Analysis of Fire Station Location Alternatives

Town of Orleans, Massachusetts

Orleans Fire Rescue

CRITERION
ASSOCIATES

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EXECUTIVE SUMMARY

The Town of Orleans, through the Orleans Fire Rescue Department, retained Criterion Associates to conduct a study focused on determining the best location for a new fire station located within the Town to provide for the highest levels of service possible from a single location. This study was conducted with the full cooperation and assistance from the Fire Rescue Department, as part of an on-going effort to provide enhanced fire and rescue response capability to the Town of Orleans. This is in response to several concerns / challenges related to the current facility. This was also conducted with an awareness that the availability of suitable parcels in the Town of Orleans is very restricted given land use, build out, and size of available parcels.

This document provides the following information:

- Maps showing the following:
  - Distribution of calls for service
  - Fractile performance (i.e., % of calls reached in a set amount of time)
- Analyses focused on:
  - Fractile response times
  - Expected response time (i.e., a calculation of drive time under various scenarios and assumptions).

The project team from Criterion Associates utilized two different analytical methodologies for assessing the potential fire station locations in the Town of Orleans. These include:

- Evaluating the performance of each system by calculating the fractile performance based on the location of stations and calls for service.
- Assessing the "expected response time" of the system by calculating the aggregate travel time to the all call addresses to which the Orleans Fire Rescue Department responded within the data set provided by the Town.

To conduct these analyses, the project team from Criterion Associates needed to provide the GIS software (Criterion Associates utilizes state of the art ESRI software and modules for all calculations in this report) with timestamps against which to measure the performance. This makes it possible to compare various alternatives across a common measure. These standards exist for fire / EMS and are recognized nationally as appropriate benchmarks.

The project team was given a list of possible sites by the Town of Orleans. In addition, we utilized the GIS software to identify a theoretical "best" location – albeit one that may or may not be available, of suitable size, and any other possible constraint. The results of these analyses are provided, below:

Fractile and Expected Response Time Performance

Scenario	Fractile Performance <4-Minutes of Drive Time	Fractile Performance <8-Minutes of Drive Time	Expected Response Time in Minutes
6A / Canal / Rt28 Circle[1]	67.40%	96.80%	3.86
58 Eldredge Pkwy. [2]	55.10%	99.60%	3.93
48 Eldredge Pkwy.[3]	68.10%	96.60%	3.94
139 Main St.	72.40%	96.10%	3.96
46 Eldredge Pkwy.[4]	64.50%	96.60%	4.24
18 Bay Ridge Ln.	51.80%	95.40%	5.08

[1] This site was identified using the GIS model as the best location in the Town of Orleans for a single station without regard to lot size, current use, availability, best possible use, etc. It is a theoretical location that should be used to assess the efficacy of other properties that are more suitable, available, etc.

[2] Note that if the Fractile Performance target was set to 4:15 all three properties on Eldredge Parkway would have the same results.

[3] See note above

[4] See note above

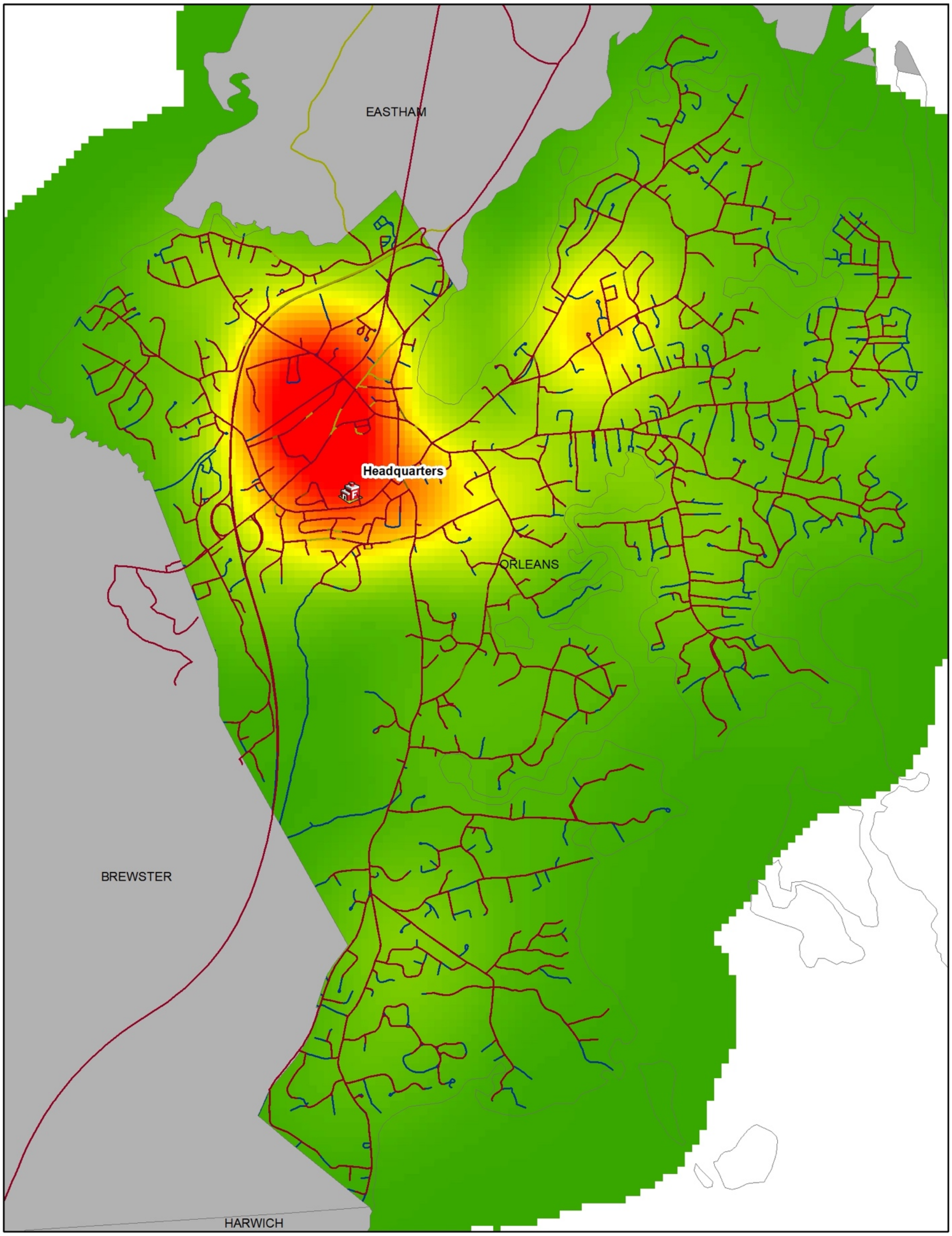
Note the seemingly significant variances for the three addresses on Eldredge Parkway – even though they are all quite close to one another. This is driven by the fact that some call locations with numerous responses are fractions of a minute closer or further from one or the other of the three addresses on Eldredge Parkway. This is also driven by the tightness of the call cluster shown in the heat map indicating the distribution of calls for service in the northern end of the Town.

The project team from Criterion Associates has not made any effort to determine the suitability, geo-technical issues, land-use issues, etc. associated with any of these properties. The Town's committee that has been appointed to identify site options will need to take that next step. ***It is clear, however, from***

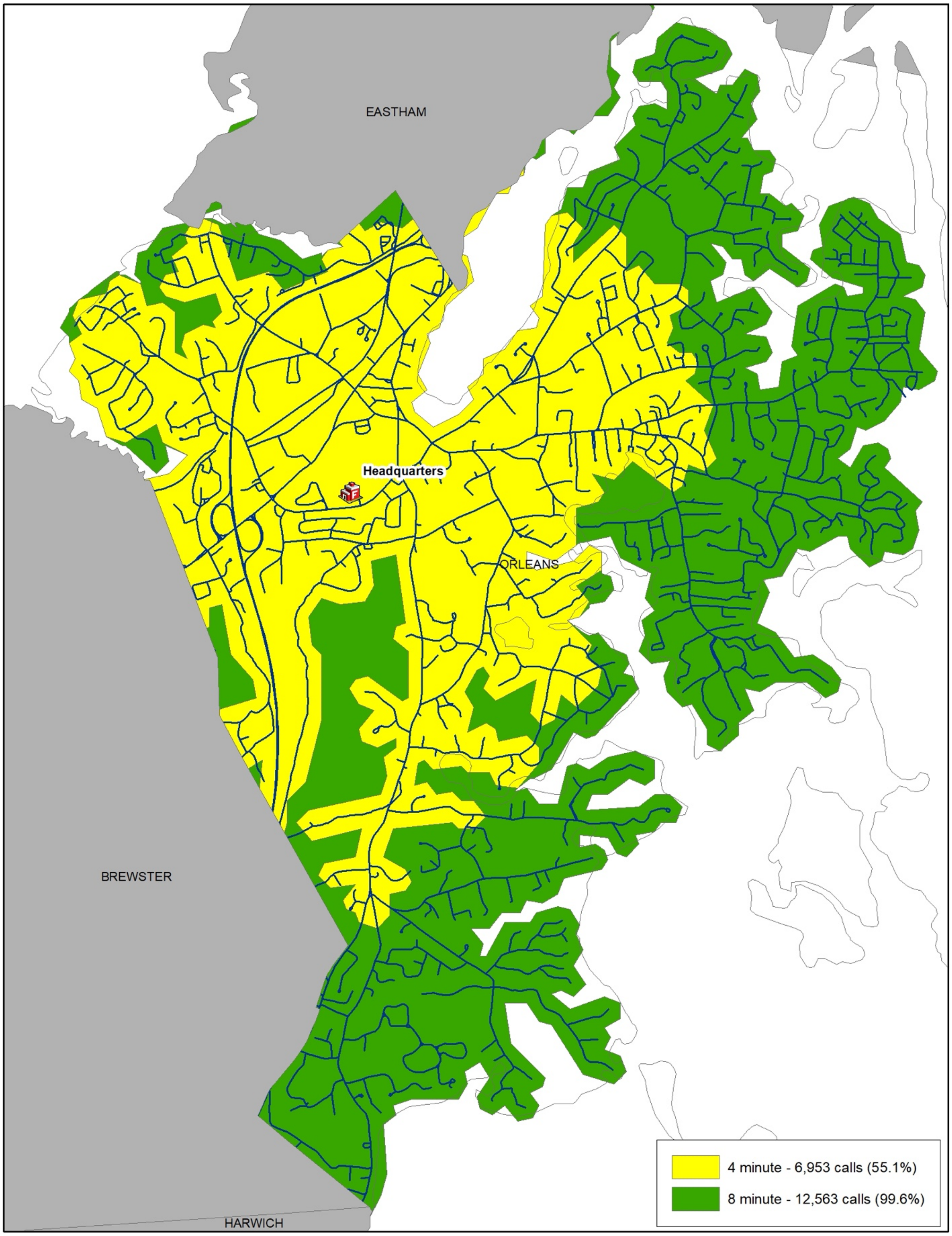
the analyses contained in this report, that the most advantageous location for a new Fire-Rescue facility is in the area immediately surrounding the current facility.

The illustrative maps for the scenarios run by the project team are provided on the following pages.

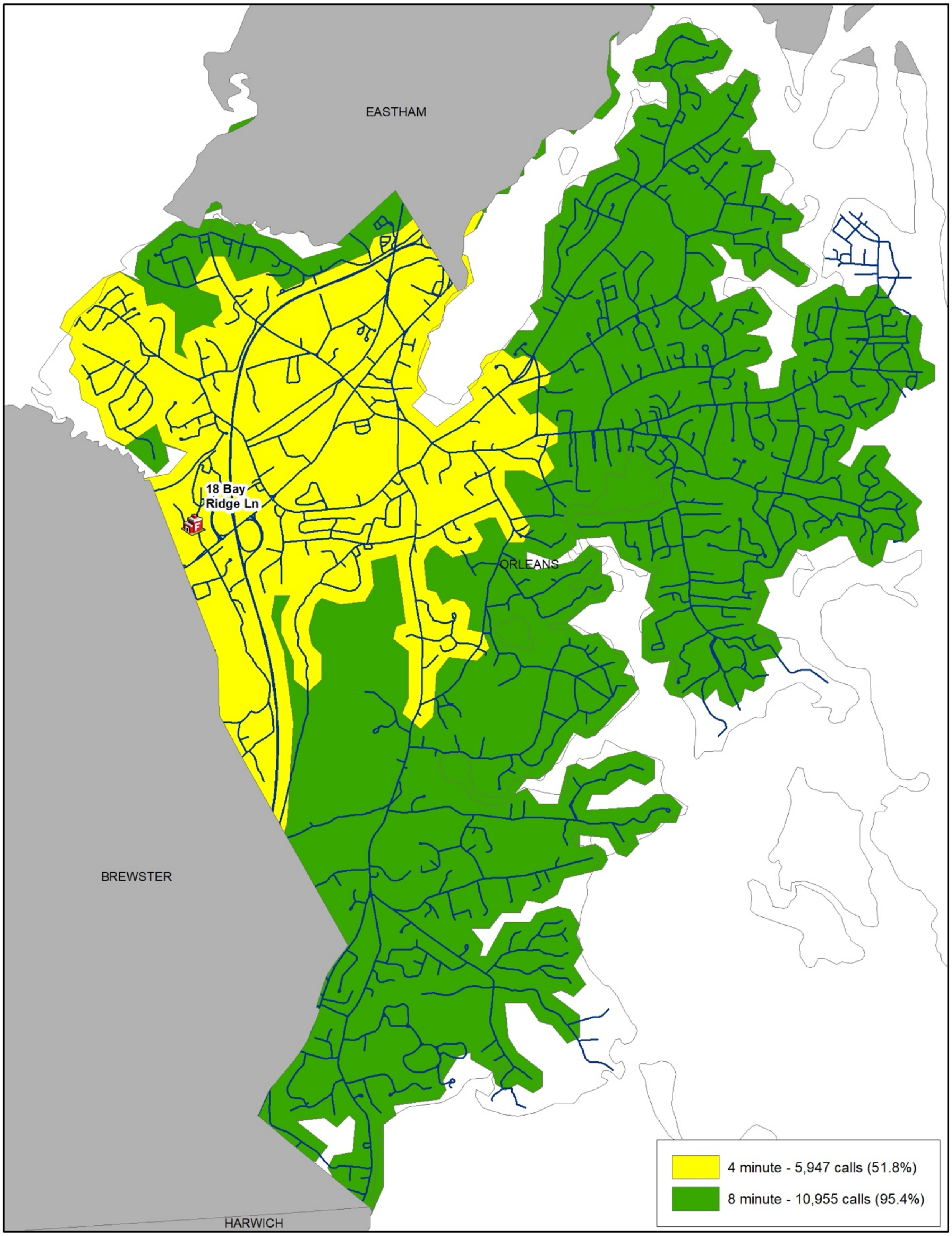
Distribution of Fire Rescue Calls for Service Within the Town of Orleans



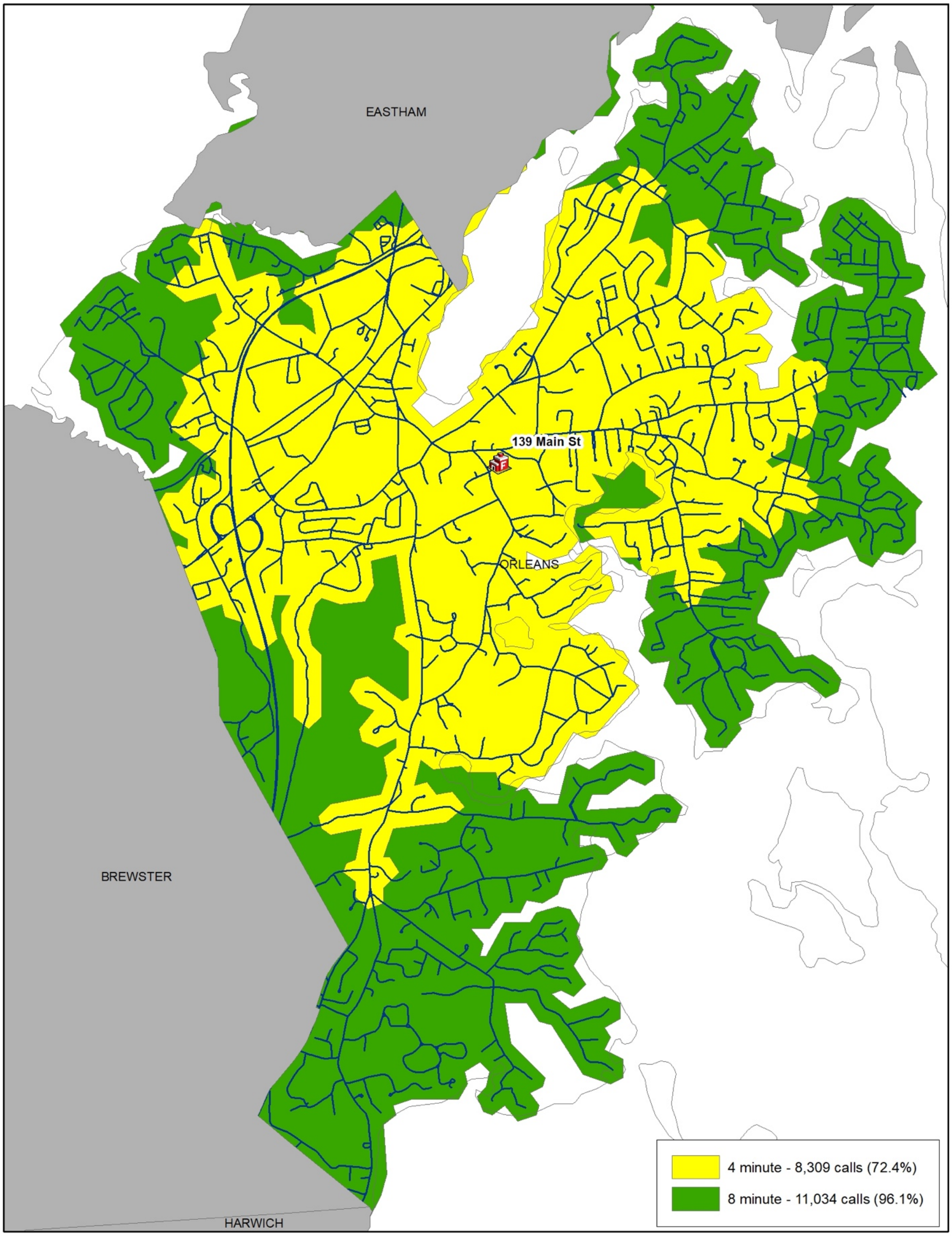
Fractile Performance: Current System (58 Eldredge Parkway)



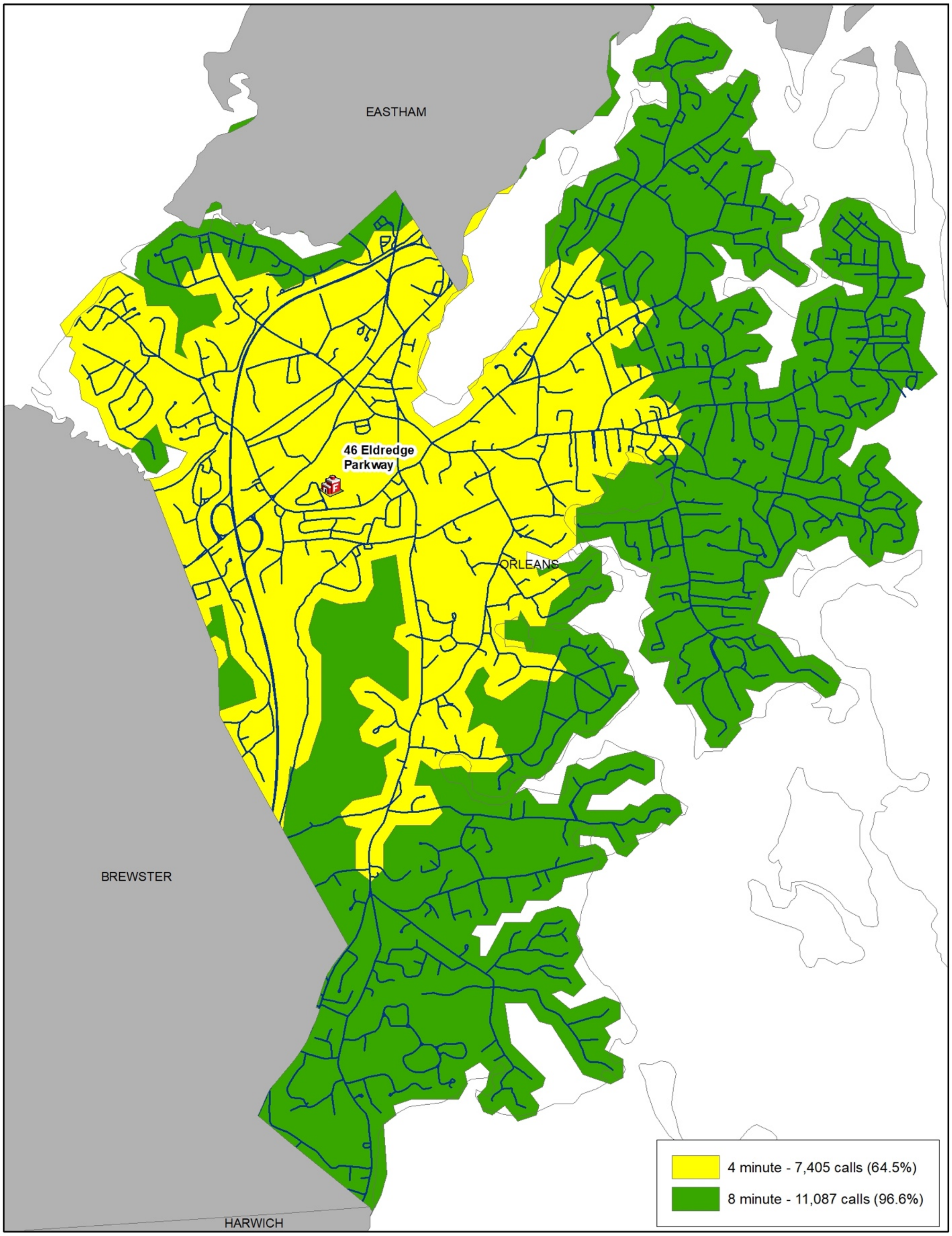
Fractile Performance: 18 Bay Ridge Lane



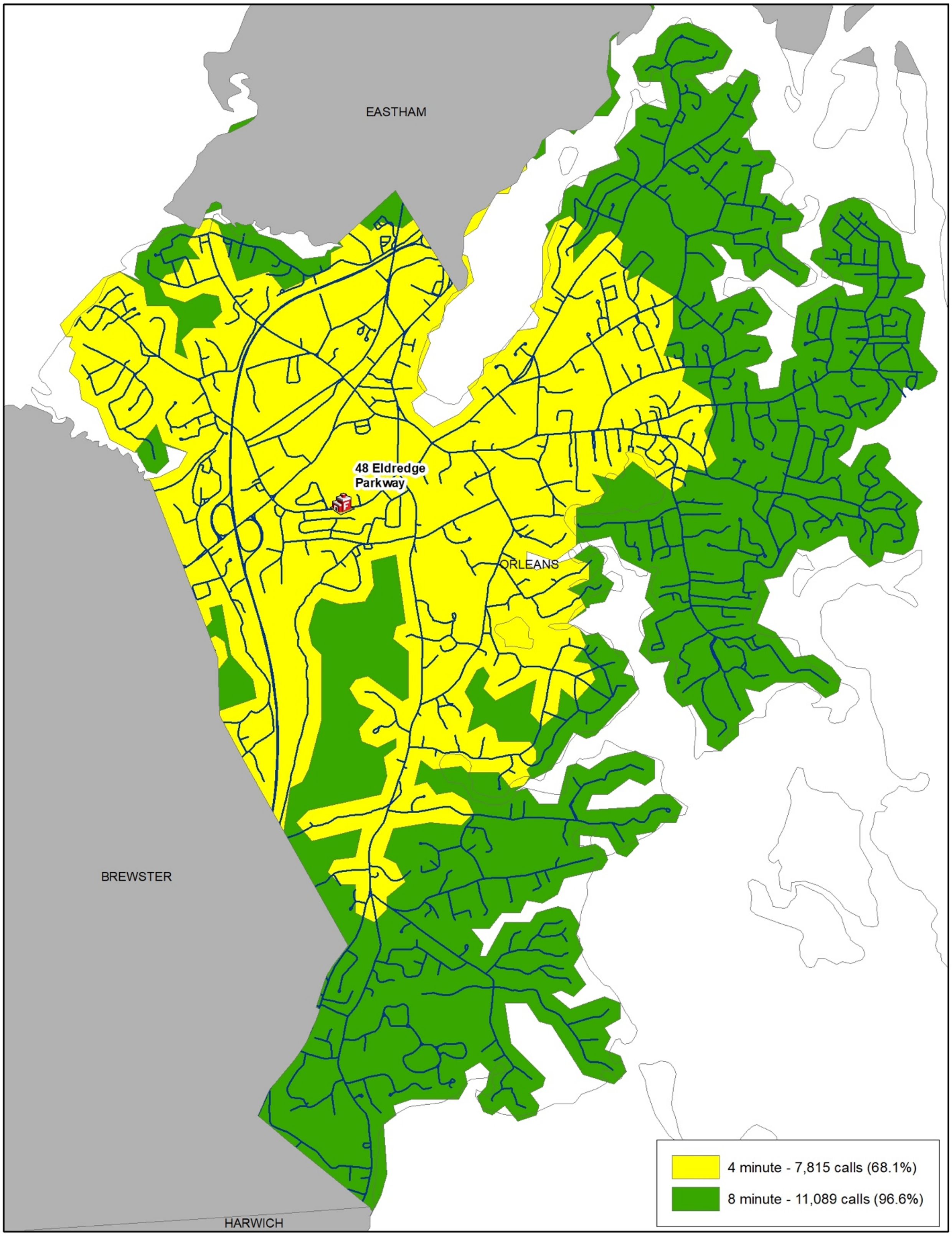
Fractile Performance: 139 Main Street



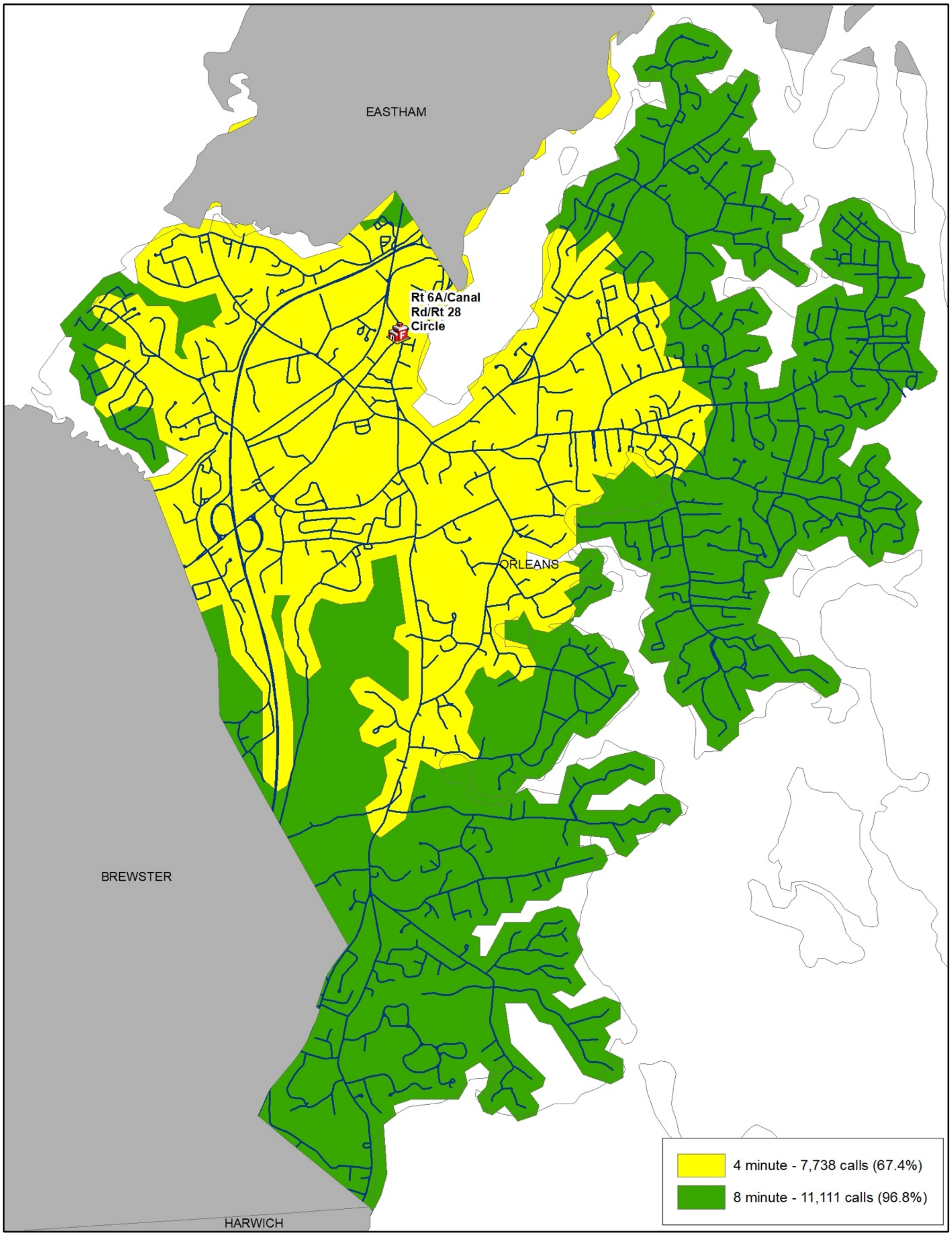
Fractile Performance: 46 Eldredge Parkway



Fractile Performance: 48 Eldredge Parkway



Fractile Performance: Optimal Single Location



APPENDIX: ANALYTICAL APPROACH

The adoption of performance standards for fire and EMS response is a critical first step in the evaluation of service levels and staffing alternatives. While there are national standards that can be used to evaluate fire and EMS service delivery, each community must identify the key risks and necessary level of protection it needs based on its own unique circumstances. Once these performance standards are established a community can assess its performance and determine if current resources support the desired level of service.

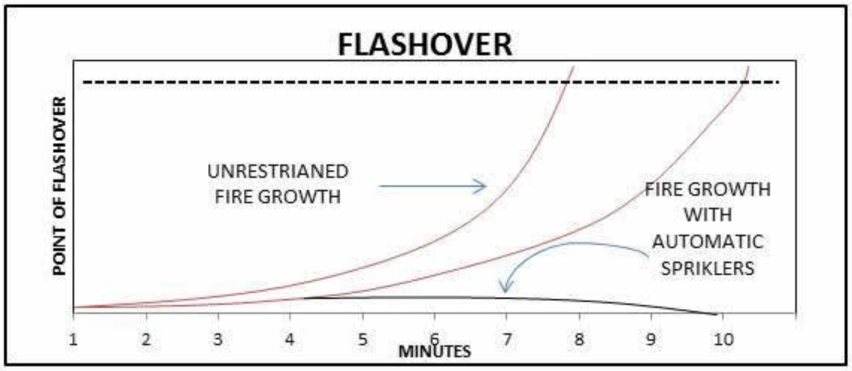
The project team from Criterion Associates makes use of two distinct but related measures for evaluating the efficacy of each scenario. This approach is utilized to bring additional clarity to managers and policy makers as they assess possible alternatives.

Fractile Response Time Performance

Nationwide, a great deal of effort and research has been put into developing performance objectives for the delivery of fire and EMS services. This effort is critical for agencies making decisions about deployment and location of emergency resources. The objectives promoted for fire/rescue and EMS have their basis in research that has been conducted into two critical issues:

- What is the critical point in a fire's "life" for gaining control of the blaze while minimizing the impact on the structure of origin and on those structures around it?
- What is the impact of the passage of time on survivability for victims of cardiac arrest?

The exhibit, that follows, shows a typical "flashover" curve for interior structure fires. The point in time represented by the occurrence of "flashover" is critical because it defines when all the contents of a room become involved in the fire. This is also the point at which a fire typically shifts from "room and contents" to a "structure" fire – involving a wider area of the building and posing a potential risk to the structures surrounding the original location of the fire.



DETECTION OF FIRE	REPORT OF ALARM 911 OR DIRECT	FIRE RESPONSE TIME			
		DISPATCH UNITS	TURN OUT	RESPONSE TIME	SET UP
TIME VARIES	TIME DIRECTLY MANAGEABLE				

Typical Fire Flashover Timeline

Note that this exhibit depicts a fire from the moment of inception – not from the moment that a fire is detected or reported. This demonstrates the criticality of early detection and fast reporting as well as rapid dispatch of responding units. This also shows the critical need for a rapid (and sufficiently staffed) initial response – by quickly initiating the attack on a fire, "flashover" can be averted. The points, below, describe the major changes that occur at a fire when "flashover" occurs:

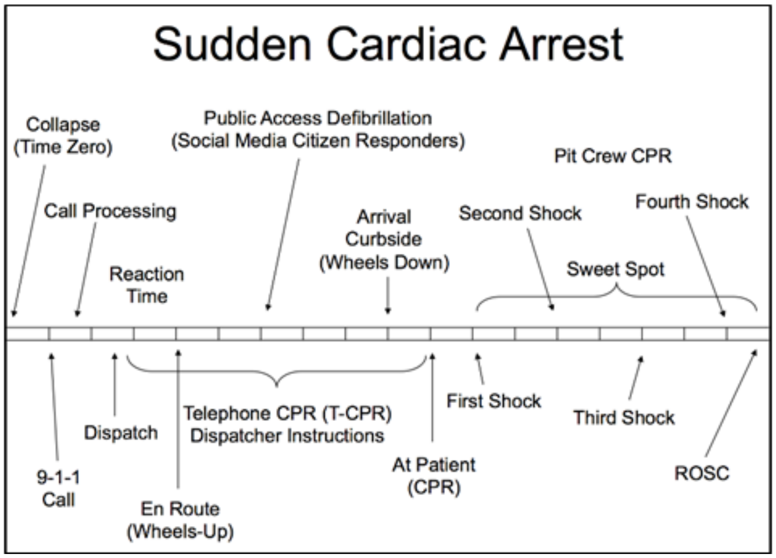
- It is the end of time for effective search and rescue in a room involved in the fire. It means that likely death of any person trapped in the room – either civilian or firefighter.
- After this point in a fire is reached, potable extinguishers can no longer have a successful impact on controlling the blaze. Only larger handlines will have enough water supply to affect a fire after this point.
- The fire has reached the end of the "growth" phase and has entered the fully developed phase. During this phase, every combustible object is subject to the full impact of the fire.
- This also signals the changeover from "contents" to "structure" fire. This is also the beginning of collapse danger for the structure. Structural collapse begins to become a major risk at this point and reaches the highest point during the decay stage of the fire (after the fire has been extinguished).

It should be noted that not every fire will reach flashover – and that not every fire will "wait" for the 8-minute mark to reach flashover. A quickly responding fire crew can do things to prevent or delay the occurrence of flashover. These options include:

- Application of portable extinguisher or other “fast attack” methodology.
- Venting the room to allow hot gases to escape before they can cause the ignition of other materials in the room.
- Not venting a room – under some circumstances this will stifle a fire and prevent flashover from occurring.

Each of these techniques requires the rapid response of appropriately trained fire suppression resources that can safely initiate these actions. In the absence of automatic fire suppression systems, access to interior fires can again limited by a safety requirement related to staffing levels. OSHA and related industry standards require the presence of at least 2-firefighters on the exterior of a building before entry can be made to a structure in which the environment has been contaminated by a fire. In the absence of a threat to life demanding immediate rescue, interior fire suppression operations are limited to the extent a fire service delivery system can staff to assure a minimum of 4-people actively involved in firefighting operations. The second issue to consider is the delivery emergency medical services. One of the primary factors in the design of emergency medical systems is the ability to deliver basic CPR and defibrillation to the victims of cardiac arrest. The exhibit, that follows, demonstrates the survivability of cardiac patients as related to time from onset:

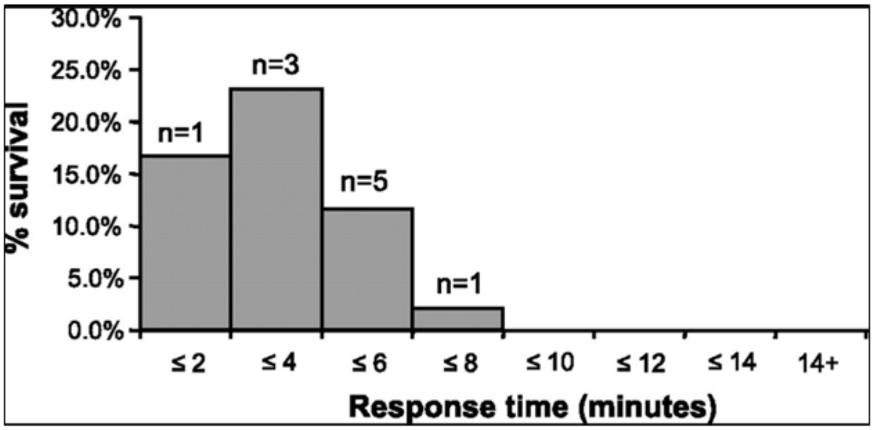
Typical Cardiac Arrest Timeline



This graph illustrates that the chances of survival of cardiac arrest diminish approximately 10% for each minute that passes before the initiation of CPR and/or defibrillation. These dynamics are the result of extensive studies of the survivability of patients suffering from cardiac arrest. While the demand for services in EMS is wide ranging, the survival rates for full arrests are often utilized as benchmarks for response time standards as they are more readily evaluated because of the ease in defining patient outcomes (a patient either survives or does not). This research results in the recommended objective of provision of basic life support within 4-minutes of notification and the provision of advanced life support within 8 minutes of notification. The goal is to provide BLS within 6 minutes of the onset of the incident (including detection, dispatch and travel time) and ALS within 10 minutes. This is often used as the foundation for a two-tier system where fire resources function as first responders with additional (ALS) assistance provided by responding ambulance units and personnel.

With cardiac arrest – and opioid overdose has a similar timeline – rapidity of initial treatment (CPR, AED, drugs) can have a significant impact on patient survival outcomes:

Cardiac Arrest Survival Rate vs. Timeline



Additional research shows the impact and efficacy of rapid deployment of automatic defibrillators to cardiac arrests. This research – conducted in King County (WA), Houston (TX) and as part of the OPALS study in Ontario, Canada – shows that the AED can be the largest single contributor to the successful outcome of a cardiac arrest – particularly when accompanied by early delivery of CPR. It is also important to note that these medical research efforts have been focused on a small fraction of the emergency responses handled by typical EMS systems – non-cardiac events make up the majority of EMS and total system responses and this research does not attempt to address the need for such rapid (and expensive) intervention on these events.

The results of these research efforts have been utilized by communities and first responders, often on their own with no single reference, to develop local response time and other performance objectives. However, there are now three major sources of information to which responders and local policy makers can refer when determining the most appropriate response objectives for their community:

- The Insurance Services Office (ISO) provides basic information regarding distances between fire stations. However, this "objective" does little to recognize the unique nature of every community's road network, population, calls for service, call density, etc.
- The National Fire Protection Association (NFPA) promulgated a documented entitled: "NFPA 1710: Objective for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments." This document (NFPA 1710) was first published in 2001 and updated in every several years – has and

generated a great deal of dialogue and debate – which is still on going. This document is not a requirement for communities to follow – local authorities can and must determine for themselves an appropriate service level – but it is an important starting point for most service level discussions.

- The Commission on Fire Accreditation International (CFAI) in its "Objectives of Coverage" manual places the responsibility for identifying "appropriate" response objectives on the locality. These objectives should be developed following a comprehensive exercise in which the risks and hazards in the community are compared to the likelihood of their occurrence.

Expected Response Time

The project team from Criterion Associates also uses a calculation we term "expected response time" in our analyses. This is intended to give managers, policy makers, and the community the ability to assess each option in an easy-to-understand number. While the fractile performance is a key consideration, this second methodology provides insight into why certain options might be better or worse than others. Calculating the expected response times for each scenario was performed using the following approach:

- All call locations in the data set were utilized.
- For each of the scenarios, the project team then used the GIS software to calculate the fastest response time from the set of station in the scenario.
- Response times are then aggregated by multiplying the number of responses against the drive time for each address.
- These response times are then summed and then divided by the total number of calls for all 100 addresses.