2019

# Cumberland County EMS Evaluation

FINAL

AUGUST 2019

County Technical Assistance Service
INSTITUTE FOR PUBLIC SERVICE

# Contents

Background ..... 2
Study Data ..... 2
Time of Day ..... 5
Day of Week ..... 8
Response Times ..... 14
Incident Density ..... 20
Call to Clear Times ..... 22
Overlapping Incidents ..... 24
Recommendations ..... 25

## Background

The University of Tennessee's County Technical Assistance Service (CTAS) was requested by the Cumberland County Mayor and Emergency Medical Service Director to assist with evaluating current ambulance utilization and identifying areas that may need to be planned for increased coverage.

## Study Data

The incident database provided for the study totaled 11,381 records for January 2018 to December 2018. These were assigned priority codes of 1 (high) to 3 (low) based on the incident code list used by the department (See Attachment 1 for a list of incident code assignments). Non-medical emergency calls (suspicious person or vehicle, hang-up, missing person, etc.) were excluded, leaving a total of 11,254 records.

The remaining records were geocoded by creating an address locator in ESRI ArcMap using the incident street location, the ESN boundary as a place delimiter, and the EMS centerline file. By this method, all but 10 addresses could be geocoded within the county, leaving of total of 11,244 for the final analysis.

The ESN number in the incident record matched the ESN point location of geocoded addresses for approximately 98 percent of records. The original assigned ESN number was used for statistical analysis. The incident database included records for 31 ESNs.

An estimate of the 2010 population for each of the ESNs was made by using the summing the population values for each centroid point of census blocks in the 2010 US Census Redistricting values. For each ESN, the following table shows the total number of 2018 incidents, the percentage of total incidents, the total population, and percentage of total population. Also estimated for each ESN was the total incident rate per 1,000 population ((total incidents/population)*1000).

*Table 1. ESN Population and Incident Rate*

| ESN | Total Incidents | Percent of Total Incidents | Estimated 2010 Population | Percent of 2010 Population | Rate Per 1000 |
|---|---|---|---|---|---|
| 001 | 64 | 0.6% | 141 | 0.3% | 454 |
| 004 | 4577 | 40.7% | 5292 | 9.4% | 865 |
| 005 | 712 | 6.3% | 1682 | 3.0% | 423 |
| 006 | 797 | 7.1% | 3147 | 5.6% | 253 |
| 007 | 19 | 0.2% | 577 | 1.0% | 33 |
| 008 | 106 | 0.9% | 1399 | 2.5% | 76 |
| 009 | 199 | 1.8% | 1670 | 3.0% | 119 |
| 010 | 207 | 1.8% | 2296 | 4.1% | 90 |
| 011 | 123 | 1.1% | 1183 | 2.1% | 104 |
| 012 | 103 | 0.9% | 1147 | 2.0% | 90 |
| 013 | 717 | 6.4% | 6787 | 12.1% | 106 |
| 014 | 7 | 0.1% | 56 | 0.1% | 125 |
| 015 | 414 | 3.7% | 2885 | 5.1% | 144 |
| 016 | 44 | 0.4% | 608 | 1.1% | 72 |
| 017 | 16 | 0.1% | 67 | 0.1% | 239 |
| 018 | 133 | 1.2% | 1356 | 2.4% | 98 |
| 019 | 98 | 0.9% | 836 | 1.5% | 117 |
| 020 | 24 | 0.2% | 417 | 0.7% | 58 |
| 021 | 1146 | 10.2% | 6972 | 12.4% | 164 |
| 022 | 29 | 0.3% | 301 | 0.5% | 96 |
| 023 | 235 | 2.1% | 1467 | 2.6% | 160 |
| 024 | 43 | 0.4% | 704 | 1.3% | 61 |
| 025 | 92 | 0.8% | 950 | 1.7% | 97 |
| 026 | 78 | 0.7% | 972 | 1.7% | 80 |
| 027 | 164 | 1.5% | 1925 | 3.4% | 85 |
| 028 | 461 | 4.1% | 4287 | 7.6% | 108 |
| 029 | 8 | 0.1% | 31 | 0.1% | 258 |
| 030 | 211 | 1.9% | 2043 | 3.6% | 103 |
| 031 | 87 | 0.8% | 1195 | 2.1% | 73 |
| 032 | 293 | 2.6% | 3202 | 5.7% | 92 |
| 033 | 37 | 0.3% | 453 | 0.8% | 82 |
| Total | 11244 | 100.0% | 56048 | 100.0% | 4924 |

The large percentage of incidents occurring with ESN 004 relative to other ESNs is because ESN 004 encompasses most of the EMS coverage area medical facilities as well as a dense population. Over 21 percent of the total 2018 incidents, for example, are addressed at the Cumberland Medical Facility. Other common incident locations are shown in Table 2

*Table 2. Most Common Addresses for EMS 2018 Incidents*

| Incident Location | ESN | Number of Incidents |
|---|---|---|
| 421 S MAIN ST (Cumberland Medical Center) | 004 | 2399 |
| 456 WAYNE AVE (Wyndridge Health and Rehab) | 004 | 292 |
| 80 JUSTICE ST (Life Care Center of Crossville) | 004 | 250 |
| 121 DOOLEY ST (Rai Care Center) | 006 | 234 |
| HOMER PARSONS RD (private residence) | 028 | 79 |
| 37 PARK PLACE AVE | 006 | 61 |
| 100 SAMARITAN WAY (Good Samaritan Society) | 021 | 57 |
| 887 WOODLAWN RD (Dominion Senior Living) | 005 | 55 |
| 55 W LAKE RD (Wharton Nursing Home) | 015 | 48 |

Common incident locations are shown in the map in Figure 1, using graduated sizes increasing with the number of total incidents for the 2018 study year. The map also shows ESN boundaries and station locations.

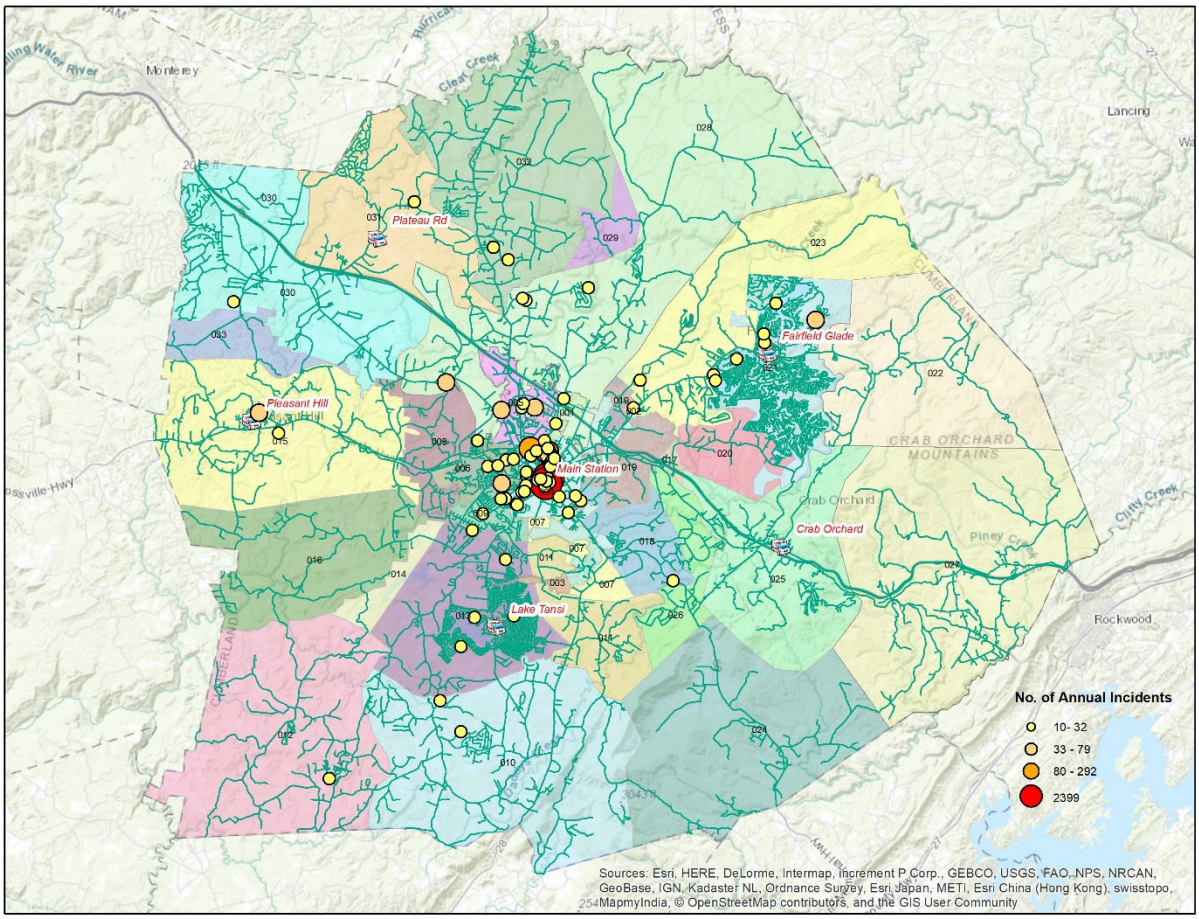


*Figure 1. Locations with 10 or More Incidents in 2018*

The rate of incidents by ESN symbolized by graduated colors is shown in the map in Figure 2, as calculated by the method described for Table 1, estimating population from Census 2010 block data. The total number of incidents for each ESN is also shown on the map in parenthesis after the ESN label.

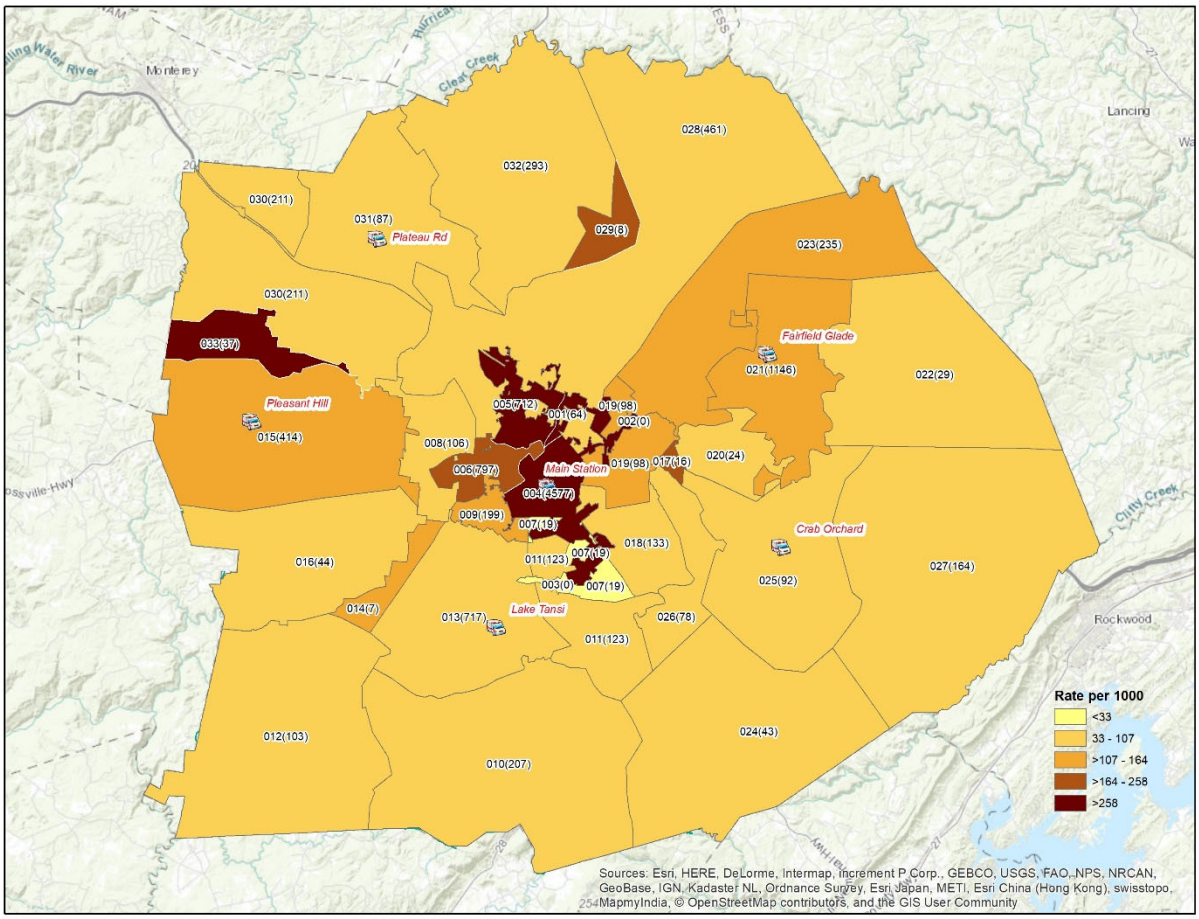


*Figure 2. Rate of Incidents by ESN*

## Time of Day

Incidents were catalogued by the hour of day in which the call was received and evaluated by one of four time range categories (Figure 3) as well as by each hour of the day (Figure 4). Two thirds of incidents in the 2018 data were logged between 6am and 6 pm, with the highest rate occurring between 2 and 3 pm.

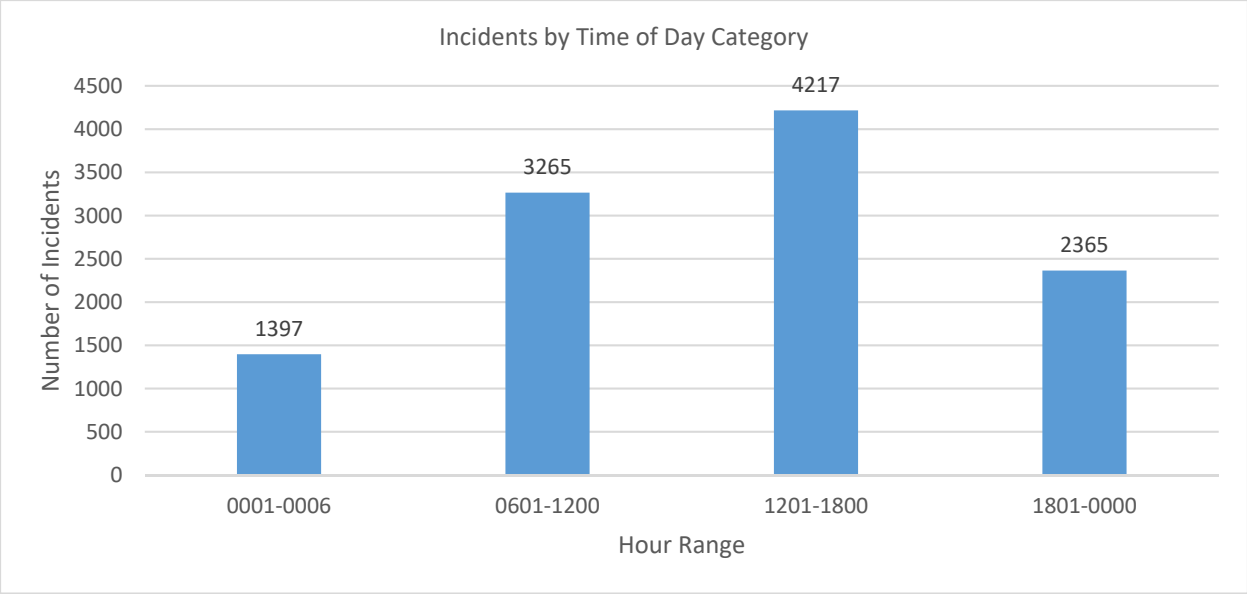


*Figure 3. Total Incidents by Time of Day Category*

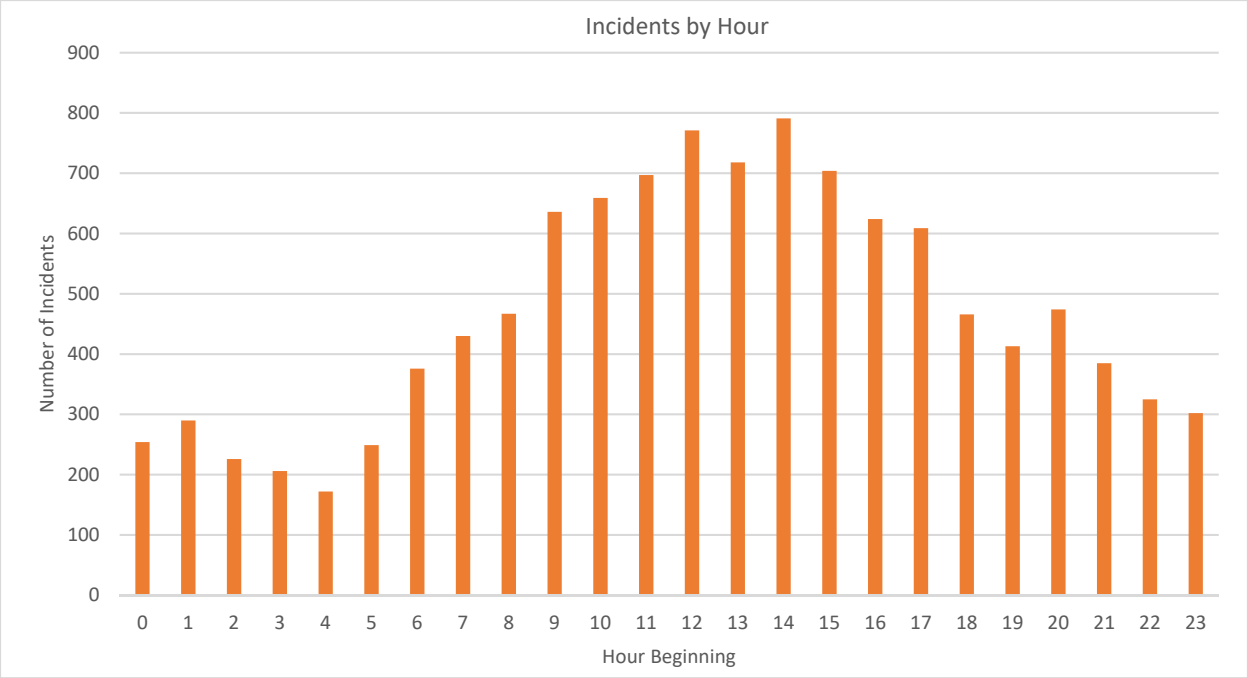


*Figure 4. Total Incidents by Hour of Day*

The distribution of incidents by time of day category for each ESN is displayed in Table 3 and symbolized in Figure 5.

*Table 3. Incidents by Time of Day Category by ESN*

| ESN | 0000-6000 | % | 0601-1200 | % | 1201-1800 | % | 1801-0000 | % | Total No. |
|---|---|---|---|---|---|---|---|---|---|
| 001 | 8 | 13 | 19 | 30 | 23 | 36 | 14 | 22 | 64 |
| 004 | 572 | 12 | 1233 | 27 | 1871 | 41 | 901 | 20 | 4577 |
| 005 | 97 | 14 | 205 | 29 | 249 | 35 | 161 | 23 | 712 |
| 006 | 58 | 7 | 245 | 31 | 363 | 46 | 131 | 16 | 797 |
| 007 | 1 | 5 | 5 | 26 | 12 | 63 | 1 | 5 | 19 |
| 008 | 8 | 8 | 36 | 34 | 35 | 33 | 27 | 25 | 106 |
| 009 | 24 | 12 | 60 | 30 | 70 | 35 | 45 | 23 | 199 |
| 010 | 37 | 18 | 61 | 29 | 60 | 29 | 49 | 24 | 207 |
| 011 | 20 | 16 | 30 | 24 | 40 | 33 | 33 | 27 | 123 |
| 012 | 15 | 15 | 25 | 24 | 40 | 39 | 23 | 22 | 103 |
| 013 | 84 | 12 | 201 | 28 | 265 | 37 | 167 | 23 | 717 |
| 014 | 1 | 14 | 2 | 29 | 3 | 43 | 1 | 14 | 7 |
| 015 | 52 | 13 | 129 | 31 | 144 | 35 | 89 | 21 | 414 |
| 016 | 6 | 14 | 21 | 48 | 10 | 23 | 7 | 16 | 44 |
| 017 | 1 | 6 | 6 | 38 | 4 | 25 | 5 | 31 | 16 |
| 018 | 19 | 14 | 40 | 30 | 47 | 35 | 27 | 20 | 133 |
| 019 | 13 | 13 | 30 | 31 | 27 | 28 | 28 | 29 | 98 |
| 020 | 1 | 4 | 5 | 21 | 10 | 42 | 8 | 33 | 24 |
| 021 | 154 | 13 | 384 | 33 | 358 | 31 | 250 | 22 | 1146 |
| 022 | 3 | 10 | 6 | 21 | 9 | 31 | 11 | 38 | 29 |
| 023 | 30 | 13 | 71 | 30 | 90 | 38 | 44 | 19 | 235 |
| 024 | 7 | 16 | 13 | 30 | 13 | 30 | 10 | 23 | 43 |
| 025 | 12 | 13 | 29 | 32 | 35 | 38 | 16 | 17 | 92 |
| 026 | 12 | 15 | 21 | 27 | 30 | 38 | 15 | 19 | 78 |
| 027 | 16 | 10 | 40 | 24 | 62 | 38 | 46 | 28 | 164 |
| 028 | 48 | 10 | 160 | 35 | 152 | 33 | 101 | 22 | 461 |
| 029 | 3 | 38 | 2 | 25 | 0 | 0 | 3 | 38 | 8 |
| 030 | 26 | 12 | 64 | 30 | 69 | 33 | 52 | 25 | 211 |
| 031 | 11 | 13 | 25 | 29 | 26 | 30 | 25 | 29 | 87 |
| 032 | 54 | 18 | 85 | 29 | 88 | 30 | 66 | 23 | 293 |
| 033 | 4 | 11 | 12 | 32 | 12 | 32 | 9 | 24 | 37 |
| Total | 1397 | 100 | 3265 | 100 | 4217 | 100 | 2365 | 100 | 11244 |

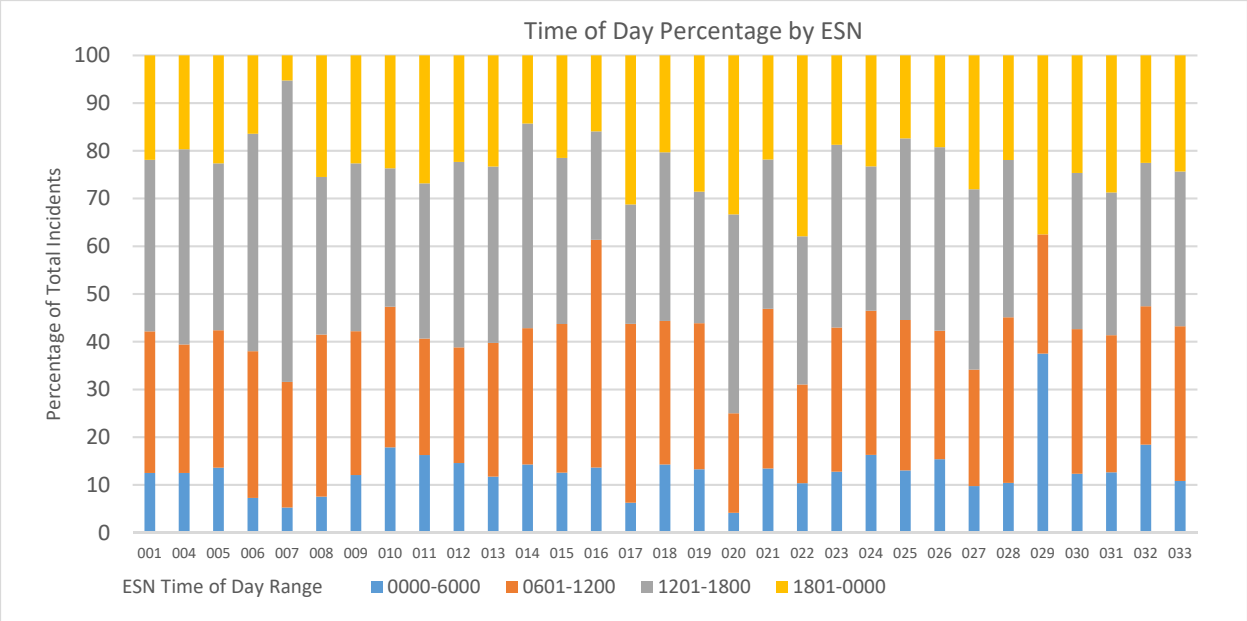


*Figure 5. Percentage of Incidents by Time of Day Category by ESN*

## Day of Week

The distribution of 2018 incidents by day of the week is shown in Figure 6. Tuesday and Friday were nearly equal as days having the highest number of incidents. The fewest number of incidents occurred on Sundays.

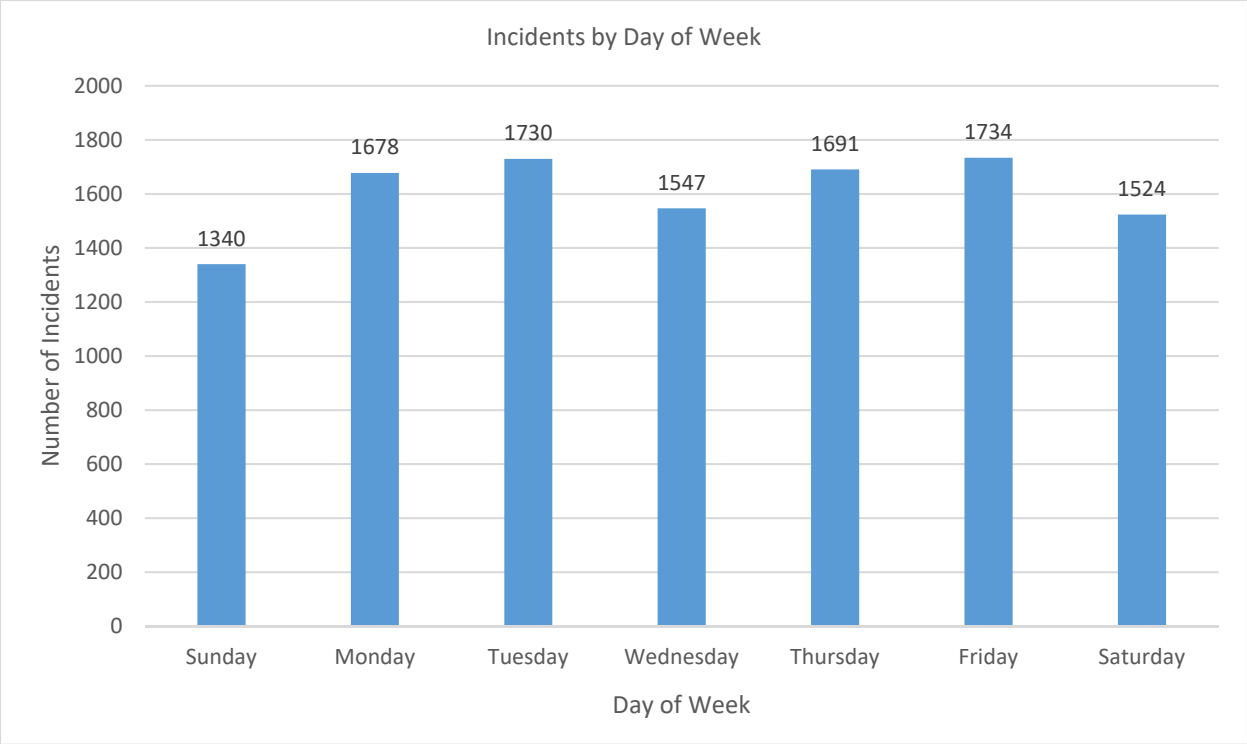


*Figure 6. Total incidents by Day of Week*

The distribution of incidents by day of the week for each ESN in shown in Table 4, which also includes a column chart to symbolize the percentage of total incidents for that ESN for each day of the week.

*Table 4. Percentage of Incidents by Day of Week by ESN*

| ESN | Sun% | Mon% | Tues% | Weds% | Thurs% | Fri% | Sat% | Total Num | S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 001 | 10.9% | 18.8% | 7.8% | 18.8% | 10.9% | 14.1% | 18.8% | 64 | | | | | | | |
| 004 | 10.4% | 14.3% | 16.1% | 14.7% | 15.3% | 16.6% | 12.8% | 4577 | | | | | | | |
| 005 | 10.4% | 16.4% | 17.1% | 11.5% | 15.2% | 16.3% | 13.1% | 712 | | | | | | | |
| 006 | 8.3% | 16.9% | 15.6% | 12.5% | 16.4% | 17.1% | 13.2% | 797 | | | | | | | |
| 007 | 15.8% | 10.5% | 10.5% | 26.3% | 26.3% | 5.3% | 5.3% | 19 | | | | | | | |
| 008 | 7.5% | 14.2% | 19.8% | 17.0% | 8.5% | 18.9% | 14.2% | 106 | | | | | | | |
| 009 | 13.6% | 16.6% | 16.6% | 15.6% | 9.5% | 15.6% | 12.6% | 199 | | | | | | | |
| 010 | 19.3% | 14.5% | 16.9% | 14.0% | 11.6% | 13.0% | 10.6% | 207 | | | | | | | |
| 011 | 11.4% | 18.7% | 15.4% | 17.1% | 15.4% | 6.5% | 15.4% | 123 | | | | | | | |
| 012 | 17.5% | 12.6% | 11.7% | 14.6% | 14.6% | 17.5% | 11.7% | 103 | | | | | | | |
| 013 | 14.8% | 15.2% | 12.0% | 15.2% | 13.1% | 14.8% | 14.9% | 717 | | | | | | | |
| 014 | 0.0% | 0.0% | 28.6% | 0.0% | 0.0% | 28.6% | 42.9% | 7 | | | | | | | |
| 015 | 12.8% | 14.5% | 13.5% | 13.0% | 18.4% | 14.0% | 13.8% | 414 | | | | | | | |
| 016 | 11.4% | 6.8% | 9.1% | 15.9% | 20.5% | 25.0% | 11.4% | 44 | | | | | | | |
| 017 | 12.5% | 12.5% | 6.3% | 12.5% | 25.0% | 6.3% | 25.0% | 16 | | | | | | | |
| 018 | 14.3% | 9.8% | 15.0% | 9.8% | 13.5% | 18.8% | 18.8% | 133 | | | | | | | |
| 019 | 11.2% | 11.2% | 20.4% | 14.3% | 17.3% | 14.3% | 11.2% | 98 | | | | | | | |
| 020 | 12.5% | 8.3% | 8.3% | 25.0% | 12.5% | 16.7% | 16.7% | 24 | | | | | | | |
| 021 | 15.3% | 15.8% | 15.2% | 12.0% | 14.4% | 13.3% | 14.0% | 1146 | | | | | | | |
| 022 | 10.3% | 13.8% | 17.2% | 24.1% | 10.3% | 10.3% | 13.8% | 29 | | | | | | | |
| 023 | 15.3% | 18.3% | 11.9% | 15.7% | 14.5% | 9.4% | 14.9% | 235 | | | | | | | |
| 024 | 16.3% | 16.3% | 23.3% | 14.0% | 16.3% | 11.6% | 2.3% | 43 | | | | | | | |
| 025 | 13.0% | 14.1% | 16.3% | 10.9% | 9.8% | 14.1% | 21.7% | 92 | | | | | | | |
| 026 | 11.5% | 14.1% | 14.1% | 12.8% | 20.5% | 11.5% | 15.4% | 78 | | | | | | | |
| 027 | 11.6% | 15.2% | 18.3% | 14.6% | 15.2% | 11.0% | 14.0% | 164 | | | | | | | |
| 028 | 9.8% | 15.2% | 14.3% | 11.1% | 19.7% | 13.4% | 16.5% | 461 | | | | | | | |
| 029 | 37.5% | 12.5% | 0.0% | 0.0% | 12.5% | 25.0% | 12.5% | 8 | | | | | | | |
| 030 | 14.2% | 14.7% | 13.3% | 12.8% | 10.9% | 15.2% | 19.0% | 211 | | | | | | | |
| 031 | 19.5% | 12.6% | 13.8% | 18.4% | 5.7% | 17.2% | 12.6% | 87 | | | | | | | |
| 032 | 16.4% | 15.0% | 15.7% | 9.9% | 16.4% | 16.7% | 9.9% | 293 | | | | | | | |
| 033 | 16.2% | 8.1% | 16.2% | 8.1% | 13.5% | 18.9% | 18.9% | 37 | | | | | | | |
| | | | | | | | Total | 11244 | | | | | | | |

The top 10 incident types coded by the Cumberland EMS represent 76 % of total incidents. These types are charted in Figure 7.

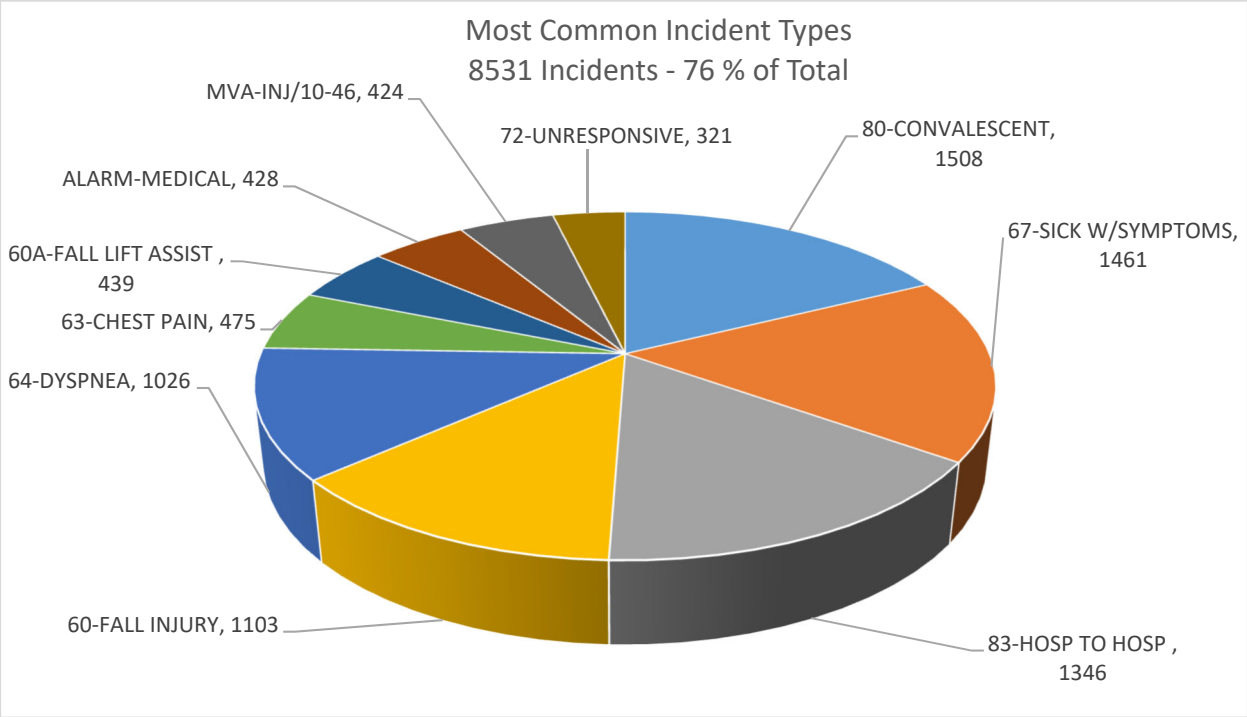


*Figure 7. Most Common Incidents by Type*

As Figure 8 shows, over half (51.3%) incidents were coded as Priority 3, with 18.7% as Priority 2, and 30% as Priority 1.

*Figure 8. Incident Percentages by Priority Class*

Most (58%) of Priority 3 incidents are located in ESN 004. Priority 3 incidents in ESN 004 are 30% of total incidents in the county and 73% of all incidents within ESN 004. By contrast, Priority 1 incidents are the most prevalent priority type in all but four of the remaining ESNs. Priority 1 incidents average 44% of all incidents within each ESN. The number and percentage of incidents by ESN for each priority category is presented in Table 5. The location of these incidents by priority overlaid on an ESN map is show in Figure 9.

*Table 5. Number and Percent of Incidents by Priority by ESN*

| ESN | One | One% | Two | Two% | Three | Three% | Total | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|---|
| 001 | 36 | 56.3% | 14 | 21.9% | 14 | 21.9% | 64 | | | |
| 004 | 774 | 16.9% | 467 | 10.2% | 3336 | 72.9% | 4577 | | | |
| 005 | 280 | 39.3% | 213 | 29.9% | 219 | 30.8% | 712 | | | |
| 006 | 199 | 25.0% | 144 | 18.1% | 454 | 57.0% | 797 | | | |
| 007 | 11 | 57.9% | 4 | 21.1% | 4 | 21.1% | 19 | | | |
| 008 | 40 | 37.7% | 23 | 21.7% | 43 | 40.6% | 106 | | | |
| 009 | 78 | 39.2% | 53 | 26.6% | 68 | 34.2% | 199 | | | |
| 010 | 95 | 45.9% | 39 | 18.8% | 73 | 35.3% | 207 | | | |
| 011 | 59 | 48.0% | 23 | 18.7% | 41 | 33.3% | 123 | | | |
| 012 | 43 | 41.7% | 27 | 26.2% | 33 | 32.0% | 103 | | | |
| 013 | 303 | 42.3% | 198 | 27.6% | 216 | 30.1% | 717 | | | |
| 014 | 5 | 71.4% | 1 | 14.3% | 1 | 14.3% | 7 | | | |
| 015 | 166 | 40.1% | 97 | 23.4% | 151 | 36.5% | 414 | | | |
| 016 | 20 | 45.5% | 11 | 25.0% | 13 | 29.5% | 44 | | | |
| 017 | 7 | 43.8% | 4 | 25.0% | 5 | 31.3% | 16 | | | |
| 018 | 61 | 45.9% | 27 | 20.3% | 45 | 33.8% | 133 | | | |
| 019 | 41 | 41.8% | 23 | 23.5% | 34 | 34.7% | 98 | | | |
| 020 | 15 | 62.5% | 4 | 16.7% | 5 | 20.8% | 24 | | | |
| 021 | 398 | 34.7% | 329 | 28.7% | 419 | 36.6% | 1146 | | | |
| 022 | 12 | 41.4% | 10 | 34.5% | 7 | 24.1% | 29 | | | |
| 023 | 82 | 34.9% | 81 | 34.5% | 72 | 30.6% | 235 | | | |
| 024 | 22 | 51.2% | 10 | 23.3% | 11 | 25.6% | 43 | | | |
| 025 | 48 | 52.2% | 22 | 23.9% | 22 | 23.9% | 92 | | | |
| 026 | 35 | 44.9% | 16 | 20.5% | 27 | 34.6% | 78 | | | |
| 027 | 66 | 40.2% | 36 | 22.0% | 62 | 37.8% | 164 | | | |
| 028 | 168 | 36.4% | 82 | 17.8% | 211 | 45.8% | 461 | | | |
| 029 | 4 | 50.0% | 1 | 12.5% | 3 | 37.5% | 8 | | | |
| 030 | 97 | 46.0% | 46 | 21.8% | 68 | 32.2% | 211 | | | |
| 031 | 46 | 52.9% | 18 | 20.7% | 23 | 26.4% | 87 | | | |
| 032 | 148 | 50.5% | 63 | 21.5% | 82 | 28.0% | 293 | | | |
| 033 | 14 | 37.8% | 6 | 16.2% | 17 | 45.9% | 37 | | | |
| Total | 2283 | | 1398 | | 5779 | | 11244 | | | |

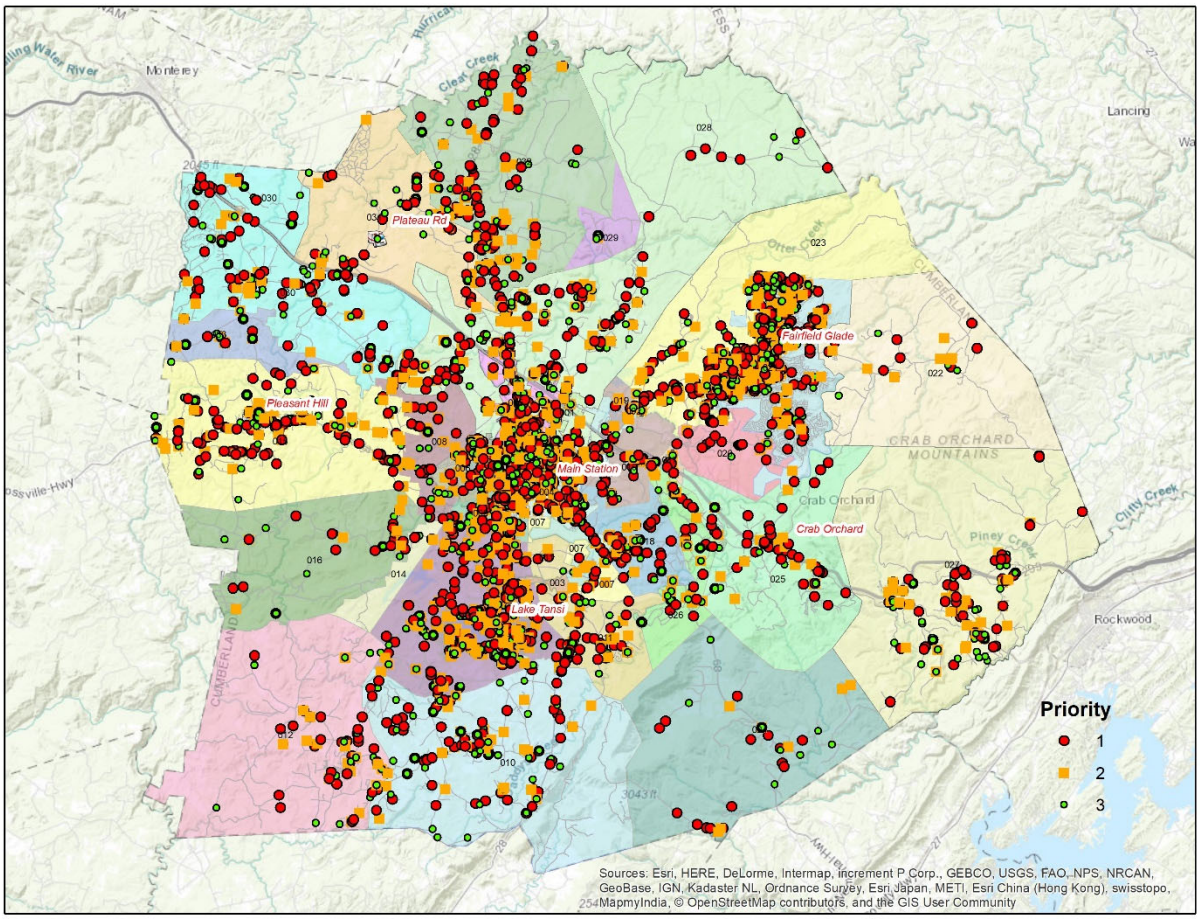


*Figure 9. Location of Incidents by Priority*

## Response Times

Response times are defined as **time from Dispatch to On Scene**. Response times were calculated for each incident where values are present. . Grouped by Priority category, the Response time average values in minutes for each response interval are shown by ESN in Table 6. Also included are times from call received to dispatch on route and from call received to clear scene.

*Table 6. Response Time in Minutes by Priority by ESN*

| | Priority 1 | | | Priority 2 | | | Priority 3 | | |
|---|---|---|---|---|---|---|---|---|---|
| ESN | Disp-Route | Disp-Scene | Call-Clear | Disp-Route | Disp-Scene | Call-Clear | Disp-Route | Disp-Scene | Call-Clear |
| 001 | 1.1 | 7.9 | 58.2 | 0.6 | 7.1 | 60.6 | 0.5 | 5.4 | 67.7 |
| 004 | 1.2 | 4.7 | 43.0 | 1.2 | 4.7 | 40.9 | 4.8 | 13.7 | 127.3 |
| 005 | 1.5 | 6.3 | 53.5 | 1.3 | 6.5 | 54.6 | 2.6 | 7.6 | 54.3 |
| 006 | 1.3 | 6.3 | 47.7 | 1.5 | 6.6 | 53.8 | 1.6 | 7.6 | 47.6 |
| 007 | 0.9 | 9.2 | 47.4 | 3.6 | 10.8 | 84.2 | 0.4 | 5.9 | 50.4 |
| 008 | 1.2 | 9.3 | 62.3 | 2.3 | 9.3 | 50.0 | 2.1 | 11.5 | 47.7 |
| 009 | 1.3 | 7.8 | 45.7 | 0.8 | 7.2 | 61.8 | 0.9 | 7.3 | 56.1 |
| 010 | 1.6 | 13.3 | 58.6 | 2.7 | 13.4 | 79.7 | 1.7 | 13.7 | 60.1 |
| 011 | 1.5 | 10.2 | 47.9 | 1.6 | 12.0 | 57.5 | 1.5 | 10.8 | 42.2 |
| 012 | 1.7 | 17.6 | 77.3 | 1.7 | 17.5 | 53.1 | 2.8 | 19.3 | 64.4 |
| 013 | 1.4 | 7.9 | 50.8 | 1.6 | 8.5 | 43.9 | 1.6 | 9.0 | 47.7 |
| 014 | 1.5 | 10.7 | 52.0 | 0.2 | 8.3 | 52.2 | 0.6 | 6.6 | 167.1 |
| 015 | 1.4 | 10.1 | 70.5 | 1.4 | 11.3 | 65.2 | 2.2 | 11.8 | 77.6 |
| 016 | 1.2 | 14.2 | 53.7 | 2.2 | 12.5 | 71.3 | 1.6 | 15.7 | 95.9 |
| 017 | 1.4 | 9.0 | 57.8 | 1.4 | 8.2 | 61.1 | 1.0 | 8.0 | 32.5 |
| 018 | 1.1 | 7.5 | 44.6 | 1.4 | 7.1 | 47.1 | 1.8 | 8.1 | 43.2 |
| 019 | 1.0 | 6.5 | 47.1 | 2.3 | 8.4 | 70.0 | 1.2 | 7.2 | 52.7 |
| 020 | 1.4 | 13.0 | 67.6 | 0.4 | 12.3 | 56.9 | 2.1 | 15.0 | 70.4 |
| 021 | 1.6 | 10.9 | 58.3 | 1.8 | 10.9 | 59.1 | 1.8 | 11.6 | 60.0 |
| 022 | 1.7 | 17.4 | 79.2 | 2.5 | 20.5 | 105.8 | 0.9 | 19.0 | 72.9 |
| 023 | 1.6 | 10.0 | 55.1 | 1.6 | 10.1 | 47.9 | 1.9 | 10.8 | 53.6 |
| 024 | 1.6 | 20.6 | 79.5 | 1.3 | 20.0 | 85.6 | 1.4 | 19.8 | 69.9 |
| 025 | 2.0 | 11.6 | 72.9 | 1.4 | 11.1 | 57.1 | 1.3 | 12.0 | 60.4 |
| 026 | 1.4 | 10.7 | 65.6 | 1.5 | 11.8 | 60.8 | 1.7 | 11.5 | 60.4 |
| 027 | 1.7 | 16.6 | 83.6 | 2.4 | 16.8 | 101.0 | 1.7 | 18.2 | 81.4 |
| 028 | 1.3 | 11.0 | 55.3 | 1.2 | 10.2 | 50.6 | 2.1 | 14.5 | 68.4 |
| 029 | 2.3 | 26.6 | 77.8 | 2.3 | 20.6 | 63.7 | 1.2 | 25.1 | 68.6 |
| 030 | 1.5 | 14.1 | 83.3 | 1.5 | 15.2 | 68.7 | 2.1 | 14.5 | 70.7 |
| 031 | 1.4 | 11.5 | 75.3 | 1.1 | 12.9 | 78.5 | 1.6 | 13.8 | 75.6 |
| 032 | 1.3 | 13.3 | 68.5 | 1.6 | 14.7 | 67.7 | 1.7 | 15.6 | 68.2 |
| 033 | 1.8 | 14.1 | 83.6 | 1.5 | 15.1 | 75.1 | 2.4 | 17.2 | 89.9 |

For analysis, Response times in minute range categories were estimated for all calls and for each priority category by ESN. For all 11,244 incidents, approximately 59% were on scene in 10 minutes or less, with over one-fourth (26%) in five minutes or less. When only Priority 1 and Priority 2 calls are considered,

65.2% of calls are on scene within 10 minutes (Table 7). Response time intervals are charted for Priority 1 (Figure 10) and Priority 2 (Figure 11) separately, although the distribution among time intervals is nearly identical.

*Table 7. Number and Percent of Total Incidents (11,244) by Response Interval, Priority 1 and 2 Incidents*

| Interval | Priority 1 Count | Priority 1 % | Priority 2 Count | Priority 2 % |
|---|---|---|---|---|
| 0 to 5 | 862 | 25.6% | 533 | 25.5% |
| 5 to 10 | 1337 | 39.6% | 832 | 39.8% |
| 10 to 15 | 632 | 18.7% | 429 | 20.5% |
| >15 | 542 | 16.1% | 298 | 14.2% |
| Total | 3373 | | 2092 | |

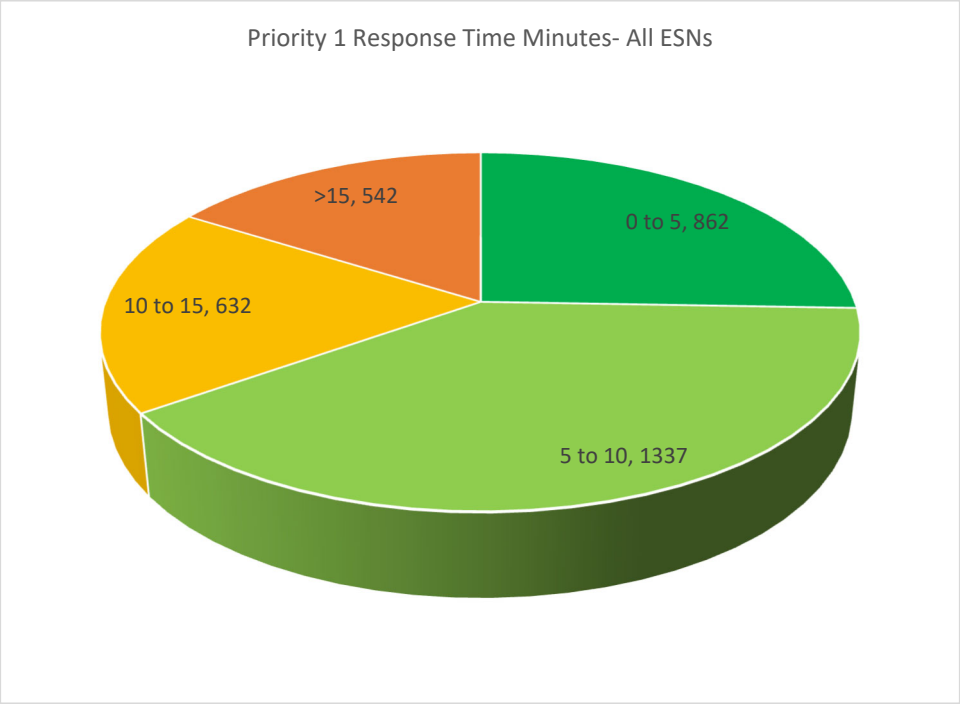


*Figure 10. Priority 1, Number of Incidents by Response Time Interval in Minutes, All ESNs*

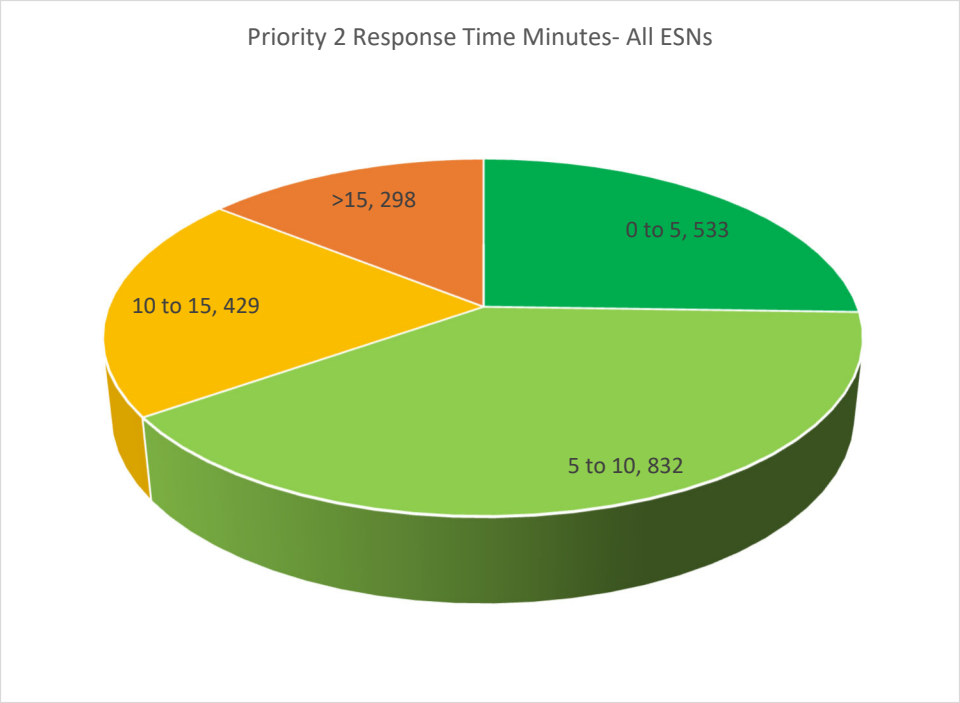


*Figure 11. Priority 2, Number of Incidents by Response Time Interval in Minutes, All ESNs*

To assess further response times by ESN by priority and reduce the impact of outliers, the 90th percentile value for the Dispatch to Scene value was calculated for each ESN for Priority 1 and Priority 2 incidents. That is, in 90 percent of incidents occurring in that ESN, the dispatched crew has arrived on scene from time of dispatch within that time interval. Table 8 and Figure 12 show these values by ESN. These demonstrate a strong correlation (91.4% correlation coefficient) between Priority 1 and Priority 2 response times within ESNs. ESN 90th percentile response times are mapped for Priority 1 incidents only in Figure 13.

*Table 8. 90th Percentile Response Time in Minutes by Priority, By ESN*

| ESN | Priority 1 | Priority 2 |
|---|---|---|
| 001 | 12.9 | 13.0 |
| 004 | 7.7 | 7.7 |
| 005 | 9.0 | 9.0 |
| 006 | 9.5 | 10.1 |
| 007 | 16.6 | 15.0 |
| 008 | 13.6 | 13.2 |
| 009 | 10.3 | 9.4 |
| 010 | 18.3 | 17.8 |
| 011 | 13.9 | 14.5 |
| 012 | 21.2 | 21.0 |
| 013 | 12.5 | 13.1 |
| 014 | 12.8 | 8.3 |
| 015 | 15.5 | 16.8 |
| 016 | 15.2 | 16.9 |
| 017 | 11.7 | 9.8 |
| 018 | 10.3 | 9.2 |
| 019 | 8.8 | 12.0 |
| 020 | 17.0 | 14.4 |
| 021 | 17.5 | 18.0 |
| 022 | 25.6 | 29.8 |
| 023 | 15.6 | 13.6 |
| 024 | 28.6 | 32.4 |
| 025 | 18.3 | 20.4 |
| 026 | 14.2 | 14.3 |
| 027 | 24.4 | 22.6 |
| 028 | 15.8 | 15.0 |
| 029 | 28.6 | 20.6 |
| 030 | 20.8 | 20.6 |
| 031 | 17.8 | 17.5 |
| 032 | 18.7 | 20.2 |
| 033 | 21.7 | 18.6 |

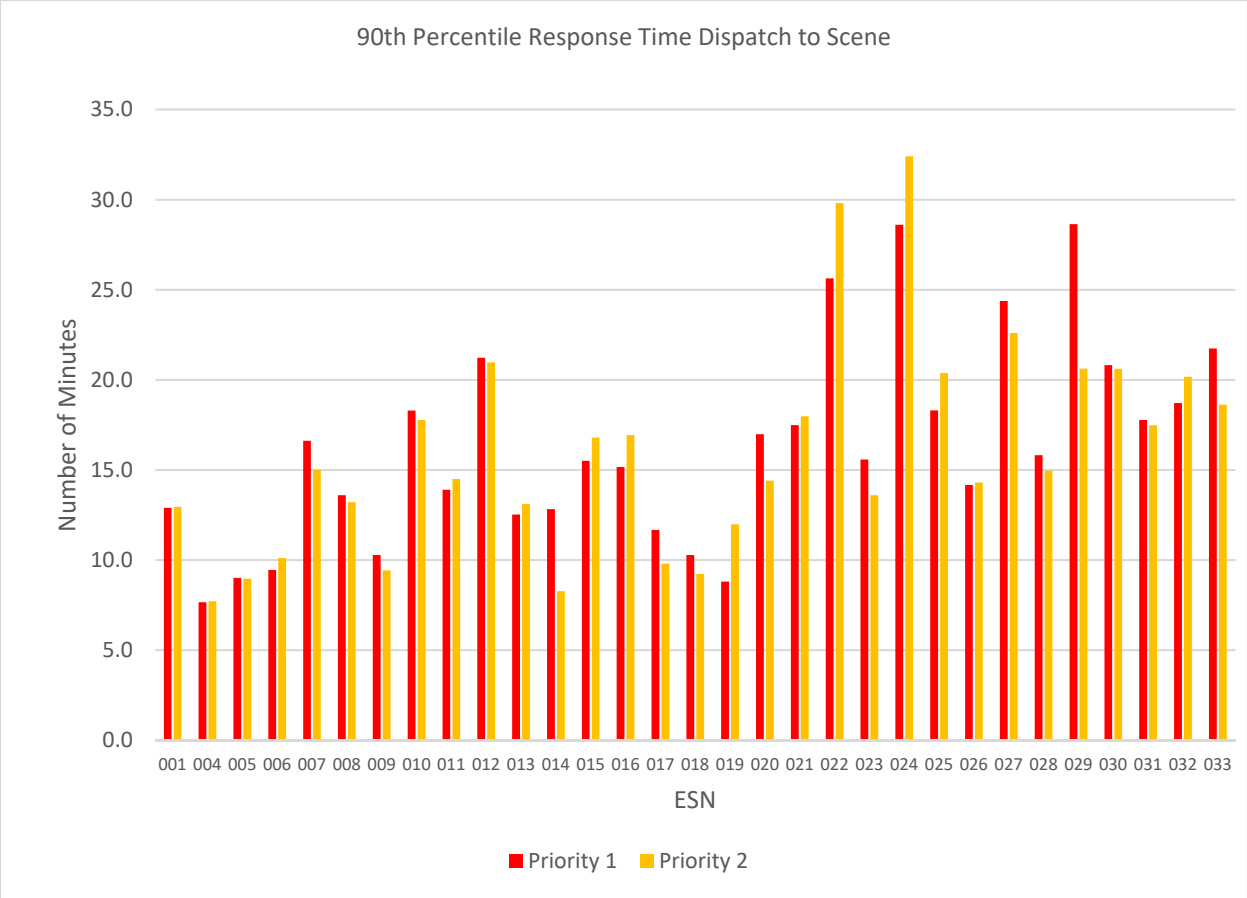


*Figure 12. 90th Percentile Dispatch to Scene Time in Minutes by Priority, By ESN*

90th percentile response time for Priority 1 incidents is symbolized in the map below.

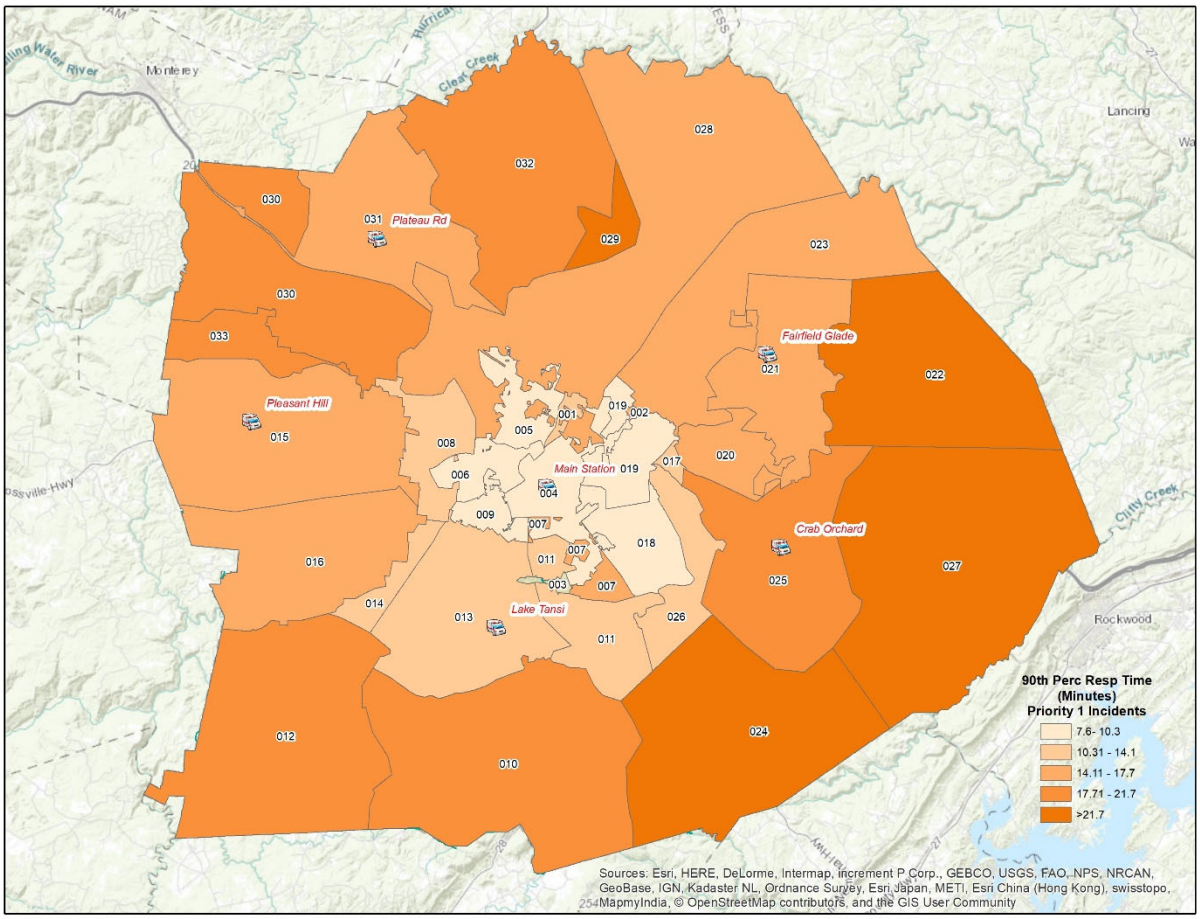


*Figure 13. 90 Percentile Response Time in Minutes, Priority 1 Incidents*

## Incident Density

A "heat map" of incidents can be plotted using a GIS kernel density function which calculates the density of selected features in a neighborhood around those features. Higher values indicate a greater density of features. A heat map of all incidents for Cumberland County would be centered in Crossville. However, although ESN 004 in the center of Crossville contains the plurality of incidents, it has a relatively lower proportion of Priority 1 calls compared to other ESNs and dispatch location distances to incident locations are shorter. A heat map of Priority 1 incidents with a dispatch to scene time of 10 minutes or more is presented in Figure 14, which also displays the point locations of these incidents. Using these criteria, the highest density of these incidents is near the Fairfield Glade station.

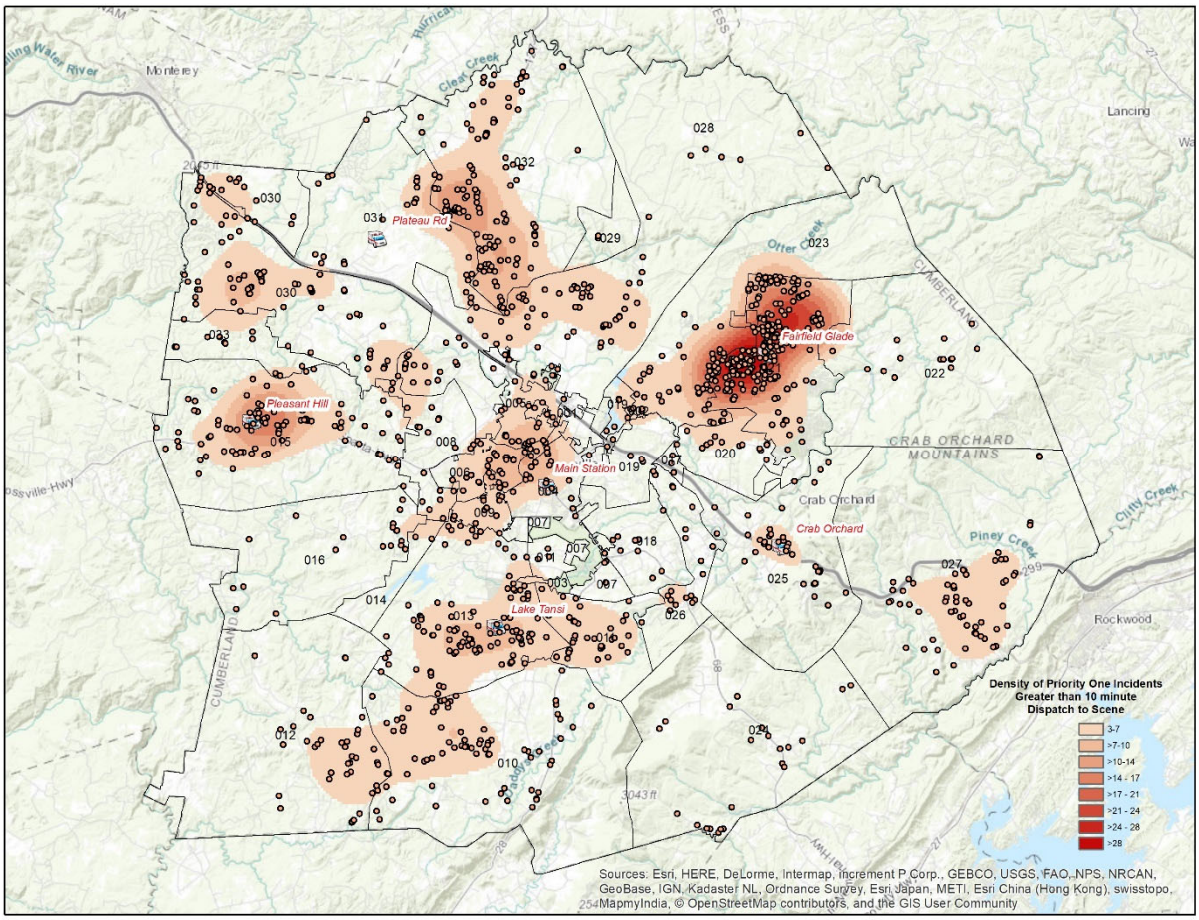


*Figure 14. Heat Map of Priority 1 Incidents with Response Times Greater Than 10 minutes*

Response time patterns can also be assessed with "hot spot" analysis. The ESRI GIS Optimized Hot Spot Analysis function was used to display clustering of incidents that have similar values. An area is designated a hot spot if a higher-than-average value for the event being analyzed is grouped in a cluster. Cooler or cold spots have lower-than-average values. The higher the value of clustered incidents, the "hotter" the spot. A hot spot analysis of Priority 1 and 2 incidents is mapped in Figure 15, with each incident point weighted by the dispatch to scene time.

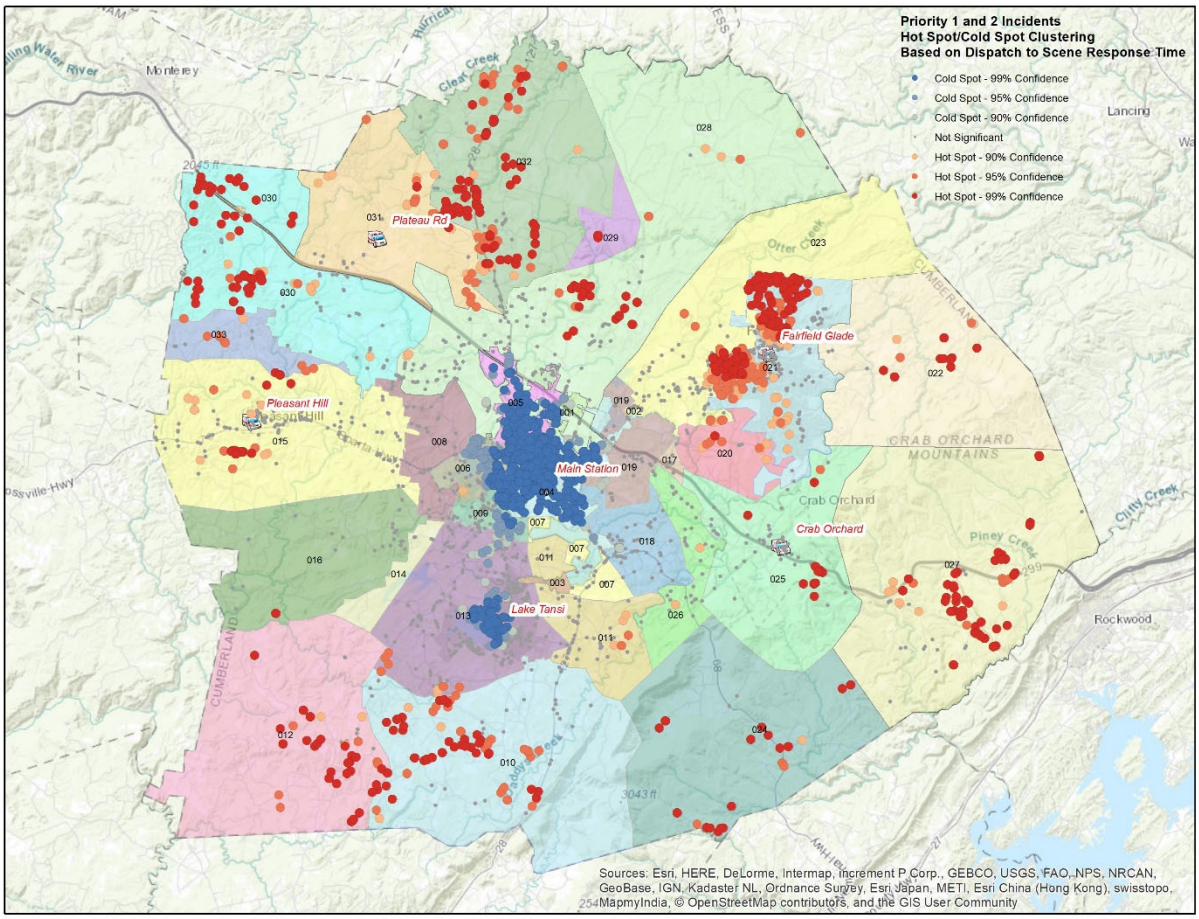


*Figure 15. Priority 1and 2 Incident Hot Spot Analysis Dispatch to Scene Time*

## Call to Clear Times

The average call received time to clear scene across all incidents that have this data is 61.3 minutes for Priority 1 incidents, 63.7 for Priority 2 incidents and 67.2 minutes for Priority 3 incidents. The average call received to clear time by ESN is presented in Table 9.

*Table 9. Call to Clear Time by ESN (Minutes)*

| ESN | Priority 1 | Priority 2 |
|---|---|---|
| 001 | 58.2 | 60.6 |
| 004 | 43.0 | 40.9 |
| 005 | 53.5 | 54.6 |
| 006 | 47.7 | 53.8 |
| 007 | 47.4 | 84.2 |
| 008 | 62.3 | 50.0 |
| 009 | 45.7 | 61.8 |
| 010 | 58.6 | 79.7 |
| 011 | 47.9 | 57.5 |
| 012 | 77.3 | 53.1 |
| 013 | 50.8 | 43.9 |
| 014 | 52.0 | 52.2 |
| 015 | 70.5 | 65.2 |
| 016 | 53.7 | 71.3 |
| 017 | 57.8 | 61.1 |
| 018 | 44.6 | 47.1 |
| 019 | 47.1 | 70.0 |
| 020 | 67.6 | 56.9 |
| 021 | 58.3 | 59.1 |
| 022 | 79.2 | 105.8 |
| 023 | 55.1 | 47.9 |
| 024 | 79.5 | 85.6 |
| 025 | 72.9 | 57.1 |
| 026 | 65.6 | 60.8 |
| 027 | 83.6 | 101.0 |
| 028 | 55.3 | 50.6 |
| 029 | 77.8 | 63.7 |
| 030 | 83.3 | 68.7 |
| 031 | 75.3 | 78.5 |
| 032 | 68.5 | 67.7 |
| 033 | 83.6 | 75.1 |
| Average | 61.3 | 63.7 |

## Overlapping Incidents

Over all incidents, approximately 23.4 % of calls are overlapping -- received during the same hour as another call is received. More of these occur in ESN 004 (2,138) than in any other ESN. If the address of the Cumberland Medical Center is excluded from this count, this total for ESN 004 is 606. The next greatest number of overlapping incidents occurs within 021 (162). A map of these overlapping calls is shown in Figure 16.

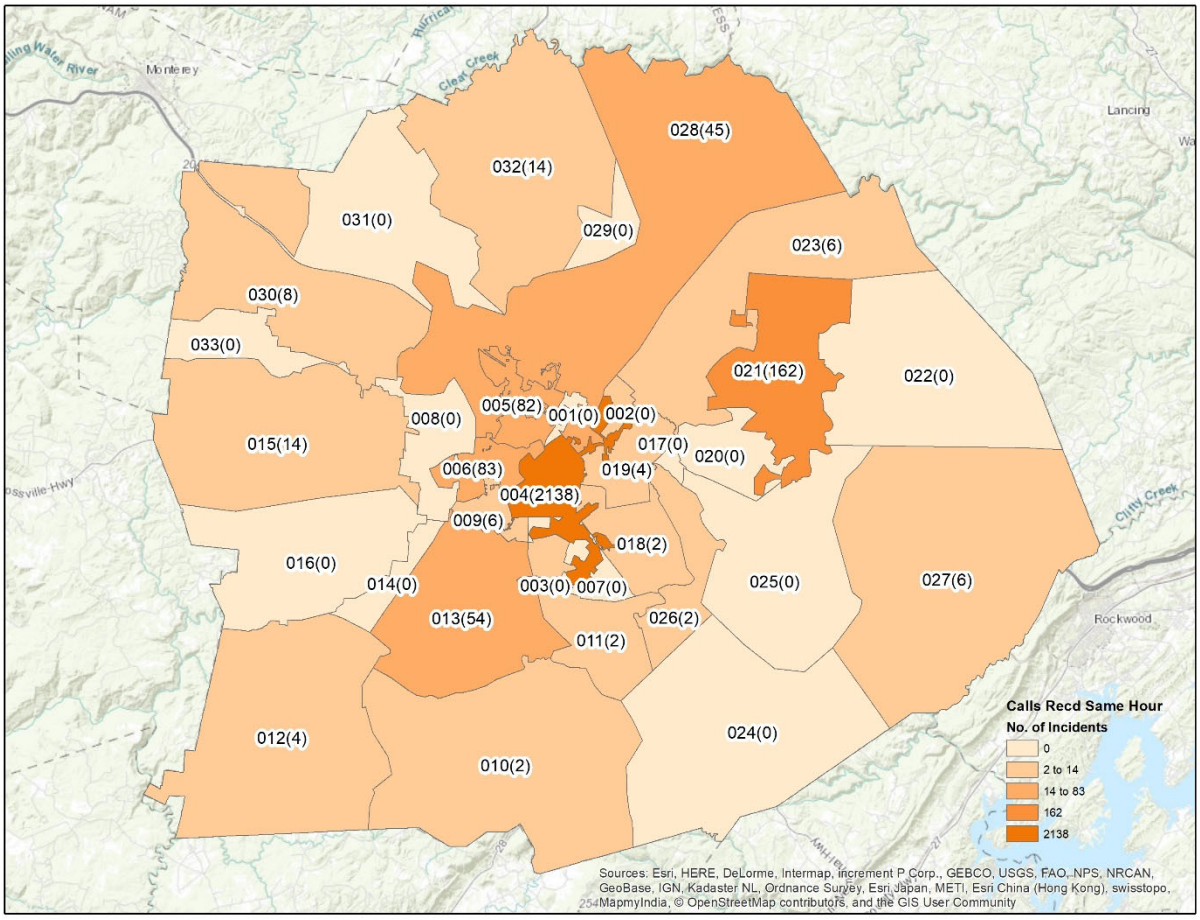


*Figure 16. Incidents Overlapping in the Same Hour*

## Recommendations

Cumberland County has unique challenges to provide ambulance service coverage in a cost-effective manner. The area's road network, geographic features, and large areas of rural population do make it difficult to provide a consistent response time to the entire county. The EMS department should continue to rotate/move up trucks to help cover areas vacant due to the assigned ambulance being committed on a response or unavailable. The addition of an ambulance Monday – Friday approximately 0800-1800-time span in the Fairfield Glade area should be considered as the funds are available. This can be accomplished by converting the basic life support (BLS) ambulance to an advanced life support (ALS) ambulance and backfilling the Fairfield Glade station while the Fairfield Glade ambulance is on a call. This truck can be used to cover other areas as needed based on system demand.

Attachment 1.

## Incident Type and Priority

Incident Types and Assigned Priority Codes are shown in the table below:

| Code and Description | No in Study DB | Priority Assigned |
|---|---|---|
| 01-CHOKING | 22 | 1 |
| 11-WOUND STABBING | 3 | 1 |
| 16-HEAD INJURY | 5 | 1 |
| 03-CARDIAC ARREST | 2 | 1 |
| 37-HEART ATTACK | 108 | 1 |
| 04-ANAPHYLACTIC SHK | 29 | 1 |
| 40-DRUG OVERDOSE | 56 | 1 |
| 43-BURN THERMAL | 1 | 1 |
| 45-EPILEPTIC SEIZURES | 24 | 1 |
| 51-STROKE | 225 | 1 |
| 57-OB LABOR | 7 | 1 |
| 59-PREGNANCY | 3 | 1 |
| 61-UNCONSCIOUS | 7 | 1 |
| 63-CHEST PAIN | 475 | 1 |
| 64-DYSPNEA | 1026 | 1 |
| 07-HEMORRAE/UNCO | 102 | 1 |
| 72-UNRESPONSIVE | 321 | 1 |
| 76-CPR IN USE | 10 | 1 |
| ALARM-MEDICAL | 428 | 1 |
| LIFE ALERT | 5 | 1 |
| LIFE LINE ALARM | 79 | 1 |
| MVA-INJ/10-46 | 424 | 1 |
| SHOOTING/10-38/LAW | 1 | 1 |
| SHOOTING-CODE10/EMS | 10 | 1 |
| 13-CUTS / HEAD | 1 | 2 |
| 15-CUTS /EXTREMITY | 3 | 2 |
| 21-BACK INJURY | 9 | 2 |
| 25-HIP INJURY | 6 | 2 |
| 27-ARM INJURY | 2 | 2 |
| 30-LEG INJURY | 16 | 2 |
| 31-LEG FRACTURE | 3 | 2 |
| 32-HEMORRAGE/CON | 8 | 2 |
| 44-CONVULSIONS | 172 | 2 |
| 46-DIABETIC | 149 | 2 |
| 48-MENTAL DISTURB | 106 | 2 |
| 50-PNEUMONIA | 5 | 2 |
| 53-APPENDICITIS | 1 | 2 |
| 54-INSECT BITE | 1 | 2 |
| 56-OB MISCARRIAGE | 3 | 2 |
| 58-OB DELIVERED | 1 | 2 |
| 60-FALL INJURY | 1103 | 2 |
| 62-SEMI CONSCIOUS | 73 | 2 |
| 66-ABDOMINAL PAIN | 160 | 2 |
| 71-HEADACHE | 6 | 2 |
| ASSUALT AND BATTERY/10-77 | 23 | 2 |
| DOMESTIC/10-86 | 60 | 2 |
| FIGHT/10-59 | 18 | 2 |
| FIRE ENVIROMENTAL/HAZMAT | 1 | 2 |
| FIRE STRUCTURE/10-72S | 18 | 2 |
| FIRE/10-72 | 10 | 2 |
| HIT AND RUN WITH INJURY | 5 | 2 |
| SUICIDE ATTEMPT | 25 | 2 |
| WANT OFFICER NEED INV/10-43 | 104 | 2 |
| 36-BACK PAIN | 47 | 3 |

| | | |
|---|---|---|
| 47-KIDNEY PROBLEMS | 7 | 3 |
| 60A-FALL LIFT ASSIST | 439 | 3 |
| 67-SICK W/SYMPTOMS | 1461 | 3 |
| 67A-SICK UNKN | 273 | 3 |
| 69-INTOX/ALCOHOL | 4 | 3 |
| 73-DEAD ON ARRIVAL | 19 | 3 |
| 79-CHECK UP | 235 | 3 |
| 80-CONVALESCENT | 1508 | 3 |
| 82-DIALYSIS | 259 | 3 |
| 83-HOSP TO HOSP | 1346 | 3 |
| CIVIC ASSIST/10-99 | 15 | 3 |
| DOA/10-70 | 37 | 3 |
| FIRE ALARM/10-72A | 3 | 3 |
| FIRE VEHICLE/10-72V | 2 | 3 |
| MVA/10-45 | 26 | 3 |
| SUICIDE THREAT | 37 | 3 |
| SUICIDE/10-94 | 6 | 3 |
| WELFARE CHECK | 55 | 3 |

## Types Excluded from Analysis

| Complaint Code | Number |
|---|---|
| SUSPICIOUS PERSON OR VEHICLE | 32 |
| MISSING PERSON/10-60 | 8 |
| BUSY/10-06 | 7 |
| HANGUP | 7 |
| MATTER OF RECORD | 6 |
| ALARM/10-57 | 5 |
| TRAFFIC STOP/10-81 | 5 |
| OPEN LINE | 4 |
| UNRULY JUVENILE | 4 |
| ROAD CLOSED | 4 |
| ANIMAL CONTROL/10-90 | 4 |
| SERVICE WARRANT OR CIVIL PAPER/10-82 | 4 |
| SIGNAL 6 | 4 |
| THEFT REPORT/10-96 | 3 |
| DRIVING WHILE INTOXICATED/10-49 | 3 |
| HIT AND RUN NO INJURY | 3 |
| DRUGS/10-84 | 3 |
| BREAKING AND ENTERING IN PROGRESS/10-27A | 2 |
| PUBLIC DRUNK/10-58 | 2 |
| CONFIDENTIAL TRAFFIC/10-35 | 2 |
| DISTURBING THE PEACE/10-87 | 2 |
| BREAKING AND ENTERING/10-27/REPORT | 2 |
| BOLO | 1 |
| DISORDERLY SUBJECT/10-26 | 1 |
| EXTRA PATROL | 1 |
| FOOT PURSUIT/10-63 | 1 |
| STOLEN VEHICLE/10-44 | 1 |
| STRANDED MOTORIST/10-89 | 1 |
| PROWLER/10-56 | 1 |
| RAPE10-55B | 1 |
| RECKLESS DRIVER | 1 |
| SEARCH WARRANT | 1 |
| FIRE BRUSH/WOODS/10-72B | 1 |