Appendix: E – Response Time Thresholds and Triggers

Introduction

Like a lot of communities in San Bernardino County, the City of Fontana is not static; it continues to experience growth with new construction of commercial, industrial, and residential structures. As part of the Plan for Providing Service, reviewing service levels at least annually is appropriate. This process using developed response time standards, would evaluate response criteria (A copy of the Criterion Table to Determine When a New Station is Needed is shown in Figure 22: Criterion Table to Determine When a New Station is Needed, and determines when to make modifications, changes, or additions to existing facilities as to maintain the proposed District's established response time standards.

What follows is a discussion of how the process was developed and could be applied to the proposed Fontana Fire Protection District.

When a community creates a fire department and builds its first fire station, a response time criterion is usually established. This response time anticipates that it applies to 100 percent of the area covered by the boundaries of that fire station. This is especially true when there is only one fire station and a small area to cover. Simply speaking, a central fire station is among the first public buildings created in most communities, no matter how small. As the community grows away from that station in incremental steps, the expectation is that the original fire station will still provide adequate coverage.

However, that expectation is fraught with many problems. In the simplest of terms, the total area covered by a fire department may or may not be highly developed initially; and even if a crew from the fire station responds, it may not do so in a timely manner. Most fire departments begin as totally volunteer. They usually are operated with this staffing pattern for economic reasons. When population and service area increases, there is often pressure to add full time staff and to consider adding additional stations.

In fact, there are many variations on this theme. Older, established cities tended to be denser and smaller in dimension, but they often annexed new areas. Newer communities may be created from a much larger area than the first fire station can cover. Urban sprawl, which is a currently an active

discussion in other areas of public policy and is specifically within LAFCO's legislative mandate, has resulted in the timing of additional fire station construction and staffing being a topic of concern.

Station Siting

Often when a fire department constructs its first fire station in an area, the values at risk and hazards to be protected are within a close driving distance. In effect, the first fire station in a community is a *centroid*. That is, the local fire station is the center of the response capacity of the jurisdiction. Earlier in the 20th century, fire stations were often characterized on maps by having a circle drawn around the station with a l.5 mile radius. This was sometimes used to describe the area of coverage. However, fire apparatus responds using the roadbed that consists of angles and distances that did not result in the circle being the true description of the coverage. Not only that, but one cannot place fire stations exactly three miles apart and have the two circles overlap. When they are placed closer together than the 1.5 mile radius, there is not only overlap, but also gaps where there does not appear to be coverage.

Later, the circle was replaced by diamond-shaped templates that could be overlaid over the station and rotated to estimate the relative advantage of road distances. This contemporary method used to evaluate fire stations is based upon using the actual road-network in a computer model. This system uses time and distance to create a network that more closely represents how far the company can respond from its fire station, using the adopted time standards. A few years ago, the method that was in vogue was called FLAME. This is an acronym for Fire Station Location and Mapping Environment. From the time the first station is built, it creates an expectation that the facility can and will provide a timely response to calls for service in the area surrounding that facility.

When the original criterion was set for response time from that facility, there is an immediate *location – allocation* created by that station. The station provides a response to a given area within a reasonable time in a pattern that essentially is an overlay on the streets and highways that radiate outward from that location. Even before any incidents occur in a community, the road-network geography and the topographical attributes of a community create a *dynamic segmentation* that results in the ability of fire professionals to reasonably predict what areas can be and those that will not be covered. Today the preferred tool for conducting this type of analysis is through Geographical Information Systems (GIS).

There are many infrastructure components that have an effect upon the *location allocation* concept. Among these are road and highways networks, impedance factors such as traffic patterns and processes (stoplights and signs), and turn impedance, i.e.: roadbed configuration and elevation impedance (slope). It is axiomatic that there is an inverse distance-weighting factor that results in longer response times to areas further away from the centroid of the station. This is called distance *decay*. The manner and means of response involve the use of the roadbed, but also involve dealing with differences in elevation and competing vehicles on the roadbed. In short, the further away from the location of an incident and the higher the impedance for response, the less effective any specific resource is in dealing with the initial stages of an emergency event as you move away from the station's location.

The use of the concept of using *travel time* itself is not exactly new. However, for many years the basic criterion was road mileage only. The standard that was normally applied was that a fire station was expected to be able to reach any incident within 1.5 miles of the station *within five-minutes of driving time*. Time was a secondary consideration. That standard was based upon data from the 1940's with respect to road conditions and traffic patterns. A lot has changed since then. For decades, the Insurance Services Office (ISO) has based fire station locations on a 1.5-mile separation.[35] In general, this has served as the *rule of thumb*, but it does not deal with the vagaries of physical response (such as geography, transportation, and weather). Secondarily, it did not place any emphasis on response needed for emergency medical service (EMS) incidents, such as basic life support (BLS) or advanced life support (ALS).

The concept of using actual travel time today is based upon a more accurate representation of the level of service for an all-risk approach. It is more performance-based. Today, most fire agencies set a time standard that includes three elements, two of which were missing from the strict use of mileage for station location, specifically alarm processing time and turnout time. The actual time of road travel has often been used to set the communities' expectations of performance.

Using this approach, stations are seldom located in a linear fashion. This concept is based on the time intervals identified in the Standards of Response Coverage section of the *Self Assessment Manual* published by the Commission on Fire Accreditation International. This process leads to the

[35] ISO is an independent organization that serves insurance companies, fire departments, insurance regulators, and others by providing information about risk. ISO uses the Fire Suppression Rating Schedule (FSRS) to review the fire-fighting capabilities of individual communities.

development of a standard of response cover, or a time and level of staffing designed to control an emergency at a minimum level of loss. The process is however, a policy choice based on risk and local conditions.

The basic performance standards for time goals are based on the rapid speed of fire growth and consequences of emergency medical situations over a short time frame. It has been determined that both fires and medical emergencies can gain a foothold that result in excessive losses when the times are excessive. The most common benchmark time standards used are:

- Alarm processing time — 60 seconds
- Turnout time — 60 seconds
- Travel time
    - Fire response — four minutes, 90 percent of the time
    - ALS response — four minutes, 90 percent of the time

The contemporary method of measuring performance looks at response time on incidents as an indicator of levels of service. The way this is done is two-fold. The first is to measure the actual performance during emergencies; the second is to monitor the system to determine when the system fails to achieve the performance goals.

One point of caution — Response time criterion should only be applied to calls that are emergency calls. When incidents are analyzed, the data should be reviewed to assure that non-emergency calls are not used when calculating performance. There are many calls for service that fire departments log as incidents that are non-threatening scenarios and the responding companies will handle them on an as–needed basis. To include these times in the analysis of emergency services tends to skew the outcome, leading to a false service indicator.

Response Failure

To understand when response failure occurs, we must define first what is being measured and how we measure the performance goal. For example, a basic question to be answered is whether a department is protecting the dirt or the incidents? Are we going to measure percentage of performance by first-due district, or department wide? Generally, fire protection practitioners try to position stations to cover 90 percent of the ground in each first-due district, to provide overlap for concentration, redundancy for multiple calls, and for equity of access for customer service. It is

economically impossible to cover 100 percent of the ground. Based on actual call loading, we could strive for 80 to 90 percent of the calls within first-due and concentration total reflex measures.

If the measure for either area or incidents is set at 80 to 90 percent effectiveness, how much over the performance measure is acceptable? For example, if an historical incident measure is at the 85 percentile, BUT the other five percent are covered in the next 60 seconds, is that acceptable?

Maybe yes, maybe no. It is important to understand that values at risk, type of unmet calls and the total number of calls can combine to create a need. If the deficiency is only five percent or 25 calls out of 500, depending on the size of the measurement area the gap may or may not be significant.

For example, if the performance requirement was to arrive at the scene of an emergency within four minutes of travel time, 90 percent of the time, this criterion could be applied to one year of response data to see if the goal was achieved. It should be noted that this criterion allows for ten percent of the calls to go beyond the four minutes of traveling time over a given reporting period. This provides flexibility in the assessment of coverage to cope with anomalies such as extra-ordinary response conditions, those responding from out of district, or for delays caused by simultaneous alarms.

This raises an additional question: Of the ten percent overage, how many of the incidents are covered within the next 30 to 60 seconds?

The first indication of a problem of providing service is when a number of alarms that exceed the performance standard are documented. This may or may not be a function of new growth. It could be the result of in-fill that causes a higher number of alarms for the company than it can service. This is especially true when alarms come in simultaneously.

Moreover, when areas are being developed that begin to extend travel times, they do not automatically become the source of new alarms. In fact, new construction often has a period of several years before adding to fire service demand. The same is not necessarily true from the perspective of emergency medical service.

When is a New Station Needed?

The question that many communities have to address is when is a second or third fire station required to meet time goals? Obviously, this has been answered in any community that has more than one fire

station. The problem comes in finding a quantifiable threshold to determine that point for each specific situation because it varies from community to community and even within a specific jurisdiction. The overall answer is part financial and part professional judgment. In fact, in the literature of the fire service today, there is very little definitive guidance on how this should be accomplished.

There are several steps that can be identified. They consist of:

- Identifying areas with minimum coverage
- Identifying feasible locations for a new facility
- Evaluating those locations using specific criterion

The description in this appendix is based upon a growing body of knowledge aimed at quantifying this process. What is unfortunate is that there is no universally acceptable algorithm. The fire protection planning process does allow for an evaluation of potential loss as a result of deteriorating response times. One form of measurement is to assess the road and transportation network to ascertain the percentage of road mileage that theoretically is covered by the time criterion. This is done using computer-based modeling that will create a polygon that describes the *areas of coverage*. In fact, this process will also identify gaps and deficiencies where response time is not adequate.

As growth and development extends beyond the range of travel time of one station, the percentage of calls that exceed the performance requirement should begin to increase. It should be noted that growth, in and of itself, does not create an instantaneous demand. New construction has the advantage of better codes, a higher level of owner interest, and limited deterioration of fire-breeding conditions.

A more subtle difference in today's fire service is the fact that community demand for medical services is almost from day one of occupancy. In short, this means that new construction may place more values and lives at risk, but the demand for service will be incremental. When demand for service does begin, it will be based upon two factors - nature of the occupancy and hazards that are present.

Incident increase may first appear as a change in the performance of an existing company in the annual analysis of emergency calls. For example, if a station has 1,000 alarms and a 90 percent compliance rate with the response standard, there would be about 100 alarms per year that were

beyond the goal. This would be the baseline for existing response performance. If the following year, the number of alarms was 1,200 and percentage dropped to 85 percent, this would indicate that the department is losing ground on response performance. If the change in the number of alarms had merely increased because of more calls in the same area, the response time percentage should have remained fairly similar. (One exception to this rule is when a single company has such a high call volume that it cannot handle all calls without "call queuing".)

However, since the alarm rate went up and the performance went down, the failure threshold may be approaching. The change in alarms that were not met may now go to 180 (15 percent of the overall). As stated earlier, analysis needs to be performed on the deficiency to determine how many of those incidents were handled in the increment of 60 seconds beyond the performance time.

Based upon actual response time analysis, one threshold that needs to be considered is the increase in alarms and the percent of calls handled under the criterion adopted. Anything more than a ten percent increase in calls and a ten percent reduction in performance, is a signal to evaluate the level of service being provided.

In larger departments, most practitioners are factoring out non-emergency calls and for actual incident performance, only looking at *core emergencies*. The definition of "core" can be made locally based on risk and importance to the community, but they are usually structure fires and moderate to severe status EMS calls.

In general, if more than one measure is slipping, an evaluation of all Standards of Coverage factors, along with the reason why the data is slipping, is required. A one-year snap-shot may not be valid if the agency had a big storm event, a catastrophic weather event, major wildland fire, and stacked a bunch of calls for just one month of the year.

An Incident Analysis approach depends upon having emergencies, which does not address what is at risk. That is where the mapping technology applies. As structures and different types of fire problems are constructed on the ground, they may represent additional lives and property that are at risk that deserve equity in protection. One of the elements for creating a governmental entity is to control land use and to create mechanisms for collecting taxes and determining ownership. Furthermore, these same individuals and properties are paying the taxes, fees, and permits for the level of service being

provided. In one sense when growth occurs, the new properties are usually safer than the older part of the community because they are constructed to a higher standard.

What is clear to almost any community is that being slightly out of the response standard range does not trigger a new facility.

Assessed valuation or increased revenues in the form of benefit assessment or mitigation fees provide incentive for new fire stations to be constructed and staffed when the fire agency can afford them. One threshold that needs to be carefully monitored is the revenue stream that accrues from development. That revenue stream should provide a threshold when different elements of future fire stations can be determined. For example, it takes several years to evolve a location into a fire station site. As the revenue stream proceeds, funds could be available for site acquisition, initial plans and specifications, site treatment, and construction. This may be a multi-year process.

The threshold for construction should be to provide a new fire station into any zone in the city or jurisdiction that has more than 35 to 50 percent of its parcels developed. Some of the secondary measures currently being used are 300 to 500 calls for service for any individual fire company or a service population of 10,000 to justify a full-time paid company. Another factor to include is whether a community has an adopted sprinkler ordinance. The following criterion grid illustrates a series of measures that may be useful deciding when a new fire station should be deployed within a city. Similar grids could be developed to help establish triggers for the deployment of additional emergency equipment and personnel.

Figure 22: Criterion Table to Determine When a New Station is Needed

Criterion Grid to Determine When a New Station is Needed				
Action Choices	**Travel Distance**	**Criterion**		
		Response Time Parameter	**Out of Area Calls**	**Building/Risk Inventory**
Maintain status quo	*Enter local information*	**1st due company** *Enter local response time*	*Enter existing out of area calls*	*Enter local building/risk inventory*
Temporary facilities and minimal staffing	Risks locations 1.5 to 3.0 miles from existing station	**1st due company** Exceeds 5-minutes travel time 10% of the time, but never exceeds 8 minutes.	More than 10% of calls are in adjacent area	New area has 25% of same risk distribution as in initial area of coverage
Permanent station needed	Risk locations exceeding 4.0 miles from the station	**1st due company** Exceeds 5-minutes travel time 20-25% of the time. Some calls < 8 m.	More than 20-25% of calls are in outlying area	New area has 35% of same risk distribution as in initial area of coverage
Permanent station essential	Outlying risk locations exceeding 5.0 miles from the 1st station	**1st due company** Exceeds 5-minutes travel time 30% of the time. Some calls <10 m.	More than 30% of calls are in outlying area	New area has 50% of same risk distribution as in initial area of coverage

The decision process has to be placed into the context of staffing pattern decisions. It is not uncommon to have a station constructed, and have the staffing pattern evolve over years from one system to another. In the case of a station under consideration, it should be anticipated that a policy decision needs to be made with respect to the staffing system to be used as soon as possible. It is anticipated that a completely volunteer system would not be viable for this type of facility. Conversely, a fully-staffed paid company has a significant price tag to it. A combination staffing system would seem to be the most practical for the first five years of consideration. These are the staffing configurations used in the matrices developed to describe thresholds and triggers that should be evaluated in the future.

Experience has shown that it takes multiple elements of the standards of coverage to be out-of-balance along with having additional economic resources to justify an additional paid company or staffing increase on one or more companies.