in Arizona showed how data-gathering technology like LPRs can influence police efficiency and resource allocation and illustrated the effectiveness of those technologies on reducing hotspot crimes. Specifically, Mesa police were interested in whether these technologies could reduce auto theft and increase the recovery of stolen vehicles and the apprehension of thieves. The department deployed an auto theft unit of four patrolmen in various types of cars all outfitted with LPRs. Each camera was linked to state-level data on stolen vehicles and other vehicles of interest, with a small amount of warrant information being linked as well. After methodically sweeping hotspots for 30 weeks, results of the study showed that the LPR patrol unit was more likely than other patrol units to recover stolen vehicles and to apprehend auto thieves. However, the LPR unit was only nominally more likely to make arrests for auto theft. Only four auto theft or stolen plates arrests were made, with the remainder being for unrelated crimes, either observed or based on warrants. The patrols saw a two-week time frame during which auto thefts and reports of drug activity were reduced. However, a sustained reduction in actual auto theft was not realized. Based on these results, Mesa concluded that,

while LPR cameras may not be cost effective for hotspot crime patrols, a specialized unit may be able to impact a targeted offense, at least in the short-term. In addition, while increasing scanned license plates may lead to more matches with the database of auto theft information, it is best to deploy a manual patrol unit as well (Koper, Taylor, & Woods, 2013).

Conclusion

Technology use by police departments began in the 1960s with computers cautiously being integrated into stations that could afford them, with many tasks still being done by hand. Crime maps did not consist of the advanced information we have access to today, but pushpins on a map on the wall. As computer technology became more advanced and more affordable, many cities saw the positives of becoming more computerized, starting with their data management systems. This eventually led to data analysis being done to meet growing demands for police professionalism and accountability. New York City set the standard in the 1990s by implementing CompStat and using its data to more efficiently and effectively allocate its resources to higher crime areas and focus on high-risk offenders. This standard led to other cities implementing similar programs that helped bring their crime statistics down. In time, law enforcement has implemented increasingly advanced systems that allow them to analyze even more detailed aspects of crime, such as the Blue C.R.U.S.H. data that can focus on the time of day and day of the week crimes are occurring. These data often are used in RTCCs that monitor these hotspot areas to inform management decisions on more effective and efficient allocation of resources.

METHODS

MPD provided the PSI with data of Blue C.R.U.S.H. offenses and calls for service within all nine precincts for the 2020 calendar year. This data were then separated into each precinct for a more thorough examination of each precinct. Using the data presented by precincts in PowerPoints to see where each precinct was labeling a hotspot, and by using the offense data provided, the PSI was able to get an accurate count of Blue C.R.U.S.H. offenses the week after an area was labeled a hotspot.

Blue C.R.U.S.H. PowerPoints

These PowerPoints cover a wide arrange of data that would be helpful for any precinct commander to know. Besides the total range of Blue C.R.U.S.H. offenses, larcenies are also a major focus of these PowerPoints. Larcenies make up a major part of the total crime within Memphis.

The PowerPoints include:

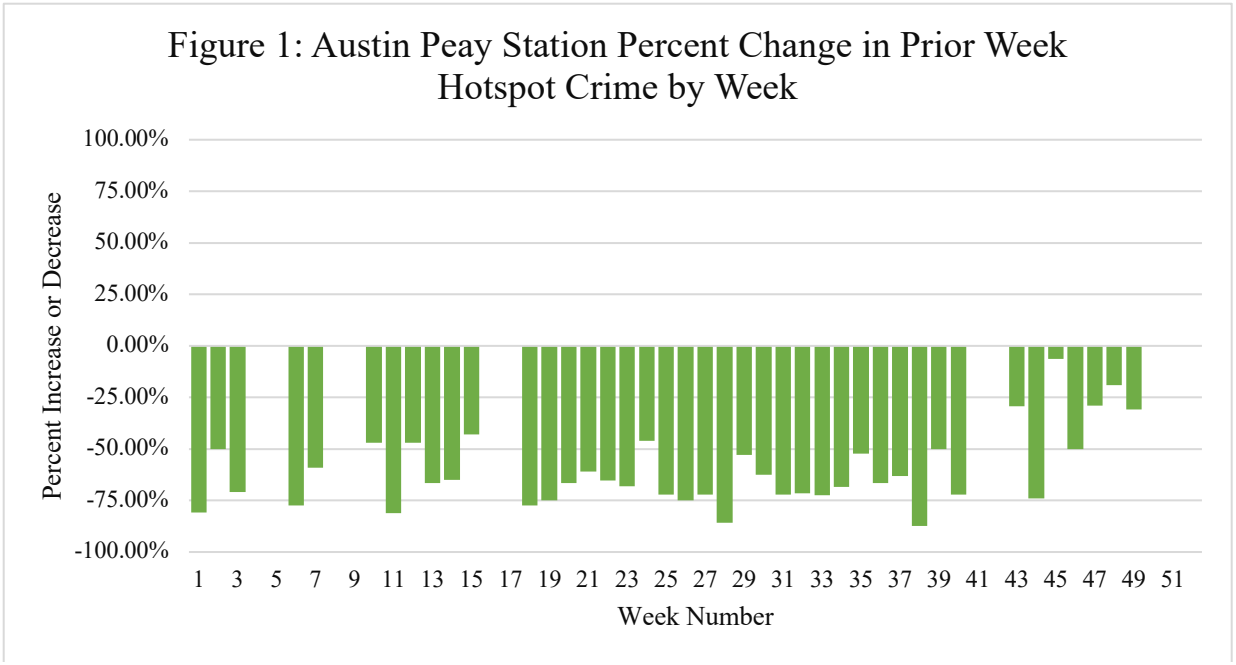
- The number of guns reported stolen/recovered
- The Trend of Blue C.R.U.S.H. offenses by week & four-week comparisons
- Budgeting
- Hotspots
- General Investigation Bureau arrests & clearances
- Officer weekly productivity
- Larceny reports & offenses
- Larceny hot times & hot days

ANALYSIS AND RESULTS

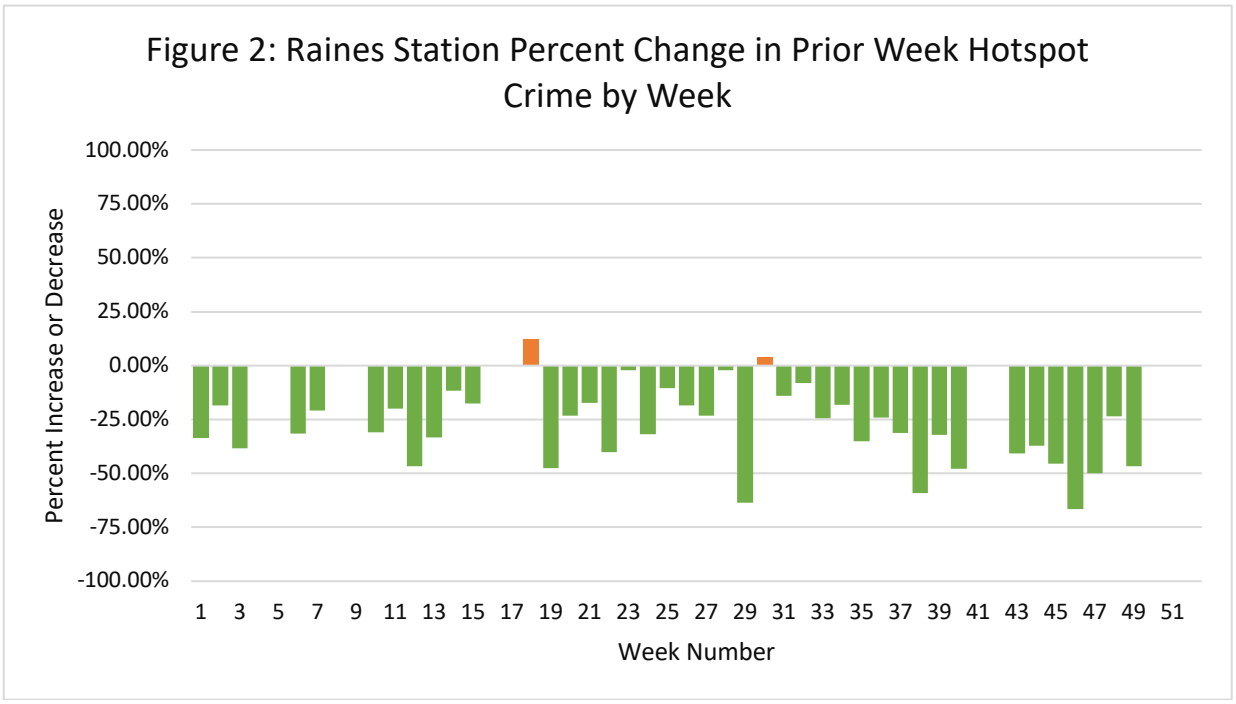
Hotspot Evaluation

To determine whether MPD is being data driven when using its resources, the PSI examined changes in crime within chosen hotspots in each precinct. MPD crime analysts provide each precinct colonel a general map of his or her precinct that maps reported crimes within that precinct during the prior four weeks. The precinct colonel and his or her staff then determine which areas are considered hotspots.

An analysis was conducted for calendar year 2020 to determine whether identifying an area as a hotspot appeared to have any short-term impact on the number of reported Blue C.R.U.S.H. crimes the week after that area was identified. Figures 1-9 show the increase or decrease within each precinct's hotspots the week after those spots were selected. Figure 10, titled 'MPD – All Stations,' represents the average increase or decrease within all hotspots across all nine precincts. On each of these charts, the numbers from 1 to 52 on the bottom axis represent the weeks of the year. For example, Week 1 is December 30, 2019, through January 5, 2020. The percentages represent the decrease (negative/green) or increase (positive/orange) of Blue C.R.U.S.H. crimes within the chosen hotspots one week after they were considered hotspots.



**Weeks 4, 5, 8, 9, 16, 17, 41, 42, 50-52 are not represented.*



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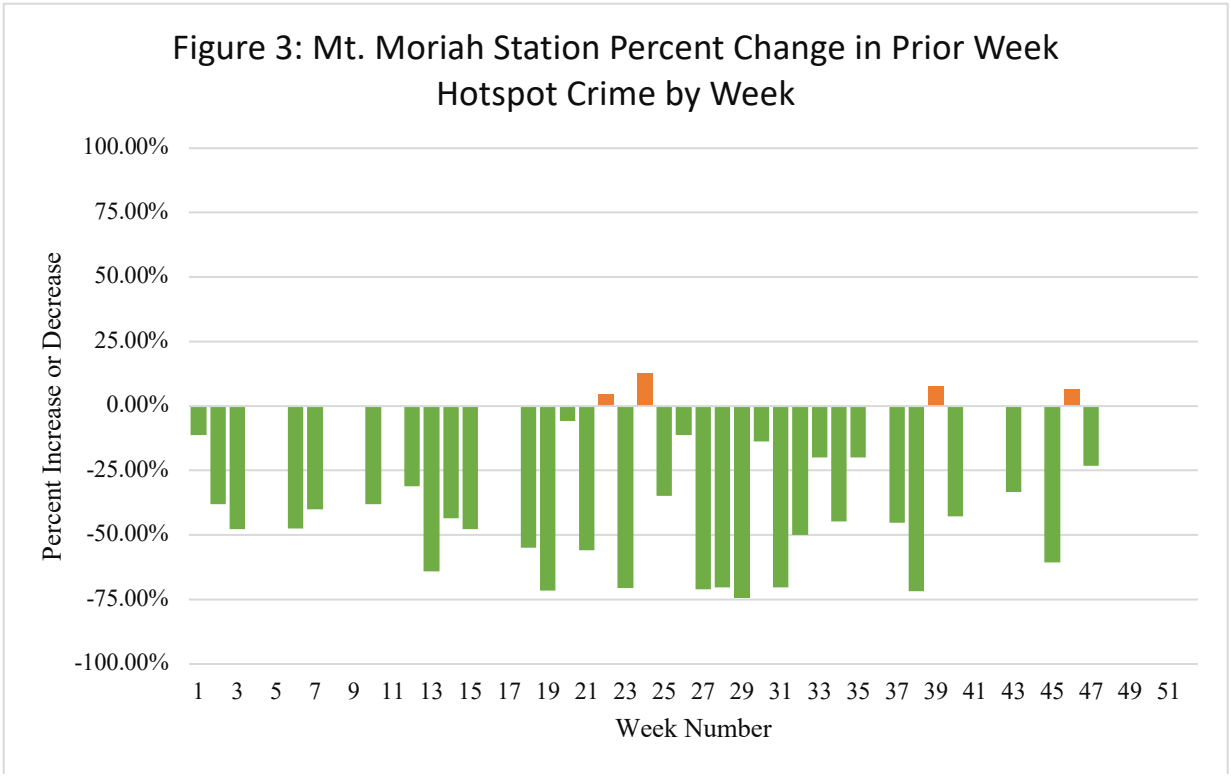

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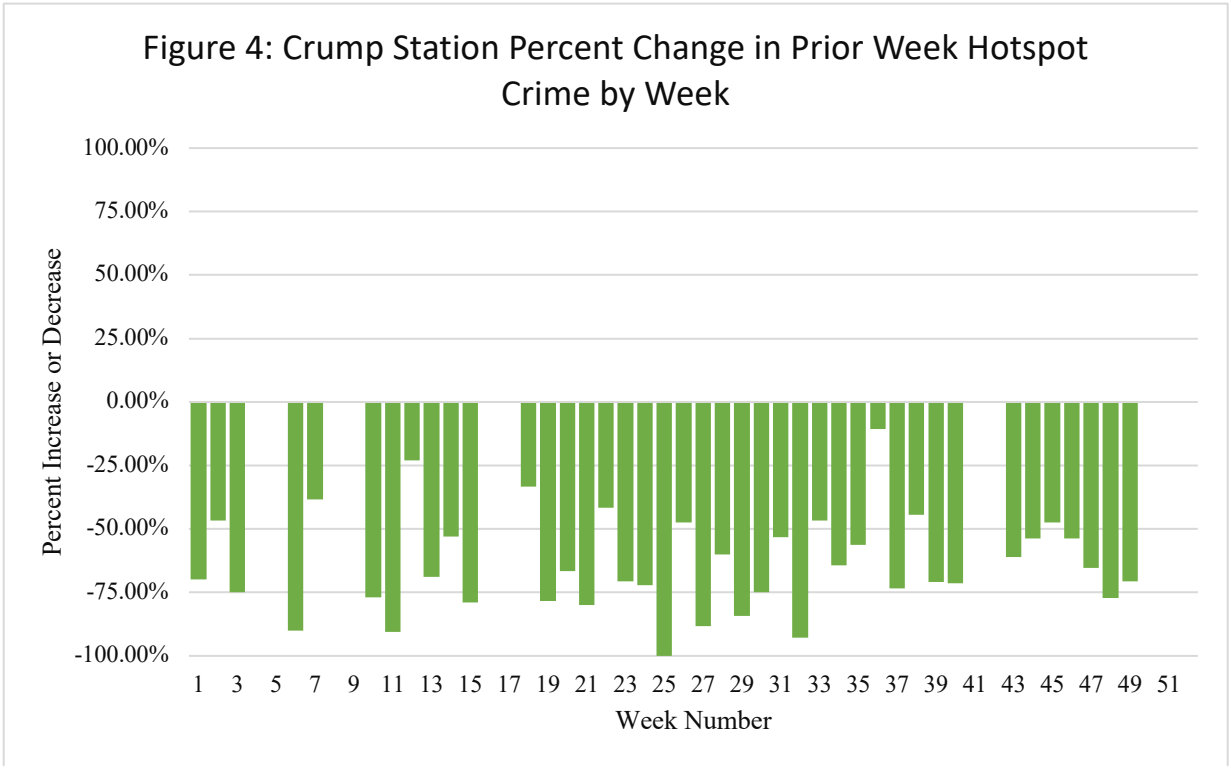

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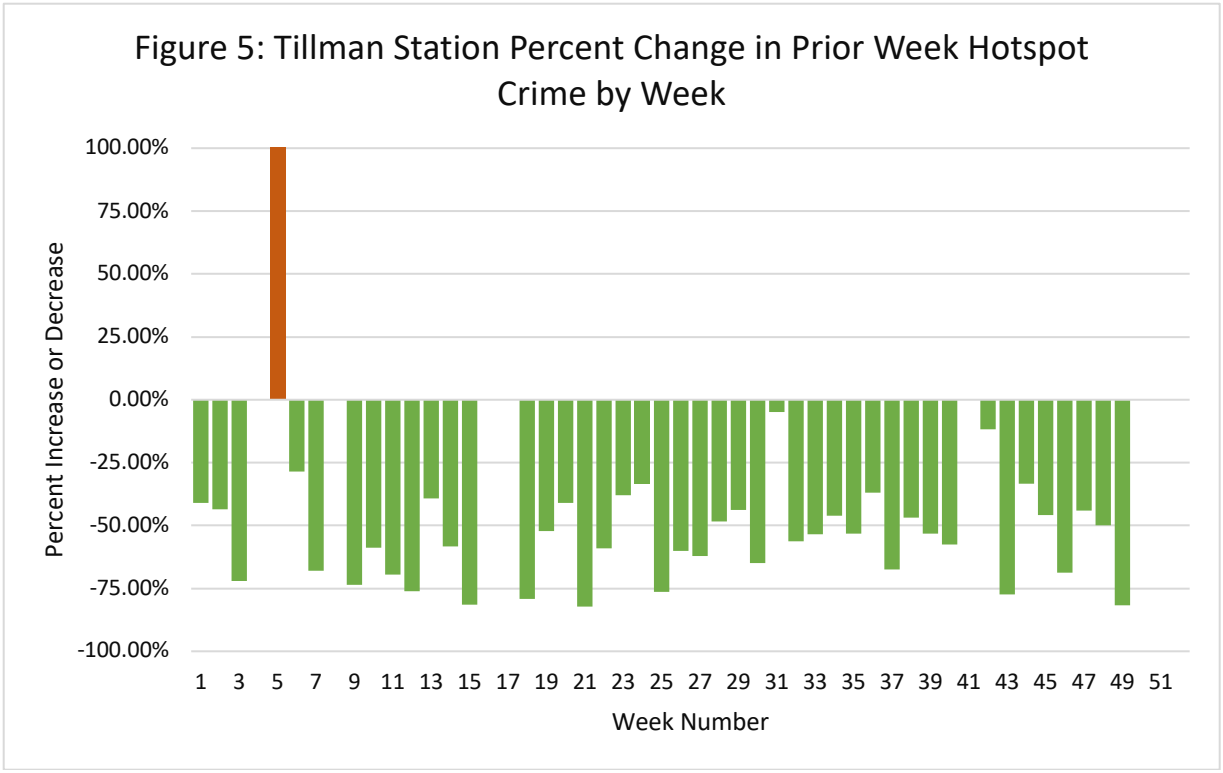

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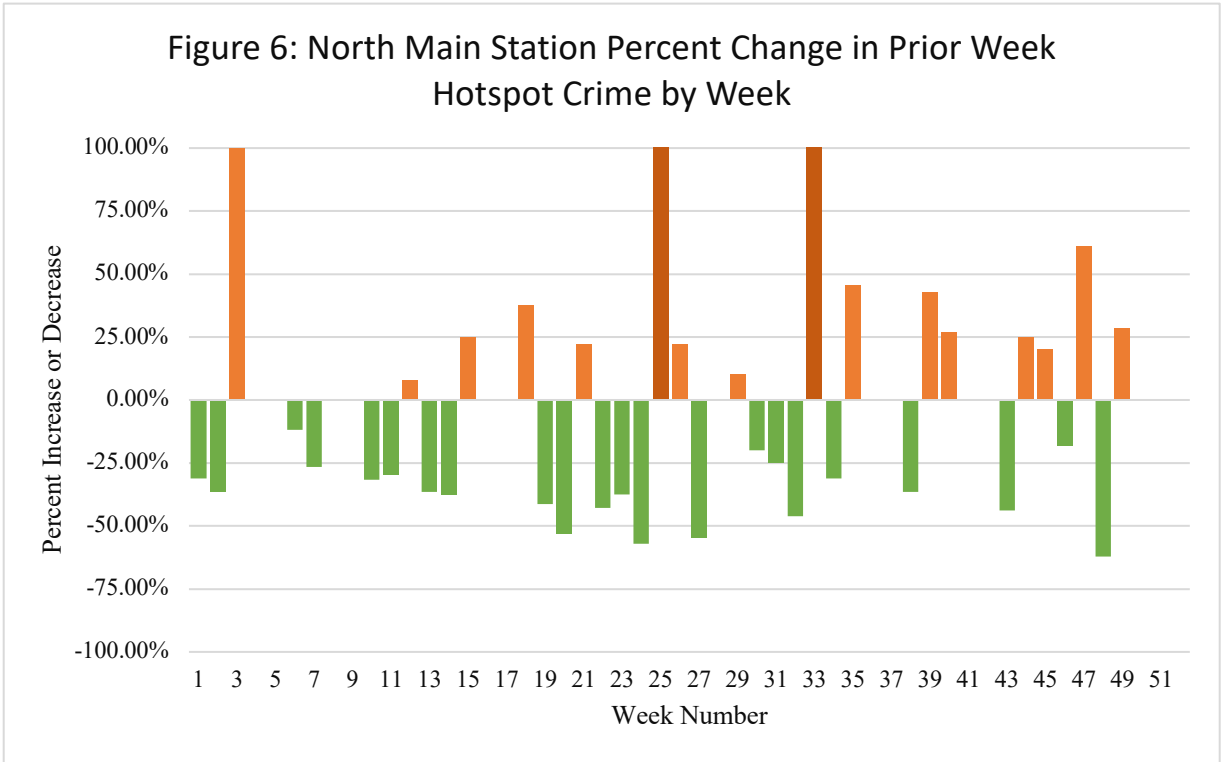

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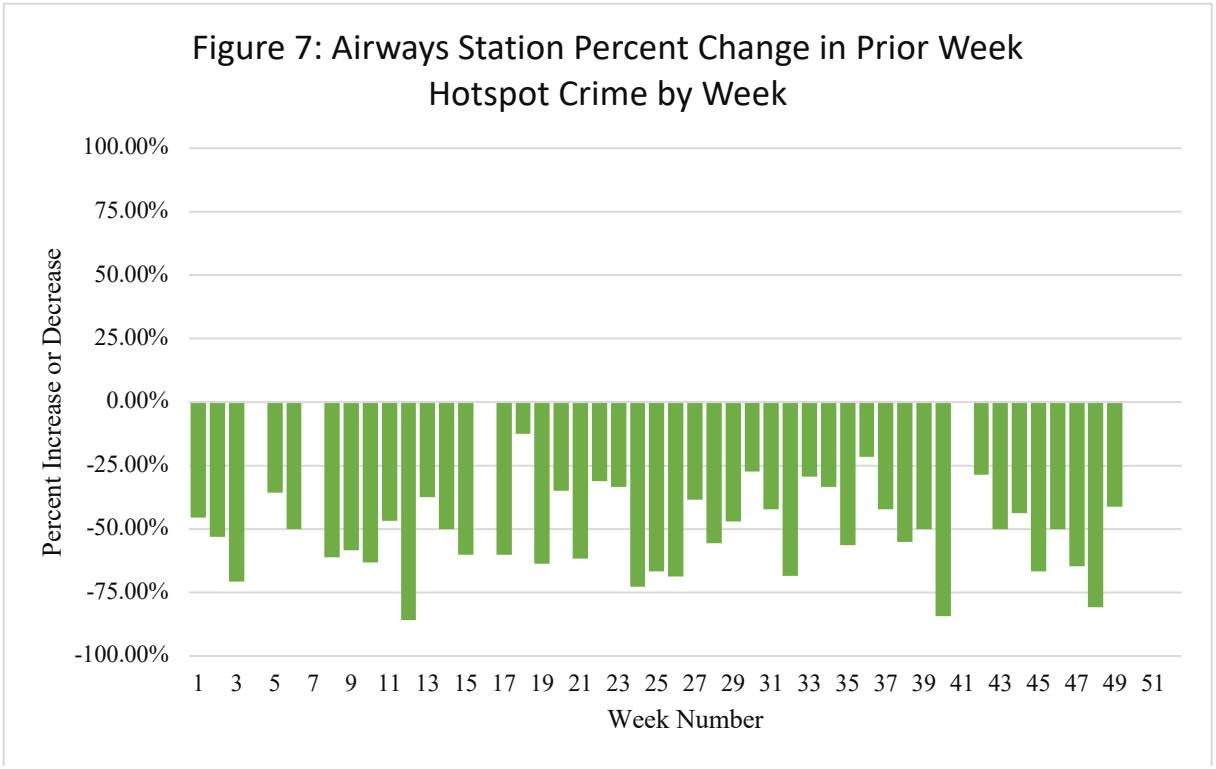
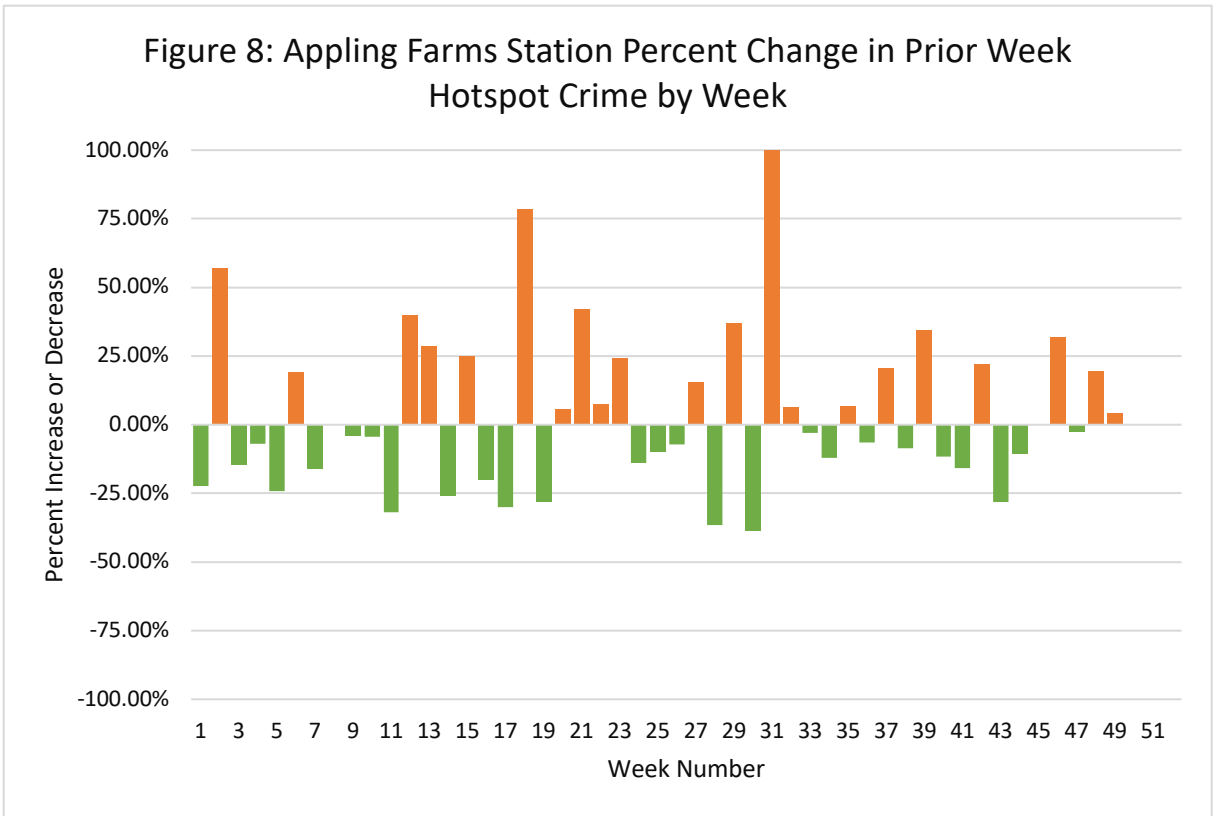


**Weeks 4, 16, 41, 50-52 are not represented.*



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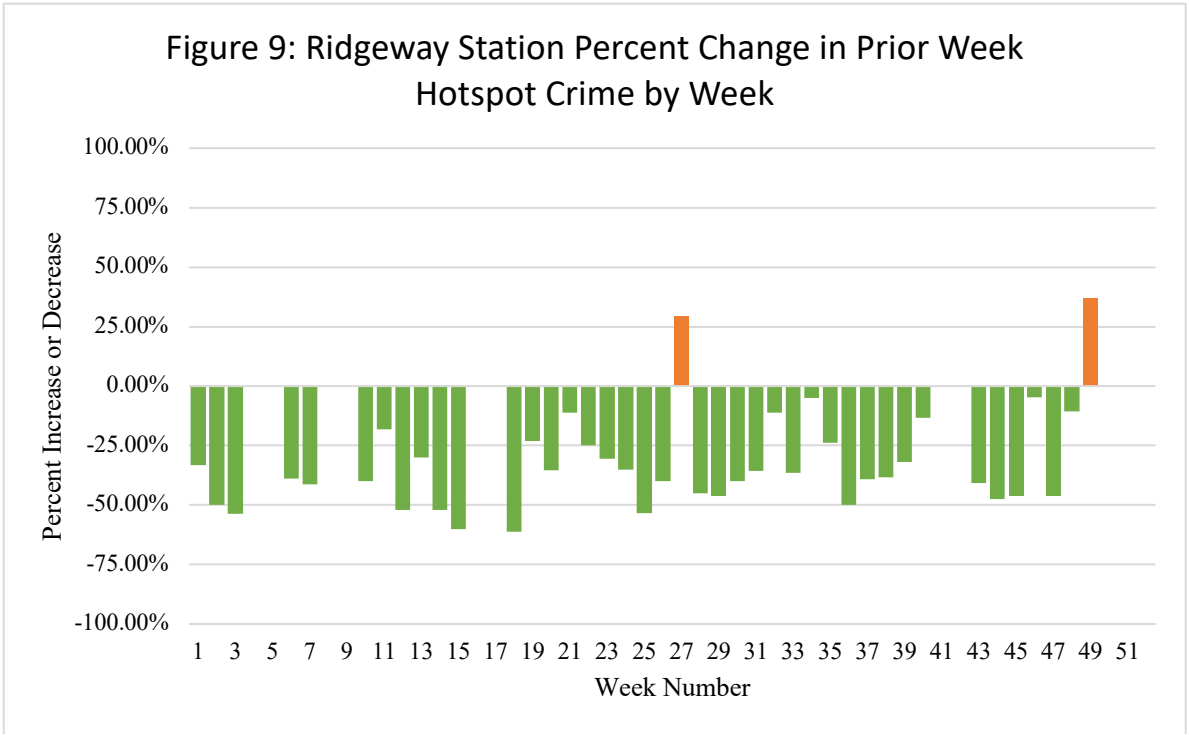

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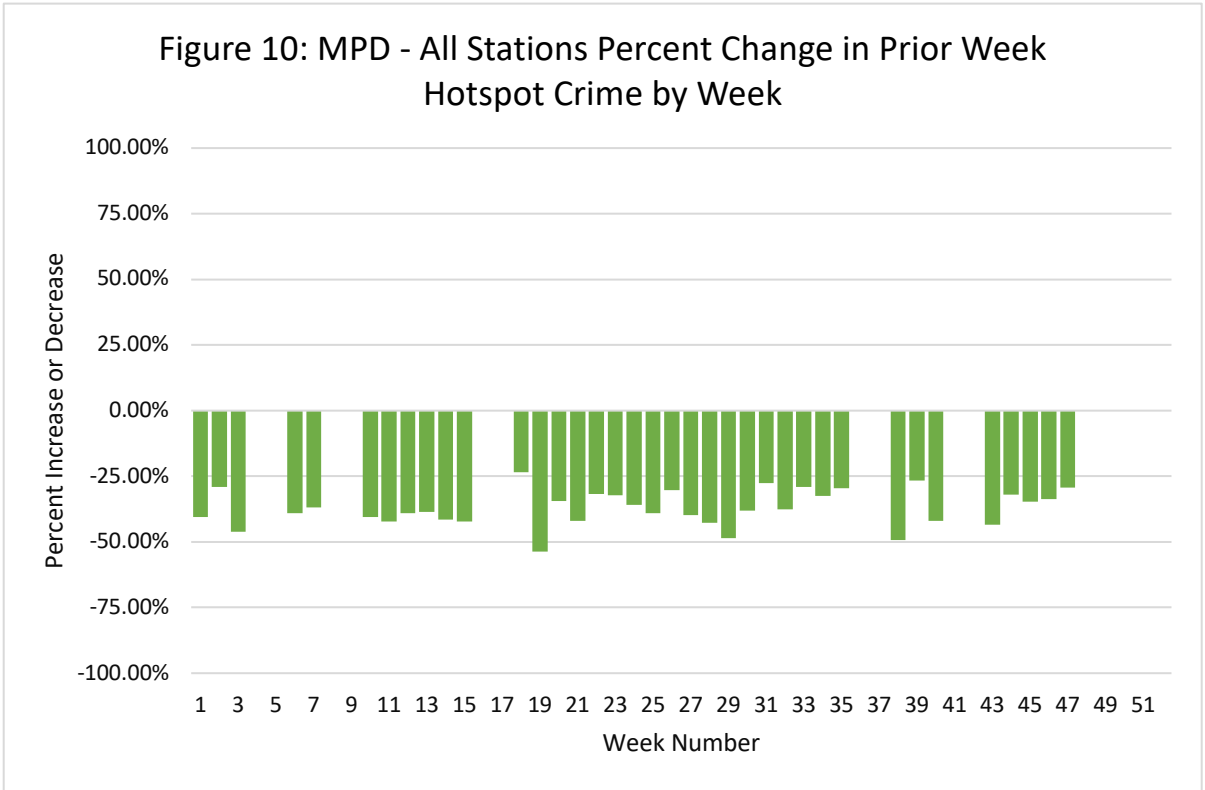


**Weeks 4, 5, 8, 9, 16, 17, 36, 37, 41, 42, 48-52 are not represented.*

Table 1 examines each precinct individually for the percentage of weeks reporting decreases and increases in hotspot crimes and the average percent change for the year. Two precincts [Austin Peay & Crump] had a decrease in crimes within their chosen hotspots for 100% of the weeks examined. Four precincts [Raines, Tillman, Airways, & Ridgeway] had decreases in crimes within their chosen hotspots for 90% or higher of the weeks examined. One precinct [Mt. Moriah] had a decrease in crimes for 82% of the weeks examined. The remaining two had decreases for 56% of the weeks [North Main] and 53% of the weeks [Appling Farms]. On average, the three highest decreases in Blue C.R.U.S.H. offenses weekly were Crump (-63.96%), Austin Peay (-60.56%), and Airways (-49.97%), which are the same three from the last assessment. However, on a yearly average, Appling Farms saw a 3.92% increase. As a whole, MPD had a decrease in crime in these hotspots every single week, and on average reduced Blue C.R.U.S.H. offenses in these hotspots by -37.16% weekly.

Table 1: Reported Blue C.R.U.S.H. Crimes - Percentage of Weeks Reporting Decrease/Increase in Hotspot Areas and Average Percent Change for Year 2020

Precinct	Number of Weeks	% Decrease	% Increase	Yearly Avg.
Austin Peay	41	100.00%	0.00%	-60.56%
Raines	41	95.12%	4.88%	-28.54%
Mt. Moriah	39	82.05%	10.26%	-35.73%
Crump	41	100.00%	0.00%	-63.96%
Tillman	44	97.73%	2.27%	-48.84%
North Main	39	56.41%	41.03%	-1.04%
Airways	46	97.83%	0.00%	-49.97%
Appling Farms	49	53.06%	42.86%	3.92%
Ridgeway	41	95.12%	4.88%	-32.40%
MPD	37	100.00%	0.00%	-37.16%

**Note - Number of Weeks represent how many weeks we have Blue C.R.U.S.H. and hotspot data. Some precincts do not equal 100% due to weeks having 0% change.*

Table 2 shows the average number of weekly Blue C.R.U.S.H. offenses within a hotspot the week that it is labeled a hotspot, the number of offenses the week after, and the average of the change from week to week. MPD saw a decrease of 76.11 crimes the week after labeling areas as hotspots. The three precincts that had the highest decrease of crimes the week after were Tillman (-14.15), Austin Peay (-13.12), and Crump (-12.10), the same three from the previous assessment. As mentioned above, Appling Farms on average saw an increase in percentage of Blue C.R.U.S.H. offenses. However, it had an average decrease of offenses weekly by -0.28 offenses.

Table 2: Weekly Average of Crimes in Hotspots & Weekly Change for 2020

Precinct	Number of Weeks	Week of Avg.	Week After Avg.	Weekly Change Avg.
Austin Peay	41	21.28	8.16	-13.12
Raines	41	35.35	25.36	-9.99
Mt. Moriah	39	23.56	13.86	-9.70
Crump	41	18.37	6.27	-12.10
Tillman	44	26.42	12.27	-14.15
North Main	39	14.64	13.00	-1.64
Airways	46	17.32	8.41	-8.91
Appling Farms	49	28.14	27.86	-0.28
Ridgeway	41	20.63	13.41	-7.22
MPD	37	203.54	127.43	-76.11

**Note - Number of Weeks represent how many weeks we have Blue C.R.U.S.H. and hotspot data.*

As shown in Table 3, compared to 2018, one precinct fell considerably below in the percent decrease, North Main (66.00% to 56.41%) which had already decreased in the last assessment (73.08% to 66.00%). Two precincts saw a sizable jump in the percent of weeks reporting a decreased, Raines (72.00% to 95.12%), and Ridgeway (86.00% to 95.12%).

Table 3: Reported Blue C.R.U.S.H. Crimes - Percentage of Weeks Reporting a Decrease in Hotspot Areas Comparison 2018 & 2020

Precinct	2018 % Decrease	2020 % Decrease
Austin Peay	98.00%	100.00%
Raines	72.00%	95.12%
Mt. Moriah	94.00%	82.05%
Crump	98.00%	100.00%
Tillman	94.00%	97.73%
North Main	66.00%	56.41%
Airways	100.00%	97.83%
Appling Farms	56.00%	53.06%
Ridgeway	86.00%	95.12%
MPD	100.00%	100.00%

**Note - In 2018 all precincts had their Blue C.R.U.S.H. PowerPoints submitted.*

When comparing the average percentage of weekly change in Blue C.R.U.S.H. offenses, several precincts saw substantial changes. Regarding improving the decrease of crimes in hotspots, the three highest improvements were Raines (10.75%), Ridgeway (9.05%), and Crump (8.90%). When it comes to lessening the decrease of crimes in theses hotspots, the three lower precincts were Mt. Moriah (-9.19%), North Main (-8.77%), and Airways (-2.83%).

Table 4: Reported Blue C.R.U.S.H. Crimes - Percentage of Weeks Average Percent Change of Blue C.R.U.S.H. Crimes in Hotspot Areas Comparison 2018 & 2020

Precinct	2018 Yearly Average	2020 Yearly Average
Austin Peay	-54.84%	-60.56%
Raines	-17.79%	-28.54%
Mt. Moriah	-44.92%	-35.73%
Crump	-55.06%	-63.96%
Tillman	-41.20%	-48.84%
North Main	-9.81%	-1.04%
Airways	-52.80%	-49.97%
Appling Farms	3.64%	3.92%
Ridgeway	-23.35%	-32.40%
MPD	-32.99%	-37.16%

**Note - In 2018 all precincts had their Blue C.R.U.S.H. PowerPoints submitted.*

Finally, in Table 5 we examine the difference between the yearly average decrease of Blue C.R.U.S.H. offenses in these hotspots. MPD as a whole saw a considerable change. In 2018 all nine precincts on average decreased Blue C.R.U.S.H. offenses by -84.78 in designated hotspots the week after, in 2020 that number jumps to decreasing these offenses by -76.11.

Table 5: Average Weekly Change of Blue C.R.U.S.H. Offenses Comparison for 2018 & 2020

Precinct	2018 Weekly Change Avg.	2020 Weekly Change Avg.
Austin Peay	-12.38	-13.12
Raines	-7.02	-9.99
Mt. Moriah	-12.06	-9.7
Crump	-12.8	-12.1
Tillman	-16.34	-14.15
North Main	-2.72	-1.64
Airways	-11.14	-8.91
Applying Farms	-1.52	-0.28
Ridgeway	-8.80	-7.22
MPD	-84.78	-76.11

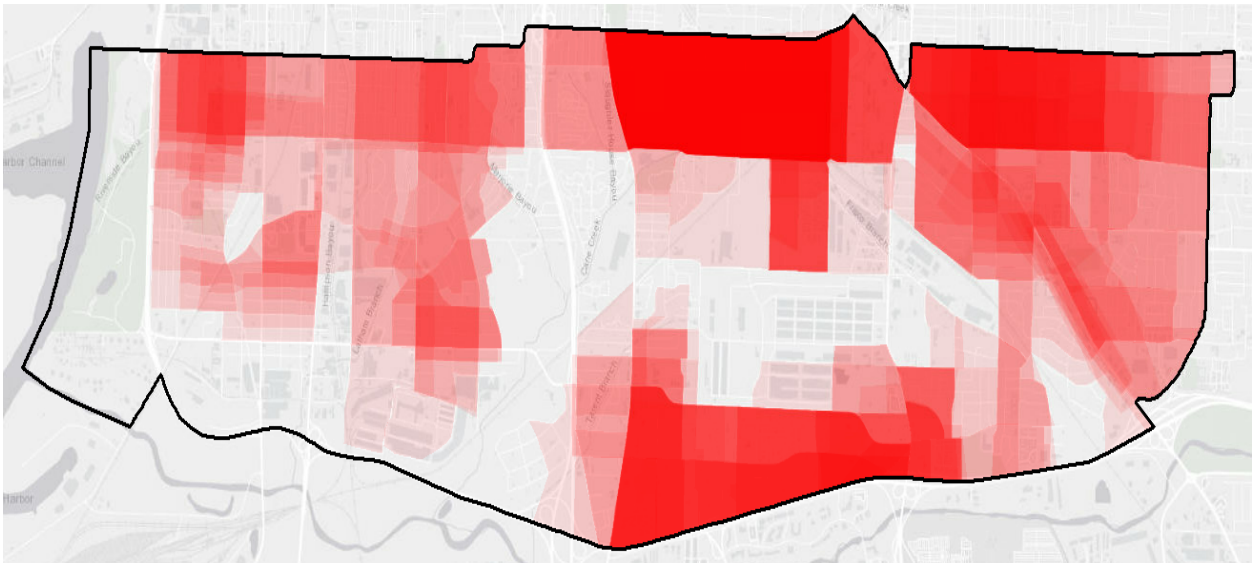
**Note - In 2018 all precincts had their Blue C.R.U.S.H. PowerPoints submitted.*

Hotspot Placement

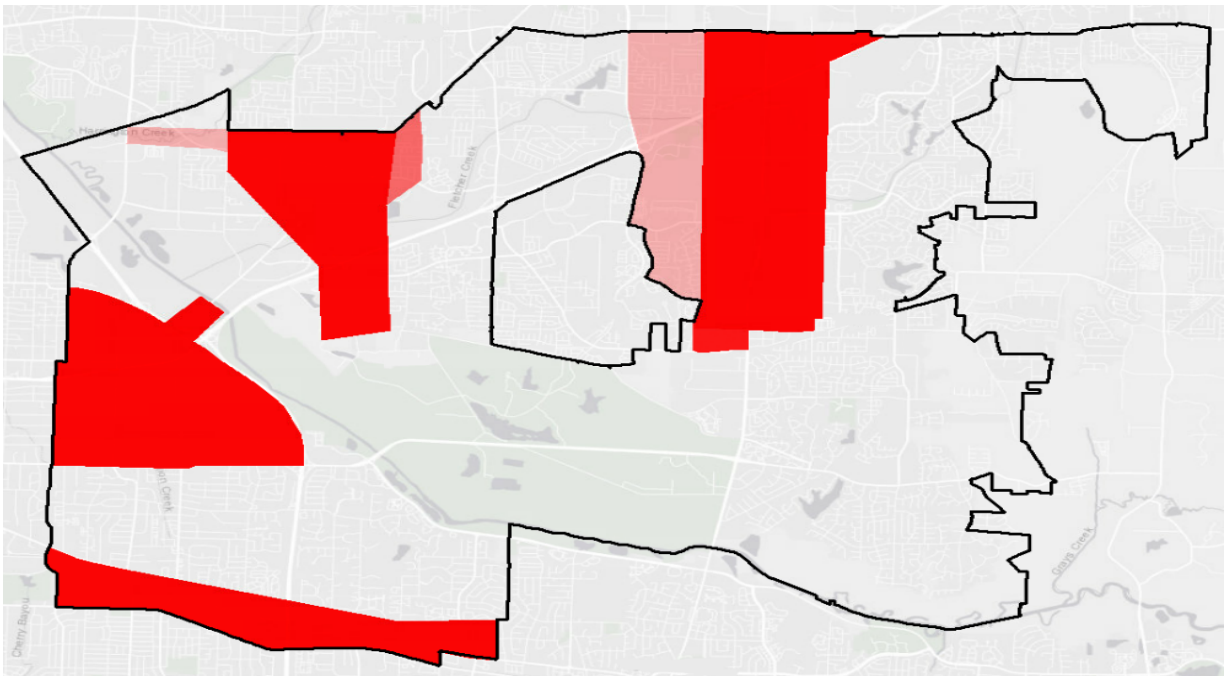
As mentioned earlier in the assessment, precinct colonels are given the ability to decide which areas are hotspots based off information given to them by the data analysts. For this assessment two precincts were chosen to compare: Airways and Appling Farms. These two were chosen since they represented the two precincts that did the best and worst based on the last assessment. Airways saw a decrease in Blue C.R.U.S.H. offenses every week after labeling an area a hotspot, while Appling Farms was chosen because it was the precinct with the lowest percentage of weeks that had a decrease in crime in 2018 (56.00%).

Graphs 1 & 2 show an overlay map of Airways [Graph 1] and Appling Farms [Graph 2] precinct hotspot locations for the 2020 calendar year. While the maps do not necessarily tell us anything about displacement of crimes, or the effectiveness of the hotspot locations, we can see that Airways, which had a decrease of Blue C.R.U.S.H. offenses every week, had hotspots that were more spread out across the entire precinct. Appling Farms, however, only focused on four primary areas throughout the year and only decreased crime slightly over half of the year.

Graph 1: Airways Precinct Overlay Map of Hotspot Locations in 2020



Graph 2: Appling Farms Precinct Overlay Map of Hotspot Locations in 2020



CONCLUSIONS AND RECOMMENDATIONS

Based on data analysis, the PSI provides the following conclusions and recommendations:

1) The data provided to the Public Safety Institute show that the precincts are having an impact in their hotspot locations. However, data were not provided for a substantial number of weeks, so a full years' worth of data could not be examined. It was impossible to examine enough data to develop any recommendations to improve the data-driven ability of the precincts.

2) As seen with Graphs 1 and 2 of the hotspot placements, it would appear that precincts which frequently move around their designated hotspots have a higher chance of decreasing crime the following week. This may be due to helping ensure that displacement does not create issues in the surrounding areas.

3) Allocation of resources based on identification of a hotspot is a reactive model to combat crime numbers. The precinct commanders examine all crimes that have happened within a four-week period. It could be beneficial if MPD used more of a predictive model in an attempt to determine where crime may happen next. Such a predictive analytics model would be a massive undertaking for MPD and the RTCC, but it could have a more significant impact on crime.

LIMITATIONS

The primary limitation of this assessment is the lack of data from the Memphis Police Department. Originally the PSI had requested calls for service, Blue C.R.U.S.H. offense data, and weekly TRAC PowerPoints for three precincts. However, all of the material was not available. Upon reaching back out to MPD, the assessment switched (in order to make data collection easier), and the only data requested were the weekly TRAC PowerPoints for all nine precincts. Only 81% of the PowerPoints for each precinct were provided. Out of the 52 weeks of the year there, were 37 weeks where all nine precincts had their Blue C.R.U.S.H. PowerPoints submitted to the PSI.

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