**GEOSPATIAL INTELLIGENCE AND REDUCING AND MITIGATING THE SPREAD OF THE
CORONAVIRUS IN MARION COUNTY INDIANA**

by
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Abstract

This Capstone report assesses real-time data and presents current concerns the city of Indianapolis is facing today with the spread of the Coronavirus. Geospatial intelligence is also incorporated to provide mitigation procedures to reduce continual spread of the virus and dispersion of vaccines. Additionally, a business plan has been designed to describe and identify procedures necessary for an organization to answer intelligence requirement questions. This project will use the intelligence cycle to properly evaluate factors to prevent, protect, mitigate, and respond to decrease the spread of the virus. Implementing the intelligence cycle will also provide a better understanding on the spread of the Coronavirus in the city of Indianapolis and surrounding counties.

Keywords: Geospatial Intelligence (GEOINT), Geographic Information Systems (GIS), Coronavirus (COVID-19), Indianapolis, Marion County.

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Introduction

Since the spring of 2020, the United States has been infected by the Coronavirus that currently has no cure. The Coronavirus is a virus that is spread from person-to-person contact. On May 1st, 2020, Indiana Governor, Eric Holcomb, initiated Stage 4 of reopening the state. Stage 4 comprises opening office buildings, cultural entertainment and tourism businesses, waterparks, amusement parks, movie theaters, and bars to 50% capacity while government buildings, retail malls, large venues, horse racing sites, and parks and playgrounds stay open to full access with no restrictions.[1] Additionally, Stage 4 includes suggesting, but not requiring, individuals to wear face masks while keeping 6-feet social distancing.

As of June 10, 2020, during Stage 4 reopening, the State of Indiana saw a total of 38,033 confirmed cases. By the end of my real-time data collection process on July 10, 2020, Indiana's total confirmed cases had increased to 49,575, roughly a 30.34% increase within a one-month time period.[2] Furthermore, the number of deaths varied day by day for the state of Indiana, yet the rate of deaths increased 17.10% also within a one-month time period.

Statewide, the number of Coronavirus tests also increased. In mid-June there were 315,390 tests and by the mid-July 542,292 tests were reported, a 71.94% increase. Interestingly, while the confirmed cases, number of deaths, and total tests increased, the number of hospitalizations decreased over time. From June 10th, 2020 to July 10th, 2020 the number of hospitalizations went from 887 to 714, a 19.50% decrease. These results in confirmed cases, number of deaths, tests, and hospitalizations in the state, required a deeper understanding about

how the Coronavirus was impacting Indiana's major city, Indianapolis, located within Marion County, and its surrounding counties.

Requirements

Identifying requirements is a critical part of GEOINT and reflects the issues and questions most important to policymakers. Specifically, intelligence requirements define questions and identify the intelligence needed that will help in answering these questions. These answers will contribute towards minimizing the risk of continual spread of the Coronavirus. Requirements will also determine if additional testing sites are needed and how distribution of vaccines will be performed when a cure to Coronavirus is created. Below are some critical questions and types of intelligence and software used.

Intelligence Requirement Questions for Marion County

1. Based on all the data collected, processed, and exploited, what can be done to change the spread of the Coronavirus in Indianapolis?

2. Where is the virus going and at what rate is the virus spreading?

3. Where are large (more than 1000) crowd events occurring and what can be done to mitigate the risk of spread at these events? Does the city of Indianapolis need crowd control mandates or orders?

4. Where are the current testing sites in the city of Indianapolis? Does the city need more? If so, where?

5. Should the city of Indianapolis mitigate large gatherings such as events at the Indianapolis 500?

6. Where is the population most densely located in Indianapolis?

7. How will the virus spread geographically once the city opens with no population limits?

8. What makes the rate of infection go up?

9. At what rate is the Coronavirus spreading in the counties surrounding Indianapolis? Does Indianapolis or these suburban counties need to limit outside travels?

10. When the city of Indianapolis receives vaccines, how will vaccines be distributed? Who needs vaccines first?

11. How do we prevent nursing homes from having another Coronavirus outbreak?

12. How do we reach communities or sub-communities that do not want to communicate with government officials? How do we better protect them from the virus?

13. How does the city of Indianapolis prevent city healthcare and local state employees from spreading the virus?

Types of Intelligence

1. Geographic Information Systems (GIS) data from Johns Hopkins University & Medicine Coronavirus Research Center for the following counties: Marion County, Hancock County,

Shelby County, Johnson County, Morgan County, Hendricks County, Boone County, and Hamilton County.

2. Satellite imagery from DigitalGlobe and Google Earth on the city of Indianapolis (Marion County).

3. Open Source Intelligence (OSINT) through social media, newspapers, and local media articles. Also, outreach to advocacy groups (Latino, homeless, substance abusers, undocumented migrants).

Types of Software

1. ArcGIS Pro

2. Microsoft Office: Word and Excel

Collection

In GEOINT an assortment of data may need to be collected to answer the intelligence requirements. GEOINT uses data from other intelligence disciplines such as Open Source Intelligence (OSINT), which was also utilized for this project. Each source applied in this project was carefully reviewed to guarantee the quality and reliability of the information. The expectation is that data from this research effort can then be applied through the intelligence cycle to offer policymakers accurate assessments to answer the requirement questions.

The Coronavirus data collection employed for this project involved gathering OSINT for both the county data and zip code data. The county data was collected in real time during a one-

month period from Johns Hopkins University & Medicine Coronavirus Research Center website. For the most up-to-date statistics, the data used was based on the information posted each day by Johns Hopkins University and sourced by the Red Cross, Definitive Healthcare, and American Community Survey experts.[3] The zip code data was also collected in real-time through SAVI. SAVI is a project of The Polis Center in the Indiana University School of Liberal Arts at Indianapolis University-Purdue University of Indianapolis (IUPUI). The data collected and used in this OSINT was from the Indiana State Department of Health and updated daily.[4] Social media was also incorporated to collect information for this project, specifically Facebook. Facebook was used to collect Coronavirus data from the Indiana Department of Homeland Security and the Indiana State Department of Health. The last OSINT collected data was obtained from local news media articles such as the Indianapolis Star and WXIN Indianapolis Fox 59 Local News.

To meet the needs of the requirements, GIS data was also gathered. The following GIS spatial data was collected from the Homeland Infrastructure Foundation-Level Data (HIFLD) database: nursing homes, hospitals, law enforcement, veterans' health medical facilities, urgent care, and schools' layers. The HIFLD database provided geospatial information collected across multiple United States government agencies.[5] Additionally, the Marion County and zip code boundary lines were retrieved from the Open Indy Data Portal. The Open Indy Data Portal is another database that offers Indianapolis data for education and governmental purposes. The information provided through this database is updated annually from the City of Indianapolis and Marion County's IndyGIS office.[6] Most importantly, the GEOINT imagery data used was collected from ESRI through ArcGIS Pro. ESRI sources are imagery maps from ESRI, but also from HERE,

Garmin, FAO, NOAA, USGS, OpenStreetMap, GIS User Community; companies that update imagery daily.[7]

Processing and Exploitation

For this project, the collected information was not obtained in a ready-to-use format. Therefore, all the information required processing and exploiting.[8] For example, after the Coronavirus data was collected, the data was organized by state, county, month, and date. Classifying data is essential for analysts to efficiently locate needed information, particularly during an emergency. Categorizing collected data ensures "that all incident GIS files are stored in the proper location within a standardized directory structure" to diminish ambiguity, promote effective workflow, and facilitate the data archival process.[9] For this Capstone project, the Coronavirus data collected in real-time was saved and organized by date in MS Excel documents; two separate folders/databases were created for county and zip code data; and the local media news' articles were saved in their own folder as a MS Word document, containing the title of the article and date. Each article had the source publication information and website link, in case back references were needed. All the GIS spatial data and imagery maps were saved into a geodatabase (.gdb) using ArcGIS PRO, and feature class and tables were labeled with a name and date.

It is important to note that the data used was 'unfiltered' and thus needed to be exploited. In other words, collected data had to be cleaned and translated for the ArcGIS Pro program to read the data for the analysis and production phase. For example, the county Coronavirus data

collected from the Johns Hopkins University website did not provide an easy downloadable spreadsheet. This data was collected from the website and transferred to an excel spreadsheet. From here, the data was organized to make it readable when being used in ArcGIS PRO and saved in a comma-separated values (.csv) file. The same was completed for the zip code data. The collected imagery was exploited by reviewing the images; and a review determined if the images correctly displayed Marion county and surrounding counties. Exploiting the images also determined if there were any energy interactions disrupting the images. Energy interactions include atmospheric scattering and absorption, more specifically, Rayleigh scatter, Mie scatter, or nonselective scatter.[10]

Analysis and Production

After cleaning and organizing the collected raw intelligence, the analysis and production phase of the intelligence cycle usually begins. But, prior to analyzing the spread of the Coronavirus in Indianapolis, the collected data was sorted and entered into ArcGIS Pro to produce visual representations of the data or maps. Satellite imagery assisted in visually depicting geographical activities and physical features in Marion County. These maps and satellite imagery helped describe the spatial analysis in preparation of disseminating methods to prevent, protect, mitigate, and respond to decrease the spread of the virus. The following analysis began with Marion County itself, continued with a closer look at Marion County by zip codes and finalized with an analysis of counties that surround Marion County.

Marion County

The city of Indianapolis was given the nickname "Crossroads of America" in 1937 because of multiple major highways connecting the city to the United States. Since then the population in Marion County continued to grow. According to the Data USA, "between 2017 and 2018 the population of Marion County, IN grew from 950,082 to 954,670, a 0.483% increase".[11] In 2019, the population within Marion County was approximately 964,582, living in a total of 426,024 housing units, and population per square mile of 2,279.6 and expected to continue to grow.[12] Marion county has 396.30 square miles of land, allowing this flourishing County to hold many events for its population and out-of-town visitors. Every year in May only, Marion County hosts the Broad Ripple Art Fair, Grand Prix of Indianapolis, Miller Lite Carb Day, Indianapolis 500, Indian Market & Festival, Indiana Black Expo, Brickyard 400, Indiana State Fair, and the Red Bull Indianapolis GP (See Figure 1 for 2020-2021 Events).

Event	Date	Average Crowd Count
Broad Ripple Art Fair	2021	16,000
Grand Prix of Indianapolis	July 4, 2020 (no spectators)	35,000
Miller Lite Carb Day	August 21, 2020	N/A
Indianapolis 500	August 23, 2020	300,000
Indian Market & Festival	2021	N/A
Indiana Black Expo	Canceled	300,000
Brickyard 400	July 5, 2020 (no spectators)	60,000
Indiana State Fair	August 7-23, 2020	879,000
Red Bull Indianapolis GP	October 2, 2020	215,850

Figure 1: Broad Ripple Art Fair, Grand Prix of Indianapolis, Indianapolis 500, Indian Market & Festival, Indiana Black Expo, Brickyard 400, Indiana State Fair, and the Red Bull Indianapolis GP.

Although the Broad Ripple Art Fair and the Indian Market & Festival have been postponed, some large crowd events are still scheduled in the next coming months. Five of the nine events

listed will take place at the Indianapolis Motor Speedway. These decisions were made without a full sense of the spread of the virus. Beginning on June 10th, 2020 through July 10th, 2020, Marion County had a total of 887 new cases. At the end of the data collection, July 10th, 2020, Marion County had a total of 11,812 confirmed cases with 1,237.29 cases per 100,000 population. With the increase in new Coronavirus cases, the death count increased by 9.52%, a total of 690 deaths by July 10th giving Marion County a 5.84% fatality rate.[13] As the Coronavirus continues to increase, postponing these large crowd events is in the best interest of the community.

Marion County by Zip Code

The number of confirmed cases was collected for each zip code in Marion County on four separate dates. This is demonstrated in *Comparison of Confirmed Coronavirus Cases* (Figure 2). Comparing each date, displays the geographic spread of the virus since the city opened in May 2020. For example, comparing June 29th and July 1st maps, the zip codes 46240 (North) and 46217 (South) increased in new case counts. However, from July 1st to July 7th, the same two zip codes decreased in new case counts. The following day, July 8th, the number of confirmed cases jumped again (increasing) within the same two zip codes, 46240 and 46217. A point to highlight is that zip codes surrounding these areas also increased in confirmed Coronavirus case counts, specifically zip codes 46250 and 46205.

Comparison of Confirmed Coronavirus Cases

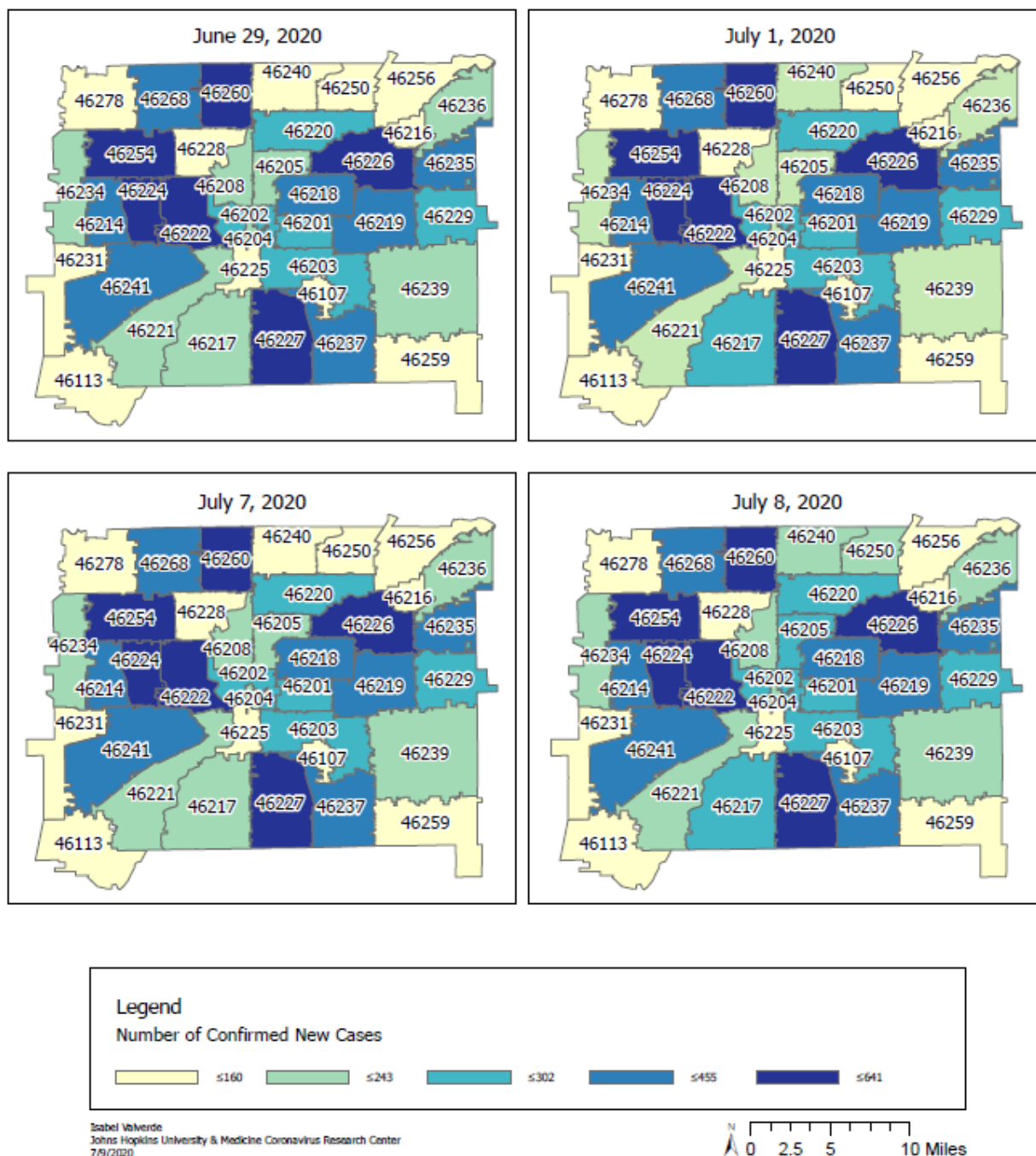## Count by Zip Code in Marion County

Figure 2: Map of the comparison of confirmed coronavirus cases.

The data from the previous map was used to run a hotspot analysis, using ArcGIS PRO; the *Comparison of Coronavirus Hotspot Locations* (Figure 3) shows significant areas where high

Figure 3: Map of the comparison of coronavirus hotspot locations.

clustering of Coronavirus new case counts occurred. This demonstrates the direction where the Coronavirus is moving and an area where the spread is significant.

After running the hotspot analysis for each of the four mentioned days, the zip code data was collected; the output included the same zip code areas, 46208, 46214, 46224, 46228, 46234, and 46254. These zip codes were the focus areas of interest for this report. *Comparison of Demographics* (Figure 4) compares Marion County's hotspot areas to demographics whereas the Population map shows that the center of the hotspot areas, 46254 and 46224, has the highest population spread (Figure 4, map 1). However, only zip code 46224 has both high population and population density.

Viewing the Population Density Map (Figure 4, map 2), a clear distinction can be made about the population density: zip codes 46214, 46224, and 46208 have higher population density per 100,000. It should be emphasized that zip code 26214 has a 90% hotspot confidence level and high population density. Reviewing the Housing Unit (Figure 4, map 3), within the hotspot areas, there is only one zip code with high housing unit counts, zip code 46254. This is the largest zip code within the hotspot area. Therefore, the more land in the larger zip code areas leaves room for more housing developments. The larger area also contributes as to why zip code 46254, with highest housing units, has low population density, with more area between and among housing developments. In addition, the Unemployment map (Figure 4, map 4) reveals that in the hotspot area of new Coronavirus case counts, unemployment is low. This is an interesting find, because if new case count is high in these zip codes but unemployment is low, the employed individuals who live in these areas must travel for work, have occupations that involve contact with other individuals, or cannot practice social distancing as much as the unemployed.

Therefore, within the hotspot zip code locations, population density and unemployment rates

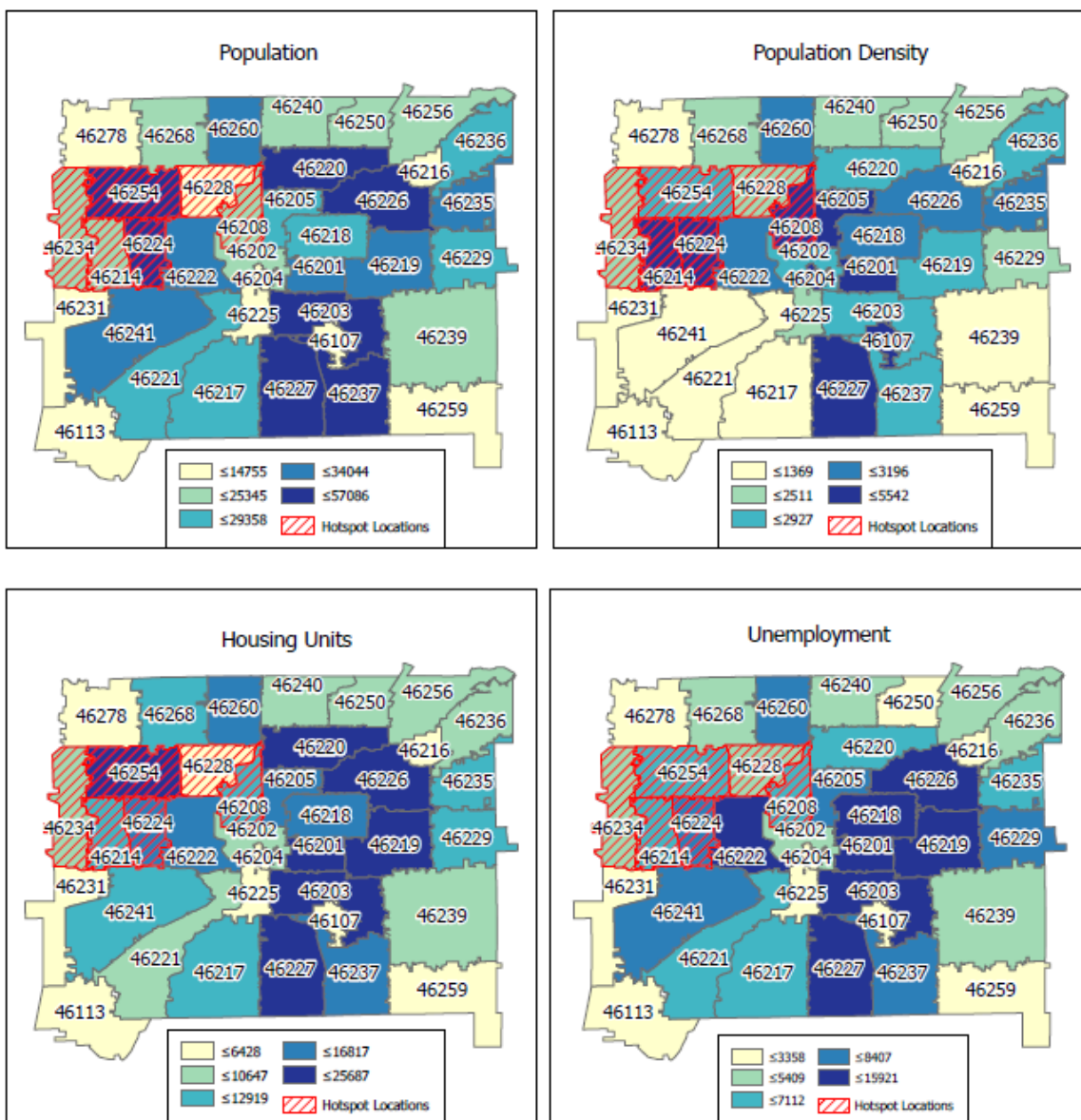may contribute to the increase in the rate of growth.

Figure 4: Maps of the comparison of demographics within Marion County. Map 1 Population, Map 2 Population density, Map 3 Housing Units, and Map 4 Unemployment.

The findings from the *Comparison of Demographics* map (Figure 4) are significant as these zip codes surround Marion County's most popular and largest event location, the Indianapolis Motor Speedway. Figure 5 demonstrates the proximity of the Indianapolis Motor Speedway (right) to Marion County's hotspot zip code areas. As mentioned previously, the Indianapolis Motor Speedway will host five large crowd events during this pandemic. The Grand Prix of Indianapolis, Miller Lite Carb Day, Indianapolis 500, Brickyard 400, and the Red Bull Indianapolis GP.
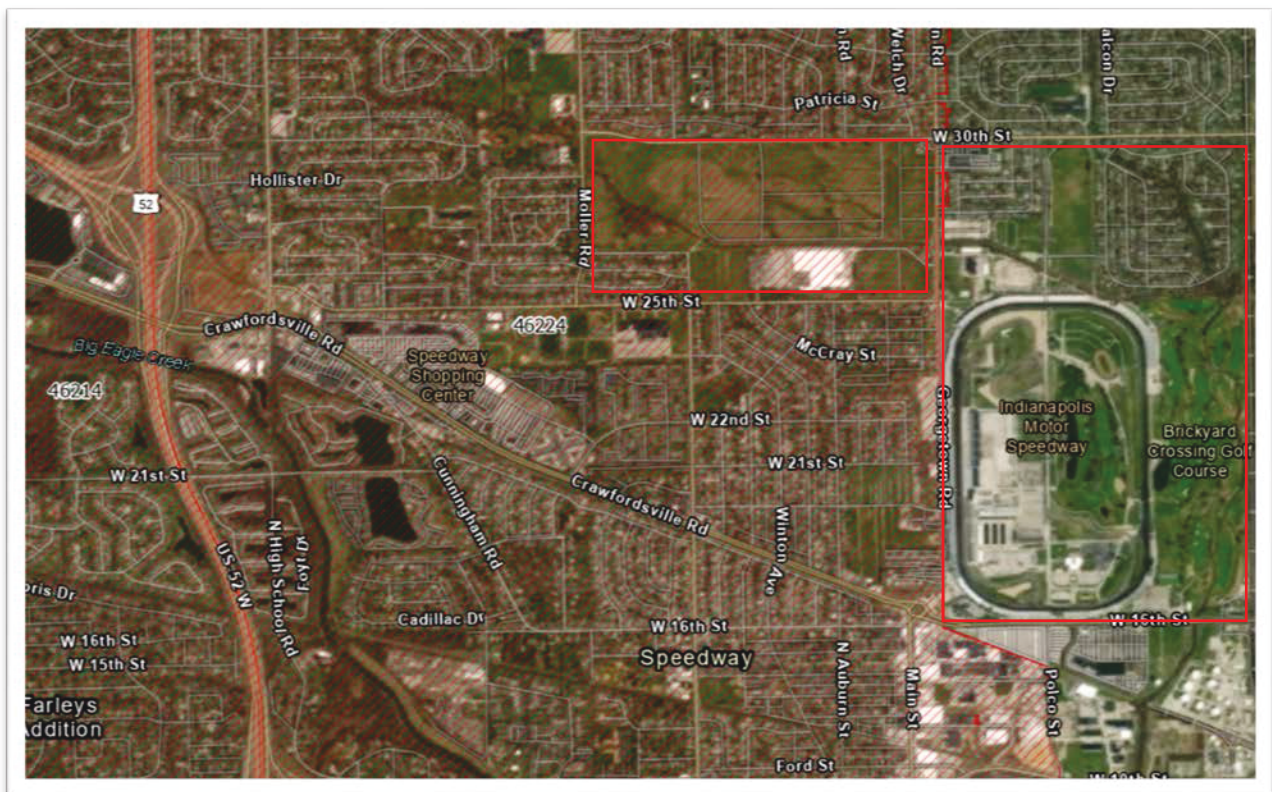

Figure 5: ESRI, HERE, Garmin, FAO, NOAA, USGS, OpenStreetMap, GIS User Community.

As of July 22, only one event will continue at 50% capacity, the Indianapolis 500. Though Marion County has decided to run all Motor Speedway events, Marion County will have to

consider that individuals will 1) be coming out of state, 2) visiting tourist destinations, restaurants, and malls, and 3) occupying hotels that will increase the spread of the Coronavirus. Additionally, Marion County will have to direct everyone attending these spectator events to wear masks, wash hands, and maintain social distancing as recommended by the Centers of Disease Control and Prevention (CDC) to avoid exposure and prevent increased spread of COVID-19.

As for other large crowd events, the Broad Ripple Art Fair (Figure 6, 1 acre) and the Indian Market & Festival (Figure 7, 14 acres) have been postponed until 2021. Geographically, comparing the Indianapolis Motor Speedway (560 acres) to the Broad Ripple Art Fair and the Indian Market & Festival, the Motor Speedway has more land to population ratio. The Broad Ripple Art Fair and the Indian Market & Festival both have less land to population ratio. As a result, these events take place in smaller and more confined areas that would potentially limit individuals from adhering to social distancing.

Figure 6: ESRI, HERE, Garmin, FAO, NOAA, USGS, OpenStreetMap, GIS User Community.
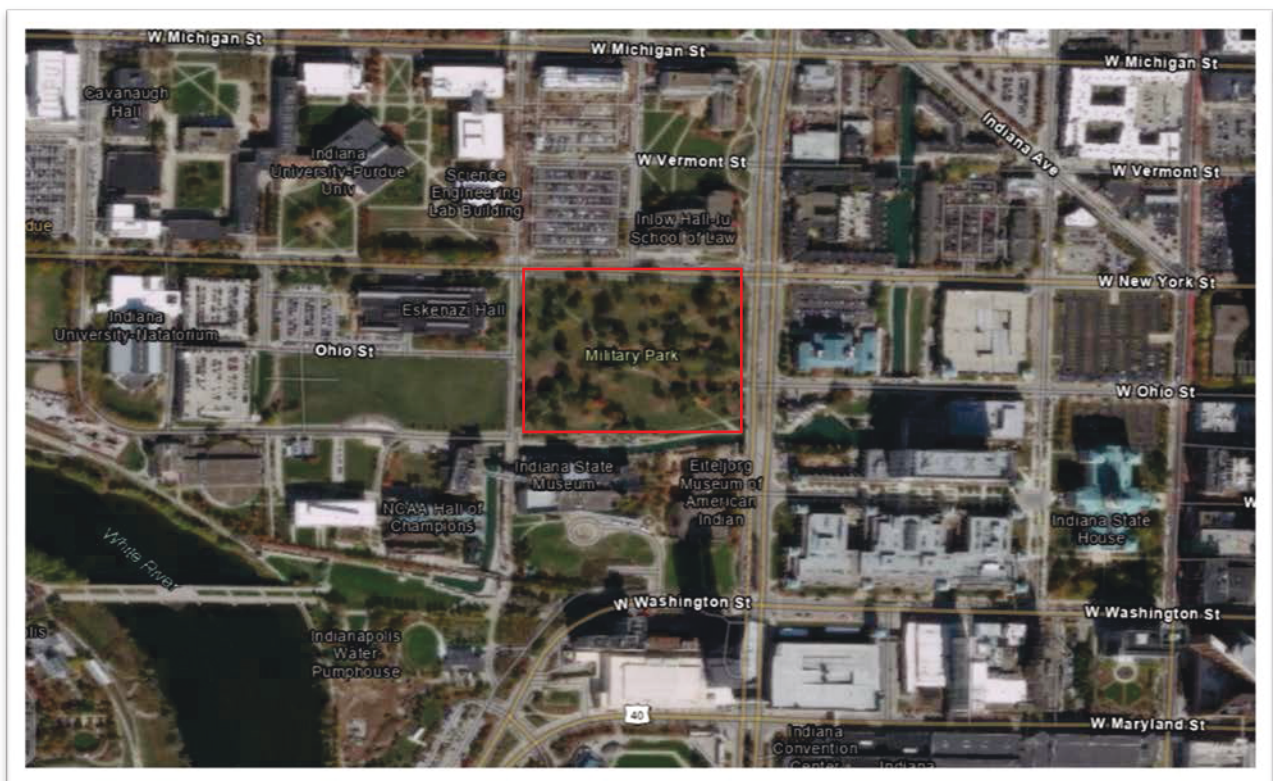

Figure 1: ESRI, HERE, Garmin, FAO, NOAA, USGS, OpenStreetMap, GIS User Community.

The last large crowd event for Indianapolis in 2020 will be the Indiana State Fair. This event covers 250 acres and on average draws 890,000 people during the 2.5 week-long event. Due to the increasing new Coronavirus case count and the lack of participation from worldwide vendors, the Indiana State Fair canceled all events, except the Indiana State Fair 4-H Livestock Competition & 4-H Project Showcase.[14] However, the presence of these two events at the Indiana State Fair Grounds could potentially increase the number of Coronavirus cases and increase spread throughout new metropolitan areas. This is because the Indiana State Fair Grounds are close to the hotspots located in my analysis (Figure 8).
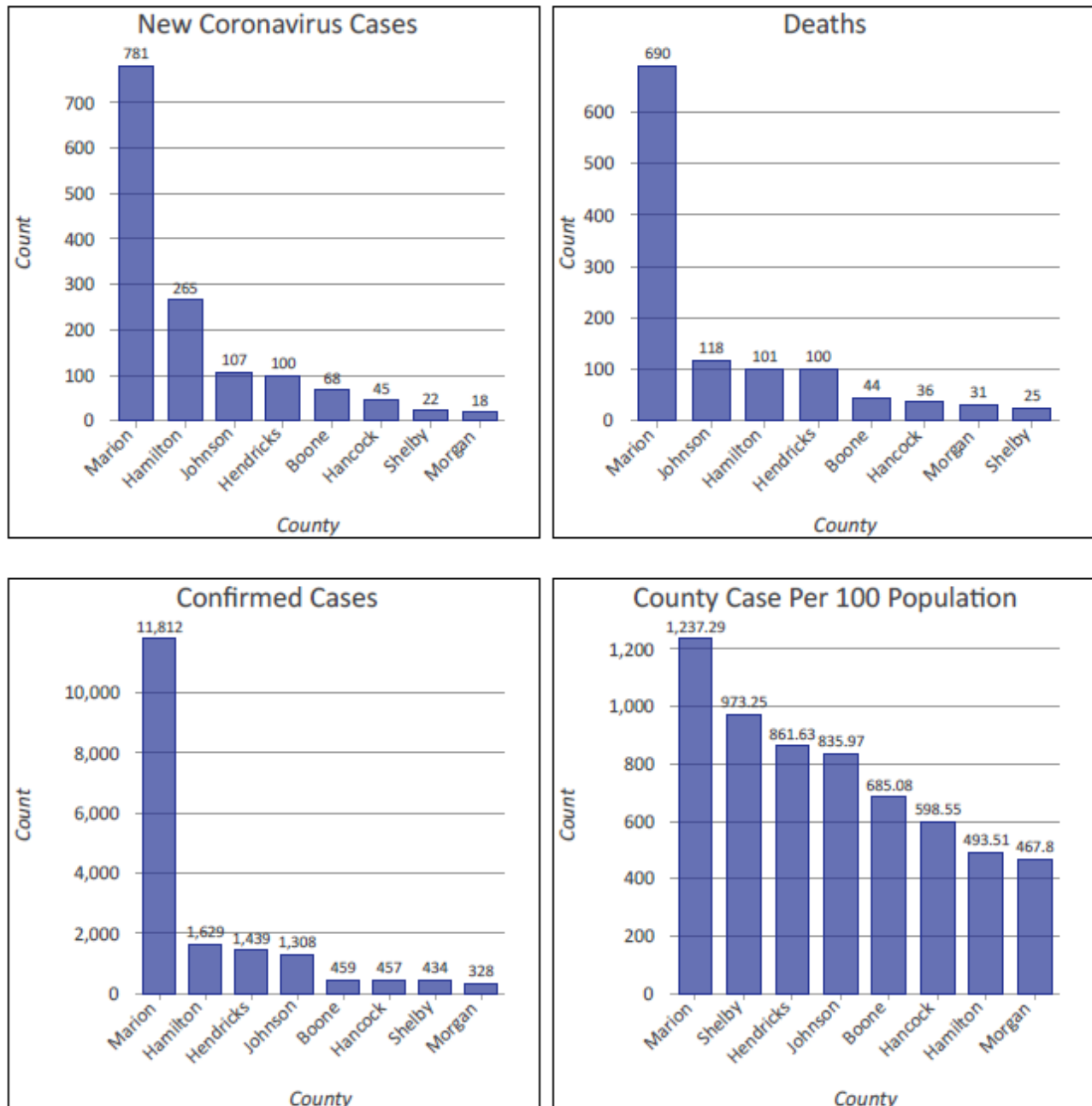

Figure 8: ESRI, HERE, Garmin, FAO, NOAA, USGS, OpenStreetMap, GIS User Community.

Surrounding Counties

The surrounding counties also affect the spread of Coronavirus within Marion County. Many people who work within metropolitan Indianapolis, however, live outside of the city. In a comparison among the surrounding counties and Marion County, the latter has far more new cases, number of deaths, total confirmed cases, and cases per 100,000 population count than its surrounding counties. This is demonstrated in the *Comparison of Coronavirus Data* graphs (Figure 9). However, comparing all surrounding counties shows which counties have the highest new case counts, deaths, confirmed cases, and cases per population of 100,000. The comparison shows that Hamilton, Hendricks, and Johnson counties have been impacted by the Coronavirus. As of July 10, 2020, these counties have nearly double the new cases, deaths, and confirmed cases than the other surrounding counties.

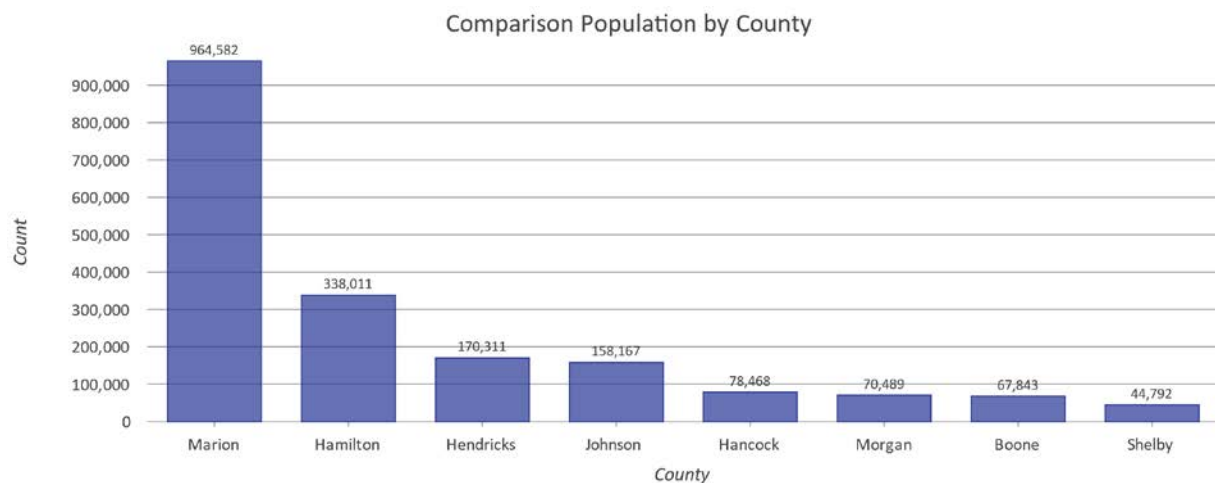# Comparison of Coronavirus Data

Data Collected From 6/10/2020 to 7/10/2020

Figure 9: Map of the comparison of Coronavirus data by county. The data was collected from June 10, 2020 – July 10, 2020. Data was collected periodically not daily.

Furthermore, demographically, Hamilton, Hendricks, and Johnson counties also have high population. This is demonstrated in the *Comparison Population by County* graph (Figure 10). However, geographically, these counties are not rural areas such as Hancock, Morgan, Boone, and Shelby counties. Therefore, Hamilton, Hendricks, and Johnson counties should –with Marion county– reduce in the future the spread of the Coronavirus (Figure 10).

Comparison Population by County

County	Count
Marion	964,582
Hamilton	338,011
Hendricks	170,311
Johnson	158,167
Hancock	78,468
Morgan	70,489
Boone	67,843
Shelby	44,792

Figure 10: United States Census Bureau.

Geospatial Intelligence and Mitigation

Just recently, July 18, 2020, due to the unfortunate increase of new case counts and deaths, Indiana Governor Eric Holcomb made the decision to keep Indiana in Stage 4 of its reopening stages. In Indianapolis, Mayor Joe Hogsett also increased the Coronavirus tests and mandated everyone in Marion County to wear masks. As a result, "dozens of people rallied in Indianapolis on Sunday to stop what they call an overreach in Indiana—being required to wear masks to help stop the spread of COVID-19".[15] Everyday Marion County is faced with needing to protect people from the Coronavirus. However, many individuals feel the government should not control every aspect of their lives. Therefore, reducing the spread of the Coronavirus is not only

about collecting and analyzing Coronavirus data, it also involves considering how the people of Indianapolis will react to Coronavirus mandates during large crowd events and city mitigation.

The purpose of mitigation procedures is to reduce the continual spread of the virus and dispersion of vaccines as they become available. These measures can be made more effective if they are informed by geospatial intelligence. It is vital that the government, healthcare providers, and community members are each a part of the mitigation to reduce the spread of the Coronavirus and the dispersion of vaccines. The first step in reducing the spread of the Coronavirus is reducing large crowd events; more specifically, the frequency that Marion County holds sizeable crowd events. It is evident that the Indianapolis Motor Speedway is a major economic source for Marion County. However, the Indianapolis Motor Speedway not only brings large crowds from around the world, it is located in Marion County's current Coronavirus hotspot area. Events such as this should be spaced out. As it stands, the Indianapolis Motor Speedway will host events on August 21st and 23rd with another in October. GEOINT indicates that the events in August (the Indianapolis 500 and Miller Lite Carb Day) ought to provide the public with strict protective measures along with public awareness of the current Coronavirus spread within Marion County:

- Crowds must continue to practice 6-feet of social distancing inside the speedway. Therefore, markers should be placed at all open entrances, food stations, and restrooms.
- Infographics should be posted throughout the speedway implementing social distancing and promoting personal hygiene.
- The Indianapolis Motor Speedway should provide additional face masks and hand sanitizers.

- All hygiene areas in restrooms should be marked (soaps, sinks, and disinfection supplies).

- All individuals –employees and crowds– should have their temperatures taken, anyone showing signs of high fever should not be allowed inside the speedway.

- A waiver should be signed that all individuals attending speedway events will practice strict measures to prevent the spread of the virus. Additionally, individuals should also be informed of the risk they can be exposed to by visiting Marion County's hotspot areas.

- Individuals should be stamped on hand to inform local surrounding entertainment stores that such individual has been an Indianapolis hotspot area of the virus.

- Crowd capacity should be decreased to 25% crowd capacity.

- The number of event participants and employees to occupy a restroom should be limited to allow social distancing.

- The Indianapolis Motor Speedway should not add additional restroom locations such as protopodites.

- There should be close access to all water fountains inside the Indianapolis Motor Speedway.

The second mitigation step is to improve sanitation practices in critical infrastructures within the Marion County hotspot zip codes. The infrastructure believed to be most impacted include special needs and community lifeline infrastructures. For example, nursing homes, hospitals, law enforcement departments, veterans' health administration medical facilities, urgent care, private schools, public schools, colleges, and universities. These infrastructures see

the most person-to-person traffic, consequently, it is essential to kill the virus in these areas to prevent spread. In the Marion County hotspot areas, there are a total of 92 special needs and lifeline infrastructures (Figure 11).
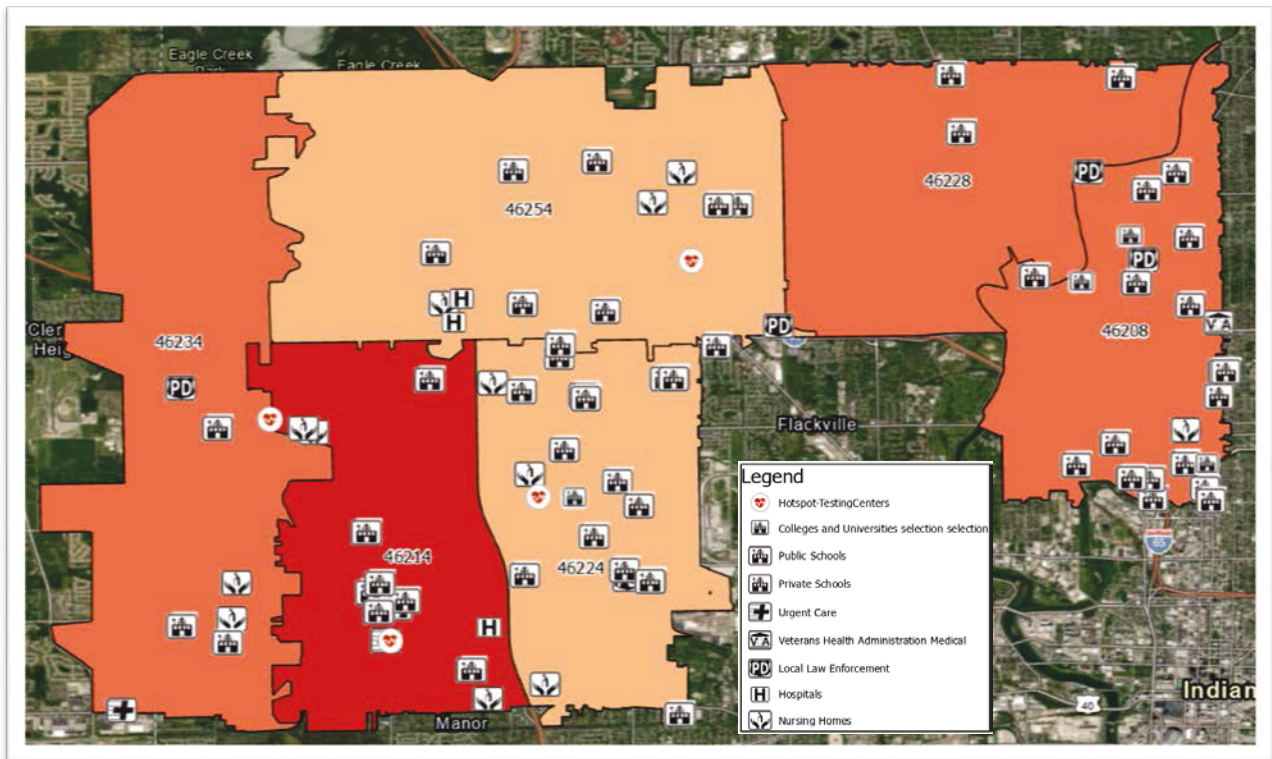
Figure 11: ESRI, HERE, Garmin, FAO, NOAA, USGS, OpenStreetMap, GIS User Community, Homeland Infrastructure Foundation-Level Data (HIFLD).

To reduce the spread of each special needs and lifeline infrastructures, strict disinfection, cleaning, and social distancing techniques should be as followed:

- Daily cleaning with soap and water by employees will reduce the risk of the virus.

- Use of disinfectants that are no less than 60% alcohol.

- Cleaners should wear long sleeves and eye protection during cleaning process,

- Employees should wear face masks, practice social distancing, have temperature tested before starting shifts, and carry hand sanitizer.
- Only permit employees and patients to enter infrastructures. No visitors at the hotspot locations.

The Third mitigation step in reducing the spread of the virus is to monitor Hamilton, Hendricks, and Johnson counties. Marion County should determine the number of individuals traveling between counties. Monitoring of individuals who visit from Hamilton, Hendricks, and Johnson counties can be completed by the IMPD Homeland Security Bureau highway surveillance system. The IMPD Homeland Security Bureau department has access to all highway cameras, and all Indiana license plates have county names. Monitoring surveillance cameras and license plates daily would provide a sense of incoming and outgoing traffic.

The fourth mitigation step to reduce the spread of virus is to increase testing centers within the hotspot areas and all of Marion County. Currently, only 14.81% of Marion Counties testing centers are located in the critical hotspot areas. Therefore, analysis indicates that the city of Indianapolis, should add 2 testing areas within each hotspot zip code. An overview of all testing centers in Marion County indicates that there are currently 27 testing sites (Figure 11).[16] Figure 11 displays areas where Marion County's zip codes do not even have one testing center. These areas are lighter in color and see fewer new case counts. However, a good reason why these areas have fewer new case counts, is because they do not have access to close testing centers. Therefore, geospatial analysis indicates that it is essential to get at least one testing center within

each zip code of Marion County. Allowing more testing centers access could provide a better understanding of the spread of the Coronavirus in these areas and surrounding areas.
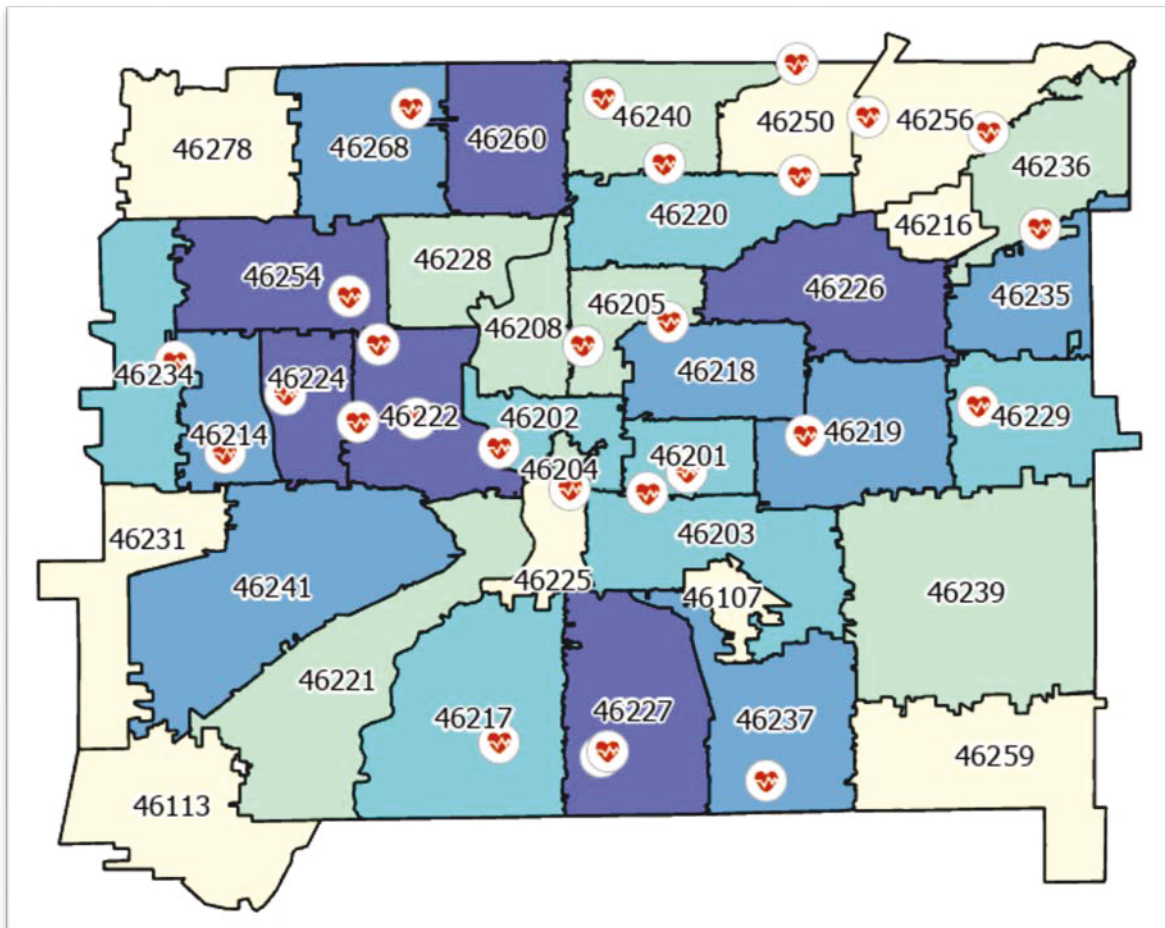
Figure 11: Indiana State Department of Health.

The fifth mitigation step to reach out to individuals is through social media and crowdsourcing technology. Social media is a platform that almost all have access to, and for analytic purposes, it is geospatially registered. In particular, social media can reach persons who do not trust to provide information or reach out to government officials for help. Social media is a great source to publicize information on testing and vaccine information still needs to get out

to these entities. The majority of these individuals within Marion County includes Spanish speaking communities. Many Spanish-speaking communities seem to trust more their local churches rather than government officials. Therefore, in order to properly reach out to these communities without involving the government officials but also ensure Marion County protects everyone, church administrators must reach out through social media. Local Marion County churches can also post public health announcements and hold testing site at church locations periodically. This would allow members of the community to be more comfortable in getting the help and information needed to reduce the spread of the Coronavirus. Furthermore, crowdsourcing applications should also be shared with church administrators. Crowdsourcing applications can allow users, such as Marion County Spanish-speaking community, to provide data to Marion County anonymously. This will provide a deeper understanding as to how the virus is spreading within anonymous communities. The social media church outreach and crowdsourcing applications can also be used within the homeless and criminal groupings in Marion County.

Dissemination and Consumption

After completing the analysis of Marion county and surrounding counties data, it is clear that Marion County has been affected by the Coronavirus. As it continues to spread, dissemination of geospatial information is critical to properly evaluate factors to prevent, protect, mitigate, and respond to decrease the spread of the virus. Dissemination of geospatial reports should provide policymakers with a better understanding on the current spread of the

Coronavirus in the city of Indianapolis and surrounding counties. Current, estimative, and warning intelligence should be disseminated to specific parties, depending on the need for information. Current intelligence should be shared daily with the Indianapolis Mayor's office, the Indiana Department of Homeland Security, and the Indiana Centers for Disease Control and Prevention because these organizations are at the forefront of the Coronavirus control and mitigation procedures. Estimative intelligence evaluates potential Coronavirus developments that could affect the spread of the virus within the city of Indianapolis.[17] Estimative intelligence reports should be disseminated to all special needs and community lifeline. The dissemination for the confirmed Marion County hotspot special needs and community lifeline locations will be provided in daily reports (See Example 1, Sample Report). All others outside the Marion County hotspot locations will be provided weekly reports. Any and all warning intelligence discovered during the analysis stage will be disseminated to a public website and social media accounts. For example, reports would have been issued on the dates when the hotspot zip code areas, 46208, 46214, 46224, 46228, 46234, and 46254, were discovered.

Also, as a contribution to alleviate a problem that affects us all, a hypothetical Business Plan was created to describe and identify procedures necessary for an organization to answer intelligence requirement questions (Figure 13). This Business Plan offers a layout of the collection, analysis, processing and exploitation, and dissemination plan during a health emergency pandemic.

EXAMPLE 1, SAMPLE REPORT

INDIANA DEPARTMENT OF HOMELAND SECURITY
Health Division
July 2, 2020

1. **Current Situation as of 2020 July 2:** The National Geospatial-Intelligence Agency (NGA) Health Division has been monitoring the spread of the Coronavirus in Marion County. Data has been collected from the Indiana Department of Health and the Johns Hopkins University & Medicine Coronavirus Research Center Marion County. The NGA Health Division has observed an increase in new cases, case per population, confirmed cases, and hospitalization counts within 24 hours. This is days before Marion County's fourth of July large crowd event, the Grand Prix of Indianapolis at the Indianapolis Motor Speedway:

   o Case per population has increased from 1,186.69 to 1,192.77 within 24 hours.
   o The number of confirmed cases increased to 58 positive Coronavirus cases.
   o The death count due to Coronavirus has neither increased nor decreased.
   o Hospitalization counts has the largest increase, 204 hospitalized yesterday to 220 hospitalized today.

2. **Analysis:** There is a noticeable increase of Coronavirus cases that cannot be ignored prior to Marion County hosting the Grand Prix of Indianapolis at the Indianapolis Motor Speedway. Assessment of Coronavirus data by Marion County zip code was conducted on July 1st, 2020 (Figure 1). The data revealed that zip codes near the Indianapolis Motor Speedway are Marion County hotspot areas for the spread of the Coronavirus (Figure 2):
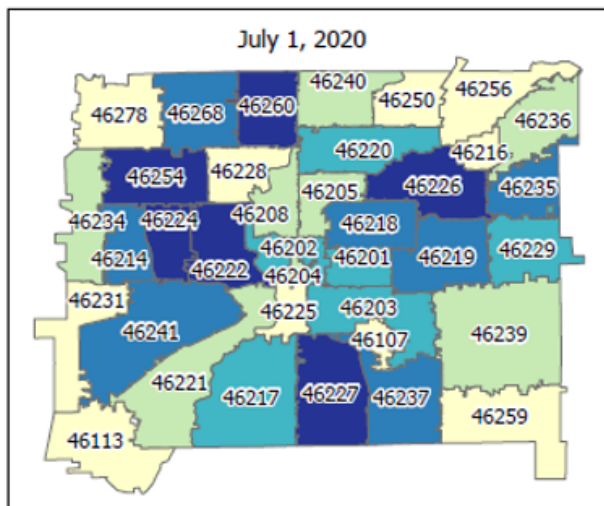

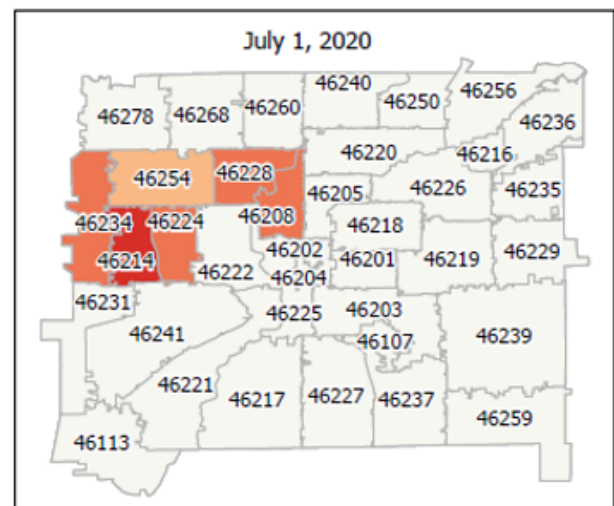*Figure 1: Zip code map of Marion County's new case count of the Coronavirus*

Figure 2: Hotspot map of Marion County's new case count of the Coronavirus

The following zip codes display areas of high clustering of Coronavirus new case counts occur.

- o Zip codes 46224, 46254, 46228, and 46208 are hotspot areas surrounding the Indianapolis Motor Speedway.
- o Should a large crowd event be held at the Indianapolis Motor Speedway, it is with great certainty that the spread of the Coronavirus will increase.

3. **Recommended Actions:** Should the Grand Prix of Indianapolis at the Indianapolis Motor Speedway occur on July 4th, 2020:

- o The Indianapolis Motor Speedway must host the event with no spectators.
- o All employees and racetrack participants must be checked in prior to entering the Indianapolis Motor Speedway.
- o All employees and racetrack participants must have temperature checked before entry to the Indianapolis motor Speedway.
- o All employees must wear masks during the entirety of the event.
- o Strict 6-feet social distancing must be met.
- o All food stations must be sanitized, and all individuals can only eat at food stations, masks must be immediately placed after eating.
- o All cleaning areas must be marked (soaps, sinks, and hand sanitizer stations).

4. **Event Summary:** The Coronavirus was detected in China in late 2019. The spread of the virus has now reached staggering rates in the United States. This virus is a human to human contact virus. Therefore, the rate of spread is fast. Currently, there is no vaccine to cure the contaminated individuals. Monitoring the spread of the virus has given the NGA Health Division a better understanding of where the virus has increased or decreased is case counts. Marion County has seen an increase within 24 hours just before a large crowd event is to take place. It was also confirmed that the Indianapolis Motor Speedway is at the center of Marion County's hotspot area of new case counts. Marion County should be aware of the increased number of new case counts, case per 100,000 population density, positive cases, and hospitalization rates.

EXAMPLE 2 - BUSINESS PLAN

GIS		Daily	Weekly	Monthly
GIS Analyst 1	Collect Coronavirus data.	✓		
	Add input into database.	✓		
GIS Analyst 2	Analyze Coronavirus data.	✓		
	Add input into database.	✓		
OSINT		Daily	Weekly	Monthly
OSINT Analyst 3	Collect Coronavirus data set through OSINT from the local church administrators.	✓		
	Exploit and process data.		✓	
	Convert raw data using ArcGIS Pro to create an elevation layer of Site A1.		✓	
GEOINT		Daily	Weekly	Monthly
GEOINT Analyst 4	Analyze the data and answer intelligence requirement questions using the data.	✓		
	Convert raw data using ArcGIS Pro to create visual representation of the spread of the Coronavirus data.	✓		
Web Publisher		Daily	Weekly	Monthly
	Publish information to display current health updates collected and analyzed by GIS, OSINT, and GEOINT analysts.		✓	
Digital Technology		Daily	Weekly	Monthly
ArcGIS Pro	To plan effectively, information between analysts will be shared through an ArcGIS Pro organization portal.	✓		
ArcGIS Online	ArcGIS Online will be used to create web layers to provide appropriate visualization of the collected data and made to the public.		✓	
Facebook	Posts will be published. Specifically, statistics and tips on decreasing the spread of Coronavirus. Geographical analysis will also be published.	✓		
Published Articles	Articles will be published when analysis of the images has again confirmed changes to the city of Indianapolis and the severity of the Coronavirus threat has increased.		✓	
E-mails	E-mails will be sent out to customers once the final intelligence report is completed.			✓

	A second email will be sent when we hold a public briefing to inform policymakers.			✓
Organization Website	A website will be used to display all information pertaining the current health concerns Indianapolis is facing today with the spread of the Coronavirus. The website will also provide mitigation procedures to reduce continual spread of the virus and dispersion of vaccines.		✓	

Endnotes

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Biographical Statement

Isabel Valverde a student who has completed a Master of Science in Geospatial Intelligence program from Johns Hopkins University. She has also received a Master of Professional Studies in Applied Intelligence from Georgetown University (May 2020). As an undergraduate student, she has received a Bachelor of Science in Physics from Purdue University (2017) with minors in Mathematics and Spanish. Her current field is intelligence analysis with a concentration in Geographic Information System (GIS). She is interested in analyzing crime and national security issues related to monitoring human activity patterns and movements using GIS.