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Map Project Report

Comparing Old and New Response Time Standards for the Encinitas Fire Department

Introduction

For most constituents, first responder response times are ostensibly the easiest and most straightforward measure for determining the performance of their fire departments. For this reason, response time is a sensitive topic for career fire departments across the country. With one of the biggest shares of municipal budgets, the bar of performance expectations is set high for fire agencies. However, the current standards for response times are broad and therefore, hardly applicable to all departments nationwide. Consequently, the standards may provide little assistance in measuring the performance of firefighting operations for some departments, such as the City of Encinitas. To better meet individual needs, analyzing historic response times of a single city can be an effective means of setting realistic expectations and standards for that particular city. The Encinitas Fire Department is one example of an agency implementing this practice. This study takes a sample of historic data and analyzes it to inform how the standards should be set for response times in Encinitas, as well as demonstrates the hypothetical change in standard compliance.

Background

In 2001, the National Fire Protection Association (NFPA) published the first edition of the NFPA 1710 standard. The 1710 standard was “the first organized approach to defining levels of service, deployment capabilities, and staffing levels for substantially career fire departments” (NFPA, 2015, p. 1). Data collected across North American fire agencies were used as a basis for establishing response times, which are identified in the standard. Since then, the standard has

been updated several times, with the most recent one released in September 2015 (2016 edition).

The 2016 NFPA 1710 standard outlines the following for response times in section 4.1.2.1:

- “80 seconds turnout time [time from incident notification to station departure] for fire and special operations response”
- “60 seconds turnout time for EMS [emergency medical service] response”
- “240 seconds or less travel time for the arrival of the first arriving engine company at a fire suppression incident” as well as “at an emergency medical incident” (p. 1710-8).

Additionally, section 4.1.2.4 states:

- “The fire department shall establish a performance objective of not less than 90 percent for the achievement of each turnout time and travel time objective specified in 4.1.2.1” (see above) (p. 1710-9).

In summary, the new standard suggests that the total response time (turnout time and travel time) should be no more than five minutes and twenty seconds (05:20) for fires and other incidents requiring personal protective equipment (PPE) and no more than five minutes (05:00) for medical incidents (EMS). Furthermore, fire agencies should aim to respond to these incidents within the given timeframes at least 90 percent of the time. According to NFPA, departments should aim to meet this standard, but are not required by law.

As listed in the Encinitas Fire Department’s strategic plan, the agency’s goal is currently five minutes or less, 80% of the time, for the first engine on scene for any type of incident, and has remained the standard since it was introduced in 2001 (City of Encinitas, 2012). However, Encinitas fails to meet even these less strict standards, year after year. This single standard fails to take into account the differences in the time of the call (day versus night) and the type of call (EMS versus PPE). At night, firefighter/paramedics are awakened and take longer to get ready to

go to a call. PPE calls take more time because firefighter/paramedics dress in turnout gear.

Therefore, the Department is currently looking at introducing new standards, one for each of the four separate scenarios:

- EMS day incidents
- EMS night incidents
- PPE day incidents
- PPE night incidents

Data Analysis

The data used for this analysis is Encinitas Fire Department call data from 2014. 2014 comprises a year's worth of the most recent available data of incidents and response times, which is important for considering the changes in seasons and weather patterns. While one year of data is insufficient to set the new standards, the process used will be helpful for when enough data is collected to officially establish them. Moreover, given the amount of data and the scope of this project, one year is sufficient to conduct an initial analysis and permits an adequate assessment for preliminary findings. To make proper use of the data, at least five years' worth of data should be analyzed in the future.

As previously discussed, the call data is most useful when separated into four distinct categories of response times for 2014: EMS calls during the day; EMS calls at night; PPE calls during the day; and PPE calls at night. EMS and PPE (fires, rescue) calls are the most frequent and time-sensitive, and therefore, are prioritized in response time analysis.

The standard will be determined this way because the travel portion of the response time is one variable that is out of the Department's control, unless another station were to be built. A new station is highly unlikely because one was recently added within the last few years. Thus, with the six existing stations, the goal is to determine reasonable response times that the community can expect first responders to meet. There are three components to the response time: dispatch time (the call to 9-1-1 and any call transfers that must be made), turnout time (the time from call notice to station departure) and travel time (the time from the instant the engine wheels start moving forward to the moment it arrives on scene). Dispatch time is expected to be around one minute for every call. Turnout times are expected to be about sixty (60) seconds for EMS calls and eighty (80) seconds for PPE calls. However, travel times vary greatly, as do total response times during the day versus during the night. The current response time standard accounts for response time differences in EMS versus PPE calls, but does not account for whether the calls occur during the day or at night. Using the Department's historic data is essential for determining desired standards that would not exist otherwise.

Data Source and Cleaning Process

The call data came from a consultant who collects and analyzes data for the Encinitas Fire Department. The consultant also designed a website that allows the Department to look at data in easy-to-understand graphs, charts, and tables. The data was downloaded from the website, called FireStats, via Microsoft Excel.

The data were cleaned with the following procedures:

1. Deleted dozens of unneeded columns that contained irrelevant or no data
2. Filtered out calls that were “not urgent”
3. Removed duplicate incident identification numbers (“ID”) where an ENC (Encinitas) response apparatus was not the first on scene
4. Removed incidents where ENC was not the first on scene
5. Filtered out incidents that did not occur in Encinitas
6. Calculated turnout time by subtracting the “En Route” time from the “Dispatch” time for each incident
7. Calculated travel time by subtracting the “Arrival” time from the “En Route” time for each incident
8. Calculated total response time by adding turnout and travel times for each incident
9. Removed records when “On-Scene” time was not recorded
10. Divided data by EMS and PPE. EMS calls included the following call groups: Motor vehicle accident, assist/service, medical, and medical-staged; PPE calls included all fire incidents, hazardous conditions, hazardous materials, rescue, and alarm
11. Further divided EMS and PPE data by day (8:00 a.m. to 7:59 p.m.) and night (8:00 p.m. to 7:59 a.m.)

The shapefile for the city boundaries came from the San Diego Association of Governance (SANDAG) SanGIS regional GIS (geographic information systems) data warehouse. The shapefile for the streets in Encinitas was from the Encinitas GIS Department.

Data Configuration

The shapefiles from SANDAG provided the map on which to locate the incidents. By creating an event theme, the incident locations were placed on the map according to their longitude/latitude values. A join was also performed to connect the locations of the incidents to their response times using the incident ID number. From there, the four sets of response time data were split into two categories, compliant and non-compliant (with the Department's standard of five minutes or less). Then, the four sets of data were split even further to reflect compliance with the old standards (five minutes or less) compared to compliance with the new standards (value varies according to the 90th percentile of all response times for that category), which is reflected in the maps below.

Discussion

Four pairs of maps are presented below that consider the difference in response time compliance according to the old standard and in comparison with the new standard. A table is included before each pair of maps displaying the most important data reflected in the maps. The first data is the average, which, when viewed by itself seems a little confusing. However, when combined with the three other categories, the average is pretty close to five minutes. This describes the original standard, when there were not separate categories, but an "average." Thus, the map on the left displays compliance or lack thereof for calls under five minutes.

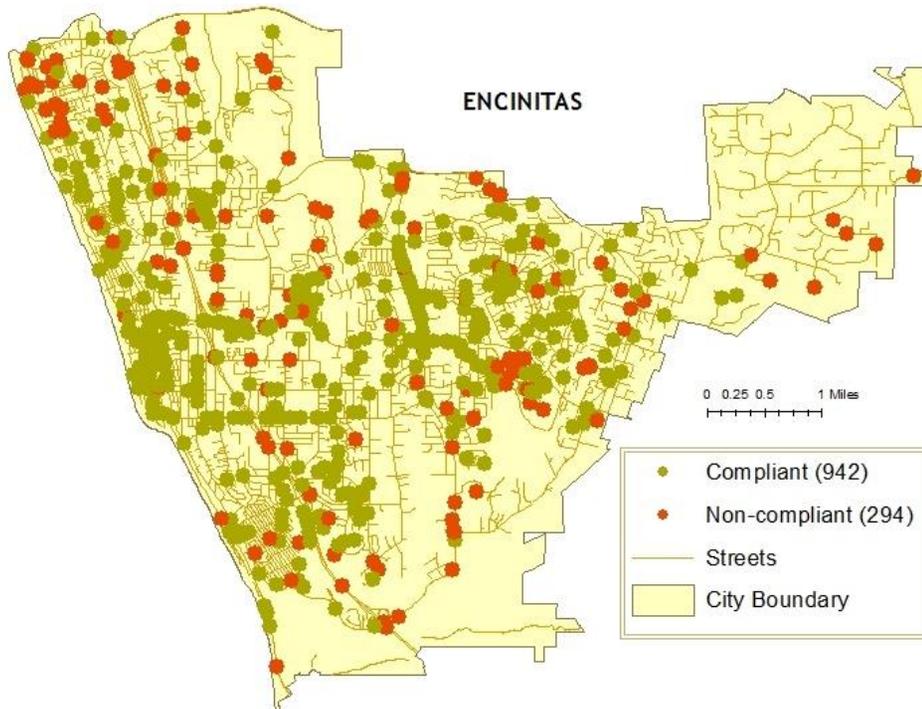
The map on the right displays response time compliance under the new standard of the 90th percentile of calls. The new standard presented here is not official, but the process used to reach the figure is how the standard would actually be calculated if the 2014 data were replaced with several years of data. See the limitations section for more discussion on this matter.

Findings

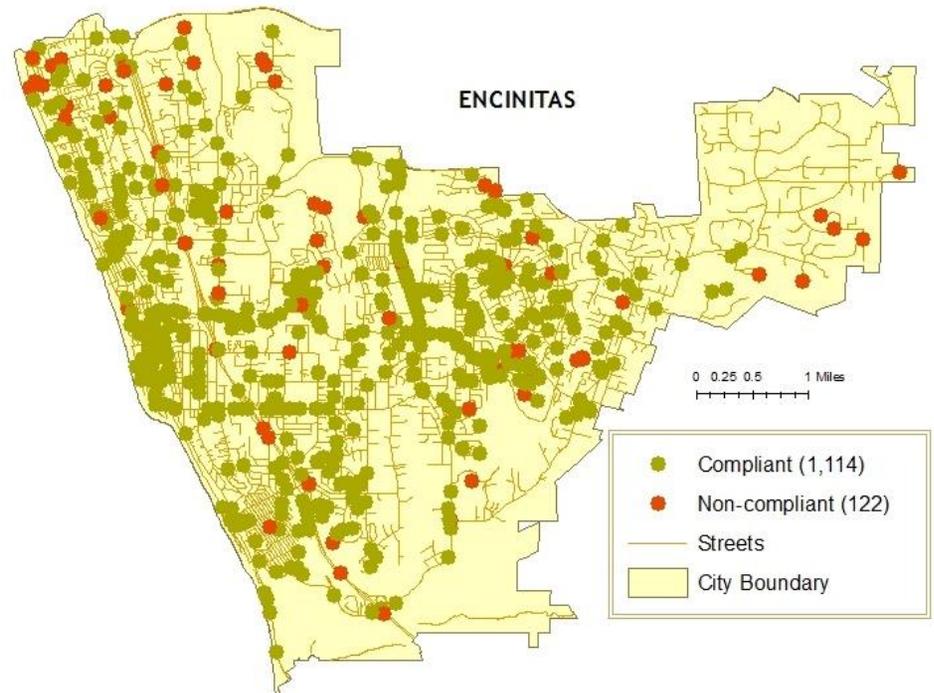
EMS Day - Only 76% of response times meet the current standard, but 90% would meet the new standard.

Average	0:04:13	90th Percentile	0:05:49
Less than 5 min	944	Less than 5:49	1112
Total	1236	Total	1236
Percentage	76.38%	Percentage	90%

2014 EMS Day Incidents
Response Time Compliance Under Old Standards



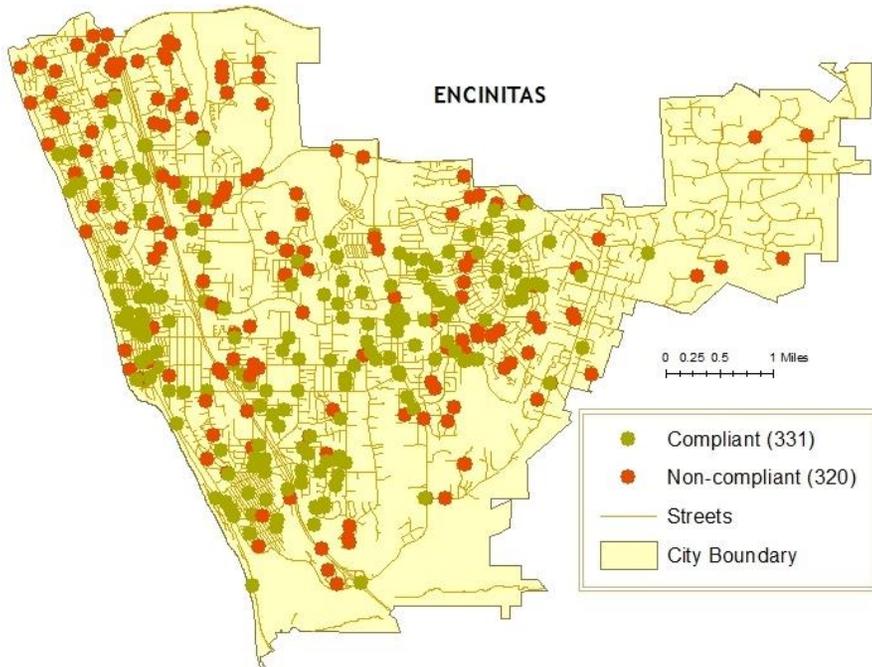
2014 EMS Day Incidents
Response Time Compliance Under New Standards



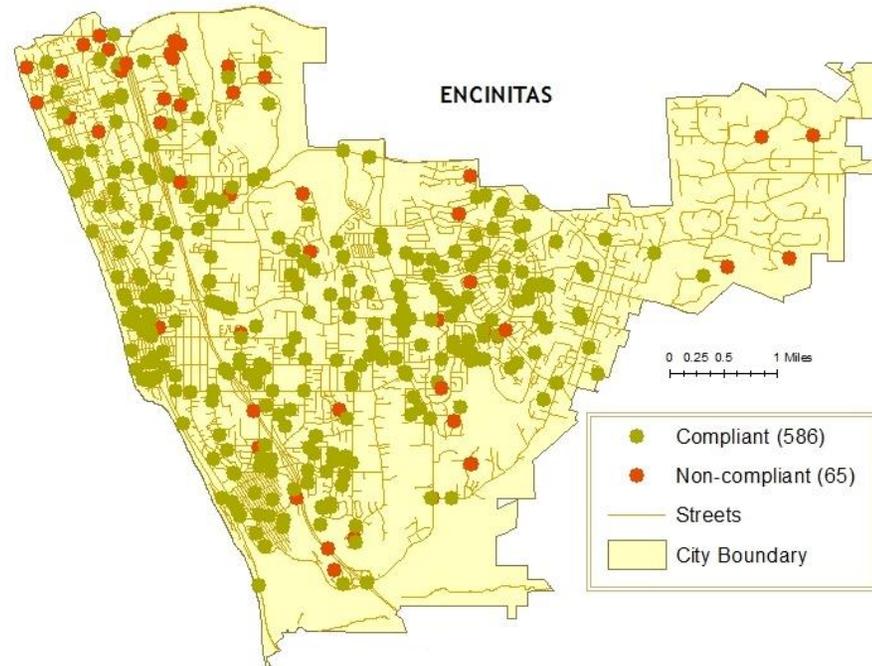
EMS Night - Only 51% of response times meet the current standard, but 90% would meet the new standard.

Average	0:05:07	90th Percentile	0:06:38
Less than 5	331	Less than 6:38	586
Total	651	Total	651
Percentage	50.84%	Percentage	90%

2014 EMS Night Incidents
Response Time Compliance Under Old Standards



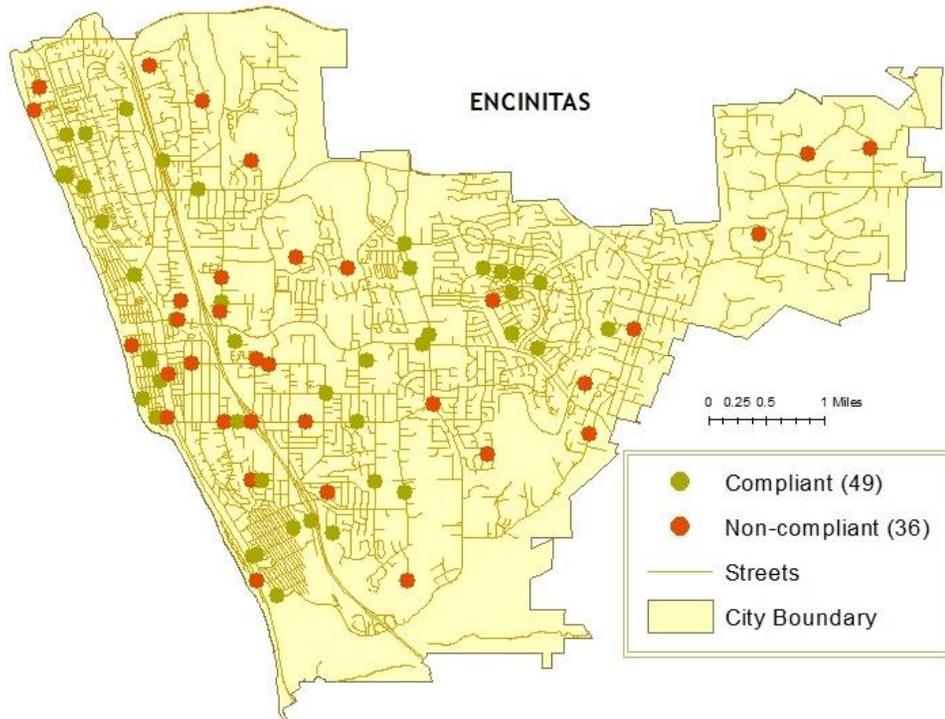
2014 EMS Night Incidents
Response Time Compliance Under New Standards



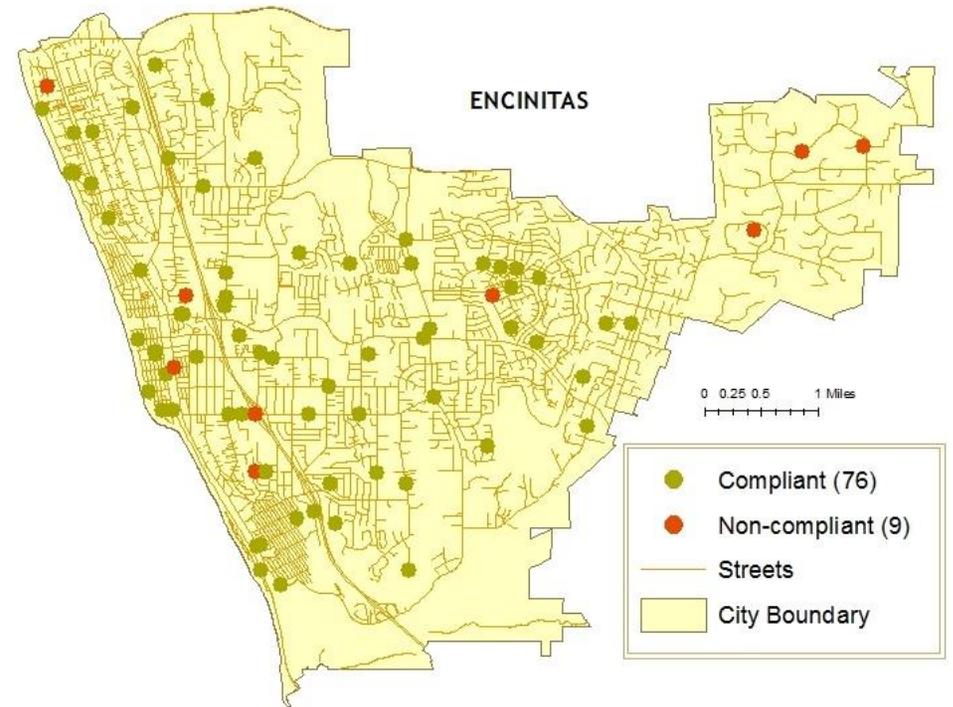
PPE Day - Only 58% of response times meet current standard, but ~90% would meet the new standard.

Average	0:05:11	90th Percentile	0:07:49
Less than 5	49	Less than 7:49	76
Total	85	Total	85
Percentage	57.65%	Percentage	89%

2014 PPE Day Incidents
Response Time Compliance Under Old Standards



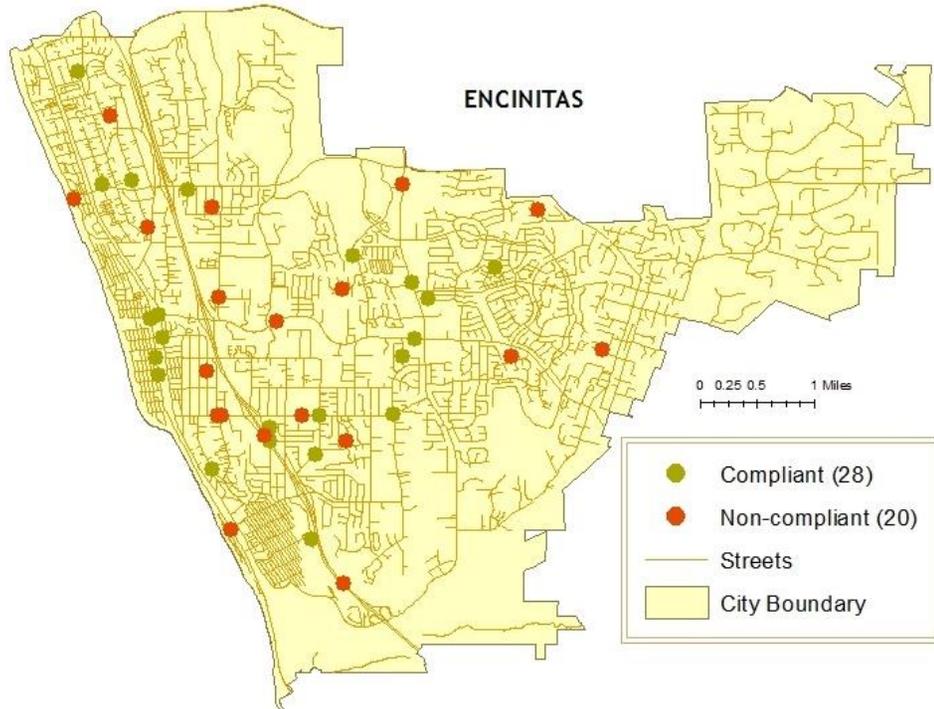
2014 PPE Day Incidents
Response Time Compliance Under New Standards



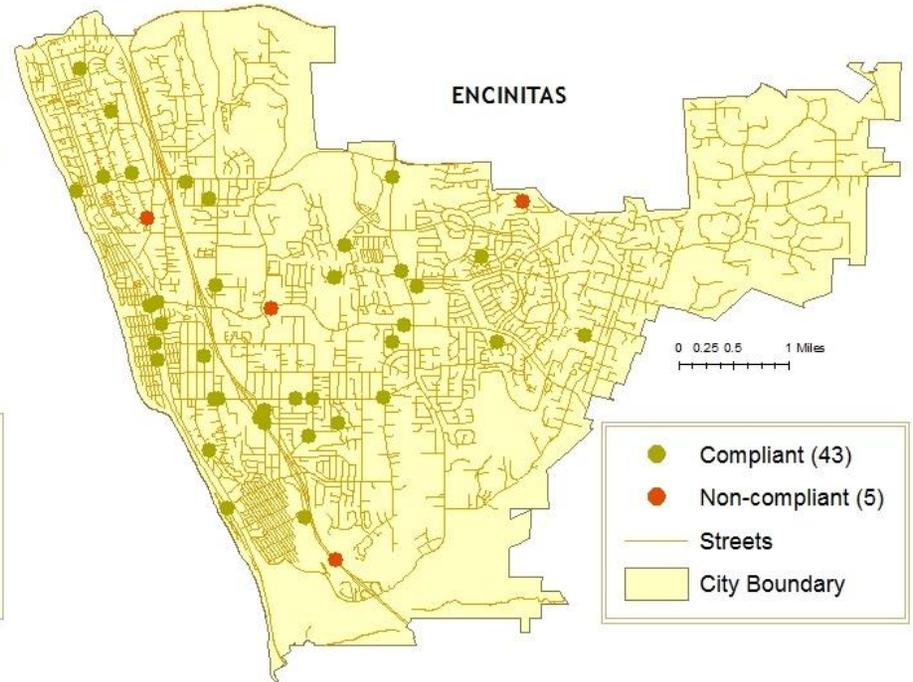
PPE Night - Only 58% of response times meet current standard, but 90% would meet the new standard.

Average	0:05:21	90th Percentile	0:07:38
Less than 5	28	Less than 7:38	43
Total	48	Total	48
Percentage	58.33%	Percentage	90%

2014 PPE Night Incidents
Response Time Compliance Under Old Standards



2014 PPE Night Incidents
Response Time Compliance Under New Standards



Limitations

This analysis is limited by using only a year's worth of data. Without limitations, at least five years' worth of response time data would be incorporated into the analysis. This would provide the amount of data required to establish a more realistic response time standard. In statistics, the bigger the sample, the more representative the data is of the entire population (or response times in this case).

On the same token, since the 90th percentile from the call data was used to set the standard, engine companies are automatically meeting the goal in this study. However, in a perfect world, this figure would be calculated based on five years' worth of total response times. Here, the 90th percentile of response times from 2014 alone is considered, so the data is being compared to itself. Thus, all maps on the right show 90% compliance. While the new standard defined here is not particularly useful, the process for reaching it once more data is available is now established, based on this study. In a more thorough analysis, the data for 2010-2014 data will be used to determine what the actual 90th percentile figure is and this figure will become the standard. Then, 2015's 90th percentile figure can be compared to the standard (based on 2010-2014 data) to measure the Department's performance for the year of 2015.

Separately, with more time, maps that indicated specific time intervals would be used to show how areas surrounding fire stations match up against the new standards, which would especially help residents see where their property falls in the different response time zones.

Finally, the importance of meeting the response time standards in some incidents more than others was not discussed, due to the scope of this study. However, with more time, a look at individual cases might provide some insight on whether the standards are truly appropriate as they currently exist.

GIS Application

The application of GIS is appropriate for examining this issue for visualization purposes. The increase in response time standard compliance that the Department achieves by establishing new standards is easily visible using maps, especially when the maps are compared to one another.

The maps produced for this study paint a picture that is otherwise difficult to capture. The alternative is showing statistical figures, which does not have the same impact when it comes to showing how much more or less first responders meet their goals under the new standards.

People tend to understand the numbers when they are represented with shapes and colors in a cohesive manner and within context of what matters to them, such as a map that includes where they live.

Conclusion

While the difference in compliance is easier to see in some response time categories compared to others, the difference should be much more apparent when more call data is available and incorporated. Nonetheless, the maps in every category demonstrate that with new standards, first responders fall in compliance more often with the newly established standards than those pre-determined for them by the NFPA 1710 standard, as well as those originally set by the Department. This is indicated by the decrease in incidents marked by a red circle when comparing the old standard maps to the new standard maps for each call category. While the response times have not actually decreased, the importance of these changes lies within the public's perception of the Department's compliance with standards, which many constituents inaccurately view as the law. Therefore, setting realistic expectations for first responders is essential for being able to reasonably meet the public's needs and requests, which the Encinitas Fire Department can successfully accomplish using the process formulated in this study.

References

City of Encinitas. (November 2012). *Joint Strategic Work Plan*. Retrieved from <http://encinitasca.gov/modules/showdocument.aspx?documentid=266>.

National Fire Protection Association (NFPA). (2015). 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. Quincy, MA: National Fire Protection Association. Retrieved from <http://www.nfpa.org/codes-and-standards/document-information-pages?mode=code&code=1710&tab=editions>.