February 2018

GIS Analysis

Frederick County Life at the Top VIRGINIA

Frederick County Fire Rescue, Virginia

Prepared by:

FITCH & ASSOCIATES

FITCH & ASSOCIATES, LLC
2901 Williamsburg Terrace #G ▪ Platte City ▪ Missouri ▪ 64079
816.431.2600 ▪ www.fitchassoc.com

CONSULTANT REPORT

DRAFT GIS Analysis
Frederick County, VA

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ESTABLISHING BASELINE PERFORMANCE

The first step in completing GIS planning analyses is to establish the desired performance parameters. Measures of total response time can be significantly influenced by both internal and external influences. For example, the dispatch time, defined as the time from pick up at the 911 center to the dispatching of units, contributes to the customer's overall response time experience, but may be outside of a Department's direct control. Another element in the total response time continuum is the turnout time, defined as the time from when the units are notified of the incident until they are actually responding. Turnout time can have a significant impact to the overall response time for the customer and is generally considered under management's control. Understandably, turnout time may vary considerably depending on the staffing and notifications processes utilized by each department.

However, the travel time, defined as the period from when the units are actually responding until arrival at the incident is a factor of the number of fire stations, the ability to travel unimpeded on the road network, the existing road network's ability to navigate the community, and the availability of the units. Largely, travel time is the most stable variable to utilize in system design regarding response time performance.

Therefore, these GIS planning analyses will focus on travel time capability as the unit of measure. The calendar year (CY) 2016 performance for travel time across programs is provided below. Overall, the travel time is 10.4 minutes or less for 90% of the incidents.

Table 1: 90th Percentile Turnout and Travel Time of First Arriving Units by Program

Program	Dispatch and Turnout Time	Travel Time	Response Time	Sample Size
EMS	7.3	10.1	16.1	7,519
Fire	7.5	11.7	17.6	1,088
Rescue	8.6	9.6	17.6	15
Hazmat	8.0	10.7	17.1	274
Total	**7.3**	**10.4**	**16.4**	**8,896**

More granular analyses recognize that variability exists within individual station performance. The 90th percentile performance for each agency is provided below. This analysis generally combined the most utilized apparatus from each station area to approximate the staffed performance.

Table 2: 90th Percentile Dispatch, Turnout and Travel Time of First Arriving Units by Station

Station	Unit	Dispatch and Turnout Time	Travel Time	Response Time	Sample Size
Clear Brook	A131/A132/E13	7.2	10.5	16.4	697
Gainesboro	A162/A161/E16	7.4	11.4	17.8	256
Gore	A141/A142/E14	7.9	13.2	19.3	207
Greenwood	A184/A183/A181/E18	7.0	8.3	14.1	1,431
Middletown	A121/A122/RE12/ET12	7.3	11.9	18.1	541
Millwood Station	A211/A212/RE21/E21	6.9	10.0	15.9	945
North Mountain	A192/A191/W19	9.9	11.2	18.4	220
Reynolds Store	A202/A201/E20	7.8	12.2	17.6	177
Round Hill	A151/A152/RE15/E15	6.9	9.8	15.4	1,109
Star Tannery	A171/E17	7.1	15.5	20.5	127
Stephens City	A111/A112/A113/E11	7.0	9.5	15.4	1,641
Total		**7.1**	**10.3**	**16.1**	**7,325**

Comparison to National References

There are two notable references for travel time available to the fire service in National Fire Protection Association (NFPA) 1710[1] and the Commission on Fire Accreditation International (CFAI)[2]. NFPA 1710 suggests a 4-minute travel time at the 90th percentile for first due arrival of Basic Life Support (BLS) and Fire incidents and the CFAI recommends a 5 minute and 12 seconds travel time for first due arrival in an urban/suburban population density and 13 minutes travel time for rural populations. The arrival of an Advanced Life Support (ALS) unit is recommended at 8-minutes travel time by NFPA 1710. It is important to note that the latest edition (9th edition) of the CFAI guidelines have de-emphasized response time and only reference the legacy standards with a separately provided companion document[3].

The CFAI recommendations are more closely aligned with the departments' historical performance as the aggregate performance is 10.3 minutes at the 90th percentile. However, the department is not currently capable of meeting the more restrictive recommendation of 4 minutes travel time or less at the 90th percentile. Analyses were conducted to determine the capacity of the departments to meet NFPA 1710. With the current configuration of stations, the departments could achieve approximately 84% coverage within 8 minutes with the inclusion of some of the Winchester stations. However, it would require 11 stations to meet 8-minutes for all urban responses.

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[1] National Fire Protection Association. (2010). NFPA 1710, *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments*. Boston, MA: National Fire Protection Association.
[2] CFAI. (2009). Fire & emergency service self-assessment manual, (8th ed.). Chantilly, Virginia: Author. (page 71)
[3] CFAI. (2016). Fire & emergency service self-assessment manual, (9th ed.). Chantilly, Virginia: Author.

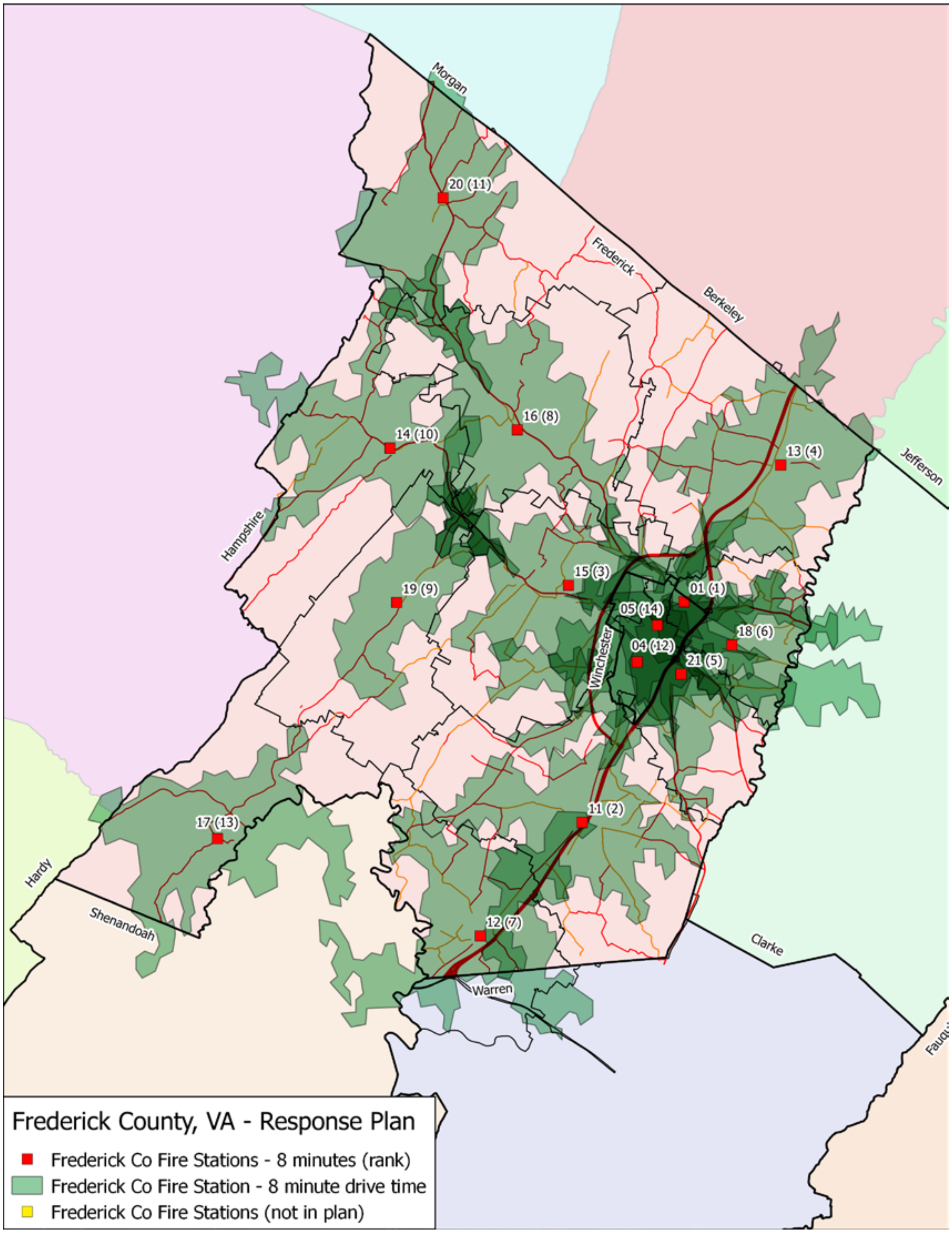
When referring to the marginal utility analysis provided below, the ascending rank order is the station's capability to cover risk (incidents) in relation to the total historical call volume of the sample period (CY 16). The Station number is the current Fire Department fire station identifier. The station capture is the number of calls the station would capture within an 8-minute travel time. The total capture is the cumulative number of calls captured with the addition of each fire station. The percent capture is the total cumulative percentage of risk covered by each station. The goal would be to achieve at least 90 percent capture.

Therefore, the station that contributed the most to the overall system's performance was Station 1 on the first row and would capture 27.01% of the risks within 8-minutes. Station 11 would cover an additional 18.18% of the risk bringing the cumulative total to 45.19% between Stations 1 and 11. In total, with 14 fixed fire stations, 84.42% of the incidents could be responded to within 8-minutes travel time. Results are provided as Table 3 and in drive time mapping format as Figure 1 below.

Table 3: Marginal Fire Station Contribution for 8-Minute Travel Time

Rank	Station Number	Station Capture	Total Capture	Percent Capture
1	1	2,622	2,622	27.01%
2	11	1,764	4,386	45.19%
3	15	1,049	5,435	56.00%
4	13	539	5,974	61.55%
5	21	459	6,433	66.28%
6	18	287	6,720	69.24%
7	12	254	6,974	71.85%
8	16	250	7,224	74.43%
9	19	227	7,451	76.77%
10	14	199	7,650	78.82%
11	20	186	7,836	80.73%
12	4	170	8,006	82.49%
13	17	156	8,162	84.09%
14	5	32	8,194	84.42%

Figure 1: Current Fire Station Bleed Maps for 8-Minute Travel Time



Validation of Planning Analysis

The first step in this validation analysis is to utilize the historical performance to validate the planning analyses utilized by the GIS system. The historical performance demonstrated a 10.4 overall department capability from the existing fire stations at the 90th percentile. The planning assessments estimated approximately 93.42% at 10-minutes travel time. Therefore, there is high degree of agreement between the planning tools and the actual historical performance.

Internal Performance Objectives

The Department does not currently utilize a uniform system of internal performance objectives. Therefore, in addition to the previous 8-minute travel time analysis, 10 and 12–minute travel time plans were developed to understand and validate the current configuration for the aggregate response time performance.

EVALUATION OF VARIOUS DISTRIBUTION MODELS

As previously discussed, these analyses utilized CY 2016 historical performance as the desired performance for system designs. Therefore, the 8-minute travel time will be utilized to most closely represent both current and future performance if service levels are maintained. The following additional analyses are utilized to compare and contrast the various potential distribution models.

Current Station Distribution Plans

10-Minute Travel Time

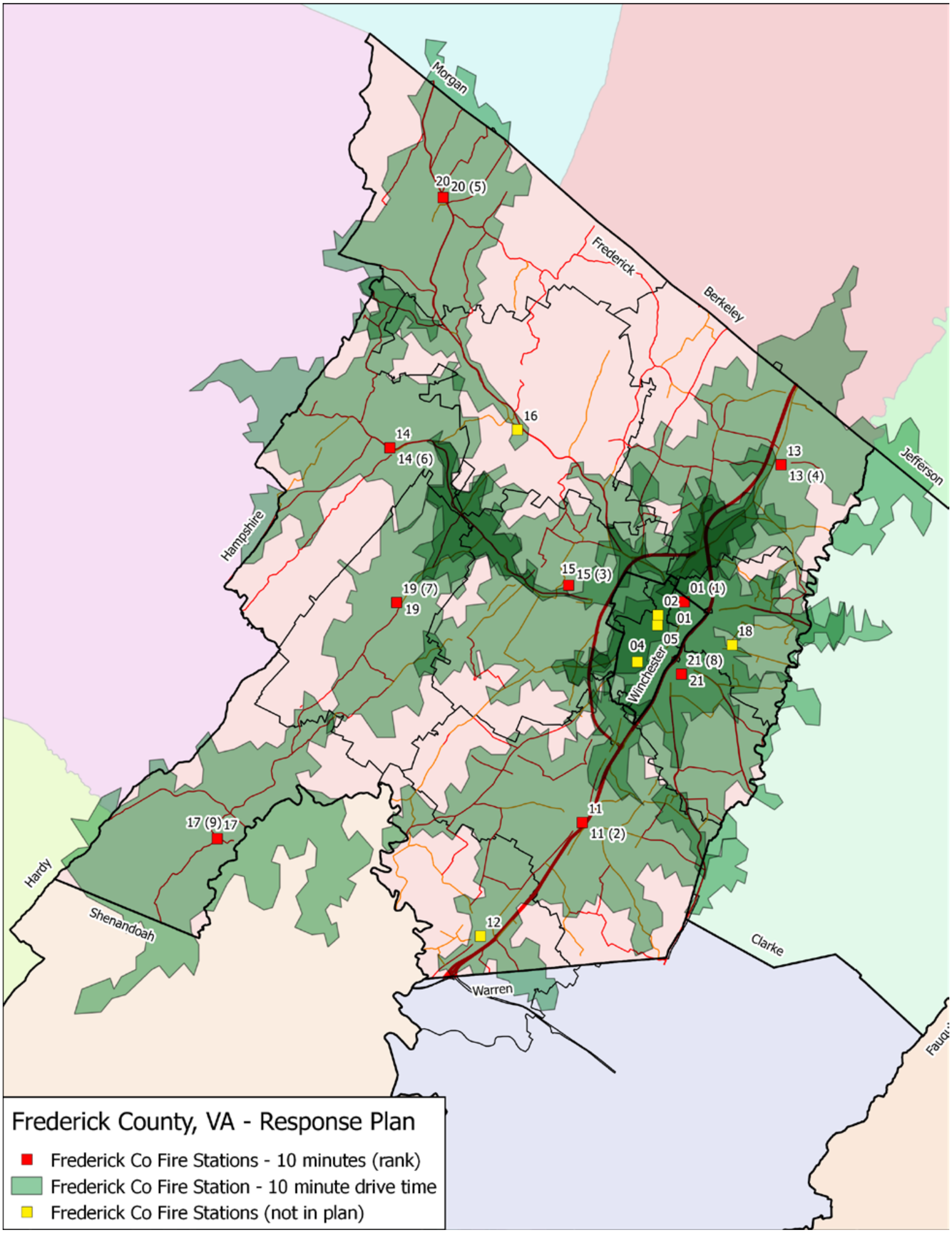
The analysis demonstrates that the current station configuration can achieve approximately 90% of the incidents within 10 minutes. The planning tools utilize average road speeds and current road networks that will more closely replicate the large fire apparatus.

While it is understood that fire stations may be placed for a wide variety of options, from a purely operational standpoint, area fire departments could achieve a 10-minute travel time performance for 91% of the incidents with a total of 9 fixed facilities.

Table 4: Marginal Fire Station Contribution for 10-Minute Travel Time – All Incidents

Rank	Station Number	Station Capture	Total Capture	Percent Capture
1	1	4,236	4,236	43.64%
2	11	2,420	6,656	68.58%
3	15	617	7,273	74.93%
4	13	363	7,636	78.67%
5	20	318	7,954	81.95%
6	14	251	8,205	84.54%
7	19	231	8,436	86.92%
8	21	203	8,639	89.01%
9	17	169	8,808	90.75%
10	16	120	8,928	91.98%
11	12	105	9,033	93.07%
12	4	22	9,055	93.29%
13	18	12	9,067	93.42%

Figure 2: Current Stations with an 10-Minute Travel Time at the 90th Percentile



12-Minute Travel Time

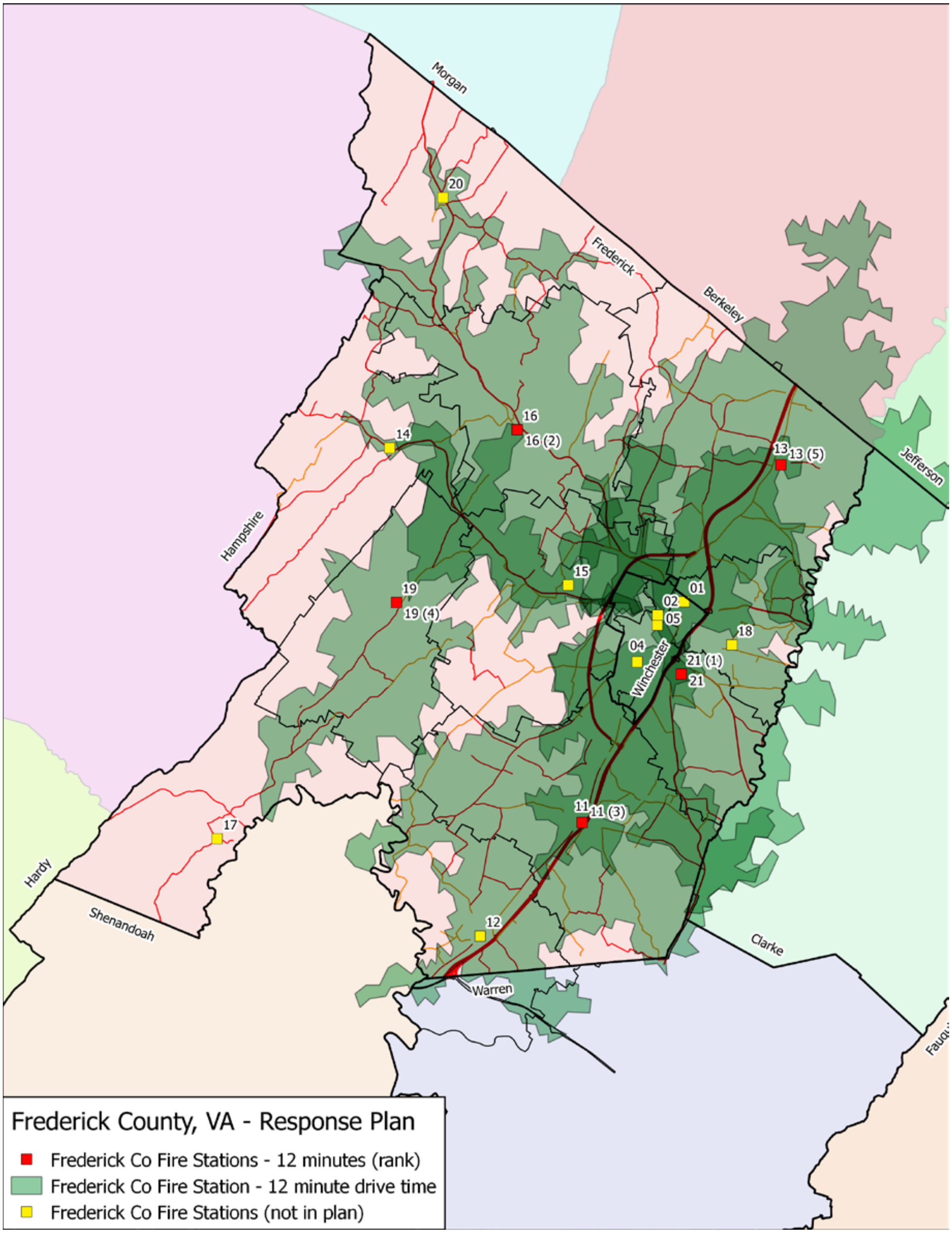
The analysis demonstrates that the current station configuration can achieve approximately 90% of the incidents within 12 minutes. The planning tools utilize average road speeds and current road networks that will more closely replicate the large fire apparatus.

While it is understood that fire stations may be placed for a wide variety of options, from a purely operational standpoint, area fire departments could maintain a 12-minute travel time performance for 90% of the incidents with a total of 5 fixed facilities.

Table 5: Marginal Fire Station Contribution for 12-Minute Travel Time – All Incidents

Rank	Station Number	Station Capture	Total Capture	Percent Capture
1	21	5,994	5,994	61.76%
2	16	1,402	7,396	76.20%
3	11	754	8,150	83.97%
4	19	397	8,547	88.06%
5	13	278	8,825	90.92%
6	14	170	8,995	92.67%
7	20	114	9,109	93.85%
8	15	96	9,205	94.84%
9	17	67	9,272	95.53%
10	12	58	9,330	96.13%
11	18	35	9,365	96.49%
12	4	17	9,382	96.66%

Figure 3: Current Stations with an 12-Minute Travel Time at the 90th Percentile

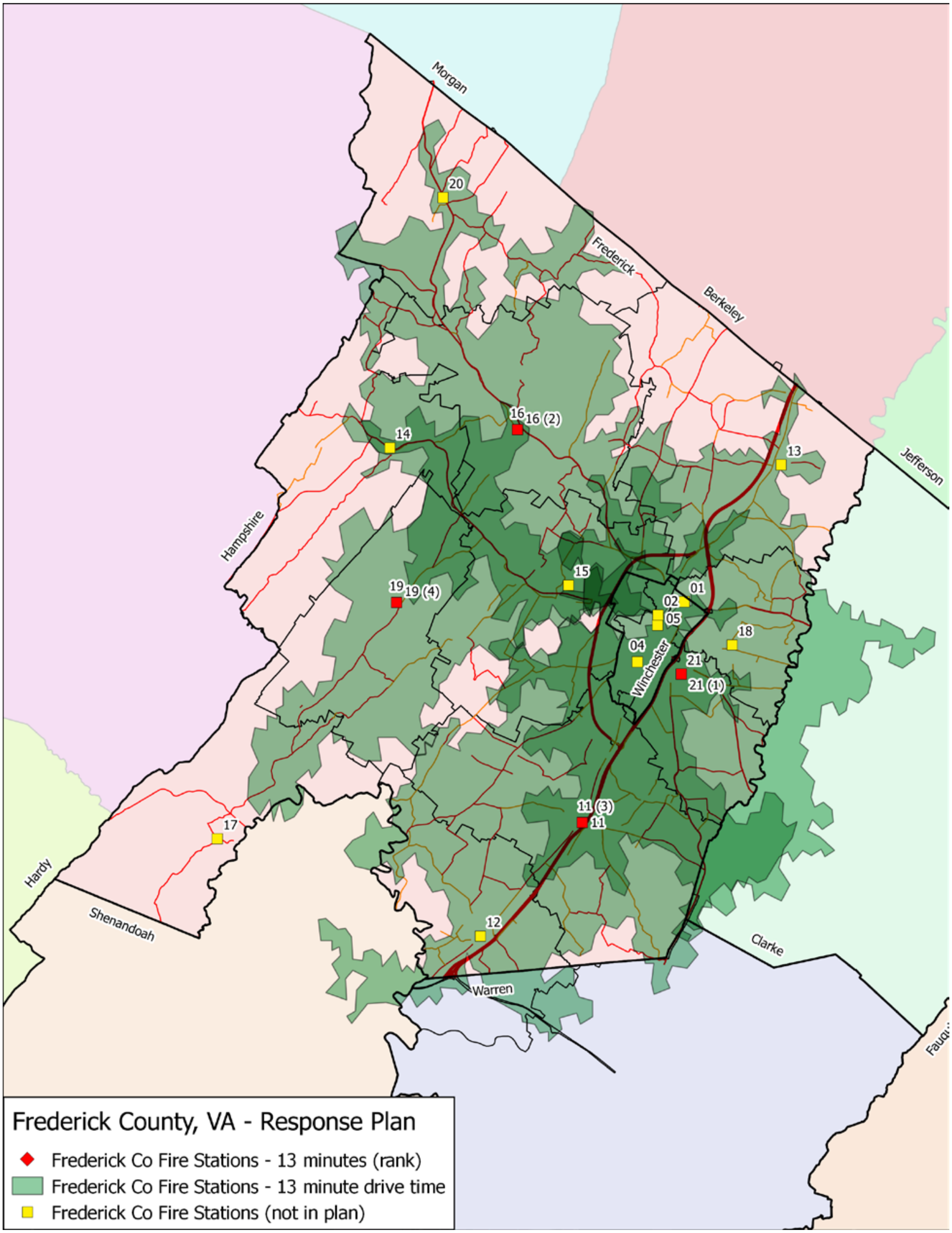


Similarly, we evaluated a 13-minute travel time plan. With the current configuration, agencies could maintain a 13-minute travel time to all incidents 90% of the time 4 fixed facilities.

Table 6: Marginal Fire Station Contribution for 13-Minute Travel Time – All Incidents

Rank	Station Number	Station Capture	Total Capture	Percent Capture
1	21	6,583	6,583	67.82%
2	16	1,196	7,779	80.15%
3	11	725	8,504	87.62%
4	19	398	8,902	91.72%
5	13	165	9,067	93.42%
6	20	159	9,226	95.05%
7	14	94	9,320	96.02%
8	17	72	9,392	96.76%
9	12	36	9,428	97.14%
10	15	17	9,445	97.31%
11	4	1	9,446	97.32%

Figure 4: Current Stations with a 13-Minute Travel Time at the 90th Percentile



Differentiated Service Models for Urban/ Suburban and Rural

8-Minute Urban/Suburban and 13-Minute Rural Travel

The 8-minute travel time modeling suggests that a 14-station configuration would achieve a travel time of 8-minutes or less to 84% of the incidents in the *Development* area. This scenario would require the commitment of three Winchester stations, 1, 4, and 5, respectively.

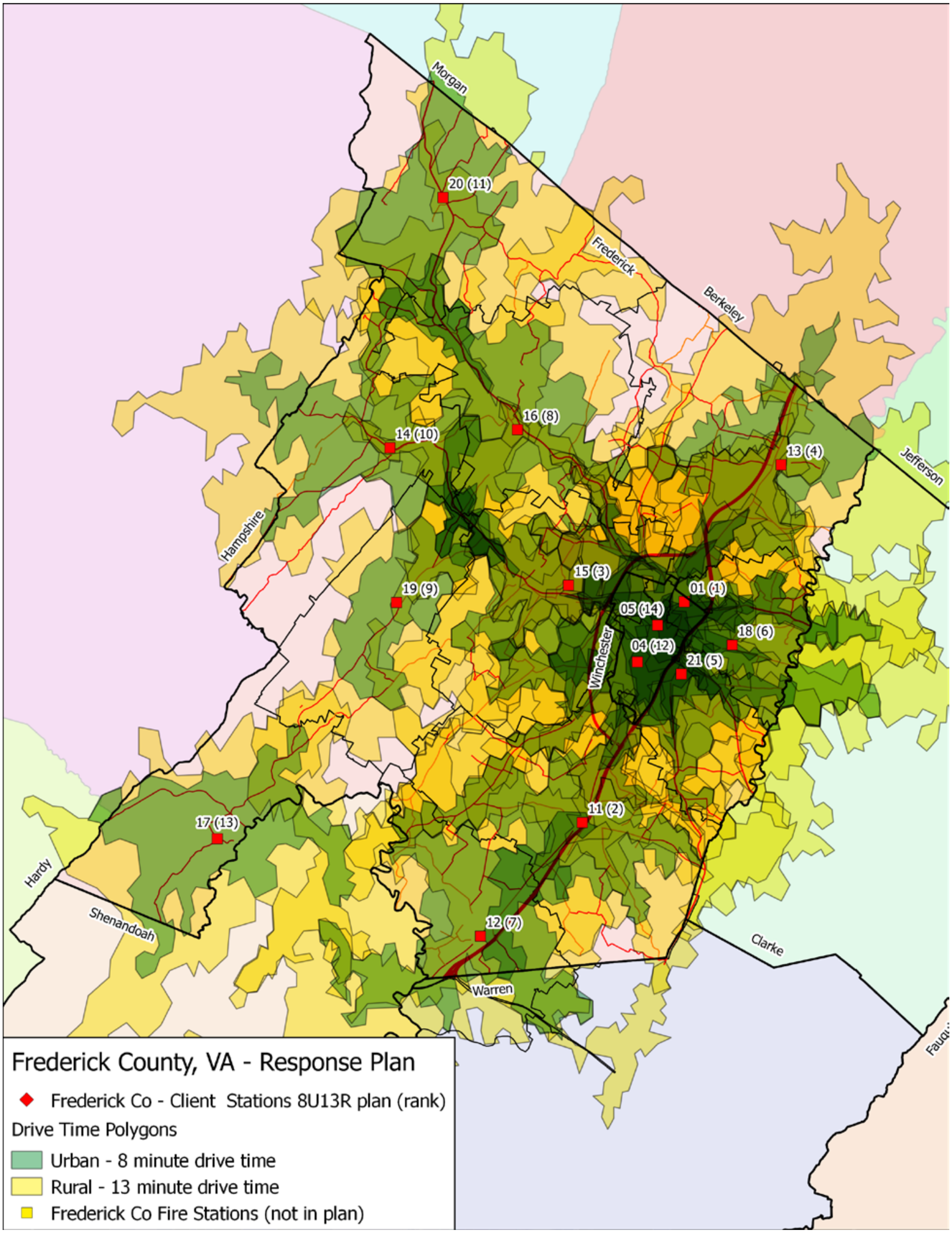
A detailed and comprehensive discussion between Frederick County and Winchester would be needed to contemplate any significant collaboration as would be necessary in this scenario with the associated potential call volume. At the least, what this analysis does suggest is that the City of Winchester's stations are well located to serve the County areas in a controlled and responsible manner when needed.

This scenario falls short of the urban/suburban response of 8-minutes at 90% but does utilize the stations already in the plan to capture nearly 97% of the incidents 13-minutes. Therefore, approximately 3.3% of the incidents in the rural areas would receive service longer than 13-minutes.

Table 7: Marginal Fire Station Contribution for 8-Minute Urban/Suburban and 13-Minute Rural Travel Time

Rank	Station Number	Station Capture	Total Capture	Percent Capture
1	1	2,622	2,622	27.01%
2	11	1,764	4,386	45.19%
3	15	1,049	5,435	56.00%
4	13	539	5,974	61.55%
5	21	459	6,433	66.28%
6	18	287	6,720	69.24%
7	12	254	6,974	71.85%
8	16	250	7,224	74.43%
9	19	227	7,451	76.77%
10	14	199	7,650	78.82%
11	20	186	7,836	80.73%
12	4	170	8,006	82.49%
13	17	156	8,162	84.09%
14	5	32	8,194	84.42%
15	11	572	8,766	90.32%
16	16	244	9,010	92.83%
17	13	169	9,179	94.57%
18	19	91	9,270	95.51%
19	14	69	9,339	96.22%
20	5	47	9,386	96.70%

Figure 5: Travel Time Bleed Maps for 8-Minute Urban/Suburban and 13-Minute Rural Travel Times



10-Minute Urban/Suburban and 13-Minute Rural Travel

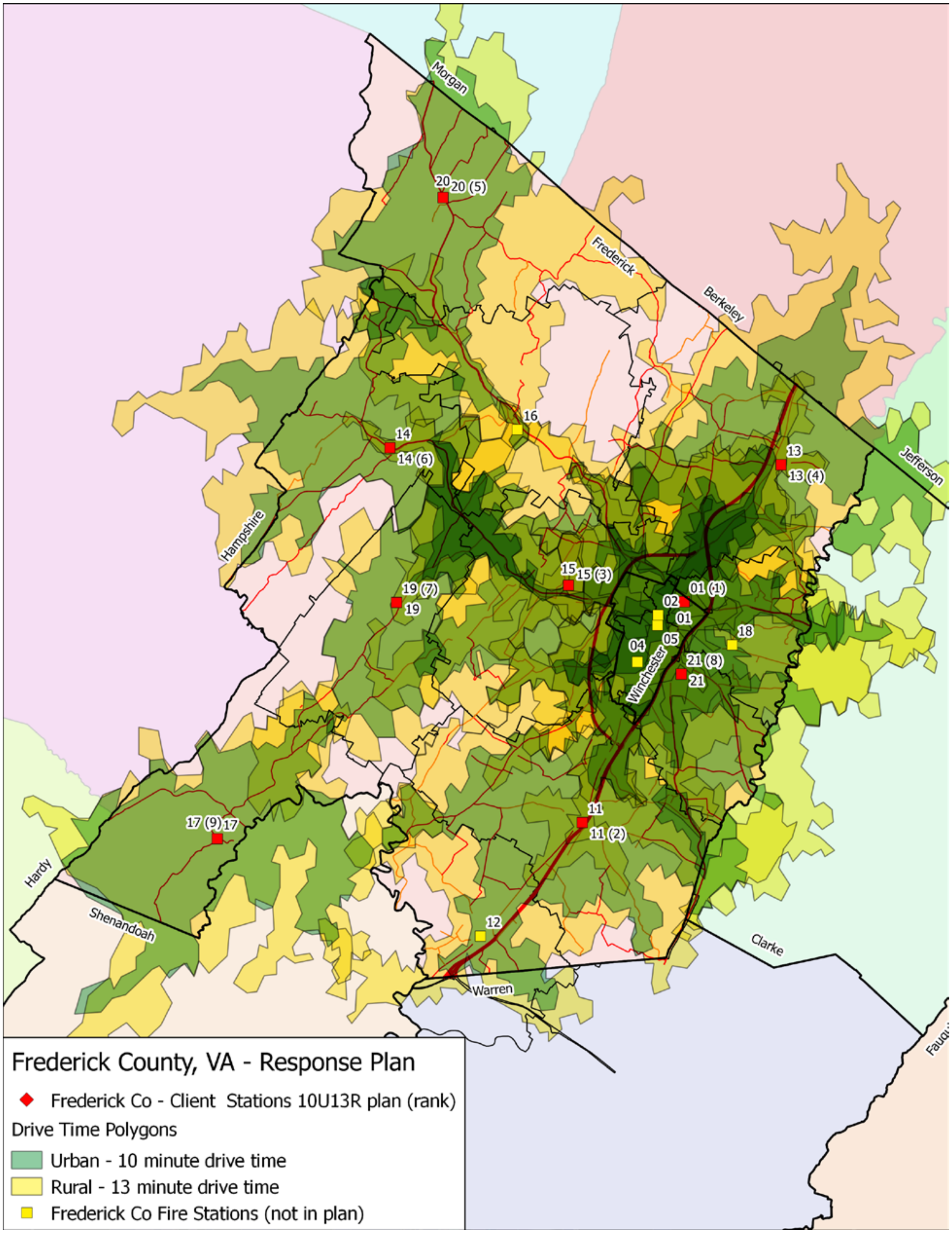
The 10-minute travel time modeling suggests that a 9-station configuration would achieve a travel time of 10-minutes or less to 90.75% of the incidents in the Urban/Suburban areas and over 97% of the rural incidents in 13-minutes or less. Similar to the previous analysis, this assumes collaboration with the City of Winchester. Winchester's Station 1 would be the only station that does not provide any rural coverage and Station 16 is the only station that is needed for rural coverage that was not already included in the requisite stations for the urban and suburban areas.

Therefore, this configuration would require a 10-station deployment model to continue to meet 10-minutes urban/suburban and 13-minutes rural responses for greater than 90% of the incidents. In this model, 2.7% of the rural incidents would have a response time greater than 13 minutes.

Table 8: Marginal Fire Station Contribution for 10-Minute Urban/Suburban and 13-Minute Rural Travel Time

Rank	Station Number	Station Capture	Total Capture	Percent Capture
1	1	4,236	4,236	43.64%
2	11	2,420	6,656	68.58%
3	15	617	7,273	74.93%
4	13	363	7,636	78.67%
5	20	318	7,954	81.95%
6	14	251	8,205	84.54%
7	19	231	8,436	86.92%
8	21	203	8,639	89.01%
9	17	169	8,808	90.75%
10	16	227	9,035	93.09%
11	11	223	9,258	95.38%
12	13	68	9,326	96.08%
13	12	36	9,362	96.46%
14	20	31	9,393	96.78%
15	19	25	9,418	97.03%
16	14	10	9,428	97.14%
17	15	9	9,437	97.23%
18	17	7	9,444	97.30%
19	21	2	9,446	97.32%
20	12	1	9,447	97.33%

Figure 6: Travel Time Bleed Maps for 10-Minute Urban/Suburban and 13-Minute Rural Travel Times



8-Minute Urban/Suburban and 13-Minute Rural Travel - Frederick County Only

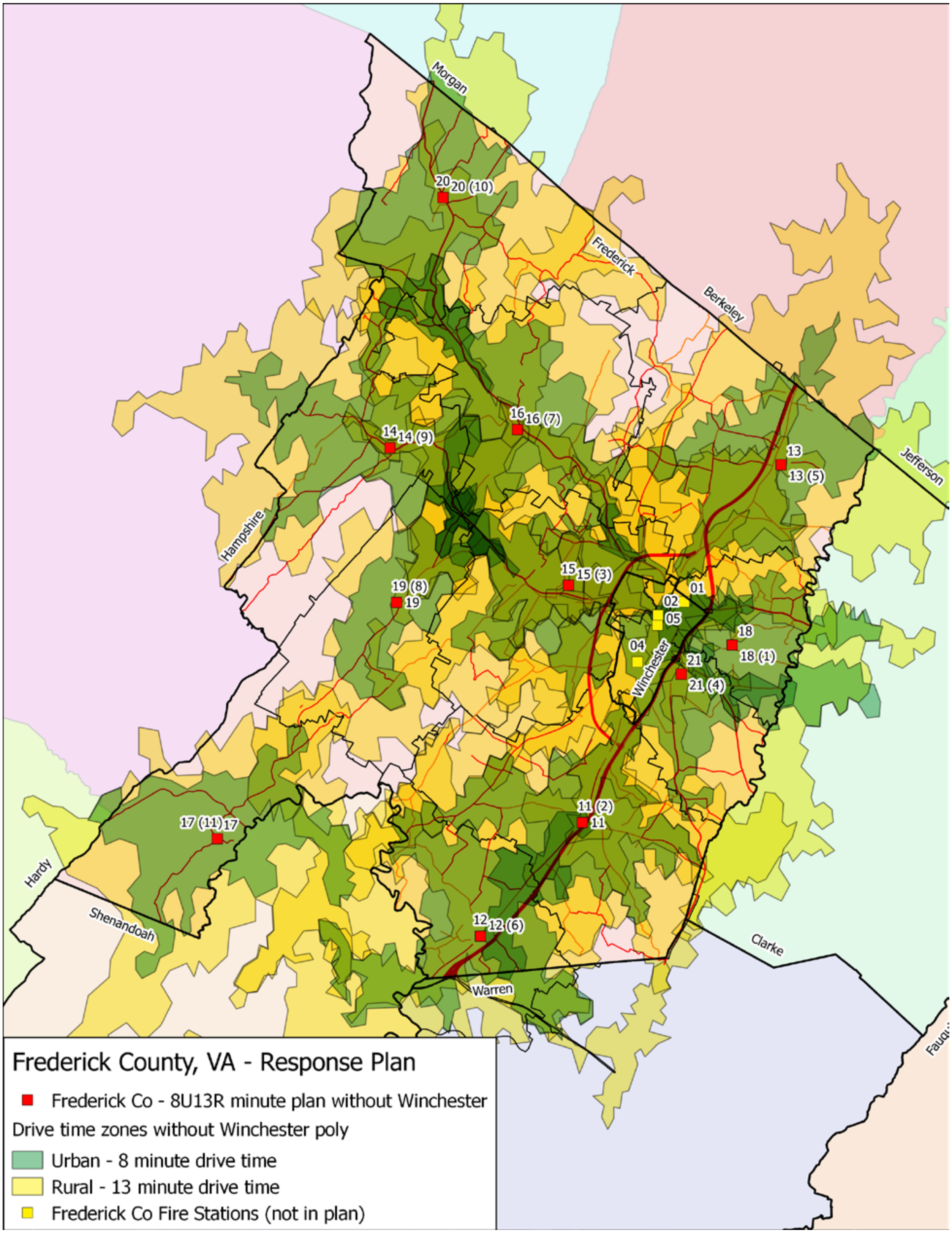
The 8-minute travel time modeling suggests that an 11-station configuration would achieve a travel time of 8-minutes or less to approximately 80% of the incidents in the urban/suburban areas without utilizing the City of Winchester. While it is less efficient than with utilizing Winchester stations, it only accounts for approximately 4% loss of coverage.

This scenario falls short of the urban/suburban response of 8-minutes at 90% and continues to require all 11 current fire station locations. This model would provide for greater than 97% coverage of rural incidents within 13-minutes or less. Therefore, approximately 2.7% of the incidents in the rural areas would receive service longer than 13-minutes.

Table 9: Marginal Fire Station Contribution for 8-Minute Urban/Suburban and 13-Minute Rural Travel Time

Rank	Station Number	Station Capture	Total Capture	Percent Capture
1	18	1,953	1,953	20.12%
2	11	1,764	3,717	38.30%
3	15	1,315	5,032	51.84%
4	21	725	5,757	59.31%
5	13	720	6,477	66.73%
6	12	254	6,731	69.35%
7	16	250	6,981	71.92%
8	19	227	7,208	74.26%
9	14	199	7,407	76.31%
10	20	186	7,593	78.23%
11	17	156	7,749	79.84%
12	21	942	8,691	89.54%
13	11	235	8,926	91.96%
14	16	210	9,136	94.13%
15	19	91	9,227	95.06%
16	13	86	9,313	95.95%
17	14	69	9,382	96.66%
18	20	25	9,407	96.92%
19	12	16	9,423	97.08%
20	15	14	9,437	97.23%
21	17	9	9,446	97.32%

Figure 7: Travel Time Bleed Maps for 8-Minute Urban/Suburban and 13-Minute Rural Travel Times



10-Minute Urban/Suburban and 13-Minute Rural Travel – Frederick Stations Only

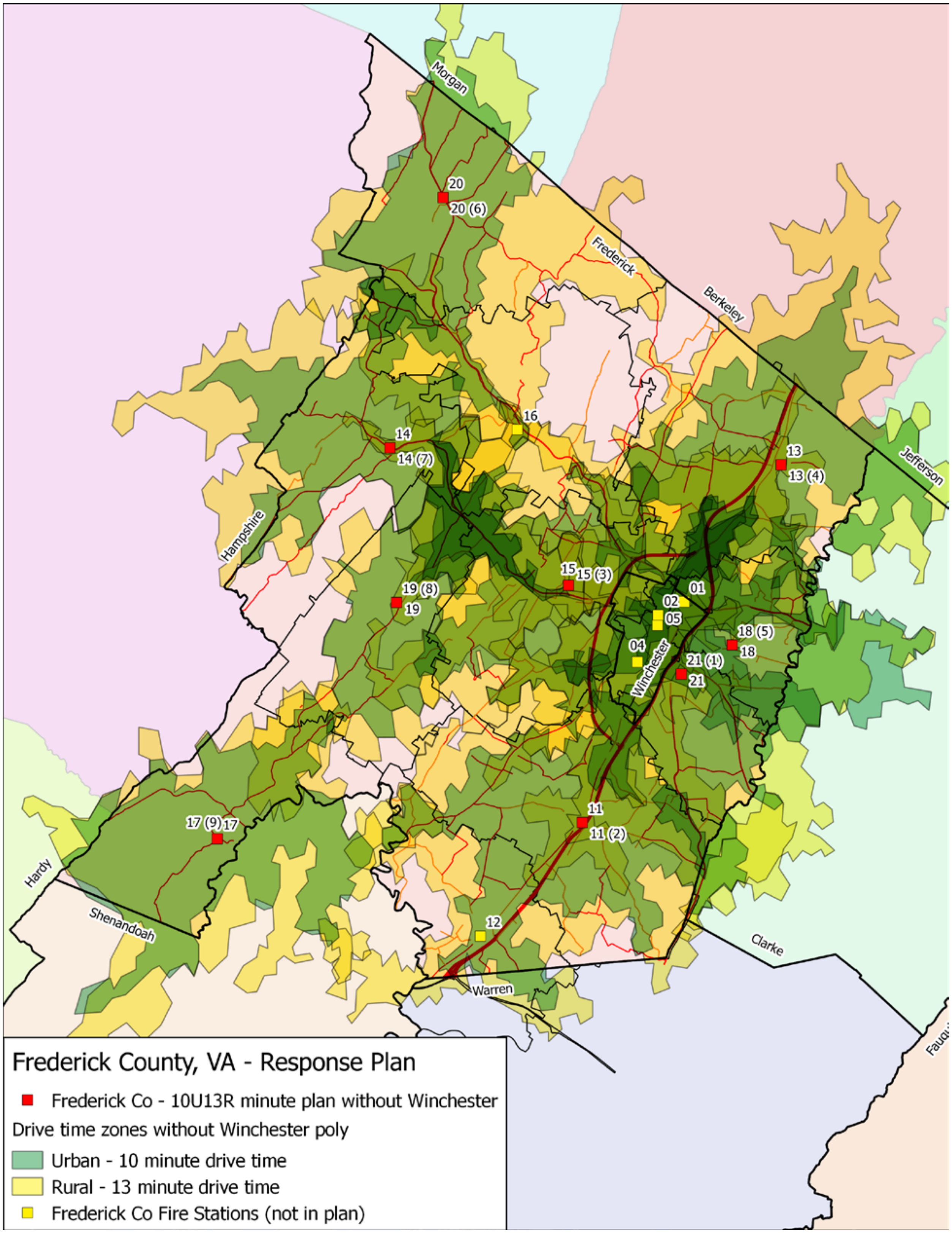
The 10-minute travel time modeling suggests that a 9-station configuration would achieve a travel time of 10-minutes or less to 90.87% of the incidents in the Urban/Suburban areas and approximately 97% of the rural incidents in 13-minutes or less. Similar to the previous analysis, Station 18 would be the only station that does not provide any rural coverage and no additional stations are needed for rural coverage that were not already included in the requisite stations for the urban and suburban areas.

Therefore, this configuration would require a 9-station deployment model to continue to meet 10-minutes urban/suburban and 13-minutes rural responses for greater than 90% of the incidents. *This model requires one less station than if the City of Winchester provided coverage.* In this model, 3.4% of the rural incidents would have a response time greater than 13 minutes.

Table 10: Marginal Fire Station Contribution for 10-Minute Urban/Suburban and 13-Minute Rural Travel Time

Rank	Station Number	Station Capture	Total Capture	Percent Capture
1	21	3,658	3,658	37.69%
2	11	1,694	5,352	55.14%
3	15	1,535	6,887	70.96%
4	13	560	7,447	76.73%
5	18	404	7,851	80.89%
6	20	318	8,169	84.16%
7	14	251	8,420	86.75%
8	19	231	8,651	89.13%
9	17	169	8,820	90.87%
10	11	223	9,043	93.17%
11	20	163	9,206	94.85%
12	15	85	9,291	95.72%
13	13	56	9,347	96.30%
14	17	15	9,362	96.46%
15	14	11	9,373	96.57%
16	19	6	9,379	96.63%
17	21	2	9,381	96.65%

Figure 8: Travel Time Bleed Maps for 10-Minute Urban/Suburban and 13-Minute Rural Travel Times

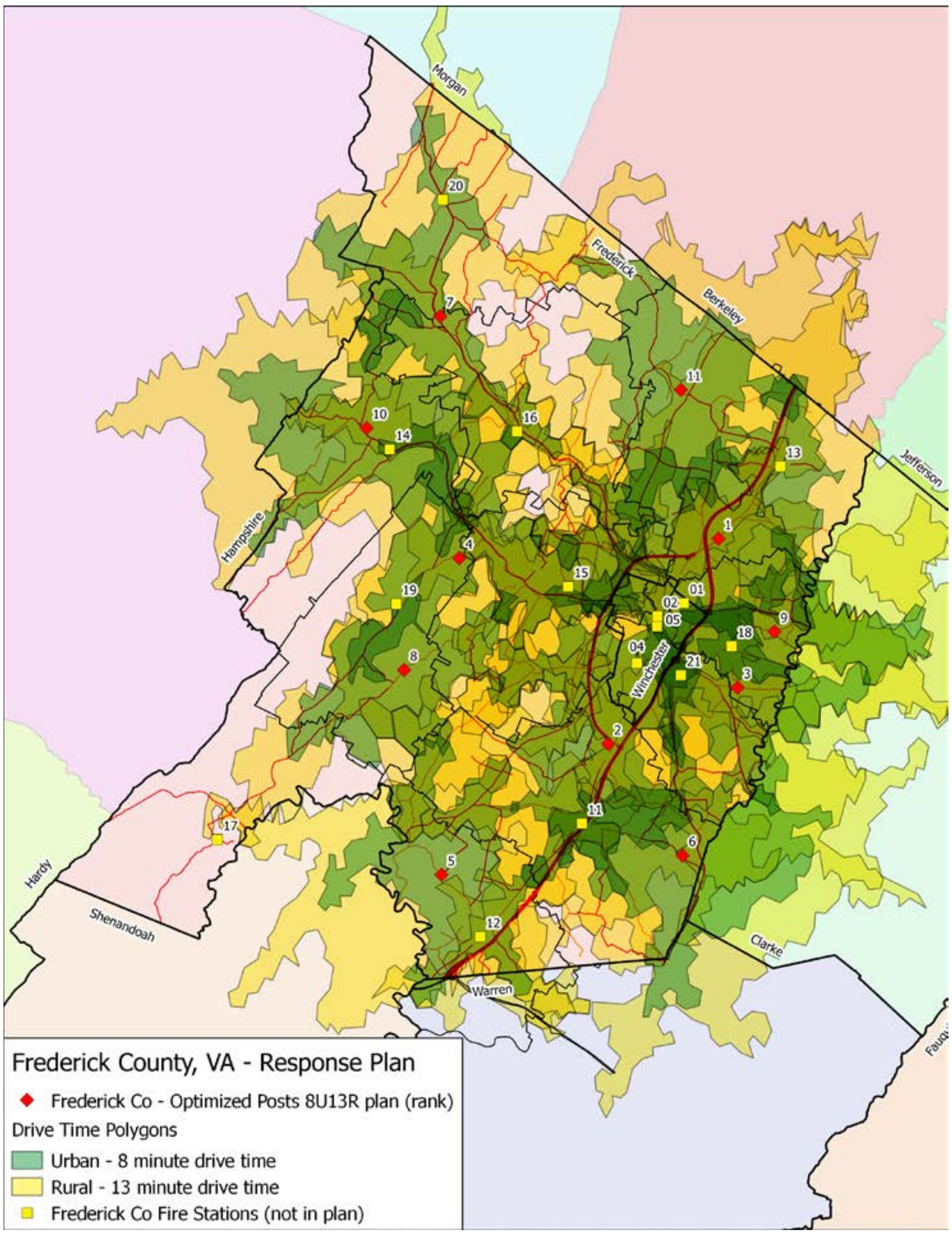


Optimized Station Distribution Plans

8-Minute Urban/Suburban and 13-Minute Rural Travel Time

Analyses were completed to develop an optimized station distribution model for an 8-minute travel time as well. This evaluation suggests, that an optimized 11-station model can provide for 90.6% effectiveness covering all incidents within 8-minutes or less travel time in the urban/suburban areas and 96.96% in 13-minutes in the rural areas. In comparison, the current station distribution would require more than 14 stations. Alternatively, the current 11-station configuration can achieve 84% at 8-minutes. A graphic illustration is presented below.

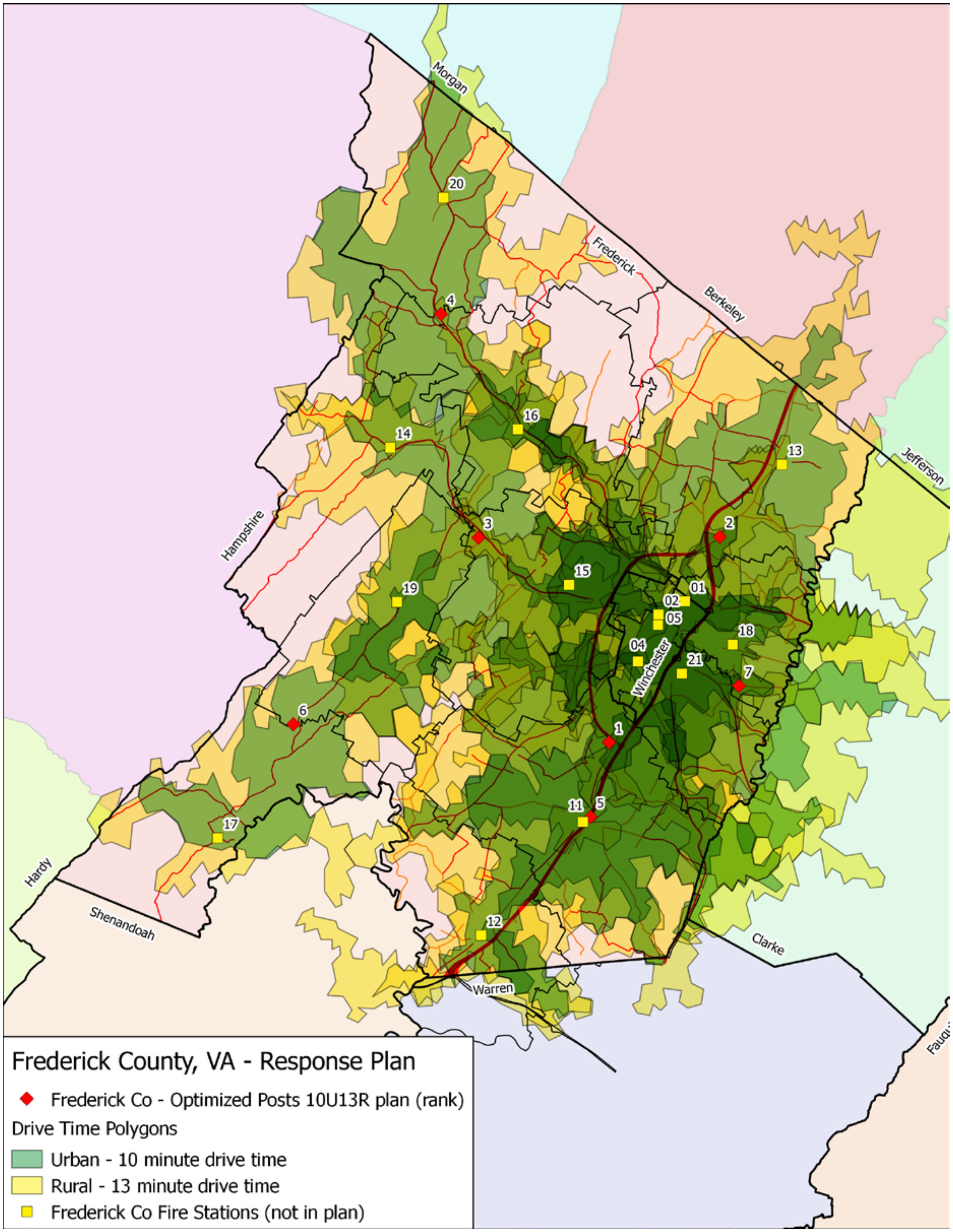
Figure 9: Optimized Station Deployment Plan - 8-Minute Urban/Suburban and 13-Minute Rural Travel Time



10-Minute Urban/Suburban and 13-Minute Rural Travel Time

Analyses were completed to develop an optimized station distribution model for a 10-minute travel time as well. This evaluation suggests, that an optimized 7-station model can provide for greater than 90% effectiveness covering all incidents within 10-minutes or less travel time for urban/suburban areas and 96.57% within 13-minutes in the rural areas. In comparison, the current station configuration would require 9 stations for commensurate service. A graphic illustration is presented below.

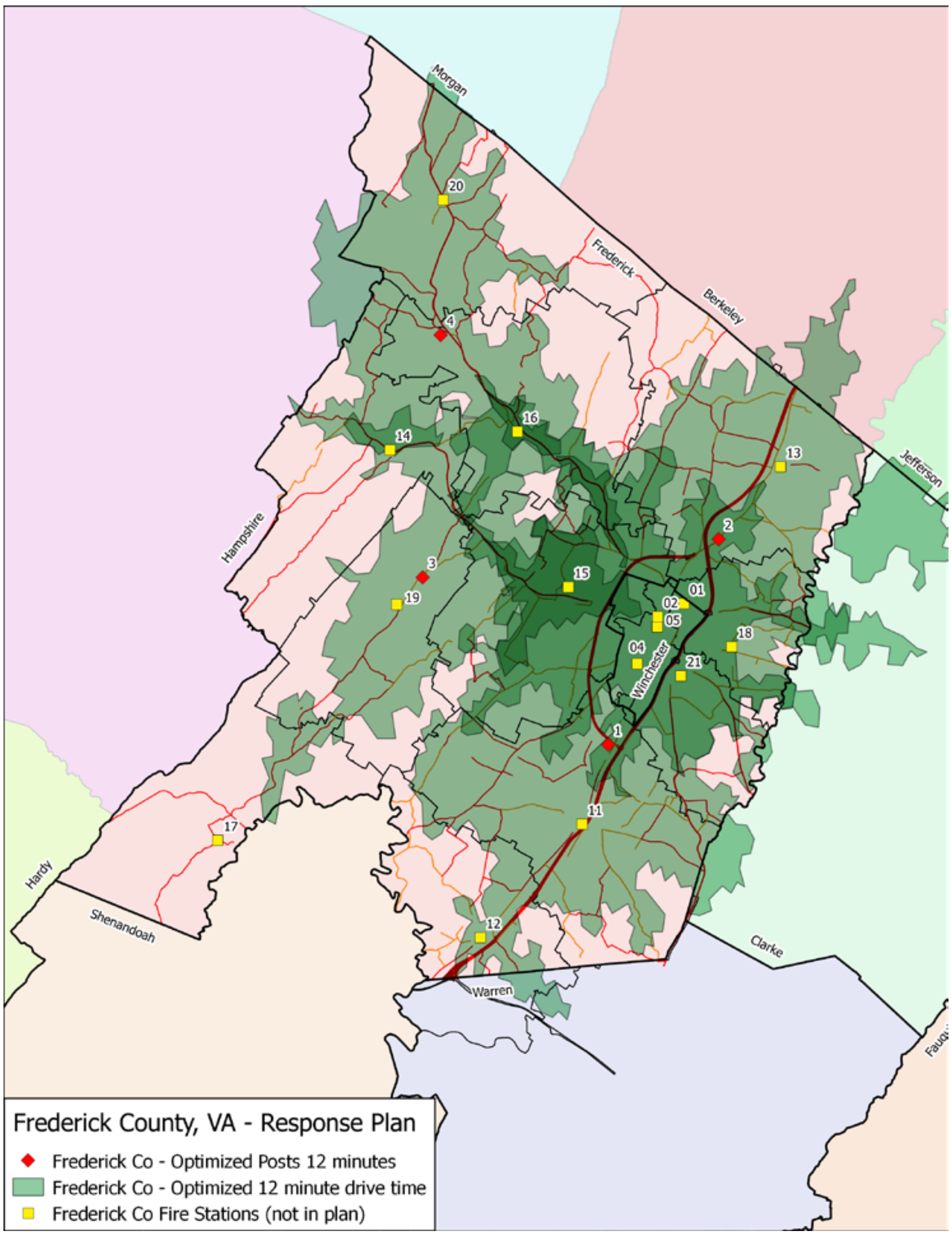
Figure 10: Optimized Station Deployment Plan - 10-Minute Urban/Suburban and 13-Minute Rural Travel Time



12-Minute Travel Time

Analyses were completed to develop an optimized station distribution model for a 12-minute travel time. This evaluation suggests, that an optimized 4-station model can provide for greater than 90% effectiveness covering all incidents within 12-minutes. A graphic illustration is presented below. When referring to the figure below, it is evident that the optimized station locations would require 4-fixed facilities to meet the geographic limitations within the response jurisdiction. For reference, the current configuration would require a total of 5-fixed facilities to meet 90% of the incidents within the desired performance window.

Figure 11: Optimized Station Deployment Plan – 12--Minute Travel Time



Geographic Coverage without Consideration for Call Distribution

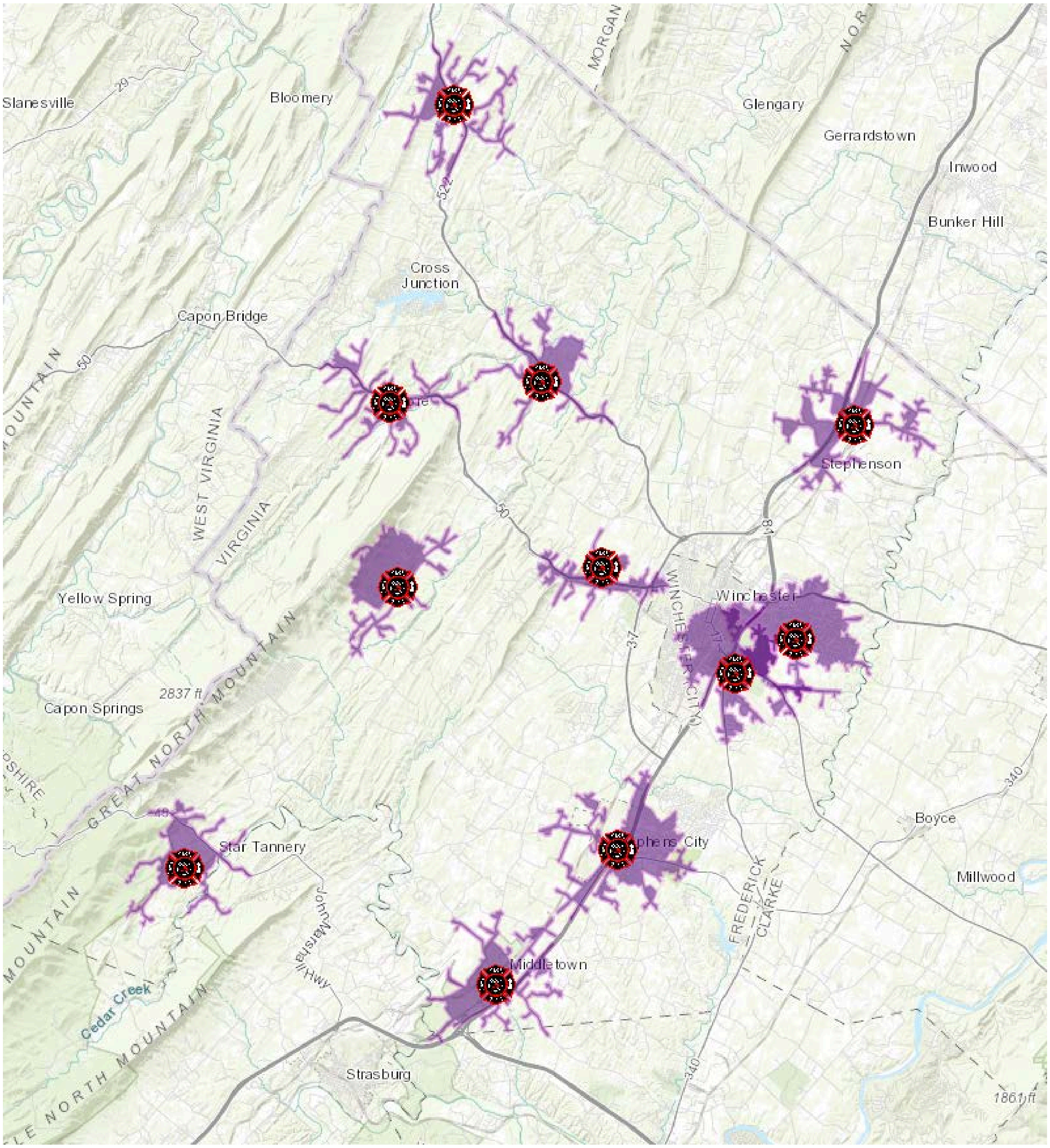
While there are multiple deployment strategies that may be adopted, two clear policy positions emerge in communities. First, position stations that are best prepared to meet the community's historical distribution of calls or demand for services. The advantage to this approach is that it is a more efficient model to address meeting 90% of the risk within the desired performance. This is a very stable outlook for communities that are established and are growing in density or in-fill rather than through significant annexations or urban growth.

A second strategy is to provide station response coverage purely on a geographic lens without any consideration for how calls are distributed throughout the community. In addition, this analysis utilized distance without consideration to the relative impendence and/or the robustness of the road network. For example, when time is the unit of measure, a station could travel a farther distance on a highway then through a school zone but this approach caps the coverage area at 1.5 miles regardless of available travel speeds. This strategy more closely follows the recommendations of the Insurance Services Office (ISO). Therefore, the following analyses examine the current coverage areas through the lens of ISO utilizing 1.5-mile engine, 2.5-mile truck polygons, and 5-mile station locations, respectively. However, analyses at the 2.5-mile polygon demonstrated that the distances between stations would far exceed the capability to cover within 1.5-miles.

Engine/Ladder Coverage 2.5 Miles

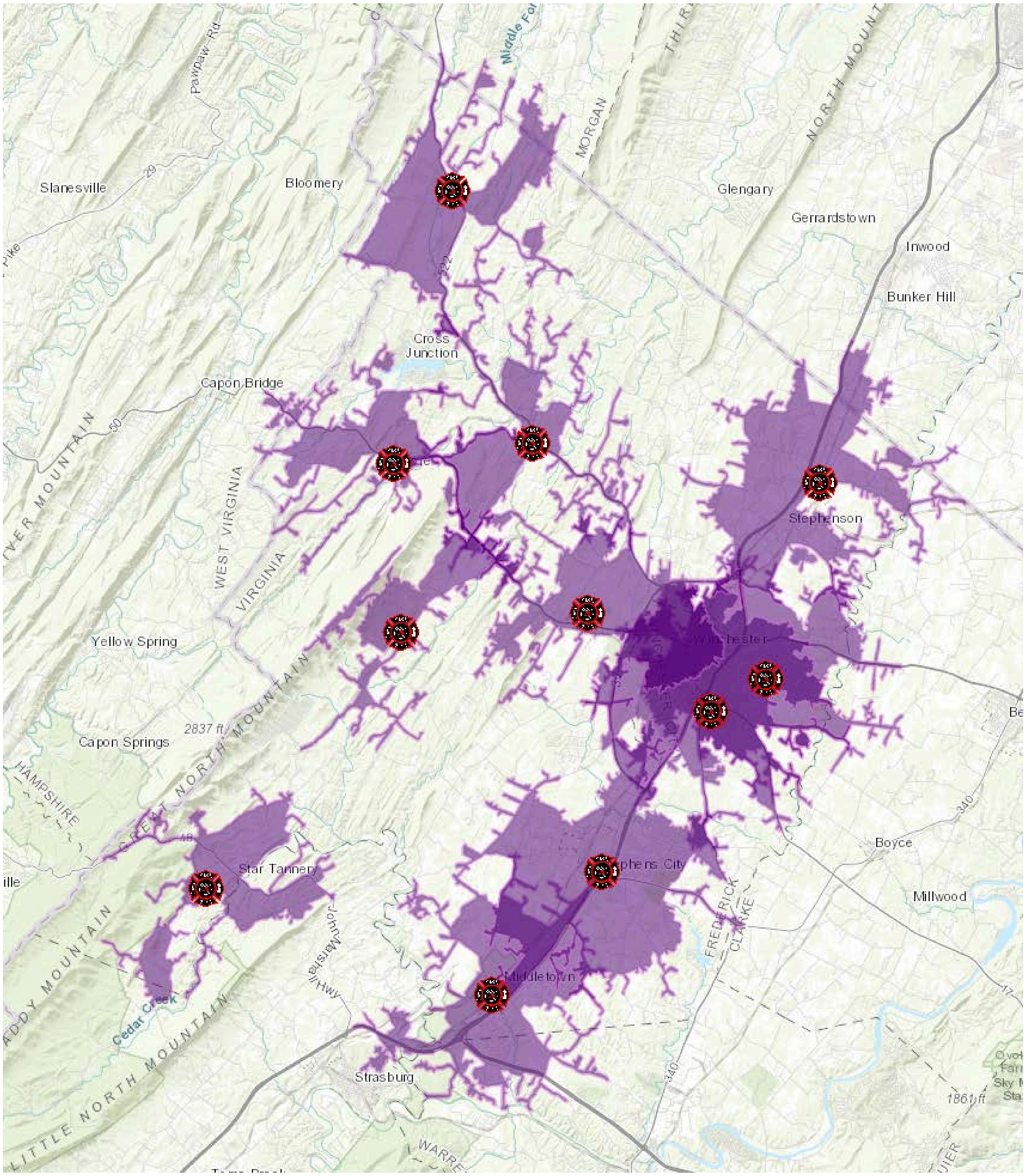
When examining the 2.5-mile polygons for truck coverage, the Department does not have sufficient coverage based on the potential geographic coverage only and without consideration for the distribution of risk or built-upon areas. ISO will afford additional points for having either a ladder/tower truck or quint at more than 50% of the stations. Results are provided below.

Figure 12: All Current Stations - ISO 2.5 Mile



Finally, analyses of the ISO 5-Mile distance between stations and built-upon property, suggests that only Star Tannery Station 17 in the southwestern end is outside of the 5-road miles.   Mapping is provided below.

Figure 13: All Current Stations - ISO 5 Mile



EFFECTIVE RESPONSE FORCE MAPPING

Similar to previous discussion, there are two prevailing recommendations for the time to assemble an effective response force for structure fires. First, NFPA 1710 suggests that the Effective Response Force (ERF) should arrive in eight (8) minutes travel time or less in the urban areas. Second, the CFAI provides a baseline travel time performance objective of 10 minutes and 24 seconds 90% of the time or less in the urban areas. Additionally, the CFAI allows for 13-minutes in the suburban areas and 18 minutes in the rural areas. Therefore, both 10, 13, and 18-minute travel times were created to demonstrate the relative coverage throughout the jurisdiction.

Overall, the ERF coverage is more robust near the municipal centers where the greatest historical demand exists. The rural areas of the county are more challenged since they do not benefit from concentric response zones.

Figure 14: 10-Minute ERF – All Current Stations

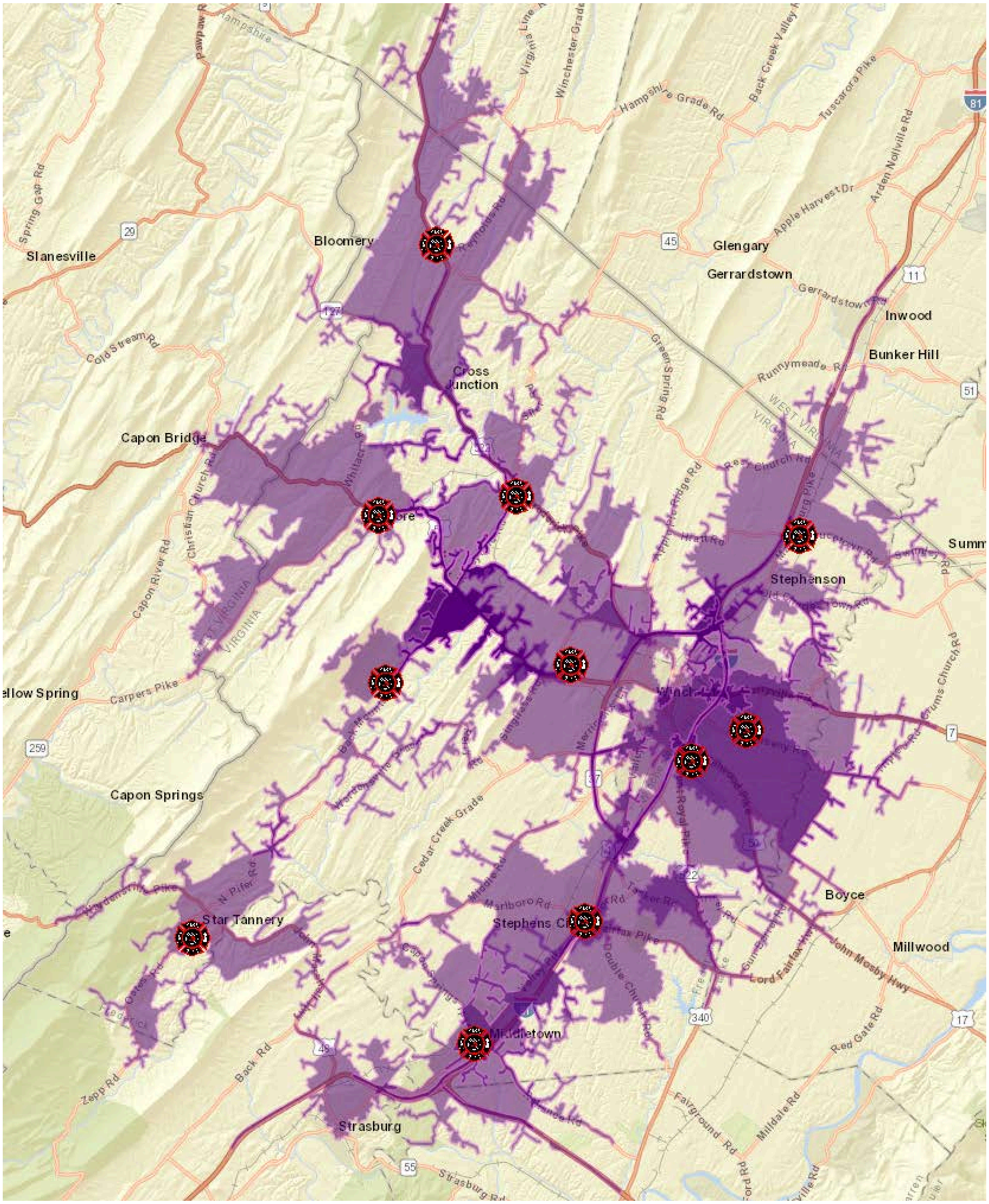


Figure 15: 13-Minute ERF from All Current Stations

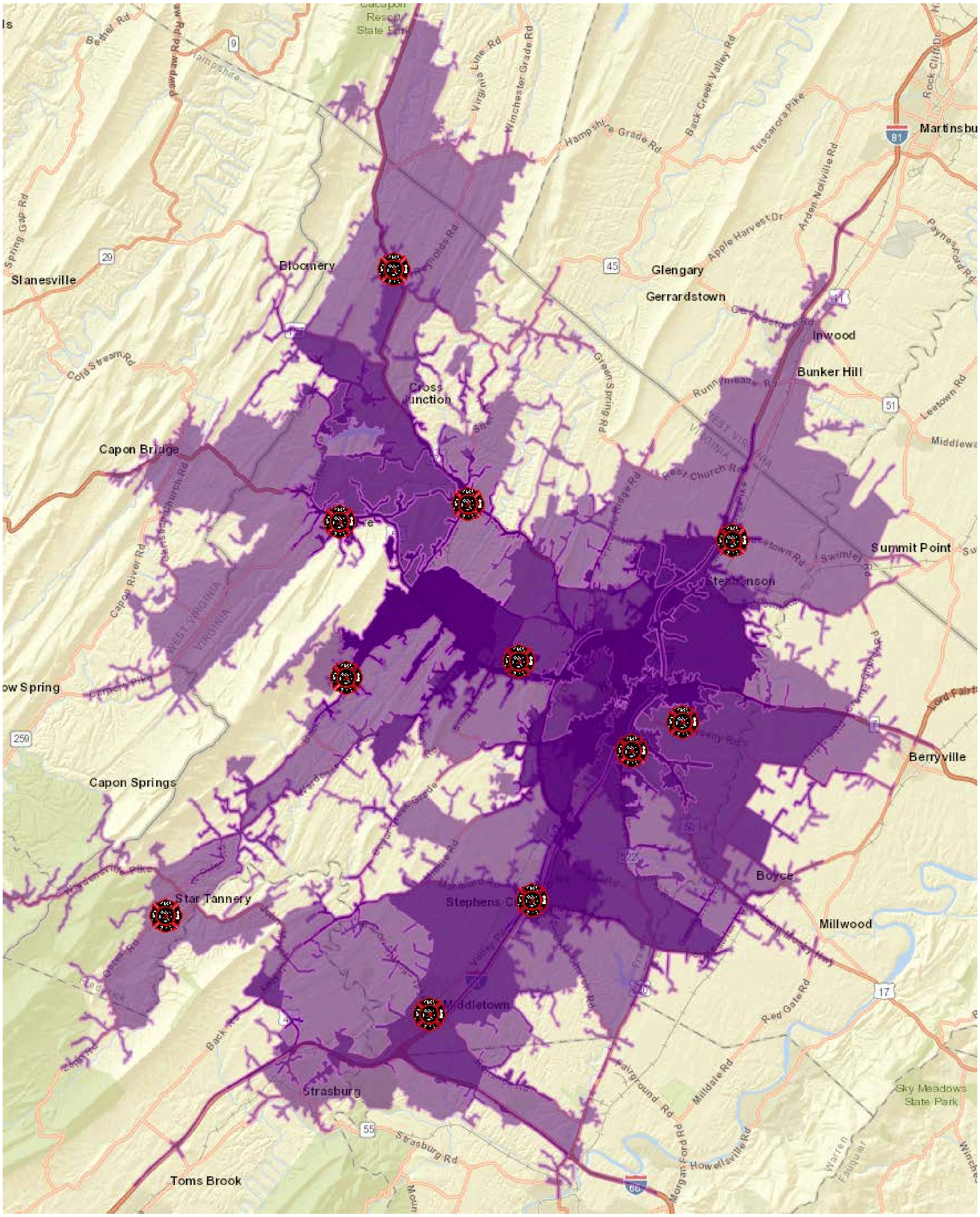
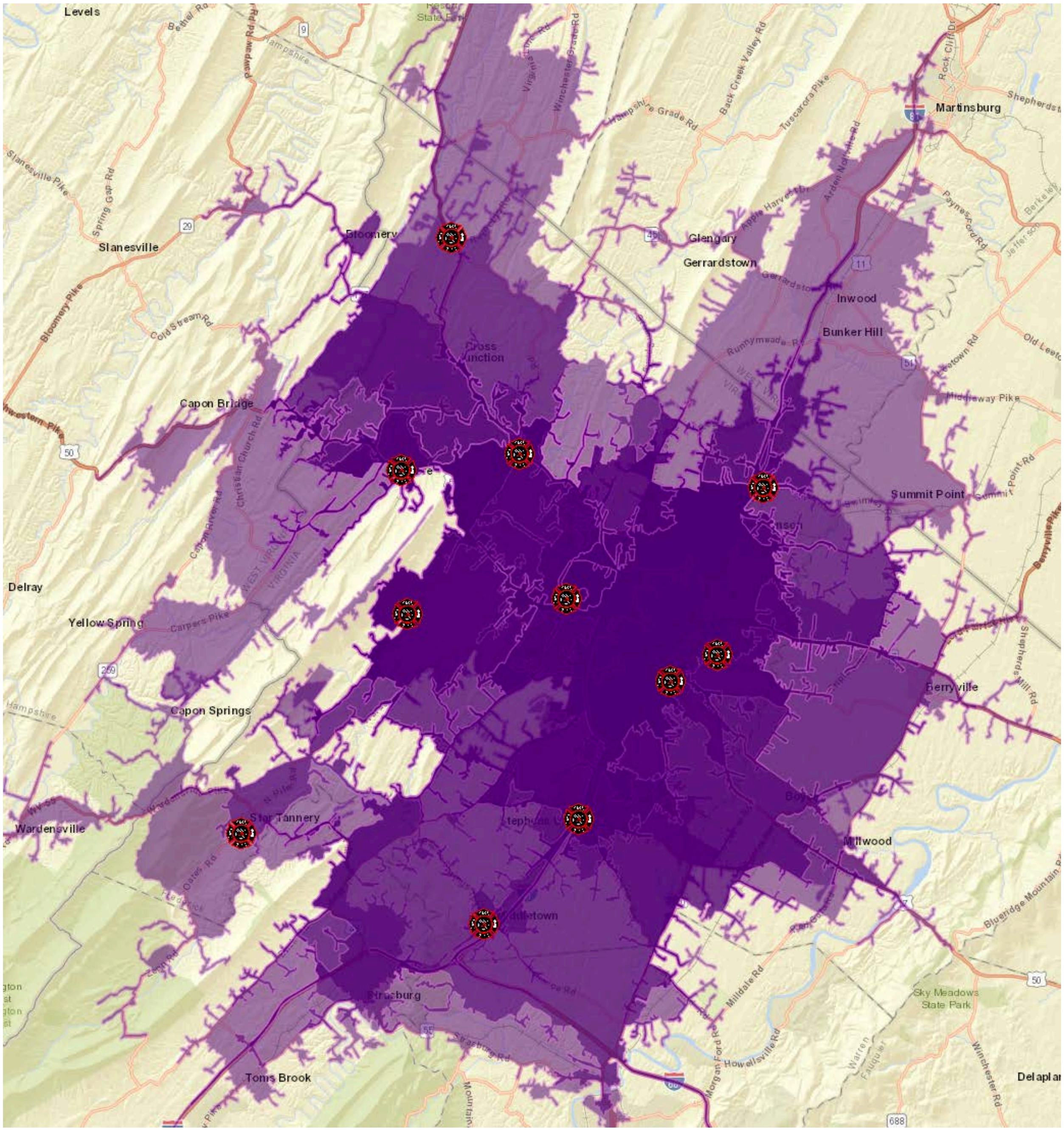


Figure 16: 18-Minute ERF from All Current Stations



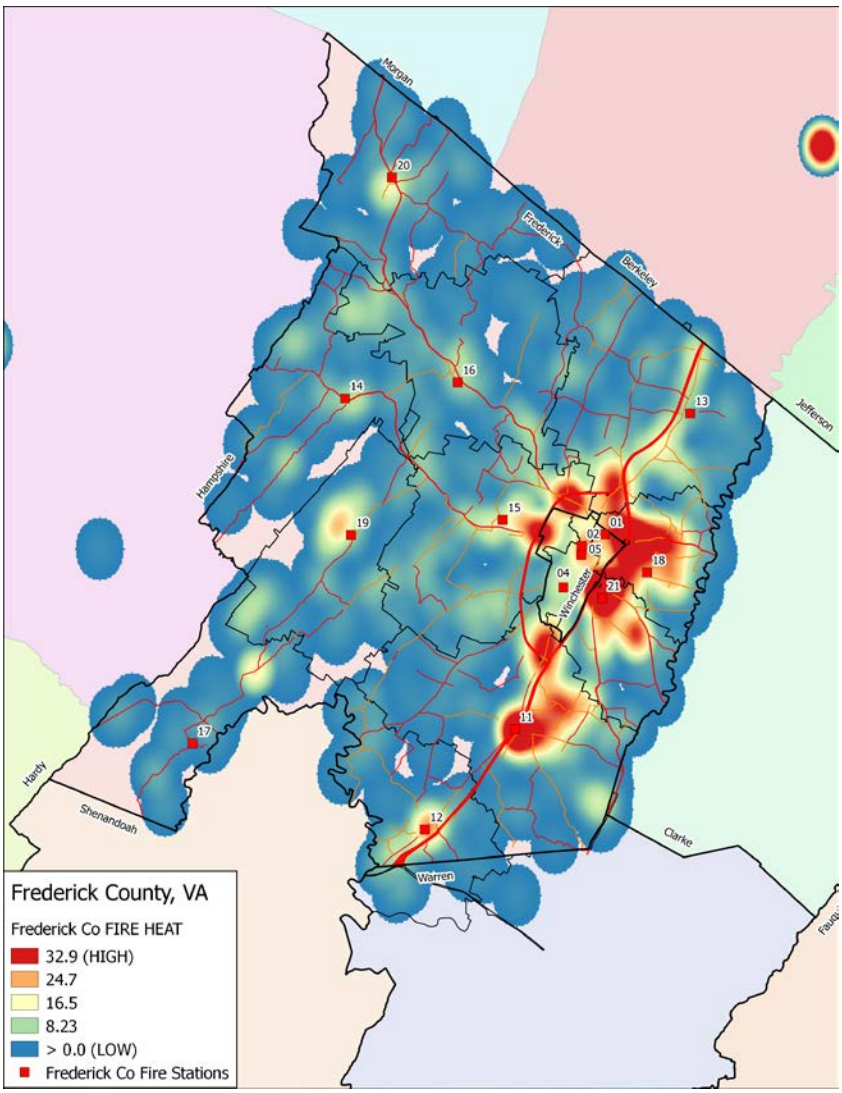
DISTRIBUTION OF RISK ACROSS THE JURISDICTION

Distribution of Demand by Program Areas

Heat maps were created to identify the concentration of the historic demand for services by program area. Therefore, the following mapping will present the relative concentration of service demands by fire and EMS, respectively. The Blue areas have the least demand and the dark red areas have the highest concentration of demand.

When reviewing the heat maps, it is clear that the greatest relative density of service demands is generally located near Station's 11, 21, and 18 and around the perimeter of the City of Winchester. However, the rather infrequent experience of the fire demands lend to a more evenly distributed profile across the County.

Figure 17: Heat Map for Fire Related Incidents



The distribution of EMS calls follow a similar pattern as the fire related incidents, however, the distribution may be more concentrated than with the fire incidents. Therefore, the concentration of incidents is much more clearly defined in and around Station's 11, 21, 18, and 15 around the perimeter of Winchester. Since the majority of calls are for EMS incidents, ALL Calls follows a similar pattern. The mapping output is provided below.

Figure 18: Heat Map for EMS Related Incidents

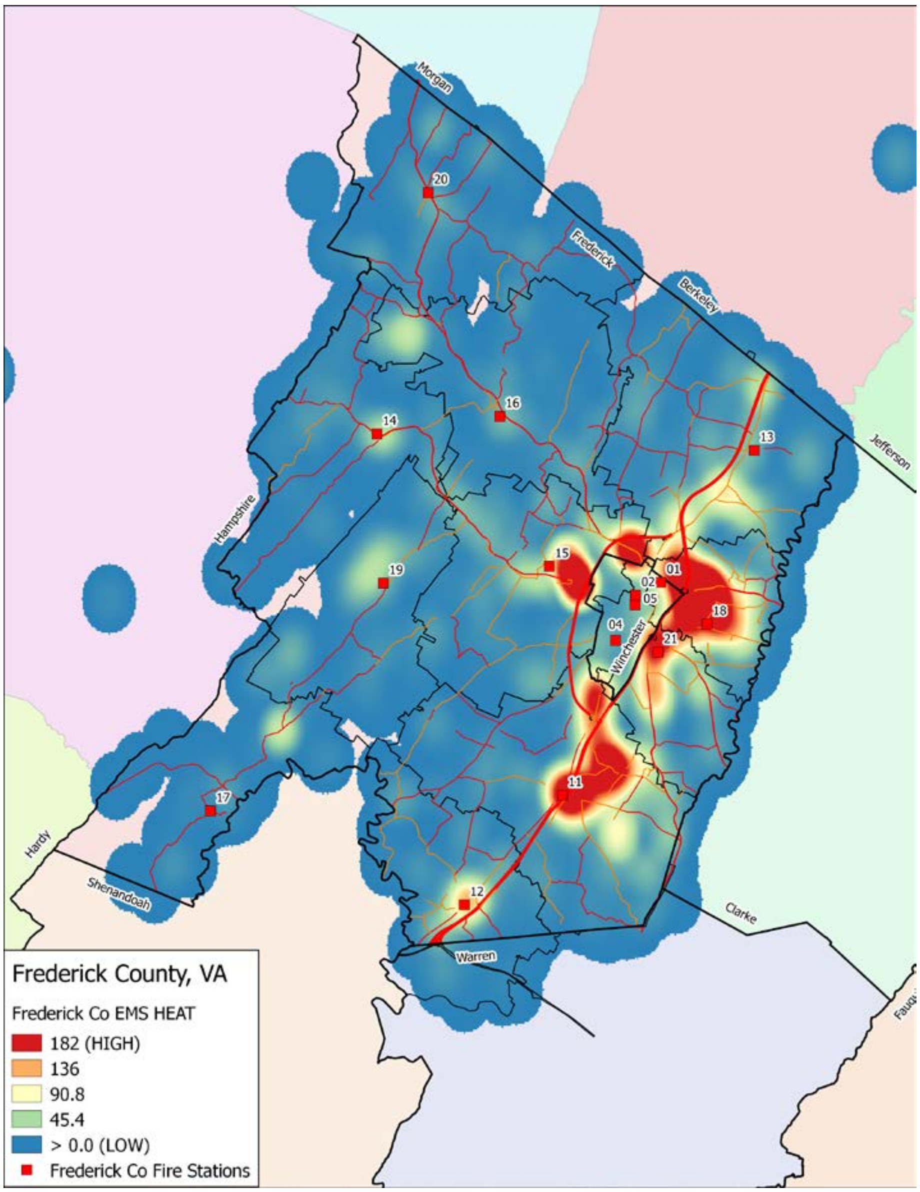
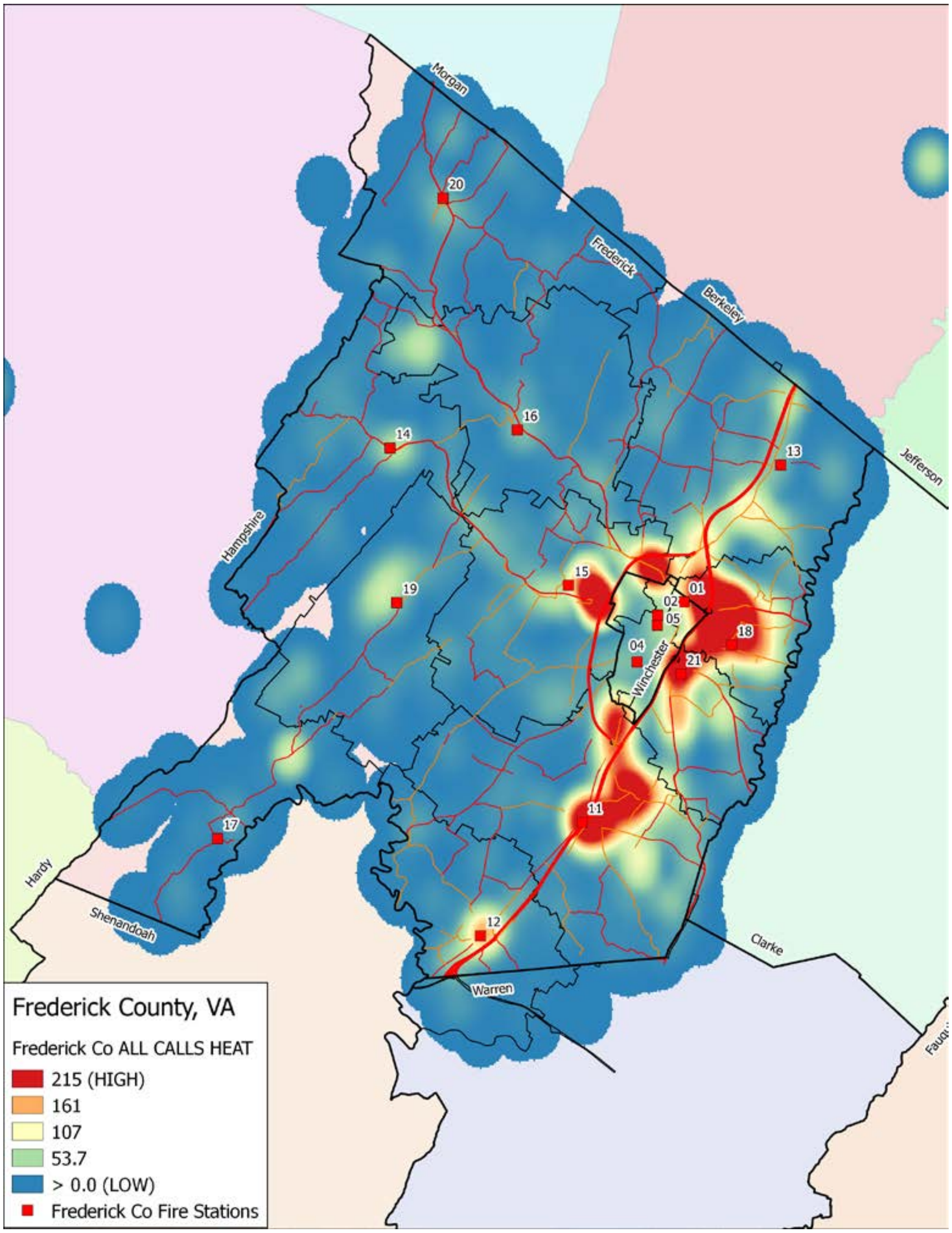
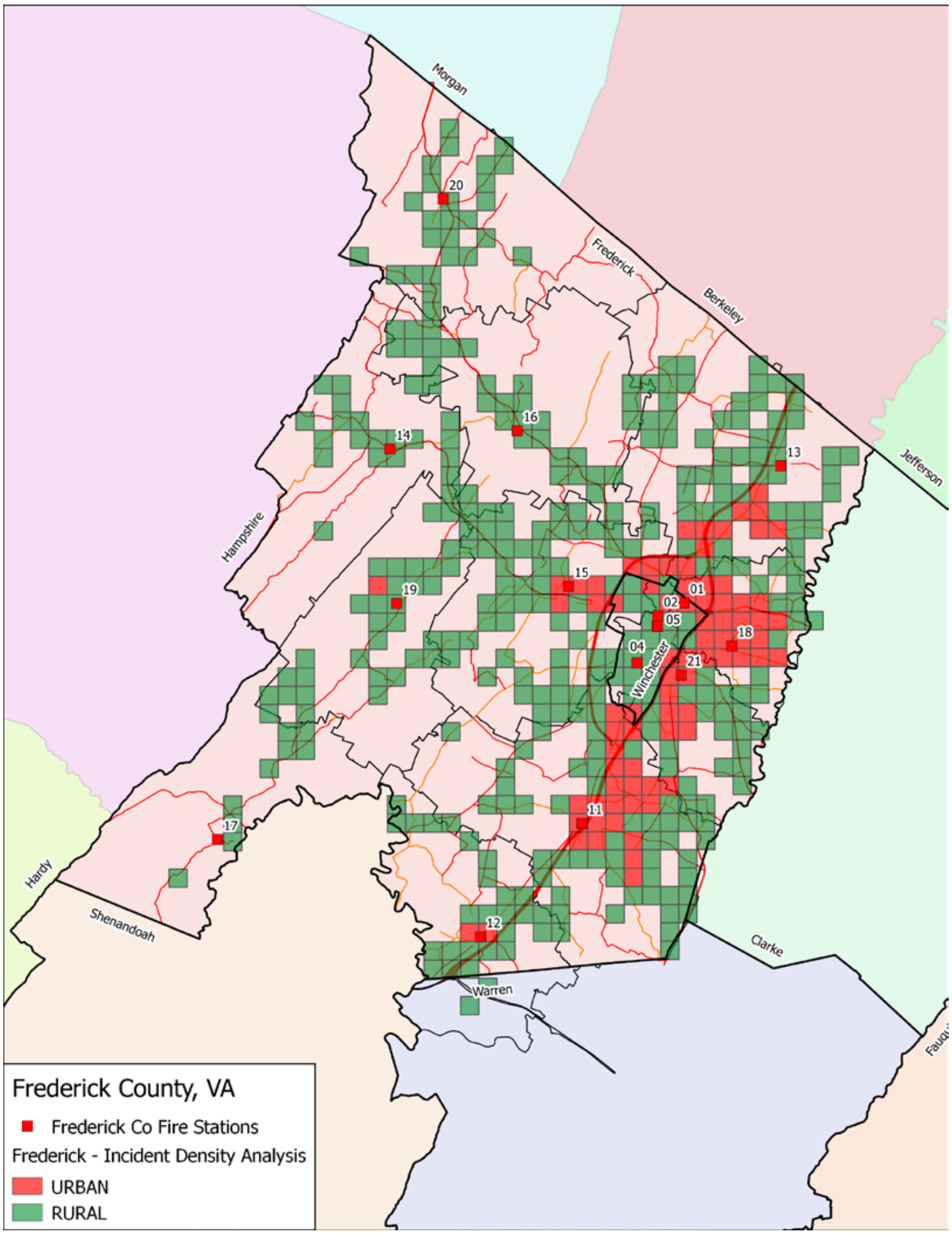


Figure 19: Heat Map for All Incidents



Finally, we calculate call density based on the relative concentration of incidents based on approximately 0.5-mile geographic areas as well as the adjacent 0.5-mile areas. The results demonstrate an urban and rural designation based on call density for services and not based on population. The red areas are designated as urban service areas and the green areas are designated as rural service areas. Any area that is not colored has less than one call every six months in the 0.5-mile area and the adjacent areas.

Figure 20: Urban and Rural Call Density Map with Current Stations



Long-Term Sustainability of the Models Presented

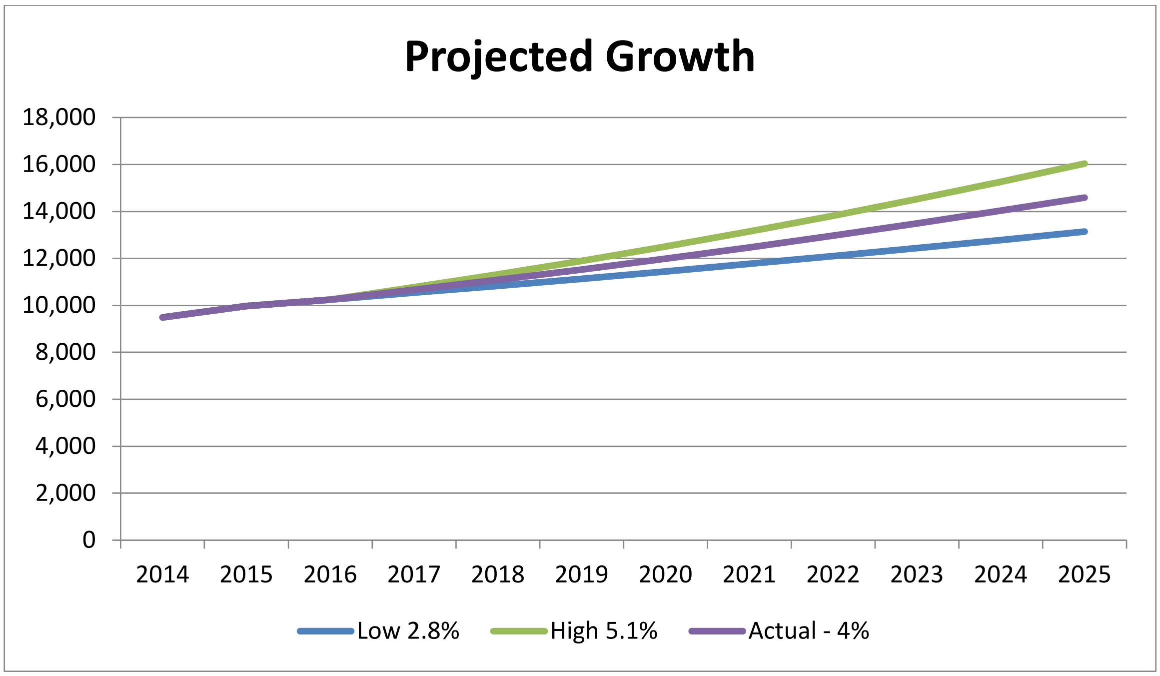
It is important to understand that the distribution models are restrictive to the geographic limitations of the jurisdiction and the historical demand for services. Therefore, the number of stations is descriptive of the number of fixed facilities required from which to deploy resources. These analyses do not specifically describe the concentration of resources required at each fire station facility to adequately handle the demand for services. For example, some stations may require two or more units in order to handle the demand for services.

With respect to the long-term sustainability of the deployment models presented here, the models will remain accurate for as long as the jurisdictions' overall coverage area has not expanded. In other words, since the County's square mileage will remain constant, then the deployment strategy will be sustainable indefinitely with respect to the coverage area. As other variables such as population density or changes in socioeconomic status change over time, there may be a need for a higher concentration of resources necessary to meet the growing demand for services, but not additional stations. The most prominent reason that the geographic distribution model would need to be updated is for changes in traffic impedance that significantly limit the historical average travel speed. Monitoring travel time performance, system reliability, and call concurrency will provide timely feedback for changes in the environment that could impact the distribution model.

Projected Growth

The available data set was restricted to two years with an annualized growth of approximately 4%. The following straight-line projection should be used with caution due to the variability across years. Therefore, data must be reviewed annually to ensure timely updates to projections with the goal of utilizing at least 5-years of continuous data.

Figure 21: Projected Growth of 4.02%

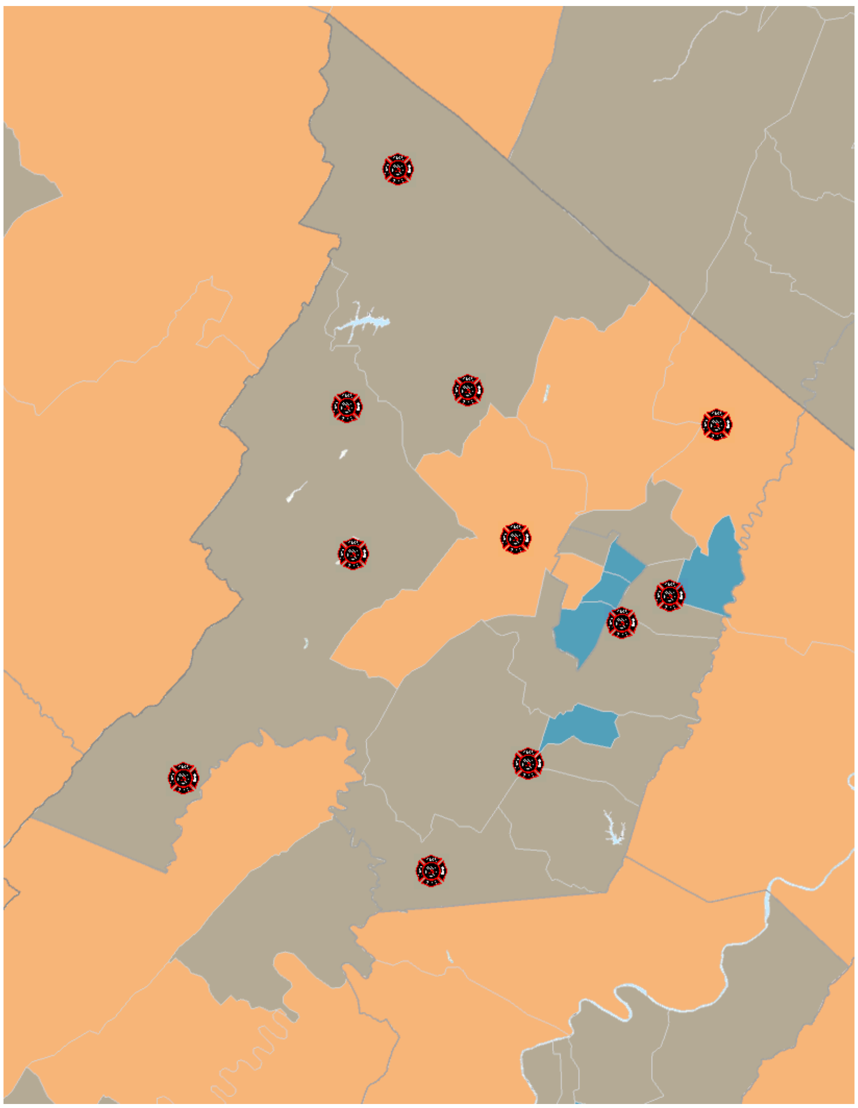


Assuming that future demands will be reasonably distributed across the various stations in the system, the system will require a redistribution of workload and ultimately reinvestment in resources to meet the growing demand. While the system should be evaluated continuously for performance and desired outcomes, the department should specifically re-evaluate workload and performance indicators for every 1,000-call increase to ensure system stability.

Population Characteristics

Generally, older populations and very young populations are considered to be most vulnerable to the frequency and incidents of fire. In addition, older populations historically utilize EMS services with greater frequency. It is important to understand, what field crews often recognize intuitively, is that the distribution of population risks are not uniform across the jurisdiction. According to these data, overall the median age is less than 52. The median age is provided below.

Figure 22: Median Age - 2016



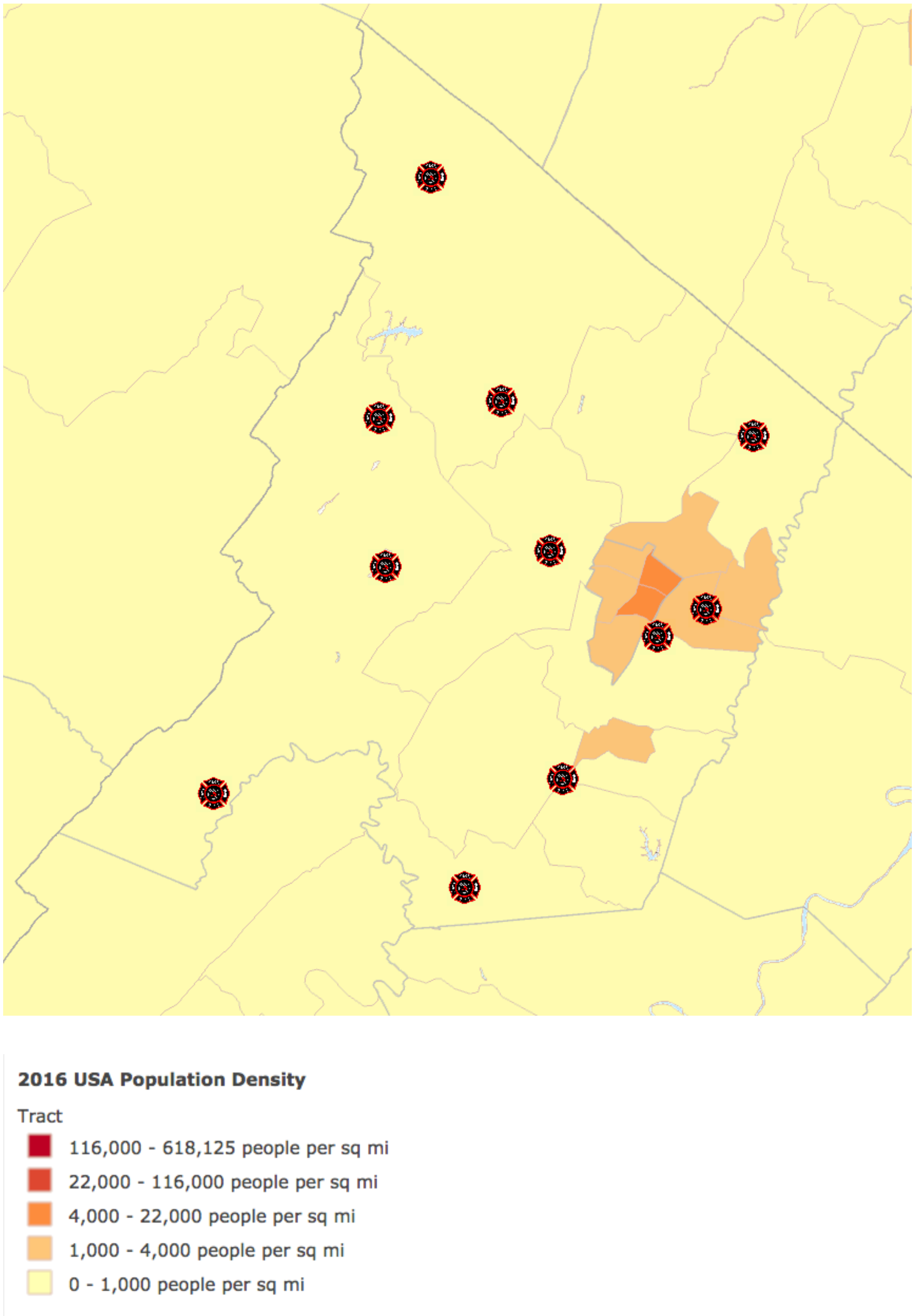
2016 USA Median Age

Tract

- 52 - 86 years of age
- 44 - 52 years of age
- 36 - 44 years of age
- 27 - 36 years of age
- 0 - 27 years of age

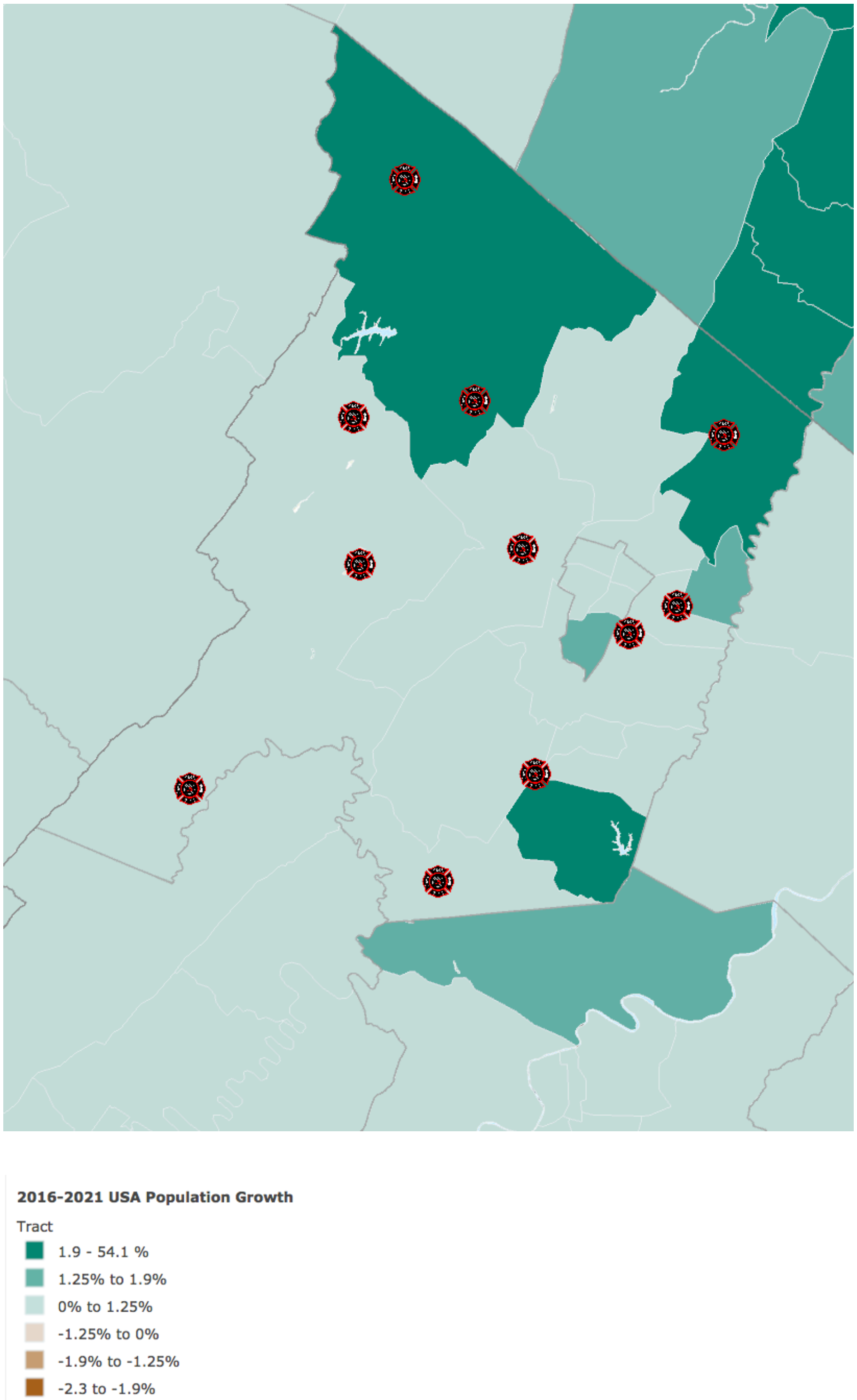
The population density in the County is largely of a rural density with some urban/suburban areas near the municipal boundaries.

Figure 23: Population Density by Census Block - 2016



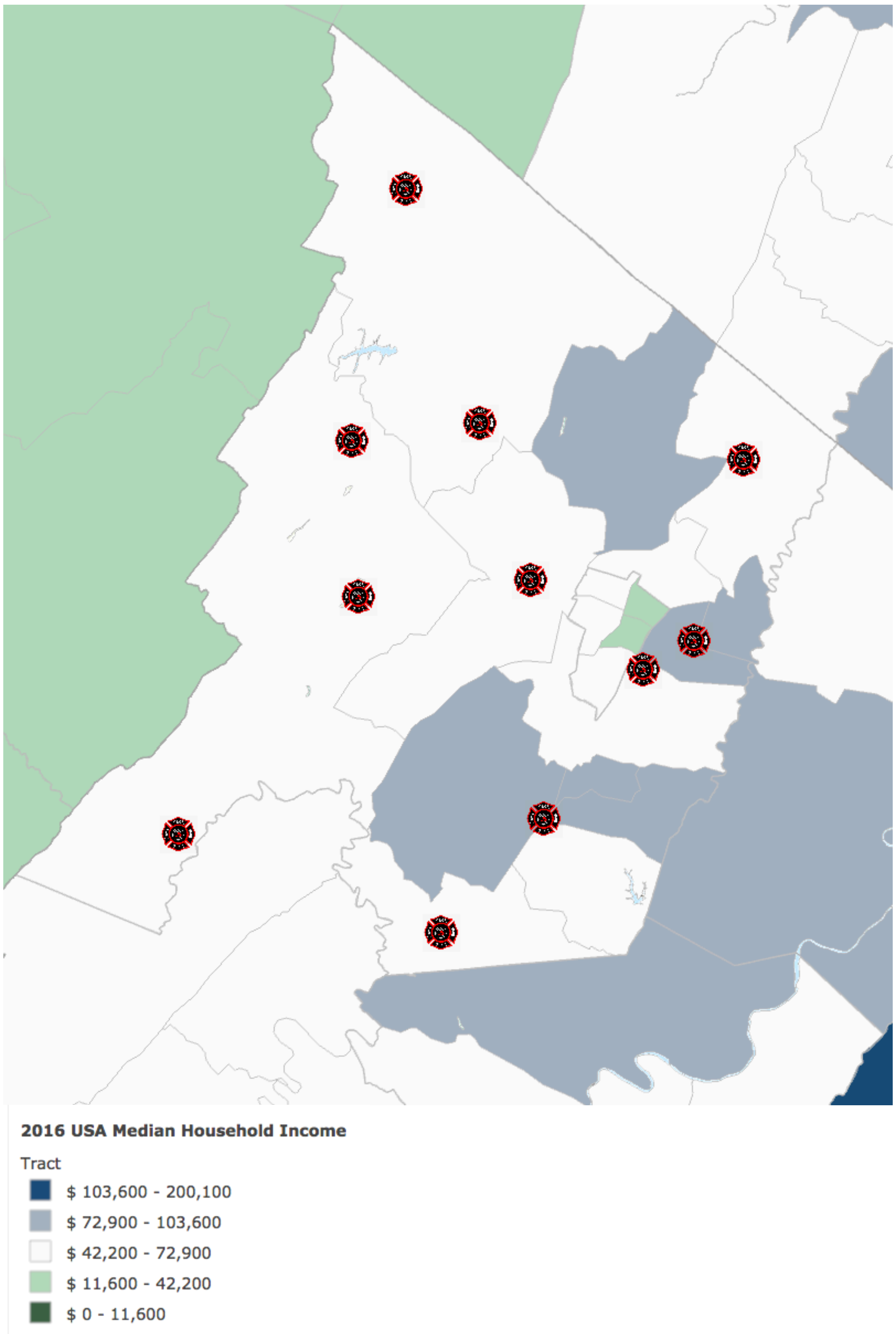
However, as a growing community, the population change is increasing at a moderate rate. The greatest growth areas are to the northwest, northeast, and southeast portions of the county. There are no reductions in population projected.

Figure 24: Annual Population Change 2016-2021



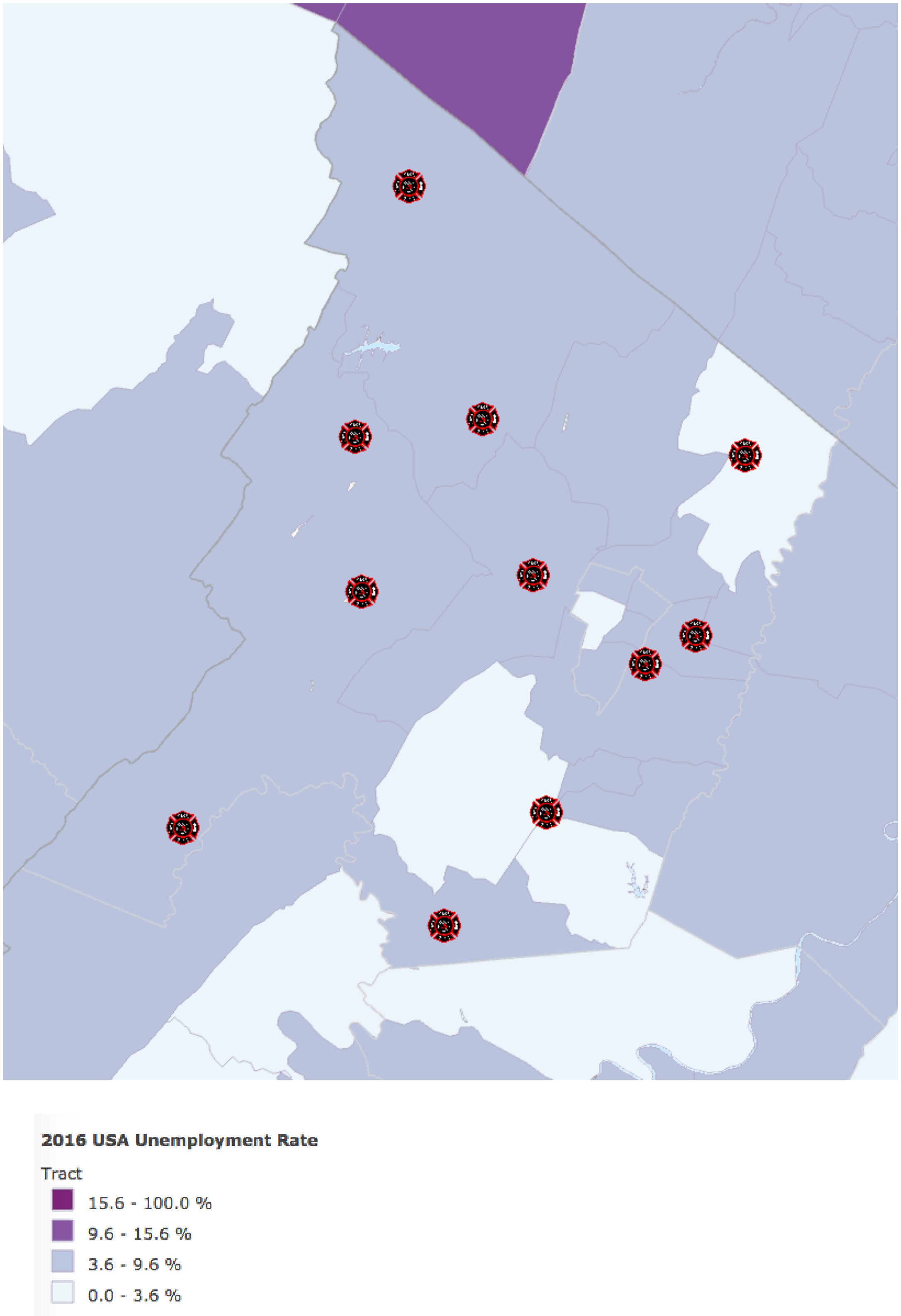
Population alone is not the sole variable that influences the demand for services as socioeconomic and demographic factors have greater influence over demand. The median household income was evaluated to determine the degree to which the community had underprivileged populations.

Figure 25: Median Household Income -2016



Finally, unemployment rates were evaluated across the county.

Figure 26: Unemployment Rates -2016



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